5.0 ENVIRONMENTAL CONSEQUENCES

This chapter summarizes the project area's affected environment and potential effects of implementing the No-Action Alternative, the Proposed Action Alternative, and Alternative 2. A brief description of the affected environment is provided for each resource area. These sections use the best data available to define baseline conditions and each resource area section also describes how related resource conditions may be affected by the No-Action Alternative, Proposed Action and Alternative 2. These conditions and consequences are presented for each of the following resource areas:

- Geology, Soils, and Paleontological Resources;
- Water Quantity and Quality;
- Aquatic Resources;
- Terrestrial Resources;
- Federally Listed Threatened and Endangered Species;
- Land Use, Management, and Planning;
- Cultural Resources;
- Recreation Resources;
- Aesthetic Resources; and
- Socioeconomics.

Future No-Action Conditions are very similar to baseline conditions for those resource areas that are mostly land-based, such as terrestrial resources, land use, and cultural resources. Recreational facilities are not expected to change under future No-Action conditions but the amount of recreation use at these facilities is expected to increase over time. The assessment of No-Action Alternative effects for water-based resource areas (primarily water quantity, water quality, aquatic resources, part of geology and soils) relied to a great extent on the overall modeling approach summarized in the next paragraph. The land-based resource areas also used the modeling results to some extent, but only if they were needed to help define the affected environment and potential impacts.

To help define baseline and future project operations and related changes in lake elevations and streamflows under each of the three alternatives, complex modeling was undertaken with input from members of the collaborative. CALSIM II, HYDROPS™, WQRRS and PHABSIM modeling was conducted to simulate project operations and related hydrology effects and is described further in Appendix C. This modeling helped the PDEA study team and collaborative better understand Oroville Facilities and SWP operations under each of the four model scenarios described below. The first two

scenarios were referred to as the "benchmark scenarios" in the modeling workshops because both of these scenarios were used as baselines for impact assessment as noted below. For the purposes of modeling, baseline conditions are considered 2001 Existing Conditions.

- 2001 Existing Conditions – this model scenario uses 2001 "level of development" assumptions to simulate project operations under existing conditions. The latest SWP and CVP water demands available (2001), SWP and CVP coordinated operations, existing SWP and CVP infrastructure, existing minimum flow releases and other level of development-related assumptions were used to simulate existing conditions over the historic hydrologic record and during each of five water year types. For those resource areas relying upon the modeling, the results associated with this model scenario served as the baseline for assessing the impacts of future conditions associated with the No-Action Alternative.

- 2020 No-Action Conditions – this scenario was used to simulate future operations and hydrology conditions under the No-Action Alternative. 2020 level of development assumptions were used along with the same historic hydrology data set used in the existing conditions modeling. The modeling results for this scenario were compared to the 2001 existing conditions model results to help define the potential hydrology-related effects of the No-Action Alternative. The modeling results associated with this scenario also were used as the baseline for assessing the potential hydrology-related incremental impacts of the Proposed Action and Alternative 2, as described in the next bullet.

- 2020 Conditions under the Proposed Action and Alternative 2 – these model scenarios were used to simulate future operations under these alternatives. They also include the same 2020 level of development assumptions and historic hydrology data set as used for the 2020 No-Action Alternative modeling. The PM&E measures that have the potential to affect project operations (the new Low Flow Channel flows and temperature criteria-related measures) were also included in the 2020 Alternative 2 model runs. The results of these runs were compared to the 2020 No-Action model results to define the potential incremental effects of Alternative 2. Since the Proposed Action does not include any PM&E measures that would affect project operations, the 2020 results that apply to the No-Action Alternative also simulate 2020 conditions under the Proposed Action.

To complete the environmental assessments of the Proposed Action and Alternative 2, each resource area section addresses how related resources may be affected by the PM&E measures included in the Proposed Action and Alternative 2.

Section 5.1 provides a brief overview of the general locale. Section 5.2 identifies cumulatively affected resources that were evaluated, describes the geographic and temporal scope of the cumulative effects analysis, and summarizes the related actions included in the analysis. In Sections 5.3 through 5.12, the potential environmental consequences of the No-Action Alternative, Proposed Action, and Alternative 2 are defined in each resource area sub-section following the approach described above.

Supporting information for this chapter can be found in Appendices A through I and in the Study Plan Reports that document the results of the various technical studies conducted as part of the collaborative process. The Study Plan Reports can be found at the Oroville Facilities public website, http://orovillerelicensing.water.ca.gov.

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5.1 GENERAL LOCALE

The Oroville Facilities are located in California's Central Valley. This valley includes two major river basins—the Sacramento River on the north and the San Joaquin River on the south. The Sacramento and San Joaquin Rivers converge in the Sacramento–San Joaquin Delta (Delta); from there, water flows to San Francisco Bay and then to the Pacific Ocean. The Sacramento River contributes approximately 85 percent and the San Joaquin River contributes approximately 10–15 percent of the Delta water inflow in most years (Figure 5.1-1).

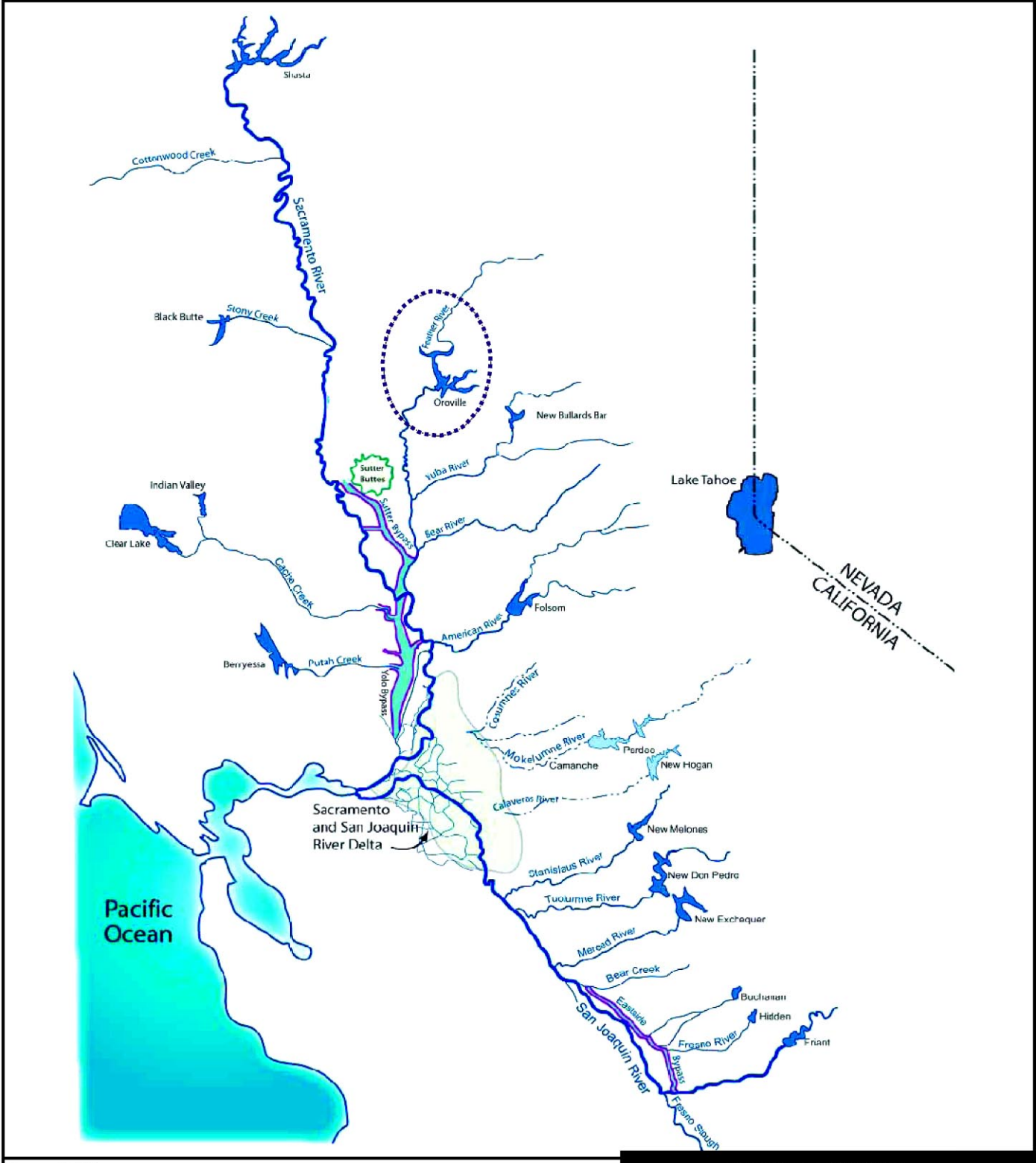
The Sacramento River basin is composed of three major sub-basins: the American River sub-basin, the Feather River sub-basin, and the Sacramento River sub-basin. The Feather River sub-basin is composed primarily of the Bear River, Yuba River, and Feather River. The Feather River, a major tributary to the Sacramento River, provides about 25 percent of the flow in the Sacramento River as measured at Oroville Dam.

Climate in the region follows a Mediterranean pattern, with cool wet winters and hot dry summers. Temperatures range from below zero to above 100 degrees Fahrenheit (ºF). Approximately 95 percent of the annual precipitation occurs during the winter months. Precipitation ranges from 33 inches at the City of Oroville, to more than 90 inches at the orographic (i.e., mountain) crest near Bucks Lake, to less than 20 inches in the eastern headwaters. Precipitation above 5,000 feet occurs primarily as snow, which regularly accumulates in excess of 5–10 feet in winter. There are infrequent summer thunderstorms, predominantly in the eastern third of the watershed. These storms can produce significant rainfall of short duration over a relatively small area.

Principal land use activities in the region include recreation, agriculture, timber production, hydropower generation, and livestock grazing. About 4 percent (roughly 70 square miles) of all land in Butte County is devoted to urban uses.

5.1.1 Feather River Basin

The Feather River watershed is located at the north end of the Sierra Nevada. The watershed is bounded by the volcanic Cascade Range to the north, the Great Basin on the east, the Sacramento Valley on the west, and higher elevation portions of the Sierra Nevada on the south. The Feather River watershed upstream of Oroville Dam is approximately 3,600 square miles and comprises approximately 68 percent of the Feather River basin. Downstream of Oroville Dam, the basin extends south and includes the drainage of the Yuba and Bear Rivers. The Yuba River joins the Feather River near the City of Marysville, 39 river miles downstream of the City of Oroville, and the confluence of the Bear River and the Feather River is 55 river miles downstream of the City of Oroville. Approximately 67 miles downstream of the City of Oroville, the Feather River flows into the Sacramento River, near the town of Verona, about 21 river miles upstream of Sacramento. The Feather River watershed, upstream of the confluence of the Sacramento and Feather Rivers, has an area of about 5,900 square



Source: DWR

20 0 20 40 60 Miles

Original Scale 1 : 2,217,600
1" = 35 miles
(approximate)

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Oroville Facilities
FERC Project No. 2100

FIGURE 5.1-1
California Central Valley
and
San Francisco Bay-Delta Area

Prepared by: PJ -- EDAW, Inc. Date 11/12/04 P:\2000\0s016.gis\arcview\pdea_non-gis.apr

miles.

The upper watershed (upstream of the Oroville Facilities) includes the West Branch, Upper North Fork, Lower North Fork, South Fork, and Middle Fork Feather River and is ruggedly mountainous, bisected by deep canyons in the western third of the watershed. The central third of the watershed is a transition zone consisting of broad alluvial valleys surrounded and separated by high, steep peaks and ridges. The headwater areas of the eastern third consist of long, broad meadow systems separated by relatively low ridges. Elevations range from 922 feet at the crest of Oroville Dam to more than 10,400 feet at Mount Lassen. The major tributaries as well as the major forks of the Feather River (including the South Fork, East Branch North Fork, North Fork, and Middle Fork) generally flow from east to west.

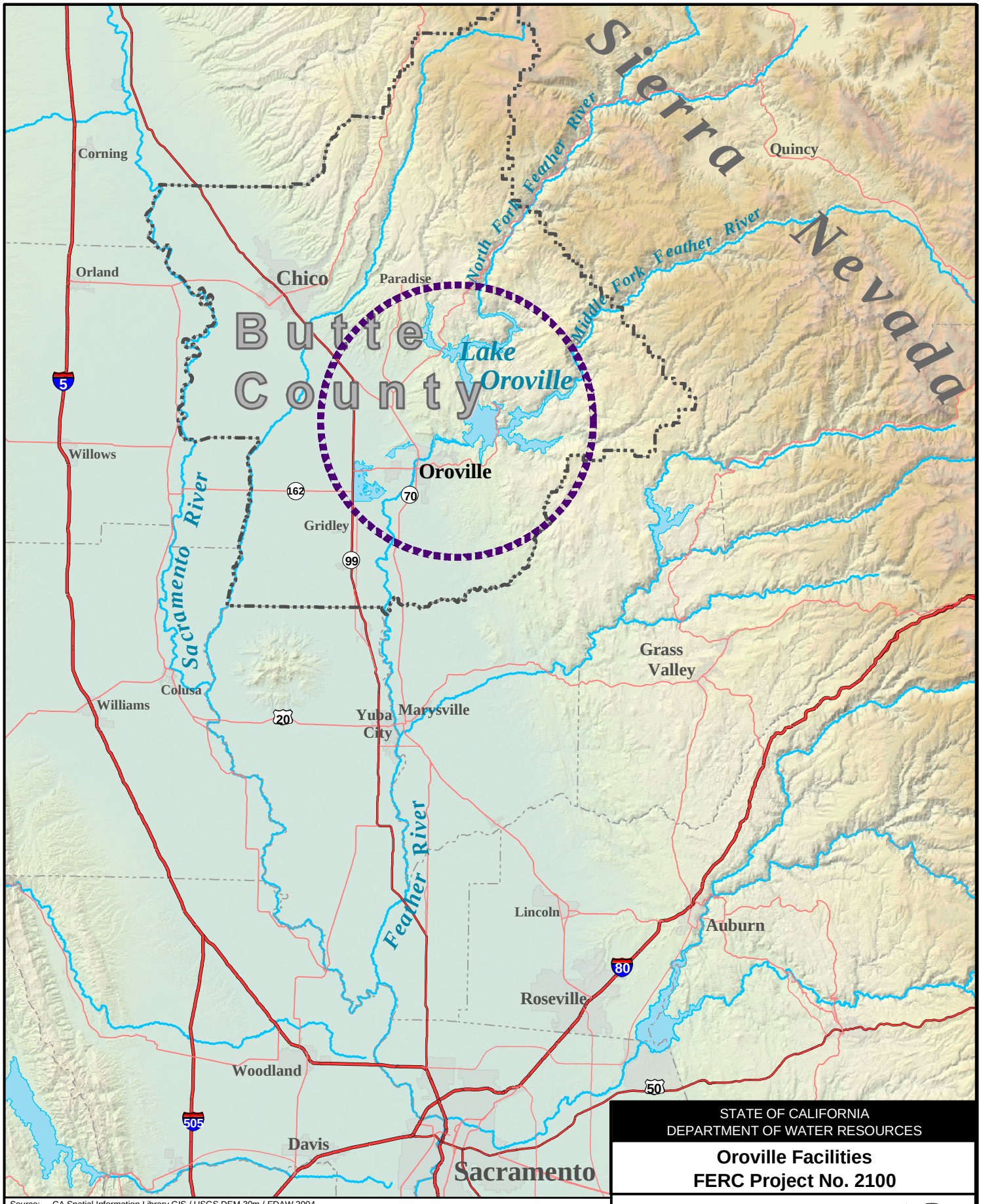
The upper watershed of the Feather River is owned and managed by a variety of federal, State, and local entities, including USFS, BLM, DPR, DFG, Butte County, and the City of Oroville. The North Fork Feather River canyon serves as a major east-west transportation arterial (Union Pacific Railroad and State Route [SR] 70) and has extensive hydropower generation development, producing more than 1,750 MW of electricity. The Middle Fork Feather River upstream of the Oroville Facilities is federally designated as a Wild and Scenic River.

5.1.2 Project Area

The Oroville Facilities are located on the Feather River in the foothills of the Sierra Nevada in Butte County, California (Figure 5.1-2). Oroville Dam is located 5 miles east of the City of Oroville and about 130 miles northeast of San Francisco.

The West Branch, North Fork, South Fork, and Middle Fork Feather River are the primary rivers that form the reservoir at Lake Oroville. Prior to construction of Oroville Dam, the Middle and South Forks joined 5.4 river miles above the Oroville Dam site, and were then joined by the North Fork 3 river miles below their confluence. Their confluence is now Lake Oroville, a 3.54 maf reservoir that is one component of the Oroville Facilities. About half of the flow into Lake Oroville comes from the North Fork Feather River. The average annual inflow, dependent on annual precipitation, into Lake Oroville is approximately 4 maf. Outflow from the Oroville Facilities typically varies from spring seasonal highs averaging about 8,000 cubic feet per second (cfs) to about 3,500 cfs in November.

Downstream of Oroville Dam, the Feather River flows can be diverted into the Thermalito Complex and the Feather River Fish Hatchery, and used to maintain instream flows in the Low Flow Channel of the Feather River. Some of the water diverted to the Thermalito Complex is returned to the Feather River approximately 6 miles downstream of Oroville Dam. The Feather River, downstream of the Thermalito Afterbay Outlet and the confluence of the Low Flow Channel, is generally known as the lower Feather River. The lower Feather River flows through a variety of habitat types, agriculture, and urban areas until its confluence with the Sacramento River. The flows



Source: CA Spatial Information Library GIS / USGS DEM 30m / EDAW 2004

10 5 0 10 20 Miles

Original Scale 1 : 760,320
1" = 12 miles

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Oroville Facilities
FERC Project No. 2100

FIGURE 5.1-2

Project Vicinity

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in the lower Feather River are maintained relatively constant through regulation of the Thermalito Afterbay Outlet.

The mean annual discharge of the Oroville Facilities into the Feather River is in excess of 3.0 maf. In addition, mean annual releases to the Feather River Service Area (FRSA) from Lake Oroville total just under 1.0 maf. Hence the total mean annual discharge from the Oroville Facilities is approximately 4.0 maf. These waters are used for a variety of beneficial uses including recreation, coldwater aquatic habitat, hydropower generation, irrigation, and domestic and municipal water supply. The Oroville Facilities are a critical part of the SWP, providing much of the system's water collection and storage, flood management, and power production capacity.

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5.2 CUMULATIVELY AFFECTED RESOURCES

This section defines the resources and related actions that are included in the PDEA's cumulative effects analysis. It also describes the geographic and temporal scope of the analysis. Each cumulative effects subsection in Chapter 5.0 presents the results of the cumulative analysis that was conducted for the resources listed in Section 5.2.1.

Cumulative effects are impacts on the environment that result from the incremental impacts of an action when added to the effects of other past, present, or reasonably foreseeable future actions, regardless of the agency, company, or person undertaking the action (from the Council on Environmental Quality's [CEQ] regulations for implementing NEPA—40 Code of Federal Regulations [CFR] Section 1508.7). 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).

A number of important information sources were used to prepare this section and the individual cumulative effects subsections found in the remainder of this chapter, including:

- Input received from resource agencies and other stakeholders during the collaborative process (including DWR 2002; Interagency Task Force 2000a, 2000b; NOAA Fisheries 2001; pers. comm., Croom 2002; pers. comm., Harlow 2002);
- Comments received from resource agencies and other stakeholders, including the public, during project scoping, including comments received on Scoping Documents 1 and 2;
- Comments received on the April 30, 2004, PDEA Progress Summary;
- FERC's guidance document entitled *Preparing Environmental Assessments, Guidelines for Applicants, Contractors, and Staff* (FERC 2001); and
- The CEQ's *Considering Cumulative Effects under NEPA* (CEQ 1997).

Related FERC and CEQ guidance was used to develop the approach and format of each of the cumulative effects subsections included in each of the resource areas identified in this chapter. Each subsection 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 this chapter's affected environment sections. The discussion of historical impacts is limited by the amount of available information. Potential cumulative effects in the future are then defined for each of the resources listed in Section 5.2.1. These potential effects may occur as reasonably foreseeable related actions interact with the incremental effects of the alternatives defined in Chapter 3.0.

5.2.1 Cumulatively Affected Resources and Related Actions

Based on the information provided by the sources noted above, 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.

- Water quantity (Feather River releases below Oroville Dam, Thermalito Diversion Dam, and Thermalito Afterbay, and Lake Oroville water surface elevations);
- Aquatic resources (spring-run Chinook salmon and Central Valley steelhead);
- Geology and soils (gravel recruitment, sediment transport, and large woody debris);
- 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);
- Recreation (project recreation resources affected by related actions, Feather River flows downstream of Oroville Dam, or Lake Oroville water surface elevations); and
- Cultural resources (resources within the FERC project boundary affected by related actions, Feather River flows below Oroville Dam, or Lake Oroville water surface elevations).

The criteria listed below are from the FERC guidelines noted above and were used to help determine which resource topics should be the focus of the cumulative analysis.

- Is the resource affected by the project and other developmental activities in the basin? If the answer is yes, apply the next criterion; if the answer is no, do not include the resource in the cumulative analysis.
- Is mitigation or enhancement of the resource needed? If the answer to this question is no, do not include the resource in the analysis. If the answer to this question is yes, then the resource should be included in the analysis.

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;

- Agricultural development and land uses;
- Water resource development needed to support urban or agricultural development (including upstream and downstream diversions, storage and conveyance for supply purposes, upstream hydroelectric facilities, and downstream levee and dike construction for flood management purposes);
- 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;
- Hunting;
- Other recreational activities outside of the FERC project boundary;
- Timber harvesting;
- Watershed management improvement activities;
- The CALFED Bay-Delta Program and its implementation;
- The Central Valley Project Improvement Act (CVPIA) and its implementation;
- Pacific Gas and Electric Company's (PG&E) Poe Project relicensing;
- PG&E's Upper North Fork Feather River Project relicensing;
- South Feather Water and Power Agency's South Fork Feather River Project relicensing;
- The Yuba-Feather Supplemental Flood Protection Project; and
- Implementation by the Central Valley Regional Water Quality Control Board of its water quality control plan (Basin Plan) and enforcement of various water quality–related regulations.

Appendix F contains additional information regarding many of the projects and regulatory proceedings listed above. In addition to the related actions above, a wide range of SWP, CVP, and other water project–related "level of development" assumptions were made to complete the comprehensive CALSIM II and HYDROPS™ modeling conducted for the cumulative analysis and other impact assessments summarized in subsequent sections of this chapter. Additionally, these modeling efforts simulate the effects of upstream projects on hydrology within the FERC project boundary and downstream areas. They also help define existing streamflow and

reservoir level conditions under different water year types as well as projected (2020) hydrology conditions under each of the alternatives. Level of development assumptions include existing and projected CVP and SWP water demands, coordinated CVP and SWP operations, various types of release requirements, and planned infrastructure improvements that affect such operations.

5.2.2 Geographic Scope

This section describes the geographic areas where cumulative effects on the resources listed in Section 5.2.1 have occurred, or are expected to occur. Per related FERC and CEQ 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 Facility operations, the effects of the alternatives defined in Chapter 3.0, and the effects of the related actions described in Section 5.2.1 above.

The geographic scope of the analysis of cumulative effects on spring-run Chinook salmon and Central Valley steelhead is broad, given 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 before other hydroelectric and water development projects were constructed by 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 where commercial harvesting and predators account for fairly high mortality levels of juvenile and adult salmon and steelhead. The geographic scope of the geomorphology-related resource topics (gravel recruitment, sediment transport, and large woody debris) ranges from the upper Feather River watershed, downstream in and along the Feather River to its confluence with the Sacramento River. The other resources included in the cumulative analysis have a more limited geographic scope that generally consists of the following locations and nearby lands: Lake Oroville, the Feather River below Oroville Dam, Thermalito Forebay and Thermalito Afterbay, and the Oroville Wildlife Area.

5.2.3 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 (approximately 30–50 years after the existing license expires in 2007).

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 project vicinity. Additional information regarding the nature and timing of key events and related actions affecting these resources is found in Appendix F and the cumulative effects subsections, and in some cases, the affected environment sections that provide historic context and other background information related to the selected resources.

Cumulative effects on 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 manmade 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; the addition of local, federal, and State pumps in the southern Delta; 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. 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 are still the focus of recovery efforts and their population numbers are a concern in many portions of their range. Section 5.7 summarizes the status of these species throughout their range and in the Feather River basin.

Cumulative effects on water quality and the other resources listed in Section 5.2.1 probably began during the 1849 California Gold Rush with extensive hydraulic and hard-rock mining activities. These activities led to major amounts of sediment and heavy metals moving into streams and other receiving waters; downstream transport of sediment and metals 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 amounts of lower Feather River channelization, levee construction, and maintenance have occurred as the U.S. Army Corps of Engineers (USACE), U.S. Bureau of Reclamation (USBR), and State and local agencies have provided 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 area is still a fairly common event, 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 resource values. DWR also is investigating the feasibility of taking additional steps to coordinate Lake Oroville flood control operations with such 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 as further described in Section 5.4.3. Most of 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. Work on 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 Appendix F.

5.3 GEOLOGY, SOILS, AND PALEONTOLOGICAL RESOURCES

In this section each of the three alternatives is evaluated for its potential effects on the geologic, geomorphic, and soils-related resources within the project area. This includes the No-Action Alternative, and the Proposed Action and Alternative 2, which present different groupings of proposed PM&E measures. These PM&E measures are proposed to address effects of the Oroville Facilities identified during the initial scoping process. Refer to Section G-GS1.1 of Appendix G-GS1 for further description of modeling efforts associated with geomorphic processes within the FERC project boundary.

5.3.1 Affected Environment

The watershed upstream of Oroville Dam includes the five main branches of the Feather River (West Branch of the North Fork, Upper North Fork, Lower North Fork, Middle Fork, and South Fork) and ten smaller tributary creeks (second order or larger) that drain directly into the reservoir footprint. This watershed drains an area of 3,611 square miles. The North Fork and Middle Fork watersheds comprise 3,222 square miles of this area, including portions of the foothill and mountain regions of the northern Sierra Nevada and southern Cascade Range. The South Fork and West Branch watersheds contain the additional 389 square miles.

At full pool, Lake Oroville has a perimeter of approximately 167 miles and a surface area of approximately 15,810 acres. When the reservoir elevation is 640 feet (ft), the shoreline perimeter decreases to approximately 107 miles and the reservoir surface area is approximately 5,796 acres. The areal extent between the shoreline at full pool level and the shoreline at 640 ft (i.e., areal extent of the fluctuation zone) is approximately 10,000 acres.

Major issues related to geology, soils and geomorphology identified during the scoping process included:

- Effects of project operations on natural geomorphic processes, including: (1) channel morphology and stability; (2) sediment accumulation and transport; (3) spawning gravel; (4) large woody debris recruitment; (5) habitat; (6) biological resources;
- Potential need for more storage/flood protection;
- Coordination of long-range watershed planning activities with local, State, and federal agencies and private landowners; and
- Cumulative effects of project operations on sediment transport and other geomorphic processes.

5.3.1.1 Regional Geologic and Seismic Setting

Regional Geologic Setting

Approximately 85 percent of the project area above the Thermalito Diversion Dam is located within the metamorphic belt of the Sierra Nevada Geomorphic Province. The remaining 15 percent of the project area is located within the Cascade Range Geomorphic Province. The area downstream of Thermalito Diversion Dam is within the Sacramento Valley portion of the Great Valley Geomorphic Province.

The Sierra Nevada Geomorphic Province consists of granitic intrusions, andesitic flows and breccia, basalt, metamorphic rocks, ultramafic rocks, and unconsolidated sedimentary deposits. Highly weathered or decomposed granite, erodible and prone to landslides, occurs in the eastern watershed and along portions of the North Fork Feather River.

The Cascade Range Geomorphic Province extends about 500 miles from southern British Columbia in the north to Lassen Peak in the south and comprises 495 square miles of the watershed, from Lake Almanor to Lassen Peak. Rocks of this province include Pliocene to Holocene age tuff, breccia, volcanic ash, lava flows, and basaltic to rhyolitic lahars.

The Great Valley Geomorphic Province is a narrow, elongated, asymmetrical, north-northwest trending basin extending for about 450 miles between the Sierra Nevada and Coast Ranges Provinces. The northern portion is known as the Sacramento Valley (Norris 1990). The valley floor is an alluvial plain of unconsolidated Holocene deposits that overlie more consolidated alluvial and lacustrine deposits of Quaternary to Jurassic age. Below these sedimentary deposits are found the shales and sandstones of the Cretaceous Great Valley Sequence and upper Jurassic bedrock of metamorphic and igneous rocks associated in the east with the Sierra Nevada and in the west with the Coast Ranges (Norris 1990).

Regional Faulting and Seismic Setting

The project area lies in an area that has historically experienced relatively low seismic activity. The only known active fault (movement within the last 35,000 years) near the Oroville Facilities area is the Cleveland Hill fault. This approximately 5.5-mile-long fault is located approximately 3 miles south of Oroville Dam. The Cleveland Hill fault ruptured on August 1, 1975, causing the magnitude 5.7 Oroville earthquake. Other historic seismic events in the project area include a magnitude 4.6 earthquake that occurred near Chico on May 24, 1966, and a magnitude 5.7 earthquake located about 20 miles east of Chico that occurred on February 8, 1940. With the exception of these seismic events, most of the significant Quaternary and historic regional seismic activity is concentrated on faults located more than 60 miles to the north, east, and southeast of the project area.

5.3.1.2 Geologic Conditions—Upstream Project Area

Geologic Setting

The western metamorphic belt of the Sierra Nevada Geomorphic Province underlies a significant portion of the Oroville Facilities watershed. These rocks range in age from Ordovician to Cretaceous, and extend from about Mariposa in the south to Lake Almanor in the north (Norris 1990). This metamorphic belt is defined largely by a collective system of faults, the Foothills Fault System, that formed initially during the tectonic evolution of the region (Carlson 1990).

Rocks of the western metamorphic belt include gabbroic, diabase, and granitic rocks exposed to the south and east of Lake Oroville. Most of the lower watershed consists of rocks of the western geomorphic belt. These rocks include the Foothill Melange-Ophiolite belt (Carlson 1990), with an almost continuous, 3-mile-wide band of serpentine that crosses through the watershed and metamorphosed gabbroic, diabasic, and granitic rocks exposed to the south and east of Lake Oroville. These rock units are structurally weak and landslide-prone. Naturally occurring asbestos, a common constituent of serpentine, has been noted in water quality samples at relatively high background concentrations.

Soil Conditions

Soils in the tributary areas upstream of Oroville Dam are derived from weathering of the parent rock material in each area; Mesozoic and Paleozoic metasedimentary and volcanic rocks; Mesozoic intrusive plutonic rocks; and Cenozoic volcanic and sedimentary rocks. Soil profiles in the metamorphic and igneous rocks underlying the central and western portions of Lake Oroville tend to be thick, while thin soil profiles tend to develop on the intrusive igneous rocks underlying the eastern portion. Along the lower portions of the Middle Fork and South Fork Feather River, intrusive rocks that are exposed tend to decompose readily into their basic mineral assemblages. These rocks do not generally form deep soil profiles, but can be readily eroded by wave/wind action.

Slope Stability/Landsliding

Landslides are numerous along the banks of Lake Oroville and common along the North Fork and Middle Fork Feather River. The landslides occur in granitic and metamorphic rocks that form the hills and valleys of the westernmost portion of the Sierra Nevada. Many of the landslides continue into the depths of the reservoir. The amount of material derived from active landslide activity is considered minimal when compared to the amount of incoming watershed sediment and material derived from shoreline erosion. Nonetheless, it should be noted that significant reactivation of inactive or ancient slide masses could introduce large volumes of material into the reservoir and could even block portions of the upper arms of Lake Oroville. There is evidence that a large prehistoric landslide, the Bloomer Hill Landslide, temporarily blocked the North Fork Feather River (see Study Plan Report SP-G2).

The total area of all confirmed landslides mapped in the Lake Oroville area is approximately 4,154 acres. Of this total, approximately 328 acres (8 percent) are active, 579 acres (14 percent) are considered inactive, and the remaining 3,246 acres (78 percent) are ancient landslides. Approximately 15 miles of shoreline is mapped as landslide material, representing less than 9 percent of the 167 miles of total shoreline length. Appendix C of SP-G1, *Effects of Project Operations on Geomorphic Processes Upstream of Oroville Dam*, contains map coverage of landslides around Lake Oroville.

Shoreline Erosion

Shoreline erosion and slope failures are most prevalent during the first months or years of initial impoundment (Morris and Fan 1997). The amount of bank erosion for a particular length of shoreline is closely related to the underlying geologic material, soil cover, and wave/wind action.

Moderately sloping banks, most prevalent in the Lake Oroville main basin and lower portions of the tributary arms, are generally more susceptible to wave action from wind currents across a wide expanse of water, and from wave action caused by recreational powerboats. The rarely occurring gently sloped banks around the reservoir exhibit minimal erosion because they are protected from wave/wind action and because recreational powerboat speeds are slower in the protected coves where they occur.

Lower elevations within the reservoir fluctuation zone are exposed to erosion less frequently than those areas near the normal maximum pool level. Between 1968 and 2003, the lowest 100 ft of the fluctuation zone (i.e., from elevation 640 ft to elevation 740 ft) were exposed to shoreline erosion only 10 percent of the time. Areas above the 840-foot elevation were exposed to shoreline erosion more than 60 percent of the time. Overall, the shoreline elevation stayed within the relatively narrow range of 835 to 855 ft nearly 35 percent of the time.

5.3.1.3 Geologic Conditions—Downstream Project Area

Geologic Setting

Metamorphic bedrock crops out between Oroville Dam and the Feather River Fish Hatchery. Along the boundary between the Sierra Nevada/Cascade provinces and the Great Valley province west of Lake Oroville, scattered sedimentary and volcanic deposits of the Ione, Laguna, and Tuscan formations blanket older bedrock units. Downstream river banks consist of about 1 percent bedrock, 5 percent Laguna, 3 percent Modesto, 24 percent slickens, 10 percent tailings, 14 percent floodplain deposits, 38 percent alluvial edge, and 5 percent levees. Unconsolidated river sediments including floodplain, point bar, channel, and other deposits are found in the Feather River meander belt. Stream channel deposits occur in active channels of the Feather River and tributary streams and are transported downstream as a result of present-day hydrologic conditions. These deposits contain clay, silt, sand, gravel, cobbles, and boulders in various layers and mixtures that reflect conditions at the time of deposition.

Sedimentary debris from hydraulic mining in the late 19th and early 20th centuries filled the riverbed and adjacent floodplain of the lower Feather River, resulting in a thick deposit of fine-grained, clay-rich, light yellow-brown colored material known as slickens. The slickens have in turn been buried by more recent floodplain deposits but are evident in eroding banks along most of the river. Dredge tailings from later gold mining are found as large piles of gravels and cobbles adjacent to the river between the Cities of Oroville and Gridley. A large volume of the dredge tailings was excavated and used in the construction of Oroville Dam. Much of the OWA is covered with these deposits.

Soil Conditions

The soils in the study area downstream of Oroville Dam are found on relatively level land, with most slopes ranging from 0 to 2 percent. The highest slope, with the exception of riverbank and road cuts, is 5 percent. The most common parent material for the soils is river alluvium, with some soils derived from mining debris deposited during the hydraulic mining period.

The predominant soil types or textures in the 100-year floodplain are characterized as fine sandy loam, loamy sand, and loam to silt loam. Minor soil types are clay, clay loam, sandy clay loam, sandy loam, silt loam, silty clay, sand and gravel, and river wash. Many of the soils are further divided by occurrence of flooding, such as occasionally flooded to frequently flooded. The soils range from shallow to very deep, with most being moderately deep to very deep. Floodplain soils are conducive to agriculture and many areas of riparian floodplain and fluvial terraces have been converted to irrigated crops and orchards.

Riverbank Erosion

While erosion occurs on both river bends and straight reaches, erosion rates tend to be higher in bends than on straight reaches. Given that the lower Feather River possesses a relatively low sinuosity, it also possesses relatively low erosion rates. The overall bank erosion rate is 1.7 ft/ft/yr which is quite low compared to the Sacramento River rate of about 16 ft/ft/yr. Bank erosion is also affected by bank moisture and composition. Dry banks erode at lower rates than wet banks, all other factors being equal. Receding flows after bank full discharge tend to be the most erosive because banks are saturated, piping and liquefaction can be triggered by the positive seepage pressures, and the support and buoyancy is lost. Sand banks are the most erodible, followed by sandy gravel banks. Coarser gravel and cobble banks tend to be more erosion resistant, eroding at relatively low rates. Banks consisting of clay and silt also erode at low rates, primarily because of the cohesive nature of clay. Slickens contain abundant clay and subsequently have low bank erosion rates.

5.3.1.4 River Geomorphology

Conditions Upstream of Oroville Dam

The upper Feather River watershed (outside the boundary of the Oroville Facilities) is producing high sediment yields because of accelerated erosion. A U.S. Soil

Conservation Service report, *East Branch North Fork Feather River Erosion Inventory Report* (USSCS 1989), estimated that 90 percent of the erosion in the 1,209-square-mile study area was accelerated erosion, a rate greater than natural geologic rates. Sediment derived from accelerated erosion can reduce reservoir capacity, degrade water quality, and harm fish and wildlife. A large amount of this sediment is captured by several reservoirs on the North Fork and South Fork Feather River, upstream of Lake Oroville. High sediment yields have significantly impaired storage capacity and hydroelectric operations of these upstream reservoirs. In the lower two-thirds of the Feather River watershed (above Oroville Dam), that sediment that is transported below the upstream reservoirs essentially passes through deeply incised canyons of the Middle Fork and North Fork Feather River, developing little in the way of floodplains. Lake Oroville captures nearly all of the remaining sediment. It is estimated that the reservoir trap efficiency level of Oroville Dam is more than 97 percent.

During development of the study plan for SP-G1, it was assumed that Oroville Facilities operations could have a significant effect on sediment deposition and the formation of deltas, and as such the stream geomorphology, above the full-pool level upstream of Lake Oroville. However, because Oroville Facilities operations include an annual reservoir level fluctuation of between 50 and 250 ft, sediment deposition does not occur above Lake Oroville. The initial SP-G1 shoreline survey, performed while reservoir levels were between El. 690 and El. 840 ft, did indicate that substantial sediment deposition does occur within the fluctuation zone along the tributary channels.

Conditions Downstream of Oroville Dam

About 5 miles below Oroville Dam, the Feather River emerges from the Sierra Nevada and enters the Sacramento Valley. Here the stream gradient flattens significantly and the topography is subdued. The topography is mostly flat, with the exception of overflow channels, multiple channel areas, and both artificial and natural levees occurring along the river course. Honcut Creek, the Yuba River, and the Bear River join the Feather River before it enters the Sacramento River at Verona. The elevation of the valley floor varies from about 150 ft msl at Oroville to about 25 ft msl at Verona.

The lower Feather River meander belt consists of Recent alluvium and stream channel deposits. Of the two, the alluvium is older, but both consist of river deposits, including floodplain deposits, point bar deposits, channel fill, oxbow lake deposits, tributary delta deposits, and hydraulic mining debris. The deposits range in size from clay, silt, and sand to gravel, cobbles, and boulders. Coarse deposits predominate near Oroville and fine deposits predominate from Gridley downstream. Older alluvial deposits, not directly linked to the present Feather River, form terraces on both sides of the active stream channel. These deposits are typically higher in elevation and more resistant to erosion, and they define the boundaries of the active meander belt.

On the Feather River, a variety of human-induced changes have affected this balance between erosion and deposition. Normally an alluvial river is balanced in terms of erosion and deposition. A river is aggrading if deposition is greater than erosion, and degrading if erosion is greater deposition. In most cases, a river shifts from aggrading

to degrading because of changes in river flow and sediment availability. Geologic units exposed along the Feather River suggest that the river was degrading during the Holocene era. Before 1855, the lower Feather River was a meandering stream, believed to be similar to the present Sacramento River between Red Bluff and Colusa. Between 1855 and the early 20th century, the large pulse of sediment from hydraulic mining changed the lower Feather River into an aggrading river. A thick deposit of fine, clay-rich slickens was deposited in the channel and on the floodplain.

Following the period of mining debris deposition, a series of dams was built within the upper Feather River watershed. The cumulative effect of the reservoirs above Oroville Dam was the nearly complete capture of sediments eroded from the watershed. Presently, only silt and clay, little sand, and essentially no gravel or cobble-sized clasts are discharged to the Feather River below Oroville Dam. As such, the Feather River below Oroville Dam is sediment-starved. More recent in-river gravel-mining pits within the historic riverbed act as localized sediment traps. This overall lack of sediment changes downriver patterns of sediment transport, deposition, scour, mobilization of sediment, and turbidity levels. These changes to the river hydrology and sedimentation patterns have in turn altered channel morphology, including changes to the channel shape, stability, and capacity.

There are no current sediment transport measurements available on the Feather River. The FLUVIAL-12 program is used to estimate long-term bedload yields based on sediment transport equations; however, these results are not actual sediment transport measurements. A detailed discussion of sediment transport is presented in the SP-G2 Task 7 draft report *Hydraulic and Sediment Transport Modeling with Fluvial 12*.

Modeling results from a 50-year FLUVIAL-12 model run predict the sediment yield for the next 50 years in the lower Feather River with the assumption that the sediment inflow into the study reach is cut off by Oroville Dam. The amount of bedload material in the Feather River passing the Thermalito Afterbay Outlet (end of the Low Flow Channel) was modeled at 0.3 million tons, or about 6,000 tons per year, or 16 tons per day. This is about 3 percent of the pre-dam bedload of 485 tons per day estimated by the U.S. Geological Survey (USGS). The yield is primarily a result of channel erosion because Oroville Dam traps nearly all (greater than 97 percent) of the incoming bed material. Finer sediments are more easily removed from the channel boundary, leaving the coarser sediment behind. The selective sediment transport has resulted in the gradual coarsening and armoring of the bed material. The modeling also showed that much of the sediment delivered from the channel above River Mile (RM) 61 is trapped in gravel mining pits excavated in the channel.

The modeled pattern of sediment delivery shows a sharp rise in delivery in the High Flow Channel just below the Thermalito Afterbay Outlet. This is related to the increase in flow from Thermalito Afterbay and therefore an increase in erosion from the channel boundary. The total yield of the Low Flow Channel and High Flow Channel is 2.9 million tons for 50 years.

The model run shows a large increase in sediment particle size after 50 years. The largest increases in size were found directly below the Fish Barrier Dam, from 120 millimeters (mm) to 150 mm, and at RM 56, from 60 mm to 110 mm.

The modeled channel geometry changed because of scour and fill, which is not generally distributed uniformly across the channel width. Furthermore, scour of the bed may be accompanied by scour or fill in the overbank area, or vice versa. These changes in channel morphology in turn directly affect the hydraulics of flow and sediment transport.

Changes in channel geometry are depicted in the model by changes in thalweg profile and changes in channel cross section. Modeled water surface and channel thalweg profiles show that channel bed degradation is predicted at most cross section locations, with aggradation occurring in some locations. Cross section measurements showed average post-dam thalweg decreases of 1–5 ft in the Low Flow Channel, 1–4 ft between the Thermalito Afterbay Outlet and the Gridley Bridge, and 2–5 ft from Gridley Bridge to Honcut Creek. Channel degradation is consistent with continued erosion. Future changes are limited by bed armoring, which in turn will reduce future bed erosion and sediment yield.

Those reaches near gravel mining areas are subject to greater changes than other areas. This is because of the disruption in channel profile and cross section, resulting in sediment deposition within the mining areas and scour in the areas above and below.

Feather River Geomorphic Reaches

The Feather River has been divided into 11 geomorphic reaches based on a variety of geologic and channel configuration characteristics such as channel shape, gradient, planform, bed material, and depth/width ratio. The geomorphic reaches have been labeled Reaches 1–11, moving downstream to upstream starting from the confluence of the Feather River with the Sacramento River (RM 0). Figures 5.5-2 and 5.5-3 provide additional information regarding specific river mile locations along the Feather River, from the Fish Barrier Dam to the confluence of the Sacramento River.

The reaches along the Low Flow Channel near the OWA are characterized by coarse dredge tailings composing both the bed and banks. Riffles, point bars, midchannel islands, and multiple channels are common, but cobbles and boulders armor most of these depositional features. These features are believed to be relict and static, left over from pre-Oroville Dam hydraulic conditions. Levees severely constrict the floodplain along the upper portion of this reach. There are overflow weirs into the OWA in at least four places. Much of the reach has been mined for gravel, resulting in many pits, multiple channel areas, and resultant channel complexity.

Stream Classification

Changes in channel geometry occur as bank erosion, bed erosion, and sediment transport move sediment out of the system. These changes affect the geomorphic and biological function of the stream system. Changes in depth, width, gradient, location of the thalweg, erosion, meandering, sinuosity, and other geomorphic factors affect the mesohabitat. These changes, in turn, affect the amount of riffle, run, or pool habitat, type of riparian habitat, and eroding bank habitat. A stream classification system is useful in defining and quantifying channel geometry and mesohabitat along and between river systems.

Large Woody Debris

Large woody debris, defined as material measuring greater than 6 inches in diameter and 6 ft long, contributes to sediment trapping, and therefore has an effect on riverbed morphology. Analysis has shown that large woody debris is unevenly distributed in the Feather River. The Low Flow Channel was found to have the lowest amount of large woody debris. From the Thermalito Afterbay Outlet to Honcut Creek the river has a moderate amount of large woody debris. The Feather River from Honcut Creek to the Yuba River has a significantly higher amount of large woody debris. The Feather River below the Yuba River has a fairly low abundance of large woody debris. Long stretches of riverbank in this reach have been hardened with levees for flood management or riprapped for bank protection, with consequent reductions in riparian vegetation and long stretches of riverbank devoid of vegetation.

5.3.1.5 Paleontological Resources

The known fossil-bearing formations within the project area are the Calaveras Limestone, the Monte del Oro, and the Laguna. These formations are known to contain noteworthy examples of invertebrate or plant fossils (Monte del Oro and Calaveras) or vertebrate fossils (Laguna). Also occurring within the project area are portions of the Ione and Tuscan Formations. These formations have the potential to contain vertebrate fossils or noteworthy examples of invertebrate or plant fossils. Other rock formations exposed within the project area are not expected to contain fossils because of their igneous or metamorphic nature.

The Monte del Oro Formation is exposed north of Oroville and contains plant and leaf impressions in the shale units. This formation is equivalent to the Mariposa Formation, which is exposed along the length of the western Sierra Nevada and contains many fossil localities. Calaveras Limestone is exposed in scattered blocks within the mélange sequence and contains invertebrate fossils in exposures near Lime Saddle. Excavations into the Laguna Formation have, in places, revealed a Plio-Pleistocene vertebrate fauna. One such location may be near Thermalito Afterbay.

5.3.1.6 Hazardous Materials

Hazardous materials are defined in Section 66260.10, Title 22 of the California Code of Regulations (CCR) as:

> A substance or combination of substances which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may either (1) cause, or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, or disposed of or otherwise managed.

Hazardous materials within the FERC project boundary are managed through the coordination of federal, State, and County laws, regulations, and programs. A thorough search of available environmental databases has indicated that there are 36 sites within the FERC project boundary where there is some type of hazardous materials information, whether it relates to existing underground storage tanks, aboveground storage tanks, hazardous materials handling, hazardous waste generation, or hazardous materials spill incidents.

There appear to be no significant hazardous materials or waste issues within the FERC project boundary. DWR conducts its hazardous materials and wastes management activities within the requirements of local, State, and federal laws and regulations.

5.3.2 Environmental Effects

Summary of Potential Effects on Geology, Soils, and Paleontological Resources

Table 5.3-1 summarizes the potential effects on geology, soils, and paleontological resources under No-Action Alternative conditions and with implementation of the Proposed Action and Alternative 2. No facilities or operational changes that would affect paleontological resources have been identified.

In general, continued current operations (No-Action Alternative) or the proposed future operations (Proposed Action and Alternative 2), any program that may include environmental, recreational, land use, or cultural resource improvement projects should specify that special precautions, such as Best Management Practices (BMPs), would be implemented to prevent or reduce:

- Erosion, removal, disturbance, and compaction or shifting of gravels in the Feather River channel downstream of the Fish Barrier Dam, except as appropriate for protection or improvement of fish habitat;
- Discharge of silt, petroleum hydrocarbons, and other harmful substances or debris into the Feather River;
- Construction of new facilities on or near areas prone to landsliding or highly erodible soils; and
- Changes to Oroville Facilities borrow areas (e.g., historic, current, and/or future gravel mining areas) that cause them to become sources of silt or other fines during floods or to dissipate stream maintenance flows or trap anadromous fish.

In general, the implementation of BMPs would have no adverse effect on existing geologic, geomorphic, or soils-related resources.

Table 5.3-1. Summary of potential effects on geology, soils, and paleontological resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Flood Management	Regular intermediate flood flushing flows to maintain geomorphic function of the river and replenish fish and riparian habitat absent	Same as No-Action Alternative	Same as No-Action Alternative
Channel Erosion and Property Loss	Benefit because the continued reduction of high volume flow events has significantly reduced downstream channel erosion and property loss within the floodplain	Same as No-Action Alternative	Same as No-Action Alternative
Altered Channel Morphology—Gravel Recruitment	Upstream gravel recruitment contribution blocked and resultant changes to substrate quality and streambed armoring	Beneficial because of Gravel Supplementation and Improvement Program	Same as Proposed Action
Altered Channel Morphology—Sediment Transport	Changed natural geomorphic function and gravel armoring	Beneficial because of Gravel Supplementation and Improvement Program	Same as Proposed Action
Altered Channel Morphology—Woody Debris Recruitment	Deprivation of upstream contribution of large woody debris and incremental reduction in habitat quality and complexity in the lower Feather River	Beneficial because of Large Woody Debris Supplementation and Improvement Program	Same as Proposed Action
Altered Channel Morphology—Habitat (Channel) Abundance	Same as Existing Conditions	Beneficial because of enhancement of existing side channels (e.g., Moe's Ditch and Hatchery Ditch)	Beneficial because of new side-channel creation and increased flows in the Low Flow Channel
Altered Channel Morphology—Channel Complexity	Incremental decrease in channel complexity and habitat diversity downstream of Oroville Dam	Beneficial because of Large Woody Debris Supplementation and Improvement Program and the side-channel enhancements (e.g., Moe's Ditch and Hatchery Ditch)	Beneficial because of Large Woody Debris Supplementation and Improvement Program, enhancement of existing side channels, and creation of new side-channel habitat

Table 5.3-1. Summary of potential effects on geology, soils, and paleontological resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Lower Feather River Channel Geomorphic Function	Reduced frequency of occurrence of channel-forming flows	Same as No-Action Alternative	Adverse because of structural modifications to Shanghai Bench and/or the Sunset Pumps Diversion, which could increase channel erosion and incision
Hazardous Materials	Minor risks of accidents associated with hazardous materials	Slightly higher risks of accidents associated with hazardous materials with higher usage of hazardous materials	Same as Proposed Action

5.3.2.1 No-Action Alternative

With implementation of the No-Action Alternative, baseline conditions identified in Section 5.3.1, Affected Environment, would continue into the future. In general, existing Oroville Facilities operations and maintenance activities would remain largely the same as under Existing Conditions. There would be however, some effects on geologic, geomorphic, and soils-related resources within the study area with continued existing Oroville Facilities–related operations activities. These effects include effects on property loss, channel morphology, and geomorphic function (including channel shaping flows, erosion, gravel recruitment, sediment transport, woody debris recruitment, habitat abundance, and channel complexity). The following subsection provides qualitative analyses of those effects.

Lower Feather River Geomorphic Functions Affected by the Oroville Facilities

Flood Protection/Management

With implementation of the No-Action Alternative, the USACE-designated objective flows in the Feather River downstream of Oroville Dam are 180,000 cubic feet per second (cfs) above the confluence with the Yuba River, and 300,000 cfs below the Yuba River. Current operations generally limit high-flow releases to conserve water for power generation and water supply. The Indicators of Hydraulic Alteration analysis showed that the Oroville Facilities contribute to a reduction in the frequency of occurrence of intermediate high-flow (flood) events, which typically occur on a 2- to 10-year interval. These events are important in maintaining the geomorphic function of the river and replenishing fish and riparian habitat under natural conditions; of course, restoration of such events would defeat the primary project purposes including flood control.

Channel Erosion and Property Loss

With the implementation of the No-Action Alternative, there would continue to be a beneficial effect from the project because the reduction in natural, high-volume flow events (e.g., spring snowmelt runoff, winter flooding) has caused a significant reduction in channel erosion and property loss along the lower Feather River below Oroville Dam. One of the primary functions of the dam is to store winter and spring runoff, which has in turn altered the natural flow regime in the river below the dam. One of the results of a regulated flow regime is that there has been an increase in development and urbanization within the river's natural floodplain (both outside and inside levees). The attenuation of peak flood flows, which in the northern Sierra Nevada Geomorphic Province are typically associated with winter storms and spring snowmelt, has generally resulted in decreased rates of bank erosion and a reduction on the rate of channel migration (SP-G2, Tasks 5 and 7). While there has continued to be incremental sediment loss in the lower Feather River (discussed below), the results of the operation of the project have reduced the average rates of erosion, and therefore reduced overall property losses along the river.

Channel Morphology and Geomorphic Function

With implementation of the No-Action Alternative, there would continue to be an effect on the natural geomorphic processes of the Feather River below Oroville Dam. This includes the incremental loss of sediment (particularly coarse sands and gravels) in the lower Feather River as a result of the blockage by the Oroville Facilities, as indicated in the FLUVIAL-12 Sediment Transport Modeling (SP-G2, Task 7). This results in channel armoring and resulting effect on Chinook salmon and steelhead spawning habitat. However, the 1983 Operating Agreement between DFG and DWR provides for an annual recommendation to DWR for mutual agreement on spawning gravel maintenance activities. Large woody debris recruitment, which plays an important role in gravel retention and channel complexity, is also limited in the Low Flow Channel by the Oroville Facilities under the No-Action Alternative.

No facilities or operational changes that would affect paleontological resources have been identified under the No-Action Alternative.

Hazardous Materials

The No-Action Alternative is not anticipated to result in an increase in usage of hazardous materials in the project area. DWR would follow a number of safety-related standard operating procedures during construction and O&M activities, including traffic control measures, careful handling and offsite dumping of toxic materials, scheduling construction activities to avoid conflicts with nearby recreation activities, etc. These procedures would greatly reduce the risk of accidents and related hazards to the public.

5.3.2.2 Proposed Action

This subsection provides qualitative analyses of potential effects on geologic, geomorphic, and soils-related resources with the implementation of the Proposed

Action, relative to the No-Action Alternative. Several of the baseline incremental effects identified above under the No-Action Alternative are addressed under the Proposed Action. These consist of various aspects of channel morphology and geomorphic function, including gravel recruitment, sediment transport, large woody debris recruitment, and channel complexity. The Proposed Action also addresses channel (habitat) abundance.

Lower Feather River Geomorphic Functions Affected by the Oroville Facilities

Channel Morphology and Geomorphic Function

With implementation of the Proposed Action, there would be beneficial effects on the natural geomorphic processes on the Feather River below Oroville Dam. These include increased gravel recruitment and sediment transport with the implementation of the Gravel Supplementation and Improvement Program. The Gravel Supplementation and Improvement Program would also improve spawning habitat for Chinook salmon and steelhead. The Proposed Action would also help to improve Low Flow Channel complexity through the Large Woody Debris Supplementation and Improvement Program. Apart from increased channel complexity, the Large Woody Debris Supplementation and Improvement Program would enhance salmonid rearing habitat by providing instream cover habitat and shallow-edge habitats within existing riffles and glides. There would also be beneficial effects on channel complexity as a result of the enhancement of existing side channels in the Low Flow Channel (e.g., Moe's Ditch and Hatchery Ditch).

No facilities or operational changes that would affect paleontological resources have been identified for the Proposed Action.

Hazardous Materials

Construction of new facilities and habitat improvements included in the Proposed Action, as well as some O&M activities, would require the use of some hazardous materials, including various types of chemicals, engine oil, and other fluids. Unexpected accidents could occur during construction or O&M activities, and there is the potential that some construction and O&M traffic could cause additional safety hazards. However, as described above for the No-Action Alternative, DWR would follow a number of safety-related standard operating procedures during construction. These procedures would substantially lower the risk of accidents and hazards.

Increased recreational opportunities may increase the use of certain hazardous materials in the project area by recreationists, i.e., vehicular and boat fuels and oils. Public health hazards associated with the use of such materials, however, would be minor.

5.3.2.3 Alternative 2

This subsection provides qualitative analyses of potential effects on geologic, geomorphic, and soils-related resources with the implementation of Alternative 2,

relative to the No-Action Alternative and the Proposed Action. There are a few slight differences between Alternative 2 and the No-Action Alternative and Proposed Action with regard to geology, geomorphology, and soils. There are no additional measures related to gravel recruitment, sediment transport, or large woody debris recruitment; however, additional channel complexity (habitat and abundance) is evaluated in Alternative 2. These additional measures are designed primarily to improve fish habitat in the Low Flow Channel of the Feather River. In addition, Alternative 2 proposes to make structural modifications to Shanghai Bench and the Sunset Pumps Diversion. The actions included in Alternative 2 are qualitatively evaluated below.

Lower Feather River Geomorphic Functions Affected by the Oroville Facilities

Channel Morphology and Geomorphic Function

With implementation of Alternative 2, there would be a beneficial effect on channel complexity as a result of the enhancement of available existing side-channel habitat (e.g., Moe's Ditch and Hatchery Ditch) and creation of additional side-channel habitat in the Low Flow Channel. It is assumed that the flows required to maintain these additional side channels are part of flow increases described in Alternative 2, which are discussed further in Section 5.4.2.1, Water Quantity. DWR determined that the relatively minor and uncertain incremental benefits of these measures on habitat would be outweighed by the substantial capital costs and power losses, however.

Lower Feather River Channel Geomorphic Function

With implementation of Alternative 2, there would likely be an adverse effect on the geomorphic function of the lower Feather River channel near Shanghai Bench and the Sunset Pumps Diversion. Structural modifications to these areas are proposed to aid in the passage of green sturgeon and river lamprey. These modifications, however, could result in the removal of a geologically stable barrier, and the resulting upstream migration of the nick point could cause an increase in channel erosion and incision and affect upstream riffles by removing gravels.

No facilities or operational changes that would affect paleontological resources have been identified under Alternative 2.

Hazardous Materials

For the same reasons described in Section 5.3.2.2 for the Proposed Action, this alternative would lead to a minor increase in the risk of construction- and O&M-related accidents and hazards in the project area.

5.3.3 Cumulative Effects

This section summarizes the potential cumulative effects on geology, soils, and paleontological resources under No-Action Alternative conditions and with implementation of the Proposed Action and Alternative 2.

5.3.3.1 Geology, Soils, and Paleontology

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 potential effects were identified for paleontological resources, there will be no further discussion regarding this topic. As described in Section 5.2, Cumulatively Affected Resources, cumulative effects include past, present, and reasonably foreseeable related actions that incrementally affect resources in combination with a proposed action. 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 analysis.

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 large woody debris 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 ancestral floodplain through the development of non-project flood control levees; and
- Large-scale erosion from mining and timber harvesting activities.

Cumulative Effects of the Oroville Facilities and 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 Oroville, which regulated streamflow and blocked sediment transport through the watershed. Furthermore, as the risk of floodflows decreased downstream, more lands within the floodplain were converted to agricultural and urban use, which has further reduced the

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 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 geology present in the upper watershed. The presence of steep bedrock-lined canyons in much of the upper watershed has confined the river's channel morphology, and thereby maintained a moderate to steep channel shape.

Although the Feather River reaches above Lake Oroville have continued to flow through 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 large woody debris transport though the Feather River watershed. For example, while the Middle Fork Feather River has remained relatively unaltered until 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 events resulting in an interruption of the natural geomorphic processes. Several of the effects from historic land uses and human-induced changes to in 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. The loss of riparian forests within the watershed from timber harvesting result in the loss of the soil retaining riparian cover. The results of this expose the barren soils to increased rates of erosion, which cause 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. 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 ft above the 1875 high-water mark. The levee system was eventually partially extended (no levee above Honcut Creek on river-left) from Oroville to Sacramento. While the result of levee placement has been a reduction in flooding, the Feather River has become almost completely disconnected from its historic floodplain in these locations.

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 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 large woody debris 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 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 Lake Oroville.

Dams, Flow Regulation, and Flood Control

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 streamflow patterns, reduced floodflows, and reduced sediment discharge downstream.

Sediment Transport and Gravel Recruitment

Beginning in 1967, the Oroville Facilities started to regulate the lower Feather River and added to the change in streamflow and sediment discharge. 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 spawning gravel available in downstream reaches. In addition, the loss of large woody debris recruitment has reduced the ability of the river to trap sediments as they move through the system during high-flow events. Overall, the lack of gravel and large woody debris recruitment reduces the channel complexity of the lower Feather River.

Channel cross sections surveyed by USACE between 1909 and 1911 were resurveyed by DWR in 1965 and 1969, and then again in 2002 and 2003. These sections show net continuing scour, both widening and deepening the channel. Detailed descriptions and

analysis of these sections are provided in the SP-G2 Task 3/Task 4 report *Channel Cross-Sections and Photography*.

Channel Meandering

Before 1855, the lower Feather River below Oroville was a meandering stream, 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 aggradation in the lower Feather River and subsequent seasonal overbank flooding. Resulting 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 hydraulic mining and dam construction. Currently, the river is eroding vertically through the hydraulic mining debris, incising the river channel. USGS (1972) documented channel changes between 1909 and 1970. USACE surveyed the lower Feather River between Oroville and Verona and published a series of topographic river surveys between 1909 and 1911. USGS (1972) compared some of these cross sections in the Oroville-to-Honcut Creek reach with cross sections from 1909. These cross sections are shown in the SP-G2 Task 7 report *Hydraulic and Sediment Transport Modeling with Fluvial 12* and the SP-G2 Task 5 report *Dam Effects on Channel Hydraulics and Geomorphology.* In general, the cross sections show a large increase in cross-sectional area, with an increase in both depth and width. This has also increased channel capacity and the ability to convey flood water 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 watershed continue to trap sediment. As a result, sediment eroded from the banks and bed is not replenished from upstream. 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.

5.3.3.2 Cumulative Effects of the Alternatives and Future Related Actions

This section summarizes the potential cumulative effects on geology and soils under the No-Action Alternative, the Proposed Action, and Alternative 2.

No-Action 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-Action Alternative. The Oroville Facilities and other upstream hydroelectric dams will continue to contribute incrementally to the reduction in sediment transport and reduction in gravel recruitment and large woody

debris on portions of the 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 large woody debris. 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 will reduce salmonid spawning and rearing habitat over time. The Oroville Facilities would continue to attenuate peak flows, providing flood protection benefits downstream.

Proposed Action

Under the Proposed Action, the Gravel Supplementation and Improvement Program and Large Woody Debris Supplementation Program would provide some improvement in the level of channel complexity downstream. Side-channel habitat improvements would provide additional spawning and rearing habitat available to salmonids. There would be a continued reduction in sediment transport and gravel recruitment from the upper watershed above Lake Oroville and significant flood damage reduction benefits would still be provided downstream.

Alternative 2

Although Alternative 2 would increase the flow within the Low Flow Channel, the increase would not affect geology and soils resources within the FERC project boundary. The Gravel Supplementation and Improvement Program and Large Woody Debris Supplementation Program would provide the same level of improvement in the level of channel complexity downstream as described for the Proposed Action. Additional side-channel habitat enhancements would provide additional but difficult to quantify spawning and rearing habitat available to salmonids. There would be a continued reduction in sediment transport and gravel recruitment from the upper watershed above Lake Oroville and significant flood damage reduction benefits would still be provided downstream.

5.3.4 Unavoidable Adverse Effects

The physical presence of the Oroville Facilities and the functional interactions of the facilities and operations have resulted in unavoidable adverse effects on geologic and soils-related resources. Although the operation of the Oroville Facilities results in reduced channel-shaping flows (floodflows), reducing channel complexity below Oroville Dam compared to natural conditions, they provide substantial flood damage reduction benefits downstream by controlling floodflows.

5.4 WATER QUANTITY AND QUALITY

This section describes the affected water quantity and quality environment as well as potential effects of the alternatives. More specifically, Section 5.4.1, Affected Environment, includes an overview of water use and hydrology, and existing water quality conditions in the project study area. Section 5.4.2, Environmental Effects, provides an evaluation of potential effects on water use and hydrology and water quality related to implementation of the No-Action Alternative, the Proposed Action, and Alternative 2. Cumulative effects are discussed in Section 5.4.3, and unavoidable adverse effects are described in Section 5.4.4.

Modeling was used to simulate operations of the SWP, including the Oroville Facilities, under different scenarios. These scenarios include existing conditions used to define the affected environment. The related modeled 2001 Existing Conditions scenario represents the "existing conditions benchmark study." To support this assessment of effects, 2020 level of development conditions were used to model future water quantity conditions assuming that either the No-Action Alternative, the Proposed Action, or Alternative 2 would be fully implemented. Appendix C provides additional information on these models and Appendix G-WQ1 includes water quality modeling results that supplement the results summarized in this section.

Temperature modeling was conducted to support the water quality assessment and was coordinated with the water quantity modeling noted above (see Appendix C). Section 5.4.1.2 summarizes the water quality affected environment using related modeling results for the temperature subsection, while the studies listed below were used to describe existing conditions for other water quality parameters. Section 5.4.2.2 describes the potential water quality effects of the alternatives. Appendix G-WQ2 describes the affected water quality environment and provides supporting information for the water quality effect assessment. The methodology for the water quality effect assessment is summarized below.

DWR conducted seven relicensing studies specifically designed to address water quality issues:

- SP-W1, *Project Effects on Water Quality Designated Beneficial Uses for Surface Waters,* characterizes existing water quality conditions at different times of year throughout the project area to provide a basis for understanding effects of potential future actions on water quality.

- SP-W2*, Contaminant Accumulation in Fish, Sediments, and the Aquatic Food Chain,* investigated levels of metals and pesticide and other organic contaminants in tissues of fish and crayfish from the Thermalito Complex impoundments and the lower Feather River.

- SP-W3*, Recreational Facilities and Operations Effects on Water Quality,* examined water quality conditions near recreational facilities in the project area and other

areas with heavy recreation use, and evaluated effects of baseline and potential future recreational activities on water quality.

- SP-W5*, Project Effects on Groundwater,* surveyed groundwater in wells downgradient from Thermalito Forebay and Thermalito Afterbay.
- SP-W6*, Project Effects on Temperature Regime,* obtained continuous water temperature measurements in the lower Feather River and evaluated effects of project operations.
- SP-W7*, Land and Watershed Management Effects on Water Quality,* evaluated the potential effects of pesticide treatment and stormwater discharge on water quality of waters in and downstream of the project area.
- SP-W9*, Project Effects on Natural Protective Process,* assessed the effectiveness of natural protective processes in the lower Feather River's riparian vegetation and hyporheic zones on biological, physical, and chemical integrity of the ecosystem.

The water quality temperature effect assessment was conducted by using simulated conditions from the following three models: CALSIM II, HYDROPS™, and WQRRS. A brief summary of these modeling tools is provided below and more detail regarding the models and the temperature results is found in Appendix C and Appendix G-WQ-2, respectively.

- CALSIM II is a SWP and CVP simulation tool utilizing a 73-year sequential synthetic hydrology and monthly time step. CALSIM II provided much of the modeled hydrology results summarized in the water quantity sections.
- HYDROPS™ is an hourly power optimization model with a 1-week time horizon. Using weekly operational boundary conditions developed from the disaggregated monthly results of CALSIM II, HYDROPS™ simulates operations and generation at the Oroville Facilities while meeting all facilities constraints and operational requirements.
- WQRRS simulates water temperatures throughout the Oroville Facilities and Feather River based on the hourly flow output from HYDROPS™. The flow-stage relationships used in WQRRS were developed in the Feather River flow-stage model (a HEC-RAS-based model).

5.4.1 Affected Environment

5.4.1.1 Water Quantity

Regional Overview

The Oroville Facilities were developed as part of the SWP and provide water storage, flood control, power generation, water quality improvement, and recreation, fish, and

wildlife enhancement. The physical arrangement of the Oroville Facilities is illustrated in Figure 5.4-1 along with the major locations used in the water quantity analysis.

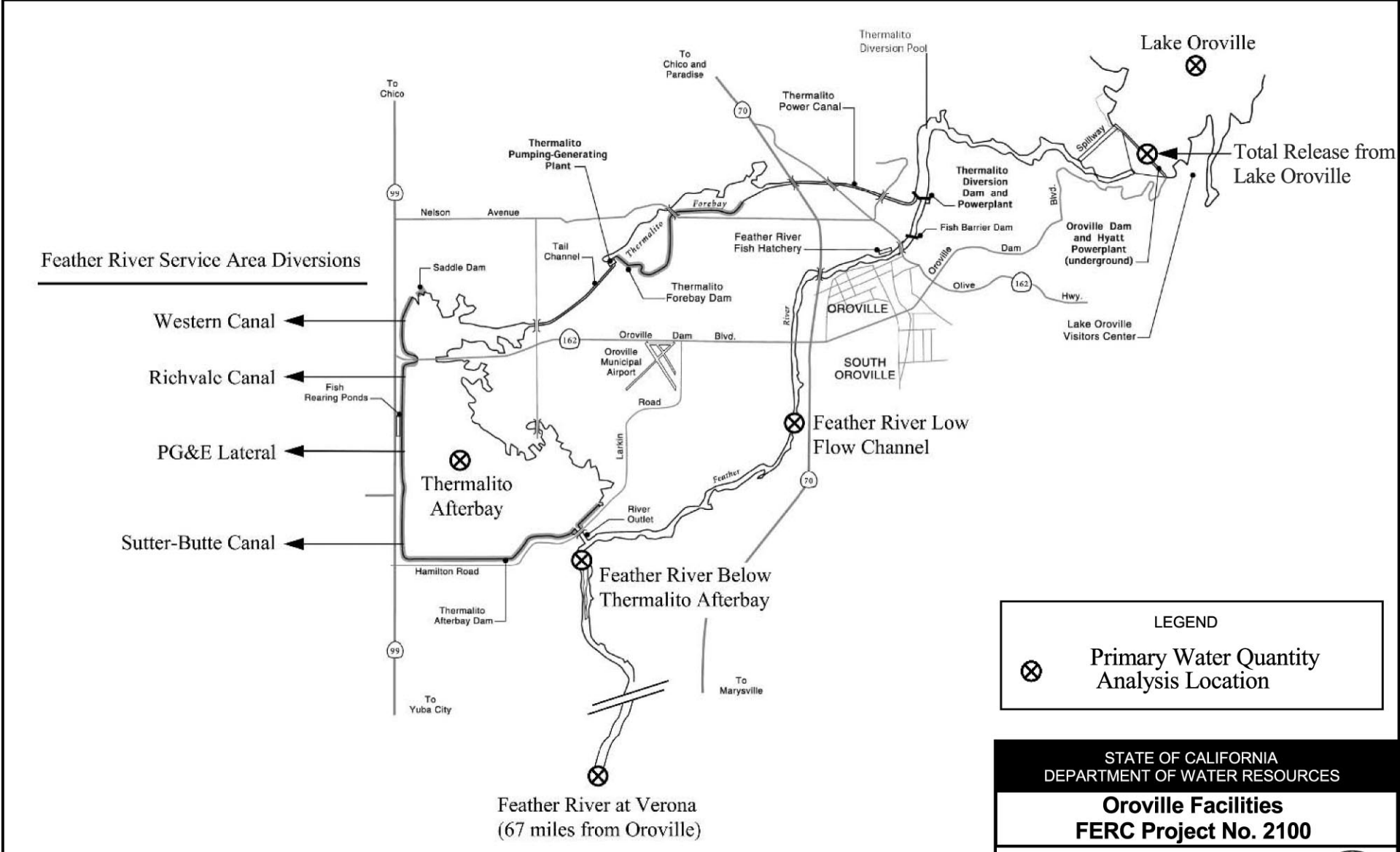
The Oroville Facilities alter streamflow in the Feather River by regulating water at Oroville Dam, the Thermalito Diversion Dam, and the Thermalito Afterbay Complex. These facilities divert water for water supply, flood control, Sacramento–San Joaquin Delta (Delta) water quality requirements, and instream flow requirements, as described more fully in Chapter 2.0. Hydroelectric power operations do not alter the streamflow in the Feather River downstream of the Thermalito Afterbay Outlet; hydroelectric power is generated from the releases made for other purposes. Streamflow alterations vary based on different hydrologic water year types. Water year types are determined according to the Sacramento Valley water year type definitions developed by the State Water Resources Control Board (SWRCB) as part of Bay-Delta regulatory activities. The water year type classifications include Critical, Dry, Below Normal, Above Normal, and Wet. Critical water years are sometimes referred to as Critically Dry water years.

Water Use

The Oroville Facilities divert water for senior water right holders in the Feather River Service Area (FRSA) and supply supplemental water to the SWP contractors. Monthly irrigation diversions of up to 150,000 acre-feet (af) are made from the Thermalito Afterbay Complex to the FRSA during the May-through-August irrigation season. Average annual FRSA diversions are slightly less than 1 maf. Annual water deliveries to meet FRSA entitlements and SWP contractor Table A amounts under modeled existing conditions are provided in Table 5.4-1. In addition to the modeled 2001 Existing Conditions information, Table 5.4-1 also includes information about FRSA and SWP water delivery (from the Oroville Facilities) for 2020 No-Action Conditions (i.e., the year 2020 level of development), the Proposed Action, and Alternative 2. This information is included here to assist comparison. See Section 5.4.2, Environmental Effects, for a detailed analysis of potential effects related to implementation of the No-Action Alternative, the Proposed Action, and Alternative 2.

Water diversions to meet FRSA entitlements occur primarily during the irrigation season, April–October. Under 2001 Existing Conditions, the average annual diversion of water to meet FRSA entitlements is about 994 thousand acre-feet (taf). The minimum and maximum annual diversions over the modeling period are 613 taf and 1,057 taf, respectively.

Water is required in all months of the year to meet SWP contractor requests, with the highest requests typically in June through August and the lowest in January. Water available for delivery varies depending on hydrological conditions and operating requirements. Under modeled 2001 Existing Conditions, the average annual delivery to meet SWP contractor requests, is about 3,051 taf. The maximum and minimum annual deliveries over the modeling period are 3,914 taf and 761 taf, respectively.



Source: DWR / EDAW 2004

1 0 1 2 3 4 Miles

Original Scale 1 : 126,720
1" = 2 miles

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Oroville Facilities
FERC Project No. 2100

FIGURE 5.4-1

Oroville Facilities
and
Primary Water Quantity Analysis Locations

Prepared by: PJ -- EDAW, Inc.
Date 12/15/04
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Table 5.4-1. Modeled water supply deliveries for the alternatives (annual average deliveries).

Annual FRSA Delivery (taf)				
	2001 Existing Conditions	2020 Conditions		
		No-Action Alternative	Proposed Action	Alternative 2
Mean	994	994	994	994
Max	1,057	1,057	1,057	1,057
Min	613	611	611	611
Annual SWP Contractors Deliveries (taf)				
	2001 Existing Conditions	2020 Conditions		
		No-Action Alternative	Proposed Action	Alternative 2
Mean	3,051	3,246	3,246	3,246
Max	3,914	4,199	4,199	4,199
Min	761	788	788	788

Note: taf = thousand acre-feet. Annual SWP contractor deliveries includes releases from Oroville as well as other water available to the SWP to divert from the Delta.
Source: DWR; 2004 CALSIM II Existing Conditions Benchmark Modeling Results

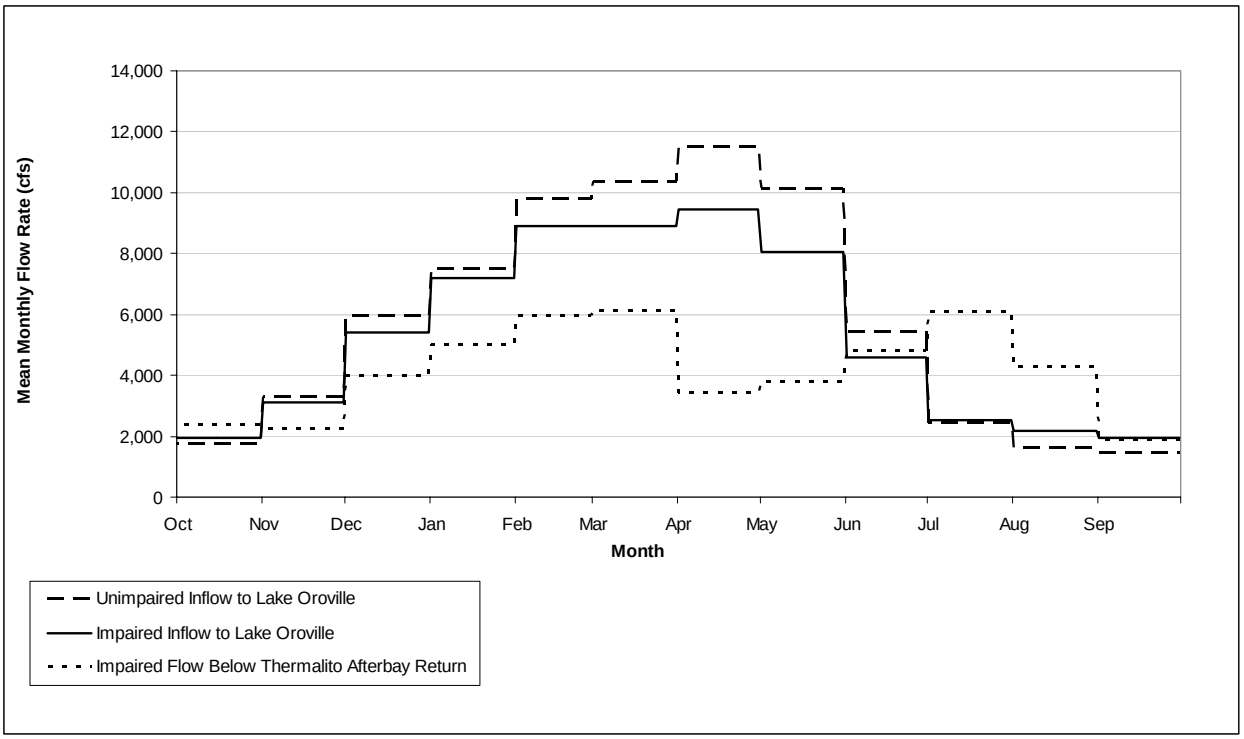
More detailed information regarding water supply, including a monthly breakdown of deliveries under modeled 2001 Existing Conditions, modeled 2020 No-Action Conditions, and the Proposed Action and Alternative 2, is included in Appendix G-WQ1.

Surface Water Hydrology

Unimpaired flow in the Feather River is altered by other hydroelectric, water storage, and diversion projects upstream of the Oroville Facilities, Lake Oroville operation, and by diversions from Thermalito Afterbay to meet FRSA entitlements. Upstream projects alter Feather River flow through operation of storage facilities and by diversions from the river and its tributaries.

The average annual unimpaired flow of the Feather River at Oroville is about 5,800 cfs (4.2 maf). Much of the runoff occurs in the January through June period. Summer inflows are sustained at about 1,000 cfs because of snowmelt and groundwater accretions from the upper watershed. Due to several diversions upstream, actual annual inflow into Lake Oroville is about 4.0 maf. Annual flows are variable and depend upon precipitation. From 1979 to 1999, annual inflows ranged from a minimum of 1.7 maf to as high as 10 maf.

Operation of Lake Oroville alters flow in the Feather River by storing inflows and making releases later in the year, or in subsequent years to meet downstream requirements. Mean monthly outflow from the project typically varies from a low of 2,000 cfs to a high of about 9,000 cfs. Mean monthly Feather River unimpaired and regulated (impaired) inflow to Lake Oroville and the flow below the Thermalito Afterbay Outlet is shown in Figure 5.4-2. In general, the inflow to Lake Oroville is reduced from unimpaired



Source: DWR, 2004 CALSIM II Modeling Results; California Data Exchange Center

Figure 5.4-2. Lake Oroville mean monthly impaired and unimpaired inflow and flow below Thermalito Afterbay Outlet for modeled 2001 Existing Conditions.

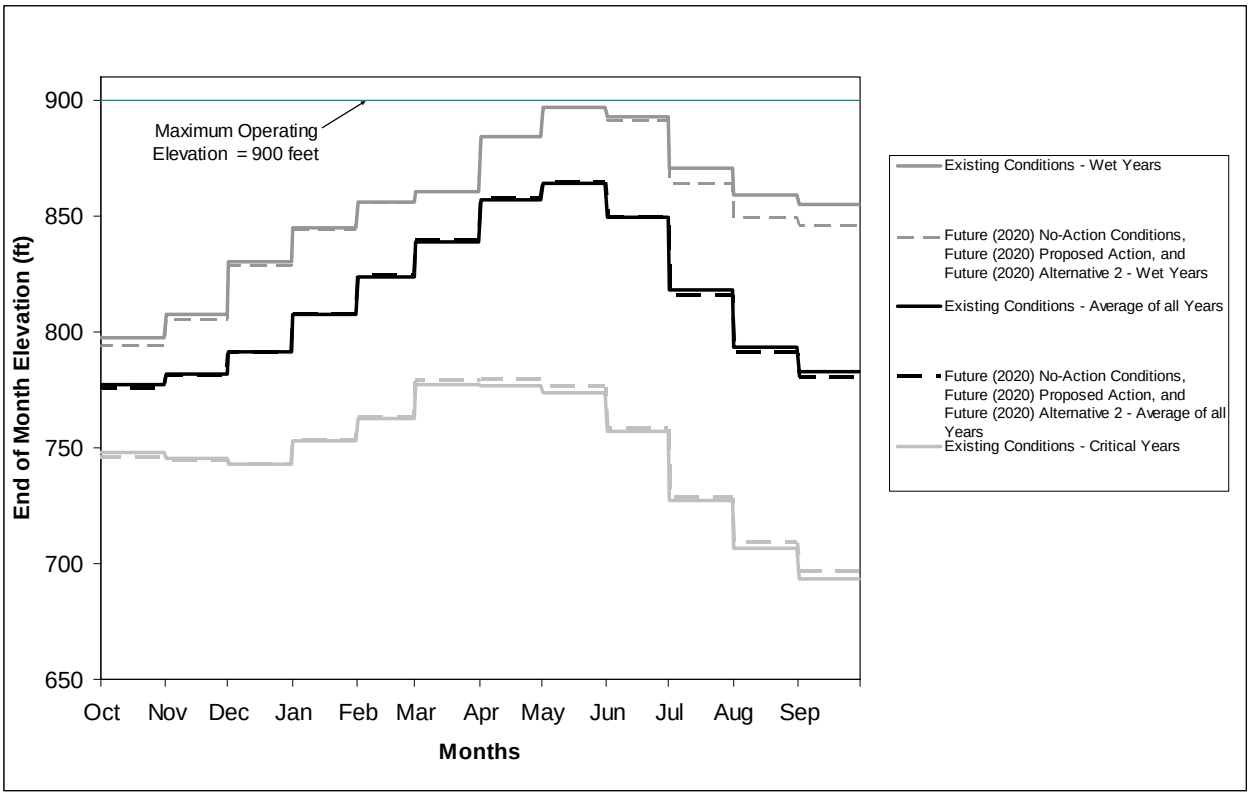
conditions during the months of November–June, primarily due to upstream diversions and storage operation. Typically, the inflow to Lake Oroville tends to be slightly greater than unimpaired conditions in the months of August–October due to releases from storage during those months from upstream projects.

The following sections provide a brief summary of existing surface water hydrology conditions and related operating parameters.

Lake Oroville

Lake Oroville is generally operated to store water and provide flood protection during the winter and the spring snowmelt period and make releases in the summer and fall to meet downstream requirements. Lake Oroville end of month elevations were simulated using CALSIM II modeling and are used to describe the reservoir operation under the modeled 2001 Existing Conditions.

Lake Oroville end of month elevations for average, wet, and critically dry year types are shown in Figure 5.4-3 for modeled 2001 Existing Conditions. In addition, the figure includes Lake Oroville end-of-month information for the modeled 2020 No-Action Conditions and the Proposed Action and Alternative 2 to assist comparison. During the wetter years, Lake Oroville typically fills to capacity, or near capacity, in May or June. In drier years, the reservoir reaches its maximum elevation as early as March and does

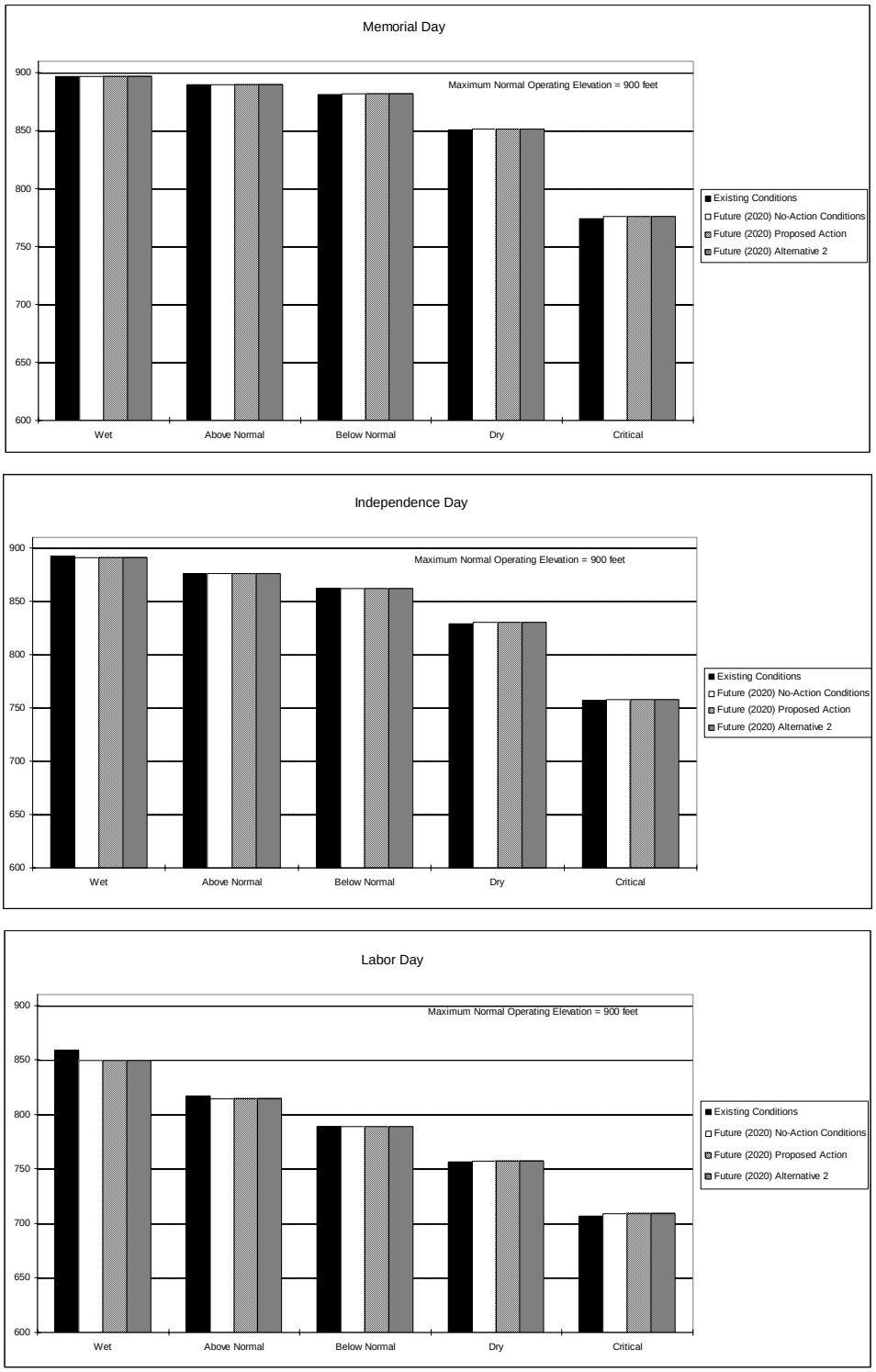


Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-3. Lake Oroville end-of-month elevation for wet years, average years, and critically dry years.

not fill to capacity, which reduces DWR's ability to meet downstream requirements and fulfill SWP contractor requests.

Average Lake Oroville water surface elevations on Memorial Day, Independence Day, and Labor Day under different water year types for 2001 Existing Conditions, 2020 No-Action Conditions, and the Proposed Action and Alternative 2 are shown in Figure 5.4-4. On Memorial Day, in wet years, Lake Oroville is typically at or near its maximum normal operating elevation of 900 feet (ft) (mean sea level [msl]). In drier hydrologic years, the elevation of Lake Oroville is lower because the inflow to the reservoir is less. On Memorial Day, in critically dry years, the surface elevation of Lake Oroville averages about 774 ft, representing a drawdown of about 126 ft from the maximum normal operating elevation of 900 ft. The surface elevation of Lake Oroville is reduced through the summer season as releases from storage are required to meet downstream requirements, including instream flow, environmental requirements, in-basin uses, and the FRSA and SWP water supply requests. Under the Coordinated Operating Agreement (COA) the SWP and CVP operate jointly to meet Delta water quality requirements and other water demands within the Sacramento River basin. These requirements are referred to as "in-basin" demands. On Labor Day Lake Oroville average elevation is about 707 ft in critical years and 859 ft in wet years, representing drawdowns of about 193 ft and 41 ft, respectively.



Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-4. Average Lake Oroville elevation by water year type under Existing Conditions (2001) , Future (2020) No-Action Conditions, Future (2020) Proposed Action and Future (2020) Alternative 2 Conditions.

Elevation-frequency plots of Lake Oroville water surface elevation for Memorial Day, Independence Day, and Labor Day for 2001 Existing Conditions, 2020 No-Action Conditions, and the Proposed Action and Alternative 2 are shown in Figure 5.4-5. For 2001 Existing Conditions on Memorial Day, Lake Oroville elevation has a 90 percent probability of being at elevation 787 ft or higher and a 50 percent probability of being at elevation 885 ft. These represent drawdowns of about 137 ft and 15 ft, respectively, from the maximum normal operating elevation of 900 ft.

Similarly, on Labor Day, Lake Oroville elevation has a 90 percent probability of being at elevation 725 ft and a 50 percent probability of being at elevation 791 ft. These represent drawdowns of about 175 ft and 109 ft, respectively, from the maximum normal operating elevation of 900 ft.

Thermalito Afterbay

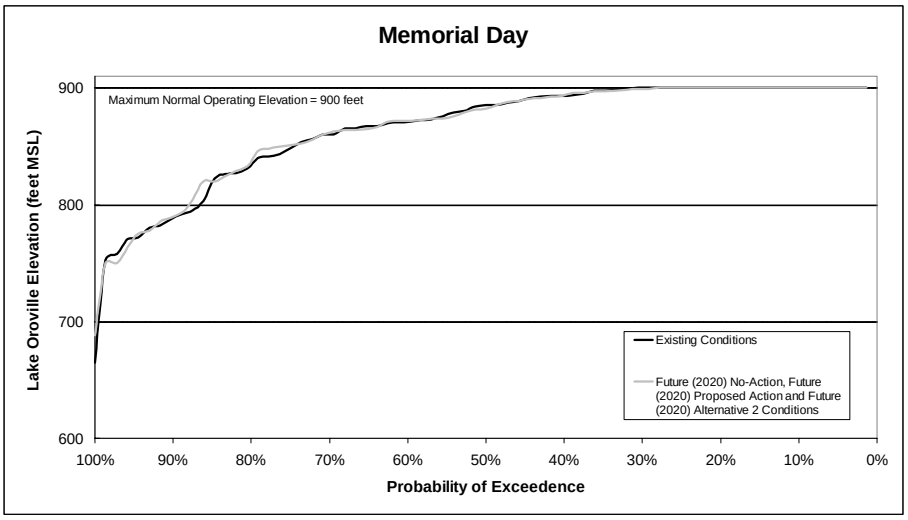
Thermalito Afterbay is operated to meet multiple requirements including regulation of inflow from the Thermalito Pumping-Generating Plant, providing water for withdrawal during pump-back operation, and to make releases through the Thermalito Afterbay Outlet to the Feather River. Thermalito Afterbay is also the location where diversions are made to meet FRSA irrigation entitlements. To successfully meet each requirement, a high degree of operational flexibility is required at Thermalito Afterbay.

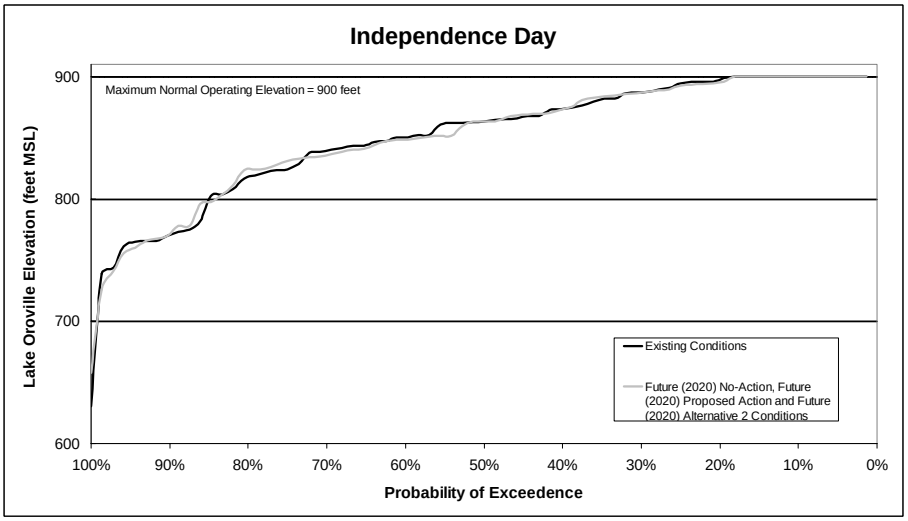
Thermalito Afterbay operation is not affected by natural hydrologic conditions; it is primarily affected by operational requirements. Generally, there are no seasonal differences in the operation of Thermalito Afterbay and the water surface elevation varies from about 124 to 136 ft (msl) throughout the year. When peaking and/or pump-back power operations occur, Thermalito Afterbay tends to operate on a weekly cycle, with its elevation typically increasing about 3 ft gradually during the Monday through Friday period. On Saturday and Sunday, the elevation is typically reduced by about 3 ft, with a majority of the elevation change occurring on Sunday.

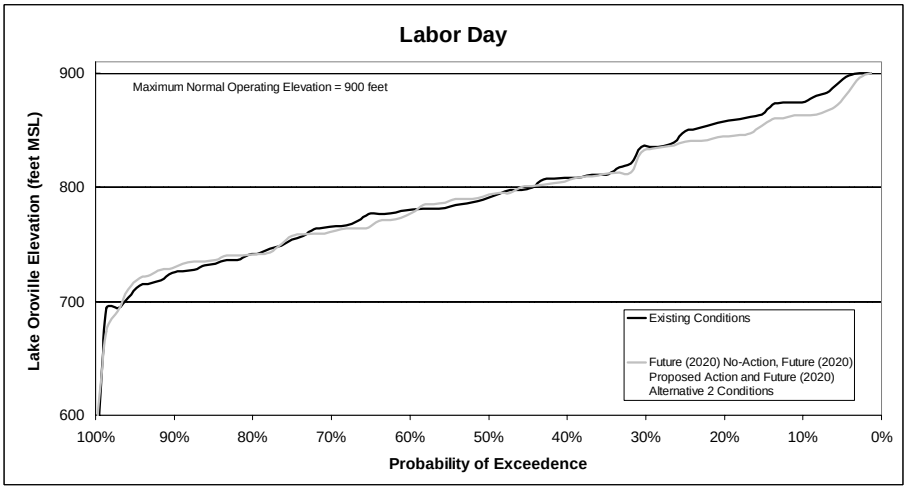
Operational flexibility is required at Thermalito Afterbay to comply with all the existing flow release requirements for water supply, water quality, and instream flow needs, and to periodically recharge brood ponds to support nesting waterfowl. As a result, the elevation of Thermalito Afterbay fluctuates over short periods of time. Historical water levels for water year 2001 are shown in Figure 5.4-6. While actual fluctuations vary significantly from month-to-month and year-to-year, the 2001 water year provides an indication of the upper and lower bounds for an annual operating cycle.

Feather River

Releases from Lake Oroville are made into the Diversion Pool below Oroville Dam, where water can be released through the Thermalito Diversion Dam Powerplant (or the Thermalito Diversion Dam spillway during flood release periods) to the Low Flow Channel of the Feather River or diverted through the Thermalito Power Canal, through the Thermalito Forebay, through the Thermalito Pumping-Generating Plant and into

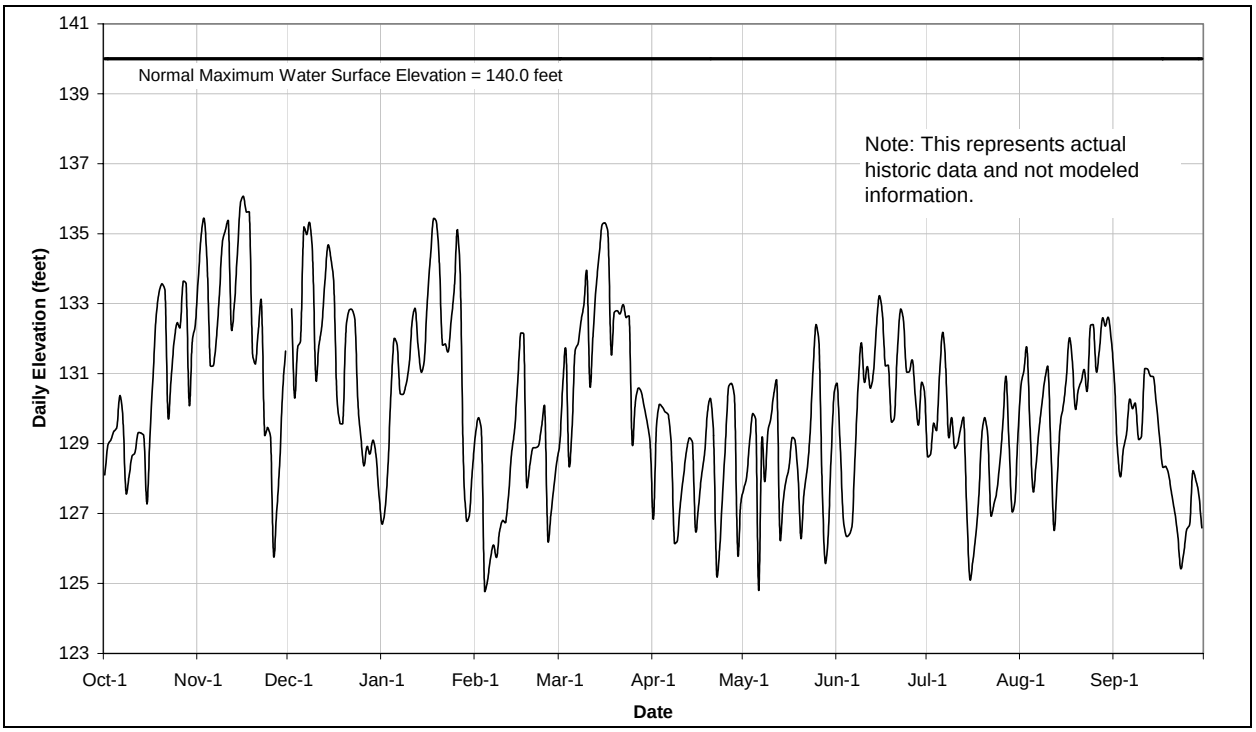






Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-5. Lake Oroville elevation under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action and Future (2020) Alternative 2 Conditions.



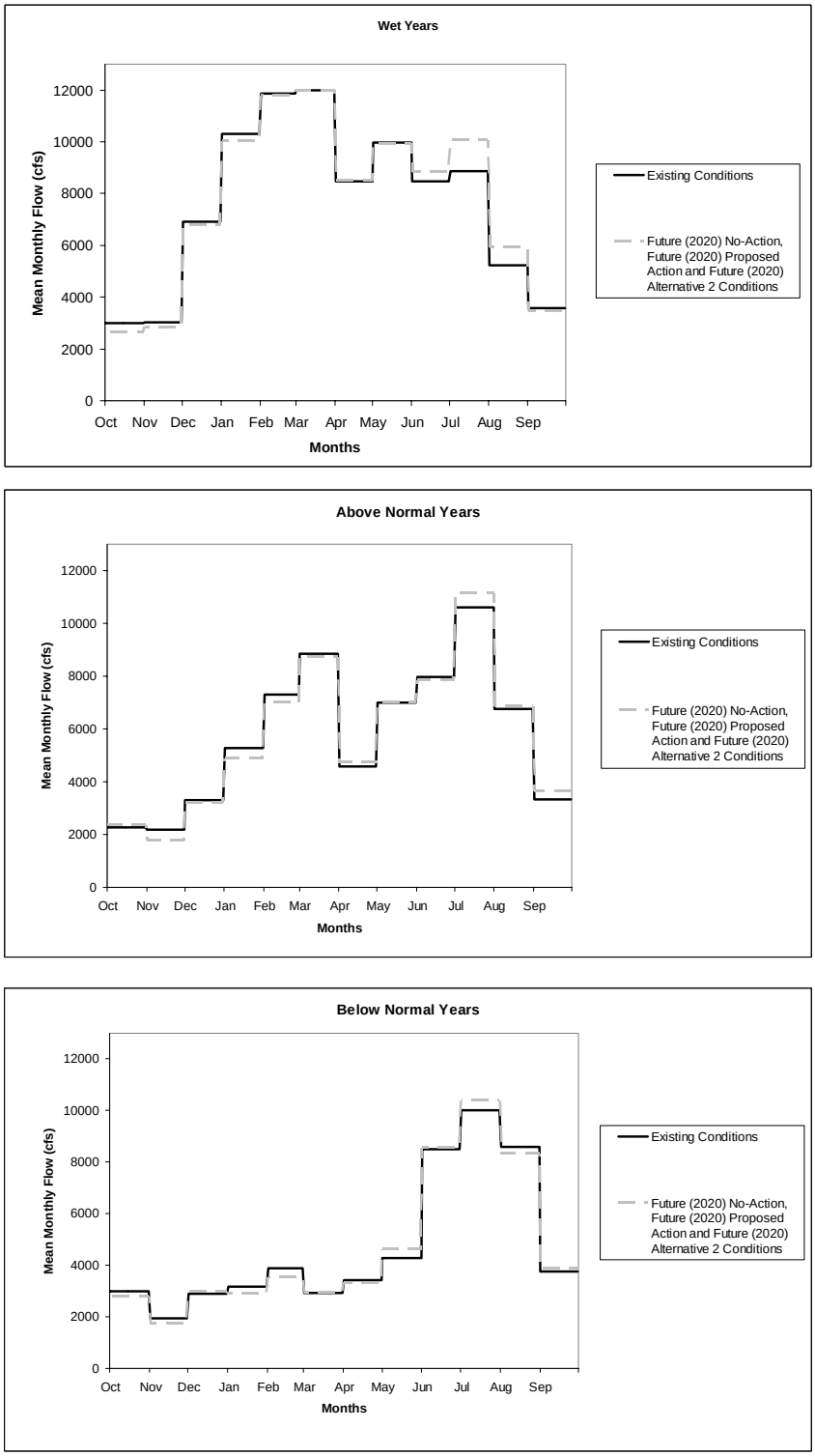
Source: California Data Exchange Center

Figure 5.4-6. Thermalito Afterbay historic water surface elevations, Water Year 2001.

Thermalito Afterbay. Flows can be diverted from Thermalito Afterbay to meet local FRSA requirements or released through the Thermalito Afterbay Outlet back into the Feather River, where they combine with flows passing through the Low Flow Channel.

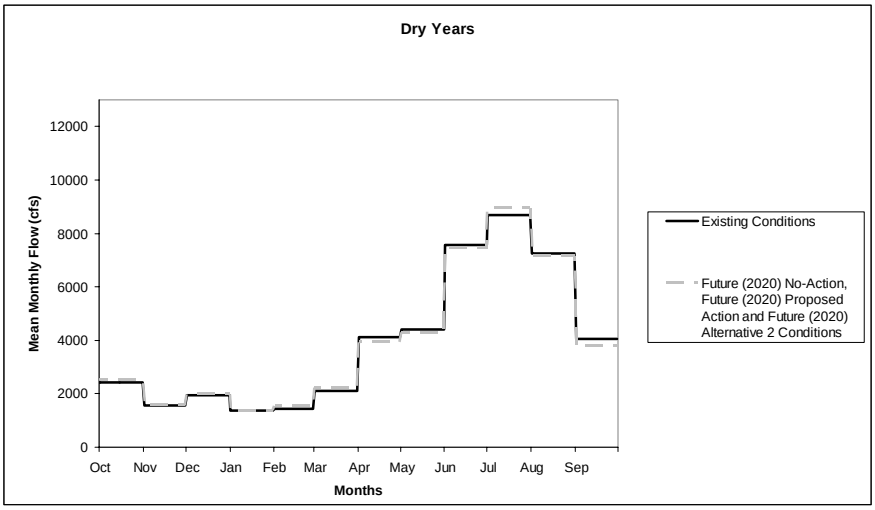
The total release from Lake Oroville under 2001 Existing Conditions is shown in Figure 5.4-7. In addition to the 2001 Existing Conditions information, Figure 5.4-7 also includes total Lake Oroville release information for the 2020 No-Action Conditions and the Proposed Action and Alternative 2. 2020 modeling results are included in Figure 5.4-7 to help the reader compare the results of each model run.

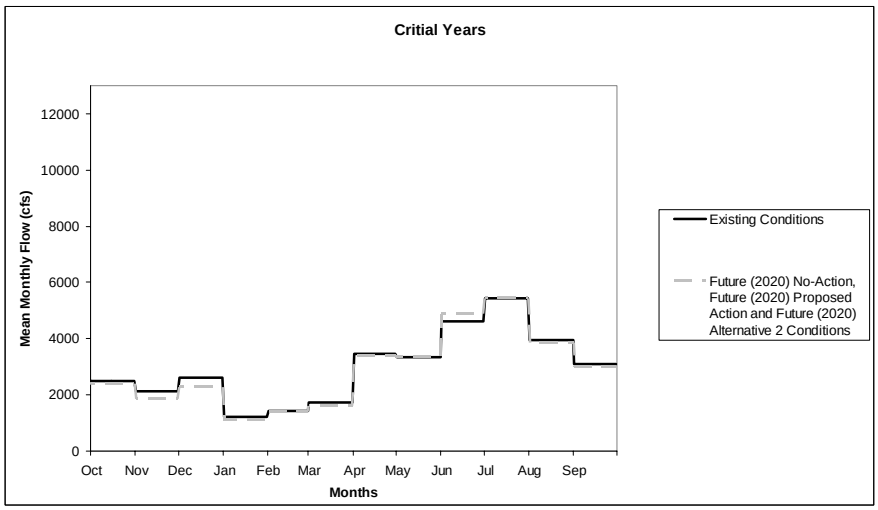
In above normal and wet years, the maximum total release from Lake Oroville typically occurs in February and March. This is due primarily to large releases being made from the reservoir to meet flood control criteria and maintain adequate flood reservation storage volume in the reservoir. In below normal, dry, and critically dry years, the maximum total release from Lake Oroville typically occurs during the month of July. In these drier years, high inflow is typically stored in the winter and spring with releases from storage made during the irrigation season to meet water supply demands. A summary of modeled flow in the Feather River for the 2020 No-Action Conditions and the Proposed Action and Alternative 2 is presented in Table 5.4-2.



Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-7. Lake Oroville total release under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action, and Future (2020) Alternative 2 Conditions.





Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-7 (Continued). Lake Oroville total release under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action, and Future (2020) Alternative 2 Conditions.

The flow in the Low Flow Channel is at least 600 cfs, however, this flow can be modified if required by operating emergencies beyond the control of the Licensee. In some above-normal and wet years, releases from Lake Oroville storage are required in excess of power generation capacity at Thermalito Pumping-Generating Plant for flood management purposes. When this occurs, additional water is released to the Low Flow Channel.

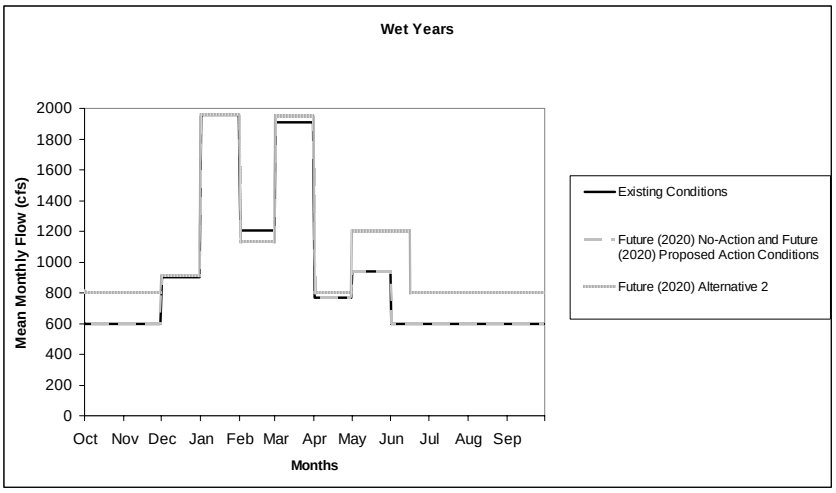
Typical mean monthly flow in the Low Flow Channel under existing conditions is illustrated in Figure 5.4-8.

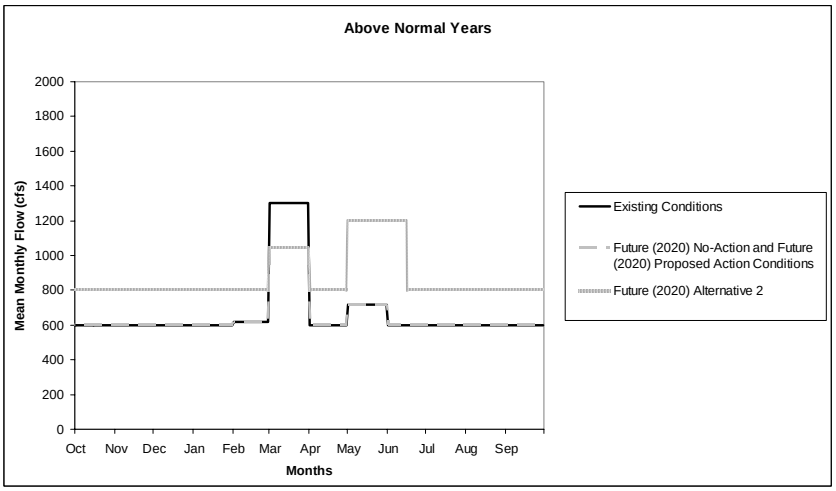
Table 5.4-2. Modeled Feather River flow volume for the alternatives (annual average volume).

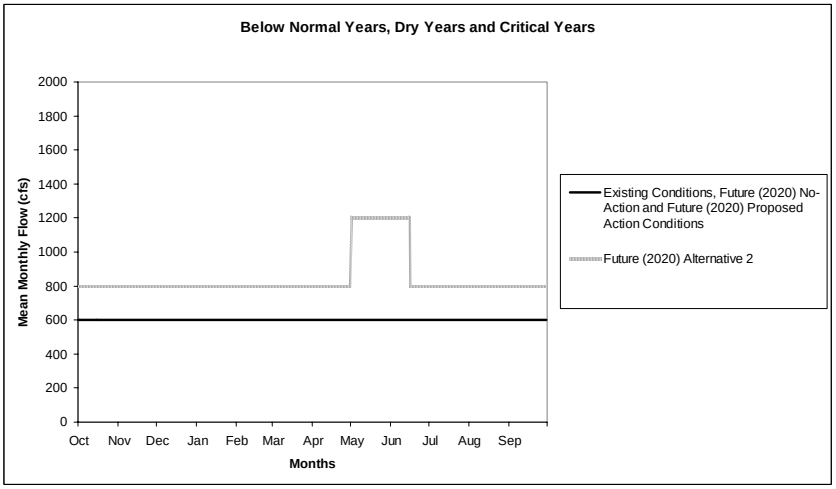
Total Release from Lake Oroville (taf)				
	2001 Existing Conditions	2020 Conditions		
		No-Action	Proposed Action	Alternative 2
Mean	3,816	3,816	3,816	3,816
Max	13,392	13,350	13,350	13,350
Min	1,143	1,173	1,173	1,173
Low Flow Channel (taf)				
	2001 Existing Conditions	2020 Conditions		
		No-Action	Proposed Action	Alternative 2
Mean	514	511	511	688
Max	3,547	3,464	3,464	3,548
Min	434	434	434	616
Feather River Below Thermalito Afterbay (taf)				
	2001 Existing Conditions	2020 Conditions		
		No-Action	Proposed Action	Alternative 2
Mean	3,022	3,022	3,022	3,022
Max	12,596	12,521	12,521	12,521
Min	646	657	657	657
Feather River at Verona (taf)				
	2001 Existing Conditions	2020 Conditions		
		No-Action	Proposed Action	Alternative 2
Mean	5,408	5,412	5,412	5,412
Max	22,733	22,433	22,433	22,433
Min	821	820	820	820

Note: taf = thousand acre-feet
Sources: DWR, 2004 CALSIM II Existing Conditions Benchmark Modeling Results

Flow in the Feather River below Thermalito Afterbay Outlet (High Flow Channel) varies with water released by the Oroville Facilities for the many commitments DWR has related to releases for downstream water quality control, flood management releases, SWP contractor deliveries, and other purposes. The Feather River flow below Thermalito Afterbay under 2001 Existing Conditions for different water year types is shown in Figure 5.4-9. This flow was simulated using CALSIM II modeling and is used to describe the 2001 Existing Conditions for flow in the Feather River below Thermalito Afterbay. In addition to the 2001 Existing Conditions information, Figure 5.4-9 also includes total Lake Oroville release information for the 2020 No-Action Conditions and the Proposed Action and Alternative 2. A summary of modeled flow volume in the Feather River is shown in Table 5.4-2.

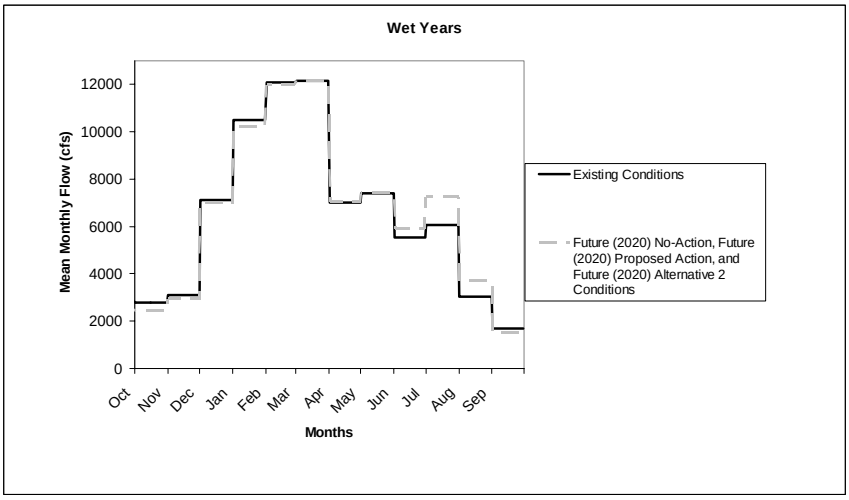


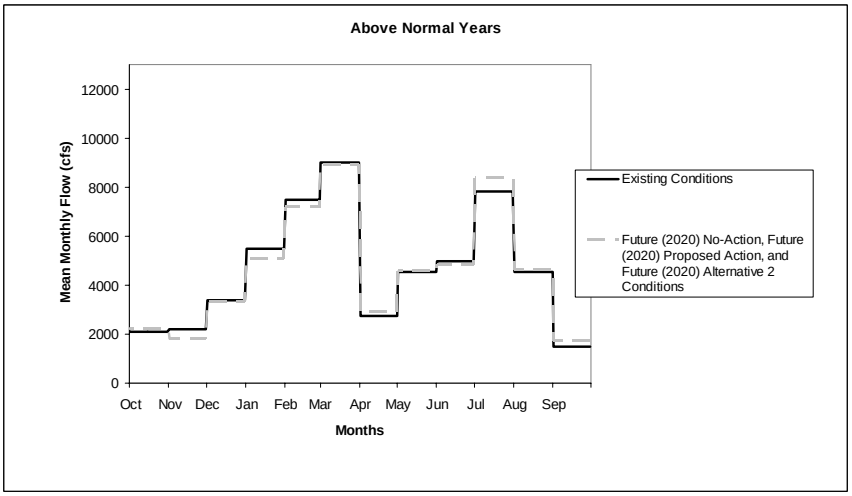


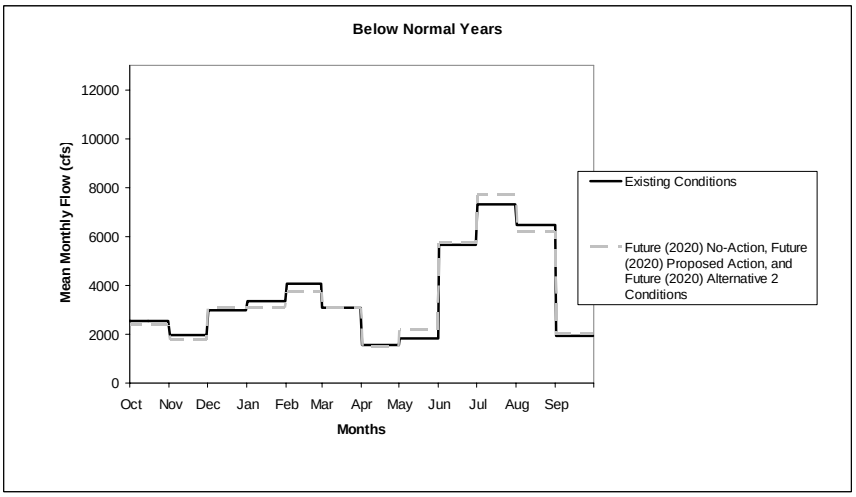


Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-8. Low Flow Channel flow under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action, and Future (2020) Alternative 2 Conditions.

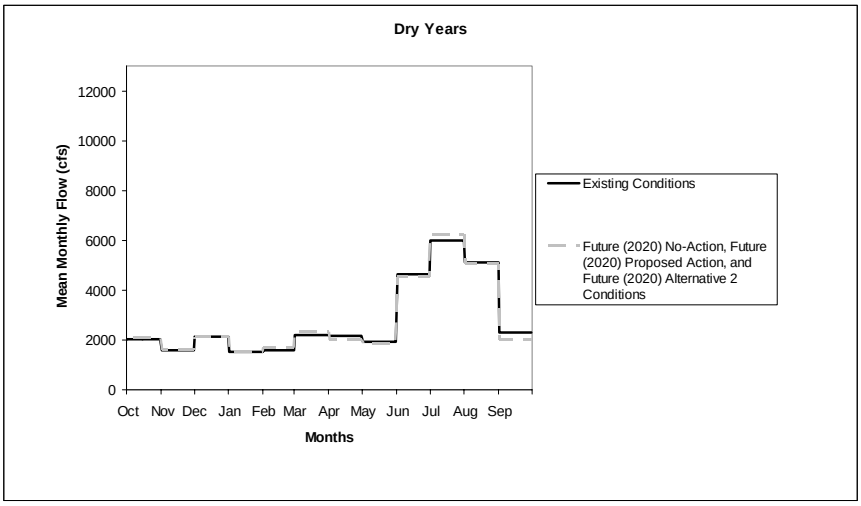


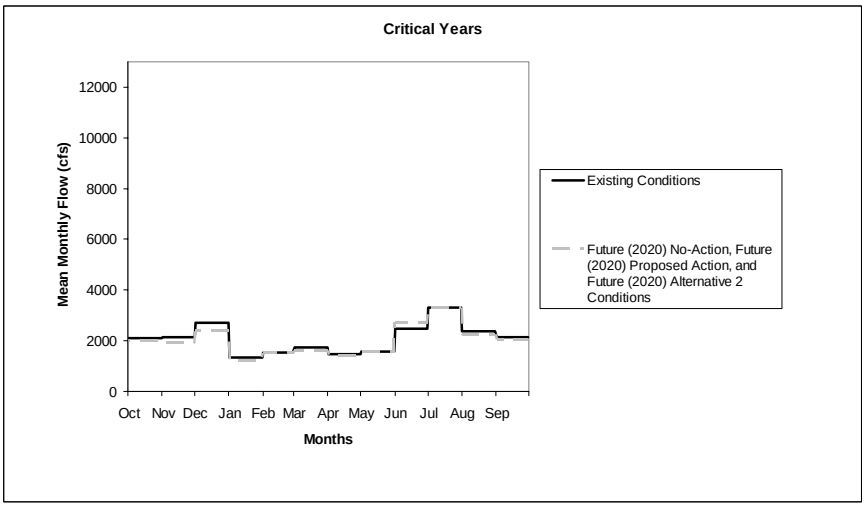




Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-9. Feather River flow below Thermalito Afterbay under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action, and Future (2020) Alternative 2 Conditions.





Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-9 (Continued). Feather River flow below Thermalito Afterbay under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action, and Future (2020) Alternative 2 Conditions.

In above normal and wet years, the maximum flow in the Feather River below Thermalito Afterbay typically occurs during February or March because high releases from Lake Oroville are made to meet flood control criteria and maintain adequate flood reservation storage volume in the reservoir. In below normal, dry, and critical years, the maximum flow in the Feather River below the Thermalito Afterbay Outlet typically occurs during the month of July. In these years, high inflow is typically stored in the winter and spring with little or no release made for flood management purposes. Releases from storage to meet downstream SWP contractor demands typically peak in July. The minimum flow for the year typically occurs during September.

Approximately 67 miles downstream of the Fish Barrier Dam, the Feather River flows into the Sacramento River near the town of Verona. Flow in the river at Verona is typically greater than the flow below Thermalito Afterbay as flow increases from tributary

accretions along the length of the river. The Feather River flow at Verona under 2001 Existing Conditions for different water year types is shown in Figure 5.4-10. This flow was simulated using CALSIM II modeling. In addition to the 2001 Existing Conditions information, Figure 5.4-10 also includes Feather River flow at Verona information for 2020 No-Action Conditions, the Proposed Action, and Alternative 2.

Groundwater Hydrology

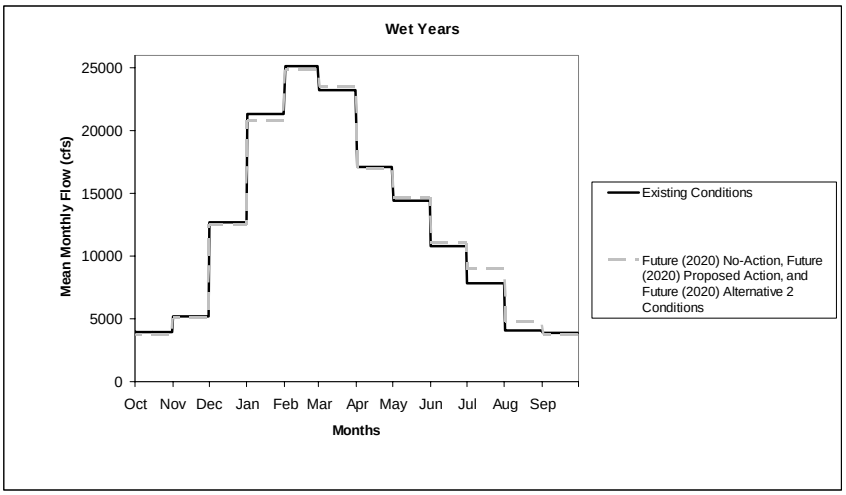
Oroville Dam and Lake Oroville are underlain by relatively impermeable igneous and metamorphic bedrock that largely eliminates interaction between groundwater and Lake Oroville. However, Thermalito Forebay and Thermalito Afterbay are located on more permeable volcaniclastic and consolidated alluvial sediments where reservoir water and local groundwater do interact. Thermalito Afterbay was constructed on an older, dissected upland, consisting of coarse gravels cemented in a sandy clay matrix. The upland area is adjacent to the edge of the groundwater basin to the west where younger alluvial materials overlap the older sediments. Existing information from well driller reports indicate that there are at least two aquifers in the area, a confined zone and an unconfined zone, and there may be localized areas of semiconfined zones. Aquifer zones are not uniform in thickness, and there is not much uniformity in the depth at which different aquifer materials are encountered in area wells.

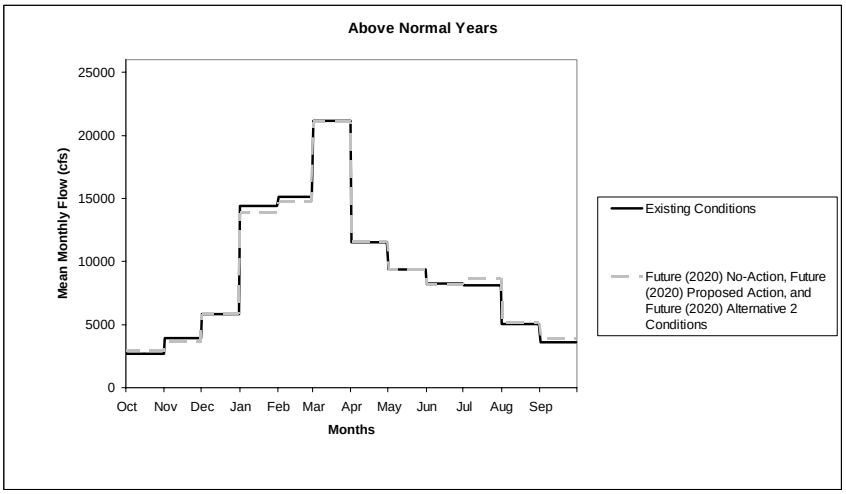
Groundwater flows in a south-southwest direction in the vicinity of Thermalito Forebay and Thermalito Afterbay. Localized seepage occurs from these reservoirs, and pumps have been installed to return the water to the reservoirs. Information developed as part of SP-W5 indicates that the Oroville Facilities may have increased groundwater levels through recharge in the vicinity of Thermalito Forebay.

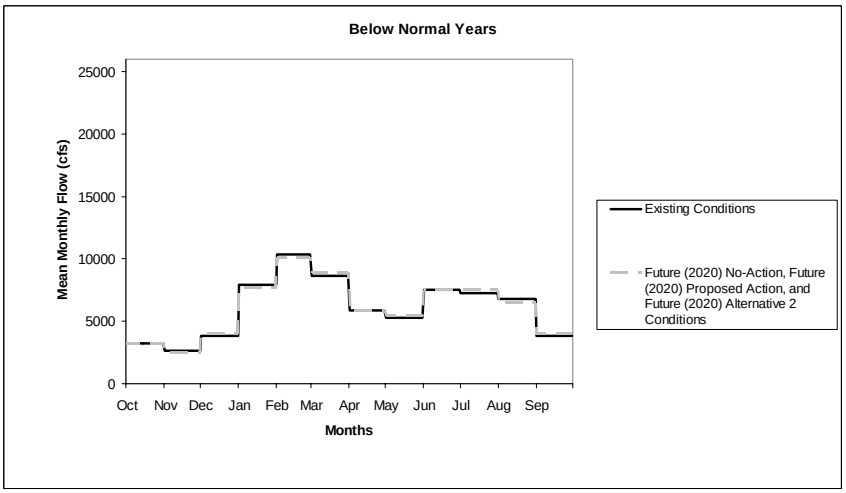
Flood Management

Flood management is a major benefit of the Oroville Facilities. The facilities are an integral component of the flood management system for areas along the Feather and Sacramento Rivers downstream of Oroville Dam. During the wintertime, the Oroville Facilities are operated under flood control criteria specified by the U.S. Army Corps of Engineers (USACE). Flood control releases are based on the release schedule in the flood control diagram or the emergency spillway release diagram prepared by the USACE, whichever requires the greater release (see Figure 3.1-3 for a depiction of the flood control space required by USACE). During flood events, Lake Oroville and Oroville Dam are operated to attenuate the peak inflow of the natural flood hydrograph, substantially reducing both the magnitude and the frequency of flooding for Oroville, Marysville, Yuba City, and many smaller communities near the Feather River.

Flood control space requirements are based primarily on USACE’s goal to protect urban and agricultural areas along the Feather River below Lake Oroville. When flood control space is not required to accomplish flood management objectives, the reservoir space

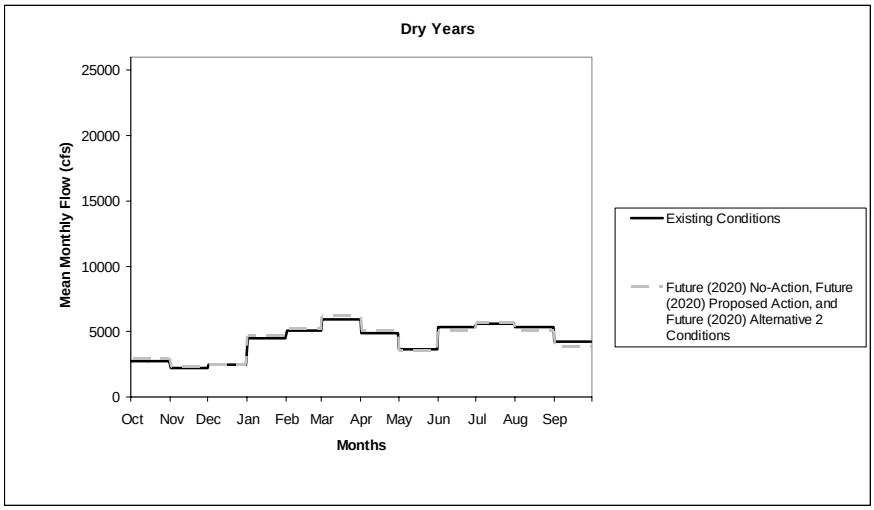


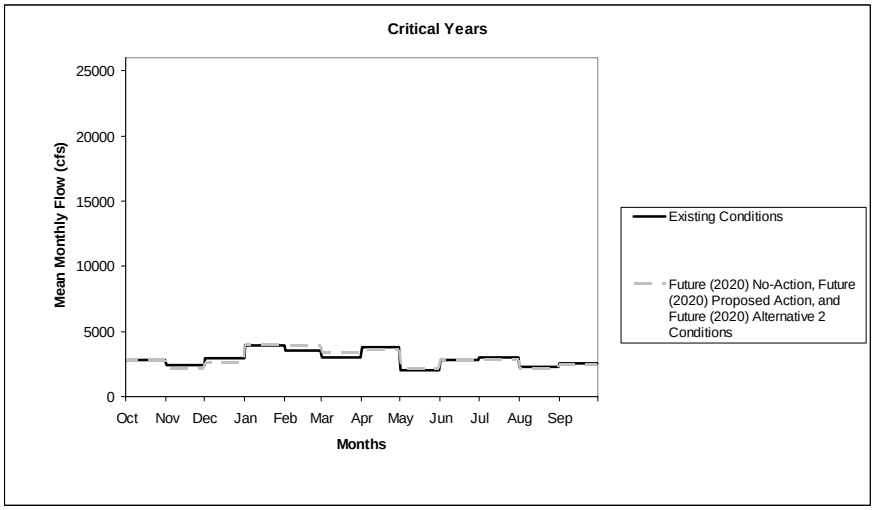




Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-10. Feather River flow at Verona under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action, and Future (2020) Alternative 2 Conditions.





Source: DWR, 2004 CALSIM II Modeling Results

Figure 5.4-10 (Continued). Feather River flow at Verona under Existing Conditions (2001), Future (2020) No-Action Conditions, Future (2020) Proposed Action, and Future (2020) Alternative 2 Conditions.

can be used to store water to be used for other purposes. From October through March, the maximum allowable storage limit (the point at which specific flood release would have to be made) varies from about 2.8 to 3.2 maf to ensure adequate space in Lake Oroville to handle flood inflows. This allows higher reservoir levels when the prevailing hydrology is dry while maintaining adequate flood protection under USACE requirements. Flood control space requirements, determined through planning studies, vary from a minimum of 375 taf to a maximum of 750 taf of storage, depending on hydrologic conditions.

Decisions regarding flood releases are made in consultation with USACE. To fully utilize downstream channel capacities and storage space under various flood conditions, a maximum release capability of 150,000 cfs throughout the range of flood control space is desirable. However, since some reduction in this capacity in the lower

range of flood control space would not seriously reduce flood control accomplishments but would reduce cost appreciably, it was mutually agreed between the State of California and the United States that a smaller release capacity at the lower levels would be acceptable (Department of the Army, 1970). The full 150,000 cfs release capacity must be provided when storage is within the upper half of the flood control space, and sufficient capacity in the lower levels to enable control of the standard project flood using the routing criteria found on the flood control diagram. A release capacity of 85,000 cfs occurs when the reservoir water surface elevation is at 848.5 ft (bottom of the flood control storage space), and the 150,000 cfs release capacity when the reservoir water surface elevation is at 863.5 ft (msl).

Baseline Conditions

Baseline water quantity conditions of the Oroville Facilities described in the subsections above are summarized in the bullets below.

- *Water Use*: The Oroville Facilities allow DWR to meet a number of existing water supply and environmental commitments further described in Chapters 2.0 and 3.0. These include the provision of FRSA entitlements for irrigation diversions from Thermalito Afterbay and SWP contractor supply deliveries.

- *Surface Water Hydrology:* Oroville Facilities operations for flood management, water supply, and environmental commitment purposes affect downstream Feather River hydrology by altering flow magnitude, timing, and duration. While hydroelectric power operations may alter the flow patterns within the Oroville Facilities, they do not alter the flow magnitude, timing, or duration in the Feather River downstream of the Thermalito Afterbay Outlet.

- *Groundwater Hydrology:* Operation of the Oroville Facilities will continue to result in elevated groundwater levels near Thermalito Forebay and Thermalito Afterbay. There are no identified adverse effects associated with such elevated levels in these locations. Rather, this is a beneficial effect.

- *Flood Management:* The Oroville Facilities provide flood management and damage reduction benefits to many downstream communities (including Oroville, Yuba City, Marysville, and Sacramento), as well as highly developed and productive agricultural areas along the Feather River and Sacramento Rivers downstream of Oroville Dam.

Oroville Facilities operations will continue to affect hydrology in the project area, including alterations to the magnitude, duration, and timing of flow in the Feather River below Oroville Dam. The cumulative effects subsection (Section 5.4.3) provides additional information regarding how the Oroville Facilities, other projects in the Feather River basin, and other related actions affect Feather River hydrology.

5.4.1.2 Water Quality

This section addresses water quality parameters that were selected in consultation with the Relicensing Environmental Work Group as most important in determining compliance with applicable water quality standards to protect the designated beneficial uses in the Central Valley Regional Water Quality Control Board's (RWQCB) Water Quality Control Plan (Basin Plan). The lower Feather River (i.e., the Feather River from Oroville Dam downstream to its confluence with the Sacramento River) is identified on the Central Valley RWQCB 303(d) list of waters as being impaired by sources of mercury, certain pesticides, and toxicity of unknown origin. It is important to note, however, that the Oroville Facilities are not the source of the constituents identified on the 303(d) list for the lower Feather River.

The SP-W1 study report provides information regarding several water quality parameters. This PDEA assesses the following: alkalinity, hardness, color, floating material, oil and grease, taste, and odor. While these parameters were sampled and evaluated in the relicensing water quality studies, related beneficial use conditions are generally good. The SP-F1 study report provides analyses of the aquatic benthic macroinvertebrates community, which were conducted as an overall indicator of water quality in the project area.

Regional Overview

This section describes current and important seasonal and long-term water quality conditions in the Feather River watershed. Water quality conditions of groundwater are also described. The descriptions of existing water quality conditions include discussions of regulatory compliance and potential baseline effects of the Oroville Facilities and their operations.

Surface Waters

Section 303 of the federal Clean Water Act (CWA) requires states to adopt water quality standards that "…consist of designated uses of the navigable waters involved and water quality criteria for such waters based upon such uses." The SWRCB carries out its water quality protection obligations and authority through the adoption of specific Basin Plans. The Basin Plans establish water quality standards for particular water bodies by designating beneficial uses of those waters and water quality objectives to protect those uses. The Central Valley RWQCB provides additional protection of water quality within the Central Valley region by designating additional, water body-specific objectives in its Basin Plan. Because beneficial uses, together with their corresponding water quality objectives, can be defined per federal regulations as water quality standards, these plans encompass State and federal requirements for water quality control.

Prior to issuance of a new license for the Oroville Facilities, federal law will require a Section 401 water quality certification by the SWRCB or a waiver of such certification. The certification requires a determination by the SWRCB that the project complies with appropriate requirements of the Central Valley RWQCB Basin Plan, which includes the

water quality objectives for protection of designated beneficial uses. The beneficial uses identified in the Basin Plan for Lake Oroville include municipal and domestic supply, irrigation, power, contact and non-contact recreation, warm and cold freshwater habitat, warm and cold spawning, and wildlife habitat. Beneficial uses in the Feather River from the Fish Barrier Dam to the Sacramento River include municipal and domestic supply, irrigation, non-contact recreation, canoeing and rafting, warm and cold fish migration, warm and cold freshwater habitat, warmwater and coldwater spawning, and wildlife habitat.

DWR's Division of Operation and Maintenance, as part of the SWP, has conducted water quality monitoring for various inorganic, organic and biological parameters regularly since 1968. Current water quality monitoring within project waters includes testing at Lake Oroville, Thermalito Forebay and Thermalito Afterbay. Nutrients are monitored twice a year, in April and November within the reservoir at Oroville Dam. Aluminum, barium, cadmium, mercury, silver, chlorinated organics, organo-phosphorus pesticides, herbicides, carbamates and other pesticides are monitored quarterly at Thermalito Forebay. At Thermalito Afterbay, nutrients are monitored twice a year while aluminum, barium, cadmium, mercury and silver are monitored monthly and bromide and suspended solids are monitored quarterly. This monitoring program was augmented as part of relicensing to collect additional specific data.

The Oroville Facilities relicensing studies evaluated water quality parameters potentially affected by the Oroville Facilities and for which the Central Valley RWQCB has established water quality objectives in the Basin Plan. These parameters include, but are not limited to, water temperature, dissolved oxygen and pH, conductivity and minerals, sediment, turbidity, suspended material, settleable material, metals, pesticides and other organic contaminants, petroleum byproducts, nutrients, bacteria (pathogens), and toxicity. In addition, the benthic macroinvertebrate community was studied according to protocols endorsed by the SWRCB.

The Central Valley RWQCB Basin Plan includes both numerical and narrative objectives. Numerical objectives have been established for some parameters that can be measured quantitatively (such as milligrams per liter [mg/L] of a chemical contaminant), while narrative objectives have been established for parameters that may not be readily quantifiable (such as taste and odor) or have not been quantified in the Basin Plan (such as toxicity). Both numerical and narrative objectives are applicable in determining effects on beneficial uses. Demonstration of compliance with water quality standards and other appropriate requirements is needed in the application for water quality certification.

Results of the water quality studies conducted for the Oroville Facilities were used to determine compliance of the project with Basin Plan objectives. Compliance with numerical objectives was determined by comparison of the results of water quality measurements to the numerical value of the objectives, while compliance with narrative objectives was determined by comparison of the results to other applicable criteria or standards that are recognized as levels protective of beneficial uses. Other applicable

criteria or standards used to augment the evaluation of water quality were obtained from the following sources:

- Criteria of the U.S. Environmental Protection Agency (USEPA) California Toxics Rule (USEPA 2000a);
- Criteria of the National Recommended Water Quality Criteria (USEPA 1999);
- Criteria of the nutrient criteria guidance documents (USEPA 2000b, 2000c, 2000d, 2001);
- Drinking water standards and health advisories (USEPA 2000e);
- Drinking water criteria (DHS 2004);
- Agriculture water quality (Ayers and Westcot 1985);
- Draft bacterial limits guidelines (DHS 2001); and
- Methyl mercury tissue contaminant action levels established by the California Office of Environmental Health Hazard Assessment pursuant to USEPA recommended criteria (USEPA 2001).

Table G-WQ2.4.2-2 in Appendix G-WQ2 lists the objectives, standards, and criteria used to evaluate Basin Plan compliance of project surface waters with respect to the water quality parameters previously listed, other than water temperature.

Numerical water temperature criteria specific to the Feather River have been established at two locations associated with the Oroville Facilities: at the Feather River Fish Hatchery, and at Robinson Riffle in the Low Flow Channel of the Feather River. The hatchery objectives were established in a 1983 agreement between DWR and DFG concerning the operation of the Oroville Division of the SWP for management of fish and game. The temperature objectives for the Feather River Fish Hatchery are listed in Table 5.4-3. The temperature objective for Robinson Riffle is not to exceed 65 degrees Fahrenheit (°F) between June 1 and September 30. The temperature criterion for

Table 5.4-3. Feather River Fish Hatchery temperature objectives (±4°F between April 1 and November 30).

Period	Temperature (°F)
April through May 15	51
May 16-31	55
June 1-15	56
June 16 - August 15	60
August 16-31	58
September	52
October - November	51
December - March	55

Source: Initial Information Package (DWR 2001)

Robinson Riffle was included in the NOAA Fisheries 2002 and 2004 Operations Criteria and Plan (OCAP) Biological Opinions (NOAA 2002 and 2004).

In May 1969, DWR entered into an agreement with water districts that are now the Joint Water District Board to provide them with water based upon prior rights. The agreement discusses diversion season and amounts of diversion, but it does not set numerical criteria for water temperature of agricultural diversions. A similar agreement between DWR and the Western Canal Water District discusses the diversion season and amount of diversion without setting any specific temperature requirement.

The 1983 agreement between DWR and DFG also established a narrative water temperature objective for the Feather River downstream of the Thermalito Diversion Dam and Thermalito Afterbay Outlet. This narrative objective requires water temperatures that are suitable for fall-run Chinook salmon during the fall (after September 15) and suitable downstream of the Thermalito Afterbay Outlet for shad, striped bass, and other warmwater species from May through August. This objective has no direct effect on operations because it is not well defined, but it has encouraged operators to seek opportunities to provide colder water to the High Flow Channel during the fall months.

Groundwater

The Central Valley RWQCB also designates beneficial uses and water quality objectives for groundwater. The Basin Plan considers all groundwater in the Central Valley region suitable or potentially suitable, unless otherwise designated, for municipal and domestic, agricultural, industrial service, and industrial process supplies. Therefore, the water quality objectives for groundwater differ somewhat from those for surface waters. Table G-WQ2.4.7-1 in Appendix G-WQ2 lists the objectives, standards, and criteria used to evaluate Basin Plan compliance of project groundwater with respect to the relevant water quality parameters.

Water Temperature

Operation of the Oroville Facilities influences Feather River temperatures, which generally comply with the water quality criteria in the Basin Plan. When exceedances do occur they are minor. The following subsections describe the relationship between temperature and beneficial uses, summarize the results of related relicensing studies, and provide more information regarding project effects.

Relationship to Beneficial Uses

Water temperature has effects on many of the Basin Plan designated beneficial uses for the Feather River. The beneficial uses identified in the Basin Plan that temperature can potentially affect are irrigation, contact and non-contact recreation, warm and cold freshwater habitat, migration, and spawning. Although the Basin Plan does not have a numerical temperature criterion for irrigation, water temperatures associated with irrigation water can potentially affect agriculture because growth of crops are temperature dependent. The potential effects of water temperatures on rice production

are discussed in the agriculture subsection of Section 5.8, Land Use, Management, and Planning, and in the related appendix (Appendix G-LU.1). Water temperatures also affect recreation, particularly contact recreation. The potential of water temperatures in the Feather River and the Oroville Facilities to affect warm and cold freshwater habitat, spawning, and fish migration is discussed in Section 5.5.

Results of Relicensing Studies

This section describes the existing water temperature conditions associated with the Oroville Facilities, upper watershed streams, and the lower Feather River based on continuous data from thermographs installed in the streams and rivers and monthly depth profiles from the reservoirs associated with the Oroville Facilities. Temperatures were monitored beginning in the spring of 2002 and monitoring continues to the current day. A discussion of complete results is available in the SP-W6 Study Plan Report.

Simulated water temperature results for existing conditions using WQRRS modeling were used for assessing the potential effects of the No-Action Alternative. These simulated conditions are summarized in the No-Action Alternative effects subsection of Section 5.4.2.2.

Thermal Regime of Tributaries to Lake Oroville

Water temperature data collected from the West Branch and North, Middle, and South Forks of the Feather River, including tributaries to these streams such as Concow Creek, Fall River, and Sucker Run Creek, are similar and follow seasonal patterns. Water temperatures begin to warm in May and June and reach maximum temperatures ranging from 70 to 80°F in late July and early August. The waters begin cooling in late September, with water temperatures ranging from 40 to 50°F in November through March. Mean summer water temperatures range from 68°F at Fall River, upstream of Feather Falls, to 75°F at West Branch near Paradise.

Lake Oroville

Water temperatures in Lake Oroville's North, Middle, and South Fork arms, the main body, and near the dam follow seasonal patterns. Surface (epilimnion) water temperatures at these areas begin to warm in the early spring, and reach maximum temperatures approaching mid-80°F during late July, and then gradually decline to winter minimums. The transition zone between the upper warmer and lower colder waters (metalimnion) ranges from about 30 to 50 ft below the surface during mid-summer. The deeper water (hypolimnion) reaches a temperature of about 44ºF near the reservoir bottom. Drawdown of reservoir water levels and gradual cooling of surface waters through the fall extends the depth of the epilimnion and by late winter, relatively uniform temperatures exist throughout the water column in Lake Oroville.

Diversion Pool, Fish Barrier Pool, and Thermalito Forebay

The temperature of the water released from Lake Oroville generally affects water temperatures in the Diversion Pool, the Fish Barrier Pool, and Thermalito Forebay. The

water warms a few degrees during hot weather, especially at the surface, as the water flows downstream in these facilities.

Thermalito Afterbay

Water temperatures in Thermalito Afterbay increase during the spring through summer and decrease in the winter in response to the temperature of water delivered from the South Forebay and atmospheric conditions. Thermalito Afterbay can be described as North Afterbay (north of State Route [SR] 162) and South Afterbay (south of SR 162). Water temperatures in the North Afterbay were very similar to those in the South Forebay throughout the year. During spring, however, water temperatures increase more rapidly in the South Afterbay than in the North Afterbay. Temperature differences between the North and South Afterbay ranged from essentially no change in April to about 9°F or more in September.

Water Released from Thermalito Afterbay

Water is released from Thermalito Afterbay to several irrigation canals and to the Feather River. Water temperatures can vary from the northern to the southern part of Thermalito Afterbay. The Western Canal and Sutter Butte Canal are two of the principal irrigation canals that receive water from Thermalito Afterbay, with the Western Canal receiving its water from the North Afterbay and the Sutter Butte Canal receiving its water from the South Afterbay. Water temperatures are usually warmer at the outlet to the river than at either the Western or Sutter Butte Canal outlets. Based on the water temperature monitoring in 2002 and 2003, temperatures at the Thermalito Afterbay Outlet were as much as 11.3°F warmer than those at the Western Canal diversion, and up to 7.2°F warmer than those at the Sutter Butte Canal diversion).

Feather River Downstream of the Fish Barrier Dam

Water temperatures in the Feather River downstream of the Fish Barrier Dam vary seasonally. The river temperature patterns are best described separately for the Low Flow Channel and the High Flow Channel. The Low Flow Channel is considered the Feather River between the Fish Barrier Dam and the confluence of the Thermalito Afterbay Outlet. The High Flow Channel is the Feather River downstream of the confluence of the Low Flow Channel and the Thermalito Afterbay Outlet.

Low Flow Channel. Water temperatures in the Low Flow Channel begin to warm in March and maximum temperatures are reached in July and early August with a range from 61°F upstream of the Feather River Fish Hatchery to 69°F upstream of the Thermalito Afterbay Outlet. This reach of the river begins cooling in September, with water temperatures dropping to 45°F throughout the reach by February. Water released from the Feather River Hatchery varies little from those of the river near the hatchery.

High Flow Channel (Feather River Below the Thermalito Afterbay Outlet). Water temperatures in the High Flow Channel begin to warm in March and reach maximum temperatures during June and July, which range from 71°F at the Thermalito Afterbay Outlet to 77°F immediately downstream of the Bear River confluence. River cooling begins in late August, with minimum temperatures of 44°F to 45°F reached by January or February.

Releases from the Thermalito Afterbay Outlet as well as flow contribution from Honcut Creek, Yuba River, and Bear River influence High Flow Channel water temperatures from April through October. Except during periods of high flow through Thermalito Afterbay, which occur frequently in July and August, releases from Thermalito Afterbay during the warm season generally raise the water temperature of the river. Honcut Creek and Bear River inflows also tend to increase Feather River temperatures downstream of their confluences during this period. Flows contributed by the Yuba River tend to cool the Feather River during the warmer spring and summer months.

Baseline Project Effects (Temperature)

Overview. Operation of the Oroville Facilities influences Feather River water temperatures, as part of the existing baseline conditions. Temperature-related issues raised at public meetings during the Oroville Facilities relicensing process include:

- Effects of project facilities and operations, including pump-back operations, on thermal stratification and other thermal processes in project waters, including availability of cold water for release in various water year types under current and future operational demands;
- Effects of water releases and operations on water temperatures in the Diversion Pool, Thermalito Forebay, Thermalito Afterbay, the OWA, the Low Flow Channel, and downstream areas;
- Effects of existing and future project facilities at the Feather River Fish Hatchery;
- Effects on water delivered for agriculture;
- Effects on the quality and availability of suitable temperature for salmonids and other aquatic resources; and
- Effects of existing project facilities and operations on access to the coldwater pool during below-normal water years and multiple below-normal water years under existing and future operational demands, and effectiveness of the Temperature Control Device in providing access.

The temperature of releases from Oroville Dam is designed to meet Feather River Fish Hatchery and the Robinson Riffle temperature requirements, while also conserving the coldwater pool in Lake Oroville. Historical water temperatures indicate that the Robinson Riffle criterion is almost always met when the Feather River Hatchery objectives are met. Due to temperature requirements of endangered fish species and

the hatchery and overriding meteorologic conditions, the temperature requests for agriculture can be difficult to satisfy.

Water is withdrawn from the reservoir at depths that will provide sufficiently cold water to meet the Feather River Fish Hatchery and Robinson Riffle objectives. The reservoir depth from which water is released initially determines the river temperatures, but atmospheric conditions, which fluctuate from day to day, modify downstream river temperatures. Altering the reservoir release depth requires installation or removal of shutters at the intake structures. Shutters are held at the minimum depth necessary to release water that meets the Feather River Fish Hatchery and Robinson Riffle criteria.

Water released from the reservoir and used for power generation may be pumped back into the lake for reuse later. While pump-back operations can draw water that has warmed in Thermalito Forebay or Thermalito Afterbay back into the Diversion Pool and Lake Oroville, these activities are monitored to identify potential adjustments necessary to operations to meet downstream water temperature requirements.

Project Baseline Conditions at the Feather River Fish Hatchery

Generally, water temperature criteria for the Feather River Fish Hatchery are in compliance with the 1983 agreement between DFG and DWR. Monitoring data indicate general compliance with the Feather River Fish Hatchery temperature requirements, with the exception of an extended warm period in the fall of 2002, when the temperature objectives were met 95 percent of the time (Table 5.4-4).

Project Baseline Conditions in the Low Flow Channel

The current water temperature objective for the Low Flow Channel requires a daily mean temperature of less than or equal to 65°F from June 1 through September 30 at River Mile 61.6 (Robinson Riffle). During an extended warm period in the fall, the objective was exceeded by a small amount during water temperature monitoring in 2002 and 2003: on June 19, 2002, the mean temperature was 65.5°F, and during July 2003 the objective was exceeded on 5 occasions, with a maximum daily mean temperature of 66.0°F.

Project Baseline Effects at Agricultural Diversion Points

Agricultural water withdrawals are made directly from Thermalito Afterbay at several points. The project-related water temperature concern for agricultural users is the temperature of the water diverted from Thermalito Afterbay during the growing season, which generally begins in April or May. DWR has entered into a contractual agreement for the delivery of water to agricultural users and any concerns are discussed and resolved under the agreement. Water temperature, air temperature, amount of water applied, variety of rice planted are all factors that affect rice production. As shown in Figure 5.4-11, Feather River water temperatures are currently higher in the early spring and lower later in the season than those that prevailed before the Oroville Facilities were constructed.

Table 5.4-4. Compliance with fish hatchery temperature objectives during April 2002 through March 2004.

Dates	Days Below Minimum Objective	Days Above Maximum Objective	% of Days Below Min	% of Days Above Max
Year 2002-2003				
April through May 15	0	1	0	2
May 16-31	0	0	0	0
June 1-15	0	0	0	0
June 16 - August 15	7	0	11.5	0
August 16-31	2	0	12.5	0
September	0	0	0	0
October - November	0	23	0	37.7
December - March	0	0	0	0
Year 2003-2004				
April through May 15	0	0	0	0
May 16-31	1	0	6.3	0
June 1-15	0	0	0	0
June 16 - August 15	2	0	3.2	0
August 16-31	1	0	5.9	0
September	0	0	0	0
October - November	0	0	0	0
December - March	0	0	0	0

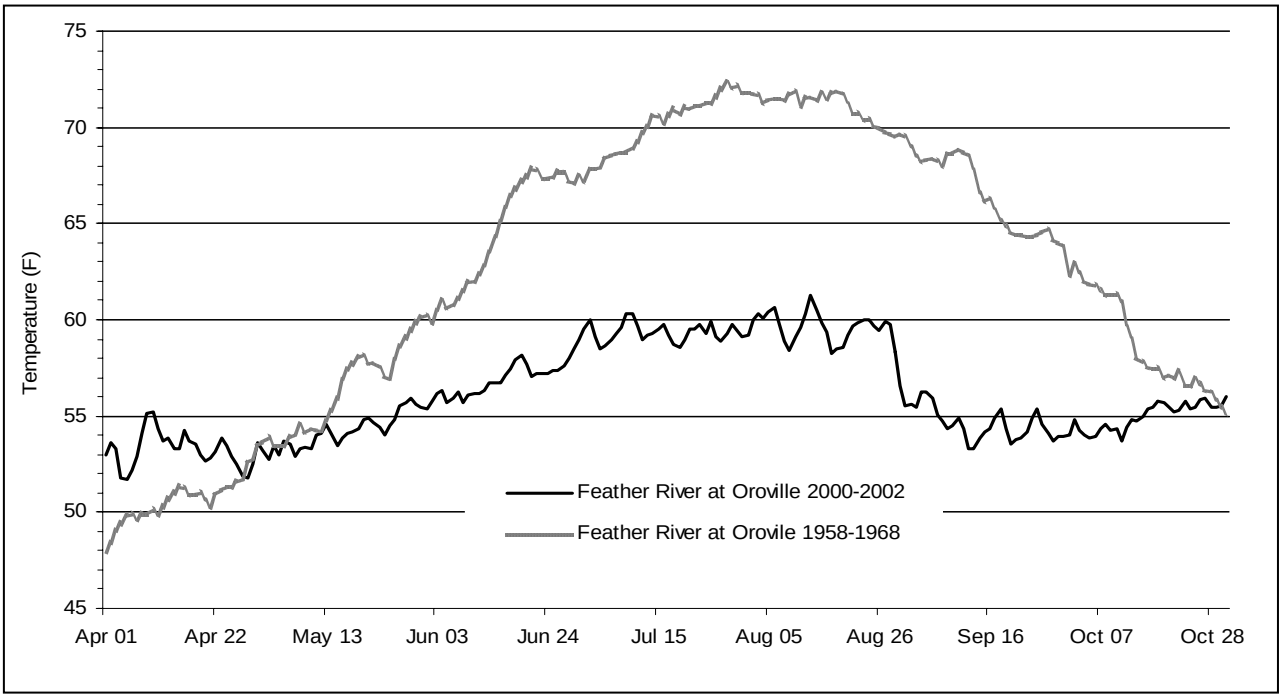


Figure 5.4-11. Pre- and post-Oroville Facilities water temperatures in the Feather River at Oroville Gauge.

Water temperatures at Thermalito Afterbay canal outlets can be influenced by several factors, including air temperatures, water temperatures of the Lake Oroville releases,

meteorologic conditions, and operations that determine the residence time of water in Thermalito Afterbay. Residence time influences the amount of atmospheric warming that can occur in Thermalito Afterbay before the water reaches the agricultural diversions. Oroville Facilities operations that determine the effective residence time of water in Thermalito Afterbay include: (1) the volume of inflows compared to the total releases from Thermalito Afterbay, including the release to the river and agricultural diversions; (2) the volume of water in Thermalito Afterbay; and (3) the amount of peaking and pump-back operations occurring. As shown in Figure 5.4-12, when residence time is decreased due to increased diversions to the Western and Sutter Butte Canals and the Feather River, the temperature of water released from Thermalito Afterbay to the Western Canal also decreases.

The location of an agricultural diversion in Thermalito Afterbay can affect how long water resides in Thermalito Afterbay prior to reaching the diversion. The diversion locations for the Western Canal and Richvale are located opposite the Thermalito Afterbay inlet in the northernmost portion of Thermalito Afterbay. This is an area with reduced effective volume because the SR 162 bridge structure constricts afterbay flows. Water entering the Thermalito Afterbay inlet from the tail canal flows toward these diversions, reducing residence time in Thermalito Afterbay. The Sutter Butte Main Canal diversion is on the south side of Thermalito Afterbay, which allows water to warm more in Thermalito Afterbay before it is diverted.

During Oroville Facilities pump-back operations, warmer water tends to be drawn from the southern, main body of Thermalito Afterbay into the more isolated northern portion, providing some warming of water at the Western Canal and Richvale diversion locations. Infrared photographs taken during pump-back operations show a plume of warm water being drawn from the southern portion of Thermalito Afterbay through the constriction at the SR 162 bridge and into the northern portion of Thermalito Afterbay.

Project Effects of Pump-Back Operations

Data representing recent pump-back operations were reviewed to evaluate effects on Feather River Fish Hatchery temperature objectives and reservoir stratification. During pump-back operations, water is pumped from Thermalito Afterbay, to Thermalito Forebay, into the Thermalito Power Canal, to the Diversion Pool, and back into Lake Oroville. Pump-back operations have no effects on Lake Oroville water column temperatures and pump-back operations are curtailed if hatchery temperatures would not otherwise be met.

Baseline Water Temperature Conditions on the Feather River Downstream of the Thermalito Afterbay Outlet

Water temperatures in the Feather River downstream of the Thermalito Afterbay Outlet are influenced by meteorological conditions, release rates and depths from Oroville Dam, and the relative volumes of flow diverted to the Thermalito Complex or directed

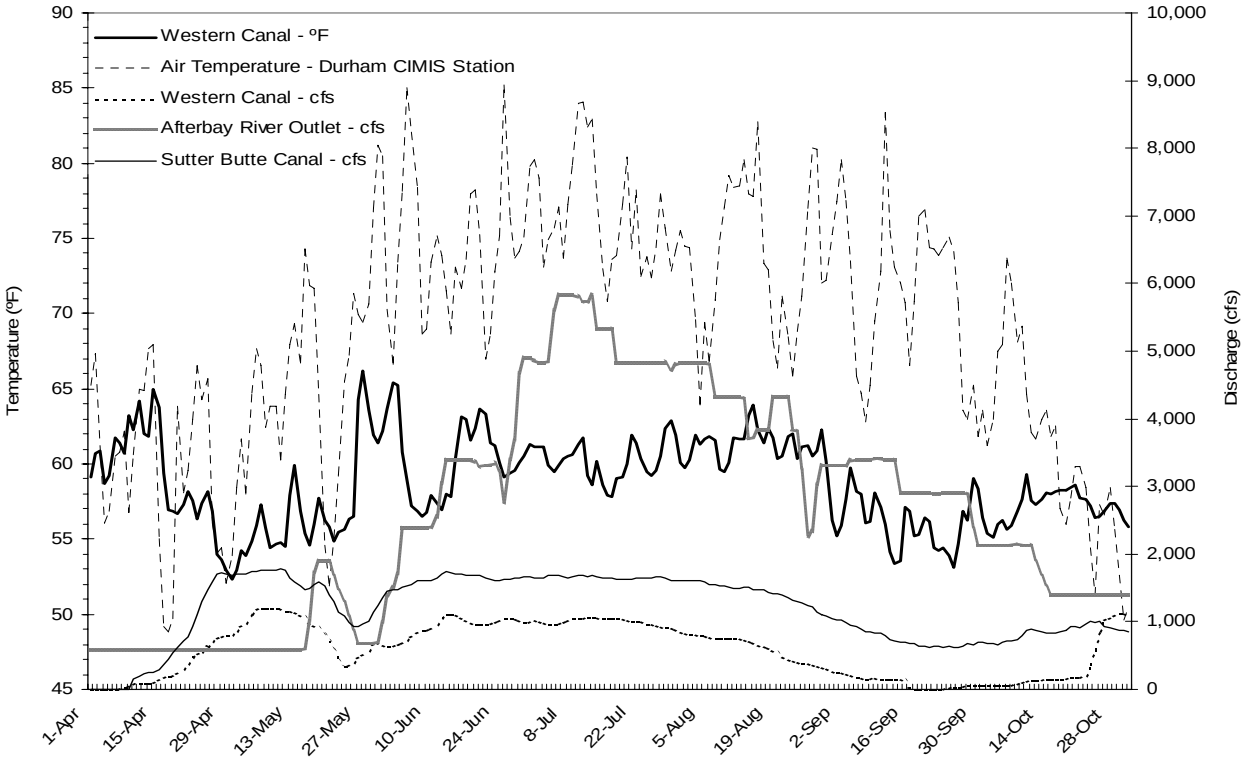


Figure 5.4-12. Effects of air temperatures and flows released from Thermalito Afterbay on Western Canal water temperatures during the 2002 growing season.

down the Low Flow Channel. Warming of water in the Thermalito Afterbay is primarily related to meteorological conditions (Figure 5.4-12). Release rates from Oroville Dam can affect water temperature in the High Flow Channel because of the residence time of the water in the afterbay. Based upon the results of relicensing studies, the volume of flow released from the Oroville Facilities potentially affects water temperatures as far downstream as the Honcut Creek confluence.

Dissolved Oxygen, pH

Dissolved oxygen (DO) and pH levels within the study area generally complied with the water quality objectives of the Basin Plan. When exceedence did occur they were minor. The following subsections describe the relationship between DO and pH and beneficial uses, summarize the results of related relicensing studies, and provide more information regarding potential baseline project effects.

Relationship to Beneficial Uses

The beneficial uses identified in the Basin Plan that DO and pH can potentially affect are warm and cold freshwater habitat.

Results of Relicensing Studies

The SP-W1 study report provides seasonal information regarding DO and pH levels in the study area, including the upper watershed, Lake Oroville, the Thermalito Complex impoundments, and the lower Feather River. The Basin Plan objectives for DO and pH are provided in Table G-WQ2.4.2-2 in Appendix G-WQ2. SP-W1 also provides evaluations of the effects of decomposing salmon carcasses and non-project related treated sewage discharges on DO levels in the lower Feather River.

For upstream tributaries, within the FERC project boundary, all DO concentrations met the Basin Plan objective for cold water (minimum of 7.0 mg/L). On the West Branch Feather River, upstream of Lake Oroville, a DO measurement was 4.9 mg/L. In upstream tributaries, all pH concentrations were within the range specified as the Basin Plan objective (i.e., 6.5–8.5).

In Lake Oroville, most of the DO and the pH levels at the monitoring stations met the Basin Plan objectives. Occasionally, when the reservoir thermally stratified during the summer, DO measured near the surface and bottom of the reservoir did not meet the objective. In February 2002, the pH at the Middle Fork area of Lake Oroville exceeded the objective.

Downstream of Oroville Dam, DO and pH concentrations are generally consistent with the Basin Plan objectives. The Basin Plan has a specific DO objective for the Feather River from the Fish Barrier Dam to Honcut Creek of 8.0 mg/L during September through May. The DO concentrations in the lower Feather River dropped below the objective at the station downstream of the Feather River Fish Hatchery (5.4 mg/L) on October 27, 2003, which was during the salmon spawning period when decomposing salmon carcasses were present, and also dropped below the objective at 3 other stations during mid-December 2002 (6.5–7.6 mg/L). One pH value (6.3) obtained at the Thermalito Afterbay Outlet was slightly below the objective.

Baseline Conditions

The DO and pH values in the relicensing study area were generally within the Basin Plan water quality objectives.

Conductivity and Minerals

Concentrations of dissolved inorganic minerals, and associated electrical conductivity, routinely comply with Basin Plan water quality objectives in the project study area. However, use of salt at the Feather River Fish Hatchery coincided with detectable changes in electrical conductivity in the Low Flow Channel on one occasion. The following subsections describe the relationship between conductivity and minerals and beneficial uses, and summarize the results of related relicensing studies.

Relationship to Beneficial Uses

The beneficial uses identified in the Basin Plan that conductivity and mineral contents can potentially affect are warm and cold freshwater habitat.

Results of Relicensing Studies

The SP-W1 study provides information regarding conductivity and dissolved minerals in the study area, while SP-W7 provides more focused information regarding minerals in stormwater runoff. Results of both studies were utilized to determine compliance with water quality objectives.or goals.

Conductivity and minerals at most monitoring sites were routinely below objectives for the Feather River. On one date, in the Low Flow Channel downstream of the hatchery, the conductivity was (151 µmhos/cm) which is over the the Basin Plan objective of 150 µmhos/cm (see SP-W1).

Baseline Conditions

The mineral and conductivity values in the relicensing study area were routinely within the Basin Plan water quality objectives.

Sedimentation, Turbidity, Suspended Solids, and Settleable Matter

Dams and reservoirs can affect the transport of sediment by trapping sediment and also reducing the size of the sediment that are released or spilled below the dam. The following subsections describe the relationship between related water quality parameters and beneficial uses, and summarizes the results of related relicensing studies.

Relationship to Beneficial Uses

All of the beneficial uses identified in the Basin Plan can be affected when sedimentation, suspended solids, and settleable matter are excessive. The Basin Plan includes a narrative criterion for total suspended solids (TSS) designed to prevent impairment from nuisance conditions. The Basin Plan also contains numerical objectives for the allowable change in turbidity from the background levels resulting from controllable factors.

Results of Relicensing Studies

The SP-W1 study provides information regarding turbidity, TSS, and settleable matter in the study area based on monthly sampling. Results of the study were compared to the water quality objectives and criteria listed in Table G-WQ2.4.2-2 in Appendix G-WQ2 to determine compliance with the Basin Plan. Settleable matter concentrations were at trace or undetectable levels for the large majority of samples and are not discussed further.

Results from the SP-W1 study indicate that the tributaries to Lake Oroville typically have very low levels of turbidity and TSS, except during storm events. Lake Oroville acts as a sediment trap which results in low concentrations in Lake Oroville, the Feather River immediately downstream of Oroville Dam, and the Thermalito Complex. Downstream of the Thermalito Afterbay Outlet, turbidity and TSS concentrations generally increase. This increase is potentially related to inputs from downstream tributaries in the lower Feather River. Approximately half of the samples from the Feather River at Shanghai Bend, the Feather River near Verona, and Honcut Creek failed to meet the Basin Plan turbidity objectives. The Bear River and Sacramento River stations each exceeded the turbidity objectives in all but one sample.

The U.S. Soil Conservation Service considers the upper Feather River watershed to be subject to accelerated erosion as a result of human-caused disturbances (United States Soil Conservation Service 1989). However, the numerous dams and reservoirs upstream of Lake Oroville are known to be effective traps of sediment, thereby reducing the quantity of sediment transported into Lake Oroville.

Wind and wave action within Lake Oroville can cause erosion along the shoreline, which in turn could contribute to minor sedimentation within the reservoir. Most shoreline erosion likely occurred during the first years following initial reservoir filling with scouring loss of the original topsoil.

Downstream of Oroville Dam, the release of “sediment-starved” water can cause scour and erosion of channel substrate and transport of additional suspended sediment. However, the reduction of larger channel-forming flows resulting from flood storage in Lake Oroville has had the opposite effect, reducing bank erosion and large channel meandering. Overall, observations and modeling conducted for the SP-G2 study indicate that channel erosion would slowly decrease over time downstream of Lake Oroville.

Baseline Conditions

The Oroville Facilities and project operations inhibits sediment transport and deposition. Due to the large size of Lake Oroville, most sediments that flow into the reservoir from the upper watershed are effectively retained, and only suspended material passes through to the lower Feather River basin. Wave and wind action on shorelines cause erosion.

Appropriate BMPs and other mitigation measures are typically implemented to avoid and minimize potential effects related to erosion from various activities within the FERC project boundary.

Sediment trapping behind Oroville Dam results in release of relatively sediment-free water downstream of Lake Oroville. Fluvial modeling results for the lower Feather River indicate that channel erosion and scour will likely decrease over the long-term as the supply of erodable sediment is depleted.

Metals

The Oroville Facilities are not a source of metals. However, they do affect metal loadings below Oroville Dam by trapping sediment behind the dam. Some fish tissue samples collected from fish in the project area exhibit accumulation of mercury above related public health criteria. The following subsections describe the relationship between metals and beneficial uses,and summarize the results of related relicensing studies.

The California Office of Environmental Health Hazard Assessment (OEHHA) indicates that there have been no recorded incidences of mercury health effects from consumption of sport fish from California waters, and the potential for health effects is minimal at the fish tissue mercury levels typically found in California unless a person is eating considerably greater quantities of fish than recommended (OEHHA 2003).

Relationship to Beneficial Uses

The beneficial uses identified in the Basin Plan that metals can potentially affect are non-contact recreation (fishing) and warm and cold freshwater habitat.

Results of Relicensing Studies

The results from SP-W1 provide information regarding metals concentrations in water in the overall study area. SP-W2 reports on metals concentrations in tissues collected from fish and crayfish in the project area. SP-W3 gives information on levels of metals during the 2003 recreation season near recreational facilities and other locations in the project area with heavy recreation use. The SP-W7 report examines metals concentrations in stormwater drainage within and outside the FERC project boundary.

The results from the studies were compared to the numerical limits used for Basin Plan objectives while results from tissue sample analyses were compared to guidelines and criteria from various regulatory agencies (Appendix G-WQ2).

Water Samples. Results from the SP-W1 study indicate that existing conditions allow metal concentrations in some water samples to exceed the Basin Plan objectives. Figure G-WQ2.5-1 in Appendix G-WQ2 depicts the location for each sampling station and the number of times any the numerical limits were exceeded. The results also indicate water samples that exceed objectives typically increased in frequency downstream of the FERC project boundary.

Results from the SP-W7 study indicate that stormwater drainage samples from the City of Oroville and Kelly Ridge, a residential area outside of the FERC project boundary, near Oroville Dam, exceed the Basin Plan objectives for arsenic, aluminum, iron, manganese, and zinc. These results indicate that the Oroville Facilities are not a source for these constituents.

Tissue Samples. Fish tissue samples for metals contaminants were collected from sites in Lake Oroville, the lower Feather River (the Low Flow Channel and the High Flow

Channel), the Thermalito Complex (Thermalito Forebay, Thermalito Afterbay, and Potters Pond), and two ponds in the OWA. Crayfish tissue samples were obtained from the Thermalito Complex and in the lower Feather River (Appendix G-WQ2).

Results from the SP-W1 study indicate that metal concentrations in tissue samples are below or are occasionally elevated based on comparison to recommended guidelines and criteria from various regulatory agencies. Fish consumption advisories by OEHHA are relatively common in the Sierra Nevada foothills, Delta, and Coastal Ranges of California where historic mercury ore mining and processing or gold mining activities occurred. There is no current OEHHA fish advisory for any of the water bodies in the Feather River watershed.

Baseline Conditions

Historic gold mining practices upstream of the project area, as well as the development of municipal and industrial land uses in the upper watershed and along the lower Feather River, continue to be the primary source for most of the metals found in the project area. Since metals are usually associated with sediments, and Lake Oroville inhibits sediment transport, the Oroville Facilites probably act as a sink. Hence, the Oroville Facilities likely have few baseline effects on metals concentrations in the project area, and any effects that might be present are difficult to quantify. The sources of excess metals, particularly mercury, are unrelated to the Oroville Facilities.

Sediment capture in Lake Oroville from upstream sources occurs. A principal beneficial effect is to inhibit the transport of contaminated sediments to the lower Feather River and other water bodies. There is no evidence that operations of the Oroville Facilities have contributed to the elevated metals concentrations in fish tissues. However, the Oroville Facilities increase sport fishing opportunities in the project area. As discussed above, OEHHA considers the potential health risks associated with fish consumption of California sportfish in waterbodies where fish advisories have been issued to be low, unless the rate of fish consumption is considerably greater than the recommendations.

Pesticides

The use of pesticides at the Oroville Facilities is minor. The local Mosquito Abatement District is responsible for mosquito control within the OWA.

Relationship to Beneficial Uses

The beneficial uses identified in the Basin Plan could potentially be affected by pesticides.

Results of Relicensing Studies

The results of SP-W1 provides information regarding pesticide concentrations in water in the overall study area. SP-W2 reports on pesticide concentrations in tissues collected from fish and crayfish in the project area, and SP-W7 reports results of

sampling for pesticides following treatment for mosquito abatement in some OWA ponds.

Results of SP-W1 indicate that the pesticide diuron was detected in one sample and the concentration was well below the USEPA criteria. The sample was collected upstream of the FERC project boundary.

The results of SP-W2 indicate pesticides and polychlorinated biphenyls (PCBs) were detected in fish and crayfish tissue. The fish tissue guidelines used for this evaluation are provided in Appendix G-WQ2.

The results of SP-W7 indicate that methoprene and malathion, and their breakdown byproducts, were below detection levels. These pesticides are typically applied for mosquito control in the OWA. However, the Mosquito Abatement District apparently used different pesticides during the year of monitoring, but did not inform DWR of this change.

Baseline Conditions

The use of pesticides at the Oroville Facilities is minor. The Mosquito Abatement District applies pesticides for the control of mosquitoes to OWA ponds. Additionally, herbicides are applied for maintenance of recreational and other facilities within the FERC project boundary. However, application methods should be in accordance with County Agriculture Commissioner Bulletins and pesticide label rates. Some Pesticides are detected in fish tissue samples.

Petroleum Byproducts and Fuel Additives

Project-related boating and stormwater runoff from recreation use areas could contribute to infrequent and isolated detections of petroleum byproducts and fuel additives. The following subsections describe the relationship between these parameters and beneficial uses, and summarizes the results of related relicensing studies.

Relationship to Beneficial Uses

The beneficial uses identified in the Basin Plan that petroleum products can potentially affect are municipal and domestic water supply, warm and cold freshwater habitat, and wildlife habitat. The California drinking water standards are not applicable to ambient concentrations in source water supplies because the standards specifically apply to water after it has been treated.

Results of Relicensing Studies

Results of SP-W1 indicate petroleum products were largely undetected in water samples. Similar results are reported in SP-W7 for water samples collected in storm drains and the lower Feather River.

Baseline Conditions

Project activities and facilities likely provide no direct source of petroleum byproducts and fuel additives.

Nutrients

Project-related recreation use and operation of the Feather River Fish Hatchery may contribute to increased nutrient loading in the project area. The following subsections describe the relationship between these nutrients and beneficial uses, and summarizes the results of related relicensing studies.

Relationship to Beneficial Uses

The beneficial uses identified in the Basin Plan that nutrients can potentially affect are warm and cold freshwater habitat.

Results of Relicensing Studies

The SP-W1 study results provide information on nitrogen and phosphorus concentrations in the study area, SP-W3 provides information on nutrients near recreational facilities, and SP-W7 provides information on nutrients in stormwater runoff. Results of all three studies were compared to Central Valley RWQCB Basin Plan water quality objectives and criteria (Appendix G-WQ2). Nutrient concentrations throughout the study area were consistently below most Basin Plan objectives for protection of beneficial uses.

The SP-W1 study also provides results of three focused investigations: (1) monitoring of periphyton (attached algae) density and dominant taxa to assess nutrient conditions, (2) nutrient additions from decomposition of spent salmon carcasses, and (3) nutrients from the Sewerage Commission Oroville Region (SCOR) treated sewage discharge downstream of the Thermalito Afterbay Outlet. The SCOR facility is not operated by DWR.

Phosphorus and nitrate plus nitrite concentrations did not exceed Basin Plan criteria or objectives. Levels of total phosphorus in water samples from the tributaries upstream of Lake Oroville were frequently below 3 micrograms per liter (µg/L), and levels of total nitrogen (ammonia plus nitrate plus nitrite) were sometimes below 15 µg/L (see study report SP-W1). Water samples collected from the upper watershed frequently exceeded the USEPA recommended criteria for phosphorus and nitrate plus nitrite to avoid eutrophication, which suggests that these streams often have an overabundant supply of nutrients.

The periphyton monitoring program included stations in the tributaries upstream of Lake Oroville and in the lower Feather River. These algae dominated most samples from all stations. Green algae, which are considered indicative of higher nutrient levels than diatoms, were dominant in a sample downstream of the SCOR outlet collected in June.

Low levels of nutrients were detected in most of the water samples collected during the salmon spawning season to evaluate effects of decomposing salmon carcasses on water quality. The study found no clear evidence of an effect of salmon carcasses on nutrient levels in the lower Feather River.

Water samples collected from the water column and from within gravel substrates at stations immediately upstream and downstream of the SCOR outlet showed no consistent differences in nutrient concentrations. However, the periphyton community at the station downstream of the SCOR outlet had characteristics indicative of a higher nutrient status than the communities at other stations.

Baseline Conditions

Nutrient concentrations throughout the study area were consistently below most Basin Plan objectives for protection of beneficial uses, hence, the Oroville Facilitieshave no apparent influence on nutrient levels. Nutrient levels are likely related to recreational activities and operation of the Feather River Fish Hatchery. Lake Oroville and the Thermalito Complex impoundments result in increased levels of recreation, which could potentially increase nutrient inputs. Phosphorus and nitrate plus nitrite concentrations did not exceed Basin Plan criteria or objectives; hence, the effects of these sources on nutrient concentrations in the future are likely to be minimal.

Pathogens (Bacteria)

Water samples from several recreational areas in the project area, where concentrated use occurs, contain high bacterial counts on a seasonal basis when recreational activity and wildlife are present in high numbers. The following subsections describe the relationship between pathogens and beneficial uses, and summarizes the results of related relicensing studies.

Relationship to Beneficial Uses

The beneficial uses identified in the Basin Plan that pathogens can potentially affect are contact recreation and municipal and domestic water supply. The Basin Plan's numerical water quality objectives for fecal coliform bacteria concentrations in natural water bodies are designed to reduce human exposure to pathogens. The California Department of Health Services (DHS) also provides draft guidance for freshwater beaches. The California drinking water standards are not applicable to ambient concentrations in source water supplies because the standards specifically apply to water after it has been treated.

Results of Relicensing Studies

The SP-W1 study results provide information regarding indicator bacteria in the study area, SP-W3 provides information near recreational facilities, and SP-W7 provides information on stormwater runoff (Appendix G-WQ2).

The monthly monitoring study results generally indicate very low bacterial concentrations in the upper watershed tributaries to Lake Oroville and open water sites within Lake Oroville. Elevated bacterial concentrations were detected periodically at many recreation sites within Lake Oroville and the Thermalito Complex based on weekly samples. The DHS-recommended level of bacteria contamination to trigger beach posting or closure was exceeded at least once at each recreation area monitored in 2003. Based on visual observations of large amounts of waterfowl present near recreation areas, it is apparent that the recreation facilities are also attractive to migratory waterfowl that may also directly discharge fecal wastes to water or nearby drainage ways.

Baseline Conditions

There are occasional elevated bacteria concentrations at certain areas within the Oroville Facilities. Recreation activities, such as swimming and wading, have the greatest potential for discharges of fecal wastes and exposure to human pathogens. Recreation facilities also attract wildlife (waterfowl and shorebirds) that may also directly discharge fecal wastes to water. Bacterial contaminations were elevated during seasonal peak recreational activity and during non-recreation periods when many waterfowl are present, which indicates bacteria may be coming from both sources.

Aquatic Toxicity Tests

Aquatic toxicity was detected in some water samples collected in the project area; however, the data indicate that the Oroville Facilities are not likely a major contributor to these effects. The following subsections describe the relationship between toxicity and beneficial uses, and summarize the results of related relicensing studies.

Relationship to Beneficial Uses

Toxicity tests are primarily designed to identify potential impairment for designated beneficial uses that pertain to aquatic organisms, such as warm and cold freshwater habitat and fish spawning. The Basin Plan objective is narrative, and it states that “all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses … in aquatic life.”

Results of Relicensing Studies

The SP-W1 study results provide aquatic toxicity information that was compiled using USEPA’s standardized freshwater acute and chronic toxicity tests using fathead minnow (*Pimephales promelas*) and zooplankton (*Ceriodaphnia dubia*). Water samples from nine upper watershed tributary sites were collected bimonthly during in summer, following the first flush in the fall, following winter dormant spraying in February, and again during the high runoff period in April or May. Water samples from eight lower Feather River monitoring sites (Fish Barrier Dam to Honcut Creek) were analyzed monthly. Water samples from three OWA ponds were also analyzed. Toxicity identification evaluation (TIE) procedures were used for samples from sites with

confirmed toxicity to evaluate whether particulate matter, metals, and/or polar organic compounds were associated with the toxicity.

The SP-W7 study also evaluated toxicity of stormwater from the following locations: several City of Oroville drains, the Feather River Fish Hatchery settling ponds, and the Feather River at Oroville, downstream of the hatchery, and at SR 162.

In the upper watershed tributaries, positive reproductive toxicity to *Ceriodaphnia* was present at all 9 regularly sampled sites, with frequency of toxicity per site ranging from 20 to 83 percent of the sampling dates. Survival toxicity to *Ceriodaphnia* was generally absent. Survival toxicity to fathead minnows in filtered samples occurred in all but 1 of the upper watershed sites, with frequency of toxicity per site ranging from 0 to 20 percent of sampling dates.

At the lower Feather River sites, reproductive toxicity to *Ceriodaphnia* was present on 21 to 58 percent of the sampling dates, which is similar to the range of frequencies at the upper tributaries sites. However, survival toxicity to *Ceriodaphnia* was detected more frequently at the lower Feather River sites than at the upper watershed sites, ranging from 4 to 33 percent of dates. The hatchery settling pond and the Feather River downstream of the hatchery had the two highest reproductive toxicity and survival toxicity rates. *Ceriodaphnia* reproductive toxicity was also present in the majority of storm event samples, and survival was reduced at several sites during one storm event.

Survival toxicity to fathead minnows was present at all 8 regularly sampled lower Feather River sites, with the frequency in filtered samples ranging from about 4 to 18 percent of sampling dates. The sites with the highest fathead minnow toxicities were City of Oroville, the hatchery settling pond, the Feather River downstream of the hatchery, and the Thermalito Afterbay Outlet. Fathead minnow toxicity was generally absent in the storm event samples.

Detections of toxicities in the OWA ponds were relatively infrequent or absent both for *Ceriodaphnia* and fathead minnows.

The TIE evaluation for several August 2003 sample sites confirmed that toxicity could be reduced when particulate matter, metals, and/or polar organic compounds were removed from the samples, but could not determine cause-and-effect relationships for specific contaminants or sample locations.

<u>Baseline Conditions</u>

The Oroville Facilities are not a significant source of contaminants in the project area. Presence of aquatic toxicity in tests with *Ceriodaphnia* and fathead minnows in sites in the upper watershed and lower Feather River is indicative of the presence of toxic constituents. The project has no direct influence on water quality of the upper watershed sites and has no known direct discharges of toxic contaminants, hence, the Oroville Facilities likely have few effects on aquatic toxicity in the project area.

Groundwater Quality

Groundwater recharge at the Thermalito Afterbay complex appears to be the only potential groundwater effect of the project, and this is considered a beneficial effect. Groundwater level monitoring in the vicinity of Thermalito Forebay found that groundwater levels increased about 10 ft shortly following completion of Thermalito Forebay (see SP-W5, Draft Report). The following subsections describe the relationship of groundwater quality to beneficial uses, summarize the results of related relicensing studies, and provide more information regarding baseline conditions.

Relationship to Beneficial Uses

Groundwater in the Feather River Basin is an important source of drinking water and water for irrigation. The Basin Plan considers all groundwaters in the Central Valley region suitable or potentially suitable, at a minimum, for municipal, agricultural, industrial service, and industrial process supplies. The California drinking water standards are not applicable to ambient concentrations in source water supplies because the standards specifically apply to water after it has been treated.

Results of Relicensing Studies

The results of SP-W5 provide information on the groundwater water quality around the Thermalito Forebay and Thermalito Afterbay complex. Water quality was measured by sampling groundwater from 18 wells in the vicinity of these reservoirs (2 sampled wells were upgradient from the Thermailto Complex). Each well was sampled once in the late spring or early summer and once in the fall of 2003. Temperature, pH, and specific conductance were measured at the time of sampling. The groundwater samples were analyzed for general mineral composition, aluminum, and mercury.

Groundwater quality results were compared to the surface water quality results collected from two sites in Thermalito Afterbay and two sites in Thermalito Forebay. Two of the groundwater wells were located upgradient from the Thermalito Complex. Results from the 2 upgradient wells showed no obvious differences from those of the 16 downgradient wells. The mineral content of the groundwater samples was consistently higher than that of the surface water samples. Specific conductance and total dissolved solids were consistently higher in the groundwater samples than in the surface water samples. The metal content in groundwater was consistently lower than that of surface water samples (Table G-WQ2.5.3-1 in Appendix G-WQ2).

Baseline Conditions

The results of the groundwater survey indicate that the Oroville Facilities are not affecting local groundwater quality conditions. Mineral content was consistently higher in the groundwater samples than in the surface water samples, while metal concentrations were generally lower in the groundwater samples. No consistent differences in groundwater quality were found between the upgradient and downgradient well samples.

5.4.2 Environmental Effects

This section describes the potential water quantity and quality effects of the three alternatives.

5.4.2.1 Water Quantity

No-Action Alternative

In general, the existing water quantity conditions described in Section 5.4.1.1, would continue under the No-Action Alternative. The existing Oroville Facilities operations and maintenance activities described in Chapter 3.0 would continue, and the Oroville Facilities would continue to meet a wide range of existing water supply, flood management, and environmental commitments. Minimum flows in the Low Flow Channel would be maintained at 600 cfs, the current target flow level.

Under the No-Action Alternative flow releases into the Low Flow Channel would generally not differ from existing conditions. Additionally, flow fluctuations to meet water temperature objectives in the Low Flow Channel also would not differ under the No-Action Alternative compared to existing conditions. Flow releases in the High Flow Channel under the No-Action Alternative differ by month and water year type compared to existing conditions; however, flow fluctuations would remain similar in frequency, magnitude, and duration.

While water use, surface water hydrology, groundwater hydrology, and flood management conditions under the No-Action Alternative would be very similar to existing conditions, there would be some changes in future water use and surface water hydrology. Changes in future water use and surface water hydrology under the No-Action Alternative are summarized in Table 5.4-5. These changes were defined by comparing modeled 2020 No-Action Conditions to modeled 2001 Existing Conditions.

There are no new operational changes proposed at the Oroville Facilities as part of the No-Action Alternative; however, there are a number of reasons that future water use and surface water hydrology No-Action Conditions are expected to be different than existing conditions. The modeled 2020 conditions assumed:

- Changes in land use, agricultural demands, and municipal demands throughout the CVP/SWP systems;
- Full implementation of South Delta improvements, such as an increase in the pumping capacity of the Banks pumping plant; and
- Increasing requests of SWP water customers over time.

Additional information regarding No-Action Alternative water quantity effects is provided in the subsections that follow.

Table 5.4-5. Summary of modeled water quantity conditions and effects of the alternatives.

	2001 Existing Conditions	2020 No-Action Conditions	2020 Proposed Action Conditions	2020 Alternative 2 Conditions
Water Use				
Modeled Annual FRSA Deliveries (taf)	Average: 994	Average: 994	Same as No-Action Conditions	Same as No-Action Conditions
Modeled Annual SWP contractor Out-of-Delta Deliveries (taf)	Average: 3,051	Average: 3,246	Same as No-Action Conditions	Same as No-Action Conditions
Surface Water Hydrology				
Lake Oroville Elevations at the end of September	Average: 783	Average: 780	Same as No-Action Conditions	Same as No-Action Conditions
Total Releases from Lake Oroville (taf)	Average: 3,816	Average: 3,816	Same as No-Action Conditions	Same as No-Action Conditions
Flows in the Low Flow Channel (taf)	Average: 514	Average: 511	Same as No-Action Conditions	Average: 688
Thermalito Afterbay Elevations	Water levels fluctuate 3-6 ft, repeats on a weekly basis	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Average Feather River Flows Below Thermalito Afterbay (taf)	Average: 3,022	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Average Feather River Flows at Verona (taf)	Average: 5,408	Average: 5,412	Same as No-Action Conditions	Same as No-Action Conditions
Groundwater Hydrology	No effect on groundwater	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Flood Management	Oroville Facilities operated using USACE flood control criteria	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Average Annual Net Generation [1]	2,334,000 MWh based on Operations Modeling	2,318,100 MWh based on Operations Modeling	2,318,100 MWh based on Operations Modeling	2,310,300 MWh based on Operations Modeling

Notes:
[1] *Additional information regarding existing power generation and the related effects of the alternatives is found in Chapter 6.0.*

Water Use

Under modeled 2020 No-Action Conditions, FRSA monthly irrigation diversions would continue in the amount up to a maximum of 230 taf from the Thermalito Afterbay Complex during the May-through-August irrigation season. Average annual irrigation diversions from the reservoir would remain slightly less than 1 maf, leaving about 3 maf for flow in the Feather River downstream of the project. Water releases into the lower Feather River would flow into the Sacramento River and into the Delta.

Annual water deliveries to meet FRSA entitlements and SWP contractor requests under modeled No-Action Conditions are provided in Table 5.4-1 in Section 5.4.1.1, Water Quantity. There is very little change in the FRSA water deliveries under the modeled 2020 No-Action Conditions. The average delivery remains at 994 taf, with the maximum delivery of 1,057 taf occurring in a wet year. The minimum year of record, which occurs in a critical year, indicates a modeled difference from 613 taf under modeled 2001 Existing Conditions to 611 taf under modeled 2020 No-Action Conditions, a reduction of only about 0.3 percent.

Under the modeled 2020 No-Action Conditions, SWP contractor water requests and annual deliveries through the Delta from Lake Oroville increase. Under modeled 2020 No-Action Conditions, the average delivery increases to 3,246 taf, an increase of 195 taf (6 percent). The maximum delivery of 4,199 taf occurring in a wet year is an increase of 285 taf (7 percent) over the modeled 2001 Existing Conditions. The minimum delivery of 788 taf occurring in a wet year is an increase of 27 taf (3 percent) over the modeled 2001 Existing Conditions.

Additional detailed information regarding water use, including a monthly breakdown of deliveries under modeled 2001 Existing Conditions, modeled 2020 No-Action Conditions, the Proposed Action, and Alternative 2 is included in G-WQ1.

Surface Water Hydrology

The following sections provide a brief summary of key surface water modeling results and the potential effects of the No-Action Alternative. The location map showing key surface water hydrology data points is Figure 5.4-1, Oroville Facilities and Primary Water Quantity Analysis Locations.

Lake Oroville. Lake Oroville water surface elevations under modeled 2020 No-Action Conditions are shown in Figures 5.4-3 and 5.4-4 while probability plots of Lake Oroville water surface elevation for Memorial Day, Independence Day, and Labor are shown in Figure 5.4-5. In general, Lake Oroville would be operated similarly under modeled 2020 No-Action Conditions compared to modeled 2001 Existing Conditions.

The end-of-month water surface elevations differ by water year type. In average and wet years, Lake Oroville would be operated with slightly less storage primarily during the June-through-December period and water surface elevations would be about 2–3 ft lower on average during July through September. In critically dry years, Lake Oroville

would be operated with slightly more storage and water surface elevation would be about 1–3 ft higher during July through September and 1–2 ft lower during October and November.

Lake Oroville water surface elevations on Memorial Day, Independence Day, and Labor Day differ by water year type. On Memorial Day, there would be very little difference in water surface elevation of Lake Oroville during wet, above normal, below normal, and dry years (less than 1 ft); however, during critically dry years, Lake Oroville would average about 2 ft higher. On Independence Day, there would be very little difference in operation of Lake Oroville during above normal and below normal years (less than 1 ft); however, during wet years, Lake Oroville would average about 1 ft lower and during dry and critically dry years, Lake Oroville would average about 1 ft higher. On Labor Day, during wet years, there would be a reduction in elevation of about 9 ft while above normal years there would only be a reduction of about 3 ft. During critically dry years there would be an increase of about 2.5 ft and during below normal and dry years, there would be little change (less than 1 ft).

Thermalito Afterbay. Under 2020 No-Action Conditions, there would likely be no operational fluctuation changes in Thermalito Afterbay. Thermalito Afterbay would continue to be operated to meet multiple requirements, including re-regulation of inflow from the Thermalito Pumping-Generating Plant, providing a source of water for withdrawal during pump-back operation, making releases through the Thermalito Afterbay Outlet to the Feather River, and serving as a source of diversions for FRSA irrigation entitlements.

Feather River Below Oroville Dam. The total monthly release from Lake Oroville under 2020 No-Action Conditions for each water year type is shown in Figure 5.4-7. The general operational goals and commitments of the Oroville Facilities remain the same; hence, the total release from the reservoir would be very similar when compared to 2001 Existing Conditions. In the future No-Action, there would be slightly less releases made during the winter months and slightly more releases made during the summer months.

The mean monthly flow in the Low Flow Channel under 2020 No-Action Conditions is illustrated in Figure 5.4-8. The mean monthly flow in the Low Flow Channel would be at least 600 cfs. In some above normal and wet years, releases from Lake Oroville storage would be required in excess of power generation facility capacity. This would occur when releases from storage are required to meet flood control criteria or in times of reservoir spill.

The Feather River flow below the Thermalito Afterbay Outlet under 2020 No-Action Conditions is shown in Figure 5.4-9. The mean monthly flow would remain the same as under 2001 Existing Conditions; however, there would tend to be slightly more flow in the Feather River below the Thermalito Afterbay Outlet during the months of May through August and slightly less flow in the remaining months.

The Feather River flow at Verona under 2020 No-Action Conditions is shown in Figure 5.4-10. The effect of the No-Action Alternative at this location would be slightly more flow in the Feather River during the months of May through August and slightly less flow in the remaining months.

Groundwater Hydrology

The storage of water in Lake Oroville, Thermalito Afterbay operations, and releases to the Feather River under the modeled 2020 No-Action Alternative would remain very similar to modeled 2001 Existing Conditions. Therefore, there is no indication that operation of the Oroville Facilities under the No-Action Alternative would affect groundwater levels or migration.

Flood Management

The No-Action Alternative would not change existing flood management practices. DWR would continue to operate Lake Oroville to meet the flood control criteria established by USACE.

Proposed Action

The Proposed Action neither includes PM&E measures that affect water quantity nor proposes changes to the operation of the Oroville Facilities; therefore, water quantity effects would be the same as described in the 2020 No-Action Alternative

Alternative 2

Alternative 2 includes PM&E measures that would cause water quantity effects. These measures and their potential effects are described below.

Minimum Flow in Low Flow Channel

This PM&E measure would increase the minimum flow from 600 cfs to 800 cfs in the Low Flow Channel. DWR would provide the additional water to the Low Flow Channel by reducing its diversions into the Thermalito Power Canal at the Diversion Dam and instead discharge this flow into the Feather River below the dam. Therefore, additional releases from Oroville Dam would not be needed to meet this 800 cfs minimum flow requirement, and there would be no effect on Lake Oroville storage and surface elevations. There would, however, be a reduction in power generation, a slight reduction in diversions to the Thermalito Power Canal and into Thermalito Afterbay, and hence, the flow returned to the Feather River through that route.

Thermalito Afterbay Temperature Control

This PM&E measure would maintain a minimum continuous flow of 1,200 cfs in the Low Flow Channel from May 1 through June 15 of every year (not to exceed the total release to the Feather River). This is an increase of 600 cfs over the minimum flow release in the No-Action Alternative and the Proposed Action. DWR would provide the additional

water to the Low Flow Channel by reducing its diversions into the Thermalito Power Canal at Thermalito Diversion Dam and would instead discharge this flow into the Feather River below the dam. Therefore, additional releases from Oroville Dam would not be needed, and Lake Oroville storage and surface elevations would not be affected. Under certain meteorological conditions, there could be a slight increase (warming) of temperatures. Additionally, there would be a slight reduction in power generation, a reduction in diversions to the Thermalito Power Canal and into Thermalito Afterbay, and hence, the flow returned to the Feather River through that route.

The combined effects of the PM&E measures described above were modeled and are summarized in Table 5.4-5. The average annual flow in the Low Flow Channel under this alternative would be approximately 688 taf. This is an increase of about 35 percent over 2020 No-Action Conditions. The average annual flow in the Low Flow Channel under critically dry conditions would be about 616 taf. This would be an increase of about 42 percent over 2020 No-Action Conditions. Average annual power generation losses of about 7,800 MWh would result due to additional flows being bypassed around the Thermalito Pumping-Generating Plant.

The typical operational pattern and weekly cycle at Thermalito Afterbay would be the same as existing conditions. Delivery of water to FRSA water customers at the related Thermalito Afterbay diversion points would not change, and flood management operations would not be affected. Instream flows below the Thermalito Afterbay Outlet also would remain unchanged relative to 2020 No-Action Conditions. Similarly, there would be no effect on water deliveries under Alternative 2 as FRSA and SWP contractor water supply deliveries would be the same as the modeled deliveries under 2020 No-Action Conditions. Also, changes in groundwater would not likely occur under Alternative 2.

5.4.2.2 Water Quality

No-Action Alternative

Baseline conditions, as described in Section 5.4.2.1, would continue under the No-Action Alternative. This section addresses the baseline condition associated with the No-Action Alternative.

Section 5.4.2.1 described how designated beneficial uses in the Central Valley RWQCB Basin Plan are potentially affected if water quality objectives are not met. The following water quality parameters may be affected by the project alternatives and hence are the focus of the following assessment sections:

- Water temperature;
- Minerals;
- Sedimentation and turbidity;
- Metals;

- Pesticides;
- Petroleum byproducts and fuel additives;
- Nutrients; and
- Pathogens.

Baseline effects on water quality have been categorized as temperature-related, recreation-related, and other effects. The temperature influences are associated with project operations, including Lake Oroville storage management, Feather River flow and temperature management, Thermalito Forebay and Thermalito Afterbay water management, and pump-back operations. Recreation-related influences are associated with increased recreational activity, and construction and implementation of recreation PM&E measures. The other influences are associated with miscellaneous activities not covered above, but are related to operations-related flow changes and PM&E measures involving natural resources (fisheries, wildlife and vegetation) management.

Table 5.4-6 summarizes the key results of the No-Action Alternative, Proposed Action, and Alternative 2 effects assessments, along with related existing conditions for each affected water quality parameter. The subsections following the table provide more detailed information about the potential effects of the No-Action Alternative.

Temperature Conditions

The various influences of the project described in Section 5.4.1.2 would continue under the No-Action Alternative. The expected changes in river and reservoir hydrology and water temperatures under the 2020 No-Action conditions were simulated in the CALSIM II, HYDROPS™, and WQRRS modeling studies. The models indicate there would be minor differences in water temperatures over time as described below.

The temperature results for the 2001 Existing Conditions and 2020 No-Action Alternative scenarios were compared at various locations. The model results indicate that there are seasonal variations in water temperatures. Generally, there would be no measurable change in water temperatures in the Lower Feather River because the coldwater pool volume is sufficient for temperature management. Further, the modeling results indicate a slight beneficial effect in the Lower Feather River due to release pattern changes. Figures G-WQ2.3-1 through G-WQ2.3-12 in Appendix G-WQ-2 summarize the simulation results for the 2001 Existing Conditions and 2020 No-Action Alternative scenarios at these and a number of other locations.

Lake Oroville creates a coldwater pool and serves as an important resource for temperature management in the Feather River. The coldwater pool volume is defined as the volume of water below the depth where 50°F temperature occurs at the main Oroville Dam intake structure. The coldwater pool volume is expected to decrease over time under the No-Action Alternative because additional releases of water will likely be needed to meet increasing demands, and incorporated into the 2020 No-Action Alternative modeling scenario.

Table 5.4-6. Summary of existing water quality conditions and potential effects.

Topic	Existing Conditions	No-Action Alternative [a]	Proposed Action	Alternative 2
Water Temperature Effects				
Lake Oroville	Reservoir is thermally stratified in summer and retains large coldwater pool volume below the warmer surface water. End-of-September coldwater pool volume can be depleted during some months of some critical dry years.	Reduction in modeled end-of-November coldwater pool volume caused by increased storage releases to meet higher demand	Same as No-Action Alternative	Same as No-Action Alternative, but slightly more reduction in coldwater pool volume caused by increased coldwater releases to meet new temperature objectives
Low Flow Channel at Robinson Riffle	Lake Oroville release temperatures generally meet temperature criteria.	No measurable change in water temperatures because coldwater pool volume is sufficient for temperature management	Same as No-Action Alternative	Minor changes in water temperatures.
Feather River Fish Hatchery	Lake Oroville release temperatures generally meet Hatchery objectives.	No measurable change in water temperatures because coldwater pool volume is sufficient for temperature management. Modeling results indicate a slight beneficial effect in the Lower Feather River due to release pattern changes.	Same as No-Action Alternative	Minor changes in water temperatures
Thermalito Afterbay Water Temperature	Release temperatures and facility operations currently have good record of meeting target objectives for majority of time.	No measurable change in water temperatures	Same as No-Action Alternative	Under certain meteorological conditions, a slight increase (warming) of temperatures

Table 5.4-6. Summary of existing water quality conditions and potential effects.

Topic	Existing Conditions	No-Action Alternative [a]	Proposed Action	Alternative 2
Feather River downstream of Afterbay Outlet	Lake Oroville flow attenuation and storage generally affect water temperatures during the spring and during the summer and early fall.	No measurable change in water temperatures	Same as No-Action Alternative	Same as No-Action Alternative
Recreation-Related Effects				
Sedimentation and Turbidity	Minor and baseline localized, short-term erosion and turbidity associated with recreation and maintenance activities	Same as Existing Conditions	Same as Existing Conditions regarding shoreline erosion. Also construction-related erosion, but avoided or minimized with use of BMPs	Same as Proposed Action; effects would differ slightly
Metals	Metals were generally at low levels in water samples. Metals in fish tissues exceeded human health and wildlife criteria for mercury. Lake Oroville traps contaminated sediments, resulting in reduced mercury levels in the lower Feather River.	Potential for construction-related discharges of some metals	Same as No-Action Alternative but with less human exposure to mercury due to PM&E measure for education and awareness	Same as Proposed Action; effects would differ slightly
Petroleum byproducts and fuel additives	Fuel additives detected near marinas and recreation use areas. Petroleum byproducts detected near developed marinas at levels below regulatory criteria.	Same as Existing Conditions	Same as Existing Conditions. with additional construction discharges associated with new facilities, but controllable with BMPs	Same as Proposed Action; effects would differ slightly

Table 5.4-6. Summary of existing water quality conditions and potential effects.

Topic	Existing Conditions	No-Action Alternative [a]	Proposed Action	Alternative 2
Nutrients	Nutrients are generally at low levels. Recreation, wildlife, and Feather River Fish Hatchery discharges may cause localized, short-term increases.	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions; effects would differ slightly
Pathogens	Bacteria levels and exposure to bacteria occur occasionally, however effects are isolated and seasonal. Background watershed and reservoir samples have low levels.	Same as Existing Conditions	Same as Existing Conditions, however education and awareness PM&E may reduce human exposure	Same as Proposed Action; effects would differ slightly
Other Effects				
Dissolved Oxygen	Dissolved oxygen (DO) and pH levels generally complied with the water quality objectives of the Basin Plan.	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Minerals and Conductivity	Occasional elevated minerals and conductivity in the Low Flow Channel	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Sedimentation and Turbidity	Large amount of sediment trapped in Lake Oroville. Clear-water releases from Lake Oroville likely contribute to scour and armoring downstream.	Negligible effects	Minor construction erosion, but avoided or minimized with BMPs. Localized and temporary increases in turbidity with fish habitat improvements	Same as Proposed Action; effects would differ slightly

Table 5.4-6. Summary of existing water quality conditions and potential effects.

Topic	Existing Conditions	No-Action Alternative [a]	Proposed Action	Alternative 2
Pesticides	Pesticides detected in fish tissue samples. Mosquito abatement in the OWA.	Same as Existing Conditions	Same as Existing Conditions. Noxious weed control would increase use of herbicides, but BMPs minimize effects.	Same as Proposed Action

[a] *The No-Action Alternative column summarizes potential No-Action effects that are in addition to the Baseline Conditions that would continue under this alternative. Baseline water quality effects of the project are summarized briefly in the existing conditions column and in more detail in Section 5.4.2.1.*

Recreation-Related Conditions

The existing influences of the project described in Section 5.4.1.2 would continue under the No-Action Alternative. Recreational activities that affect water quality include: boating, boat launching, and boat fueling activities; swimming and other in-water body contact sports; runoff from nearshore marinas, camping, and day use areas; and runoff or direct discharges of waste in the upper watershed resulting from camping, hiking, and other trail use activities. The intensity of most recreation activities would likely increase as population increases and generates additional demand for recreational opportunities. Estimates of future demand for recreation based on the results of SP-R12, *Projected Recreation Use*, indicate that recreational use of the Oroville Facilities will increase approximately 34 percent by 2020.

Sedimentation and Turbidity

Under the No-Action Alternative, increased levels of boating, hiking, fishing, horseback riding, swimming, and camping in the Feather River Basin can be expected. The relicensing studies found no substantially adverse turbidity or total TSS effects being caused by up-slope or in-water recreational activities. Therefore, the increased recreation activity associated with this alternative would likely not cause adverse effects on water quality objectives. Assuming best management practices (BMPs), it is unlikely that the increased erosion would be sufficient to adversely affect beneficial uses.

Metals

Under the No-Action alternative, the presence of metals and pesticides in the project area would continue. Several metals were found during the relicensing studies at concentrations that exceeded Basin Plan objectives, but the studies indicate the exceedances are not associated with project operations or recreational activities. Therefore, the expected increases in recreation would not likely result in additional metals loading. Recreational sport fishing activity at the Oroville Facilities may increase and result in more people exposed to contaminated fish. However it is important to note that consumer information published by OEHHA considers the health risks of eating contaminated fish to be low based on the typical fish consumption practices and tissue levels found in fish of the state. There is no current OEHHA fish advisory for any of the water bodies in the Feather River watershed.

Petroleum Byproducts and Fuel Additives

Recreation activity is expected to increase under the No-Action Alternative. Increased recreational activity has the potential to increase petroleum byproducts from boating activity or accidental spills during fueling or motor vehicle leakage. Low-level and minor discharges could occur as recreation use increases over time. Future activities and facilities will likely provide no direct source of petroleum byproducts (and MTBE), other than incidental fuel uses for vehicles, watercraft, and equipment. California's ban on MTBE use will result in the phase-out of potential MTBE discharges over time.

Nutrients

Recreation activity is expected to increase under the No-Action Alternative however, recreation-related nutrient impacts would be minor. Increased levels of boating, hiking, fishing, horseback riding, swimming, and camping in the Feather River Basin have the potential to increase nutrient loading as a result of increased human or animal wastes and erosion. BMPs would continue to be implemented; therefore, it is unlikely that the increased nutrients loading would be sufficient to adversely affect water quality.

Pathogens

Recreation activity is expected to increase under the No-Action alternative. Increased use would likely continue to result in seasonally elevated indicator coliform bacteria concentrations at the major developed and undeveloped swimming areas. Based on existing monitoring data, it is expected that these potential effects would be isolated to the intensive recreation use areas and not be dispersed throughout the project area.

Other Conditions

The operations-related flow effects under the modeled 2020 No-Action Alternative would be very similar to the modeled 2001 Existing Conditions. Other baseline activities related to natural resources management include minor landscaping actions near visitor and employee facilities, and activities associated with the 1983 Operating Agreement between DFG and DWR. Effects associated with landscaping actions and implementation of the 1983 agreement are considered minor. Activities conducted by other agencies include fire suppression and mosquito control. Effects associated with these activities are considered minor.

Proposed Action

Temperature Effects

Under the Proposed Action, the baseline effects of the project described in Section 5.4.1.2 would continue. The Proposed Action assumes no changes to hydrologic related operations as compared to the 2020 No-Action Alternative. Therefore, the temperature-related effects of the Proposed Action would be the same as described for future conditions under the modeled 2020 No-Action Alternative.

Recreation-Related Effects

Under the Proposed Action, a variety of water quality effects could be caused by the proposed improvements or expansion of existing recreation facilities, or creation of entirely new recreation sites. Key recreation facility improvements include: major expansion plans for the Bidwell Canyon and Loafer Creek facilities at Lake Oroville; boat launching and docking improvements on Lake Oroville; numerous swimming area improvements around Lake Oroville and Thermalito Complex sites; and implementation of the programmatic Trails Program elements around Lake Oroville.

Most of the construction-related effects of the Proposed Action would be short-term and could be avoided or minimized with implementation of appropriate BMPs (see below); however, the new and expanded facilities would likely result in increases in activities that potentially contribute to waste discharge including: boating, boat launching, and fueling; water contact sports; runoff from nearshore developed (i.e., marinas, campgrounds) and dispersed recreation sites; and upper watershed camping and trail use activities. The new facilities and improvements are expected to result in an approximate 8 percent increase in recreational visitation and use of Oroville Facilities through 2020 in addition to the increase that would occur under the No-Action Alternative. The Proposed Action would also include measures to monitor bacteria levels at swimming areas, implement public education campaigns to increase awareness of the health risks associated with water contact recreation and exposure to toxins from consumption of contaminated fish, install additional trash disposal containers at numerous sites, and implement improved debris management activities at McCabe Creek.

Sedimentation and Turbidity

Implementation of the Proposed Action would involve considerable new construction activities for recreational facilities. Construction activities have the potential to increase sedimentation and turbidity, and effective mitigation of these effects largely depends on the adoption and proper use of standard BMPs. Grading, earth-moving, excavation and utility installation, infrastructure development, and building construction disturb existing vegetation cover, soil, and drainage systems. If uncontrolled, these soil materials result in soil erosion and other construction-related material to drainage channels and roadside ditches. The potential effects of construction can be effectively minimized through diligent implementation of BMPs for erosion control and runoff prevention. Typically, all construction activities disturbing more than 1 acre of land need a National Pollutant Discharge Elimination System (NPDES) stormwater permit. Implementation of an appropriate BMP program should effectively avoid or minimize adverse water quality effects.

Increased levels of boating, hiking, fishing, horseback riding, swimming, and camping in the project area would likely occur as a result of increased opportunities afforded by new trails and swim areas and the expansion of campgrounds. All these activities potentially increase erosion and sedimentation. The relicensing studies found no substantially adverse turbidity or total TSS effects being caused by up-slope or in-water recreational activities. Therefore, the increased recreation activity associated with this alternative would likely not cause exceedances of water quality objectives.

Metals

The relicensing studies indicate that project operations or recreational activities are not the cause of metal concentrations to exceed Basin Plan criteria. Therefore, the expected increases in recreation would likely not affect metals concentrations in water samples. Some construction and recreation-related activities (e.g., painting, boat maintenance) can cause incidental discharges of some metals. However, the BMPs

adopted for construction activities should limit adverse effects of metals. Increased recreational sport fishing activity could increase exposure to mercury contamination in fish tissues. However, the Proposed Action includes implementation of a public awareness program to inform anglers about the appropriate fish consumption.

Petroleum Byproducts and Fuel Additives

The additional construction and recreational activity associated with this alternative has the potential to increase petroleum byproducts from boating activity, accidental spills during fueling, or motor vehicle leakage. Existing monitoring data indicates that the additional recreation use would not lead to exceedances of Basin Plan water quality objectives for petroleum byproducts. Future activities and facilities will likely provide no direct source of petroleum byproducts (and MTBE), other than incidental fuel uses for vehicles, watercraft, and equipment. California's ban on MTBE use will result in the phase-out of potential MTBE discharges.

Nutrients

The additional construction and recreational activity associated with this alternative has the potential to increase nutrient load. BMPs would be implemented, therefore, it is unlikely that the increased nutrients loading would be sufficient to adversely affect water quality.

Pathogens

Recreation activity is expected to increase under this alternative. Increased use would likely result in seasonally elevated indicator coliform bacteria concentrations at the major developed and undeveloped recreation facilities. This alternative includes implementation of a bacterial monitoring and public awareness program at swimming areas. These programs improve the detection of adverse water quality conditions as well as inform the public how to reduce human waste contamination.

Other Conditions

The Proposed Action includes several natural resources management–related measures, including fisheries measures, wildlife measures, and botanical measures. Implementation of these measures would require various degrees of streambed or earth-moving disturbances that could potentially result in sedimentation, turbidity, and erosion. Some of the measures could also potentially affect contaminants and available nutrients.

The lower Feather River fisheries habitat improvement measures would require periodic disturbance to bottom sediments in the Low Flow Channel that would likely cause localized increases in sedimentation and turbidity. Once the initial disturbance is completed, fine sediments would be removed from the gravel by instream flows and long-term turbidity and downstream sedimentation effects should be minimal. However, adoption of appropriate BMPs for all of these construction activities would likely avoid and minimize potential adverse water quality effects.

The wildlife habitat improvement measures would require initial disturbance for the construction of wildlife brood ponds, development of upland habitat, and installation of wildlife boxes. These measures typically involve ground disturbing activities that could affect erosion and sedimentation. However, adoption of appropriate BMPs for all of these construction activities would likely avoid and minimize potential adverse water quality effects.

The botanical measures include an Invasive Species Management Plan to reduce noxious non-native plant species populations. Herbicides would be used in conjunction with other measures to reduce the noxious plants. The use of herbicides could lead to contamination of the water bodies listed above. The use of less toxic herbicides, restricting application periods, applying in accordance with label rates, and following the County Agriculture Bulletins virtually eliminate the potential adverse effects from herbicide use.

Alternative 2

Temperature Effects

Alternative 2 includes operations-related changes that alter water temperatures in the Low Flow Channel and Thermalito Afterbay. The minimum instream flow requirement in the Low Flow Channel would be increased from the existing 600 cfs to 800 cfs and the temperature objectives for Robinson Riffle in the Low Flow Channel would be modified to achieve the temperatures specified in Table 5.4-7.

Table 5.4-7. Alternative 2 water temperature objectives for Robinson Riffle.

Dates	Temperature Objective (°F)
January 1 - April 30	54
May 1 – May 31	60
June 1-15	63
June 16 - August 31	64
September 1 – October 15	58
October 16 – November 30	56
December 1 - 31	54

Water Temperature

Water temperature was modeled for 2020 conditions under Alternative 2 at three locations: the Diversion Pool, Robinson Riffle, and downstream of the Thermalito Afterbay Outlet. Figures G-WQ2.3-1 through G-WQ2.3-12 in Appendix G-WQ2 summarize the simulation results for Alternative 2 at these and a number of other locations.

The results indicate temperatures increase and decrease between the modeled 2020 No-Action Alternative and Alternative 2 for the three locations. The model indicates that seasonal variations in water temperatures occur; however, the year-to-year variations are relatively minor. Model results also indicate frequent exceedances of the Robinson Riffle objectives defined in Table 5.4-7. However, it is important to note that the 50th

and 80th percentile modeling results indicate that the new temperature objectives and minimum flows included in Alternative 2 would lead to cooler temperatures most of the time.

The differences in water temperatures between the No-Action Alternative and Alternative 2 are attributable to higher flow releases and colder temperature objectives at Robinson Riffle. Generally speaking, because of atmospheric warming, releases of colder water most strongly affect temperatures at upstream stations, while increased flows most strongly affect temperatures at downstream stations.

The increased flow in the Low Flow Channel would not affect flow downstream of the Thermalito Afterbay Outlet because less water would be diverted through the Thermalito Pumping-Generating Plant. Less diversion of water through the Thermalito Pumping-Generating Plant could cause slight warming of water, under certain meteorological conditions by increasing the residence time of water in Thermalito Afterbay.

Lake Oroville creates a coldwater pool and serves as an important resource for temperature management in the Feather River. The coldwater pool volume under Alternative 2 decreases in the future because increased coldwater releases are needed to meet Robinson Riffle temperature criteria and additional water would be released to meet increasing future demands.

Recreation-Related Effects

Under Alternative 2, a variety of water quality effects could be caused by the proposed improvements or expansion of existing recreation facilities, or creation of entirely new recreation sites. The recreation improvements and new facilities included in this alternative would cause the same type of effects as those described under the Proposed Action; however, their magnitude would be greater. Some of these effects would occur in different locations relative to trail use, additional improvements for the Bidwell Canyon and Loafer Creek facilities, construction of new facilities at the Lime Saddle area on Lake Oroville, extension of the boat ramp at Spillway, addition of three floating campsites, and numerous improvements and new facilities for the Diversion Pool and Thermalito Complex areas. Most of the construction-related effects would be short term and could be minimized or avoided with appropriate BMPs.

Sedimentation and Turbidity

Implementation of Alternative 2 would involve additional construction activity compared to the Proposed Action. Most of the additional construction would occur near Lake Oroville and the Thermalito Complex impoundments. Some of the additional construction activity would likely extend over several years; however, implementation of an appropriate BMP program should effectively avoid or minimize adverse water quality effects from construction.

Increased levels of recreation associated with boating, hiking, fishing, horseback riding, and swimming can be expected as a result of increased opportunities created by new trails and swim areas, and the expansion of campgrounds. All of these activities

potentially increase erosion and sedimentation. The relicensing studies found no substantially adverse turbidity or total TSS effects being caused by up-slope or in-water recreational activities. Therefore, the increased recreation activity associated with this alternative would likely not cause exceedences of water quality objectives.

Metals

The relicensing studies indicate that project operations or recreational activities are not the cause of metal concentrations to exceed Basin Plan criteria. Therefore, the expected increases in recreation would likely not affect metals concentrations in water samples. Some construction and recreation-related activities (e.g., painting, boat maintenance) can cause incidental discharges of some metals. However, the BMPs adopted for construction activities should limit adverse effects of metals. Increased recreational sport fishing activity could increase exposure to mercury contamination in fish tissues. However, this alternative includes implementation of a public awareness program to inform anglers about appropriate fish consumption.

Petroleum Byproducts and Fuel Additives

The additional construction and recreational activity associated with this alternative has the potential to increase petroleum byproducts from boating activity, accidental spills during fueling, or motor vehicle leakage. Existing monitoring data indicates that the additional recreation use would not lead to exceedances of Basin Plan water quality objectives for petroleum byproducts. Future activities and facilities will likely provide no direct source of petroleum byproducts (and MTBE), other than incidental fuel uses for vehicles, watercraft, and equipment. California's ban on MTBE use will result in the phase-out of potential MTBE.

Nutrients

The additional construction and recreational activity associated with this alternative has the potential to increase nutrient loads. BMPs would be implemented; therefore, it is unlikely that the increased nutrient loading would be sufficient to adversely affect water.

Pathogens

The additional recreational use associated with Alternative 2 would likely increase the duration and intensity of seasonally elevated indicator coliform bacteria concentrations at major developed and undeveloped swimming areas. This alternative includes implementation of a bacterial monitoring and public awareness program at swimming areas. This program improves the detection of adverse water quality conditions as well as informs the public how to reduce human waste.

Other Conditions

The PM&E measures included in this alternative that have potential effects involve different types of natural resources management actions. Alternative 2 includes measures to establish new side-channel habitat to benefit steelhead and spring-run

Chinook salmon, as well as a measure to modify the streambed at two lower Feather River locations to improve conditions for passage by sturgeon. Both measures would entail streambed disturbance activities that would likely cause some sedimentation and turbidity.

The proposed changes to operations under Alternative 2 would change flows in the Low Flow Channel and these changes would potentially modify water quality in the Low Flow Channel. The water quality studies indicates that constituent concentrations generally meet water quality objectives under existing conditions. The proposed increase in flow and reduced temperature targets should benefit constituent concentration; hence, such changes are not expected to adversely affect beneficial uses.

The construction of four brood ponds near Thermalito Afterbay, the lower Feather River fisheries habitat improvement measures (including side channel habitat construction), and the Fuel Load Management Plan could potentially cause localized increases in sedimentation and turbidity. Such activities have the potential to increase turbidity and sedimentation during their implementation phase. However, adoption of appropriate BMPs for all of these construction activities would likely avoid and minimize potential adverse water quality effects.

The botanical measures include an Invasive Species Management Plan to reduce noxious non-native plant species populations. Herbicides would be used in conjunction with other measures to reduce the noxious plants. The use of herbicides could lead to contamination of the water bodies listed above. The use of less toxic herbicides, restricting application periods, applying in accordance with label rates, and following the County Agriculture Bulletins reduce the potential adverse effects from herbicide use.

5.4.3 Cumulative Effects

5.4.3.1 Water Quantity

Chapter 5.0, Section 5.2, describes the approach and scope of the cumulative effects analysis along with a number of related actions addressed in the cumulative analysis. This section addresses potential water quantity cumulative effects. Water quantity 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 operations of the Oroville Facilities.

The CALSIM II modeling conducted for this PDEA 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 control 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 for more information regarding the assumptions used in the CALSIM II modeling).

Cumulative Effects of the Project and 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, and Butt Valley, Poe, Bucks, Rock Creek and Cresta Dams. In the 1960s, DWR constructed three projects: Frenchman Lake, Antelope Lake, and Lake Davis. All of these upstream projects are described in Appendix F.

These upstream reservoir projects have a cumulative effect on the hydrology of the Feather River, upstream and downstream of the Oroville Facilities. In general, these projects alter the natural runoff magnitude, volume, and timing of flow in the Feather River. The average annual impaired inflow into Lake Oroville is a little less than 4.0 maf (Table 5.4-8). Mean monthly Feather River flow below the Thermalito Afterbay Outlet is reduced from unimpaired conditions during the months of November–June and is increased during the months of July–October (Table 5.4-9).

Cumulative Effects of the Alternatives and Future Related Actions

Future cumulative water quantity effects associated with reasonably foreseeable related actions, and future conditions under the No-Action Alternative, Proposed Action, and Alternative 2, are represented by the 2020 modeling results. All of the reasonably foreseeable related actions included in the future No-Action CALSIM II model runs were also included in the model runs used to simulate future water supply and hydrology conditions under the Proposed Action and Alternative 2.

Table 5.4-8. Lake Oroville mean monthly unimpaired and impaired inflow.

Feather River at Oroville Unimpaired Flow (taf)												
Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
108	196	365	460	544	639	685	625	324	151	101	88	4,286
Lake Oroville Mean Monthly Impaired Inflow (taf)												
Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
121	185	333	443	495	548	562	494	274	156	135	117	3,863
Effect of Upstream Projects on Lake Oroville Inflow (% difference)												
Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
11	-6	-9	-4	-10	-17	-22	-26	-18	3	25	25	-11

Note: taf = thousand acre-feet.

Source: DWR 2004, CALSIM II 2001 Existing Conditions Benchmark Modeling Results; The California Data Exchange Center

Table 5.4-9. Feather River below Thermalito Afterbay Outlet mean monthly impaired and unimpaired flow.

Feather River at Oroville Unimpaired Flow (taf)												
Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
108	196	365	460	544	639	685	625	324	151	101	88	4,286
Feather River Flow Below Thermalito Afterbay Impaired Flow (taf)												
Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
146	135	247	308	330	378	205	235	286	376	263	114	3,022
Effect of all Projects on Feather River Flow Below Thermalito Afterbay (% difference)												
Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
26	-45	-48	-49	-65	-69	-235	-166	-13	60	62	23	-42

Note: taf = thousand acre-feet.

Source: DWR 2004, CALSIM II 2001 Existing Conditions Benchmark Modeling Results; The California Data Exchange Center

The Proposed Action does not include any PM&E measures that would change the operation of the Oroville Facilities compared to the 2020 No-Action Alternative. Therefore, future cumulative water quantity conditions under the Proposed Action would be the same as those in the future under the No-Action Alternative. Although the quantity of water supply would not be affected by the alternative, the cost of this water supply would increase due to implementation of the PM&E measures included in the Proposed Action.

Alternative 2 affects water quantity in the Low Flow Channel. This alternative includes an increase in the minimum flow in the Low Flow Channel to 800 cfs at all times and to 1,200 cfs from June 16 through April 30 and May 1 through June 15. This alternative diverts water through the Low Flow Channel rather than diverting water to Thermalito Afterbay. Therefore, cumulative effects on water quantity under this alternative would be the same as those under the Proposed Action.

5.4.3.2 Water Quality

This section provides a broad overview of cumulative water quality effects in the project vicinity. The affected environment and effects assessment for temperature were based on comprehensive monitoring during 2002–2003 for SP-W6 and on temperature modeling studies. The temperature modeling and results described in the earlier sections are a cumulative effects analysis because they use modeled hydrology input from CALSIM II, HYDROPS™, and other sources.

Cumulative Effects of the Project and Past and Present Related Actions

The wide range of past and present related actions listed in Section 5.2, including agricultural and urban development, extensive mining activities, recreation, timber harvesting, and other actions, cause a number of adverse water quality effects. The adverse effects include an increase in erosion and sedimentation, petroleum byproducts—fuel additives, nutrients, pathogens, and toxicity in the project vicinity.

The Oroville Facilities influence water quality by trapping and accumulating sediment that is transported from the upper watershed, shoreline erosion, and creation of recreational facilities that result in the potential for increased contamination, and changing hydrologic conditions. Downstream of Oroville Dam and the Thermalito facilities, several other related actions affect water quality, including: the City of Oroville SCOR facility, treated and untreated urban stormwater runoff,and in-channel activities such as water supply management or diversions, levee maintenance, vegetation management, and recreation.

Temperature

Section 5.4.1.2 describes the historical and existing temperature patterns in the lower Feather River and how the project facilities comply with federal and State water temperature criteria. Water temperature patterns are influenced by operations at Oroville Dam. Currently, water temperatures downstream of Oroville Dam are generally

warmer in the spring and cooler in the summer as compared to pre-project conditions. The temperature of water in the Feather River normally reaches equilibrium with atmospheric conditions well upstream of the confluence with the Sacramento River. Consequently, the project has no effect on water temperatures outside of the basin.

Cumulative Effects of the Alternatives and Future Related Actions

A variety of related actions are expected to affect water quality in the future. In the watershed above Lake Oroville, the U.S. Forest Service and U.S. Bureau of Land Management should continue to update and implement their respective land and resource management plans. Downstream of the Oroville Facilities, related actions that would likely affect water quality include continued population increases in the Oroville, Marysville, and Yuba City areas and associated increases in discharges of wastes from urban runoff and treated wastewater from these and other municipalities.

Future regulatory activities by the Central Valley RWQCB and USEPA should improve water quality of the lower Feather River. The Central Valley RWQCB is expected to renew, and make more stringent, its “ag waiver program” for irrigated agriculture by January 2008. This program currently waives the requirement for waste discharge requirements for agricultural irrigation drainage and requires interim water quality monitoring to be conducted to provide information to evaluate the water quality effects of agricultural discharges. USEPA is phasing out the unrestricted use of commercial and residential diazinon and urban runoff discharges of this pesticide should decline in the future.

No-Action Alternative

The incremental water quality effects associated with the No-Action Alternative, Proposed Action, and Alternative 2 are generally expected to make only a minor contribution to future cumulative effects.

Under the 2020 No-Action Alternative, project operations are projected to generally comply with temperature criteria at the Feather River Fish Hatchery and Robinson Riffle. Relative to existing conditions, water temperatures should not change on either a seasonal or water year-type basis.

Proposed Action

The Proposed Action results in construction activities and implementation of a variety of new fish and wildlife habitat enhancement and natural resource management–related PM&E measures. However, the purpose of many of the PM&E measures is to improve resource conditions, and use of erosion control practices and other BMPs during construction would avoid and minimize potential water quality effects.

Under the Proposed Action, project operations are projected to generally comply with temperature criteria at the Feather River Fish Hatchery and Robinson Riffle. The Proposed Action conditions are projected to be nearly identical to future No-Action

conditions because there would be no operations-related hydrology changes associated with the proposed PM&E measures.

Alternative 2

Alternative 2 results in construction activities, habitat modifications, and enhancements associated with additional recreation opportunities. The purpose of many of the PM&E measures is to improve resource conditions, and use of erosion control practices and other BMPs during construction would avoid and minimize potential water quality effects.

Temperature criteria compliance under Alternative 2 is projected to improve slightly in the Low Flow Channel with implementation of new instream temperature criteria for Robinson Riffle. Water temperatures at the Thermalito Complex could increase slightly, under certain meteorological conditions.

5.4.4 Unavoidable Adverse Effects

5.4.4.1 Water Quantity

Unavoidable and adverse water quantity and supply effects are not expected under any of the three alternatives.

5.4.4.2 Water Quality

The No-Action Alternative, the Proposed Action, and Alternative 2 could all lead to some minor unavoidable and adverse water quality effects.

No-Action Alternative

Recreation use within the FERC project boundary is expected to increase by the year 2020. Therefore, a possible increase in the exposure of recreationists to two potential health risks could occur: coliform bacteria in isolated swimming areas where waterfowl and recreation use occurs, and consumption of fish with elevated concentrations of mercury.

Proposed Action

Implementation of the PM&E measure to increase public awareness and education for avoidance and elimination of bacterial concentrations and consumption of fish exposed to mercury contamination is expected to reduce the incidence of consumption of fish exposed to contaminants.

Alternative 2

Modeled water temperatures at Robinson Riffle indicate a minor reduction in Lake Oroville's coldwater pool compared to the No-Action Alternative or the Proposed Action.

Implementation of the PM&E measure to increase public awareness and education for avoidance and elimination of bacterial concentrations and consumption of fish exposed to mercury contamination is expected to reduce the incidence of consumption of fish exposed to contaminants.

5.5 AQUATIC RESOURCES

This section of the PDEA describes the fisheries-related resources within the project study area. Section 5.5.1, Affected Environment, includes an overview of the fish species located within the project study area; defines the species of primary management concern; describes the water bodies these species inhabit; and outlines applicable laws, ordinances, regulations, and standards related to fisheries resources. Section 5.5.2, Environmental Effects, provides an analysis of potential effects related to implementation of the No-Action Alternative, the Proposed Action, and Alternative 2. Cumulative effects are discussed in Section 5.5.3, and Section 5.5.4 identifies unavoidable adverse effects. The analysis relied on both printed documents and personal communication citations, which are included in Chapter 11.0, Literature Cited.

Appendix G-AQUA2, Methodology, includes a discussion of the methods utilized to assess potential effects on reservoir and riverine fish species based on their individual life stages. This appendix also addresses the methods used to assess potential effects on upstream passage, macroinvertebrate populations, woody debris recruitment, gravel recruitment, channel complexity, and water quality criteria for aquatic life as they relate to fish habitat.

5.5.1 Affected Environment

Operation of the Oroville Facilities influences environmental conditions within the lower Feather River, as well as within Lake Oroville and its upstream tributaries, the Diversion Pool, Thermalito Forebay, Thermalito Afterbay, the Feather River Fish Hatchery, the Fish Barrier Pool, and the OWA ponds. An overview of the Oroville Facilities and associated water bodies as they relate to aquatic resources is provided in Section 5.5.1.1, Facilities, Waterbodies, and Related Fisheries Resources. Applicable laws, ordinances, regulations, and standards related to fisheries resources are provided in Section 5.5.1.2.

Evaluating potential effects on aquatic resources within the project study area requires an understanding of fish species' life histories and life stage-specific environmental requirements. General information is provided in Section 5.5.1.3, Fish Species Overview, regarding the species of primary management concern that occur within the Oroville Facilities project study area, as well as other species of local or regional importance. To reduce redundancy, discussions regarding some species with similar life histories, habitat requirements, and/or management strategies and objectives have been combined. Species-specific information for warmwater and coldwater species is provided separately in Section 5.5.1.3. More detailed information regarding fish species is provided in Appendix G-AQUA1, Affected Environment, which summarizes the results of the aquatics Study Plan Reports.

This section describes the affected environment related to fisheries and aquatic ecosystems in all water bodies that may be influenced by implementation of the alternatives. This includes the upper Feather River tributaries, Lake Oroville, the

Diversion Pool, Thermalito Forebay, Thermalito Afterbay, the Fish Barrier Pool, the Feather River Fish Hatchery, OWA ponds, and the lower Feather River.

Fish species of primary management concern include:

- State and/or federally listed species within the project study area (spring-run Chinook salmon and Central Valley steelhead);
- Species that are recreationally or commercially important (fall-run Chinook salmon, Central Valley steelhead, American shad, coho salmon, striped bass, and four species of black bass);
- Candidate species for listing under the California Endangered Species Act (CESA) or federal Endangered Species Act (FESA) (green sturgeon); and
- State species of special concern (fall-run Chinook salmon, Sacramento splittail, green sturgeon, river lamprey, and hardhead).

Special emphasis is placed on these fish species to facilitate compliance with applicable laws, particularly CESA and/or FESA, and to be consistent with State and federal restoration/recovery plans and federal biological opinions. This focus is consistent with:

- The CALFED Bay-Delta Program's (CALFED) 2000 Ecosystem Restoration Program Plan (ERPP) and Multi-Species Conservation Strategy (MSCS);
- The programmatic determinations for the CALFED program, which include DFG's Natural Community Conservation Planning Act approval and the programmatic biological opinions (BOs) issued by the National Marine Fisheries Service (NOAA Fisheries) and USFWS;
- The USFWS 2001 Final Restoration Plan for the Anadromous Fish Restoration Program (AFRP), which identifies specific actions to protect anadromous salmonids;
- The DFG 1996 Steelhead Restoration and Management Plan for California, which identifies specific actions to protect steelhead (McEwan and Jackson 1996); and
- DFG's *Restoring Central Valley Streams, A Plan for Action* (1993), which identifies specific actions to protect salmonids.

Improvement of habitat conditions for these species of priority management concern will likely protect or enhance conditions for other fish resources, including native resident species.

The overall fish species composition within the project study area is summarized in Table 5.5-1. Table 5.5-1 identifies those species that are considered species of primary management concern related to the Oroville Facilities and indicates whether each

species is native or introduced, identifies the general geographic distribution of the species by water body, and summarizes both the regulatory and abundance/management status of each species within the project study area.

Major issues related to fisheries identified during the scoping process included:

- Effects of project operations on aquatic resources, including populations and habitats of: (1) warmwater fish; (2) coldwater/anadromous fish; (3) special-status species; and (4) macroinvertebrates and other aquatic organisms;
- With respect to anadromous fish, project effects on populations, habitat quantity and quality, fish passage, and recruitment to ocean populations;
- Effects of fisheries management plans and activities on a balanced coldwater and warmwater fishery;
- Compliance of project operations with SWP Feather River flow constraints and adequacy of constraints to protect anadromous fish and other aquatic species; and
- The cumulative effect of existing and future project effects on regional fisheries, fish passage, and habitat quality and quantity within project-affected areas.

5.5.1.1 Regional Overview and Management Status

Facilities, Waterbodies, and Related Fisheries Resources

Detailed physical descriptions of the Oroville Facilities are provided in Section 3.1.1, Existing Oroville Facilities. Detailed descriptions of Oroville Facilities operations are provided in Section 3.1.2, Current Project Operations and DWR Commitments.

Upstream Tributaries

There are four major upstream tributaries to Lake Oroville: the North Fork Feather River, the West Branch of the North Fork Feather River, the Middle Fork Feather River, and the South Fork Feather River (see Figure 5.5-1). The Middle Fork Feather River is designated as a National Wild and Scenic River and a Heritage Trout Water by DFG (DFG Website).

The coldwater fish species present in the upstream tributaries above Lake Oroville and below the first impassable fish barrier include rainbow trout and brown trout. The warmwater fish species in the upstream tributaries include bluegill, brown bullhead, carp, largemouth bass, redeye bass, roach, smallmouth bass, spotted bass, Sacramento pikeminnow, Sacramento sucker, and sculpin.

Project operations associated with the Oroville Facilities do not control flows and/or temperatures within the upstream tributaries. However, operations of the Oroville Facilities do potentially influence other aquatic resources in the upper Feather River

tributaries up to the first impassable fish barriers (see Figure 5.5-1). The upstream tributary first impassable fish barriers were identified as the falls below Big Kimshew Creek (provisional impassable barrier) for the West Branch of the North Fork Feather River, Poe Dam on the North Fork Feather River, Curtain Falls for the Middle Fork Feather River, and Ponderosa Dam for the South Fork Feather River (see Section G-AQUA1.3.1.1 in Appendix G-AQUA1 for additional information on upstream tributary migration barriers). There are several types of potential operational effects on fisheries resources in the upstream tributaries up to the first impassable fish barriers, including fish interactions, nutrient transfer, and sediment deposition in the tributary arms of Lake Oroville.

Fish within Lake Oroville can potentially interact with the upstream tributary fisheries through predation, competition for available food and habitat, disease transmission, and genetic introgression (see Section G-AQUA1.5.1 in Appendix G-AQUA1 for additional information on potential fisheries interactions). Lake Oroville reservoir operations influence the accessibility of the upstream tributaries to fish species within Lake Oroville through the stage elevation of the reservoir. When Lake Oroville stage elevations are near full pool, Big Bend Dam becomes passable to fish; when reservoir stage elevations are reduced, sediment wedges in the tributary arms of the reservoir may be exposed and may inhibit or prohibit fish movement from the reservoir into the upstream tributaries. Increases or decreases in reservoir stage elevations also increase or decrease the distance from the reservoir to fish habitat in the upstream tributaries above the reservoir high pool mark, which also may influence the amount and frequency of fish interactions between the reservoir fishery and the upstream tributary fishery.

The Oroville Facilities, including Oroville Dam, Thermalito Diversion Dam, and the Fish Barrier Dam, currently block the upstream movement of anadromous fish to that portion of historical spawning areas in the upstream tributaries of the Feather River below the next impassable barrier (hydroelectric dams and facilities upstream that pre-date this project). Blockage of anadromous fish from upstream tributaries deprives these areas of fish-derived nutrients that could otherwise contribute to the productivity of both the aquatic and terrestrial ecosystems in and adjacent to the upstream tributaries. (See Section G-AQUA1.6 in Appendix G-AQUA1 for additional information on nutrient transfer.)

Lake Oroville

Lake Oroville is a warm, monomictic reservoir that thermally stratifies in the spring, destratifies in the fall, and remains destratified throughout the winter. Due to this stratification, Lake Oroville has been said to contain a “two-story” fishery, supporting both coldwater and warmwater fisheries that are thermally segregated for most of the year. The coldwater fish use the deeper, cooler, well-oxygenated hypolimnion, whereas the warmwater fish are found in the warmer, shallower, epilimnetic, and littoral zones. Once Lake Oroville destratifies in the fall, the two fishery components mix in their habitat utilization.

Lake Oroville's coldwater fishery is primarily composed of coho salmon and brown trout, although rainbow trout and lake trout are periodically caught. The coldwater fisheries for coho salmon and brown trout are sustained by hatchery stocking. Lake Oroville's coldwater fishery is not self-sustaining, possibly due to insufficient spawning and rearing habitat in the reservoir and accessible tributaries, and natural and artificial barriers to migration into the upstream tributaries, where sufficient spawning and rearing habitat has historically existed (DWR 2001). A "put-and-grow" hatchery program is currently in use, where salmonids are raised at DFG hatcheries and stocked in the reservoir as juveniles, with the intent that these fish will grow in the reservoir before being caught by anglers (DWR 2001). Lake Oroville's warmwater and coldwater fish species are listed in Table 5.5-1 (see Section G-AQUA1.3.2.1 in Appendix G-AQUA1 for more information on Lake Oroville fish species composition).

The Lake Oroville warmwater fishery is a regionally important self-sustaining warmwater recreational fishery. The black bass fishery is significant, both in terms of angler effort and economic effect on the area (see Section G-AQUA1.3.2.3 in Appendix G-AQUA1 for additional information on black bass). Spotted bass are the most abundant bass species in Lake Oroville, followed by largemouth, redeye, and smallmouth bass. Catfish are the next most popular warmwater sport fish at Lake Oroville, with both channel and white catfish present. White and black crappie are also found in Lake Oroville, though populations fluctuate widely from year to year. Bluegill and green sunfish are the two primary sunfish species in Lake Oroville, though redear sunfish and warmouth are also present in very low numbers. Although common carp are considered by many to be a nuisance species, they are also abundant in Lake Oroville (DWR 2001). The primary forage fish in Lake Oroville are wakasagi and threadfin shad. Threadfin shad were intentionally introduced in 1967 to provide forage for game fish, whereas the wakasagi migrated down from an upstream reservoir in the mid-1970s (DWR 2001).

Table 5.5-1. List of fish species within the study area.

Common Name	Scientific Name	Regulatory Status [1]	Primary Mgmt. Concern Species [2]	CA Native or Introduced	Location Within Study Area [3]	Abundance/Mgmt Status [4]
Pacific lamprey	*Lampetra tridentata*	FSC	No	Native	LFR	Watch list
River lamprey	*Lampetra ayresi*	CSC, FSC	Yes	Native	LFR	Watch list
Green sturgeon	*Acipenser medirostris*	CSC; FC [5]	Yes	Native	LFR	Special concern
White sturgeon	*Acipenser transmontanus*	---	No	Native	LO, LFR	Stable or increasing
American shad	*Alosa sapidissima*	---	Yes	Introduced	LFR	Widespread and stable
Threadfin shad	*Dorosoma petenense*	---	No	Introduced	LO, TA, LFR	Widespread and expanding
Common carp	*Cyprinus carpio*	---	No	Introduced	UT, LO, TF, DP, TA, LFR, OWA	Widespread and expanding
Golden shiner	*Notemigonus crysoleucas*	---	No	Introduced	LO, DP,TF, TA, OWA	Widespread and expanding
Hardhead	*Mylopharodon conocephalus*	CSC	Yes	Native	LO, TF, DP, TA, LFR	Watch list
Hitch	*Lavinia exilicauda*	---	No	Native	TA, LFR	Watch list
Sacramento pikeminnow	*Ptychocheilus grandis*	---	No	Native	UT, LO, TF, DP, TA, LFR	Stable or increasing
Sacramento splittail	*Pogonichthys macrolepidotus*	CSC; [6] FSC	Yes	Native	LFR	Special Concern
Sacramento blackfish	*Orthodon microlepidotus*	---	No	Native	OWA	Stable or increasing
Goldfish	*Carassius auratus*	---	No	Introduced	LO	Widespread and stable
Sacramento sucker	*Catastomus occidentalis*	---	No	Native	UT, LO, TF, DP, TA, LFR, OWA	Stable or increasing
Black bullhead	*Ameiurus melas*	---	No	Introduced	LFR	Widespread and stable
Brown bullhead	*Ameiurus nebulosus*	---	No	Introduced	LFR, OWA	Widespread and stable
White catfish	*Ameiurus catus*	---	No	Introduced	LO, LFR, OWA	Widespread and stable

Table 5.5-1. List of fish species within the study area.

Common Name	Scientific Name	Regulatory Status [1]	Primary Mgmt. Concern Species [2]	CA Native or Introduced	Location Within Study Area [3]	Abundance/Mgmt Status [4]
Channel catfish	*Ictalurus punctatus*	---	No	Introduced	LO, LFR, OWA	Widespread and stable
Wakasagi	*Hypomesus nipponensis*	---	No	Introduced	LO, TF, DP, TA, LFR	Widespread and expanding
Fall-run Chinook salmon	*Oncorhynchus tshawytscha*	CSC, FSC [7]	Yes	Native	FRFH, LFR	Watch list
Spring-run Chinook salmon	*Oncorhynchus tshawytscha*	ST; FT	Yes	Native	FRFH, LFR	Threatened or endangered
Coho salmon	*Oncorhynchus kisutch*	CSC; FT [8]	No	Native	LO	Threatened or endangered
Central Valley steelhead	*Oncorhynchus mykiss*	FT	Yes	Native	FRFH, LFR	Threatened or endangered
Rainbow trout	*Oncorhynchus mykiss*	---	Yes	Native	UT, LO, TF, DP, TA, LFR	Widespread and stable
Brown trout	*Salmo trutta*	---	Yes	Introduced	UT, LO, LFR	Widespread and stable
Brook trout	*Salvelinus fontinalis*	---	Yes	Introduced	TF, DP, TA, LFR	Widespread and stable
Lake trout	*Salvelinus namaycush*	---	No	Introduced	LO	Localized
Western mosquitofish	*Gambusia affinis*	---	No	Introduced	OWA	Widespread and expanding
Threespine stickleback	*Gasterosteus aculeatus*	---	No	Native	LO	Stable or increasing
Prickly sculpin	*Cottus asper*	---	No	Native	UT, LO, TF, DP, TA, LFR, OWA	Stable or increasing
Riffle sculpin	*Cottus gulosus*	---	No	Native	UT, LO, TA, LFR, OWA	Watch list
Striped bass	*Morone saxatilis*	---	Yes	Introduced	LFR	Widespread and stable
Bluegill	*Lepomis macrochirus*	---	No	Introduced	LO, TF, DP, TA, LFR, OWA	Widespread and stable
Green sunfish	*Lepomis cyanellus*	---	No	Introduced	LO, LFR, OWA	Widespread and stable or expanding

Table 5.5-1. List of fish species within the study area.

Common Name	Scientific Name	Regulatory Status [1]	Primary Mgmt. Concern Species [2]	CA Native or Introduced	Location Within Study Area [3]	Abundance/Mgmt Status [4]
Redear sunfish	*Lepomis microlophus*	---	No	Introduced	LO, LFR, OWA	Widespread and stable
Warmouth	*Lepomis gulosus*	---	No	Introduced	LO, OWA	Localized
Black crappie	*Pomoxis nigromaculatus*	---	No	Introduced	LO, DP, TA, OWA, LFR	Widespread and stable
White crappie	*Pomoxis annularis*	---	No	Introduced	LO, TA, OWA, LFR	Widespread and stable
Largemouth bass	*Micropterus salmoides*	---	Yes	Introduced	LO, TF, DP, TA, LFR, OWA	Widespread and stable
Smallmouth bass	*Micropterus dolomieu*	---	Yes	Introduced	LO, DP, TA, LFR	Widespread and stable
Redeye bass	*Micropterus coosae*	---	Yes	Introduced	LO, LFR	Localized
Spotted bass	*Micropterus punctulatus*	---	Yes	Introduced	LO, TA, LFR	Widespread and expanding
Tule perch	*Hysterocarpus traski*	---	No	Native	DP, TF, TA, LFR	Stable or increasing

[1] *FT=listed as threatened under FESA; ST=listed as threatened under CESA; FE=federal endangered; SE=State endangered; FC=candidate for listing under FESA; CC=candidate for listing under CESA; FSC=federal species of concern; CSC=California species of special concern.*

[2] *Species of primary management concern evaluated in this analysis include those that are recreationally or commercially important, State- and/or federally listed species within the project study area under FESA or CESA, candidate species for listing under FESA or CESA, and California species of special concern.*

[3] *Frequently or infrequently observed in the following: UT=upstream tributaries; LO=Lake Oroville; DP=Diversion Pool; TF=Thermalito Forebay; TA=Thermalito Afterbay; FBP=Fish Barrier Pool; FRFH=Feather River Fish Hatchery; OWA=Oroville Wildlife Area ponds; LFR=Lower Feather River.*

[4] *As defined in Moyle 2002.*

[5] *After reviewing the petition for listing green sturgeon, on January 29, 2003 NOAA Fisheries determined that such listing was not warranted, although it was still considered a candidate species. On April 15, 2004, NOAA Fisheries announced that the Northern and Southern Distinct Population Segments of Green Sturgeon would change in listing status from a candidate species to a species of concern (69 FR 19977). However, recent litigation challenging NOAA Fisheries' determination that green sturgeon do not warrant listing as an endangered or threatened species under FESA asserted that the agency was arbitrary and capricious in failing to examine whether habitat loss constituted a significant portion of the species' range. The court partially agreed with the Plaintiff's motion, and has remanded the determination back to NOAA Fisheries for further analysis and decision as to whether green sturgeon are endangered or threatened in a significant portion of its range. Hence, according to NOAA Fisheries' April 15, 2004 interpretation of FESA provisions, green sturgeon are considered a candidate species as well as a species of concern, until this matter is resolved (NOAA Fisheries 2004a).*

[6] *USFWS removed Sacramento splittail from the list of threatened species on September 22, 2003, and did not identify it as a candidate for listing under FESA. Sacramento splittail is identified as a California species of special concern and, informally, as a federal species of concern.*

Table 5.5-1. List of fish species within the study area.

Common Name	Scientific Name	Regulatory Status [1]	Primary Mgmt. Concern Species [2]	CA Native or Introduced	Location Within Study Area [3]	Abundance/Mgmt Status [4]

[7] *Although late-fall-run Chinook salmon does not occur within the project study area, the Central Valley fall-run/late-fall-run Chinook salmon is identified as one Evolutionarily Significant Unit (ESU). In 1999, the Central Valley ESU underwent a status review after NOAA Fisheries received a petition for listing. Pursuant to that review, NOAA Fisheries found that the species did not warrant listing as threatened or endangered under FESA, but sufficient concerns remained to justify addition to the candidate species list. On April 15, 2004, NOAA Fisheries published a notice in the Federal Register acknowledging establishment of a species of concern list, addition of species to the species of concern list, and revision of the candidate species list. In this notice, NOAA Fisheries announced the Central Valley Fall-run and Late Fall-run Chinook Salmon ESU change in status from a candidate species to a species of concern. Therefore, according to NOAA Fisheries' April 15, 2004 interpretation of FESA provisions, the Central Valley ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977).*

[8] *These special-status species designations pertain only to coho salmon within their native habitats. Coho salmon occur within the project study area as a result of stocking programs and are managed for their recreational importance only.*

Source: Initial Information Package (DWR 2001); Moyle 2002

Water surface elevation fluctuations in Lake Oroville occur on a seasonal basis, resulting from seasonal variations in upstream tributary inflows into the reservoir, as well as seasonal variations in Oroville Facilities reservoir releases. Reservoir stage elevation reductions as well as the rate of reductions can reduce the amount of littoral fish habitat, invertebrate recruitment as a fisheries food base, coldwater pool volume, quantity of coldwater fishery habitat, and bass nest survival from dewatering (see Section 5.4.1.1, Water Quantity, for more information on reservoir drawdown characteristics, and Section G-AQUA1.3.2.3 in Appendix G-AQUA1 for additional information on bass nest dewatering).

Oroville Facilities releases from selected water depth ranges from the reservoir affect the downstream water temperatures of the Thermalito Complex and the lower Feather River. Oroville Facilities water temperature releases directly affect the quantity, quality, and distribution of fish habitat in the Thermalito Complex and the lower Feather River (see Section G-AQUA1.3.3.2 in Appendix G-AQUA1 for additional information on facility effects on fish habitat within the Thermalito Complex). The quantity and water temperature range selected for release from the reservoir also affects the coldwater pool volume and the quantity and quality of the coldwater fisheries habitat available in the reservoir (see Section 5.4.2.1, Water Quality, for additional information regarding effects on coldwater pool volumes).

The elevations of the sediment wedges in the tributary arms of the reservoir (see Figure 5.5-1) are influenced by Oroville Facilities operations (see Section G-AQUA1.3.1.1 in Appendix G-AQUA1 for additional information on upstream tributary sediment wedges). As sediment loads are suspended in the upstream tributary flows, a portion of the sediment load is deposited at the interface of the tributary and the reservoir (see Section 5.3.1.1, Geology and Soils, for additional information on sediment wedges). The stage elevation of the reservoir during these sediment deposition events determines the elevation of the resulting sediment wedge formation, which in turn determines the frequency and duration of sediment wedge exposure from reservoir operations as potential fish passage barriers. As sediment wedges are exposed by reductions in reservoir surface elevations, the sediment is remobilized and redeposited at a lower stage elevation of the reservoir. The remobilization of the sediment can also potentially affect reservoir water quality suitability for aquatic life (see Section 5.4.1.2, Water Quality, for additional information on water quality effects).

Lake Oroville traps upstream tributary contributions of gravel and sediment to the lower Feather River. Oroville Dam stops all of the gravel and most of the sand from being transported into the lower Feather River; generally, only fine sediment is discharged to the river below the dam (see Section 5.3.1.1, Geology and Soils, for additional information on reservoir effects on gravel and sediment transport). The gravel and sediment captured in the reservoir affect the fluvial geomorphologic functions of the lower Feather River and its contribution to the quality, quantity, and distribution of fish habitat in the lower Feather River (see Section G-AQUA1.8.1.4 in Appendix G-AQUA1 for more information regarding Feather River fish habitat). The reservoir also traps large woody debris contributions from the upstream tributaries and blocks the transport

of these resources from contributing to the development and maintenance of fish habitat quality and diversity in the lower Feather River.

Diversion Pool

The Diversion Pool is located between Oroville Dam and Thermalito Diversion Dam (see Figure 5.5-2). The Diversion Pool is supplied with cold water from Lake Oroville's hypolimnion to meet water temperature requirements at the Feather River Fish Hatchery per the 1983 DWR Operating Agreement with DFG and at Robinson Riffle in the Low Flow Channel of the lower Feather River per the 2000 NOAA Fisheries Biological Opinion (see Section 5.4.1.2, Water Quality Affected Environment, for additional information on water temperature requirements). The water intake for the Feather River Fish Hatchery is in the Diversion Pool at the Diversion Dam. Water temperatures in the Diversion Pool seldom exceed the high 50s (°F). As a result of the primarily coldwater habitat, the Diversion Pool fishery is dominated by coldwater salmonids including rainbow trout, brook trout, brown trout, and Chinook salmon (DWR 2001, 2002). Although the Diversion Pool is not currently stocked, a lack of barriers between the Diversion Pool and Thermalito Forebay allows fish stocked in Thermalito Forebay to migrate freely into the Diversion Pool (DWR 2001, 2002). Project peaking and pump-back operations, especially during the summer, potentially can increase water temperatures in the Diversion Pool, but the hatchery water temperature requirements limit the water temperature effects to ranges below salmonid water temperature requirements.

Thermalito Forebay

Thermalito Forebay is an open, cold, shallow reservoir with a high surface area-to-volume ratio with few water surface elevation fluctuations (DWR 2001, 2002) (see Figure 5.5-2). Thermalito Forebay remains cold throughout the year because it is supplied with water from the Diversion Pool, although pump-back operations from Thermalito Afterbay can increase water temperatures in the forebay somewhat (see Section G-AQUA1.3.3.2 in Appendix G-AQUA1 for more information regarding the influences of project operations on Thermalito Forebay). Because of the cool water temperatures, Thermalito Forebay provides habitat primarily for coldwater fish (DWR 2001, 2002), although warmwater fish species in Lake Oroville are believed to exist in the forebay in low numbers as well (DWR 2001). DFG manages Thermalito Forebay as a put-and-take trout fishery, where rainbow trout and brook trout of approximately 0.5 pound are stocked biweekly (DWR 2001, 2002). Surplus inland Chinook salmon from Lake Oroville stocking efforts also have been stocked in Thermalito Forebay (DWR 2001, 2002). Thermalito Forebay is the second most popular reservoir sport fishery of the Oroville Facilities (DWR 2001, 2002).

Thermalito Afterbay

Thermalito Afterbay constitutes the most hydrologically complex regime of all of the Oroville Facilities reservoirs (DWR 2001) (see Section 5.4.1.1, Water Quantity Affected Environment, for more information on Thermalito Afterbay fluctuation characteristics).

Thermalito Afterbay is a large, shallow, open reservoir with frequent water level fluctuations and a high surface-to-volume ratio (see Figure 5.5-2). Water temperatures can vary widely around the afterbay in the summer, with water in the low 60s near the tailrace channel that feeds the afterbay, and water in the mid 80s in the backwater areas that do not readily circulate (DWR 2001). Changes in flow rates, direction, and water surface elevations resulting from project operations affect water temperatures and the quality, quantity, and distribution of fish habitat in Thermalito Afterbay (see Section G-AQUA1.3.4.2 in Appendix G-AQUA1 for additional information regarding Thermalito Afterbay habitat availability). Thermalito Afterbay provides habitat for both coldwater and warmwater fish.

In addition to a popular largemouth bass fishery, other warmwater species including smallmouth bass, spotted bass, various species of sunfish, bluegill, white crappie, black crappie, catfish, and common carp occur in Thermalito Afterbay (DWR 2001). Tule perch also has recently been confirmed in the afterbay (pers. comm., See 2003). Although salmonids are not currently stocked, rainbow trout have been observed in Thermalito Afterbay. Most of the Lake Oroville sport fish species probably occur in the afterbay to some degree (DWR 2001).

Water surface elevations in Thermalito Afterbay change on a weekly and daily frequency, depending on power generation and pump-back operations. The shallow nature of Thermalito Afterbay results in obvious fluctuation effects with only a few feet of water surface elevation changes (DWR 2001). Mudflats can be exposed and a significant amount of the littoral zone can be dewatered, which affects the quantity of habitat available to fish species. Reductions in Thermalito Afterbay water surface elevations can dewater bass nests and potentially affect the sustainability of the centrarchid populations (see Section G-AQUA1.3.2.3 in Appendix G-AQUA1 for further discussion of bass nest dewatering).

Oroville Facilities operations affect the water temperatures and their distribution in Thermalito Afterbay, which affects coldwater and warmwater fish habitat quantity, quality, and distribution in the afterbay as well as the water temperatures at the agricultural diversions and Thermalito Afterbay Outlet (see Section 5.4.2.1, Water Quality Environmental Effects, for additional information on water temperature effects in Thermalito Afterbay). Project operations that affect Thermalito Afterbay water temperatures include Oroville Dam release water temperatures and those operational variables that determine the effective reside time of water in the afterbay. Oroville Facilities operations that determine the effective residence time of water in the afterbay include the volume of inflows compared to the total releases from the afterbay (at both the Thermalito Afterbay Outlet and the agricultural diversions), afterbay stage elevations, and the amount of peaking and pump-back.

Fish Barrier Pool

The Fish Barrier Pool is located between the Thermalito Diversion Dam and the Fish Barrier Dam (see Figure 5.5-2). The Fish Barrier Dam diverts fish into a fish ladder that leads to the Feather River Fish Hatchery. The flow over the dam maintains fish habitat

in the Low Flow Channel of the Feather River between the dam and the Thermalito Afterbay Outlet, and provides attraction flow for the hatchery. Because of the relatively constant discharge of 600 cubic feet per second (cfs) into the Fish Barrier Pool from the Thermalito Diversion Dam Powerplant, the Fish Barrier Pool remains at a stable pool elevation, except during periods of spill releases when flood flows are routed through the Fish Barrier Pool. The sportfish found in the Diversion Pool are also likely to occur within the Fish Barrier Pool to some degree, although no stocking or sampling has been conducted (see Section G-AQUA1.3.2.1 in Appendix G-AQUA1 for further discussion regarding Lake Oroville, Diversion Pool, and Thermalito Forebay fish species composition).

Feather River Fish Hatchery

The Feather River Fish Hatchery facilities include the Fish Barrier Dam below Oroville Dam, the fish ladder, holding tanks, hatchery buildings, and raceways (DWR 2002) (see Figure 5.5-2). DWR constructed the Feather River Fish Hatchery in 1967 to compensate for salmonid spawning habitat lost with construction of Oroville Dam. The facility is operated by DFG and maintained by DWR, and can accommodate 15,000 to 20,000 adult fish annually. The hatchery is one of five major Central Valley hatcheries producing and releasing fall-run Chinook salmon, one of three producing and releasing steelhead, and the only hatchery producing and releasing spring-run Chinook salmon (DWR 2002).

The hatchery complex uses water that is diverted from the Diversion Pool, which receives cold, hypolimnetic water (which rarely exceeds the mid to high 50s [°F]) from Lake Oroville. Water temperatures for the hatchery water intake are monitored for operational compliance with the hatchery water temperature requirements per the 1983 Oroville Operating Agreement between DWR and DFG.

Feather River Fish Hatchery practices of releasing hatchery production in San Pablo Bay have been suggested as contributing to increased straying rates of fish returning to non-natal tributaries for spawning. Hatchery operations may affect water quality conditions, such as temperature, dissolved oxygen, and pH, which in turn potentially may affect the rate or severity of fish disease occurrences both in the hatchery and in the lower Feather River (DWR 2002). Fish species, holding densities, and the presence and amount of pathogens in the environment also may be related to the frequency or severity of occurrence and spread of fish diseases. Hatchery practices also may potentially affect the genetic integrity of distinct runs of Chinook salmon, with the potential to co-mingle spring and fall Chinook salmon runs in the hatchery (see Sections G-AQUA1.8.2 and G-AQUA1.7.2 in Appendix G-AQUA1 for further information on hatchery operations). Hatchery-produced fish have the potential to adversely affect naturally spawning salmonid runs in the Feather River and other Central Valley streams through competition with wild spawned salmonids for food and habitat, potential transmission of diseases, predation, and through genetic introgression.

OWA Ponds

The OWA contains over 75 warmwater ponds and sloughs, along with vast complexes of emergent marsh and flooded cottonwood, willow, and sycamore trees, totaling approximately 11,980 acres (see Figure 5.5-2). The OWA pond water levels are replenished, in part, by the Feather River, which seeps through the porous levees and substrates, or floods into the OWA during high flow events. Because the stage of the Feather River is controlled by Oroville Facilities operations, fish and their habitat in the OWA may potentially be affected by Oroville Facilities releases. After the floods on the Feather River in 1997, DWR repaired a levee in the OWA with a culvert that connects flows directly from the Feather River into the OWA, which has resulted in areas of the OWA being permanently inundated. The permanently inundated area increased the amount of potential fish and wildlife habitat in the OWA, but species of invasive aquatic plants are growing to densities that reduce the quality of or eliminate potential fish habitat (see Section G-AQUA1.3.5.1 in Appendix G-AQUA1 for additional information on OWA ponds).

Largemouth bass, channel catfish, white catfish, bluegill, green sunfish, and carp are all highly abundant in the OWA ponds, along with populations of black and white crappie (see Section G-AQUA1.3.5.1 in Appendix G-AQUA1 for further discussion of OWA fish species composition and management). The fish are replenished through natural reproduction in the ponds and from the Feather River, which floods into the OWA during Oroville Facilities high flow release events.

Lower Feather River

The lower Feather River extends from the Fish Barrier Dam (RM 67) to the confluence with the Sacramento River (RM 0). The Low Flow Channel extends from the Fish Barrier Dam to the Thermalito Afterbay Outlet (RM 59) and the High Flow Channel from the Thermalito Afterbay Outlet to the confluence with Honcut Creek (RM 44) (see Figure 5.5-2). The reaches of the lower Feather River are identified by the confluences with Honcut Creek to Yuba River (RM 27.5), Yuba River to Bear River (RM 12.5), and Bear River to the confluence with the Sacramento River (see Figure 5.5-3).

The lower Feather River supports a variety of anadromous and resident fish species. Fish species of primary management concern present in the lower Feather River include spring-run Chinook salmon, fall-run Chinook salmon, Central Valley steelhead, rainbow trout, brown trout, brook trout, green sturgeon, striped bass, river lamprey, American shad, hardhead, Sacramento splittail, largemouth bass, smallmouth bass, redeye bass, and spotted bass (see Section G-AQUA1.4.2 in Appendix G-AQUA1 for more information on Feather River fish species).

Chinook salmon are the most numerous fish species in the lower Feather River; 30,000 to 170,000 Chinook salmon spawn in the lower Feather River annually. Approximately two-thirds of the natural Chinook salmon spawning occurs between the Fish Barrier Dam and the Thermalito Afterbay Outlet (RM 67–59), and one-third of the spawning occurs between the Thermalito Afterbay Outlet and Honcut Creek (RM 59–44).

Chinook spawning typically occurs from September through December. Most juvenile Chinook salmon emigrate from the lower Feather River within a few days of emergence, and 95 percent of the juvenile Chinook have typically emigrated from the Oroville Facilities project area by the end of May. Fish exhibiting the typical life history of the spring-run are found holding at the Thermalito Afterbay Outlet and the Fish Barrier Dam as early as April.

Most of the natural steelhead spawning in the Feather River occurs in the Low Flow Channel, particularly in the upper reaches near Hatchery Ditch, a side channel located between RM 66 and 67 (see Section G-AQUA1.8.2.2 in Appendix G-AQUA1 for additional information on steelhead spawning). Limited steelhead spawning also occurs below the Thermalito Afterbay Outlet. Soon after emerging from gravel, a moderate percentage of the fry appear to emigrate. The remainder of the population rears in the river for at least 6 months to 1 year. Studies have confirmed that juvenile rearing and probably adult spawning are associated with secondary channels within the Low Flow Channel. The smaller substrate size and greater amount of cover (compared to the main river channel) likely make these side channels more suitable for juvenile steelhead rearing. Currently, this type of habitat comprises less than 1 percent of the available habitat in the Low Flow Channel (DWR 2001).

The occasional capture of larval green sturgeon in outmigrant traps suggests that green sturgeon spawn in the Feather River (Moyle 2002) however, NOAA Fisheries (2002) reports that evidence of green sturgeon spawning in the Feather River is unsubstantiated. Substantial efforts including scuba and snorkel surveys, hook and line sampling, and larval traps during preparation of the Oroville Facilities studies were all unsuccessful in documenting their presence in the lower Feather River. Sturgeon passage may be impeded at Shanghai Bench and Sunset Pumps on the lower Feather River at lower flow ranges, and sturgeon are reported as not typically entering the mouth of the Feather River at flows lower than approximately 5,000 cfs (see Section G-AQUA1.4.3.1 in Appendix G-AQUA1 for more information regarding sturgeon passage impediments).

Sacramento splittail intermittently use the lower Feather River from February through May for spawning, egg incubation, and initial rearing. Splittail utilize shallow flooded vegetation for spawning and are infrequently observed in the lower Feather River from the confluence with the Sacramento River up to Honcut Creek. The majority of spawning activity in the lower Feather River is thought to occur below the Yuba River confluence and occur in greatest abundance in the Sutter Bypass during high flow events (see Section G-AQUA1.4.3.3 in Appendix G-AQUA1 for more information on splittail habitat use).

Oroville Facilities releases are regulated and subject to regulatory flow criteria. Under an agreement with DFG, flows in the Low Flow Channel are regulated at 600 cfs, except during flood events when flows have reached as high as 150,000 cfs (DWR 1983). The instream flow requirements below Thermalito Afterbay are 1,700 cfs from October through March, and 1,000 cfs from April through September. In critical years, however, the minimum flow can be reduced to 1,200 cfs from October to February, and 1,000 cfs

for March. Flows in the High Flow Channel are maintained at or below 2,500 cfs from October 15 through November 30 to prevent Chinook salmon redd dewatering.

The magnitude of Oroville Facilities releases can affect the quality, quantity, and distribution of fish habitat in the lower Feather River in several ways, including changes in water stage elevations, inundated area, water depth, water velocities, water quality, and water temperatures. Flows in the lower Feather River are regulated by the Oroville Facilities and other project releases. Oroville Facilities releases determine the flows in the upstream reaches of the lower Feather River and contribute proportionately to total flows below the confluences with Honcut Creek, Yuba River, Bear River, and locations of other flow accretions or depletions. High Oroville Facilities releases contribute to the inundation of floodplain habitat utilized for salmonid juvenile rearing and emigration and splittail spawning, contribute to attraction flows for immigrating fish, and facilitate fish passage at potential fish passage impediments in the lower Feather River (see Sections G-AQUA1.8.3.4, G-AQUA1.8.4.2, G-AQUA1.4.3.3, and G-AQUA1.3.1.1 in Appendix G-AQUA1 for more information regarding flow-related effects on fishes). The timing and magnitude of releases from the Oroville Facilities can affect the quantity, quality, and distribution of salmonid spawning and rearing habitat in the Low Flow Channel and High Flow Channel and may affect predation rates on juvenile salmonids. Project structures associated with the release facilities may influence predation of juvenile salmonids by producing turbulence, eddies, and other in-river conditions that can be advantageous for predatory species (see Section G-AQUA1.11.4.1 in Appendix G-AQUA1 for more information on predation of juvenile salmonids).

The frequency and magnitude of high flow events drive many fluvial geomorphic processes that contribute to the development and maintenance of fish habitat quality, quantity, and distribution. Some of the fluvial geomorphic processes that affect fish habitat characteristic quality, quantity, and distribution include channel shaping, river meander, bank cutting, gravel and sediment recruitment, transport, and deposition, and large woody debris recruitment and retention (see Section 5.3.1.1, Geology and Soils Affected Environment, for additional information on fluvial geomorphic processes). Oroville Facilities releases moderate the flow regime in the lower Feather River. The relatively static flow regime in the Low Flow Channel, with the exception of high volume releases associated with high flow events, reduces fluvial geomorphic processes in this reach of the river and results in channel stabilization and reduces gravel and large woody debris recruitment, which reduces the diversity of instream habitat and affects fish and wildlife habitat quality.

Fluctuations in Oroville Facilities releases occur under flood management operations, scheduled operation-maintenance activities, storm events, or emergency shutdowns. The timing, location, and magnitude of flow fluctuations may result in redd dewatering or scouring and juvenile stranding, and may affect the timing of juvenile salmonid emigration (see Sections G-AQUA1.8.2.6 and G-AQUA1.8.4.2 in Appendix G-AQUA1 for more information regarding flow fluctuation effects on salmonids).

Changes in flows and the resulting changes in water velocity may affect the distribution of suitable habitat for some fish species. In the case of extremely high flows, such as

those occurring during a high flow event, the resulting water velocities may make some areas of the lower Feather River unsuitable for some fish species for the duration of the high flow event. High water velocities that occur during the higher ranges of Oroville Facilities releases can scour salmonid redds and mobilize substrate, which could potentially affect fish habitat substrate suitability, quality, and distribution.

Increases or decreases in flow releases from the Oroville Facilities result in increases or decreases in water depths in the lower Feather River. Increases in Oroville Facilities releases, such as those occurring during a high flow event, could result in an increase in the amount of potentially suitable fish habitat for those fish species having minimum water depth requirements. Similarly, reductions in releases could potentially reduce the amount of potentially suitable fish habitat for those fish species with minimum water depth requirements. The greatest proportion of deep water and the greatest water depth diversity occur in the upstream-most reach of the lower Feather River, between the Fish Barrier Dam and the Thermalito Afterbay Outlet. Downstream of the Thermalito Afterbay Outlet, the river tends to become progressively shallower and less diverse in its depth distribution.

Oroville Facilities releases affect water temperatures in the upper portions of the lower Feather River. Oroville Facilities releases are currently managed to primarily benefit coldwater fisheries management (DWR 2002). Water temperatures tend to be coldest in the upper-most portions of the lower Feather River near the Fish Barrier Dam and warm progressively moving downstream during the spring, summer, and fall. The Low Flow Channel water temperatures have been managed to comply with the 2002 and 2004 supplemental NOAA Fisheries BOs on the interim operations of the CVP and SWP on federally listed threatened Central Valley spring-run Chinook salmon and Central Valley steelhead (NOAA Fisheries 2002 and NOAA Fisheries 2004a). These BOs stipulated that from June 1 through September 30, DWR shall, to the extent possible and consistent with SWP requirements, control water temperatures to a daily average water temperature of less than or equal to 65°F at Robinson Riffle (see Figure 5.5-2). In October 2004, NOAA Fisheries issued a BO on the effects of the long-term CVP and SWP OCAP, which superceded all previous BOs regarding the CVP and SWP OCAP (NOAA Fisheries 2004b). Water temperature objectives prescribed in the October 2004 OCAP BO at RM 61.6 near Robinson Riffle remained 65°F from June 1 through Sept 30 to protect over-summering steelhead.

Water temperatures in the lower Feather River below the Thermalito Afterbay Outlet in the spring, summer, and fall can be increased by releases from Thermalito Afterbay. The amount of water temperature increase in the lower Feather River below the Thermalito Afterbay Outlet is affected by ambient air temperatures, the proportion of flows released from the afterbay in comparison to flows in the Low Flow Channel, and by the duration of reside time of water in the afterbay (see Section 5.4.1.2, Water Quality Affected Environment, for additional information on Thermalito Afterbay and lower Feather River water temperatures).

The water temperature regime associated with the baseline operations of the Oroville Facilities may expose pre-spawning adult salmonids to elevated water temperatures

that can adversely affect production (e.g., increased pre-spawning mortality, decreased fertilization, increased egg retention). Existing operations may also expose pre-spawning adult Chinook salmon to elevated water temperatures during the holding time period, which may adversely affect reproductive success. Water temperatures also can directly affect the spawning and incubation periods of salmonids, as well as the distribution of salmonid spawning and rates of egg and alevin survival (see Section G-AQUA1.8.2.5 in Appendix G-AQUA1 for more information on water temperature effects on egg and alevin survival). Rearing juveniles exposed to high water temperatures may experience acute direct mortality or sublethal chronic thermal stress, which can be evidenced through indicators such as disease outbreaks, reduction in growth and food conversion efficiency, hyperactivity or disorientation, etc. (See Sections G-AQUA1.8.3.2 and G-AQUA1.8.3.3 in Appendix G-AQUA1 for additional information on water temperature effects on juvenile salmonids.) Elevated water temperatures also may affect the abundance and emigration pattern of Feather River juvenile salmonids. Warm water temperatures have the potential to create habitat conditions that are advantageous for some predatory fish species, which in turn may affect the juvenile rearing and emigration success of salmonids in the lower Feather River. (See Section G-AQUA1.11.3 in Appendix G-AQUA1 for more information regarding predation of juvenile salmonids.)

The Oroville Facilities physically block the upstream basin contributions of gravel, sediment, and large woody debris from the lower Feather River, and the upstream passage of anadromous salmonids to historical spawning areas.

Oroville Dam, Thermalito Diversion Dam, and the Fish Barrier Dam block gravel contribution from the upstream Feather River to the lower Feather River (see Section 5.3.1.1, Geology and Soils, for additional information on gravel recruitment and lower Feather River substrate conditions). High flow releases from the Oroville Facilities mobilize smaller substrate particle sizes. The smaller substrate sizes are not replaced by upstream gravel, so this results in a gradual relative coarsening of the particle size distribution of the substrate in the upper portions of the lower Feather River. Coarsening and armoring of the substrate size can affect fish spawning habitat suitability, quality, and distribution for salmonids and other fish species spawning in gravel substrates (see Section G-AQUA1.8.2.1 in Appendix G-AQUA1 for more information regarding spawning substrate suitability). In general, the reach of river with the highest proportion of coarse substrate components is the upstream-most portion of the lower Feather River below the Fish Barrier Dam and above the Thermalito Afterbay Outlet.

More than 97 percent of the sediment from the upstream watershed is trapped in the upstream reservoirs, resulting in sediment starvation downstream (see Section 5.3.1.1, Geology and Soils, for additional information on sediment recruitment). Only very fine sediment is discharged from Lake Oroville to the river below. Depletion of the sediment load in the lower Feather River results in reduced formation of sediment benches, which affects riparian vegetation colonization and succession. The riparian vegetation provides overhanging cover for rearing fish, riparian shade, invertebrate contributions to

the fish food base, and future large woody debris site contributions. Soft sediment substrates also contribute to the function of capture and retention of large woody debris.

The Oroville Facilities block the upstream contribution of large woody debris (see Section 5.3.1.1, Geology and Soils, for additional information on large woody debris recruitment and fluvial geomorphic functions). Large woody debris creates zones of differential scour and deposit, creating gravel bars for use as spawning habitat by anadromous salmonids (Lassettre and Harris 2001). Logs, root wads, and undercut banks provide juvenile salmonid rearing cover from predators, velocity refuges, and increased concentrations of drifting food organisms. Debris-formed pools also provide adult salmonid holding habitat. Large woody debris is an important functional component in the development and maintenance of habitat diversity and contributes to instream cover complexity (DWR 2002). The lowest proportion of instream cover complexity occurs in the upstream-most reach of the lower Feather River, from the Fish Barrier Dam to the Thermalito Afterbay Outlet. Downstream of the Thermalito Afterbay Outlet, the river increases in instream cover complexity. The farther downstream in the Feather River, the more the opportunity for lower Feather River large woody debris contribution to accumulate from the riparian vegetation of the river, as well as from potential large woody debris contributions from lower Feather River tributaries.

The Oroville Facilities currently block the upstream migration of anadromous salmonids into historical spawning habitat in upstream tributaries. This blockage of upstream migration results in an overall reduction of total salmonid spawning habitat and a lack of access to historical upstream habitat, which may affect natural selection processes and eventually the genetic characteristics of the fish species. It also deprives these upstream tributary reaches of the energy and nutrients that would otherwise be transferred there by the anadromous salmonid carcasses (see Section G-AQUA1.6 in Appendix G-AQUA1 for more information regarding nutrient transfer).

Restricted access to historic spawning grounds causes spring-run Chinook salmon to spawn in the same lowland reaches that fall-run Chinook salmon utilize as spawning habitat. The overlap in spawning sites, 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 in the lower Feather River (Hedgecock et al. 2001). At present, the genetic distinctness of Feather River spring-run Chinook is still officially undetermined, although additional analysis has been conducted to determine the genetic distinction of spring-run and fall-run Chinook salmon (see Section G-AQUA1.7 in Appendix G-AQUA1 for more information).

The Fish Barrier Dam blocks upstream migration of anadromous salmonids and concentrates the intensity of habitat utilization to unnaturally high levels in the Low Flow Channel. This increased concentration of intensity causes increased competition for spawning habitat and contributes to increased adult pre-spawning mortality levels and redd superimposition rates, which contributes to egg and alevin mortality (see Sections G-AQUA1.8.2.4, G-AQUA1.8.2.5, and G-AQUA1.8.2.6 in Appendix G-AQUA1 for additional information on salmonid life stages and associated mortality estimates). Redd superimposition occurs when spawning Chinook salmon dig redds on top of

existing redds dug by other Chinook salmon. The rate of superimposition is a function of spawning densities and typically occurs in systems where spawning habitat is limited (Fukushima et al. 1998). Redd superimposition may disproportionately affect early spawners, and therefore potentially affect Chinook salmon exhibiting spring-run life history characteristics.

As discussed in Section 5.4.1.2, six of the relicensing studies specifically address metals contamination in the project area. As part of these studies, water quality samples were collected at 17 locations within the lower Feather River. Samples exceeding aquatic life water quality criteria occurred for four constituents: total aluminum, iron, copper, and lead. In the reach of the Feather River extending from the Fish Barrier Dam downstream to the Thermalito Afterbay Outlet, 19 percent of the water quality samples exceeded aquatic life water quality criteria. Samples taken from the reach of the Feather River extending from the Thermalito Afterbay Outlet downstream to the confluence with the Sacramento River were variable, but all were higher than the upstream reach and 3 exceeded aquatic life water quality criteria 100 percent of the time. Copper exceeded aquatic life water quality criteria in 5 of 276 samples; two of these occurrences were in the reach of the Feather River extending from the Fish Barrier Dam downstream to the Thermalito Afterbay Outlet. Iron only exceeded aquatic life water quality criteria at three sampling locations; all locations were downstream of the lower Feather River confluence with Honcut Creek. Lead exceeded aquatic life water criteria only once at several stations, but three or four times at the two most downstream stations on the Feather River.

5.5.1.2 Applicable Regulations, Standards, Agreements, Policies, and Programs

Aquatic resources in the Oroville Facilities study area are managed by State and federal agencies and supported by a variety of private, local, and regional entities. Only a few of the government agencies, however, have regulatory authority over topics related to aquatic resources such as water quality. These agencies derive their respective mandates from an often diverse collection of statutes, legislative policies, executive branch directives, and implementation of regulations.

The Oroville Facilities are regulated through a federal license issued by FERC. FERC has broad authority over almost all aspects of hydroelectric projects. There are two exceptions related to aquatic resources where the State of California has regulatory authority. The first is compliance with the water quality certification requirements of Section 401 of the federal Clean Water Act (CWA). The SWRCB implements this regulatory program on behalf of the federal government. Second, the California Fish and Game Commission sets State angling regulations.

The California Fish and Game Commission primarily regulates the aquatic resources of lakes and streams on State lands, with implementation responsibility through DFG. When federal lands are involved, the federal land management agency is responsible for habitat management and DFG is responsible for management of fish and wildlife populations (California Fish and Game Commission, Management and Utilization of Fish and Wildlife on Federal Lands, 1999 in CPUC 2000).

Given this jurisdictional context, the following narrative summarizes the regulations, standards, agreements, policies, and programs with a direct bearing on the management of aquatic resources and their habitats at the Oroville Facilities. The agencies responsible for implementation are also identified.

State Plans, Policies, and Management Objectives

The following State plans and policies are pertinent to the management of fish and aquatic resources at State-owned hydroelectric projects such as Oroville. Other applicable plans and policies are discussed in Chapter 4.0.

1978 Oroville Wildlife Area Management Plan

The Oroville Wildlife Area Management Plan provides policy direction and management guidance on OWA lands and serves as the official planning document for the OWA (Hodson 1978). The plan's purpose is to provide "for the preservation and enhancement of the fish and wildlife resources of the Oroville Wildlife Area and for reasonable use and enjoyment by the public." Recommendations for fisheries include maintaining the warmwater fishery resources and habitat and developing additional warmwater fisheries. The 1978 OWA Management Plan will likely be updated upon completion of the Oroville Facilities relicensing process.

Key Fish and Game Commission Policies and Management Objectives Related to Fish and Aquatic Resources

The California Fish and Game Commission has formally adopted the following policies related to aquatic resources:

- Commission Designated Wild Trout Waters—It is the policy of the Fish and Game Commission to designate certain State waters to be managed exclusively for wild trout. The Fish and Game Commission established the California Wild Trout Program in 1971, with an objective of protecting and enhancing fisheries sustained by wild strains of trout. The waters managed by the Fish and Game Commission include lakes and streams, which are designated as either Catch-and-Release and/or Wild Trout. The Fish and Game Commission set forth a policy which states: "all necessary actions, consistent with State law, shall be taken to prevent adverse effect by land or water development projects affecting designated wild trout rivers." It is the responsibility of DFG, through the Wild Trout Program, to implement the Trout and Steelhead Conservation and Management Planning Act of 1979, which requires annual statewide inventories of trout streams and lakes, evaluations of catch-and-release regulations, and to recommend waters for catch-and-release angling regulations. The Middle Fork Feather River is one of the original streams included in the Wild Trout Program, and is designated as a Wild Trout River. Trout that are managed in the Middle Fork Feather River include rainbow and brown trout.

- Salmon Management Objectives—It is the policy of the Fish and Game Commission that salmon be managed to protect, restore, and maintain the

populations and genetic integrity of all identifiable stocks. Salmon streams shall be inventoried for quantity and quality of habitat, including instream flow requirements. Restoration plans shall identify habitats for restoration and acquisition and opportunities to protect or guarantee future instream flows. Existing salmon habitat shall not be diminished further without offsetting the effects of the lost habitat. All available steps shall be taken to prevent loss of habitat, and DFG shall oppose any development or project that will result in irreplaceable loss of fish. Artificial production shall not be considered as appropriate mitigation for loss of wild fish or their habitat.

- Steelhead/Rainbow Trout Management Objectives—It is the policy of the Fish and Game Commission that steelhead be managed to protect and maintain the populations and genetic integrity of all identifiable stocks. The remainder of this policy is similar to the policy for salmon.

- Trout Management Objectives—It is the policy of the Fish and Game Commission that natural reproduction and rearing of trout will be encouraged to the greatest extent possible by protecting and improving habitat and by affording protection from disease, predators, and competing fish species. Artificial propagation and rearing of trout will be utilized only when necessary to augment natural production. Catchable-sized trout shall be stocked only in lakes, reservoirs, and streams where natural reproduction and growth are inadequate to maintain populations capable of supporting fishing.

- Warmwater Game Fish Stocking—It is the policy of the Fish and Game Commission that maintenance stocking of warmwater game fish is not recommended because satisfactory populations are usually sustained by natural reproduction. The policy describes the circumstances under which stocking is permitted.

- Land Use Planning—This policy articulates the Fish and Game Commission's desire to have DFG coordinate closely with other State, federal, and local planning agencies in the formulation and implementation of any plans that may affect fish and wildlife resources.

- Management and Utilization of Fish and Wildlife on Federal Lands—It is the policy of the Fish and Game Commission that DFG will manage and protect all fish and wildlife and threatened or endangered native plants on lands administered by the federal government. This policy will not extend to the right of the federal government to manage habitat and control access on its property. Management and protection of migratory fish and wildlife will be coordinated between DFG and the federal government on all lands under federal jurisdiction.

- Management and Utilization of Fish and Wildlife on Private Lands—It is the policy of the Fish and Game Commission that the owners or tenants of privately owned lands shall be actively encouraged to propagate, conserve, and promote the wise use of fish and wildlife populations on their lands, consistent with other

reasonable uses. This policy describes the procedures for setting up Private Lands Wildlife Habitat Enhancement and Management Areas with DFG.

- Water—It is the policy of the Fish and Game Commission that the quantity and quality of the waters of California should be apportioned and maintained so as to produce and sustain the maximum numbers of fish and wildlife. DFG is directed to review and comment on proposed water development projects, on applications for licenses or permits for water use, water development, and on projects affecting aquatic habitat. It is also directed to recommend and seek the adoption of proposals necessary or appropriate for the protection and enhancement of fish and wildlife and their habitat, and to oppose the issuance of permits or licenses that have not prevented or adequately compensated for damage to fish and wildlife resources. Other directives to DFG are specified.

1996 DFG Steelhead Restoration and Management Plan for California

Goals for steelhead restoration and management are outlined in DFG's 1996 *Steelhead Restoration and Management Plan for California*. The two goals are: (1) to increase natural production, as mandated by *The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act of 1988*, in an attempt to created self-sustaining steelhead populations and maintain them in good condition; and (2) to enhance opportunities for angling and non-consumptive uses.

The plan focuses on the restoration of native and wild stocks, as these stocks have the greatest value insofar as maintaining genetic and biological diversity. Suggested strategies to accomplish these two goals include restoring degraded habitat; restoring access to historic habitat that is currently blocked; reviewing angling regulations to ensure that steelhead adults and juveniles are not over-harvested; maintaining and improving hatchery runs, where appropriate; and developing and facilitating research to address deficiencies in information on fresh water and ocean life history, behavior, habitat requirements, and other aspects of steelhead biology.

1993 DFG Restoring Central Valley Streams, A Plan for Action

In 1993, DFG published *Restoring Central Valley Streams: A Plan for Action*, which was developed to address the protection of anadromous fish habitat in Central Valley streams (DFG 1993). This plan identified the following four priorities for the Feather River, and establishes them as recommendations:

1. Maintain 1.5 maf of carryover storage in Lake Oroville on October 1 of each year to preserve cold water;

2. Adopt new flow release criteria for the Feather River following completion of the DWR instream flow study;

3. Maintain specified streamflow and temperature standards at the riffle 1 mile below Thermalito Afterbay Outlet and at Shanghai Bench; and

4. Avoid peaking power operations at Lake Oroville when storage is at or below 1.7 maf.

Regional Regulations and Policies

CALFED

The California Water Policy Council and the Federal Ecosystem Directorate united in June 1994 to form CALFED. In June 1995, CALFED issued its Bay-Delta Program to develop a long-term, comprehensive solution to environmental issues in the Sacramento–San Joaquin Delta (Delta) and San Francisco Bay. The CALFED Bay-Delta Program is a collaborative effort of 23 federal and State agencies focusing on restoring the ecological health of the Bay-Delta estuary while ensuring water quality improvements and water supply reliability to all users of the Bay-Delta water resources. The CALFED plan includes a range of balanced actions that can be taken forward to a comprehensive, multi-agency approach to managing Bay-Delta resources. The Bay-Delta watershed includes the Sacramento and San Joaquin rivers and their tributaries, including the Feather River.

The Framework Agreement for CALFED states that the State and federal agencies will work together in three areas of Bay-Delta management:

- Water quality standards formulation;
- Coordination of SWP and CVP operations with regulatory requirements; and
- Long-term solutions to problems in the Bay-Delta estuary.

In the August 28, 2000, CALFED Record of Decision (ROD), the U.S. Bureau of Reclamation (USBR) and other State and federal agencies committed to implementing a long-term plan to restore the Bay-Delta. This plan consists of many activities associated with eight separate elements including the ecosystem restoration program, water quality program, levee system integrity program, water use efficiency program, water transfer program, watershed program, storage, and conveyance.

CALFED Ecosystem Restoration Program

The CALFED Ecosystem Restoration Program (ERP) is an unprecedented collaboration among local partners and governmental agencies to improve ecosystem processes and diverse habitats for species in the Bay-Delta watershed. The ERP is designed to maintain, improve and increase aquatic and terrestrial habitats, and improve ecological functions in the Bay-Delta. The ERP works to support sustainable populations of diverse and valuable plant and animal species, and support recovery of at-risk species in the Bay-Delta watershed. The Feather River is included in the ERP and 26 programmatic restoration actions are identified. The actions include improving a variety of aquatic and terrestrial habitats for at-risk species, improving water quality conditions (e.g., flow and temperature regimes), maintain or improve coarse sediment supply to

the lower Feather River, and improving natural floodplain/river interactions and connectivity (CALFED 2000).

Central Valley Project Improvement Act (Public Law 102-575, Title 34)

The Central Valley Project Improvement Act (CVPIA) was signed into law on October 30, 1992, and is designated as Title 34 of the Reclamation Projects Authorization and Adjustment. Subsection 3406(a) of the CVPIA amends the authorization of the U.S. Department of the Interior's 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. Subsection 3406(e) of the CVPIA requires that not later than 5 years after the date of enactment of the Act, the Secretary of the Interior shall provide Congress with specifically identified supporting investigations related to the restoration and enhancement of anadromous fishes affected by the CVP. Most of these investigations have been completed and reports submitted. Successful implementation of the CVPIA in concert with the activities of CALFED requires the cooperation of DWR in fishery restoration efforts.

The CVPIA identifies several goals to meet the new fish and wildlife purposes. Significant among these is the broad goal of restoring natural populations of anadromous fish (Chinook salmon, steelhead, green and white sturgeon, American shad, and striped bass) in Central Valley rivers and streams to double their recent average levels (see discussion below regarding the Anadromous Fish Restoration Program).

Anadromous Fish Restoration Program

The Anadromous Fish Restoration Program (AFRP) was developed to comply with Section 3406(b)(1) of the CVPIA. The Secretary of the Interior was directed to:

> develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991 ...

The responsibilities of implementing the CVPIA, and in particular Section 3406(b)(1), were jointly imparted to USFWS and USBR, although USFWS has assumed the lead role in development of the AFRP. The Final Restoration Plan for the AFRP was adopted on January 9, 2001, and will be used to guide the long-term development of the AFRP.

Coordinated Operations Agreement

The CVP and SWP use the Sacramento River and the Delta as common conveyance facilities. Reservoir releases and Delta exports must be coordinated to ensure that the projects operate in accordance with agreed upon procedures.

The Coordinated Operations Agreement (COA) between the United States of America and DWR to operate the CVP and SWP was signed in November 1986. Under the COA, USBR and DWR agree to operate the CVP and SWP in a manner to meet Sacramento Valley and Delta needs while maintaining their respective annual water supplies as identified in the agreement. Coordination between the two projects is facilitated by implementing an accounting procedure based on the sharing principles outlined in the COA. Although the principles were intended to cover a broad range of conditions, changes introduced by past NOAA Fisheries and USFWS biological opinions, by the SWRCB Decision 1641 (D-1641), and by the CVPIA were not specifically addressed by the COA. However, these variances have been addressed by USBR and DWR through mutual informal agreement. When water must be withdrawn from storage to meet Sacramento Valley and Delta requirements, 75 percent of the responsibility is borne by the CVP and 25 percent by the SWP. The COA also provides that when unstored water is available for export, 55 percent of the sum of stored water and the unstored export water is allocated to the CVP and 45 percent is allocated to the SWP.

Basin Plans

The preparation and adoption of water quality control plans (Basin Plans) is required by the California Water Code (Section 13240) and supported by the federal CWA. Section 303 of the CWA requires states to adopt water quality standards, which "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses." According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and a program of implementation needed for achieving the objectives. State law also requires that Basin Plans conform to the policies set forth in the Water Code beginning with Section 13000 and any State policy for water quality control. Because beneficial uses, together with their corresponding water quality objectives, can be defined per federal regulations as water quality standards, the Basin Plans are regulatory references for meeting the state and federal requirements for water quality control (40 Code of Federal Regulations [CFR] 131.20).

Basin Plans are adopted and amended by RWQCBs under a structured process involving full public participation and State environmental review. Basin Plans, and amendments thereto, do not become effective until approved by the SWRCB. The objectives of these plans are set to protect beneficial uses of the waterbodies including municipal uses such as drinking water. Adherence to the basin plan objectives allows for the continued use of the waterbodies to meet criteria, including drinking water treatment standards.

The Oroville Facilities are located within the Central Valley Water Quality Control Plan (WQCP) area, which includes the Sacramento and San Joaquin River basins and involves an area bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. The area covered in this WQCP extends

some 400 miles, from the California–Oregon border southward to the headwaters of the San Joaquin River.

Operation of the Oroville Facilities also must comply with the San Francisco Bay/Sacramento–San Joaquin Delta Estuary (Bay-Delta estuary or estuary) Basin Plan. The watershed of the Bay-Delta estuary provides drinking water to two-thirds of California's population and water for a multitude of other urban uses. Additionally, it supplies some of California's most productive agricultural areas, both inside and outside of the Estuary. The Bay-Delta estuary itself is one of the largest ecosystems for fish and wildlife habitat and production in the United States. However, historical and current human activities (e.g., water development, land use, wastewater discharges, introduced species, and harvesting), exacerbated by variations in natural conditions, have degraded the beneficial uses of the Bay-Delta estuary, as evidenced by declines in populations of many biological resources of the estuary (Central Valley RWQCB 1998).

The Bay-Delta Estuary Plan provides the component of a comprehensive management package for the protection of the estuary's beneficial uses that involves salinity (from saltwater intrusion and agricultural drainage) and water project operations (flows and diversions), as well as a dissolved oxygen objective. This plan supplements other water quality control plans adopted by the SWRCB and RWQCBs, and State policies for water quality control adopted by the SWRCB, relevant to the Bay-Delta estuary watershed. These other plans and policies establish water quality standards and requirements for parameters such as toxic chemicals, bacterial contamination, and other factors with the potential to impair beneficial uses or cause nuisance.

SWRCB D-1641

The WQCP for the Bay-Delta estuary contains the current water quality objectives. SWRCB D-1641 contains the current water right requirements to implement the Bay-Delta water quality objectives. In D-1641, the SWRCB assigned responsibilities to USBR and DWR for meeting these requirements on an interim basis. These responsibilities require that the CVP and SWP be operated to meet water quality objectives in the Delta, pending a water rights hearing to allocate the obligation to meet the water quality and flow-dependent objectives among all users of the Sacramento and San Joaquin River Basin waters with water rights assigned after 1914. The San Joaquin River Agreement and Sacramento Valley Water Management Agreement are settlements between DWR and USBR with water users upstream of the Delta in which the CVP and SWP will continue to meet the D-1641 water quality requirements. Therefore, the water rights hearing to allocate that responsibility was no longer needed and the hearing was dismissed.

Flow Standards and Agreements

1983 Oroville Operating Agreement Between DWR and DFG

Minimum flows in the lower Feather River were established by a 1983 agreement between DWR and DFG (DWR 1983). The agreement *Concerning the Operation of the*

Oroville Division of the State Water Project for Management of Fish and Wildlife establishes criteria for flow and water temperature for the Low Flow Channel and the reach of the Feather River below the Thermalito Afterbay Outlet to the confluence with the Sacramento River for preservation of salmon spawning and rearing habitat. The agreement specifies that DWR release a minimum of 600 cfs into the Feather River from the Thermalito Diversion Dam for fisheries purposes. This is the total volume of flows from the Diversion Dam outlet, the Diversion Dam Powerplant, and the Feather River Fish Hatchery pipeline.

For a Lake Oroville surface elevation greater than 733 feet, the minimum instream flow requirements on the Feather River below the Thermalito Afterbay Outlet are listed in Table 5.5-2 (DWR 1983).

Table 5.5-2. Minimum instream flow requirements on the Feather River.

Percent of normal[1] runoff (%)	October-February (cfs)	March (cfs)	April-September (cfs)
> 55	1,700	1,700	1,000
< 55	1,200	1,000	1,000

[1] *Normal runoff is defined as 1,942,000 af, which is the mean (1911–1960) April through July unimpaired runoff near Oroville.*

Source: Initial Information Package (DWR 2001)

The agreement includes a requirement that if during October 15 through November 30 the hourly flow is greater than 2,500 cfs, then the flow minus 500 cfs must be maintained until the following March unless the high flow was due to flood management operations or mechanical problems. This requirement is to protect any spawning that could occur in overbank areas during the higher flow rate by maintaining flow levels high enough to keep the overbank areas submerged. In practice, the flows are maintained below 2,500 cfs from October 15 to November 30 to prevent spawning in the overbank areas.

The agreement also specifies a narrative objective for water temperature below the Thermalito Afterbay Outlet and a numerical objective for temperatures of water provided to the Feather River Fish Hatchery. Below the Thermalito Afterbay Outlet, temperatures must be suitable for fall-run salmon during fall months (after September 15). From May through August, temperatures must be suitable for shad, striped bass, and other warmwater fish. Under the agreement, the water supply for the Feather River Fish Hatchery must adhere to the water temperature objectives (a deviation of plus or minus 4°F is allowed between April 1 and November 30) listed in Table 5.5-3.

Table 5.5-3. Water temperature objectives.

Period	Temperature (+/- 4°F)
April 1–May 15	51°
May 16–May 31	55°
June 1–June 15	56°
June 16–August 15	60°
August 16–August 31	58°
September 1–September 30	52°
October 1–November 30	51°
December 1–March 31	no greater than 55°

Source: Initial Information Package (DWR 2001)

Meeting the water temperature criteria is facilitated by a shutter-controlled intake gate system at the dam that selects water for release from various reservoir depths, depending on the desired water temperature. Through the relicensing program for the Oroville Facilities, NOAA Fisheries is suggesting a new set of water temperature objectives that would provide colder water downstream for protection of steelhead and spring-run Chinook salmon.

1969 Agreement Between DWR and Joint Water Districts

In May 1969, DWR entered into agreements with several water districts to provide them with water based upon prior rights (DWR 1969). The agreement among Richvale Irrigation District, Biggs-West Gridley Water District, Butte Water District, Sutter Extension Water District (i.e., the Joint Water District), and DWR includes terms describing the amounts of water that the State is required to make available to the districts. The agreements generally do not have specific requirements for water quality, although the May 1969 agreement between DWR and the Joint Water District specifies that DWR is to provide water at temperatures reasonably related to achieving agricultural production within the Joint Water District service area.

Water temperatures at the agricultural diversion points within the Thermalito Complex are influenced by Oroville Facilities operations. Water temperatures within Thermalito Afterbay are influenced by the temperature and quantity of water released from Oroville Dam. The amount of water released affects its residence time in the afterbay; the longer the residence time, the more opportunity the water has to warm. Other factors influencing water temperatures in the Thermalito Complex include stage elevations and pump-back operations within Thermalito Afterbay.

The Oroville Facilities are operated to meet water temperature objectives for the Feather River Fish Hatchery water supply and for the Feather River downstream of the Thermalito Afterbay Outlet. These water temperature objectives sometimes conflict with temperatures desired by agricultural diverters. DWR accommodates these agricultural diverters by releasing water that is as close as possible to the maximum temperature allowable under the DFG-DWR agreement (i.e., 4°F higher than the objectives stated above).

Biological Opinions

In 2002, NOAA Fisheries issued a BO on the interim operations of the CVP and SWP on federally listed threatened Central Valley spring-run Chinook salmon and Central Valley steelhead (NOAA Fisheries 2002). This BO established quantitative water temperature criteria for the lower Feather River between the Fish Barrier Dam and RM 61.6 (near Robinson Riffle). The BO stipulates that from June 1 through September 30, DWR shall to the extent possible and consistent with SWP requirements control water temperatures to a daily average water temperature of less than or equal to 65°F to protect over-summering steelhead from thermal stress and from warmwater predator species. The requirement is not intended to preclude pump-back operations at the Oroville Facilities needed to assist the State of California with supplying energy during periods when the California Independent System Operator (ISO) anticipates a Stage 2 or higher alert.

In addition, the 2002 NOAA Fisheries BO established ramping rates to minimize adverse effects of flow fluctuations associated with upstream reservoir operations on incubating eggs, fry, and juvenile spring-run Chinook salmon and steelhead. The NOAA Fisheries BO stipulates that during periods outside of flood management operations, and to the extent controllable during flood management operations, DWR shall ramp down releases to the Low Flow Channel, as presented in Table 5.5-4.

Table 5.5-4. NOAA Fisheries 2002 Biological Opinion required ramping rates.

Feather River Low Flow Channel Releases (cfs)	Rate of Decrease (cfs)
5,000 to 3,501	1,000 per 24 hours
3,500 to 2,501	500 per 24 hours
2,500 to 600	200 per 24 hours

Source: NOAA Fisheries 2002

In February 2004, NOAA Fisheries issued a supplemental BO to the 2002 BO on the interim operations of the CVP and SWP on federally listed threatened Central Valley spring-run Chinook salmon and Central Valley steelhead (NOAA Fisheries 2004c). The supplemental BO was issued to assess the 2-year extension of the Biological Opinion and to assess changes in operations of the Trinity Division of the Central Valley Project. No changes in operations of the Oroville Facilities were proposed during the time period analyzed by NOAA Fisheries, and thus, the supplemental BO did not provide additional reasonable and prudent measures or additional terms and conditions for operation of the Oroville Facilities and did not change its opinion that the CVP and SWP, as proposed, was not likely to affect the continued existence of Central Valley spring-run Chinook salmon and Central Valley steelhead (NOAA Fisheries 2004c). However, NOAA Fisheries did require DWR to work with NOAA Fisheries engineers to assist the Feather Water District in the design of a fish screen for their diversion on the Feather River.

In October 2004, NOAA Fisheries issued a BO on the effects of the long-term CVP and SWP Operations Criteria and Plan (OCAP) on federally listed endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, threatened southern Oregon/northern California coast coho salmon, and threatened central California coast steelhead and their habitat (NOAA Fisheries 2004b). The October 2004 BO superceded all previous Biological Opinions regarding the CVP and SWP OCAP. Water temperature objectives prescribed in the October 2004 OCAP BO at RM 61.6 near Robinson Riffle remained 65°F from June 1 through Sept 30 to protect over-summering steelhead. However, ramping rates were altered slightly from the 2002 OCAP BO and are presented in Table 5.5-5.

Table 5.5-5. NOAA Fisheries 2004 Biological Opinion required ramping rates.

Feather River Low Flow Channel Releases (cfs)	Rate of Decrease (cfs)
5,000 to 3,501	1,000 per 24 hours
3,500 to 2,501	500 per 24 hours
2,500 to 600	300 per 24 hours

Source: NOAA Fisheries 2004b

In July 2004, USFWS issued a BO for the coordinated operations of the CVP and SWP and the OCAP on the federally threatened delta smelt (USBR 2004). Because delta smelt are not present in the Feather River and because the CVP and SWP OCAP is not likely to jeopardize the continued existence of delta smelt, no specific operational terms and conditions were provided by USFWS for the Oroville Facilities.

Stocking and Habitat Enhancement Programs

Federal Energy Regulatory Commission (FERC) Order 2100-054

Order 2100-054 is a revised order on the original Oroville Recreation Plan *Oroville Reservoir Thermalito Forebay, and Afterbay Recreation Report* that was approved on September 22, 1994. Included in this plan are comments regarding recreation and fishery-related issues. FERC ordered DWR to formulate and implement a fisheries management plan that would “promote a multi-species warmwater and coldwater fishery with the general goal of benefiting a diverse angling community.” DWR conducted fish stocking and habitat improvements programs at Lake Oroville in accordance with the FERC order and filed reports on an annual basis from 1994 until 1999 regarding: (1) Lake Oroville fish stocking and fish habitat improvements, (2) the DFG Chinook salmon recommendations, and (3) a discussion of DWR’s role in fisheries management at Lake Oroville (FERC 1994).

Prior to 2000, Chinook salmon and brown trout were stocked in Lake Oroville. An infectious hematopoetic necrosis (IHN) outbreak in 2000 at the Feather River Fish Hatchery resulted in DFG issuing a moratorium on stocking salmonids in Lake Oroville until testing of the susceptibility of other salmonid stocks was completed. DFG concluded that coho salmon were the only salmonid that could be stocked in Lake

Oroville due to their resistance to IHN (FERC 2004). Beginning in 2002, coho salmon were stocked in Lake Oroville. By the spring of 2003, coho as long as 20 inches were being caught by anglers and had largely taken the place of Chinook salmon and brown trout (DWR 2003). Current stocking goals for coho salmon are outlined in the *2003 – January 31, 2007 Salmonid Stocking Strategy*. The stocking plan is in effect through the end of the current FERC license period. However, the stocking of coho salmon in Lake Oroville did not take place as scheduled in 2004 due to an outbreak of bacterial kidney disease (BKD) and NOAA Fisheries has expressed some concern as to the stocking of coho salmon in the future.

Feather River Fish Hatchery Management

DWR constructed the Feather River Fish Hatchery to compensate for salmonid spawning habitat lost due to the construction and operation of the Oroville Facilities. The hatchery has been operated by DFG since the late 1960s, releasing millions of spring and fall Chinook salmon fry, fingerlings, smolts, and yearlings, and steelhead yearlings to fulfill DWR's Oroville FERC license conditions. Goals for the hatchery are defined in terms of numbers of eggs taken each year for rearing and the number of fish to be released as smolts or yearlings. DFG operates the hatchery under contract to DWR, and DWR pays for most hatchery-associated expenses. Hatchery operations are conducted as part of DWR and DFG obligations pursuant to provisions of FESA (DWR 2002).

5.5.1.3 Fish Species Overview

Detailed information regarding the life history and habitat requirements of each of the following fish species is provided in Section G-AQUA1.4 of Appendix G-AQUA1, which summarizes the results of the aquatics Study Plan Reports.

Warmwater Fish Species

Black Bass

Black bass species within the project area include spotted bass (*Micropterus punctulatus*), largemouth bass (*M. salmoides*), smallmouth bass (*M. dolomieu*), and redeye bass (*M. coosae*). None of these species of black bass are native to California; however, all are considered important recreational game fish.

Black bass spawn in the spring from March through June, with peak spawning activity in early May. All species prefer similar spawning habitat and are nest builders. Nest building begins at water temperatures around 54°F (12.2°C) and spawning continues until water temperatures exceed 75.2°F (24°C) (Aasen and Henry 1981; Baylis et al. 1993; Davis and Lock 1997; Graham and Orth 1986; Miller and Storck 1984; Wang 1986). Black bass spawning occurs in water 1–4 feet (0.3–1.2 m) deep near shore and has been observed as deep as 20 feet (6.1 m) in clear water (Davis and Lock 1997). In California, with changing reservoir levels, spawning has been observed at water depths up to 13.1–16.4 feet (4–5 m) (Moyle 2002).

Black bass species are found throughout the affected environment including tributaries upstream of Lake Oroville (DWR Unpublished Work 2003), Lake Oroville (DWR 2003a), Thermalito Forebay (DWR 2003a), Thermalito Afterbay, and the lower Feather River from the mouth of the Thermalito Afterbay Outlet to the confluence with the Sacramento River (DWR 2003b). Black bass species are seldom observed in the Low Flow Channel, probably due to colder water temperatures (DWR 2003b).

Catfish

Two species of catfish are found in the project area: channel catfish (*Ictalurus punctatus*) and white catfish (*Ameiurus catus*). Neither species is native to California; however, both are popular game fish. Adult channel catfish tend to be slightly larger than white catfish (13.8–17.7 inches vs. 11.8–15.7 inches [35–45 centimeters (cm) vs. 30–40 cm]) and, when in a river environment, are typically found in faster moving water, although both species do well in large reservoirs (Moyle 2002). Both species of catfish are frequently observed in Lake Oroville (DWR 2003a).

In California, channel catfish generally spawn from April through June, while white catfish spawn slightly later during June through July (Moyle 2002). Spawning channel catfish require water temperatures ranging from 69.8 to 84.2°F (21 to 29°C), with 78.8 to 82.4°F (26 to 28°C) being the optimum water temperature range (Moyle 2002). Channel catfish typically construct nests in cave-like structures, and one reason for unsuccessful introductions has been suggested to be a lack of spawning habitat (Moyle 2002). Cave-like structures have been constructed in Lake Oroville to promote the channel catfish fishery (DWR 1997). In large impoundments, nests generally occur among rubble and boulders along protected shorelines at depths of 6.6–13.2 feet (2–4 m) (McMahon and Terrell 1982). White catfish construct nests in shallow depressions in sand or gravel near cover or utilize cave sites similar to channel catfish (Moyle 2002).

Crappie

Two species of crappie currently inhabit the project area: white crappie (*Pomoxis annularis*) and black crappie (*P. nigromaculatus*). Neither species is native to California; however, both are popular game fish. Sexually mature crappie are generally 4–8 inches (10–20 cm) in length and seem to prefer water temperatures ranging from 80.6 to 84.2°F (27 to 29°C) (Moyle 2002). Black crappie are more frequently observed in Lake Oroville, although both species are present (DWR 2003a).

Both species of crappie spawn in late spring and early summer, with white crappie tending to spawn a little earlier, although there is substantial overlap. Crappie spawn in water temperatures ranging from 62.6 to 68°F (17 to 20°C), at a depth of 3.3–23 feet (1–7 m) (Moyle 2002). Males of both species construct nests utilizing vegetation in shallow depressions in mud or gravel substrate (Moyle 2002).

Forage Fish

Two species of forage fish are found within the project area: threadfin shad (*Dorosoma petenense*) and wakasagi (*Hypomesis nipponensis*). Neither species is native to

California, and both were introduced with the express purpose of serving as forage fish for game species in California lakes and reservoirs. Wakasagi were introduced to Lake Almanor in 1959 to serve as forage for salmonids (Aasen et al. 1998). They have migrated downstream and are now found in Lake Oroville (Aasen et al. 1998; Fuller 2000) and are frequently observed in both Lake Oroville and Thermalito Forebay (DWR 2003a). Wakasagi spawn in the spring in small tributaries where eggs adhere to rocks or submerged vegetation (Aasen et al. 1998). Wakasagi normally spawn after their first year (Aasen et al. 1998), with a few surviving to spawn again in their second year. California wakasagi can tolerate a wide range of water temperatures, for both growth and reproduction (Moyle 2002).

Threadfin shad were first introduced in 1951 (Moyle 2002). Threadfin shad are broadcast spawners with fertilized eggs adhering to submerged logs or vegetation. In California, threadfin shad spawning takes place during April through August and peaks in June and July when water temperatures exceed 68°F (20°C) (Moyle 2002; Wang 1986). Although originally introduced as a forage fish, the success of this program has been limited, and some authors suggest that the fish may actually compete for food resources with juvenile game fish (Moyle 2002). Threadfin shad have been infrequently observed in Lake Oroville (DWR 2003a).

Minnows

Four species of minnow are commonly found in the project area: Sacramento pikeminnow (*Ptychocheilus grandis*), hardhead (*Mylopharodon conocephalus*), hitch (*Lavinia exilicauda*), and Sacramento splittail (*Pogonichthys macrolepidotus*). All four species are native to the Sacramento River drainage (Moyle 2002).

Sacramento pikeminnow is ranked as the third most common species of native fish in the lower Feather River (Seesholtz et al. 2003). Pikeminnow are resident year-round and, therefore, all lifestages are present. Spawning generally takes place from April through June (Moyle 2002), and the preferred water temperatures for spawning are in the range of 59 to 68°F (15 to 20°C). In reservoirs, pikeminnow have been observed spawning in very shallow water (a few inches in depth), as well as in water as deep as the thermocline (Patten and Rodman 1969). Pikeminnow are known predators of juvenile salmonids.

Hardhead was designated as a State species of special concern by DFG in 1995 and is listed as a Class 3 Watch List species, meaning that it occupies much of its native range, but was formerly more widespread or abundant within that range (Moyle et al. 1995). Hardhead are fairly common in the Sacramento River and lower mainstems of the American and Feather rivers. Hardhead are resident year-round; therefore, all lifestages are present in the Feather River. Hardhead are frequently observed in the Feather River from the Fish Barrier Dam downstream to the confluence with the Sacramento River (Moyle 2002). Juvenile recruitment suggests that hardhead spawn from April through June in Central Valley streams, but the spawning may extend into August in the foothill streams of the Sacramento–San Joaquin drainage. Hardhead

reportedly spawn in water temperature ranges from 55 to 75°F (12.8 to 23.9°F) (Cech Jr. et al. 1990; Moyle 2002; Wang 1986).

Like hardhead, hitch is also a Class 3 Watch List species as designated by DFG (Moyle 2002). Females normally spawn between March and June (Wang 1986) and are broadcast spawners, selecting habitat and conditions similar to hardhead (Moyle 2002). Hitch are frequently observed in the Feather River from the Thermalito Afterbay Outlet to the confluence with the Sacramento River (DWR 2003b).

Sacramento splittail were designated as a threatened species under FESA by USFWS on February 8, 1999 (USFWS 1999b). Splittail were listed as threatened throughout their entire range, which includes the Feather River (USFWS 1999b). On September 22, 2003, USFWS issued a Notice of Remanded Determination for the Sacramento Splittail (USFWS 2003). This removed the Sacramento splittail from the endangered species list; however, Sacramento splittail is still considered a species of special concern by DFG.

Other than incidental observations of splittail in the Feather River (Seesholtz et al. 2003; USFWS 1995a), there have been no directed studies of abundance in this area. Because splittail have been observed in the Feather River, it is assumed that some spawning takes place. Sacramento splittail spawning can occur anytime between late February and early July, but peak spawning occurs in March and April (Moyle 2002). Splittail spawn primarily in inundated floodplains (Moyle 2002; Wang 1986). The literature indicates that adult splittail migrate into inundated areas during February (Moyle 2002), and that peak splittail spawning occurs from March through April (Moyle 2002). Spawning reportedly is followed by 3 to 7 days of egg incubation (Moyle 2002), and the larvae remain in the vegetation for another 7 to 10 days, feeding on zooplankton. Approximately 10 to 14 days after splittail eggs are fertilized, they reportedly develop into free-swimming larvae (Sommer et al. 1997). Juvenile rearing continues until juvenile splittail have transformed into benthic-feeding juveniles. After floodplain waters begin to recede, juveniles leave the floodplain and begin to migrate downstream to brackish waters. Juvenile splittail begin appearing at Delta salvage pumps in April and peak during late April and May, suggesting that most juvenile out-migration from the Feather River has occurred by the end of May (Daniels and Moyle 1983; Sommer Unpublished Work).

Sacramento splittail spawning generally occurs in water with a depth of 3.0–6.6 feet (0.9–2.0 m) over submerged vegetation (Moyle 2002; Wang 1986). This same habitat is used for initial juvenile rearing. Splittail have a wide thermal tolerance during this time period, and temperatures may range from 48 to 75°F (Moyle 2002; Sommer et al. 1997; Wang 1986).

Sacramento Sucker

The Sacramento sucker (*Catostomus occidentalis*) is common in the project area and is native to California (Wang 1986). The Sacramento sucker is described as one of the few native fish species that have thrived despite massive changes to historic habitat

(Moyle 2002). Spawning occurs between late February and early June, with peak spawning during March and April (Moyle 2002). Suckers prefer water temperatures for spawning between 53.6 and 64.4°F (12 and 18°C), with water depths of 11.8 inches (30 cm) or more (Moyle 2002). The Sacramento sucker is infrequently observed in Lake Oroville and frequently observed in Thermalito Forebay (DWR 2003a). It is also common in the lower Feather River (Seesholtz et. al 2003).

Smelt

Two species of smelt, delta smelt (*Hypomesus transpacificus*) and longfin smelt (*Spirinchus thaleichthys*), are native to California (Moyle 2002) and common in the Sacramento-San Joaquin Delta. Neither of these species is found within the project area. USFWS listed delta smelt as a threatened species under FESA in March 1993 (CFR 58 12854), and critical habitat for delta smelt has been designated within the Delta and adjoining waterbodies. Delta smelt also is listed as threatened under CESA. Additional discussion regarding delta smelt is provided in Section 5.7, Federally Listed Threatened and Endangered Species.

Longfin smelt is designated as a State species of special concern by DFG. Longfin smelt is a euryhaline species, meaning they can tolerate a wide range of salinities. This is particularly evident in the Delta where they are found in areas ranging from almost pure seawater upstream to areas of pure freshwater. In this system, they are most abundant in San Pablo and Suisun bays (Moyle 2002). They tend to inhabit the middle to lower portion of the water column. Longfin smelt spend the early summer in San Pablo and San Francisco bays, generally moving into Suisun Bay in August. Most spawning is from February to April at water temperatures of 44.6 to 58.1°F (7 to 14.5°C) (Moyle 2002). The majority of adults perish following spawning. Longfin smelt eggs have adhesive properties and are probably deposited on rocks or aquatic plants upon fertilization. Newly hatched longfin smelt are swept downstream into more brackish parts of the estuary. Strong Delta outflow is thought to correspond with longfin smelt survival, as higher flows transport longfin smelt young to more suitable rearing habitat in Suisun and San Pablo bays (Moyle 2002). Longfin smelt are rarely observed upstream of Rio Vista in the Delta (Moyle et al. 1995).

Striped Bass

Striped bass (*Morone saxatilis*) is an introduced game fish that frequents the project area in April through June for spawning (Bell 1991; Hassler 1988; Hill et al. 1989; Moyle 2002; Wang 1986). Striped bass have also been reported in Thermalito Forebay (DWR 2003a), which may indicate a small landlocked breeding population. The striped bass fishery is one of the most valuable sport fisheries in California, both in terms of the recreation it provides and economic wealth it generates (Skinner 1962).

Female striped bass reach sexual maturity at age 4 to 6, while males reach sexual maturity at age 2 to 3 (Moyle 2002). The maximum age of striped bass is estimated at over 30 years; however, fish older than 10 years are uncommon (Moyle 2002). In

California, striped bass have reportedly attained lengths of up to 49.2 inches (125 cm) and weights up to 90.4 pounds (41 kilograms [kg]) (Moyle 2002).

Striped bass are broadcast spawners, with peak spawning activity occurring from April through June (Wang 1986). Striped bass spawn in mainstem rivers and have shown little preference for substrate (Wang 1986). Based on various studies, the water temperature range in which spawning occurs is reported to be approximately between 59 and 68°F (20°C) (Bell 1991; Hassler 1988; Hill et al. 1989; Moyle 2002).

Sunfish

Three species of sunfish, bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), and redear sunfish (*L. microlophus*), are common in the project area. None of these species is native to California, although all are popular recreational gamefish (Moyle 2002; Wang 1986).

All three sunfish species exhibit a similar life history, have a similar lifespan, and attain similar sizes; therefore, the traits of bluegill are discussed herein. Spawning normally occurs as water temperatures exceed 68°F (20°C) (Wang 1986). In California, spawning occurs throughout the summer, with peak spawning in June and July (Wang 1986). All three species generally inhabit small warm streams, ponds, and lake edges (Moyle 2002). All of the sunfishes are frequently observed in Lake Oroville, and a small population of bluegill may exist in Thermalito Forebay (DWR 2003a). Bluegill, green sunfish, and redear sunfish are also common in the OWA ponds (DWR 2003a) and in the lower Feather River (Seesholtz et. al 2003).

Tule Perch

The tule perch (*Hysterocarpus traski*) is native to California, including the Sacramento River system (Froese and Pauly 2002). As a species, the tule perch population is stable or increasing while the Sacramento River population of tule perch retains a Watch List status (Moyle 2002).

Tule perch prefer lotic water habitats with temperatures less than 71.6°F (22°C) and are reportedly not found in temperatures greater than 77°F (25°C) (Moyle 2002). Beds of surfacing aquatic plants, deep pools, and banks with complex cover, such as overhanging bushes, fallen trees, undercutting, and riprap, provide the preferred environment for tule perch (Moyle 2002). Tule perch are livebearers with females producing 25 to 60 young (Moyle 2002). Mating generally occurs in late summer, with females storing sperm from multiple males (Wang 1986). Actual fertilization takes place in January and birth occurs in May (Wang 1986). Young are released among tule marshes and other types of vegetation (Wang 1986). A few tule perch have been observed in Thermalito Forebay (DWR 2003a) and they are common in the lower Feather River (Seesholtz et. al 2003).

Coldwater Fish Species

American Shad

The American shad (*Alosa sapidissima*) is an introduced species (Moyle 2002) that provides high recreational and economic value (Froese and Pauly 2002). American shad are present in the Feather River from May through mid-December, during the adult immigration, spawning, and emigration periods of their lifecycle (DWR 2003b). American shad are an anadromous species, and the population in California is considered widespread and stable (Moyle 2002).

The Sacramento River supports large runs of shad in late May and early June during their upstream spawning migration (Moyle 2002). American shad are broadcast spawners and normally spawn over sand or gravel substrate in main river channels (Moyle 2002). In the Sacramento River, American shad prefer water temperatures ranging from 62.6 to 75.2°F (17 to 24°C) for spawning (Moyle 2002) but elsewhere have been reported to spawn in water temperatures between 46 and 79°F (7.8 and 26.1°C) (Painter et al. 1979; USFWS 1995c; Wang 1986). Emigration of juveniles from the spawning area takes place from July through December, generally peaking in August and September (Painter et al. 1979). Juveniles may spend up to 1 year in freshwater (Moyle 2002).

Chinook Salmon

Chinook salmon (*Oncorhynchus tshawytscha*) are native to California, including the Feather River. Chinook salmon have a varied life history. Within the Sacramento River system, three different evolutionarily significant units (ESUs) of the species are recognized based on the time of year that upstream migrations begin. Spring-run Chinook salmon normally begin migration during March and continue through the beginning of September, holding in coldwater pools until ready to spawn. Fall-run Chinook salmon begin upstream migration in the summer and last until December. Although not located within the project area, a small winter-run population of Chinook salmon also exists within the Sacramento River system, with upstream migration beginning in December (DWR 1982; DWR 2004; Moyle 2002; NOAA Fisheries 1999; Sommer et al. 2001).

On September 19, 1999, the Central Valley spring-run Chinook salmon ESU was listed as Threatened under FESA by NOAA Fisheries (NOAA Fisheries 1999). The Central Valley spring-run Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries, including the naturally spawned spring-run Chinook salmon in the lower Feather River (NOAA Fisheries 1999). Additional discussion regarding spring-run Chinook salmon is provided in Section 5.7, Federally Listed Threatened and Endangered Species.

In the same September 19, 1999 ruling, NOAA Fisheries determined that naturally spawned Central Valley fall-run Chinook salmon were not warranted for listing under FESA (NOAA Fisheries 1999), but were designated as a candidate for listing (NOAA

Fisheries 1999). On April 15, 2004, NOAA Fisheries announced the Central Valley fall-run Chinook salmon change in status from a candidate species to a species of concern. The Central Valley fall-run Chinook salmon ESU includes all naturally spawned populations of fall-run Chinook salmon in the Sacramento and San Joaquin River basins and their tributaries, which includes naturally spawned fall-run Chinook salmon in the lower Feather River (NOAA Fisheries 1999).

The timing of adult Chinook salmon spawning activity is strongly influenced by water temperature. When daily average water temperatures decrease to approximately 60°F (15.5°C), female Chinook salmon begin to construct nests (redds) into which their eggs (simultaneously fertilized by the male) are eventually released. Fertilized eggs are subsequently buried with streambed gravel. Spawning activity in the Feather River occurs from late August through December and generally peaks in mid to late November (Myers et al. 1998).

The intragravel residence period of incubating eggs and alevins (yolk-sac fry) is highly dependent upon water temperature. The intragravel egg and fry incubation life stage for Chinook salmon generally extends from about mid-October through March. Egg incubation survival rates are dependent on water temperature and intragravel water movement. Incubation temperatures of approximately 62 to 64°F (16.7 to 17.8°C) reportedly appear to be the physiological limit for embryo development resulting in 80 to 100 percent mortality prior to emergence (USFWS 1999a). Egg incubation survival is highest at water temperatures at or below 56°F (13.3°C) (NOAA Fisheries 1993; USFWS 1995c).

Within the project area, fall-run Chinook salmon fry emergence generally occurs from late-December through March. In the Sacramento River basin, fall-run Chinook salmon juvenile emigration occurs from January through July (Vogel and Marine 1991; Yoshiyama et al. 1998). Emigration surveys conducted by DFG have shown no evidence that peak emigration of Chinook salmon is related to the onset of peak spring flows in the lower American River (Snider et al. 1997). Temperatures required during emigration are believed to be about the same as those required for successful rearing. Water temperatures reported to be optimal for rearing of Chinook salmon fry and juveniles are between 45 and 65°F (7.2 and 18.3°C) (NOAA Fisheries 2002; Rich 1987; Seymour 1956). Raleigh et al. (1986a) reviewed the available literature on Chinook salmon thermal requirements and suggested a suitable rearing temperature upper limit of 75°F (23.8°C) and a range of approximately 53.6 to 64.4°F (12 to 18°C). Juvenile fall-run Chinook salmon normally rear for 1 to 7 months in freshwater before migrating to the ocean (Yoshiyama et al. 1998). Fall-run Chinook salmon from the Feather River normally spend 4 to 5 years in the ocean (Moyle 2002). Returning fall-run Chinook salmon average 35.4 inches (90 cm) in length (Moyle 2002).

Coho Salmon

Coho salmon (*O. kisutch*) are native to California and while no wild populations currently exist in the Feather River, they are stocked in Lake Oroville (DWR 2001). The Central California Coast ESU for coho salmon was listed as Threatened under FESA on

December 2, 1996. Coho salmon also is designated as a state species of special concern. These special-status species designations pertain only to coho salmon within their native habitats. Coho salmon occur within the project area as a result of stocking programs and are managed for their recreational importance only. Coho salmon supports valuable commercial and sport fisheries in the Pacific Southwest Region. According to the Pacific Fishery Management Council (PFMC), the sport fishery accounted for 58 percent of the total catch of coho salmon along the California coast in 1985 (Hassler 1987).

California coho salmon within their native habitat generally have a 3-year life-cycle, with about half spent in freshwater and half spent in saltwater (Moyle 2002). Coho salmon die after spawning, with peak spawning migrations in California occurring from late December through January followed by immediate spawning (Weitkamp et al. 1995). Coho salmon spawn in riffles at water temperatures of 42.8 to 53.6°F (6 to 12°C) (Hassler 1987). Juveniles remain in freshwater for 12 to 15 months then migrate to the ocean where they remain for 16 to 18 months before returning to spawn (Moyle 2002). Coho salmon have been introduced to the Great Lakes, and small reproducing populations have been observed in tributaries of Lake Superior (Nonindigenous Aquatic Species Database website 2004); therefore, under certain conditions, the saltwater lifecycle phase of coho salmon may not be a requirement for successful reproduction.

Lamprey

Two species of lamprey, river lamprey (*Lampetra ayresi*) and Pacific lamprey (*L. tridentata*), are found within the project area. Pacific lamprey are more frequently observed in the Feather River than river lamprey (DWR 2003b). Both species are native to California and are on the Watch List (Moyle 2002), however, river lamprey is designated as a State species of special concern by DFG. Both species spend 3 to 4 years in freshwater as ammocoetes (larval form of lamprey) before the metamorphosis to the adult form takes place, at which time they migrate to the ocean (Beamish 1980; Moyle 2002).

River lamprey congregate upstream of saltwater for 4 months as young adults, rapidly grow to 9.8–12.2 inches (25–31 cm), and enter the ocean in late spring (Moyle 2002). After approximately 3 months in the ocean, river lamprey return to freshwater to spawn in the fall (Moyle 2002). River lamprey hold in freshwater for up to 8 months until spawning from April through June (Beamish 1980). Lamprey construct gravel nests, and river lamprey are reported to spawn at water temperatures of 55.4 to 56.3°F (13–13.5°C) (Wang 1986).

Juvenile Pacific lamprey migrate to the ocean in the fall where they spend approximately 3.5 years in saltwater (Beamish 1980). Pacific lamprey enter freshwater in April through June. By September, upstream migration is complete, and adults overwinter and spawn in the spring of the following year (Bayer et al. 2001; Beamish 1980; Close et al. 2002). Crude nests are constructed in gravelly areas, and the water temperature range for Pacific lamprey spawning is 53.6 to 64.4°F (12 to 18°C) (Moyle 2002).

Steelhead/Rainbow Trout

Steelhead and rainbow trout are the same species (*O. mykiss*), with steelhead being the anadromous form. Steelhead are native to California. On March 19, 1998, naturally spawned Central Valley steelhead was listed as Threatened under FESA by NOAA Fisheries (NOAA Fisheries 1998). The Central Valley steelhead ESU includes all naturally spawned populations of steelhead (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries residing below naturally formed and artificial impassable barriers (e.g., waterfalls and dams), which includes the naturally spawned steelhead in the Feather River (NOAA Fisheries 1998). Additional discussion regarding Central Valley steelhead is provided in Section 5.7, Federally Listed Threatened and Endangered Species.

Rainbow trout are the most popular and widely distributed gamefish in California (Moyle 2002) and are currently stocked in Thermalito Forebay (DWR 2001). Naturally spawning populations of rainbow trout currently exist in the tributaries above Lake Oroville (DFG website 2003).

Most wild rainbow trout spawn in the spring between February and June (Moyle 2002). Rainbow trout normally spawn by constructing redds (nests) in coarse gravel substrate, 0.5 to 5.1 inches in diameter, in the tail of a pool or riffle (Moyle 2002). The number of eggs per female normally depends on size of the fish at spawning but ranges from 200 to 12,000 eggs (Moyle 2002). Most spawning is observed when water temperatures are between 46 and 52°F (7.8 and 11.1°C) in water flowing at from 0.2–3.6 feet per second (ft/sec) (USFWS 1995c). Water temperatures above approximately 63°F (17.2°C) are reportedly lethal to developing rainbow trout embryos (Moyle 2002). Eggs normally hatch in 3 to 4 weeks, with alevins remaining in the gravel for another 2 to 3 weeks (Moyle 2002).

For the first year of life, juvenile rainbow trout normally inhabit cool, fast-flowing streams and rivers where riffles predominate over pools and there is cover from riparian vegetation and undercut banks (Moyle 2002). Older rainbow trout tend to move into deeper runs or pools (Moyle 2002). Rainbow trout are reportedly found where daytime water temperatures range from 32°F (0°C) in the winter to 80.6°F (27°F) in the summer, although 73.4°F (23°C) is reportedly lethal for unacclimated fish (Moyle 2002).

Sturgeon

Two species of sturgeon, white sturgeon (*Acipenser transmontanus*) and green sturgeon (*A. medirostris*), are found within the project area. White sturgeon are more commonly observed in the Feather River than green sturgeon (DWR 2003b), although both species are native to California. Green sturgeon currently is a candidate species for listing as threatened or endangered under FESA. On April 15, 2004, NOAA Fisheries announced that the Northern and Southern Distinct Population Segments of Green Sturgeon would change in listing status from a candidate species to a species of concern (69 FR 19977). However, recent litigation challenging NOAA Fisheries' determination that green sturgeon do not warrant listing as an endangered or

threatened species under FESA asserted that the agency was arbitrary and capricious in failing to examine whether habitat loss constituted a significant portion of the species' range. The court partially agreed with the Plaintiff's motion, and has remanded the determination back to NOAA Fisheries for further analysis and decision as to whether green sturgeon are endangered or threatened in a significant portion of its range. Hence, according to NOAA Fisheries' April 15, 2004 interpretation of FESA provisions, green sturgeon are considered a candidate species as well as a species of concern, until this matter is resolved (NOAA Fisheries 2004a). Green sturgeon also are designated as a species of special concern in California (Moyle et al. 1995).

White sturgeon are known to spawn in the Feather River (Moyle 2002). The presence of larval green sturgeon in salmon outmigrant traps indicates that the Feather River may support a spawning green sturgeon population (Environmental Protection Information Center et al. 2001). However, NOAA Fisheries (2002) reports that evidence of green sturgeon spawning in the Feather River is unsubstantiated; substantial efforts (including scuba and snorkel surveys, hook and line sampling, and larval traps) during preparation of the Oroville Facilities studies were all unsuccessful in documenting their presence in the lower Feather River. Both species begin an upstream spawning migration between February and June, with spawning occurring between April and June (Beamesderfer and Webb 2002; Moyle 2002). A few white sturgeon have been observed in Lake Oroville (DWR 2003a).

White sturgeon are broadcast spawners (Oregon Department of Fish and Wildlife website 2003). Suitable water temperatures for white sturgeon spawning in California are 46.4 to 66.2°F (8 to 19°C); peak spawning occurs at water temperatures of approximately 57.2°F (14°C) (Moyle 2002). Juveniles remain in freshwater for 1 to 4 years before migrating to the ocean (Moyle 2002).

Green sturgeon may reach an age of 20 years before spawning (NOAA Fisheries Website 2002) and then spawn every 4 to 11 years (Pacific States Marine Fisheries Commission website 2003). Green sturgeon spawning migrations occur between February and July (DFG website 2002), with peak spawning activity between April and June (Beamesderfer and Webb 2002). Green sturgeon also are broadcast spawners (Beamesderfer and Webb 2002). Green sturgeon can spawn in water temperatures ranging from 46.4 to 68°F (8 to 20°C) (Cech et al. 2000; DFG website 2002; Environmental Protection Information Center et al. 2001; Moyle 2002; USFWS 1995b). Juveniles remain in freshwater for up to 4 years before beginning a seaward migration (Beamesderfer and Webb 2002; Environmental Protection Information Center et al. 2001).

<u>Trout</u>

Brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), and lake trout (*S. namaycush*) are found within the project area. None of these species are native to California, and all were introduced to provide a recreational sport fishery. All three species have been stocked in either Lake Oroville or Thermalito Forebay (DWR 2001). Brook trout and lake trout are not true trout but actually members of the char family.

Catchable-size brook trout are currently stocked in Thermalito Forebay (DWR 2001). Lake trout were stocked in Lake Oroville during 1984 and 1985, and a few lake trout are still observed in Lake Oroville (DWR 2003a) suggesting the possibility of a small breeding population. Brown trout were stocked in Lake Oroville as recently as 2000 (DWR 2001).

Adult trout are largely bottom-oriented pool dwellers in streams and rivers (Moyle 2002). Escape cover (for adults and juveniles) is provided by overhanging and submerged vegetation, undercut banks, and instream objects such as debris piles, logs, and large rocks (Raleigh et al. 1986b). The water temperature tolerance range for trout is 32 to 80.6°F (0 to 27°C), although the preferred water temperatures for trout are reportedly 53.6 to 68°C (12 to 20°C) (Raleigh et al. 1986b).

All three species spawn in the fall or winter. In California, brook trout spawn from September through January, brown trout from November through December, and lake trout from September through November (Moyle 2002). Brook trout normally spawn in small tributaries but have been observed spawning on the gravel bottom shallows of some lakes (Moyle 2002). Brown trout spawn in small tributaries (Raleigh et al. 1986b). Lake trout are one of the few salmonids that do not construct redds; instead, they broadcast spawn in deep cold water of lakes (Moyle 2002).

Baseline Project Conditions

Baseline effects associated with the Oroville Facilities are discussed in detail in the above subsections under Facilities, Waterbodies, and Related Fisheries Resources. In general, baseline effects are associated with blocking sediment, gravel, and large woody debris contributions from the upstream tributaries to the lower Feather River, as well as blocking fish passage from the lower Feather River to the upstream tributaries. In addition to this physical blockage, the Oroville Facilities will continue to alter the flow regime and water temperatures in the lower Feather River, which affects fish habitat quality, quantity, and distribution, as well as the geomorphic processes that affect fish habitat complexity and diversity. More specifically, baseline project effects include:

- Blockage of the upstream migration of anadromous salmonids to historic spawning grounds in tributaries of the Feather River upstream of Oroville Dam, resulting in redd superimposition and genetic introgression between fall-run and spring-run Chinook salmon populations, high spawning densities in the lower Feather River, and high juvenile rearing densities in the lower Feather River;

- Continued supplementation of Chinook salmon population levels due to Feather River Fish Hatchery production;

- Blockage of gravel, sediment, and large woody debris contributions from the upstream tributaries to the lower Feather River by Oroville Dam, preventing these resources from contributing to the development and maintenance of fish habitat quality and diversity in the lower Feather River;

- Slightly adverse effects due to continued dewatering of bass nests during spawning season, although the effect is not great enough to change the self-sustaining nature of the bass fishery. Continued benefits to Lake Oroville warmwater fisheries with ongoing implementation of the Habitat Enhancement Program;

- Reduced habitat complexity and diversity in the lower Feather River due to regulated flows;

- Potential for disease transmission associated with the Feather River Fish Hatchery and Lake Oroville stocking programs;

- Straying of adult Chinook salmon from the Feather River Fish Hatchery;

- High rates of pre-spawning mortality associated with a combination of stress related to high water temperatures, river flows, disease, high spawning densities, and recreational angling; and

- Fluctuations in Oroville Facilities releases resulting in redd dewatering and juvenile stranding.

5.5.2 Environmental Effects

Summary of Potential Effects on Aquatic Resources

Table 5.5-6 summarizes the potential effects on aquatic resources under No-Action Alternative conditions, as well as under the Proposed Action and Alternative 2.

Table 5.5-6. Summary of potential effects on aquatic resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Habitat Components Affected by Oroville Facilities			
Chinook Salmon Spawning Segregation	Continued spatial and temporal overlap of the spring-run and fall-run Chinook salmon spawning, resulting in ongoing genetic introgression between the runs and increased rates of redd superimposition	Beneficial due to installation of fish barrier weirs and the hatchery adaptive management program	Same as Proposed Action
Macroinvertebrate Populations	Continued reduced productivity and species diversity	Beneficial due to the Large Woody Debris and Gravel Supplementation and Improvement Programs, and side-channel enhancement	Same as Proposed Action plus additional benefit from new side-channel creation
Woody Debris Recruitment	Continued deprivation of large woody debris upstream contribution and incremental reduction in habitat quality and complexity in the lower Feather River	Beneficial due to Large Woody Debris Supplementation and Improvement Program	Same as Proposed Action
Gravel Recruitment	Continued blockage of upstream gravel recruitment contribution and ongoing degradation of substrate quality and streambed armoring	Beneficial due to Gravel Supplementation and Improvement Program	Same as Proposed Action
Channel Complexity	Continued incremental decrease in channel complexity and habitat diversity downstream of Oroville Dam	Slightly beneficial due to Large Woody Debris Supplementation and Improvement Program and side-channel enhancements	Same as Proposed Action plus additional unquantified benefits from new side-channel creation
Water Quality Criteria for Aquatic Life	No effect	Same as No-Action Alternative	Same as No-Action Alternative

Table 5.5-6. Summary of potential effects on aquatic resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Reservoir Fisheries			
Warmwater Reservoir Fisheries	Continued dewatering of bass nests during spawning season, although the effect is not great enough to change the self-sustaining nature of the bass fishery. No effect in Thermalito Afterbay.	Same as No-Action Alternative	Same as No-Action Alternative, additionally, the reservoir fish stocking program and downstream fishery would slightly benefit from water sterilization at the hatchery.
Coldwater Reservoir Fisheries	Continued stocking program	Same as No-Action Alternative	Same as No-Action Alternative
Lower Feather River Fish Species			
American Shad	No effect	Same as No-Action Alternative	Same as No-Action Alternative
Black Bass	No effect	Same as No-Action Alternative	Same as No-Action Alternative
Fall-run Chinook Salmon	Continued degradation of spawning gravel, large woody debris cover, and habitat complexity	Beneficial due to Hatchery Adaptive Management Program, and Large Woody Debris and Gravel Supplementation and Improvement Programs	Same as Proposed Action, with additional unquantified beneficial effects due to increased flows in the Low Flow Channel, decreased water temperatures, new side-channel creation,
Green Sturgeon	No effect	Same as No-Action Alternative	Slightly beneficial effect to green sturgeon (if present) due to physical modification of potential passage impediments in the lower Feather River and improved suitability of water temperatures

Table 5.5-6. Summary of potential effects on aquatic resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Hardhead	No effect	Same as No-Action Alternative	Same as No-Action Alternative
River Lamprey	Continued degradation of spawning gravel	Slightly beneficial due to Gravel Supplementation and Improvement Program	Same as Proposed Action
Sacramento Splittail	No effect	Same as No-Action Alternative	Same as No-Action Alternative
Striped Bass	No effect	Same as No-Action Alternative	Same as No-Action Alternative

5.5.2.1 No-Action Alternative

Detailed analyses of potential effects of the Oroville Facilities on habitat components, warmwater and coldwater reservoir fish species, and lower Feather River fish species under the No-Action Alternative are provided in Appendix G-AQUA3, No-Action Alternative. A summary of potential effects on federally listed threatened and endangered fish species under the No-Action Alternative is provided in Section 5.7.3.1, Fish Species. Although this discussion focuses on specific, largely negative effects, in general it must be recognized that a substantial purpose of the current Oroville Facilities is fishery enhancement, and that both the anadromous and non-anadromous species benefit in myriad ways from project operations.

Habitat Components Affected by Oroville Facilities

Chinook Salmon Spawning Segregation

Under the No-Action Alternative, there would be a continued effect on Chinook salmon spawning segregation due to the continued spatial and temporal overlap of spring-run and fall-run Chinook salmon spawning, which would result in continued genetic introgression between the runs and elevated rates of redd superimposition for spring-run Chinook salmon.

Macroinvertebrate Populations

There would continue to be an incremental reduction in nutrient status due to the continued blockage of nutrients from the continued blockage of fish passage, compared to the existing condition. In addition, the incremental degradation of gravel substrate and armoring and loss of large woody debris would continue to degrade macroinvertebrate habitat quality.

Woody Debris Recruitment

Under the No-Action Alternative, there would continue to be loss of large woody debris in the lower Feather River as a result of the continued blockage by the Oroville Facilities of large woody debris contributed by upstream sources.

Gravel Recruitment

Under the No-Action Alternative, there would continue to be incremental loss of gravel in the lower Feather River as a result of the continued blockage by the Oroville Facilities of gravel contributed by upstream sources.

Channel Complexity

Under the No-Action Alternative, there would continue to be loss of channel complexity with incremental channel entrenchment in the lower Feather River as a result of the moderated flow regime due to Oroville Facilities operations.

Water Quality Criteria for Aquatic Life

Under the No-Action Alternative, there would continue to be a neutral effect on water quality for aquatic life.

Warmwater Reservoir Fisheries

Under the No-Action Alternative, in Lake Oroville, there would be continued dewatering of bass nests during spawning season, although the effect is not great enough to change the self-sustaining nature of the bass fishery. Under the No-Action Alternative, in Thermalito Afterbay, there would no effect on warmwater bass fishery.

Coldwater Reservoir Fisheries

Under the No-Action Alternative, there would be a continued coldwater reservoir fisheries due to the continued fish stocking program.

Lower Feather River Fish Species

American Shad

Under the No-Action Alternative, there would be no effects on the quantity, quality, or distribution of habitat for American shad.

Black Bass

Under the No-Action Alternative, there would be no effects on the quantity, quality, or distribution of habitat for black bass.

Fall-run Chinook Salmon

Under the No-Action Alternative, each life stage evaluated for fall-run Chinook salmon would continue to have slightly less than optimum conditions.

Green Sturgeon

Under the No-Action Alternative, there would be no effect on the quantity, quality, or distribution of habitat for green sturgeon.

Hardhead

Under the No-Action Alternative, there would be no effect on the quantity, quality, or distribution of habitat for hardhead.

River Lamprey

Under the No-Action Alternative, there would be incremental degradation of lamprey spawning substrate conditions in the No-Action Alternative compared to the existing condition.

Sacramento Splittail

Under the No-Action Alternative, there would be no effect on the quantity, quality, or distribution of habitat for Sacramento splittail.

Striped Bass

Under the No-Action Alternative, there would be no effect on the quantity, quality, or distribution of habitat for striped bass.

5.5.2.2 Proposed Action

Detailed analyses of potential effects of the Oroville Facilities on habitat components, warmwater and coldwater reservoir fish species, and lower Feather River fish species with implementation of the Proposed Action is provided in Appendix G-AQUA4, Proposed Action. A summary of potential effects on federally listed threatened and endangered fish species with implementation of the Proposed Action is provided in Section 5.7.1.3, Fish Species.

Habitat Components Affected by Oroville Facilities

Chinook Salmon Spawning Segregation

Implementation of the Proposed Action would result in a beneficial effect on Chinook salmon spawning segregation leading to a decrease in genetic introgression due to installation of fish barrier weirs, the Gravel Supplementation and Improvement Program, and the Large Woody Debris Supplementation and Improvement Program and Hatchery Adaptive Management Program improvements.

Macroinvertebrate Populations

Implementation of the Proposed Action would result in a beneficial effect on macroinvertebrates with implementation of the side-channel enhancement, Gravel Supplementation and Improvement Program, and Large Woody Debris Supplementation and Improvement Program.

Woody Debris Recruitment

Implementation of the Proposed Action would result in a beneficial effect on woody debris recruitment with implementation of the Large Woody Debris Supplementation and Improvement Program.

Gravel Recruitment

Implementation of the Proposed Action would result in a beneficial effect on gravel recruitment with implementation of the Gravel Supplementation and Improvement Program.

Channel Complexity

Implementation of the Proposed Action would result in a beneficial effect on channel complexity due to enhancement of side-channel habitat and the Large Woody Debris Supplementation and Improvement Program.

Water Quality Criteria for Aquatic Life

Water quality conditions for aquatic life are not expected to change with implementation of the Proposed Action, with the exception of any short-term water quality effects associated with instream construction activities such as the fish barrier weirs, enhancement of side-channel habitat, large woody debris placement, or gravel placement, ripping, or raking. See Section 5.4.2.2, Water Quality, for the evaluation of construction related effects on water quality.

Warmwater Reservoir Fisheries

No changes to warmwater fisheries habitat quality, quantity, or distribution are anticipated with implementation of the Proposed Action, relative to the No-Action Alternative.

Coldwater Reservoir Fisheries

Implementation of the Proposed Action would not affect the quality or quantity of coldwater fish habitat availability in Oroville Facilities reservoirs.

Lower Feather River Fish Species

American Shad

Implementation of the Proposed Action would result in no effects on the quantity, quality, or distribution of habitat for American shad.

Black Bass

Implementation of the Proposed Action would result in no effects on the quantity, quality, or distribution of habitat for black bass.

Fall-Run Chinook Salmon

Implementation of the Proposed Action would result in a slightly beneficial to beneficial effect on each life stage evaluated for fall-run Chinook salmon (see the detailed analyses provided in Appendix G-AQUA4). Implementation of the Proposed Action would have an overall beneficial effect on fall-run Chinook salmon.

Green Sturgeon

Implementation of the Proposed Action would result in no effect on the quantity, quality, or distribution of habitat for green sturgeon.

Hardhead

Implementation of the Proposed Action would result in no effect on the quantity, quality, or distribution of habitat for hardhead.

River Lamprey

Implementation of the Proposed Action would result in a beneficial effect on river lamprey due to improved spawning substrate conditions from the Gravel Supplementation and Improvement Program.

Sacramento Splittail

Implementation of the Proposed Action would result in no effect on the quantity, quality, or distribution of habitat for Sacramento splittail.

Striped Bass

Implementation of the Proposed Action would result in no effect on the quantity, quality, or distribution of habitat for striped bass.

5.5.2.3 Alternative 2

Detailed analyses of potential effects of the Oroville Facilities on habitat components, warmwater and coldwater reservoir fish species, and lower Feather River fish species with implementation of Alternative 2 is provided in Appendix G-AQUA5, Alternative 2. A summary of potential effects on federally listed threatened and endangered fish species with implementation of Alternative 2 is provided in Section 5.7.1.3, Fish Species.

Habitat Components Affected by Oroville Facilities

Chinook Salmon Spawning Segregation

Implementation of Alternative 2 would result in a beneficial effect on Chinook salmon spawning segregation leading to a decrease in genetic introgression due to installation of fish barrier weirs, the Gravel Supplementation and Improvement Program, the Large Woody Debris Supplementation and Improvement Program, and Hatchery Adaptive Management Program improvements.

Macroinvertebrate Populations

Implementation of Alternative 2 would result in a beneficial effect on macroinvertebrates with side-channel creation and enhancement, the Gravel Supplementation and

Improvement Program, and the Large Woody Debris Supplementation and Improvement Program.

Woody Debris Recruitment

Implementation of Alternative 2 would result in a beneficial effect on woody debris recruitment with implementation of the Large Woody Debris Supplementation and Improvement Program.

Gravel Recruitment

Implementation of Alternative 2 would result in a beneficial effect on gravel recruitment with implementation of the Gravel Supplementation and Improvement Program.

Channel Complexity

Implementation of Alternative 2 would result in a beneficial effect on channel complexity due to enhancement of existing and creation of additional side-channel habitat and the Large Woody Debris Supplementation and Improvement Program.

Water Quality Criteria for Aquatic Life

Water quality conditions for aquatic life are not expected to change with implementation of Alternative 2, with the exception of any short-term water quality effects associated with instream construction activities such as the fish barrier weirs, enhancement and creation of side-channel habitat, large woody debris placement, or gravel placement, ripping, or raking. See Section 5.4.2.2, Water Quality, for the evaluation of construction related effects on water quality.

Warmwater Reservoir Fisheries

No changes to warmwater fisheries habitat quality, quantity, or distribution are anticipated with implementation of Alternative 2.

Coldwater Reservoir Fisheries

Implementation of Alternative 2 would not affect the quality or quantity of coldwater fish habitat availability in Oroville project reservoirs because operational changes under Alternative 2 are not anticipated to change the effective volume of suitable coldwater fish habitat.

Lower Feather River Fish Species

American Shad

Implementation of Alternative 2 would result in no effect on the quantity, quality, or distribution of habitat for American shad.

Black Bass

Implementation of Alternative 2 would result in no effect on the quantity, quality, or distribution of habitat for black bass.

Fall-run Chinook Salmon

Implementation of Alternative 2 would result in a slightly beneficial to beneficial effect on each life stage evaluated for fall-run Chinook salmon (see the detailed analyses provided in Appendix G-AQUA5). Implementation of Alternative 2 would have an overall beneficial effect on fall-run Chinook salmon.

Green Sturgeon

Implementation of Alternative 2 would result in a beneficial effect on the quantity, quality, or distribution of habitat for green sturgeon due to slightly improved water temperatures and from physical modifications of potential fish passage impediments at Shanghai Bench and Sunset Pumps that would result in an increased range of flows that would reduce sturgeon passage impediments.

Hardhead

Implementation of Alternative 2 would result in no effect on the quantity, quality, or distribution of habitat for hardhead.

River Lamprey

Implementation of Alternative 2 would result in a beneficial effect on river lamprey due to improved spawning substrate conditions from the Gravel Supplementation and Improvement Program.

Sacramento Splittail

Implementation of Alternative 2 would result in no effect on the quantity, quality, or distribution of habitat for Sacramento splittail.

Striped Bass

Implementation of Alternative 2 would result in no effect on the quantity, quality, or distribution of habitat for striped bass.

5.5.3 Cumulative Effects

Cumulative effects are defined in Section 5.2, Cumulatively Affected Resources. Cumulative effects on spring-run Chinook salmon and Central Valley steelhead are discussed in Section 5.7.4.

5.5.4 Unavoidable Adverse Effects

The physical presence of the Oroville Facilities and the functional interactions of the facilities and operations have resulted in unavoidable adverse effects on aquatic resources. In general, the types of unavoidable adverse effects are associated with blocking sediment, gravel, and large woody debris contributions from the upstream tributaries to the lower Feather River, as well as blocking fish passage from the lower Feather River to the upstream tributaries. In addition to this physical blockage, the Oroville Facilities alter the flow regime and water temperatures in the lower Feather River, which affects fish habitat quality, quantity, and distribution, as well as the geomorphic processes that affect fish habitat complexity and diversity. At the same time, it could be concluded that on balance the project contributes a new positive benefit to the fisheries as a result of the extensive habitat provided by the project itself and current programs to restore fishery values.

5.5.4.1 Habitat Components Affected by Oroville Facilities

Upstream Passage

The Oroville Facilities block the upstream migration of anadromous salmonids to historic spawning grounds in tributaries of the Feather River upstream of Oroville Dam to the first fish barriers (hydropower dams that pre-date the construction of Oroville Facilities). Adverse effects of this barrier to upstream migration include:

- Genetic introgression between fall-run and spring-run Chinook salmon populations;
- Unnaturally high spawning densities in the lower Feather River; and
- Unnaturally high juvenile rearing densities in the lower Feather River.

Project effects on anadromous salmonids are described in the SP-F10 Study Plan Reports, which are summarized in Section G-AQUA1.8 of Appendix G-AQUA1. PM&E measures implemented under the Proposed Action and Alternative 2 would partially alleviate these adverse effects through gravel and large woody debris supplementation, installation of fish barrier weirs to control access to spawning habitat, enhancement and creation of side-channel habitat, and increased minimum flows in the Low Flow Channel. While these PM&E measures are expected to increase habitat quantity and quality for anadromous salmonids in the lower Feather River, continued high densities of spawning and juvenile rearing populations are expected to persist.

Macroinvertebrate Populations

Macroinvertebrate populations in the project area are described in the interim and final reports for SP-F1, Task 1/Task 2*, Evaluation of Project Effects on Non-Fish Aquatic Resources,* which are summarized in Section G-AQUA1.1 of Appendix G-AQUA1. This report found that collection sites in the Feather River, downstream of Lake Oroville, indicated lower species diversity than those collection sites located upstream of Lake

Oroville. Species diversity is generally considered a metric of ecosystem health. Allan (1995) reports that because of reduced or altered river flows below impoundments, a river's historic connection to the floodplain is severed, leading to reduced productivity and a lack of species diversity. The presence of the reservoir and the large exposed surface area of the reservoir changed the species composition of the macroinvertebrate community, which in turn changed the nature of the available food base for other aquatic resources in the lower Feather River. This change in species composition is expected to persist with the implementation of any of the alternatives.

Several PM&E measures likely would have a beneficial effect on macroinvertebrate community structure. Large woody debris and gravel supplementation, combined with the enhancement and creation of side-channel habitat, would create a more diverse habitat encouraging colonization of a more diverse aquatic invertebrate community. Increased minimum flows would also increase aquatic habitat for aquatic macroinvertebrates. Although no basis for historical comparisons exists, a direct effect on macroinvertebrate communities that would inhabit reservoir shorelines has occurred, and would likely continue with implementation of any of the alternatives. Reservoir stage elevation fluctuations due to pump-back operations and power, water supply, and flood management activities prevent macroinvertebrates from colonizing these areas, resulting in an unavoidable adverse effect on macroinvertebrate populations.

Lower Feather River Fish Habitat Quality and Quantity

Proposed PM&E measures with implementation of the Proposed Action and Alternative 2 affecting the lower Feather River, such as large woody debris and gravel supplementation combined with side-channel habitat enhancement and increased minimum flows in the Low Flow Channel under Alternative 2, would likely provide significant improvements in the quantity and quality of salmonid habitat in the lower Feather River. While improving the quantity and quality of salmonid habitat in the lower Feather River, a corresponding reduction in habitat for warmwater species in the Low Flow Channel would be unavoidable. Because warmwater species are not frequently observed upstream of the Thermalito Afterbay Outlet and ample warmwater species habitat exists downstream of that point, the unavoidable adverse effects of these PM&E measures on warmwater species likely would be negligible.

Reservoir Spawning Habitat Quality and Quantity

Continued reservoir fluctuations due to pump-back operations and power, water supply, and flood management activities under all three alternatives would affect spawning habitat for warmwater species in the project reservoirs. SP-F3.1, Task 4C, which is summarized in Section G-AQUA1.3.4 of Appendix G-AQUA1, evaluated bass nest dewatering in Thermalito Afterbay and describes the effects of reservoir surface elevation fluctuations. These same effects would also occur in Lake Oroville and potentially result in unavoidable adverse effects on those species that utilize near-shore habitat for spawning; however, habitat enhancement programs would offset some of these adverse effects in Lake Oroville.

Channel Complexity

Several fish species of primary management concern, and different life stages of these species, are dependent upon a diversity of habitat types in the lower Feather River. Increases in channel complexity would lead to an increase in habitat diversity within a particular river reach. Construction of the Oroville Facilities has contributed to the disruption of natural geomorphic processes in the lower Feather River. Attenuation of peak flows, decreased winter flows, increased summer flows, and changes to historic flow frequencies have led to a general decrease in channel complexity downstream of Oroville Dam. SP-G2, *Effects of Project Operations on Geomorphic Processes Downstream of Oroville Dam*, provides an evaluation of project effects as they relate to channel complexity in the lower Feather River. Some improvement in the level of channel complexity is anticipated with PM&E measures supplementing gravel and large woody debris, side-channel enhancements, and increased minimum flow in the Low Flow Channel of the lower Feather River. However, the river would continue to have reduced habitat complexity and diversity under any of the alternatives due to regulated flows and flood control levees.

5.5.4.2 Reservoir Fish Species

Diseases

The risk of disease transmission by stocked salmonids in Lake Oroville to naturally reproducing salmonids in the lower Feather River and the possibility of infecting the Feather River Fish Hatchery water supply with disease-causing pathogens is a major concern. Fish diseases common to the Feather River were investigated in the SP-F2 report, which is summarized in Section G-AQUA1.2 of Appendix G-AQUA1. The disease of primary concern is IHN. An IHN outbreak in 2000 at the Feather River Fish Hatchery resulted in DFG issuing a moratorium on stocking salmonids in Lake Oroville until testing of the susceptibility of other salmonid stocks was completed. DFG concluded that coho salmon were the only salmonid that could be stocked in Lake Oroville due to their resistance to IHN (FERC 2004). Coho salmon from an aquaculture facility in Washington were stocked in 2002 and 2003; however, the 2004 supply of fish was infected with BKD; therefore, no stocking was permitted. Current plans call for the stocking of 170,000 coho salmon in 2005. However, NOAA Fisheries has raised a concern about the stocking of coho salmon and potential genetic introgression with other California coho salmon populations. At present, the issue is unresolved. Current hatchery protocols and testing procedures should minimize the potential for disease transmission if an appropriate source stock is located; however, the increased potential for disease transmission would remain an unavoidable adverse effect of the Oroville Facilities. Under Alternative 2, water sterilization facilities would be installed at the Feather River Fish Hatchery, reducing the concern of an infected water supply transmitting disease to hatchery stocks.

5.5.4.3 Lower Feather River Fish Species

Straying

Reports on straying rates associated with Chinook salmon from the Feather River Fish Hatchery show varied results. Straying rates were evaluated in the SP-F15, Task 4 report, based on Cramer and Chapman's (2002) analysis of straying rates for Chinook salmon reared at the Feather River Fish Hatchery. Based on several years of data, straying rates for Chinook salmon released in the Feather River were estimated at 8 percent, while fish released in San Pablo Bay exhibited up to a 54 percent straying rate. These same rates were found for releases from the Coleman National Fish Hatchery. The same report showed straying rates of 8 and 32 percent, respectively, for fish released at the Nimbus Hatchery on the American River. In contrast, a DFG study as reported in SP-F9, *Evaluation of Project Effects on Natural Salmonid Populations,* which is summarized in Section G-AQUA1.7 of Appendix G-AQUA1, reported straying rates of 5 percent for Feather River released fish and 10 percent straying rates for fish released in San Pablo Bay. Results from all studies were based on coded wire tag recoveries. The Hatchery Adaptive Management Program, included in the Proposed Action and Alternative 2, are designed to modify hatchery practices, such as juvenile release location, to reduce straying. Even with reductions in the straying rates from the Hatchery Adaptive Management Plan, straying rates above natural straying rates will likely continue to occur; therefore, straying of anadromous salmonids would continue to be an unavoidable adverse effect of Oroville fish hatchery operations.

Pre-Spawning Mortality

Pre-spawning mortality of Chinook salmon in the lower Feather River was investigated in the SF-F10, Task 2B report, *Potential Effects of Facility Operations on Spawning Chinook Salmon,* which is summarized in Section G-AQUA1.8.2 of Appendix G-AQUA1. Pre-spawn mortality from 2000 through 2003 was estimated at 39.7 to 42.5 percent, which was considered high. The highest rates of pre-spawn mortality occurred in September and ranged from 77 to 100 percent. A combination of stress associated with high water temperature, river flows, disease, high spawning densities, and recreational angling likely account for the high pre-spawn mortality estimates in the lower Feather River.

Angling pressure would likely increase in the future. Pre-spawn mortality is likely to remain at currently high levels; therefore, pre-spawning mortality would continue to be an unavoidable adverse effect of the Oroville Facilities.

Redd Superimposition

Construction of the Oroville Facilities created a barrier to upstream migration for anadromous fish species, resulting in high densities of spawning salmonids in the reach of the Feather River downstream of the Fish Barrier Dam. High densities of anadromous salmonid spawners in the lower Feather River are also a likely effect of the production levels and contributions from the Feather River Fish Hatchery, which

constructed to compensate for the loss of salmonid spawning habitat caused by the original construction of the Oroville Facilities. Redd superimposition is a direct result of high densities of spawning activity in the Low Flow Channel (for a discussion of redd superimposition, particularly in the lower Feather River, see SP-F10, Task 2B, *Evaluation of Potential Effects of Oroville Facilities Operations on Spawning Chinook Salmon* in Section G-AQUA1.8.2 of Appendix G-AQUA1).

Several PM&E measures implemented under the Proposed Action and Alternative 2 could potentially reduce the current level of redd superimposition. Both the supplementation of gravel and creation of side-channel habitat would increase spawning habitat availability, thus reducing spawning densities. Installation of fish barrier weirs in the Low Flow Channel would allow for selective access to spawning habitat, reducing the incidence of redd superimposition on early spawners (e.g., spring-run Chinook salmon). However, even with a reduction in its current rate, redd superimposition would continue to occur and would be an unavoidable adverse effect of the Oroville Facilities.

Genetic Introgression

One effect of blocking upstream migration of anadromous salmonids has been the elimination of the spatial separation between fall- and spring-run Chinook salmon spawning. Restricted access to historic spawning grounds has caused spring-run Chinook salmon to spawn in the same lowland reaches that fall-run Chinook salmon utilize as spawning habitat. The overlap in spawning with temporally adjacent runs may be responsible for in-breeding between the two Chinook salmon populations in the lower Feather River. At present, the genetic distinctness of Feather River spring-run Chinook salmon is undetermined, although conflicting reports exists. For example, Nobriga and Buffaloe (2000) report that there is no longer any genetic distinctness between spring-run and fall-run Chinook salmon populations in the Feather River due to the forced co-existence of the spawning populations. In contrast, Banks et al. (2000) suggest that some level of genetic distinctness between the two populations still exists.

Installation of fish barrier weirs as proposed in the Proposed Action and Alternative 2 would alleviate some of the potential for genetic introgression between spring- and fall-run Chinook salmon populations by allowing selective passage of fish on a temporal basis. However, because some fall-run Chinook salmon have been documented to exhibit spring-run timing characteristics, segregation of the populations likely would not be complete. For this same reason, even with adaptive management practices in the Feather River Fish Hatchery designed to minimize spring-run and fall-run Chinook salmon interbreeding, some genetic introgression would be expected to continue to occur in the hatchery. Therefore, genetic introgression of anadromous salmonids would continue to be an unavoidable adverse effect of the Oroville Facilities.

Redd Dewatering and Juvenile Stranding

Almost constant flow regimes are maintained in the Low Flow Channel of the Feather River where most salmonid spawning occurs. Flow regimes downstream of the

Thermalito Afterbay Outlet are also maintained at fairly constant rates, but more fluctuation does occur depending on project operational requirements. Fluctuations in Oroville Facilities releases may occur under flood management operations, scheduled maintenance-operation activities, storm events, and component failure or emergency shutdowns. The timing, location, and magnitude of flow fluctuations may result in redd dewatering under any of the alternatives (see Section G-AQUA1.8 of Appendix G-AQUA1, Tasks 2D and 4A, for more information regarding flow fluctuation effects on salmonids); therefore, salmonid redd dewatering would continue to be an unavoidable adverse effect of the Oroville Facilities.

Juvenile stranding is a direct result of flow fluctuations; therefore, the same operational components involved in redd dewatering would apply (see above discussion on redd dewatering) and would be expected to continue to be an unavoidable adverse effect of the Oroville Facilities.

Poaching

Due to increased public access and recreation visitation, poaching of aquatic species may increase with implementation of each of the alternatives. The installation of unattended fish barrier weirs may also provide increased opportunities for poaching with the implementation of the Proposed Action and Alternative 2. PM&E measures that provide for the posting of regulatory and educational signs detailing illegal fishing practices and consequences may partially offset the potential for increased poaching. However, increased poaching would be an unavoidable adverse effect of the Oroville Facilities.

5.6 TERRESTRIAL RESOURCES

This chapter describes the botanical and wildlife resources located within the project study area. This section also evaluates potential effects on these resources that occur with implementation of the alternatives, including the No-Action Alternative, the Proposed Action, and Alternative 2. An overview and evaluation of potential effects on federally listed plant and wildlife species are presented in Section 5.7.

The Oroville Facilities are located along the Feather River within the foothill physiographic zones of California's Sierra Nevada Range at elevations ranging from 900 feet (ft) at Oroville Dam to approximately 1,200 ft in the upper reaches around Lake Oroville and 100 ft at the lower end of the OWA. This includes the lower foothills and the eastern edge of the Sacramento Valley. Oroville's botanical resources consist of vegetation communities, including riparian and wetlands, special-status plant species, and noxious or invasive weeds. Wildlife resources include wildlife habitats and species, special-status wildlife species, and commercially important wildlife species.

As part of relicensing, wildlife and botanical resources were evaluated based on input from resource agencies and interested parties. Detailed field investigations were conducted in accordance with standard methodologies recommended by the resource agencies, pertinent jurisdictions, or affiliations with oversight for the individual resource area. Botanical field investigations included surveys for vegetation mapping, invasive weeds, special-status plant species, and riparian and wetland resources. Wildlife investigations included surveys for wildlife habitats and species, special-status wildlife species, non-native wildlife species, and recreationally/commercially important wildlife species. All surveys were conducted during 2002, 2003, and 2004. The following technical studies were conducted to address the specific resource issues identified during scoping:

- SP-T1, *Effects of Project Features and Operation on Wildlife and Wildlife Habitat;*
- SP-T2, *Project Effects on Special Status Species;*
- SP-T3/5, *Project Effects on Riparian Resources, Wetlands, and Associated Floodplains;*
- SP-T4, *Biodiversity, Vegetation Communities, and Wildlife Habitat Mapping;*
- SP-T6, *Interagency Wildlife Management Coordination and Wildlife Management Plan Development;*
- SP-T7, *Project Effects on Noxious Terrestrial and Aquatic Plant Species;*
- SP-T8, *Project Effects on Non-Native Wildlife;*
- SP-T9, *Recreation and Wildlife;*

- SP-T10, *Effects of Project Features, Operations, and Maintenance on Upland Plant Communities;* and

- SP-T11, *Effects of Fuel Load Management and Fire Prevention on Wildlife and Plant Communities.*

Detailed descriptions of the study methods are included in the study plan reports.

The principal botanical and wildlife resource regulations considered in development and implementation of the relicensing studies include the Federal Endangered Species Act of 1973, as amended (FESA), California Endangered Species Act (CESA), Federal Migratory Bird Treaty Act of 1972 (MBTA), Federal Eagle Protection Act, National Environmental Policy Act (NEPA), California Environmental Quality Act (CEQA), California Native Plant Protection Act, BLM and USFS sensitive species management guidelines, and various DFG code sections.

Nomenclature conforms to *The Jepson Manual* (Hickman 1993) and Oswald (1994) for plant species; Sawyer and Keeler-Wolf (1995) and Holland (1986) as modified by DWR botanists for vegetation communities; and Mayer and Laudenslayer (1988) for wildlife habitats.

5.6.1 Affected Environment

The Oroville Facilities are located within the Sacramento Valley and Sierra Nevada Foothills subregions of the California Floristic Province (Hickman 1993). Broad vegetation patterns in this area correspond with elevational changes from the valley floor to the upper elevation of the mountain range, ranging from valley grasslands to foothill woodlands (characterized by blue-oak /foothill pine woodlands with varying amounts of chaparral) to mixed conifer forests in the higher elevations. These patterns vary from place to place and are dependent not only on elevation but precipitation, temperature, soils, aspect, slope, and disturbance history (SNEP 1996). This area is characterized by seasons of hot, dry summers and moderately cold, wet winters. Temperatures range from below zero to above 100°F. Approximately 95 percent of the annual precipitation occurs during the winter months. Precipitation ranges from less than 33 inches per year at Oroville to from 5 to 10 ft per year at the upper elevations of the study area.

Major management issues identified during the scoping process include:

- Effects of project operations and maintenance activities on wildlife and wildlife habitat, including: (1) upland habitats; (2) function and composition of riparian and wetland habitats; (3) vernal pools; (4) special-status species and their habitats; and (5) recreationally and commercially important species including waterfowl;

- Effects of project-related recreation on wildlife and wildlife habitats within the project area; and

- Coordination of interagency wildlife and wildlife habitat management activities, including fire prevention management practices and control of undesirable non-native wildlife species.

5.6.1.1 Botanical Resources

This section describes the affected environment as it relates to botanical resources including vegetation communities, invasive-non native plant species, and special-status plants and analyzes the baseline effects on these resources.

Botanical resources in the project area are influenced by a variety of factors. Vegetation patterns correspond with elevational changes and are dependent on precipitation, temperature, soils, aspect, slope, and disturbance history. Unique geologic and geomorphic conditions exist within the project area and affect plant habitats and species. The primary parent rock types around Lake Oroville are granitic, volcanic, metamorphic, and sedimentary. Unique formations include serpentine outcrops located within the West Branch and Big Bend area of the North Fork arm of the reservoir and gabbro-derived soils located along the South Fork arm. Vernal pools and swale complexes are a common part of the valley grassland habitats below Lake Oroville. These pools are of the Northern Hardpan type that occurs in areas of hummocky ground on terrace-alluvial derived Redding soils (DFG 1998). These formations tend to support a number of endemic and rare plant species.

Operation of the Oroville Facilities influences environmental conditions within and around Lake Oroville, its upstream tributaries, areas in and around the Thermalito Complex, and the OWA, as well as the Feather River floodplain below the project area. In general, the environmental effects on botanical resources of the Oroville Facilities may occur from: (1) reservoir operations and water releases; (2) timing, magnitude, frequency, and duration of water level fluctuations; (3) facility maintenance or development; (4) vegetation and/or wildlife habitat management; (5) noxious weed management; (6) road maintenance and development; and (7) recreational use or development and/or maintenance associated with recreation areas. These are the principal actions that were used to analyze potential effects on botanical resources.

Botanical field investigations included surveys for vegetation mapping, invasive weeds, special-status plant species, and riparian and wetland resources. Surveys were conducted during 2002, 2003, and 2004. Please refer to each study plan report for more detailed information.

<u>Vegetation Associations/Communities within the Project Area – Baseline</u>

The study area for the vegetation community/land use mapping included the Oroville Facilities FERC project boundary, a 1-mile area beyond the boundary, and the Feather River floodplain (within the Federal Emergency Management Area [FEMA] 100-year floodplain) downstream of the FERC project boundary. Vegetation community/land use types and acreages are identified in Table 5.6-1. Maps depicting the vegetation communities may be found in Figures 5.6-1a through 5.6-1j. A comprehensive

vegetative communities/land use map was developed based on field surveys and aerial photography.

Table 5.6-1. Vegetation/land use within the study area.

Community Type	FERC Project Boundary		1 Mile Outside FERC Project Boundary		Feather River Floodplain	
	Acres	%	Acres	%	Acres	%
Upland Forest/Woodland	11,101	27	62,145	62	64	<1
Upland Herbaceous	2,752	7	12,218	12	2,661	8
Upland Shrub/Scrub	232	<1	2,289	2	0	0
Agriculture	126	<1	10,063	10	16,174	51
Disturbed/Urban/Bare	2,328	5	10,333	10	3,084	8
Riparian Forest/Woodland	3,238	8	1,043	1	4,269	13
Riparian Shrub/Scrub	215	<1	286	<1	2,175	7
Wetland	912	2	348	<1	210	<1
Open Water	19,796	48	767	<1	3,151	10
Aquatic/Submerged	443	1	33	<1	90	<1
TOTALS	**41,143**	**98**	**99,525**	**97**	**31,878**	**97**

Source: SP-T4

Vegetation communities are broad categories that represent an assemblage of similar vegetation association types. Associations are typically defined by dominant or co-dominant species and are based in part on the classification systems of Sawyer and Keeler-Wolf (1995) and Holland (1986). In total, seven natural vegetative community types were identified in the study area: upland forest/woodland, upland herbaceous, upland shrub/scrub, riparian forest/woodland, riparian shrub/scrub, wetlands, and aquatic/submerged vegetation. Other areas were mapped based on land uses such as disturbed, agriculture, urban or as rock outcrop, or open water. Nearly half (20,000 acres) of the 41,000 acres within the FERC project boundary are surface waters. Discussion of these waters is not addressed here; however, plants that do inhabit backwaters and edges of these waters were mapped and are discussed under aquatic/submerged.

The majority of vegetation around Lake Oroville and the Diversion Pool consists of a variety of native vegetation associations including mixed oak woodlands, foothill pine/mixed oak woodlands, and oak/pine woodlands with a mosaic of chaparral. Open areas within the woodlands consist of annual grassland species. Below Oroville Dam and the Diversion Pool, vegetation around open waters of the Thermalito Complex consists of emergent wetland types with annual grasslands on the surrounding slopes. Open cottonwood riparian forests occur throughout much of the OWA, with mixed riparian and willow scrub near the Feather River.

Two types of special-status species habitat are found within the project area. Vernal pools and serpentine/gabbro soils were not mapped as part of the vegetation communities but were mapped as associations during special-status species surveys.

These unique communities were mapped using aerial photos, soils and geologic maps, and field surveys. These communities are listed in Table 5.6-1.

Upland Communities

Upland Forest/Woodland Community – The upland forest/woodland community is the largest community in the project area, occupying over 11,100 acres. Lands around Lake Oroville and the Diversion Pool are mostly composed of open to dense woodland, forest, and chaparral communities. Although there is some degree of disturbance (dirt roads, natural land slides, etc.) in these vegetation types, the majority of this area is in a mostly natural state.

Upland woodland/forests in the vicinity of the project area are comprised of a variety of mixed oak woodlands, foothill pine/mixed oak woodlands, and oak/pine woodlands with a mosaic of chaparral. Twenty-one associations of upland woodland/forest types were identified in the project area. Typical dominant species include interior and canyon live oaks (*Quercus wislizenii, Q. chrysolepis*), blue oak (*Q. douglasii*), and foothill pine (*Pinus sabiniana*). Blue oaks drop out fairly quickly as the dominant woodland type with distance upstream from the dam. Farther up the arms of the reservoir, live oaks and foothill pine are replaced by mixed hardwood/conifer types, comprised of ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), black oak (*Quercus kelloggii*), madrone (*Arbutus menziesii*), and canyon live oak.

Upland Herbaceous Communities – Approximately 392 acres of annual grasslands occur above the dam, usually as small openings among woodland, forest, and chaparral vegetation. Around Thermalito Forebay and Thermalito Afterbay, annual grasslands are the major upland vegetation type, occupying over 2,300 acres. Annual grasslands are comprised mostly of non-native annual grasses such as soft chess (*Bromus hordeaceus*), red brome (*B. madritensis* ssp. *rubens*), wild oats (*Avena* spp.), however, native forbs such as lupine (*Lupinus* spp.), clarkia (*Clarkia* spp.), and popcorn flower (*Plagiobothrys* spp.) and perennial bulbs such as brodiaea (*Brodiaea* ssp.), Mariposa lily (*Calochortus luteus)* are interspersed with the grasses. Some grassland areas are heavily infested with the noxious weeds yellow starthistle (*Centaurea solstitialis*) and medusahead grass (*Taeniatherum caput-medusae*).

Vernal pools and vernal pool/swale complexes are a common part of the valley grassland habitats in this area and are discussed in further detail under special-status plant habitats.

Upland Shrub/Scrub Communities – Approximately 232 acres of upland shrub/scrub communities (chaparral) occur within the FERC project boundary around Lake Oroville and the Diversion Pool. Shrub/scrub vegetation in the project vicinity consists mostly of chaparral vegetation, which is characterized by evergreen, tough waxy leaves. Common chaparral species include whiteleaf manzanita (*Arctostaphylos viscida*), buckbrush (*Ceanothus cuneatus*), toyon (*Heteromeles arbutifolia*), and scrub oak (*Quercus berberidifolia*). Chaparral is typically found on soils that are rocky or gravelly, and nutrient poor. Wildfire is a fundamental component of chaparral ecosystems, and

most species have adaptations that encourage regrowth after fire. Stands of chaparral that undergo many years without fire are extremely flammable due to accumulated standing dead vegetation, leaf litter, and resinous foliage.

Agricultural and Disturbed Lands

Agriculture – A small number of areas (126 acres) within the FERC project boundary are currently developed for agricultural uses. Approximately 100 acres within the grasslands surrounding Thermalito Afterbay have been converted to dryland cereal crop production for the benefit of waterfowl. Other agricultural types within the FERC project boundary include eucalyptus groves, deciduous and evergreen orchards, vineyards, and rice fields.

Disturbed/Urban/Bare – Approximately 2,300 acres of disturbed areas were mapped within the FERC project boundary, which include lands mostly barren of vegetation. These may be lands that have a high degree of human disturbance such as urban (developed) areas, levees, roads, gravel tailings from historic mining activities, gravel bars that result from natural processes, and natural rock outcrops.

Riparian Communities

The project area and the Feather River have a history of land uses that have affected natural river processes within the floodplain, including hydraulic mining, gravel mining, gold dredging, timber harvesting, construction of levees and dams, water diversion, agricultural encroachment, and urbanization. Historically, river systems in the project area were flanked by extensive floodplains that supported riparian forests and associated wetlands (Katibah 1984).

Riparian zones typically consist of a mosaic of vegetation types of various ages and species. Cottonwoods (*Populus fremontii*) and willows (*Salix* spp.) are usually the first species to colonize bare streambanks and bars. As vegetation from one cohort matures, it traps sediment and provides habitat for later successional species. Riparian shrub/scrub vegetation typically occurs along the margins of rivers and streams that are continually disturbed by point-bar deposition during higher flows.

A comprehensive vegetative/cover map was developed for riparian and wetland resources within the FERC project boundary and the Feather River FEMA 100-year floodplain downstream of Oroville Dam. A riparian and wetland resource study including riparian recruitment downstream of the dam was conducted under Study T-3/5 and may be found in Figures 5.6-2a through 5.6-2g.

Riparian Forest/Woodlands – Approximately 3,238 acres of riparian forest/woodland occur within the FERC project boundary. Over 2,450 acres of Fremont cottonwood forest occurs within the project area, most of which occurs in the OWA. Other riparian forest types in the OWA include valley mixed riparian (490 acres), mixed willow riparian (99 acres), and cottonwood/black willow riparian (117 acres). Eighteen acres of riparian vegetation dominated by valley oaks occur in and around the OWA.

A very small percentage of these habitat acreages occur upstream from the dam. Around Lake Oroville, native riparian habitats are restricted to narrow strips along drainages, consisting mostly of alders, willows, and occasional cottonwoods and sycamores. A small amount of riparian vegetation occurs around the Thermalito Complex. The north shore of Thermalito Forebay is lined with a thin strip of mixed riparian species (mostly willows) with an understory of emergent wetland vegetation. Cottonwoods and willows occur in scattered areas around the high water elevation of Thermalito Afterbay.

Riparian Shrub/Scrub – During relicensing studies, 215 acres of riparian shrub habitat were mapped within the project area. These shrub associations occur almost entirely along the Feather River directly upstream and downstream of the Thermalito Afterbay Outlet. They are a mix of species but are predominately Arroyo willow (*Salix lasiolepis*) and sandbar willow (*S. exigua*). Non-native species such as giant reed (*Arundo donax*) and scarlet wisteria (*Sesbania punicea*) are prominent in the riparian shrub community along the Feather River above the outlet in the Low Flow Channel.

Wetland/Aquatic Communities

Wetlands – Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency or duration to support a prevalence of hydrophytic vegetation (plants that are specially adapted to inundated or saturated soils). Wetlands generally include marshes, ponds, bogs, and vernal pools.

A total of 912 acres of wetland vegetation were mapped in the project area (Table 5.6-2), most of which occurs around Thermalito Afterbay. Less than 7 acres of wetland vegetation occurs around Lake Oroville and the Diversion Pool, mostly associated with seeps and springs that are a natural part of the landscape above the high water line. Approximately 42 acres of emergent wetland vegetation occur along the edges of ponds in the OWA.

Table 5.6-2. Acreages of wetland vegetation types for major project features.

	Thermalito Afterbay	Thermalito Forebay	Diversion Pool	Lake Oroville	OWA
Bulrush	<1	0	0	0	0
Cattail	<10	0	0	0	<1
Mixed emergent	234	10	0	<1	42
Rush	381	<1	0	<1	0
Rush/verbena	201	0	0	0	0
Verbena	36	<1	0	0	0
Seep/wet area	0	0	<1	6	0
Totals	**852**	**11**	**<1**	**6**	**42**

Source: SP-T3/5

Ninety-four percent of the wetland vegetation occurs around Thermalito Afterbay. The frequent and steady fluctuations of water levels support a lower band mixed emergent

species. Waterfowl brood ponds constructed in inlets of Thermalito Afterbay support emergent vegetation along much of their shores. More detail for wetlands maybe found in SP-T3/5.

Aquatic/Submerged – Aquatic/submerged vegetation refers to both the free-floating plant species that occur on small ponds and slow-moving or sheltered riverine backwaters and the submerged rooted vegetation common in the deeper ponds of the OWA.

A total of 443 acres of aquatic/submerged vegetation was mapped in the project area, approximately 400 acres of which is water primrose (*Ludwigia peploides*). Water primrose occurs along the margins of ponds, waterways, and backwaters of the Feather River. Free-floating plants include mosquito fern (*Azolla* spp.), duckweed (*Lemna* spp.), and watermeal (*Wolffia* spp.), which occur primarily in the smaller ponds or canals in the OWA.

Special-Status Plant Habitats

Vernal Pools

Vernal pools are seasonally flooded depressions that are underlain by a substrate that limits drainage. They result from a combination of soil conditions, summer-dry Mediterranean climate, topography, and hydrology and support specialized plants and animals, including a large number of threatened and endangered species.

Approximately 49 acres of vernal pools and ephemeral swales were mapped within the project area (Figures 5.6-1h through 5.6-1j). These pools range in size from very small (less than 3 ft diameter) to larger pools covering nearly an acre. Multiple-pool complexes range in size from 0.5 to 5 acres. The majority of pools are fairly shallow, although large deep pools also exist.

A total of 60 plant species were identified as occurring in vernal pools in the project area. Eleven of these species (18 percent) are non-native species. In comparison, 39 percent of the species found in the project area, excluding vernal pools and swales, are non-native species.

Serpentine and Gabbro

Vegetation types that occur on soils derived from serpentinitic and gabbroic rock types include sparse grassland, chaparral, and woodlands. Serpentine-derived soils tend to have low levels of nitrogen, phosphorus, and calcium, combined with high levels of magnesium and potentially toxic elements such as nickel, chromium, and cobalt. Gabbro-derived soils tend to be mildly acidic and are rich in iron and magnesium and often contain other heavy metals such as chromium. These soil types support unique assemblages of plant species with many endemic species, including a high number of special-status plant species and support a high level of plant diversity. Serpentine and

gabbro soils in the project area are potential and suitable habitat for the federally listed Layne's ragwort (*Senecio layneae*).

Approximately 172 acres of serpentinite and serpentine-derived soils occur in the project area (Figures 5.6-1a and 5.6-1b). Numerous northwest to southeast trending bands of serpentine occur in the North Fork and West Branch arms of Lake Oroville. Vegetation typically consists of sparse foothill pines and scattered chaparral shrubs. These outcrops harbor many endemic species including two special-status plant species: cut-leaved ragwort (*Senecio eurycephalus* var*. lewisrose*i) and Butte County calycadenia (*Calycadenia oppositifolia*).

Approximately 64 acres of gabbro and gabbro-derived soils occur in the project area along the South Fork arm of Lake Oroville (Figure 5.6-1f). Plant species composition is similar to surrounding vegetation, typically a mix of moderate to dense foothill or ponderosa pine and mixed oak woodland. One special-status species, Brandegee's clarkia (*Clarkia brandegeae*), was observed on gabbro soils.

Feather River Floodplain

The Feather River extends for approximately 55 miles below the FERC project boundary before the confluence with the Sacramento River. Approximately 32,000 acres occur within the Feather River FEMA 100-year floodplain outside the FERC project boundary and downstream of Lake Oroville.

Although the Feather River is tightly restricted by levees in some areas, much of the river has large set-back levees, forming a wide floodplain. Over half of the floodplain has been converted to agriculture.

Invasive Non-native Plant Species

Nearly all plant communities within the project vicinity have invasive and/or noxious weed species as a component. A noxious weed as defined by the California Department of Food and Agriculture (DFA) means any "species of plant that is, or is liable to be, troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate" (DFA Website). An invasive species is defined by the National Invasive Species Council under Executive Order 13112 as "a species that is (1) non-native (or alien) to the ecosystem under consideration, and (2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health" (Center for Invasive Plant Management Website).

Sixty-four species of noxious or invasive plant species listed by DFA, the California Invasive Plant Council, the U.S. Department of Agriculture, and the Plumas National Forest have potential to occur within the project area. During relicensing surveys, all non-native species were identified in the project area and the distributions and densities of all listed species were mapped and recorded. Thirty-nine of the 64 target weed species were identified and mapped within the project area during 2002 and 2003.

Twenty of the highest rated target weed species were identified in the project area during 2002 and 2003 surveys (Table 5.6-3).

The numbers of weed species and infestations are substantially greater in lower elevation riparian and wetland areas than in upland communities, especially where some disturbance has occurred. Eighteen of the species in Table 5.6-3 were found below Oroville Dam in the OWA and in and around the Thermalito Complex. Eleven of these species were found around Lake Oroville. Overall, 219 species of non-native plants were identified in the project area.

Species of greatest concern near the Thermalito Complex include purple loosestrife (*Lythrum salicaria*), giant reed, tree of heaven (*Ailanthus altissima*), yellow starthistle, and scarlet wisteria. Within the surrounding grasslands, yellow starthistle and medusahead are most widespread and have most likely affected native plant species to the greatest extent. Approximately 85 of the ~900 acres of wetland/riparian margin of Thermalito Afterbay contain varying densities of purple loosestrife. Please refer to SP-T7 for maps and more detailed discussions. This species affects both native vegetation and wintering waterfowl nesting habitat.

Noxious weed species in the project area are most prolific in the OWA. The species of greatest concern to native riparian and wetland plant communities and wildlife habitat in this area include giant reed, tree of heaven, scarlet wisteria, parrots feather (*Myriophyllum aquaticum*), and Himalayan blackberry (*Rubus discolor*). Tree of heaven is intermingled with the valley elderberry (*Sambucus mexicanus*), habitat for the federally threatened valley elderberry longhorn beetle, in approximately 250 acres of the OWA.

Water primrose (*Ludwigia peploides*) is an aquatic plant species that occurs along the margins of ponds, waterways, and backwaters of the Feather River. Both the native (ssp. *peploides*) and non-native (ssp. *montevidensis*) subspecies occur in the area. This perennial species grows in dense mats and has been increasing in abundance since the mid 1990s. This increase has caused adverse ecological effects on several important fish species in the OWA. It has, however, increased habitat for the federally and State-listed giant garter snake.

Numerous noxious weed species occur around Lake Oroville, primarily in disturbed areas near roads, trails, and facilities, and in the immediate vicinity of the spillway and the associated power facilities. The species identified as those of greatest concern are skeleton weed (*Chondrilla juncea*); French, Spanish, and Scotch brooms (*Genista monspessulana, Spartium junceum, Cytisus scoparius*); Himalayan blackberry; and tree of heaven. Other species include edible fig (*Ficus cariea*) and starthistle.

Table 5.6-3. Target weed species identified in the project area.

Genus species **Common name**	**Cal-IPC List***	**DFA List****	**Around Lake Oroville**	**Below Oroville Dam**
Ailanthus altissima Tree of heaven	A-2	-	x	x
Arundo donax Giant reed	A-1	-	-	x
Bromus madritenis ssp. *rubens* Foxtail chess	A-2	-	x	x
Centaurea solstitialis Yellow starthistle	A-1	C	x	x
Chondrilla juncea Skeleton weed	-	A	x	-
Cortaderia selloana Pampas grass	A-1	-	-	x
Cytisus scoparius Scotch broom	A-1	C	-	x
Eucalyptus globulus Blue-gum eucalyptus	A-1	-	-	x
Ficus carica Edible fig	A-2	-	x	x
Foeniculum vulgare Fennel	A-1	-	x	x
Genista monspessulana French broom	A-1	C	x	x
Lythrum salicaria Purple loosestrife	Red Alert	B	-	x
Mentha pulegium Pennyroyal	A-2	-	-	x
Myriophyllum aquaticum Parrot feather	B	-	-	x
Myriophyllum spicatum Eurasian milfoil	A-1	-	-	x
Rubus discolor Himalayan blackberry	A-1	-	x	x
Sapium sebiferum Chinese tallow tree	Red Alert	-	x	-
Saponaria officinalis Bouncing-bet	A-2	-	-	x
Sesbania punicea Scarlet wisteria	Red Alert	-	-	x
Spartium junceum Spanish broom	B	-	x	-
Taeniatherum caput-medusae Medusahead	A-1	C	x	x

** California Invasive Plant Council List of Exotic Pest Plants of Greatest Ecological Concern: List A-1: Most invasive wildland pest plants, widespread; List A-2: Most invasive wildland pest plants, regional; List B: Wildland pest plants of lesser invasiveness; List Red Alert: Species with potential to spread explosively, infestation currently restricted.*
*** California Department of Food & Agriculture List of Noxious Weeds: List A: Most invasive wildland pest plants - eradication, containment or other holding action at the State-County level; List B: Includes species less widespread and more difficult to contain - eradication, containment, control or other holding action at the discretion of the Commissioner; List C: Weeds that are so widespread that the agency does not endorse State or County-funded eradication except in nurseries.*
Source: SP-T7

Special-Status Plant Species

Species identified here as special-status species include rare plants that are currently listed by the USFS and/or BLM as Sensitive or Special Interest Species and taxa on the California Native Plant Society (CNPS) Lists 1, 2, and 3. Species listed by USFWS as federally Threatened, Endangered, or Candidate species are addressed in Section 5.7. All California-listed species with potential to occur in the project area are also federally listed species and are addressed in Section 5.7.

A list of 51 special-status plant species with the potential to occur in the project area was developed based on information compiled from USFWS (1999 and 2002); the DFG (2002), Natural Diversity Database records (CNDDB); the CNPS Inventory (2001); Plumas National Forest Sensitive and Special Interest Plant list (USFS 2003); DFG's Special Plants List (DFG 2001); and the USFS Pacific Southwest Region Sensitive Plant list (USFS 1998). Botanical surveys were conducted in accordance with standard guidelines issued by DFG (2000), USFWS (1996), and the CNPS (2001). Relicensing studies indicate the presence of suitable habitat within the project area for 41 vascular plant species, 2 bryophytes (mosses), and 1 lichen species (Table 5.6-4). Detailed descriptions and analysis are included in SP-T2.

Fourteen special-status plant species were found within the project area during relicensing studies, as listed in Table 5.6-4. Five of these species were found within the OWA and Thermalito Complex. Four-angled spikerush and Sanford's arrowhead were found around the margins of Thermalito Afterbay. Four-angled spikerush was also found bordering Thermalito Forebay, small ponds in the OWA, and the larger One-Mile Pond in the OWA. Fox sedge was found bordering the Diversion Pool. Columbian watermeal was found in a number of ponds in the OWA. Ahart's paronychia was located along the margins of vernal pools south of Thermalito Forebay.

Nine special-status species were found in upland habitats around the Diversion Pool and/or lands around Lake Oroville. These include Butte County calycadenia, dissected-leaved toothwort, Brandegee's clarkia, white-stemmed clarkia, Mosquin's clarkia, Butte County fritillary, cut-leaved ragwort, Humboldt lily, and shield-bracted monkeyflower.

Table 5.6-4. Special-status plant species with potential for occurring within the study area.

Scientific name **Common name**	**Status FWS1/ CNPS2/PNF3**	**Habitat (elevation)**	**Found in Project Area**
Agrostis hendersonii Henderson's bent grass	SC/3/--	Valley and foothill grassland (mesic), vernal pools (70-305 m)	
Allium jepsonii Jepson's onion	SC/1B/--	Cismontane woodland, lower montane conifer forest/ serpentinite or volcanic (300-1,160 m)	
Allium sanbornii var. *sanbornii* Sanborn's onion	--/4/SI-1	Chaparral, cismontane woodland, lower montane conifer forest/ usually serpentinite, gravelly (260-1,410 m)	
Arenaria "grandiflora" Large-flowered sandwort	--/4/SI-1	Granite sand on road banks and openings in woods (500-1,000 m)	

Table 5.6-4. Special-status plant species with potential for occurring within the study area.

Scientific name **Common name**	**Status FWS1/ CNPS2/PNF3**	**Habitat (elevation)**	**Found in Project Area**
Balsamorhiza macrolepis var. *macrolepis* Big-scale balsamroot	--/1B/SI-1	Chaparral, cismontane woodland, valley and foothill grassland / sometimes serpentinite (90-1,400 m)	
Calycadenia oppositifolia Butte County calycadenia	--/1B/S	Chaparral, cismontane woodland, lower montane conifer forest, meadows and seeps, valley and foothill grassland/ volcanic or serpentinite (215-945 m)	Yes
Calystegia atriplicifolia ssp. *buttensis* Butte County morning glory	SC/1B/--S	Lower montane conifer forest (600-1,200 m)	
Cardamine pachystigma var. *dissectifolia* Dissected-leaved toothwort	--/3/SI-1	Chaparral, lower montane conifer forest/ usually serpentinite, rocky (255-2,100 m)	Yes
Carex vulpinoidea Fox sedge	--/2/--	Marshes and swamps (freshwater), riparian woodland (30-1,200 m)	Yes
Castilleja rubicundula ssp. *rubicundula* Pink creamsacs	--/1B/--	Chaparral (openings), cismontane woodland, meadows and seeps, valley and foothill grassland/ serpentinite (20-900 m)	
Clarkia biloba ssp. *brandegeae* Brandegee's clarkia	--/1B/S	Chaparral, cismontane woodland/ often roadcuts (295-885 m)	Yes
Clarkia gracilis ssp. *albicaulis* White-stemmed clarkia	--/1B/S	Chaparral, cismontane woodland/ sometimes serpentinite (245-1,085 m)	Yes
Clarkia mildrediae ssp. *lutescens* Golden-anthered clarkia	--/4/SI-1	Cismontane woodland, lower montane conifer forest (openings)/ often roadcuts (275-1,750 m)	
Clarkia mildrediae ssp. *mildrediae* Mildred's clarkia	--/1B/SI-1	Cismontane woodland, lower montane conifer forest/ sandy, usually granitic (245-1,710 m)	
Clarkia mosquinii Mosquin's clarkia	SC[4]/1B/S	Cismontane woodland, lower montane conifer forest/ rocky, roadsides (185-1,170 m)	Yes
Cypripedium fasciculatum Clustered lady's slipper	SC/4/S	Lower montane conifer forest, north coast conifer forest/ usually serpentinite seeps and stream beds (100-2,435 m)	
Downingia pusilla Dwarf downingia	--/2/--	Valley and foothill grassland (mesic), vernal pools (1-445 m)	
Eleocharis quadrangulata Four-angled spikerush	--/--/2/--	Marshes and swamps (freshwater) (30-500 m)	Yes
Fritillaria eastwoodiae Butte County Fritillary	SC/3/S	Chaparral, cismontane woodland, lower montane conifer forest (openings)/ sometimes serpentinite (50-1,500 m)	Yes
Fritillaria pluriflora Adobe-lily	SC/1B/--	Chaparral, cismontane woodland, valley and foothill grassland/ often adobe (60-705 m)	

Table 5.6-4. Special-status plant species with potential for occurring within the study area.

Scientific name **Common name**	**Status FWS1/ CNPS2/PNF3**	**Habitat (elevation)**	**Found in Project Area**
Hibiscus lasiocarpus Rose-mallow	--/2/--	Marshes and swamps (freshwater) (0-120 m)	
Juncus leiospermus var. *ahartii* Ahart's dwarf rush	SC/1B/--	Valley and foothill grasslands (mesic) (30-100 m)	
Juncus leiospermus var. *leiospermus* Red Bluff dwarf rush	--/1B/--	Chaparral, cismontane woodland, meadows and seeps, valley and foothill grassland, vernal pools/ vernally mesic (35-1,020 m)	
Lewisia cantelovii Cantelow's lewisia	--/1B/S	Broadleaved upland forest, chaparral, cismontane woodland, lower montane conifer forest/ mesic, granitic, serpentinite seeps (385-1,370 m)	
Lilium humboldtii ssp. *humboldtii* Humboldt lily	--/4/SI-1	Chaparral, lower conifer forest/ openings (30-1,800 m)	Yes
Lupinus dalesiae Quincy lupine	--/1B/S	Chaparral, cismontane woodland, lower/ upper montane conifer forest, openings, often in disturbed areas (855-2,500 m)	
Mimulus glaucescens Shield-bracted monkeyflower	--/4/SI-1	Chaparral, cismontane woodland, lower montane conifer forest, valley and foothill grassland/serpentinite seeps (60-1,240 m)	Yes
Monardella douglasii ssp. *venosa* Veiny monardella	SC/1B/--	Cismontane woodland, valley and foothill grassland (heavy clay) (60-410 m)	
Myosurus minimus ssp. *apus* Little mousetail	SC/3/--	Valley and foothill woodland, vernal pools (alkaline) (20-640 m)	
Paronychia ahartii Ahart's paronychia	SC/1B/--	Cismontane woodland, valley and foothill grassland, vernal pools (30-510 m)	Yes
Penstemon personatus Closed-throated beardtongue	SC/1B/S	Chaparral, lower/upper montane conifer forest, metavolcanic (1,065-2,120 m)	
Perideridia bacigalupii Bacigalupi's yampah	--/4/SI-1	Chaparral, lower montane conifer forest/ serpentinite (450-1,000 m)	
Rhynchospora californica California beaked-rush	SC/1B/--	Bogs and fens, lower montane conifer forest, meadows and seeps, marshes and swamps (freshwater) (45-1,010 m)	
Rhynchospora capitellata Brownish beaked-rush	--/2/SI-1	Lower/upper montane conifer forest, meadows and seeps, marshes and swamps, mesic (455-2,000 m)	
Sagittaria sanfordii Sanford's arrowhead	SC/1B/--	Marshes and swamps (assorted shallow freshwater) (0-610 m)	Yes
Sedum albomarginatum Feather River stonecrop	--/1B/S	Chaparral, lower montane conifer forest/ serpentinite (260-1,785 m)	

Table 5.6-4. Special-status plant species with potential for occurring within the study area.

Scientific name **Common name**	**Status FWS1/ CNPS2/PNF3**	**Habitat (elevation)**	**Found in Project Area**
Senecio eurycephalus var. *lewisrosei* Cut-leaved ragwort	--/1B/S	Chaparral, cismontane woodland, lower montane conifer forest/ serpentinite (550-1,470 m)	Yes
Sidalcea robusta Butte County checkerbloom	SC/1B/--	Chaparral, cismontane woodland (90-1,600 m)	
Silene occidentalis ssp. *longistipitata* Long-stiped catchfly	SC/1B/SI-1	Chaparral, lower/upper montane conifer forest (1,000-2,000 m)	
Trifolium jokerstii Butte County golden clover	--/1B/SI-1	Valley and foothill grassland (mesic), vernal pools (50-385 m)	
Wolffia brasiliensis Columbian watermeal	--/2/--	Marshes and swamps (assorted shallow freshwater) (30-100 m)	Yes
Bryophytes			
Bruchia bolanderi Bolander's bruchia moss	--/2/S	Lower/upper montane conifer forest, meadows and seeps, damp soil (600-1,700 m)	
Mielichhoferia elongata Elongate copper moss	--/2/SI-1	Cismontane woodland (metamorphic rock, usually vernally mesic) (500-1,300 m)	
Lichens			
Hydrothyria venosa Waterfan	--/--/S	Attached to rocks in cool mountain brooks and streams; submerged	

[1] USFWS: SC - federal species of concern (not a formal listing).
[2] CNPS: List 1B - plants rare, threatened, or endangered in California and elsewhere; List 2 - plants rare, threatened, or endangered in California but more common elsewhere; List 3 - plants about which more information is needed; List 4 - plants of limited distribution.
[3] Plumas National Forest (PNF): S - Sensitive; SI-1 - Special Interest category 1 (Survey and recommend conservation measures).
[4] USFWS recognizes two subspecies of Clarkia mosquinii, ssp. mosquinii and ssp. xerophila, both as SC.
Source: SP-T2

Baseline Project Conditions

Baseline project operations, land management practices, and project-related recreation activities have the potential to affect botanical resources in the project area including vegetation communities, riparian resources, non-native invasive plant species, and special-status plant species. Direct and indirect as well as short and long-term effects may result in changes to the dynamics and stability of existing botanical resources, including changes in species diversity and distribution. Direct and indirect effects result from:

- *Lake Oroville Water Level Fluctuations*: Water levels in Lake Oroville fluctuate in response to power production, flood management, and water withdrawals for irrigation or municipal water use. The large daily and seasonal fluctuations in Lake Oroville water level, in addition to the reservoir's steep slopes and poor soils, adversely affect the establishment of hydrophytic plant species and the development of typical littoral and riparian communities along the shoreline. Few

species can withstand inundation for periods of time that are typical within the drawdown zone of the reservoir as well as the dry harsh conditions of summer and fall. Areas exposed by a spring/early summer drawdown may support some vegetation where conditions are favorable, but plant diversity is often low and may be dominated by non-native invasive species. Habitat improvements for warmwater game fish in Lake Oroville have included planting of willows (*Salix* sp.) and buttonbush (*Cephalanthus occidentalis*) within select areas along the reservoir shoreline. These have been moderately successful and have had a moderately beneficial effect on both riparian communities along the shoreline and warmwater fish habitat.

- *Thermalito Complex Water Level Fluctuations*: Water released for daily peak power generation and pump-back operations results in minimal water level fluctuations in the Diversion Pool, Power Canal, and Thermalito Forebay. The relatively consistent water level in the forebay maintains a narrow wetland/ riparian zone. One special-status species (four-angled spikerush) occurs in the wetland margin of Thermalito Forebay. The water levels in the forebay have a beneficial effect on both wetland vegetation and special-status species habitat. Thermalito Afterbay, however, fluctuates on a daily/weekly cycle. Over 900 acres of wetland habitat occur along the north and east edges of the afterbay. The frequent water level fluctuations within this shallow reservoir adversely affect the structural and species diversity of the wetland vegetation and create optimal conditions for the non-native invasive species, purple loosestrife (*Lythrum salicaria*). This species has replaced and affected native wetland plant species and occupies over 85 acres of the ~900 acres of the wetland.

  Two special-status species (four-angled spikerush and Sanford's arrowhead) occur within the wetland margins of the afterbay and associated brood ponds. These species cannot tolerate the periods of drawdown in the afterbay and are restricted to low areas within the wetland margin or in the brood pond margins where a more constant water source is maintained. The relatively consistent water levels in the brood ponds and low-lying areas around the afterbay have a beneficial effect and provide and maintain habitat for these species.

- *Discharge to the Feather River*: Riparian vegetation along the Feather River has been affected by a number of causes including historic hydraulic mining, historic and current land uses, flood management levees, flow regulation, and the presence of dams including Oroville Dam. Historically, rivers in this area experienced high flows from December through March with snowmelt keeping the water levels high through late spring. These types of flows provide sediment for floodplain deposition and scour fresh surfaces for germination of early successional riparian species.

  Under current operations, Lake Oroville is managed to capture winter and spring rains. Water is released from Lake Oroville to the Feather River as needed to meet water supply, flood management, power generation, water quality improvement, and fish and wildlife enhancement. The amount and timing of

project-related flows downstream of Lake Oroville could adversely affect the extent, distribution, composition, and function of riparian vegetation along the Feather River.

Low Flow Channel - Flows in the Low Flow Channel (between Thermalito Diversion Dam and the Afterbay Outlet) are maintained year round at a minimum flow of 600 cfs, except during large flood events. Levees severely restrict the floodplain in this reach, and piles of dredger tailings have replaced the natural floodplain soils increasing the floodplain elevation along the river. The vegetation along this reach is characterized by a high percentage of non-native invasive species and a lack of well-developed woody riparian vegetation. During low flows, riparian vegetation such as alder and non-native species grow within the active channel along the edges of the Feather River. This vegetation gets scoured when flows are high, such as during releases for flood management. This flow management results in an adverse effect on riparian plant communities because the vegetation remains in an early successional stage of development and favors noxious/invasive weed species.

High Flow Channel - Flows below the Thermalito Afterbay Outlet typically are reduced dramatically after winter high flow events, and remain low until irrigation demands increase flows in June through September. These flows dramatically drop after downstream irrigation demands decrease and before the winter rains begin. Levees outside the FERC project boundary along the High Flow Channel reduce the available floodplain along portions of the river. Although large set-back levees occur along much of the river, the majority of this floodplain has been converted to agriculture. In addition, levees and banks have been artificially stabilized by other entities, resulting in additional impaired riparian recruitment. The riparian forests downstream of the project area are commonly fragmented and narrow with little to no understory compared to historic riparian forests in the area. Although project flows have less effect in these areas than the effect of agriculture and urbanization, they do affect riparian recruitment. In areas where large meander bends occur, large patches of riparian habitat exist. These existing riparian plant communities are experiencing little or no recruitment of new riparian species. Riparian vegetation away from the active channel that would normally be maturing into a later successional stage is composed of large, older cottonwoods with relatively low structural and species diversity. These forests are not replacing themselves as the older trees die out. The general lack of riparian recruitment observed during riparian/recruitment studies (DWR 2004a), as well as the low structural and species diversity, is an adverse effect associated with the current flow regime that affects the long-term health of the riparian communities downstream of the project area.

- *Ground/Soil Disturbance from Operations and Maintenance Activities*: Project area land management agencies including DWR, DFG, and DPR conduct a wide variety of maintenance activities within the Project area. Some of these activities affect plant habitats. These activities include maintenance of roads and parking lots, levees, and transmission line rights-of-way. Road maintenance activities

have the potential to adversely affect plant communities through direct removal or by disturbance activities that tend to promote the establishment of non-native invasive species. Wetlands can be affected by operations and maintenance activities that change drainage flows or patterns or that result in direct physical disturbance. Natural areas immediately adjacent to disturbed sites tend to have a high percentage of non-native species. The replacement of native vegetation with non-native invasive species is considered an adverse effect. Utility line corridors are cleared of trees and shrubs as they encroach into the corridor. This disturbance promotes establishment of invasive species along the edges of the corridor. These plants tend to move into the adjacent natural areas and adversely affect botanical resources. Invasive weeds are currently controlled within the project area along roadways and around project facilities.

- *Disturbance from Project-Related Recreation*: Botanical resources may be directly and indirectly affected by project-related recreation. Recreation within the project area includes recreational related disturbances within the project area could result from O&M, enhancement, and/or construction of facilities and recreation activities including boating, fishing, camping, and hiking.

  Facilities Maintenance - DWR, DPR, and DFG conduct maintenance activities associated with the various recreation areas. GIS data analysis identified approximately 90 acres of trails and a number of roads associated with recreation. Maintenance activities include surface repair and vegetation management by pruning, removal, and/or herbicide treatment. These activities can result in ground disturbance that can introduce invasive species into the adjacent natural areas and adversely affect botanical resources. A number of special-status plant populations occur in and/or near recreation areas. Improvement to roads, trails, and/or camping areas may have an adverse effect on these species.

  Recreational Use - Recreational use impact studies indicate that there are some moderate adverse effects on vegetation at the Thermalito Afterbay Outlet and the Stringtown Car-top Boat Ramp. Adverse effects on upland vegetation types from dispersed recreation were highest from user-defined trails where vegetation was removed and/or trampled. Most were in steep areas leading to the water's edge of Lake Oroville, which in turn has created soil erosion problems. Direct damage to vegetation also occurs at a number of dispersed recreation sites. These activities also provide disturbance areas for invasion by noxious species.

- *Wildlife Habitat and Vegetation Management*: DFG conducts a habitat enhancement program in the OWA that includes the planting of upland nesting cover and foraging vegetation for waterfowl. Approximately 200 acres of land are tilled and planted each year. These plantings consist of a variety of non-native invasive species that have spread into adjacent grasslands and vernal pool habitats replacing native plant species and lowering native plant diversity. This action adversely affects both native plant communities and special-status species habitats by degradation and introduction of non-native invasive plant species.

Fire suppression has resulted in adverse effects by limiting suitable habitat for some special-status plants that inhabit openings in woodland and chaparral communities. Lack of fire has resulted in unnatural monotypic, even-aged, dense stands of brush. Vegetation densities within the project area are relatively high, especially in upland habitats around Lake Oroville and the Diversion Pool. Continued fire suppression would result in the reduction of special-status plant habitat within these communities.

5.6.1.2 Wildlife Resources

This section describes the affected environment as it relates to wildlife resources including wildlife habitats, wildlife species richness, non-native species, and commercially or recreationally important wildlife species in the project area and current wildlife management activities.

Wildlife and wildlife habitats in the project area are greatly influenced by the project's proximity to the Sierra Nevada, the Sacramento Valley, an abundance of surface water associated with the Oroville Facilities and the Feather River, and adjacent land uses. The diversity of wildlife habitats within and adjacent to the project area also reflects variability in slope, aspect, precipitation, elevation, hydrology, land use, and localized edaphic conditions. Wildlife habitats in the project area support a variety of wildlife species, including numerous recreationally and commercially important species as well as special-status species.

Wildlife habitats in the project area are managed by several land management agencies including the U.S. Forest Service (USFS), U.S. Bureau of Land Management (BLM), DPR, DFG, and DWR. Project area lands are managed under six federal, State, and local land resource management plans: DWR Proposed Amended Recreation Plan for Lake Oroville State Recreation Area, USFS Plumas National Forest Land and Resource Management Plan (PNF 1988) as amended by the Sierra Nevada Forest Management Plan (USFS 2001) including provisions of the Herger-Feinstein Quincy Library Group Forest Recovery Act of 1998; BLM Redding Resource Management Plan (BLM 1993); DPR Resources Management Plan and General Development, Lake Oroville State Recreation Area (DPR 1973), DFG Oroville Wildlife Management Area Management Plan (DFG 1978) and Management Plan for the Thermalito Afterbay Unit of the OWA (DFG no date), Land Management Plan for the Protection of the Potential Habitats of Special Status Species of Fairy and Tadpole Shrimp (DWR 2004a), and three Bald Eagle Nest Territory Management Plans (DWR 2004b, 2004c, 2004d). Because this document contains sensitive information on the location and nature of endangered species, it is considered confidential and is exempt from Freedom of Information Act regulations.

The principal wildlife resource statutes forming the basis for land management activities regarding management of wildlife resources and considered in development and implementation of the relicensing studies include the Federal Power Act of 1920, as amended, the Endangered Species Act (ESA) of 1973, as amended, California Endangered Species Act (CESA), federal Fish and Wildlife Coordination Act, federal

Migratory Bird Treaty Act of 1972, federal Bald Eagle Protection Act of 1940, as amended, National Environmental Protection Act (NEPA) and California Environmental Quality Act (CEQA). The US Bureau of Land Management (BLM) and US Forest Service (USFS) sensitive species management guidelines, and various DFG code sections, including Section 3500 were also considered. Descriptions of the acts are provided in Chapter 4.0, Section 4.2.

Detailed field investigations were completed during 2002, 2003, and 2004 within the project area and focused on addressing management issues identified during scoping. Field investigations included surveys of wildlife habitats and species, special-status wildlife species, non-native species, and recreationally/commercially important species; results are reported in the final Study Plan Reports SP-T1, *Effects of Project Operations and Features on Wildlife and Wildlife Habitat*; SP-T2; SP-T4; SP-T6, *Interim Interagency Wildlife Management Coordination and Wildlife Management Plan Development*; SP-T8, *Project Effects on Non-Native Wildlife*; SP-T9, *Recreation and Wildlife;SP-T11,Effects of Fuel Load Management and Fire Prevention on Wildlife and Plant Communities*. The studies were conducted in the same study area described for botanical resources (Section 5.6.1). Detailed descriptions of the study area, methods and results are contained in the individual relicensing study plan reports.

This section briefly describes wildlife habitats, wildlife species richness, non-native species, and commercially or recreationally important wildlife species in the project area and current wildlife management activities. Federally listed wildlife species that potentially occur in the project area are addressed in Section 5.7.

Wildlife Habitats

Twenty-four habitat types (using the CWHR classification system) occur within the project area as listed on Table 5.6-5 and described in SP-T4. The distribution of these habitats is shown on Figures 5.6-3a through 5.6-3e. Principal wildlife habitat types include lacustrine (open water), montane hardwood, blue oak/foothill pine, valley/foothill riparian, montane hardwood/conifer, annual grassland, barren, freshwater emergent wetland, urban, and blue oak woodland. The dominant habitat type is lacustrine which covers 19,851 acres (about 48 percent) of the project area. Tree-dominated habitats cover about 36 percent of the project area. Riparian woodlands along the Feather River and dominated by cottonwoods and willows represent about 8 percent of the total wildlife habitat. The 12 least common habitat types, Douglas-fir, Sierra mixed conifer, dryland grain, montane riparian, deciduous orchard, valley oak woodland, evergreen orchard, irrigated hayfield, ponderosa pine, eucalyptus, pasture, and vineyard, occur on less than 1 percent of the project area. However, three of these uncommon habitat types (eucalyptus, montane riparian, and valley oak woodland) exhibit high species richness values (SP-T4).

Table 5.6-5. Summary of wildlife habitat acreages within the project area.

CWHR Habitat Type	Total Acres Within Project Area	Percentage of Project Area
Lacustrine	19,851.9	48.2
Montane hardwood	3,295.0	8.0
Blue oak/foothill pine	3,518.8	8.6
Valley foothill riparian	3,398.1	8.3
Montane hardwood/conifer	3,179.8	7.7
Annual grassland	2,751.5	6.6
Barren	1,394.4	3.4
Freshwater emergent wetland	911.6	2.2
Urban	868.2	2.1
Blue oak woodland	793.3	1.9
Riverine	452.9	1.1
Mixed chaparral	234.3	0.6
Douglas-fir	169.6	0.4
Sierra mixed conifer	112.5	0.3
Dryland grain	98.3	0.2
Montane riparian	54.3	0.13
Deciduous orchard	11.0	<0.1
Valley oak woodland	9.8	<0.1
Evergreen orchard	8.1	<0.1
Irrigated hayfield	3.3	<0.1
Ponderosa pine	3.2	<0.1
Eucalyptus	2.6	<0.1
Pasture	0.7	<0.1
Vineyard	0.2	<0.1

CWHR = California Wildlife Habitat Relationships database
Source: SP-T4

Habitat types in the project area have undergone varying degrees of disturbance from both natural and human-induced changes. Pre-project land management related disturbances (fire/logging) may be responsible for the preponderance of small to medium size classes of tree habitat types, and lack of decadent size classes of chaparral stands indicate recent disturbance. Valley foothill riparian habitat along the Feather River has experienced perturbations dating to the 1800s with hydraulic gold mining, as described in Section 5.6.1.

A brief description of the predominant habitat types within the project area is presented below.

*Lacustrine habita*t includes lakes, reservoirs, and ponds greater than 5 acres in size containing standing water (Mayer and Laudenslayer 1988). Lacustrine habitat is subdivided into the limnetic zone (deep open water), littoral zone (shallow water areas where light penetration occurs to the bottom), and shore (water border with less than 2 percent vegetative cover). Lacustrine habitat occurs in the project area at Lake Oroville, the Diversion Pool, Thermalito Forebay, and Thermalito Afterbay, as well as in ponded habitat along the Feather River.

Montane hardwood habitat is dominated by a pronounced hardwood layer with an infrequent and poorly developed shrub understory. This habitat occurs on steep and rocky substrates in the upper elevations of the project area. Discontinuous patches of montane hardwood/conifer habitat are present within the project area. This habitat is most common on north-facing slopes on the upper arms of Lake Oroville. This habitat becomes increasingly common at higher elevations upslope from the project area.

Blue oak/foothill pine habitat exhibits high structural and plant species diversity because of the presence of multilayered tree canopies, shrub understory, and herbaceous ground cover. This habitat is found in the foothill elevation of the project area.

Mature valley/foothill riparian habitat is structurally composed of a dominant deciduous overstory (California sycamore, valley oak, and cottonwood); an understory tree layer (white alder, Oregon ash); and a shrub layer (willows, poison oak, elderberries). Extensive stands of mature valley/foothill riparian habitat occur within the project area along the Feather River downstream of the community of Oroville. Narrow strips of riparian habitat also occur in association with the tributaries to Lake Oroville.

Annual grassland habitat is primarily composed of annual grasses and forbs and occurs in areas receiving less than 40 inches of precipitation per year. Moist areas within annual grasslands can support perennial species like purple needlegrass and Idaho fescue. Vernal pools can occur in annual grassland habitat where depressions are underlain by impervious clay or hardpan soils. Annual grassland habitat occurs around Thermalito Forebay, Thermalito Afterbay, the Thermalito Power Canal, upland locations along the Feather River, and in isolated patches within the blue oak/foothill pine habitat around Lake Oroville.

Barren habitats are defined as areas with less than 2 percent herbaceous cover and less than 10 percent tree cover. Within the project area, barren areas primarily include dredger tailings along the Feather River and in the OWA, unvegetated gravel bars, reservoir drawdown zones, and rock outcrops.

Emergent wetland habitats are dominated by short, erect, rooted hydrophytes (cattail, tule, bulrush) and occur in waters less than 6 ft in depth. Stands tend to be dense and structurally simple. Seasonal flooding restricts species diversity to those species adapted to anaerobic soil conditions. Emergent wetlands are a successional community developing from open water through time to upland habitat. Erosion rates control the rate of successional change. Strips of emergent wetland habitat are found around Thermalito Afterbay, Thermalito Forebay, within dredger ponds in the OWA, and in backwater areas along the Feather River. Emergent wetlands are generally absent within the drawdown zone of Lake Oroville or within the steeper drainages upslope from the reservoir.

Urban/disturbed habitat is structurally divided into five classes including tree grove, street strip, shade tree/lawn, lawn, and shrub cover (Mayer and Laudenslayer 1988). Urban habitats frequently exhibit high structural diversity, high plant species diversity, and extensive edge areas. Both native and non-native plant species occur. However,

non-native annual and perennial species are frequently dominant. Maintenance normally precludes community succession in urban/residential habitat. Areas mapped as urban habitat within the project area include man-made structures and recreational facilities.

Riverine habitat (streams and rivers) structure consists of open water (greater than 2 ft in depth), submerged near shore areas, and banks with less than 10 percent canopy cover (Mayer and Laudenslayer 1988). Riverine habitat occurs throughout the project area along the Feather River and its tributaries.

The extensive *riparian habitat* present within the OWA is the largest remaining block of riparian habitat along the Feather River and provides breeding habitat for a variety of neotropical migrants. These habitats also serve as nursery areas for many wildlife species including two large mixed heron/egret rookeries.

The 11,000-acre OWA, west of the City of Oroville, is managed by DWR and DFG for wildlife habitat and recreational activities. Habitats within the OWA include lacustrine, riverine, freshwater emergent, valley foothill riparian, and annual grassland and dryland grain/seed crops. This area includes 6,000 acres including and surrounding Thermalito Afterbay and the 5,000 acres adjacent to and straddling 12 miles of the Feather River. Past wildlife habitat enhancement programs have included wetland habitat enhancements, a wood duck/wildlife nest box program, and dryland farming for nesting cover and improved wildlife forage. Habitat quality in this area is adversely affected by historic dredger tailings within the Feather River floodplain.

Wildlife Species

The CWHR database was used to predict wildlife species occurrence within project area habitats. Observations of species were also noted during relicensing studies. Modeling results indicate that 334 wildlife species may occur within the size and density classes of habitat types present within the project area including 13 amphibians, 22 reptiles, 235 birds, and 64 mammals (SP-T4) and 6 federally listed species, 1 candidate species, 14 non-native species, and 55 recreationally and/or commercially important species.

Non-Native Wildlife Species

Fourteen non-native vertebrate wildlife species may occur within the project area including six birds, seven mammals, and one amphibian (Table 5.6-6). Several of these species were introduced by DFG as harvest species, or are currently managed as harvest species.

Relicensing studies summarized in SP-T8 indicate that bullfrog and wild turkey currently occur at population levels that may adversely affect native species or are in conflict with DPR management goals. Bullfrogs are present in high densities within the dredger ponds of the OWA. These population levels may be a factor in the low occurrence or absence of native ranids. Extensive control experimentation in California and elsewhere has not yielded viable control methods at this time. DPR considers the

relatively high population of non-native wild turkey in the Loafer Creek area as inappropriate in a State Park setting.

Table 5.6-6. List of non-native vertebrate wildlife potentially found within the project area.

Common Name	Scientific Name	Status
Bullfrog	*Rana catesbeiana*	DFG Harvest
House sparrow	*Passer domesticus*	-
Bobwhite quail	*Colinus virginianus*	DFG Harvest
Ring-necked pheasant	*Phasianus colchicus*	DFG Harvest
Wild turkey	*Meleagris gallopavo*	DFG Harvest
Rock dove	*Columba livia*	-
European starling	*Sturnus vulgaris*	-
Virginia opossum	*Didelphis virginiana*	DFG Harvest
Black rat	*Rattus rattus*	-
Norway rat	*Rattus norvegicus*	-
House mouse	*Mus musculus*	-
Muskrat	*Ondatra zibethicus*	DFG Harvest
Red fox	*Vulpes vulpes*	-
Feral pig	*Sus scrofa*	DFG Harvest

Source: SP-T8

Commercially and Recreationally Important Species

The project area provides seasonal or year-round habitat for a variety of commercially or recreationally important wildlife species. Fifty-five species classified as harvest species by DFG may occur within the project area (Table 5.6-7). Black-tailed deer are an important big-game species in eastern Butte County. The project area contains a portion of the winter range of two migratory deer herds (Bucks Mountain and Mooretown herds) as well as a small resident population.

Waterfowl are the most important (both commercial and recreational) group of wildlife in the lower elevation areas of Butte County. Lands managed for commercial grain production or natural wetlands support high wintering densities of ducks, geese, swans, and shorebirds. These lands also provide waterfowl nesting and brooding habitat. Waterfowl hunting access fees provide landowners with financial incentives to manage for waterfowl. Portions of the OWA within the FERC boundary are managed by DFG to provide habitat for nesting and wintering waterfowl. Approximately 3 percent of the recreational use of this Wildlife Area is related to hunting as indicated in SP-T9. The Thermalito Complex provides resting and foraging habitat for open water and diving waterfowl species (ruddy duck, bufflehead, scaup, ring-necked duck, common goldeneye, and common merganser), which is generally lacking in surrounding agricultural areas.

Upland game species including mourning dove, wild turkey, ring-necked pheasant, and several species of quail are found within the project area and provide hunting opportunities on adjacent private lands as well as on some public lands, including the OWA.

Numerous furbearers including badger, mink, beaver, raccoon, gray fox, weasels, muskrat, bobcat, and opossum may occur in the project area. However, current commercial harvest of these species within the project area is believed to be negligible. Use of steel leg-hold traps is currently prohibited in California.

Non-consumptive uses (bird watching, sightseeing, or nature study) are estimated to be greater than all wildlife-related consumptive use combined within the project area on an annual basis as indicated in SP-T9. Students from local colleges, high schools, and elementary schools make use of the project area for nature/biological education and study.

State Listed Species

Seven State-listed wildlife species may occur within the project vicinity (Table 5.6-8). Species protected under both the State and federal endangered species acts (e.g., bald eagle, giant garter snake, and yellow-billed cuckoo) are addressed separately in Section 5.7.2.2.

Table 5.6-7. List of commercially or recreationally important wildlife species that may occur within the immediate vicinity of the Oroville Facilities.

Common Name	Scientific Name	Habitat
MAMMALS		
American badger	*Taxidea taxus*	AG, BO/FP
Beaver	*Castor canadensis*	VFR, R, L
Black bear	*Urus americanus*	PP, MC, MH/C
Black-tailed hare	*Lepus californicus*	AG
Bobcat	*Felis rufus*	All terrestrial
Brush rabbit	*Sylvilagus bachmani*	MC, VFR
Coyote	*Canis latrans*	All terrestrial
Desert cottontail	*Sylvilagus audubonii*	AG, BO/FP
Douglas tree squirrel	*Tamiasciurus douglasii*	PP, MH/C
Ermine	*Mustela erminea*	PP, MH/C
Gray fox	*Unocyon cinereoargenteus*	VFR, MC, BO/FP, PP, MH/C
Long-tailed weasel	*Mustela frenata*	PP, BP/FP, MC, VFR, MH/C
Mink	*Mustela vison*	R, VFR
Black-tailed deer	*Odocoileus hemionus*	VFR, PP, BO/FP, MC, MH/C
Raccoon	*Procyon lotor*	All terrestrial
Striped skunk	*Mephitis mephitis*	All terrestrial
Virginia opossum	*Didelphis virginina*	AG, FEW,VFR
Western gray squirrel	*Sciurus griseus*	BO/FP, PP, VFR, MH/C
Western spotted skunk	*Spilogale gracilis*	MC, VFR, BO/FP, MH/C
Feral pig	*Sus scrofa*	AG, BO/FP, VFR
AMPHIBIANS		
Bullfrog	*Rana catesbeiana*	FEW, R, L
BIRDS		
American coot	*Fulica americana*	AG, FEW
American crow	*Corvus brachyrhynchos*	AG, CR, U, O/V
American wigeon	*Anas americana*	FEW, R, L, AG
Band-tailed pigeon	*Columba fasciata*	MH/C
Barrow's goldeneye	*Bucephala islandica*	FEW, R, L

Table 5.6-7. List of commercially or recreationally important wildlife species that may occur within the immediate vicinity of the Oroville Facilities.

Common Name	Scientific Name	Habitat
Blue-winged teal	*Anas discors*	FEW, AG, L, R
Bufflehead	*Bucephala albeola*	FEW, L, R
California quail	*Callipepla californica*	VFR, MH/C, AG, BO/FP, U, MC
Canada goose	*Branta canadensis*	R, FEW, AG, L, C
Canvasback	*Aythya affinis*	FEW, L
Cinnamon teal	*Anas cyanoptera*	FEW, L
Common goldeneye	*Bucephala merganser*	R
Common merganser	*Mergus merganser*	R, L, FEW
Common snipe	*Gallingo gallingo*	FEW, C
Eurasian wigeon	*Anas americana*	FEW, L, R, AG
Gadwall	*Anas strepera*	FEW, L, R
Greater white-fronted goose	*Anser albifrons*	FEW, AG, C
Green-winged teal	*Anas crecca*	FEW, L, R
Hooded merganser	*Lophodytes cucullatus*	FEW, L, R
Lesser scaup	*Aythya affinis*	FEW, L
Mallard	*Anas platyrhynchos*	FEW, R, L, C
Mountain quail	*Oreortyx pictus*	VFR, MC, MH/C
Mourning dove	*Zenaida macroura*	AG, VFR, BO/FP, R, C, U
Northern pintail	*Anas acuta*	FEW, L
Northern shoveler	*Anas clypeata*	FEW, AG, L, C
Redhead	*Aythya americana*	FEW, L
Ring-necked duck	*Aythya collaris*	L, R
Ring-necked pheasant	*Phasianus colchicus*	FEW, AG, C
Ross' goose	*Chen rossii*	FEW, AG, C
Ruddy duck	*Oxyura jamaicensis*	FEW, L, R
Snow goose	*Chen caerulescens*	FEW, C
Tundra swan	*Cygnus columbianus*	L, AG
Wild turkey	*Melaegris gallopavo*	BO/FP, MH/C, PP, VFR
Wood duck	*Aix sponsa*	L,R

HABITAT KEY
AG=annual grassland
BO/FP=blue oak/foothill pine
C=cropland
FEW= freshwater emergent wetland
L=lacustrine
MC=mixed chaparral
MH/C=montane hardwood/conifer
O/V=orchard/vineyard
PP=ponderosa pine
R=riverine
U=urban/residential
VFR=valley/foothill riparian

Source: CWHR modeling results for Butte County 200, SP-T6

Table 5.6-8. State-listed wildlife species potentially occurring in the project area.

Wildlife Species	State Status
Bald eagle (*Haliaeetus leucocephalus*)	Threatened
Giant garter snake (*Thamnophis couchi gigas*)	Threatened
Swainson's hawk (*Buteo swansonii*)	Threatened
Greater sandhill crane (*Grus canadensis tabida*)	Threatened
Bank swallow (*Riparia riparia*)	Threatened
Peregrine falcon (*Falco peregrinus anatum*)	Endangered
Yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	Endangered

Source: SP-T2

Swainson's Hawk

The Swainson's hawk was listed as a threatened species by the State in 1983. This species is not federally listed. By 1993, it was estimated that this migratory species had experienced a 91 percent population decline in California (Bloom 1980). The Statewide population was estimated at 375 pairs in 1980.

Swainson's hawks were historically found throughout most of lowland California (Grinnell and Miller 1944). Swainson's hawks use a variety of agricultural crops for foraging including alfalfa, fallow fields, beet, tomato, irrigated pasture, rice (non-flooded), and cereal grains. Current distribution is limited to northeast California (primarily Modoc, Siskiyou, and Lassen counties) and the Central Valley. This species decline is believed to be related to agricultural and urban land conversions (Estep 1989).

A nesting pair of Swainson's hawks was discovered during the course of the relicensing studies as discussed in SP-T2. This pair nested in a thin strip of mature riparian habitat within the OWA adjacent to the Feather River during 2002 and 2003. This nest produced two young during each breeding season. Foraging activity occurred primarily in a young walnut orchard adjacent to the FERC project boundary. No other sightings of adult Swainson's hawks were made at any other location within the FERC project boundary.

Greater Sandhill Crane

Both the lesser and greater subspecies of sandhill crane winter in the Central Valley of California. The greater sandhill crane subspecies is classified as a State threatened species. This species is not federally listed but is considered a sensitive species by Region 5 of USFS.

Wintering crane habitat consists of an open expanse of shallow water for communal roosting, rice or corn fields for foraging, and irrigated pasture for loafing (DFG 1992a). No nesting sandhill cranes occur within the study area. Survey data indicate that a limited amount of marginally suitable sandhill crane wintering habitat is present within the FERC project boundary around Thermalito Afterbay. Further, survey results

indicate that greater sandhill crane use of the FERC project boundary and adjacent agricultural habitats is at best uncommon as discussed in SP-T2.

Bank Swallow

The State of California listed the bank swallow as a threatened species in March 1989.

Bank swallows occur in riverine habitat and require a sandy or silty vertical bluff or riverbank for nesting (Zeiner et al. 1990a). Floods or very high flows are required to create and maintain the eroded banks favored by this migratory, colonial species.

No bank swallow nest colonies were identified within the project area. Surveys conducted on the Feather River downstream from the project area in 2002 and 2003 identified 8 and 15 active colonies, respectively (Figures 5.6-4a and 5.6-4b). Total number of burrows in active colonies was 2,274 in 2002 and 3,594 in 2003 as discussed in SP-T2.

American Peregrine Falcon

The American peregrine falcon was federally listed as an endangered species in 1970 and subsequently listed as endangered by the State of California. USFWS recently delisted peregrine falcons but they remain State listed. The breeding population of peregrine falcons in California has increased from 2 known active nest locations in 1970 to over 120 nesting pairs in 1999.

Three active peregrine nest locations were identified within the study area during the 2002 and 2004 breeding seasons, and four active territories were present in 2003 as discussed in SP-T2. Two of these locations had been used historically. Two additional new or previously unknown nest territories were identified during the course of the relicensing surveys. During 2002, 2003, and 2004 the same two nest territories were occupied and fledged a collective minimum of three young per year. One pre-fledgling was salvaged by DFG after it fell or flew from the nest site in 2003 and again in 2004. These chicks later fledged at another location and are not included in the production data. The two newly documented nest territories were the only territories where incubation behavior was not observed. This production of 1.0 young per active nest and 1.5 young per occupied nest compare favorably with Statewide production data collected between 1975 and 1988, which averaged 0.83 young per active nest and 1.04 young per occupied nest (Jurek 1989). However, the Federal Pacific Coast Recovery Plan goal of 1.5 young per pair was not met during 2002, 2003, or 2004 (USFWS 1982).

Other Special-Status Species

This section includes a brief overview of other special status wildlife species including State Species of Concern, Federal Species of Concern, USFS Sensitive Species, and BLM Sensitive Species. Species covered in this section are listed in Table 5.6-9.

Table 5.6-9. Other special-status species with the potential to occur in the project vicinity.

Special-Status Species	Status
American bittern (*Botaurus lentiginosus*)	FSC
American white pelican (*Pelecanus erythrorhynos*)	CSC
Barrow's goldeneye (*Bucephala islandica*)	CSC
Bell's sage sparrow (*Amphispiza belli belli*)	FSC, CSC
Black swift (*Cypseloides niger*)	FSC, CSC
Black tern (*Chilidonas niger*)	CSC
Black-crowned night heron (*Nycitcorax nycticorax*)	BLM
California gull (*Larus californicus*)	CSC
California horned lark (*Eremophila alpestris actia*)	CSC
California spotted owl (*Strix occidentalis caurina*)	FSC, CSC, FS, BLM
California thrasher (*Toxostoma redivivum*)	FSC
Common loon (*Gavia immer*)	CSC
Cooper's hawk (*Accipiter cooperi*)	CSC
Double-crested cormorant (*Phalacrocorax auritus*)	CSC
Ferruginous hawk (*Buteo regalis*)	FSC, CSC, BLM
Golden eagle (*Aquila chrysaetos*)	CSC, FSC, BLM
Lark sparrow (*Chondestes grammacus*)	FSC
Lawrence's goldfinch (*Carduelis lawrencei*)	FSC
Lewis's woodpecker (*Melanerpes lewis*)	FSC
Loggerhead shrike (*Lanius ludovicianus*)	FSC, CSC
Long-billed curlew (*Numenius americanus*)	FSC, CSC
Long-eared owl (*Asio otus*)	CSC
Merlin (*Falco columbarius*)	CSC
Northern goshawk (*Accipiter gentilis*)	FSC, CSC, FS
Northern harrier (*Circus cyaneus*)	CSC
Nuttall's woodpecker (*Picoides nuttallii*)	FSC
Oak titmouse (*Parus inornatus*)	FSC
Osprey (*Pandion haliaetus*)	CSC
Prairie falcon (*Falco mexicanus*)	FSC, CSC
Purple martin (*Progne subis*)	CSC
Red-breasted sapsucker (*Sphyrapicus rubber*)	FSC
Rufous hummingbird (*Selasphorus rufus*)	FSC
Sharp-shinned hawk (*Accipiter striatus*)	CSC
Short-eared owl (*Asio flammeus*)	CSC
Tricolored blackbird (*Agelaius tricolor*)	FSC, CSC, BLM
Vaux's swift (*Chaetura vauxi*)	FSC, CSC
Western burrowing owl (*Athene cunicularia*)	FSC, CSC, BLM
Western least bittern (*Ixobrychius exilis*)	CSC
Yellow warbler (*Dendroica petechia brewsteri*)	CSC
White-tailed kite (*Elanus leucurus*)	FSC
White-faced ibis (*Plegadis chihi*)	FSC, CSC
Yellow-breasted chat (*Icteria virens*)	CSC
Foothill yellow-legged frog (*Rana boylii*)	FSC, CSC, BLM, FS
Western spadefoot (*Scaphiopus hammondii*)	FSC, BLM
California horned lizard (*Phrynosoma coronatum*)	CSC, BLM
Northwestern pond turtle (*Clemmys marmorata marmorata*)	FSC, CSC, FS
Western mastiff bat (*Eumops perotis*)	FSC, CSC, BLM
Fringed myotis (*Myotis thysanodes*)	FSC, BLM
Long-eared myotis (*Myotis evotis*)	FSC, BLM
Long-legged myotis (*Myotis volans*)	FSC

Table 5.6-9. Other special-status species with the potential to occur in the project vicinity.

Special-Status Species	Status
Marysville kangaroo rat (*Dipodomys californicus eximus*)	FSC, CSC, BLM
Occult little brown bat (*Myotis occultus*)	CSC
Pale big-eared bat (*Corynorhinus townsendii pallescens*)	FSC, CSC, BLM, FS
Pallid bat (*Antrozous pallidus*)	CSC
River otter (*Lontra canadensis sonorae*)	CSC, BLM
San Joaquin pocket mouse (*Perognathus inornatus inornatus*)	FSC, BLM
Small-footed myotis (*Myotis ciliolabrum*)	FSC, BLM
Spotted bat (*Euderma maculatum*)	FSC, CSC, BLM
Townsend's big-eared bat (*Corynorhinus townsendii townsendii*)	CSC, FS, BLM, FSC
Western red bat (*Lasiurus blossevillii*)	FS
Yuma myotis (*Myotis yumanensis*)	BLM

Status Key
CSC-California Species of Special Concern
FSC-Federal Species of Concern
BLM-BLM Sensitive Species
FS-USFS Sensitive Species.
Source: SP-T2

Sixty-one special-status species have the potential to occur in the project vicinity, including 41 species classified as California Species of Special Concern, 35 Federal Species of Concern, 20 BLM Sensitive Species, and 7 USFS Sensitive Species. Per stakeholder direction during the Study Plan Report development process, no specific surveys were conducted for these species on a project-wide basis. However, all sightings of these species during the course of other relicensing wildlife studies were recorded and entered into a GIS database. Further, more intensive surveys of all federal lands in the project area were completed for USFS and BLM Sensitive Species. Of the 61 special-status species with the potential to occur within the project vicinity, 30 species were observed within or adjacent to the project area including American bittern, American white pelican, Barrow's goldeneye, black tern, black-crowned night heron, California gull, common loon, Cooper's hawk, double-crested cormorant, golden eagle, lark sparrow, Lewis's woodpecker, loggerhead shrike, long-billed curlew, northern harrier, Nuttall's woodpecker, oak titmouse, osprey, prairie falcon, red-breasted sapsucker, sharp-shinned hawk, short-eared owl, tri-colored blackbird, western burrowing owl, yellow warbler, white-tailed kite, white-faced ibis, yellow-breasted chat, foothill yellow-legged frog, and northwestern pond turtle.

American white pelican, double-crested cormorant, and osprey observations were most common with between 180 and 597 individual records in the GIS database. Least frequently observed species include Barrow's goldeneye, western burrowing owl, and short-eared owl. Additional information on special-status species locations and observed habitat use is included in Chapter 14 of SP-T2.

Baseline Project Conditions

A number of current project operations, land management practices, and project-related recreational activities affect wildlife and habitat in the project area, either directly or

indirectly. Short- and long-term effects result in changes to the dynamics and stability of existing wildlife communities, including changes in species diversity and wildlife distribution, and may affect reproductive success. Direct and indirect effects may result from the following:

- *Lake Oroville Water Level Fluctuations:* Water levels in Lake Oroville fluctuate in response to needs for power production, flood management, and water withdrawals for irrigation or municipal water use. Daily and seasonal fluctuations in water levels generally favor the establishment of upland plant communities along the shoreline instead of riparian vegetation more typically associated with natural lakes. The zone exposed in late summer, fall, and winter by reservoir drawdown usually does not support any vegetation and may be subject to erosion. Areas exposed by a spring/early summer drawdown may support some vegetation if conditions are favorable, but plant biomass and diversity within this habitat are usually low and can be dominated by non-native, weedy species that provide limited, poor quality wildlife habitat as discussed in SP-T1. In addition, the barren zones created by reservoir drawdown can affect the ability of wildlife to access water, which in turn causes them to be more vulnerable to predation.

- *Thermalito Afterbay Water Level Fluctuations:* Relatively minor water level fluctuations occur at the Diversion Pool, Thermalito Forebay, and within dredger ponds associated with the OWA. However, Thermalito Afterbay water level fluctuations are more extreme and can adversely affect critical life stages of certain wildlife species, including nesting and brooding waterfowl and nesting grebes as discussed in SP-T1. Exposed mudflats that occur during some Thermalito Afterbay fluctuations provide habitat for a variety of wildlife species, but they can also increase predation and loss of species attempting to traverse them to reach either cover or open water.

- *Feather River Flow Fluctuations:* Dams and hydroelectric project operations affect downstream hydrology by altering flow magnitude, timing, and duration. Fisheries operations and other procedures to accommodate the needs of specific species may also affect the timing and quantity of hydrologic flows. These hydrological variations often affect streambank habitat, including bank swallow nesting habitat, by altering erosion and sediment deposition processes and by affecting recruitment and survival of riparian plant species. July project releases can increase river stage by over 3 ft potentially inundating portions of bank swallow nest colonies outside the FERC project boundary when small numbers of pre-fledged young are present as discussed in SP-T1. In addition, hydroelectric project operations can affect wetlands that may be hydrologically connected to the river. Changes to riparian and wetland areas can affect the amount, quality, and connectivity of habitat available to wildlife, with the greatest effects on obligate species that depend on these habitats for food and cover. Further, spring/summer flow fluctuations can result in direct mortality of bank nesting species.

- *Ground/Soil Disturbance and Habitat Degradation from Operations and Maintenance Activities:* Project maintenance and/or operations may affect wildlife habitat by disturbing surfaces, resulting in direct elimination of habitat, degradation of habitat quality, and/or displacement of wildlife as discussed in SP-T1. Effects on habitat may be direct, through removal and development, or indirect, through disturbance or nonselective application of herbicides and pesticides that allow establishment of noxious weeds and other non-native wildlife species.

- *Disturbance from Project-Related Recreation:* Wildlife and wildlife habitat may be directly and indirectly affected by project-related recreation as discussed in SP-T9. Development and use of recreational facilities cause direct loss of habitat as vegetation is removed or altered and soil is disturbed. These processes also promote the establishment of non-native plant species, which alter habitat structure and composition. Recreational activity often results in accumulation of trash and garbage, attracting non-native wildlife species, which may then displace resident wildlife. The availability of additional food can also change the composition and population dynamics of native species, increasing the abundance of raccoons, rodents, gulls, and crows. Additionally, recreational developments typically include nocturnal lighting and structures, which may cause resident wildlife to avoid the area. Increased human presence can also cause avoidance by some resident wildlife.

5.6.2 Environmental Effects

This section describes the potential effects of the No-Action Alternative, the Proposed Action, and Alternative 2 on wildlife and plant species, including special-status species, harvest and recreationally/commercially important species, and their associated habitats. A summary of effects is provided in Table 5.6-10. Federally listed species are addressed in Section 5.7.

Potential direct and indirect effects on wildlife and plant species and habitat associated with baseline project operations and PM&E measures are identified. Direct effects associated with baseline operations and PM&E measures are mainly habitat disruption or destruction due to construction activities, public use, and operations and maintenance activities.

Quantification of habitat loss is summarized where possible as to less than or greater than 1 acre and the severity of the adverse effect on wildlife habitat is based on the amount and quality of habitat loss.

Indirect effects include habitat degradation resulting from erosion, dust, increased noise, night-lighting, and increased human presence and activities. Indirect effects on wildlife species include: (1) increased wildlife mortality, such as increased road kills from increased public traffic; or (2) loss of reproductive productivity from habitat displacement, such as displacement of nesting waterfowl and/or loss of nest sites or access to over-wintering habitat due to human presence and activity associated with

recreation. Direct and indirect effects on sensitive plant species include: (1) ground disturbance due to O&M activities; or (2) disturbance due to recreational activities.

Since PM&E measures are generally conceptual and do not include specific details as to exact location and areal extent of specific construction, and operational and maintenance requirements, potential effect levels on the resource are estimated as either beneficial or adverse.

Potential effects on terrestrial resources both wildlife and botanical are summarized in Table 5.6-10.

Table 5.6-10. Summary of potential effects on wildlife resources and habitats.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Wildlife Habitat Affected by Oroville Facilities			
Lacustrine	Same as Existing Conditions	Same as No-Action Alternative	Same as No-Action Alternative
Montane Hardwood	Same as Existing Conditions	Same as No-Action Alternative	Same as No-Action Alternative
Blue Oak/Foothill Pine	Same as Existing Conditions	Slightly adverse due to recreational developments	Moderately adverse due to habitat loss from increased recreational developments
Valley Foothill Riparian (riparian)	Same as Existing Conditions	Slightly beneficial due to ESA protection of VELB habitat	Same as Proposed Action. In addition, slight benefit due to riparian habitat added with side-channel development
Montane Hardwood Conife	Slightly beneficial due to ESA protection of bald eagle nesting habitat	Same as No-Action Alternative	Same as No-Action Alternative
Annual Grassland	Neutral to slightly beneficial due to reduced OHV damage	Slightly adverse due to minor habitat modification/loss associated with waterfowl enhancements and additional recreational developments	Same as Proposed Action
Barren	Continued gravel harvest continues to create barren habitats	Neutral to slightly beneficial if barren gravel tailings are converted to more productive wildlife habitats	Same as Proposed Action
Freshwater Emergent Wetland	Continued degradation of wetlands due to project maintenance and recreational use	Beneficial due to ESA protection of giant garter snake habitat	Same as Proposed Action
Urban	Neutral to slightly beneficial due to additional conversion to urban habitat	Same as No-Action Alternative	Same as No-Action Alternative
Blue Oak Woodland	Same as Existing Conditions	Slightly adverse due to recreational developments	Moderately adverse due to habitat loss from increased recreational developments

Table 5.6-10. Summary of potential effects on wildlife resources and habitats.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Riverine	Continued blockage of gravels and LWD	Beneficial due to gravel and LWD supplementation actions	Same as Proposed Action. In addition, slight benefit due to riverine habitat added with side-channel development
Other habitats (Mixed Chaparral, Sierran mixed conifer, Mixed conifer, mixed conifer hardwood)	Same as Existing Conditions	Neutral, habitats represent less than 1 per cent (50 acres) of total project area	Same as Proposed Action
Lake Oroville Wildlife Species			
Piscivorous Species	Moderately beneficial due to fisheries enhancement and stocking actions	Same as No-Action Alternative	Same as No-Action Alternative
Montane Hardwood Conifer Species	Slightly beneficial due to ESA habitat protections associated with bald eagle nest territory protections	Same as No-Action Alternative	Same as No-Action Alternative
Feather River Wildlife Species			
Bank swallow	Continued baseline project effects on nesting bank swallows	Same as No-Action Alternative	Same as No-Action Alternative
Western Pond Turtle	Same as Existing Conditions	Adverse due to fish barrier weir restricting movement or take through drowning	Same as Proposed Action
Piscivorous Species	Moderately beneficial due to on-going fisheries enhancement and stocking actions	Same as No-Action Alternative	Same as No-Action Alternative
Thermalito Complex Wildlife Species			
Nesting grebes	Potential continued baseline effects related to high speed boating use and water level fluctuation, however data suggest that the relative effect of these two forms of disturbance vary from year to year	Same as No-Action Alternative	Same as No-Action Alternative

Table 5.6-10. Summary of potential effects on wildlife resources and habitats.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Migratory and Resident Waterfowl	Same as Existing Conditions	Beneficial due to additional brood pond construction, habitat development, protection, and maintenance actions	Same as Proposed Action
Upland Game Species	Same as Existing Conditions	Moderately beneficial due forage and cover enhancements	Same as Proposed Action
Oroville Wildlife Area			
Swainson's Hawk	Same as Existing Conditions	Potential disturbance of nesting hawks associated with fisheries enhancement actions. However standard avoidance measures implemented would result in neutral effect.	Same as Proposed Action
Nesting Waterfowl	Same as Existing Conditions	Moderately beneficial due to nest cover enhancements and invasive plant control actions	Same as Proposed Action
Plant Communities			
Upland Forest/Woodland	Slightly adverse due to dispersed recreation use	Slightly adverse due to recreational/cultural enhancements/developments	Same as Proposed Action
Upland Shrub/Scrub	Slightly adverse due to dispersed recreation use	Slightly adverse due to recreational/cultural enhancements/developments	Same as Proposed Action
Upland Herbaceous	Effects on native grassland species continued from wildlife vegetation plantings	Slightly adverse due to recreational/cultural enhancements/developments and construction of brood ponds	Same as Proposed Action
Riparian Forest/Woodland	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions. In addition, slight benefit due to riparian habitat added with side-channel development

Table 5.6-10. Summary of potential effects on wildlife resources and habitats.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Riparian Shrub/Scrub	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions. In addition, slight benefit due to riparian habitat added with side-channel development
Wetlands	Slightly adverse effect from operations on species and structural diversity	Moderately beneficial – additional brood ponds will increase wetlands; Invasive Species Management Plan will lessen adverse effects on wetland habitats	Moderately beneficial – additional brood ponds will increase wetlands; Invasive Species Management Plan will lessen adverse effects on wetland habitat
Aquatic Submerged	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Special-Status Plant Species			
Lake Oroville Species	Same as Existing Conditions	Slightly adverse due to increased recreational use; possible adverse effects from enhancements for cultural and recreational resources	Same as Proposed Action
Wetland Species – Thermalito Complex and the OWA	Same as Existing Conditions	Beneficial due to construction of brood ponds and invasive species management	Same as Proposed Action
Vernal Pool Species	Moderately beneficial – vernal pool conservation measures will protect pools identified as T&E invertebrate habitat – not all vernal pools/swales are protected under these measures	Same as No-Action Alternative	Same as No-Action Alternative

Notes: LWD = large woody debris; VELB = Valley elderberry longhorn beetle

5.6.2.1 Botanical Resources

The continued operation of the Oroville Facilities has the potential to affect botanical resources. This section addresses the effect of the No-Action Alternative, Proposed Action, and Alternative 2 on botanical resources including plant communities, invasive plant species, and special-status plant species. Special-status plant species addressed in this section include species that are not officially listed under the FESA but are recognized by resource agencies or groups (e.g., CNPS) or regulatory or land management agencies as requiring protection and special consideration because of their uniqueness, declining status, or limited distribution. Federally listed plant species are addressed in Section 5.7. California listed species with potential to occur in the project area are also federally listed and thus are discussed under Section 5.7.

The analysis of effects on botanical resources from the alternatives considers the following:

- Effects as a result of existing and future project facilities, operations, and maintenance on special-status species and vegetation communities, including upland habitat types, wetlands, riparian, and waters of the United States;
- Effects on botanical resources as a result of project-related recreation facilities, maintenance, and use;
- Potential project-related introduction, distribution, and management of non-native and noxious terrestrial and aquatic weeds;
- Considerable alteration of plant natural communities as a result of fire prevention/fuel load control;
- Effects of existing and future project operations on riparian habitats and floodplains, both within the project area and downstream, including reservoir fluctuation zones; and
- Potential project-related effects on special-status plant species.

Methods used to assess potential effects on botanical resources from the No-Action Alternative, Proposed Action, and Alternative 2 include a review of results from project studies on vegetation, special-status plant species, riparian and wetland resources, invasive species, upland plant communities, as well as other relevant studies. GIS analysis was used to estimate effects on resources such as vegetation communities and special-status plant populations. Adverse effects are those effects that degrade, destroy, or alter plant populations and communities in such a manner as to affect species composition, biodiversity, and/or the functionality or survival of the population or community. A beneficial effect is one that enhances or creates a more suitable environment for plant populations or communities.

No-Action Alternative

A number of baseline project operations, land management activities, and project-related recreational activities affect botanical resources. Baseline project effects are described in Section 5.6.1.1. In addition, this alternative includes implementation of a number of environmental/conservation measures designed to avoid or minimize project effects on botanical and terrestrial resources.

Conservation/Environmental Measures

Conservation measures included in the Draft Programmatic Biological Assessment (DWR 2004) relating to nesting bald eagles may have a slightly beneficial effect on plant communities by reducing effects from recreational use in areas closed during nesting season. Conservation measures associated with vernal pool invertebrate habitats are designed to minimize baseline project effects on vernal pool habitats by restricting access and include actions designed to prevent sediment or discharges into vernal pools. These measures reduce vernal pool habitat degradation and will have a beneficial effect on vernal pool plant species including special-status plant species for those vernal pools that are included as habitat for vernal pool invertebrates.

Proposed Action

This section provides an analysis of potential effects on botanical resources with implementation of the Proposed Action, relative to the No-Action Alternative. No modifications to project operations related to minimum flow, ramping rates, water supply, or flood management are included in the Proposed Action. The alternative includes existing measures as described in the No-Action Alternative, as well as protection, mitigation, and enhancement (PM&E) measures designed to address a number of baseline effects and direct effects of project operations. These measures are described in Chapter 3.0 and include measures to enhance cultural, environmental, and recreational resources.

PM&E Measure Activities

Several of the PM&E measures included in this alternative are designed to protect existing fish, wildlife, and plant habitats and would have varying adverse and beneficial direct and indirect effects on botanical resources. Measures included in the Proposed Action that would affect botanical resources are discussed below.

Environmental Enhancement Measures

Fisheries – A number of actions are designed to improve or enhance fishery resources and have the potential to affect botanical resources. The placement of large woody debris and improvements to Moe's Ditch and Hatchery Ditch have the potential to benefit riparian and wetland vegetation, although these actions may result in short- or long-term adverse effects from construction activities.

Large woody debris placement may trap sediment, which could have a beneficial effect by providing fresh surfaces for riparian vegetation recruitment. Large woody debris may also help moderate peak flows and prevent scouring of existing riparian vegetation. However, the large woody debris would be anchored by cables to artificial or natural structures, which could result in short-term adverse effects on riparian vegetation. Improvement to Moe's Ditch and the Hatchery Ditch would result in short-term adverse effects on riparian vegetation from construction activities.

Actions with the potential for long-term direct loss of riparian habitat include the construction of two fish barrier weirs and one salmon egg-taking station in the Low Flow Channel. These actions would result in the loss of less than 1 acre of riparian vegetation. No effects on special-status species are likely to occur from these measures. The Low Flow Channel has a high concentration of non-native invasive species. Construction and disturbance activities will most likely remove some non-native plants but would also create disturbed areas for potential invasion by noxious species.

Terrestrial – A number of measures are designed to improve or enhance habitats for wildlife species in Thermalito Afterbay and the OWA. These include construction of additional waterfowl brood ponds, recharge of brood ponds at regular intervals, waterfowl nesting cover enhancement, enhancement of upland cover/forage, and installation of wildlife boxes in the OWA.

No effects on vegetation or special-status plant species are expected to occur from the installation of wildlife boxes in the OWA. The construction of additional brood ponds would result in short-term adverse effects on emergent wetland vegetation, as well as effects on annual grassland vegetation in areas used for staging and borrow materials. Long-term beneficial effects on emergent wetland vegetation, such as increased species and structural diversity and the creation of additional habitat for special-status species are expected from the construction of these ponds. The recharge of brood ponds may beneficially affect vegetation diversity; however, effects on special-status species are unknown at this time. The enhancement of cover and forage crops for waterfowl and game birds and the use of fertilizers on these crops have the potential to adversely affect vernal pools and swales and adjacent upland vegetation by introducing and creating a favorable environment for non-native invasive plant species.

An Invasive Species Management Plan is included under this alternative to address effects on native plant communities from project-related activities and the subsequent invasion by non-native species. This plan aims to reduce noxious non-native species and restore native vegetation where appropriate. This program would target purple loosestrife in Thermalito Afterbay as well as a number of other species in the OWA and around Lake Oroville. Wide-scale broadcast treatments of herbicides are restricted in most areas due to conservation measures for ESA species. Thus, the effect from overspray to adjacent native vegetation and special-status plant species and their habitats should be negligible. This program is expected to be highly beneficial to native plant communities and special-status species and their habitat.

Cultural Resource Measures

Two PM&E measures relating to cultural resources have the potential to result in direct loss of plant communities and special-status species and/or their habitats. These actions include the establishment of a curation facility and the provision of lands for planting and harvesting traditional plants. Currently, there are no location or project descriptions available to determine the type and quantity of potential effects. Maintenance and construction activities associated with these actions may provide additional disturbance areas for the establishment of invasive species. However, with the implementation of the Invasive Species Management Plan, these potential effects would be minimal.

Recreational Enhancement Measures

Under the Proposed Action, recreation facilities would be upgraded to include improved accessibility, provide additional and improved day use and trail facilities, provide for campground expansion and/or improvements, improve boating facilities, and develop ADA accessible areas.

While not all recreational enhancement measures would affect botanical resources, a number of actions under the Proposed Action would result in long-term adverse effects on plant communities. Although most of these actions would result in minor amounts of plant community loss (< 1 acre), enhancements at the Bidwell Canyon and Loafer Creek recreation areas would result in >5 acres and >10 acres, respectively. Actions with some adverse direct effects on plant communities include:

- *Bidwell Canyon Recreation Area:* (1) expansion of Bidwell Canyon Marina parking lot (removal of ~2 acres of open/disturbed blue oak/foothill pine woodland, (2) construction of new replacement campground at Bidwell Canyon (affect ~5 acres of dense mixed oak/foothill pine), and (3) trail relocation (minor effect).

- *Loafer Creek Recreation Area:* (1) construction of new camp loop for the 2 new group RV/tent campsites (affects >10 acres of mixed oak/foothill pine communities), and (2) improved ADA access (minor effects on blue oak, mixed oak, foothill pine, chaparral, and annual grassland).

- *Enterprise Boat Ramp:* Improvements to day use area (minimal effect).

- *Foreman Creek:* Improvement to day use area (minor effects on blue oak/foothill woodlands and annual grasslands).

- *Saddle Dam:* Construction of new trail for shoreline access (minor effect on mixed oak/foothill pine, annual grassland, and chaparral).

- *Diversion Pool:* Improvement of day use facilities at Lakeland Boulevard (effects on blue oak/foothill pine woodland and annual grassland).

- *Thermalito Forebay:* (1) construction of shoreline access trails (affects riparian, emergent wetland, and annual grassland), (2) basic facility improvements of North Forebay Aquatic Center, (mostly urban, minimal effect on annual grassland), and (3) construction of new day use facilities at South Forebay (mostly disturbed, minimal effect on annual grassland).

- *Thermalito Afterbay:* (1) construction of new day use facility at Larkin Road Car-top BR (mostly disturbed, minor effects on annual grassland and emergent wetland), and (2) construction of a campground and day use facilities at Thermalito Afterbay Outlet (mostly barren, some negative effects on riparian and wetland vegetation).

The measures outlined above would affect plant communities by direct removal of vegetation; however, except for the campground and parking lot expansions at Bidwell Canyon and Loafer Creek, the remaining actions would result in only minor amounts of loss to plant communities (<1 acre each). Indirect adverse effects include the increased likelihood of invasion by non-native species in areas of disturbance and effects on adjacent botanical resources as recreational use increases. No direct adverse effects on special-status plant species are expected from these measures, although minor indirect adverse effects may occur from increased recreational use.

Conservation Measures

Conservation measures included in the Proposed Action include actions to minimize or avoid take of federally listed wildlife species. These actions were developed in consultation with USFWS and included in a draft BA (DWR 2004). These protection measures include conservation measures related to nesting bald eagles, giant garter snake, California red-legged frog, Valley elderberry longhorn beetle, and vernal pool tadpole and fairy shrimp. While these measures are designed to protect ESA wildlife habitats, they would also protect and/or reduce adverse effects on botanical resources. A number of conservation measures for nesting bald eagles and vernal pool invertebrates are included and addressed under the No-Action Alternative. Additional measures for nesting bald eagles included in the Proposed Action would not affect botanical resources. A number of measures for vernal pool invertebrate habitat included in the Proposed Action would protect vernal pool plant habitat in addition to those identified under the No-Action Alternative.

Conservation measures for giant garter snake and California red-legged frog habitat would limit operation and maintenance activities within and near wetland vegetation around Thermalito Forebay and Thermalito Afterbay and in the OWA. These measures would benefit and help protect both wetland and riparian vegetation and habitat for three special-status plant species that occur within the wetland margin of Thermalito Forebay and Thermalito Afterbay, the Diversion Pool, and within a few ponds in the OWA. These plant species include four-angled spikerush (*Eleocharis quadrangulata*), Sanford's arrowhead (*Sagittaria sanfordii*), and fox sedge (*Carex vulpinoidea*). Modifications to the existing gravel-mining operations in the OWA to address effects on giant garter snake habitat would also benefit both wetland and riparian vegetation.

These conservation measures address the need for noxious weed control and allow for treatment of invasive species that adversely affect native vegetation, such as purple loosestrife.

Conservation measures for the valley elderberry longhorn beetle would benefit a number of botanical resources, including riparian woodland and shrub communities. No beneficial or adverse effects on special-status plant species are expected from conservation measures for the valley elderberry longhorn beetle. Although these measures are protection measures mainly related to avoidance during maintenance and operations activities, treatment of adjacent non-native invasive plant species would be allowed if BMPs and other protective measures are followed to ensure that no adverse effects occur to the valley elderberry. The ability to treat adjacent invasive species would have beneficial indirect effects on both the valley elderberry and the plant communities in which it grows.

Alternative 2

This section provides an analysis of potential effects on botanical resources with implementation of Alternative 2, relative to the No-Action Alternative and the Proposed Action. Detailed descriptions of the alternatives are described in Chapter 3.0. Alternative 2 includes measures included under the No-Action Alternative and Proposed Action, with additional measures relating to cultural, environmental, and recreational resources. No modifications to project operations related to ramping rates, water supply, or flood management are included in Alternative 2, except for flow increases in the Low Flow Channel and temperature adjustments at Robinson Riffle. This section addresses these actions and others unique to Alternative 2.

PM&E Measure Activities

Environmental Enhancement Measures

Aquatic Resource Measures: Alternative 2 includes three additional PM&E measures that have potential to directly affect botanical resources. These include the increase of minimum base flows in the Low Flow Channel from 600 cfs to 800 cfs, side-channel creation, and structural modifications to allow sturgeon passage at Shanghai Bench and Sunset Pumps in the Feather River downstream of the project area.

- *Low Flow Channel:* An increase in the minimum base flow from 600 cfs to 800 cfs would most likely have no adverse or beneficial effects on riparian and wetland plant communities both within the Low Flow and High Flow Channels.

- *Side-channel Improvements:* Alternative 2 provides for the creation of side channels in the Low Flow Channel in addition to the improvements to Moe's Ditch and Hatchery Ditch described under the Proposed Action. These actions may have short-term adverse effects on riparian and wetland vegetation from construction activities. Riparian restoration is a component of this action and should result in long-term beneficial effects on riparian and wetland vegetation by

creation of addition habitat. However, the Low Flow Channel experiences high flows during extreme flow events, and riparian and wetland vegetation has a high probability of being removed during these flows. Without a natural flow regime following high flow events, natural regeneration will be unlikely. Although these high flow events do not occur often, regular maintenance and restoration may be required to sustain riparian and wetland vegetation and to inhibit the invasion by non-native invasive species. The Low Flow Channel currently has a high percentage of non-native species. Riparian restoration efforts would be highly beneficial to the riparian and wetland plant communities.

- *Modifications to Shanghai Bend and Sunset Pumps:* These actions would have minor short-term adverse effects on riparian vegetation. Both sites have a high level of disturbance with low densities of riparian vegetation present on the site.

Terrestrial Resource Measures

Same as Proposed Action.

Cultural Resource Measures

Alternative 2 includes the relocation of mortar cupules from the fish hatchery to a more appropriate site. The area for relocation is to be identified and effects on botanical resources cannot be determined at this time. This action has the potential to adversely affect botanical resources, including plant communities and special-status species and habitats. However, these effects could be minimized with appropriate placement of the mortars.

Recreational Enhancement Measures

PM&E measures included in Alternative 2 would provide additional and improved day use and trail facilities; convert almost all trails into multi-use trails; provide for additional campground facility enhancements at Bidwell Canyon, Loafer Creek, and Lime Saddle campgrounds; improve boating facilities; provide facilities to support special events around Lake Oroville and the Diversion Pool; and construct a whitewater park.

While not all recreational resource measures would affect botanical resources, a number of actions under Alternative 2 would result in permanent adverse effects on plant communities resulting in losses greater than 1 acre. These actions with adverse direct effects on plant communities include:

- *Bidwell Canyon Recreation Area:* Addition of a new parking area would result in the permanent adverse loss of >1 acre of dense mixed oak/foothill pine woodland.

- *Loafer Creek Recreation Area:* (1) construction of a new activity center would result in the permanent loss of >1acre. Potential creation of a swimming facility could result in direct effects on plant communities with potential indirect adverse effects on adjacent vegetation from increased recreational use.

- *Lime Saddle Recreation Area:* (1) new dock and trail to the campground would result in minor long-term adverse effects on ~0.5 acre mixed oak/foothill pine woodland, (2) new shoreline access and day use facilities at Parish Cove would result in long-term adverse effects on >4 acres of blue oak woodland and annual grassland, (3) trail construction to link Lime Saddle Campground to Marina would result in long-term adverse effects on more than 5 acres of mixed oak/blue oak woodlands and annual grasslands, (4) construction of additional campsites would result in long-term adverse effects on mixed oak/blue oak and foothill pine woodlands, (5) construction of a new parking area would result in long-term adverse effects on ~4 acres of disturbed annual grassland and blue oak woodland, and (6) construction of new swimming facility at this location would result in long-term adverse effects on mixed oak/blue oak and foothill pine woodlands.

- *Oroville Dam:* Construction of additional parking could result in a long-term adverse effect on mixed oak/foothill pine/chaparral vegetation.

- *Diversion Pool:* (1) construction of additional day use sites, take-out facilities, and spur trails would result in long-term adverse effects on >1 acre of blue oak/foothill pine woodland, and (2) construction of flexible event center (in an area already disturbed) would have minor adverse effects on oak woodland.

- *Low Flow Channel:* (1) construction of observation access would result in a long-term adverse effect on riparian woodland and riparian shrub communities, and (2) construction of a whitewater park below the Diversion Pool would result in permanent long-term adverse effects on blue oak/foothill pine woodland.

The measures outlined above would affect plant communities by direct removal of vegetation. Effects may be reduced by minimizing disturbance footprint, siting on previously disturbed surfaces, and the use of BMPs to reduce effects on adjacent plant communities. Indirect adverse effects on plant communities include the increased likelihood of invasion by non-native species in areas of disturbance and effects on adjacent botanical resources as recreational use increases.

Construction of additional day use sites, take-out facilities, and spur trails around the Diversion Pool has the potential for direct adverse effects on the special-status plant species fox sedge (*Carex vulpinoidea*). No direct adverse effects on other special-status plant species are expected from other recreational enhancements measures, although indirect adverse effects may occur from increased recreational use.

<u>Conservation Measures</u>

Same as Proposed Action.

5.6.2.2 Wildlife Resources

No-Action Alternative

Baseline project operations, land management activities, and project-related recreational activities can affect wildlife resources. Baseline project effects are described in Section 5.6.1.2. In addition, the No-Action alternative includes implementation of a number of environmental/conservation measures designed to avoid or minimize baseline project effects on wildlife resources. Chapter 5, Section 5.7 evaluates project effect on federally listed wildlife species and their habitats.

Wildlife Habitats

O&M Activities

The conservation measures implemented under the No-Action Alternative are designed to address baseline project effects from O&M activities to federally listed species, specifically bald eagle nesting habitat and vernal pool invertebrate habitat. Effects associated with operational water level fluctuations at Lake Oroville, Thermalito Afterbay, Feather River flow fluctuations, and effects on riparian habitats will continue under the No-Action Alternative.

Draft Programmatic Biological Assessment Conservation Measures (Appendix E)

Implementation of conservation measures related to avoidance of human activity near nesting bald eagles will have a beneficial effect on non-listed wildlife and habitats due to the protection from recreational development or habitat modification. The conservation measures related to avoidance of human activity near nesting bald eagles involve:

- Administrative closure of land and shoreline areas to human entry during the nesting season around the three bald eagle nest territories;
- Signage, patrol, and enforcement of closure;
- Nest and population surveys;
- Habitat improvement measures; and
- Limitations on current and future habitat disturbance.

Conservation measures implemented under this alternative to protect nesting bald eagle habitat will limit habitat losses to other co-occurring wildlife species and prevent future wildlife habitat modification or loss within the nest territories.

None of these measures to benefit the bald eagle habitat result in direct or indirect wildlife habitat loss. These measures limit future habitat disturbance related to recreational development and maintenance. The habitat improvements included in this conservation measure are minor and localized consisting of fireproofing the nest tree to

minimize potential loss during wildfire and placement of fish habitat structures within foraging areas to concentrate prey species.

Conservation measures associated with vernal pool invertebrate habitat are designed to avoid or minimize baseline project effects on vernal pool habitats and include:

- Signage and fence maintenance to prevent illegal OHV use in areas containing vernal pools;
- Implementation of actions to prevent sediment or contaminate discharge into vernal pools; and
- Monitoring to determine conservation measure effectiveness.

These measures are designed to reduce habitat degradation and will not result in direct or indirect wildlife habitat loss. Some minor habitat benefits may occur as a result of abandonment and revegetation of unneeded maintenance roads.

Wildlife Species

Draft Programmatic Biological Assessment Conservation Measures (Appendix E): Nesting Bald Eagles and Control of OHV Use in Vernal Pools and Grasslands

Conservation measures implemented under this alternative to protect nesting bald eagle habitat will limit disturbance/displacement of other co-occurring wildlife species and prevent future wildlife habitat modification or loss within the nest territories.

Conservation measures designed to minimize illegal OHV use in vernal pool invertebrate habitats (see Section 5.6.3) will serve to prevent soil compaction or sedimentation into vernal pool habitats, which can adversely affect vernal pool ecology and function. These vernal pools and other seasonal wetlands can also provide seasonal habitat for a variety of wildlife species including frogs, toads, snakes, and shorebirds. Measures implemented under this alternative, which reduce sedimentation or compaction of pools, could benefit these wildlife, as well as the federally listed vernal pool tadpole and fairy shrimp.

Control of OHV use in vernal pool and adjacent grassland habitats would also reduce the potential for vehicle-related damage or mortality to ground-nesting bird species' nests, eggs, and young as well as to more sedentary wildlife species.

Potential adverse effects on nesting western and Clark's grebes may occur related to baseline recreational boating use and Thermalito Afterbay water level fluctuations. Data suggest that the relative effect of these two forms of disturbance vary from year to year. However, recent studies indicate grebe production at the Thermalito Complex are among the highest levels in their range.

Commercially and Recreationally Important Species

None of the actions included within this alternative would affect or benefit winter or resident deer habitat or populations.

Minor potential benefits to nesting waterfowl, pheasants, and quail may occur if conservation measures reduce spring/summer OHV use (and associated nesting losses) in grassland habitats.

None of the actions within this alternative are predicted to affect furbearer populations or improve opportunities for non-consumptive uses (bird watching or nature study).

State-Listed Species

Three State-listed wildlife species potentially affected by the No-Action Alternative are protected under both the State and federal endangered species acts (i.e., bald eagle, giant garter snake, and yellow-billed cuckoo). Potential effects on these species are discussed in Section 5.7.2.2. Potential effects on four State-listed threatened species (Swainson's hawk, greater sandhill crane, bank swallow, and the State-listed endangered peregrine falcon) are discussed below.

- *Swainson's Hawk* – No baseline project effects on Swainson's hawk nesting or foraging habitat have been identified. Two wildlife habitat enhancements (waterfowl nest cover and forage enhancements) continued under this alternative have the potential to result in minor improvements to Swainson's hawk foraging habitat.

- *Greater Sandhill Crane* – No baseline project effects on wintering greater sandhill crane habitat have been identified. Lack of documented wintering use of the project area indicates that habitat modifications associated with this alternative are unlikely to affect wintering or foraging use.

- *Bank Swallow* – None of the actions under the No-Action Alternative would address baseline hydrologic effects identified. No bank swallow nesting habitat currently exists within the project area. None of the activities within this alternative would create additional nesting habitat or provide other benefits to nesting bank swallows. DWR is currently consulting with DFG to design mitigation measures for potential affects to bank swallows due to project operations. DWR and DFG have agreed in concept and DWR is actively pursuing implementation of a conservation easement.

- *Peregrine Falcon* – No baseline project effects on peregrine falcons have been identified. Peregrine falcons nest on cliffs or cliff-like human structures. This type of nest location serves to limit human intrusion as a factor in nesting success. Further, none of the activities would adversely affect or benefit foraging peregrine falcons or foraging habitat.

Other Special-Status Species

No actions included under this alternative were designed specifically to benefit any State or federal species of concern. However, actions designed to increase habitat structure and plant species diversity or enhance prey populations may benefit some special-status species.

Piscivorous species (double-crested cormorant, American white pelican, osprey, black tern, California gull, river otter, and black-crowned night heron) would benefit from continuation of the warm and coldwater fisheries enhancement measures if they maintain or concentrate prey fish populations.

Maintenance of habitat diversity resulting from continued implementation of several PM&E measures would benefit several special-status species including:

- Continued waterfowl nest cover enhancements designed to increase cover height and density would benefit foraging and nesting habitat for northern harrier and short-eared owl.

- Continued placement of additional nest boxes within the OWA could be expected to provide cover and nest sites for ringtail, a DFG fully protected species.

Short-term habitat loss or species disturbance/displacement will occur as a result of continued implementation of waterfowl forage enhancements. These enhancements generally result in reduced ground cover density and plant species diversity during the spring nesting season. This reduced vegetative cover would adversely affect the quality of northern harrier, California horned lark, and short-eared owl nesting habitats.

Proposed Action

The Proposed Action includes additional PM&E measures beyond those previously identified and discussed under the No-Action Alternative. No modifications to project operations related to minimum flow, ramping rates, water supply, or flood management are included in the Proposed Action. The Proposed Action includes the existing measures as described in the No-Action Alternative (and Affected Environment), as well as protection, mitigation and enhancement measures designed to address a number of baseline effects and direct effects of project operations. Several PM&E measures would have varying adverse and beneficial direct and indirect effects on wildlife resources. These PM&E measures are described in Chapter 3.0 and generally include actions to enhance cultural, environmental, and recreational resources. PM&E measures are described in Chapter 3.0. A summary of potential effects associated with the PM&E measures is provided in Table 5.6-10.

PM&E Measures

Wildlife Habitat

Several of the PM&E measures included in the Proposed Action are designed to protect existing fish or wildlife habitats. These habitat protection actions include 36 conservation measures developed in consultation with USFWS to protect/preserve habitat for species protected under the Federal Endangered Species Act and generally reserve these lands from development or disturbance. These protection measures include conservation measures related to nesting bald eagles, giant garter snake, California red-legged frog, valley elderberry longhorn beetle, and vernal pool tadpole and fairy shrimp. Descriptions of these conservation measures are included in Section 5.7.3 and in the Biological Assessment in Appendix E. While these conservation measures are designed to protect ESA-listed species habitats, they also serve to protect co-occurring wildlife species dependent upon mature coniferous forest, freshwater emergent wetlands, riparian, annual grassland, and vernal pool habitats.

Numerous PM&E measures included within the Proposed Action are designed to improve or enhance wildlife habitats for specific fish and wildlife species through direct habitat manipulation. These habitat manipulations include actions to enhance fish and wildlife food, water, cover, or space including:

- Large woody debris (LWD) program serves to enhance habitat structural diversity and improve cover (riverine, riparian and freshwater emergent wetland);
- Construction and recharge of waterfowl brood ponds serves to improve habitat structural, plant species diversity, and cover (freshwater emergent wetland);
- Waterfowl nest cover and forage enhancements improves habitat diversity through development of tall, dense herbaceous cover which is generally lacking in the project area (annual grassland);
- Wildlife box placement program improves habitat quality through development of nesting habitat and cover for secondary cavity nesting species (riparian);
- Invasive species management program maintains or improves habitat quality by maintaining native plant species to which native wildlife species are adapted (riparian, freshwater emergent wetland, annual grassland, riverine); and
- Reduced boat speeds on the afterbay north of SR 162 improves habitat quantity and quality through reduced shoreline erosion which prevents establishment of vegetative cover (lacustine, fresh water emergent wetland).

Other PM&E measures included within the Proposed Action, while not designed as wildlife habitat improvements, have the potential to improve wildlife habitat conditions while addressing fishery enhancements, recreation, and aesthetic actions including:

Recreation

- Consolidation of camping activities within the OWA would limit habitat loss and degradation to a single location rather than the current dispersed effects (riverine, lacustrine, riparian);
- Increased trash removal within the OWA would locally reduce non-native species populations and associated competition with native wildlife species (riparian, riverine, annual grassland, barren);
- Installation of additional vehicular barriers within the OWA would prevent habitat degradation associated with OHV use and illegal dumping (riparian, freshwater emergent wetland);
- Increased patrol and enforcement within the OWA would serve to reduce habitat degradation associated with OHV use, wildfire, illegal dumping of trash and hazardous materials, and violation of area/seasonal closures (riparian, freshwater emergent wetland, annual grassland, riverine); and
- Restrictions on motorized wheeled vehicle use within the drawdown zone of Lake Oroville would restrict shoreline erosion and associated vegetative damage (barren, lacustrine).

Aesthetics

- Screening of equipment storage areas would serve to limit indirect habitat losses (blue oak woodland).

Recreation Enhancement Measures

Many of the recreation-related PM&E measures included under the Proposed Action would result in short- or long-term direct or indirect wildlife habitat losses. Disturbance of habitat would allow invasion of non-native plant species and elimination or degradation of native wildlife habitat. Incorporation of design measures including revegetation and restoration measures and implementation of a Invasive Species Management Plan would minimize these potential effects (See Section 5.6.1).

Other PM&E Measures

Fishery, cultural and terrestrial related PM&E measures that could result in adverse short-term construction related habitat disturbance or loss include:

- Gravel Supplementation and Improvement Program including harvest areas, access improvements, staging areas, materials storage, placement, ripping and raking (riparian, freshwater emergent wetland);

- Fish barrier weirs (2) and 1 salmon egg-taking station in the Low Flow Channel including access improvements, installation and removal, staging and storage would result in less than 1 acre disturbed (riverine, riparian);

- Construction of waterfowl brood ponds would result in modification of about 26 acres including ponds, access improvements, borrow areas, and staging areas (fresh water emergent wetland, annual grassland);

- Waterfowl nest cover and forage enhancements would modify 240 acres including site access, soil disturbance, and fertilization (annual grassland);

- Invasive Species Management Plan including site access, treatment, and revegetation (riparian, freshwater emergent wetland, annual grassland, riverine);

- Moe's and Hatchery ditch improvements (riparian, annual grassland); and

- Establishment of a Native American plant propagation area for harvesting traditional plants, construction of a cultural resources curation facility, access improvements, and soil disturbance (unknown).

Fishery enhancement and recreation-related PM&E measures that would result in some level of direct wildlife habitat loss are listed below.

Lake Oroville

- Expansion of Bidwell Canyon Marina parking, replacement of Bidwell Canyon campsites, and road widening at Bidwell Canyon facilities (blue oak/foothill pine woodland). These 3 Bidwell Canyon PM&E measures would total 5 acres of disturbance of habitat;

- Construction and maintenance of a shoreline access trail at Saddle Dam facilities (annual grassland, mixed chaparral);

- Improvements to Foreman Creek day use facilities (annual grassland, blue oak/foothill pine); and

- Construction and maintenance of two new group RV campsites including utilities and hookups, and improved ADA access at Loafer Creek (blue oak/foothill pine). (Disturbance would be up to 10 acres.)

Diversion Pool

- Construction and maintenance of Lakeland Boulevard trailhead improvements (annual grassland, barren, blue oak foothill pine).

Thermalito Forebay

- Construction and maintenance of Thermalito Forebay shoreline access and trails (annual grassland, riparian);
- Facility improvements of the North Thermalito Forebay Aquatic Center (urban, annual grassland); and
- Construction and maintenance of South Thermalito Forebay day use facility and improvements (annual grassland, barren).

Thermalito Afterbay

- Construction and maintenance of Larkin Road day use facility improvements (annual grassland, fresh water emergent wetland); and
- Construction and maintenance of Thermalito Afterbay Outlet camping and day use area (riparian, barren).

Fisheries

- Gravel Supplementation and Improvement Program efforts (riverine, fresh water emergent wetland, riparian); and
- Construction of two fish barrier weirs and egg collection station (riverine, riparian).

Location and project description information is currently lacking for several additional cultural resource-related PM&E measures with the potential to result in direct wildlife habitat loss including:

- Establishment of a cultural resources curation facility (unknown); and
- Establishment of plant propagation area for harvesting of traditional plants (habitat unknown).

Most of the PM&E measures identified within the Proposed Action involve only minor amounts of direct habitat loss (<1 acre/each). Only 2 PM&E measures (Bidwell Canyon camping/parking improvements, and Loafer Creek new group campsite facilities) are expected to result in direct wildlife habitat loss greater than 1 acre. Approximately 5 acres would be disturbed from the Bidwell Canyon Campground improvements and about 10 acres would be disturbed with the Loafer Creek new campsites.

Wildlife Species

The PM&E measures contained in the Proposed Action have the potential to affect individual wildlife species in either a beneficial or adverse manner. Several of the PM&E measures would serve to maintain or enhance native wildlife species including:

- Thirty-six conservation measures developed in consultation with USFWS for the protection of federally listed species. Cumulatively, these measures place severe restrictions on future habitat disturbance on over 8,000 acres within the project area and preserve riparian, annual grassland (including vernal pools), freshwater emergent wetland, and mature coniferous forest habitats. See Section 5.6.2.1 for further discussion regarding effects on vegetation communities.

- Implementation of Invasive Species Management Plan (this is discussed in detail in Section 5.6.2.1).

- Wildlife habitat improvement measures (construction of waterfowl brood ponds, installation of wildlife boxes, recharge of waterfowl brood ponds, and waterfowl nest cover and forage enhancements) are designed to benefit selected wildlife species within portions of the project area. These species include waterfowl, small mammals, raptors, secondary cavity nesters, aquatic reptiles and amphibians, and ground nesting or seed/grain eating birds.

- Reducing boat speeds in Thermalito Afterbay north of SR 162 would reduce disturbance and associated energetic costs to resident and migratory waterfowl and shorebirds.

- Increased patrol and enforcement on project lands could reduce wildlife disturbance and losses associated with OHV use, illegal hunting, arson, illegal dumping of trash and hazardous materials, trespass, and violation of seasonal or area recreational closures.

- The Gravel Supplementation and Improvement Program could provide more productive wildlife habitats if source areas are converted from barren gravel tailings.

- Installation of additional vehicular barriers within the OWA could serve to reduce vehicle-related mortality of sedentary wildlife and reduce wildlife disturbance/displacement.

- Restrictions on motorized wheeled vehicle use within the drawdown zone of Lake Oroville could serve to reduce disturbance/displacement of both lacustrine and terrestrial wildlife species.

In addition to direct habitat loss, native wildlife species could be affected in other ways by implementation of the Proposed Action including increased recreational or construction-related disturbance/displacement, improved habitat conditions for non-native competitors, and construction-related mortality as well as increases in traffic related mortality during operations.

Wildlife species can be adversely affected by indirect habitat loss associated with disturbance/displacement resulting from short-term construction-related activities or

long-term increases in recreational use. PM&E measures with the potential to result in either short-term reduction in wildlife use due to increased human disturbance include all of the actions involving construction-related activities. Long-term increases in wildlife disturbance/displacement are likely to be associated with those PM&E measures that serve to increase recreational use, extend the period of recreational use, or expand the area of recreational use (see Section 5.6.2.1 for further discussion of effects on vegetation communities and associated wildlife habitats) including:

- Additional Bidwell Canyon parking and campground facilities;
- New group camping areas at Loafer Creek;
- Additional trail construction including Saddle Dam and Thermalito Forebay;
- Facility improvements at Thermalito North Forebay Aquatic Center;
- Thermalito South Forebay day use facilities; and
- Swim beach construction and subsequent use.

PM&E measures that result in concentration of recreational uses in space or time could reduce wildlife disturbance if they reduce dispersed areawide recreational uses. PM&E measures with the potential to result in decreased dispersed recreational uses include:

- Construction of fishing piers at Thermalito Forebay;
- Construction of wildlife viewing improvements in OWA;
- Consolidation of existing OWA campgrounds at a single location; and
- Construction of swim beaches and subsequent use at several locations.

Many of the non-native wildlife species that occur in the project area have evolved in close association with humans and could be expected to benefit from PM&E measures resulting in increased human use or construction of additional structures. Increased populations of these non-native species can adversely affect native wildlife. Incorporation of design measures to limit non-native species use of new structures, continued use of rodenticides at structures, and improved garbage management at recreation facilities and dispersed use areas would all serve to limit population increases of non-native wildlife species, including house mouse, Norway rat, black rat, European house sparrow, European starling, and Virginia opossum.

Opportunities to reduce construction-related mortality can be realized to the extent possible by minimizing disturbance footprint, siting on barren or previously disturbed areas, avoidance of spring (reproductive season) construction, and avoidance of sensitive (and productive) wildlife habitats.

Commercially and Recreationally Important Wildlife

Several PM&E measures included within the Proposed Action are designed specifically to enhance habitat conditions for commercially or recreationally important wildlife species (CRIS) including;

- Additional waterfowl brood ponds;
- Seasonal recharge of brood ponds;
- Waterfowl nest cover enhancements;
- Migratory waterfowl and upland game forage plot enhancements; and
- Wildlife nest box program.

Other PM&E measures not designed specifically as enhancements for CRIS may also provide benefits to these species including:

- Invasive Species Management Plan to replace non-native and other undesirable plant species with native species more suitable for waterfowl and upland game bird forage and cover (see Section 5.6.3.1 for further discussion of the program);
- Reduced boat speeds on Thermalito Afterbay north of SR 162 to reduce disturbance and energetic cost to resident and migratory waterfowl;
- Increased patrol and enforcement within the OWA to limit wildlife losses associated with illegal hunting, trespass within area closures during the waterfowl nesting season, and illegal dumping in wetland or aquatic habitats; and
- Giant garter snake conservation measures to reserve wetland/waterfowl habitats from development.

State-Listed and Special-Status Species

State-Listed Species

Discussion of potential effects associated with the Proposed Action on bald eagle and giant garter snake, both State-listed and federally listed threatened species, and the yellow-billed cuckoo, a federal candidate species, are included in Section 5.7.2.2.

- Swainson's Hawk – Two wildlife habitat enhancements (waterfowl nest cover and forage enhancements) included within the Proposed Action have the potential to result in minor improvements to Swainson's hawk foraging habitat.

  None of the PM&E measures within the Proposed Action would result in modification of nesting habitat. However, implementation of some activities could result in disturbance/displacement of nesting hawks. Potential disturbance/displacement of nesting Swainson's hawks related to PM&Es

including enhancement of side-channel habitat are not expected to be adverse, with implementation of DFG Swainson's hawk avoidance measures.

Several activities associated with PM&E measures in the Proposed Action have the potential to increase human/equipment activities near the currently identified Swainson's hawk nest territory including: gravel harvest and placement associated with the Gravel Supplementation and Improvement Program, fisheries side-channel enhancements, gravel raking/ripping, large woody debris collection and placement, and invasive plant species control efforts. DFG guidelines for the protection of Swainson's hawk nest territories limit human intrusion/disturbance within 0.5 mile of active nest territories during the nesting season. Scheduling implementation of activities associated with PM&E measures within 0.5 mile of active nest territories to outside the nesting season would minimize potential affects to nesting Swainson's hawks.

- *Greater Sandhill Crane* – None of the PM&E measures within the Proposed Action would affect greater sandhill crane nesting habitat.

- *Bank Swallow* – No bank swallow nesting habitat currently exists within the project area. None of the activities within the Proposed Action would create additional nesting habitat or provide other benefits to nesting bank swallows. None of the activities within the Proposed Action would adversely affect bank swallow nesting or foraging habitat downstream of the project area. None of the actions in this alternative would address baseline hydrologic effects related to flooding of nest colonies during the period that prefledged young are potentially present. As noted in the No-Action Alternative, DWR is currently consulting with DFG to develop measures to address project operations potentially affecting bank swallows.

- *Peregrine Falcon* – None of the activities in PM&E measures under the Proposed Action would modify current nesting habitat or result in disturbance/displacement of nesting peregrine falcons. Further, none of the activities would adversely affect or benefit foraging peregrine falcons or foraging habitat.

Other Special-Status Species

Actions designed to increase habitat structural and plant species diversity or enhance prey populations may benefit some special-status species.

Piscivorous species (double-crested cormorant, American white pelican, osprey, black tern, California gull, river otter, black-crowned night heron) would benefit from many of the fisheries enhancement measures if they successfully increase or concentrate prey fish populations.

Increased habitat diversity resulting from implementation of several PM&E measures would benefit a wide range of special-status species including:

- Restricting OHV use in and around vernal pool habitats could serve to protect ground-nesting birds, nests, eggs, and young from vehicle-associated mortality. Species expected to benefit from this measure include California horned lark, northern harrier, and short-eared owl. Restricting OHV use in and around vernal pool habitats could also benefit the relatively sedentary western spadefoot from direct vehicle-related mortality or loss of friable soils for burrowing.

- Construction of additional brood ponds would provide additional nesting or foraging habitat for some lacustrine or wetland species including American bittern, black tern, black-crowned night heron, northern harrier, osprey, short-eared owl, white-tailed kite, and pond turtle. Regular spring recharge of brood ponds would also benefit these species by maintaining habitat conditions during the nesting season.

- Restricting high speed boating use on a portion of Thermalito Afterbay could reduce disturbance and resulting energetic costs of afterbay lacustrine and wetland special-status species including American bittern, American white pelican, Barrow's goldeneye, black tern, black-crowned night heron, California gull, common loon, double-crested cormorant, and osprey.

- Waterfowl nest cover enhancements are designed to increase cover height and density and would benefit northern harrier and short-eared owl foraging and nesting habitat.

- Placement of additional nest boxes within the OWA could be expected to provide cover and nest sites for the ringtail, a DFG fully protected species.

Short-term construction related habitat loss or species disturbance/displacement would occur as a result of implementation of several of the PM&E measures including Lower Feather River fish habitat improvement activities. These activities and resulting adverse species effects include:

- Gravel harvest, gravel grading/washing, gravel placement, side-channel development, and fish barrier weir construction/maintenance would result in short-term habitat loss/degradation to several special-status riverine species including river otter, pond turtle, double-crested cormorant, American white pelican, black tern, California gull, and osprey.

- Placement of two fish barrier weirs could act as a barrier to some riverine special-status species like river otter and pond turtle. Further, depending on velocities, the weirs could trap and drown pond turtles if they are unable to pass through the weir openings.

- Waterfowl forage enhancements generally result in reduced ground cover density during the spring nesting season. This reduced vegetative cover would adversely affect the quality of habitats for northern harrier and short-eared owl.

- Bidwell Canyon Campground parking improvements and construction of an additional campground loop could adversely affect habitats used by Cooper's hawk, oak titmouse, and Lewis's woodpecker for nesting. Retention of mature trees and snags during construction would serve to limit habitat loss for these species. Construction timing can be staged to limit nesting losses.

Alternative 2

Alternative 2 includes additional PM&E measures beyond those previously identified and discussed under the No-Action Alternative and the Proposed Action. No modifications to project operations related to ramping rates, water supply, or flood management are included in Alternative 2 except for flow increases in the Low Flow Channel and temperature adjustments at Robinson Riffle. Alternative 2 includes the existing measures as described in the No-Action Alternative (and Affected Environment) to address baseline effects of project operations and maintenance, as well as PM&E measures relating to cultural, environmental, and recreational resources.

Effects associated with PM&E measures carried forward from the No-Action Alternative and the Proposed Action and included in Alternative 2 would be the same as discussed under those alternatives and are not discussed further within this alternative assessment.

Some PM&E measures included in Alternative 2 would have no effect on wildlife habitat and wildlife species and are not discussed in this section. Several PM&E measures would have varying adverse and beneficial direct and indirect effects on wildlife resources. PM&E measures are described in Chapter 3.0. A summary of potential effects associated with the PM&E measures is provided in Table 5.6-10.

Wildlife Habitats

Several of the PM&E measures included within Alternative 2 are designed to protect existing fish or wildlife habitats. These habitat protection actions include 36 conservation measures developed in consultation with USFWS to protect/preserve habitat for species protected under the federal Endangered Species Act (ESA) and generally reserve or limit these lands from development or disturbance (see Appendix E). These protection measures include conservation measures related to nesting bald eagles, giant garter snake, California red-legged frog, valley elderberry longhorn beetle, and vernal pool tadpole and fairy shrimp. While these conservation measures are designed to protect ESA habitats, they also serve to protect co-occurring wildlife species dependent upon mature coniferous forest, freshwater emergent wetlands, riparian, annual grassland, and vernal pool habitats.

Other PM&E measures included within Alternative 2, while not designed as wildlife habitat improvements, have the potential to improve wildlife habitat conditions including:

- Creation of additional side-channel salmonid spawning and rearing habitat would increase the amount and quality of riverine and riparian habitat.

PM&E measures in Alternative 2 that would result in some level of direct wildlife habitat loss include:

Lake Oroville

- Expansion of Bidwell Canyon Marina parking would result in loss/degradation of blue oak/foothill pine woodland habitat;
- Construction of camp store shell at Bidwell Canyon would result in loss of blue oak/foothill pine habitat;
- Potential construction of a swimming facility at either Loafer Creek or Lime Saddle based on results of feasibility study could result in loss of blue oak woodland and urban habitats;
- Construction of a cultural resources curation facility and Native American plant propagation area would result in loss of wildlife habitats (the locations of these facilities are not known at this time);
- Provision of new shoreline access and day use facilities at Parish Cove would result in loss/degradation of annual grassland, chaparral, blue oak/foothill pine habitats;
- Trail construction to link Lime Saddle Campground and Marina would result in loss and degradation of annual grassland, chaparral, blue oak/foothill pine habitats;
- Construction of additional campsites at Lime Saddle Campground would result in loss of annual grassland, chaparral, blue oak/foothill pine habitats;
- Construction of a new low water boat ramp at Lime Saddle would affect barren and lacustrine habitats;
- Extension of Spillway Boat Ramp would effect barren and lacustrine habitats;
- Construction of additional parking at Oroville Dam Overlook Day Use Area would effect urban habitat;
- Construction and maintenance of a new group campsite at Lime Saddle would result in loss and degradation of blue oak/foothill pine habitat, and
- Construction and maintenance of activity center at Loafer Creek would result in loss and degradation of blue oak/foothill pine habitat.

Low Flow Channel

- Construction of trail to viewing access area for salmon spawning viewing would result in loss and degradation of riparian and urban habitats; and

- Construction of a whitewater park within the Fish Barrier Pool area would result in loss and degradation of barren, riparian, riverine, blue oak/foothill habitats.

Diversion Pool

- Construction of additional trails and day use facilities at dispersed use locations around the Diversion Pool would result in loss and degradation of annual grassland and blue oak/foothill pine habitats; and

- Construction of a flexible event center north of the Diversion Pool group staging area would result in loss of annual grassland habitat.

Many of the PM&E measures identified within Alternative 2 involve greater direct wildlife habitat loss than those projected under the No-Action Alternative or Proposed Action. PM&E measures in Alternative 2 expected to result in direct adverse long-term habitat losses greater than 1 acre include:

Lake Oroville

- Expansion of Bidwell Canyon Marina parking and day use facilities;

- Construction of camp store shell at Bidwell Canyon;

- Construction of a swimming facility at either Loafer Creek or Lime Saddle based on results of feasibility study;

- Provision of a new shoreline access and day use facilities at Parish Cove;

- Trail construction to link Lime Saddle Campground and Marina;

- Construction of additional campsites at Lime Saddle Campground;

- Construction of additional parking at Oroville Dam Overlook day use area; and

- Construction and maintenance of a new campground activity center at Loafer Creek.

Diversion Pool

- Construction of a flexible event center north of the Diversion Pool group staging area.

Low Flow Channel

- Construction of a whitewater park near the Diversion Pool; and

- Construction of trail to viewing access area for salmon spawning viewing.

Implementation of this alternative would result in greater direct wildlife habitat loss than other alternatives considered. Direct wildlife habitat loss of blue oak/foothill pine, urban, annual grassland, mixed chaparral, Sierran mixed conifer, mixed hardwood conifer, barren, riverine, and riparian would occur. The Oroville Facilities are a major recreation area in Northern California with 1.7 million recreation days per year. Recreational use of these facilities will increase over time as human population increases. Current levels of direct and indirect wildlife habitat loss are quantified in Study Report SP-T9.

Direct habitat loss of about 1,500 acres (3.6 percent of the project area) was estimated while direct and indirect habitat losses were estimated to total over 6,000 acres (15 percent of the project area). Incremental increased wildlife habitat losses associated with this alternative would degrade the project area's wildlife habitats and species populations.

Wildlife Species

The PM&E measures in Alternative 2 have the potential to affect individual wildlife species in either a beneficial or adverse manner through habitat alterations. Several of the PM&E measures would serve to maintain or enhance native wildlife species throughout the FERC project boundary including:

- Thirty-six conservation measures developed in consultation with USFWS for the protection of federally listed species (Appendix E). Together, these measures place severe restrictions on future habitat disturbance on over 8,000 acres within the project area and preserve riparian, annual grassland (including vernal pools), freshwater emergent wetland, and mature coniferous forest habitats. For identification of species within these habitats, see the analysis in SP-T4.

- Reducing boat speeds in the northern portion of Thermalito Afterbay serves to reduce disturbance and associated energetic costs to resident and migratory waterfowl, open water lacustrine species, and shorebirds. Reduced high speed boating use would reduce take of grebe nests and eggs (Ivy 2004). Appendix A in SP-T9 presents additional information on species effects related to high-speed boating use.

- Creation of additional side-channel salmonid spawning and rearing habitat would also benefit riverine wildlife species including shorebirds, egrets, herons, osprey, river otter, terns, gulls, and aquatic reptiles and amphibians. Increased riparian habitat quality (greater structural and plant species diversity) would improve riparian habitat connectivity benefiting riparian wildlife especially neotropical migratory birds.

In addition to direct habitat loss, native wildlife species could be adversely affected directly in other ways by implementation of Alternative 2, including increased recreational or construction-related disturbance/displacement, increased human presence and activity, improved habitat conditions for non-native competitors, and construction-related mortality. Recreation-related direct and indirect wildlife effects are

discussed in greater detail within study plan report SP-T9. This report also contains CWHR modeling of wildlife species occurrence related to wildlife habitats associated with existing recreational facilities.

Wildlife species can be adversely affected by indirect habitat loss associated with disturbance/displacement (erosion, night-lighting, harassment, noise, and increased human presence) resulting from short-term construction-related activities or long-term increases in recreational use. PM&E measures with the potential to result in either short-term reduction in wildlife use due to increased human disturbance include all of the actions involving construction-related activities. Long-term adverse increases in wildlife disturbance/displacement are likely to be associated with those PM&E measures that serve to increase recreational use or extend the period or expand the area of recreational use including:

- Additional parking facilities at Bidwell Canyon BR, Loafer Creek, Parish Cove, Lime Saddle, Foreman Creek, Oroville Dam Overlook, whitewater park, and Diversion Dam;
- New campground developments at Lime Saddle and installation/operation of additional floating campsites;
- Additional trail construction/access improvements at Lime Saddle, Parish Cove, Diversion Pool, and Feather River Fish Hatchery; and
- New or expanded day use facilities at Bidwell Canyon, Loafer Creek, Lime Saddle, Stringtown Car-top BR, Diversion Pool, whitewater park, and north of the Diversion Pool.

Many of the non-native wildlife species that occur in the project area have evolved in close association with humans and could be expected to benefit from PM&E measures resulting in increased human use or construction of additional structures. Increased populations of these non-native species can adversely affect native wildlife. Incorporation of design measures to limit non-native species use of new structures, continued use of rodenticides at structures, and improved garbage management at recreation facilities and dispersed use areas would all serve to limit population increases of non-native wildlife species including, house mouse, Norway rat, black rat, European house sparrow, European starling, and Virginia opossum.

Opportunities to reduce construction-related wildlife mortality could be realized to the extent possible by minimizing disturbance footprint, siting on barren or previously disturbed areas, avoidance of spring (reproductive season) construction, and avoidance of sensitive (and productive) wildlife habitats.

<u>Commercially and Recreationally Important Wildlife</u>

One PM&E measure included within Alternative 2 was designed specifically to enhance habitat conditions for commercially or recreationally important wildlife species. Limiting

boat speed on the northern portion of Thermalito Afterbay would benefit resident and migratory waterfowl. A literature review of recreational effects on wildlife species and habitats is included in Appendix A of SP-T9. This review contains additional information on the effect of high speed boating use on waterfowl.

State-Listed Species

Three State-listed wildlife species potentially affected by Alternative 2, bald eagle, giant garter snake and yellow-billed cuckoo, are protected under both the federal and State endangered species acts. Potential effects on these species are discussed in Section 5.7.3.

Potential effects on three State-listed threatened species, Swainson's hawk, greater sandhill crane, and bank swallow, as well as the State-listed endangered peregrine falcon are discussed below.

- *Swainson's Hawk* – None of the PM&E measures within Alternative 2 would result in modification of nesting habitat. However, implementation of some activities could result in disturbance/displacement of nesting hawks.

  Potential disturbance/displacement of nesting Swainson's hawks related to fisheries enhancement actions, including creation of additional side-channel habitat in and adjacent to riparian habitats are not expected to be adverse, with implementation of DFG Swainson's hawk avoidance measures.

  DFG guidelines for the protection of Swainson's hawk nest territories limit human intrusion/disturbance within 0.5 mile of active nest territories during the nesting season. Scheduling implementation of activities associated with PM&E measures within 0.5 mile of active nest territories to outside the nesting season would minimize potential effects on nesting Swainson's hawks.

- *Greater Sandhill Crane* – None of the PM&E measures within Alternative 2 would affect greater sandhill crane nesting habitat. Further, the lack of documented wintering use of the project area indicates that habitat modifications associated with Alternative 2 are unlikely to affect wintering or foraging use.

- *Bank Swallow* – No bank swallow nesting habitat currently exists within the project area. None of the activities within Alternative 2 would create additional nesting habitat or provide other benefits to nesting bank swallows. None of the activities within Alternative 2 would adversely affect bank swallow nesting or foraging habitat downstream from the project area. As noted in the No-Action Alternative, DWR is currently consulting with DFG to develop measures to address project operations potentially affecting bank swallows.

- *Peregrine Falcon* – None of the activities in PM&E measures under this alternative would modify current nesting habitat or result in disturbance/displacement of nesting peregrine falcons. Further, none of the

activities would adversely affect or benefit foraging peregrine falcons or foraging habitat.

Other State Special-Status Species

Actions designed to increase habitat structure and plant species diversity or enhance prey populations may benefit some State special-status species.

- Restricting high speed boating use on the northern portion of Thermalito Afterbay would reduce disturbance and resulting energetic costs of Thermalito Afterbay lacustrine and wetland special-status species including American bittern, American white pelican, Barrow's goldeneye, black tern, black-crowned night heron, California gull, common loon, double-crested cormorant, and osprey.

Short-term construction related habitat loss or species disturbance/displacement would occur as a result of implementation of several of the PM&E measures.

- Construction of additional salmonid spawning habitat would have a short-term adverse effect on riparian and riverine special-status species including, yellow-breasted chat, yellow warbler, river otter, osprey, and black-crowned night heron.

- Additional Lake Oroville camping opportunities, day use, parking, and trails could adversely affect habitats used by Cooper's hawk, oak titmouse, and Lewis' woodpecker for nesting. Retention of mature trees and snags during construction would serve to limit habitat loss for these species and construction timing can be staged to limit nesting losses however, long-term habitat loss/degradation may occur for these special-status species.

5.6.3 Cumulative Effects

5.6.3.1 Botanical Resources

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

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; the loss or reduction of special-status plant species populations. Detailed information regarding historic information, trends, and current threats to these botanical resources can be found in Study Plan Reports 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 effects identified in this PDEA and non-project related effects on botanical resources including native plant communities, special-status plant species, and non-native invasive plants.

Cumulative Effects of the Project and Past and Present Related Actions

Plant Communities

Riparian Resources: Historically, rivers in the Sacramento Valley were flanked by extensive floodplains that supported riparian forests and associated wetlands (Katibah 1984). These forests were maintained by complex fluvial geomorphic processes including hydrology, erosion, sediment transport, and depositional patterns. The Feather River has a long history of land uses which 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 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. Channelization and levee construction were completed by the 1940s. A number of hydroelectric and reservoir projects were constructed in the upper watershed prior to the construction of the Oroville Facilities that regulated streamflow and blocked sediment. As the risk of floodflows decreased downstream, more lands within the floodplain were converted to agricultural and urban use.

The construction of Oroville Dam in the 1960s further altered streamflow patterns, reduced floodflows, and reduced sediment discharge downstream. Today riparian forests along the Feather River downstream of Oroville Dam are narrow and fragmented, with little or no recruitment of new riparian species and are relatively low in structural and species diversity. Additional information on riparian resources in the project vicinity can be found in SP-T3/5.

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 SP-T10.

Over the last century California grasslands have been heavily affected by the invasion of non-native species. Construction of Thermalito Forebay and Thermalito Afterbay converted over 3,000 acres of grasslands with vernal pools and swales to project waters and emergent wetland vegetation. Over 200 acres of grasslands containing vernal pools and swales around the afterbay have been plowed and converted to non-native species for wildlife enhancement for foraging and nesting cover. Upland plant communities and associated wetlands have been and continue to be lost largely due to non-project related agricultural and urban development outside the FERC project boundary.

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 special-status species habitats 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 removed over 3,000 acres of grasslands containing vernal pools and potential special-status plant species habitat.

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 establishment.

Cumulative Effects of the Alternatives and Future Related Actions

No-Action Alternative

Plant Communities: Under this alternative, effects on botanical resources as identified in Section 5.6.2.1 would continue. Flow management, lack of sediment transport, and increasing water use demands downstream of Oroville Dam would continue to adversely affect riparian resources within the Feather River floodplain. Non-native plant species would continue to affect riparian and wetland areas. Riparian vegetation would continue to be lost to agricultural and urban development. 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 and agricultural demands. Within the project area grasslands and vernal pools and swales not designated as listed species habitat, and thus not protected by included BA measures, would continue to have moderate adverse effects from project related activities, recreational use, and invasions by non-native plant species. Wildlife enhancements in the OWA for waterfowl nesting cover and foraging vegetation would

continue to affect grasslands, vernal pools, and swales by introducing non-native species and fertilizer use which encourages non-native species over native species.

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 and encroachment into natural areas for 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 and agricultural demands. Although conservation measures relating to vernal pool invertebrates would reduce effects on these species habitats in the project area, there will continue to be some adverse effects from project-related activities, recreational use, and invasions by non-native plant species into habitats not protected under these measures.

Non-native Invasive Species: Non-native species would continue to increase in the project vicinity under the No-Action Alternative. These species affect both natural plant communities and special-status species habitats.

Proposed Action

Under the Proposed Action, effects on botanical resources would continue. These effects are similar to those described under the No-Action Alternative above. However, an Invasive Species Management Plan included in this alternative would have highly beneficial effects on native plant communities in the project area and those associated with downstream waters. This plan targets species that are considered to have the greatest effect on plant communities (especially wetland and riparian vegetation) and those that are affecting special-status species habitats. Thermalito Forebay, Thermalito Afterbay, and waterfowl brood ponds would continue to benefit special-status wetland plant species. Construction of additional ponds under this alternative would benefit these species as well.

Alternative 2

Under Alternative 2, adverse effects on botanical resources would continue and increase with the additional proposed PM&E measures. These effects would be similar to those described under the No-Action Alternative and Proposed Action.

5.6.3.2 Wildlife Resources

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

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 5.6.1.2 for more detailed information on effects). Detailed information regarding

wildlife and wildlife habitats, State-listed species and special-status species is contained in Study Plan Reports SP-T1, SP-T2, and SP-T9.

Cumulative Effects of the Project and Past and Present Related Actions

Historic Effects

The principal historic project and non-project effects on wildlife and wildlife habitat within the project area include:

- Reservoir development resulting in conversion of upland, riparian, and wetland habitats in the Feather River floodplain to less productive habitats (lacustrine and barren). Further, reservoirs act as dispersal barriers to some sedentary wildlife species affecting territorial behaviors and reducing gene flow in local populations.

- Flood management in the Feather River floodplain resulting in disruption of geomorphic processes essential for the maintenance and development of riparian/wetland habitats. An indirect effect of flood management activities is that it allows for urban and agricultural development in the historic Feather River floodplain with further reduction in extent of riparian and wetland habitats. Flood management related bank stabilization actions have resulted in loss of riparian habitats and reduction in species populations that utilize this habitat.

- Urban and agricultural conversion resulting in loss/degradation of riparian, wetland, and upland wildlife habitats.

- Gravel/gold mining in the Feather River floodplain resulting in degradation and loss of riparian/wetland habitats.

- Fire suppression resulting in disruption of natural successional processes affecting composition, density, and structure of upland wildlife habitats.

Current Effects

The principal current project and non-project effects on wildlife and wildlife habitats include:

- Urban development not under DWR control, resulting in alteration, loss, and degradation of upland, riparian, and wetland habitats.

- Reservoir water level fluctuations resulting in a barren shoreline, used by relatively few wildlife species. The lack of cover in barren areas could increase predation rates for upland species traversing from upland habitats to lacustrine habitats.

- Feather River flow regimes resulting in disruption of natural geomorphic processes, essential for the maintenance and development of riparian/wetland habitats. Some flow regimes can directly affect wildlife species production.

- Recreational development and use.
- Maintenance activities including pesticide and herbicide use, grading, gravel harvest, and drainage control activities.

Cumulative Effects of the Project and Past and Present Related Actions On State-listed Species and Species of Special Concern

Historical Effects

Principal historic actions affecting habitats of two State-listed species in the project area (Swainson's hawk and bank swallow) include:

- Project and non-project urban and agricultural conversion of habitat resulting in the loss/degradation particularly of riparian, wetland, and upland habitats. These losses have resulted in a significant decline in the State-listed Swainson's hawk population in the project area.
- Flood management in the Feather River floodplain resulting in disruption of geomorphic process essential for the maintenance and development of riparian/wetland habitats. An indirect effect of flood management activities is that it allows for urban and agricultural development in the historic Feather River floodplain, with further reduction in extent of riparian and wetland habitats. Flood management related bank stabilization actions have resulted in loss of riparian habitats, as well as reduction in species populations that utilize this habitat and loss of bank swallow nesting habitat.

Current Effects

Current project and non-project actions affecting the two State-listed species described above include:

- Non-project urban development resulting in alteration, loss, and degradation of upland, riparian and wetland habitats.
- Feather River flow regimes resulting in disruption of natural geomorphic processes, which are essential for the maintenance and development of riparian/wetland habitats. Further, some flow regimes can directly affect wildlife species production.
- Recreational development and use.
- Maintenance activities including pesticide and herbicide use, grading, gravel harvest, and drainage control activities.

Cumulative Effects of the Alternatives and Future Related Actions

Wildlife Habitat

Wildlife habitat (especially annual grassland, blue oak woodland, and blue oak/foothill pine habitats) will continue to be lost to urban development within the project area as human population increases.

Direct and indirect wildlife habitat losses associated with recreational use and development in the project area would continue to increase over time as the human population increases and recreational demand increases. All project alternatives would increase recreational use and development. The No-Action Alternative involves the least direct and indirect wildlife habitat loss, while Alternative 2 would result in the greatest habitat losses. Conservation measures serve to limit increased recreational use and development affects within annual grassland, freshwater emergent wetland, riparian, vernal pools, and mature coniferous forest habitats.

Flow regime effects on riparian habitat would continue under all alternatives. The proposed flow modifications considered under Alternative 2 would not result in significant change in the quantity and quality of riparian habitat within the Feather River floodplain or stimulate natural geomorphic processes.

Introduction of large woody debris and spawning gravel would increase riverine and riparian habitat values.

Effects associated with project maintenance activities are similar for all alternatives. Conservation measures would reduce project maintenance effects on annual grassland, freshwater emergent wetland, riparian, vernal pools, and mature coniferous forest habitats. Mosquito abatement actions disrupt the aquatic and terrestrial food chains and are likely to increase in the future to control the spread of West Nile virus.

State-listed Species and Species of Concern

Cumulative effects on State-listed species and species of concern would continue under all alternatives with actions described in Section 5.6.3.2 that eliminate or degrade 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.

- *Swainson's Hawk* – Flow regime effects on riparian habitat would continue under all alternatives. The proposed flow modifications considered under Alternative 2 would not result in significant change in the quantity and quality of riparian habitat within the Feather River floodplain or stimulate natural geomorphic processes or improve Swainson's hawk riparian habitat.

- *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 alternatives.

5.6.4 Unavoidable Adverse Effects

None of the potential effects described above can be completely avoided. However, most of these effects can be minimized or compensated for with implementation of the measures designed to reduce the level of adverse effect through avoidance, minimization or mitigation. Wildlife habitat losses can be minimized by including:

- Minimization of disturbance footprint;
- Siting on barren or previously disturbed habitats;
- Establishment of buffer zones for construction activities;
- Establishment of construction windows including dry season construction and grading design to minimize potential soil erosion and off-site habitat degradation;
- Adherence to design criteria to avoid sensitive wildlife habitats including wetlands, vernal pools, riparian areas containing elderberry shrubs, or loss of snags/mature trees;
- Retention of screening vegetation to the extent possible to minimize indirect habitat losses; and
- Revegetation using site appropriate native plant species (as needed).

5.6.4.1 Botanical Resources

As described in Sections 5.6.1.1 and 5.6.2.1, baseline project effects under each alternative would continue to affect botanical resources. A number of measures to avoid or reduce effects are included under the No-Action Alternative, Proposed Action, and Alternative 2. Long-term, short-term, or cumulative effects on botanical resources that would occur despite these measures are considered unavoidable adverse effects. Under all alternatives, there would be some unavoidable adverse effects on botanical resources.

No-Action Alternative

With implementation of the No-Action Alternative, baseline project effects on botanical resources associated with project reservoir water level fluctuations would continue. A number of conservation measures included under the No-Action Alternative that are designed to minimize adverse effects on federally listed wildlife species would also benefit and lessen effects on botanical resources, including plant communities, vernal pools, and special-status plant species habitats. Effects on the recruitment and retention of riparian habitat downstream of Oroville Dam would continue. Non-native

invasive plant species would continue to spread throughout the project area, affecting wetland, riparian, and upland habitats as well as special-status species habitats.

Proposed Action

Baseline project effects on botanical resources associated with project reservoir water level fluctuations would continue with the Proposed Action. Additionally, project operational effects on the recruitment and retention of riparian habitat downstream of Oroville Dam would continue; however, minor benefits would occur with the Large Woody Debris Supplementation Program. Upgrades to recreational facilities would result in some unavoidable direct loss of native plant communities and indirect effects from increased recreational use. Cultural resource measures would result in the unavoidable loss of plant communities from construction activities.

Alternative 2

Baseline project effects on botanical resources associated with project reservoir water level fluctuations would continue with Alternative 2. Additionally, project operational effects on the recruitment and retention of riparian habitat downstream of Oroville Dam would continue; however, minor benefits would occur with the Large Woody Debris Supplementation Program, creation of side-channel habitat, and increased minimum flow in the Low Flow Channel. Recreation facilities upgrades and construction of new facilities such as the whitewater park and the flexible event center would result in some unavoidable direct loss of native plant communities and indirect effects from increased recreational use. Cultural resource measures would result in the unavoidable loss of plant communities from construction activities.

5.6.4.2 Wildlife Habitats

As described in Sections 5.6.1.2 and 5.6.2.2, baseline project effects under each alternative would continue to affect wildlife resources. A number of measures to avoid or reduce effects are included under the No-Action Alternative, Proposed Action, and Alternative 2. Long-term, short-term, or cumulative effects on wildlife resources that would occur despite these measures are considered unavoidable adverse effects. Under all alternatives, there would be some unavoidable adverse effects on wildlife resources.

Potential unavoidable adverse effects on wildlife habitats include minor wildlife habitat loss/degradation associated with development and use of recreational facilities within blue-oak/foothill pine, blue-oak woodland, and annual grassland habitats and project operational effects on retention/recruitment of riparian habitat.

No-Action Alternative

With implementation of the No-Action Alternative, baseline project effects on wildlife resources associated with project reservoir water level fluctuations would continue. Potential adverse effects on nesting western and Clark’s grebes may occur related to

baseline recreational boating use and Thermalito Afterbay water level fluctuations. Data suggest that the relative effect of these two forms of disturbance vary from year to year. However, recent studies indicate grebe populations at the Thermalito Complex are among the highest levels in their range. A number of conservation measures included under the No-Action Alternative that are designed to minimize adverse effects on federally listed wildlife species.

Proposed Action

Baseline project effects on wildlife resources associated with project reservoir water level fluctuations would continue with the Proposed Action. Construction activities related to PM&E measures could result in the unavoidable loss of wildlife habitat. Construction of fish barrier weirs within the Low Flow Channel of the Feather River to benefit listed salmonids could result in the creation of a wildlife dispersal barrier or the drowning of western pond turtle. Potential disturbance/displacement of nesting Swainson's hawks related to fisheries enhancement actions in and adjacent to riparian habitats are not expected to be adverse, with implementation of DFG Swainson's hawk avoidance measures. Project operational effects on bank swallow nest productivity would continue under the Proposed Action.

Alternative 2

Baseline project effects on wildlife resources associated with project reservoir water level fluctuations would continue with Alternative 2. Construction activities related to PM&E measures could result in the unavoidable loss of wildlife habitat. Construction of fish barrier weirs within the Low Flow Channel of the Feather River to benefit listed salmonids could result in the creation of a wildlife dispersal barrier or the drowning of western pond turtle. Potential disturbance/displacement of nesting Swainson's hawks related to fisheries enhancement actions, including creation of additional side-channel habitat in and adjacent to riparian habitats are not expected to be adverse, with implementation of DFG Swainson's hawk avoidance measures. Project operational effects on bank swallow nest productivity would continue under Alternative 2.

Recreation facilities upgrades and construction of new facilities such as the whitewater park and the flexible event center would result in some unavoidable direct loss of wildlife habitat and indirect effects from increased recreational use.

5.7 FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

5.7.1 Regional Overview and Management Status

This chapter describes the aquatic, botanical, and wildlife species, and their habitats, located within the project study area that are federally listed as threatened and endangered, proposed for listing under the Federal Endangered Species Act of 1973 (ESA), as amended, and that are candidates for listing. State listed threatened and endangered species, and species of concern are discussed in Section 5.6.

This section also evaluates potential effects on federally listed fish, plant, and wildlife species and their habitats that could occur with implementation of the No-Action Alternative, the Proposed Action, and Alternative 2. An overview and evaluation of potential effects on federally listed fish, plant, and wildlife species are presented in Section 5.7.3. A analysis of these potential effects is provided in Study Plan Reports for listed fish species in Appendix G and in the draft Programmatic Biological Assessment (BA) for listed threatened and endangered, and candidate plant and wildlife species in Appendix E.

Fish species federally listed as endangered or threatened under the ESA, including Central Valley spring-run Chinook salmon, Central Valley steelhead, and delta smelt, are discussed in Section 5.7.3.1. Plant and wildlife species that are federally listed as threatened and endangered, proposed for listing, or are candidates for listing are discussed in Section 5.7.3.2 for wildlife and Section 5.7.3.3 for plants.

Operation of the Oroville Facilities influences environmental conditions in the project area including within and around Lake Oroville, its upstream tributaries, areas in and around the Thermalito Complex, and the OWA, as well as the Feather River floodplain below the project area. In general, the environmental effects on aquatic and terrestrial resources occurring within the project area may occur from: (1) reservoir operations and water releases; (2) timing, magnitude, frequency, and duration of water level fluctuations; (3) facility maintenance or development; (4) vegetation and/or wildlife habitat management; (5) noxious weed management; (6) road maintenance and development; and (7) recreational use or development and/or maintenance associated with recreation areas. The analyses of potential effects on fish, plants, and wildlife that are federally listed, proposed for listing, or candidates considered these actions in the analysis of potential effects associated with the No-Action Alternative, Proposed Action, and Alternative 2 in Sections 5.7.3.1, 5.7.3.2, and 5.7.3.3.

As part of relicensing, federally listed fish, plants, and wildlife resources were evaluated based on input from resource agencies and interested parties. Detailed field investigations were conducted in accordance with standard methodologies recommended by the resource agencies, pertinent jurisdictions, or affiliations with oversight for the individual resource area. All surveys were conducted during 2002, 2003, and 2004. Technical studies were conducted to address the specific issues identified during scoping and are referenced in the following sections and contained in Appendix G for fish species and in the relevant Study Plan Reports for plant and wildlife

species; the Study Plan Reports also include detailed descriptions of the study methods.

The principal federal regulations addressed in development and implementation of the relicensing studies for federally listed species, species proposed for listing, and candidate species are the ESA and Bald Eagle Protection Act. These acts and other federal acts that were considered are contained in Section 4.2. FERC designated DWR as its nonfederal representative for purposes of informal consultation under ESA Section 7.

A draft Programmatic BA (Appendix E) was prepared for terrestrial plant and wildlife species and non-anadromous fish species potentially occurring within the project area. Conservation measures contained in the draft Programmatic BA were developed in consultation with the U.S. Fish and Wildlife Service (USFWS) under the Section 7 ESA informal consultation process and are discussed in detail in the draft Programmatic BA. These conservation measures are described in Section 5.7.3 as applicable to the No-Action Alternative, the Proposed Action, and Alternative 2. A draft Programmatic BA is under development for anadromous fish species.

5.7.2 Affected Environment

5.7.2.1 Federally Listed Fish Species

A general discussion of fisheries and aquatic resources within the study area is provided in Section 5.5, Aquatic Resources. The following discussion specifically addresses those fish species that are federally listed as endangered or threatened, including Central Valley spring-run Chinook salmon, Central Valley steelhead, and Delta smelt. Federally listed fish species are included in Table 5.7-1.

Table 5.7-1. Federally listed fish species.

Common Name	Scientific Name	Regulatory Status [1]	Primary Mgmt. Concern Species [2]	CA Native or Introduced	Location Within Study Area [3]	Abundance/ Mgmt Status [4]
Spring-run Chinook salmon	*Oncorhynchus tshawytscha*	ST; FT	Yes	Native	FRFH, LFR	Threatened or endangered
Central Valley steelhead	*Oncorhynchus mykiss*	FT	Yes	Native	FRFH, LFR	Threatened or endangered

Source: Initial Information Package (DWR 2001); Moyle 2002

[1] *FT = listed as threatened under ESA; ST = listed as threatened under CESA; FE = federal endangered; SE = State endangered; FC = candidate for listing under ESA; CC = candidate for listing under CESA; FSC = federal species of concern; CSC = California species of special concern.*

[2] *Species of primary management concern evaluated in this analysis include those that are recreationally or commercially important, State- and/or federally listed species within the project study area under ESA or CESA, candidate species for listing under ESA or CESA, and California species of special concern.*

[3] *Frequently or infrequently observed in the following: UT = upstream tributaries; LO = Lake Oroville; DP = Diversion Pool; TF = Thermalito Forebay; TA = Thermalito Afterbay; FBP = Fish Barrier Pool; FRFH = Feather River Fish Hatchery; OWA = Oroville Wildlife Area ponds; LFR = Lower Feather River.*

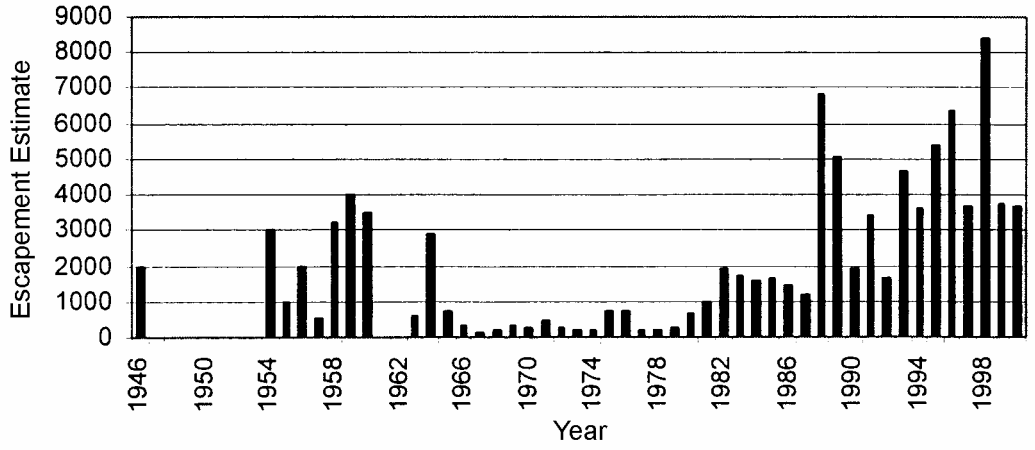
[4] *As defined in Moyle 2002.*

Of particular interest and importance is the distribution of Chinook salmon and steelhead spawning and rearing habitat in relation to the Oroville Facilities. Before construction of the major dams in the Central Valley, an estimated 6,000 miles of spawning and rearing habitat was accessible to Chinook salmon and steelhead. Currently, an estimated 95 percent of this habitat is blocked by dams or other obstructions (USFWS 1988 in CPUC 2000). The Oroville Facilities have the potential to directly affect spawning and rearing habitat for these species, as well as other species identified by State and/or federal resource agencies as species of special concern because of their declining numbers or limited distribution.

DWR constructed the Feather River Fish Hatchery in 1967 to compensate for salmonid spawning habitat lost with construction of Oroville Dam. Each year, approximately 9,000–18,000 salmon and 2,000 steelhead are artificially spawned at the hatchery. Salmon and steelhead raised at the hatchery are transported for release in the Feather and Sacramento Rivers, in Lake Oroville and other California reservoirs, and in San Pablo Bay north of San Francisco Bay (DWR 2002).

Prior to construction of the Oroville Facilities, the Feather River spring-run Chinook salmon population was similar in magnitude to the size of the present hatchery run (Figure 5.7-1). Spring-run Chinook salmon ascended the very highest streams and headwaters of the Feather River watershed prior to the construction of hydroelectric power dams and diversions (DFG 1998 in DWR and USBR 2001). Before Oroville Dam (1946 through 1963), available population estimates ranged from 500 to 4,000 fish and averaged 2,200 per year (DFG 1998 in DWR and USBR 2001). However, Feather River spring-run Chinook salmon had probably been significantly affected by hydroelectric power facilities in the upper watershed well before completion of Oroville Dam. For instance, DFG found substantial overlap in the spawning distributions of fall-

run and spring-run Chinook salmon upstream of the Oroville Dam site (DFG 1998 in DWR and USBR 2001).



Source: DWR and USBR 2001

Figure 5.7-1. Estimated adult spring-run Chinook salmon population abundance in Feather River, California.

As in several of the other spring-run streams, returns of spring-run Chinook salmon to the Feather River Fish Hatchery suggest that the population has been increasing slightly in the recent past (DWR and USBR 2001). This population trend could be caused by a large number of potentially contributing factors, some occurring within the project area and others unrelated to project operations (e.g., ocean cycle survival, decadal cycles, etc.), and are assessed further in the cumulative effects analysis provided in Section 5.7.4.1.

In September 2001, the U.S. District Court in Eugene, Oregon, in *Alsea Valley Alliance v. Evans* (161 F. Supp. 2d 1154, D. Oreg. 2001; *Alsea* decision) ruled that the ESA does not allow NOAA Fisheries to list a subset of an evolutionarily significant unit (ESU) and that NOAA Fisheries had improperly excluded stocks from the listing after it had decided that certain hatchery stocks were part of an ESU. Although the Court's ruling affected only the Oregon Coast coho salmon, it called into question nearly all of NOAA Fisheries' Pacific salmonid listing determinations. In its June 14, 2004, proposed listing determinations for 27 ESUs of West Coast salmonids, NOAA Fisheries states that "for the proposed listing determinations … to be compliant with the Court's ruling in the *Alsea* case, all populations or stocks (natural, hatchery, resident, etc.) included in an ESU must be listed if it is determined that the ESU is threatened or endangered under the ESA" (NOAA Fisheries 2004a).

<u>Central Valley Spring-run Chinook Salmon</u>

On September 19, 1999, the Central Valley spring-run Chinook salmon Evolutionarily Significant Unit (ESU) was listed as threatened under the ESA by National Oceanic and Atmospheric Administration (NOAA) Fisheries (NOAA Fisheries 1999). The Central

Valley spring-run Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries, which includes the naturally spawned spring-run Chinook salmon in the lower Feather River (NOAA Fisheries 1999). On June 14, 2004, NOAA Fisheries proposed that Central Valley spring-run Chinook salmon remain listed as threatened under the ESA (NOAA Fisheries 2004a). In addition, NOAA Fisheries concluded that the Feather River Fish Hatchery produces spring-run Chinook salmon that are genetically more similar to fall-run Chinook salmon and determined that these hatchery produced fish are not included as part of the ESU. This conclusion and its consistency with the *Alsea* decision is currently pending resolution.

On December 10, 2004, NOAA Fisheries issued a proposed rule designating critical habitat for seven ESUs of Pacific salmon and steelhead in California. The lower Feather River below Oroville Dam is identified as critical habitat for Central Valley spring-run Chinook salmon. Inaccessible stream reaches in the upper Feather River above Oroville Dam may be essential to the conservation of the Central Valley spring-run Chinook salmon ESU and NOAA Fisheries is seeking comment on whether this unoccupied habitat should be proposed as critical habitat (NOAA Fisheries 2004b). Public hearings will be held in January 2005 to receive comments and feedback on the proposed rule. Following the public comment period and hearings, the final rules are scheduled to be completed by NOAA Fisheries by June 2005 (NOAA Fisheries 2004b). The Central Valley spring-run Chinook salmon ESU also is listed as threatened under the California Endangered Species Act (CESA). A discussion of Chinook salmon in general is provided in Section 5.5.1.3, Fish Species Overview.

Adult spring-run Chinook salmon immigration into the Sacramento–San Joaquin Delta (Delta) and lower Sacramento River occurs from mid-February through July, and peaks during April-May (Moyle 2002). Suitable water temperatures for adult upstream migration reportedly range between 51 and 67°F (10.5 and 19.4°C) (Bell 1991). Other authors suggest that varying degrees of adverse effects could potentially occur to migrating adult Chinook salmon at water temperatures of 60, 64, and 68°F (15.6, 17.8, and 20°C) (Berman 1990; USEPA 2003; Marine 1992; NOAA Fisheries 1997; NOAA Fisheries 2000; ODEQ 1995; Ordal and Pacha 1963; USFWS 1995). In addition to suitable water temperatures, adequate flows are required to provide migrating adults with olfactory and other cues needed to locate their spawning reaches (DFG 1998).

The primary characteristic distinguishing spring-run Chinook salmon from the other runs of Chinook salmon is that adult spring-run Chinook salmon hold in areas downstream of spawning grounds during the summer months until their eggs fully develop and become ready for spawning. Maximum water temperatures for adult Chinook salmon holding while eggs are maturing are reported to be approximately 59 to 60°F (15 to 15.6°C) (NOAA Fisheries 1997). However, variation among studies suggests that holding adult Chinook salmon exposed to water temperatures above 60, 64, and 68°F (15.6, 17.8, and 20°C) have varying degrees of effects on individuals (Berman 1990; USEPA 2003; Marine 1992; NOAA Fisheries 1997; NOAA Fisheries 2000; ODEQ 1995; Ordal and Pacha 1963; USFWS 1995). Spring-run Chinook salmon spawn in the upper Sacramento River upstream of Red Bluff Diversion Dam, the lower Yuba River, and the

lower Feather River. Spawning has been reported to primarily occur during September and October, peaking in mid-September (Moyle 2002). Available literature suggests that water temperatures above 56, 58, 60, and 62°F (13.3, 14.4, 15.6, and 16.7°C) each have varying effects on spawning adult Chinook salmon and incubating embryos (Combs and Burrows 1957; Dauble and Watson 1997; Groves and Chandler 1999; Hinze 1959; Johnson and Brice 1953; NOAA Fisheries 1993; NOAA Fisheries 1997; NOAA Fisheries 2002; Seymour 1956; USBR Unpublished 2003; USFWS 1995; USFWS 1999). Although some portion of an annual year-class may emigrate as post-emergent fry (individuals less than 45 millimeters [mm] in length), most are believed to rear in the upper Sacramento River and tributaries during the winter and spring and emigrate as juveniles (individuals greater than 45 mm in length, but not having undergone smoltification) or smolts (silvery colored fingerlings having undergone the smoltification process in preparation for ocean entry). Juvenile spring-run Chinook salmon normally rear for 3 to 15 months before migrating to the ocean (Yoshiyama et al. 1998). The timing of juvenile emigration from the spawning and rearing grounds varies among the tributaries of origin, and can occur during the period extending from October through April (Vogel and Marine 1991). In the Feather River, data on juvenile spring-run emigration timing and abundance have been collected sporadically since 1955 and suggest that November and December may be key months for spring-run emigration (Painter et al. 1977). Spring-run Chinook salmon from the Feather River normally spend 3 years in the ocean (Moyle 2002). Detailed discussion of the effects of exposure to elevated water temperatures on various life stages of spring-run Chinook salmon is provided in Section G-AQUA1.8 of Appendix G-AQUA1.

Central Valley Steelhead

On March 19, 1998, naturally spawned Central Valley steelhead was listed as threatened under the ESA by NOAA Fisheries (NOAA Fisheries 1998). When originally listed, the Central Valley steelhead ESU included all naturally spawned populations of steelhead (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries residing below naturally formed and artificial impassable barriers (e.g., waterfalls and dams), which includes the naturally spawned steelhead in the Feather River (NOAA Fisheries 1998). On June 14, 2004, NOAA Fisheries proposed that Central Valley steelhead remain listed as threatened under the ESA. In their proposed rule (NOAA Fisheries 2004a), NOAA Fisheries concluded that there are two artificial propagation programs considered to be part of the Central Valley steelhead ESU (i.e., the Coleman National Fish Hatchery on Battle Creek and the Feather River Fish Hatchery), although both programs are intended to support recreational fisheries for steelhead rather than to supplement naturally spawning populations. In addition, NOAA Fisheries proposed that resident steelhead occurring with anadromous populations below impassable barriers also be included in the ESU. Steelhead runs in the Feather River are sustained largely by the Feather River Fish Hatchery (McEwan and Jackson 1996).

On December 10, 2004, NOAA Fisheries issued a proposed rule designating critical habitat for seven ESUs of Pacific salmon and steelhead in California. The lower Feather River below Oroville Dam is identified as critical habitat for Central Valley

steelhead. Inaccessible stream reaches in the upper Feather River above Oroville Dam may be essential to the conservation of the Central Valley steelhead ESU and NOAA Fisheries is seeking comment on whether this unoccupied habitat should be proposed as critical habitat (NOAA Fisheries 2004b). Public hearings will be held in January 2005 to receive comments and feedback on the proposed rule. Following the public comment period and hearings, the final rules are scheduled to be completed by NOAA Fisheries by June 2005 (NOAA Fisheries 2004b).

Steelhead are known to live up to 9 years in the Central Valley (Moyle 2002). Adult steelhead immigration into Central Valley streams typically begins in December and continues into March. Steelhead may re-enter fresh water anytime between July and May, but immigration generally peaks during January and February (Moyle 2002). Optimal immigration temperatures have been reported to range from 46 to 52°F (7.8 to 11.1°C) (NOAA Fisheries 2000). However, other authors suggest that varying biological effects could occur to adult steelhead after exposure to water temperatures above 52, 56, and 70°F (11.1, 13.3, and 21.1°C) during immigration and holding (Bruin and Waldsdorf 1975; Leitritz and Lewis 1980; McCullough et al. 2001; NOAA Fisheries 2000; NOAA Fisheries 2002; SWRCB 2003; USBR 1997; USBR 2003). Spawning occurs between January and March (McEwan 2001). Optimal spawning temperatures have been reported to range from 39 to 52°F (3.8 to 11.1°C) (DFG 2000). However, other authors suggest that varying biological effects could occur to adult steelhead after exposure to water temperatures above 52, 54, 57, and 60°F (11.1, 12.2, 13.8, 15.6°C) during steelhead spawning and embryo incubation (USEPA 2001; Humpesch 1985; Kamler and Kato 1983; Kwain 1975; McCullough et al. 2001; NOAA Fisheries 2000; NOAA Fisheries 2001; NOAA Fisheries 2002; Redding and Schreck 1979; Rombough 1988; SWRCB 2003; Timoshina 1972; USBR 1997; USFWS 1995; Velsen 1987). Unlike Chinook salmon, many steelhead do not die after spawning. Those that survive return to the ocean and may spawn again in future years. Most steelhead in California spawn twice (Busby et al. 1996).

Optimal egg incubation temperatures have been reported to range from 48 to 52°F (8.8 to 11.1°C) (NOAA Fisheries 2000). However, other authors suggest that varying biological effects could occur to adult steelhead after exposure to water temperatures above 52, 54, 57, and 60°F (11.1, 12.2, 13.8, and 15.6°C) during steelhead spawning and embryo incubation (USEPA 2001; Humpesch 1985; Kamler and Kato 1983; Kwain 1975; McCullough et al. 2001; NOAA Fisheries 2000; NOAA Fisheries 2001; NOAA Fisheries 2002; Redding and Schreck 1979; Rombough 1988; SWRCB 2003; Timoshina 1972; USBR 1997; USFWS 1995; Velsen 1987). Preferred water temperatures for fry and juvenile steelhead rearing are reported to range from 45 to 65°F (7.2 to 18.3°C) (NOAA Fisheries 2000). Each degree increase between 65°F (18.3°C) and the upper lethal limit of 75°F (23.9°C) reportedly becomes increasingly less suitable and thermally more stressful for the fish (Bovee 1978). Juveniles spend 1 to 2 years in freshwater before migrating to the ocean. The primary period of steelhead emigration occurs from March through June (Castleberry et al. 1991). Most steelhead in the Central Valley return to spawn after 1 year in the ocean while a smaller number may spend 2 years (Busby et al. 1996). Detailed discussions of the effects of exposure

to elevated water temperatures on various life stages of steelhead are provided in Section G-AQUA1.8 of Appendix G-AQUA1.

5.7.2.2 Federally Listed Wildlife Species

This section identifies special-status wildlife species and their habitats protected under the ESA that potentially occur in the project area. This includes species that are threatened, endangered or proposed for listing or candidate species. Wildlife species potentially occurring in habitats within the project area that are listed under the CESA as threatened or endangered and that also have federal status are addressed in this section.

Potential habitats were delineated by converting vegetation mapping for the project area (See Section 5.6.1) to the California Wildlife Habitat Relationship habitat classification system. Surveys of potential habitats for threatened and endangered species as well as visual surveys for the occurrence of the species were conducted in 2002 (valley elderberry longhorn beetle, California red legged frog, bald eagle), 2003 (bald eagle, vernal pools) and 2004 (bald eagle, vernal pools) for threatened and endangered species in accordance with applicable DFG or USFWS protocols, where appropriate.

Identification of potential habitats and compilation of information for the above listed species, species occurrence and life histories were compiled from California Wildlife Habitat Relationship (CHWR) database and the Natural Diversity Database (CNDDB) for the project area and within a one-mile radius as well as other national, State and/or county biological survey records and databases, websites, printed articles and discussions with local wildlife agencies.

Detailed descriptions and analysis are included in SP-T2, *Project Effects on Special Status Species,* and in the Draft Programmatic BA for Terrestrial and Non-Anadromous Species in Appendix E.

Survey methods for State listed species and special-status species are addressed in Section 5.6.1.2.

Relicensing studies as described in SP-T2 indicate the presence of or occurrence of potentially suitable habitat within the project area for seven species currently listed or proposed for listing under the ESA. These species include bald eagle, California red-legged frog, giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole shrimp, Conservancy fairy shrimp, and vernal pool fairy shrimp.

<u>Federally Listed Species</u>

USFWS issued a letter on January 28, 2004 (Appendix A of the BA found in Appendix E), which listed species that potentially may occur in the project area. Seven wildlife species protected under the ESA have the potential to occur within the project vicinity and are listed in Table 5.7-2. No designated or proposed critical habitat occurs within the project area for federally listed species.

Informal consultation with USFWS occurred throughout the collaborative Alternative Licensing Process for the Oroville Facilities, including Plenary and Working Group meetings beginning in November 12, 2000. The Draft Programmatic BA for Terrestrial and Non-Anadromous Species was submitted to USFWS on May 19, 2004. Mountain yellow-legged frog, a federal candidate species, is not listed in Table 5.7-2 as it is restricted to elevations ranging from 4,500 feet to over 12,000 feet, but primarily occurs above 5,900 feet (Zeiner et al. 1990b). This species does not occur within the project area. Likewise, the project area is outside of the range of California tiger salamander. There are no records for the species occurring within the FERC project boundary as described in SP-T2. The only record of occurrence in Butte County was a 29-year-old record at Gray Lodge Wildlife Management Area approximately 40 miles from the project. Subsequent surveys at Gray Lodge since 1965 have not recorded the presence of this species. Western Yellow-billed cuckoo is a federal candidate species requiring deciduous riparian thickets or forests with dense, low understory near slow-moving waterways (Zeiner et al 1990a). Potential cuckoo habitat within the project area and adjacent lands is restricted to riparian habitat within the OWA (Figure 5.7-6). Very few blocks of suitable habitat (dense low understory) greater than 25 acres and 300 feet in width occur within this area. Most of the areas within the OWA dominated by riparian vegetation are historic dredger tailings. No cuckoos were identified during surveys of potentially suitable nesting habitat within the project area during either 2002 or 2003 (see SP-T2). Only one breeding pair was identified on the Feather River well downstream of the project area during the 1988 survey (Laymon and Halterman 1988). The lack of suitable habitat and no recent recorded sightings indicates that this species does not occur within the FERC project boundary.

Table 5.7-2. Federally listed species occurring in the project vicinity.

Wildlife Species	Federal Status
Bald eagle (*Haliaeetus leucocephalus)*	Threatened
Giant garter snake (Thamnophis couchi gigas)	Threatened
California red-legged frog (*Rana aurora draytonii*)	Threatened
Vernal pool fairy shrimp (*Branchinecta lynchi*)	Threatened
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	Threatened
Conservancy fairy shrimp (*Branchinecta conservatio*)	Endangered
Vernal pool tadpole shrimp (*Lepidurus packardi*)	Endangered

Source: SP-T2

Bald Eagle

USFWS listed the southern bald eagle as an endangered species in March 1967. After a federal status review, it was downlisted to threatened in 1995. The species is currently proposed for federal delisting (USFWS 1999). This species is currently State listed as endangered.

Bald eagles historically nested throughout California near sea coasts, major rivers, and lakes. More than 160 pairs currently nest in California (up from 28 pairs in 1978) while hundreds of additional bald eagles migrate into California during the winter.

Nesting habitat is described as old-growth trees and snags in remote mixed stands near water (Zeiner et al. 1990a). In a 1979 survey of 95 bald eagle nest sites in Northern California, 87 percent were in dominant or co-dominant ponderosa pine or sugar pine (Lehman 1979). Associated stands were generally open (less than 40 percent canopy cover), and within 1 mile of a water body. Approximately one-third of the nest sites were within 0.1 mile of a water body, and 85 percent of the nests had an unobstructed view of the water body. Seventy percent of the nests were associated with reservoirs.

Three active bald eagle nest territories currently exist within the FERC project boundary, with one additional active nest territory present on the North Fork Feather River upstream of the project area as discussed in SP-T2. All three active nests are on Lake Oroville. Population monitoring (2002 through 2004) indicates that reproduction (1.0 fledglings/active nest) meets USFWS Bald Eagle Pacific Recovery Plan goals (USFWS 1986).

Giant Garter Snake

The giant garter snake was listed as a threatened species under the ESA during October 1993. It has also been listed as threatened under the CESA since 1971.

The giant garter snake is endemic to the wetlands of the Central Valley of California. Historic range is believed to include valley floor wetlands from the vicinity of Butte County south to near Bakersfield. Historically, giant garter snakes were found in natural wetlands associated with flood basins.

Thirteen sub-populations of giant garter snake have been identified. Population information is generally lacking. The northern extent of the current range of this species is described as Sacramento and Contra Costa counties (Fox 1951), to near Gridley (Hansen and Brode 1980), to the vicinity of Chico (Rossman and Stewart 1987). In addition to natural wetlands, giant garter snakes are now found in agricultural wetlands (rice), managed wetlands (duck clubs and State and federal refuges), agricultural drains, ponds, and other artificial waterways.

The Giant Garter Snake Recovery Plan (Miller and Hornaday 1999) describes the essential habitat components for this aquatic reptile as: (1) adequate water during the snakes' active season (early spring through mid-fall) to support dense populations of prey; (2) presence of emergent herbaceous cover (cattails and tules) for escape cover and foraging habitat; (3) grassy upland habitat adjacent to waterways for basking; and (4) higher elevation upland habitat for flood flow refuge. This species is absent from larger rivers, riparian woodlands, and wetlands with sand, rock, or gravel substrates (Miller and Hornaday 1999).

Suitable giant garter snake habitat was identified within portions of Thermalito Forebay, Thermalito Afterbay, the OWA, and lands subject to rice agriculture adjacent to the Thermalito Afterbay but outside the FERC project boundary (Figures 5.7-2a through 5.7-2c). About 4,280 acres of suitable habitat have been identified within the project area as described in SP-T2. No giant garter snakes were observed during the course of

the relicensing studies. However, unconfirmed sightings of this species have been received historically from biologists working near Robinson Borrow Pond (adjacent to the FERC project boundary), Cherokee Canal (2 miles west of Thermalito Afterbay), and within Thermalito Afterbay. No suitable habitat is present at Lake Oroville. Several small, isolated patches of backwater habitats along the Feather River provide suitable habitat. The rice fields and canals along the western border of Thermalito Afterbay have suitable habitat for giant garter snake. These canals are primarily on private property outside of the FERC project boundary. Rice fields and agricultural ditches provide habitat for most of the current populations of the giant garter snake (USFWS 1997), and these areas are expected to have populations of giant garter snake. Further, these canals offer dispersal channels for giant garter snake to eventually move into the OWA waters that have potentially suitable habitat. However, State Route (SR) 99 serves at least as a partial barrier to this dispersal habitat.

California Red-Legged Frog

The California red-legged frog was federally listed as a threatened species in June 1996. This species is considered a Species of Special Concern by the State. The California red-legged frog has been extirpated from approximately 70 percent of its former range with only 2 known populations remaining east of the coast range.

The California red-legged frog can occur from sea level up to approximately 5,000 feet elevation, with most known populations below 3,500 feet. This species uses a variety of aquatic habitats for reproduction including streams, deep pools, backwaters, ponds, marshes, sag ponds, dune ponds, and lagoons (USFWS 2000). Breeding adults are generally associated with deep (greater than 2 feet), slow moving water bordered by dense, low riparian or emergent vegetation (USFWS 2000). Upland areas near breeding locations can also be used extensively during the summer (USFWS 2000). Several reasons for the population decline have been identified, including habitat loss (alteration, degradation, and fragmentation), urbanization, agricultural practices, water management activities, mining, livestock practices, recreational effects, timber harvest practices, exploitation (as food), disease, introduced species (e.g., bullfrog, mosquitofish, and largemouth bass), drought, and contaminants (USFWS 2000).

California red-legged frogs are not currently known to exist within the FERC project boundary. However, the largest remaining population within the Sierra Nevada range is within 1 mile of the FERC project boundary in the North Fork Feather River drainage. Suitable red-legged frog habitat was identified within portions of Thermalito Forebay, Thermalito Afterbay, and the OWA (Figure 5.7-3a through 5.7-3c). Neither Lake Oroville nor the portion of the reservoir's tributaries within the project area contain suitable habitat.

Vernal Pool Invertebrates

The project area is known to be within the range of three federally listed eubranchiopod species: the vernal pool fairy shrimp, the Conservancy fairy shrimp, and the vernal pool tadpole shrimp.

The tadpole shrimp is federally listed as an endangered species. This tadpole shrimp species is found in vernal pools throughout the Sacramento Valley and is reported to occur in Butte County. The tadpole shrimp is omnivorous and generally forages on the bottoms of pools in dense vegetation. Tadpole shrimp tend to be slow growing and are usually collected after the vernal pool has been ponded for 30 days.

The Conservancy fairy shrimp is federally listed as an endangered species. This species is reported from large (>1.2 acres) and deep (>6 inches) turbid alkaline pools. This species of fairy shrimp has an extremely disjunct distribution, known from Tehama and Butte Counties, in the northern part of the Sacramento Valley, Solano County at the Jepson Prairie, Merced County, in the San Joaquin Valley near Haystack Mountain, and an isolated occurrence from northeastern Ventura County (Eriksen and Belk 1999).

The vernal pool fairy shrimp is federally listed as a threatened species. This shrimp species is found in vernal pools throughout the Central Valley and western Riverside County in California, and near Medford, Oregon (Eriksen and Belk 1999). This fairy shrimp species occurs in neutral to slightly alkaline vernal pools throughout the California Central Valley, and in rock outcrop pools along the Interior Coast Ranges, south of the Delta.

Typical habitat for fairy shrimp and tadpole shrimp in California includes vernal pools, ponded areas within vernal swales, rock outcrop ephemeral pools, playas, alkali flats, and salt lakes (Eng et al. 1990). Pool volume is important in determining potential shrimp habitat because deeper pools with a large surface area can more easily maintain their dissolved oxygen levels. Similarly, deep pools will pond long enough to allow the shrimp to complete their lifecycle.

None of these three invertebrate species are known to occur within the project area. However, vernal pool fairy shrimp are documented to occur at two locations immediately adjacent to the FERC project boundary (DFG 2004a). Relicensing studies indicate that 18.4 acres of suitable vernal pool invertebrate habitat is present within the project area, all occurring in the grasslands around Thermalito Afterbay and Thermalito Forebay (see SP-T2, Figures 5.7-4 and 5.7-4a through 5.7-4c).

<u>Valley Elderberry Longhorn Beetle</u>

The valley elderberry longhorn beetle was federally listed as a threatened species in August 1980. The known distribution of this species has greatly increased through additional survey efforts since its initial listing. USFWS now identifies the species range as throughout the Central Valley and up to 3,000 feet in elevation on the eastern edge of the valley and to the Coast Range watershed divide along the western side of the valley (USFWS 1984).

The beetle is primarily restricted to riparian habitat and adjacent uplands. The valley elderberry longhorn beetle is dependent upon its host plant the elderberry (*Sambucus* sp.) throughout its life cycle. The valley elderberry longhorn beetle spends most of its 2-

year life cycle boring within the stem in a larval stage. The beetles emerge from the stem March through June as adults to lay eggs, completing the life cycle (Barr 1991).

Elderberry bushes are one of the most common shrub species in high terrace habitats within the portion of the OWA bordering the Feather River (Figures 5.7-5 and 5.7-5a through 5.7-5h). Over 90 acres of elderberry shrubs have been mapped on project levees in this area. Elderberry shrubs are rare at Lake Oroville, Thermalito Forebay, and Thermalito Afterbay. Several small patches of elderberry shrubs are present within the project area between Oroville Dam and Table Mountain Boulevard.

Baseline Project Conditions

Baseline project operations potentially could cause direct and indirect effects on special-status wildlife species and habitats within the project area. Short- and long-term effects may result in changes to the dynamics and stability of existing wildlife communities, including changes in species diversity and wildlife distribution, and may affect reproductive success. Direct and indirect effects may result from the following:

- *Lake Oroville Water Level Fluctuations:* Water levels in Lake Oroville fluctuate in response to needs for power production, flood management, and water withdrawals for irrigation or municipal water use. Long-term population monitoring of nesting bald eagles on Shasta Lake indicate a positive correlation between bald eagle productivity (number of young produced per occupied nest) and the average water surface elevation during April through June (Reclamation 1992). A similar relationship may occur on Lake Oroville. However, the limited bald eagle reproduction information available on Lake Oroville does not allow meaningful evaluation.

- *Thermalito Afterbay Water Level Fluctuations:* Relatively minor water level fluctuations occur at the Diversion Pool, Thermalito Forebay, and within dredger ponds associated with the OWA. However, Thermalito Afterbay water level fluctuations are more extreme and can adversely affect the habitat of the highly aquatic giant garter snake. Exposed mudflats that occur during some Thermalito Afterbay fluctuations may increase predation and loss of individual giant garter snakes attempting to traverse these areas to reach either shoreline cover or aquatic foraging areas.

- *Ground/Soil Disturbance and Habitat Degradation from Operations and Maintenance Activities:* Project maintenance and/or operations may affect ESA habitats by disturbing surfaces, resulting in direct elimination of habitat, degradation of habitat quality, and/or displacement of wildlife. Federally listed vernal pool tadpole and fairy shrimp are sensitive to sedimentation, drainage control, and herbicides associated with road and levee maintenance activities (Appendix E). Valley elderberry longhorn beetles and their habitats are sensitive to facilities maintenance activities including grading, pruning, herbicide use and pesticide use (Appendix E).

- *Disturbance from Project-Related Recreation:* Wildlife and wildlife habitat may be directly and indirectly affected by project-related recreation. Development and use of recreational facilities causes direct loss of habitat as vegetation is removed or altered and soil is disturbed as described in SP-T9, *Recreation and Wildlife*. Bald eagles can be intolerant of human activity during the breeding season. However, tolerance to human activity varies from pair to pair. Human activity can result in nest abandonment and subsequent loss of production (Bogener 1980; Detrich 1980; Lehman 1983).

  In some cases, breeding bald eagles have relocated their nest in response to human activity (Thelander 1973). Recreational off-highway vehicle (OHV) use can damage vernal pools by disruption of overland flow patterns and from direct habitat destruction as described in SP-T2. The weight of the vehicle can crush or displace fairy and tadpole shrimp when present during the wet season or destroy their cysts in the summer. The compacted soils in the resulting tire ruts are unsuitable for sustainability of the vernal pool ecology, affecting the growth of aquatic plants and algae.

5.7.2.3 Federally Listed Botanical Species

This section addresses federally listed plant species and habitat within the Oroville Facilities project area. This includes species that are listed as threatened or endangered by USFWS. Plant species listed under the CESA as threatened or endangered with the potential to occur in the project area that also have federal status are addressed in this section.

Botanical surveys were conducted during 2002, 2003, and 2004 in accordance with standard guidelines issued by DFG (2000), USFWS (1996), and the California Native Plant Society (CNPS) (2001). Surveys were conducted during the time of year when the target species were identifiable. Field investigations were conducted in a manner that emphasized all potential habitats for the target threatened and endangered plant species (i.e., vernal pools/valley grasslands and serpentine/gabbro soils). Local reference sites were visited where possible. Areas surveyed included valley grasslands around Thermalito Afterbay and Thermalito Forebay, serpentine soils in the West Branch and North Fork area of Lake Oroville, and gabbro soils along the South Fork arm of Lake Oroville. All plant species encountered during these surveys were identified to the lowest taxonomic status possible. Detailed descriptions and analysis are included in SP-T2.

Information on the above listed species with the potential to occur in the project area were compiled from rare plant descriptions and distributions obtained from California Natural Diversity Database (CNDDB) records, a review of CNPS (2001), *Manual of the Vascular Plants of Butte County California* (Oswald 1994), *The Jepson Manual* (Hickman 1993), other State and/or County biological survey records, web-based and printed articles, and discussions with local authorities.

Surveys for special-status species, other than those officially listed as threatened, endangered, or rare species by USFWS and DFG, are addressed in Section 5.6. Nomenclature conforms to Hickman (1993) and Oswald 1994.

Relicensing studies indicate that potentially suitable habitat exists within the project area for seven federally listed and State-listed plant species (Table 5.7-3). No habitat for the federally and State-listed Hartweg's golden sunburst (*Pseudobahia bahiifolia*) was located along the Feather River downstream of the project area. No federally listed or State-listed plant species were found within the study area during the 2002, 2003, and 2004 surveys.

Although no federally listed plant species were found within the project area, potentially suitable habitat does exist for all of the seven listed species. Approximately 49 acres of vernal pool and vernal swale habitat exists within the grasslands of the project area. Approximately 172 acres of serpentine-derived soils and 64 acres of gabbro-derived soils exist within the project area.

Table 5.7-3. Federally listed plant species with potential to occur in the project area.

Scientific Name **Common Name**	**Status USFWS/ State**	**Habitat (elevation)**	**Found in Project Area**
Federally or State Listed			
Chamaesyce hooveri Hoover's spurge	Threatened	Vernal pools (25–250 meters [m])	No
Limnanthes floccosa ssp. *californica* Butte County meadowfoam	Endangered/ Endangered	Valley and foothill grassland (mesic), vernal pools (50–90 m)	No
Orcuttia pilosa Hairy Orcutt grass	Endangered/ Endangered	Vernal pools (55–200 m)	No
Orcuttia tenuis Slender Orcutt grass	Threatened/ Rare	Vernal pools (35–1,760 m)	No
Pseudobahia bahiifolia Hartweg's golden sunburst	Endangered/ Endangered	Cismontane woodland, valley and foothill grassland/clay (15–150 m)	No
Senecio layneae Layne's ragwort	Threatened/ Rare	Chaparral, cismontane woodland/ serpentinite or gabbroic (200–1,000 m)	No
Tuctoria greenei Greene's tuctoria	Endangered/ Rare	Vernal pools (30–1,070 m)	No

Source: SP-T2

Vernal Pool Habitat

Vernal pool and swale complexes are a common part of the valley grassland habitats in the project area. These pools are of the Northern Hardpan type and occur in complexes in areas of hummocky ground on terrace-alluvial derived redding soils (DFG 1998). The Northern Hardpan pools are most threatened by urban expansion, agriculture, and long-term intensive grazing.

Approximately 49 acres of vernal pools and ephemeral swales containing vernal pool plant species were identified in the FERC project boundary, all of which occur in the grasslands around Thermalito Afterbay and Thermalito Forebay. These pools range in size from very small (less than 3 feet [ft] in diameter) to larger pools covering nearly an acre. The majority of pools are fairly shallow; however, large, deep pools that hold water longer also occur in the area. These pools and ephemeral drainages are suitable habitat for five federally listed plant species: Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica*), hairy Orcutt grass (*Orcuttia pilosa*), slender Orcutt grass (*O. tenuis*), Greene's tuctoria (*Tuctoria greenei*), and Hoover's spurge (*Chamaesyce hooveri*). A sixth species, Hartweg's golden sunburst (*Pseudobahia bahifolia*), typically inhabits upland sites associated with undulating mima mound topography.

Serpentine and Gabbro Habitats

Serpentine and gabbro soils in the project area are potential and suitable habitat for Layne's ragwort (*Senecio layneae*). Approximately 172 acres of serpentinite and serpentine-derived soils occur in the project area in the North Fork and West Branch arms of Lake Oroville. Approximately 64 acres of gabbro and gabbro-derived soils occur in the project area along the South Fork arm of the reservoir.

Federally Endangered Species

Butte County Meadowfoam (*Limnanthes floccosa* ssp. *californica*)

This winter annual herb appears in late March to early May in ephemeral drainages, vernal pool depressions in ephemeral drainages, and occasionally around the edges of isolated vernal pools at elevations of 165 to 197 feet.

Sixteen of the 18 remaining populations of Butte County meadowfoam occur on private land and are subject to urban development, agricultural land conversion, and highway widening or realignment. There are 4 occurrence records for Butte County meadowfoam from approximately 5 miles north of Thermalito Afterbay in the vicinity of Shippee, California.

There were no occurrences of Butte County meadowfoam located in the project area during these surveys. Approximately 49 acres of vernal pools, ephemeral drainages, and pool/swale complexes occur in the project area in the grasslands around the Thermalito Complex. Many of the ephemeral drainages could potentially support Butte County meadowfoam. White meadowfoam (*Limnanthes alba* ssp. *alba*) is a common early inhabitant of ephemeral drainages and depressions within the project area. This species is closely related to the listed Butte County meadowfoam (*L. floccosa* ssp. *californica*) and occurs in similar habitat.

Hairy Orcutt Grass (*Orcuttia pilosa*)

This annual grass species occurs in drying vernal pool habitat along the eastern margin of California's Central Valley at elevations ranging from 100 to 400 feet. This late season species grows in vernal pool bottoms and along edges of pools.

Of the original 40 known populations of hairy Orcutt grass, 12 are thought to have been extirpated due to agricultural land conversion, urbanization, and intensive cattle grazing. One occurrence of hairy Orcutt grass is documented within 8 miles of the project area.

No occurrences of hairy Orcutt grass were found within the project area. Many of the larger, deeper pools were observed to be associated with clay soils that form a nearly impermeable pool bottom and are suitable habitat for this species.

Hartweg's Golden Sunburst (*Pseudobahia bahiafolia*)

This annual herb in the sunflower family is closely associated with mima mound topography in annual grasslands and blue oak woodlands.

The type locality for this species was historically known in Yuba County along the bank of the Feather River near the confluence with the Yuba River. This type locality has been extirpated. Currently, this species is known from two general areas in eastern San Joaquin County. The extirpated Yuba County occurrence is more than 26 miles south of the Oroville Facilities FERC project boundary.

No occurrences or potential habitat for Hartweg's golden sunburst were found downstream of the project area along the Feather River floodplain. The vernal pools in the grasslands around Thermalito Forebay and Thermalito Afterbay contain areas of hummocky ground that could be potential habitat for this species.

Greene's Tuctoria (*Tuctoria greenei*)

Greene's tuctoria is federally listed as an endangered species and is a California rare species. This species occurs from May to July along the eastern margin of the California Central Valley. Greene's tuctoria occupies small or shallow vernal pools or the margins of deeper pools.

Forty-one occurrences have been documented from Fresno to Shasta Counties. However, 19 of these populations, from Fresno, Madera, Stanislaus, Tulare, and San Joaquin counties are thought to have been extirpated. The remaining populations occur in Butte, Glenn, Merced, Shasta, and Tehama Counties. All populations are on private lands except one population at the Sacramento National Wildlife Refuge. One occurrence of Greene's tuctoria is within 150 feet of the FERC project boundary, one within 5 miles, and another within 10 miles of the project area.

No occurrences of Green's tuctoria were found in the project area. Potentially suitable habitat exists in the larger, deeper pools that are associated with impermeable clay soil bottoms.

Federally Threatened Species

Hoover's Spurge (*Chamaesyce hooveri*)

This prostrate annual herb grows in the bottom of drying vernal pools on the eastern margin of California's Central Valley. This species typically inhabits larger, deeper pools in areas otherwise barren of vegetation.

According to current CNDDB records, 4 of the 30 occurrences of Hoover's spurge have been extirpated. The 26 extant occurrences are distributed along remnant alluvial terraces and fans, mostly along the eastern edge of the Great Central Valley in Tulare, Merced, Stanislaus, Butte, Glenn, and Tehama Counties, where it occurs below 820 feet elevation. The majority of occurrences are located near the Butte-Tehama county line in the northern Sacramento Valley. The nearest occurrence of Hoover's spurge is approximately 8 miles north of the FERC project boundary.

Although suitable habitat exists within the project area, no occurrences were found within the study area during relicensing surveys.

Slender Orcutt Grass (*Orcuttia tenuis*)

This annual grass species is found most often in the drying bottoms of large, deep vernal pools. It is restricted to Northern California and occurs in disjunct populations from Siskiyou County to Sacramento County. Two occurrences of slender Orcutt grass occur within 1 mile of the project area.

Large, deep vernal pools with clay soils that form a nearly impermeable pool bottom occur in the project area. These deep pools are suitable habitat for this species. Slender Orcutt grass was not found in the project area during these surveys.

Layne's Ragwort (*Senecio layneae*)

This perennial herb is found in open rocky areas of serpentine and gabbroic derived soils within chaparral and chaparral/open pine or oak woodlands at elevations of 660 to 3,300 feet.

There are 43 extant occurrences of Layne's ragwort identified in the CNDDB from El Dorado, Tuolumne, and Yuba Counties. Two of the 43 records are in Yuba County, approximately 5 miles southeast of the South Fork arm of Lake Oroville.

Approximately 172 acres of serpentine and serpentine-derived soils and 64 acres of gabbro and gabbro-derived soils occur in the project area around Lake Oroville. These serpentine- and gabbro-derived soils with sparse vegetation cover are potential habitat for Layne's ragwort. Layne's ragwort was not found in the project area during relicensing studies.

Baseline Project Conditions

There are no baseline project effects on federally listed plant species. Surveys for listed species were conducted on all potential listed plant species habitats within the Oroville Facilities project area. No occurrences were found within the project area.

5.7.3 Environmental Effects

5.7.3.1 Federally Listed Fish Species

Table 5.7-4 summarizes the potential effects on federally listed threatened and endangered fish species under No-Action Alternative conditions, as well as under the Proposed Action and Alternative 2. Details are provided in the narrative that follows.

Table 5.7-4. Summary of potential effects on federally listed threatened and endangered fish species.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Lower Feather River Fish Species			
Spring-run Chinook Salmon	Degradation of spawning substrate and habitat quality from continuing loss of large woody debris and redd superposition.	Beneficial due to fish barrier weirs, Hatchery Adaptive Management Program, existing side-channel enhancement, and Large Woody Debris and Gravel Supplementation and Improvement Programs	Same as Proposed Action plus creation of new side-channel habitat, increased quantity of spawning habitat from increased Low Flow Channel flows, and slight improvement of water temperatures
Steelhead	Degradation of spawning substrate and habitat quality from continuing loss of large woody debris	Beneficial due to fish barrier weirs, Hatchery Adaptive Management Program, existing side-channel enhancement, and Large Woody Debris and Gravel Supplementation and Improvement Programs	Same as Proposed Action plus creation of new side-channel habitat and slight improvement of water temperatures

No-Action Alternative

An analyses of potential effects on habitat components affected by the Oroville Facilities, warmwater and coldwater reservoir fish species, and lower Feather River fish species under the No-Action Alternative are provided in Appendix G-AQUA3, No-Action Alternative. A summary of potential effects on habitat components under the No-Action Alternative is provided in Section 5.5.2.1, No-Action Alternative. The following summarizes potential effects on federally listed threatened and endangered fish species under the No-Action Alternative.

Spring-run Chinook Salmon

Under the No-Action Alternative, there continue to be less than optimal conditions for each life stage evaluated for spring-run Chinook salmon (see the analyses provided in Appendix G-AQUA3).

Steelhead

Under the No-Action Alternative, there would be a continuation of less than optimal conditions for each life stage evaluated for steelhead (see the analyses provided in Appendix G-AQUA3). Under the No-Action Alternative, there would be an overall adverse effect on steelhead.

Proposed Action

An analyses of potential effects on listed species habitat components affected by the Oroville Facilities, with implementation of the Proposed Action, are provided in Appendix G-AQUA4. A summary of potential effects on habitat components with implementation of the Proposed Action is provided in Section 5.5.2.2, Proposed Action. The following summarizes potential effects on federally listed threatened and endangered fish species with implementation of the Proposed Action.

Spring-run Chinook Salmon

Under the Proposed Action, there would be a beneficial effect on each life stage evaluated for spring-run Chinook salmon (see the analyses provided in Appendix G-AQUA4). Under the Proposed Action, there would be an overall beneficial effect on spring-run Chinook salmon.

Steelhead

Under the Proposed Action, there would be a neutral to beneficial effect on each life stage evaluated for steelhead (see the analyses provided in Appendix G-AQUA4). Under the Proposed Action, there would be an overall beneficial effect on steelhead.

Alternative 2

An analyses of potential effects on listed species habitat components affected by the Oroville Facilities, with implementation of Alternative 2, is provided in Appendix G-AQUA5. A summary of potential effects on habitat components with implementation of Alternative 2 is provided in Section 5.5.2.3, Alternative 2. The following summarizes potential effects on federally listed threatened and endangered fish species with implementation of Alternative 2.

Spring-run Chinook Salmon

Implementation of Alternative 2 would result in a beneficial effect on each life stage evaluated for spring-run Chinook salmon (see the analyses provided in Appendix G-AQUA5). Implementation of Alternative 2 would have an overall beneficial effect on spring-run Chinook salmon.

Steelhead

Implementation of Alternative 2 would result in a slightly beneficial to beneficial effect on each life stage evaluated for steelhead (see the analyses provided in Appendix G-AQUA5). Implementation of Alternative 2 would have an overall beneficial effect on steelhead.

5.7.3.2 Federally Listed Wildlife Species

Table 5.7-5 summarizes the potential effects on federally listed threatened and endangered wildlife species under No-Action Alternative conditions, as well as under the Proposed Action and Alternative 2. Details are provided in the narrative that follows.

Table 5.7-5. Summary of potential effects on federally listed wildlife species and habitat.

Effect Topic	No-Action Alternative	Proposed Action	Alternative 2
Nesting Bald Eagle	Beneficial due to implementation of nest territory management plans and other conservation measures	Same as No-Action	Same as No-Action
Wintering and Foraging Bald Eagle Habitat	Overall neutral. Little or no recreation-related effect	Same as No-Action	Same as No-Action
Giant Garter Snake	Continued habitat degradation/loss associated with operations, maintenance and recreation use	Beneficial due to implementation of 13 conservation measures that compensate for or avoid potential operations, maintenance, or recreational effects	Same as Proposed Action
Valley Elderberry Longhorn Beetle	Beneficial due to implementation of conservation measures identified in Draft Biological Opinion	Beneficial due to implementation of 3 conservation measures which avoid or minimize potential maintenance and recreational effects	Same as Proposed Action
Vernal Pool Fairy and Tadpole Shrimp	Moderately beneficial due to implementation of several conservation measures designed to minimize maintenance and recreational effects	Beneficial due to implementation of 11 conservation measures which avoid or minimize potential maintenance and recreational effects	Same as Proposed Action
California Red-Legged Frog	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions

No-Action Alternative

Under the No-Action Alternative, selected conservation measures developed in coordination with USFWS under the Section 7 ESA informal consultation process and discussed in detail in the draft Programmatic BA would be implemented to avoid or minimize baseline project effects on vernal pool invertebrates and bald eagle nesting habitats (see Section 5.7.2.2). These conservation measures would also be implemented in the future. An analysis of potential effects on these species is provided in the draft Programmatic BA in Appendix E and SP-T2. A summary of the potential effects on federally listed threatened and endangered and candidate species and habitat is provided in Table 5.7-5. Designated critical habitat for federally listed species does not occur within the FERC project boundary, and no effects on critical habitat will occur within this alternative (Appendix E).

The selected conservation measures as stated in the Draft Programmatic Biological Assessment include:

- During settlement negotiations, strive to consider, operate, and manage resource actions in a fish and wildlife friendly manner within all project-area lands that are currently within designated Wildlife Management Area (WMA) boundaries, and balance the needs of fish and wildlife with human recreational needs or other competing actions to the extent feasible.

- Post and maintain, or require third-party State agencies to do so, appropriate signage (e.g., “Sensitive or Closed Area—No Vehicular Access—Violators Will be Cited”) as necessary to reduce recreational use effects on vernal pool habitat. A major focus of such signage will be the locations of historical or new problem areas. (This measure has been implemented.)

- Designate a listed-species Coordinator within DWR to implement and regulate implementation of conservation measures. The Coordinator will be DWR’s primary contact person for all communications with USFWS.

- Develop and adopt bald eagle territory management plans for each active bald eagle nest territory located on Lake Oroville, or on or near (<0.25 mile) any other project feature. Such plans shall be developed in consultation with DFG and USFWS. The three initial plans, which will be finalized and implemented at least 3 months before the start of the 2005 bald eagle nesting season, are for the Crystal Hill, Potter Ravine, and Bloomer nesting territories. If and when any new nesting territories are discovered, they will be disclosed by telephone and in writing to both DFG and USFWS within 10 working days, and DWR shall then develop draft site-specific management plans within an additional 30 calendar days, unless an extension results from the necessary consultations with DFG and USFWS. (The three nest territory management plans have been adopted.)

  Survey annually in the spring of each year for the first 5 years, beginning in 2005, then in the spring of every other year thereafter over the remaining life of the

FERC license, all vernal pools in the project baseline inventory. Surveys will be timed just as vernal pools are drying. One objective will be to detect and record any adverse effects that may threaten this habitat, such as OHV use, broken or cut fences, missing signs, sedimentation, or other adverse factors. Another objective will be to evaluate the implementation of each of the vernal pool minimization and conservation measures. The annual vernal pool survey results and associated minimization and conservation measure evaluations sub-report will be approved (via signature) by DWR's Oroville Field Division Chief. This approved sub-report shall then be integrated into the annual meeting of USFWS, DFG, DWR, involved agencies, and others and annual overall listed-species report.

- Begin implementation, by December 31, 2005, a sediment-trapping program, using various measures (e.g., gravel, rock, silt fencing, silt-screening, hay bales, wattles, coconut mats) to reduce and/or prevent sedimentation into vernal pool habitat. This shall initially be an experimental program. Through adaptive management over time, the best-performing measure(s) will then be selected and routinely (at least annually checked and repaired) implemented, as necessary, over the life of the FERC license. However, erosion-control matting in which coconut, straw, or other absorbent fibers are wrapped in one or two layers of small-size (<0.75 x 0.75-inch mesh) plastic mesh or nylon netting material shall be avoided, because such materials have been found to entrap and kill snakes. Netting 0.75 x 0.75 inch or larger, which is unlikely to entangle and entrap snakes, may continue to be used in sediment-trapping features.

- Abandon and then revegetate, by December 2006, all roads that DWR determines are no longer necessary and needed to facilitate project operations or management. A particular focus of the closings shall be any roads that are currently causing siltation problems into nearby vernal pool habitat.

- Review, by December 31, 2006, all of DWR's existing gravel-mining operations which are in or within 200 feet of giant garter snake habitat and identify modifications to them as necessary to be more garter snake "friendly."

Proposed PM&E measures described in Chapter 3.0 in the No-Action Alternative include programs for enhancement of habitat for warmwater game fish, ongoing gravel maintenance (the 1983 agreement between DWR and DFG states that each year DFG will recommend to licensee, for mutual agreement, a spawning maintenance program) in the Feather River, and vegetation and wildlife management. These PM&E measures are not well defined at this time in terms of their geographic location and timing and implementing activities but potentially could indirectly or directly affect threatened and endangered species and habitats. In general, PM&E measures that would enhance or concentrate fish prey populations would be largely beneficial to foraging bald eagles along the Feather River. PM&E measures that potentially could disturb threatened and endangered species or habitat would be required to incorporate protective measures specific to each species potentially affected during the program design and

implementation to avoid or minimize effects as described in detail in the draft Programmatic BA.

Threatened and Endangered Species

Bald Eagle. Under the No-Action Alternative, implementation of the three bald eagle nest territory management plans, as indicated in the conservation measures above, would reduce the potential for baseline recreation-related loss of eagle productivity and thus aid in meeting Pacific Bald Eagle Recovery Plan goals (USFWS 1986). Potential baseline project effects on nesting bald eagle related to Lake Oroville reservoir fluctuations would continue under the No-Action Alternative. Additional bald eagle production monitoring specified in the conservation measures would allow future quantification and evaluation of this potential effect. Implementation of this alternative is not likely to adversely affect nesting bald eagles.

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

California Red-legged Frog. No baseline project effects on California red-legged frog or its habitat have been identified under the No-Action Alternative. None of the actions included under this alternative have the potential to affect the current known red-legged frog population within the North Fork Feather River drainage or associated designated critical habitat.

Valley Elderberry Longhorn Beetle. Under the No-Action Alternative, baseline project effects on valley elderberry longhorn beetle and its habitat would potentially continue at low levels, related to road and levee maintenance activities.

Vernal Pool Fairy Shrimp Conservancy Fairy Shrimp and Tadpole Shrimp. Under the No-Action Alternative, baseline project effects identified in Section 5.7.2.1 would be avoided or minimized through implementation of conservation measures. These measures are designed to minimize or avoid OHV damage to vernal pool habitats and project maintenance activities potentially resulting in decreased sediment or contaminant discharges to vernal pool habitats, and compaction/degradation of pool habitats.

Proposed Action

The Proposed Action includes additional PM&E measures beyond those previously identified and discussed under the No-Action Alternative. Effects discussed in the No-Action Alternative (Section 5.7.3.2) are expected to be the same for the Proposed Action for all activities that are carried forward from the No-Action Alternative. These PM&E measures are described in Chapter 3.0 and generally include actions to address cultural, environmental, and recreational resources. Not all PM&E measures included

within this alternative affect wildlife habitat or species. This assessment is limited to those PM&E measures with the potential to affect species or habitats protected under the ESA.

A summary of the potential effects of the Proposed Action on federally listed and candidate species is described below and summarized in Table 5.7-5. An analysis of these potential effects is provided in the draft Programmatic BA in Appendix E.

Designated critical habitat for federally listed species does not occur within the FERC project area, and no effects on designated critical habitat will occur.

Threatened and Endangered Species

Bald Eagle. None of the proposed PM&E measures included within the Proposed Action would adversely affect bald eagle nesting habitat. All PM&E measures proposed are in compliance with existing bald eagle nest territory management plans developed in consultation with USFWS and DFG and would result in a beneficial effect. However, the number and location of bald eagle nest territories are not static over time. Identification of new or previously unknown nest territories over the term of the FERC License would require additional consultation and protective measures.

The Proposed Action contains four conservation measures developed in consultation with USFWS to minimize potential direct and indirect effects associated with operations and maintenance and with current and future recreational use and development. These measures also identify a monitoring program to evaluate the effectiveness of bald eagle conservation measures over time.

Several PM&E measures have the potential to directly or indirectly affect bald eagle foraging and or wintering habitat within the FERC project boundary. PM&E measures that enhance or concentrate prey populations would be largely beneficial to foraging bald eagles. Likewise, activities that limit potential sources of disturbance/displacement to foraging or wintering bald eagles may also provide some level of benefit. PM&E measures that would directly or indirectly benefit bald eagles and their habitats include:

- Continued implementation of activities associated with bald eagle nest territory management plans would protect nesting eagles from disturbance and protect habitat from adverse modification (Appendix E);
- Fish stocking and fish habitat improvement actions that would enhance or concentrate prey species;
- Waterfowl habitat enhancement actions including new brood ponds and upland habitat enhancements would enhance or concentrate prey species; and
- Actions designed to limit wheeled vehicle traffic within the Lake Oroville fluctuation zone would minimize disturbance of nesting, foraging, and wintering eagles.

Several PM&E measures contained under the Proposed Action have the potential to result in a short-term increase in disturbance/displacement of foraging or wintering bald eagles. Disturbance/displacement associated with construction activities would generally be short-term/seasonal and would be considered a potentially slightly adverse indirect effect. Construction-related activities within the Lake Oroville fluctuation zone (boat ramp extensions, protection of cultural resources) would occur during periods of maximum annual drawdown (mid-August through October). This period is after the bald eagle nesting season and before the influx of wintering eagles. Likewise, PM&E measures involving construction-related activities along the Feather River are unlikely to be scheduled or permitted during the winter months when wintering bald eagles are present in the project area.

Several recreation-related PM&E measures contain activities that may lead to increased long-term disturbance/displacement of foraging or wintering bald eagles. Examples of these activities include actions to increase/expand recreational access or use. These would generally be a slightly adverse indirect effect.

Potential baseline project effects related to Lake Oroville water level fluctuations would continue under the Proposed Action. These would generally be a slightly adverse indirect effect. Data collected at Shasta Lake show a positive correlation between water level fluctuations and bald eagle productivity; however, data collected at Lake Oroville are inconclusive. Future analysis of this potential effect would be possible based on the ongoing eagle nest productivity monitoring program as set forth in the three Bald Eagle Nest Territory Management Plans (DWR 2004a, 2004b, 2004c), a conservation measure within the draft Programmatic BA.

Giant Garter Snake. The Proposed Action contains 12 conservation measures developed in consultation with USFWS to minimize or avoid potential project effects on giant garter snake related to baseline project water level fluctuations, recreation use and development, and project maintenance activities.

Several activities associated with PM&E measures in the Proposed Action have the potential to improve giant garter snake habitat including: construction of additional brood ponds, recharge of brood ponds, introduction of large woody debris or other cover/structure into the Low Flow Channel of the Feather River, and invasive plant control actions. These are considered beneficial effects.

Several PM&E measures in the Proposed Action have the potential to adversely effect giant garter snakes or their habitats directly and indirectly, including actions related to aquatic primrose control, Feather River Gravel Supplementation and Improvement Program, fish barrier weir construction, side-channel creation activities in the Low Flow Channel, development of additional facilities at the Thermalito North Forebay aquatic center, construction of additional trails at Thermalito Forebay, development of a swim beach at the Larkin Road Car-top BR adjacent to Thermalito Afterbay, and development of waterfowl forage and cover enhancements adjacent to Thermalito Afterbay. All of these activities would occur within or adjacent to giant garter snake habitat and have at least some potential to destroy or degrade either upland or aquatic elements of giant

garter snake habitat. However, incorporation of protective measures into the project design would minimize or avoid potential effects with implementation of the thirteen conservation measures into the project, and the potential effects are considered beneficial (Table 5.7-5). These protective measures include:

- Temporal limitations on excavation and deep soil disturbance (construction activities limited to April 1 through October 31, when the giant garter snake is active) within 200 feet of giant garter snake habitat to protect hibernating snakes in habitats adjacent to Thermalito Afterbay and the OWA;
- Limitations on the annual amount and timing of aquatic primrose control methods;
- Avoiding/minimizing loss or degradation of identified giant garter snake habitat;
- Design of gravel extraction areas in the OWA to provide/improve giant garter snake habitat;
- Establishment of a 200-foot buffer around identified giant garter snake habitat within which habitat loss/degradation would be strictly limited in areas adjacent to Thermalito Afterbay and the OWA;
- Annual limitation on the amount of upland habitat within 200 feet of identified giant garter snake habitat that can be developed as waterfowl nest cover or forage enhancements in areas adjacent to Thermalito Afterbay; and
- Brood pond construction and recharge of brood ponds adjacent to Thermalito Afterbay would create refugia for giant garter snake during periods of Thermalito Afterbay water level fluctuations. This action would minimize and compensate for baseline project effects.

California Red-legged Frog. Two conservation measures were developed in consultation with USFWS to minimize and avoid potential effects on red-legged frog habitat. These measures would allow retention of suitable habitat for future potential recolonization or reintroduction.

None of the PM&E measures within the Proposed Action has the potential to affect the current known California red-legged frog population within the North Fork Feather River drainage and designated critical habitat (outside the FERC project boundary).

Valley Elderberry Longhorn Beetle. The Proposed Action contains three conservation measures developed in consultation with USFWS to minimize or avoid potential project effects on valley elderberry longhorn beetle and their habitat. These measures would limit effects associated with current and future recreation development and use as well as ongoing road/levee maintenance activities and create a beneficial effect on longhorn beetle habitat (Table 5.7-5).

In the project area, valley elderberry longhorn beetle habitat is largely restricted to lands along the Feather River floodplain in the OWA. Elderberry shrubs are generally uncommon or absent from Lake Oroville and Thermalito Complex. Few of the PM&E measures included in the Proposed Action provide any benefit to longhorn beetle or its habitat. However, invasive plant control activities aimed at giant reed *(Arundo donax)* and Chinese tree of heaven *(Ailanthus altissimus)* control could provide benefit to valley elderberry longhorn beetle and its host plant through control of these invasive competitors. Conservation measures implementing best management practices (BMPs) related to herbicide use would be employed. Increased visitor management and construction of additional vehicular barriers within the OWA would limit future OHV damage to habitat and also be a beneficial effect.

Several PM&E measures within the Proposed Action involve vegetative disturbance or removal within the Feather River floodplain where elderberry shrubs are present, including construction access for the OWA and Feather River fish habitat improvements, gravel harvest, gravel size grading/washing, equipment access associated with spawning gravel placement, collection or placement of large woody debris, fish barrier weir construction/maintenance, invasive plant species control, and recreational enhancements at the Thermalito Afterbay Outlet. Incorporation of protective measures would be required during program design and implementation to avoid or minimize effects on habitat. These protective measures include conservation measures within the draft Programmatic BA and may include avoidance, construction of vehicle/equipment barriers, dust abatement, individual plant treatment during invasive plant control, and establishment of buffer zones around valley elderberry longhorn beetle habitat. Mitigation banking would be considered only where avoidance/protection measures cannot be implemented to avoid take and, if implemented, would be a beneficial effect as mitigation replacements rates require replacement at either 3 to 1 or 5 to 1.

Construction of an additional trail at the Saddle Dam trailhead access and at Lime Saddle would be designed to avoid elderberry shrubs. Likewise, waterfowl forage and cover enhancements activities would be designed to avoid individual elderberry shrubs adjacent to Thermalito Afterbay.

Establishment of a nursery/propagation area for Native American cultural plants could become a valley elderberry longhorn beetle take issue if elderberry stems are harvested. Future ESA project-specific consultation would need to be implemented if elderberry shrubs were potentially affected by this PM&E measure.

<u>Vernal Pool Fairy and Tadpole Shrimp</u>. Eleven conservation measures were developed during the informal consultation process with USFWS to minimize or avoid baseline project effects on vernal pool habitats, including measures designed to avoid OHV use and minimize effects associated with road and levee maintenance activities.

Several PM&E measures included in the Proposed Action have the potential to affect vernal pool invertebrate habitat, including Thermalito Afterbay waterfowl forage and cover enhancements, construction access and materials borrow areas associated with

brood pond construction, Thermalito Forebay trail development, additional development of the Thermalito North Forebay Aquatic Center, development of additional day use facilities at the Larkin Road Car-top BR, and invasive plant species control efforts in the Thermalito Complex. All of these activities would be designed to minimize effects on vernal pool invertebrate habitat through avoidance or use of buffers to limit sedimentation and chemical contamination within 200 feet of vernal pools following applicable conservation measures to reduce impacts on vernal pool habitats and would be a beneficial effect. Opportunities exist to design brood pond borrow areas in a manner that creates additional vernal pool invertebrate habitat.

Baseline Project Effects Addressed under the Proposed Action

The Proposed Action includes PM&E measures that address several baseline project effects identified in Section 5.7.2.2, including actions to address adverse effects associated with Thermalito Afterbay water level fluctuations, Feather River flow fluctuations, wildlife habitat disruption/degradation associated with operations and maintenance activities, and effects associated with recreational development and use. This alternative does not contain PM&E measures that address potential adverse effects associated with Lake Oroville water level fluctuations on bald eagle nest productivity.

Construction of additional waterfowl brood ponds and periodic seasonal recharge of brood ponds addresses baseline effects on the giant garter snake from water level fluctuations in Thermalito Afterbay. These PM&E measures would provide conditions where aquatic, emergent, and terrestrial cover are adjacent and would provide secure cover/foraging locations for giant garter snake during Thermalito Afterbay water level fluctuations.

Several of the ESA species conservation measures included within the Proposed Action address potential baseline effects associated with operations and maintenance (O&M) activities in freshwater emergent wetland, riparian, annual grassland, and mature coniferous forest habitats. Specific O&M-related conservation measures include:

- Limitations on herbicide and pesticide use near valley elderberry longhorn beetle, giant garter snake, or vernal pool habitats;
- Restrictions related to road maintenance activities near valley elderberry longhorn beetle and vernal pool habitats;
- Restrictions on earth-moving activities to limit sedimentation or altered hydrology in areas containing vernal pools and season restrictions on earthmoving to protect hibernating giant garter snakes;
- Implementation of sediment trapping on selected roads to reduce sediment effects on vernal pool habitats;
- Gravel placement on selected roads to reduce sediment effects on vernal pool habitats;

- Abandoning and revegetation of selected roads to reduce vehicular damage and sedimentation in vernal pool habitats; and

- Limitation on treatment methods for non-native plant control in ESA habitats.

Several of the ESA conservation measures included in the Proposed Action address potential baseline effects related to recreational use and development. Specific conservation measures that would be implemented include:

- Periodic patrol and enforcement to monitor/prevent OHV use in ESA habitats and human entry into bald eagle nest territories;

- Signage, and fence/barrier maintenance to limit OHV damage to ESA habitats;

- Limitations on additional recreational developments and use relative to bald eagle, giant garter snake, vernal pool invertebrates, and valley elderberry longhorn beetle habitats; and

- Educational signage to prevent recreational disturbance/take of ESA species.

Alternative 2

Alternative 2 includes additional PM&E measures beyond those previously identified and discussed under the No-Action Alternative and the Proposed Action. Proposed PM&E measures in Alternative 2 include actions to address recreation, environmental, and cultural resources. A summary of the potential effects of Alternative 2 on federally listed and candidate species and habitats is described below and summarized in Table 5.7-5. An analyses of these potential effects are contained in the draft Programmatic BA provided in Appendix E.

Designated critical habitat for federally listed species does not occur within the FERC project area, and no effects on critical habitat would occur.

Threatened and Endangered Species

Bald Eagle. None of the PM&E measures included in Alternative 2 would affect bald eagle nesting habitat. All actions are in compliance with existing bald eagle nest territory management plans developed in consultation with USFWS and DFG. However, the number and location of bald eagle nest territories are not static over time. Identification of new or previously unknown nest territories over the term of the FERC License would require additional consultation and protective measures.

Alternative 2 contains no additional conservation measures beyond those discussed in the Proposed Action to minimize potential effects associated with current and future recreational use and development. These measures also identify a monitoring program to evaluate the effectiveness of bald eagle conservation measures over time.

Several PM&E measures in this alternative have the potential to result in a short-term increase in disturbance/displacement of foraging or wintering bald eagles, and the effect is considered potentially slightly adverse (Table 5.7-5). Disturbance/displacement associated with construction activities would generally be short-term and seasonal. Construction-related activities within the Lake Oroville fluctuation zone (boat ramp extensions, protection of cultural resources) would occur during the period of maximum annual drawdown (mid-August through October), after the bald eagle nesting season and before the influx of wintering eagles. Likewise, PM&E measures involving construction-related activities along the Feather River are unlikely to be scheduled or permitted during the winter months when wintering bald eagles are present.

Several PM&E measures contain activities that may lead to minor levels of increased long-term disturbance/displacement of foraging or wintering bald eagles. Examples of these sorts of activities include actions to increase/enhance recreational access or use including:

- New campground, parking, or day use facilities;
- New shoreline access or trails;
- Additional floating campsites;
- Additional special event facilities; and
- Boat ramp extensions.

Baseline project conditions related to Lake Oroville water level fluctuations on bald eagle production would continue under this alternative, as discussed in Section 5.7.3.2.

Giant Garter Snake. Alternative 2 contains the same 12 conservation measures discussed in the Proposed Action to minimize or avoid potential project effects on giant garter snake related to water level fluctuations, recreation use and development, and project maintenance activities.

PM&E measures in Alternative 2 such as side-channel spawning creation actions at the Western Canal, and within the OWA southeast of the Thermalito Afterbay Outlet would potentially adversely affect giant garter snakes or their habitat. However, the conservation measures and the development of additional brood ponds adequately minimize any adverse effects to the giant garter snake and their habitat.

California Red-legged Frog. Alternative 2 contains the same two conservation measures as described in the Proposed Action, which were developed in consultation with USFWS to minimize and avoid potential effects on red-legged frog habitat. These measures would allow retention of suitable habitat for future potential decolonization or reintroduction.

None of the PM&E measures in Alternative 2 have the potential to affect the current known red-legged frog population within the North Fork Feather River drainage or its designated critical habitat (outside the FERC project boundary).

Valley Elderberry Longhorn Beetle. Alternative 2 contains no additional conservation measures beyond the three conservation measures discussed under the Proposed Action to minimize or avoid potential project effects on valley elderberry longhorn beetles and their habitat. These measures would limit effects associated with current and future recreation development and use, as well as road/levee maintenance activities.

Valley elderberry longhorn beetle habitat is largely restricted to lands along the Feather River floodplain. Elderberry shrubs are generally uncommon or absent from Lake Oroville and the Thermalito Complex. None of the PM&E measures included in Alternative 2 would provide any benefit to valley elderberry longhorn beetles or their habitat.

Several PM&E measures in Alternative 2 involve vegetative disturbance or removal within the Feather River floodplain where elderberry shrubs are present, including sturgeon passage improvement actions, and construction of additional salmonid spawning channels. Incorporation of valley elderberry longhorn beetle protective measures would be required during program design and implementation to avoid or minimize effects on beetle habitat. These protective measures may include avoidance, construction of vehicle/equipment barriers, dust abatement, individual plant treatment during invasive plant control, and establishment of buffer zones around habitat.

Vernal Pool Fairy and Tadpole Shrimp. Eleven conservation measures were discussed under the Proposed Action to avoid baseline project effects on vernal pool habitats, including measures designed to avoid OHV use, as well as minimize effects associated with road and levee maintenance activities. No additional conservation measures are included under this alternative.

None of the PM&E measures included in Alternative 2 have the potential to affect vernal pool invertebrate habitat.

Baseline Project Conditions Addressed under Alternative 2

Alternative 2 contains no additional PM&E measures that address baseline project conditions.

5.7.3.3 Federally Listed Botanical Species

No-Action Alternative

Federally listed threatened or endangered plant species were not located within the project area during the relicensing studies. Therefore, activities associated with the No-Action Alternative would not have effects on listed plant species. 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 consult with USFWS prior to implementing these actions.

Proposed Action

See "No-Action Alternative." The baseline project effects addressed would be the same under the Proposed Action.

Alternative 2

See "No-Action Alternative." The baseline project effects addressed would be the same under Alternative 2.

5.7.4 Cumulative Effects

5.7.4.1 Federally Listed Fish Species

Cumulative effects are defined in Section 5.2, Cumulatively Affected Resources. As discussed in Section 5.2, spring-run Chinook salmon and Central Valley steelhead have the potential to be cumulatively affected by continued operation of the Oroville Facilities and other past, existing, and reasonably foreseeable related actions. This section focuses on potential cumulative effects on spring-run Chinook salmon and Central Valley steelhead. Additional information regarding the current status of these species is provided in Section 5.7.2.1, Federally Listed Fish Species.

Study Plan Report summaries addressing project effects on spring-run Chinook salmon and steelhead are presented in Section G-AQUA1.3 of Appendix G-AQUA1, Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area; Section G-AQUA1.5 of Appendix G-AQUA1, Fisheries Management; Section G-AQUA1.8 of Appendix G-AQUA1, Salmonids and Their Habitat in the Feather River Below the Fish Barrier Dam; and Section G-AQUA1.11 of Appendix G-AQUA1, Predation. A description of each spring-run Chinook salmon and steelhead life stage and the time periods associated with them is presented in Appendix G-AQUA1.

Cumulative Effects of the Project and 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 to 1,000,000 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 ESU for spring-run Chinook salmon are approximately 6,700, of which 4,300 return to the Feather River each year (DFG 1993). No information differentiating

between naturally and hatchery spawned population estimates of spring-run Chinook salmon in the Feather River is currently available.

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). It is likely that the Feather River spring-run population of Chinook salmon was significantly affected by hydroelectric power facilities in the upper watershed upstream of Oroville Dam well before the construction of Oroville Dam. Prior to Oroville Facility construction, DFG found significant overlap in the spawning distribution of spring- and fall-run Chinook salmon upstream from present-day Lake Oroville (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 number of fish returning to Feather River Fish Hatchery) (DWR and USBR 2001). The Feather River run numbered at least 3,400 in 2004 (DWR 2004a). The Central Valley spring-run Chinook salmon ESU is more thoroughly discussed in Section 5.7.2.1.

Like Chinook salmon, steelhead abundance in California has been greatly reduced from historic levels (McEwan and Jackson 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 McEwan and Jackson 1996). The steelhead spawning population for the Central Valley was estimated to be 27,000 in the 1960s (DWR and USBR 2001). McEwan and Jackson (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 is in place to compensate for steelhead losses due to SWP Delta pumping facilities and habitat loss as a result of the Oroville Facilities. Today, the Feather River steelhead population is supported almost entirely by the Feather River Fish Hatchery, which produces about 400,000 yearling steelhead each year (DWR and USBR 2001). The Central Valley steelhead ESU is more thoroughly discussed in Section 5.7.2.1.

Several factors influence overall populations of steelhead and Chinook salmon. The construction of dams and other water storage projects over the years has created impassable barriers to upstream migration, significantly reducing the quantity of freshwater habitat for spawning and juvenile rearing in addition to altering natural geomorphic processes. Altering natural geomorphic processes reduces the quality of remaining habitat downstream from dams. Effects of this alteration of geomorphic

processes on aquatic wildlife are most acute immediately following dam construction as species adjust to the new environment. Longer term, dams block the recruitment of spawning gravel and large woody debris to downstream reaches, causing streambed armoring and unfavorable habitat for juvenile rearing. 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 (e.g., El Nino events), timber harvest, 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 5.5.1.2, Applicable Regulations, Standards, Agreements, Policies, and Programs. These include: (1) the CALFED Bay-Delta Program (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 Central Valley Project Improvement Act (CVPIA) (Public Law 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.

The U.S. Bureau of Reclamation (USBR) and DWR work closely with USFWS, NOAA Fisheries, and DFG to coordinate CVP/SWP operations with fishery needs. This coordination is facilitated through several forums. The CALFED Ops Group consists of USBR and DWR (known as the Project Agencies), and USFWS, NOAA Fisheries, and DFG (collectively referred to as the Management Agencies), State Water Resources Control Board (SWRCB) staff, and the U.S. Environmental Protection Agency (USEPA). The CALFED Ops 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 Ops Group process, including the Operations and Fishery Forum (OFF), the Data Assessment Team (DAT), the B2 Interagency Team (B2IT), and the EWA Team (EWAT). In addition, several fisheries-specific teams have been established to provide guidance on resource management issues. These teams include the Sacramento River Temperature Task Group (SRTTG), the Delta Smelt Working Group (Working Group), the American River Operations Work Group (AROG), the San Joaquin River Technical Committee (SJRTC), the Delta Cross Channel (DCC) Project Work Team, and the South Delta Fish Forum.

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 from the Fish Barrier Dam (DWR 2001). Federal ocean fisheries management and restoration programs that have been implemented to reduce ocean harvest effects 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, special enforcement activities, and special regulations (e.g., closures of certain areas, zero bag limits) in key tributaries (DFG 2002).

Anadromous fish hatcheries in California provide a substantial fraction of the commercial and recreational fisheries harvest for Chinook salmon and steelhead (DFG et al. 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 et al. 2001). Hatcheries in California have also implemented programs to enhance steelhead populations. Four hatcheries, located in the Central Valley, have programs for mitigation of lost habitat and supplementation of 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 facility is part of the licensed project under P-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 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 Section G-AQUA1.7 of Appendix G-AQUA1 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 (Yoshiyama et al. 1996).

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 agricultural 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 eliminated from the San Joaquin drainage with the completion of the Friant Dam in 1942 (Fisher 1994). At the same time, construction of Shasta Dam eliminated 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).

It is estimated that 211 river miles of freshwater habitat was available to anadromous salmonids in the Feather River Basin prior to any dam construction in the Feather River (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 much higher 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 5.7-7 shows the location of the dams in the Feather River Basin and the date of construction associated with each dam.

Development of 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 5.7-7 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 construction of the Rock Creek Dam in 1950 because the Cresta Dam is located downstream and was constructed in 1927.

In general, the upstream-most portions of the historic anadromous salmonid spawning habitat represented the highest quality habitat, having cooler water temperatures associated with higher elevations and unimpaired flows, as well as smaller tributary sizes with a higher proportion of cover and habitat complexity. As the extent of anadromous salmonid spawning habitat was sequentially limited to farther downstream reaches by the construction of hydroelectric projects in the upstream watershed, the quality of accessible spawning habitat has become generally characterized as having warmer water temperatures associated with lower elevations and regulated flow regimes. The lower tributary reaches also tend to be larger in size, and have lower proportions of cover and habitat complexity, providing a lower overall quality of habitat. Table 5.7-7 illustrates that 37 percent of the total river miles of anadromous salmonid spawning habitat lost in the Feather River basin due to hydroelectric dam construction is attributable to the Oroville Facilities and 31.4 percent is attributable to Cresta Dam. However, because it is located further upstream and is higher in elevation, it is likely that the construction of Cresta Dam resulted in the loss of a greater quantity and higher quality of habitat than the loss of habitat that occurred with construction of the Oroville Facilities.

Table 5.7-6. Dam construction and anadromous salmonid habitat losses in the Feather River Basin.

Tributary	Dam	Date Constructed	River Miles Lost	Percent of Total River Miles Lost	Cumulative Loss
West Branch	Miocene	1907	11.1	6.1	11.1
North Fork	Big Bend [1]	1908	0.0	0.0	11.1
North Fork	Butt Valley [2]	1924	0.0	0.0	11.1
North Fork	Canyon [3]	1927	30.9	17.1	42.0
North Fork	Cresta	1949	56.7	31.4	98.7
North Fork	Rock Creek	1950	0.0	0.0	98.7
North Fork	Poe	1958	6.6	3.7	105.3
South Fork	Ponderosa	1958	8.4	4.7	113.7
North Fork	Caribou Afterbay	1959	0.0	0.0	113.7
Feather River	Oroville	1967	66.9	37.0	180.6
North Fork	Chester Diversion	1975	0.0	0.0	180.6

[1] Big Bend Dam was constructed with a fish ladder – assuming it was functional at the time of construction, 0 miles lost.
[2] Butt Valley Dam constructed on Butt Creek. Salmonid usage of Butt Creek is unknown.
[3] Canyon Dam forms Lake Almanor.
Sources: Yoshiyama et al. 1996; Yoshiyama et al. 2001

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 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 the top of redds previously dug by other Chinook salmon. Redd disruption can result in increased egg and alevin mortality leading to reduced production.

Redd superimposition may disproportionately affect early spawners and therefore have a greater adverse effect 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, precipitate an 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 elimination of the 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 that fall-run Chinook salmon use. 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 5.7-8. 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 et al. 2001).

Table 5.7-7. 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: DWR and USBR 2001

Between September 1999 and December 2000, DFG and NOAA Fisheries 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 et al. 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 et al. 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 resources, 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 et al. 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.

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 management; navigation; provision of water for irrigation and domestic uses; fish and wildlife protection, restoration, and enhancement; and power generation (DWR and USBR 2001), 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 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; and Comanche 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. Both 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 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). A 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 unavailable for anadromous fish. 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.

Unaltered river systems form a continuum from headwaters to river mouth, in which processes taking place upstream influence downstream dynamics, and dams interrupt this continuum. For example, dams eliminate the recruitment of sediment and large woody debris to downstream reaches. Sediment, in the form of gravel is important to salmonid spawning, and large woody debris 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 streambed occurs. The result is a loss of spawning habitat, and large woody debris that served as cover for juveniles is depleted. In addition, lack of gravel and large woody debris combined with regulated flow regimes reduce channel complexity and habitat diversity.

Other actions that have contributed to the degradation of spring-run Chinook salmon and steelhead in the Central Valley include urban development, agricultural practices, forestry practices, levee and dike construction 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 an increase in tillable land but incurs a cost of a substantial loss of aquatic habitat. Water diversions for agricultural irrigation result in

reduced flow regimes in rivers and streams utilized by anadromous salmonids. Agricultural runoff 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 increased levels of solar radiation, increasing water temperatures. Logging activities are also associated with increased sediment production as a result of erosion. For example, the upper Feather River watershed is reportedly producing high sediment loads due to accelerated erosion. The Natural Resource Conservation Service's East Branch North Fork Feather River Erosion Inventory Report estimated that 90 percent of the erosion in the 1,209-square-mile study area was accelerated erosion (NRCS 1998). Accelerated erosion is a soil loss greater than natural geologic conditions, which can reduce reservoir capacity, degrade water quality, and harm fish and wildlife. Road building in riparian zones may also lead to increased fine sediment loading and erosion, reducing the quality of aquatic habitat.

Cumulative Effects of the Alternatives and Future Related Actions

Three alternatives address future operations of the Oroville Facilities: the No-Action Alternative, the Proposed Action, and Alternative 2. These alternatives differ in the level of resources and financing directed toward future operations. From an aquatic resource perspective, as it relates to threatened and endangered species, there are very few differences between Existing Conditions and the No-Action Alternative (see Section 3.1, Proposed Action and Alternatives, for a detailed description of existing conditions and each alternative).

Proposed resource actions included in Alternative 2 address some of the issues associated with upstream migration barriers. Both the Proposed Action and Alternative 2 would implement resource actions targeted at increasing the quantity and quality of anadromous salmonid spawning and juvenile rearing habitat downstream of the Fish Barrier Dam. Resource actions under both alternatives include supplementation of spawning gravel, large woody debris supplementation, and the enhancement of side-channel habitat. Fish barrier weirs would be installed in the Low Flow Channel under both alternatives 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 adverse effects of redd superimposition, particularly on spring-run Chinook salmon, may be reduced. Additional information on the implementation and potential benefits of a fish barrier weir system is included in Appendix G-AQUA4, Proposed Action.

Under the No-Action Alternative, there would be no ongoing effort by DWR or DFG to monitor and evaluate effects of the Feather River Fish Hatchery. Both the Proposed Action and Alternative 2 would implement an adaptive management approach to program operations at the Feather River Fish Hatchery. 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 Section G-AQUA1.7 of Appendix G-AQUA1 for more information on

Feather River Fish Hatchery operations). Release location has a dramatic effect on straying rates, as illustrated by the studies mentioned above. 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 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 in the same place. In addition, the Feather River Fish Hatchery released 100 percent of its spring-run Chinook salmon in San Pablo Bay (DFG et al. 2001). Although it is well documented that off-site releases result in increased straying rates, those same studies report significantly higher survival rates for those fish transported to San Pablo Bay as opposed to on-site releases. Because of the potential risks to genetic integrity of stocks and potentially adverse ecological effects, the DFG and NOAA Fisheries joint review of California's anadromous fish hatcheries recommends that spring-run Chinook salmon from the Feather River Fish Hatchery be released instream, and fall-run Chinook salmon from both the Feather River and Nimbus Hatcheries be released instream (DFG et al. 2001). Considerable debate exists regarding the efficacy of instream versus San Pablo Bay releases. Proponents of San Pablo Bay releases argue that after nearly 150 years of habitat destruction and loss, there is no genetic diversity among Central Valley Chinook populations and that altering hatchery practices will reduce the effectiveness of hatcheries in preserving the salmon fishing industry (DFG et al. 2001).

Gravel and large woody debris supplementation programs are proposed in both the Proposed Action and Alternative 2. Under current regulated flow regimes, large woody debris 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 large woody debris and gravel. This redistribution is a normal ecosystem function; however, the large woody debris and gravel in the upstream reaches of the Low Flow Channel would need to be replaced following these events. Because high-flow events cannot be predicted, both the Large Woody Debris and Gravel Supplementation and Improvement Programs would be implemented for the duration of the project. In the event that large woody debris and gravel move out of the Feather River during extreme flow events, they would provide fish habitat benefits downstream on the Sacramento River, perhaps as far as the Delta.

Channel complexity downstream of the Fish Barrier Dam would be directly increased by the proposed improvements to Moe's Ditch and Hatchery Ditch with implementation of the Proposed Action and the establishment of additional side-channel habitat under Alternative 2 (see Appendices G-AQUA4, Proposed Action, and G-AQUA5, Alternative 2, for a description and evaluation of these resource actions). The supplementation of gravel and large woody debris may indirectly enhance channel complexity by diverting flows and creating more interaction with the floodplain.

In summary, implementation of the PM&E measures described above and included in the Proposed Action and Alternative 2 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 PM&E measures would contribute to the reduction 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.

5.7.4.2 Federally Listed Wildlife Species

Potential cumulative effects discussed in this section address the following species protected under the ESA: bald eagle, giant garter snake, California red-legged frog, valley elderberry longhorn beetle, and vernal pool invertebrates.

Cumulative effects discussed in this section include effects leading to habitat loss and degradation as a result of baseline project water level fluctuations, Feather River flow fluctuations, project operations and maintenance activities, and changes in project recreational facilities or uses (see Section 5.6.1.2 for more detailed information on effects). For the purpose of the cumulative effects analysis, lands within 1 mile of the FERC project boundary and along the Feather River floodplain downstream to the Sacramento River are addressed. Detailed information regarding species trends, historical information, and current threats to the species is contained in Appendix E, Draft Biological Assessment, and SP-T2, SP-T3/5, and SP-T9.

The cumulative effects evaluations are limited to the additive effects of project-related effects identified in this PDEA to wildlife species and habitats protected under the ESA.

Cumulative Effects of the Project and Past and Present Related Actions

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 or the Lake Oroville Area. The target goal for Zone 27 was 15 nesting territories, including 4 in the Lake Oroville area. In 1985, there were four known territories in Zone 27. Historically, at least five bald eagle nest territories have been documented within and adjacent to the project area; of these, three territories were occupied in 2002 and 2003 (Appendix E).

Historic actions that have served to reduce bald eagle populations in the project area include habitat alterations and loss, human encroachment, 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-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 random, 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 associated with expansion of transportation systems. Historic introduction and spread of rice agriculture in the Sacramento Valley has provided 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 form 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 counties.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle is found in isolated populations throughout the Central Valley, although it is locally common. 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) estimated to cover 922,000 acres. Approximately 90 percent of riparian habitat in California has been lost to agricultural and urban development over the last 150 years. In 1991, approximately 323,871 acres supported valley elderberry longhorn beetle habitat in parks, wildlife areas, and public lands in the Central Valley and adjacent foothills of which valley elderberry longhorn beetle was present in 187,466 acres (Barr 1991).

Historic threats to this species 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 human population growth, and further development of agriculture, cities, industry, transportation, and water resources in the foreseeable future (USFWS 1996) resulting 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 to 85 percent since the 1970s from urban development; water, 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 Alternatives and Future Related Actions

Bald Eagle

The adoption of bald eagle territory management plans (Appendix E) into the FERC License (under all alternatives) serves to limit habitat disturbance and recreational development/use within those portions of bald eagle nest territories within the FERC project boundary.

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.

Residential development on private or Tribal lands adjacent to the project area is likely to continue to occur in the future and will serve to reduce 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 (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 impact bald eagles through habitat modification and disturbance. Future commercial timber harvest, including biomass harvest associated with fuels management activities, are planned in the project area.

No significant differences in cumulative effects were identified between project alternatives.

Giant Garter Snake

A potential cumulative effect on this species is insecticide use by county and municipal agencies. Both Butte County, through its Mosquito Control District, and the City of Oroville annually administer active mosquito abatement programs, which apply insecticide fog around the Feather River and the Thermalito Complex, including the OWA. This program has the potential to reduce insect populations in the project area and, as such, could indirectly 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 illegally on a sporadic basis.

Residential development and associated grading/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.

Under the No-Action 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.

Both the Proposed Action and Alternative 2 contain conservation measures developed in consultation with USFWS to minimize or avoid potential project effects associated with water level fluctuations, recreational development/use, environmental contaminants, and maintenance activities. These measures would serve to reduce cumulative effects over those predicted under the No-Action Alternative. The Proposed Action would further reduce cumulative effects through increased patrol/enforcement and erection 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.

California Red-Legged Frog

Potential habitat exists in the project area for California red-legged frog, although the habitat is degraded. Actions that may further degrade the habitat include insecticide use within the project area by county and municipal agencies. Butte County, through its Mosquito Abatement District, and the City of Oroville 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.

None of the PM&E measures within the No-Action Alternative would affect California red-legged frogs or their habitat.

Valley Elderberry Longhorn Beetle

Future activities that would have a cumulative effect on elderberry beetle populations in the project area include herbicide and insecticide use, recreation use and development, road and levee maintenance, and gravel extraction activities with the project area.

Butte County, through its Mosquito Abatement Program, and the City of Oroville 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 increase effect on insects, including valley elderberry longhorn beetle, in the project area. Efforts to control West Nile virus are likely to increase the level of mosquito abatement actions in the future.

Indiscriminate and unauthorized recreational activities including camping, OHV travel, and establishment of new trails in areas populated with valley elderberry shrubs may adversely affect the valley elderberry longhorn beetle by direct effect on elderberry shrubs and indirectly through soil disturbance and/or compaction affecting the elderberry shrubs.

Commercial and local mining companies extract gravel from the dredger spoils piles within the Feather River floodplain. Baseline operations potentially could affect valley elderberry longhorn beetle habitat through dust and habitat disturbance or destruction from extraction activities and truck traffic.

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

Both the Proposed Action and Alternative 2 contain conservation measures developed in consultation with USFWS to minimize or avoid potential project effects associated with recreational development/use, environmental contaminants, and maintenance activities. These measures would serve to reduce cumulative effects over those predicted under the No-Action Alternative. Further, the Proposed Action and Alternative 2 include PM&E measures to improve OWA visitor management through patrol/enforcement and the erection of additional vehicular barriers. Both of these actions would serve to reduce potential effects associated with dispersed recreation use including OHV use to valley elderberry longhorn beetle habitats.

Vernal Pool Invertebrates

Butte County, through its Mosquito Abatement Program, and the City of Oroville annually administer an active mosquito abatement, 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.

Under all alternatives, 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. Continued vehicular damage to vernal pools in the project area may affect vernal pools through soil compaction, which may directly alter overland flow patterns and increase sedimentation, limit water collection within the pools, or destroy the integrity of the physical properties of the pool. Soil compaction may also result in decreasing habitat suitability for some vernal pool plant species or encourage algae inhabitation, thus directly affecting the pools' suitability to sustain a viable invertebrate population. OHV use may also result in physically crushing or directly damaging adults and cysts within a vernal pool.

Continued urban development in the project area would result in degradation and loss of additional vernal pool habitats.

Under all alternatives, 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 its actions, which may include grading, mechanical and/or chemical weed control, alteration of drainage patterns, and alteration of soil chemical and physical characteristics inherent to vernal pool integrity.

No significant differences in cumulative effects were identified between project alternatives.

5.7.4.3 Federally Listed Botanical Species

No-Action Alternative

Federally listed threatened or endangered plant species were not located within the project area during the relicensing studies. Therefore, there would be no cumulative effects associated with the No-Action Alternative on listed plant species. 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 consult with USFWS prior to implementing these actions.

Proposed Action

Federally listed threatened or endangered plant species were not located within the project area during the relicensing studies. Therefore, there would be no cumulative effects associated with the Proposed Action on listed plant species. Future actions would be analyzed as described under the No-Action Alternative.

Alternative 2

See "Proposed Action." For the same reasons as described for the Proposed Action, there would be no cumulative effects associated with Alternative 2 on listed plant species.

5.7.5 Unavoidable Adverse Effects

5.7.5.1 Federally Listed Fish Species

Unavoidable adverse effects on energy and nutrient levels, macroinvertebrate populations, lower Feather River habitat quality and quantity, channel complexity, and water quality criteria for aquatic life for all aquatic resources, including federally listed threatened and endangered fish species, are discussed in Section 5.5.4.1, Habitat Components Affected by Oroville Facilities.

Section 5.5.4.3, Lower Feather River Fish Species, provides a detailed discussion of unavoidable adverse effects on spring-run Chinook salmon associated with straying, pre-spawning mortality, redd superimposition, genetic introgression, redd dewatering and juvenile stranding, and poaching. Section 5.5.4.3 also provides a detailed discussion of unavoidable adverse effects on steelhead associated with redd dewatering, juvenile stranding, and poaching.

However, assuming the environmental baseline under ESA Section 7 is current operations, and given the extensive fishery enhancement measures currently in place at the Oroville Facilities, effects on listed fish species under the No-Action Alternative may be considered neutral or beneficial. Effects of the Proposed Action and Alternative 2 would also be beneficial as a result of their additional enhancement measures.

5.7.5.2 Federally Listed Wildlife Species

No-Action Alternative

Potential unavoidable adverse effects to giant garter snake and valley elderberry longhorn beetle and their habitats would occur under the No-Action Alternative as this alternative does not contain conservation measures designed to minimize or avoid adverse effects to these species. Adoption of additional conservation measures would be required under the No-Action Alternative for ESA compliance.

Proposed Action

No unavoidable adverse effects to species and habitats protected under the Federal Endangered Species Act (under USFWS authority) would occur under the Proposed Action or Alternative 2. Thirty-six conservation measures were developed in consultation with USF&WS to avoid, minimize, or mitigate adverse project effects. Implementation of these measures under the new License serves to avoid adverse effects to these species and habitats including designated critical habitat over the term of the new License.

Alternative 2

Same as Proposed Action.

5.7.5.3 Federally Listed Botanical Species

No-Action Alternative

Federally listed threatened or endangered plant species were not located within the project area during the relicensing studies. Therefore, there would be no unavoidable adverse effects associated with the No-Action Alternative on listed plant species. 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 consult with USFWS prior to implementing these actions.

Proposed Action

Federally listed threatened or endangered plant species were not located within the project area during the relicensing studies. Therefore, there would be no unavoidable adverse effects associated with the Proposed Action on listed plant species. Future actions would be analyzed as described under the No-Action Alternative.

Alternative 2

See “Proposed Action.” For the same reasons as described for the Proposed Action, there would be no unavoidable adverse effects associated with Alternative 2 on listed plant species.

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5.8 LAND USE, MANAGEMENT, AND PLANNING

This section summarizes the affected environment associated with land use and management, and analyzes potential effects on land use that could result from the No-Action Alternative, the Proposed Action, and Alternative 2. The analysis of potential effects on land use, management, and planning considers:

- Changes to use of existing lands that would alter the use of that land, such as changes in levels or types of activity;
- Direct effects on adjacent land uses, such as placing incompatible land uses together; and
- The potential for conflict with lands owned or managed by local, State, or federal government.

The methodology used to evaluate potential land use effects considered baseline information provided in Section 5.8.1, Land Use Affected Environment, as summarized from SP-L1, *Land Use Study*, and SP-L2, *Land Management*. It also compares the baseline land use effects that are referenced in these two Study Plan Reports to evaluate potential effects associated with the No-Action Alternative.

As for the Proposed Action and Alternative 2, detailed information on proposed changes to existing facilities and operations or the development of new facilities was collected and reviewed against the baseline conditions identified in the Study Plan Reports. This information included the physical location, size, and operating criteria of facilities, mapped on the land use and land ownership maps that delineate boundaries within and 0.25 mile beyond the FERC project boundary. Based on the mapping, characteristics of proposals, and field-level reconnaissance, potential land use incompatibilities were identified and analyzed in the context of common land use compatibility issues (e.g., public health/safety, noise). The mapping and field-level efforts also allowed the determination of whether land uses would be precluded in certain areas or whether there would be any disruptive effects on existing communities.

In addition, the analysis included a review of the alternatives in the context of established local, State, or federal land use and management plans to determine whether the alternatives are consistent with such plans. The plan consistency analysis in this section only focused on land use and management–related plans. The consistency of such plans is evaluated in detail in Chapter 9.0, Consistency with Comprehensive Plans. All plan consistency analyses are based on information acquired as part of SP-L3, *Comprehensive Plan Consistency*.

Other land use and management–related studies were also used, including SP-L4, *Aesthetic/Visual Resources*; SP-L5, *Fuel Load Management Evaluation*; and SP-R4, *Assess Relationship of Fish/Wildlife Management and Recreation*, to help assess the effects of the alternatives on land use, land management, and planning.

5.8.1 Affected Environment

This section provides an overview of land ownership, management, and land use patterns in the study area (which is defined as lands within 0.25 mile of the FERC project boundary). The discussion includes spatial information related to ownership and land use patterns relative to five distinct study sub-areas: (1) Lake Oroville, (2) the Diversion Pool and Thermalito Forebay, (3) Thermalito Afterbay, (4) the Low Flow Channel and the OWA, and (5) Feather River Service Area (FRSA). Although the FRSA is not within the FERC project boundary, it is applicable for the discussion of land use issues related to agriculture. Detailed information on land ownership, management, and use in the study area is provided in SP-L1, *Land Use Study,* and information on land management is contained in SP-L2, *Land Management Study*. Additional information for agricultural land use affected environment is included in Appendix G-LU1. These documents contain detailed maps that graphically depict the land ownership, management, and use patterns found in the study area.

Major issues related to land use and management identified during the scoping process included:

- Assessment of potential uses of project lands for public use and access, open space, recreation, watershed and natural resources protection/management, energy resources, and cultural values;
- Structure, funding, and staffing of land management for the OWA, Lake Oroville State Recreation Area (LOSRA), and Thermalito Afterbay; and
- Coordination of fuel management practices to lower the risk of loss of property, lives, and natural resources.

5.8.1.1 Land Ownership, Management, and Use Patterns

Land ownership within the study area is characterized by substantial public land holdings. Figures 5.8-1a, 5.8-1b, and 5.8-1c depict land ownership in the study area and within the FERC project boundary. Land ownership in the FRSA is made up of mostly private land holders for agricultural production land uses; see Appendix G-LU1 (Figure G-LU1-2) for a definition of the FRSA geographic area and agricultural land use types. Overall, approximately 69 percent (approximately 48,600 acres) of land within the approximately 70,500-acre study area is publicly owned. Of the publicly owned land in the study area, approximately 23 percent (approximately 11,000 acres out of 48,600) is owned by the federal government, 77 percent (approximately 37,200 acres) is owned by the State, and nearly 1 percent (approximately 400 acres) is owned by local jurisdictions (Butte County, the City of Oroville, and the Feather River Recreation and Park District [FRRPD]). Private entities own approximately 29 percent (approximately 20,700 acres) of land in the study area. The remaining approximately 2 percent of the study area (approximately 1,200 acres) is considered to be the “Other” ownership type, which primarily represents road rights-of-way that are often held in fee by the State (i.e., Caltrans) or county.

All of the land within the FERC project boundary is publicly owned. Approximately 14 percent (5,900 acres) of the lands in the FERC project boundary is owned by the federal government, and 86 percent (35,200 acres) is owned by the State (i.e., DWR, DFG).

DWR, on behalf of the State of California, "owns" or has fee-title (i.e., is the controlling agency for) to about 29,200 acres and DFG "owns" or has fee-title to approximately 5,700 acres of State-held lands within the FERC project boundary. In addition, DWR owns and manages approximately 2,200 acres of land in noncontiguous parcels east of Oroville Dam and along the banks of the Thermalito Power Canal in specific areas inside and outside of the FERC project boundary. Figure 5.3-1, DWR Land Management Map, of SP-L2 illustrates the locations of these lands and the facilities with which they are associated in the study area.

Table 5.8-1 summarizes the land ownership distribution of the study area and FERC project boundary. More detailed ownership data are available in SP-L1, *Land Use Study.*

Table 5.8-1. Land ownership inside the FERC project boundary and in the study area.

Landowner	Inside the FERC Project Boundary[1]		Study Area[2]	
	Acres	Percent	Acres	Percent
Public				
Federal	5,900	14%	11,000	15%
State	35,300	86%	37,200	53%
Local Agencies	0	0%	400	1%
Subtotal: Public	**41,200**	**100%**	**48,600**	**69%**
Private	0	0%	20,700	29%
Other[3]	0	0%	1,200	2%
TOTAL	**41,200**	**100.0**	**70,500**	**100.0**

[1] Includes lands within the FERC project boundary.
[2] Includes lands within 0.25 mile of the FERC project boundary.
[3] Represents road right-of-way and public trust areas (e.g., river channel) without an official parcel number.
Source: SP-L2, Table 5.2-1

Land management in the study area is diverse, as illustrated by the multiple public land owners/managers described later in this section. In addition, there are substantial private property interests that are located inside the study area, but outside the FERC project boundary. As illustrated in Figure 5.5-1, Land Management Direction, from SP-L2, *Land Management Study*, land management direction for most lands within the FERC project boundary emphasizes recreation, wildlife conservation, and public facilities. Lands adjacent to the FERC project boundary within the study area have different management directions, such as agricultural/rural residential development, timber preserve, conservation, recreation, and scenic lands.

Land use patterns within the study area are diverse. To categorize the variety of land uses, a land use classification system was developed for this document that utilizes eight major land use classifications: Reservoir/Open Water; Recreation; Conservation;

Resource Extraction; Undeveloped; Urban; Rural; and Other. Study Report SP-L1 describes how the eight classifications were developed and the location patterns.

The following discussion provides an overview of the land ownership, management, and use patterns for the four geographic sub-areas of the Oroville Facilities (i.e., Lake Oroville, the Diversion Pool and Thermalito Forebay, Thermalito Afterbay, and the Low Flow Channel and OWA).

Lake Oroville

Ownership patterns in the Lake Oroville sub-area vary by location. Most of the land in the study area outside of the FERC project boundary is privately owned, and most of the land within the FERC project boundary is State-owned. Lands underlying and adjacent to the main body of Lake Oroville are primarily owned by DWR, but managed by DPR as part of the LOSRA. There are scattered areas of federally owned lands both within the study area and within the FERC project boundary (including underneath Lake Oroville). Federal lands are generally located in the upper ends of the branches of Lake Oroville. The West Branch Feather River area is characterized by a relatively large amount of BLM land. The ownership pattern in the North Fork Feather River area is the most diverse in the study area, characterized by blocks of noncontiguous properties owned/managed by DWR, USFS (both Plumas and Lassen National Forest), DPR, and private interests. The Middle Fork and South Fork Feather River areas have similar ownership characteristics, containing a mix of DWR, BLM, USFS, and private land owners/managers. A small portion of the only Bureau of Indian Affairs (BIA)–administered property (Enterprise Rancheria) is located along the Middle Fork Feather River tributary outside of the FERC project boundary. Lands along the east, west, and south banks of the main body of Lake Oroville outside of the FERC project boundary but within the study area are owned predominantly by private interests with limited public land holdings.

Lands underlying and adjacent to the main body of Lake Oroville, as well as surface waters of the LOSRA, are managed almost exclusively for recreation use. Small areas outside of the FERC project boundary but within the study area in the Upper North, Middle, and South Forks are classified by the USFS as unproductive forest lands (due to steep terrain and difficult access) that receive minimal management. Lands managed by BLM in these areas have been identified in the BLM's Redding Resource Management Plan (RRMP) for transfer to other entities.

The Middle Fork and South Fork Feather River areas have similar management characteristics, containing a mixture of lands managed by DPR, BLM, USFS, and private interests. Most of the lands along these two branches are currently managed for recreation and resource conservation, with limited areas for timber preserve. Butte County also has jurisdiction along these branches for private lands, although some are not provided with a zoning classification and continue to receive little to no management direction.

Lake Oroville covers approximately 15,400 surface acres when the reservoir level is at 900 feet above mean sea level (msl) (DWR 2001). Although Lake Oroville is classified as Reservoir/Open Water under the land use classifications used in this report, the reservoir's primary purpose is water supply serving the SWP; secondary uses include power generation, flood management, recreation and fishery/wildlife habitat enhancement. For the most part, land immediately adjacent to the reservoir is contained within the LOSRA and is managed by DPR for recreational purposes and it has additional value as wildlife habitat. These lands include various developed facilities such as marinas, campgrounds, boat launches, as well as undeveloped areas that are open to the public for dispersed recreational use. The only notable urban use in this sub-area is the Kelly Ridge residential development located adjacent to the FERC project boundary. Kelly Ridge is located on the south side of the reservoir, just east of Oroville Dam. On USFS lands in the upper portions of the North and South Fork Feather River branches are several areas classified as Resource Extraction. These areas would potentially allow timber harvest. The remainder of the Lake Oroville sub-area has been classified as Undeveloped and Conservation, with isolated rural areas.

Diversion Pool and Thermalito Forebay

The Diversion Pool and Thermalito Forebay study area contains land owners such as the federal government, the State, Butte County, the City of Oroville, the FRRPD, and private interests. Public ownership in this segment tends to be at the State and local level, with several small BLM properties located west of Oroville Dam the only federal properties in the sub-area. All lands within the FERC project boundary in this portion of the project are owned by the State. DWR is the primary landowner in this sub-area, administering land underlying the Diversion Pool and Thermalito Forebay, which is managed by DPR as part of the LOSRA. This sub-area also contains the majority of the City- and County-owned property in the study area. City properties are located along Montgomery Street within the city limits of Oroville; these properties are outside the FERC project boundary. A cluster of County-owned properties is located just east of Thermalito Forebay, south of the FERC project boundary. In this sub-area, private interests own the majority of the land outside the FERC project boundary but within the study area.

The Diversion Pool and Thermalito Forebay area is particularly diverse in terms of land use. These lands contain a variety of management directions, including public facility management, commercial, recreation, agriculture, residential, and conservation. This sub-area is bisected by State Route (SR) 70, which separates the Diversion Pool area to the east and the Power Canal and Thermalito Forebay area to the west. Other transportation infrastructure includes the Union Pacific Railroad and numerous city/county roadways. The three water features, the Diversion Pool, Power Canal and Thermalito Forebay, represent a significant land use and are classified as Reservoir/Open Water.

For the most part, the Recreation classification surrounds these water features, and includes the North and South Forebay recreation sites. Areas classified as Residential are located primarily west of the dam in the City of Oroville. Similarly, a range of

Commercial/Industrial lands are found in the Oroville area along the Low Flow Channel of the Feather River. The majority of the Oroville Facilities are located within the FERC project boundary in this sub-area, including Oroville Dam, the Hyatt Pumping-Generating Plant, Palermo Canal Outlet Tunnel, Thermalito Diversion Dam, the Fish Barrier Dam, the Feather River Fish Hatchery, and the Thermalito Forebay Dam and Thermalito Pumping-Generating Plant. In terms of rural land uses, several pockets of land classified as Agriculture are found interspersed along with areas classified as Undeveloped.

Thermalito Afterbay

Ownership in the Thermalito Afterbay sub-area includes the State, Butte County, and the City of Oroville. Lands within the study area and outside of the FERC project boundary are primarily owned by private interests, with the exception of small clusters of City- and State-owned properties within and around the OWA. All lands within the FERC project boundary in this portion of the project are owned by the State.

Management in the Thermalito Afterbay area is somewhat complex. DFG is the primary land manager in this sub-area, which includes lands underlying Thermalito Afterbay as part of the OWA. However, DWR is responsible for recreation management at Thermalito Afterbay. DFG management direction for this area is primarily wildlife conservation and recreation. DWR has several third party leases and supports the active management of lands through these leases, which can improve land management accountability within the study area.

The Thermalito Afterbay sub-area is the most uniform in terms of land use. This area is characterized primarily by the Reservoir/Open Water and Conservation classifications within the FERC project boundary, and Undeveloped and Agriculture classifications outside the FERC project boundary (but within the study area). The Reservoir/Open Water classification reflects Thermalito Afterbay, and the Conservation classification represents the fact that this area is managed by DFG as part of the OWA. Outside the FERC project boundary, Agriculture-based lands are concentrated west of SR 99 and south of Hamilton Road. Land use features located in this sub-area include several brood ponds, a shooting range, model airplane club, the Western Canal & Richvale Canal Outlet, Sutter Butte Canal Outlet and the Thermalito Afterbay Outlet, as well as several recreation sites, including the Monument Hill, Wilbur Road, and Larkin Road recreation facilities.

Low Flow Channel and OWA

Land within the study area that is outside of the FERC project boundary is owned by an array of entities. Most of the land is owned by private interests, with other parcels owned by the State, Butte County, and the City of Oroville. Lands within the FERC project boundary are owned by the State.

The OWA is the primary feature of the Low Flow Channel and OWA sub-area. Those portions of the OWA within the FERC project boundary are owned by the State and managed by DFG. Lands in this sub-area located outside the FERC project boundary

are managed by a mix of public and private interests, including DFG, Butte County, and the City of Oroville. Part of the Low Flow Channel is within the FERC project boundary and part is outside. DFG management direction for the OWA, which applies primarily to lands within the FERC project boundary, is wildlife conservation and recreation. Management direction for some locations within this sub-area may be inconsistent at times.

The eastern part of the OWA is the major feature of the Low Flow Channel and OWA sub-area and is located predominantly within the FERC project boundary. Because of DFG management of the OWA, most land within the Low Flow Channel and OWA sub-area has been classified Conservation. However, it is acknowledged that recreation use of the OWA (which includes the Rabe Road Shooting Area located outside of the FERC project boundary) is considerable, with an emphasis on hunting and fishing activities. Other recreation uses in this area, but outside of the FERC project boundary, include the Clay Pit State Vehicular Recreation Area (SVRA). In addition, there are currently gravel mining and rock removal leases to the west of SR 70 (within the OWA) that are held by private interests under lease agreements with the State. According to State lease records, the area associated with gravel mining and rock removal operations within the OWA totals approximately 160 acres (DWR 2003). These lands are classified as Resource Extraction. Lands in this sub-area that are located outside the FERC project boundary are diverse in terms of land use: Residential areas located north of the OWA along SR 162 and to the east of the OWA near Palermo Road, Commercial/Industrial areas located along Feather River Boulevard, Agriculture areas that surround the lower half of the OWA outside the FERC project boundary, and Undeveloped areas interspersed within and around the OWA.

5.8.1.2 Land Management Entities

This section identifies the land management entities responsible for managing lands within the study area and FERC project boundary, reviews the locations of lands managed by the various entities, and discusses the management direction of the entities. Figure 5.1-2, Primary Land Management Responsibility, of SP-L2 depicts the entities responsible for managing lands in the study area.

Federal

Federal lands account for approximately 15 percent (11,000 acres) of the study area and 14 percent (5,900 acres) of land within the FERC project boundary. Two federal agencies (USFS and BLM) manage the federal lands within the FERC project boundary (Table 5.8-2).

U.S. Forest Service – USFS manages approximately 7 percent (4,800 acres) of lands in the study area and 12 percent (2,000 acres) of lands within the FERC project boundary. Approximately 95 percent of the USFS lands are contained within the Plumas National Forest. The remaining 5 percent of USFS lands are located in the Upper North Fork and are part of the Lassen National Forest but are managed by the Plumas National Forest.

Management of USFS lands in the study area and FERC project boundary is guided by several management plans and documents including the Plumas National Forest Land and Resource Management Plan (LRMP), Herger Feinstein Quincy Library Group Forest Recover Act Environmental Impact Statement (EIS), and the Sierra Nevada Framework Record of Decision (ROD). The Forest's LRMP management goals and policies direct the management of the Forest over 10 to 15 years (the "planning period") and help meet long-term objectives over a 50-year period (the "planning horizon"). The LRMP is the document that guides most of the day-to-day management of the Forest. LRMP directives for the lands in the study area and FERC project boundary primarily

Table 5.8-2. Summary of public entity land management.

Public Entities	ACRES OF MANAGEMENT			
	Inside FERC Project Boundary	Percent Inside FERC Project Boundary	Study Area	Percent of Total Study Area
Federal				
USFS*	2,000	5%	5,100	7%
BLM	3,900	9%	5,800	8%
Other	0	0%	0	0%
Subtotal Federal	**5,900**	**14%**	**11,000**	**15%**
State				
DWR	2,000	5%	2,200	3%
DPR	22,100	54%	23,000	32%
DFG	11,200	27%	12,000	17%
Other	0	0%	0	0%
Subtotal State	**35,300**	**86%**	**37,200**	**52%**
Local Jurisdictions	**Private/Local Lands Subject to Local Land Management**			
Butte County	0	0%	21,300	31%
City of Oroville	0	0%	1,100	2%
Subtotal Local	**0**	**0%**	**22,400**	**33%**
TOTAL	**41,200**	**100%**	**70,500**	**100%**

**Includes all management authority except for recreation and law enforcement, which was transferred to DPR.*
Sources: Butte County 2003, staff review of acreage totals from USFS, BLM, DWR, DPR, DFG, and City of Oroville; SP-L2, Table 5.1-1

emphasize resource conservation, provision of high quality recreational opportunities, and protection of visual resources.

All USFS lands are managed through specific land use designation called Management Prescriptions. Each Management Prescription is comprised of appropriate standards and guidelines that will meet some particular need (such as special habitat protection, recreation, recreation quality enhancement, or timber production) while allowing other compatible activities. This direction supplements the Forest-wide Standards and Guidelines, which must always be applied (USFS 1998).

Some USFS lands in the study area and FERC project boundary (along the Upper North Fork and South Fork) have Management Prescriptions that would allow for

varying degrees of timber harvest, and some are located in areas that might support timber harvest if not for steep terrain and difficult access. Many of these lands have been classified as unproductive or unsuitable for timber harvest. Due to resource protection concerns and difficult access, many of the USFS lands in the study area and FERC project boundary have been managed in the past as de facto resource conservation lands. Under current USFS direction, these lands are being considered for fuel load management if they could be a threat to nearby urbanized areas.

The USFS does not actively manage facilities or activities on most lands within the study area and FERC project boundary. The USFS and DPR have an agreement concerning management of USFS lands within the FERC project boundary that are part of the LOSRA. The agreement, dated March 16, 1978, allows DPR to conduct law enforcement activities on USFS lands (the USFS does, however, provide law enforcement to address illegal activities that take place on USFS lands such as illegal dumping of trash and hazardous materials, drug production lab debris, and vandalism of cultural resource sites). The USFS retains all other authorities. In the agreement, the USFS "transferred interest" in USFS lands "within project boundaries shown in Exhibit K of the FERC license No. 2100 to permit the DPR to use, and protect said lands in a manner necessary to administer them for recreation purposes and, to the extent permissible, to enforce all applicable laws and regulations thereon." The USFS is not interested in changing or terminating the agreement at this time but will reevaluate the agreement during the next Forest Plan revision (pers. comm., Taylor 2004). Currently, any development planned in conjunction with the Oroville Facilities on USFS lands, including construction of any facilities or infrastructure, within the National Forest must be approved by the USFS prior to implementation (pers. comm., Humphreys 2003).

U.S. Bureau of Land Management – Federal lands managed by BLM are scattered throughout the region, primarily in the northern reaches of the West Branch Feather River, within the main body of the reservoir, and in the Middle and South Fork tributaries. In total, BLM manages approximately 8 percent (5,800 acres) of the land in the study area and 9 percent (3,900 acres) of lands within the FERC project boundary. Most of these lands are noncontiguous, scattered parcels, some of which are submerged under Lake Oroville (see Figure 5.2-2 in SP-L2).

BLM manages lands in the study area under the direction of the 1993 RRMP. Lands managed by BLM in and around the study area are designated as "undeveloped public lands." BLM has expressed a desire to surplus many properties in the study area and FERC project boundary with public agencies. At an operational level, BLM has prioritized the following three management objectives for lands in and near the study area (pers. comm., Berg 2003):

1. Identify what lands are of specific interest to the State of California within the study area;

2. Design the mechanism(s) to effect transfer of surplus federal lands to the State of California; and

3. Complete transfer.

DWR and DPR have engaged in discussions with BLM regarding potential transfer of BLM lands to the State of California. In addition, DPR has submitted applications to BLM for land transfer sites within the study area in the vicinity of Stringtown Mountain along the South Fork of the Feather River. This area is of great cultural interest to the four recognized tribes in the Oroville area. Cultural issues are currently the major local management issues facing the BLM (pers. comm., Matzat 2003).

Federal–Other – Due to the nature of the Geographic Information Systems (GIS) mapping process, certain lands in the study area are classified as Federal–Other (none of these lands are within the FERC project boundary). These lands represent areas that are coded as federal lands in the Butte County parcel base. The parcel base does not track agency-level ownership information, and these lands are not covered by the agency-specific data sources. These areas are a product of agency-specific data not completely matching the boundaries in the parcel data, thus resulting in small "sliver" polygons that cannot be attributed to a particular agency. These lands represent a minor percentage (less than 1 percent) of the study area total.

State of California

The State of California (DWR) owns and manages approximately 53 percent (37,200 acres) of land in the study area and 86 percent (35,300 acres) of land within the FERC project boundary. DWR and DFG have fee title to all of the State-owned land within the FERC project boundary and have a mandate to manage public recreation and fish and wildlife preservation and enhancement in connection with the SWP. At the Oroville Facilities, the management of various resources is shared among three agencies—DWR, DPR, and DFG. In 1961, DWR transferred recreational interests and management responsibility for 23,000 acres within the FERC project boundary to DPR. These lands constitute the majority of the LOSRA. DPR is charged with designing, constructing, operating, and maintaining public recreation facilities on these lands. In 1961, DWR transferred approximately 12,000 acres of land within the FERC project boundary to DFG. These lands constitute much of the OWA reserving any interests necessary to construct, operate, and maintain the SWP. DFG is charged with State-wide management of fish and wildlife habitats/associated recreational facilities.

The following sections discuss the State agencies with land and resource management responsibilities within the study area and FERC project boundary.

California Department of Water Resources

As the owner, manager, and operator of the Oroville Facilities, which include all dams, powerhouses, and transmission facilities located within the FERC project boundary, DWR has direct management responsibility for approximately 2,000 acres within the FERC project boundary that are not managed by DPR as part of the LOSRA or DFG as part of the OWA. The lands that DWR has primary management responsibility for are generally related to operation of the project. DWR also has primary management

responsibility for approximately 2,200 acres in the study area. Management of the Oroville Facilities is based on the terms of the existing FERC license. Day-to-day operations of the facilities are the responsibility of DWR. DWR has leased several parcels totaling approximately 700 acres to private groups or individuals in locations where DWR has primary management authority, as well as in locations within the OWA and LOSRA. These leases are generally located on scattered, noncontiguous parcels west of Oroville Dam and within the OWA and are summarized in Table 5.8-3. In addition, Table 5.3-1 of SP-L2, *Land Management Study,* provides more detailed information regarding known third-party lease arrangements with DWR.

Table 5.8-3. DWR third-party leases.

Purpose	Type	Acres	Lessee
Cattle grazing	Private	417	John Campbell
Community recreation	Local public	44	FRRPD
Cemetery	Private	23.7	Cemetery*
Site for flying model airplanes	Private	Not Known	Model Aircraft Flying Facility
Shooting range	Local public	9	Butte College
Rock removal	Local public	10	Joint Water Districts Board
Gravel extraction	Private	50	Mathews Ready Mix
Gravel extraction	Private	100	Granite Construction
Game bird raising	Private	77	K & L Quail Ranch*

** Outside FERC project boundary but within the 0.25-mile study area.*
Source: Maria Chin, DWR Division of Land and Rights-of-Way November 2003 (See SP-L2, Section 5.3-1)

California Department of Parks and Recreation

As mentioned previously, upon completion of the Oroville Facilities, the recreational interest for lands within what is now the LOSRA was transferred by DWR to DPR. The transfer was completed under the *Agreement for Transfer to Department of Parks and Recreation of Interest in Certain Real Property at Oroville Division of State Water Project*. DPR has the primary recreational management responsibility for most of the land underlying and surrounding Lake Oroville and its facilities, including lands that comprise the LOSRA. DPR coordinates management of the LOSRA with DWR, California Department of Boating and Waterways (DBW), DFG, CDF, Butte County, California Highway Patrol (CHP), USFS, volunteer organizations, and other groups and agencies. Although DPR manages the majority of LOSRA's recreational aspects, DWR bears the ultimate responsibility under the current FERC license for ensuring funding, development, and management of current and additional recreation facilities and FERC Project 2100. The Davis-Dolwig Act (Water Code Sections 11910–11925) requires DWR to plan for and acquire land for recreation in conjunction with all SWP facilities. In keeping with its responsibility, DWR works with DPR and DFG to provide for recreational opportunities and funding throughout the FERC project boundary and LOSRA.

The LOSRA consists of major facilities at Loafer Creek, Bidwell Canyon, Spillway, Lime Saddle, the Lake Oroville Visitors Center, and North and South Thermalito Forebay and includes waters and lands in the West Branch, Upper North Fork, Lower North Fork,

Middle Fork, South Fork, and the main basin. Figure 5.3-2 of SP-L2, *Land Management Study,* depicts the locations of these facilities.

DPR has management responsibility for approximately 32 percent (23,000 acres) of land within the study area. Within the FERC project boundary, DPR has management responsibility for approximately 54 percent (22,100 acres) of the land within the FERC project boundary, all of which is located in the LOSRA. DPR's management responsibilities for the LOSRA include addressing a variety of issues such as safety, facilities maintenance, and overall visitor management for all recreational activities. DPR coordinates these activities, when appropriate, with DWR, DBW, DFG, CDF, Butte County, CHP, volunteer organizations, and other groups and agencies.

The LOSRA is managed under the guidance of the LOSRA General Plan (GP), which was developed by the DPR in 1973 and is currently being updated. An amendment adopted in 1988 details additional development in the Lime Saddle area. The GP describes allowable recreational uses and intensities for various areas around the reservoir, such as Bidwell Canyon, Lime Saddle, Goat Ranch, and others. In compliance with the FERC Order of October 1, 1992, DWR prepared the Amended Recreation Plan (ARP) in 1993 as the recreation plan for the LOSRA. The ARP was adopted by the FERC Order of September 22, 1994 and superseded the 1966 Plan, Bulletin 117-6. DWR developed the ARP for the LOSRA to address public concerns associated with the recreation development associated with the project. The 1993 ARP describes a number of improvements and DWR commitments to construct specific facilities and take actions to address the fisheries and recreation needs at the project; additional improvements and actions deemed necessary by FERC were included in the September 22, 1994, Order. The 1993 ARP also detailed the timeframe for the completion of additional proposed recreational facilities. DWR acknowledges in the ARP that as the licensee, they are responsible for funding specific improvements. The ARP describes the fish and wildlife resources, facilities, local area, user patterns, operation of LOSRA and OWA facilities, economic considerations, recreation plan, and the fisheries management plan. The ARP puts forth recommendations for facility expansion and modification in light of these findings. These recommendations have since been implemented.

<u>California Department of Fish and Game</u>

DFG manages approximately 12,000 acres of land, or 17 percent of the total study area. Most of this area (11,200 acres) is located within the FERC project boundary. DFG manages fish and wildlife habitat and associated recreational use for both surface water and dry lands within the OWA and the fish and wildlife habitat of the LOSRA. In addition, DFG manages and operates the Feather River Fish Hatchery. Figure 5.3-3 of SP-L2, *Land Management Study,* illustrates the locations of DFG-managed lands, as well as facilities for which the agency is responsible within the study area. Most of the land area for which DFG provides day-to-day management is within the OWA and is located within the FERC project boundary. The OWA includes Thermalito Afterbay and a wide swath of wildlife habitat straddling the Low Flow and High Flow Channel sections of the project south and west of the City of Oroville.

DFG manages the OWA, the wildlife and habitats of the LOSRA, and its other State-wide responsibilities under the California Fish and Game Code, Sections 1525–1530, and the California Fish and Game Commission's Hunting and Other Public Uses on State and Federal Lands California Regulations (DFG 2002). To ensure compatibility with the goals and uses of the Oroville Facilities within the LOSRA, DFG is also responsible for managing fish and wildlife resources and recreation activities pursuant to the Davis-Dolwig Act (Water Code Section 11917). Within the OWA, DFG strives to carry out management responsibilities as identified in the 1978 Oroville Wildlife Area Management Plan (DFG 1978). DFG intends to revise the Management Plan in the near future.

Remote areas within the OWA that are accessible by road have been susceptible to illegal activities, such as dumping, fires, and lawless behavior. Consequently, some access restrictions have been implemented.

Local Entities

Butte County

All lands in the study area owned by Butte County are located outside the FERC project boundary. County-owned properties generally reflect administrative uses for government services. In total, the County owns approximately 100 acres of land, which represents less than 1 percent of the study area and FERC project boundary. Butte County has land management jurisdiction over approximately 21,300 acres of private lands within the study area, which represents approximately 31 percent of the entire study area. There are no private lands within the FERC project boundary. All private development in Butte County is subject to the policies detailed in the Butte County GP and Zoning Ordinance.

The Butte County Zoning Ordinance is the regulatory mechanism that implements the county's land use designations listed in the Butte County General Plan. The zoning ordinance is a set of districts with different regulations on permitted uses, residential densities, lot sizes, signs, parking, and the intensity and placement of structures. The written text of the ordinance is accompanied by maps dividing the entire jurisdiction into zoning districts.

The majority of private lands under Butte County jurisdiction outside of and adjacent to the FERC project boundary are designated Unclassified, consisting primarily of constrained areas that require minimal oversight. The County's land use designations are summarized in Table 5.4-1 of SP-L2, *Land Management Study*. For each designation, this table describes both primary and secondary use and identifies the implementing zoning designations. The County's zoning designations, aggregated into categories, are illustrated in Figures 5.4-1a through 5.4-1c, Butte County Zoning, of SP-L2, *Land Management Study*.

City of Oroville

The City of Oroville owns a limited number of properties in the study area, all of which are located outside of the FERC project boundary. City-owned properties typically represent uses pertaining to government services and recreation. In total, the City owns roughly 150 acres of land in the study area.

Part of the study area is located within the boundary of the City of Oroville. These areas are located south of Lake Oroville and west of Saddle Dam and include the shoreline of Lake Oroville between the Saddle Dam and the northeastern edge of the Oroville Dam Spillway, the Diversion Pool, Thermalito Forebay, Thermalito Afterbay, the Low Flow Channel of the Feather River, and the OWA. In total, roughly 1,100 acres (or 2 percent of the total study area) are located within the City limits. No lands owned by the City of Oroville are located within the FERC project boundary. Figure 5.4-2, City of Oroville Zoning, of SP-L2, *Land Management Study,* illustrates the City of Oroville zoning within the City as it relates to the study area.

All development and activity within the City of Oroville is subject to the policies outlined in the City's GP and Zoning Ordinance. The objectives detailed in the GP pertaining to land use serve as a framework within which the city makes decisions relating to activities and developments within the study area that fall under its authority. The policies detailed in the plan represent the city's adopted commitments to actions that are intended to implement the community's broader objectives.

The Land Use Element of the Oroville GP designates areas near the project facilities as "Medium Density Residential" and "Parks." These land use designations are described in SP-L2, *Land Management Study.*

Oroville GP policies that relate to the operation and management of Lake Oroville generally include enhancement of recreational and biological resources at Lake Oroville, as well as reducing potential flood and seismic hazards. Policies that specifically mention the Oroville Facilities are listed in Table 5.4-3 of SP-L2, *Land Management Study*, organized by element of the Oroville GP.

Feather River Recreation and Park District

Another local entity that owns and administers lands in the study area is the FRRPD, which was established in 1953 and provides a variety of park and recreational services to residents of southeast Butte County. FRRPD holdings in the study area, which include Riverbend Park located west of SR 70 at Montgomery Street consisting of 50 owned and 100 DFG leased acres as well as roughly 18 owned acres and 34 acres leased from DWR for Nelson Avenue Park.

Other Local Districts/Agencies

There is also a set of public agencies, including local districts, that own property in the study area. Aside from the FRRPD described above, the following entities own land within the study area but outside the FERC project boundary: Sacramento and San

Joaquin Drainage District, County Board of Education, County Housing Authority, Thermalito Irrigation District, Richvale Irrigation District, Oroville Area Public Utility District, Oroville Elementary School District, Oroville Union High School District, Thermalito Elementary School District, Biggs-West Gridley Water District, Western Canal Water District, and South Feather Water and Power Agency. In total, these entities own approximately 156 acres of land in the study area, representing less than 1 percent of the study area total.

Private

There are no private ownership interests within the FERC project boundary; however, land in the study area (including land outside the FERC project boundary) is predominantly owned by public agencies (approximately 69 percent) and private interests who own approximately 29 percent of lands in the study area. One of the larger private landowners in the study area is Pacific Gas and Electric Company (PG&E). This entity primarily uses lands in the study area for transmitting power. In general, management of private lands must comply with current land use planning guidelines (i.e., general plans) and regulations (i.e., zoning ordinances) of Butte County and the City of Oroville.

Other

The remaining lands in the study area are either State or County road rights-of-way or areas without an official parcel number, which are often attributed to public trust lands such as the river channel. Because these lands do not reflect meaningful ownership information, they have been classified as “Other.” There are approximately 1,200 acres of other-owned land, representing nearly 2 percent of the study area total.

5.8.1.3 Existing Land Use

The section is based on information in the SP-L1, *Land Use Study*, developed using available GIS data for the study area. Existing land uses in the study area have been organized into eight major land use classifications as shown in Table 5.8-4, which summarizes the respective major land use classifications within the FERC project boundary and in the study area. Figures 5.8-2a, 5.8-2b, and 5.8-2c illustrate the existing land use patterns in the study area.

Agricultural Resources

One of the sub-classifications shown in Table 5.8-4 is Agricultural, which refers to several, more specifically defined, agriculture-related land uses within the study area and FERC project boundary. These uses include fallow fields, hayfields, orchards, pastures, rice, row crops, and vineyards. In addition to improving the reliability of water supply availability for agriculture resources, the Oroville Facilities may potentially affect agricultural resources in several ways, including influencing water temperatures at agricultural diversions, changing the groundwater table, changing water quality, erosion attributable to Oroville Facilities releases, and contributing aquatic weeds and weed seeds from Thermalito Afterbay into the agricultural irrigation distribution and

conveyance system. With respect to water temperature and agricultural diversions, contractual agreements between DWR and several water districts serving agricultural needs includes terms describing the amount of water that DWR is seasonally required to make available to the districts for these purposes. Issues related to these diversions are addressed under the terms of these agreements. An overview of agricultural resources is provided in Appendix G-LU1, Agricultural Resources.

Table 5.8-4. Land uses in the study area.

Land Use	FERC Project Boundary		Study Area[1]	
	Acres[2] (approx.)	Percent	Acres[2] (approx.)	Percent
Urban				
Residential	0	0%	1,100	2%
Commercial/Industrial	0	0%	100	<1%
Project Facilities	400	<1%	700	1%
Other Urban	100	<1%	400	<1%
Subtotal: Urban	*500*	*1%*	*2,300*	*4%*
Rural				
Rural Residential	0	0.0%	400	1%
Agriculture	0	<1%	2,200	3%
Subtotal: Rural	*0*	*0%*	*2,600*	*4%*
Recreation	12,600	30%	13,900	20%
Conservation	7,300	18%	12,300	17%
Resource Extraction	200	<1%	700	1%
Undeveloped/Habitat	1,000	2%	18,700	26%
Other	200	<1%	700	1%
Reservoir/Open Water[3]	18,900	46%	19,300	27%
TOTAL[4]	**41,200**	**100.0%**	**70,500**	**100.0%**

[1] Includes the FERC project boundary and non-project lands adjacent to and within 0.25 mile of the FERC project boundary.
[2] Acres are approximate and rounded to the nearest 100.
[3] Measure at full pool elevation (including all project water features).
[4] Numbers may not add up to 100 percent due to rounding.
Source: EDAW 2003

Fuel Load Management and Wildfire Potential

Because of the wildfire potential associated with buildup of vegetation (fuel loading) in the Sierra Nevada foothills, the issue of fuel load management was studied. The information in this subsection is based on SP-L5, *Fuel Load Management Evaluation*, which contains detailed information pertinent to fuel loading issues in the project area. In addition, a general overview of fuel load management is provided in Appendix G-LU2. The definition of fuel loading varies among land management and fire prevention organizations. For this PDEA, fuel loading refers to a buildup of fuels, particularly vegetation, that can burn and contribute to wildfires. Buildup of vegetation throughout California and the West is of great concern because of the potential for damage associated with wildfires. Fire is a natural evolutionary force that has influenced Sierra Nevada ecosystems for millennia. It has influenced biodiversity, plant reproduction, vegetation development, insect outbreak and disease cycles, wildlife habitat

relationships, soil functions and nutrient cycling, gene flow, selection, and, ultimately, sustainability (SNEP 1996).

As with most lands in and near the Sierra Nevada, the project area has a history of fire events. Figure G-LU2-1 in Appendix G-LU2 depicts the location and approximate configuration of large fires (more than 50 acres) that have occurred in the project area since the early 1900s. In recent years (between 1990 and June 2003), there have been 13 fires that have burned more than 50 acres within the FERC project boundary.

The U.S. Forest Service (USFS), the U.S. Bureau of Land Management (BLM), the California Department of Forestry and Fire Protection (CDF), and DPR, along with Butte County and the City of Oroville, have developed policies, plans, and programs for fire management/suppression and/or for fuel loading. In addition, the Butte County Fire Safe Council and the Oroville Community Association focus on wildfire-related issues. The main function of these organizations is provide education to local residents relating to issues associated with wildfires such as reducing fuel loading. These organizations work closely with CDF's local unit, the Butte Unit, in outreach and educational programs.

There are a number of public concerns related to fuel loading and the potential for wildfire. Based on recent history, it can be assumed that there will continue to be wildfires in and near the FERC project boundary. The buildup of vegetation will continue to add to fuel loads and increase the potential of wildfire. At the same time that fuel load accumulation is occurring, recreation users and others are attracted to the OWA, project recreation facilities, and other areas within the FERC project boundary, thus contributing to the risk of wildfire; however, several entities are addressing fuel loading and related wildfire risks within the FERC project boundary and in the vicinity of the project. There are continuing planning efforts from entities such as CDF and local fire safety councils. In addition, DPR will likely continue fuel load reduction treatments to some degree on LOSRA lands.

5.8.1.4 Future Land Use

The discussion of future land use direction is limited to general patterns of land uses for private lands as prescribed in the Butte County GP. Private lands the GP has jurisdiction over include unincorporated as well as incorporated areas of the county. For incorporated areas, such as the City of Oroville, the county's and city's GPs are designed to be consistent with one another. Although the GP also assigns land use designations to federal and State lands, the county has no jurisdiction over federal or State lands. Nevertheless, the land use designations the GP 'assigns' to federal and State lands is generally compatible with or similar in intent to the designations developed by the federal and State agencies. Therefore, the GP was selected to use to represent potential future land use.

Future Land Use Direction Patterns within the Study Area

Lake Oroville

Lake Oroville is the dominant feature of this sub-area. As a water feature, it does not have a formal land use designation under the Butte County GP. Generally, future planned land uses immediately surrounding the reservoir are designated as Public, reflecting the large quantity of public land management adjacent to the reservoir. Because entities such as the DPR, USFS, and BLM implement their own land use planning, this designation does not provide information on allowable land uses. Lands are primarily designated Agricultural Residential and Timber-Mountain on the east side of the reservoir and Agricultural Residential and Grazing and Open Land on the west side.

Lands along the tributaries that feed into Lake Oroville also possess distinct planned land use patterns. In addition to Agricultural Residential and Grazing and Open Land, the West Branch Feather River area also contains limited Low Density Residential to the west and Foothill Area Residential to the east. The North Fork area is planned for Grazing and Open Land along with Timber-Mountain land uses. Along the Middle Fork and South Fork reaches, the primary planned land use designation is Timber-Mountain. However, the South Fork area also contains Agricultural Residential north and south of the reservoir and limited Grazing and Open Land areas to the south. The Kelly Ridge area is designated Public near the reservoir and Low Density Residential, with very limited amounts of Commercial, farther inland.

Diversion Pool and Thermalito Forebay

This area, which extends from Oroville Dam to the west side of Thermalito Forebay, is characterized by a range of future planned land uses. Just west of the dam, the study area is designated primarily Public and Agricultural Residential. Moving west, planned land uses become more urban in nature, including Low, Medium, and High Density Residential, as well as Commercial uses adjacent to the FERC project boundary in the City of Oroville. In proximity to the Thermalito Forebay area, Grazing and Open Land uses are planned to the north and Low Density Residential uses are planned to the south.

Thermalito Afterbay

Future planned land uses in the Thermalito Afterbay area are more uniform. Grazing and Open Land uses continue into the northern reaches of this sub-area, while Public and Agricultural Residential uses are planned to the east. Limited areas of Orchard and Field Crop uses are located west of SR 99 and south of Hamilton Road; these agricultural areas are within the study area but outside the FERC project boundary.

Low Flow Channel and OWA

The Low Flow Channel and OWA area is planned primarily for Public uses associated with the OWA. However, there are isolated pockets of areas designated for Industrial

uses in the southern portions of the OWA, corresponding primarily to gravel extraction operations. Agricultural Residential uses are also planned to the east of the OWA, as well as to the southeast of the Oroville Municipal Airport, which is located north of the OWA. The northern portion of this area is designated Low and Medium Density Residential and Commercial land uses located on both sides of SR 162.

Proposed Land Uses

Proposed land uses represent development projects in the Oroville area that are on record with (but not necessarily approved by) local planning departments and can expect to be developed in the foreseeable future (as of September 2003). Not all projects are considered here; only projects proposed by others and located in the study area that are greater than 5 acres for residential use or over 40,000 square feet for commercial use are considered. It should be noted that non-development projects are also being proposed in the study area, which may warrant consideration in the Oroville relicensing process, including a set of fuel management projects near residential developments in the vicinity of Big Bend, Brush Creek, Berry Creek, and Feather Falls.

Table 5.8-5 describes the type and location of proposed projects considered in this report. Figure 5.5-1 in SP-L1 shows these projects relative to the Oroville Facilities. All of the proposed projects are found south of the Low Flow Channel of the Feather River.

Table 5.8-5. Proposed projects within the study area that are on record with local planning departments.[1]

Number	Name	APN	Type	Size	City/ County	Status
1	Sierra Valley Apartments	031-140-082, 085, 005	Residential	5.74 acres	City	Approved, but not constructed
2	PIC Phase III	031-070-062	Commercial	40,000 sq ft	City	Approved and under construction
3	Cherokee Estates Subdivision	031-400-013	Residential	5.38 acres	City	Approved, but not constructed
4	Tentative Subdivision Map	030-120-044	Residential	13.8 acres	County	Application pending
5	Tentative Subdivision Map	030-032-002, 030-033-001, 002	Residential	82.64 acres	County	Application pending

[1] *The information on projects in unincorporated Butte County and the City of Oroville is dated August 2003 and September 2003, respectively.*
Sources: pers. comm., Baker 2003; pers. comm., Ostrander 2003; DWR 2003 (From Table 5.5-1 in SP-L1)

The three projects located within the City limits (PIC Phase III, Cherokee Estates Subdivision, and Sierra Valley Apartments) are clustered together in the area just west and north of where Low Flow Channel begins traveling south, near the Fish Barrier Dam. The other two projects, both of which are tentative subdivision maps, are located in unincorporated Butte County just south of Thermalito Forebay.

5.8.1.5 Baseline Project Conditions

The baseline conditions relevant to land use associated with the existing project are summarized below.

- Lake Oroville, the Diversion Pool, Power Canal, Thermalito Forebay, Thermalito Afterbay, and the Low Flow Channel are bodies of open water that function as physical barriers, geographically separating land uses. Depending on a variety of considerations, this separation can have either beneficial or adverse land use effects.

- DFG's existing management of the OWA is constrained by both resource management conflicts and fiscal constraints.

- Current accumulation of ladder fuels within the study area boundary is a potential source of public concern on land management. This issue is particularly problematic along the urban/wildland interface where potential wildfire fed by accumulated fuels could threaten life and property within developed areas.

- Oroville Dam has a beneficial effect on land management and use downstream of the dam by protecting these lands from inundation and other flood-related damage.

- The Oroville Facilities also benefit agricultural, municipal, and industrial lands by providing water for irrigation and other uses on these lands as well as electricity.

5.8.2 Environmental Effects

Summary of Potential Effects on Land Use, Management, and Planning

Table 5.8-6 summarizes the potential effects on land use, management, and planning for the No-Action Alternative, the Proposed Action, and Alternative 2. The ensuing subsections provide a more detailed analysis of these potential effects.

5.8.2.1 No-Action Alternative

The baseline conditions summarized in Section 5.8.1, Affected Environment, would continue under the No-Action Alternative.

Effects on Land Ownership, Management, and Use

Lake Oroville

Fire prevention and suppression equipment and facilities upon USFS lands are an example of an existing measure resulting in no effect or moderately beneficial effects on land use in the Lake Oroville vicinity.

Land use in and around Lake Oroville will be affected by the development and adoption of Bald Eagle Management Plans. As discussed below under Compatibility with Land Use Classifications and Patterns for Recreation Lands, exclusion of human entry from the primary zone during significant portions of the year could adversely affect recreational lands.

Both fire prevention and suppression equipment and facilities, along with the Bald Eagle Management Plans included in the No-Action Alternative, would also be incorporated in the Proposed Action and Alternative 2.

Table 5.8-6. Comparison of effects of alternatives on land use, management, and planning.

	No-Action Alternative	Proposed Action	Alternative 2
Effects on Land Ownership, Management, and Use			
Fire prevention and suppression facilities on National Forest Lands	No effect or moderately beneficial effects	Same as No-Action Alternative	Same as No-Action Alternative
Development and adoption of Bald Eagle Management Plans	Local adverse effects for recreation access	Same as No-Action Alternative	Same as No-Action Alternative
Improved interagency recreation management	Same as Existing Conditions	No effect or moderately beneficial land use and management effects	Same as Proposed Action
Recreation facility enhancements at Bidwell Marina and Enterprise	Same as Existing Conditions	No effect or moderately beneficial land use and management effects	Same as Proposed Action
Construction of additional recreation facilities at the Diversion Pool and improved recreation facilities and access at Lakeland Boulevard	Same as Existing Conditions	Neutral or moderately beneficial land use and management effects	Same as Proposed Action
Construction of four additional brood ponds	Same as Existing Conditions	Neutral or moderately beneficial land use and management effects	Same as Proposed Action
Recreation enhancements around Thermalito Afterbay such as new day use facilities at the Thermalito Afterbay Outlet	Same as Existing Conditions	Neutral or moderately beneficial land use and management effects	Same as Proposed Action
Addition of a camp store shell at Bidwell Canyon and a new day use area and associated trails and other facilities at Parish Cove near Lime Saddle	Same as Existing Conditions	Same as No-Action Alternative	Neutral land use and management effects
A potential future whitewater boater take-out in the upper North Fork	Same as Existing Conditions	Same as No-Action Alternative	Possible adverse land use effects if sited adjacent to a highly sensitive land use
Creation of competition-style public whitewater boating facilities and a flexible event center with arena both of which would have grandstands	Same as Existing Conditions	Same as No-Action Alternative	Possible periodic adverse effects on surrounding land uses

Table 5.8-6. Comparison of effects of alternatives on land use, management, and planning.

	No-Action Alternative	Proposed Action	Alternative 2
Effects on Land Management and Related Entities			
Transfer of BLM lands currently contained within the FERC project boundary to the licensee	Same as Existing Conditions	Same as No-Action Alternative	Beneficial land management effects
Development of a Fuel Load Management Plan to reduce fuels along the urban/wildland interface	Same as Existing Conditions	Same as No-Action Alternative	Beneficial land management effects
Recreation Planning and Management Coordination	Same as Existing Conditions	Beneficial land management effects	Same as Proposed Action
Hazardous Materials	Slight increase in usage of hazardous materials; risk of accidents minor	Same as No-Action Alternative but slightly higher usage of hazardous materials and thus risks of related accidents	Same as Proposed Action
Wildfire Potential	Potential for increased risk over time as fuel loading increases and recreational use increases, without coordinated fuel load management	Improved inter-agency coordination should benefit wildfire suppression activities	Same as Proposed Action, additionally, fuel load management plan should improve fuel load conditions and reduce risks of wildfire
Compatibility with Land Use Classifications and Patterns	No effect or moderately beneficial effects	Same as No-Action Alternative	Same as No-Action Alternative
Effects on Agricultural Resources			
Prime and Other Farmland	Same as Existing Conditions	Same as Existing Conditions	Same as Existing Conditions
Agricultural Cultural Practices	Same as Existing Conditions	Slightly beneficial due to invasive non-native weed control	Same as Proposed Action
Agricultural Production	Same as Existing Conditions	Same as No-Action Alternative	Slightly beneficial effect due to possible improvement (i.e., warming) of water temperatures under certain meteorological conditions.
Effect on Future Land Uses	Same as Existing Conditions	Same as No-Action Alternative	Same as No-Action Alternative
Consistency with Federal, State, Regional, County, and Municipal Management Plans	Same as Existing Conditions	Same as No-Action Alternative	Possibly inconsistent with certain provisions in the OWA Management Plan

Effects on Land Management Entities

Federal

As none of the existing measures would involve federal lands, there would be no effect on USFS, BLM, or other federal interests.

State of California

Effects on the State of California land management activities are not expected under the No-Action Alternative.

Other

Effects on other land management agencies are not expected under the No-Action Alternative.

Compatibility with Land Use Classifications and Patterns

Reservoir/Open Water

None of the existing measures comprising the No-Action Alternative would affect compatibility with the Reservoir/Open Water land use classifications and patterns in the study area.

Recreation Lands

The No-Action Alternative would generally have no effect or moderately beneficial effects on recreational lands within the study area. One potential land use/recreation conflict associated with all three of the alternatives is the proposed development and adoption of Bald Eagle Management Plans to protect existing bald eagle territories. The nest site at Potters Ravine is located on or near recreation lands and its territory is affected by existing recreational use. See Section 5.10 for analysis of effects on specific recreation resources and facilities.

Conservation Lands

The No-Action Alternative would have no effects or moderately beneficial effects on conservation lands owned and managed by federal and State agencies within the study area.

Undeveloped Lands

The No-Action Alternative would not directly affect undeveloped land, as no undeveloped land is proposed for development under the No-Action Alternative.

Urban-Developed Lands

The No-Action Alternative would not directly affect urban developed land.

Rural/Agricultural Lands

Prime and Other Farmland – The No-Action Alternative would not cause any loss or conversion of Prime or other farmland because the implementation of this alternative would not include any construction activities that result in such conversions. In addition, erosion rates and conversion of prime farmland due to erosion in the lower Feather River are not expected to increase under this alternative. Prime and other farmland land use designations also would not change.

Agricultural Cultural Practices – Changes in Thermalito Afterbay operations are not expected under the No-Action Alternative. Therefore, the rate and type of potential weed contribution from Thermalito Afterbay into the agricultural diversion system under the No-Action Alternative would be the same as under existing conditions.

Agricultural Production – An evaluation of Thermalito Afterbay and agricultural diversion water temperatures was conducted to determine whether the No-Action Alternative or other alternatives have the potential to cause water temperature effects. Since Thermalito Afterbay operations and timing and magnitude of flow releases from Thermalito Afterbay would change only minimally from the existing condition in the No-Action Alternative, it is expected that there would be no appreciable change in water temperatures at the agricultural diversions under the No-Action Alternative compared to the existing condition. Additional information regarding the approach and results of this analysis is found in Appendix G-LU1 and the temperature-related subsections of the Water Quantity and Quality section (Section 5.4) and related appendix material.

Potential effects on agricultural production from changes in other water quality parameters or groundwater tables associated with the Proposed Action also were evaluated. However, groundwater quality and water table depth do not currently have an adverse influence on agricultural production in the project vicinity. Since changes in project operations are not expected under this or any of the primary alternatives at Thermalito Afterbay, related changes in water quality or water table elevations influencing agricultural resources also are not expected

Resource Extraction Activities

The No-Action Alternative would not directly affect resource extraction activities.

Wildfire Potential

The baseline effects summarized in Section 5.8.1, Affected Environment, would continue under the No-Action Alternative. With implementation of the No-Action Alternative, wildfires would continue to occur in and near the FERC project boundary unless new actions are taken by CDF, DPR, local fire safety councils, BLM, and other agencies. Based on the fire history of the area, it can be assumed that the risk of fires

would continue and that the risk may increase over time without some type of coordinated approach to fuel load management together with local actions aimed at potential fire ignition and suppression.

Effect on Future Land Uses

The No-Action Alternative would not directly affect future land uses.

Consistency with Federal, State, Regional, County, and Municipal Management Plans

The No-Action Alternative appears to be consistent with all federal, State, regional, county, and municipal management plans reviewed in SP-L2, *Land Management Study*.

5.8.2.2 Proposed Action

The Proposed Action contains some of the existing measures included in the No-Action Alternative, as well as a number of actions that may directly or indirectly affect lands within the study area. As with the No-Action Alternative, the majority of these measures would either cause no effects or would cause moderately beneficial effects since they would not result in adverse effects either because there would be no changes to land use/ownership, or there would be no resulting land use or management incompatibility.

Effects on Land Ownership, Management, and Use

Lake Oroville

A number of recreation measures included in the Proposed Action would result in no effect or moderately beneficial land use and management effects around the shoreline of Lake Oroville. These include improved interagency recreation management and a variety of recreation facility enhancements at Bidwell Marina, and Enterprise BR.

As reviewed under the No-Action Alternative, land use in and around Lake Oroville would also be affected by the development and adoption of Bald Eagle Management Plans.

Diversion Pool and Thermalito Forebay

Recreation enhancements, including construction of additional recreation facilities at the Diversion Pool and improved recreation facilities and access at Lakeland Boulevard, would result in neutral or moderately beneficial land use and management effects.

Thermalito Afterbay

Land use effects in the vicinity of Thermalito Afterbay could potentially result from construction of four additional brood ponds proposed under the Proposed Action. From a land use and management perspective, this change would be neutral or moderately beneficial. Recreation enhancements around Thermalito Afterbay such as new day use

facilities at the Thermalito Afterbay Outlet would result in neutral or moderately beneficial land use and management effects.

Low Flow Channel

No effects on land ownership, management, and use within the vicinity of the Low Flow Channel are anticipated under the Proposed Action.

Effects on Land Management and Related Entities

Federal

No changes are included under the Proposed Action that would directly affect BLM, USFS, the BIA, or other federal interests.

State of California

State land management agencies (including DPR, DFG, and others) would benefit by clarification of management responsibility proposed under the Proposed Action. Recreation planning and management coordination proposed among DWR, DPR, and DFG would address existing resource management conflicts discussed under the Affected Environment and No-Action Alternative sections, resulting in beneficial effects on land management.

Local Entities

Local land management entities would not be directly affected by the Proposed Action.

Private

Proposed improvements to recreational facilities could cause increased activity, resulting in indirect effects on surrounding areas such increased noise, and traffic, as discussed under the No-Action Alternative.

Other

No effects are anticipated to affect other land management agencies under the Proposed Action.

The Proposed Action includes establishment of a curation facility, possibly affecting existing or future land use and public access.

Compatibility with Land Use Classifications and Patterns

Reservoir/Open Water

None of the existing or proposed PM&E measures comprising the Proposed Action would affect compatibility with the Reservoir/Open Water land use classifications and patterns in the study area.

Recreation Lands

The Proposed Action would generally have moderately beneficial effects on recreational lands within the study area. One potential land use conflict associated with all three of the alternatives (and discussed under the No-Action Alternative analysis) is the proposed development and adoption of Bald Eagle Management Plans.

Conservation Lands

As discussed above, the Proposed Action would have neutral or moderately beneficial effects on conservation lands owned and managed by federal and State agencies within the study area.

Undeveloped Lands

As discussed above the Proposed Action would not directly affect undeveloped land, as no undeveloped land is proposed for development under this alternative.

Urban-Developed Lands

The Proposed Action would benefit urban developed land through improved recreation facilities and access at Lakeland Boulevard. Urban lands would indirectly benefit as well from expansion of Bidwell Marina parking and other facility improvements which are used by nearby urban populations.

Rural/Agricultural Lands

Prime and Other Farmland – The Proposed Action would not cause any losses or conversions of Prime or other farmlands for the same reasons described in Section 5.8.2.1 for the No-Action Alternative.

Agricultural Cultural Practices – An Invasive Species Management Plan to reduce noxious non-native plant species included in the Proposed Action is expected to reduce the rate and type of weed contribution from Thermalito Afterbay into the agricultural diversion system. Terrestrial and noxious weed management programs, as well as exotic and invasive weed management programs, should act to decrease the occurrence of weeds and weed seeds in Thermalito Afterbay. The quantity of weeds and weed seeds in related agricultural diversion facilities also should be reduced.

Agricultural Production – Under the Proposed Action, operations in Thermalito Afterbay would not differ from the operational procedures associated with the No-Action Alternative. Therefore, the Thermalito Afterbay water temperature regime, flows, and effective reside time of water are not expected to change with implementation of the Proposed Action. In addition, resulting water temperatures at the agricultural diversion points are not expected to change, and agricultural production would therefore not be affected. (The approach of the analysis and its results are described further in Section 5.8.2.1 and Appendix G-LU1.)

Potential effects on agricultural production from changes in other water quality parameters or groundwater tables associated with the Proposed Action also were evaluated. However, groundwater quality and water table depth do not currently have an adverse influence on agricultural production in the project vicinity. Since changes in project operations are not expected under this or any of the primary alternatives at Thermalito Afterbay, related changes in water quality or water table elevations influencing agricultural resources also are not expected.

Resource Extraction Activities

The Proposed Action would not directly affect resource extraction activities.

Effect on Future Land Uses

Wildfire Potential

The potential for wildfires at the Oroville Facilities would not differ from the No-Action Alternative. However, improved coordination among State land management agencies should benefit wildfire suppression activities.

Consistency with Federal, State, Regional, County, and Municipal Management Plans

The Proposed Action appears to be consistent with all federal, State, regional, county, and municipal management plans reviewed in SP-L2, *Land Management Study*.

5.8.2.3 Alternative 2

Alternative 2 contains existing measures included in the No-Action Alternative as well as a number of actions included under the Proposed Action that may directly or indirectly affect lands within the study area. In addition, Alternative 2 includes several additional PM&E measures that could affect land use and management both directly or indirectly. As with the other alternatives, the majority of these measures would either cause no adverse effects or would cause moderately beneficial effects. Most of these measures would either not change land use and/or ownership, or there would be no resulting land use or management incompatibility.

Effects on Land Ownership, Management, and Use

Lake Oroville

Effects on Lake Oroville under Alternative 2 would generally be the same as those under the Proposed Action, as the same PM&E measures relevant to land use reviewed under the previous alternative would also be included in Alternative 2. In addition, there are three additional actions proposed under Alternative 2 relevant to land use. The first would be the addition of a camp store shell at Bidwell Canyon. This store would serve campground users and would not likely generate adverse land use effects on surrounding land uses including the nearby residential community. The second would

be a new day use area and associated trails and other facilities at Parish Cove near Lime Saddle, also resulting in no adverse land use effects. The last would be a potential future whitewater boater take-out in the upper North Fork. Although unlikely given the remoteness of the area, a new whitewater boater take-out could result in adverse land use effects if sited adjacent to a highly sensitive land use such as protected bald eagle nest and forage sites.

Diversion Pool and Thermalito Forebay

Effects on the Diversion Pool and Thermalito Forebay under Alternative 2 would generally be the same as those under the Proposed Action, as the same PM&E measures reviewed under the previous alternative would also be included in Alternative 2. Alternative 2 would also involve creation of competition-style public whitewater boating facilities (including viewing grandstands) and a flexible event center, both located near the Diversion Pool. Depending on the size of these grandstands and the frequency and popularity of competition, both of these actions could result in infrequent adverse effects such as noise, parking, litter, etc., to surrounding land uses.

Thermalito Afterbay

Land use effects in the vicinity of Thermalito Afterbay under this alternative would generally be the same as under the Proposed Action.

Low Flow Channel and OWA

No land use effects within the vicinity of the Low Flow Channel are anticipated under Alternative 2.

Effects on Land Management and Related Entities

Federal

Alternative 2 calls for the transfer of BLM lands currently contained within the FERC project boundary to the licensee. This action would consolidate jurisdictional and enforcement responsibilities within the FERC project boundary (benefiting BLM by reducing management responsibility for lands within the FERC project boundary).

State of California

DWR would assume title for existing BLM lands within the FERC project boundary.

Local Entities

Alternative 2 includes the development, in coordination with other responsible entities, of a Fuel Load Management Plan and cost-sharing strategy to reduce fuels along the urban/wildland interface. This would benefit local entities, including municipal governments and fire districts, by proactively managing fire hazards and providing financial assistance.

Private

Proposed improvements to recreational facilities discussed above could result in increased activity, resulting in indirect effects on surrounding areas such increased noise and traffic, as discussed under the Proposed Action.

Other

No additional effects on other land management agencies are expected under Alternative 2. Alternative 2 includes establishment of a curation facility, as discussed under the Proposed Action.

Compatibility with Land Use Classifications and Patterns

Reservoir/Open Water

None of the existing or proposed PM&E measures comprising Alternative 2 would affect compatibility with the Reservoir/Open Water land use classifications and patterns in the study area.

Recreation Lands

Alternative 2 would generally have moderately beneficial effects on recreational lands within the study area. One potential land use conflict associated with all three of the alternatives (and discussed under the No-Action Alternative analysis) is the proposed development and adoption of Bald Eagle Management Plans.

Conservation Lands

As discussed above, Alternative 2 would have neutral or moderately beneficial effects on conservation lands owned and managed by federal and State agencies within the study area.

Undeveloped Lands

Alternative 2 would have a beneficial effect on undeveloped lands through the development and implementation of a Fuel Load Management Plan. Other than that plan, Alternative 2 would not directly affect undeveloped land, as no undeveloped land is proposed for development under this alternative.

Urban-Developed Lands

Alternative 2 would indirectly beneficially affect urban developed land through improved recreation facilities and access at Lakeland Boulevard, the Bidwell Marina, and other sites (as discussed under the Proposed Action). There may also be some indirect adverse effects on urban developed lands from crowds using grandstands, as discussed above in reference to proposed developments near the Diversion Pool.

Rural/Agricultural Lands

Prime and Other Farmland – For the same reasons described in Section 5.8.2.1 for the No-Action Alternative, implementation of Alternative 2 is not expected to cause any loss or conversion of Prime or other farmland.

Agricultural Cultural Practices – With respect to potential effects on agricultural cultural practices, actions associated with implementation of Alternative 2 are identical to those actions included under the Proposed Action (see Section 5.8.2.2).

Agricultural Production – Alternative 2 includes reduced releases from Thermalito Afterbay Outlet due to the increase in minimum Low Flow Channel flows (from 600 cfs to 800 cfs), and the increase in Low Flow Channel flows of up to 1,200 cfs from May 1 through June 15. The new water temperature targets included in Alternative 2 also would alter the water temperature of project releases. Neither of these operational changes associated with Alternative 2 would affect afterbay operations. Less diversion of water through the Thermalito Pumping-Generating Plant could cause slight warming of water under certain meteorological conditions by increasing the residence time of water in Thermalito Afterbay. (See Appendix G-LU1 for additional information.)

Resource Extraction Activities

Alternative 2 would not directly affect resource extraction activities.

Wildfire Potential

Alternative 2 includes the development of a Fuel Load Management Plan to reduce fuels along the vicinity of the wildland/urban interface and to improve future related interagency planning, management and coordination. The plan would incorporate a cost sharing structure among the affected local, State, and federal agencies. It is expected that the completion and implementation of a plan would result in improved fuel load management on project lands and lead to an associated reduction in the risk of wildfires in the future.

Effect on Future Land Uses

Alternative 2 would not directly affect future land uses.

Consistency with Federal, State, Regional, County, and Municipal Management Plans

Alternative 2 appears to be consistent with all federal, regional, county, and municipal management plans, as reviewed in SP-L2, *Land Management Study*.

5.8.3 Unavoidable Adverse Effects

5.8.3.1 No-Action Alternative

The baseline project effects comprising the No-Action Alternative would not result in unavoidable adverse effects on land use, management, and planning.

5.8.3.2 Proposed Action

No unavoidable adverse effects on land use, management, and planning are anticipated to result from the Proposed Action.

5.8.3.3 Alternative 2

No unavoidable adverse effects on land use, management, and planning would likely result from Alternative 2.

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5.9 CULTURAL RESOURCES

This section provides an overview of the prehistoric, historical, and ethnographic resources of the project area, and describes the potential environmental effects on these resources that would result from the No-Action Alternative, the Proposed Action, and Alternative 2. Section 106 of the National Historic Preservation Act (NHPA) and FERC regulations require that these resources be inventoried and evaluated for their eligibility for inclusion in the National Register of Historic Places (NRHP), that project-related effects be determined, and that consultation concerning these effects and the management of NRHP-eligible resources (historic properties) be conducted with appropriate parties (e.g., federal land management agencies, federally recognized Indian tribes, and the State Historic Preservation Officer [SHPO]).

The analysis of effects presented in this section is generally qualitative, rather than quantitative. This approach is necessary because not all potential effects on historic properties can be meaningfully addressed in a site-specific manner at this time due to the large number of resources identified during the course of the studies. Actions that have the potential to alter the values of historic properties that might make these resources eligible for inclusion in the NRHP are characterized as “affecting” or having an “effect on” the resources. Judgments as to the severity of those effects, and whether they would be “adverse effects” as used in the regulations implementing Section 106 of the NHPA (36 Code of Federal Regulations [CFR] 800) are not made. Actions that would preserve, protect, stabilize, or enhance those aspects of cultural resources that might make them eligible for inclusion in the NRHP are said to have a “beneficial effect.”

5.9.1 Affected Environment

Cultural resources are those sites, objects, buildings, structures, and traditional areas associated with the prehistoric and historic past. Information on the cultural resources of the project area is based on the results of three technical studies: a historical and archaeological inventory; an ethnographic and ethnohistoric inventory; and an inventory and evaluation of the buildings and other structural elements of the Oroville Facilities. A detailed description of the prehistoric and historical cultural resources of the project area is provided in the *Draft Final Archaeological and Historical Resources Inventory Report* (DWR 2004a). The *Ethnographic and Ethnohistoric Inventory of Konkow Maidu Cultural Places* (DWR 2004b) provides a thorough description of the ethnographic and ethnohistoric cultural context and documented resources. The *Historic Properties Inventory and Evaluation: Oroville Facilities, Butte County, California* (DWR 2004c) provides a description and evaluation of each of the buildings and major structural features (e.g., Oroville Dam) associated with the construction and operation of the Oroville Facilities. The discussion below summarizes those reports. Because these documents contain sensitive information on the location and nature of cultural resources, they are considered confidential and are exempt from Freedom of Information Act regulations.

A more complete discussion of these topics is provided in Appendix G-CUL.

Major management issues identified during the scoping process include:

- Effects of project operations, maintenance, and recreation on cultural resources including archaeological sites, historic resources, and traditional use areas;
- Evaluation of the need and methods to protect cultural resources; and
- Providing for the interpretation of cultural resources and accessibility of cultural resources data.

5.9.1.1 Regional Setting

Prehistoric Setting

The Feather River region has been occupied by Native American peoples for at least 3,000 years, and continued up to and beyond the arrival of Euroamerican immigrants in the mid 1800s. The Feather River provided fresh water, abundant fish and other riverine resources, and a transportation corridor. The adjacent woodlands provided oaks, numerous other plants, and game such as deer. These resources, supplemented by trade with neighboring tribal groups, provided the Konkow-Maidu with the resources they needed for food, shelter, clothing, and the pursuit of a variety of ceremonial and sacred practices.

Archaeologists working in Northern California have been researching a number of major trends, themes, and issues characterizing the prehistory of the Feather River–Lake Oroville area. Prehistoric archaeology in this region has focused on defining archaeological contexts, examining past lifeways, and studying cultural processes. Important research topics include the paleoenvironment (e.g., conditions of the vegetative communities 3,000 years ago), site-formation processes, and cultural chronology. Issues related to determining past lifeways—including technology, subsistence-settlement, social organization, demography, and ideology/religion—have also been explored. Questions concerning cultural processes have dealt mainly with the nature of hunter-gatherer adaptations.

Prehistoric peoples of the Feather River region resided in an area containing a suite of habitats embedded within grassland, scrubland, deciduous woodland, and coniferous forest biomes. Over time, the people developed subsistence adaptations increasingly focused upon the gathering and use of fish (e.g., native slow-water species and anadromous salmonids), large mammals (e.g., elk, deer, pronghorn), and acorns. These were supplemented by a host of other plants and animals. Various technological innovations were intimately tied to subsistence, including changes in weaponry (e.g., the introduction of the bow and arrow, fishing facilities), milling equipment (e.g., the shift from use of manos and metates to mortars and pestles), and textile arts (e.g., the development of basketry). Procuring additional resources was a primary goal of elaborately developed trade networks, which frequently transported goods over long distances (e.g., obsidian and marine-shell ornaments). Trade was one aspect of the increasing elaboration of social organization through time, and development of regional

religions such as the Kuksu cult. Forces affecting cultural change through time have been proposed to include localized population growth, in-migration of foreign peoples, and environmental change.

The basic outline of prehistoric cultural chronology in the project area and environs was first developed by Olsen and Riddell (1963) and later expanded and elaborated by Ritter (1968, 1970) and Kowta (1988). The earliest securely dated archaeological complex in the Lake Oroville area is known as the Mesilla Complex, which has been dated between ca. 3,000 and 2,000 years Before Present (BP). This was followed by the Bidwell Complex (ca. 2,000–1,200 BP), the Sweetwater Complex (ca. 1,200–500 BP), and the Oroville Complex (ca. 500–150 BP). The Oroville Complex represents protohistoric Konkow-Maidu. The Kuksu religion was probably present in some form during this late period. Political organization was very similar to the pattern described in the ethnographic literature, consisting of autonomous tribelets. Population density is believed to have reached its highest levels at the time of Euroamerican contact.

Ethnographic Setting

Residents of the project area spoke closely related dialects of the Konkow language, which extended throughout the Northwest Maidu or Konkow territory. Konkow is a sister language to Maidu (Northeastern or Mountain Maidu) and to Nisenan (Southern Maidu). Together, these three languages make up the Maiduan language family, classified as a member of the Penutian language stock (Shipley 1978).

The Konkow were organized in village communities in which a larger, major village provided the central ceremonial and political focus for several nearby affiliated villages. These communities incorporated three to five smaller villages, with a total population estimated at 200 people. Chiefs of these communities were known for their leadership ability, wealth, and generosity (Dixon 1905; Kroeber 1925). Several such village communities have been identified in the general Oroville region, with some locations occurring within the project area (Rathbun n.d.).

Subsistence was based on a mixture of gathering, fishing, and hunting that occurred on a seasonal basis during the course of the year. Salmon, deer, acorns, and pine nuts were among the most important food items. Trade with neighboring tribes was used to supplement the locally available resource base, and to foster intertribal relationships. Elaborate ceremonies, including the Kuksu cult, were practiced during the fall, winter, and spring. Traditional competitive games provided an important opportunity for social interactions with teams from neighboring communities.

The influx of Spanish explorers, trappers, early settlers, and cattle ranchers in the early 1800s introduced diseases and disrupted both the environment and certain traditional Native American practices. With the onset of the Gold Rush in 1848, the Feather River was the site of intensive settlement and mining activities that severely affected the fishery and displaced Native American inhabitants. Some Native Americans began working for miners, ranchers, or settlers; many, however, were sent to the Nome Lackee reservation in Tehama County, only to return shortly thereafter because of poor

conditions (Jewell 1987). A second relocation of local Native Americans was undertaken in fall 1863, when almost 500 Indians were forced to march 100 miles across the Sacramento Valley to the Round Valley reservation (Hill 1978). This was a devastating march for the Maidu during which there were heavy losses, particularly among the very young and older population. Ultimately, the Maidu experienced a loss of 80 to 90 percent of their population and virtually all of their lands as a result of Euroamerican colonization. Today, local traditions and festivals such as the Feather River First Salmon Ceremony are indications of the rejuvenation of traditional values, practices, and community involvement, including classes to renew the Konkow language and to teach basketry arts.

Historic Setting

On the far northeastern frontier of Spanish California, the Feather River area was first explored by the Spanish in the early 19th century and later exploited by fur trappers in the 1820s and 1830s. The latter incursion led to the introduction of diseases that severely disrupted the indigenous Native American society. The Mexican rancho period in northeastern California began in the 1840s, but it was soon interrupted, first by the American takeover of California and then by the Gold Rush.

Three months after gold was discovered at Sutter's Mill near the town of Coloma, John Bidwell found gold on the Feather River at what became known as Bidwell's Bar. The Feather River was a major gold-producing area, with all the social, economic, and environmental consequences found elsewhere in the mining West. By 1850, there were more than 3,000 miners in Butte County, with most of these men pursuing the relatively easily worked surface placer deposits. The miners quickly outnumbered the small Mexican and much larger indigenous population inhabiting the area and began to reshape the landscape. As mining operations became more complex and costly, mining corporations began to dominate the local industry, with the construction of reservoirs, dams, and extensive ditches. Later hydraulic mining and dredging became the preferred means of extracting gold ore. This latter process continued well into the 20th century and is reflected in approximately 8,000 acres of dredger tailings in the OWA.

Following the influx of miners to the region, the foothills and valleys along the Feather River and between the Feather and Sacramento rivers soon became a center for ranching and agriculture—first cattle, then wheat, and later fruit, rice, and other crops. Timber harvesting was conducted first locally to support the mining industry, then on a more regional scale to provide lumber for residential and commercial use. The rise of agriculture to a preeminent position in the local economy was tied to the establishment of irrigation, including the adaptation of water-delivery systems from mining to agriculture, and the establishment of more robust and reliable transportation systems. In the 20th century, the area became an important source of hydroelectric power and a vital source of water for California.

5.9.1.2 Archaeological Resources

Archaeological resources consist of the material remains (artifacts, features, and alterations to the land) left behind by people who once used the area recently or in the distant past. Archaeological sites may be related to one or both of these timeframes.

Area of Potential Effects

The Area of Potential Effects (APE) is the geographic area within which an undertaking may directly or indirectly cause alterations in the character or use of NRHP-eligible sites (36 CFR 800.16[d]). For archaeological resources, the limit of the APE for the Oroville Facilities was defined as being the existing FERC project boundary, which encompasses approximately 41,000 acres.

Inventory/Evaluation Methods

An archaeological inventory of about one-half of the 31,000 accessible (i.e., non-inundated) acres within the APE was completed. This inventory began with the review of historic maps, previously completed archaeological surveys and site records, literature on the history and natural environment of the project area, and other resources such as census records, homestead proofs, and mining claims. Oral interviews were conducted to gather more specific information on certain historic-era resources.

This extensive background research was followed by re-visits to previously recorded sites to update site information. An intensive archaeological survey of the accessible portion of the fluctuation zone around Lake Oroville (between approximately 690 and 900 feet above mean sea level) was conducted to examine the area subject to regular inundation and exposure from fluctuations in reservoir levels. In the portion of the APE that is above the maximum pool, areas around developed recreation facilities and those deemed likely to contain historic resources were examined. Additionally, a random sample of approximately 25 percent of the land was inventoried to gather information that could be extrapolated to unsurveyed portions of the APE. The archaeological inventory, which was conducted with the participation of trainees representing each of three local tribes from the Mooretown, Berry Creek, and Enterprise rancherias, involved approximately 15,500 acres of land. The survey resulted in the recording of 803 archaeological and historic resources.

Areas that were too steep to safely survey were examined, but were not subject to an intensive pedestrian survey. Dense vegetation and occasionally thick forest duff made it difficult to see the ground surface within the area above the maximum reservoir elevation, and additional sites are almost certainly present in these areas. Furthermore, historic-era disturbances, such as mining along streamcourses and the intensive gold dredging within the present-day OWA, have so heavily modified the ground surface that prehistoric sites have been either obliterated or obscured. For example, only one prehistoric bedrock mortar site was encountered within the 2,100 acres surveyed within

the OWA, while the density of prehistoric sites in the remainder of the surveyed area is approximately one site for every 40 acres examined.

Appendix G-CUL provides additional information on the inventory methodology. Full details of this inventory are described in the *Draft Final Archaeological and Historical Resources Inventory Report* (DWR 2004a).

Formal evaluations of the prehistoric archaeological resources against the criteria for eligibility in the NRHP, as defined at 36 CFR 60.4, have not been initiated pending further discussion with some of the consulting parties. Consequently, all of the documented prehistoric sites are unevaluated, and are considered potentially eligible for inclusion in the NRHP for purposes of the analysis of effects.

A program of formal evaluations for a representative sample of about 50 of the historic-era archaeological resources has been initiated, but results of this investigation are pending. Consequently, all of the documented historic-era sites are considered potentially eligible to the NRHP for purposes of the analysis of effects.

Prehistoric Archaeological Sites

At the end of the 2003 archaeological field season, 325 archaeological sites containing materials from the prehistoric past—91 of which co-occur with historic-era resources—were known to occur within the APE. This total includes 93 sites that were previously recorded in areas that were inundated and could not be revisited. These prehistoric resources primarily include small bedrock milling sites used for processing plants, limited lithic scatters serving short-term or specialized purposes, and extensive open-air residential sites that may have been used as village locations for extended periods of time. Sites assigned to the latter category often contain several different types of tools and other artifacts, as well as evidence of semi-subterranean house features and/or midden deposits.

Other prehistoric site types known to occur in the Feather River region, such as quarries and lithic workshops, rock art, sites within caves and rock shelters, and cemetery areas were found infrequently during the 2002-2003 inventory effort. Based on the information obtained from the fluctuation zone, where visibility during drawdown allowed for a more complete and thorough archaeological inventory, Table 5.9-1 summarizes the approximate percentage of each of the main site categories. Additional information on these site categories is provided in Appendix G-CUL. Detailed information, including archaeological site records, is presented in the *Draft Final Archaeological and Historical Resources Inventory Report* (DWR 2004a).

Table 5.9-1. Prehistoric archaeological site categories within the fluctuation zone.

Site Category	Percentage of Total Prehistoric Sites
Bedrock Milling	36 percent
Open-air Residential	33 percent
Limited Lithic Scatters	30 percent
Caves and Rock Shelter	Less than 1 percent
Rock Art	Less than 1 percent
Quarries and Workshops	Less than 1 percent
Cemetery Areas	Less than 1 percent

Source: DWR 2004a

The percentages listed above may not accurately reflect the frequency of these site types within the broader APE. Because of the excellent visibility within the fluctuation zone, where vegetative cover was virtually nonexistent, most of the prehistoric-era resources were found within this area, which is generally closer to the major watercourses. Consequently, the open-air residential sites documented at this time are likely over-represented, while smaller lithic scatters, which are perhaps more common in the upland areas of the APE, are probably under-represented. More intensive archaeological investigations would be needed to clarify and refine the nature and relevance of site categories, and gather more specific data on the number, nature, age, and distribution of these diverse site types.

Historic-Era Archaeological Sites

The archaeological inventory resulted in the recording of 553 historic-era archaeological sites within the APE. An additional 19 sites with historic-era components had previously been recorded within areas that were inundated and inaccessible during the recent inventory efforts. Ninety-three of the 572 resources containing evidence of use during the historic period are found in conjunction with prehistoric-era components. As described in the *Draft Final Archaeological and Historical Resources Inventory Report* (DWR 2004a) and summarized in Appendix G-CUL, the historic-era archaeological sites represent a variety of developmental themes. These themes include transportation, settlement, mining, water conveyance systems, industry and commerce (e.g., logging), and agricultural development. Some archaeological resources are representative of more than one of these major themes, such as a ditch that was constructed for mining purposes and later used for agricultural pursuits. Based on information obtained from the 553 resources documented, Table 5.9-2 indicates the approximate percentages of the dominant historical themes represented in the APE.

5.9.1.3 Ethnographic Resources

Ethnographic and ethnohistoric resources are locations that have special cultural significance or sensitivity for Native Americans or other ethnic groups. These resources may be related to sacred and/or traditional uses of both site-specific locations, such as

Table 5.9-2. Historic-era archaeological sites within the Area of Potential Effects.

Primary Historic Theme	Percentage of Total Historic-era Sites
Transportation	32 percent
Settlement	28 percent
Mining	22 percent
Water Systems	13 percent
Industry and Commerce	2 percent
Agricultural Development	1 percent
Other	2 percent
Total	100 percent

Source: DWR 2004a

an ethnographic village, and general areas such as a mountain that is a central element of Maidu myths or legends.

Area of Potential Effects

Information on ethnographic resources was solicited for a broader area than the FERC project boundary. This was done for three main reasons. First, much of the needed data came from oral interviews that solicited information unconstrained by modern political boundaries. Secondly, resources of traditional concern to ethnographic populations may be indirectly affected, such as by visual intrusions, meaning that the APE for these types of resources needs to consider these potential effects. Finally, these resources may consist of large areas (e.g., a sacred mountain), rather than site-specific locations necessitating an expansion of the APE.

For this project, the APE for ethnographic resources was expanded beyond the FERC project boundary to include Stringtown Mountain, and up Bald Rock Canyon to the base of Bald Rock Dome (see Appendix G-CUL for additional details and a map of the expanded APE for ethnographic resources).

Inventory/Evaluation Methods

The investigation into ethnographic and ethnohistoric resources for this project was conducted in consultation and collaboration with the Maidu Advisory Council and members of local Konkow tribal groups. The inventory was based on two main informational sources: published and unpublished archival materials, and interviews with knowledgeable local Native Americans. Oral interviews began in fall 2002, and continued into fall 2004. These interviews were held with numerous local tribal elders who were born and raised in the project area, including members from the Berry Creek, Enterprise, and Mooretown rancherias, as well as the Konkow Valley Band of Maidu. Many of the elders participated in multiple interviews, and field visits were used regularly in combination with oral interviews to assist in the data-gathering process. A total of 88 oral interviews have been conducted and documented (DWR 2004b).

The library and archival phase of work involved the review of extensive materials at local and regional repositories, including the Butte County Public Library; the Meriam Library at California State University, Chico; and the California State Archives. This literature was supplemented by the review of historic maps and federal census records, which provided critical information to help develop and understand the history of the Native American community in this area.

Appendix G-CUL provides additional information on the methodology used to conduct the ethnographic and ethnohistoric inventory. Full details of this investigation are described in the *Ethnographic and Ethnohistoric Inventory of Konkow Maidu Cultural Places* (DWR 2004b).

Formal evaluations of the ethnographic and ethnohistoric resources against the criteria for eligibility in the NRHP, as defined at 36 CFR 60.4, are in preparation.

Documented Ethnographic and Ethnohistoric Resources (Including Traditional Cultural Properties)

The ethnographic and ethnohistoric inventory led to the identification of 144 locations in or close to the APE. These locations of ethnographic and/or ethnohistoric importance have been organized into 14 site categories, based on the uses that were most commonly undertaken at these locations. The most common of these site categories, villages and fishing grounds, are reflective of the intensive settlement of the various forks of the Feather River in the project area, as well as the value of the fisheries that occurred in this area. Additional information on these site categories, including information on the geographical distribution of the various ethnographic and ethnohistoric resource locations, is provided in Appendix G-CUL. More complete information is provided in the confidential report titled *Ethnographic and Ethnohistoric Inventory of Konkow Maidu Cultural Places* (DWR 2004b).

While many locations served multiple purposes for the local Native American community, each of the 144 documented sites has been placed into one of the 14 categories, as shown in Table 5.9-3.

5.9.1.4 Historical Structures

Historical structures associated with the Oroville Facilities that may be eligible for listing in the NRHP include the dams, power plants, reservoirs, and canals associated with the hydroelectric facilities, along with the Lake Oroville Visitors Center, the Feather River Fish Hatchery, and the DWR Oroville Field Division facility on Glen Drive. While all of these structures are less than 50 years in age, the regulations implementing Section 106 of the NHPA (36 CFR 800) require the consideration of more recent properties that may have “exceptional” importance to the nation’s history (36 CFR 60.4[g]).

Table 5.9-3. Ethnographic and ethnohistoric site categories within the Area of Potential Effects.

Site Category	Number of Locations
Village	30
Cemetery	3
Camp	3
Fishing Ground	29
Spawning Ground	13
Hunting Ground	2
Gathering Area	7
Swimming Hole/Picnic Area	7
Ceremonial Site	2
Mythological Site	12
Petroglyph	2
Historic Event/Battle Site	2
Trail	11
Place Name	21
Total	144

Source: DWR 2004b

Area of Potential Effects

The APE established for the evaluation of historical structures was equivalent to the FERC project boundary, except that the APE was expanded to include the DWR Oroville Field Division facility.

Inventory/Evaluation Methods

The inventory and evaluation of the buildings, structures, and objects associated with the Oroville Facilities began with a field reconnaissance, followed by extensive research into DWR records, photographs, and historic maps to help ascertain specific dates of construction for each feature. Published literature and unpublished archival information was used to help develop the historical context for these resources. Each of the involved historical structures was then inspected in the field, photographed, and documented on standard DPR forms.

These resources were also evaluated against the criteria for inclusion in the NRHP (36 CFR 60.4), both as individual resources and as part of a historic district. Additional information on the inventory and evaluation of historical structures is provided in Appendix G-CUL. The technical report entitled *Historic Properties Inventory and Evaluation: Oroville Facilities, Butte County, California* (DWR 2004c) contains detailed information on this investigation, including substantial background information on the development of the Oroville Facilities.

Elements of the built environment not directly associated with the hydroelectric facilities, such as campgrounds, marinas, roads, and trails, were not included in this investigation because these features were built following construction of the hydroelectric system, and are not considered to possess “exceptional” significance as defined at 36 CFR 60.4(g).

Documented Historical Structures

As indicated in Table 5.9-4, a total of 16 historical structures associated with the Oroville Facilities were documented and evaluated against the NRHP criteria (36 CFR 60.4). Two of these resources, Oroville Dam and the Hyatt Pumping-Generating Plant, appear to be eligible for inclusion in the NRHP as individual properties under the "exceptional importance" criterion (36 CFR 60.4[g]). These two structures, along with 12 additional facilities, are all considered contributing elements to the proposed Oroville Division Historic District under NRHP criteria A and C at the State level of significance because of the historical significance of the Oroville Facilities and the importance of many of these facilities within the field of engineering and design.

As defined in the guidelines published by the National Park Service (DOI 1991), a district "possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development." As a significant component of the SWP, the proposed Oroville Field Division Historic District, with contributing elements listed in Table 5.9-4, appears to meet this definition, and is recommended as eligible to the NRHP under criteria A, C, and G (DWR 2004c).

Two resources, the Thermalito Fish Hatchery Annex and the Thermalito Diversion Dam Power Plant, were built in the 1980s and are not considered eligible either as individual resources or as elements of the proposed historic district.

Table 5.9-4. Historical structures within the Area of Potential Effects.

Resource	Date Built	Individually Eligible	Contributing Element to the Historic District
Lake Oroville Visitors Center	1972-1974	No	Yes
Oroville Dam	1961-1968	Yes	Yes
Oroville Peripheral Dams: Parish Creek and Bidwell Bar Canyon	1966-1968	No	Yes
Hyatt Pumping-Generating Plant and Intake Structure	1963-1969	Yes	Yes
Oroville Area Control Center and Switchyard		No	Yes
DWR Field Division Facility	1968-1969	No	Yes
Fish Barrier Dam	1962-1964	No	Yes
Visitor Viewing Platform	1966-1968	No	Yes
Feather River Fish Hatchery	1966-1967	No	Yes
Thermalito Fish Hatchery Annex	1989	No	No
Thermalito Diversion Dam	1962-1968	No	Yes
Thermalito Diversion Dam Power Plant	1984-1989	No	No
Thermalito Power Canal	1965-1967	No	Yes
Thermalito Power Plant	1964-1969	No	Yes
Thermalito Forebay	1965-1968	No	Yes
Thermalito Afterbay	1965-1968	No	Yes

Source: DWR 2004c

5.9.1.5 Baseline Project Conditions

As documented during the cultural resources inventories described above, the condition of the archaeological and historical resources, ethnographic and ethnohistoric resources, and historical structures within the APE has been affected to varying degrees. These baseline effects include reservoir level fluctuations, operations and maintenance activities, and public use.

Reservoir Level Fluctuations

Archaeological sites and ethnographic resources located within the fluctuation zone of Lake Oroville (i.e., at elevations between 640 and 900 feet) are periodically subjected to inundation, exposure to the air, and the effects of water movement, including waves from wind or boats. The movement of water as the reservoir level fluctuates can cause sheet erosion, shoreline erosion, siltation, and the decomposition of organic remains contained within some archaeological sites as a result of alternating periods of inundation and exposure. These fluctuations and effects on cultural resources within this zone have continued since the reservoir was filled.

The magnitude of this baseline effect is determined by a combination of variables. The location of the resource within the fluctuation zone determines how frequently the site is inundated, exposed, or subject to both inundation and exposure on an annual basis. Resources at higher elevations are inundated only when the reservoir is near capacity. Those at lower elevations are exposed only when the reservoir is drawn down below normal levels, while those at middle elevations are often inundated and exposed during the same year. Another variable affecting the magnitude of this effect is the nature of the resource. Sites such as isolated bedrock mortars remain reasonably intact in spite of regular inundation, while prehistoric sites with midden deposits containing organic material are highly susceptible to the effects of inundation, exposure, and wave action.

Depending on soil conditions, the degree of slope, and the location of a resource relative to wave action and river currents, cultural resources may be experiencing substantial erosion, mild erosion, or siltation. At lower elevations, some archaeological sites have probably been buried under silt accumulating in the reservoir. The archaeological and historical inventories documented the presence or absence of these baseline project effects, but detailed analysis of the magnitude of this effect on NRHP-eligible sites has not been conducted.

The fluctuation of Lake Oroville also continues to affect the ability of the Native American community to pursue traditional practices such as plant gathering, fishing, and other river-based activities.

Operations and Maintenance Activities

Some elements of the routine operation and maintenance of the Oroville Facilities, the recreational facilities in the LOSRA, and the wildlife management activities within the OWA and elsewhere continue to effect cultural resources. These effects include the removal of rock from the historic dredge mining site in the OWA, the collection and

removal of woody debris from the McCabe Creek area, the installation of certain wildlife enhancement structures within archaeological sites, and the maintenance of recreational facilities that overlap with archaeological sites. The presence of baseline effects on archaeological resources from these maintenance and operational procedures was documented in the archaeological and historical resources inventory (DWR 2004a).

Public Use

Public use of the facilities and lands within the APE is causing effects on some cultural resources. These baseline effects from public use include the use of wheeled motorized vehicles off of developed road surfaces, the use of motorized boats, looting, and vandalism. Based on the results of the archaeological inventory (DWR 2004a), the use of off-highway vehicles has affected almost 20 percent of the documented resources, and continues to be a threat to sites at or near places that are reasonably easy to access by vehicle. The effect of wakes from motorized boats on cultural resources, while a consequence of public use, is analyzed under the reservoir level fluctuation topic (Section 5.9.2) because of the similar effects of wind-driven waves and waves generated by boats. Evidence of looting and vandalism was observed at approximately 20 percent of the recorded archaeological sites, and was concentrated in locations readily accessible to the public.

5.9.2 Environmental Effects

Summary of Potential Effects on Cultural Resources

Table 5.9-5 provides a summary of the potential effects on cultural resources for the No-Action Alternative, the Proposed Action, and Alternative 2. The ensuing subsections provide a more detailed analysis of these potential effects.

Table 5.9-5. Summary of potential effects on cultural resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Reservoir Level Fluctuations			
Archaeological Resources	Effects from erosion and cyclical inundation	Beneficial effects through HPMP and related cultural resources measures	Same as Proposed Action
Ethnographic and Ethnohistoric Resources	Effects from erosion, cyclical inundation, and continued loss of access	Beneficial effects through HPMP and related cultural resources measures	Same as Proposed Action
Historical Structures	Same as Existing Conditions	Same as No-Action Alternative	Same as No-Action Alternative

Table 5.9-5. Summary of potential effects on cultural resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Operations and Maintenance Activities			
Archaeological Resources	Degradation from woody debris removal, facility maintenance, and potential new effects from biological enhancements	Beneficial effects through HPMP and related cultural resources measures	Same as Proposed Action
Ethnographic and Ethnohistoric Resources	Same as archaeological resources; potential beneficial effects from biological enhancements	Same as above	Same as Proposed Action
Historical Structures	Potential degradation from maintenance, repairs, and replacement	Same as above	Same as Proposed Action
Public Use			
Archaeological Resources	Increased disturbance from off-road motorized vehicle use, looting, and vandalism	Potential adverse effects from increased use, however, beneficial effects through HPMP and related cultural resources measures	Same as Proposed Action
Ethnographic and Ethnohistoric Resources	Same as archaeological resources; plus potential loss of mythological, sacred, or ceremonial values	Same as above	Same as above
Historical Structures	Same as Existing Conditions	Same as No-Action Alternative	Same as No-Action Alternative
New Development Measures			
Archaeological Resources	Not applicable	Potential effects through new ground-disturbing activities; reduced effects from HPMP and related cultural resource measures; beneficial effects from Interpretation and Education Program	Additional potential effects from increased degree of development; reduced effects from HPMP and related cultural resources measures
Ethnographic and Ethnohistoric Resources	Not applicable	Same as archaeological resources; potential beneficial effects from biological enhancements	Same as Proposed Action
Historical Structures	Not applicable	No effects	Same as Proposed Action

Table 5.9-5. Summary of potential effects on cultural resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Cultural Resources PM&E Measures			
Archaeological Resources	Not applicable	Avoid or reduce other effects through HPMP and related measures; beneficial effects from signage program and redirected public use; enhance Site Stewardship Program.	Similar to Proposed Action, with the enhanced Site Stewardship Program fully funded.
Ethnographic and Ethnohistoric Resources	Not applicable	Same as archaeological resources; local curation facility of benefit to local Native American community	Same as above
Historical Structures	Not applicable	Reduced effects from operations and maintenance activities through HPMP	Same as Proposed Action

5.9.2.1 No-Action Alternative

The analysis of the environmental effects of the No-Action Alternative is based on the continuation of the baseline project effects described in Section 5.9.1.5, activities being implemented before the issuance of the new license as described in Section 3.1 (e.g., implementation of certain measures described in the draft terrestrial Biological Assessment [BA]), changes in reservoir levels as modeled for 2020, and effects that are based on the passage of time over the course of the new license (e.g., potential deterioration of historic structures if not maintained over the next 20–30 years).

Reservoir Level Fluctuations

As noted in Section 5.9.1.5, the routine fluctuation of Lake Oroville can cause sheet erosion, shoreline erosion from wind and waves, siltation, and the decomposition of organic remains as a result of alternating periods of inundation and exposure. The annual fluctuation range of the reservoir is affected primarily by climatic conditions. No substantive revisions to the operation of the Oroville Facilities are anticipated under the No-Action Alternative. However, as indicated in Section 5.4, water quantity under Future (2020) No-Action Conditions would be affected by water delivery requirements unrelated to the hydroelectric operations. Under modeled conditions, the projected water delivery requirements would affect the level of Lake Oroville to varying degrees relative to existing conditions. However, the anticipated changes would be minor (see Section 5.4.2.1); therefore, this analysis assumes that long-term reservoir fluctuations and the effects of wave action under the No-Action Alternative would be similar to the historical trends that have previously affected cultural resources.

Archaeological Resources

As documented in the *Draft Final Archaeological and Historical Resources Inventory Report* for the Oroville Facilities (DWR 2004a), approximately 325 archaeological resources are known to occur within the area between the maximum and minimum pool elevations (640–900 feet). Each of these sites is subject to potential effects from reservoir fluctuation, including wave action. However, not all of the resources located in this zone were found to be affected during the archaeological inventory. Approximately 25 percent of the sites in this area were found to be unaffected by ongoing disturbance (DWR 2004a). As noted in Section 5.9.1.5, waves are generated both by wind and by motorized boats. While the latter effect mechanism is technically related to public use, the effects of wind-driven versus boat-generated wave action on archaeological sites were not assessed separately during the archaeological inventory.

The total number of known archaeological sites within the fluctuation zone includes 232 sites containing prehistoric materials and 122 sites containing historic-era materials. Because 29 of these 354 sites represent use during both the prehistoric and historic past, a total of 325 distinct site locations are found within the fluctuation zone. It is anticipated that a number of undocumented archaeological sites occur within the area between 640 and 680 feet, which could not be inventoried (DWR 2004a).

Based on the inventory results, approximately 75 percent of the archaeological and historical resources documented in the fluctuation zone continue to be disturbed by the rising and falling of the reservoir water level and the affects of waves generated by wind and motorized boats (DWR 2004a).

Before inundation of the reservoir, an additional 94 archaeological sites were documented at elevations below 690 feet. These sites continue to be inundated, and a current assessment of site condition is not possible. While these sites are not normally subject to the effects of reservoir fluctuation, it is assumed that they would continue to be subject to erosion, siltation, and possibly the gradual loss of organic material under the No-Action Alternative.

Ethnographic Resources

Reservoir fluctuation would continue to disturb ethnographic and ethnohistoric resources located within the fluctuation zone (640–900 feet elevation). These include ethnographic resources that co-occur with documented archaeological sites, as well as certain fishing sites, spawning grounds, swimming holes, and other resource gathering areas that are regularly or occasionally inundated. As noted in Section 5.9.1.5, the inability to access traditionally used sites would continue under the No-Action Alternative.

Historical Structures

Because of the location (above maximum pool) or nature (dams, canals) of these resources, fluctuation of Lake Oroville under the No-Action Alternative is not expected to disturb the 14 NRHP-eligible historical structures described in Section 5.9.1.4.

Operations and Maintenance Activities

Operation and maintenance of the existing Oroville Facilities hydroelectric power system, the LOSRA, and the OWA have the potential to affect cultural resources. As described in Section 5.9.1.5, this includes baseline project effects such as the removal of woody debris from the McCabe Creek area, gravel mining in the OWA, certain wildlife enhancement activities, and the maintenance of recreational facilities that cross through archaeological sites. The effects on cultural resources from the continuation of these activities, as well as the implementation of the draft BA measures, are described below.

Archaeological Resources

Approximately 40 percent of the archaeological sites documented in the *Draft Final Archaeological and Historical Resources Inventory Report* for the Oroville Facilities (DWR 2004a) were found to have been affected by various development activities such as road construction, the installation of recreational facilities, and vegetative clearing. However, some of these effects were associated with the original construction of Lake Oroville and would not continue under the No-Action Alternative. In those situations where operational and management actions continue to affect archaeological sites, such as those near McCabe Creek, these disturbances would continue under the No-Action Alternative.

The improvement of warmwater fish habitat through plantings, construction of brush shelters, and channel modifications has the potential to disturb archaeological sites that might occur in these areas. The number and specific nature of these potential effects cannot be characterized until these programs are further defined and archaeological site evaluations are completed, as necessary.

Elements of the No-Action Alternative related to maintaining minimum flows, ramping, water supply, fish stocking, and temperature criteria would not be expected to affect archaeological resources.

Ethnographic Resources

The baseline and potential operational and maintenance activities of the No-Action Alternative that would affect ethnographic resources that co-occur with documented archaeological sites would be similar to those described above. These effects would result primarily from direct physical alteration of resources such as an ethnographic village that is also the location of a documented archaeological site.

Elements of the No-Action Alternative related to maintaining minimum flows, ramping, and water supply would not be expected to affect ethnographic resources.

Historical Structures

The routine maintenance of the Oroville Facilities under the No-Action Alternative has the potential to affect the 14 NRHP-eligible historical structures described in Section 5.9.1.4. Modifications to these structures or equipment associated with these properties

could adversely affect those values that contribute to the NRHP eligibility of these resources by removing or altering important architectural elements, or otherwise affecting the setting, materials, workmanship, or associations of these historical resources. As these facilities continue to age over the course of the new license, structural repairs, equipment replacement, or facilities upgrades would become more common, and this potential effect would become more likely to occur.

None of the hydrologic changes or wildlife enhancement activities associated with the No-Action Alternative are expected to affect the NRHP-eligible historic structures.

Public Use

As noted in Section 5.9.1.5, public use of the lands within the project area (use of motorized vehicles off of developed road surfaces, as well as the looting or vandalism of certain archaeological sites) is affecting cultural resources. The anticipated increase in recreational demands as a result of population growth has the potential to lead to further effects on cultural resources under the No-Action Alternative.

Archaeological Resources

Approximately 130 of the archaeological sites documented in the *Draft Final Archaeological and Historical Resources Inventory Report* for the Oroville Facilities (DWR 2004a) were found to have been affected by the use of wheeled motorized vehicles in areas not developed for vehicle use. This effect was characterized as “heavy” at more than 75 percent of these sites, indicating that the potential for substantial damage to archaeological site values was considerable. This effect is occurring at locations both within and above Lake Oroville, but is most commonly observed in places where motor vehicle access is facilitated by existing roadways (e.g., near Foreman Creek, at the Enterprise Boat Ramp [BR] and Day Use Area [DUA], and in the Craig Saddle area).

Another aspect of public use that is affecting approximately 20 percent of the archaeological sites is the intentional damage of these resources through looting or vandalism. These baseline effects include defacement of sites (e.g., graffiti), the illegal collection of artifacts found on the surface, and the illegal excavation of sites. As with the effects from off-road vehicle use, these effects are documented primarily in proximity to developed recreation facilities and areas of public access such as trails.

Under the No-Action Alternative, these baseline project effects are expected to continue In addition, based on projected population growth and associated recreation demand in the project area, it is expected that public use of the project area will increase, creating an increased potential for effects on archaeological resources.

Ethnographic Resources

The effects of public use on ethnographic resources are similar to those described for archaeological resources when the ethnographic resource co-occurs with an archaeological site. Public use can also affect ethnographic resources that are of

mythological or ceremonial value to the local Native American community. These values often require solitude, or a lack of visual and audible intrusions that may be created by public use of the area. Under the No-Action Alternative, baseline project effects from public use would continue. Increases in public use are expected at locations where recent improvements have been made, and as a result of the expected increase in public use of the area due to population growth.

Historical Structures

Public use under the No-Action Alternative is not expected to affect the 14 NRHP-eligible historical structures described in Section 5.9.1.4.

5.9.2.2 Proposed Action

The assessment of the environmental effects of the Proposed Action on cultural resources follows the basic structure of the No-Action Alternative, but includes two new subsections to address aspects of the Proposed Action: New Development Measures and Cultural Resources PM&E Measures. When the environmental effects on cultural resources under the Proposed Action would be similar to those under the No-Action Alternative, reference is made to the previous analysis, rather than repeated in this section.

Reservoir Level Fluctuations

The aspects of reservoir level fluctuations that affect cultural resources are described in Section 5.9.1.5, Baseline Project Conditions, and Section 5.9.2.1, No-Action Alternative, and the nature of these effects would not change under the Proposed Action. However, as a result of the cultural resources PM&E measures described below, the effects of reservoir level fluctuations on cultural resources would be less severe than under the No-Action Alternative.

Operations and Maintenance Activities

The effects of the operations and maintenance of existing facilities on cultural resources would be the same as those described in Section 5.9.2.1, except that the cultural resources PM&E measures described below would be implemented. The analysis of the construction, operation, and maintenance of new developments under the Proposed Action is presented under “New Development Measures” below.

Public Use

As a consequence of the new recreational developments that would be constructed under the Proposed Action (e.g., new trails, new facilities at Loafer Creek), an increase in recreational use of the project area compared to the No-Action Alternative is anticipated. This additional public use has the potential to create an increase in the magnitude and severity of effects on archaeological and ethnographic resources through looting, vandalism, and off-road motorized vehicle use, as described in Section

5.9.2.1. The cultural resources PM&E measures incorporated in the Proposed Action address the effects of this increased public use.

New Development Measures

Under the Proposed Action, a number of actions would be implemented to address biological resources, recreational activities, aesthetics, and land management practices. These measures include specific development proposals, such as providing a low-water boat ramp and ten new picnic sites at the Enterprise BR/DUA, constructing four brood ponds for waterfowl in Thermalito Afterbay, and programs such as development of a Recreation Management Plan and an Invasive Species Management Plan. These aspects of the Proposed Action are detailed in Section 3.2; the effects of these new development measures on cultural resources are described below.

Archaeological Resources

New developments that would involve ground-disturbing activities have the potential to affect archaeological resources that may be located in these areas. For example, construction of new recreational vehicle (RV) campsites at Loafer Creek, new facilities at the Enterprise BR/DUA, and new day use amenities at Foreman Creek would involve ground-disturbing activities in areas known to contain archaeological sites. Implementation of on-the-ground components of the Invasive Species Management Plan to be developed under the Proposed Action could also affect archaeological sites through ground disturbance (e.g., mechanical vegetation removal) or through the setting of controlled burns in areas of archaeological sensitivity. Protocols to address these potential effects on archaeological resources will be provided in the Historic Properties Management Plan (HPMP) described below in the cultural resources PM&E measures.

Measures such as the relocation of the floating campsites closer to Lime Saddle, improvements related to salmonid fisheries and garter snake habitat, and new developments proposed in areas not containing archaeological sites would not be expected to have an effect on these resources.

The development of an Interpretation and Education Program under the Proposed Action is expected to provide beneficial effects to both the recreational experience and to archaeological resources by improving public awareness of the values of cultural resources and of the laws and regulations protecting these resources. The modification of recreation use and provision of information regarding the preservation of cultural resources at Foreman Creek would have beneficial effects on the archaeological resources in this area.

Ethnographic Resources

For those ethnographic resources that are associated with archaeological sites, the effects of new development measures involving ground disturbance would be the same as described above. The Interpretation and Education Program, as well as measures intended to improve natural habitats, have the potential to provide beneficial effects on ethnographic resources by increasing opportunities to enhance the public awareness of

the traditional and continuing Maidu use of the area, and by enhancing plant and animal species of traditional interest to the Native American community.

Historical Structures

No effects on the 14 NRHP-eligible historical structures are anticipated as a result of the new development measures under the Proposed Action.

Cultural Resources PM&E Measures

Under the Proposed Action, measures for the protection of, or mitigation for the baseline project effects on, cultural resources are proposed, including the development of the HPMP. These measures were developed in compliance with the requirements of Section 106 of the NHPA. As described in Section 3.2, these measures include: developing a programmatic plan to determine when the stabilization of historic properties is appropriate; conducting data recovery of historic properties subject to imminent loss; restricting public access at specific boat-in campgrounds where appropriate; and limiting travel outside of designated areas by motorized wheeled vehicles. The Proposed Action also includes measures to: expand the existing Site Stewardship Program; identify and set aside areas for planting and/or harvesting traditionally used plants; develop and implement an interpretive and educational signage program; and establish a curation facility for housing archaeological collections associated with the Oroville Facilities. These measures will be documented more fully in the HPMP prepared in accordance with the guidelines for HPMPs issued by FERC and the Advisory Council on Historic Preservation (2002). The effects of these measures on cultural resources are described below.

Archaeological Resources

Baseline project effects on archaeological resources from reservoir level fluctuations, public use, and operations and maintenance activities (see Section 5.9.1.5, Baseline Project Conditions, and Section 5.9.2.1, No-Action Alternative), would be reduced through implementation of the cultural resources PM&E measures. Potential effects on archaeological resources from the proposed new development measures would also be addressed through the HPMP and specific cultural measures noted above.

Effects on NRHP-eligible sites from reservoir level fluctuations would be addressed through stabilization or through data recovery at sites subject to imminent loss. The HPMP will provide additional information on the historic properties stabilization plan and data recovery program. Effects from public use (the expected increased usage from improved facilities provided under the Proposed Action and the population growth over time that would occur under any scenario) would be addressed through the measures restricting public use and access, the installation of interpretive and educational signs, and the expanded Site Stewardship Program, which would help monitor and resolve effects on sites from looting and vandalism. In situations where effects on NRHP-eligible sites from public use could not be resolved through the above actions, data recovery would be performed.

The HPMP will provide measures to address effects on archaeological resources from both baseline operational and maintenance activities that affect sites (see Section 5.9.1.5), as well as from the new development measures described under the Proposed Action. These measures focus on identifying and avoiding archaeological sites, when feasible; modifying programs such as wildlife habitat enhancement that are affecting or could affect NRHP-eligible sites; or using data recovery for sites subject to imminent loss.

The establishment of a local curation facility to house archaeological collections from the project area would have no effect on archaeological resources.

The implementation of the interpretive and educational signage program would have a beneficial effect on archaeological resources by emphasizing both the values of these resources and the laws and regulations applicable to site protection and preservation. The signage program would help reduce effects on sites occurring as a result of vandalism and looting.

Ethnographic Resources

The effects of the cultural resources PM&E measures on ethnographic resources that co-occur with archaeological sites would be the same as those described above, with the added beneficial effect of addressing the traditional values of these properties to the Native American community.

The establishment of a local curation facility and the measure to identify and set aside areas for traditional plant gathering would both have a beneficial effect on ethnographic resources by addressing issues of concern to the Native American community.

Historical Structures

The HPMP will include provisions related to the routine maintenance of the 14 NRHP-eligible historical structures described in Section 5.9.1.4. These measures would focus on the use of appropriate materials in the repair and maintenance of these structures to retain those values that make these properties eligible for inclusion in the NRHP. If the future repair, maintenance, or replacement of these structures would involve the loss of these values, measures to address these effects (e.g., recording architectural features in accordance with the standards of the Historic American Buildings Survey and Historic American Engineering Record) will be provided in the HPMP.

None of the other cultural resources PM&E measures would have an effect on historic structures.

5.9.2.3 Alternative 2

The assessment of the environmental effects of Alternative 2 on cultural resources is organized in the same manner as the assessment of the Proposed Action (Section 5.9.2.2). The basic effect mechanisms for the Proposed Action (i.e., reservoir level fluctuations, operations and maintenance activities related to existing facilities, public

use, new development measures, and cultural resources PM&E measures) are also applicable to Alternative 2. When the environmental effects on cultural resources under this alternative would be similar to those under the No-Action Alternative or the Proposed Action, reference is made to the previous analysis, rather than repeated in this section.

Reservoir Level Fluctuations

The aspects of baseline reservoir level fluctuations that affect cultural resources are described in Section 5.9.2.1, No-Action Alternative. The nature of these effects would not change under Alternative 2. As described under the Proposed Action (Section 5.9.2.2), several PM&E measures for cultural resources would reduce the effects of reservoir level fluctuations relative to the No-Action Alternative. The effects on archaeological resources, ethnographic resources, and historic buildings under Alternative 2 would be the same as those under the Proposed Action.

Operations and Maintenance Activities

The effects of the operations and maintenance of existing facilities on cultural resources are the same as those described in Section 5.9.2.2, Proposed Action. The analysis of the construction, operations, and maintenance of new developments under Alternative 2 is presented under “New Development Measures” below. The increase in the minimum flow within the Feather River downstream of the Thermalito Diversion Dam and the Feather River Fish Hatchery from 600 cubic feet per second (cfs) to 800 cfs is not expected to affect cultural resources.

Public Use

As a consequence of the new recreational developments that would be constructed under Alternative 2 (e.g., new and expanded facilities at Bidwell Marina, Loafer Creek, and Lime Saddle), an increase in recreational use of the project area compared to both the No-Action Alternative and the Proposed Action is anticipated. This additional public use has the potential to create an increase in the magnitude and severity of effects on archaeological and ethnographic resources through looting, vandalism, and off-road motorized vehicle use, as described in Section 5.9.2.1. The cultural resources PM&E measures described below address the effects of this increased public use.

New Development Measures

Under Alternative 2, a number of actions in addition to those incorporated in the Proposed Action would be implemented to address biological resources, recreational activities, aesthetics, and land management practices. These measures include specific development proposals such as establishing side-channel habitat for fish species, expanding the parking lot and other facilities at the Bidwell Canyon BR, constructing a whitewater park near the Diversion Pool, and providing additional recreational facilities in the Loafer Creek area and at Lime Saddle. These aspects of

Alternative 2 are detailed in Section 3.3; the effects of these new development measures on cultural resources are described below.

Archaeological Resources

As described in Section 5.9.2.2, new developments that would involve ground-disturbing activities have the potential to affect archaeological resources that may be located in these areas. The increased number of development proposals under Alternative 2 represents a higher potential for effects on archaeological resources as compared to the Proposed Action. Protocols to address these potential effects on archaeological resources will be provided in the HPMP noted in Section 5.9.2.2.

As with the Proposed Action, development measures that do not involve ground disturbance (e.g., providing additional floating campsites) and ground-disturbing activities located in areas that do not contain archaeological resources are not expected to have an effect on archaeological resources.

Ethnographic Resources

For those ethnographic resources that are associated with archaeological sites, the effects of new development measures involving ground disturbance would be the same as described above. Elements of the Proposed Action having beneficial effects on ethnographic resources (e.g., elements of the Interpretation and Education Program) would be similar under Alternative 2.

Historical Structures

No effects on the 14 NRHP-eligible historical structures are anticipated as a result of the new development measures under Alternative 2.

Cultural Resources PM&E Measures

Most of the cultural resources PM&E measures incorporated in the Proposed Action (Section 5.9.2.2) are included in Alternative 2. However, the measure related to use of the existing Site Stewardship Program, would be enhanced under Alternative 2 by funding a full-time position to help implement this program. A new cultural resources measure is included under this alternative to relocate the bedrock mortar cupules from near the Feather River Fish Hatchery to a more appropriate location.

Archaeological Resources

The effects of the cultural resources PM&E measures on archaeological resources are similar to those described for the Proposed Action (Section 5.9.2.2). The enhanced Site Stewardship Program is expected to be more effective under Alternative 2 because a full-time position would be funded to implement this program.

Relocating the bedrock mortar cupules at the Feather River Fish Hatchery would have no effect on archaeological resources.

Ethnographic Resources

As with the Proposed Action, the effects of the cultural resources PM&E measures on ethnographic resources that co-occur with archaeological sites would be the same as those described above, with the added beneficial effect of addressing the traditional values of these properties to the Native American community. For example, while relocating the bedrock mortar cupules at the Feather River Fish Hatchery would have no effect on archaeological resource values, this measure would have a beneficial effect on ethnographic resources by placing this feature in a more appropriate setting.

Historical Structures

The effects of the cultural resources PM&E measures on historical structures would be the same as under the Proposed Action.

5.9.3 Cumulative Effects

As noted in Section 5.2, Cumulatively Affected Resources, cumulative effects include past, present, and reasonably foreseeable related actions that incrementally affect cultural resources in combination with a proposed action. For this analysis, the source of these effects is not restricted to activities directly associated with the Oroville Facilities. For example, local population growth and related urban development, and actions taken by federal land managing agencies such as the USFS and BLM are considered in this analysis. A list of these reasonably foreseeable actions is provided in Section 5.2.1 and Appendix F of this document.

Cumulative effects are relevant to archaeological sites and ethnographic and ethnohistoric resources, as described in Section 5.9.1. Because of their unique nature, the 14 NRHP-eligible historical structures associated with the Oroville Facilities noted in Section 5.9.1.4 are not considered subject to cumulative effects.

5.9.3.1 Effects of the Project and Past and Present Related Actions

As noted in Section 5.9.1.1, 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 dramatically altered the traditional Native American use of the land (as noted in Section 5.9.1.1).

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 excavation. The extensive dredge mining tailings along the Feather River were affected by the use of these materials for

construction of Oroville Dam. Similarly, traditionally used plant gathering areas, hunting and fishing grounds, swimming holes, and even residences and cemeteries were lost with the construction of the project. Since that time, the construction and use of campgrounds, trails, and other support facilities, Lake Oroville surface fluctuation, and certain operations and maintenance activities have affected additional cultural resources (Section 5.9.1.5). Continued development in and around the 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 and affected resources traditionally used by the local Maidu community.

5.9.3.2 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-Action Alternative, Proposed Action, and Alternative 2 as documented in Section 5.9.2. This analysis is qualitative in nature, and highlights the relative degree of cumulative effects under each of these three scenarios.

No-Action Alternative

Under this alternative, the baseline project effects on cultural resources would continue; increased public use would create additional effects from off-highway vehicle (OHV) use, vandalism, and looting; and activities involving new ground disturbance could further affect archaeological sites and ethnographic resources (see Section 5.9.2.1). The loss of archaeological sites and access to traditionally used resources resulting from future related actions (e.g., continued development in and around the City of Oroville, timber harvesting) would continue unabated. The No-Action Alternative includes some biological resources measures related to native plant and animal species. While these measures were not designed specifically to address concerns of the Native American community, they could have some beneficial effects on ethnographic and ethnohistoric resources. However, the potential for long-term cumulative effects on archaeological sites and ethnographic and ethnohistoric resources would be the highest under the No-Action Alternative.

Proposed Action

With the inclusion of the HPMP and measures to reduce, avoid, or otherwise resolve project-related effects on cultural resources, as described in Section 5.9.2.2, the potential for long-term cumulative effects on archaeological sites and ethnographic resources would be the least under the Proposed Action. A number of new development projects would be constructed under this scenario, and recreational use and potential related effects on cultural resources would be greater than under the No-Action Alternative; however, the Proposed Action also includes measures that would result in beneficial effects on these resources (e.g., the Interpretation and Education Program).

Alternative 2

The potential cumulative effects on cultural resources under Alternative 2 would be very similar to those under the Proposed Action. As noted in Section 5.9.2.3, the increased potential for effects on archaeological sites and ethnographic resources from the additional development proposals under this alternative would be offset by the enhanced Site Stewardship Program.

5.9.4 Unavoidable Adverse Effects

As described in Section 5.2, baseline project conditions, proposed new developments, and increased public use would affect cultural resources. Measures to avoid or reduce those effects are included in the Proposed Action and Alternative 2. Long-term, short-term, or cumulative effects on cultural resources that would occur despite these protective measures are considered unavoidable adverse effects. Under all alternatives, there would be some unavoidable adverse effects on archaeological sites and ethnographic and ethnohistoric resources.

5.9.4.1 No-Action Alternative

With implementation of the No-Action Alternative, baseline project effects on archaeological sites, ethnographic and ethnohistoric resources, and historical structures would continue. In addition, public use of the area would increase because of population growth and some new development activities associated with the BA would occur, creating the potential for an increased level of effects on these resources. No measures to reduce these effects are included in this alternative, resulting in a considerable number of unavoidable adverse effects.

5.9.4.2 Proposed Action

The cultural resources PM&E measures included in the Proposed Action would reduce baseline project effects, as well as help avoid or reduce the potential effects from increased public use and new development proposals. No unavoidable adverse effects on historical structures are anticipated, and certain beneficial effects on cultural resources are also considered under the Proposed Action. However, not all effects on archaeological sites and ethnographic and ethnohistoric resources can be avoided. For example, the effects of reservoir level fluctuations and effects from increased public use (e.g., looting and vandalism) would continue to adversely affect archaeological sites. New proposed developments may also result in unavoidable effects on archaeological sites. Over time, these effects would contribute to a cumulative loss of these resources.

The implementation of the HPMP included in the Proposed Action, with approval of a Programmatic Agreement by FERC, the SHPO, the Advisory Council on Historic Preservation (ACHP), and other consulting parties under Section 106 of the NHPA, would satisfactorily resolve adverse effects on historic properties (i.e., those resources eligible for inclusion in the NRHP) over the term of the new license.

5.9.4.3 Alternative 2

As with the Proposed Action, measures to avoid or reduce effects on cultural resources are included in Alternative 2, but some unavoidable adverse effects on archaeological sites and ethnographic resources would occur as a result of reservoir fluctuation, operations and maintenance activities, public use, and proposed new developments. No unavoidable adverse effects on historical structures are anticipated.

Given the greater degree of new development under this scenario, the residual unavoidable adverse effects would be slightly greater under Alternative 2 than under the Proposed Action. However, the protective measures, combined with approval of the Programmatic Agreement and adoption of the HPMP, would satisfactorily resolve adverse effects on historic properties under Section 106 of the NHPA.

5.10 RECREATION RESOURCES

This section describes the affected environment and the potential environmental effects on recreation resources for each of the three alternatives.

Section 5.10.1 describes the affected environment in terms of the regional and project recreational setting, the recreation access and facilities provided in the project area, specially designated recreation areas in the vicinity, recreational use levels, recreation management, and baseline effects of project operations that will continue into the future.

The Recreation and Socioeconomics Work Group developed 17 study plans to guide 17 separate but interrelated recreation studies (2 additional studies investigated socioeconomic issues and related recreation spending). The 17 recreation studies provided a comprehensive source of information to define the affected environment and also supported assessment of the effects of the No-Action Alternative, Proposed Action, and Alternative 2 on recreation resources, as described in Section 5.10.2 below. The 17 studies include the following:

- SP-R1, *Vehicular Access Study*;
- SP-R2, *Recreation Safety Assessment*;
- SP-R3, *Assessment of the Relationship of Project Operations and Recreation*;
- SP-R4, *Relationship Assessment of Fish/Wildlife Management and Recreation*;
- SP-R5, *Assessment of Recreation Areas Management*;
- SP-R6, *ADA Accessibility Assessment*;
- SP-R7, *Reservoir Boating*;
- SP-R8, *Recreation Carrying Capacity*;
- SP-R9, *Existing Recreation Use Study*;
- SP-R10, *Recreation Facility Inventory and Condition Report*;
- SP-R11, *Recreation and Public Use Impact Assessment*;
- SP-R12, *Projected Recreation Use*;
- SP-R13, *Recreation Surveys*;
- SP-R14, *Assessment of Regional Recreation and Barriers to Recreation*;
- SP-R15, *Recreation Suitability*;
- SP-R16, *Whitewater and River Boating*; and

- SP-R17, *Recreation Needs Analysis*.

The studies provide information on existing and historical recreation conditions and establish the needs or desires that specific PM&E measures are intended to satisfy. This information provides a basis for assessing the extent to which specific actions are likely to meet those needs or desires. Professional judgment based on thorough familiarity with the recreation resources and issues of the project gained over the course of the collaborative relicensing effort is also an important element in assessing effects on recreation quality or quantity. Site- and activity-specific projected recreation visitation to the project area for the year 2020 provided by the Projected Recreation Use Study (SP-R12) serves as a baseline for determining effects on future project visitation. Results of the Carrying Capacity Study (SP-R8) indicate when limiting factors will begin to affect potential future visitation at a site, and in turn prevent use levels from reaching the unconstrained levels estimated in Relicensing Study SP-R12, *Projected Recreation Use Study*.

5.10.1 Affected Environment

This section presents combined results from recreation relicensing studies that summarize the components of the affected environment. The affected environment including the surrounding regional area (SP-R14, *Assessment of Regional Recreation and Barriers to Recreation*) as well as recreation lands, sites, and activity types available at Lake Oroville are discussed (SP-R10, *Recreation Facility Inventory and Condition Report*). Recreation use levels for the various activities are also presented (results from SP-R9, *Existing Recreation Use*). The existing recreation management structure (results from SP-R5, *Assessment of Recreation Areas Management*) is also discussed for each of the geographical areas within the FERC project boundary.

Major issues related to recreation and socioeconomics identified during the scoping process included:

- Adequacy of recreation facilities, funding and maintenance and public safety to accommodate demand and provide a quality recreation experience.
- Adequacy of fisheries and wildlife resource management to provide recreation opportunities.
- Effects of facilities operations on recreation and socioeconomic opportunities.
- Socioeconomic effects of project operations and recreation on local governments, residents, agriculture, businesses, and other interests.

5.10.1.1 Regional and Project Recreational Setting

This section provides a description of the overall regional and project recreational setting, and a discussion of the role of the facilities in meeting regional and local recreation needs, to provide context to the subsequent description of the recreation opportunities and facilities provided within the project area.

Regional Setting

Reservoirs of various sizes are numerous in Northern California, offering recreationists many choices in destinations, settings, and activities. The 2 largest reservoirs (in terms of surface area) in the State are within 2 hours drive of Oroville: Shasta Lake, with 29,500 surface acres and Lake Almanor with 27,064 surface acres. Both of these reservoirs are in attractive mountainous settings. Three reservoirs in the region are similar in size to Lake Oroville, including Folsom Reservoir (12,000 acres), Lake Berryessa (21,000 acres), and Trinity Lake (16,535 acres). Smaller reservoirs (less than 5,000 acres) are more numerous and include Black Butte Lake, Bucks Lake, Bullards Bar Reservoir, Butt Valley Reservoir, East Park Reservoir, Englebright Lake, Indian Valley Reservoir, Lake Pillsbury, Lake Spaulding, Little Grass Valley Reservoir, Stony Gorge Reservoir, SWP Upper Feather River Reservoirs (Antelope, Frenchman, Davis), and Whiskeytown Lake. These waterbodies range in surface acreage from 698 acres (Lake Spaulding) to 4,700 acres (Bullards Bar). The region also offers 2 large and well known natural lakes: Lake Tahoe (122,200 acres) and Clear Lake (40,000 acres).

Many of these other lakes and reservoirs have facilities similar in type to Lake Oroville's and offer similar recreation experiences, activities, and opportunities. All of these regional water bodies have boat launching facilities and campgrounds. Lake Oroville is unique in offering floating campsites and equestrian trail riding combined with equestrian camping.

Project Setting

The Oroville facilities are located at the edge of the foothills of the Sierra Nevada and on the eastern margin of Sacramento River Valley. Lake Oroville sits above the City of Oroville and is surrounded by steep slopes with mixed oak and conifer woodlands. Several hills and ridges rise from 1,000 to 2,000 feet or more above the reservoir. Aside from Oroville Dam and developed recreation areas, most of the surrounding lands are undeveloped and natural appearing. The reservoir has narrow and winding forks, and has a surface area of over 15,000 acres at the full pool elevation of 900 feet msl, making it the fourth largest reservoir in California in surface acres after Shasta Lake, Lake Almanor, and Lake Berryessa.

Water from Lake Oroville is released from Oroville Dam to the Diversion Pool, which winds about 4.5 miles between steep wooded hillsides. The Thermalito Diversion Dam diverts most of the water released to the Diversion Pool down a 10,000-foot-long canal to Thermalito Forebay, a 630-acre hourglass-shaped reservoir sitting at the base of low-lying grass covered hills. Water passed to the Forebay in turn flows through a powerhouse and canal to the 4,300-acre Thermalito Afterbay, a broad and shallow reservoir surrounded on two sides by a low earthfill dam and by flat to gently rolling grasslands. Water is discharged into canals at several Afterbay locations for agricultural use. Water not diverted from Thermalito Afterbay is released back to the Feather River through the Thermalito Afterbay Outlet, near the southeast corner of the reservoir.

Water not routed through Thermalito Forebay and Thermalito Afterbay from the Diversion Pool passes to the Low Flow Channel of the Feather River; the 9-mile-long section of the river upstream of the Thermalito Afterbay Outlet. The first half mile of the Low Flow Channel is occupied by the Fish Barrier Pool, a small reservoir formed by the Fish Barrier Dam at the Feather River Fish Hatchery. The Low Flow Channel flows between levees, passing near downtown Oroville and residential areas before entering the OWA. The main management unit of the OWA consists of over 5,000 acres of land on both sides of the Feather River and is dominated by gravel and cobble tailing piles interspersed with cottonwood and willow-lined ponds. The Afterbay and surrounding lands are managed as a part of the OWA. The FERC project boundary terminates about 5 miles downstream of the Thermalito Afterbay Outlet, at the southern end of the OWA.

The climate in the project area follows a Mediterranean pattern, with hot dry summers and cool wet winters. Summer high temperatures are typically in the 90s (°F) and may exceed 100°F, while winter high temperatures average in the mid 50s. Nearly all of the precipitation in the project area occurs during the late fall, winter, and early spring months with November through March precipitation averaging about 5-6 inches per month.

Importance of Recreational Opportunities/Facilities to the Public

The project area is a regional draw for recreationists with Lake Oroville being one of the largest reservoirs in the State and with the excellent fishing in Lake Oroville and also the Feather River during annual salmon and steelhead runs. However, there is also heavy local use of Lake Oroville and other project facilities, including a significant amount of off-season use. The predominantly local use is attributable to the close proximity of the City of Oroville and surrounding communities to the southern end of Lake Oroville and to the downstream areas. Many recreation areas are within a few minutes drive of these communities, and some residential areas are immediately adjacent to developed recreation facilities. Lake Oroville is also the closest reservoir for residents of other Butte County cities such as Paradise and Chico. Over one-half of those surveyed on-site for the Recreation Surveys (SP-R13) were from Butte County, demonstrating the importance of the project area to local residents. Some of the facilities do not have user fees, such as car-top boat ramps, the Lake Oroville Visitors Center, boat launching and day use facilities at Thermalito Afterbay, and all areas of the Diversion Pool and the OWA. Remaining developed areas typically have user fees that conform to those imposed at other State Recreation Areas.

5.10.1.2 Public Recreational Access and Facilities

The existing Oroville Facilities host a wide variety of recreation opportunities. The major components of the Oroville Facilities that host recreation are Lake Oroville, the Diversion Pool, Thermalito Forebay, Thermalito Afterbay, and the OWA. Most of a nearly 14-mile stretch of the Feather River downstream from the Diversion Pool is also within the FERC project boundary. The upper 9 miles of this stretch is the Low Flow Channel of the Feather River, from the Diversion Pool to the Thermalito Afterbay Outlet.

Nearly 5 miles of the river below the outlet are also within the boundary. A description of access to these project areas and a description of project facilities and recreational opportunities provided are included below. Table 5.10-1 summarizes the existing recreation facilities within the project area.

Table 5.10-1. Recreation facilities within the Oroville project area.

Facility Type	Name	
Campgrounds	***Drive-In Campgrounds and Camping Areas*** • Bidwell Canyon Campground • Lime Saddle Campground • Lime Saddle Group Campground • Loafer Creek Campground • Loafer Creek Group Campground • Loafer Creek Horse Campground • North Thermalito Forebay "En Route" Recreational Vehicle Campground • OWA Primitive Camping areas	***Boat-in Campsites (BICs) and Floating Campsites*** • Goat Ranch BIC • Foreman Creek BIC • Craig Saddle BIC • Bloomer Cove BIC • Bloomer Knoll BIC • Bloomer Point BIC • Bloomer Group BIC • Floating Campsites (10 distributed in various Lake Oroville locations)
Day Use Areas (DUAs)	• Loafer Creek DUA • Oroville Dam Overlook DUA • Diversion Pool DUA	• Model Aircraft Flying Facility • OWA – Afterbay Outlet
Boat Ramps (BRs)	***BRs with DUAS*** • Bidwell Canyon BR/DUA • Lime Saddle BR/DUA • Monument Hill BR/DUA • North Thermalito Forebay BR/DUA • South Thermalito Forebay BR/DUA • Spillway BR/DUA	***BRs without DUAs*** • Afterbay Outlet BR • OWA unimproved BRs • Wilbur Road BR • Larkin Road Car-top BR • Enterprise BR • Foreman Creek Car-top BR • Stringtown Car-top BR • Dark Canyon Car-top BR • Nelson Bar Car-top BR • Vinton Gulch Car-top BR
Trails and Trailheads	***Trails*** • Bidwell Canyon Trail • Wyk Island Trail • Chaparral Interpretive Trail • Dan Beebe Trail • Brad Freeman Trail • Loafer Creek Loop Trail • Loafer Creek Day Use/Campground Trail • Roy Rogers Trail • Potter's Ravine Trail	***Trailheads*** • Saddle Dam Trailhead • Powerhouse Road Trailhead • Lakeland Boulevard Trailhead • East Hamilton Road Trailhead • Tres Vias Road Trailhead • Toland Road Trailhead
Special Use Facilities	• Feather River Fish Hatchery	• Lake Oroville Visitors Center

Source: EDAW 2004

Formal and Informal Public Access to the Project Area

Most access to the project area is through formal roads; informal access is generally limited to residential areas. The access to Lake Oroville, as well as to the other geographic areas within the project area, is discussed below.

Access to Lake Oroville

Three major highways—State Routes (SR) 70, 99, and 162—provide road access to Lake Oroville. Two major interstate highways—Interstate 5 (I-5) and Interstate 80 (I-80)—connect to these State highways. SR 70 is a two- to four-lane highway that runs north/south between Sacramento and the City of Oroville and turns northeast/southwest a few miles north of the City of Oroville. SR 70 crosses the West Branch arm of Lake Oroville before continuing north to Quincy. SR 99 is a two- to four-lane highway that runs primarily north/south and roughly parallel to SR 70 and I-5, providing an additional route between the Sacramento area and Red Bluff. SR 99 northbound connects Chico to Red Bluff and southbound connects Chico to Sacramento. SR 162 is a two-lane highway that runs east/west between I-5 and the City of Oroville. The road continues east through the City of Oroville before crossing the reservoir at the mouth of the Middle Fork arm. The City of Oroville is 42 miles from I-5. Generally, the major recreation areas are easily accessible from these highways; however, the limited public road network makes accessing remote forks of Lake Oroville more difficult.

Access to the Diversion Pool, Thermalito Forebay, Thermalito Afterbay, Feather River, and the OWA

The Diversion Pool is accessible via Cherokee Road off of Table Mountain Boulevard and SR 70. A gravel road (known locally as Burma Road) runs alongside about 1 mile of the west shoreline and provides access to the pool for anglers and car-top boaters and trail access at the terminus of the road for hikers and bike riders.[1] The Thermalito Forebay is accessible via SR 70, with the North Forebay BR/DUA located immediately adjacent to the highway. Local roads provide access to the two developed sites at the north and south ends of the Forebay. The Thermalito Afterbay is accessible via both SR 99 and SR 162. SR 99 runs parallel to the western side of Thermalito Afterbay and SR 162 crosses Thermalito Afterbay and divides it into north and south parts. SR 162 along with Larkin Road along the east side of Thermalito Afterbay provides immediate access to the three developed facilities on Thermalito Afterbay. The OWA is accessible via gravel roads off of SR to the north, SR 70 and Pacific Heights Road to the east, and Larkin Road to the west. There are no paved roads that enter the OWA; all roads are gravel and generally run atop elevated levees and former railroad beds.

Facilities and Opportunities in the Project Area

The project area provides a wide range of facilities and accompanying recreational opportunities. A description of the facilities and opportunities at Lake Oroville, the

[1] During the recreation study period, this trail was designated for multiple-use, including equestrians.

Diversion Pool, Thermalito Forebay, Thermalito Afterbay, and the OWA is provided below (see Figure 5.10-1).

Lake Oroville

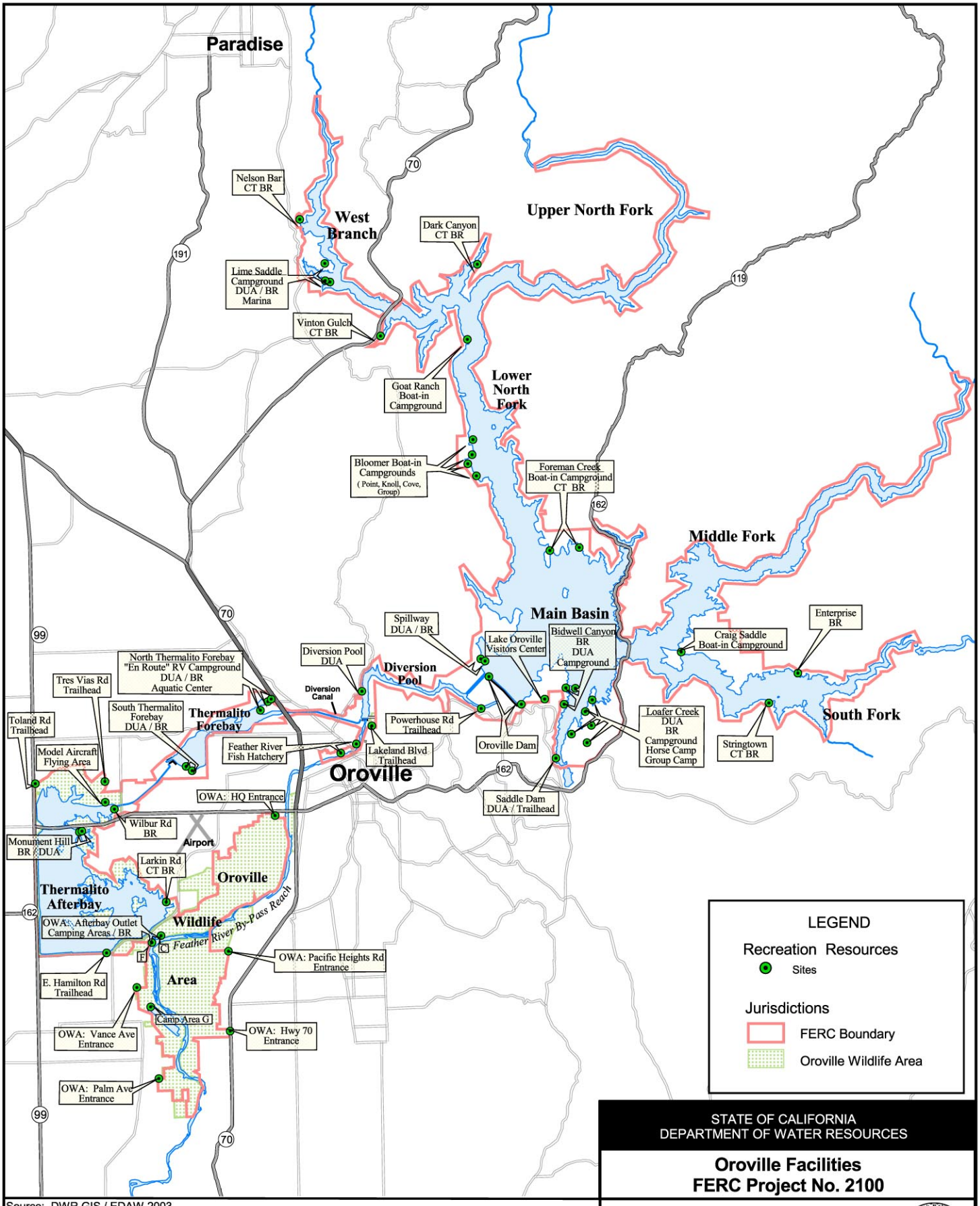
Lake Oroville is 1 of the largest reservoirs in California, with over 15,000 surface acres and 167 miles of shoreline at full pool. The reservoir elevation fluctuates more than 100 feet, on average, each year and can fluctuate 150 feet or more some years. The amount of fluctuation depends largely on the amount of winter precipitation in the watershed and resulting spring inflow into the reservoir. The reservoir and the lands and recreation facilities surrounding the reservoir are part of Lake Oroville State Recreation Area (LOSRA), managed by DPR. There are major recreation facilities at Lime Saddle, Spillway, Bidwell Canyon, and Loafer Creek. The Lime Saddle area is located on the western shoreline of the West Branch (of the North Fork Feather River) arm of the reservoir. The recently improved Spillway Recreation Area is adjacent to the Oroville Dam spillway, at the north end of the dam and at the southwest corner of the reservoir. Bidwell Canyon is located at the southern end of the reservoir. The Loafer Creek Recreation Area is the largest and most diverse recreation complex on the reservoir, located directly across Bidwell Cove from the Bidwell Canyon area.

Boating

Boating facilities at Lake Oroville include two full-service marinas and five boat ramps. The two concessionaire-operated marinas are located at Lime Saddle and Bidwell Canyon. They offer long- and short-term moorage and covered and open dock slips as well as boat rentals, gas, pump-out stations, and small stores with bait and tackle and convenience goods. There is also a restaurant/bar at the Bidwell Canyon Marina. The major launch ramps are located at Bidwell Canyon, Spillway, Lime Saddle, and Loafer Creek. The Bidwell Canyon ramp is a multi-lane boat ramp with parking for more than 200 vehicles and boat trailers. The Spillway area contains the largest boat launching facility on the reservoir, with ramps and parking areas at two levels to accommodate seasonal water level changes. The upper level ramp has 12 lanes with 3 floating docks and a parking area, providing space for 350 vehicles with boat trailers and more than 100 single vehicles. The lower level ramp provides 8 launch lanes and 3 floating docks, along with additional parking close to the ramp. The Lime Saddle ramp is a multi-lane boat ramp with parking for several hundred vehicles and boat trailers. The Loafer Creek ramp is a seasonal, multi-lane boat ramp with a floating dock and parking for nearly 200 vehicles and trailers. Each of the major ramps provides restrooms, and all but Loafer Creek provide fish cleaning stations for anglers.

In addition to these major ramps, the 2-lane Enterprise ramp provides seasonal launching with parking for 40 vehicles and trailers on the South Fork arm of the reservoir, primarily serving nearby rural residents. There is a vault restroom at this site.

There are also five car-top boat ramps scattered around the reservoir that provide for small-boat access to the water and are also used for swimming, bank fishing, and picnicking. Most of these facilities are situated on more remote parts of the reservoir



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Oroville Facilities
FERC Project No. 2100

Source: DWR GIS / EDAW 2003

1 0 1 2 3 4 5 6 7 Miles

Original Scale 1 : 190,080
1" = 3.0 miles

FIGURE 5.10-1

Project Area and Associated Recreation Sites

Prepared by: PJ -- EDAW, Inc.
Date 11/16/04
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and provide a less-developed setting than the main boat ramps. Along with occasional hand launching of canoes and kayaks, the sites are used for a limited amount of trailer-launching, mostly of small fishing boats, although this is not officially permitted at some sites. No boarding docks are provided, and parking is primarily undeveloped roadside parking. Most areas have pit toilets. Use levels are generally low to moderate. Most car-top ramps are improved (concrete) at their upper elevations, but lower reaches are simply abandoned roads that are not maintained.

Seven two-stall floating toilets anchored at various locations around the reservoir provide for the sanitary needs of boaters.

A limited amount of whitewater boating activity occurs on the Big Bend area of the North Fork Feather River when Lake Oroville reservoir pool levels are sufficiently low to expose several miles of river. (This area forms the Upper North Fork arm of the reservoir when water levels are higher.) Generally, a sufficient length of the run is exposed during the fall months (when the run is normally used) only during dry or critically dry water years. Even when several miles of the river are exposed, paddlers are faced with an equally long or longer flat water paddle after completing the run to reach the takeout at the Dark Canyon Car-top boat ramp. Paddlers who boat the Big Bend run put in just upstream of the project area boundary.

A few expert-level whitewater paddlers are reported to make the Class V Bald Rock Canyon run on the Middle Fork of the Feather River. The run begins outside the project area, several miles upstream of the Middle Fork arm of the reservoir, and terminates at the reservoir. Paddlers are required to make a several-hour long flat water paddle to take out at the Bidwell Bar bridge or the Loafer Creek boat ramp.

Day Use

There are day use areas at Lime Saddle, Spillway, Loafer Creek, and Bidwell Canyon near the boat launch facilities, each providing picnic sites and restrooms (shared with the boat ramp). The day use area at Bidwell Canyon is centered on a historic bridge and tollhouse that have been relocated to the site and includes a short loop trail. This site includes new interpretive exhibits in the tollhouse.

The largest day use area is at Loafer Creek with 30 picnic tables and numerous barbeque grills set beneath mature oaks. Amenities include bathrooms and showers and a popular swimming access when the reservoir is above 850 feet. The day use facilities at Spillway overlook the boat ramp and the main basin of the reservoir and consist of several picnic table sites beneath shade structures, with irrigated lawn areas. Potable water and flush toilets are provided. The day use sites at Lime Saddle also overlook the boat ramp, but are less developed.

Picnic tables are provided at each end of the crest of Oroville Dam, where visitors come to enjoy expansive views of the reservoir and the Sacramento Valley. The mile-long crest is popular with walkers, joggers, and bike riders. Parking and toilets are available

at the entrance to the dam crest road. Recently, California poppy seeds were broadcast across the downstream face of the Oroville Dam.

An overlook next to the Bidwell Bar Bridge has a new interpretive sign featuring a project area map. Most other shoreline day use at Lake Oroville occurs at the car-top boat ramps described above, where non-boating visitors picnic, swim, and fish from the shoreline.

Camping

All the developed campgrounds in the project area are located at Lake Oroville: at Lime Saddle, Loafer Creek, and Bidwell Canyon. The campground at Lime Saddle, constructed on a peninsula across from the boat ramp and marina, has 45 family sites (15 are full-hookup RV sites), restrooms, and showers. The Loafer Creek Campground has 137 tent/RV sites (no hookups), showers, and restrooms. The Bidwell Canyon Campground has 75 full hookup sites for both tent and RV camping, showers, and restrooms. There are group campgrounds at Lime Saddle (6 sites) and Loafer Creek (6 group sites) and an equestrian campground at Loafer Creek (15 sites).

The Loafer Creek equestrian campground is a specialized facility, with a horse washing station and horse tethering and feeding stations near each campsite. Recent improvements include paving the access road, replacement of feeder boxes, and installation of corrals and a 50-foot round exercise pen.

Self-contained RVs can use a portion of Spillway's upper parking lot for overnight "en-route" stays. There are also ten unique floating campsites anchored in several arms of the reservoir. Each is a two-story structure with tent/sleeping space, a gas grill, table, sink, restroom, and storage area. Camping boaters also have access to four primitive boat-in camp areas with dozens of designated tent sites, each with picnic tables and fire rings, and vault toilets.

Trails and Trailheads[2]

There are several trails near Lake Oroville, primarily in the Bidwell Canyon and Loafer Creek areas, and a trail along the southwest shoreline of the reservoir with the trailhead at the Spillway BR/DUA. Two trails in the Loafer Creek area, the Roy Rogers Trail (4.0 miles) and Loafer Creek Loop Trail (3.2 miles), are limited to equestrian and hiking use only. Hikers and bike riders may use the Loafer Creek Day Use/Campground Trail (1.7 miles) and the service road linking the equestrian camp to Saddle Dam and the Bidwell Canyon area. The Bidwell Canyon area includes the Bidwell Canyon Trail (4.9 miles) for bike riders and hikers, and the roughly-parallel Dan Beebe Trail (14 miles) for equestrians and hikers. The Potters Ravine Trail (8.2 miles) starting at the Spillway BR parking lot is available to all user types. The Wyk Island Trail (0.2 mile) is associated with the Bidwell Canyon DUA and is for pedestrians only. The 0.2-mile Chaparral Trail is an interpretive trail next to the Lake Oroville Visitors Center.

[2] During the recreation study period, almost all of the trails described in this section were multiple-use.

The Saddle Dam Trailhead at the south end of Lake Oroville is primarily used by equestrians. It provides access to the Bidwell Canyon and Dan Beebe trails in the Bidwell Canyon area and, by crossing the Saddle Dam, to the Loafer Creek Loop Trail and Roy Rogers Trail in the Loafer Creek area. Recent improvements at the site include grading and gravelling of the parking area, and installation of a picnic table, hitching posts, and a vault toilet.

Visitor Center

The Lake Oroville Visitors Center, situated atop Kelly Ridge between Oroville Dam and the Bidwell Canyon area, features exhibits on the engineering and construction of the hydroelectric power facilities, including the Oroville Dam, and explains how the Oroville Complex distributes water and electrical power to its destinations. There are also interpretive displays on the native culture and the natural resources of the area. A 47-foot viewing tower provides a panoramic view of the reservoir and its surroundings. Shaded picnic areas and a short interpretive trail are provided nearby.

Diversion Pool

The Diversion Pool covers a 4.5-mile stretch of the Feather River from Oroville Dam to Thermalito Diversion Dam. The narrow pool covers 320 acres, winds between steep wooded hillsides, and provides opportunities for visitors to enjoy quiet, uncrowded conditions.

Day Use and Angling

This area is primarily used by shoreline picnickers, anglers, and walkers seeking a quiet undeveloped setting. The only facility provided is a vault toilet; no other day use or camping facilities are provided. A former DWR storage yard near the Thermalito Diversion Dam has been cleared, graded and graveled for use as an equestrian and other event staging area.

Boating

Only non-motorized and electric motor boats are allowed on the Diversion Pool. There is an undeveloped boat access point at the Diversion Pool DUA for hand launching of boats.

Trails and Trailheads

At the end of the DUA access road (locally known as Burma Road) is a trailhead where hikers and bike riders can access the 41-mile Brad Freeman Trail, which follows Burma Road and the north shoreline of the Diversion Pool before climbing to Oroville Dam. A multiple-use segment of the Brad Freeman Trail also follows the opposite shore, running on a former railroad bed. The two sides are linked by the segment of trail that crosses Oroville Dam. (The majority of this trail makes a large loop around Thermalito Forebay and Thermalito Afterbay, through the OWA, and along the Feather River Low Flow Channel, as described below.)

The 14-mile Dan Beebe Trail is an equestrian trail (hikers are also permitted) winding through the hillsides above the south side of the Diversion Pool which links to Kelly Ridge and continues to the Saddle Dam trailhead. The Lakeland Boulevard Trailhead sits above Thermalito Diversion Dam on the east side of the lower Diversion Pool and provides access to both trails. The large parking area serves as an equestrian staging area with portable toilets and picnic tables. The Powerhouse Road Trailhead is near the upstream end of the Diversion Pool and provides access to the Brad Freeman Trail, but has no facilities.

Thermalito Forebay

Thermalito Forebay is a 630-acre hourglass-shaped reservoir that is divided into north and south portions at a point where the pool narrows at the Nelson Avenue bridge crossing.

Day Use

The 300-acre North Forebay DUA, the most popular day use site in the project area, features a large sandy beach and swim area on a shallow lagoon connected to the main body of the Forebay. A large picnic area adjacent to the beach provides more than 100 picnic tables, many under shade structures, dispersed across a tree-shaded lawn. The picnic area is suitable for family or large group picnics, and has both flush toilet restrooms and vault toilets. A few picnic sites are also provided on the opposite side of the lagoon. The South Forebay DUA provides several shaded picnic sites and a sandy area for swimming. A vault restroom was recently added to the site. RV en-route camping is available at the North Forebay (RV's may park for the night).

Boating

Only non-motorized boats are permitted on the North Forebay, which is popular with users of small sailboats and paddle craft. The North Forebay DUA provides two boat ramps with floating docks and an Aquatic Center. The Aquatic Center is a 1,200 sq ft boat storage facility used by California State University, Chico and others for boating instruction and events. The South Forebay is open for motorized boating and the South Forebay DUA at the opposite end of the pool includes a boat ramp with floating dock.

Angling

The Forebay is stocked regularly with trout and both the South and North Forebay DUA are popular with local shore anglers. The South Forebay provides a fish cleaning station. Some boat angling also occurs on both portions of the Forebay.

Trails and Trailheads

A paved trail encircles the swim lagoon at the North Forebay DUA. The Brad Freeman Trail also passes through the site and runs near the north shore of the North Forebay crosses the pool at Nelson Avenue, and runs atop the earthfill dam along the east side of the South Forebay.

Thermalito Afterbay

Thermalito Afterbay is a shallow reservoir at the southwest corner of the project area covering 4,300 acres at maximum operating storage. Unlike Lake Oroville, the elevation of Thermalito Afterbay fluctuates during much of the year on a weekly cycle, with 4–6 feet of elevation change during a typical week. The typical daily elevation change is 1-2 feet. The pool is raised during the week and drawn down over the weekend, as dictated by hydroelectric power operations. Water temperatures can vary widely around Thermalito Afterbay in the summer, with water in the low 60s (°F) near the tailrace channel, in the mid-70s in the warmest deeper water areas near the outlet, and in the mid-80s in shallow backwater areas (DWR 2001a).

Boating

There are three boat launch facilities on the eastern shore of Thermalito Afterbay used by pleasure boaters, anglers, and hunters. The Wilbur Road BR near the north end of the pool provides two launch lanes, a floating dock, a recently installed vault toilet, and a paved parking area. The Monument Hill BR/DUA also provides two launch lanes and a floating dock. This area is popular with personal watercraft (PWC) riders, as well as water-skiers who frequently use the nearby water-ski slalom course. The Larkin Road Car-top BR is on the southern portion of Thermalito Afterbay and provides a vault toilet and a low-gradient paved ramp used to launch PWC and other small boats. Windsurfers commonly launch from several informal shoreline access points near the SR 162 bridge.

Day Use

The day use facilities on Thermalito Afterbay are at Monument Hill and include a small sand beach with picnic tables, additional shaded picnic sites on the hill above, and flush toilets. Informal swimming also occurs at Larkin Road Car-top BR.

Angling

The diverse temperature structure of Thermalito Afterbay provides suitable habitat for both coldwater and warmwater fish, including a popular largemouth bass fishery. Fishing in Thermalito Afterbay occurs both from the shore and from boats. A fish cleaning station is provided at Monument Hill DUA.

Trails and Trailheads

The Brad Freeman Trail runs around the north, west, and south sides of Thermalito Afterbay. Three trailheads are located in the area; one on the south side (East Hamilton Road), and two on the north side (Toland Road and Tres Vias Road). There are no facilities at any of these trailheads, which are primarily used by hunters.

Other Facilities and Opportunities

Additional facilities at Thermalito Afterbay include hunting blinds that have been installed at various points along the shoreline for the use of waterfowl hunters. A special youth pheasant hunt is held in the area each fall. A model aircraft flying facility is used by a local club near the north shoreline and has benefited from recent improvements, including new runways, tables, shade ramadas, and a vault toilet.

Oroville Wildlife Area and Feather River

The OWA, not including the Thermalito Afterbay subunit described above, consists of about 5,700 acres of lands on both sides of the Feather River, most of which is within the FERC project boundary. A large percentage of the OWA is covered with gravel and cobble spoil piles left behind by historic gold dredging in the river. There are numerous small willow and cottonwood-lined ponds in areas where this material has been removed. The OWA is adjacent to or straddles about 10 miles of the Feather River. The lower 1.25-miles of the Low Flow Channel and, the upper 1.5 miles of the Low Flow Channel, upstream of the OWA, are within the FERC project boundary.

Day Use

There is a vault toilet at the Thermalito Afterbay Outlet area. There also are designated primitive camping areas at the Thermalito Afterbay Outlet, but no developed camping facilities.

The Feather River Fish Hatchery is located at the upper end of the Low Flow Channel of the Feather River, immediately below the Fish Barrier Dam and about one-half mile below the Thermalito Diversion Dam. The hatchery provides interpretive displays related to salmon and trout, and seasonally provides a unique opportunity for visitors to watch fish ascend the fish ladder to the hatchery through underwater windows. Tours of the hatchery itself are also offered to the public. Additional amenities at the hatchery include an overlook platform at the base of the Fish Barrier Dam, riverbank benches, and restrooms.

Day use of the east side of the Fish Barrier Pool has recently been improved to include a pedestrian trail (Sewim Bo River Trail), shade ramadas, picnic tables, and landscaping.

Boating

A few motorized and non-motorized boaters use the 9-mile Low Flow Channel, the upper 1.5-mile and lower mile of which are within the FERC project boundary. Few developed boat access facilities are provided, particularly at the upstream end where non-motorized boaters would most desire to launch. Non-motorized boats are occasionally hand launched from the riverbank near the Feather River Fish Hatchery.

The only formal boating facility on the Feather River in the OWA is a gravel boat ramp at the Thermalito Afterbay Outlet. There are several other unpaved and informal boat

launch sites along the west bank of the river. Some motorized boating activity (primarily anglers) on the river in the OWA originates from a private campground boat ramp across the river from the OWA (outside the FERC project boundary) and from access point downstream of the project area.

Angling

The Feather River draws most visitors to the OWA, in particular its steelhead and salmon fishery. The most visited site in the area is the well-known Thermalito Afterbay Outlet area, where Thermalito Afterbay releases water into the Feather River. During the peak of the steelhead and salmon seasons, the site is heavily used by both boat and bank anglers from throughout the region. Anglers also gain access to the riverbank and several riffles at several dispersed locations where levee roads provide close vehicle access. Fishing also occurs at some of the OWA ponds.

Trails and Trailheads

The Brad Freeman Trail runs through the northern portion of the OWA following the gravel levee-top road network and former railroad beds. Informal walking paths exist where visitors may access the Feather River from roadside parking areas. Paved (street) segments of the Brad Freeman trail run near the east riverbank of the Low Flow Channel from the OWA to the Diversion Dam, linking Riverbend Park and the Feather River Nature Center.

Hunting

The ponds in the OWA draw waterfowl hunters during the fall and winter hunting seasons. Dove and quail hunting also occurs during the fall, and a special lottery turkey hunt is held each spring. Deer hunting is permitted, but limited to bows, shotguns and handguns (no rifles allowed).

ADA Accessibility at Project Area Facilities

Facilities required to be ADA accessible within the study area meet, or will soon be upgraded to meet, ADA technical standards. These include facilities such as parking spaces, restrooms, pathways between parking and restrooms, and campsites. Not all recreation facilities are required to be made accessible. Additionally, the managing agencies have met the required ADA standards by providing disabled recreationists access to the “programs” available in the area. Programmatic access is required by the Americans with Disabilities Act Access Guidelines. All indoor facilities are required to be made accessible while outdoor facilities are required to be made accessible by “program.” The programs that are accessible include campgrounds, boating facilities, picnic areas, and beach/water access.

The ADA Accessibility Study (SP-R6) identified a few opportunities to go beyond programmatic compliance in addressing access deficiencies. For example, most of the paved walkways between the parking area and the picnic sites at the Loafer Creek DUA are too steep for disabled visitors to use. Also, the Recreation Needs Analysis (SP-

R17) identified opportunities to expand special facilities such as ADA fishing piers (only one exists in the project area, at the North Forebay DUA).

Specially Designated Areas in the Project Area Vicinity

Though all located outside of the FERC project boundary, there are several federally-designated areas in the vicinity of Lake Oroville including one Scenic Area, one National Recreation Trail and one National Scenic Trail, a Scenic Byway, and a Wild and Scenic River. A description of each is given below.

Feather Falls Scenic Area and National Recreation Trail

The Feather Falls Scenic Area is a 15,000-acre area managed by Plumas National Forest. The scenic area is southwest of Bucks Lake and northeast of Lake Oroville, near the town of Feather Falls. The Feather Falls National Recreation Trail is a 9-mile loop trail that leads to Feather Falls. The trailhead is approximately 20 miles east of the City of Oroville. Feather Falls, at 640 feet, is the sixth highest waterfall in the contiguous United States and fourth highest in California. The trail also provides excellent views across the Canyon of the Middle Fork Feather River to Bald Rock Dome, a large barren granite dome that rises above the canyon and dominates the scenery for miles around.

Feather River National Scenic Byway

The byway, dedicated by the USFS in 1998, follows SR 70 from the north end of Lake Oroville up through the gorge of the North Fork of the Feather River. Travelers enjoy spectacular views and many points of cultural, geologic, and historical interest along the 130-mile route.

Middle Fork Feather Wild and Scenic River

The Middle Fork Feather River (MFFR) was designated a National Wild and Scenic River (WSR) in 1968. The MFFR WSR is currently administered by Plumas National Forest and runs from near Beckwourth to Lake Oroville. It is located outside of the FERC project boundary. The designated reach totals 77.6 miles, including 32.9 miles of Wild River area, 9.7 miles of Scenic River area, and 35 miles of Recreational River area designation. The lower part of the MFFR flows through a deep canyon with numerous large boulders, narrow steep canyon walls, and some impassable waterfalls. Rafting and kayaking opportunities are considered to be for experts only (Class V). The upper stretches of the river however, are gentler with easy access, proving opportunities for rafting and canoeing.

Pacific Crest Trail

The Pacific Crest Trail (PCT) is 1 of 8 National Scenic Trails in the United States, this one spanning some 2,650 miles from Mexico to Canada through three western states. The route was first explored in the late 1930s by teams of young men from the YMCA. Once proven feasible, trail pioneers Clinton Clarke and Warren Rogers lobbied the

federal government to secure a border-to-border trail corridor. Largely through the efforts of hikers and equestrians, the PCT was eventually designated one of the first scenic trails in the National Trails System by Congress in 1968 and was dedicated in 1993. The PCT generally runs in a north-south direction, east of the project area. The PCT crosses the Middle Fork Feather River and SR 70 near the town of Belden, approximately 40 miles northeast of the project area.

Recreational Opportunities/Facilities Outside the Project Area

A few sites offer recreational opportunities and facilities in the immediate vicinity of the project area. Although adjacent to the OWA, two facilities located in the Clay Pit (a borrow area used in the construction of Oroville Dam) are outside of the FERC project boundary. Also in the vicinity of the project area but outside the FERC project boundary are Riverbend Park and Bedrock Park.

The Clay Pit State Vehicular Recreation Area (SVRA), located 3 miles southwest of the City of Oroville, provides a riding area for OHV enthusiasts and is managed by DPR. The clay used to build Lake Oroville Dam was taken from this area, resulting in a large shallow pit ringed with low hills, providing about 220 acres of riding area. The site has a gravel staging/parking area for loading and unloading vehicles. The site is accessed from Larkin Road.

The Rabe Road Shooting Range, managed by DFG, is an unstaffed public shooting area with unmarked backstops (undefined places to place paper targets), a graded and graveled parking area, seven picnic tables, and a vault toilet building. It is technically a rifle range, but pistol use commonly occurs there as well. The shooting range is directly adjacent to Clay Pit SVRA.

Riverbend Park and the adjacent Bedrock Park are located on the Low Flow Channel of the Feather River on the west side of the City of Oroville, and are owned and managed by the Feather River Recreation and Parks District (FRRPD). Riverbend Park provides riverbank access and day use amenities such as a Frisbee golf course, a paved loop trail with exercise stations, benches, and picnic tables. The adjacent Feather River Fish Ponds (recently improved and operated by FRRPD in a lease partnership with DFG as part of the West Park Riverbend Corridor) include parking and restrooms. At this location, visitors can fish from the pond banks and off of piers. The piers and restrooms are ADA accessible. Bedrock Park is a smaller facility that provides access to the river for anglers and swimmers, shaded picnic sites and irrigated lawn area, and restrooms. Bedrock Park is separated from Riverbend Park by SR 70 but the two parks are connected by a paved bike and walking trail.

Plumas National Forest lands also offer access to a range of activity opportunities including camping, boating, hiking, and OHV use. One of the closest opportunities to the Oroville Facilities is the Feather Falls trail, described above. Boaters can also hike to the base of the falls from the upper reaches of the Middle Fork arm of Lake Oroville when the reservoir water level is high.

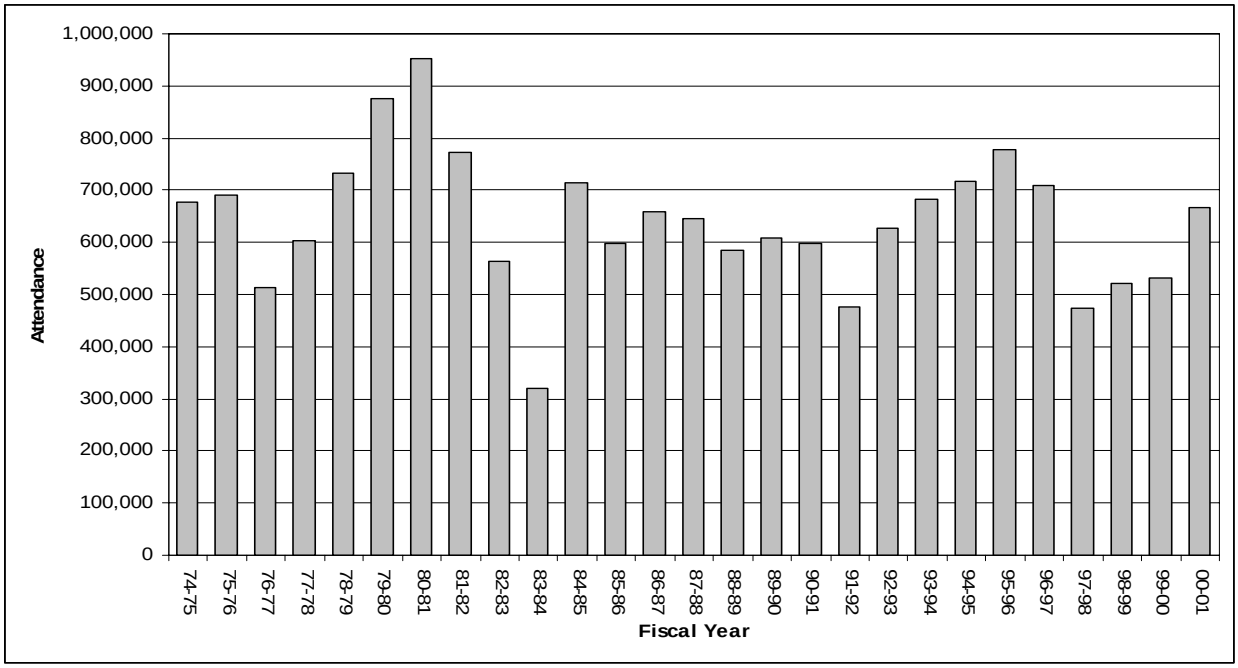
5.10.1.3 Recreational Use, User Characteristics and Capacity

This subsection describes historic and current recreation use levels by activity and for various geographical areas within the FERC project boundary. Recreation use levels are measured in recreation days. A single recreation day (RD) represents participation in recreation at a site during a single calendar day by one person for any length of time. This is followed by a discussion of issues related to the capacity of recreation areas and facilities to support current use.

Historic Use Levels

Official DPR estimates of attendance for LOSRA are available on a fiscal year (FY) basis (July through June) for the period 1974-75 to 2000-01. Figure 5.10-2 illustrates these data. The estimates represent a compilation of daily use data at various park units into monthly and FY totals, and so are comparable to RD estimates of current use. LOSRA comprises the majority of the project area, and includes all Lake Oroville, Diversion Pool, and Thermalito Forebay recreation sites and surrounding lands and waters. The data also include attendance at the Clay Pit SVRA since FY 1996-97. Historic attendance data are not available for Thermalito Afterbay and the OWA because these data were not regularly collected by the two managing agencies, DWR and DFG, until about 1997.

The annual average total attendance across the 27 years for which data are available was about 650,000 visits. Although considerable variation is seen in the data, for most years attendance was between 500,000 and 700,000 visits. Attendance peaked during FY 1980-81 at over 950,000 visits and was over 700,000 visits for several years around that time. The lowest attendance was recorded for FY 1983-84 with just over 320,000 visits. However, investigation of the very low attendance estimate for FY 1983-84 for the purpose of relicensing studies yielded the conclusion that the estimate may not be accurate and is most likely a result of counting problems. The next lowest attendance estimate was about 472,000 visits for FY 1997-98, and attendance was only slightly higher for FY 1991-92 with about 477,000 visits. FY 1991-92 fell in the midst of a multi-year drought, which severely reduced the water levels in Lake Oroville. (Statistical modeling performed for the Projected Recreation Use Study (SP-R12) established that pool level in Lake Oroville was positively related to attendance at Lake Oroville recreation sites.) Attendance appears to be on an upward trend since the low in FY 1997-98.



Source: DWR 2003

Figure 5.10-2. Recreation visitor attendance at LOSRA recreation sites, fiscal years 1974-75 to 2000-01.

2002-2003 Estimated Annual Use

The Existing Recreation Use Study (SP-R9) estimated use within the project area by site and divided use at each site by activity. The following describes the total amount of use by each activity at each major geographic area within the project area according to the popularity of each activity. Estimates of use by activity were made based mainly on observational data; professional judgment and informal observations were used where necessary. Estimates of use are for the period from May 15, 2002 to May 14, 2003. Activities included in estimates were bank fishing, boating access, camping, sightseeing, hunting, picnicking, swimming, and trail use. The term “boating access” is used because boating activities do not literally occur at the site; the site provides access for boaters to the body of water where boating activities actually take place. Sightseeing includes activities such as driving for pleasure, touring sites, or looking around. Picnicking also includes the activities of resting and relaxing.

Boating

Boating (reported as boating access in the Existing Recreation Use Study (SP-R9) because boating does not actually occur at sites) was the most popular activity in the project area. At Lake Oroville, 45 percent or about 411,011 recreation days (RDs) were accounted for by boating. Boating was also popular at Thermalito Afterbay, where 52,557 RDs or about 56 percent of use at Thermalito Afterbay was boating access. Boating was not as popular at Thermalito Forebay (10 percent of use/14,234 RDs), the river or ponds within the OWA (8 percent of use/25,021 RDs), or Diversion Pool (4 percent of use/729 RDs) as it was at Lake Oroville or Thermalito Afterbay.

Angling

Angling by boat was included in the estimate for boating; however, the amount of bank angling was estimated separately. Bank fishing was the third most popular activity overall within the project area. Bank angling was extremely popular in the OWA compared to the rest of the geographic areas within the FERC project boundary. About 67 percent of the use within the OWA was estimated to be bank angling, equivalent to 213,709 RDs. Almost one-quarter (24 percent) of use at Thermalito Forebay was estimated to be bank angling, about 32,110 RDs. About one-fifth of the use at Diversion Pool was estimated to be from bank angling with 4,371 RDs. Bank angling accounted for less than 10 percent of total use at Lake Oroville (5 percent/48,145 RDs) and at Thermalito Afterbay (4 percent/3,992 RDs).

Trail Use

Use of specific trail segments by number of people (using infrared trail counters) and trail use at trailheads were estimated, with results presented the Existing Recreation Use Study (SP-R9). Generally, trail use is relatively low; it may even have been elevated during the study period because trails were designated multi-use and thus opened to more user groups. Trail use data show that the highest trail use occurred in October, with about 50-60 people using specific trails within the FERC project boundary on peak days. This is an average of five people per hour, a relatively low level of use. The lowest trail use occurred from mid-December through mid-March, with no use recorded on many days and peak daily use of 10 or fewer people on representative trail segments. As for use at trailhead sites, this accounted for only 1 percent of total use at Lake Oroville (4,690 RDs) and Thermalito Afterbay (891 RDs). However at Diversion Pool, one-half of use was estimated to be from trail use (10,403 RDs). Trail use accounted for about 1 percent of total RDs within the project area.

General Day Use

Three general day use activities were estimated in the Existing Recreation Use Study (SP-R9) including picnicking, sightseeing, and swimming. Sightseeing was the second-most popular activity within the project area, picnicking was fourth, and swimming was fifth. Combined, these activities were most popular at the Feather River Fish Hatchery where 100 percent of use was accounted for by general day use activities (160,395 RDs). General day use activities were also very popular at Thermalito Forebay, where 62 percent of total use or 85,034 RDs were accounted for these activities, owing in part to the very popular swimming lagoon at North Forebay BR/DUA. This lagoon is one of the only two formal swimming areas within the FERC project boundary. Over one-third of use at Lake Oroville (36 percent/ 328,109 RDs) and Thermalito Afterbay (38 percent/35,928 RDs) was accounted for by picnicking, sightseeing, and swimming. One-quarter of total use at Diversion Pool was accounted for by these 3 activities, or 5,100 RDs. At the OWA, 22 percent of total use was estimated to be from these general day use activities, equivalent to 70,866 RDs.

Camping and Other Overnight Use

Camping primarily occurs at Lake Oroville, where all of the developed campgrounds are located. About 7 percent of the total use at Lake Oroville was estimated to be from camping, about 62,300 RDs. There was also low use of the RV en-route camping at North Forebay BR/DUA (39 RDs) and Spillway BR/DUA (91 RDs, included in Lake Oroville total). Overall, camping was the sixth most popular activity in the project area with about 4 percent of total use.

Other Recreational Uses

There are four other main activities for which use estimates were generated including hunting, walking, target shooting, and OHV use.

Most of the hunting in the project area occurs in two geographic areas: the greater OWA and Thermalito Afterbay portion of the OWA. Hunting access occurs at these areas at three main locations: the West and East Levee Roads in the south portion of the OWA, and trailheads near Thermalito Afterbay including South Wilbur Road Trailhead, Toland Road Trailhead, and Tres Vias Road Trailhead. Hunting accounted for 27 percent of total use at these trailheads, or 4,995 RDs. Within the OWA, hunting only accounted for 3 percent of total use or 8,866 RDs. (The percentage of total use is low in part because hunting is seasonal with most hunting occurring between October and January.) Hunting is also allowed in the more remote parts of LOSRA away from developed recreation areas, but the level of activity is believed to be low as virtually no such use was discerned during recreation surveys.

Walking use tends to be mostly at the Oroville Dam/Overlook DUA and North Forebay BR/DUA. Due to its proximity to the Kelly Ridge residential area, its views of the reservoir and Sacramento Valley, and the mile-long crest with pedestrian walkway, the Oroville Dam is a popular place to walk, jog, or bicycle. There were an estimated 56,930 RDs associated with walking, jogging, and bicycling across the dam. At the North Forebay BR/DUA, walking generally occurs on the path around the swimming cove. The North Forebay is located fairly close to residential areas and therefore receives many local visitors who enjoy walking there. There were an estimated 4,303 RDs from walkers at the North Forebay BR/DUA.

Project Area Visitor and Visit Characteristics

The following summary serves to describe in general terms the visitors to the project area and their use of the area for recreation based on survey results.

Most project area visitors are regular visitors to the area (three or more visits per year) and most visit during the spring and fall as well as summer. Over 60 percent of visitors surveyed were from Butte County or an adjacent county, and nearly all of the remaining visitors were from elsewhere in northern California.

Visitors to Lake Oroville, where most project area camping facilities are located, were fairly evenly divided between day and overnight users. In contrast, from 60-90 percent

of visitors to other parts of the project area were day users. Most overnight visitors stayed 2 or 3 days, and most stayed in campgrounds or with family/friends. Nearly 90 percent of visitors from Butte County and the adjacent counties were day users, while most visitors from more distant locations were overnight visitors. Day user visits averaged 4-6 hours in length. About one-quarter of visitors surveyed at Lake Oroville also planned to visit other portions of the project area, and about 30-45 percent of visitors to most downstream areas planned to visit Lake Oroville sites.

Group sizes at most areas average 2-4 people. Large groups were more common at Thermalito Forebay, where the median group size was 7 people. Proximity to their homes and desirable natural resource features such as high water quality were the predominant reasons for visitors to come to most of the project area. Fishing opportunities was the predominant reason among OWA visitors. Project area visitors participated in a wide range of activities, but water-based recreation such as motorboating, water-skiing, swimming, and angling were the predominant activities in most areas. Other important activities, in particular at Diversion Pool and the Feather River, were trail walking/hiking, biking and horseback riding. Sightseeing, picnicking, and general relaxing are also important at many areas.

Existing Recreation Capacity

The existing capacity status and identified capacity issues of resource areas and facilities for boating, camping, day use, angling, and trail use are summarized here.

Boating

The Reservoir Boating Study (SP-R7) indicated that boat traffic is moderately dense on Lake Oroville during peak season holidays, and many additional boats spend time moored on or near shore, where there may be competition for mooring sites. The study also established that the typical length of time boaters wait to use the ramps is not excessive, although waits of 20-30 minutes may occasionally occur at peak use times. Observation of peak holiday weekend launching at the Spillway boat ramp, the largest such facility on the reservoir, indicated that back-ups at the ramp were minimal and waits were short. Corresponding with these conditions, boaters' perceptions of crowding and conflict problems on the project reservoirs are low, and these problems appear to be short-term and localized where they do occur, typically only during holiday peak use conditions.

Facility capacity limits affect recreation access at Bidwell Canyon, where boaters frequently cannot gain access to the boat ramp during high-water summer weekends and holidays due to lack of parking. This is in part due to Bidwell Canyon Marina boaters parking their vehicles in vehicle/boat trailer spaces in the boat ramp parking lot, which is exacerbated by insufficient marina parking. This problem is particularly acute when reservoir pool levels are high; additional marina parking becomes available in the fluctuation zone as the pool level falls. The boat ramp and marina parking is commonly full to capacity by mid-morning on some weekends, causing arriving visitors to be turned away. Boaters wishing to launch a boat can instead drive 3 miles to the Spillway boat

ramp, where ample parking is available. Marina boaters may park in the adjacent residential area and walk to the marina.

Parking capacity for boaters wanting to launch their boats at Lime Saddle is also an issue during some peak use periods. The parking areas are shared by boat ramp users and marina boaters. As observed at Bidwell Canyon, vehicle/trailer spaces are often used by marina boaters due to an insufficient number of spaces for single vehicles. Additional parking is available at a gravel overflow lot outside the park entrance.

Camping

Average occupancy of campgrounds during summer recreation season weekends, the peak use period, was generally not high during the relicensing study period, averaging about 50-60 percent at most sites. An exception was the Loafer Creek Group campground, with an average occupancy rate of over 80 percent, and near 100 percent occupancy during July and August. The floating campsites also had high occupancy rates, ranging between 84 and 94 percent on both weekdays and weekends through the summer months. The Lime Saddle Group Campground and Loafer Creek Equestrian Campground had low occupancy rates during the summer recreation season, below 35 percent. Equestrian campground occupancy was higher during the spring and fall, when trail riding conditions were more favorable. Occupancy of all campgrounds may be higher during years with more consistent high reservoir pool levels than existed during the relicensing study period.

Day Use

Use of the developed day use facilities in the project area was generally moderate, and crowding problems were not found. However, use of the largest day use area on Lake Oroville, the Loafer Creek DUA, was greatly reduced during the study period by low reservoir water levels. Use of the North Forebay DUA, the largest such facility in the project area, exceeded parking capacity only occasionally during peak holiday periods.

Angling

Boating activity on the project area reservoir is generally low during the off-season, which is the period when most angling occurs. Anglers on the project area reservoirs had few complaints about crowding; however, bank and boat anglers in the OWA and on the Feather River Low Flow Channel expressed concern about crowding. The high concentration of both boat and bank anglers at the Thermalito Afterbay Outlet can sometimes cause conflicts between anglers (in particular between bank and boat anglers). The majority of anglers contacted in the OWA (including at the Thermalito Afterbay Outlet) considered the areas where they fished to be moderately to extremely crowded.

Trail Use

Use of most trails appears to be low or moderate, with the highest use occurring during the spring and fall. A high percentage of trail users (generally over 90 percent)

expressed satisfaction with the condition of the trails (poor trail conditions are one indicator of overuse), and perceptions of crowding were very low.

5.10.1.4 Recreation Management

This subsection describes the current responsibilities and activities of four primary State agencies, and other local and federal agencies, as related to recreation management and describes existing recreation management issues and problems identified by the recreation technical studies.

In 1961, the California Legislature passed the Davis-Dolwig Act (California Water Code Sections 11900–11925), which defined responsibilities of four State agencies (DWR, DPR, DFG, and DBW) for providing recreational opportunities and fish and wildlife enhancements as part of the SWP. DWR is charged with planning for public recreation and fish and wildlife preservation and enhancement in connection with the development of SWP facilities. This duty involves acquiring land and locating and constructing all works and project features so as to allow for fish and wildlife enhancement and recreational uses following construction of the project. DPR is authorized to design, construct, operate, and maintain public recreation facilities. DFG is responsible for managing fish and wildlife resources. DBW, in turn, is charged with planning, designing, and constructing boating-related facilities.

Lands, facilities, and recreational interests in the study area are also owned and managed by two federal land management agencies; the Bureau of Land Management (BLM) and the US Forest Service (USFS); and a local parks agency, the Feather River Parks and Recreation Department (FRRPD). The properties and management responsibilities of each agency are detailed in a series of deeds, agreements, and transfers between the agencies involved.

Relevant agency ownership, management responsibilities, and current management practices throughout the study area are presented below by geographic area. Additional detail on organizational structure and budget are provided in Relicensing Study SP-R5, *Assessment of Recreation Areas Management*. Under FERC regulations, DWR is ultimately responsible for public access, recreation opportunities, and associated development within the FERC project boundary.

<u>Management of Lake Oroville State Recreation Area</u>

The Lake Oroville State Recreation Area (LOSRA) comprises approximately 28,000 of the approximately 41,100 acres within the FERC project boundary and, as described in Section 5.10.1.2 above, contains most of the recreation waters, land, and facilities within the FERC project boundary.

<u>DWR</u>

DWR has transferred management responsibilities (“recreational interest”) for most lands, waters, and recreation facilities within LOSRA to DPR. Although DWR does not manage the majority of the recreational opportunities and facilities in the LOSRA or the

project area, it is responsible, under its existing FERC License, for implementing a variety of recreation-related projects and improvements, ensuring funding, operation, development, and management of current and additional recreation facilities within the project area. By necessity as well as by statute, DWR works closely with other agencies, including DPR, DFG, and DBW, to both fund and implement the programs and improvements required by FERC. Although in many cases DWR is not involved in the direct implementation of recreation improvements and programs at the field level, it is ultimately DWR's responsibility to ensure that all improvements, maintenance, and studies prescribed in the FERC License are properly carried out. Consistent with its responsibilities, DWR works with DPR, DBW, and DFG to provide for recreational opportunities and funding throughout the study area.

DPR

As the manager of LOSRA, DPR is the primary provider of recreation opportunities and facilities within the project area. DPR's Core Programs, linked directly to the agency's mission, include Resource Protection, Education and Interpretation, Facilities, Public Safety, and Recreation (DPR 2001). Routine tasks performed by DPR staff include collecting fees and monitoring attendance; cleaning and maintaining restrooms and toilet buildings; servicing trash receptacles; maintaining camping and day use areas including launch ramps, courtesy docks, and 47 miles of trails; monitoring and maintaining buoys and vessels; and maintaining recreation area grounds and landscaping. DPR and DWR maintain a floating debris removal program on Lake Oroville whereby boats are use to picked up debris and deliver it to collection points (cove areas with debris containment booms), where it is collected from the shore after the reservoir has receded.

DPR is also responsible for carrying out boat safety inspections and providing safety patrols at Lake Oroville, Thermalito Forebay, and Diversion Pool. (Patrols are not regularly conducted in the Diversion Pool and Thermalito Forebay due to relatively low levels of boating activity.) Less frequent tasks include road maintenance for approximately 21 miles of road, maintenance of all park utilities (including electrical, water, and wastewater facilities), and capital improvement of all recreational facilities. Under the direction of DPR, two private concessionaires operate and maintain facilities at Bidwell Canyon and Lime Saddle Marinas, subject to DPR contracts and oversight (pers. comm., Feazel 2002).

Utility services in the recreation area are overseen by a water/sewer plant supervisor. In addition to LOSRA staff, DPR's other Northern Buttes District administrative staff provide additional aid to all units in the DPR District. DPR annually hires additional seasonal support staff in the summer to operate entrance stations and carry out basic facility maintenance tasks.

The Seventh Generation: The Strategic Vision of California State Parks (DPR 2001) outlines the strategies and management practices that DPR follows in managing parks throughout the State. DPR manages interpretive programs, most Lake Oroville Visitors Center activities, special events coordination, and general recreational opportunities

with that guiding document in mind. More specific to the project area, DPR is currently circulating a draft updated General Plan for LOSRA. The General Plan update establishes a long-range vision for the park and provides guidelines to protect and improve the park's natural, cultural, and recreational values. It is being prepared in coordination with the DWR Recreation Management Plan for the Oroville Facilities being prepared within the relicensing process for submittal to FERC.

Although DPR manages the majority of LOSRA's recreational aspects, as stated, DWR bears the ultimate responsibility under the current FERC License for ensuring funding, development, operation, and management of current and additional recreation facilities at the Oroville Facilities. In addition, the Davis–Dolwig Act requires DWR to plan for and acquire land for recreation in conjunction with all SWP development. Under the Davis–Dolwig Act, DPR has the authority to design, construct, operate, and maintain recreation facilities of the SWP.

DBW

DBW, another department of the California Resources Agency, administers a number of programs, including boating and aquatic safety education and training programs, boat and yacht licensing programs, and programs that fund the development of public-access boating facility projects. DBW funds and constructs various projects at LOSRA and the OWA related to boating and boating-related facilities, including boat-in facilities, launch ramps and associated parking areas, floating restrooms, other restrooms at boat ramps, and general renovation of boating facilities. Projects pursued by DBW are typically proposed following suggestions from other agencies and from the public through DBW's public outreach programs. Following construction, the responsibility for operation and maintenance of facilities is turned over to the appropriate land managing agency—in this case it is DPR (LOSRA) or DWR (Thermalito Afterbay). DBW neither owns nor manages any recreational facilities or activities within the study area (pers. comm., DiGiorgio 2003).

DBW has spent $9.4 million on constructing and maintaining boating facilities that support boating at LOSRA since 1995. When this amount is adjusted (normalized) to 2002 using the Consumer Price Index for California, DBW expenditures for recreation-related projects at LOSRA total $18 million.

DFG

DFG management in the LOSRA is limited to the enforcement of hunting and fishing regulations and the California Fish and Game Code, management of the fish stocking program, and participation in biological studies (pers. comm., Atkinson 2003). DFG also participates in some habitat improvement programs, the project management of wildlife and special-status species habitat, and related issues falling under Statewide DFG jurisdiction.

BLM

BLM is responsible for scattered lands managed under the direction of the 1993 Redding Resource Management Plan (RRMP) discussed below. Within the FERC project boundary, BLM manages approximately 3,852 acres of land in scattered, non-contiguous parcels along the West Branch, the North, Middle, and South Forks of Lake Oroville. BLM lands within the FERC project boundary represent 9.4 percent of the total 41,142 acreage of the project. Of the total acres of BLM-administered public lands within the study area, approximately half are submerged under Lake Oroville. Currently, BLM does not actively manage recreation on any lands within the study area (pers. comm., Williams 2003; pers. comm., Ritter 2002).

USFS

Within the LOSRA boundary, there are 1,811 acres of Plumas National Forest lands, which are comprised of several fragmented holdings distributed proportionately between the North, Middle, and South Forks of Lake Oroville. There are also 228 acres of Lassen National Forest lands within the LOSRA, located on the North Fork arm of the reservoir, which are administered by the Plumas National Forest (pers. comm., Graham 2004). All National Forest (NF) lands within the study area are part of the USFS French Creek, Galen, Kellogg, and Feather Falls Management Areas, where ownership is a checkerboard of private, State, and federally-owned parcels (USFS 1988).

The French Creek, Galen, Kellogg, and Feather Falls Management Areas, including those areas that overlap with the study area, are managed with a number of specific goals related to resource conservation, provision of high quality recreational opportunities, and protection of visual resources. The Forest Plan specifically calls for the promotion of efficient recreation management in both the French Creek and Galen Management Areas by allowing DPR to manage recreation on Plumas National Forest lands that fall within the LOSRA boundary, per a 1978 Memorandum of Agreement between the two agencies (USFS 1988; USFS and DPR 1978).

Management of Oroville Wildlife Area

The OWA consists of 2 informal subunits: the 5,700-acre original management area adjoining the Feather River (formerly known as the Oroville Borrow Area) owned by DFG, and the approximately 6,000 acres of Thermalito Afterbay and surrounding lands managed by DFG under an agreement with DWR. The non-Afterbay portion of the OWA is managed primarily for dispersed types of recreation such as hunting, fishing, and bird watching and developed facilities are minimal. Waterfowl and upland game hunting are permitted in the OWA, including in Thermalito Afterbay. The area is managed primarily for day use but primitive camping areas are located near the Larkin Road access point (Thermalito Afterbay Outlet).[3] Limited gravel extraction also occurs in a few locations. The Afterbay subunit is also managed for dispersed types of recreation

[3] Primitive camping was allowed at another interior OWA location, One-Mile Pond, until March 2004. The designation of this area for camping was terminated due to the conflicts it presented with adjacent areas of the OWA being closed to nighttime use.

and for day use only, but it also has three additional developed boat launching and day use facilities.

DFG

DFG's goals in managing the lands and facilities at wildlife areas are to maximize the amount and quality of habitat available for fish and wildlife, while also providing for use and enjoyment of the area by the public (DFG 1978; pers. comm., Atkinson 2003; pers. comm., Rischbieter 2003). Ideally, DFG manages wildlife areas to protect and enhance fish and wildlife habitats and the populations that depend on them, while allowing compatible recreation in the areas used by the public only to the extent that such uses do not interfere with the primary goals of fish and wildlife management.

DFG manages the OWA under the 1978 Oroville Wildlife Area Management Plan (DFG 1978), the California Fish and Game Commission's Hunting and Other Public Uses on State and Federal Lands California Regulations (DFG 2002b), and the California Fish and Game Code, Sections 1525–1530 (OLC 2003c). DFG, with limited assistance from DWR, works to achieve the objectives laid out in these documents through its lands, facilities, and fish and wildlife management strategies and practices. Additionally, as the State agency responsible for enforcement of hunting and fishing regulations on all public and private lands, DFG coordinates with the other management agencies in the study area to ensure that regulations are enforced.

DFG management responsibilities at the OWA includes facilities management, maintenance (such as solid waste collection and removal), boundary posting, fencing and signage repairs, code enforcement, and patrolling for illegal uses such as dumping and OHV use. DFG management actions also include habitat enhancement and inventorying and monitoring of vegetation and wildlife, including the monitoring of habitat improvement areas (pers. comm., Atkinson 2003). DFG's habitat enhancement program includes a wood duck nest-box program and dry land farming for nesting cover and improved wildlife forage. Fish and wildlife-related facilities also include hunting blinds located within the OWA.[4]

A unique aspect of the OWA, compared with other California State Wildlife Areas, is the ongoing gravel mining activity. Mining is not typically consistent with the California Fish and Game Code or with any of the management goals set forth by DFG for wildlife areas. Leases providing for gravel extraction from the OWA are allowed due to legal agreements (developed prior to the designation as a wildlife area) that provide for this use, though some are a result of a land exchange between DFG and commercial gravel interests.

DWR

As a result of the 1993 Amended Recreation Plan, new day use facilities were constructed at Thermalito Afterbay by DWR in coordination with DFG (DWR 1993).

[4] DFG terminated day-to-day management activities and staffing at the OWA, effective March 1, 2004, owing to State Budget shortfalls.

DWR continues to manage two paved boat ramps and one car-top ramp and associated day use facilities on Thermalito Afterbay. The new facilities have led to increased use levels that may not be fully compatible with a designated wildlife area (pers. comm., Atkinson 2003). DWR also funds a contract with the Butte County Sheriff's Department for boat patrol on the Thermalito Afterbay portion of the OWA.

In 1993, a memorandum of agreement (MOA) was created for “Development and Management of Thermalito Afterbay Brood Ponds and Surrounding Habitat.” This MOA was created between DWR, DFG, and the California Waterfowl Association to implement a plan for the development, operation, and maintenance of brood ponds and surrounding habitat to enhance wildlife at Thermalito Afterbay as part of the Central Valley Joint Venture Implementation Plan. DWR constructed three brood ponds, one per year following the MOA dated August 17, 1993 (DWR 2003).

Management of Recreation on the Feather River

About 10 miles of the Feather River, including about 5 miles of the Low Flow Channel, flows adjacent to and through the OWA; thus, recreation management of the river overlaps to a large extent with the OWA management discussed above. However, about 3 miles of the Low Flow Channel, about half of which is within the FERC project boundary, is upstream of the OWA and provides additional recreation opportunities.

The first three-quarters of a mile of the Low Flow Channel below the Thermalito Diversion Dam is occupied by the Fish Barrier Pool, which is accessible to the public by nearby trails but which receives very little use. The Fish Barrier Pool and approximately 1 mile of the river downstream from the Fish Barrier Dam is within the FERC project boundary. The Feather River Fish Hatchery occupies much of the right riverbank immediately below the Fish Barrier Dam. The remaining 1.5 miles of the river and adjacent riverbanks are outside the FERC project boundary and are owned or managed by the City of Oroville, the FRRPD, or are in private ownership.

Fishing Regulations

The segment of the Feather River in the project area is one of the most popular seasonal fishing destinations on the region, hosting tens of thousands of anglers each year (DWR 2001a), most of whom are drawn by the well-known salmon and steelhead fisheries. The most popular location for anglers to congregate is at the Thermalito Afterbay Outlet within the OWA, but anglers also boat, wade and use the riverbanks in the upstream section. DFG holds primary responsibility for fish and wildlife management within the State and therefore has jurisdiction to enforce DFG laws on all lands within the project area, including all of the Feather River. Most of the Feather River is open to fishing during certain periods each year. Fishing along the Feather River from the Fish Barrier Dam downstream to the Table Mountain bicycle bridge is prohibited year-round. Fishing from the Table Mountain Bridge to the Highway 70 bridge is permitted from January 1 to July 15 (barbless hooks only). Fishing is permitted throughout the year on the remainder of the river within the project area, but catch limits for trout and salmon vary by season.

Feather River Fish Hatchery (DWR and DFG)

The Feather River Fish Hatchery was built in 1967 to compensate for salmon and steelhead trout spawning grounds lost due to the construction of the Oroville Dam. The hatchery was designed as a relatively compact facility where a large number of adult salmon and steelhead could be held and artificially spawned.

The Feather River Fish Hatchery is funded by DWR and managed by DFG. DWR has assisted DFG with fish rearing and stocking, and with developing management protocols at the hatchery. The Fish Barrier Dam, located immediately upstream of the hatchery, prevents fish from traveling further upstream. The flow over the dam maintains fish habitat in the Low Flow Channel of the Feather River between the dam and the Thermalito Afterbay Outlet while providing attraction flow for the hatchery. Salmon and trout follow a fish ladder from the base of the dam up to the hatchery, where they are artificially spawned. Underwater viewing windows allow visitors to watch the fish as they swim and leap up the ladder. Hatchery facilities have a production capacity of 10 million fall-run salmon, 5 million spring-run salmon, and 450,000 steelhead annually (pers. comm., Kastner 2003). However, diseases have reduced hatchery production in some recent years.

FRRPD

The FRRPD, established by Butte County in 1952 to provide recreation and park services to the residents of the City of Oroville and surrounding communities, is a special assessment district encompassing 700 square miles of southeastern Butte County (City of Oroville 1995; FRRPD 2002). The FRRPD provides a variety of recreation programs to the community and owns or leases several parks and sports facilities, several of which lie near or adjacent to the study area (City of Oroville 1995; FRRPD 2003). Riverbend Park and the adjacent Bedrock Park on the Feather River are important community assets and are linked to the Diversion Pool and the OWA recreation sites within the project area by a paved segment of trail (part of the 41-mile Brad Freeman Trail).

5.10.1.5 Visitors' Experience, Perceptions, and Preferences

This subsection summarizes information obtained primarily by recreation visitor surveys conducted throughout the project area that outlines overall satisfaction, perceptions of key issues, and perceptions related to recreation facilities and management. Additional information was obtained through on-site observations. The summary is organized by management area and primary recreation activities in those areas.

Lake Oroville State Recreation Area

LOSRA visitors indicated they were satisfied with their overall recreation experience and relatively few felt crowded. From 70 to over 93 percent of visitors to these areas indicated they were satisfied, very satisfied, or extremely satisfied with their trip to the area. Regarding crowding at recreation sites, about 67 percent of Thermalito Forebay visitors, 70 percent of Lake Oroville visitors, and over 90 percent of Diversion Pool

visitors rated their perception of crowding between “not at all crowded” to “slightly crowded.”

Additional information is reported below that describes specific activity groups’ level of satisfaction, and existing issues and problems identified at LOSRA through the completion of recreation technical studies.

Boating

In general, the Recreation Surveys (SP-R13) indicated that boaters enjoy a high level of satisfaction with their boating experiences, with about 74 percent stating they were satisfied to extremely satisfied. Large majorities felt the number of boat ramps, marinas, boat-in gas stations, and boat-in campsites were adequate. Relatively few boaters felt the number of watercraft on the water or interactions/conflicts between boaters was more than a slight problem and large majorities felt most of these issues were not a problem at all. Boaters’ greatest concerns related to exposed land and shallow areas during low water levels, which are unavoidable effects of reservoir drawdown and which are most prevalent during the late summer and during drought periods.

Boaters’ use of several of the boat ramps may be hampered by the lack of boarding docks for some of the launch lanes and a majority of boaters felt the number of docks or temporary moorage sites was too few. Also, excessive floating debris, mud and debris on the boat ramps, and partially grounded floating docks during low water periods were observed at some locations. Some boaters expressed concern about the amount of floating woody debris that remains on the surface of Lake Oroville during the spring and early summer, in spite of DWR’s and DPR’s collection efforts.

Camping

Overall, LOSRA campers expressed high satisfaction with their experience at the campgrounds and 74 percent of campers said they were satisfied, very satisfied, or extremely satisfied with their trip. Large majorities of Lake Oroville visitors felt the number of campgrounds, campsites with RV hookups, group campsites, and number of shower facilities were adequate. Nearly half of those visitors felt that the number of floating campsites was too few. The floating campsites are a unique and popular type of facility, but the limited number of suitable sites and high maintenance requirements are likely to limit further expansion.

A few campers at each campground made requests for a range of additional amenities, such as play areas for children, more convenient trail access to the shoreline, and more availability of food and convenience items.

Angling

About 76 percent of Lake Oroville anglers, 80 percent of Thermalito Forebay anglers, and 91 percent of Diversion Pool anglers stated they were satisfied with their angling experience. Those who were not satisfied most often said their failure to catch fish was

the reason, but most anglers reported catching fish and catch rates appear to be good. Anglers' perception of crowding in the areas where they fished were generally low with 74 percent at Thermalito Forebay, 76 percent at Lake Oroville, and 100 percent at Diversion Pool considering these areas to be not at all crowded to slightly crowded. With exception of at the Diversion Pool, large majorities of LOSRA visitors felt the number of fish cleaning stations was adequate.

Trail Use

About 83 percent of visitors whose primary activity was trail use indicated that they were satisfied, very satisfied, or extremely satisfied with their trip. Also, a high percentage of trail users (generally over 90 percent in each management area) expressed satisfaction with the condition of the trails. Large majorities of Lake Oroville, Diversion Pool, and Thermalito Forebay visitors considered the number of paved and unpaved bike trails, hiking trails, and equestrian trails to be adequate; while not a majority, about 43 percent of Diversion Pool trail users felt the number of equestrian trails was too few. A similar percentage of Lake Oroville and Diversion Pool trail users felt the number of signs indicating trail locations was too few.

In general, few LOSRA trail users (6-9 percent) reported encounters with other trail users that they felt put them at risk. The most common types of such encounters were reported by equestrians in reference to bike riders; other encounters involved walkers with dogs and illegal motorized trial use. A minority of equestrian trail users surveyed expressed dissatisfaction with multiple-use trails (shared with bikes) and expressed a desire for separate trails.

Swimming and Other Day Use

The primary issues surrounding swimming opportunities and other day use activities are related to project operations and are discussed below in Section 5.10.1.6, Baseline Effects of Project Operations on Recreation Resources. Related to this is the finding that from one-half to two-thirds of Lake Oroville and Diversion Pool visitors felt the number of swim areas and developed day use or picnic areas along shore were too few and about one-third of Lake Oroville visitors considered access to the shoreline to be a moderate or big problem. Reservoir drawdown is the primary constraint on these types of shoreline developments at Lake Oroville.

In regards to other types of day use facilities, large majorities of LOSRA visitors felt the number of group picnic sites, equestrian facilities, and restrooms was adequate.

An additional issue related to swimming involved water quality at the popular swim beach at the North Forebay DUA. Water quality testing done for environmental technical studies indicated that bacteria levels were consistently high in the area during the summer, possibly due to the high number of geese present in the area.

Oroville Wildlife Area

In keeping with prior data analysis and technical study plan reports, data from the greater OWA and Thermalito Afterbay visitors is reported separately, although Thermalito Afterbay is managed as a part of the OWA.

Most OWA visitors indicated they were satisfied with their overall recreation experience. About 64 percent of OWA visitors and 69 percent of Afterbay visitors indicated they were satisfied, very satisfied, or extremely satisfied with their trip to the area. Regarding crowding at recreation sites, about 67 percent of Thermalito Afterbay visitors rated their perception of crowding between not at all crowded and 3 slightly crowded. However, perceptions of crowding at the OWA were higher with about 50 percent rating crowding between moderately crowded and extremely crowded. These responses are strongly associated with the Thermalito Afterbay Outlet site, described previously as one of the most popular salmon and trout angling locations in the region, particularly during the fall spawning run.

Additional information is reported below that describes specific activity groups' level of satisfaction, and existing issues and problems identified at the OWA through the completion of recreation technical studies that may reduce enjoyment and satisfaction for some visitors.

Areawide Issues

Three issues appear to be affecting recreation satisfaction and enjoyment in many areas of the OWA. First among these is safety and security. Although the majority of OWA visitors surveyed felt overall safety and security as well as law enforcement presence was not a problem in that area, higher percentages (20 and 30 percent, respectively) than in any other area felt these were moderate or big problems. Second is litter accumulation, which was noted at camping and day use areas as well as along parts of the riverbank and dispersed access areas used by anglers. Three quarters of OWA visitors considered litter along the shoreline to be a moderate or big problem, and 58 percent held this perception of sanitation along the shoreline. Third, parts of the gravel levee-top roads that provide access to most of the OWA are rough and washboard with frequent potholes.

Camping

Large majorities of OWA and smaller majorities of Thermalito Afterbay visitors felt the number of campgrounds, campsites with RV hookups, group campsites, and shower facilities were too few. However, as described above, the level of recreation development represented by developed campgrounds generally conflicts with the policies and goals of the DFG for management of State Wildlife Areas.

Some campers expressed dissatisfaction with the primitive camping facilities provided in the OWA. Litter, vegetation damage, and other ecological effects were noted in the primitive camping areas, as were camper concerns about personal safety and adequate law enforcement presence.

Angling

About 82 percent of OWA anglers and 72 percent of Thermalito Afterbay anglers stated they were satisfied with their angling experience. As at LOSRA, those who were not satisfied most often said their failure to catch fish was the reason, but most anglers reported catching fish and catch rates appear to be good. Crowding and undesirable site conditions such as litter, overflowing garbage cans, and dirty (or the lack of) restrooms were also given as reasons. Anglers' perception of crowding in the areas where they fished were generally low at Thermalito Afterbay with about 63 percent of Afterbay anglers considering the area to be not at all crowded to slightly crowded. In contrast, only 31 percent of OWA anglers considered the areas where they fished to be not at all to slightly crowded, while about 54 percent considered it moderately to extremely crowded.

Most Afterbay visitors considered the number of fish cleaning stations to be adequate (one is provided at Monument Hill DUA), but about 90 percent considered the number provided at the OWA (none are provided) to be too few. It should be noted that DFG recommends that fish be cleaned in the Feather River, as the entrails provide nutrients to the system that would normally be provided by natural salmon mortality.

Other issues about which OWA anglers expressed concern included rude behavior by other anglers, illegal fishing practices, and the amount of litter on the riverbanks. The high concentration of anglers at the Thermalito Afterbay Outlet can sometimes cause conflicts between anglers (in particular between bank and boat anglers), and many anglers felt additional law enforcement was needed.

Hunting and Other Open Space Activities

Three out of four hunters interviewed within the OWA were satisfied with their hunting experience, and most who were hunting for ducks (the most commonly hunted game in the area) were successful, as were most turkey hunters, and over 40 percent of pheasant hunters. However, dissatisfied hunters felt that the habitat in the area needed improvement and several hunters felt habitat had declined in recent years. Exotic weeds invading many of the ponds used for waterfowl hunting was seen as a major problem.

Wildlife viewing and nature study opportunities are prevalent in the OWA, with a large variety of species of birds, mammals, reptiles and amphibians. However, as described previously, the lack of facilities along with trash accumulation, dumping, and rough roads may discourage organized nature study field trips by school groups or by individuals. Over one-half of Afterbay visitors and nearly three-quarters of OWA visitors considered the number of interpretive programs and educational opportunities to be too few.

Boating on Thermalito Afterbay

Use of powerboats and PWC at speeds greater than 5 mph is technically not allowed by DFG within State Wildlife Areas, in accordance with boating speed restrictions specified

in Title 14 of the Fish and Game Code. However, these speed limits have historically not been enforced. To the contrary, boating access improvements used by all types of power boaters including water-skiers and PWC riders have been constructed in recent years and a water-ski slalom course was installed. Essentially, boating speeds are not enforced on Thermalito Afterbay due to conflicting management goals; in this case, DWR's goal is to provide recreational boating opportunities and DFG's goal is to limit activities inconsistent with wildlife management, enhancement, and protection (pers. comm., Atkinson 2003).

Feather River

In keeping with prior data analysis and technical study plan reports, discussion for the Feather River is for sites on the Low Flow Channel portion of the river, upstream of the OWA. Other Feather River sites are included within the OWA, since all of the recreation access and sites are within the OWA. Low Flow Channel survey sites included the Feather River Fish Hatchery (within the FERC project boundary) and Riverbend Park (outside the FERC project boundary).

Most Feather River visitors indicated they were satisfied with their overall recreation experience. About 62 percent of visitors indicated they were satisfied, very satisfied, or extremely satisfied with their trip to the area. About 77 percent of anglers said they were satisfied with their fishing experience. Regarding crowding at recreation sites, about 76 percent of visitors rated their perception of crowding "not at all crowded" and "slightly crowded."

Few issues and problems were identified at the Feather River Fish Hatchery or other Feather River areas through the completion of recreation technical studies. Large majorities considered most trail, camping, and boating facilities to be adequate in number. About 74 percent considered the number of fish cleaning stations to be too few (none are provided). Although not a majority, about 43 percent considered the number of restrooms to be too few. Few visitors considered any management issues, water condition issues, or user interaction issues to be a problem. The issue of litter along the shoreline may be considered an exception, with 41 percent considering this to be a moderate or big problem.

Projectwide

A few issues pertinent to recreation across the project area were identified through the completion of the recreation technical studies and other aspect of the relicensing program.

First, the collaborative relicensing process has included a discussion of a need for a comprehensive trails plan to resolve issues around multiple use of trials and trail safety, and well as issues surrounding needs for trail expansion, trail maintenance, development of more loop trails, and potential for specially-designed single-track mountain bike trails. The Recreation Needs Analysis (SP-R17) recommends that a

Comprehensive Non-Motorized Trails Program be developed to address all trail and trailhead management issues.

Second, the Recreation Needs Analysis suggests that a comprehensive Interpretation and Education (I&E) Program should be developed to plan and coordinate I&E efforts among the several agencies who provide access and facilities in the area. In addition, it was noted that few interpretive facilities exist downstream of Lake Oroville, with the exception of fisheries-related displays at the Feather River Fish Hatchery and standard informational bulletin boards at some sites.

Third, several stakeholder groups believe that non-local visits to the area, an important factor in economic growth, could be increased by additional facilities to support special events. DPR and FRRPD are responsible for permitting or organizing several special events each year. Special events that are currently being offered in the Lake Oroville area on an annual basis or more frequently include but are not limited to major fishing tournaments, equestrian trail rides, a competitive mountain bike ride, a triathlon, an Independence Day celebration, a salmon festival, and Butte Sailing Club events. Each of these events occurs in total or in part within the project area. Specific interest has been identified in new or enhanced facilities to support these event or other events such as water-skiing competitions, power boat races, and PWC races, some of which have been held in the project area in past years.

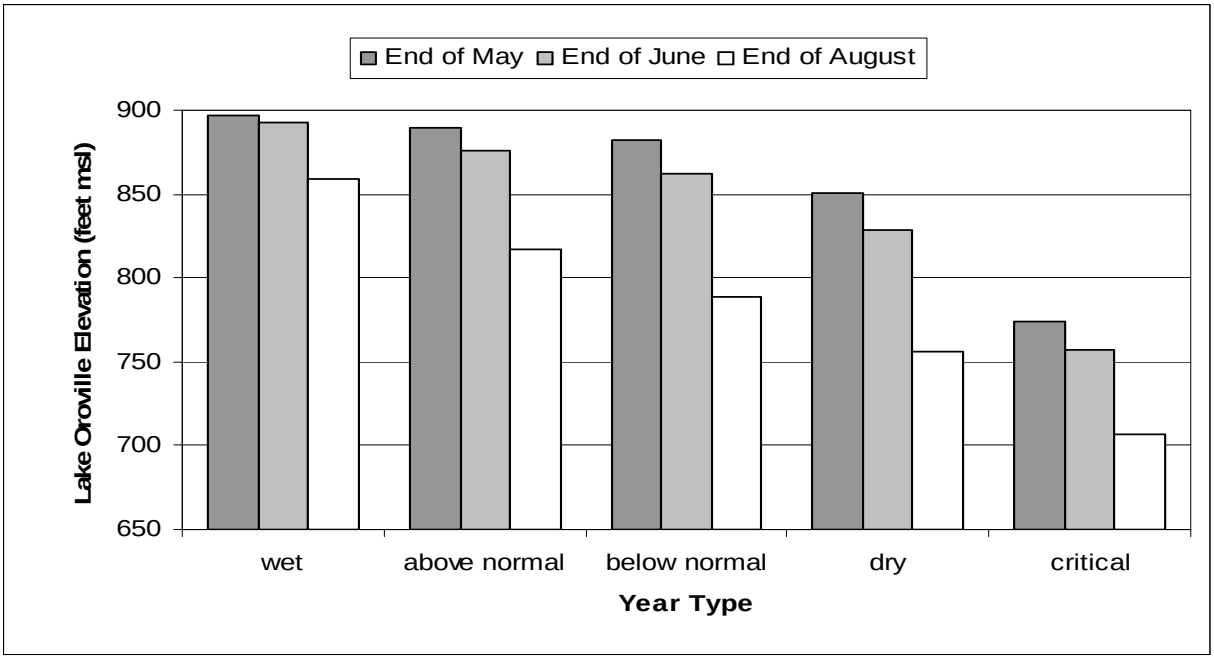
5.10.1.6 Baseline Effects of Project Operations on Recreation Resources

Several important effects of project operations on recreation resources, identified within the recreation studies and quantified using hydrologic modeling conducted by the licensee, would continue into the future. Prominent among these are effects of the drawdown of Lake Oroville during the normal annual cycle of reservoir operations. Other effects include weekly fluctuations in water level at Thermalito Afterbay, cold water temperatures through the peak summer boating and swimming period in areas downstream of Lake Oroville (Diversion Pool, Thermalito Forebay and Thermalito Afterbay, and Feather River), and regulated flows in the Low Flow Channel of the Feather River.

Lake Oroville Drawdown Effects

The annual drawdown of Lake Oroville affects boating, shoreline access and use (including swimming), and indirectly affects angling and camping. Effects are slight but negative in most cases (and positive in some cases) at pool levels within about 50 feet of full pool (850 to 900 feet msl). Effects are moderately negative in most cases at pool levels between 800 and 849 feet, but are more severe at certain types of facilities. Below 800 feet, effects become more substantial at several facilities, and 1 major boat ramp closes at a pool elevation of 775 feet. Access to the reservoir for both boaters and shoreline users is available down to pool levels below 700 feet, but the quantity and quality of access is progressively reduced as the pool level declines.

Hydrologic modeling based on historic hydrologic conditions for a 73-year period (1922-1994) has produced simulations of Lake Oroville elevations at several key end-of-month dates during the peak summer use season, for different water-year types (wet, above normal, below normal, dry, and critical) under existing operating conditions and levels of demand for water (see Figure 5.10-3). These results can be used to evaluate likely reservoir conditions at specific times of year and the associated effects on recreation. Results for the end of May represent conditions soon after the Memorial Day holiday weekend, the traditional start of the peak boating season. Results for the end of June represent conditions just before the Independence Day holiday, which often is the highest use period of the year. Results for the end of August represent conditions just prior to the Labor Day weekend, after which recreation activity typically declines sharply.



Source: DWR 2004

Figure 5.10-3. Modeled Lake Oroville elevation during peak recreation season under Existing Conditions, by water year type (average pool level).

Effects on Boating

Drawdown affects the number of boat ramps and launch lanes available to boaters and the ease of use of the facilities. Both the number of ramps and the number of launch lanes available decreases with decreasing pool levels, with the major developed launch ramps narrowing in stages and each closing due to low water at different elevations. Pool elevations below 800 feet result in the most substantial effects with 1 ramp closed and at least 16 of the 33 total launch lanes reservoir-wide unavailable.

The results of the hydrologic modeling described above indicate that the average pool elevation at the end of May would be 775 feet during critical years. This means that two of the five developed boat ramps on the reservoir would be closed from the start of the season or soon after. The average pool elevation on that date in other (wetter) years

would be about 850 feet or higher, and effects on boat ramps would be minor. Modeling results for the end of June are similar to the end of May, with substantial effects on boat ramps only in critical years. The modeling for the end of August, however, indicates that baseline operations effects would include average pool elevations below 800 feet in below normal years and much below 800 feet during dry and critical years. Average pool elevation in above normal years is expected to be just slightly above 800 feet at that date.

Regarding low-water access, the ramps at Lime Saddle, Bidwell Canyon, and Spillway each provide boaters access to the water down to pool elevations between 702 and 695 feet msl. This means that boaters will have access to the water at these sites during all but the lowest low water periods, which may occur during the late fall and winter during droughts. The reservoir pool elevation fell below 700 feet for several weeks in late 2002 but prior to that had not been below 700 feet since March 1991. Each of these ramps provides 2 or 3 launch lanes at their lowest usable elevations.

The ramp at Loafer Creek primarily serves boaters camping at the Loafer Creek Campground and becomes unusable at the substantially higher elevation of 775 feet msl. This means the ramp is likely to be unavailable by mid- to late-summer during drier than normal years. When the ramp is closed, boating campers in the Loafer Creek area, the primary users of the ramp, can instead drive several miles to the Bidwell Canyon or Spillway ramps.

The remaining developed ramp, the Enterprise boat ramp, is a two-lane facility that primarily serves rural residents on the east side of the reservoir. The ramp closes below pool elevations of about 835 feet msl, which means the ramp is likely to be unavailable during part of the summer boating season, even during above normal water years. The ramp may be closed for all or most of the summer boating season during drier than normal years. When the ramp is closed, the primary users from the local rural area are required to drive a considerable distance to a ramp at the south end of Lake Oroville in order to launch their boat.

In addition to launch ramp and lane closures, low pool levels make use of most of the boat ramps more difficult by requiring boaters to walk long distances up and down the steep ramps between the water and their vehicles parked above. In particular, boaters using the Lime Saddle and Bidwell Canyon ramps, where low-level parking is limited or non-existent, complain about the long and steep walk to and from their vehicles from their boats when the pool level is low. Two other ramp conditions related to reservoir drawdown have also been a problem at times: mud and debris on the ramps, and floating boarding docks being partially or completely grounded as the reservoir reaches low water levels.

The car-top boat ramps (essentially old roads within the inundation zone) vary in respect to when pool elevation limits their use. This feature depends on the slope of the land and the length and condition of the old roads that provide access to the shore and water. The three ramps on the West Branch arm of Lake Oroville have steep shorelines, making hand launching difficult at low water levels and limiting other

shoreline use. The Vinton Gulch and Nelson Bar Car-top boat ramps provide trailer launching only at high or moderately high pool levels (above 840-850 feet msl). These sites continue to provide some opportunity for hand launching of boats until the pool elevation falls below about 825 feet. Steep and rocky shorelines preclude use by boaters below that elevation. At the Dark Canyon Car-top BR, the access road runs for some distance along the side of Dark Canyon cove providing opportunities for hand and trailer launching until the reservoir is below about 765 feet msl.

The gently-sloped shoreline of the Foreman Creek Car-top BR attracts shoreline use by both boaters and non-boaters and the road extends far into Lake Oroville, providing launching opportunities even at low pool levels. However, the road may be covered by mud and debris at low pool elevations, and use of the area was observed to be low at those times. Similarly, the abandoned road at the Stringtown Car-top BR extends far enough into the reservoir to be used for launching at low pool levels. The County road leading to Stringtown Car-top BR, however, is long and winding, and relatively few boats are launched in the area. The dominant use is by fishermen using small boats, and who generally fish in nearby parts of the reservoir. (A sign stating that trailer launching is prohibited is posted at the turnoff to the Stringtown Car-top ramp.)

In addition to the facility-related effects, drawdown can affect the recreational experience of boaters while out on the reservoir. Although crowding has generally not been found to be a problem on Lake Oroville, the surface area available for boaters to use decreases as the pool level falls. At 800 feet elevation, the reservoir has about 11,250 surface acres, nearly a 30 percent decrease from full pool. As the reservoir shrinks, coves favored by house boaters and others for anchoring and mooring to the shoreline, and for water-skiing and similar sports, become gradually dewatered. This increases competition among boaters for these sites, which may become a greater concern only during years when severe drawdown occurs during the peak summer boating season. Declining water levels also increase the number of outcrops and other such obstructions at or near the surface, which limits boating activity in some areas. For safety, hazards in high-traffic areas are marked with buoys and a 5mph boat speed limit is imposed within 200 feet of shore (reservoir-wide) year-round.

Effects on Angling

Effects of project operations on reservoir boating, as discussed above, also apply to angling to a large degree in that most angling in the area (with the exception of angling on the Feather River) occurs from boats. Therefore, drawdown has effects on fishing at Lake Oroville to the extent that boater access is affected. However, angling activity at Lake Oroville, including major fishing tournaments, peak during the fall and spring and usually does not appear to be greatly affected by the typically low, off-season pool levels. The typically reduced number of launch lanes available during those seasons has generally not been a major impediment to these events, except during the most extreme low water conditions. (For example, a tournament was held November 23, 2002 at the Bidwell Canyon boat ramp when the reservoir pool elevation was below 700 feet msl.) Although conflicts may occur if few launch lanes are usable, relatively few

pleasure boaters use the launch facilities during the non-summer months, reducing competition for use of the ramps and potential conflicts.

Effects of drawdown on bank fishing may be greater, in that low water levels make the shoreline less accessible in most areas. However, at a few locations on Lake Oroville, a moderate degree of drawdown leads to more exposed and accessible shoreline for bank fishing that at high water levels is not available or is difficult to reach.

Effects on Shoreline Use and Swimming

The Oroville Facilities are located in a region with hot summer temperatures, and often warm temperatures in the late spring and early fall, which helps make swimming an activity much in demand. Lake Oroville has one developed swim area at Loafer Creek, but much of the swimming activity is more informal in nature. Swimming activity often occurs at the same locations and in conjunction with other shoreline-based day use activities such as picnicking, sunbathing or relaxing in the shade, and bank fishing.

The swim beach and associated facilities at the Loafer Creek Day Use Area are used by both day users and campers staying at the nearby Loafer Creek camping facilities. The area receives heavy use during periods of high reservoir water levels; however, the beach becomes unusable as designed when the reservoir is more than about 50 feet below full pool. Historically, this has meant that the beach has not been usable at all during the summer some years and has been unusable a large part of the summer most years.

Several other small day use facilities without swim beaches exist at Lake Oroville, generally in association with boat ramps, and each with picnic tables, grills, and shade structures or trees. Lake Oroville visitors also use the car-top ramp areas as informal swimming and day use areas. Several of these become more usable by swimmers, picnickers, anglers, and others as reservoir level decreases, exposing more usable shoreline. Visitors have expressed demand for additional developed shoreline access sites but reservoir drawdown combined with steep shoreline slopes is a severe constraint on such additions.

Shoreline use by swimmers, anglers, and others becomes more difficult and less enjoyable as the pool level decreases due to the primarily steep and muddy shorelines in most areas. A moderate level of drawdown has beneficial effects at Stringtown Car-top ramp, because it provides areas of shoreline for parking and recreation use, whereas very little shoreline is accessible or useable at reservoir elevations near full pool.

Effects on Camping

With the exception of boat-in camping, most camping is not directly affected by reservoir drawdown. Only the Bidwell Canyon campground provides sites close to the shoreline. Shoreline use in that area becomes difficult or undesirable due to steep and muddy conditions as the pool elevation falls more than about 50 feet below full pool. Campers at the Lime Saddle and Loafer Creek campgrounds may hike to the shoreline near the

campgrounds, and would also find the shoreline areas increasingly less favorable for use as the pool level falls.

Regarding boat-in camping, at moderate and low water levels the campsites can be a significant distance from the water. Routes from the shoreline to the campsites through the fluctuation zone become lengthy and steep, making these campsites less attractive. Therefore, boat-in campgrounds are generally more popular when the reservoir level is high and become generally unused as the reservoir level drops more than 50 to 70 feet below full pool (830-850 feet msl).

The aesthetic experience of floating campsite users can be negatively affected by drawdown because of the exposed shoreline that becomes a dominant aspect of the visual setting. Access to the floating campsites is not usually affected by drawdown during the majority of the recreation season. (Other aesthetic effects of reservoir drawdown which may affect the enjoyment of visitors to Lake Oroville are discussed in Section 5.11, Aesthetic Resources.)

Effects on Trails

Access to trails or trailheads is not generally affected by reservoir drawdown; however, some trail users would like to have more trails that provide access to the water, which currently is only provided by a few trails when the reservoir is at or near full pool. Additional access may be difficult or infeasible due to changing water levels. Additionally, the aesthetic effect of drawdown can affect the recreational setting for trail users using shoreline trails and therefore affect the recreational trails experience.

Lake Oroville Temperature Effects

As with most deep lakes and reservoirs in areas with temperate climates, Lake Oroville stratifies thermally each year, meaning that warmer waters are located near the surface and colder waters are located at depth. This two-layered system provides an opportunity for both a coldwater fishery (e.g., salmon and trout) and warmwater fishery (e.g., black bass, catfish) to flourish. The warmer waters at the surface, which are generally in the high-70s to mid-80s (°F) during the summer, provide good conditions for swimming and other water-contact recreation such as water-skiing, wake-boarding, and riding personal watercraft.

Thermalito Afterbay Pool Fluctuation Effects

Overall, the surface elevation fluctuates much less at Thermalito Afterbay than at Lake Oroville. The pool elevation fluctuates as much as 4-6 feet on a weekly basis due to project operations, with a rapid drawdown and the lowest elevations typically occurring during weekends. The changes in elevation follow a weekly cycle dictated by hydroelectric power operations and can generally be characterized by a gradual increase in elevation from Monday through Friday followed by a more rapid decrease in elevation during the weekend. The typical 24-hour elevation gain is about 1 foot; the typical 24-hour elevation loss is about 2 feet. Most weeks, the range in elevation is about 3-4 feet. Fluctuations are similar during wetter than normal and dryer than normal

years, although weekly fluctuation during dry years may be slightly greater, in the range of 3-6 feet.

Effects on Boating

Stakeholder input indicates that the low pool levels can cause concerns for boaters using the Thermalito Afterbay boat ramps, particularly when the water level approaches the toe of the ramps. Low water levels also create a risk of grounding or stranding of boats in shallow areas.

Effects on Angling

Angling may be affected to some degree by daily or weekly changes in elevation or temperature changes that affect the fisheries or their reproduction in Thermalito Afterbay, which can in turn affect angling success rates.

Water Temperature Effects Downstream of Lake Oroville

The temperature of the water in the Feather River is regulated during much of the year by drawing of water from lower, colder strata of Lake Oroville. DWR is required to control water temperatures in the river to meet the needs of the Feather River Fish Hatchery and steelhead trout and spring-run Chinook salmon. At mile 61.6 of the Low Flow Channel, the average daily water temperature is required to be less than or equal to 65°F during the months of June through September. As discussed in Section 5.10.1.4, Recreation Management, a 1983 agreement between DWR and DFG specifies water temperature objectives for the Feather River Fish Hatchery ranging from 55°F to 60°F through the summer months. As a result of these requirements, water temperatures are cold year-round in the reservoirs and in the Feather River downstream of Lake Oroville.

Water temperatures are generally uniformly cold in the Diversion Pool and most of Thermalito Forebay, rarely rising above 60°F during the summer. Surface water temperatures in the shallow swim cove where a beach is located can rise into the low-70s, although the water a meter or more below the surface remains at temperatures similar to the main pool of the Forebay. Thermalito Afterbay water temperatures can vary widely. Summer water temperatures are in the low 60s near the tailrace channel where water enters the pool, in the 70s in areas near the outlet to the river, and in the mid-80s in the backwater areas that do not readily circulate (DWR 2001b).

Effects on Swimming

The cold water temperatures in the Diversion Pool and Feather River (generally from the upper-50s to mid-60s) can make swimming unattractive for most people. No swimming was observed in Diversion Pool and little was observed in the Feather River during the study period. Prior to construction of the Oroville Dam, summer water temperatures in this area reached 70-75°F, and swimming was a popular activity. Currently, most of the visitors entering the river are wading anglers.

The cool water temperatures in most of Thermalito Forebay and Thermalito Afterbay reduce the desirability of the water for swimming but, as noted above, some warming of the water does occur in certain areas and several swim beach locations receive substantial use. The substantially warmer water at the North Forebay DUA swim beach, in particular, makes that area very popular with swimmers.

Swimming and water-skiing are popular summer activities at Thermalito Afterbay although water temperatures are less than ideal in some areas, with the warmest waters accessible to most pleasure boaters and skiers reaching the low 70s.

Effects on Angling

Changes in temperature that affect fish populations would also affect fishing success, and subsequently affect the fishing experience. The cold water temperatures of the downstream reservoir and the Feather River support well-utilized coldwater fisheries in all of these areas. The diverse temperature structure of Thermalito Afterbay provides suitable habitat for both warmwater and coldwater fish, including a popular largemouth bass fishery.

Low Flow Effects on the Feather River

The Feather River in the project area consists of two sections: the upper reach, also referred to as the Low Flow Channel, from the Thermalito Diversion Dam to the Thermalito Afterbay Outlet, and the lower reach, downstream of the Thermalito Afterbay Outlet. The Low Flow Channel generally has a flow rate of between 600-700 cfs (600 cfs is the required minimum for fisheries purposes) at most times, although flows may be much higher during the winter and spring of wetter than normal years, as water is released from Lake Oroville for flood control purposes. High volumes of water will also be carried in the Low Flow Channel during actual flood events. Flows in the lower reach are more variable with the lowest flows (about 2,000-4,000 cfs) occurring during the fall and winter most years and higher flows (from 5,000-8,000 cfs) occurring during the mid- and late-summer. Wetter than normal years will result in higher late winter and spring flows (from 6,000-12,000 cfs), while critical years will result in reduced flows (1,500-3,000 cfs) throughout the year.

Effects on Boating

Effects on boating occur, but are not common on this portion of the Feather River. The low flows in the Low Flow Channel reduce navigability, particularly for jet boats and other powered watercraft, because of shallows and riffles created by the low flows and growth of aquatic weeds. Conversely, low flows may make boating easier for novice paddlers and fishing boats wishing to anchor in the river. Paddlers who find shallows and riffles to be a barrier to navigation or who desire a more challenging paddle would have their enjoyment increased with greater flows. In the lower reach, the greater flows increase navigability. Very high flows may make boating more challenging, however field observations suggest that anglers who boat on the river during the prime late

summer and fall fishing season are not deterred from using this very popular fishery resource during high flows.

Effects on Angling

The primary potential effect of low flows on recreation results from potential adverse effects on the coldwater fishery in the river, which is the major focus of most recreation activity there. However, wading by anglers on the river, which is a common angling technique, is made easier by the stable low flows. In the lower reach, the greater flows make wading more difficult in deeper areas. Wading anglers tend to adjust to the higher flows by staying in shallower water or by fishing from the bank or gravel bars.

5.10.2 Environmental Effects

In this section, each of the three alternatives is evaluated for potential effects on recreation. This includes a No-Action Alternative, which describes the future effects of maintaining existing (baseline) conditions, and two action alternatives. The two action alternatives present different groupings of PM&E measures to address recreation resource issues identified during scoping and investigated during the recreation technical studies. The Proposed Action contains those PM&E measures that are fully supported by the recreation study plan reports including the recreation needs analysis.

Evaluating the Effects of Non-Operational PM&E Measures

The recreation resources of an area are primarily composed of the access, facilities, and services provided for public use to facilitate the enjoyable use of the natural resource base contained within the project area. However, the environmental, social and managerial settings are also important factors in determining the overall recreation setting and the type and quality of recreation experiences supported. Therefore, PM&E measures that alter the access, facilities and services provided, or that alter the environmental, social or managerial setting can potentially affect, positively or negatively, the nature and amount of recreation use that can be supported and the quality of the recreational experience.

The environmental setting would be affected by any action that alters the existing vegetation or terrain or changes the level of development of an area, for example, from a wooded and undeveloped site to a more developed site (See Section 5.11 for an evaluation of related to changes in the areas visual character or scenic quality). The social setting may be affected by actions that change the number or type of visitors using a site, or their activities and behavior. The managerial setting may be affected by direct or indirect management actions, whether through staffing, regulatory, signage, or fee changes, that alter the degree of management presence in an area.

The PM&E measures associated with the Proposed Action and Alternative 2 are described in as much detail as is available. Where possible, the specific site, size and components of the action are provided. In some cases, precise locations or the size or number of new facilities depend on future field evaluations and are yet to be

determined. Each PM&E measure is described as having a beneficial, neutral, or adverse effect on recreation resources.

The analysis of the potential effects of non-operational PM&E measures on recreation resources and opportunities is focused on actions that would result in one or more of the following:

- Changes in accessibility to recreation sites or facilities;
- Changes in capacity of recreation sites;
- Changes in level of public safety at recreation sites;
- Conversion of recreation facilities or use areas to other uses, or limitations on the amount or type of recreation activity that may occur in an area;
- Changes in aesthetic conditions that could affect visitor appreciation of an area and the quality of the recreation experience;
- Reduction of opportunities related to one activity resulting in an increase in opportunities for other recreational uses (shifting activities);
- Changes in management of fisheries and wildlife resources (environmental or regulatory changes) that bring about changes in fishing or hunting opportunities;
- Changes in operations and maintenance and clean-up activities associated with existing and new recreation areas;
- Shifts in recreation funding, development, and management structure;
- Changes that affect two competing uses, such as altering river flows to increase fishery habitat versus altering flows for boating; and/or
- Temporary (or short-term) effects on recreation such as restrictions on activities due to construction, dust, or noise, and visual effects during construction.

Evaluating the Effects of Operational PM&E Measures

Changes in project operations for both the Proposed Action and Alternative 2 would be minimal and would have minimal effects on recreation. In particular, little or no change in the timing or magnitude of Lake Oroville drawdown, one of the most important aspects of operations relating to recreation, is expected. However, some effects on recreation may result from proposed changes in Feather River flows in the Low Flow Channel and secondary changes in pool levels of Thermalito Afterbay. (Operational changes that alter the amount of water flowing down the Low Flow Channel will also affect the amount of water flowing through Thermalito Afterbay.) Evaluation of the effects of these operational and non-operational measures relies on information from the technical studies, field observations, and professional judgment. Observation and

interviews of recreationists were conducted on the Low Flow Channel when flow changes similar to those proposed in the Proposed Action and Alternative 2 were implemented on a test basis.

The analysis of the potential effects of operational PM&E measures on the recreation resource and recreation opportunities is focused on PM&E measures that would result in one or more of the following:

- Fluctuation of reservoir water levels, in particular the amount, rate and timing of drawdown;
- Changes in river flows that may affect angling, boating, or body contact recreation such as swimming and wading; or
- Changes in river or reservoir temperature that may affect fisheries or recreational swimming or wading.

The following sections evaluate the effects of the No-Action Alternative, the Proposed Action, and Alternative 2 on recreation resources and opportunities. Table 5.10-2 summarizes the effects.

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Boating			
Enhance ADA accessibility at Bidwell Canyon and Lime Saddle Marinas	Same as Existing Conditions	Beneficial. Better access for users with disabilities. Construction – short-term adverse effects	Same as Proposed Action
Additional boarding docks at main boat ramps	Same as Existing Conditions	Beneficial. Facilitate launching, increase launching efficiency	Same as Proposed Action
Additional boating information	Same as Existing Conditions	Beneficial. Better information for trip planning	Same as Proposed Action
New low water boat ramp at Bidwell Canyon	Same as Existing Conditions	Beneficial. Launching ability below 695 ft msl. Construction – short-term adverse effects	Same as Proposed Action
Expand Bidwell Canyon Marina parking	Same as Existing Conditions	Beneficial for boating. Increase parking capacity. Construction – short-term adverse effects. Neutral effect on camping. Keep same number of sites	Same as Proposed Action
Encourage Lime Saddle Marina repairs	Same as Existing Conditions	Beneficial. Return to previous capacity and services	Same as Proposed Action

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Continued maintenance of Stringtown road above of 866'	Same as Existing Conditions	Same as No-Action plus slightly beneficial due to placement of warning sign for boat launchers	Same as Proposed Action
Extend Enterprise to 750'	Same as Existing Conditions	Beneficial. Increased launching ability, higher quality of experience. Construction – short-term adverse effects	Same as Proposed Action
More frequent adjustment of boarding docks	Same as Existing Conditions	Beneficial. Increased usability of docks	Same as Proposed Action
Increased debris removal at boat ramps	Same as Existing Conditions	Beneficial. Increased launching safety and ramp usability	Same as Proposed Action
Basic facility improvements to Aquatics Center	Same as Existing Conditions	Beneficial. Meet users' growing needs. Construction – short-term adverse effects	Same as Proposed Action
Restrict boat speeds on Afterbay north of SR 162	Same as Existing Conditions	Adverse and beneficial effects. Motorized pleasure boaters reduce use of northern part of Thermalito Afterbay and increase use by non-motorized boaters	Same as Proposed Action
Increase Bidwell Canyon BR parking	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase boat ramp parking. Construction – short-term adverse effects
Open gravel service road at Loafer Creek as a car-top ramp	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase number of days can launch at Loafer Creek
Consider adding more parking at Lime Saddle BR/DUA	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase BR parking. Construction – short-term adverse effects[1]
New low water boat ramp at Lime Saddle	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increased low water access. Construction – short-term adverse effects
Extend Spillway below 695 ft msl	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increased low water access
Consider coordinating future boater take-out or watercraft tow service for whitewater boaters	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase quality of whitewater experience

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Consider obtaining real time river flow data below PG&E Poe Powerhouse	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Facilitate trip planning
Whitewater park	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. New boating opportunities
Camping			
Enhance ADA accessibility at Loafer Creek Group and Equestrian Campgrounds	Same as Existing Conditions	Beneficial. Access enhanced for users with disabilities. Construction – short-term adverse effects	Same as Proposed Action
2 new group RV sites at Loafer Creek	Same as Existing Conditions	Beneficial. Increased capacity and new opportunity. Construction – short-term adverse effects	Same as Proposed Action
Review en-route camping at Spillway	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Better information to determine need for this opportunity
Relocate 3 existing floating campsites closer to Lime Saddle	Same as Existing Conditions	Beneficial. More opportunities for visitors based out of Lime Saddle	Same as Proposed Action
3 additional floating campsites on Lake Oroville	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase camping capacity
Develop campground facility at Thermalito Afterbay Outlet	Same as Existing Conditions	Beneficial. Increased camping capacity and improved facilities. Construction – short-term adverse effects	Same as Proposed Action
Restrict access in inundation zone to specific BICs during low reservoir levels	Same as Existing Conditions	Adverse effects. Reduced BIC capacity, reduced informal day use	Same as Proposed Action
Camp store shell at Bidwell Canyon Campground	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Easier access to supplies. Construction – short-term adverse effects
Modify existing group use meeting hall as a campground activity facility at Bidwell Canyon	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Enhance camping experience. Construction – short-term adverse effects
New campground activity facility at Loafer Creek	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Enhance camping experience. Construction – short-term adverse effects

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Trail linking Lime Saddle Campground to Marina	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Connect sites, expand trail opportunities
New courtesy dock for Lime Saddle Campground users	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Better boater access to campground
Consider constructing 25 to 50 new RV/tent sites at Lime Saddle	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase camping capacity. Construction – short-term adverse effects
Consider constructing 1 new group RV site at Lime Saddle	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase camping capacity. Construction – short-term adverse effects
Angling			
ADA accessible fishing pier at Diversion Pool and South Forebay	Same as Existing Conditions	Beneficial. Facilities for visitors with disabilities. Construction – short-term adverse effects	Same as Proposed Action
Some short additional shoreline access trails at North Forebay	Same as Existing Conditions	Beneficial. Expand fishing opportunities and utilization	Same as Proposed Action
Feather River fishery enhancements: salmonid habitat enhancements and hatchery related actions	Same as Existing Conditions	Mixed. Beneficial - Enhanced angling experience. Adverse effects - Potential boating impediments and increased angling restrictions	Same as Proposed Action
Additional Feather River fishery enhancements: salmonid habitat enhancements, sturgeon passage, and hatchery related actions	Same as Existing Conditions	Same as No-Action Alternative	Mixed. Beneficial - Enhanced angling experience. Adverse effects - Potential increased angling restrictions
Additional fish cleaning stations at North Forebay and Loafer Creek	Same as Existing Conditions	Beneficial. Enhance angling experience	Same as Proposed Action
Trail Use			
Short trail to shoreline at Saddle Dam Trailhead	Same as Existing Conditions	Beneficial. Increased recreational access	Same as Proposed Action
Trail loop opportunities at Forebay area	Same as Existing Conditions	Beneficial. New trail opportunities, enhance trails experience. Construction – short-term adverse effects	Same as Proposed Action
Adopt trails plan as described in RMP	Same as Existing Conditions	Beneficial. Expand trail opportunities and resolve user conflicts	Same as Proposed Action

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Giant garter snake measure to maintain habitat	Same as Existing Conditions	Adverse effects. Limit trail locations around Forebay to avoid impacts to GGS	Same as Proposed Action
Implement increased level of multi-use trails	Same as Existing Conditions	Same as No-Action Alternative	Beneficial – trails available to a broader spectrum of users
Swimming and Other Shoreline-based Day Use			
Improve ADA accessibility at Loafer Creek DUA, swimming beach and cove	Same as Existing Conditions	Beneficial. Access enhanced for visitors with disabilities. Construction – short-term adverse effects	Same as Proposed Action
Improve shoreline conditions, add basic day use amenities at Foreman Creek and redirect recreation usage to specific areas	Same as Existing Conditions	Beneficial. Enhanced day use experience. Construction – short-term adverse effects. Redirection – neutral	Same as Proposed Action
Reconstruct restroom building at Dark Canyon Car-top BR	Same as Existing Conditions	Beneficial. Enhance recreational experience. Construction – short-term adverse effects	Same as Proposed Action
Day use facilities at Enterprise BR	Same as Existing Conditions	Beneficial. Enhance recreational experience. Construction – short-term adverse effects	Same as Proposed Action
Conduct feasibility study to assess new swimming opportunities at Lime Saddle or Loafer Creek and implement results of study	Same as Existing Conditions	Beneficial. Identify feasible swimming improvements and implement results of study.	Same as Proposed Action
Additional day use facilities at Diversion Pool	Same as Existing Conditions	Beneficial. Enhance day use experience. Construction – short-term adverse effects	Same as Proposed Action
Improve day use facilities and access at Lakeland Blvd Trailhead	Same as Existing Conditions	Beneficial. New day use activities and opportunities. Construction – short-term adverse effects	Same as Proposed Action
Day use and swimming facilities at South Forebay	Same as Existing Conditions	Beneficial. Enhance day use experience. Construction – short-term adverse effects	Same as Proposed Action

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
10 new picnic sites and swim beach at Larkin Rd Car-top BR	Same as Existing Conditions	Beneficial. Expand formal swimming opportunities and increase quality of day use experience. Construction – short-term adverse effects	Same as Proposed Action
Day use facilities at Thermalito Afterbay Outlet	Same as Existing Conditions	Beneficial. Enhance day use experience. Construction – short-term adverse effects	Same as Proposed Action
Evaluate options to warm the water at North Forebay swim area	Same as Existing Conditions	Beneficial. Identify feasible swimming enhancements	Same as Proposed Action
Upgrade existing day use facilities at Lime Saddle DUA	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase quality of experience. Construction – short-term adverse effects
New DUA at Parish Cove	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Provide new DUA on northern part of reservoir. Construction – short-term adverse effects
Tables, upgrade restrooms, better parking and turnaround at Stringtown Car-top BR	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase quality of experience. Construction – short-term adverse effects
Consider constructing 30-50 additional vehicle parking spaces at Oroville Dam Overlook DUA	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Additional parking capacity. Construction – short-term adverse effects
Remote day use sites for trail users and boaters at Diversion Pool	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase range of recreation opportunity. Construction – short-term adverse effects
Open Space-Dependent Activities			
2 Watchable Wildlife sites in OWA	Same as Existing Conditions	Beneficial. Increase wildlife watching opportunities	Same as Proposed Action
Wildlife habitat enhancements	Same as Existing Conditions	Beneficial. Increase wildlife to view. Construction – short-term adverse effects	Same as Proposed Action
Public Information, Education, and Interpretation Services			
Additional directional signs	Same as Existing Conditions	Beneficial. Make sites easier to find	Same as Proposed Action

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Additional education about cultural resources at Foreman Creek	Same as Existing Conditions	Beneficial. Preserve and protect important resources	Same as Proposed Action
Potential I&E enhancements at Fish Hatchery	Same as Existing Conditions	Beneficial. Enhance recreational experience	Same as Proposed Action
Illegal fishing practice signs	Same as Existing Conditions	Beneficial. Promote responsible recreation	Same as Proposed Action
Implement I&E Program and I&E measures	Same as Existing Conditions	Beneficial. Enhance recreational experience and increase visitor education	Same as Proposed Action
Giant garter snake educational program	Same as Existing Conditions	Beneficial. Promote responsible recreation, enhance recreational experience	Same as Proposed Action
Spawning riffle observation access near Fish Hatchery	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Enhance quality of recreation experience. Construction – short-term adverse effects
Special Events			
Short-term event grandstand space for fishing tournament use at Bidwell Canyon	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase quality of recreation experience
Flexible event center	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Support equestrian and other events
Safety			
Wildland Fire Evacuation Plan for OWA	Same as Existing Conditions	Beneficial. Increase visitor safety	Same as Proposed Action
Fuel Load Management Plan	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Increase visitor safety
Debris Management at McCabe Creek	Same as Existing Conditions	Beneficial. Maintaining safety	Same as Proposed Action
Safety-related management actions	Same as Existing Conditions	Beneficial. Increasing recreation management and visitor safety	Adverse effects may occur as a result of recreational enhancements that are located in close proximity to sensitive project facilities.

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Programmatic Recreation Resources/Management/Aesthetics			
Increased visitor management and enforcement in OWA	Same as Existing Conditions	Beneficial. Curb illegal uses, disruptive behaviors, resource damage	Same as Proposed Action
More trash receptacles and litter pick-up at dispersed use areas	Same as Existing Conditions	Beneficial. Enhance recreation setting	Same as Proposed Action
Periodic monitoring at dispersed sites	Same as Existing Conditions	Beneficial. Prevent resource damage.	Same as Proposed Action
Evaluate options for additional revenue for OWA	Same as Existing Conditions	Beneficial. Increase ability to provide more recreation management	Same as Proposed Action
Recreation Planning and Management Coordination	Same as Existing Conditions	Beneficial. Resolve conflicts, more efficient and accountable recreation management	Same as Proposed Action
Additional trash receptacles and signage along Feather River	Same as Existing Conditions	Beneficial. Enhance recreation setting	Same as Proposed Action
Vehicular barriers in OWA	Same as Existing Conditions	Beneficial. Protect OWA resources and aesthetic values	Same as Proposed Action
Screen material storage by Emergency Spillway	Same as Existing Conditions	Beneficial. Enhance recreation setting	Same as Proposed Action
Clarify role of DPR, DFG, DBW, and other responsible entities	Same as Existing Conditions	Beneficial. More efficient, effective and coordinated recreation management	Same as Proposed Action
Transfer BLM lands to State, most in LOSRA	Same as Existing Conditions	Same as No-Action Alternative	Beneficial. Enhance recreation management
Enforcement to protect vernal pools	Same as Existing Conditions	Beneficial. Protect habitat, promote responsible recreation	Same as Proposed Action
Cultural Resources			
Set aside areas for planting and harvesting of traditional plants	Same as Existing Conditions	Depends on site location	Same as Proposed Action
Curation facility	Same as Existing Conditions	Depends on site location	Same as Proposed Action
Eliminate wheeled motorized vehicle use from fluctuation zone	Same as Existing Conditions	Adverse effects. Eliminate vehicular access to some shoreline areas	Same as Proposed Action
Signage program	Same as Existing Conditions	Beneficial. Enhance quality of recreation experience	Same as Proposed Action

Table 5.10-2. Summary of potential effects on recreation.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Historic Properties Management Plan	Same as Existing Conditions	Short-term adverse effects. May require partial site closure to work on cultural resources	Same as Proposed Action
Recreation Operations and Maintenance			
Operations, maintenance and monitoring at existing and new recreation sites	Same as Existing Conditions	Beneficial. Increasing recreation management of recreation effects	Same as Proposed Action
Project Operations			
Project operational effects on recreation	Minor beneficial and adverse effects could occur due to nominally increased fluctuations in Lake Oroville water surface elevations.	Same as No-Action Alternative	Same as No-Action Alternative
Maintain minimum flow in Low Flow Channel	Same as Existing Conditions – 600 cfs	Same as No-Action Alternative	Increase minimum flow of 800 cfs in LFC; seasonal increase to 1200 cfs could slightly adversely affect recreational anglers and boaters

5.10.2.1 No-Action Alternative

Adequate recreational access to the project area is mandated by FERC, and access to the shoreline and water is fundamental to providing water-based recreation. As described in Section 5.10.1, management of recreation resources in the project area includes the operation of over 30 developed recreation sites and several additional access points and dispersed use areas. In total, these sites supported nearly 1.7 million recreation days of visitor use during a 12-month study period in 2002 and 2003. The continued growth of participation in recreation activities is projected to result in about a one-third increase in recreation attendance in the project area by 2020, increasing visitor use to about 2.2 million recreation days. Growth in recreation use is presumed to increase at a similar rate throughout the anticipated license term.

Under the No-Action Alternative, existing operations and maintenance activities related to recreation access, facilities, and safety would generally continue and the effects of these project operations would continue into the future. Additionally, existing natural resource management activities such as operation of the Feather River Fish Hatchery, fish stocking and other fisheries management, and management of terrestrial wildlife habitat can potentially affect recreation resources. Under the No-Action Alternative,

existing activities supporting hatchery operations and sport fisheries stocking would continue through the next license period.

Projected Increases in Recreation Use

Table 5.10-3 provides the baseline and projected level of recreation use for the management areas and dispersed use areas in terms of recreation days (RDs) that would be expected to occur by 2020 under the No-Action Alternative. These numbers, based on the results of the Projected Recreation Use study plan report (Study R-12), take into account the capacity limits of certain facilities which would limit use levels. Overall, attendance is expected to increase by about one-third in response to population growth in the State and region and growth in demand for recreation opportunities and activities provided at the project area. Lake Oroville would remain the most visited area, accounting for about 1.3 million of a total of over 2.2 million RDs in 2020. Growth in recreation use is presumed to increase at a similar rate throughout the anticipated license term.

Table 5.10-3. No-Action Alternative projected 2020 recreation days (RDs) by management area.

Management Area	Baseline RDs (2002)	Projected 2020RDs
Lake Oroville	911,183	1,297,890
Diversion Pool	20,603	25,700
Thermalito Forebay	135,720	166,640
Thermalito Afterbay	93,368	119,960
Oroville Wildlife Area	318,462	376,770
Feather River Fish Hatchery	160,395	218,550
Dispersed Sites	18,810	22,370
TOTAL	**1,658,541**	**2,227,880**

Source: EDAW 2004

Baseline Effects of Project Operations

The effects of Oroville Facilities operations on recreation activities and facilities relate primarily to Lake Oroville reservoir drawdown, which begins in late spring to mid-summer each year and continues into the fall. The surface elevation is reduced as releases from storage are required to meet downstream demands, including instream flow, environmental requirements, and water supply needs. Although the pool level of the reservoir largely depends on hydrologic conditions in the watershed and resulting inflow, DWR attempts to minimize effects from project operations on recreation. Reservoir fluctuations at Thermalito Afterbay, alterations of flow in the Feather River, and decreased water temperatures at the Diversion Pool, Thermalito Forebay, Thermalito Afterbay, and Feather River are also affected by operational requirements and also affect recreation.

Lake Oroville Drawdown

Under the No-Action Alternative, Lake Oroville pool elevation changes would continue, based on DWR hydrologic modeling that simulates the amount and timing of drawdown

of Lake Oroville under existing (2001) conditions and in 2020. Of particular interest for recreation is whether overall pool elevation ranges and the timing of reservoir drawdown is likely to be different than what visitors have experienced in the past. The 2020 hydrologic modeling took into account Statewide development projections for 2020, planned changes to the SWP and other facilities, expected water demand, regulatory standards, and operations criteria. Model output in the form of end-of-month Lake Oroville elevations was produced for all water year types (wet, above normal, below normal, dry, critical). Year 2020 modeling results are also assumed to be representative of conditions 40 or 50 years after the issuance of the anticipated new license since development projections and other modeling parameters are not available for more distant points in time.

Figure 5.10-4 compares reservoir elevations at three end-of-month dates used to represent the peak summer recreation season (Memorial Day weekend to Labor Day weekend). Comparison of the modeling results for 2001 and 2020 indicate that the average elevation of Lake Oroville during the 2020 summer peak recreation season (June through August) is likely to be very similar to elevations under existing (baseline) conditions for all water year types.

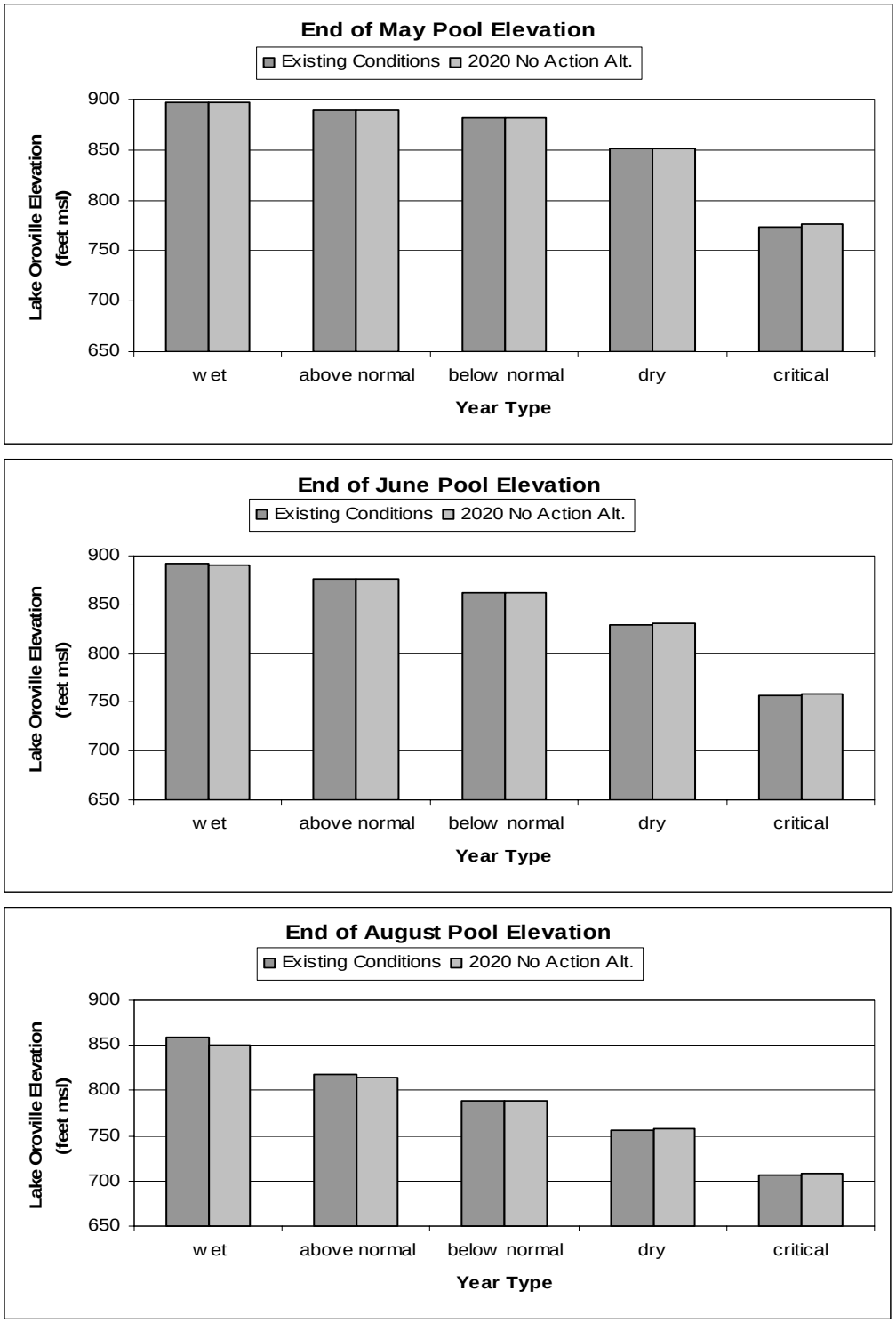
Slightly lower but still relatively high average reservoir elevations are expected in August and September during wet years. Reservoir elevations during the remainder of the fall months as well as winter and spring (October through May) would be essentially unchanged in 2020.

Diversion Pool and Thermalito Forebay Fluctuation

Under the No-Action Alternative, no changes would occur in project operations that would affect pool elevations in the Diversion Pool or Thermalito Forebay. The elevation of both reservoirs would remain at or within a few feet below 225 feet (msl), the water surface elevation at maximum operating storage. The Thermalito Power Canal hydraulically links the two reservoirs such that the elevations are about the same elevation (+/- <1 foot) at any point in time.

Thermalito Afterbay Fluctuation Effects

Thermalito Afterbay elevation changes on a weekly cycle that depends on local operations decisions related to hydroelectric power generation, pumpback operations, and the amount of water released directly to the Low Flow Channel of the Feather River. Thermalito Afterbay elevations and fluctuation would remain unchanged in 2020 under the No-Action Alternative, although slightly greater releases would be made from Lake Oroville during July and August of wet years and during July of above normal years. The cyclical weekly fluctuation of the elevation of Thermalito Afterbay of about 4-6 feet would continue, with the greatest elevation reductions and lowest pool levels



Source: DWR 2004

Figure 5.10-4. Comparison of Lake Oroville elevation modeling results for three key recreation season end-of-month dates using Existing Conditions vs. 2020 No-Action Alternative conditions.

occurring on weekends. Again, this finding is expected to be representative of conditions beyond 2020 and through the anticipated license term.

Feather River Flow Rates

The additional water released from Lake Oroville during July and August of wet years would be routed through Thermalito Afterbay, so no changes in flow are projected for the Low Flow Channel of the Feather River. Flows in the Low Flow Channel would be maintained at the current required minimum of 600 cfs. Modeling results for 2020 indicate slightly more flow in the Feather River below the Thermalito Afterbay Outlet during July and August of wet years and during July of above normal years, along with slightly lower flow during some fall and winter months. The modeling results for 2020 indicate relatively little change in flow as compared to existing conditions during below normal, dry, and critical water years.

Diversion Pool, Thermalito Forebay, Thermalito Afterbay and Feather River Water Temperature

Under the No-Action Alternative, no changes would occur in operations that would affect water temperatures downstream of Lake Oroville. Summer surface water temperatures in the upper 50s to low or mid-60s (°F) in the Diversion Pool and most areas of Thermalito Forebay and Thermalito Afterbay would continue. Summer water temperatures in the Low Flow Channel of the Feather River from the mid-50s to upper 60s would also continue.

Effects on Developed Recreation

Recreation activities potentially affected under the No-Action Alternative include boating, camping, angling, trail use, swimming, other day uses, and special events.

Boating

Current management activities related to boating would continue under the No-Action Alternative, however, no action would be taken to expand boating access or enhance facilities. The Projected Recreation Use study plan report (SP-R12) identifies boating as a high future growth activity and, as a result, projects boating visits to increase considerably throughout the anticipated license term. As use levels increase, boating satisfaction might decrease due to factors such as increased crowding, longer wait times at boat ramps, and more crowding and conflict on the water and in shoreline areas favored by boaters.

Under the No-Action Alternative, no additional parking would be provided at ramps and marinas where parking capacity is exceeded on some peak season holidays and weekends, which would cause some boaters to be turned away or diverted to other sites.

As described above, hydrologic modeling indicates that Lake Oroville drawdown would not be substantially different under 2020 conditions as compared to 2001 baseline

conditions; therefore, effects on boating related to drawdown (as described in Section 5.10.1.5) would also be essentially unchanged. Regarding management actions to address drawdown effects, under the No-Action Alternative, no measures would be taken to extend or widen launch ramps or otherwise reduce the effects of reservoir drawdown on Lake Oroville launch ramps. Thus, no future changes to boat ramp accessibility would be expected under the No-Action Alternative. However, as boating activity increases in the future, the reduced number of launch ramps and lanes available as Lake Oroville is drawn down each year may result in more boaters having to wait to launch or retrieve their boats or wait longer then they currently do. Additionally, boaters who launch at Enterprise or Loafer Creek would continue to have to travel to other boat ramps to access the reservoir at moderately low to low pool levels, respectively.

No additional efforts to remove ramp debris or adjust boarding docks at low reservoir pool levels would be made at Lake Oroville, and no additional low-water parking would be provided under the No-Action Alternative. As a result, boaters may find their use of the developed ramps constrained during low water periods and would continue to be required to make a steep walk to and from their vehicle at those times.

No boating access would be provided to Lake Oroville at very low reservoir elevations (below 695 feet msl) under the No-Action Alternative. Based on historic patterns, these very low pool levels would be expected to occur only rarely (less than once per decade) and would most likely occur during the winter when boating activity is lowest; thus, the effect of this on boaters would be relatively minor.

The No-Action Alternative would not provide additional removal of floating woody debris on Lake Oroville, which some boaters currently consider to be a problem during the spring and early summer of some years. In particular during wet years, which tend to result in increased floating debris, boaters are likely to continue to be negatively affected by floating debris, which may preclude high-speed cruising and water-skiing, and may cause a higher frequency of propeller or other boat damage.

Under the No-Action Alternative, no changes would be made in operations that would affect the magnitude, timing, or frequency of Thermalito Afterbay fluctuations and no changes or enhancements to facilities would be made to reduce the effects of fluctuations on boaters. Boaters use and enjoyment is likely to continue to be somewhat affected, although boat access would continue to be available at all times.

Under the No-Action Alternative, flow in the Low Flow Channel would remain near the current 600 cfs minimum level at most times of year and the effects of low flows would be expected to continue. No changes would be made in operations that would affect the magnitude or timing of flows in the Feather River. As a result, boaters who desire a higher flow rate, which result in higher water velocities but less exposed riffles, would be expected to focus their use below Thermalito Afterbay, where flows are greater, or perhaps be displaced to other rivers.

Camping

Under the No-Action Alternative, DPR would continue to operate and maintain developed camping, floating camping, and boat-in camping at Lake Oroville and en-route RV camping at Lake Oroville and Thermalito Forebay. DFG would continue to provide undeveloped, primitive camping at designated areas within the OWA.

The Loafer Creek Group Campground and the floating campsites are currently considered to be operating at capacity. Capacity of some other Lake Oroville campgrounds would be reached during the life of the anticipated new license. Bidwell Canyon Campground is expected to reach capacity by 2020 and the Lime Saddle and Loafer Creek Campgrounds are expected to reach capacity by 2040. Under the No-Action Alternative, no additional camping capacity would be provided and no additional group camping or equestrian camping opportunities would be provided. As a result, competition for campsites at peak use times would increase and some campers would more frequently be required to camp elsewhere due to lack of available sites in the project area.

The No-Action Alternative would provide no new enhancements or services at campgrounds.

Angling

As discussed under the boating section, no changes to boat access is expected under the No-Action Alternative as a result of changes to either boat access facilities or project operations. Therefore, baseline effects on boat angling would be similar to those outlined for boating. Given an expected low rate of growth in angling activity during the new license period and the moderate to low use levels on the reservoirs, particularly during the prime off-season angling months, capacity for reservoir boat angling is expected to be adequate through the new license period and crowding problems are not anticipated.

The No-Action Alternative would provide no additional angling facilities or enhancements. No additional trash pick up at riverbank fishing areas in the OWA or along the Low Flow Channel would be provided and the adverse aesthetic effect on anglers would continue.

Trails and Trail Use

DPR and DWR management of the approximately 75-mile developed trail network and several trailheads would continue under the No-Action Alternative. No new trails would be created. Although trail hiking, biking, and horseback riding are expected to grow at a moderate to high rate, trail opportunities are expected to be adequate through the anticipated license term. Opportunities to hike in areas of the project not served by trails, would continue to be limited.

Swimming and Other Shoreline-Based Day Use

Under the No-Action Alternative, formal swimming facilities would continue to be available at the reservoir only during the highest water level periods (generally, early to mid-summer during above normal or wet years).

Existing shoreline access at car-top ramps and other informal use areas would continue to be provided under the No-Action Alternative and informal shoreline use would be expected to continue.

Under the No-Action Alternative, no enhancements would be provided to support day use at the Diversion Pool, in particular on the south/east shoreline where none presently exist. No new sites outside of the minimally developed Diversion Pool DUA on the north/west shoreline would be provided. Vehicular access to the south/east shoreline of the Diversion Pool would continue to be restricted.

The No-Action Alternative would provide no efforts to reduce the frequently high summer bacteria levels or investigate the means to provide warmer water for swimming at the North Forebay DUA lagoon. Water quality could occasionally fall below standards for water-contact recreation at certain times, and the water temperature would continue to be somewhat lower than ideal for swimming.

Open Space-Dependent Activities

The No-Action Alternative would not provide additional areas or support facilities for open-space dependent activities such as hunting, wildlife viewing, outdoor photography and nature study. Visitors interested in pursuing these activities would continue to primarily use undeveloped and dispersed use areas.

Public Information, Education and Interpretation Services

Under the No-Action Alternative, the licensee would continue to operate and maintain the Lake Oroville Visitors Center and associated interpretive trail. No additional interpretive information or trails would be provided. The licensee would continue to work with local entities to provide water safety programs at Thermalito Forebay.

Special Events

The No-Action Alternative would not provide new or enhanced facilities to support special events.

Recreational Safety

The No-Action Alternative would not provide additional law enforcement by any of the responsible agencies at any of the project areas.

Programmatic Recreation Resources

Programmatic resources relate to recreation sites and use areas within the FERC project boundary as a whole and are not necessarily site- or activity-specific needs. They include overall agency recreation-related management responsibilities; budgetary, funding and staffing issues; recreation monitoring; and development of cross-agency coordinated projectwide trails and interpretation and education programs.

The No-Action Alternative would provide for the continued management of the project area under the existing multi-agency structure, with no review or alteration of management roles.

The No-Action Alternative would not provide for the continuation of a local recreation oversight advisory body after the beginning of the anticipated new license period.

Lastly, recreation monitoring under the No-Action Alternative would continue at present locations and levels as required by FERC Form 80 reporting requirements. No additional monitoring locations or methods, or increased monitoring frequency would be provided.

ADA Enhancements

The level of ADA access would remain unchanged under the No-Action Alternative. The No-Action Alternative would provide no additional efforts to improve the currently programmatically complaint boating, camping, and day use facilities.

Protection of Vernal Pools

DWR, DPR, and DFG are completing a program to reduce recreation use effects on vernal pool habitat by increasing signage marking sensitive vernal pool areas closed to all vehicular use where necessary. A major focus of such signage will be locations of current observed vehicular effects on vernal pools. These effects are generally in dispersed use areas where vehicular use is, in some cases, already prohibited. Effects of this action on recreation access are expected to be minor.

DWR also plans to abandon and revegetate all roads that are determined to no longer be necessary for project operations or management by December, 2006. A particular focus of the closings will be any roads that are currently causing siltation problems in nearby vernal pool habitat. Although the locations of roads to be closed are yet to be determined, the areas where siltation problems are generally occurring are low use level dispersed use areas, and some of these roads are currently closed to recreation use. Effects upon recreation areas are expected to be minor.

5.10.2.2 Proposed Action

The Proposed Action contains many PM&E measures, most of which would have effects on recreation resources or management (see Table 5.10-2). This section is a focused summary of the effects of the non-operational PM&E measures that affect

recreation because no PM&E measures that would affect project operations are included in the Proposed Action. In general, the Proposed Action would increase the quality of the recreational experience throughout the project area, increase camping capacity, add new trails, add day use facilities (including at several sites where currently there are no such facilities), increase wildlife viewing opportunities, provide increased visitor education and safety, and enhance recreation management and coordination.

Projected Recreation Use under Proposed Action

Table 5.10-4 provides the existing and projected number of recreation days (RDs) for the Proposed Action at each of the management areas. These numbers take into account increases in population and demand as well as effects of PM&E measures on recreation capacity and quality of the recreation experience. Overall, by 2020, use is projected to increase by 45 percent from the current use under the Proposed Action. Growth in recreation use is presumed to increase at a similar rate throughout the anticipated license term. Lake Oroville would remain the most visited sub-area, accounting for 58 percent of the total projected use, or about 1.4 million of the approximately 2.4 million total RDs.

Table 5.10-4. Projected RDs for Proposed Action by management area.

Management Area	Existing RDs (2002)	Projected 2020 RDs
Lake Oroville	911,183	1,395,232
Diversion Pool	20,603	44,633
Thermalito Forebay	135,720	194,829
Thermalito Afterbay	93,368	128,957
Oroville Wildlife Area[1]	318,462	395,609
Low Flow Channel[2]	160,395	229,478
Dispersed Sites	18,810	23,489
TOTAL	**1,658,541**	**2,412,227**

[1]Includes the Feather River within and adjacent to the OWA, but does not include the Thermalito Afterbay portion of the OWA.
[2]Does not include the portion of the Feather River Low Flow Channel within or adjacent to the OWA. Includes one developed site within the FERC project boundary: Feather River Fish Hatchery.
Source: EDAW 2004

Effects of PM&E Measures (Non-Operational)

The non-operational PM&E measures are discussed by the primary recreation activity that they would potentially affect. The activity categories (boating, angling, camping, etc.) are the same as those previously used to describe existing conditions in Section 5.10.1 and the future effects of the No-Action Alternative (Section 5.10.2.1).

Boating

The overall quality of the boating experience would be increased under the Proposed Action, primarily at the main boat ramps on Lake Oroville. Quality improvements include improved ADA access; additional boarding docks and more frequent

adjustments to them; additional information on access and substitute boating facilities; Aquatic Center improvements; support and encourage Lime Saddle Marina repairs; and increased debris removal at boat ramps. Lake Oroville low water access would be improved by extending the Enterprise BR, adding and extending an additional low water ramp at Bidwell Canyon. Minor potential adverse effects on boating could result from restrictions on boating speeds on the northern part of Thermalito Afterbay.

Enhance ADA accessibility at Bidwell Canyon and Lime Saddle Marinas. These PM&E measures would focus on providing better ADA accessibility at the two marinas at Lake Oroville. Currently, the marinas are not fully ADA accessible due to barriers at restrooms, marina stores, on gangways and docks, etc. Though the project is programmatically ADA compliant, enhancing ADA accessibility at the marinas would have a beneficial effect on recreation because users with disabilities would better be able to access and use the two marina facilities. Short-term adverse effects may result from inconvenience during upgrades; however, the marinas would remain open during upgrades.

Add additional boarding docks at Bidwell Canyon BR, Lime Saddle BR, Loafer Creek BR, and Enterprise BR. These PM&E measures would provide more boarding docks, if feasible, to facilitate boat launching and retrieval and increase boat launching capacity at the above mentioned boat ramps. These PM&E measures would have a beneficial effect on recreation for boaters by facilitating launching and retrieval and increasing launching efficiency, in particular for users of launch ramps and lanes currently without boarding docks.

Provide boaters with additional information about substitute boating facilities and changing access conditions at Bidwell Canyon BR, Lime Saddle BR, Spillway BR, and Loafer Creek BRs. These PM&E measures would offer boaters more information about which boat ramps are available, how many lanes are available, and any anticipated access condition changes due to low reservoir levels. This information is currently not widely available or forecasted and therefore boaters may not learn that a ramp is closed or otherwise affected by low water until they arrive on site. These actions would have a beneficial effect on recreation by assisting boaters with trip planning and diverting boaters to other ramps less affected by low water conditions.

Provide extended low water access by constructing a new low water boat ramp at Bidwell Canyon BR. This PM&E measure would create a new low water boat ramp to supplement the two existing boat ramps at Bidwell Canyon BR. The site has been identified as the most feasible location for increasing low water access due to the lack of conflicts with other facilities, nearby low water parking, and the absence of facility security concerns. Although the new low water boat ramp would not be used most years (the existing low water ramp provides access down to a pool elevation of 700 feet), the new ramp would have a beneficial effect on recreation by ensuring boat access to the reservoir during occasional periods of very low water levels. An additional beneficial effect on recreation would result from the anticipated three additional boat ramp lanes that would be added below Lake elevations of 725 feet, a 60 percent increase from existing ramp lanes at this elevation. Moreover, these additional boat

ramp lanes are an enhancement beyond the existing needs identified in SP-R17. During construction, however, there may be short-term adverse effects from disruption to the recreation setting due to construction equipment and noise. A new parking lot at top this ramp will also be constructed with spaces for approximately 50 vehicles.

Expand Bidwell Canyon Marina parking and replace Bidwell Canyon Campground loop. This PM&E measure would include constructing a new parking lot, with an estimated 80 spaces, on the site of the existing Big Pine campground loop and constructing a new campground loop adjacent or connected to the other existing campground loop. If insufficient space is available at Bidwell Canyon to replace all lost campsites, then 15 sites would be constructed at Loafer Creek. Construction of the new parking lot would require clearing, grading and paving. The existing gravel parking lot located at roughly the mid-point (elevation 750) of the existing Bidwell Canyon boat ramp will be surfaced in concrete thereby providing permanent and improved parking for about 80 vehicles at this location. This PM&E measure would have a positive effect on boating at Bidwell Canyon by increasing parking capacity for marina users and thereby reducing marina boaters' use of boat ramp parking. This would reduce the need for marina boaters to park in adjacent residential areas and the need to divert boat ramp users to other sites. During construction of the parking lot and replacement campground loop, there would be short-term adverse effects on camping due to reduced facility capacity and on boating and camping due to recreation setting disruptions. Construction would be planned for the off-season months. Long-term effects on camping would be neutral given that the same number of sites that are taken out would be replaced either at Bidwell Canyon or at Loafer Creek.

Encourage efforts by DPR and concessionaire to restore the Lime Saddle Marina. This PM&E measure would promote completing the restoration of the marina at Lime Saddle to the state it was in before it was damaged in a December 2002 wind storm. Effects of the storm included the loss of 120 boat slips, and reduced fuel, holding tank pumpout, and other services. Replacement of the lost slips would permit slip renters whose slips were destroyed, or other boaters, to moor their boats on Lake Oroville. These actions would have a beneficial effect on boating by returning marina capacity to former levels, and by re-establishing the availability of services and conveniences enjoyed by many boaters.

At Stringtown Car-top BR, install a sign warning of rough road/ramp conditions within the inundation zone. This PM&E measure would alert users to the poor condition of the old road used for vehicle access and boat launching within the inundation zone below 866 feet pool elevation. Although the old road above 866' would continue to be maintained, the road below 866' would not receive repair or maintenance. The facility is still usable and it is expected that users will continue to launch their boats there instead of driving a long distance to other boat ramps (Enterprise or Loafer Creek). Therefore, this PM&E measure would have a neutral effect on recreation in the short-term.

Develop low-water ramp at Enterprise extending to about 750 foot elevation and install facility amenities including 10 picnic sites. These PM&E measures would include creating a new low water ramp at Enterprise with gravel parking near the toe if topography permits (alignment to depend on completion of cultural resource surveys and engineering studies) and installing 10 picnic sites. The existing boat ramp at Enterprise is often unusable during the prime summer boating season due to low water, requiring the primarily local users to drive a considerable distance to another ramp. The new boat ramp and picnic sites would have beneficial effects on recreation by substantially extending the usability of this east side of Lake Oroville boat rampfor launching and better supporting picnicking and associated day use. During construction, there may be short-term adverse effects on recreation due to the inability to use the surrounding shoreline. Short-term adverse effects on the recreation setting from equipment and noise, both at the site and from the water, may also occur during construction.

More frequent adjustment of Lake Oroville boarding docks. These PM&E measures would include adjusting the cables controlling the position of boarding docks and dock placement more often at Bidwell Canyon BR, Loafer Creek BR, Lime Saddle BR, and Spillway BR. During the summer reservoir drawdown, partial grounding of docks was noted, which can damage docks and decrease usability. This measure would have a beneficial effect on recreation by increasing boarding dock usability for boat launching, which would facilitate launching and help maintain a high quality boating experience.

Increased debris removal at Lake Oroville boat ramps. This PM&E measure would include more frequent removal of floating woody debris as needed at Bidwell Canyon BR, Loafer Creek BR, Lime Saddle BR, and Spillway BR. In addition, the sand and mud deposits on these ramps would continue to be removed as the Lake Oroville pool elevation decreases. During spring and early summer high water periods, a significant amount of debris was noted at the major boat ramps on Lake Oroville. This measure would have a beneficial effect on recreation by increasing the usability of these ramps and therefore increasing the quality of the boating experience.

Provide basic facility improvements to the Aquatics Center at the North Forebay Day Use Area. This PM&E measure would include completing utility extensions and hookups that were not part of initial construction, and providing additional covered boat storage. Providing recreation programs are not included in the improvements. This measure would have a beneficial effect on recreation because the Aquatics Center would be able to meet the needs of the clubs and other groups that use the facility for sailing and boater education events. Short-term minor adverse effects may occur if the services of the Aquatics Center are disrupted due to construction or utility extension activities. Improvements will be sited to avoid any potential conflicts with vernal pool areas.

Modify recreational use patterns for protection of wildlife and to minimize effects on nesting waterfowl by restricting boat speeds on Thermalito Afterbay north of SR 162. This PM&E measure would include reducing boat speeds to 5 mph on the

northern portion of Thermalito Afterbay (north of the SR 162 bridge). This would primarily affect users of the Wilbur Road BR and would reduce pleasure motorized-boating traffic at this boat ramp; however, the Monument Hill boat ramp on the southern portion of Thermalito Afterbay is close by. Most pleasure boating takes place on the southern portion of Thermalito Afterbay, which would not be affected by speed restrictions. Anglers who use the Wilbur Road ramp would be less affected as many of these boaters stay near the ramp and faster speeds are less essential to their activity. Overall, this measure would have a minor adverse effect on recreation due to the restriction the speed limit would place on motorized pleasure boating on the northern portion of Thermalito Afterbay, and inconvenience for some anglers. Additionally, a beneficial effect will result to anglers and non-motorized boaters that prefer a more serene recreational experience.

Camping

Camping capacity and the quality of the camping experience would be increased under the Proposed Action. Quality enhancements would include better ADA accessibility and relocation of floating campsites. Camping capacity would also increase due to the creation of new group RV sites and an organized camping facility at the Thermalito Afterbay Outlet. Boat-in camping might be restricted at a few sites where sensitive cultural resources could be threatened.

Enhance ADA accessibility at the Loafer Creek Group and Equestrian Campgrounds. This PM&E measure would provide better ADA accessibility at the Loafer Creek Group and Equestrian Campgrounds, where none of the campsites are currently ADA accessible. Enhancing ADA accessibility would have a beneficial effect on recreation because access and use of these campgrounds would be enhanced for users with disabilities. Short-term adverse effects may result due to inconvenience or site closures while enhancements are being installed.

Construct two new group RV campsites with utilities at Loafer Creek Complex. This PM&E measure would include constructing a new loop and building two new group RV campsites, a facility that does not currently exist within the project area, at one of the three Loafer Creek campgrounds. There is currently a Statewide shortage of RV group camping facilities, which suggests that demand for this activity will continue. The addition of the two new group RV campsites would have an overall beneficial effect on recreation by increasing camping capacity and by increasing options for group camping. During construction there would be short-term minor adverse effects on the recreation setting due to noise and visual effects from construction activities, and on facility capacity if other campsites have to be closed during construction. Construction would typically be scheduled to occur during the off-season.

Relocate three existing floating campsites closer to Lime Saddle. This PM&E measure would include moving three of the existing floating campsites (the specific floating campsites have yet to be determined by DPR) closer to Lime Saddle. Currently there are no floating campsites on the West Branch or Upper North Fork Arm of Lake Oroville. A maintenance operation out of Lime Saddle would need to be initiated to

maintain these floating campsites; existing maintenance based at the south end of the reservoir could not feasibly service the relocated floating campsites. This maintenance operation would necessitate the purchase of an additional maintenance boat. This PM&E measure would have a beneficial effect on recreation because the opportunity for floating camping would be more available to Lake Oroville users who prefer to base their activity out of Lime Saddle. An adverse effect might occur due to reduced floating campsite availability for boaters whose activity is based out of the south end of the reservoir. Installing additional floating campsites as an alternative to relocation is not considered justifiable due to the high cost and maintenance associated with these special facilities. These facilities are uniquely provided by DWR and would not otherwise be a licensed recreational facility requirement.

Construct an organized camping facility at the Thermalito Afterbay Outlet. This PM&E measure would include adding designated campsites, garbage receptacles, restrooms, and vegetation screening at the existing primitive camping area. If these actions were taken, the measure would have a beneficial effect on recreation because camping facilities would be improved and camping capacity would increase. These actions would also serve to discourage illegal camping in other undesignated sites within the OWA, while restricting recreation development to levels considered appropriate by DFG for State wildlife areas. Short-term adverse effects may occur if all or part of the site has to close for installation of facilities or if the recreational setting is disrupted by construction equipment or noise.

Restrict access in the inundation zone to specific boat-in campgrounds (BICs) as appropriate during periods of low reservoir levels. This PM&E measure could include periodic closure of boat-in campgrounds at Bloomer BIC (3 BICs) or Goat Ranch BIC at low pool levels when cultural resources are exposed; however, restrictions could be limited to signage. This PM&E measure would have only a minor adverse effect on recreation because signage would not directly affect use of the campsites (only of the inundation zone) and any closures would occur during low water periods when the boat-in campgrounds receive very little use. Other boat-in campgrounds would be unaffected.

Angling

The quality of the fishing experience would increase through several fisheries enhancement activities, increased shoreline access for anglers, additional fish cleaning stations and improved ADA accessibility to shorelines.

Provide ADA accessible fishing pier or platform at the Diversion Pool and South Forebay DUA. These PM&E measures would include installing ADA accessible fishing piers/platforms, most likely on the west side of the Diversion Pool and at the South Forebay BR/DUA. Fishing is one of the top reasons for visiting the project area and an ADA accessible pier is only currently available at the North Forebay DUA. This measure would have a beneficial effect on recreation by expanding fishing opportunities for the disabled as well as other anglers. Short-term adverse effects may occur if all or part of the site is closed for construction or if the recreation setting is disrupted from

construction equipment or noise. Although the footprint of the structures on the shoreline would be small, development at either site would be designed to avoid conflicts with valley elderberry longhorn beetle (VELB) or giant garter snake (GGS) species use areas.

Provide limited additional shoreline access at North Forebay. This PM&E measure would add small spur trails to the water's edge on the north side of the North Forebay off of the Brad Freeman Trail and a fish cleaning station. Small piers or docks could be used to minimize shoreline effects. Currently, most of the North Forebay shoreline is not accessible to bank anglers. This measure would have a beneficial effect on recreation by expanding fishing opportunities and utilization of a currently underutilized resource. Slightly adverse effects may result from displacement of wetland and riparian vegetation. Providing more shoreline access may also conflict with GGS habitat and thus may be prohibitively expensive if mitigation requirements are substantial.

Provide fishery enhancements. There are several fisheries resources PM&E measures that would potentially increase the number of available fish by enhancing salmonid spawning habitat. These actions may improve catch rates and therefore the quality of the angling experience within the project area, although restrictions on angling may also result. Other actions relate to hatchery operations and associated activities, some of which may also lead to restrictions on angling. These measures include:

- Installation of fish barrier weirs and salmon egg-taking station downstream of the Fish Barrier Dam in the Low Flow Channel;
- Large Woody Debris Supplementation and Improvement Program extended for the life of the license or enough to meet habitat improvement goals;
- Gravel Supplementation and Improvement Program;
- Improvements to Moe's Ditch and Hatchery Ditch; and
- Hatchery Adaptive Management Program.

The first two of these actions are targeted at improving habitat for salmonid fish species in the Feather River. These measures would likely have a beneficial effect on recreation by increasing the number of fish in the river. More fish would be expected to increase catch rates, which would increase the quality of the fishing experience. The Large Woody Debris Program could have an adverse effect on boaters if the materials placed in the river form impediments to boating. An adverse effect on angling may result if installation of the fish barrier weir and salmon egg-taking station requires angling closures or other more restrictive regulations on that area of the river. Further detail on these actions is provided in Section 5.5.2, Aquatic Resources.

Trails

The quality of trail users' experiences would be improved with the anticipated trails program. Three new trails would be created under the Proposed Action: one to access

Lake Oroville shoreline and two to create new loop opportunities (along with any other trails proposed in the Trails Plan). A giant garter snake conservation measure may limit trail expansion into their habitat. Additionally, to address security concerns related to the proximity of the Hyatt switchyard to the existing Brad Freeman Trail, DWR would close and realign that portion of the trail to provide an alternative route along the toe of Oroville Dam to the north side of the dam.

Construct a short developed trail to access shoreline at Saddle Dam Trailhead. This PM&E measure would include creating a short trail from Saddle Dam Trailhead to the Lake Oroville shoreline. Very few existing trails reach the shoreline of Lake Oroville. User-created (or social trails) in this area are causing some resource effects. This measure would have a beneficial effect on recreation due to increased recreational access. Although the trail would only reach the shoreline at high elevations (full pool and slightly below), it would enhance recreational access to the shoreline at these times.

Provide new non-motorized trail loop opportunities in the Thermalito Forebay area (both the North and South Forebay areas). These PM&E measures would include siting and creating a trail around the south side of the North Forebay and a trail around the north side of the South Forebay. These trails would connect to existing trails to create a loop around the entire North Forebay and South Forebay and would link to the existing Brad Freeman Trail. This measure would have a beneficial effect on recreation by offering new trail opportunities and enhancing the trails experience of Thermalito Forebay visitors. The new trails would offer users more trail choices and a more varied recreation setting; users could travel in a loop instead of making out-and-back trips. Short-term adverse effects may occur at trail connection locations if these sites have to be closed for construction. Trails construction in the intended areas may conflict with GGS and their habitat and therefore may not be feasible or may be cost-prohibitive due to mitigation requirements.

Adopt the trails plan in concert with the Trails Focus Group activities and as described in the Recreation Management Plan (RMP) and implement the capital and O&M measures detailed in the plan. The trails plan includes a range of actions focused on the following: expanding trails to new areas; providing crossings over roads, railroad tracks, and water bodies; developing more loop trails, trail support facilities, and connections to trail systems outside the project area. Actions would be implemented on a phased basis. Additional analysis would be required to determine the feasibility of bridging major obstacles and to develop alternative trail alignments. This programmatic PM&E measure would have a beneficial effect on recreation by expanding pedestrian, bike, and equestrian trail use opportunities; resolving trail conflicts between user groups; and by implementing a trails plan that is supported by most project area trail users.

Adopt GGS conservation measure that would maintain existing amounts and quality of snake habitat. This PM&E measure may limit recreation and trail expansion along the shoreline of the North Forebay, South Forebay, and Thermalito Afterbay. Actions in GGS uplands that would be considered deleterious include trails, roads and

other permanent recreational features which could disturb, destroy, fragment, or otherwise modify the uplands. GGS habitat conservation measures may therefore limit additional shoreline access at the North Forebay and a connecting trail around the South Forebay may not be feasible.

Swimming and Other Shoreline-Based Day Use

The quality of the recreational experience for day users would be increased throughout the project area with new day use facilities added primarily downstream of Lake Oroville (Diversion Pool, Thermalito Forebay, Thermalito Afterbay, OWA) and additionally at Foreman Creek and Enterprise on Lake Oroville. Other quality enhancements would include improved ADA accessibility at Loafer Creek and replacement of vandalized facilities at Dark Canyon Car-top BR. Specific to swimming, the Proposed Action would study alternatives for additional and improved swimming opportunities at Lake Oroville and North Forebay. Stakeholders have stated several ideas for how to improve the swimming experience; however, these ideas have yet to be evaluated. Ideas for improving swimming opportunities need to be studied to evaluate their feasibility and cost. Additionally, new swimming beaches are proposed at Larkin Road Car-top BR and South Forebay BR/DUA.

Improve shoreline access and ADA accessibility to the Loafer Creek DUA, swimming beach, and cove. This PM&E measure would include providing hardened paths with an acceptable grade from the adjacent parking area and restrooms down to the lower picnic area and swimming cove/beach. Though the project is ADA compliant, Loafer Creek DUA facilities are not ADA accessible at this time. This measure would have a beneficial effect on recreation because access would be enhanced for users with disabilities. Short-term adverse minor effects may occur from disruption of the recreation setting or if all or part of the site has to close to install the new facilities.

Improve shoreline conditions and add other basic day use amenities at Foreman Creek Car-top BR and redirect recreation usage to specific areas. This PM&E measure would include adding sand to the shoreline where feasible and beneficial to facilitate swimming and adding picnic tables, a vault toilet building, trash receptacle, and shade ramadas to facilitate day use. There are currently no day use facilities at the site other than a vault toilet. Use would also be limited to certain parts of the Foreman Creek area to protect sensitive cultural resources. Specific restricted areas are yet to be determined. This PM&E measure would have a beneficial effect on recreation because day use activities such as picnicking and swimming would be enhanced due to new improvements. This would especially benefit nearby residents who have no other day use area close by. Short-term adverse effects would occur if all or part of the site has to be closed to improve the shoreline or add facilities or if the recreation setting at the site is disrupted due to construction equipment or noise. Though the specifics of how use would be redirected have not been finalized, it is assumed that recreation would still occur at the site and that redirection would be coordinated to minimize effects on recreation, and therefore have a neutral effect on recreation.

Construct 10 picnic sites at Enterprise BR. This PM&E measure would add 10 picnic sites to enhance shoreline use and would complement PM&E measures to develop launching at lower water levels than currently available (below 835 feet pool elevation) and recent vault restroom installation. The sites would be installed above the high water line and near an unpaved road above the boat ramp that currently provides unimproved shoreline access. This would have a positive effect on recreation by enhancing the recreational experience for day users at the site. There may be minor and short-term negative effects due to construction and installation activities.

Reconstruct the restroom at Dark Canyon Car-top BR. This PM&E measure would install a new vault toilet building to replace the previously destroyed toilet building. This would have a beneficial effect on recreation by enhancing the recreational experience for boaters and day users at the site. There may be minor short-term adverse effects during replacement due construction and installation activities.

Conduct a feasibility study to provide new swimming opportunities at Lime Saddle and Loafer Creek. This PM&E measure would include studying the options, costs, and benefits of providing new/improved swimming opportunities at either of the two locations. The swim beach at Loafer Creek functions well when the reservoir is sufficiently high, but the facility is not usable as designed during much of the summer season. At Lime Saddle, periods of low pool levels make Parish Cove, the undeveloped swimming area in the Lime Saddle area, generally unusable for swimming. Low pool levels, which affect both sites, are the result of hydrologic and operational factors that are not expected to change substantially in the future. Providing improved swimming opportunities would probably be accomplished most efficiently and cost effectively at Loafer Creek due to the existing swim beach and other day use facilities. Unlike Lime Saddle, the Loafer Creek swim beach is also close to several campgrounds and other heavily-used facilities in the project area, as well as major residential areas. Conducting feasibility studies for both areas could have a beneficial effect on recreation to determine which site (if at all) would be best suitable for providing swimming enhancements. Any potential construction identified in the feasibility studies would have to be evaluated after the studies are finished.

Construct additional day use facilities including 10 new picnic sites along the Diversion Pool. This PM&E measure would include siting and installing 10 new picnic sites with tables and pole grills along the west side of the Diversion Pool. The sites would be accessible from the Diversion Pool access road on the west shore and from the Brad Freeman Trail (both follow what is known locally as Burma Road). Further site analysis is needed to determine if 10 sites can be accommodated on the limited land base available. This action would have a beneficial effect on recreation by enhancing the day use experience with developed picnic sites where none are currently provided in one of the most attractive and undeveloped settings in the project area. Short-term adverse effects from construction may occur from disruption of the recreation setting or if all or part of the site has to close during installation of the new facilities. Development at the Diversion Pool DUA must avoid VELB and their habitat.

Improve day use facilities and access at Lakeland Boulevard Trailhead. This PM&E measure would include creating vehicle access and gravel parking off of Lakeland Boulevard at the south/east Diversion Pool shoreline, enhancing the shoreline for car-top boat launching, and providing picnic tables, pole grills, restroom, and access to the water's edge for trail users. Fencing would be installed to separate the access road and proposed day use facilities from the adjacent railroad tracks. This would have a beneficial effect on recreation in that new day use activities and opportunities would be available on the south/east shoreline of the Diversion Pool where none currently exist, and non-motorized boat access to the Diversion Pool would be expanded. Benefits would be enhanced by the site's close proximity to several residential areas. Short-term minor adverse effects from construction may occur from disruption of the recreation setting or if all or part of the site has to close during installation of the new facilities.

Provide day use and swimming facilities at South Forebay BR/DUA. This PM&E measure would include adding a sandy swim beach, additional landscaping and shade trees, 5-10 additional picnic tables with pole grills, and paved parking areas. This action represents continued enhancements that have been ongoing during recent years. Although sand has been placed at the shoreline in the past, additional beach development would be beneficial. This PM&E measure would have a beneficial effect on recreation by enhancing the day use experience of visitors at the South Forebay. Short-term adverse effects may occur if all or part of the site has to close for installation of facilities or if the recreational setting is disrupted by construction activities or equipment. Facility development at this site would be sited to avoid any potential conflicts with vernal pools.

Construct 10 picnic sites and a swim beach area at Larkin Road Car-top BR. This PM&E measure would include installing 10 new picnic tables, shade structures, and creating a sand swim beach at Larkin Road Car-top BR. Informal swimming currently takes place at this site, but is impeded by muddy conditions and is not separated and protected from boating use. This measure would have a beneficial effect on recreation by expanding formal swimming opportunities and increasing the quality of the day use experience by offering facilities that currently do not exist at the site. Short-term minor adverse effects may occur if all or part of the site has to close for installation of facilities or if the recreational setting is disrupted by construction equipment or noise. Expanded facilities at this site will be designed to avoid conflicts with GGS and their habitat as well as vernal pools.

Add day use facilities at the Thermalito Afterbay Outlet. This PM&E measure would include adding picnic tables and pole grills at an area near the Feather River, separated from the existing designated primitive camping area. There are currently no day use facilities at the site other than a vault toilet. This measure would have a beneficial effect on recreation by enhancing the day use experience at the Thermalito Afterbay Outlet. Though most visitors go to the Thermalito Afterbay Outlet area to fish, day use facilities would offer anglers and other visitors a chance to picnic and enjoy the river setting. Short-term adverse effects may occur if all or part of the site has to close for installation of facilities or if the recreational setting is disrupted by construction equipment or noise.

Evaluate options to warm the water and protect water quality at the North Forebay swimming lagoon. This PM&E measure would include studying different methods that could be used to warm the water in the North Forebay swimming lagoon to enhance swimming opportunities and help protect water quality in the swim area. Although surface water temperatures are reasonably warm in the lagoon, waters below the top 3 feet are cold. Bacterial contamination of the water has been found to be an occasional occurrence during the summer, possibly due to high numbers of geese and other waterfowl drawn to the area. This measure could have a beneficial effect on recreation if options for warming the water are identified and water quality is improved and protected. Possible actions resulting from the study would have to be evaluated once the study is concluded.

Open Space-Dependent Activities

More opportunities for wildlife viewing would be created by installing two Watchable Wildlife sites. The quality of the wildlife viewing and hunting experience would be increased with several measures to increase or enhance habitat for wildlife within the project area.

Locate and operate 2 ADA accessible Watchable Wildlife sites within the OWA. This PM&E measure would include siting, installing, and maintaining two ADA accessible Watchable Wildlife sites. Although the OWA provides several opportunities for observing waterfowl and other birds and wildlife, no formal viewing sites are provided. Wildlife observation is a popular and growing activity that is projected to increase over the term of the new license. This measure would have a beneficial effect on recreation by increasing the wildlife viewing opportunities in the project area, and making these opportunities more accessible and known to visitors.

Provide wildlife habitat enhancements. There are several wildlife resource PM&E measures that would affect wildlife habitat and could therefore affect wildlife viewing and hunting. These measures include:

- Construct four additional brood ponds;
- Recharge brood bonds at 3-week intervals;
- Develop upland food enhancement and nest cover for nesting waterfowl;
- Install wildlife boxes in the OWA;
- Prepare an Invasive Species Management Plan; and
- Conservation measures for bald eagles, California red-legged frog, giant garter snake, valley elderberry longhorn beetle, and vernal pools.

These measures would promote wildlife and bird use of habitats within the project area and thus could have a beneficial effect on recreation by providing more wildlife for viewing and hunting. When implementing any of these measures, any access or

recreation site closures, restrictions, or disturbances to the recreation setting (e.g. from mechanically removing invasive species or building brood ponds) would have short-term adverse effects on recreation. No long-term closures of existing recreation facilities are anticipated. Additional detail on these actions is provided in Section 5.6.2.2, Terrestrial Resources - Wildlife.

Public Information, Education and Interpretation Services

Several Interpretation and Education (I&E) measures would enhance the overall visitor recreation experience by providing increased visitor awareness and education opportunities as well as informational and directional signage. Recreation quality enhancements include an overall I&E program, more directional signs, cultural displays, fishing regulatory signs, enhancements at the Feather River Fish Hatchery, and programmatic measures to educate the public about potentially contaminated fish and potential bacterial issues at swim areas.

Provide additional directional signs for Dark Canyon Car-top BR, Stringtown Car-top BR, Vinton Gulch Car-top BR, Larkin Road Car-top BR, Wilbur Road BR, and Thermalito Afterbay Outlet area. This PM&E measure includes posting signs at key locations along the routes to these sites where signs are missing. These measures would have a benefical effect by making the sites easier to find and thus providing for a better recreational experience.

Provide additional education regarding preservation of cultural and other sensitive resources at Foreman Creek Car-top BR. This PM&E measure would include a kiosk with interpretive and informational panels or other additional interpretive programs designed to educate visitors about the cultural resources in the area and about protection of water quality within swimming areas. There currently is no posted information about water quality or cultural resources. The measure would better educate the public to help minimize damage to cultural artifacts (and to protect water quality) at Foreman Creek Car-top BR. This measure would have a beneficial effect on recreation by helping to preserve and protect important resources at the site.

Potential I&E related enhancements at Feather River Fish Hatchery. This PM&E measure would include any revisions of signs, tours, or other I&E resources that are found to be needed under the I&E program. This measure would have a beneficial effect on recreation by enhancing the recreational experience with up-to-date visitor information and educational materials.

Post both regulatory and educational signs detailing illegal fishing practices in the OWA. This PM&E measure includes posting signs that describe illegal fishing practices such as snagging, and describe the consequences of using such practices. Illegal fishing practices were found to be a problem in the OWA and along the Feather River in general. Little signage is currently present in the OWA; additional notice to visitors about regulations would increase awareness and presumably discourage illegal practices. This measure would have a beneficial effect on recreation by promoting responsible recreation and reducing adverse effects on the fishery from illegal practices.

Implement an I&E Program and I&E measures. Three PM&E measures would have a positive effect on recreation by enhancing the recreation experience and increasing visitor education. These three PM&E measures include:

- Developing a proposed I&E Program and implementing proposed capital and O&M measures;
- Educating the public about potential health risks from contaminated fish; and
- Monitoring bacteria levels at swim areas and educating the public.

These three measures would educate the public on a variety of issues, especially related to their safety, and therefore enhance the quality of the recreational experience within the project area.

In addition, an information-oriented GGS conservation measure would have a positive effect on recreation by enhancing the recreational experience and promoting responsible recreation. One of the measures includes developing and implementing a continuing public educational program, with a goal of preventing GGS from being intentionally harmed or killed as a result of the public's general fear of snakes. One activity associated with this conservation measure includes posting and maintaining signs at the North and South Thermalito Forebay use areas, Thermalito Afterbay, and at each brood pond. These signs would describe the needs of the GGS, potential threats related to recreation, and the importance of avoiding harm to the species. This action would also offer enhanced visitor education, promote responsible recreation, increase safety, and enhance wildlife viewing opportunities by educating the public on what these snakes look like, where they might be seen, and what to do if they see one.

Special Events

Same as No-Action Alternative.

Recreational Safety

A plan would be developed that would increase visitor safety and provide management direction for wildfire evacuation. Additionally, debris management at McCabe Cove would continue, boating safety would be maintained on Lake Oroville, and miscellaneous other safety actions would be enacted.

Develop and implement a Wildland Fire Evacuation Plan for the OWA. This PM&E measure would include writing and implementing a Wildland Fire Evacuation Plan for the OWA. This measure would have a beneficial effect on recreation due to increased user safety. The OWA currently lacks such a plan and in the event of a fire, the plan would guide staff in evacuating recreationists from the OWA and ensure that safety precautions are in place.

Debris management at McCabe Creek. This PM&E measure would include development and implementation of a debris management strategy to continue to

collect and remove floating debris on Lake Oroville while protecting sensitive cultural resources. Floating debris can be hazardous for all types of boaters and constrains boaters' normal use of the reservoir by requiring greatly reduced speeds and extra vigilance by boat drivers. This measure would have a beneficial effect on recreation by maintaining safety and boating enjoyment. There may be cultural resource conflicts with debris management at McCabe Creek due to exposed cultural resources.

Additional safety-related management actions. This PM&E measure would include improving incident and accident reporting, improving visitor education and management control; implementing additional safety-related actions over time which may include improved communications, additional law enforcement and/or boat patrols. This would have a beneficial effect on recreation by increasing recreation management presence as well as increasing visitor safety.

Programmatic Recreation Resources /Management /Aesthetics

Recreation management presence would be increased under the Proposed Action. This would include additional visitor management and enforcement, more litter pick-up and trash receptacles in some areas, better coordination among agencies, more OHV management, and investigation of strategies to increase recreation program funding.

Provide increased visitor management and enforcement in the OWA. This PM&E measure would include providing more staff and patrols to deter illegal activities from occurring in the OWA. Vehicle break-ins, illegal fishing practices, and other illegal activities have been noted as problems within the OWA. This measure would have a beneficial effect on recreation by curbing illegal uses or disruptive behaviors that disturb other users or cause resource damage.

Provide more trash receptacles and additional scattered litter pick-up at dispersed use areas. This PM&E measure would include placing more trash receptacles at dispersed use locations where litter problems are apparent and having more litter pick-up at these areas. Recreation studies identified litter as a high concern at many dispersed recreation sites and areas. This measure would have a beneficial effect on recreation because the cleanliness of the area would increase, improving the quality of the recreation setting and overall experience.

Provide periodic monitoring for dispersed sites. This PM&E measure would include periodic monitoring for new dispersed use sites within the project area. New sites would be identified with the goal of managing the sites before degradation or damage occurs. This measure would have a beneficial effect on recreation by preventing resource damage.

Evaluate options to provide additional revenue for new services or facilities in the OWA. This PM&E measure would include studying possible ways that more revenue could be generated, such as new user fees or stewardship passes. The OWA currently receives minimal funding and does not have any full time staff designated solely to this large and highly-used area. This measure would have a beneficial effect on recreation

by identifying ways that State agencies could offset some of the costs of managing the OWA for a large number of visitors and providing new services or facilities.

Recreation planning and management coordination. This PM&E measure would include resolving existing conflicts between wildlife management objectives and recreational activities in the OWA in coordination with DPR, DFG, and other appropriate agencies by developing a comprehensive description of recreation and wildlife management priorities and responsibilities. This would have a beneficial effect on recreation because use conflicts would be resolved and responsibilities would be defined, which is currently not the case. This would lead to more efficient and accountable recreation management.

Provide additional trash receptacles and signage along the Feather River. This PM&E measure would include placing and maintaining more trash receptacles and signs along the Feather River at access points where trash accumulation appears to be a problem. Trash along the shoreline degrades the recreation experience, especially for on-site activities such as bank fishing. Due to the high amount of bank fishing use along the Feather River, signage encouraging users to properly dispose of fishing line and tackle packaging may reduce littering. This measure would have a beneficial effect on recreation by increasing site cleanliness and reducing the adverse aesthetic effects of litter.

Erect vehicular barriers to selected areas in the OWA. This PM&E measure includes siting and installing vehicular barriers at certain areas in the OWA to prevent access to these areas by OHV users. Some areas in the OWA receive extensive OHV use even though it is not permitted. Preventing OHV use, which can cause severe effects on soil and vegetation, would allow these areas to recover from past effects. OHV users could be redirected to the nearby (non-project) Clay Pit SVRA where OHV use is appropriately managed. This measure would have a beneficial effect on recreation by protecting OWA resources and aesthetic values.

Screen material storage area north of the Oroville Dam Emergency Spillway. This PM&E measure would include planting trees and other vegetation to block views of the material storage area when viewed from the walkway on top of the Oroville Dam and from Oroville Dam Road. This measure would have a beneficial effect on recreation by increasing the quality of the recreation setting in the Oroville Dam area.

Better clarify the role of DPR, DFG, DBW, and other responsible entities in managing, maintaining, and developing project area recreation resources. This PM&E measure would include determining the recreation resource related financial, managerial, legal, security and patrolling, development, and maintenance responsibilities of the many different agencies that have jurisdiction within the project area. This would have a beneficial effect on recreation by providing more efficient, effective, and coordinated management of recreation within the project area.

Enforcement to protect vernal pools. A vernal pool conservation measure would have a beneficial effect on recreation by promoting better recreation management and

responsible recreation. The measure would encourage and promote regular patrols and enforcement of existing restrictions by DWR security staff, DPR Rangers, or DFG Wardens to reduce recreational effects on vernal pools/habitat. By enforcing regulations, recreation use would be better contained to areas that are not sensitive and recreationists would become more aware of regulations and the purpose behind them. This measure would have a beneficial effect on recreation.

Cultural Resources

Identify and set aside areas for planting. This PM&E measure would include identifying and setting aside appropriate areas for planting and harvesting of traditional plants by Native Americans. Specific locations for planting have not yet been identified; the effect of this measure cannot be determined at this time.

Establish a cultural resource curation facility. This PM&E measure would include creating a curation facility to house cultural resources found within the project area. Though a location for the facility has yet to be determined, a few options have been discussed. One option is to incorporate the facility at the DWR Oroville Field Division Headquarters where it would not affect recreation. Another possibility is to put the facility at Foreman Creek where reburial of repatriated remains could occur. This location could permanently affect recreation by removing land from recreational use. However, the facility or use could be relocated to a different location within the Foreman Creek area. Only short-term adverse effects would occur from any possible site closure due to reconfiguration of area use or construction of the curation facility as well as from the disruption to the recreation setting from equipment and noise.

Eliminate wheeled motorized vehicle use within the Lake Oroville fluctuation zone. This PM&E measure would eliminate all motorized vehicle access in the fluctuation zone, with the exception of designated areas mostly at developed and car-top boat ramps. The purpose of this action is to prevent damage to cultural resources in the inundation zone. Most motorized use outside designated areas (beyond access roads, ramps, and parking areas) is illegal, although such use occurs near some car-top ramps where this prohibition is not posted. These actions could have minor adverse effects on recreation by eliminating unauthorized vehicular access to some shoreline areas.

Implement an interpretive signage program focused on cultural resources. This PM&E measure would include creating and installing interpretive signs regarding cultural resources within the project area. This measure would have a beneficial effect on recreation by enhancing the quality of the recreation experience due to increased visitor education opportunities and promoting site preservation and responsible recreation.

There is a cultural resource PM&E measure that would have short-term adverse effects on recreation during implementation. Data recovery of historic properties and historic properties stabilization are included in the Historic Properties Management Plan. When

these measures are implemented, partial or short-term site closure at recreation sites may be required in order for the work to be completed and to protect cultural resources.

Recreation Operations and Maintenance

Continue to provide O&M and monitoring at existing and new recreation sites. This PM&E measure would include continuing O&M and monitoring at existing sites and providing O&M and monitoring at any new sites. Other related programmatic actions including managing OHV use effects, managing litter accumulation and dumping, managing user-defined trails, and managing dispersed site pioneering and creep would also be implemented. This would have a beneficial effect on recreation by increasing recreation management of recreation effects and minimizing such effects.

Project Operations

The Proposed Action does not include any actions that would change project operations.

5.10.2.3 Alternative 2

The PM&E measures proposed under Alternative 2 generally represent additional actions desired by certain stakeholders beyond those described under the Proposed Action. The need for these additional actions is generally less clear or unidentified, and not fully supported by the recreation study plan reports. Benefits of these PM&E measures are limited, particularly in relation to the cost of the action. Many of the PM&E measures in Alternative 2 have been proposed by various stakeholders as alternative responses to identified needs; however, many have substantial negative aspects related to existing operations, facilities, or recreation uses. Some do not have an apparent project nexus. Some may be infeasible for technical, operational, or environmental reasons. Other PM&E measures are included in response to needs that may arise in the distant future, but do not exist at present.

Projected Recreation Use under Alternative 2

Table 5.10-5 provides the existing and projected number of recreation days (RDs) for Alternative 2 at each of the management areas. These numbers take into account increases in population and demand as well as effects of PM&E measures on recreation use and quality of the recreation experience. Under Alternative 2, overall use by 2020 is projected to increase by about 51 percent from the current use. Growth in recreation use is presumed to increase at a similar rate throughout the anticipated license term. Lake Oroville would remain the most visited sub-area, accounting for 58 percent of the total projected use or about 1.4 million of about 2.5 million total RDs.

Table 5.10-5. Projected RDs for Alternative 2 by management area.

Management Area	Existing RDs (2002)	Projected RDs (2020)
Lake Oroville	911,183	1,445,908
Diversion Pool	20,603	45,696
Thermalito Forebay	135,720	194,829
Thermalito Afterbay	93,368	128,957
Oroville Wildlife Area[1]	318,462	395,609
Low Flow Channel[2]	160,395	279,478
Dispersed Sites	18,810	23,489
TOTAL	**1,658,541**	**2,513,966**

[1]Includes the Feather River within and adjacent to the OWA, but does not include the Thermalito Afterbay portion of the OWA.
[2]Does not include the portion of the Feather River in the OWA. Includes two developed sites within the FERC project boundary: Feather River Fish Hatchery and a proposed Whitewater Park.
Source: EDAW 2004

Effects of PM&E Measures (Non-Operational)

The non-operational PM&E measures are discussed by the primary activity that they would affect. The activity categories (boating, angling, camping, etc.) are the same as those previously used to describe existing conditions in the Section 5.10.1, Affected Environment, Section 5.10.2.1, No-Action Alternative, and Section 5.10.2.2, Proposed Action.

Boating

Several of the PM&E measures proposed under Alternative 2 related to boating represent more extensive responses to needs addressed by similar actions under the Proposed Action. In general, the need for these larger scale actions is not established, is not fully supported by the study data, and the additional benefits of these actions do not clearly justify the increased development of the natural resource base and increased costs. Other PM&E measures would provide limited benefit, either in terms of recreation users or period of need or use, to justify the management burden and costs.

Increase Bidwell Canyon BR parking. This PM&E measure would include excavating a knoll between the boat ramp and the existing parking lot and paving/painting more boat-trailer spaces to create new parking for high pool levels. This measure would be implemented in addition to the increased marina parking at Bidwell Canyon described under the Proposed Action. However, the additional 190 needed parking spaces constructed under the Proposed Action for marina users are expected to meet parking capacity needs at Bidwell Canyon BR; therefore, this PM&E measure would provide unnecessary additional parking. During construction of the parking area, there could be short-term adverse effects on boating if some of the existing parking area is closed. There would also be short-term adverse effects from disruption of the recreation setting from both the water and land due to construction equipment and noise.

Open gravel service road at Loafer Creek BR/DUA to use as car-top ramp to 750 feet msl. This PM&E measure would include allowing the public to use the DPR

service road as a car-top boat ramp after the Loafer Creek BR becomes unusable (at pool elevations below 775 feet msl). The Loafer Creek BR has been closed due to low reservoir pool levels for a large portion of some summer boating seasons, causing boaters camping at Loafer Creek to have to drive about 5 miles to the nearest available launch ramp. It is not feasible to provide launching at lower pool elevations at the existing Loafer Creek BR due to steep shoreline topography. The car-top ramp on the gravel service road would be useable to 750 feet msl, but only for small boats, so not all Loafer Creek Campground boaters would be able to use it. Therefore this ramp would not provide lower elevation launching capability for large boats, though those boaters would have access at other ramps. For the boaters that would benefit from this measure, it would have a beneficial effect on recreation by increasing the number of days that they could launch from Loafer Creek. This would increase convenience for some users, though it would also require O&M for the ramp.

Add more parking at Lime Saddle BR/DUA. This PM&E measure would add 50-60 vehicle parking spaces, possibly involving acquisition of the adjacent PG&E property. Currently, there are very few times when parking at Lime Saddle reaches capacity and visitors are turned away. During the study period Lime Saddle BR/DUA was only observed to reach parking capacity on one holiday day (July 5, 2002) and was near capacity on one peak season weekend day. This PM&E measure would only be needed if monitoring/triggers show that there is a sustained need for increased parking capacity in the future. Use of the adjacent PG&E property may require remediation of environmental contamination problems. This measure would have a beneficial effect for visitors during very limited peak use periods that parking is used to capacity. Short term negative effects on recreation may occur from disruption of the recreation setting due to construction equipment or noise or if part of the existing site or parking area has to close during construction.

Provide low water access by constructing new low water boat ramp at Lime Saddle BR. This PM&E measure would create a new low water boat ramp at Lime Saddle BR in addition to the existing boat ramp. The existing boat ramp provides launching down to a reservoir elevation of 702 feet, an elevation that is reached only during drought periods and typically during the winter when boating activity is low. This would have a limited beneficial effect on recreation by adding a relatively few number of days that visitors could launch from Lime Saddle before having to travel to another boat ramp to launch. Lime Saddle currently has no low water parking and thus it would be a long walk from the parking area to the end of the boat ramp. Also, at low water levels, boating activity in the ramp area is already constrained by the presence of the Lime Saddle Marina and its mooring field. A boat ramp extension might increase conflicts with these existing facilities and uses, thus having a negative effect on recreation. If constructed, short term adverse effects on recreation may occur from disruption of the recreation setting due to construction equipment or noise or if part or the entire site has to close to create the new boat ramp.

Extend Spillway BR below 695 feet msl. This PM&E measure would extend the low water ramp at Spillway BR. Currently, the Spillway BR includes 2 ramps, 1 of which is useable to about 815 feet msl and the other which is useable to 695 feet msl. This

second ramp at the Spillway is the only ramp within the project area which is useable to that elevation. Any such extension, then, would be needed only during periods of very low water. Such low reservoir elevations would only occur, on average, once per decade or less and even then would be expected to occur only during the winter when boating activity is normally low. There are critical dam structures adjacent to this boat ramp and access to this ramp requires crossing the dam and spillway. Utilizing resources to extend this ramp could be wasteful because of the potential for the public use of this ramp to be limited or eliminated due to security reasons in the future.

Providing a boater take-out, if feasible, or coordinate a potential non-motorized watercraft tow service for whitewater boaters. This PM&E measure would include, as one option, investigating the North Fork arm of Lake Oroville north and east of Dark Canyon Car-top BR for potential take-out sites for the relatively few whitewater boaters who opportunistically use the Big Bend run. It is unlikely that any suitable sites exist as the shoreline around this area is very steep and potential take-outs would be very far by road from the put-in, causing boaters to drive a significant distance. Alternatively, whitewater boaters have suggested that a watercraft tow service could be arranged for Big Bend run users. Currently, boaters have to paddle for about 8 miles of flatwater to reach the take-out. Since the run is only available at low reservoir elevations and is consequently not runnable, most years the tow service would not be necessary and in years where it was runnable, the run is only boated during a few months in the fall season. The tow service could be provided by the Lime Saddle concessionaire if they agreed to operate it or had the available equipment. Increased whitewater boating use would have to be monitored and additional management of this use may be needed if considerably more boaters started using the Big Bend run. The tow service would shorten the distance boaters would have to paddle from the end of the run to the take-out, or eliminate it. The tow service, though not necessary as boaters would continue to use the run without the service, would have a beneficial effect on recreation by increasing the quality of the whitewater boating experience and possibly increasing the number of whitewater boaters who use the run (currently only about a dozen paddlers use the run when it is available). If user demand increases in the future, a concessionaire-operated tow service might be economically viable.

Obtain and provide real-time river flow data for the Feather River below the PG&E Poe Powerhouse. This PM&E measure would include coordinating with PG&E to receive real time flow information for the Feather River below the Poe Powerhouse and making this information available to the public via the internet, flow call-in number, and/or other means. Reservoir pool level and river flow are key decision factors for kayakers choosing whether or not to paddle the Big Bend run and whitewater boaters feel access to this information would enhance their recreation experience. With flow information, boaters could decide whether or not to boat the Big Bend run before leaving home instead of having to drive to the put-in and then decide. Lake Oroville reservoir elevation data is already available on the internet. River flow information could be provided by the same means. This measure would have a beneficial effect on recreation by facilitating whitewater boaters' trip planning. The need for the data would be sporadic since the Big Bend run is typically only available during periods when Lake Oroville is drawn down sufficiently (during the fall season of low water years), when

paddlers would be willing to use the run. Due to the proprietary nature of real time flow data, it is uncertain whether this PM&E measure is feasible.

Add a whitewater park to the Feather River. This PM&E measure would create a public, competition-style artificial channel on the right bank of the Feather River below the Diversion Pool (on the bank of the Fish Barrier Pool). Support facilities such as parking, stairs, restrooms, and grandstands would also be included. If constructed as proposed, this measure would have a beneficial effect on recreation by offering new boating opportunities within the project area including opportunities for whitewater boating, rafting, whitewater events, boating safety courses, and spectator viewing opportunities. The need for this facility, however, is not documented as there are several existing whitewater river opportunities close to the project area on the North Fork Feather River and Middle Fork Feather River, and an existing whitewater park in Reno, Nevada, about 140 miles away (2-3 hours). It is unknown if the proposed site is technically and environmentally feasible or whether a sufficient potential user population exists to make a whitewater park in the project area economically feasible. Moreover, the proposed location is in close proximity to critical Project infrastructure and as such may pose a significant security risk. The licensee considers development of this project to be primarily driven by economic development goals related to regional tourism; as such, if economically viable, it would be better suited for private entities and not appropriate for development by the applicant. The applicant's recreation development is appropriately focused on providing access and enhancing recreation opportunities at existing project water bodies (Lake Oroville, Diversion Pool, Thermalito Forebay, Thermalito Afterbay), rather than construction of artificial water features not directly associated with the project.

Camping

Camping capacity and amenities associated with the camping experience would be increased under Alternative 2, though a need for more camping capacity and amenities was not demonstrated by the study plan reports. Capacity would be increased by the addition of sites at Lime Saddle and new floating campsites on Lake Oroville. Improvements would include a camp store, campground activity centers, and a trail and boating amenities for campers at Lime Saddle.

Review RV 'En-Route' camping at Spillway BR/DUA. This PM&E measure would include reviewing whether or not to continue allowing RV "En-Route" camping at Spillway and, if the use is to continue, whether modifications to facilities or operations are necessary. Spillway BR/DUA currently receives very little "En-Route" camping use; however, some stakeholders have requested facility enhancements to support this use. This type of camping is also provided closer to area highways at North Forebay BR/DUA. This PM&E measure would have a positive effect on recreation by providing better information to determine the need for this type of opportunity and where the need can best be met in the project area.

Add camp store shell at Bidwell Canyon Campground. This PM&E measure would include building a roughly 1,000 sq ft building with utilities, aisle/shelf space, and about

10 parking spaces for operation by a concessionaire to support expansion of campground activities. Currently, there is no store available at the campground; visitors must either go outside the project area or visit the marina store for supplies. The marina is close to the campground and sells similar items that a campground store would sell. Convenience stores are available a few miles outside the project area. This measure could have a beneficial effect on recreation by providing campers slightly easier access to supplies without having to drive into the City of Oroville or go to the marina store. Though this PM&E measure might provide some level of enhancement, the extensive relicensing studies do not support it as a current project-related need. Short-term adverse effects may occur from disruption of the recreation setting due to construction or noise or if part of the campground has to close to build the new store.

Modify the existing group use meeting hall as a new campground activity facility at Bidwell Canyon. This PM&E measure would include reconfiguring the meeting hall to be used as a campground activity facility. This would be an amenity to the Bidwell Canyon Campground but is not essential to providing a quality camping experience. The activity facility would need to be staffed by an agency or a concessionaire and could provide for indoor recreation activities and services such as bike rentals. Staff could answer visitor questions and hand out brochures (staff and information are currently available at most times at the entrance station). I&E programs could also be held at the facility. Though this PM&E measure might provide some level of enhancement, the extensive relicensing studies do not support this amenity as a current project-related need. This measure could have a beneficial effect on recreation by enhancing the recreational experience for campers at Bidwell Canyon by providing a space for them to participate in activities that are currently not available at the campground (i.e. games etc). Short-term adverse effects may result from inconvenience during modification of the hall, but it is unlikely that the campground would be closed during construction.

Construct a new campground activity facility at Loafer Creek. This PM&E measure would include siting and building a new campground activity facility at Loafer Creek for use by campers at any of the three campgrounds in the Loafer Creek area. This would be an amenity to the campground but is not essential to providing a quality camping experience. The activity facility would need to be staffed by an agency or a concessionaire and could provide activities such as bike rentals. This measure could have a beneficial effect on recreation by enhancing the recreational experience for campers at Loafer Creek by providing a space for them to participate in activities that are currently not available at the area (i.e. games, etc) as well as space for indoor I&E programs (the area already has an amphitheater). Though this PM&E measure might provide some level of enhancement, the extensive relicensing studies do not support it as a current project-related need. Short-term adverse effects may occur from disruption of the recreation setting due to construction equipment or noise or if part of the campground has to temporarily close to build the new activity facility.

Construct a trail linking the Lime Saddle Campground to the Lime Saddle Marina. This PM&E measure would include siting and constructing a trail between the Lime Saddle Campground and the Lime Saddle BR/DUA/Marina. The Bidwell Canyon and

Loafer Creek areas have trails that connect the facilities; however, Lime Saddle does not have such trails. This measure would have a beneficial effect on recreation by connecting the sites together and providing campers with a pedestrian route to the boat ramp, marina, or shoreline area rather than having to drive or walk along the roads. (However, because of the distance involved, most visitors would likely continue to drive between the facilities.) The trail would also provide additional access to the Parish Cove area where informal swimming and fishing currently occur.

Provide a new courtesy dock for use by Lime Saddle Campground visitors below the campground in Parish Cove. This PM&E measure would include siting and installing a courtesy dock in Parish Cove for use by Lime Saddle campers; however, it may not be feasible to make the dock usable at the wide range of reservoir elevations that normally occur each year. At moderate and low water levels the dock would probably need to be removed to avoid damage, and conflicts with the existing marina facilities may occur. During the periods when such a dock could be in place, it could have a beneficial effect on recreation by giving boaters a short-term docking area that would provide more convenient access to the campground and a place for picking up and dropping off passengers.

Construct approximately 25 to 50 new RV/tent campsites and other improvements at Lime Saddle Complex if needed based on monitoring results. This PM&E measure would include siting and constructing 25-50 new RV/tent campsites at the Lime Saddle Campground if monitoring shows that the campground is reaching capacity. Additionally, a new campground complex maintenance yard would be constructed with a shop and storage facilities to support the larger campground. Relicensing studies show that the campground is not currently at capacity nor is it expected to reach capacity in the near future. This PM&E measure would only be needed if monitoring demonstrates the need for more campsites at Lime Saddle in the future. If this should happen, this PM&E measure would have a beneficial effect on recreation by providing more capacity for increased camping use. Short-term adverse effects may occur from disruption of the recreation setting due to construction equipment or noise or if part of the campground has to close to build the new sites.

Provide one new group RV campsite with utilities at the Lime Saddle Complex based on monitoring results, if needed in the future. This PM&E measure would include siting and constructing one group RV campsite with utilities at the Lime Saddle Complex. Though the group campground at Lime Saddle is not currently or projected to reach capacity, current use levels are expected to increase once the site becomes better known by the public or if it begins to serve as overflow from other group sites. This PM&E measure would only be needed if monitoring demonstrates that use is increasing and additional group camping is needed in the future. If this should happen, this PM&E measure would have a beneficial effect on recreation by providing more group camping capacity and more group RV facilities. Short-term adverse effects may occur from disruption of the recreation setting due to construction equipment or noise or if part of the campground has to temporarily close to build the new site or install utilities.

Provide three additional floating campsites on Lake Oroville. This PM&E measure would provide three additional floating campsites on Lake Oroville, relatively close to Lime Saddle as there are no floating campsites nearby for users based out of Lime Saddle or other parts of the West Branch or North Fork arm of Lake Oroville. A maintenance operation out of Lime Saddle would need to be set up to maintain these floating campsites; existing maintenance based at the south end of the reservoir could not feasibly service these floating campsites. This maintenance operation would necessitate the purchase of an additional maintenance boat. This PM&E measure would have a beneficial effect on recreation at Lake Oroville by increasing capacity for this type of camping. However, the cost of developing these facilities is expected to far exceed the revenues and other benefits they will create.

Angling

The quality of the angling experience could increase through several fisheries activities.

Additional Feather River fishery enhancements. Alternative 2 includes several Feather River fishery enhancement measures and operational changes at the fish hatchery that would be implemented in addition to those proposed under the Proposed Action. These PM&E measures include:

- Establish side-channel habitat to benefit spring run Chinook salmon and steelhead;
- Structural modifications to allow sturgeon passage;
- Hatchery Adaptive Management Program with water sterilization element included;
- Marking of all hatchery reared spring run Chinook salmon and steelhead; and
- Monthly Feather River temperature targets.

The first two measures could potentially increase the number of available fish by enhancing salmonid spawning habitat and removing barriers to sturgeon passage downstream of the project area. These actions may improve catch rates and provide a new species for anglers to pursue, thereby enhancing the quality of the angling experience within the project area. These measures would have a beneficial effect on recreation by increasing the quality of the fishing experience. However, new restrictions on angling in habitat enhancement areas may also result, and could have a minor adverse effect on recreation by reducing the area that may be fished. The remaining three actions relate to hatchery operations and control of river temperatures. The hatchery operations actions would not be expected to directly affect angling. Revised temperature targets are intended to benefit the fishery in the river and thus could have a beneficial effect on angling if fish populations are increased. Further detail on these actions is provided in Section 5.5.2, Aquatic Resources.

Trails

The PM&E measure would have beneficial effects on trail-related recreation by making more trails available to more users. For example, bike riders and equestrians would gain access to trails previously closed to them. However, perceived adverse effects could result for trail users of some trail segments who would prefer to have single use trails (hike, bike, or equestrian only) or who prefer to not share trails.

Implement multi-use trail designation on more trail segments. This PM&E measure would provide any modifications to the trails program necessary to designate all trails as multi-purpose, except for trails recommended by DPR for single use (i.e. Sycamore Hill) due to safety considerations, and contingent upon FERC approval. This would allow hiking, biking, and equestrian use on most trails within the project area, having a beneficial effect to a broader spectrum of users due to increased multi-use trail designation and new trail construction.

Swimming and Other Shoreline-Based Day Use

Both the quality and opportunities for day use would be increased under Alternative 2. Day use quality improvements would include upgrading facilities and adding facilities such as more parking. A new day use area and multi-use center would be created, increasing day use opportunities and capacity. Swimming opportunities would increase in this alternative by providing a new swim facility at Loafer Creek or Lime Saddle.

Upgrade existing picnic tables and shade structures while maintaining views at Lime Saddle DUA. This PM&E measure would upgrade existing picnicking facilities at the Lime Saddle DUA to DPR standards. These facilities are functional, but do not currently meet the standards of other day use facilities within the project area. This would have a beneficial effect on recreation by increasing the quality of the day use experience. Short-term adverse effects may occur from disruption of the recreation setting due to equipment or noise or if part or all of the Lime Saddle DUA has to close during upgrades.

Provide a new shoreline day use area at Parish Cove that is linked by trail access to the Lime Saddle Campground and Lime Saddle BR/DUA/Marina. This PM&E measure would include installing picnic tables and pole grills at Parish Cove to make a new day use area at this site. Currently, swimming and bank fishing already occur at the site, but there are no developed facilities. A new trail would link the new Parish Cove DUA to the Lime Saddle Campground and BR/DUA/Marina so users at these other sites could also use the new DUA (the trail is also mentioned under camping). Parking for the Parish Cove DUA would be provided near the Lime Saddle BR/DUA/Marina. This measure would have a positive effect on recreation by providing a shoreline day use area on the upper part of the reservoir. There currently is no such facility; the Lime Saddle DUA does not offer shoreline access. A day use area at Parish Cove would offer visitors to the northern part of Lake Oroville, especially campers at Lime Saddle, a chance to picnic, relax, swim or fish on the shoreline. However, this facility would only be attractive and useable for a few weeks or months each year, when

the water level is high and the new facilities are close to the shoreline. Short-term adverse effects from construction may occur due to disruption of the recreation setting for the swimmers and bank anglers that currently use the site or if part or all of the site has to close to install the new facilities.

Add picnic tables, upgrade vault restrooms, create better parking and turnaround areas at Stringtown Car-top BR. This PM&E measure would include adding picnic tables, upgrading restrooms, and making a better parking and turnaround area at Stringtown Car-top BR. There are no picnic facilities at the site and the parking area is very small, but there was no need identified for improved/additional facilities at this site. This measure would have a beneficial effect on recreation by increasing the quality of the recreational experience at Stringtown Car-top BR through better quality facilities and enhanced picnicking opportunities. Short-term adverse effects may occur from disruption of the recreation setting due to construction equipment or noise or if part or all of the site has to close for construction, installation or upgrades. Though this PM&E measure might provide some level of enhancement, the extensive relicensing studies do not support it as a current project-related need.

Construct 30-50 additional vehicle parking spaces at Oroville Dam Overlook DUA. This PM&E measure would include siting and building vehicle parking for about 30-50 vehicles. Currently, the site is not reaching parking capacity; however, dam security concerns have caused a parking area near the dam spillway to be closed to the public. This measure would have a beneficial effect by providing additional parking capacity to replace the closed area. Short-term adverse effects from construction may occur from disruption of the recreation setting due to equipment or noise. An existing unused lot nearby may serve this function but would need upgraded pedestrian access to the dam crest.

Create day use sites for trail users and boaters at the Diversion Pool. In addition to day use facilities included in the Proposed Action, Alternative 2 would create spur-trails and boat landing areas with picnic tables, pole grills, and trash receptacles at remote points along the north and south shores of the Diversion Pool. Currently, there are no developed facilities other than a restroom at the Diversion Pool. This measure would have a beneficial effect on recreation by providing facilities for picnicking and relaxing for use by either trail users or boaters and thus increasing the quality of the recreational experience. Within the project area, day use sites in such remote locations do not exist; this measure would provide opportunities for solitude and a chance to recreate away from parking areas and roads, while maintaining the semi-primitive setting of the Diversion Pool. Use in this area is also relatively low, and studies did not identify this as a current need, so these sites may receive very little use. There also may be conflicts with VELB and habitat loss. Short-term adverse effects from construction may occur due to disruption of the recreation setting from equipment or noise. Resources necessary for site maintenance are not likely to be justified by the anticipated low use levels.

Build a swimming facility at Loafer Creek or Lime Saddle. This PM&E measure would include building a swimming facility at Loafer Creek or Lime Saddle based on the

results of feasibility studies, in addition to the swimming beach that is currently provided at Loafer Creek DUA. The goal would be to extend warm water swimming opportunities for the frequent periods where the beach is unusable due to low water. The option for a swimming pool would not provide the natural water body swimming opportunity and beach that some users would prefer and that is typically provided in these settings. Construction and operations costs are also expected to be high, and fairly extensive site alteration may be necessary. Many potential options exist for providing added swimming opportunities in the project area; the feasibility study would likely identify the most feasible and beneficial option.

Open Space-Dependent Activities

Same as Proposed Action.

Public Information, Education and Interpretation Services

The overall quality of the recreation experience would be increased at the Feather River Fish Hatchery with a new educational opportunity for viewing fish.

Add spawning riffle observation/interpretation nature trail allowing access near spawning at the Feather River Fish Hatchery. This PM&E measure would include siting and constructing a nature trail to an observation/interpretation access point at the Feather River Fish Hatchery near spawning riffles so that visitors can view spawning activities and fish passing through the area. The hatchery already has several fish viewing opportunities including a viewing platform, viewing window at the fish ladder, and viewing windows along the spawning building. Though this PM&E measure might provide some level of enhancement, the extensive relicensing studies do not support it as a current project-related need. This measure would have a beneficial effect on recreation by enhancing the quality of the recreational experience by providing another spawning viewing opportunity. Short-term adverse effects may occur from disruption of the recreation setting due to construction equipment or noise.

Special Events

Under this alternative, additional special events could be held in the project area at the proposed flexible event center. The recreational experience of fishing tournament attendees would also be enhanced.

Provide short-term event grandstand space for use by concessionaires or event organizers during fishing tournaments at Bidwell Canyon. This PM&E measure would include short-term allocated space within the Bidwell Canyon BR parking lot for concessionaires or event organizers to erect grandstands during fishing tournaments. Built-in grandstands for tournament use are already provided at Spillway BR; this measure would serve a similar function at Bidwell Canyon. This measure could have a beneficial effect on recreation by increasing the quality of the recreation experience for those watching the fishing tournament.

Create flexible event center next to the Thermalito Diversion Dam. This PM&E measure would include additional development of the staging area on the northwest side of the Thermalito Diversion Dam. Development would include an arena, fencing, delineated parking, water, restrooms, small concession/office building, and grandstand seating. Though other activities could be held at the center, it would primarily be for equestrian special events due to its location at an enhanced equestrian staging area. This measure could have beneficial effects on recreation by supporting equestrian and other events, since no such facilities exist at present. Though this PM&E measure might provide some level of enhancement, the extensive study plan reports do not support it as a current project-related need. Additionally, permanent adverse impacts to botanical species and wildlife habitat will result from construction and implementation of this PM&E measure.

Recreational Safety

In Alternative 2, visitor safety could be increased by developing a Fuel Load Management Plan.

In coordination with other responsible entities, develop a Fuel Load Management Plan. This PM&E measure would include developing a plan to reduce fuels in the vicinity of the wildland/urban interface of the project area. Such a plan does not currently exist for the project area. This measure would have a positive effect on recreation within the project area because it would increase the safety of visitors, especially at project area sites near high fuel load areas such the Bidwell Canyon recreation sites.

Programmatic Recreation Resources/Management

Transfer BLM lands within the FERC project boundary to DWR. This PM&E measure would include identifying and organizing the transfer of BLM properties within the FERC project boundary to DWR. The BLM does not currently actively manage these lands. The transfer of land to DWR would have a positive effect on recreation by enhancing recreation management of these lands, which could increase under DWR ownership in conjunction with adjacent lands currently under State ownership. With these lands under DWR jurisdiction, and the likelihood of DPR management of these lands within LOSRA, future recreation opportunities could be more efficiently developed. This measure is not included in the Proposed Action because it is not clear that BLM is prepared to implement a transfer in the near future.

Cultural Resources

Same as Proposed Action.

Recreation Operations and Maintenance

Same as Proposed Action.

Project Operations

Two actions have been proposed under Alternative 2 which would increase flows in the Feather River Low Flow Channel to benefit the coldwater fishery.

Maintain minimum flow of 800 cfs within the Feather River downstream from Thermalito Diversion Dam and the Feather River Fish Hatchery. This PM&E measure would require 800 cfs minimum flow year-round in the Low Flow Channel, 200 cfs more than the current minimum of 600 cfs. Although this increase in flow could increase boating opportunities on the Low Flow Channel, it is unlikely that substantially more boaters would use the Low Flow Channel than under current conditions. This measure could have a beneficial effect on recreation by increasing spawning and potentially, in the long term, increasing the number of fish in the Feather River.

Increase Low Flow Channel minimum to 1,200 cfs but not more than total release to Feather River May 1 to June 15. This PM&E measure is essentially a modification of the above PM&E measure and would double the current minimum flow in the Low Flow Channel from 600 cfs to 1,200 cfs from May 1 to June 15. This could have a mixed effect for boating and angling due to increased boating opportunities on the Low Flow Channel of the Feather River, but more difficult conditions for wading anglers. Most motorized boat users do not boat much on the Low Flow Channel of the Feather River, leaving this section of the Feather River very quiet and peaceful with many opportunities to view wildlife. With more motorized boat users, there may be an increase in noise and some users may be negatively affected and feel there are fewer opportunities for a quiet river experience. However, some boaters felt that the flow on the Feather River was not high enough and therefore increasing the flow would help with this concern.

5.10.3 Cumulative Effects

The recreation 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 use opportunities. The analysis of cumulative effects will also address Lake Oroville elevations and Feather River flows downstream of Oroville Dam, because each of these can have effects on recreation. Section 5.10.1 provides additional information on other similar recreation 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 (listed at the beginning of Section 5.10), as well as Study SP-L3 (*Comprehensive Plans Consistency Evaluation*) completed under the direction of the Land Use, Land Management, and Aesthetics Work Group provide the information needed for this analysis.

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

The regional and project area existing conditions and trends related to recreation that are a result of the project's incremental and baseline conditions and related actions in the region are described in detail in Section 5.10.1 Affected Environment. The following paragraphs summarize the most important actions and effects.

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 soon after construction of Oroville Dam and Lake Oroville in 1968. Most of these facilities have been managed as part of the Lake Oroville State Recreation Area, which has reported visitor attendance between approximately 500,000 and 950,000 visits most years since the mid-70's (see Figure 5.10-2). Additional recreation use, much of it dispersed in nature, has occurred at the Oroville Wildlife Area (total unknown, but estimated between 100,000 and 250,000 visitors per year).

Present actions include the operation and maintenance of the recreation facilities provided above as well as management of lands for dispersed uses such as hunting. Study plan report SP-R9 estimated that these management activities supported over 1.6 million recreation days (RDs) of use within the project area during the 12 month relicensing study period 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.

Past and present actions in the project area also include normal project operations for water storage and hydroelectric power, which result in an annual drawdown cycle at Lake Oroville and modified flows in the Feather River.

Related Actions of Regional Recreation Providers

Regional past and present related actions includes the construction and recreational developments of many moderate to large reservoirs. Study plan report SP-R14 described 20 reservoirs 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 Lake Oroville and the other project reservoirs.

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 the US Forest Service, Bureau of Land Management, and National Park Service. The Plumas National Forest to the west and the 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 unique volcanic relics. The Bureau of Land Management 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 off-highway vehicle (OHV) use. Recreation attendance figures are not available for many of these areas, but they clearly play an important role in providing both developed and dispersed recreation opportunities that complement those provided within the project area.

Cumulative Effects on Recreation of Past and Present Actions

Cumulatively, the effect of past and present actions in the project area and of related actions has been to substantially increase the amount and range of recreation opportunities in the region, particularly in regards 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 been increased substantially.

5.10.3.2 Cumulative Effects of the Alternatives and Future Related Actions

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

Future Related Actions of Regional Recreation Providers

Several providers of recreation facilities and opportunities in the region surrounding the project area have plans for future related actions that would increase recreation opportunities in the region.

Regional Reservoirs

Several of the reservoirs in the region have recently completed or plan to make additions and improvements to recreation facilities (Study SP-R14 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

The Plumas National Forest is the primary federally-managed area near to the project area. (A few parcels of the Lassen National Forest near the project are also managed by the Plumas National Forest.) The Forest's Land and Resource Management Plan (LRMP), adopted in 1988, provides future direction for management of the Forest, and emphasizes continued cooperation with DPR in managing USFS lands within LOSRA. Additional recreation management described in the plan 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.

The Bureau of Land Management 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 (RMP). 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 RMP as it relates to lands in and near the project area is the potential transfer of public lands from BLM to local, State, or other federal agencies. In particular, 6,900 acres of land within and adjacent to LOSRA are identified as available for transfer to the State of California.

In general, these Forest Service 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. These are provided within the project area primarily at the OWA. As such the future management of these federal lands provides opportunities which complement the limited amount of similar opportunities available within the project area.

State Agencies

At the state level, Study plan report SP-R14 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 action 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 (1996) 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 LOSRA and the OWA. The Scenic Highways element proposes pursuing State Scenic Highway designation for a portion of State Route 70 in the project vicinity. Related policies are established that 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.

These plans suggest that Butte County and the City of Oroville will 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 two Pacific Gas and Electric Company (PG&E) 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 immediately upstream of the Oroville Project that create two small reservoirs (each about 50 acres) and related tunnels, penstocks, powerhouse and related facilities. 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.

PG&E submitted its Draft License Application for the Poe Project in April 2001. Currently, a collaborative process is under way with the expectation of settlement agreement submittal by early 2005. It is expected that PG&E will provide supplemental flows in the river that will provide additional whitewater boating opportunities. FERC has not completed an environmental document on this project.

The settlement agreement for the Upper North Fork Feather River Project was signed in April 2004 and filed with FERC in September 2004. The Draft EIS was issued in September 2004 and is currently in the public review process. The Draft EIS 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 Lake Almanor. Trail easements around the lake are also proposed. Campground, boat ramp, and trail improvements are also proposed for the smaller Butt Valley reservoir. Minor recreation improvements are planned for the Belden Forebay and bypassed river reaches. Whitewater boating flows may also be proposed for the Belden reach.

Also of interest in relation to whitewater boating opportunities is PG&E's Rock Creek-Cresta project. The Rock Creek-Cresta project is located between PG&E's Upper North Fork Feather River project and Poe project, respectively, and consists of two dams that separate reaches of the North Fork Feather. The 2000 settlement agreement calls for whitewater releases on consecutive weekend days in both the Rock Creek and Cresta reaches June through October. The Rock Creek and Cresta releases are reported to be popular, attracting 300 to 500 paddlers per release.

Cumulative Effects of Regional and Project Area Actions

The cumulative effects of the No-Action Alternative implemented 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 population growth and increased demand for recreation activities, recreation attendance in the project area and the region would be expected to continue to increase.

The cumulative effects of the Proposed Action, which includes more than 60 PM&E measures that would enhance recreation facilities and management in the project area, and the actions of regional providers of recreation opportunities would result in growth in recreation opportunities in the region. Cumulatively, these measures will have beneficial effects on the full range of recreation opportunities available in the 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 recreation opportunities within the 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 recreation opportunities across the region, along with population growth and increased demand for recreation activities, would lead to steady growth in recreation attendance in the project area and the region.

The cumulative effects of Alternative 2, which includes several PM&E measures as alternatives to or in addition to the Proposed Action measures, and the actions of regional providers of recreation opportunities would also result in growth in recreation opportunities in the region. The additional constructed facilities in the project area (beyond those proposed in the Proposed Action) would further expand regional boating, camping, and reservoir-based day use opportunities in the region. The construction of a whitewater park alongside the Feather River would add a potentially year-round (artificial) whitewater boating opportunity to the plentiful (though seasonal) opportunities on several rivers in the region. However, the viability and feasibility of such a project is questionable. Project operational changes are proposed related to minimum flows in the Feather River, but the effects on recreation in the regional context would be negligible.

5.10.4 Unavoidable Adverse Effects

As described in Section 5.10.1.6, Baseline Effects of Project Operations on Recreation Resources, reservoir drawdown affects recreation resources at Lake Oroville and is expected to continue to do so into the future. Effects on recreation related to fluctuations and/or temperatures at Diversion Pool, Thermalito Forebay, and Thermalito Afterbay, as well as effects from Feather River flow and temperatures are also described in Section 5.10.1.6 and would continue into the future. Measures to reduce these effects are included in the Proposed Action and Alternative 2. Long-term, short-term, or cumulative effects on recreation resources that would occur despite these measures are considered unavoidable adverse effects. Under each alternative, there

would be some unavoidable adverse effects on recreation facilities, sites, and opportunities.

5.10.4.1 No-Action Alternative

With implementation of the No-Action Alternative, baseline project effects on recreation facilities, sites, and opportunities would continue. In addition, projected increases in the recreation use of the area, in particular by boaters, would create the potential for increasing the level of effect on recreation resources by increasing the number of recreationists affected. No measures to reduce these effects beyond those already implemented by the licensee are included in this alternative, resulting in several unavoidable adverse effects. These unavoidable adverse effects include routine reservoir and flow fluctuations associated with original project purposes and on-going requirements that can affect boating, reservoir access, and shoreline use such as swimming and angling. Other unavoidable adverse effects of temperature requirements from reservoir releases adversely affect warm water swimming opportunities.

5.10.4.2 Proposed Action

The recreation resource PM&E measures included in the Proposed Action would reduce baseline project effects as well as help reduce potential further effects from increased recreation use. In particular, extension of boat ramps, opening of new low-water ramps, and enhancement of shoreline day use areas would reduce the effects of reservoir drawdown at Lake Oroville. Effects to recreation resources would primarily be reduced during periods of low water, which generally occur during the late summer through winter period. However, not all effects on recreation resources resulting from project operations would be avoided. Adverse effects on recreation (water temperatures desirable for body-contact recreation, water level fluctuation) at project reservoirs and Feather River downstream of Lake Oroville would continue. However, a proposal to evaluate options for warming the water at the North Forebay DUA swim beach may reduce effects of cold water on swimming in that area in the future if feasible.

5.10.4.3 Alternative 2

As with the Proposed Action, measures to avoid or reduce effects on recreation resources are included in Alternative 2, but some unavoidable adverse effects on recreation facilities, sites, and opportunities would continue to occur as a result of reservoir fluctuation and other aspects of project operations. This alternative provides additional measures to reduce the effects of drawdown on boating facilities and access at Lake Oroville. However, these actions may not be feasible due to security concerns, conflicts with existing facilities or use, physical site limitations. They may also be difficult to justify given expected costs as well as the limited benefits provided in addition to those benefits provided by Proposed Action PM&E measures. The additional measures that are included in Alternative 2 would not reduce adverse effects on the project area reservoirs and the Feather River downstream of Lake Oroville.

5.11 AESTHETIC RESOURCES

Aesthetic resources encompass visual resources, noise, and odor. This aesthetic resources section was developed to satisfy the requirements of FERC and NEPA. One of the main objectives of this section is to describe the existing aesthetic conditions in the study area (0.25 mile outside of the FERC project boundary) and within the FERC project boundary. The existing conditions serve as the baseline conditions against which the alternatives are evaluated. Analysis of the existing conditions primarily involved describing visual elements such as topography, vegetation, and land use that (together with noise and odor) influence the aesthetic environment of the Oroville Facilities. The physical conditions of the project area that could be potentially affected are:

- Pool elevation timing changes at Lake Oroville, Thermalito Forebay, and Thermalito Afterbay that would expose shoreline areas and submerged items such as tree stumps and debris at times that are different than under the existing operating regime, particularly during peak visitation periods;
- The introduction of new infrastructure or recreation facilities where they would create a noticeable change in, or conflict with, the area's existing aesthetic character or scenic quality;
- New sources of light or glare from new buildings or facilities;
- Short-term effects on aesthetic quality associated with construction activities; and
- The introduction of new landscaping, restoration efforts, facilities management, and/or maintenance programs (e.g., removal of trash and project debris) related to the aesthetic enhancement of project lands.

5.11.1 Affected Environment

The aesthetic environment encompasses visual resources, noise, and odor. The scoping process did not reveal any concerns with noise or odors associated with the Oroville Facilities, but did identify issues related to visual resources. Hence, noise and odor issues were not discussed by the collaborative; however, they were not detected during the field reconnaissance. Therefore, the description of the affected aesthetic environment focuses on visual resources.

The Affected Environment section describes the existing aesthetic environment of the Oroville Facilities. The Oroville Facilities have been divided into five aesthetically distinct geographic areas (Lake Oroville, the Diversion Pool and Thermalito Forebay, the Thermalito Afterbay, the Low Flow Channel, and the OWA). The review of each of the five areas includes a brief description of the area's location, topography, vegetation patterns, types of views available from within the area, land uses, major aesthetic features, and types of viewers. The description of each area also includes a brief discussion of the key observations points (KOPs) that were used in SP-L4. KOPs are

locations within and near the FERC boundary chosen to represent views of the aesthetic environment of the Oroville Facilities (see Figure 5.11-1). Descriptions of each of the KOPs and photographs from each KOP are included in Appendix A of SP-L4.

Major issues related to aesthetic resources identified during the scoping process included:

- Effects of project operations, features and land uses on the aesthetic quality of project lands.
- Assessment of appropriate landscaping, restoration, and facilities management programs for aesthetic enhancement of project lands.

5.11.1.1 Regional Setting

The Oroville Facilities are located in Butte County. The western half of Butte County is situated along the eastern edge of the Central Valley. This part of the county is primarily flat, and land use is largely agricultural with scattered areas of development ranging in intensity from scattered rural residential, to suburban, to urban. The aesthetic environment of this part of the county is dominated and largely influenced by human development activities and generally has a rural character. The agricultural areas in this part of the county generally include irrigated row crops and orchards in the flatter areas and grazing in the foothills. Thermalito Forebay and Thermalito Afterbay are located in this area.

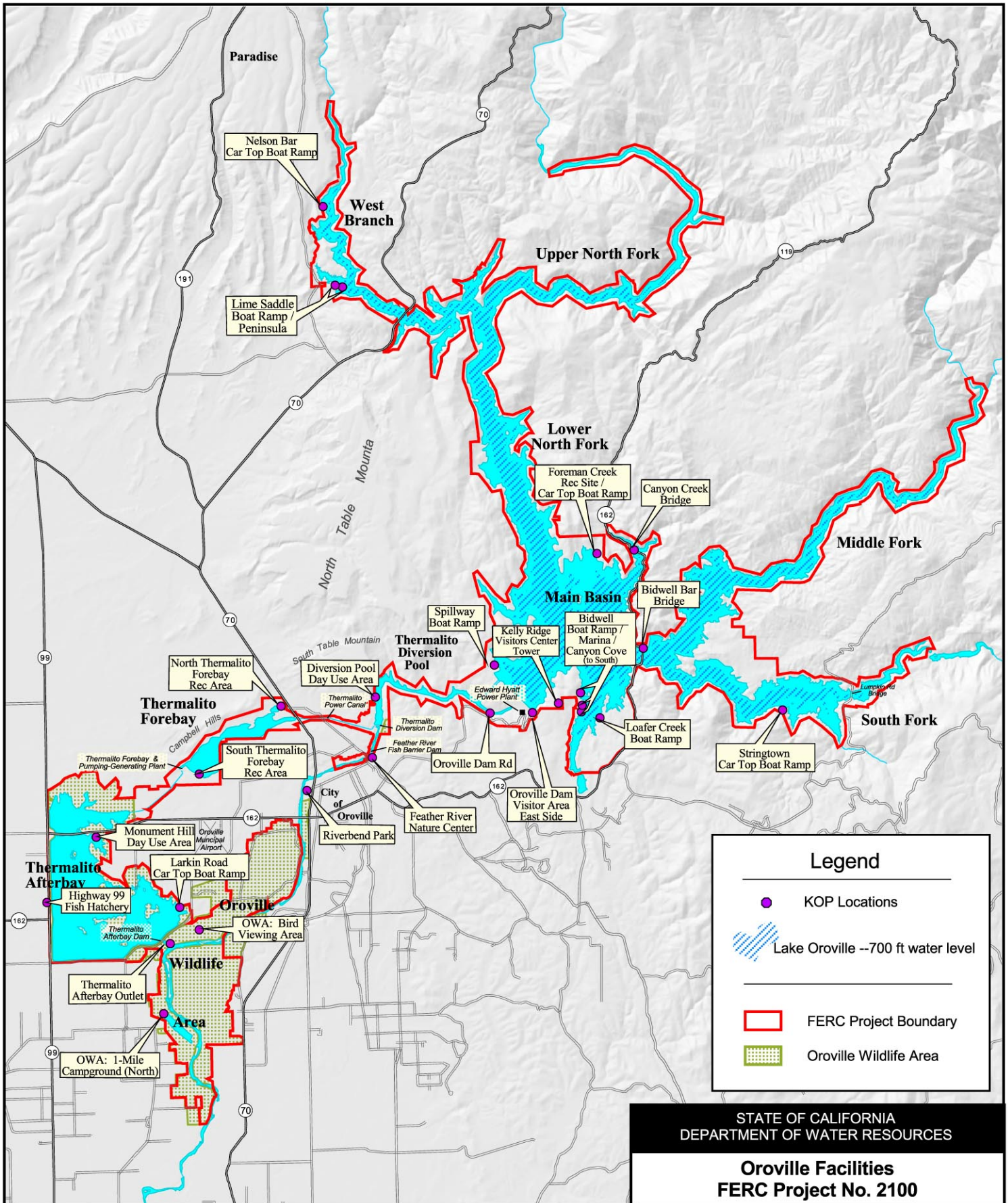
The eastern half of the county begins near the foothills of the Sierra Nevada and continues east to the range's upper slopes. This part of the county is largely undeveloped and retains much of its natural character. Scattered rural residences and small communities are located throughout this area. Vegetative cover in the foothills area includes chaparral, oak woodland, and coniferous forest. Lake Oroville is located is this area.

5.11.1.2 Project Aesthetic Environment

Lake Oroville

Lake Oroville is impounded by the Oroville Dam, an earthfill structure that rises 770 feet above the floor of the Feather River Canyon and is approximately 1.3 miles in length. The Oroville Dam is a major visible feature in the Oroville area. Its scale, shape, texture, and color contrast with the surrounding landscape. The dam's ancillary facilities (substation, equipment yards, roads, etc.) are somewhat visible and have a moderate degree of contrast with the landscape.

Three 230-kV overhead transmission lines extend approximately 9 miles from the Hyatt Power Plant Switchyard to PG&E's Table Mountain Substation and in some locations introduce contrasting shape, form, and color into the viewed landscape (particularly



Source: DWR GIS / Water Level at high pool (approx 880 ft) per USGS DOQQ / EDAW 2003

1 0 1 2 3 4 5 Miles

Original Scale 1 : 190,080
1" = 3.0 miles

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Oroville Facilities
FERC Project No. 2100

FIGURE 5.11-1

Location of Key Observation Points
(KOPs)

Prepared by: PJ -- EDAW, Inc. Date 11/16/04 P:\2000\0s016.gis\arcview\apr\kop.apr

where they are silhouetted against the sky). It must be noted that there are many other non-project transmission lines that are visible in the vicinity of the project.

Lake Oroville is a major regional aesthetic resource. At maximum operating storage capacity, the reservoir's surface area at full pool is approximately 15,800 acres in size with approximately 167 miles of shoreline. The straight line distance between Oroville Dam and the farthest reaches of both the West Branch and Middle Fork is approximately 12 miles. Lake Oroville is composed of five main "arms" or "branches," and the large, centrally located main basin. The five arms are known as the West Branch, the Upper North Fork Branch, the Lower North Fork Branch, the Middle Fork, and the South Fork. These arms range in width from as much as 1 mile in the lower portions of the Lower North Fork, to less than 100 ft in their upper reaches. The terrain adjacent to the arms is typically steep, and the arms become narrow and canyon-like toward their upper reaches. Views along the straight parts of the arms can be extensive (approximately 7 miles in the Lower North Fork), but are restricted in most areas by twisting terrain. In contrast, the main body of the reservoir affords wide open views of the surrounding landscape.

Due to steep topography and limited road access, much of Lake Oroville is not easily accessible to the public by land. The greatest number of people who view the reservoir up close are recreating on the reservoir or at its major recreational facilities. Another large group of people who view Lake Oroville are the motorists who observe it when they drive over the bridges on State Route (SR) 162 (the Bidwell Bar Bridge), SR 70, and Lumpkin Road. A third group of people who view the reservoir are the people who live near the Oroville facilities. Most of these residents live near Kelly Ridge and have views of the Loafer Creek area, the main body of the reservoir, and the Bidwell Bar Bridge area. Other areas with residential viewers are scattered along the South Fork (primarily near Enterprise), in the main basin near Canyon Creek, and along the west side of the upper reaches of the West Branch.

KOPs were selected to represent existing aesthetic conditions and the types of views available from around Lake Oroville. The KOPs represent a variety of locations around the reservoir and different types of viewing areas such as developed marinas, developed boat ramp facilities, less developed car-top boat ramps, and areas from which the project can be viewed, such as bridges and the Lake Oroville Visitors Center. The locations of the KOPs include the upper, narrow ends of branches, the wide open main basin of the reservoir, and areas outside of the FERC project boundary. Table 5.11-1 includes a brief description of the KOPs at Lake Oroville.

The water level elevation of Lake Oroville fluctuates throughout the year and influences the nearby aesthetic environment. As drawdown occurs during the course of the summer and fall, an increasingly broad ring of shoreline appears between the vegetated shoreline and the water of the reservoir. Reservoir drawdown has different effects on different locations at Lake Oroville. The upper ends of the arms or branches are the most affected by drawdowns. These shallower areas can have considerable amounts of vertical and horizontal shoreline exposed during drawdowns. The drawdowns also expose shoreline in the main basin of the reservoir, but to a lesser degree than in the

upper arms or branches. In steep portions of the main basin, such as the area near the Bidwell Bar Bridge, drawdowns can expose a considerable amount of vertical shoreline. Unlike the upper arms or branches, however, steep areas of the main basin of Lake Oroville are deep, so they do not become dewatered.

SP-L4 examined and photographed three different elevations at Lake Oroville over a 2-year period to evaluate the influence of very different reservoir elevations on the

Table 5.11-1. Lake Oroville key observation points (KOPs).

Location of KOP	Description
MR-1: Nelson Bar Car-top Boat Ramp (BR)	Represents the aesthetic conditions of the upper West Branch from the car-top boat ramp at Nelson Bar.
MR-2: Lime Saddle BR	Represents the aesthetic conditions of the portion of the West Branch near Lime Saddle from one of the more used facilities at the project.
MR-3: Lime Saddle Peninsula	Represents the aesthetic conditions of the area south of the Lime Saddle Marina in the West Branch.
MR-4: Foreman Creek Car-top BR	Represents the aesthetic conditions of the main basin of the reservoir from a car-top BR located at the northernmost part of the main basin.
MR-5: Canyon Creek Bridge	Represents the aesthetic conditions of the Canyon Creek inlet from an area adjacent to SR 162.
MR-6: Bidwell Bar Bridge (SR 162)	Represents the aesthetic conditions of the portion of the main basin of the reservoir that can be seen from near the Bidwell Bar Bridge.
MR-7: Stringtown Car-top BR	Represents the aesthetic conditions of the middle portion of the South Branch from a car-top BR.
MR-8: Bidwell Canyon BR	Represents the aesthetic conditions of the southern part of the main basin from one of the more used boat ramp facilities at the project.
MR-9: Bidwell Canyon Marina	Represents the aesthetic conditions of the southern part of the main basin near the largest marina in the project.
MR-10: Bidwell Canyon Cove to South	Represents the aesthetic conditions of the cove south of the Bidwell Canyon Marina from an area located between the marina and the Loafer Creek BR.
MR-11: Loafer Creek BR	Represents the aesthetic conditions of the southern part of the main basin from a very popular boat ramp facility.
MR-12: Lake Oroville Visitors Center Tower	Represents the aesthetic conditions of the western part of the main basin from a popular facility on top of Kelly Ridge that is outside of the FERC boundary.
MR-13: Oroville Dam Visitors Area East Side	Represents the aesthetic conditions of the western part of the main basin and the area near the Oroville Dam from an established overview area and from Oroville Dam Road.
MR-14: Spillway BR	Represents the aesthetic condition of an inlet off of the main basin from a heavily used boat ramp facility.

Source: SP-L4

aesthetic environment. The report also used exceedance data to determine the frequency that each elevation could be expected to be reached or exceeded, based on water year history for the years between 1922 and 1994, and based on actual Lake Oroville water usage data from 2001. For a detailed discussion describing exceedance data, please see Section 6.1.2.1 of SP-L4.

The exceedance data in Table 5.11-2 indicate that the three elevations used for this assessment represented a range of reservoir elevations that vary in terms of likeliness to occur at various times of the year. Reservoir elevations that approach or reach full pool (900 ft) are not common events, whereas an elevation of 830 ft has a good chance of occurring or being exceeded during most water years (85 to 75 percent). The elevation 710 ft was selected to represent very low elevations. The likelihood of an elevation of 710 ft being met or exceeded throughout the year in any given year is very high, at 95 percent. Conversely, the likelihood of a water surface elevation lower than 710 ft in any given year is 5 percent. Even though this elevation occurs infrequently, it is important to include it in the analysis to have a "worst-case" scenario example to analyze. The following describes the effects of the three elevations on the aesthetic environment. See the figures in Section 6.1.2.1 of SP-L4 for photographs from around Lake Oroville at the three elevations.

Table 5.11-2. Lake Oroville exceedance data at three elevations[1].

Month	Elevation 900 ft	Elevation 830 ft	Elevation 710 ft
April	0%	85%	95%
May	30%	80%	95%
June	25%	75%	95%
July	5%	45%	95%
August	5%	30%	95%
September	0%	30%	95%
October	0%	25%	95%

[1]Data indicate percentage or likelihood that the elevation is met or exceeded for a particular month. Another way to evaluate the data is to realize that if an elevation has a likelihood of being exceeded of, for example, 95 percent, the likelihood of Lake Oroville being at or below that elevation would be 5 percent.
Source: DWR 2004

Elevation 900 ft (Full Pool) – Full pool (elevation 900 ft) is not a common occurrence at Lake Oroville. The likelihood of an elevation of 900 ft being met or exceeded in May and June is 30 and 25 percent, respectively. The likelihood is lower in other months. At full pool, the water of the reservoir completely covers all of the shoreline of Lake Oroville up to the vegetation line and, in some areas, rises above it. Shoreline debris such as tree stumps, and exposed features such as rock outcroppings that are exposed at lower reservoir elevations, are submerged at this elevation. At full pool, trash and other floating debris that collects along exposed shorelines at lower pool elevations is carried with the rising pool and can be deposited along the high pool elevation shoreline in adjacent vegetation.

Elevation 830 ft – Lake Oroville reaches or exceeds this elevation with great regularity during the spring months. The likelihood of this elevation being met or exceeded in April, May, or June is approximately 85, 80, and 75 percent, respectively. During the summer months, the likelihood of this elevation being met or exceeded is less, approximately 45, 30, and 30 percent in July, August, and September, respectively. At elevation 830 ft, the exposed shoreline at many locations becomes a primary part of the scenery but does not dominate the scene. Some parts of the reservoir have less exposed shoreline and may have features (such as marinas) that receive viewer

attention and thus lessen the adverse effect of exposed shorelines. Because of the exposed shoreline, most viewers would be expected to find Lake Oroville less attractive at this elevation than at full pool.

Elevation 710 ft – An elevation of 710 ft is almost 200 ft below full pool. Based on exceedance data, the chance of this elevation being reached or exceeded for any month between April and October is 95 percent, which conversely means that the likelihood of this elevation being even lower or met in any given month, below April and October, is approximately 5 percent. Reservoir elevations that are this low generally only occur during the fall of very dry water years. This elevation would likely be considered the least attractive of the three elevations by most viewers.

Diversion Pool and Thermalito Forebay

The approximately 4.5-mile-long Diversion Pool follows the river bed of the Feather River, beginning approximately 0.5 miles downstream from the Oroville Dam and extending to the Thermalito Diversion Dam. The approximately 50- to 200-ft wide Diversion Pool has a riverine character as it meanders through thickly vegetated hillsides. Views within the Diversion Pool are confined and directed by the adjacent steep hillsides. Major aesthetic features that can be observed in the vicinity of the Diversion Pool include: the downstream face of the Oroville Dam, electric transmission lines (both project and non-project), an unpaved access road that runs parallel to part of the right side of the Diversion Pool, railroad tracks that follow the left side of the Diversion Pool, the railroad bridge near the end of the reservoir, and the Diversion Dam. Most viewers in this area are recreationists involved in activities such as walking, canoeing (and other non-motorized boating), wind-surfing, bicycle riding, horse-back riding, and fishing.

Only the upstream face (approximately 15 feet) of the 1,300-foot long Diversion Dam is visible from this area. The downstream face of the Diversion Dam rises 143 feet above the Feather River channel (in the Low Flow Channel area).

The linear form of the Diversion Dam, along with its color and texture, contrasts with the nearby landscape, particularly when viewed from downstream. When viewed from upstream near the Diversion Pool, the dam is much less visible.

From the Thermalito Diversion Dam, the 10,000-ft-long Thermalito Power Canal connects the Diversion Pool to the Thermalito Forebay. The linear concrete-lined channel and adjacent chain-link fence pass through flat grasslands and are adjacent to some residential areas. The Thermalito Power Canal is one of the least visible major project features. It is primarily seen by the public where Cherokee Road, SR 70, and Table Mountain Boulevard cross over it. The Thermalito Power Canal contrasts highly with the landscape it passes through.

Thermalito Forebay begins at the west end of the Power Canal and extends approximately 3 miles southwest to the Thermalito Forebay Dam. The Forebay is an hourglass-shaped, 630-acre reservoir, just west of SR 70 in the transition zone between

the flatlands of the Central Valley and the more steeply sloped terrain of the foothills. The northwest edge of Thermalito Forebay is located just southeast of the Campbell Hills, while the remainder of it is situated in flat valley land. The downstream edge of the reservoir is formed by a low earthfill dam (91 ft high at its highest point) that extends for more than 3 miles along Thermalito Forebay's southern edge. The Thermalito Forebay Dam is one of the least visible major project features.

The hourglass shape of the reservoir results in two major segments, the North Forebay and the South Forebay. The majority of people who view Thermalito Forebay do so as recreationists from either of the two main recreation areas (the North and South Thermalito Forebay Recreation Areas), or as drivers from nearby transportation routes such as SR 70, Nelson Avenue, or Grand Avenue. Given the relatively flat, open, grass-covered terrain where Thermalito Forebay is located, most views from around Thermalito Forebay are expansive.

To represent existing aesthetic conditions and the types of views available from around the Diversion Pool and Forebay, four KOPs were selected. The four KOPs are briefly described in Table 5.11-3.

Because the Diversion Pool, Power Canal, and Thermalito Forebay are all designed to share the same operating water level and are essentially the same hydraulic system, the water levels in each of these facilities rise and subside in unison. The system does not fluctuate much on a daily basis. During the summer, it is generally cycled down 2 to 4 ft during the middle of the week and then refilled by the weekend. During the winter, it may fluctuate more for varying reasons. When the elevations of these facilities are 2 to 4 ft below full pool, there are varying amounts of exposed shoreline, which can offer visual contrast to the adjacent landscape. It can be assumed that elevations at the high end of this range are considered more visually attractive to most viewers than elevations at the lower end of this range, which may be perceived by some viewers as unattractive.

Table 5.11-3. Diversion Pool and Thermalito Afterbay key observation points (KOPs).

Location	Description
TD-1: Oroville Dam Road	Represents the aesthetic conditions of the view that people driving on Oroville Dam Road have of the Spillway on the downstream face of Oroville Dam.
TD-2: Diversion Pool DUA	Represents the aesthetic conditions of the southern part of the Diversion Pool from the adjacent access road.
TD-3: North Thermalito Forebay Recreation Area	Represents the aesthetic conditions of the east part of Thermalito Forebay from a very popular recreation area.
TD-4: South Thermalito Forebay Recreation Area	Represents the aesthetic conditions of the southern and western part of Thermalito Forebay from a primitive recreation area.

Source: SP-L4

However, because the Diversion Pool and Thermalito Forebay elevations change so little over much of the year and introduce two bodies of water into the landscape of the

project area, operations do not have much of an influence on aesthetic environment of areas near the Diversion Pool and Thermalito Forebay.

Thermalito Afterbay

The approximately 4,300-acre Thermalito Afterbay is formed by a low "L"-shaped earthfill dam with a maximum height of 39 ft. The Afterbay dam extends for nearly 8 miles along the impoundment's western and southern edges, and has a very flat, level, and linear appearance. The western edge of Thermalito Afterbay Dam runs parallel to SR 99. The Afterbay Dam is one of the most visible project features. Its linear form, shape, and uniform texture contrast highly with the surrounding landscape.

The north and east edges of Thermalito Afterbay (and several islands) are defined by the surrounding rolling terrain and have an undulating, natural appearance. Since the terrain that surrounds most of Thermalito Afterbay is either flat or rolling, and because Thermalito Afterbay is so large, views in this part of the project are open and extensive. On clear days, the Sierra Nevada foothills can be seen from many parts of Thermalito Afterbay. Other major aesthetic features in the vicinity of Thermalito Afterbay include the Feather River itself, which is visible from nearby areas in the southeast part of the project area; the SR 162 (Oroville Dam Boulevard) causeway and bridge that cross the north part of Thermalito Afterbay from west to east; SR 99 (which is located west of Thermalito Afterbay dam and next to the Thermalito Fish Hatchery Annex); several recreation areas (Monument Hill Recreation Site, Larkin Road Car-top BR, and the Wilbur Road Recreation Site); a few scattered residences; and parts of the undeveloped OWA (some of which are adjacent to Thermalito Afterbay and some of which can be viewed to the southeast from near the Thermalito Afterbay Outlet). Viewers of Thermalito Afterbay and surrounding landscape include people participating in activities such as boating, swimming, picnicking, fishing, and hunting; motorists; and people viewing Thermalito Afterbay from residences in the area.

To represent existing aesthetic conditions and the types of views available from around the Thermalito Afterbay, three KOPs were chosen (Table 5.11-4).

Table 5.11-4. Thermalito Afterbay key observation points (KOPs).

Location	Description
TA-1: Larkin Road	Represents the aesthetic conditions of the view that people using this primitive recreation area have of eastern portion of Thermalito Afterbay.
TA-2: Monument Hill DUA	Represents the aesthetic conditions of the views that people using this developed recreation area have of the north part of Thermalito Afterbay.
TA-3: SR 99	Represents the aesthetic conditions of the views that people driving north on SR 99 have of the west side of the Thermalito Afterbay Dam (or levee).

Source: SP-L4

Thermalito Afterbay is a large, shallow, open body of water that has frequent water level fluctuations and a high surface-to-volume ratio. The Afterbay has several fluctuation

cycles and daily, weekly, and occasional seasonal adjustments. The Afterbay generally fluctuates on a daily basis as a result of water releases from Lake Oroville (related to power generation) and releases into the Feather River. The amount of daily fluctuation varies depending on factors such as time of year, diversion rates, release rates, and type of water. Typical daily changes for most months for the years of 2001 (a dry year) and 2003 (a wet year) were between 1 and 2 feet, with changes more frequently in the 1-foot range.

Weekly fluctuations vary more than daily fluctuations as DWR attempts to adjust power generation into particular hours of the week. A common refill pattern is that Thermalito Afterbay is at its low point on Monday and builds storage capacity over the week to reach a maximum elevation on Saturday. After a maximum is reached on Saturday, Thermalito Afterbay is often decreased through the first part of Monday and the cycle frequently starts over. The weekly fluctuations usually range from 2 to 6, feet although there are times during the year when the Thermalito Afterbay elevation is allowed to be higher or lower as a response to systemwide operations or energy prices. Fluctuations of approximately 9 to 11 feet sometimes occur during a several-week period and are most likely to occur in the winter. The general refill pattern of keeping Thermalito Afterbay highest on weekends and having fluctuations of between 2 and 6 feet results in a reservoir that generally looks “full,” although at the lower end of the range shoreline and mudflats can be exposed in shallower areas. It can be assumed that elevations at the high end of this range are considered more visually attractive to most viewers than elevations at the lower end of this range. The lowest elevations that expose the greatest amount of shoreline and have the greatest adverse influence of Thermalito Afterbay occur infrequently and generally take place in the winter.

Low Flow Channel

The upper portion of the Low Flow Channel below the Diversion Dam passes through the central part of the City of Oroville. Most of the area adjacent to this portion of the Low Flow Channel is developed and includes project facilities, such as the Feather River Fish Hatchery (which includes a 0.5-mile-long fish ladder, underwater fish viewing area, office, hatchery spawning building, rearing channels, lighted parking areas, and other facilities) and the 91-foot high, 600-foot long concrete fish barrier dam. The Feather River Fish Hatchery facilities contrast with the nearby landscape in terms of shape, color, and texture. The Fish Barrier Dam (and its waterfall) and the Fish Barrier Pool are generally visually compatible with their surroundings. Other non-project developments include the Feather River Nature Center, the Table Mountain Boulevard Bridge, scattered residences overlooking the Low Flow Channel, and trails along the adjacent levee system. People who view the upper part of the Low Flow Channel include passing motorists, recreationists, and visitors to the Feather River Fish Hatchery.

Lands adjacent to the Low Flow Channel downstream of the SR 70 bridge are much less developed than those adjacent to the upper part, next to the central part of the City of Oroville. Much of the Feather River floodplain adjacent to the Low Flow Channel, particularly along the lower portion, was drastically altered during hydraulic mining

activities in the mid 1800s until the early 1900s. It is covered by coarse debris from the hydraulic mining era and mounded remains of dredge tailings, some of which were later used as material for the construction of Oroville Dam. The dredge tailings cover large areas and contain sinuous ridges of cobble, boulders, and gravel piles up to 40 ft in height. Various vegetation communities, such as riparian and oak woodlands, have become established throughout the area.

Views from within and near the Low Flow Channel are variable due to adjacent topography, vegetation, and levels of development. Some areas have extensive open views of the Low Flow Channel and other areas have restricted views. The majority of viewers see the upper portion of the Low Flow Channel from areas near the City of Oroville. These areas include the levee and associated trail system, the Feather River Fish Hatchery complex, and the Feather River Nature Center. A number of people also have views of the Low Flow Channel as they pass over it via bridges such as the Table Mountain Boulevard Bridge and the Table Mountain Bicycle Bridge. People who view the lower portion of the Low Flow Channel do so from areas within the OWA, SR 70, or the Thermalito Afterbay Outlet, as well as other undeveloped access points.

To represent existing aesthetic conditions and the types of views available from the portion of the Low Flow Channel situated near and within the FERC boundary, two KOPs were chosen. The two KOPS are briefly described in Table 5.11-5.

Table 5.11-5. Low Flow Channel key observation points (KOPs).

Location	Description
BR-1: Feather River Nature Center	Represents the aesthetic conditions of the views that people using the Nature Center have of the upper part of the Low Flow Channel.
BR-2: Thermalito Afterbay Outlet	Represents the aesthetic conditions of the views that people recreating near this popular area in the lower part of the Low Flow Channel have of the Thermalito Afterbay Outlet area and the Feather River.

Source: SP-L4

Oroville Wildlife Area

Although the OWA includes the Thermalito Afterbay, this description focuses on the main portion of the OWA that is south and east of Thermalito Afterbay. The OWA consists of a series of ponds, levees, mining tailings, and flat and low lying areas. Although the OWA is managed for wildlife, it supports recreation and contains limited camping, a one-lane boat ramp, several unimproved boat ramps, and a number of roads in varying conditions. Views within the OWA are varied; in some portions, sparse vegetation and flat terrain allow for expansive views, while in other areas, vegetation and dredge tailings limit views considerably. Views within the main part of the Clay Pit SVRA (which is not located within the FERC project boundary) are more expansive due to the level topography of the area and the relative scarcity of shrubs and trees. Most use in the OWA and Clay Pit SVRA is dispersed, and views occur throughout the area.

To represent existing aesthetic conditions and the types of views available from the within the OWA, two KOPs were chosen and are described in Table 5.11-6.

Table 5.11-6. Oroville Wildlife Area key observation points (KOPs).

Location	Description
OWA-1: One–Mile Pond	Represents the aesthetic conditions of the views that people see from this area.
OWA-2: Bird Viewing Area	Represents the aesthetic conditions of the views that people see from this area.

Source: SP-L4

5.11.1.3 Aesthetic/Visual Resource Policies, Standards, and Guidelines

Several entities with management responsibilities for lands in the study area also have policies, elements, standards, and/or guidelines for aesthetic/visual resources. The USFS and the BLM have visual resource policies and standards that apply to lands within the study area and FERC project boundary. Caltrans is the State entity with review responsibility (for scenic highways) to ensure compliance with the visual resource components of the CEQA. DPR is responsible for managing the LOSRA, but does not have specific visual regulations. Butte County has a Scenic Highways element of the General Land Use Plan and a Scenic Highways zoning designation. Several highways in the project area have a Scenic Highway zoning designation but have not been designated as scenic highways by Butte County. SP-L4 contains more detailed information regarding relevant visual resource policies, elements, standards, and/or guidelines.

U.S. Forest Service (USFS)

The Plumas National Forest and Lassen National Forest have lands adjacent to the project in the North Fork, Middle Fork, and South Fork branches of Lake Oroville. All USFS lands in the study area are managed by the Plumas National Forest and fall under the management direction of the Plumas Land and Resource Management Plan (LRMP) (USFS 1988). The purpose of the LRMP is to guide the USFS in the efficient use and protection of USFS resources, fulfill legislative requirements, and balance local, regional, and national needs. The LRMP also prescribes management practices for specified areas, and the time periods needed to obtain these objectives. In general, the policies for the land in the areas near the project emphasize resource conservation, provision of high quality recreational opportunities, and protection of visual resources.

The LRMP uses the USFS Visual Management System (VMS) to manage the visual resources of the Plumas National Forest (USFS 1974). Visual resources throughout the National Forest have been inventoried, and the management direction is reflected in terms of Visual Quality Objectives (VQOs). The VQOs represent a composite rating of the scenic integrity or visual variety of the landscape, combined with a sensitivity level rating that can reflect the number and relative concern of viewers for the scenic quality of the landscape. Landscape variety and sensitivity levels are combined with a distance zone rating, which identifies the distance from which viewers typically experience the landscape. Based on inventory ratings and management direction, lands within the National Forest are assigned one of several VQOs. The USFS VQOs, listed from “most” to “least” aesthetically/visually protective, are: Preservation, Retention, Partial

Retention, Modification, and Maximum Modification. The following is a description of the VQOs (USFS 1974).

- *Preservation:* This VQO allows ecological changes only.
- *Retention:* This VQO provides for management activities that are not visually evident.
- *Partial Retention:* Management activities are visually evident but subordinate to the characteristic landscape when managed according to the partial retention visual quality objective.
- *Modification:* Under the Modification VQO, management activities may visually dominate the original characteristic landscape.
- *Maximum Modification:* Management activities of vegetative and landform alterations may dominate the characteristic landscape.

Based on the Plumas National Forest Plan's map titled "Visual Quality Objectives for the Preferred Alternative," USFS lands within the study area have been assigned two of the five possible VQOs (USFS 1988). The locations of the VQOs are depicted in SP-L4. These VQOs are Retention and Partial Retention. The Retention VQO has been applied to the National Forest lands that follow corridors along the South Fork Feather River, the Middle Fork Feather River (into the Feather Falls Scenic Area), and Upper North Fork Feather River. USFS lands in the study area that are outside the areas with VQOs of Retention have been assigned a VQO of Partial Retention.

In addition to assigning VQOs, the LRMP has categorized all National Forest lands into specific, distinct Management Areas. There are four Management Areas for Forest lands near the project: Galen, French Creek, Kellogg, and Feather Falls. Each Management Area has general guidelines for achieving resource objectives, along with specific standards and guidelines for managing the various resources such as visual resources, recreation, wildlife, and lands. The general management direction and standards and guidelines related to visual resources for the four Management Areas are:

- Galen – None.
- French Creek – Maintain pleasing visual corridors and minimize the visual effect of transmission lines and hydroelectric facilities.
- Kellogg – Protect unique scenic and botanical values.
- Feather Falls – Maintain pleasing visual corridors, protect unique scenic values, apply Rx-10 (VQO of Retention) and Rx-14 (VQO of Partial Retention) to the Feather Falls and Forbestown viewsheds, and continue special management of Feather Falls Scenic Area and employ Rx-3 (VQO of Retention).

In addition to the four Management Areas, there is also a National Forest Scenic Byway in the study area that passes through the FERC project boundary. The Feather River National Forest Scenic Byway begins at SR 70 approximately 10 miles north of the City of Oroville and passes through the FERC project boundary (via a bridge) near the West Branch on lands that are not part of the USFS lands. USFS lands that the Byway passes through and that can be seen from the Byway are frequently assigned VQOs such as Retention and Partial Retention to protect the scenic qualities of the Byway. However, it should be noted that VQO requirements apply only to USFS lands.

Bureau of Land Management (BLM)

The BLM manages approximately 2,000 acres of land in scattered, noncontiguous parcels along the West Branch, the Lower North, Middle, and South Forks of the Feather River, inside and outside of the FERC project boundary (see Study L-2, *Land Management Report*). The BLM is responsible for managing these lands and their resources, including visual resources, under the direction of the 1993 Redding Resource Management Plan (RRMP). Visual resource management by the BLM is based on the agency's Visual Resource Management (VRM) system. The BLM VRM system involves inventorying scenic values and establishing management objectives for those values through the resource management planning process. One component of the VRM is to assign visual resource "Inventory Classes" to parcels of land. There are four classes, each of which has objectives that differ in terms of allowable changes to the visual conditions of those parcels of land. The four VRM Classes and their objectives are listed below.

- **Class I Objective:** To *preserve* the existing character of the landscape.
- **Class II Objective:** To *retain* the existing character of the landscape.
- **Class III Objective:** To *partially retain* the existing character of the landscape.
- **Class IV Objective:** To provide for management activities which require *major modification* of the existing character of the landscape.

BLM lands in the project area have been designated as Class II lands. This designation means that the visual character of lands in the project area is to be retained by the BLM until potential transfers of much of the land are complete (see Section 5.8.1.1, Land Management).

California Department of Transportation (Caltrans)

The California State Scenic Highway Program is part of the California Streets and Highways Code, which is administered by Caltrans. The goal of the Scenic Highway Program is to preserve and enhance the natural beauty of California. A nominated highway is evaluated by the extent to which the natural landscape is seen by passing motorists and the extent to which visual intrusions (e.g., buildings, unsightly land uses, noise barriers) affect the "scenic corridor." The only eligible State scenic highway in the project area is a portion of SR 70 north of the main basin of Lake Oroville. Being

"eligible" indicates that the route is shown on the Master Plan of State Scenic Highways and does not mean that it is nominated. The segment of SR 70 crossing the project near Vinton Gulch is not currently protected by a State-approved, County-developed plan.

Butte County General Plan

The Butte County General Plan was adopted in 1996 by Butte County and the Butte County Association of Governments. The General Plan contains 12 elements (such as Land Use, Circulation, Housing, etc.), and a Scenic Highways element. The Scenic Highways Element has eight policies. They are:

- **Policy 1:** Protect valuable scenic areas for enjoyment by residents and visitors;
- **Policy 2:** Delineate scenic corridors with careful consideration of all factors;
- **Policy 3:** Consider scenic values in the design and improvement of rights-of-way;
- **Policy 4:** Control access to scenic highways to control safety;
- **Policy 5:** Locate and design utility structures to minimize visual effect, where economically feasible;
- **Policy 6:** Encourage compatible land use patterns in scenic corridors;
- **Policy 7:** Promote the County's scenic highways program; and
- **Policy 8:** Consider economic effects on property affected by a scenic highway designation.

Butte County has not designated any highway in the study area as a Scenic Highway. The Butte County Zoning Plan has assigned the zoning designation of "Scenic Highway" (S-H) to portions of four roadways within the study area. None of these highway segments have been designated as Scenic Highways by the County, but are considered eligible for designation. The four eligible segments eligible are:

- Pentz Road (within the study area west of the West Branch);
- SR 162 (along the east side of the main basin from the Canyon Creek area to south of the Bidwell Bar Bridge);
- SR 70 (on the south side of the West Branch of Lake Oroville near Vinton Gulch); and
- Lumpkin Road (at the east end of the South Fork).

See Figure 5.3-2 of SP-L4 for the locations of the segments of the highways zoned Scenic Highway.

5.11.1.4 Baseline Project Conditions

The existing Oroville Facilities is part of the landscape of the project region and are considered part of the aesthetic baseline condition against which the alternatives are evaluated. Elements of the Oroville Facilities influence the aesthetic environment near them in various ways, but are still considered part of the aesthetic baseline condition, and thus are considered neutral. Some of the elements (such as Thermalito Afterbay Dam) contrast with the adjacent landscape and would be considered by some viewers to have an adverse influence on the aesthetic environment. Other elements (such as the Thermalito Afterbay) add interest and visual variety to the landscape and would be considered to have beneficial influences.

5.11.2 Environmental Effects

5.11.2.1 No-Action Alternative

Under the No-Action Alternative, there would be no changes to project facilities, operational measures, or existing operations and maintenance (O&M) practices. The effects of project facilities and operations on the aesthetic/visual environment that are described in Section 5.11.1 would continue. The baseline project effects of the No-Action Alternative are the same as those described in Section 5.11.1, Affected Environment. Effects to visual resources are summarized for Table 5.11-7.

Operations

Under the No-Action Alternative, existing operations and measures would be continued.

5.11.2.2 Proposed Action

Effects of PM&E Measures (Non-Operational)

Under the Proposed Action, there would be no changes to the project facilities described in Section 5.11.1 that would have effects on the aesthetic environment of the project. Likewise, there would be no changes to project operations that would have effects on the aesthetic environment of the project.

The Proposed Action contains a number of PM&E measures, some of which would have effects of varying degrees on the aesthetic environment of the project. Table 5.11-7 summarizes the effects of the Proposed Action PM&E measures.

The first part of Section 5.11.2.2 summarizes the effects of the non-operational PM&E measures that affect the aesthetic environment, and the second section briefly describes the effects of the operational PM&E measures.

Lake Oroville

Eliminate Wheeled Motorized Vehicle Use Within the Lake Oroville Fluctuation Zone. The action associated with this PM&E measure would eliminate all motorized vehicle access in the fluctuation zone, except for designated areas. Eliminating access would help eliminate damage (such as erosion and disturbed vegetation) caused by motorized vehicles in some areas of Lake Oroville. This action would have a moderately beneficial effect on the aesthetic/visual environment.

Bidwell Canyon BR/Campground/Marina - Improvements. This PM&E measure would widen the campground loop road, add new campground loops for 36 replacement sites at the existing Bidwell Campground and construct additional parking. During construction, there would likely be a moderately adverse effect on the aesthetic/visual environment. If large trees were removed as part of this action, the PM&E measure would likely have an adverse long-term effect on the aesthetic/visual environment of part of the campground. If the widened road, loops, parking area, and campsites are well sited and designed with minimal disturbance to vegetation, and if disturbed areas are replanted, the effects of this PM&E measure could be neutral or even moderately beneficial.

Bidwell Canyon BR - Boat Ramp Extension. To provide a longer boat ramp for periods of low pool elevations, the existing ramp would be extended. Construction would have short-term adverse effects on the aesthetic/visual environment near the ramp and the existing parking lot. The long-term effect of the ramp extension would be neutral.

Loafer Creek CG - New RV/tent Group Camping Areas. This PM&E measure would be located at the Loafer Creek Campground and would consist of two new 50-person capacity RV/tent group camping areas that would provide new RV/tent campsites with hookups. In addition, a new camp loop road would be required. Construction would involve clearing vegetation, leveling, and grading and would have a short-term adverse effect on the aesthetic/visual environment of the part of the campground near it. When finished, the group camping areas would likely have a moderately adverse to neutral effect, depending upon factors such as site layout, retaining existing vegetation, and level of revegetation. Lights and sun reflection (glare) from RVs could have a moderately adverse effect on the aesthetic/visual environment of the part of the campground near the group camping areas depending upon where the lights and glare could be seen from (or if they could be seen).

Lime Saddle Marina - Refurbishment. This PM&E measure would support and encourage efforts by DPR and the concessionaire to restore the Lime Saddle Marina, which was damaged by a wind storm. This PM&E measure would help improve the aesthetic/visual environment of the Lime Saddle Marina area and would likely have moderately beneficial effect.

Table 5.11-7. Summary of potential effects on the aesthetic environment.

	No-Action Alternative	Proposed Action	Alternative 2
Lake Oroville			
Reservoir-wide programmatic elements for controlling OHV effects, litter, user-defined trails, and dispersed sites	Same as Existing Conditions	Long-term effect = moderately beneficial	Same as Proposed Action
Reservoir-wide increased debris removal	Same as Existing Conditions	Long-term effect = moderately beneficial	Same as Proposed Action
Provide additional directional signage at various locations around the reservoir	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Eliminate wheeled motorized vehicle use within most areas of the Lake Oroville fluctuation zone	Same as Existing Conditions	Long-term effect = moderately beneficial	Same as Proposed Action
Bidwell Canyon BR/Campground/Marina improvements (widen loop road, add parking and 36 new sites)	Same as Existing Conditions	Construction effect = short-term moderately adverse. Long-term effect = adverse to moderately beneficial	Same as Proposed Action
Bidwell Canyon BR extension (low water access)	Same as Existing Conditions	Construction effect = short-term adverse. Long-term effect = neutral	Same as Proposed Action
Bidwell Canyon Marina/BR (ADA accessibility, additional docks)	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Bidwell Canyon Marina and Campground (new camp store shell and additional parking)	Same as Existing Conditions	Same as No-Action Alternative	Long-term effect = neutral
Bidwell Canyon Marina temporary grandstand space	Same as Existing Conditions	Same as No-Action Alternative	Long-term effect = neutral
Bidwell Canyon Campground – modify DPR storage building to CG activity center	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse. Long-term effect = neutral to moderately beneficial
Bidwell Canyon BR new parking for high pool elevations	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term adverse, Long-term effect = adverse to moderately adverse

Table 5.11-7. Summary of potential effects on the aesthetic environment.

	No-Action Alternative	Proposed Action	Alternative 2
Loafer Creek Campground (2 new 50-person capacity group RV/tent camping loops and hookups)	Same as Existing Conditions	Construction effect = short-term adverse. Long-term effect = moderately adverse to neutral	Same as Proposed Action
Loafer Creek DUA/Campground – build a swimming pool either here or at Lime Saddle based on feasibility study results	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse, Long-term effect = neutral
Loafer Creek swimming area improve shoreline access, ADA accessibility, and fish cleaning station	Same as Existing Conditions	Construction effect = short-term moderately adverse. Long-term effect = neutral, depending on siting and/or screening of facilities	Same as Proposed Action
Loafer Creek BR – new dock	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Lime Saddle Marina – encourage refurbishing marina	Same as Existing Conditions	Long-term effect = moderately beneficial	Same as Proposed Action
Lime Saddle – Add additional boating dock and upgrade marina for ADA	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Lime Saddle DUA – upgrade picnic tables and shade structures	Same as Existing Conditions	Same as No-Action Alternative	Short-term effect = neutral. Long-term effect = moderately beneficial
Lime Saddle – new shoreline day use area	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse. Long-term effect = neutral
Lime Saddle Campground – new courtesy dock and trail to marina	Same as Existing Conditions	Same as No-Action Alternative	Long-term effect = neutral
Lime Saddle Campground – 25-50 new RV-tent sites	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse. Long-term effect = neutral
Lime Saddle Campground – new RV group campsite area	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse, Long-term effect = neutral

Table 5.11-7. Summary of potential effects on the aesthetic environment.

	No-Action Alternative	Proposed Action	Alternative 2
Lime Saddle BR/DUA/Marina – 50 to 60 new parking spaces	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse, Long-term effect = neutral to adverse
Lime Saddle BR – extend ramp for low water access	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short term adverse. Long-term effect = neutral
Spillway BR – extend ramp for low water access	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse, Long-term effect = neutral
Spillway "En-Route" camping modifications as needed	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse, Long-term effect = neutral to moderately adverse
Enterprise BR – extend boat ramp for low water use	Same as Existing Conditions	Construct effect = short-term moderately adverse, Long-term effect = neutral	Same as Proposed Action
Enterprise BR – add a boarding dock	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Dark Canyon Car-top BR – reconstruct restroom building	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Foreman Creek Car-top BR – improve shoreline conditions and redirect recreation usage	Same as Existing Conditions	Long-term effect = neutral or moderately beneficial	Same as Proposed Action
Stringtown Car-top BR – upgrade area – new tables, parking, etc	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term neutral, Long-term effect = moderately beneficial
Stringtown Car-top BR – Post signage indicating road below elevation 866 ft not maintained and use is at own risk	Same as Existing Conditions	Long-term effect = moderately adverse	Same as Proposed Action
Saddle Dam – construct short trail to access shoreline	Same as Existing Conditions	Long-term effect = neutral to moderately beneficial	Same as Proposed Action

Table 5.11-7. Summary of potential effects on the aesthetic environment.

	No-Action Alternative	Proposed Action	Alternative 2
Oroville Dam Overlook DUA – adding 30 to 50 new parking spaces	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term moderately adverse, Long-term effect = neutral to moderately adverse
Floating Campsites – relocate 3 floating campsites closer to Lime Saddle	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Floating Campsites – provide 3 new floating campsites	Same as Existing Conditions	Same as No-Action Alternative	Long-term effect = neutral
Screen material storage area north of the Oroville Dam Emergency Spillway	Same as Existing Conditions	Long-term effect = moderately beneficial	Same as Proposed Action
Debris management at McCabe Creek	Same as Existing Conditions	Long-term effect = moderately beneficial	Same as Proposed Action
Transfer of BLM lands within project to DWR	Same as Existing Conditions	Same as No-Action Alternative	Long-term effect = neutral
Establish a curation facility	Same as Existing Conditions	Construction effect = short-term moderately adverse, Long-term effect = neutral to adverse	Same as Proposed Action
Restrict access in inundation zone during periods of low reservoir elevation to specific boat-in campgrounds as appropriate	Same as Existing Conditions	Long-term effect = neutral to moderately beneficial	Same as Proposed Action
Diversion Pool			
Improve day use facilities at Lakeland Blvd. (new entry road, parking area, restroom, picnic facilities, car-top boat ramp)	Same as Existing Conditions	Construction effect = short-term moderately adverse, Long-term effect = adverse to neutral	Same as Proposed Action
Day use sites along Diversion Pool for trail users and boaters	Same as Existing Conditions	Construction effect = short-term neutral, Long-term effect = neutral	Same as Proposed Action
Day use sites, spur trails, boat landing areas along Diversion Pool for trail users and boaters	Same as Existing Conditions	Same as No-Action Alternative	Short-term effect = neutral Long-term effect = neutral
ADA fishing pier	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action

Table 5.11-7. Summary of potential effects on the aesthetic environment.

	No-Action Alternative	Proposed Action	Alternative 2
Whitewater park	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term adverse, Long-term effect = adverse to beneficial
Flexible event center	Same as Existing Conditions	Same as No-Action Alternative	Construction effect = short-term adverse, Long-term effect = adverse to beneficial
Thermalito Forebay			
Basic upgrade of facilities at North Thermalito Forebay Aquatic Center	Same as Existing Conditions	Construction effect = short-term moderately adverse, Long-term effect = neutral to moderately adverse	Same as Proposed Action
New non-motorized loop trail	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
Provide day use and swimming facilities at the South Thermalito Forebay BR/DUA	Same as Existing Conditions	Construction effect = short-term moderately adverse, Long-term effect = neutral to moderately adverse	Same as Proposed Action
Provide ADA fishing pier at South Thermalito Forebay BR/DUA	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action
North Thermalito Forebay - Provide limited additional shoreline access and add fish cleaning station	Same as Existing Conditions	Long-term effect = neutral, depending on siting and/or screening of facilities	Same as Proposed Action
Thermalito Afterbay			
Improvements at Larkin Road BR/DUA including swimming beach	Same as Existing Conditions	Construction effect = short-term moderately adverse, Long-term effect = neutral to moderately adverse	Same as Proposed Action
Brood ponds	Same as Existing Conditions	Moderately beneficial to beneficial if natural shape and visible to public; neutral if not visible to public; moderately adverse effect if angular in shape.	Same as Proposed Action

Table 5.11-7. Summary of potential effects on the aesthetic environment.

	No-Action Alternative	Proposed Action	Alternative 2
Oroville Wildlife Area			
Afterbay Outlet – new campground	Same as Existing Conditions	Construction effect = short-term moderately adverse, Long-term effect = beneficial	Same as Proposed Action
Afterbay Outlet – new day use facilities	Same as Existing Conditions	Construction effect = short-term neutral, Long-term effect = beneficial	Same as Proposed Action
Additional trash receptacles, signage, and enforcement at various locations throughout dispersed areas of the OWA	Same as Existing Conditions	Long-term effect = beneficial	Same as Proposed Action
Vehicle barriers in OWA	Same as Existing Conditions	Short-term effect = moderately adverse. Long-term = moderately beneficial	Same as Proposed Action
ADA accessible watchable wildlife sites	Same as Existing Conditions	Long-term effect = neutral	Same as Proposed Action

Enterprise BR - Ramp Extension. The actions associated with this PM&E would extend the boat ramp to permit boat launching below elevation 750 ft. Construction activities would result in moderately adverse short-term effects on the aesthetic/visual environment of the area near the ramp. Long-term effects would likely be neutral.

Screen Material Storage Area North of the Oroville Dam Emergency at Spillway. This PM&E measure would plant trees and other vegetation to screen material stored at the material storage area located north of the Oroville Dam Emergency Spillway. Screening would block views of the storage area when viewed from the walkway on top of the Oroville Dam and from Oroville Dam Road. The effects of this measure would be moderately beneficial.

Establish a Curation Facility. This PM&E measure would establish a curation facility in or near the project area. The location and details of this facility are not known at this time, but it can be assumed that construction of the facility would have moderately adverse effects on the aesthetic/visual environment immediately near the proposed facility. Long-term effects could vary from neutral to adverse depending on how the facilities are sited, the design of the facilities, and level of replanting. If lights were installed in conjunction with the new facilities, they could have neutral to moderately adverse effects, depending on how they are sited and/or screened.

Bidwell Canyon BR - Add Additional Boarding Dock(s) if Feasible. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Bidwell Marina - Upgrade Marina to ADA Accessibility. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Loafer Creek BR - Add an Additional Boarding Dock(s) if Feasible. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Loafer Creek - Improve Shoreline Access, add fish cleaning station, and ADA Accessibility to the DUA, Swimming Beach, and Cove. Actions associated with this PM&E measure would involve providing improving shoreline access (including ADA access), enhance angling experience, and improving the swimming facilities at Loafer Creek. Construction activities related to the upgrades could have short-term moderately adverse effects on the aesthetic/visual environment. The long-term effects on the aesthetic/visual environment would likely be neutral. Addition of a fish cleaning station could have a neutral or moderately adverse effect, depending on how it is sited and/or screened. If lights are installed in conjunction with the upgrades, they could have a neutral or moderately adverse effect, depending on how they are sited and/or screened.

Lime Saddle - Add Additional Boarding Dock(s) if Feasible. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Lime Saddle - Relocate Three Existing Floating Campsites Closer to Lime Saddle. Relocating three floating campsites closer to the Lime Saddle area would introduce additional floating elements of Lake Oroville. However, because of the presence of many boats (in storage and in use) and floating elements related to the marina, the presence of the floating campsites would have a neutral effect on the aesthetic/visual environment.

McCabe Creek - Debris Management. Removing accumulated debris from this location would have a moderately beneficial effect on the aesthetic/visual environment.

Enterprise BR - Add Boarding Dock at the Boat Ramp. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Vinton Car-top BR - Provide Additional Directional Signs. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Dark Canyon Car-top BR - Reconstruct Restroom Building. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Dark Canyon Car-top BR - Provide Additional Directional Signs. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Boat-In Campgrounds - Restrict Access in the Inundation Zone as Appropriate. This PM&E measure would apply to specific boat-in campgrounds (e.g. Bloomer, Goat Ranch) during periods of low reservoir levels. Although this measure could have beneficial effects on cultural resources, it would have a neutral effect on aesthetic/visual environment.

Foreman Creek - Improve Shoreline Conditions and Redirect Recreation Usage to Specific Areas and Add Other Basic Day Use Amenities. This PM&E measure would result in better control of the use of Foreman Creek. It would result in a neutral or moderately beneficial effect on the aesthetic/visual environment of the Foreman Creek area.

Stringtown Car-top BR - Road Below Elevation 866 ft. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect. With this PM&E measure, DWR would not maintain the road below elevation 866 ft and would install a sign (Use at Own Risk) at the edge of the crumbling and eroding road bed within the inundation zone. The road would continue to deteriorate and would have a moderately adverse effect on the aesthetic/visual environment.

Stringtown Car-top BR - Provide Additional Directional Signs. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Saddle Dam - Construct Short Developed Trail to Access Shoreline. This PM&E measure would result in better access to the Saddle Dam and would have a neutral or moderately beneficial effect on the aesthetic/visual environment.

Diversion Pool

Improve Day Use Facilities at Lakeland Blvd. These PM&E measures would involve building a new entry road, parking area, restrooms, picnic table, pole-stoves, and car-top boat launch at Lakeland Boulevard on the west side of the Diversion Pool. Clearing vegetation, leveling, and paving would be required. Construction would have short-term moderately adverse effects on the nearby aesthetic/visual environment. Long-term effects could vary from neutral to adverse, depending on how the facilities would be sited, the design of the facilities, and level of replanting. If lights are installed in conjunction with the new facilities, they could have neutral to moderately adverse effects, depending on how they are sited and/or screened.

Provide ADA Accessible Fishing Pier or Platform at Diversion Pool (east side). This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Construct Additional Day Use Facilities at Diversion Pool (east side). This PM&E measure would add 10 new picnic tables with pole grills and would have a neutral effect on the aesthetic environment.

Thermalito Forebay

North Thermalito Forebay Aquatic Center - Upgrade Facilities. Actions associated with this PM&E measure would provide basic improvements to the Aquatic Center that would result in little change to the aesthetic/visual environment. Construction activities related to the upgrades could have short-term moderately adverse effects on the aesthetic/visual environment near the North Thermalito Forebay BR/DUA. Once complete, the upgrades would have a neutral effect on the aesthetic/visual environment. If lights are installed in conjunction with the upgrades, they could have a neutral or moderately adverse effect, depending on how they are sited and/or screened.

South Thermalito Forebay BR/DUA - Provide Day Use and Swimming Facilities. Actions associated with this PM&E measure would involve providing day use and swimming facilities. Construction activities related to the upgrades could have short-term moderately adverse effects on the aesthetic/visual environment. The long-term effects on the aesthetic/visual environment would likely be neutral. If lights are installed in conjunction with the upgrades, they could have a neutral or moderately adverse effect, depending on how they are sited and/or screened.

South Thermalito Forebay BR/DUA - Provide an ADA Accessible Fishing Pier. This PM&E measure would introduce a new ADA accessible fishing pier and would have moderately adverse effects on the aesthetic/visual environment near the proposed pier during construction. The pier would have a neutral effect.

North Thermalito Forebay - Provide New Non-Motorized Trail Loop Opportunities. This PM&E measure would introduce a loop trail in the Thermalito Forebay area as a component of the proposed trails program. This measure would have a neutral effect on the aesthetic environment.

North Thermalito Forebay - Provide Limited Additional Shoreline Access and Add Fish Cleaning Station. Providing additional limited shoreline access would likely have a neutral effect on the aesthetic environment. Addition of a fish cleaning station could have a neutral or moderately adverse effect, depending on how it is sited and/or screened.

Thermalito Afterbay

Larkin Road BR/DUA - Improvements. The actions associated with these PM&E measures would involve upgrades that would include a new a swim beach, an upgraded restroom facility, shade structures, and picnic tables. Construction activities related to the upgrades could have short-term moderately adverse effects on the aesthetic/visual environment at the DUA and BR. The long-term effects of the upgrades on the aesthetic/visual environment would likely be neutral. If lights are installed in conjunction with the upgrades, they could have a neutral or moderately adverse effect, depending on how they are sited and/or screened.

Wilbur Road - Provide New Directional Signs. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Larkin Road - Provide New Directional Signs. This PM&E measure would be a very minor change to the existing aesthetic/visual environment and would have a neutral effect.

Construct Four Additional Brood Ponds. This PM&E measure could have a variety of effects on the aesthetic environment, depending on how visible the brood ponds were and their design. If the ponds were visible to the public and have a natural appearing configuration, the effect could be moderately beneficial to beneficial. If the ponds were not very visible, they would likely have a neutral effect. If the ponds were visible and angular in shape, they could have a moderately adverse effect on the aesthetic environment.

Oroville Wildlife Area

Afterbay Outlet BR/DUA - New Campground. This PM&E measure would involve developing an organized camping facility at the Thermalito Afterbay Outlet area that

would replace the widespread dispersed camping that occurs in the area. Construction of the campground would have short-term moderately adverse effects on the aesthetic/visual environment of the outlet area. Once complete, the campground would have beneficial effect on the aesthetic/visual environment because it would result in defined spaces, less dispersed use (and associated damage), and less trash and litter.

Afterbay Outlet DUA - New Day Use Facility. This PM&E measure would add a new developed day use facility at the Thermalito Afterbay Outlet (away from the proposed campground). The facility would include picnic tables and BBQs. The establishment of a formalized day use area would improve the aesthetic/visual environment of the Thermalito Afterbay Outlet area by eliminating the dispersed activities that current take place there. Construction activities would be minimal and would have a neutral effect on the aesthetic/visual environment. The existence of the facility would have a beneficial effect on the aesthetic/visual environment.

Additional Trash Receptacles and Signage at Dispersed River Access Sites. This PM&E measure would result in less trash and vandalism in the OWA and would have a beneficial effect on the aesthetic/visual environment.

Additional Signage and Enforcement Throughout the OWA. This PM&E measure would result in less trash and vandalism in the OWA and would have a beneficial effect on the aesthetic/visual environment.

Vehicle Barriers in the OWA to Restrict Access in Some Areas. This PM&E measure would place concrete barriers on some roads to restrict public vehicular access to areas where there have been management issues. The presence of the barriers would contrast with nearby environment and would have a short-term moderately adverse effect on the aesthetic/visual environment immediately near them. Use of the barriers has a moderately beneficial effect on areas where access would be restricted because there would likely be less litter and vandalism and allows the roads to revegetate over time.

Low Flow Channel

The PM&E measures in the Low Flow Channel associated with the Proposed Action would have limited or no effect on the aesthetic/visual environment.

Effects of Operational PM&E Measures

Under the Proposed Action, existing operations and measures would be continued. The effects of operations on the aesthetic/visual environment that are described in Section 5.11.1 would continue to occur under this alternative.

Baseline Project Effects – Proposed Action

Under the Proposed Action, the baseline effects of existing Oroville Facilities and operations would be the same as those described in Section 5.11.1, Affected Environment. The PM&E measures associated with the Proposed Action that would

change the existing landscape by clearing vegetation and replacing it with facilities such as parking lots, roads, and structures would have effects of varying degree. Those effects were previously described in the descriptions of each PM&E measure associated with the Proposed Action.

5.11.2.3 Alternative 2

Under Alternative 2, there would be no changes to the project facilities described in Section 5.11.1 that would have effects on the aesthetic environment of the project. Likewise, there would be no changes to project operations that would have effects on the aesthetic environment of the project.

Alternative 2 contains some PM&E measures that would have an effect on the aesthetic environment that are also in the Proposed Action and others that are only in Alternative 2. Table 5.11-7 summarizes the effects of PM&E measures that are part of Alternative 2. The detailed description of measures that are common to the Proposed Action and Alternative 2 are described under the Proposed Action in Section 5.11.2.2. The following is a description of the PM&E measures that are part of Alternative 2 only. The first part of Section 5.11.2.3 describes the effects of non-operational PM&E measures, and the second part addresses the effects of operational measures.

Effects of PM&E Measures (Non-Operational)

Lake Oroville

Reservoir-wide - Transfer BLM Lands Within the FERC project boundary to DWR. It is not possible to know at this time how a transfer would affect the aesthetic/visual environment. The PM&E measure would take lands that are currently receiving minimal management for the BLM and possibly change the management of those lands. It is assumed that transfer of the lands would result in a neutral effect on the aesthetic/visual environment.

Reservoir-wide - Fuel Load Management Plan. Implementation of a Fuel Load Management Plan could have varying effects on the aesthetic/visual environment of the project area. Factors that would influence the effects of implementation would primarily include the types of fuel load reduction techniques used, the intensity of implementation, and locations of implementation. Techniques such as thinning would change the appearance of vegetated areas to a lesser degree than would techniques such as establishing 0.25-mile-wide fire breaks. Most of the techniques would have some degree of short-term adverse effect as a result of removing vegetation with construction and other types of equipment. Over time, treated areas would “green up” and be less noticeable. Areas that would receive more focused and intense implementation would likely be affected more than areas that would receive less intensive implementation. Areas where implementation would be seen by more people would be considered to be adversely affected to a greater degree than less visible areas.

Bidwell Canyon - New Boat Ramp Parking. This PM&E measure would provide new parking for boaters and trailers during periods of high reservoir elevations. To build the new parking area, a vegetated knoll between the ramp and the existing parking lot would need to be leveled. Removal of the knoll and construction of the parking lot would have short-term adverse effects on the aesthetic/visual environment near the ramp and the existing parking lot. The parking lot would likely have a long-term adverse effect, which could likely be reduced to a moderately adverse effect if an effort is made to replant vegetation (especially trees and large shrubs) within and around the edge of the parking lot. Lights and sun reflection (glare) from vehicles parking at the parking lot could have a moderately adverse effect on the aesthetic/visual environment of the existing parking lot and ramp, depending on whether or not and for how long the lights and glare could be seen by viewers.

Bidwell Canyon - Camp Store Shell. This PM&E measure would provide a 1,000 sq ft camp store shell at Bidwell Canyon for operation by a concessionaire. In addition, 10 parking spaces would be developed, along with facilities needed by the store. The store would support marina users and campers at the campground. The development of the shell would likely have neutral effects on the aesthetic/visual environment. The color of the proposed structure should be neutral or earth-toned.

Bidwell Canyon Campground - Modification of Existing DPR Storage Building to Campground Activity Facility. This PM&E measure would modify an existing DPR building at the Bidwell Canyon Campground currently used for storage into an activity facility. Construction related to the modification would likely have a moderately adverse short-term effect on the aesthetic/visual environment of the part of the Bidwell Campground near the facility. The long-term effect would be neutral or moderately beneficial.

Bidwell Canyon BR - Grandstand Space. This PM&E measure would provide temporary event grandstand space in the parking lot for use by concessionaires or event organizers during fishing tournaments. Use of the parking area for this PM&E would likely have neutral short-term effects on the aesthetic/visual environment.

Loafer Creek DUA/Campground - New Swimming Facility. This PM&E measure would develop a swimming facility in either the Loafer Creek DUA or Campground area or Lime Saddle, based on feasibility study results. Although the location of the facilities is not known at this time, it can be assumed that if the facility were built, there would be a moderately adverse short-term effect on the aesthetic/visual environment of the area near the facility. The long-term effects of the facility would be neutral.

Loafer Creek DUA/BR - Open Service Road. This PM&E measure would open an existing gravel service road for use as a car-top boat ramp. The road would provide access to reservoir down to reservoir elevations of 750 ft. This measure would have neutral short-term and long-term effects on the aesthetic/visual environment if traffic were confined to the road and not permitted to drive on adjacent shoreline.

Loafer Creek Campground - New Campground Activity Facility. This PM&E measure would involve developing a new activity facility at the Loafer Creek Campground. The location and details of this facility are not known at this time, but it can be assumed that construction of the facility would have moderately adverse short-term effects on the aesthetic/visual environment immediately near the proposed facility. Long-term effects could vary from neutral to adverse depending on how the facilities would be sited, the design of the facilities, and level of replanting. If lights were installed in conjunction with the new facilities, they could have neutral to moderately adverse effects, depending on how they are listed and/or screened.

Lime Saddle DUA - Upgrade. This PM&E measure would upgrade existing picnic tables and shade structures at the Lime Saddle DUA. These improvements would have neutral short-term effects (from construction) and moderately beneficial long-term effects on the aesthetic/visual environment.

Lime Saddle Area - New DUA at Parish Cove. This PM&E measure would develop a new shoreline day use area at Parish Cove that would be linked by trail access to the Lime Saddle Campground and Lime Saddle BR/DUA/Marina. Although the location of the day use area is not known at this time, it can be assumed that construction activities would result in moderately adverse short-term effects on the aesthetic/visual environment near the proposed day use area. The long-term effects of the facility would likely be neutral.

Lime Saddle Campground - New Campsites. This PM&E measure would add approximately 25 to 50 new RV/tent campsites and other related improvements to the Lime Saddle Campground. Construction activities would result in moderately adverse short-term effects on the aesthetic/visual environment of the campground near the new sites. Long-term effects would likely be neutral.

Lime Saddle Campground - Group RV Site. This PM&E measure would provide a new group RV campsite with utilities at the Lime Saddle Complex. Construction of the group campsite would result in moderately adverse short-term effects on the aesthetic/visual environment of the part of Lime Saddle Campground near the proposed group site. The long-term effects of the group site would likely be neutral, depending on how much vegetation is removed to build the facility.

Lime Saddle BR/DUA/Marina - Additional Parking. This PM&E measure would consider providing 50-60 new vehicle parking spaces. This PM&E measure would consider using the adjacent PG&E property for the parking lot (which would require purchasing the property and relocating the existing PG&E maintenance facility). Construction activities would have a short-term adverse effect on the aesthetic/visual environment. The parking lot would likely have a long-term adverse effect. The adverse effect could be reduced to a moderately adverse effect if an effort is made to retain vegetation (especially trees) and if vegetation (especially trees and large shrubs) are planted within and around the edge of the parking lot. Lights and sun reflection (glare) from vehicles could have a moderately adverse effect on the aesthetic/visual environment (depending on where or if they could be seen). The relocated removal of

PG&E facilities would likely have short-term adverse effects on the aesthetic/visual environment near them during construction. Long-term effects could range from neutral to adverse, depending on where the facilities would be relocated.

Spillway BR - Boat Ramp Extension. This PM&E measure would lengthen the existing boat ramp to permit boat launching during low reservoir elevations. Construction activities would result in moderately adverse short-term effects on the aesthetic/visual environment. Long-term effects would likely be neutral.

Spillway - Review RV 'En-Route' Camping at the Spillway. Depending on what is determined to be warranted, this facility may increase in size or be decreased in size. Construction activities related to the changes could have short-term moderately adverse effects on the aesthetic/visual environment. The long-term effects would likely be neutral. If lights are installed in conjunction with the upgrades, they could have a neutral or moderately adverse effect, depending on how they are sited and/or screened.

Stringtown Car-top BR Upgrade. This PM&E measure would add picnic tables and upgrade vault restrooms at Stringtown. It would also create better parking and turnaround areas. The implementation of this PM&E measure would have neutral effects on the aesthetic/visual environment. The upgrading of facilities in this area would have moderately beneficial long-term effects.

Lime Saddle Campground - Construct a New Trail to Lime Saddle Marina. This PM&E measure would likely have a neutral effect on the aesthetic environment.

Lime Saddle BR - New Low-Water Boat Access. This PM&E measure would provide access at low reservoir elevations by constructing a new low boat ramp at Lime Saddle. During construction, there would be short-term adverse effects on the aesthetic/visual environment near the BR. The long-term effects of the ramp extension would likely be neutral.

Oroville Dam Overlook - Adding 30-50 Additional Vehicle Parking Spaces. This PM&E measure would add additional paved parking near the existing parking near the overlook area. Construction would involve clearing vegetation, leveling, and grading and would have a short-term adverse effect on the aesthetic/visual environment. When finished, the new parking area would likely have a moderately adverse to neutral effect, depending on factors such as layout, retaining existing vegetation, and level of revegetation. Lights and sun reflection (glare) from vehicles could have a moderately adverse effect on the aesthetic/visual environment of the overlook area.

Lake Oroville - Three Additional Floating Campsites. This PM&E measure would provide three additional floating campsites on Lake Oroville. The floating campsites are made of metal and produce glare to a certain degree. If the campsites were located in less developed parts of the reservoir, they might be viewed by some people as aesthetically unpleasing because they would contrast in shape, texture, and color with the nearby landscape. In areas that are popular for boating, they would not be as inconsistent with their surroundings. The campsites do have a novelty factor about

them and are likely viewed with interest by many people. Their overall effect is considered to be neutral.

Diversion Pool

Day Use Sites for Trail Users and Boaters. This PM&E measure would develop spur trails and boat-landing areas with picnic tables, pole-stoves, and trash-cans at remote points along north and south shores of Diversion Pool. The implementation of this PM&E measure would have neutral short-term and long-term effects on the aesthetic/visual environment.

Whitewater Park. This PM&E measure would create a competition-style public artificial channel on the right bank below the Diversion Pool, along with support facilities (parking, stairs, restrooms, grandstand). It would also periodically divert flows from the river to the facility. Construction activities associated with building the facility and support facilities would have short-term adverse effects on the aesthetic/visual environment of the area near the facility. The long-term effects of the channel on the aesthetic/visual environment could range from adverse to beneficial, depending on design. The effects of the supporting facilities could range from adverse to neutral. Potential adverse effects could be reduced if an effort is made to retain vegetation (especially trees) and if vegetation (especially trees and large shrubs) is planted within and around the edge of the parking lot. Lights and sun reflection (glare) from vehicles could have a moderately adverse effect on the aesthetic/visual environment (depending on where they could be seen).

Flexible Event Center. This PM&E measure would develop a flexible event center that would be located on DWR property on the north side of the Diversion Dam. In addition, there would be a "staging area" measure, which would include an arena, fencing, delineated parking, water, restrooms, small concession/office building, and grandstand seating. Construction activities associated with the flexible event center and support facilities would have short-term adverse effects on the aesthetic/visual environment. The long-term effects of the flexible event center and support facilities on the aesthetic/visual environment could range from adverse to beneficial, depending on site layout and design. Potential adverse effects could be reduced if an effort was made to retain vegetation (especially trees) and if vegetation (especially trees and large shrubs) is planted within and around the edge of the parking lot. Lights and sun reflection (glare) from vehicles could have a moderately adverse effect on the aesthetic/visual environment (depending on where or if they could be seen).

Thermalito Forebay

The PM&E measures in the Thermalito Forebay associated with Alternative 2 would have limited or no effect on the aesthetic/visual environment.

Oroville Wildlife Area

The PM&E measures in the OWA associated with Alternative 2 would have limited or no effect on the aesthetic/visual environment.

Low Flow Channel

The PM&E measures in the Low Flow Channel associated with Alternative 2 would have limited or no effect on the aesthetic/visual environment.

Effects of Operational PM&E Measures

Under Alternative 2, existing operations and measures would be continued with the additional increase in minimum instream flows from 600 to 800 cfs. The effects of operations on the aesthetic/visual environment that are described in Section 5.11.1 would continue to occur under this alternative. Additional flows within the Low Flow Channel could have slightly beneficial effects on the watercourse visual aesthetics.

Baseline Project Effects – Alternative 2

Under Alternative 2, the baseline effects of existing Oroville Facilities and operations would be the same as those described in Section 5.11.1, Affected Environment. The PM&E measures associated with Alternative 2 that would change the existing landscape by clearing vegetation and replacing it with facilities such as parking lots, roads, and structures would have effects of varying degree. Those effects were previously described in the descriptions of each PM&E measures associated with Alternative 2.

5.11.3 Unavoidable Adverse Effects

Under the three alternatives, there would be no changes to the project facilities described in Section 5.11 that would have effects on the aesthetic environment of the project. Likewise, there would be no changes to project operations that would have effects on the aesthetic environment of the project.

5.12 SOCIOECONOMICS

Activities associated with the Oroville Facilities result in a range of economic benefits to the local area, region, and the State. These benefits include, but are not limited to, local income and job generation, generation of tax revenues for local jurisdictions, reliable and affordable water supplies for SWP customers, power generation (which facilitates water deliveries and relatively inexpensive water rates), and flood management for downstream residents and land uses.

This section describes potential socioeconomic effects of the No-Action Alternative, Proposed Action, and Alternative 2 and related existing conditions. A wide range of issues falls under the purview of socioeconomics; the focus of this section, however, is on those resources that may be affected by the alternatives. The key resource topics addressed in this section include:

- Effects on the local economy;
- Indirect growth-related effects from changes in population;
- Provision of public services and associated fiscal effects;
- Rate effects on water customers served by the project; and
- Environmental justice effects.

Effects are characterized as either positive or negative and are evaluated relative to regional conditions to help put the magnitude of these socioeconomic effects into perspective.

5.12.1 Affected Environment

This subsection provides a description of existing socioeconomic conditions attributed to the project, including project-related effects on the local economy and other socioeconomic resources affected by the project. It also establishes baseline socioeconomic conditions against which the No-Action Alternative was evaluated.

5.12.1.1 Regional Setting

The Oroville Facilities are located in Butte County, which is situated in the northern portion of California's Central Valley and Sierran foothills. The economic history of the region is founded on resource extraction industries, including mining and lumber processing, and ancillary industries such as railroading. Once the local irrigation infrastructure and large-scale water projects (i.e., CVP and SWP) were put into place, the agricultural industry became more prominent in Butte County. Ultimately, the regional economy matured to the point where local businesses are able to store, process, and market a diverse range of agricultural commodities and products. In the greater Oroville area, the local economy is now dominated by agriculture (namely orchard and rice production), local and State government, and recreation and tourism–

serving businesses. (Project-related operations and maintenance [O&M)] activities by DWR, DFG, and DPR are the primary component of State government activity in the local area.) These businesses are part of the service industry that gained prominence after the construction of Oroville Dam in the late 1960s.

In 2000, Butte County had a population of just over 200,000 people; this represents growth of roughly 250 percent during the period since the construction of Oroville Dam. In the last 20 years, Butte County's growth rate has dropped behind the California average and is less than that of the other Sacramento Valley counties. The racial composition of the population in Butte County is predominantly White, and the county also has a relatively high proportion of retirees. The Chico and Paradise areas are the fastest growing areas of Butte County. The largest segment of employment is in the services sector, which is characterized by relatively low wages. Butte County residents receive a relatively high proportion of their total income derived from government transfer payments (i.e., Social Security payments, supplemental security payments, and public assistance). The median household income of residents of Butte County is significantly below the regional, State, and national averages.

5.12.1.2 Local and Regional Economic Activity

Local and regional economic conditions are directly affected by the Oroville Facilities, which have a positive effect on income and employment levels. These benefits are a result of spending by recreationists and other visitors to the Oroville Facilities and spending for project-related O&M activities, which include local procurement of goods and services and the wage and salary incomes paid to the workforce that support the project. These expenditures represent direct inputs into the economy, which, in turn, have an indirect ripple (or multiplier) effect on income and employment levels from money circulating throughout the economy. The greatest economic benefits accrue in the area around the City of Oroville, where most project facilities are located and where many of the State employees who operate and maintain the facilities reside. As a regional retail and services center, the Chico area also realizes considerable economic benefits from the project. The economies of the Paradise and Biggs-Gridley areas are relatively less affected by the Oroville Facilities. Indirectly, the project also helps support the local agricultural industry, particularly rice production, and related industries through the delivery of affordable and reliable water supplies to the Feather River Service Area (FRSA) water users, as described further in Section 5.4.1.

5.12.1.3 Population and Housing

Recreation visitation and O&M activities associated with the Oroville Facilities indirectly support local population growth. As visitor- and O&M-induced spending generate employment opportunities, new residents are drawn to the region to fill these jobs, thereby increasing population levels. The population growth attributed to the Oroville Facilities indirectly generates a demand on local housing resources. Based on existing vacancy rates, the project does not appear to be contributing to a shortage in the regional housing stock.

5.12.1.4 Public Services and Fiscal Resources

Public Services

Visitors to the Oroville Facilities generate a demand for a range of local public services, mainly law enforcement, fire protection and emergency services, and road maintenance. In addition, the local population indirectly supported by the project also places a demand on local jurisdictions for public services. Project-related public services provided by local government are primarily the responsibility of the City of Oroville and Butte County; federal and State agencies typically share public service responsibilities on public lands, and to a lesser extent private lands, depending on the type of public service. The responsibility of service providers is described below by type of service.

Law Enforcement

DPR is the primary provider of law enforcement services in the project area, which focuses its services within the Lake Oroville State Recreation Area (LOSRA). Other law enforcement service providers in the project area include: City of Oroville Police Department; Butte County Sheriff's Department; California Highway Patrol (CHP) (on non-LOSRA State lands and local roadways); DFG at the OWA and elsewhere within the project area where their statutory Game Warden responsibilities extend; DWR (through private security patrols) at DWR facilities and land-based recreation facilities at Thermalito Afterbay; and federal agencies (USFS and BLM) on federal lands located in the FERC project boundary. Because DPR provides law enforcement services in the project area, which includes areas within both the City of Oroville and unincorporated Butte County, law enforcement services in both the City of Oroville and Butte County benefit by this presence.

Fire Protection and Emergency Services

Fire protection and emergency medical services to the greater Oroville area are provided jointly by the Oroville Fire-Rescue Department, Butte County Fire-Rescue Department, and the California Department of Forestry and Fire Protection (CDF). These agencies cooperatively respond to calls within the project area based on the South County Interagency Fire Protection Agreement. Under this agreement, primary responsibility for fire protection and emergency service calls in the project area is divided among these agencies depending on the location of the incident and the availability of fire units to respond to the call, regardless of primary jurisdictional responsibilities.

Traffic and Road Maintenance

Recreation visitation at the Oroville Facilities results in traffic on local roadways. Maintenance of local roadways in the greater Oroville area is the responsibility of the Oroville Public Works Department and the Butte County Public Works Department. Traffic levels in the Oroville area are generally low; however, recreation use during peak

holiday periods can result in short-term traffic congestion, particularly near the marinas and high-use recreation areas and parking lots.

Utilities and Service Systems

Various utilities and service systems serve the project area, and may be needed to serve proposed facility developments under the alternatives and indirect population growth generated by the project. These services include water, wastewater treatment, power, and solid waste disposal.

Fiscal Conditions of Affected Local Jurisdictions

The fiscal resources of local governments in Butte County are affected by both visitors to the Oroville Facilities and the local population supported by project-related economic activity. These fiscal effects include the expenditures required to provide public services and the revenues generated by the project through tax collections and other sources. From a regional perspective (i.e., the combined effect on all affected cities and Butte County), visitors to the Oroville Facilities generate local tax revenues that exceed public service costs. From a local perspective, but not including some potentially positive fiscal effects described below, visitors to the Oroville Facilities are believed to generate a moderate annual fiscal surplus for the City of Oroville and an annual fiscal deficit for Butte County of less than one-half the City's surplus. Therefore, there is a net fiscal surplus to the region as fiscal resources to other jurisdictions in Butte County are minimally affected.

For the assessment performed in SP-R19, fiscal effects focused on project-related expenditures and revenues that are directly related to recreation visitor activities. From a more comprehensive viewpoint, recreation and O&M spending attributed directly to the Oroville Facilities also generate income, a portion of which is paid to the State and federal governments in the form of income taxes. In addition to directly benefiting the fiscal conditions of the State and federal governments, these tax dollars augment the pool of State and federal funds that are available for distribution back to local governments through intergovernmental transfers; however, because there is no direct relationship between these revenues and transfers, these positive fiscal effects could not be determined.

5.12.1.5 Socioeconomic Effects on Affected Water Customers

As the major storage facility of the SWP, Lake Oroville and other components of the Oroville Facilities play an instrumental role in allowing DWR to meet its commitment of supplying reliable and affordable water to its FRSA and SWP water customers throughout California. The SWP water deliveries contribute important economic benefits that are experienced by residential water users, as well as by the owners, employees, and customers of a wide variety of agricultural, municipal, and industrial businesses.

The delivery and use of SWP water results in many socioeconomic benefits enjoyed not only by DWR water customers but by others as well. Many of DWR's water customers

are municipal water utilities or irrigation districts, which in turn provide water to individual residents and businesses for direct consumption and use. In general, the water supplies delivered by DWR are considered to be more reliable and affordable than alternative water supplies. SWP water deliveries also serve as an important source of water for DWR customers during dry water years and droughts. An important socioeconomic effect of having an affordable and reliable source of water is that businesses enjoy relatively lower operating costs that could be considerably higher if more expensive or less reliable water supplies were needed to replace SWP deliveries. This, in turn, improves the efficiency of the economy where the businesses are located and has positive effects on income and jobs.

5.12.1.6 Environmental Justice

Environmental justice refers to the fair and equitable treatment of individuals regardless of race, ethnicity, or income level in the development and implementation of environmental management policies and actions. Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires each federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations" (Council on Environmental Quality 1997). The EO was accompanied by a memorandum that directs federal agencies to analyze the environmental effects, including human health, social, and economic concerns, of their actions where such analysis is required by the National Environmental Policy Act (NEPA). Comparable policies and guidelines have been established by the State of California Resources Agency, which includes DWR, operator of the Oroville Facilities.

Characteristics of Populations Affected by the Oroville Facilities

An important baseline effect of the Oroville Facilities is the provision of relatively affordable water to water customers, including low-income populations, within the FRSA and other SWP service areas. The Oroville Facilities also provide recreation opportunities, including access to fee-based and free facilities, to visitors from throughout the State. A summary of the demographic characteristics of populations affected by the Oroville Facilities is provided below.

The racial characteristics of the population living in the SWP service areas vary by region of the State. Locally, the racial makeup of the population in the FRSA is more uniform than that of the State, with only American Indians/Alaska Natives representing a higher proportion of the overall population. The proportion of American Indians/Alaska Natives is even higher in the City of Oroville, which is nearly four times the State average. Based on survey data collected as part of SP-R13, *Recreation Surveys*, the ethnicity of visitors to the Oroville Facilities is predominantly White/Anglo/non-Hispanic, and Latinos/Hispanics are the second most populous ethnicity.

Income-related characteristics of persons living in the SWP service areas also vary considerably. The FRSA has the lowest median household income of any service area, with the City of Oroville (included in the FRSA) having the lowest income level of any jurisdiction served by the SWP; median household income levels in both of these areas are lower than Statewide figures. The highest poverty rates occur in the San Joaquin Valley, followed by the FRSA and Southern California, all of which are higher than the State average. Based on the survey data, the household income levels for Oroville recreationists are fairly evenly distributed. The majority of visitors had a total household income that was higher than median income level for Butte County in 2000.

5.12.1.7 Other Economic Benefits of the Project

In addition to the benefits described above, other notable regional and Statewide economic benefits of the Oroville Facilities include those associated with the generation of power and flood protection. These benefits are briefly described below and are defined in more detail in Chapters 6.0 and 7.0.

Water impounded behind Oroville Dam is released for a variety of beneficial uses including the environment, water quality, flood protection, and water supply to customers statewide. The power generated during these various releases is used to offset the cost of purchasing power on the open market for pumping and conveying water from Lake Oroville to SWP customers statewide. Roughly one-third of SWP power needs are supplied by the Oroville Facilities, and this greatly enhances the reliability and cost effectiveness of delivering SWP water supplies, and their associated benefits statewide. If the amount of power generated at the Oroville Facilities were reduced, DWR would need to rely on more expensive power sources to replace project power, thus increasing project operating costs. This potential increase in operating costs would need to be passed on to SWP water customers through higher water rates Statewide.

The Oroville Facilities also provide important power benefits related to what are collectively referred to as “ancillary services,” including voltage support for the greater Northern and Central California regions and greater system stability for the entire California power grid. Without this voltage support, Northern and Central California would likely experience more frequent and longer power outages, resulting in reductions in business output and related adverse income and employment effects.

Lastly, the Oroville Facilities provide important flood protection benefits to the greater Oroville area and many other communities downstream of Oroville Dam, including Yuba City, Marysville, and Sacramento. Downstream agricultural operations also benefit from and rely upon Oroville Dam’s regulation of floodflows. Thus, much of the economic activity in Butte County and counties downstream of Lake Oroville depends, in part, on DWR’s flood management operations at Oroville Dam. Project flood management operations, which are described further in Section 5.4.1, also are critical to maintaining the structural integrity of the many levees found along the Feather River and along the Sacramento River below its confluence with the Feather River.

5.12.2 Environmental Effects

This section describes potential effects of the alternatives on socioeconomic resources. Table 5.12-1 summarizes the key results of the analysis of effects, and the subsections that follow the table focus on individual socioeconomic resource topics.

Table 5.12-1. Summary of potential effects on socioeconomic resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Local Economic Activity			
Income	No intermittent income effects related to construction or capital outlays; beneficial baseline income effects related to visitor spending and O&M expenditures.	Beneficial intermittent income effects related to construction and capital outlays; beneficial baseline income effects related to visitor spending and O&M expenditures (greater than under the No-Action Alternative).	Beneficial intermittent income effects related to construction and capital outlays (slightly greater than under the Proposed Action); beneficial baseline income effects related to visitor spending and O&M expenditures (greater than under the No-Action Alternative, slightly greater than under the Proposed Action).
Employment	No intermittent employment effects related to construction or capital outlays; beneficial baseline employment effects related to visitor spending and O&M expenditures.	Beneficial intermittent employment effects related to construction and capital outlays; beneficial baseline employment effects related to visitor spending and O&M expenditures (greater than under the No-Action Alternative).	Beneficial intermittent employment effects related to construction and capital outlays (slightly greater than the Proposed Action); positive baseline employment effects related to visitor spending and O&M expenditures (greater than under the No-Action Alternative, slightly greater than under the Proposed Action).
Population and Growth-Inducing Effects			
Population and Indirect Growth-Related Effects	Increase in population and indirect growth-related effects supported by the project due only to growth-related increases in recreation activity.	Increase in population and indirect growth-related effects supported by the project and minor adverse effects on housing.	Same as Proposed Action with slightly greater effects.

Table 5.12-1. Summary of potential effects on socioeconomic resources.

Topic	No-Action Alternative	Proposed Action	Alternative 2
Public Services and Fiscal Effects			
Effects on Public Services and Service Providers from Recreation Visitation	Minor adverse effects due to increased demands on service providers.	Same as No-Action Alternative; effects would differ slightly based on differences in projected visitation levels.	Same as Proposed Action
Fiscal Effects on Local Jurisdictions from Recreation Visitation	Beneficial annual regional fiscal effect. Beneficial, but relatively, large net annual effect on the City of Oroville and adverse, but relatively small, net annual effect on Butte County.	Same as No-Action Alternative; effects would be greater than under the No-Action Alternative based on differences in projected visitation levels.	Same as Proposed Action.
Water Supply Effects			
Effects on SWP and other Water Customers	Same as Existing Conditions.	Minor adverse effects due to increased project costs which are passed on to water users as a result of new PM&E measures.	Same as Proposed Action; effects would be greater than under the Proposed Action based on higher PM&E costs and reduced power generation.
Environmental Justice			
Effects on Minority and Low-Income Populations	Same as Existing Conditions.	Same as No-Action Alternative.	Same as No-Action Alternative.

5.12.2.1 No-Action Alternative

Local Economic Activity

The No-Action Alternative would continue current operations at the Oroville Facilities and would not include any major construction projects or major capital expenditures; as a result, there would be no additional income or employment effects related to these activities.

The No-Action Alternative would result in increased recreation-related visitor spending generated by projected increases in recreation use levels attributed to population growth. (No recreation-related PM&E measures are included under this alternative; refer to Section 5.10, Recreation Resources, for more information on projected recreation use levels.) Recreation visitor spending in Butte County would increase slightly, with most of the increased spending occurring in the greater Oroville area. This

spending increase also would slightly increase income and employment levels, primarily in the Oroville area. These effects would continue to represent a relatively small proportion of total income and employment levels in Butte County.

Population and Growth-Inducing Effects

Projected increases in recreation under the No-Action Alternative also would increase the project-supported population, which could result in growth-inducing effects such as additional demands for housing and public services and related fiscal effects, and ancillary effects on natural resource conditions. However, because changes in projected populations are expected to be relatively small, growth-inducing effects would be minor. Because short-term construction effects would not occur under the No-Action Alternative, no related population effects are expected.

Public Services and Fiscal Effects

Under the No-Action Alternative, the projected growth-related increase in recreation visitation would slightly increase demands on local service providers, primarily providers of law enforcement and fire protection and emergency services. Other types of public services, including utility services (i.e., water supply, wastewater treatment, solid waste disposal, and power), likely would not be affected because no new facilities are proposed. The increase in demand for public services generated by additional recreation visitation is expected to be met through staffing growth, with the costs being partially or fully offset by tax and other revenues generated directly and indirectly by the project.

Recreation visitation at the Oroville Facilities would continue to generate a positive net fiscal effect in the region as a whole. This regional effect includes a relatively large annual surplus to the City of Oroville and a relatively small annual deficit to Butte County. These fiscal effects are expected to represent a relatively minor share of the future budgets of the affected jurisdictions.

Water Supply Effects

Because the No-Action Alternative would not have any power-related effects and would have only minimal construction (i.e. related to Interim Projects) or capital costs, future water supply cost increases are expected to be minimal. As a result, no significant socioeconomic effects on SWP water customers are expected. For FRSA there will be no direct change in water supply or costs; this would also be true for other in-basin water users. Refer to Chapter 7.0 for additional information regarding potential rate increases under the alternatives

Environmental Justice

Environmental justice effects would occur under the No-Action Alternative only if low-income or minority populations would incur a disproportionately high share of adverse socioeconomic effects, such as increases in recreation fees or water rates paid by affected water customers. No adverse socioeconomic effects have been identified that

would disproportionately affect low-income or minority populations under this alternative; therefore, no environmental justice effects are expected.

5.12.2.2 Proposed Action

Local Economic Activity

Unlike the No-Action Alternative, the Proposed Action includes PM&E measures that provide for a range of recreation-related improvements and environmental measures. (Refer to Chapter 3.0, Proposed Action and Alternatives, for a description of features included in the Proposed Action.) Implementation of these PM&E measures would result in expenditures related to construction costs and capital outlays, which would intermittently generate income and employment benefits. The level of these benefits would fluctuate depending on the timing of facility developments and other projects.

Implementation of the Proposed Action also would increase visitor spending and baseline O&M-related expenditures through the term of the new license. The spending levels associated with increased visitor and O&M activities are anticipated to be higher than under the No-Action Alternative because proposed recreation-related PM&E measures would expand recreation capacity and improve the quality of recreation areas, which would result in additional visitation and O&M needs; consequently, positive effects on local income generation and employment would result. These economic benefits, which would be distributed across community areas with the most benefits occurring in the Oroville area, would account for a relatively small proportion of countywide income and employment levels in the future.

Population and Growth-Inducing Effects

The Proposed Action would result in the same types of population and related growth-inducing effects as the No-Action Alternative; however, the magnitude of such effects is anticipated to be slightly greater because the population supported by this alternative would be slightly higher. All population and related growth-inducing effects would still be minor.

Public Services and Fiscal Effects

Recreation activity associated with the Proposed Action would slightly increase public service demands beyond those described for the No-Action Alternative. The costs associated with the expected minor increase in the staffing needs of public service providers are expected to be mostly or fully offset by tax and other revenues generated directly and indirectly by the Oroville Facilities.

Recreation visitation to the Oroville Facilities under the Proposed Action would generate a slightly higher, positive net fiscal effect on local government in the region as a whole relative to the No-Action Alternative. The relatively large surplus generated by the project for the City of Oroville and the relatively small deficit generated by the project for Butte County would increase slightly. Fiscal conditions of other affected jurisdictions in the region would be affected even more slightly.

Socioeconomic Effects on Water Customers

As indicated in the No-Action Alternative, changes in power generation and implementation of PM&E measures could affect water costs paid by affected SWP water customers. The cost of implementing and maintaining the PM&E measures included in the Proposed Action would likely require DWR to recoup its construction costs and related increases in capital outlays and O&M costs by slightly increasing the costs it charges its water customers. Such water supply cost increases would be ameliorated for a number of reasons:

- Future cost increases would be spread across all DWR service areas and the millions of acre-feet DWR delivers each year, thus minimizing related effects on any one water customer; and
- Most SWP and FRSA water customers are municipal water utilities or irrigation districts that in turn blend SWP water deliveries with a variety of other sources before they sell and deliver water to individual households or businesses. This blending of water sources would further diminish the effects of any DWR water supply cost increases passed on to these wholesalers who then sell water to individual households or businesses.

Environmental Justice

The Proposed Action is not expected to cause any adverse environmental justice effects for the same reasons described above for the No-Action Alternative.

5.12.2.3 Alternative 2

Local Economic Activity

Construction costs and capital outlays associated with implementation of PM&E measures included in Alternative 2 are estimated to be higher than comparable costs under the Proposed Action. (Note that there would be no construction costs or capital outlays under the No-Action Alternative.) These expenditures would result in local economic benefits, including intermittent increases in income and employment, as these PM&E measures are implemented. These positive economic effects would be slightly higher than under the Proposed Action, but would only provide short term economic benefits to Butte County.

Income and employment effects generated by O&M expenditures under Alternative 2 are expected to be higher than under the No-Action Alternative, but only slightly higher than under the Proposed Action. Income and employment effects generated by visitor activity are expected to be comparable to those under the Proposed Action; however, because Alternative 2 includes features such as the proposed whitewater park and special-event facilities that could attract more out-of-county visitors (and spending), this alternative may provide some additional income- and employment-related benefits to the regional economy.

Population and Growth-Inducing Effects

The population growth supported by the Oroville Facilities under Alternative 2 would be greater than under the No-Action Alternative, but only slightly greater than under the Proposed Action. This population would slightly increase the demand for new housing, public services, and fiscal resources, potentially resulting in slightly greater effects on natural resources than under future No-Action conditions. These effects, however, are expected to be minor.

Public Services and Fiscal Effects

Because projected levels of recreation use under Alternative 2 are expected to be comparable to those expected under the Proposed Action, visitor-driven effects on law enforcement, fire protection and emergency services, and road maintenance and traffic would be similar to effects under the Proposed Action (refer to the Public Services and Fiscal Effects subsection under the Proposed Action for additional details). Alternative 2 could adversely affect emergency services and response times at Lake Oroville. Certain features of Alternative 2, however, may result in additional effects on public services. Thus, it would be more difficult to provide the same level of public services currently provided in the project area.

The demand for utility services under Alternative 2 is expected to increase slightly relative to the No-Action Alternative because of larger scale improvement projects, including special-event facilities; however, the local utilities are expected to be able to meet this additional demand.

Because projected recreation use levels under Alternative 2 are expected to be similar to use levels under the Proposed Action, fiscal effects generated by visitor activity also would be similar (refer to the Public Services and Fiscal Effects subsection under the Proposed Action for a discussion of these effects).

Socioeconomic Effects on Water Customers

The socioeconomic effects of Alternative 2 on water customers would be nearly the same as those under the Proposed Action.

Environmental Justice

Alternative 2 is not expected to cause any adverse environmental justice effects for the same reasons as those described above for the No-Action Alternative.

5.12.3 Unavoidable Adverse Effects

Under the three alternatives, there would be no changes to the project facilities described in Section 5.12 that would have unavoidable adverse effects on the socioeconomic environment.