COVER SHEET

FEDERAL ENERGY REGULATORY COMMISSION
FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE OROVILLE FACILITIES PROJECT
Docket No. P-2100-052

Section 3
Environmental Analysis
Pages 43 to 350
FEIS

3.0 ENVIRONMENTAL ANALYSIS

In this section, we first describe the general environmental setting in the project vicinity and any environmental resources that could be cumulatively affected by relicensing the Oroville Facilities. Then, we address each affected environmental resource. For each resource, we first describe the affected environment—the existing condition and the baseline against which to measure the effects of the proposed project and any alternative actions—and then the environmental effects of the proposed project, including proposed articles included in appendix A of the Settlement Agreement. Unless otherwise stated, the source of our information is the license application for the project (DWR, 2005b).

3.1 GENERAL SETTING

The Oroville Facilities are located on the Feather River and several tributaries including the North Fork, West Branch, South Fork, and Middle Forks of the Feather River. Ten creeks also flow directly into Lake Oroville. Table 7 summarizes the drainage area by major tributary and includes the local drainage to the lake in the vicinity of the major tributary (Ecosystem Sciences Foundation, 2005). The largest tributary is the North Fork, accounting for nearly 60 percent of both drainage area and inflow. Figure 7 provides a profile view of hydroelectric development along the North Fork.

Table 7. Major tributary areas and flow contribution to Lake Oroville inflow. (Source: Ecosystem Sciences Foundation, 2005)

Area	Drainage Area (square miles)	Watershed Area (%)	Mean Daily Inflow (cfs)	Inflow (%)
West Branch	167.2	4.64	346	6.47
South Fork	126.7	3.51	262	4.90
North Fork	2,156.4	59.82	3,228	60.48
Middle Fork	1,154.5	32.03	1,502	28.15
Total	3,604.8	100.00	5,338	100.00

Normal maximum pool elevations in the project range from 136 feet msl at the Thermalito afterbay to 900 feet msl at Lake Oroville. The highest point in the Feather River Watershed is Mount Lassen (elevation 10,457 feet U.S. Geological Survey [USGS] datum) and is at the northwestern end of the Lake Almanor Basin, part of the North Fork Watershed. Much of the Feather River Watershed is located on the western side of the crest of the Sierra Nevada at or above elevation 4,500 feet. Summer months are typically dry and mild, and precipitation occurs primarily during winter months, with substantial snow accumulation at the higher elevations and rain generally occurring below 3,000 feet.

3.2 CUMULATIVELY AFFECTED RESOURCES

The scope of cumulative effects is based on the Council on Environmental Quality's regulations. The following resource disciplines were determined to be cumulatively affected by the project: geology; water quantity; water quality; aquatic; terrestrial; threatened and endangered species; and cultural resources.

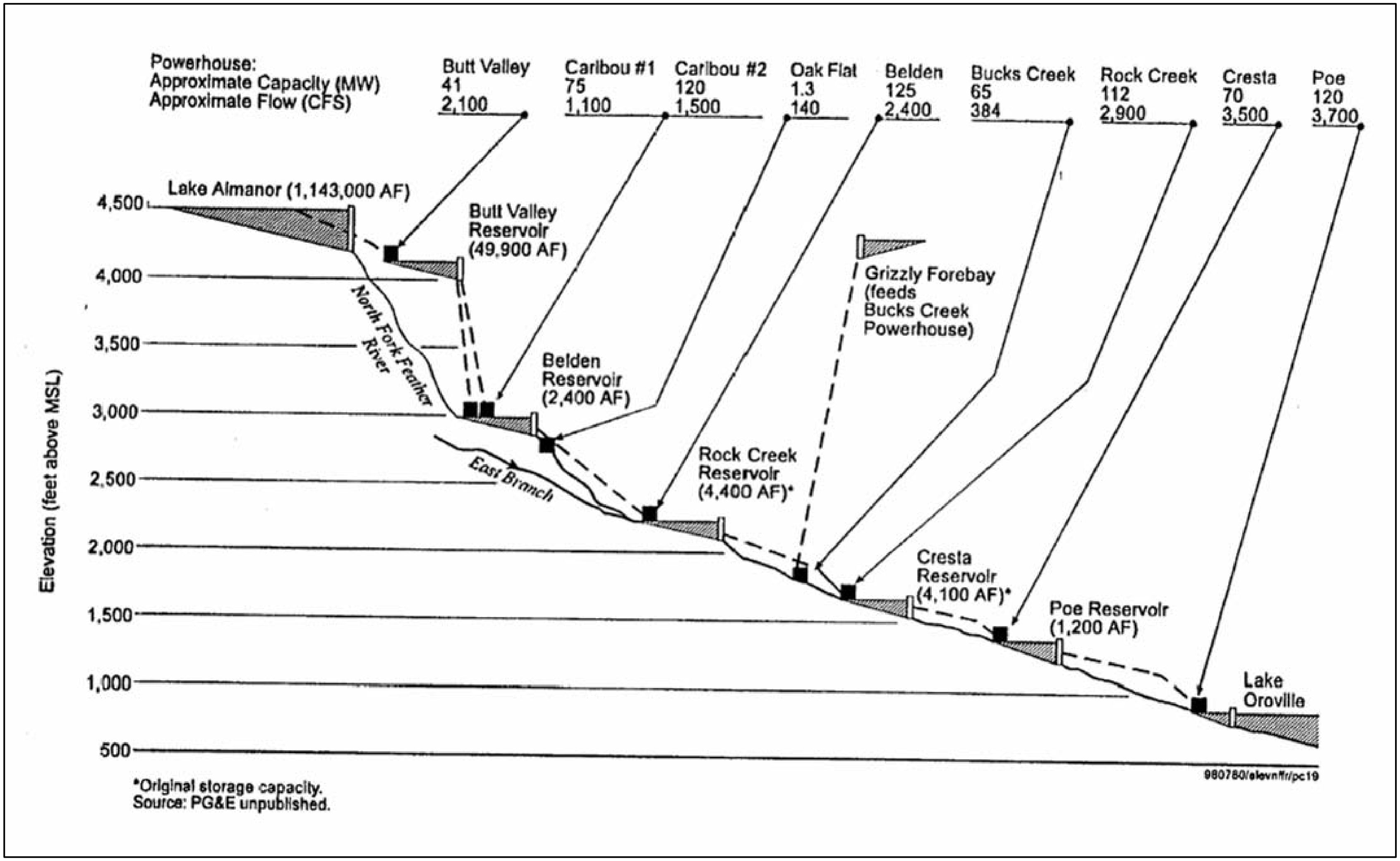


Figure 7. North Fork of the Feather River hydroelectric projects. (Source: PG&E, 2002a)

3.2.1 Geographic Scope

The geographic scope of the analysis defines the physical limits or boundaries of the Proposed Action's effects on the resources. Because the Proposed Action would affect the resources differently, the geographic scope for each resource may vary.

The geographic scope for discussing cumulative effects on spring-run Chinook salmon and steelhead is broad considering the types of related actions that affect these anadromous fish species. Accordingly, the geographic scope for cumulative effects on these species ranges from the highest elevations of the Feather River basin to the Feather and Sacramento rivers and continues through the San Francisco Bay/Sacramento-San Joaquin Delta and into the Pacific Ocean. The geographic scope for geomorphologic resource topics (gravel recruitment, sediment transport, and large woody debris [LWD]) ranges from the tributaries to Lake Oroville, downstream in and along the Feather River to its confluence with the Sacramento River. The geographic scope for all other resource topics consists of the following locations and nearby lands: Lake Oroville, the Feather River, Thermalito forebay, Thermalito afterbay, and the OWA.

3.2.2 Temporal Scope

The temporal scope of our cumulative effects analysis in this EIS includes past, present, and future actions and their possible cumulative effects on each resource. Based on the license term, the temporal scope looks 30 to 50 years in the future, concentrating on the effects of the resources from reasonably foreseeable future actions. The historical discussion, by necessity, is limited to the amount of available information for each resource.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

3.3.1 Geology, Soils, and Paleontological Resources

In this section, the No-action Alternative, the Proposed Action, and Staff Alternative are evaluated for potential effects on the geologic, geomorphic, and soils-related resources within the project area. The license application includes a description of modeling efforts associated with geomorphic processes within the FERC project boundary (DWR, 2005a, appendix G).

3.3.1.1 Affected Environment

Regional Geologic Setting

About 85 percent of the project area upstream of the Thermalito diversion dam is located within the metamorphic belt of the Sierra Nevada Geomorphic Province. The remaining 15 percent of the project area (mostly to the north) is located within the Cascade Range Geomorphic Province. The area downstream of the 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. Intrusive rocks (medium- to coarse-grained granite and trondhjemite) dominate the landscape along the South Fork and Middle Fork within the project boundary. Highly weathered and/or decomposed granite (erodible and prone to landslides) occurs in the eastern watershed and along portions of the North Fork.

The Cascade Range Geomorphic Province 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 Range 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 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).

Geologic Conditions—Lake Oroville and Lake Oroville Tributaries

Geologic Setting

The western metamorphic belt of the Sierra Nevada Geomorphic Province underlies a significant portion of the Oroville Facilities watershed. These rocks 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, which 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. Much 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, as well as 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, is known to occur in 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. Thin soil profiles tend to develop on the intrusive igneous rocks underlying the eastern portion. Along the lower portions of the Middle and South Forks, exposed, intrusive rocks tend to decompose readily into their basic mineral assemblages. These rocks do not generally form deep soil profiles, but can readily be eroded by wave and wind action.

Sediment Sources in the Feather River Watershed

The upper Feather River Watershed 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* (SCS, 1989), estimated that 90 percent of the erosion in its 1,209 square mile study area was accelerated erosion.

Accelerated erosion is defined as a soil loss rate greater than natural geologic conditions. Increased sediment yield can be from “upslope” sources including human activities like road building, timber harvesting, urbanization, overgrazing livestock, and agriculture. Other sediment sources can be from within the channel itself, typically from bank erosion and/or channel incision. These in-channel sources are both associated with changes in flow regime, decreased groundwater levels, channelization and/or bank protection, bank erosion from livestock, or other actions. High sediment yields can reduce reservoir capacity, degrade water quality, and harm fish and wildlife. High sediment yields have significantly impaired storage capacity and hydroelectric operations in several reservoirs upstream of Lake Oroville on the North Fork.

Slope Stability/Landsliding

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

Landslides are numerous along the banks of Lake Oroville and are concentrated along the North Fork arm (Bloomer Hill area) and in the South Fork arm (Stringtown Mountain area). The majority of active landslides are a result of reactivation of ancient landslides. In addition, a number of small active landslides are caused by bank/toe failure (likely due to repeated wave action along the shoreline under-cutting already unstable areas) at the edge of the reservoir, especially on the Middle Fork. Upstream of the reservoir, landslides are common along the North and Middle Forks, occurring in granitic and metamorphic rocks that form the hills and valleys of the westernmost portion of the Sierra Nevada. 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.

The total area of all confirmed landslides mapped in the Lake Oroville area is about 4,154 acres. Of this total, about 328 acres (8 percent) are active, 579 acres (14 percent) are considered inactive, and the remaining 3,246 acres (78 percent) are ancient landslides. About 15 miles of shoreline are mapped as landslide material, representing less than 9 percent of the 167 miles of total shoreline length. The license application includes map coverage of landslides around Lake Oroville (DWR, 2004k, appendix c).

River Channel and Floodplain Physiography

Both the North and Middle Forks cross the crest of the Sierra, draining drier lands in the rain shadow to the east. In the lower two-thirds of the Feather River watershed both the Middle and North Forks flow in deeply incised canyons with little or no floodplain. The North Fork has several hydroelectric developments, resulting in a series of impoundments (and sediment sinks) within the Feather River Canyon (see figure 7). Some granitic domes reach the river's edge, resulting in no overbank areas in those reaches. Other river reaches allow for development of coarse, point and/or mid-channel bars. The Middle Fork has no dams in its canyon, and as a result, maintains a natural sediment regime through its canyon reach; the lower portion is dominated by large granite domes and a dearth of floodplain areas.

The South Fork enters the Middle Fork in Lake Oroville and its watershed does not cross the crest of the Sierra. Instead, the South Fork skirts the southwest portion of the Middle Fork Watershed and mostly drains into the lower foothills of the Sierra Nevada. The South Fork has been developed for hydroelectric and water supply needs by the Oroville-Wyandotte Irrigation District (now called South Feather Water and Power). Dams and reservoirs include Ponderosa dam at the high water mark of Lake Oroville and the Lost Creek, Sly Creek, and Little Grass Valley reservoirs.

Geologic Conditions—Downstream of Lake Oroville

There are two reaches downstream of Oroville dam that are defined largely by project operation, described in section 3.3.2, *Water Quantity and Water Quality*. The low flow channel extends from the fish barrier dam to the Thermalito afterbay outlet (RM 59) and the high flow channel extends from the Thermalito afterbay outlet to the confluence with Honcut Creek (RM 44) (figure 8). For the purposes of describing and discussing the Feather River, the aforementioned two areas along with the stretch of Feather River downstream to the confluence with the Sacramento River, are further subdivided into 11 geomorphic reaches which are all described in this section.

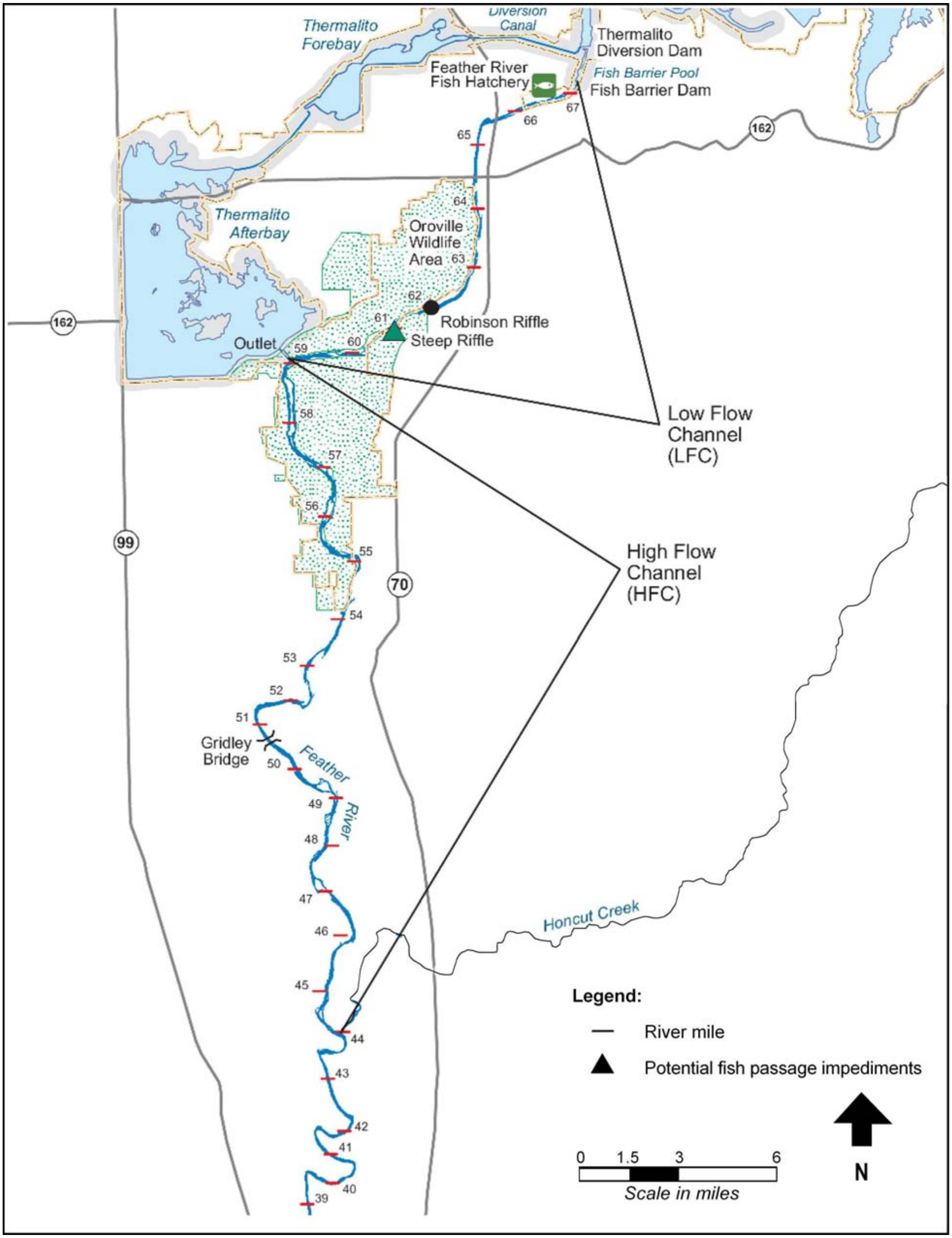


Figure 8. Distance in river miles from the confluence with the Sacramento River. (Source: DWR, 2005a) Page 1 of 2

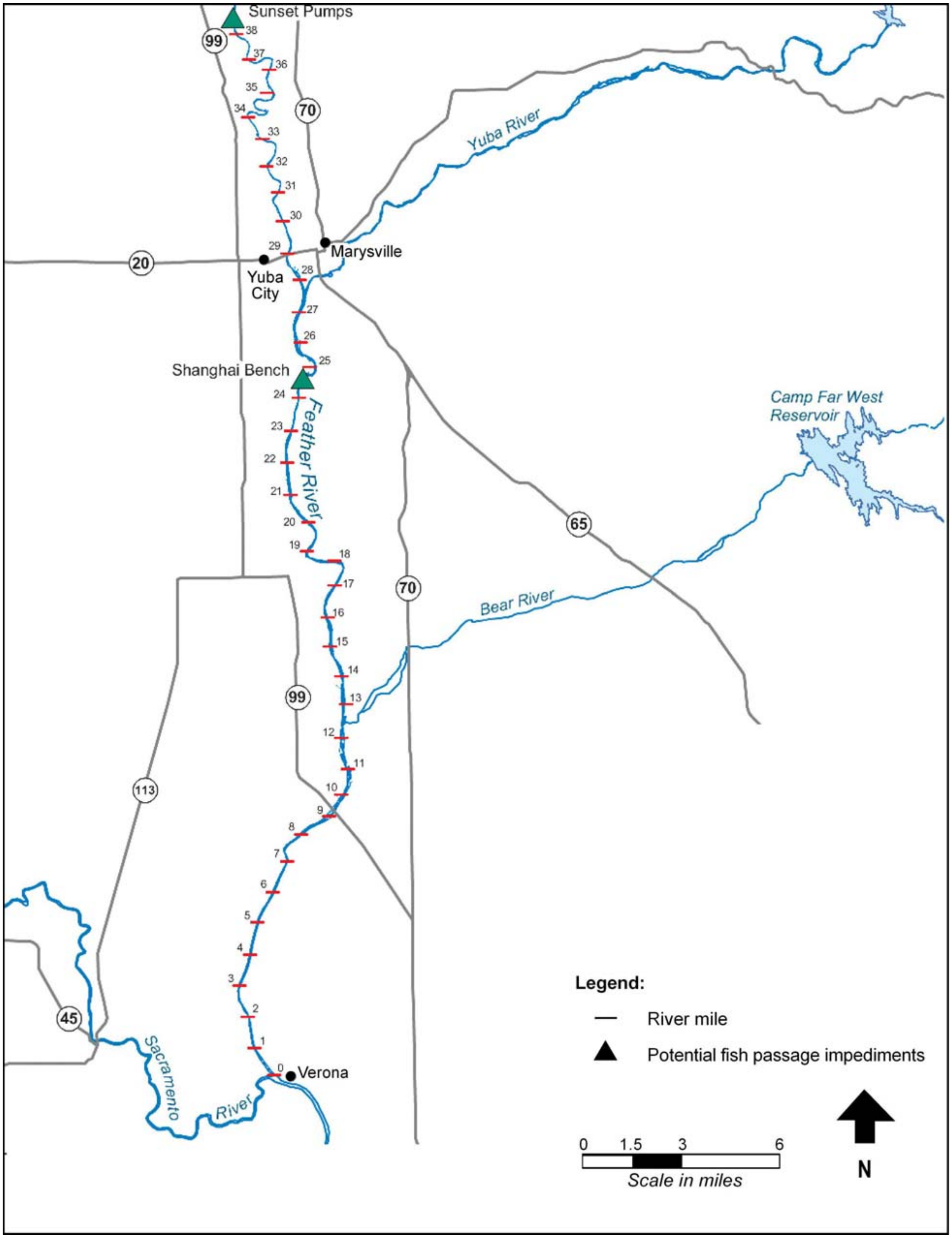


Figure 8. Distance in river miles from the confluence with the Sacramento River. (Source: DWR, 2005a) Page 2 of 2

Geologic Setting

Traveling through the Feather River watershed from upstream to downstream, it is apparent that the location of Oroville dam is roughly coincident with a marked change in the landscape. The relatively steep shorelines of the reservoir contrast with the openness of the east side of the Sacramento Valley. These changes translate to reductions in gradient and channel confinement for the river channel.

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.

River banks below Lake Oroville 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 downstream to the Sacramento River, as are outcrops of the more-resistant Laguna, Modesto, and Ione Formations that hedge in the floodplain. Stream channel deposits occur in active channels of the Feather River and tributary streams and are transported downstream as a result of current 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.

Soil Conditions

The soils in the area downstream of Oroville dam are found on relatively level land, with most slopes ranging from 0 to 2 percent. Steep cliff-like areas separate the surrounding landscape from the relatively incised floodplain areas in certain reaches of the river, mostly upstream of RM 64.5. 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.

Sediment Sources

Sedimentary debris from hydraulic mining in the late nineteenth and early twentieth centuries filled the riverbed and adjacent floodplain of the lower Feather River, resulting in thick deposits of fine-grained, clay-rich, light yellow-brown colored material known as “slickens.” These slickens have in places 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 dredge tailings was excavated and used in the construction of Oroville dam. Much of the OWA is covered with these deposits. Reductions in sediment supply to the river because of Oroville dam are discussed below in the *River Geomorphology* section under *Conditions Downstream of Oroville Dam*.

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 feet/feet/year, which is quite low compared to the nearby Sacramento River's average rate of about 16 feet/feet/year.

River Geomorphology

Conditions Upstream of Lake Oroville

The Upper Feather River Watershed (outside the boundary of the Oroville Facilities) produces high sediment yields because of accelerated erosion. Sediment derived from accelerated erosion can degrade channels and water quality, reduce reservoir capacity, and harm fish and wildlife habitat. In the lower two-thirds of the North Fork watershed upstream of Oroville dam, sediment transported downstream of the upstream reservoirs passes through a deeply incised canyon with little floodplain. Without any reservoirs in its canyon, the Middle Fork also transports its sediment through an incised canyon with little room for floodplain deposition. Sediment in the South Fork is captured by Ponderosa reservoir.

Lake Oroville captures nearly all of the sediment passing downstream to it, and an estimated 97 percent of this sediment is trapped in the reservoir. Because Oroville Facilities operations can lower the reservoir level to between 50 and 250 feet below full pool (900 feet msl), sediment deposition does not occur above Lake Oroville. Instead, substantial sediment deposition occurs laterally within and along the reservoir's tributary channels and longitudinally within and downstream of the fluctuation zone. Deposition in the reservoir arms has created sediment wedges; the locations are shown in figure 9 and discussed further in section 3.3.3, *Aquatic Resources*.

Conditions Downstream of Oroville Dam

The Feather River emerges from the Sierra Nevada and enters the Sacramento Valley downstream of Oroville dam. In this region, the stream gradient flattens significantly and the topography becomes more subdued compared to the relatively steep topography along the tributaries and main stem upstream of the dam. Bluffs and terraces, overflow channels, multiple channel areas, and both artificial and natural levees occur along the lower river. In addition, Honcut Creek and the Yuba and Bear rivers join the Feather River before it enters the Sacramento River at Verona. The elevation of the valley floor varies from about elevation 150 feet msl at Oroville to about elevation 25 feet msl at Verona.

The Feather River meander belt between Oroville dam and its confluence with the Sacramento River consists of recent alluvium and stream channel deposits. 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, more resistant to erosion, and they define the boundaries of the active meander belt. Of the sediments within the meander belt, the alluvium is older. Like the stream channel deposits, these sediments consist of river deposits including floodplain and point bar deposits, channel fill, oxbow lake and tributary delta deposits, and hydraulic mining debris. The deposits range in size from clay, silt, and sand to gravel, cobbles, and boulders. Coarse deposits (including the mine tailings cobble in the OWA) predominate near Oroville and fine deposits predominate from Gridley downstream.

On the Feather River, a variety of human-induced changes have affected the 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

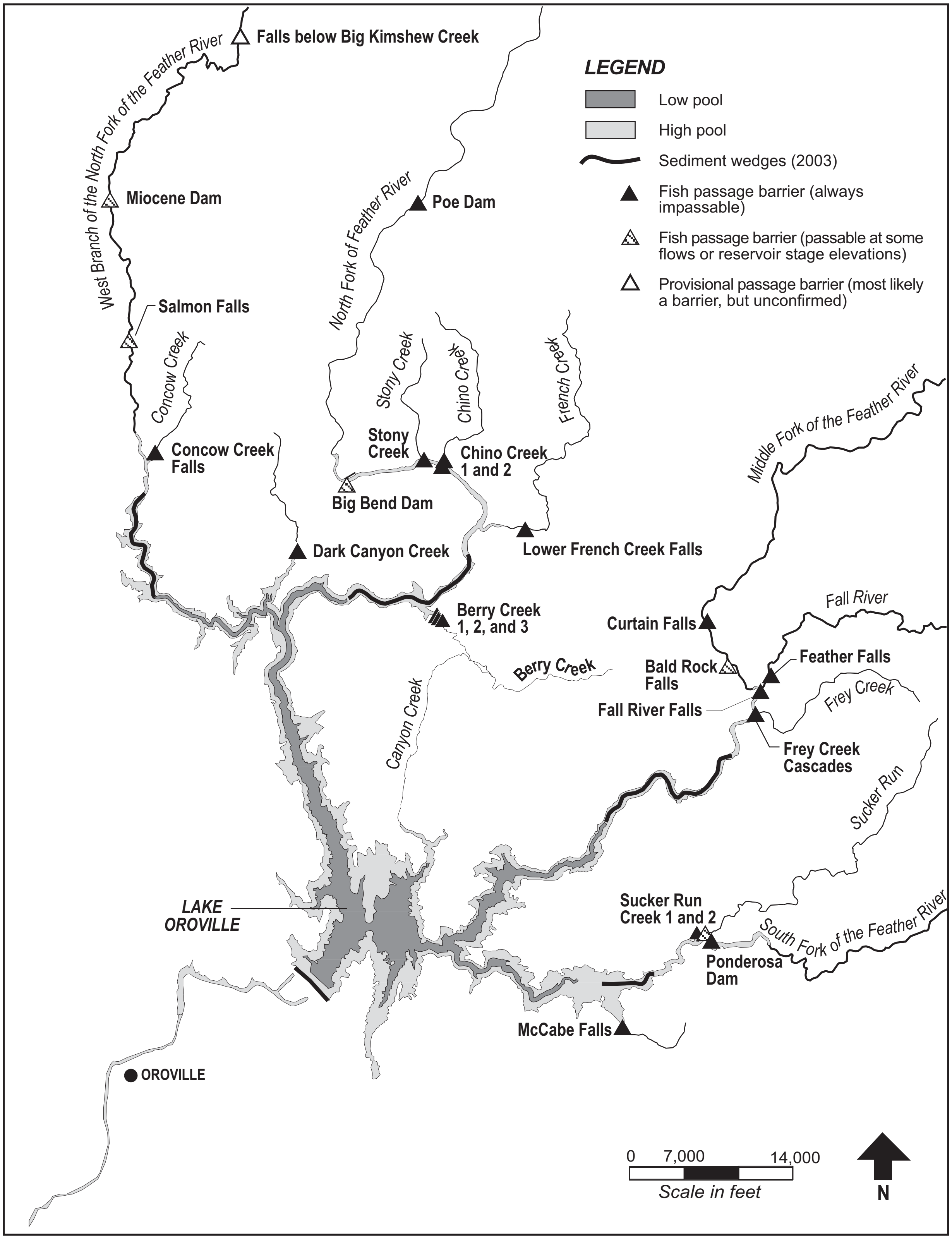


Figure 9. Lake Oroville fish passage barriers. (Source: DWR, 2005a)

cases, a river shifts from aggrading to degrading because of changes in river flow and sediment availability. Interpretation of geologic units exposed along the Feather River suggests that the river was degrading very slowly during the Holocene[28] era prior to Anglo-American occupation and alterations.

Before 1855, the 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 twentieth century, the large pulse of sediment from hydraulic mining changed the 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 Feather River watershed. The cumulative effect of these reservoirs located above Lake Oroville was a dramatic reduction in sediment supply, and with the completion of Oroville dam in 1968, the nearly complete capture of sediments eroded from the watershed.

Currently, sediment from the upstream watershed is reduced by an estimated 97 percent downstream of Lake Oroville, resulting in sediment deprivation downstream. Only silt, clay, and a very small amount of sand, and no gravel or cobble-sized substrates are currently discharged to the Feather River downstream of Oroville dam. As such, the Feather River downstream of Oroville dam is sediment-starved. Honcut Creek is the only tributary providing sediment to the river between Oroville dam and Yuba City.

Sediment transport data were available from USGS (1978) for a short period directly after the construction of project facilities. The average annual pre-dam sediment yield at the Feather River at Oroville gage was estimated to be 3,264 tons per day (1902–1962). The post-dam suspended sediment yield (1968–1975) was estimated at 42.5 tons per day. Results from FLUVIAL-12 model runs for current conditions suggest the amount of bed material load in the Feather River passing the Thermalito afterbay outlet (at the end of the low flow channel) in a 50-year period is 0.5 million ton, or about 10,000 tons per year, or 27 tons per day. This is about 6 percent of the pre-dam bedload of 485 tons per day estimated by USGS. The material comprising this bedload mostly comes from channel erosion since bed material is trapped by Oroville dam and the amount of bank erosion in the low flow reach is small. The low sediment yield from the banks is a reflection of the river’s stable banks which consist of erosion-resistant bedrock, terrace deposits, and cobbly dredger tailings. In addition, in-river gravel-mining operations within the historical 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. These effects are discussed below in section 3.3.1.2, *Environmental Effects*.

Feather River Geomorphic Reaches

The Feather River has been divided into 11 geomorphic reaches (table 8; labeled from downstream to upstream starting from the confluence of the Feather River with the Sacramento River [RM 0]) based on a variety of geologic and channel configuration characteristics, such as channel-controlling geology, planform, bed material, and depth/width ratio. A map of the Feather River with the distances from the confluence with the Sacramento River is provided in figure 8. Geomorphic reaches are discussed below, beginning at the fish barrier dam and proceeding downstream.

---

[28] The present Holocene era follows the Pleistocene epoch, a segment of geologic time roughly synonymous with the most-recent ice age, which included glaciation of the Sierra Nevada and Cascade ranges, and concurrently high sediment supply in most rivers emanating from glaciated terrain.

Table 8. Geomorphic reaches of the Feather River. (Source: DWR, 2004a)

Reach	River Miles	Bed Composition	Bank Composition	Stream Type	Sinuosity
FR-1	0.0–7.0	Sand	Sand and silt over slickens	Alluvial stable	Low
FR-2	7.0–12.5	Sand	Sand and silt over slickens	Alluvial meandering	Low
FR-3	12.5–17.0	Sand	Sand and silt over slickens	Alluvial geologic control	Low
FR-4	17.0–28.0	Sand	Sand and silt over slickens	Alluvial geologic control	Moderate
FR-5	28.0–33.5	Sand	Sand and silt over slickens	Alluvial stable	Low
FR-6	33.5–35.5	Sand and Gravel	Sand and silt over slickens	Alluvial erodible	High
FR-7	35.5–39.5	Sand and Gravel	Sand and silt over slickens	Alluvial stable	Low
FR-8	39.5–46.5	Gravel	Sand and silt over slickens	Alluvial erodible	Moderate
FR-9	46.5–53.5	Cobble and gravel	Cobble and gravel	Alluvial stable	Low
FR-10	53.5–64.0	Cobble and gravel	Cobble and gravel	Dredger tailings	NA
FR-11	64.0–68.0	Bedrock (and cobble)	Cobble and bedrock	Bedrock	NA

In the reach downstream of the fish barrier dam (reach FR-11), the channel is controlled by bedrock, and there is essentially no lateral channel migration. The bed material is bedrock, covered in most places by a veneer of cobbles and boulders up to 10 feet thick. Spawning gravel supplementation was conducted in this area in the 1980s. Sediment input from upstream or bank erosion is minimal to non-existent and because this is part of the low flow channel, flows are regulated by bypassing water through the Thermalito Complex.

Downstream, the reaches of the low flow channel near the OWA are characterized by coarse dredge tailings composing both the bed and banks. Riffles, point bars, mid-channel islands, and multiple channels are common, but cobbles and boulders armor most of these depositional features. 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 somewhat jumbled floodplain topography. The Thermalito afterbay outlet at RM 59 marks the point of re-introduction of bypassed flows, increasing discharge and beginning the high flow channel.

Farther downstream (reach FR-9), the river is sinuous and is characterized by multiple channels, mid-channel islands, point bars, and a gravel-cobble bed. The reach is not meandering, but localized bank erosion does occur. An important difference from upstream reaches is the transition to a floodplain comprising silt and marked by distributary overflow channels, most of which have been filled in by land leveling and farming activity. It is unknown if the channels are a result of deposition of hydraulic mining debris or a relic feature from pre-mining days.

From RM 39.5 to 46.5 (reach FR-8), the river meanders through a narrow corridor with characteristic evidence of meandering on the floodplain. This includes old meander scars, oxbow lakes, and active bank erosion. A number of actively eroding banks occur in this reach. Bank recession of more than 500 feet in the last 35 years is common. Armored gravel point bars have developed in most of the river bends. The bed is mostly gravel.

Reach FR-7 extends from RM 35.5 to 39.5. This reach has low sinuosity, and minimal point bar development. The channel is narrower than downstream, has incised into the floodplain, and has tall, vertical banks composed of slickens overlain by floodplain silt and sand. In some places, the slickens do not appear to be present. There are minor depositional features, mostly sand bars found in the channel, and the bed is gravel.

Immediately downstream (around RM 35.5), the river transitions from a gravel-bed channel to a sand-bed channel. The bed, at this point, is mostly sand but also contains pebbles and some gravel. The banks are primarily sand and silt deposited on the presently active floodplain. This section of river is unusual compared to other reaches, with very high sinuosity and active bank erosion and point bar formation. The point bars consist of mostly sand and minor gravel and are not armored. Meander cutoffs have occurred here in the past and will likely occur here in the near future. The relatively fine composition (sand to fine gravel) of the bed and bank is probably responsible for the instability of this reach.

The next 5 miles or so down to the confluence of the Yuba River are fairly straight with minimal bank instability and meandering, and low sinuosity. This reach is influenced by backwater effects from the Yuba River. The adjacent floodplain is confined by older terrace deposits and levees to a width that is typically less than 1 mile across. The river has a sand bed, with banks consisting of floodplain deposits overlying slickens. There are minimal point bars or other depositional features, and no multiple channels in this reach.

Reach FR-4 extends from RM 28, where the Yuba River joins the Feather, downstream to RM 17. Several large meanders occur near the bottom of the reach. Erosion resistant Modesto Formation is exposed in some places. Most banks consist of floodplain deposits overlying slickens. The bed consists mostly of sand. Shanghai Bench is a noteworthy feature near RM 25. The bench is an erosion resistant unit that appears to be Laguna Formation, with Modesto Formation on top. This bench-like outcrop forms a rapid, with a near-vertical drop of several feet in places. Jet boats can navigate the bend at summer flows but generally not at lower spring and fall flows.

From reach FR-4 to the confluence with the Sacramento River, the Feather River is relatively wide and straight with a sand bed and bars that can frequently shift. Typically, one side of the river has a bank consisting of floodplain silt and sand overlying slickens. The opposite bank typically consists of active point bar deposits of sand with some silt. This alteration indicates that some bank erosion and channel migration is occurring.

In the last 7 miles above the confluence, the river is within the Sutter Bypass, and the south bank is levied. Overflow from the Sacramento River through the Bypass can enter the river in this area, and during floods a backwater is formed. The bed consists of moving bars of sand, mobile during even the moderate flows of the summer irrigation season.

Bank Protection

Between the Thermalito afterbay outlet and Verona (where the Feather River meets the Sacramento River), about 10 percent of the river is riprapped. Table 9 displays several segments of the river and notes details on riprap location and percent of the segment covered in riprap.

Table 9. Selected Feather River segments and riprap lengths. (Source: DWR, 2005a)

River Segment	Left-bank Riprap	Right-bank Riprap	Both Banks Total	Percent of River Segment
Thermalito afterbay outlet to Honcut Creek	(Data available only for both banks together)	(Data available only for both banks together)	20,000 feet	13 % of this 14.7-mile segment
Honcut Creek to Sunset Pumps	(Data available only for both banks together)	(Data available only for both banks together)	10,000 feet	18% of this 5.2-mile segment
Sunset Pumps to Yuba City	250 feet of the left bank	7,250 feet of the right bank	7,500 feet	6% of this 11-mile segment
Yuba City to Verona	(Data available only for both banks together)	(Data available only for both banks together)	More than 25,000 feet; mostly left bank in lower 7 miles of river	8% of this 28-mile segment
Total				64,000 feet, or 10% of river downstream of Thermalito afterbay outlet

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.

Excavations into the Laguna Formation have, in places, revealed a Plio-Pleistocene vertebrate fauna. Based on mapped surface expressions of the Laguna Formation, one such location may occur near Thermalito afterbay, but is unconfirmed.

3.3.1.2 Environmental Effects

Under the Proposed Action, there would be some beneficial effects on the natural geomorphic processes on the Feather River below Oroville dam. These effects include increased coordination of the various ecological project work through the Ecological Committee (Proposed Article A100) and the Lower Feather River Habitat Improvement Plan (Proposed Article A101); a slight increase in the Feather River’s supply of sediment with the implementation of the Gravel Supplementation and Improvement Program (Proposed Article A102) and; increased channel complexity through the addition of LWD, boulders, and other habitat structures in the Feather River as part of the Structural Habitat Supplementation and Improvement Program (Proposed Article A104). The following subsection provides qualitative analyses of potential effects on geologic, geomorphic, and soils-related resources associated with the Proposed Action.

There are no measures in the Proposed Action related to improving geology, soil, and geomorphology resources upstream of the fish barrier dam. As such, conditions related to geology, soils, and geomorphology in this area (including Lake Oroville) would continue to be the same as under the No-action Alternative. The exception to this conclusion is the potential for short-term, localized shoreline and/or soil erosion, or increases in turbidity related to implementation of reservoir fishery habitat improvements (as part of the Lake Oroville warm water fishery habitat improvement program) and construction of trails and other recreational facility improvements (see section 3.3.6.2, *Recreational Resources*). These effects are discussed below in section 3.3.1.4, *Unavoidable Adverse Effects*.

Ecological Committee (Proposed Article A100)

Under Proposed Article A100, *Ecological Committee*, DWR would establish within 3 months of license issuance, an Ecological Committee to consult, review plans, and provide advice to DWR regarding specific license articles. Membership on the Ecological Committee would comprise Settling Parties who represent relevant federal and state regulatory agencies (such as NMFS, FWS, BLM, DFG, and DPR); local governmental entities and Native American tribes; and other interested Settling Parties (such as the State Water Contractors and American Rivers). The Water Board and the Central Valley Regional Water Quality Control Board (Regional Board) would be members of the Ecological Committee, even though they did not sign the Settlement Agreement. In addition, other persons would have the option to apply for membership on the Ecological Committee. Interior's 10(a) recommendation no. 1, NMFS's 10(j) recommendations (not numbered), and DFG's 10(j) recommendation no. 1 are consistent with this provision.

Staff Analysis

The Ecological Committee would be an appropriate entity to advise DWR on implementation of the adaptive ecological measures that may be included in the project license. The Ecological Committee would provide the important interdisciplinary resource perspective necessary to review monitoring results and foster sound management across multiple resource areas. This would include making recommendations on appropriate flow levels, as well as alterations to the project and its operations to enhance water temperature for salmonids. All such actions would increase the efficacy of applicable resource measures. As proposed, the members specified in appendix C of the Settlement Agreement appear to include appropriate representation across the spectrum of natural resources. Participation by the affected land and resource managing agencies at the local, state, and federal levels would provide important input.

Lower Feather River Habitat Improvement Plan (Proposed Article A101)

Under Proposed Article A101, *Lower Feather River Habitat Improvement Plan*, DWR would develop a comprehensive Lower Feather River Habitat Improvement Plan for the Feather River below the Oroville Facilities. The Plan would include the following programs which are defined in separate proposed articles in the Settlement Agreement: (1) a Gravel Supplementation and Improvement Program (described in section 3.3.5.2, *Threatened and Endangered Species*); (2) a Channel Improvement Program (described in section 3.3.5.2, *Threatened and Endangered Species*); (3) a Structural Habitat Supplementation and Improvement Program (described in section 3.3.3.2, *Aquatic Resources*); (4) a Fish Weir Program (described in section 3.3.5.2, *Threatened and Endangered Species*); (5) a Riparian and Floodplain Improvement Program (described in detail below); (6) a Feather River Fish Hatchery Improvement Program (described in section 3.3.3.2, *Aquatic Resources*); (7) a Comprehensive Water Quality Monitoring Program (described in section 3.3.2.2, *Water Quantity and Quality*); (8) an Oroville Wildlife Area Management Plan (described in section 3.3.4.2, *Terrestrial Resources*); and (9) Instream Flow and Temperature Improvements for Anadromous Fish (described in section 3.3.2.2, *Water Quantity and Quality*).

In addition, the Lower Feather River Habitat Improvement Plan would attempt to minimize the creation or exacerbation of predation or predatory habitat during the development, implementation, or operation of any future license program or action. DWR would annually report monitoring results and activities related to the Lower Feather River Habitat Improvement Plan, if appropriate, to the Ecological

Committee. After the fifth year of the new license, DWR would develop a single, comprehensive monitoring and adaptive management summary report, which would be prepared at 5-year intervals throughout the duration of the license. The comprehensive report would include the results of each of the various components of the Plan and would provide a summary of actions taken, management decisions, and proposed modifications to the various program components. Since many of the programs would be developed in the first 5 years of the new license, the first report on the Plan would be comprehensive to the extent the data is available at the time the report is due. Interior's (on behalf of FWS) 10(j) recommendation no. 1, NMFS's 10(j) recommendations (not numbered), and DFG's 10(j) recommendation no. 1 are consistent with this provision.

Staff Analysis

Natural resources and processes associated with the project are inextricably linked across resource disciplines such that it is not prudent to plan and implement actions to benefit one resource without considering the collateral effects on other resources. The measures in Proposed Article A101, *Lower Feather River Habitat Improvement Plan*, would ensure that implementation schedules are coordinated. The reporting component of the measure would provide an integrated means of evaluating the effectiveness of multiple programs. Providing comprehensive 5-year reports would provide a frequent and centralized opportunity for the Commission's oversight of the project.

Riparian and Floodplain Improvement Program (Proposed Article A106)

Under Proposed Article A106, *Riparian and Floodplain Improvement Program*, DWR would develop and file for Commission approval (within 6 months of license issuance) a plan for a four phase program to enhance riparian and other floodplain habitats for associated terrestrial and aquatic species. The plan would address the connection of portions of the Feather River with its floodplain within the OWA and, in anticipation of improving fish and wildlife habitats, would include a description of areas in which gravel extraction may take place. The plan would also include a definition of high flow events. The plan would be developed in consultation with the Ecological Committee, including specifically FWS, NMFS, DFG, and the Water Board (consultees). DWR would include with the filing of the plan, copies of consultation comments, including recommendations made in the course of such consultation, and explanations as to why any such comments were not adopted. Upon Commission approval, and after obtaining all necessary permits, DWR would implement the plan, including any changes required by the Commission. The Commission would reserve the right to make further changes to the Plan.

In Phase 1 (to be completed within 1 year of license issuance) DWR would, in consultation with the consultees listed above, develop and submit a screening level analysis of proposed riparian/floodplain improvement projects, including how flood/pulse flows may contribute to floodplain values and benefit fish and wildlife species, to the Commission. A recommended alternative would be identified in this phase that would include an assessment of the gravel value and potential extraction processes, in order to provide guidance on the scope, timing, and magnitude of the Program.

In Phase 2 (to be completed within 4 years of license issuance) DWR would, in consultation with the consultees listed above, begin conducting a full scope and feasibility evaluation and develop an implementation schedule of the Phase 1 recommended alternative. Within 6 years of license issuance, DWR would submit the Phase 1 recommended alternative and implementation schedule to the Commission for approval. Within 8 years of license issuance, DWR would complete the final design and commence construction and implementation of the approved alternative; within 15 years of license issuance DWR would fully implement this approved alternative.

In Phase 3 (to be completed within 15 years of license issuance) DWR would, in consultation with the consultees listed above, complete an evaluation of other potentially feasible projects and identify a Phase 3-recommended alternative. This phase would include reevaluating how flood/pulse flows may contribute to floodplain values and benefit fish and wildlife species and would include an assessment of the gravel value and potential extraction processes similar to the one completed in Phase 1.

In Phase 4 (to be completed within 25 years of license issuance), DWR would, upon Commission approval, implement the Phase 3 recommended alternatives.

DWR would annually collect data appropriate for evaluating the effectiveness of the Riparian and Floodplain Improvement Program and would determine whether the Program's objectives are met. DWR would prepare an annual summary report describing monitoring and implementation activities completed pursuant to the program and submit the report to the consultees listed above, for their review. Throughout the term of the license, DWR would compile these annual reports every 5 years in the Lower Feather River Habitat Improvement Plan Report that is submitted to FERC.

DWR, in consultation with the consultees listed above, would reevaluate the Plan every 5 years after initial implementation and provide all Plan updates to the Commission for information. If any changes are recommended beyond the objectives, activities, or schedules identified in the plan or license article, DWR would submit final recommendations to the Commission for approval. DWR would include with the filing, copies of the comments, including recommendations, made in the course of such consultation, and an explanation as to why any such comments or recommendations were not adopted. Upon Commission approval, DWR would implement the plan, including any changes required by the Commission. The Commission would reserve the right to make further changes to the plan. DWR would include any Commission-approved revisions to the plan into any updates to the Lower Feather River Habitat Improvement Plan. Interior's (on behalf of FWS) 10(j) recommendation no. 6, NMFS's 10(j) recommendations (not numbered), and DFG's 10(j) recommendation no. 5 are consistent with this proposed article.

Staff Analysis

The Oroville Facilities attenuate peak flows in the Feather River, which affects the condition of its riparian and floodplain habitats. The proposed measure would enhance these habitats for associated terrestrial and aquatic species and connect portions of the Feather River with its floodplain within the OWA. There are two key milestone dates set for completing the physical habitat improvements—within 15 years of license issuance and within 25 years of license issuance. Riparian reforestation requires several years to become established and can require a decade or more to grow enough to provide functional large wood on a large river. Consequently, the timing of implementing the habitat improvements would likely be a determining factor in the effectiveness of this measure. Considering the proposed implementation scenario, the existing riparian, LWD source material, and other floodplain habitat conditions would remain at existing levels, or continue to decline, for up to 15 years before any changes would be made, and it would be up to 25 years before the proposed measure would be fully implemented on the ground.

The proposed program would also include a screening-level analysis of how flood/pulse flows[29] may contribute to floodplain values and benefit fish and wildlife species. This information would also be used to determine if flood/pulse flows should be implemented, which improve the condition of the channel (e.g., scour, floodplain development).

[29] Because this analysis is a part of the "Riparian and Floodplain Improvement" measure, we have assumed in our analysis that the proposed screening-level analysis is seeking to explore how strategic, geomorphically-significant pulse or flood flows could be implemented to improve riparian and floodplain conditions, as well as benefit other channel attributes such as spawning gravel and holding and rearing habitat.

Gravel Supplementation and Improvement Program (Proposed Article A102)

Under Proposed Article A102, *Gravel Supplementation and Improvement Program*, DWR would, within the first 5 years of license issuance, supplement the Feather River with at least 8,300 cubic yards of gravel that would be distributed at up to 15 locations in the low flow or high flow channels. This measure is described in detail in section 3.3.5.2, *Threatened and Endangered Species*.

Staff Analysis

DWR estimates that since 1982 over 10,000 cubic yards of gravel have been placed in the river at some sites. This volume of gravel, which is greater than the volume DWR proposes to add over the first 5 years of the license, is just 0.04 percent[30] of the estimated total sediment deficit of the river for the 22-year period of augmentation. Because spawning size gravel is only a part of the total sediment deficit, the spawning gravel added is a higher percentage of the sediment deficit of particles this size. Despite the additions since 1982, adverse effects on natural geomorphic processes and spawning substrate are documented in DWR's studies of existing conditions.

Although the rate of gravel replenishment under the Proposed Action would be greater than what has occurred, (placing a minimum of 8,300 cubic yards over 5 years versus placing more than 10,000 cubic yards over more than 20 years); it is still a small percentage of the estimated average sediment deficit for the 5-year period. Gravel would be distributed over 15 sites in the high or low flow channels, netting an average of about 550 cubic yards per site. Proposed Article A102, *Gravel Supplementation and Improvement Program*, includes specific criteria for gravel placement in section (e)(2) which states that "Gravel placement or riffle rehabilitation at the treated riffles…[would] cover the extent of naturally observed spawning areas…[and] extend at least 50 feet upstream and 50 feet downstream of the riffle, and be a depth of at least one foot."

The objective of the proposed article would be to achieve approximately 80 percent of the spawning gravels randomly sampled in riffle complexes in the median size range preferred by Chinook salmon or steelhead. DWR would randomly monitor 10 of the 15 sites on a rotating basis where augmentation or enhancement would be performed during each 5 year period., We conclude that monitoring over the license term is important to ensure objectives are met.

Channel Improvement (Proposed Article A103) and Structural Habitat Supplementation (Proposed Article A104) Programs

Under Proposed Article A103, *Channel Improvement Program*, DWR would make improvements to two existing side channels and construct five additional side channel riffle/glide complexes of not less than a cumulative total of 2,460 feet in length of new habitat. This work would be conducted to maximize quantity/quality of channel habitat with desirable salmonid attributes (appropriate depth, velocity, substrate, cover, and vegetation) while minimizing the potential for water warming, fish stranding, and predation problems.

Proposed Article A104, *Structural Habitat Supplementation and Improvement Program*, would improve salmonid rearing habitat by creating additional cover, edge, and channel complexity through the addition of structural habitat, including LWD, boulders, and other (undefined) objects. LWD for this Program would be defined as multi-branched trees at least 12 inches in diameter at chest height, and a minimum of 10 feet in length (with a preference for approximately 20 feet or longer), with approximately 50 percent of the structures containing intact rootwads. The proposal would place a minimum of 2 pieces of LWD, boulders, or other appropriate material per riffle in the low flow and high flow channels from RM 54.2 to RM 67.2, with additional habitat features placed where appropriate.

[30] We converted cubic yards to tons using the conversion factor of 1.2 tons/cubic yards.

Proposed Articles A103 and A104 are described in detail in sections 3.3.5.2, *Threatened and Endangered Species*, and 3.3.3.2, *Aquatic Resources,* respectively.

Staff Analysis

The Oroville Facilities attenuate peak flows and impede sediment and LWD delivery to the Feather River, which affects the condition of its channel habitats. Proposed Articles A103, *Channel Improvement Program*, and A104, *Structural Habitat Supplementation and Improvement Program*, would help to improve channel complexity in the low flow channel by increasing the quantity of LWD and the extent of side channels and shallow-edge habitats within existing riffles and glides. However, these measures would do little to alleviate the larger meso-scale alterations to channel processes such as decreases in channel forming flows and decreased channel migration, which in large part form and maintain the physical habitat conditions required by salmonids and other aquatic organisms.

Further, recent telemetry tracking of tagged LWD performed on the Sacramento River (Chico Landing Subreach) over the course of approximately 1 year (Henderson, 2003) indicates that while nearly all tagged pieces of LWD stayed within the river channel (rather than getting deposited on the floodplain), downed trees traveled an average of 6 miles downstream. Although the annual rate of LWD movement may be less in the small Feather River than in the Sacramento River study, this suggests that unless individual trees are cabled in place[31] or installed in larger groups (such as part of an engineered log jam designed to stay in place at higher flows), single pieces of LWD could move out of the low flow channel (and potentially the high flow channel), relatively quickly. Maintaining and monitoring channel improvements and structural habitat elements at a minimum of 5 years would provide the basis to make any necessary adjustments to the actions undertaken as part of this program.

Fish Weir Program (Proposed Article A105)

Under Proposed Article A105, *Fish Weir Program*, DWR would install one or potentially two fish weirs near the Thermalito afterbay. This measure is described in detail in section 3.3.5.2, *Threatened and Endangered Species*.

Staff Analysis

While the purpose of the proposed fish weirs is related to management of salmonid fishery stocks, the construction of these weirs could alter channel processes, although their design could likely be such that they pass sediment and LWD. Once infrastructure such as weirs and an egg-taking station are placed on or along the river, measures to ensure that the channel stays flowing through that location may need to be taken. Measures to control channel location traditionally include rock rip rap, groins, or vanes and/or active manipulation of the channel bed and/or banks. Such methods could conflict with other measures to protect and enhance natural channel processes, expand floodplain and side channel habitat, and enhance spawning riffles. Coordination with Recreation Advisory Committee and Ecological Committee would avoid potential conflicts.

Other Recommendations

The Anglers Committee et al. recommend that DWR conduct studies to determine the amount of silt deposited and the amount of silt that will be deposited for the life for the project in the North Fork arm

[31] Safety concerns relative to channel improvements and recreation have been raised by Butte County (April 26, 2006, letter) and we note that on other rivers in the western United States the cabling of logs for habitat improvement has proved controversial because once the logs and cables move, the cable is a serious danger to boaters and swimmers, while logs from un-cabled projects merely present the same hazard as naturally occurring LWD.

downstream of Big Bend dam. The study would disclose and evaluate the effects of the displacement of water; loss of power production; adverse effects to fish and aquatic life and their habitat; effects to navigation; and fish diseases related to sediment. The study would be submitted for public review and comment. A similar study would be conducted on the West Branch arm above the Lime Saddle Marina. In the event the Commission concludes that the silt must be removed, it would require DWR to remove the silt from all areas of the reservoir as determined by the Commission and other water quality enforcement agencies.

Staff Analysis

DWR investigated the textural composition of sediment deposited in the North Fork arm below Big Bend Dam, provided bathymetric mapping and estimates of total sediment deposition, and gave an estimate of when the reservoir would be full[32] by extrapolating the estimated rate of sediment deposition to date. At the time of survey, DWR estimated that the total volume of sediment in storage is about 28,300 acre-feet. Of this amount, about 11,400 acre-feet are estimated to be derived from shoreline bank erosion; the remaining 16,900 acre-feet is ostensibly sediment from the upstream watersheds. Based on a 36-year period since the initial filling of Lake Oroville, annual sediment yield is about 470 acre-feet. In the context of a reservoir with about 3.5 million acre-feet of storage, the effects of the annual average displacement of 470 acre-feet of water relative to loss of power production are considered minimal.

We evaluate the effects of this recommendation to fish and aquatic life and their habitat in section 3.3.3.2, *Aquatic Resources*.

Reservoir Sedimentation Can Influence Navigation

Based on information on the record, we conclude that sediment deposition in the reservoir arms have a minimal effect on navigation. As reservoir elevations decrease, the former riverbed re-emerges. While the character of that riverbed is oftentimes heavily altered by the sediment deposited on it during times of inundation, there is no feasible way to alleviate this phenomenon. Further, as the river migrates through the deposited sediment, it carves a new channel, sorting sediment and establishing an equilibrium channel for the sediment load and discharge available at that time. As the reservoir recedes, the reservoir surface area for power boating decreases while whitewater boating opportunities increase as the length of flowing river grows (see section 3.3.6.2, *Recreational Resources*).

3.3.1.3 Cumulative Effects

This section summarizes the potential cumulative effects on geology, soils, geomorphology, and paleontological resources under the No-action Alternative, Proposed Action, and Staff Alternative conditions. Because we have identified no potential effects for paleontological resources there are similarly no cumulative effects for this resource.

As described in section 3.2, *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 project. 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.

[32] DWR estimates that the entire reservoir to be filled with sediment in 7,400 years.

Cumulative Effects of 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 use that has 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 addition, 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. Starting in the early 1900s, a number of hydroelectric and reservoir projects were constructed upstream of Oroville, which regulated streamflow and interrupted sediment transport through the watershed. Furthermore, as the risk of floodflows decreased downstream, more lands within the floodplain were converted to agricultural and urban uses (and protected with riprap and levees), which along with flow regulation, have further reduced the connection of the river with its floodplain. The construction of Oroville dam in the 1960s further altered streamflow patterns and reduced floodflows, erosion and channel migration rates, and sediment transport downstream.

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 largely responsible for the reduction in sediment transport, gravel recruitment, and LWD transport though the Feather River watershed.

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

1. A reduction in the supply of sediment and LWD in the Feather River downstream of the Oroville Facilities.
2. A reduction in gravel recruitment, sediment transport, and LWD transport/recruitment in the river downstream of the Oroville Facilities, as related to the altered flow regime.
3. A loss of channel meandering, a reduction in sinuosity, incision, and an overall loss in channel complexity, as related to the altered processes discussed in 1 and 2, above, and in conjunction with levees and bank protection.
4. Disconnection of the river channel from its ancestral floodplain through the development of non-project flood control levees, alteration in flow regime, and channel incision and expansion.
5. Dispersed and large-scale erosion and increased sediment supply from mining, timber harvest, agriculture, and other activities related to human infrastructure.

Cumulative Effects of the No-action Alternative and Future Related Actions

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 and 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 would continue to cause a sediment deficit in the river. These facilities would also continue to reduce sediment transport, channel migration, and the recruitment of gravel and LWD on portions of the Feather River. The continued deprivation of sediment load in the Feather River from related actions would also result in a reduction in the formation of sediment benches and point bars, which in turn would affect the ability of the channel to capture and retain quantities of LWD. These geomorphic effects would result in incremental reductions to channel complexity downstream of the Oroville Facilities. The most significant reductions in downstream channel complexity (as related to reductions in salmonid holding, spawning, and rearing habitat) are the continued coarsening of the Feather River salmonid spawning beds, homogenization of the channel (decrease in pool depth, and reduction in channel migration and alteration of pool riffle sequences), and reduction of LWD loading. The Oroville Facilities would continue to attenuate peak flows, providing a level of flood protection benefits downstream.

Cumulative Effects of the Proposed Action and Future Related Actions

Under the Proposed Action, the Gravel Supplementation and Improvement Program (Proposed Article A102), the Channel Improvement Program (Proposed Article A103), the Structural Habitat Supplementation and Improvement Program (Proposed Article A104), and the Riparian and Floodplain Improvement Program (Proposed Article A106) would provide some improvement in the level of channel complexity downstream of the fish barrier dam. Side-channel habitat improvements would provide about 2,500 feet of additional spawning and rearing habitat available to salmonids and some large wood and/or other habitat features (between 50 and 500 elements) would be placed in the river. A total of 8,300 cubic yards of gravel would be placed in the river to improve spawning habitat and offset the sediment deficit. The increase in minimum flow in the low flow channel would not affect geology, soil, and geomorphologic resources because the increase is still far below the threshold required to perform any geomorphic change, as related to channel migration, scour and sorting of spawning gravels, or recruitment of LWD. There would continue to be an estimated 97 percent reduction in sediment supply from the watershed above Lake Oroville, and a reduction in channel migration, gravel, and LWD recruitment. The Oroville Facilities would continue to attenuate peak flows, providing a level of flood protection benefits downstream.

Cumulative Effects of the Staff Alternative and Future Related Actions

Under the Staff Alternative, cumulative effects would be similar to those of the Proposed Action with the exception that the Staff Alternative would result in a smaller adverse effect on sediment supply in the river downstream of the fish barrier dam because of the five additional sites in the Gravel Supplementation and Improvement Program. The increase in minimum flow in the low flow channel would not affect geology, soil, and geomorphologic resources for the same reasons as mentioned above for the Proposed Action. There would continue to be an estimated 97 percent reduction in sediment supply from the watershed above Lake Oroville, and a reduction in channel migration, gravel, and LWD recruitment. The Oroville Facilities would continue to attenuate peak flows, providing a level of flood protection benefits downstream.

3.3.1.4 Unavoidable Adverse Effects

The continued operation of the Oroville Facilities and the functional interactions of the facilities and operations would result in unavoidable adverse effects on geologic, soil, and geomorphic resources. While some of these effects would be reduced to some degree by proposed resource enhancement measures (specifically, the supplementation of gravel, LWD, and construction of structural habitat elements), many effects such as the sediment deficit and reduced number and magnitude of geomorphically significant bankfull flows would likely continue as unavoidable adverse effects.

Some specific elements of the proposed measures could have short-term, localized unavoidable adverse effects on geology, soils, and geomorphologic resources. The Lake Oroville warm water fishery habitat improvement program would improve the habitat of the warm water fishery in Lake Oroville primarily by construction, operation, and maintenance of projects to improve warm water fishery habitat within the reservoir or fluctuation zone. While not specified, these activities would involve some sort of physical modification or addition of structure to the reservoir shoreline. As such, the construction, operation, and/or maintenance of these projects could result in localized, short-term increases in erosion.

While no detailed plans are available yet, proposed recreation enhancement measures could have similar short term effects, with the addition of hillslope erosion from recreational facility construction and improvement projects.

The proposed measure to protect vernal pools (Proposed Article A117; described in section 3.3.4.2, *Terrestrial Resources*) would include the implementation of conservation measures required by the FWS final biological opinion to protect the vernal pool invertebrate habitat within the project boundaries. While those conservation measures are not yet defined, they would likely include physical improvements to drainage infrastructure to decrease sedimentation and improve pool hydrology. These measures also could have localized, short-term increases in erosion.

The proposed measure to construct and recharge waterfowl brood ponds (Proposed Article A122; described in section 3.3.4.2, *Terrestrial Resources*) would include construction of one brood pond every 5 years over a 20-year period beginning upon issuance of this license. The ponds would be constructed by creating a small earthen berm across an inlet in the Thermalito afterbay. While the exact locations and designs of these ponds are yet to be defined, the measure would include creation of a berm by filling a portion of the Thermalito afterbay. This construction work could result in localized, short-term increases in erosion and turbidity.

The proposed Channel Improvement Program and the Structural Habitat Supplementation and Improvement Program, discussed above, would include in-channel construction consisting of the creation of habitat features and physical manipulation of the channel bed and banks. While the exact locations and designs of these actions are yet to be defined, this construction work also could result in localized, short-term increases in erosion and turbidity.

3.3.2 Water Quantity and Quality

3.3.2.1 Affected Environment

Water Quantity

The Oroville Facilities use water of the Feather River Basin to generate electricity and supply water. The river basin drains a large portion of the eastern Sierra-Cascade geomorphic area in California, and its headwaters are located on the southeastern slope of Mount Lassen and along the Sierra Nevada crest. The drainage area is 3,624 square miles at the Feather River at Oroville (USGS Gage No. 11047000)[33], located 0.4 mile downstream of the Thermalito diversion dam. The weather station most representative of the project site is the Oroville station (table 10). Comparing the data from this station with that of a higher elevation station, such as Meadow Valley (table 11) located at elevation 3,410 feet msl, it is notable that the Oroville station provides data for a relatively short 7-year period while Meadow Valley is based on a 51-year period. Accordingly, the statistics from the two stations are not directly comparable.

The Feather River Basin has mild, dry summers and heavy winter precipitation. Mean annual precipitation in the basin ranges from 11 inches in the driest areas to 90 inches in the northwestern portion of the basin near Mount Lassen. Monthly average precipitation varies considerably over the basin. For example, at Oroville, the average precipitation ranges from none in July and August to 4.1 inches in February (table 10). Much of the precipitation in the headwaters of the basin comes in the form of snow during November through March. Much of the snowpack melts by April at mid-range elevations (3,000–5,000 feet).

---

[33] The drainage area as measured at the USGS gage is slightly higher than the drainage area listed in table 7 because the gage is located downstream of the Lake Oroville dam.

Table 10. Meteorological summary for Oroville, California (elevation 199 feet msl). (Source: Canty and Associates LLC, 2005)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average air temperature (ºF)												
43	50	52	58	64	74	79	77	72	65	52	46	61
Average precipitation (inches)												
3.8	4.1	3.6	2.0	0.9	0.1	--	--	0.5	2.7	3.5	1.8	22.9
Average snowfall (inches)												
0.1	--	--	--	--	--	--	--	--	--	--	--	0.1

Note: -- - no value reported

Table 11. Meteorological summary for Meadow Valley, California (elevation 3,410 feet msl). (Source: Canty and Associates LLC, 2005)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Air Temperature (ºF)												
34	39	43	47	55	62	67	65	60	52	42	35	50
Average Precipitation (inches)												
7.5	6.0	5.3	2.6	1.6	0.8	0.2	0.3	0.8	2.7	5.0	7.0	39.8
Average Snowfall (inches)												
13.7	7.8	7.0	2.9	0.4	--	--	--	--	--	1.3	7.3	40.5

Note: -- - no value reported

Part of the Feather River Basin receives additional runoff generated by cloud seeding. Precipitation is increased in the basin above Lake Almanor by 5 percent annually as a result of Pacific Gas and Electric Company's (PG&E) Lake Almanor Cloud Seeding Project.[34]

Annual runoff patterns in the watershed above Lake Oroville are characteristic of snowmelt-dominated hydrology of Sierra Nevada mountain streams that experience peak runoff during the late winter and spring and low flows during the summer. Average annual flow downstream of Lake Oroville, including both flow in the river and flow diverted to the fish hatchery, is summarized in table 12.

[34] The North Fork Basin has been subject to the Lake Almanor Cloud Seeding Project since the winter of 1952–53. Pacific Gas and Electric Company (PG&E) implemented the project to increase snowfall during November through May in the North Fork Basin above Lake Almanor. PG&E's Lake Almanor Cloud Seeding Project includes a network of nine, ground-based cloud seeding burners located near the south and west boundaries of the target area. The Lake Almanor Cloud Seeding Project's goal is to increase snowfall during naturally occurring precipitation periods. Lake Almanor Cloud Seeding Project includes guidelines for temporary suspension or curtailment of operations under certain conditions to avoid runoff or reservoir storage beyond manageable limits.

Table 12. Summary of daily average flow discharge (cfs) data, by month and overall, for the Feather River at Oroville, CA (USGS Gage No. 11407000), water year 1971 to 2004. (Source: USGS, 2005, as modified by staff)

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Overall
Mean	579	755	1,164	2,073	2,155	2,005	959	771	535	538	530	522	1,044
Maximum	1,870	27,500	62,500	126,000	132,000	70,100	38,000	44,100	2,540	1,030	1,750	708	132,000
5% exceedance	917	1,600	1,610	3,582	10,100	8,111	648	642	661	735	718	653	932
10% exceedance	770	933	923	940	991	679	641	634	639	704	655	641	655
25% exceedance	631	635	631	634	636	635	631	625	626	627	627	628	630
50% exceedance (median)	608	615	615	614	612	617	613	525	588	609	567	591	611
75% exceedance	410	409	411	410	411	412	411	411	411	412	409	409	411
90% exceedance	403	401	400	402	402	405	404	404	406	405	403	403	403
Minimum[a]	387	382	383	380	369	378	334	372	386	360	347	222	222

[a] Since 2000, flows have not dropped below 605 cfs. Between 1993 and 1999, the minimum flow was 569 cfs.

Description of Water Resources in the Project Area

Lake Oroville is created by Oroville dam and two small saddle dams. The lake has a 3.5-million acre-feet capacity storage reservoir with a surface area of 15,810 acres at its normal maximum operating level at 900 feet msl. The Feather River extends from the fish barrier dam (RM 67) to the confluence with the Sacramento River (RM 0). Within this 67-mile reach of the Feather River, the low flow channel extends from the fish barrier dam to the Thermalito afterbay outlet (RM 59), and the high flow channel extends from the Thermalito afterbay outlet to the confluence with Honcut Creek (RM 44) (see figure 8). The reaches of the 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 8).

DWR (2005g) describes the process used to define five water year types for the Sacramento Valley, as part of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary regulatory activities.[35] DWR classifies water years as critical, dry, below normal, above normal, and wet. Critical water years are sometimes referred to as critically dry water years. DWR provided 4 representative years for different water conditions in its license application. Water year 1977 was characterized as the driest year on record. Water year 2001 was characterized as dry. Water year 1999 was characterized as average and water year 1995 as wet.

Lake Oroville

The inflow to Lake Oroville is reduced from unimpaired conditions from November to June, primarily due to upstream non-project diversions and storage operations. Typically, the inflow to Lake Oroville tends to be slightly greater than unimpaired conditions from August to October because of releases from storage during those months from upstream projects. The unimpaired inflow to Lake Oroville is estimated to be about 5,800 cfs.[36] By comparison, the average flow in the Feather River downstream of the Thermalito diversion pool (low flow channel) is 1,044 cfs for the water years from 1971 to 2004. This average flow includes the 30 to 130 cfs required to support the Feather River Fish Hatchery. A 30-inch water supply pipeline provides flow to the fish hatchery. Additional release from the Thermalito afterbay averaged 3,702 cfs for the same water years. The difference is about 1,200 cfs, which corresponds to water removed from the Feather River for consumptive use as described below under *Water Use*. Because of changes in diversion amounts and changes to instream flow releases, DWR developed a computer model to establish a more consistent baseline and to estimate the environmental effects of the alternatives on water quantity.

Thermalito Afterbay

In above normal and wet water years, the maximum flow in the high flow channel ranges from 9,500 cfs in a 25 percent exceedance year to a maximum of greater than 18,000 cfs (table 13). The maximum flow 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 normal, below normal, dry, and critical water years, the maximum flow in the Feather River downstream of the Thermalito afterbay outlet typically occurs during July and ranges from 1,600 cfs in a 90 percent exceedance year (drier) to about 4,000 cfs in a normal water year. In these water years, high inflow is typically stored in the winter and spring with little or no release made for flood management.

---

35 Year types are set by first of month forecasts beginning in February. The final determination is based on the 50 percent exceedance forecast as of May 1.

36 The period of record was not explicitly stated; however, based on Study Plan SP-G2, Task 1.2, this appears to be the annual yield from 1902 to 1967, a relatively long period of record (DWR, 2004a).

Table 13. Summary of daily average flow discharge (cfs) data, by month and overall, for the Thermalito afterbay release to Feather River, CA (USGS Gage No. 11406920), water years 1971 to 2004. (Source: USGS, 2005)

Station	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**March**	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Overall**
Mean	1,942	2,268	3,977	4,020	5,066	5,499	4,251	3,299	3,329	4,370	3,636	2,814	3,702
Maximum	7,160	17,200	17,100	18,100	18,300	17,900	18,100	17,500	13,600	10,300	10,300	9,360	18,300
5% exceedance	4,620	8,661	14,500	16,100	16,800	17,100	15,405	10,335	8,540	7,950	7,030	7,030	13,500
10% exceedance	2,840	3,503	10,370	13,200	14,800	15,700	13,000	8,411	7,421	7,251	6,080	5,650	8,640
25% exceedance	2,470	1,980	5,113	5,550	8,440	9,535	5,930	4,350	4,153	6,080	4,910	3,808	4,830
50% exceedance (median)	1,780	1,670	2,220	1,405	1,900	2,570	2,135	1,890	2,530	3,990	3,590	2,380	2,220
75% exceedance	1,270	823	1,130	799	1,010	1,110	775	922	1,488	2,620	2,123	1,540	1,240
90% exceedance	642	431	614	525	509	436	436	580	862	1,610	1,259	698	586
Minimum	35	98	386	70	346	195	193	254	77	17	375	330	17

Releases from storage to meet downstream State Water Project contractor demands typically peak in July, and the minimum flow for the year typically occurs during October and can be as low as the 600 cfs release at the Thermalito diversion dam. Historically, lower flows have occurred, but not for the last several years. About 67 miles downstream of the fish barrier dam, the Feather River flows into the Sacramento River near the town of Verona. Flow in the Feather River at Verona is typically greater than the flow downstream of the Thermalito afterbay as flow increases from tributary accretions along the length of the river.

Flow Regime

The current flow regime in the Feather River downstream of Oroville dam is different than pre-dam conditions, particularly in the low flow channel reach. Figure 10 shows the flow exceedance for the Feather River at Oroville gage[37] and indicates a reduction in all flows from pre- to post-dam. The flow exceeded 99 percent of the time decreased from 950 to 300 cfs from pre- to post-dam; the 90 percent exceedance flow decreased from 1,400 to about 300 cfs; and the 50 percent exceedance flow decreased from 3,000 to 350 cfs.

Flows at the level of the bankfull discharge (typically defined as the 2-year flow event) are responsible for the majority of the sediment transport and are considered most responsible for channel form. A natural flow regime typically includes flow ranges responsible for in-channel clearing and overbank flows to support riparian vegetation, along with channel-forming flows. A bankfull discharge fills the channel but does not inundate the floodplain. Bankfull discharges meet the following two criteria for shaping channel cross sections. First, the flows are strong enough to erode banks and transport and deposit sediment. Second, the flows occur often enough to overcome the effects of larger flows; hence, it is the more-frequent bankfull flows that have the largest effect on channel form, rather than the less-frequent higher-magnitude flows.

The pre-dam bankfull discharge (2-year flow event) for the Feather River at Oroville gage was about 65,000 cfs. The post-dam 2-year recurrence interval event for the low flow reach is about 2,000 cfs, a much smaller event that is not capable of transporting significant quantities of bedload or eroding river banks. The 65,000-cfs flow now occurs at a lower frequency level of about every 10 years. The high flow reach now has a bankfull discharge of 26,000 cfs, also significantly smaller than the pre-project event of 65,000 cfs.

Flood frequency calculations show that the pre- and post-project flood frequency curves have changed. Figure 11 shows the 2-year recurrence interval flood (bankfull discharge) decreased an order of magnitude, from 65,000 to 3,000. The 10-year recurrence event decreased from 160,000 to 75,000. The 50-year event decreased from 240,000 to 180,000 cfs.

Groundwater

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, so reservoir water and local groundwater do interact. The 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

[37] The Feather River at Oroville Gage (Gage No. 11407000) is located on the right bank of the Feather River 0.4 mile downstream of the Thermalito diversion dam, about 300 feet upstream from fish barrier dam.

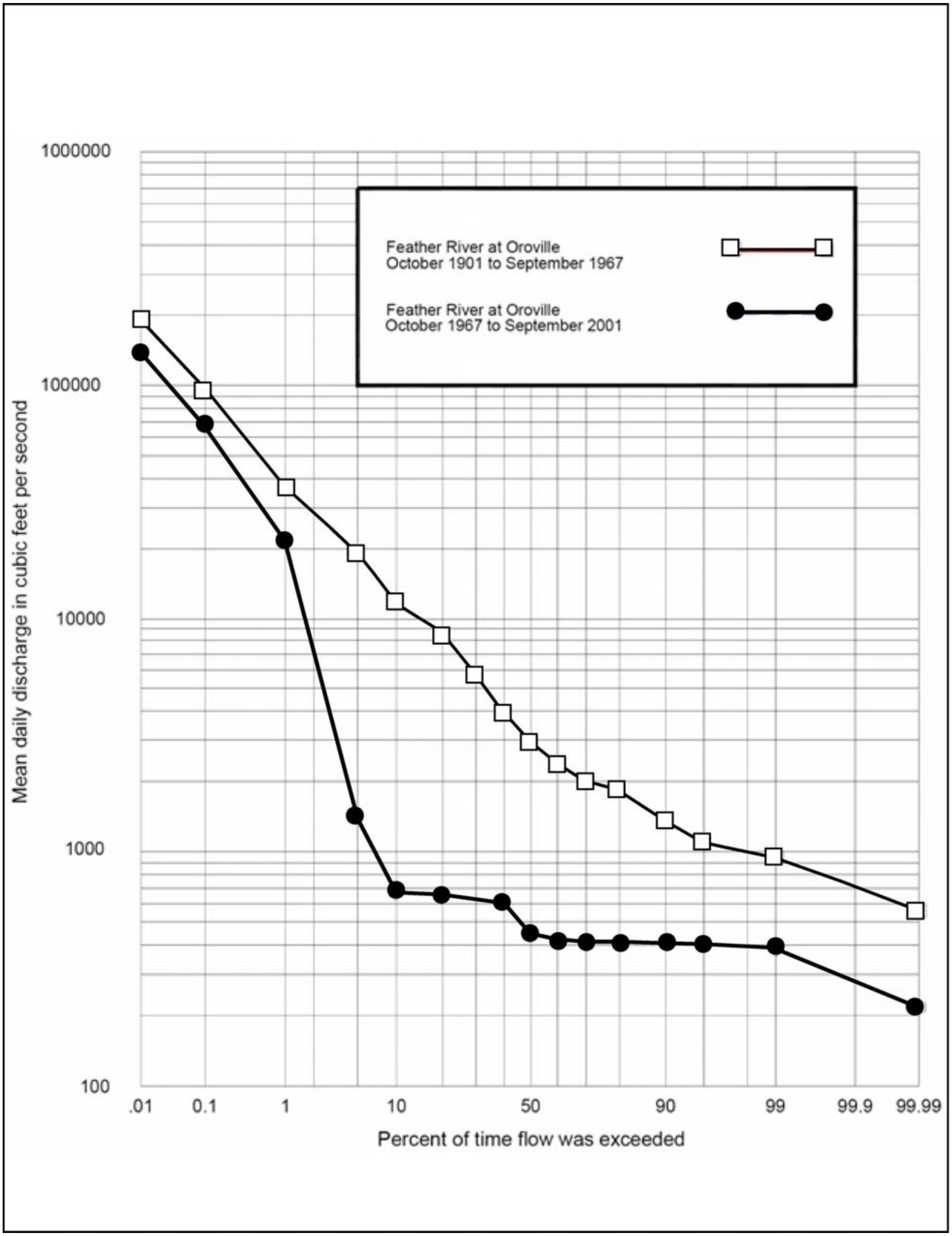


Figure 10. Flow exceedance graph for Feather River at Oroville gage. (Source: DWR, 2004l)

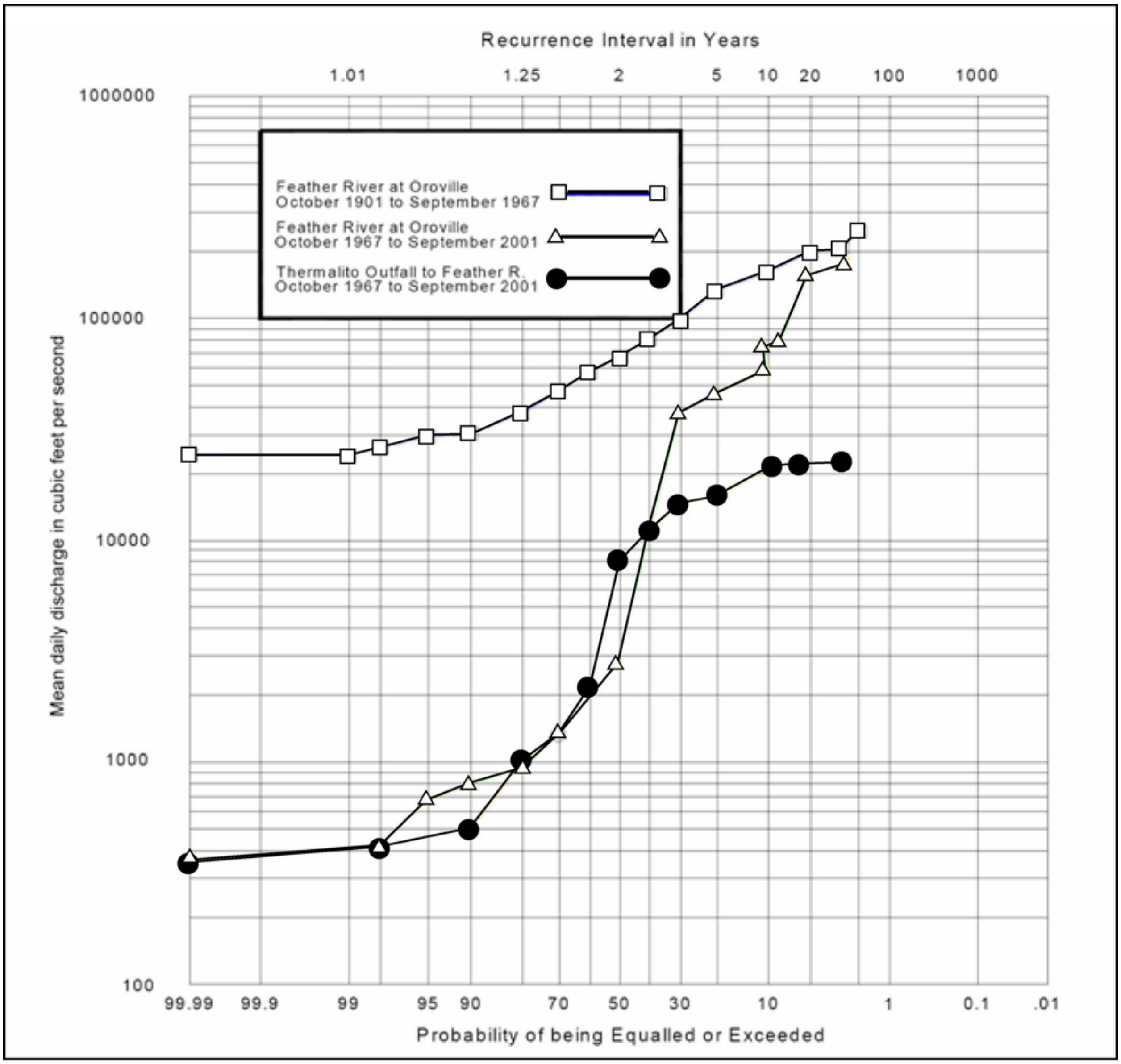


Figure 11. Flood frequency graph for Feather River at Oroville gage. (Source: DWR, 2004l).

there are at least two aquifers in the area (a confined zone and an unconfined zone), and there may be localized areas of semi-confined 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 DWR (2004b) indicates that the Oroville Facilities may have increased groundwater levels through recharge in the vicinity of Thermalito forebay.

Water Use and Flood Control

The water supply component relates to the State Water Project, a complex system for water storage and delivery that includes reservoirs, aqueducts, pumping plants and power plants. The project is more than 600 miles long and covers two-thirds of the length of California (DWR, 1997a). Three reservoirs, Lake Davis (84,400 acre-feet),[38] Antelope Lake (22,600 acre-feet), and Frenchman Lake (55,500 acre-feet), are located on Feather River tributaries upstream of the Oroville Facilities. These reservoirs provide water to the city of Portola and other local agencies that have water rights agreements with DWR (DWR, 2004c).

Feather River Service Area Water Supply Entitlements

DWR has described its contractual obligations to nine local agencies in the Feather River service area that are collectively referred to as the Feather River service area water users. They receive water according to the terms of settlement in various agreements stemming from the original construction of the project. These settlements recognize the senior water rights of those agencies and determined that DWR would provide them certain quantities of water from storage in Lake Oroville in accordance with those senior water rights. The amount of water that DWR is committed to provide these agencies is about 994,000 acre-feet per year (1,372 cfs) subject to provisions for reduction in supply under certain specific low-inflow conditions.[39] The actual amount delivered varies from year to year and ranges from 611,000 to 1,057,000 acre-feet. Water needed to meet these Feather River service area entitlements is delivered at two locations in Lake Oroville, two locations in the Thermalito power canal, four locations in Thermalito afterbay, and four locations on the high-flow channel. Most diversions for the Feather River service area occur during the April through October irrigation season. Up to 150,000 acre-feet of water are diverted from the Thermalito Complex during the peak demand months of May through August. The highest total monthly agricultural diversions from both the Feather River and the Thermalito afterbay, 190,000 acre-feet, occurred in July 2002.

DWR also has executed a number of small contracts with riparian landowners along the Feather River downstream of Oroville dam. Riparian owners are entitled to divert unimpaired flow for use on riparian land, but they are not entitled to augmented flow made available as a result of project storage. Although the quantities of water are relatively small and do not ordinarily influence State Water Project operations, diversion for riparian lands can affect Oroville releases during certain years.

Water Supply Requirements of the State Water Contractors

As a component of the State Water Project, DWR describes the Oroville Facilities as being operated to provide downstream water supply for municipal, industrial, and irrigation purposes, and water is exported to meet the requests of the water contractors. To illustrate how water releases from the Oroville Facilities are distributed for multiple downstream uses, table 14 shows DWR records from 2001 and 2002, indicating actual releases for various uses. As a practical matter, water supply exports are met with whatever water is available after Delta requirements are met. In other words, some of the water released for instream and Delta requirements may be available for export by the State Water Project once the Delta standards have been met. Table 14 shows the downstream use of water from the Oroville Facilities. The United States and DWR signed the Coordinated Operations Agreement in 1986 that specifies how the U.S. Bureau of Reclamation will operate the Central Valley Project and how DWR will operate the State Water Project in such a way as to meet Delta requirements, Sacramento Valley needs,

---

[38] Gross reservoir capacity.

[39] This value is higher than calculated using historical USGS records because it reflects the current level of demand. DWR estimates the range as 613,000 acre-feet per year to 1,057,000 acre-feet per year under current conditions.

and their own water supply requirements. DWR estimates that water supplied to the State Water Project ranges from 788,000 acre-feet to about 4.2 million acre-feet per year with an average of about 3.2 million acre-feet per year, including releases from Lake Oroville as well as other water available to the State Water Project to divert from the Delta.

Table 14. Downstream use of water from the Oroville Facilities (2001 and 2002). (Source: DWR, 2005b)

	2001		2002	
Downstream Use	**Amount Used (taf)**	**Percentage of Release**	**Amount Used (taf)**	**Percentage of Release**
Feather River service area	1,024	46	25	34
Support of exports	93	4	773	28
Instream and Delta requirements	1,099	50	1,043	38
Flood management	0	0	0	0
Total	2,216	100	2,741	100

Note: taf – thousand acre-feet

Flood Control

DWR has described the Oroville Facilities as an integral component of the Sacramento River Flood Control Project, the flood management system for areas along the Feather and Sacramento Rivers downstream of Oroville dam. From September to June, the Oroville Facilities are operated under flood control requirements specified by the Corps. Table 15 summarizes flood control operations throughout the year. Historically, the maximum flood flows released from Lake Oroville were about 160,000 cfs, which occurred in 1997. Volumes, inflows, and outflows associated with other large flood events are summarized in table 16.

Table 15. Flood control requirements for Lake Oroville. (Source: NMFS, 2004; DWR, 2006)

Period	**Flood Control Requirement Based on Date**	**Flood Control Requirement Based on Wetness Index**[a]	**Comment**
June 15–September 15	No	No	No flood control requirements
September 16–October 14	Yes	Yes	
October 15–April 1	Other	Other	Full flood control reservation space is required
April 2–June 15[b]	Yes	Yes	

[a] The Wetness Index is an index computed by multiplying the previous day's index by 0.97 and adding any new precipitation, thus it is based on accumulated precipitation. A value of 11.0 or greater corresponds to wet conditions and correspond to the provision of the full 750 thousand acre-feet of flood control space, while a value of 3.5 or less corresponds to dry conditions and to the minimum flood control space requirement of 375 thousand acre-feet (DWR, 2004d).

[b] The flood control season can end as early as May 8, or as late as June 15, because of a 10,000 acre-feet/day filling rate.

Table 16. Major spill events for Lake Oroville. (Source DWR, 2005b, exhibit H, page H-33)

Spill Began	Spill Ended	Peak Release (cfs)	Total Release (acre-feet)	Peak Inflow (cfs)
January 3, 1970	February 2, 1970	77,000	1,563,000	147,000
January 12, 1980	January 20, 1980	85,000	726,000	155,000
February 15, 1986	March 1, 1986	150,000	1,420,000	266,000
March 9, 1995	March 27, 1995	87,000	1,235,000	141,000
December 27, 1996	January 17, 1997	160,000	2,013,000	302,000

Several issues were raised during scoping, including improved operations (including flood control operations) through use of real-time watershed hydrologic projections, and the effect of flood releases on Lake Oroville dam and downstream facilities, including downstream levee stability and potential for ameliorating downstream flooding through coordinated releases with other water storage facilities (DWR, 2002a). Because the Corps is primarily responsible for flood control operations, these issues are outside of the FERC relicensing process.[40]

Water Rights

DWR has water rights to store, divert, and use water from the Feather River and its tributaries for the production of power, water supply, recreation, and fish and wildlife protection and mitigation (table 17). In addition, DWR entered into an agreement with the water districts that now compose the Joint Water District Board in May 1969 to preserve their prior water rights and discuss the diversion season and the allowable diversions (DWR, 1969), and entered into a similar agreement with Western Canal Water District and PG&E (DWR, 1986).

Water Quality

This section addresses water quality parameters that are important in determining compliance with applicable water quality standards to protect the designated beneficial uses in the Regional Board's Water Quality Control Plan (Basin Plan). The Feather River, downstream of Oroville dam to its confluence with the Sacramento River, is identified on the current U.S. Environmental Protection Agency (EPA)-approved (2006) Regional Board Section 303(d) list of waters as being impaired by mercury, certain pesticides, and toxicity of unknown origin (Regional Board 303(d) list). A TMDL for the pesticide Diazinon was established for this reach in 2004. The North Fork Feather River, between lakes Almanor and Oroville, is currently listed as impaired under Section 303(d) of the Clean Water Act due to temperature and mercury.

[40] The Costa-Machado Water Act of 2000 funded studies, design, construction, and mitigation for the Yuba-Feather Supplemental Flood Control Project, and progress has been made in several areas regarding flood control (Yuba County Water Agency, 2005). The Yuba County Water Agency received grant funding under this act to conduct a feasibility study of alternative means of providing supplemental flood control, including forecast-based operations and forecast-coordinated operations, on the Yuba and Feather Rivers. Studies and a model are under preparation to determine if forecast-based operations/forecast-coordinated operations can be implemented for emergency operations and what the effects might be on costs, water supply, and other project benefits. Details about the approach to forecast-based operations/forecast-coordinated operations and other flood management concerns are described in *SP-E4: Flood Management Study* (DWR, 2004d).

Table 17. DWR's water rights for the Oroville Facilities. (Source: DWR, 2005b; Water Board, 2005, as modified by staff)

No.	Issuance Date	When	Description[a]	Use(s)
Permit No. 16,477	September 26, 1972	Year-round diversion and September through July storage	Divert 7,600 cfs form Oroville Facilities and storage of 380,000 acre-feet in Oroville facilities	Power generation, recreation, fish and wildlife protection and/or enhancement
Permit No. 16,478	September 26,1972	Year-round diversion and September through July storage	Divert 1,400 cfs from Oroville Facilities and storage of 380,000 acre-feet in Oroville facilities	Water supply for consumptive use, recreation, fish and wildlife protection and/or enhancement
Permit No. 16,479	September 26, 1972	Year-round diversion and September through July storage	Divert 1,360 cfs from Oroville Facilities and storage of 3,500,000 acre-feet in Lake Oroville	Water supply for consumptive use and incidental power, recreation, fish and wildlife protection and/or enhancement
Permit No. 16,480	September 26, 1972	Year-round	Divert 11,000 cfs from Oroville Facilities	Power generation, recreation, fish and wildlife protection and/or enhancement

[a] DWR describes the distribution of storage and diversion within these water rights differently in the license application. Our descriptions are based on a query of the Water Rights Information Management System through the Water Board.

Surface Water

The Oroville Facilities are located near the confluence of the Feather and Sacramento rivers, and the water quality objectives are set by the Regional Board and published in the Basin Plan for the Sacramento and San Joaquin River basins (Regional Board, 2004). The Basin Plan designates the beneficial uses for Lake Oroville as municipal and domestic supply, irrigation, power, contact and non-contact recreation, warm and cold freshwater habitat,[41] warm and cold spawning, and wildlife habitat. Designated beneficial uses for the Feather River from the fish barrier dam to the Sacramento River include municipal and domestic supply, irrigation, contact and non-contact recreation, including canoeing and rafting, warm and cold fish migration, warm and cold freshwater habitat, warm and cold spawning, and wildlife habitat. Table 18 summarizes the state objectives for selected water quality parameters.

[41] The Basin Plan explicitly states that any stream segment with both cold and warm freshwater habitat beneficial use designations will be considered cold freshwater habitat in the application of the water quality objectives (Regional Board, 2004, table II-1, footnote 2).

Table 18. Applicable water quality objectives for Oroville Facilities. (Source: Regional Board, 2004)

Parameter	Objective
Temperature	Natural water temperatures of basin waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration does not affect beneficial uses.
Turbidity	Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following: increases of 1 NTU where natural turbidity is 0–5 NTU, increases of 20% where natural turbidity is 0–50 NTU, increases of 10 NTU where natural background turbidity is 50–100 NTU, and increases of 10% where natural turbidity is >100 NTU.
Dissolved oxygen	Dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time: waters designated WARM—5.0 mg/L; waters designated COLD & SPWN—7.0 mg/L; monthly median of mean daily saturation—not less than 85%; and early life stage intergravel—95th percentile saturation not less than 95%.
pH	The pH shall not be depressed below 6.5 or raised above 8.5 nor changed at any time more than 0.5 from the normal ambient pH levels.
Settleable solids	Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.
Chemical constituents	Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.
Sediment	The suspended sediment load and suspended-sediment discharge rate of surface waters shall not be altered in such a manner as to cause a nuisance or adversely affect beneficial uses.
Electrical Conductivity (at 25°C)	Not to exceed 150 μmhos/cm (90 percentile) in well mixed waters.
Fecal coliform bacteria	This criterion is set for protection of water contact recreation. Based on a minimum of not less than five samples taken during a 30-day period, the fecal coliform bacterial density shall not exceed a geometric mean of 200 most probable number/100 mL, nor should more than 10% of the total samples taken during any 30-day period exceed 400 most probable number/100 mL.

Note: °C – degrees Celsius
mg/L – milligrams per liter
mL – milliliter
NTU – nephelometric turbidity unit
μmhos/cm – micro-mhos per centimeter

The Regional Board 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 (Regional Board, 2004). Although the Basin Plan states objectives for pathogens (bacteria), chemical constituents, taste and odor, and toxicity, the groundwater objectives contained in the Basin Plan are not required under the federal Clean Water Act. Groundwater is discussed at the end of the *Water Resources* section.

Water quality in the project area is generally good. The quality of water in Lake Oroville is highly influenced by the water quality of upstream tributaries. Similarly, the water quality of the Feather

River, Thermalito forebay, and Thermalito afterbay are largely determined by the quality of water released from Oroville dam.

DWR's Division of Operation and Maintenance, as part of the State Water Project, has conducted water quality monitoring for various inorganic, organic, and biological parameters regularly since 1968. This monitoring program was augmented with an additional water quality sampling program to collect additional specific data as one of DWR's relicensing studies. The study area is generally within the FERC Project boundary but also includes tributaries to Lake Oroville and the Feather River downstream to the confluence with the Sacramento River. Specific water bodies included in the study area are the North, Middle, and South forks, West Branch and Concow Creek just above their confluences with the reservoir, Lake Oroville, the Feather River downstream from Oroville dam to the confluence with the Sacramento River, Thermalito diversion pool, forebay, and afterbay, and OWA ponds. The results of these monitoring activities, as they pertain to key parameters that may be influenced by project operations, are discussed below.

Temperature

Operation of the Oroville Facilities influences Feather River temperatures, which generally meet the Basin Plan objectives. The responsibility to meet temperature requirements below the dam may be a significant factor in meeting Basin Plan objectives. In addition to the Basin Plan temperature objectives, specific numerical water temperature criteria have been established for two locations associated with the Oroville Facilities: (1) at the Feather River Fish Hatchery, and (2) in the low flow channel at Robinson Riffle (RM 61.6). The hatchery objectives (table 19) were established in a 1983 agreement between DWR and DFG concerning the operation of the Oroville Division of the State Water Project for management of fish and game (DFG, 1983). NMFS' objective for salmonids was included in the NMFS 2002 and 2004 operations criteria and plan biological opinions (NMFS, 2002, 2004). The NMFS objective is a mean daily temperature of less than or equal to 65 degrees Fahrenheit (°F) from June 1 through September 30 at Feather RM 61.6 (Robinson Riffle in the low flow channel, see figure 8).

Table 19. Feather River Fish Hatchery temperature objectives (±4°F between April 1 and November 30). (Source: DFG, 1983)

Period	**Temperature (°F)**
April 1 through May 15	51
May 16–31	55
June 1–15	56
June 16–August 15	60
August 16–31	58
September 1–30	52
October 1–November 31	51
December 1–March 31	55

Operations of the project or the hatchery and water supply deliveries from the reservoir are also governed by the water year type in an effort to maintain the coldwater pool within Lake Oroville. During drier years when reservoir levels are low, the coldwater pool is diminished. During these years, deliveries to water contractors are reduced so that carryover storage is increased and water may be conserved for critical instream needs. In critically dry years, the coldwater pool can be exhausted, resulting in water that is warmer than desired for the most critical needs (e.g., salmonid egg incubation).

The 1983 agreement between DWR and DFG also establishes 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. Additional information about temperature requirements as they relate to fisheries is provided in section 3.3.3, *Aquatic Resources*.

Water passed from Lake Oroville for power generation may be pumped back into that reservoir for re-use. While pump-back operations can draw water that has warmed in the Thermalito forebay or afterbay back into the Thermalito diversion pool and Lake Oroville, DWR monitors these activities to ensure that no adverse effects occur to other beneficial uses during pump-back operations. DWR monitors water temperatures at the hatchery, which receives water diverted from the Thermalito diversion pool during pump-back operations. Pump-back operations are curtailed if water temperatures approach the limits of hatchery requirements.

Thermal Regime of Tributaries to Lake Oroville—DWR collected water temperature data for the West Branch and North, Middle, and South Forks arms, including tributaries, such as Concow Creek, Fall River, and Sucker Run Creek (see figure 2). Seasonal patterns of flow and temperature are similar in all tributaries to the main forks of the Feather River. Water temperatures begin to warm in May and June and reach maximum temperatures of 70 to 80°F in late July and early August and then begin to cool to ranges of 40 to 50°F in November through March. Mean summer water temperatures range from 68°F in the Fall River (a tributary of the Middle Fork) upstream of Feather Falls to 75°F in the West Branch near the town of Paradise. Temperatures of the North Fork are highly influenced by upstream hydropower operations, and daily minimum temperatures downstream of the Poe powerhouse[42] are much cooler than in the other tributaries (DWR, 2004e).

Lake Oroville—Vertical profiles of water temperatures in the main body of Lake Oroville and its North, Middle, and South Fork arms exhibit seasonal patterns that show thermal stratification into three layers: (1) the warm upper layer referred to as the epilimnion, (2) the metalimnion, which has a strong thermal gradient, and (3) the cold deep hypolimnion. Near surface waters (the epilimnion) begin to warm in the early spring, reach maximum temperatures approaching the mid-80°F during late July, and then gradually cool to winter minimum temperatures typically between 45 to 55°F. Temperatures in the deep waters (hypolimnion) remain as cool as 44°F year-round near the bottom of the reservoir. The depth of the metalimnion varies by season, ranging from about 30 feet in early-June to about 80 feet in early-November. During mid-summer, the depth of the metalimnion is around 50 feet. By late winter, relatively uniform temperatures, generally between 40 to 50°F, exist throughout the water column in Lake Oroville.

Thermalito Diversion Pool, Fish Barrier Pool, and Thermalito Forebay—The Thermalito diversion pool extends between Oroville dam and the Thermalito diversion dam. Water temperatures in the Thermalito diversion pool are controlled by the temperatures of the water released from the dam as well as water released through the Kelly Ridge powerhouse (non-project).[43] Water temperatures in the upper Thermalito diversion pool are similar both upstream and downstream from the Kelly Ridge powerhouse tailrace. Little, if any, summer stratification is found in the water column at the diversion

42 Poe powerhouse is a non-project feature located upstream of the Oroville Facilities project boundary on the Upper North Fork arm.

43 Kelly Ridge powerhouse is a component of the South Fork Feather River Project (FERC No. 2088). Water from the tailrace discharges into the Thermalito diversion pool immediately downstream of Oroville dam.

dam, except for the shallow surface layer, with most temperature profiles differing by no more than a degree below the surface layer to the bottom.

The fish barrier pool extends between the Thermalito diversion dam and the fish barrier dam on the Feather River. Water temperatures warm very little in this waterbody; water temperatures are generally within a degree or so between the upstream and downstream ends with maximum differences occasionally reaching 3ºF. Water temperatures immediately downstream from the Thermalito diversion dam ranged from 45.5 to 61.0 ºF, while those at the gage near the fish barrier dam were very similar, ranging from 45.9 to 60.6 ºF with negligible stratification.

Water temperature differences between the Thermalito forebay and Thermalito diversion pool and between the North and South forebays are very similar. Water temperatures in both the North and South forebays are warmer by a few degrees in the upper few feet of the water column during warmer months of the year, especially along the margins of these water bodies where velocities are reduced. Measured water temperatures throughout the entire forebay near the surface ranged from 45.7°F during the colder months to 67.5ºF during the warmer months, while temperatures at lower depths ranged from 45.5 to 59.2ºF in the North forebay and 45.5 to 59.9ºF in the South forebay.

Thermalito Afterbay—Thermalito afterbay consists of the North afterbay (north of State Route 162) and South afterbay (south of State Route 162). In general, water temperatures in the Thermalito afterbay increase from the spring to summer and subsequently decrease into the winter in response to the temperature of water delivered from the South forebay as well as atmospheric conditions. Water temperatures were also warmer at measurement points in areas protected from the main flow of water through the Thermalito afterbay (e.g., coves).

Year-round water temperatures in the North afterbay (and winter temperatures in the South afterbay) were very similar to those found in the South forebay. Water temperatures began progressively increasing from the north to south in the spring, with increasing differences between North and South afterbay temperatures through the summer. Temperature differences between the northern and southern portions of the afterbay in the deeper portion of the water column ranged from about 56 to 62ºF during May (difference of about 6ºF) to about 56ºF to 65ºF (a difference of about 9ºF) during the warmest part of the year (August/September). Thermalito afterbay exhibited seasonal thermal stratification where temperature differences between the top and bottom during the warmer months ranged from about 53 to 62ºF (9ºF difference) in the North afterbay to about 62 to 76ºF (14ºF difference) in the South afterbay.

Feather River Downstream of the Fish Barrier Dam

DWR also monitored water temperatures in the Feather River downstream of the fish barrier dam as part of a spring-run Chinook salmon habitat suitability study. Vertical profile results indicate that pools do not thermally stratify. Table 20 presents the mean profile water temperatures for pools in the Feather River that could be used as holding areas for spring-run Chinook salmon (discussed in section 3.3.3, *Aquatic Resources*). The results indicate that temperatures vary seasonally, including warming through the summer with increased temperatures at greater distances from Lake Oroville.

Because the Thermalito afterbay outlet substantially alters flow conditions in the Feather River, we discuss thermal conditions in the reaches upstream and downstream of the afterbay outlet separately.

Low Flow Channel—Water temperature results recorded with stationary data loggers in the low flow channel from March 2002 to March 2004 indicate that the water begins to warm in March with maximum temperatures reached in July and early August that ranged from 61°F upstream of the Feather River Fish Hatchery to 69°F upstream of the Thermalito afterbay outlet (see figure 12). The low flow channel begins cooling in September, with water temperatures dropping to 45°F throughout the reach by February. Temperatures of water released from the Feather River Fish Hatchery vary little from those of the river near the hatchery.

Table 20. Mean water temperatures (°F) in Feather River pools downstream of Lake Oroville, June–October 2002. (Source: DWR, 2004f, as modified by staff)

Location (RM)	**6/12**	**6/27**	**7/15**	**7/25**	**8/22**	**8/26**	**9/5**	**9/27**	**10/9**	**10/25**
Downstream from fish barrier dam (67.2)	53.4	56.5	54.3	54.3	61.3	56.7	54.1	53.1	55.2	56.1
Upstream from fish barrier pool (67.2)	54.0	56.7	54.5	57.2	61.2	56.8	54.1	52.9	55.2	56.1
Downstream from fish barrier pool (67)	54.9	57.9	55.6	57.7	62.4	57.2	54.5	52.9	56.5	55.9
Upstream from Highway 162 Bridge (64.5)	--	--	--	--	64.6	58.8	57.4	52.9	58.5	55.9
Upstream from afterbay outlet pool (59)	--	--	--	--	65.1	61.3	58.8	55.9	59.0	56.8
At afterbay outlet pool (58.75)	--	--	--	--	64.0	63.9	60.4	58.3	60.6	58.3
Downstream from afterbay outlet pool (58.5)	--	--	--	--	63.1	64.4	62.1	60.3	60.6	58.3
Near Mile Long pool (57)	--	--	--	--	63.7	65.7	63.0	61.3	61.9	58.6
Downstream from project boundary pool (53)	--	--	--	--	64.0	65.7	63.3	62.2	62.1	59.0

Note: -- Indicates no data recorded

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 Robinson Riffle (RM 61.6). During extended warm periods in the summer of 2002 and 2003, this objective was exceeded. On June 19, 2002, the daily mean temperature was 65.5°F. During July 2003, the objective was exceeded on five occasions, with a maximum daily mean temperature of 66.0°F.

High Flow Channel (Feather River below the Thermalito Afterbay Outlet)—Temperatures in the high flow channel are a function of flows from the Thermalito afterbay outlet, Honcut Creek, Yuba River, and the Bear River. Water in the high flow channel begins warming in March and reaches its maximum during June and July, and then cools to 44 to 45°F by January or February (figure 13). DWR reported maximum temperatures for monitoring sites in the reach ranged from 71°F at the Thermalito afterbay outlet to 77°F immediately downstream of the Bear River confluence outside the project boundary.

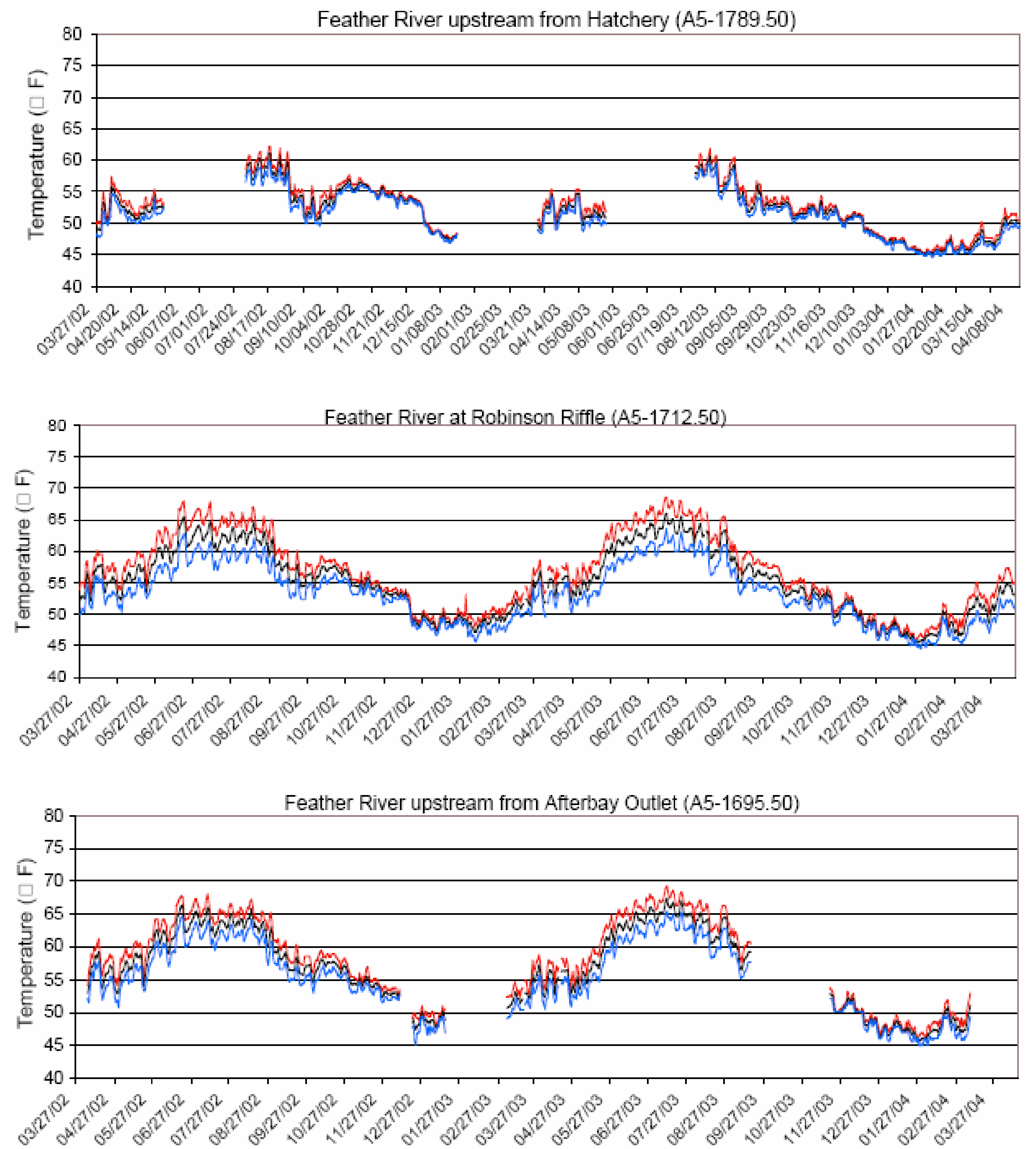


Figure 12. Maximum, mean, and minimum daily temperatures in the Feather River low flow channel. (Source: DWR, 2004e)

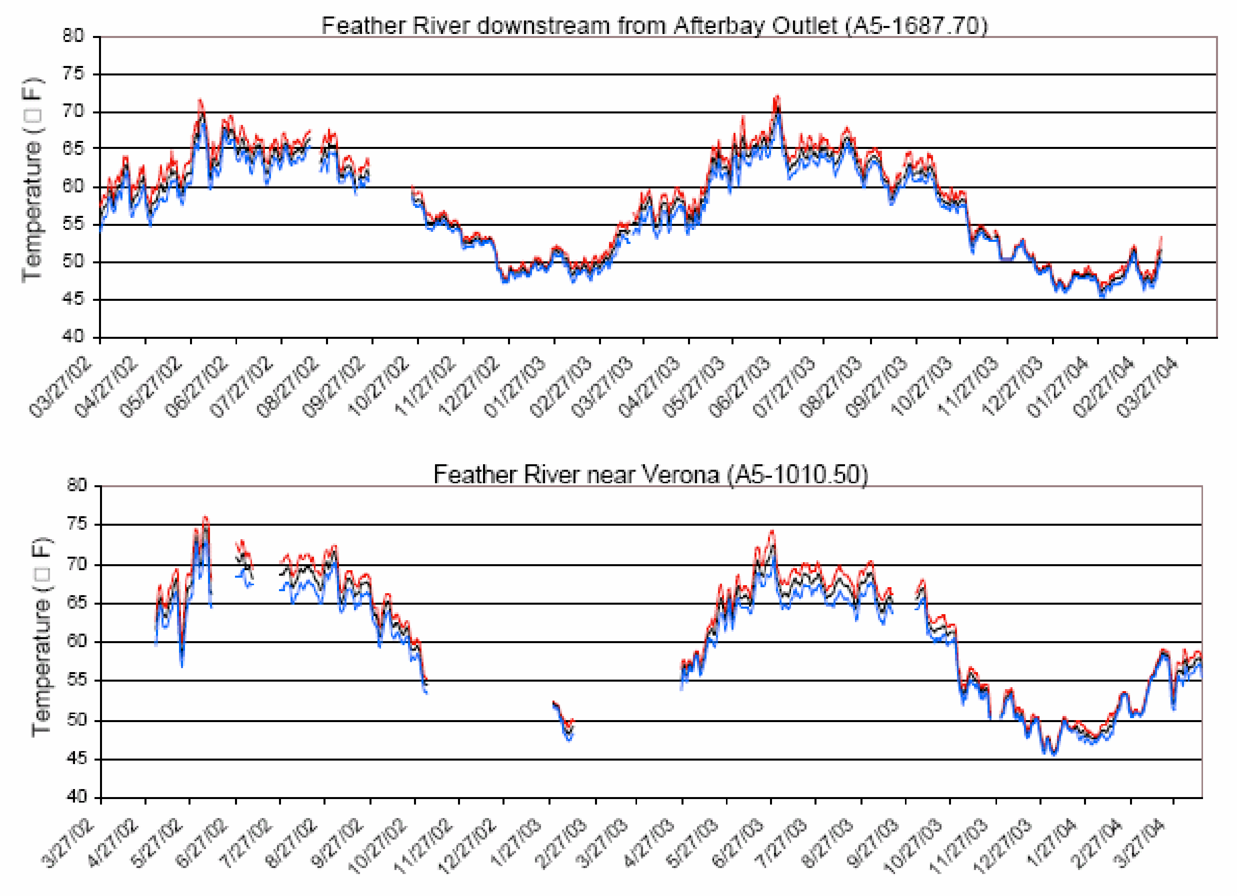


Figure 13. Maximum, mean, and minimum daily temperatures in the Feather River high flow channel. (Source: DWR, 2004e)

High flow channel water temperatures from April through October downstream of the Thermalito afterbay outlet are strongly influenced by the inflows from the Thermalito afterbay, Honcut Creek, Yuba River, and Bear River. Except during periods of high flow through Thermalito afterbay, which occur frequently in July and August, releases from Thermalito afterbay during the warm season raise the water temperature of the river. Inflows from Honcut Creek and Bear River 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.

DWR operates releases from Oroville dam by withdrawing water at depths that will provide sufficiently cold water to meet Feather River Fish Hatchery and the Robinson Riffle temperature requirements. Historical water temperature measurements indicate that the Robinson Riffle criterion is almost always satisfied when the Feather River Hatchery objectives are met. 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.

Temperature Conditions at the Feather River Fish Hatchery—Generally, monitored water temperatures satisfy the criteria set for the Feather River Fish Hatchery in the 1983 agreement between DFG and DWR. Monitoring data indicate frequent compliance with the Feather River Fish Hatchery temperature requirements, with the exception of an extended warm period in the fall of 2002 when temperatures were above the criteria about 38 percent of the time (table 21).

Table 21. Frequency at which fish hatchery water temperatures met temperature objectives from April 2002 to March 2004. (Source: DWR, 2004f)

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

Dissolved Oxygen and pH

Generally, dissolved oxygen (DO) concentrations and pH levels monitored within the study area complied with the water quality objectives of the Basin Plan (table 18). The majority of the exceedances were observed at the bottom of either Lake Oroville or Thermalito afterbay.

DO concentrations of less than the applicable state objectives were recorded in the West Branch arm, Thermalito afterbay, and in the low flow channel. Table 22 summarizes the monthly profile results that failed to meet the Basin Plan objective for DO (7.0 milligrams per liter [mg/L] for cold/spawning habitat). DO concentrations that failed to meet the objectives at the surface and bottom of Lake Oroville occurred when the reservoir was thermally stratified in the summer (DWR, 2005b). In the Feather River between the fish barrier dam and Honcut Creek, the Basin Plan has a specific DO objective of 8.0 mg/L for September through May. Measured DO concentrations in the Feather River decreased to 5.4 mg/L, which is less than the objective, at the station downstream of the Feather River Fish Hatchery on October 27, 2003. This low value occurred during the salmon spawning period when decomposing salmon carcasses were present (DWR, 2005b). DO concentrations of less than the objective were also recorded at three other stations during mid-December 2002 (6.5–7.6 mg/L).

Table 22. Summary of Basin Plan DO exceedances during 2002 to 2003. (Source: DWR, 2005b, as modified by staff)

Location	Exceedances/Samples	Minimum (mg/L)
Lake Oroville		
North Fork arm, surface	3 of 29	6.5
North Fork arm, bottom	1 of 28	0
Middle Fork arm, surface	1 of 29	5.9
Middle Fork arm, bottom	6 of 29	4.9
South Fork arm, surface	1 of 28	6.5
South Fork arm, bottom	12 of 28	1.0
Main Body, bottom	1 of 21	6.9
In front of dam, surface	1 of 30	6.4
In front of dam, bottom	4 of 29	0.7
Feather River		
Downstream of fish hatchery	1 of 30	5.4
Robinson Riffle	1 of 30	7.6
Thermalito afterbay, bottom	2 of 26	6.4
Downstream of project boundary	1 of 30	6.5

Only one measurement of pH was less than the minimum applicable pH objective (6.5 units); this was a pH value of 6.3 units reported at the Thermalito afterbay outlet.

Conductivity and Minerals

Measured 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. A single observation in the low flow channel downstream of the hatchery recorded the conductivity slightly over the Basin Plan objective, 151 μmhos/cm, which barely exceeds the objective of 150 μmhos/cm.

Turbidity

Dams and reservoirs can cause suspended sediments to be deposited in their impoundments and also reduce the size of the materials that are released or spilled downstream of the dam. DWR monthly sampling results indicate that settleable solids concentrations were at trace or undetectable levels for the majority of samples. Monitoring results from the tributaries and main branches of the North Fork indicate that typically very low levels of turbidity and total suspended solids occur, except during high flow events.[44] Generally, many of the total suspended solids readings in the North, Middle and South Forks upstream of the project boundary were well below 10 mg/L. Lake Oroville acts as a sediment trap which results in low concentrations of total suspended solids within Lake Oroville, the Feather River immediately downstream of Oroville dam, and the Thermalito Complex. Turbidity readings within the main body of Lake Oroville were typically below 10 nephelometric turbidity units. The maximum turbidity values in front of the dam were 11.6, 2.9, and 3.8 nephelometric turbidity units at the surface, middle, and low depths, respectively. Turbidity in the diversion pool, Thermalito forebay, and Thermalito afterbay was recorded consistently below 8 nephelometric turbidity units in more than 200 samples. Downstream of the Thermalito afterbay outlet, turbidity and total suspended solids concentrations generally increase, which may potentially be related to inputs from downstream tributaries in the Feather River and high flows resulting from storm events (DWR, 2005b).

The Soil Conservation Service (now the Natural Resource Conservation Service) considers the Feather River watershed upstream of Lake Oroville to be subject to accelerated erosion as a result of human-caused disturbances (DWR, 2005b). Based on the current monitoring results, the numerous dams and reservoirs upstream of Lake Oroville are likely effective traps of (suspended) sediment, thereby reducing the quantity of sediment transported into Lake Oroville. Although the quantity is reduced, what does come into the lake is trapped and settles in the upper arms of the lake as discussed in section 3.3.1.1, *Affected Environment* in *Geology, Soils, and Paleontological Resources*.

Metals

DWR monitored metal concentrations in the main tributaries to Lake Oroville, in Lake Oroville, Thermalito forebay, afterbay, and the low flow and high flow channels of the Feather River. Basin Plan objectives include dissolved metal concentrations due to their possible influence on aquatic organisms (table 23). The Basin Plan states that at a minimum, waters designated for use as domestic or municipal supply (Lake Oroville and the Feather River between the fish barrier dam and the Sacramento River) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels as specified in Title 22 of the California Code of Regulations—Drinking Water Standards. DWR's monitoring program measured total and dissolved metals concentrations throughout the project area (mercury was sampled for total recoverable mercury and total methyl mercury).

Table 23. Water quality objectives and criteria for trace metals in waters of the Feather River watershed. (Source: Regional Board, 1998, as modified by staff)

Chemical Constituent	Basin Plan Objectives (mg/L)[a,b]	California Drinking Water Standards (mg/L)[c]
Aluminum	--	Primary MCL 1.0
Arsenic	--	Primary MCL 0.05
Cadmium[d]	--	Primary MCL 0.005
Chromium	--	Primary MCL 0.05
Copper[d]	0.0056	Primary MCL 1.3
Iron	0.3	Secondary MCL 0.3

44 Total suspended solids readings taken on February 18, 2004, at the sampling sites along the main branches and tributaries to the Feather River upstream of Lake Oroville were well above 10 mg/L with maximum readings of 393 and 262 mg/L upstream and downstream of the Poe powerhouse, respectively. Flow at USGS Gage No. 11404500 on the North Fork near Pulga for this date was above 15,000 cfs (USGS, 2005).

Chemical Constituent	Basin Plan Objectives (mg/L)[a,b]	California Drinking Water Standards (mg/L)[c]
Lead[d]	≤0.015 in waters designated as domestic or municipal supply	Primary MCL 0.015
Manganese	0.05	Secondary MCL 0.05
Nickel[d]	--	Primary MCL 0.1
Selenium	--	Primary MCL 0.05
Zinc[c]	0.016	Secondary MCL 5.0

[a] As dissolved.

[b] Chemical constituent objectives listed in this table have are for water bodies other than the Feather River, and are shown here for comparison purposes only.

[c] Title 22 of the California Code of Regulations.

[d] Hardness-dependent criteria. The listed criteria are for a hardness of 50 mg/L.

Metal concentrations in several water samples exceeded the Basin Plan objectives in Lake Oroville and in the Feather River downstream of the dam. DWR study results also indicate that exceedance of the objectives typically increased in frequency in the Feather River downstream of the project boundary. Table 24 summarizes metal concentrations of samples that exceeded Basin Plan objectives. Generally, sampling sites below Oroville dam had a greater percentage of samples that exceeded Basin Plan objectives than those within project waters. Arsenic levels exceeded the EPA National Toxics Rule, toxicity to humans objective in every sample, but met drinking water and aquatic life protection objectives. DWR noted that the majority of metal concentration exceedances in the upper tributaries were recorded during storm events.

Table 24. Summary of metal concentrations that exceeded Basin Plan objectives. (Source: DWR, 2004g, as modified by staff)

Metal	Number of samples[a]	Number of samples that exceeded Basin Plan[b]	Percent	Maximum concentration (mg/L)	Comments on locations of exceedances
Aluminum	1,613	39	.0241	5.523	Tributary samples and with increasing frequency downstream
Iron[c]	1,245	286	22.97	8.088	Inputs to power canal and with higher frequency downstream of Robinson Riffle pond
Mercury	1,534	2	.0013	0.183	Sucker Run and upstream of fish hatchery
Manganese	1,612	132	.0818	2.260	All locations save for 1 near the dam in Lake Oroville and all locations in Oroville Wildlife Ponds save for 1. Other locations include Oroville fishing pond, Robinson Riffle, and Long Pond.

Metal	Number of samples[a]	Number of samples that exceeded Basin Plan[b]	Percent	Maximum concentration (mg/L)	Comments on locations of exceedances
Lead	1,620	20	.0123	3.93	Tributary samples, Thermalito afterbay, and Feather River below Oroville dam.

[a] Sum of all samples taken from all locations which include locations above and below the project boundary.

[b] Basin Plan objectives listed in table 23.

[c] Dissolved concentrations.

DWR also examined fish tissues for metals. Results from the DWR fish tissue sampling study indicate that metals concentrations in tissue samples are occasionally elevated based on comparison to recommended guidelines from various regulatory agencies, while results for mercury concentrations were noticeably higher than the 0.3 mg/kg criteria set by the EPA for methylmercury concentrations in fish tissue to protect human health (EPA, 2001). Concentrations of mercury in 214 individual fish sampled from the project area, tributaries, and the OWA ranged from 0.01 to 1.26 mg/kg (wet weight) with a mean of 0.3 mg/kg. Ninety-four of the 214 fish sampled had mercury concentrations greater than 0.3 mg/kg (DWR, 2006e). Figure 14 shows the mercury levels in individual fish and their sampling location. Incidences of fish with mercury concentrations greater than the EPA criteria diminish below the Thermalito afterbay outlet, as shown in figure 14.

Fish consumption advisories by California/EPA Office of Environmental Health Hazard Assessment (OEHHA) are fairly common in the Sierra Nevada foothills, Sacramento River Delta, and coastal ranges of California where historical mercury ore mining and processing or gold mining activities occurred. OEHHA released a Draft Health Advisory containing “Safe Eating Guidelines for Fish from the Lower Feather River” (as defined from the fish hatchery dam to the confluence with the Sacramento River) in August 2006. The advisory suggests that women and men beyond childbearing age, as well as women of childbearing age, pregnant or breastfeeding women, and children under 17 avoid eating striped bass or Sacramento pike minnow. The advisory also suggests women of childbearing age, pregnant or breastfeeding women, and children under 17 avoid eating large mouth bass, small mouth bass, and catfish.

DWR states that historical 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 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 (see section 3.3.1, *Geology, Soils, and Paleontological Resources*), the Oroville Facilities probably act as a sink for metals from upstream sources. A principal beneficial effect of this is the inhibition of contaminated sediments transport to the Feather River and other water bodies. Conversely, there is evidence that mercury concentrations in hatchery raised coho salmon are significantly lower than Lake Oroville coho salmon, indicating the presence of mercury in the food web such that uptake of mercury in Lake Oroville coho salmon is occurring. Because the Oroville Facilities provide sport fishing opportunities, the potential for human consumption of fish from the project area exists. We discuss the effects of the proposed water quality monitoring and public education program below.

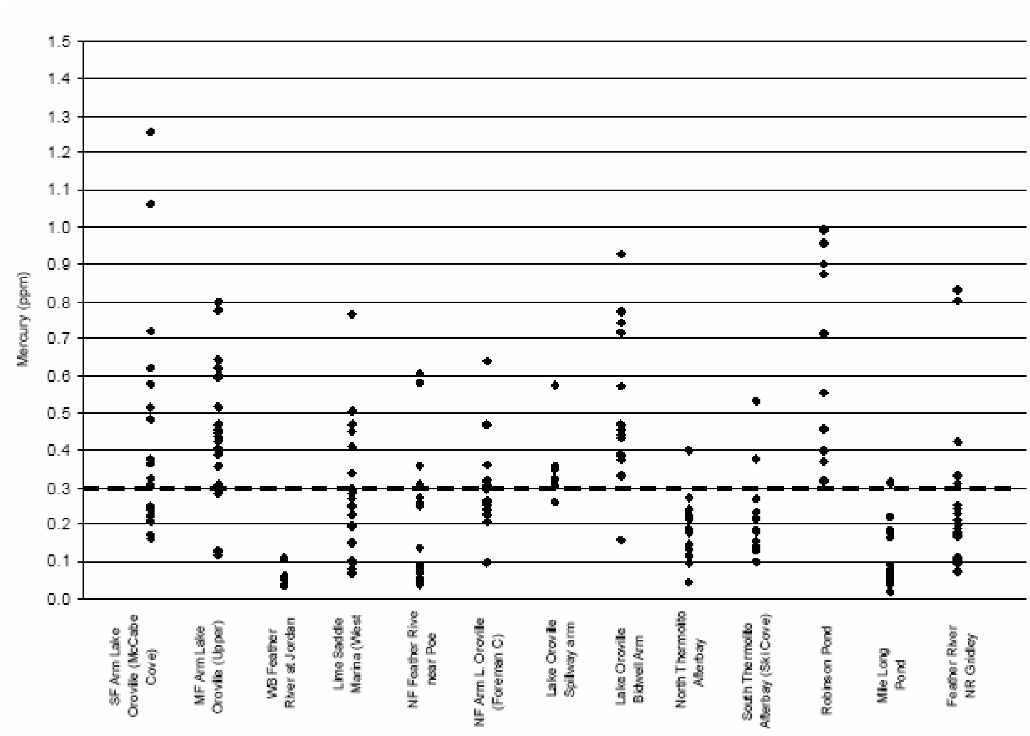


Figure 14. Concentrations of mercury in individual fish from the Oroville Facilities area (the dashed line represents the EPA recommended criteria for the protection of human health). (Source: DWR, 2006e)

Pesticides

DWR characterizes the use of pesticides at the Oroville Facilities as minor. The local Mosquito Abatement District is responsible for mosquito control within the OWA and herbicides are applied for maintenance of recreational and other facilities within the project boundary.

DWR collected samples upstream of Lake Oroville from the surface water of Lake Oroville and the Thermalito forebay and afterbay complexes, and downstream of the Thermalito afterbay outlet during the fall (after first seasonal rains) and winter (February/March; the dormant spray period) to determine if pesticides were present in project waters. DWR monitoring results indicate that the pesticide diuron was detected in one sample (recorded concentration of 1.91 micrograms per liter (μg/L), although its concentration was considerable less than the EPA drinking water criterion of 10 μg/L. This sample was collected upstream of the FERC project boundary. Methoprene and malathion, pesticides typically applied for mosquito control in the OWA, and their breakdown byproducts were not detected in DWR's sampling.

Petroleum Byproducts and Fuel Additives

Methyl tertiary butyl ether (MTBE, a fuel additive[45]), oils, greases, and waxes were investigated because of the potential to be released into Lake Oroville through boating use, fuel pumping, and fuel storage activities at or near marinas, or along the Lake Oroville shoreline. DWR study results reported in the license application indicate that MTBE (concentration of 3.1 μg/L) was detected in a single sample from the Thermalito diversion pool downstream from the Kelly Ridge powerhouse in a water sample

[45] The state of California banned MTBE as a fuel additive in gasoline beginning on January 1, 2004.

collected on November 17, 2003. This is well below the California Department of Health Services (DHS) secondary maximum contaminant level for drinking water of 5 μg/L. No other organic contaminants were detected at concentrations greater than the minimum detection limit. No oil, grease, waxes, or other similar materials causing nuisance, visible film, or coating on the surface of the water or on objects in the water were evident during monitoring.

Nutrients

DWR investigated nutrient concentrations (nitrogen and phosphorus) in the study area, near recreational facilities (near floating campsites and toilets) and in stormwater runoff to investigate whether project-related recreation use and operation of the Feather River Fish Hatchery is contributing to increased nutrient loading in the project area. Results of these efforts show that nutrient concentrations throughout the study area were consistently below most Basin Plan objectives.

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 μg/L, and levels of total nitrogen (ammonia plus nitrate plus nitrite) were sometimes below 15 μg/L. Water samples collected from the tributaries to Lake Oroville frequently exceeded the EPA-recommended criteria for phosphorus and nitrate plus nitrite that were set to avoid eutrophication, which suggests that these tributaries often have an overabundant supply of nutrients.

DWR collected samples for periphyton (attached algae) analyses from four sites on the tributaries upstream from Lake Oroville and 13 sites on the Feather River downstream of the fish barrier dam from May 2003 to March 2004. Periphyton dominated most samples in the tributaries upstream of Lake Oroville and in the Feather River. Green algae, which are considered indicative of higher nutrient levels than diatoms, were dominant in a single sample downstream of the Sewerage Commission—Oroville Region outlet collected in June 2003. This level of green algae density was not found in the upstream sampling site or at the other stations in the immediate area of the outlet (upstream and downstream of afterbay outlet and near One Mile Pond). This bloom could indicate nutrient enrichment, possibly from the Sewerage Commission—Oroville Region Outlet.

Low concentrations of nutrients were detected in most of the water samples collected during the salmon spawning season, indicating that salmon carcasses do not excessively increase nutrient concentrations in the Feather River. Water samples collected from the water column and from within gravel substrates at stations immediately upstream and downstream of the Sewerage Commission—Oroville Region outlet showed no consistent differences in nutrient concentrations. However, the periphyton community at the station downstream of the Sewerage Commission—Oroville Region outlet had characteristics indicative of a nutrient status that was greater than the communities at other stations.

Pathogens

DWR investigated coliform bacteria presence throughout the study area, near recreational facilities (including near floating campsites, restrooms, pump-out facilities and marinas with high densities of house boats) and in stormwater runoff using a monthly sampling regime and a more intensive sampling regime to collect data that is directly comparable to the Basin Plan objectives (no less than 5 samples in 30-day period criteria). The monthly monitoring study results generally indicate very low bacteria concentrations in the tributaries to Lake Oroville and most open water sites in Lake Oroville. Results of the more intensive, summer recreation site monitoring effort revealed that several recreation sites in Lake Oroville and the Thermalito Complex had elevated bacteria densities (Bedrock Park recreation area,[46] Foreman Creek boat access, Loafer Creek swim area, and Monument Hill swim area) and that the two sites sampled in the North forebay (swim area and cove) consistently exceeded Basin Plan and DHS objectives for total coliform, fecal coliform, and enterococcus bacteria. Seven of 10 samples at both the beach and cove recorded individual fecal coliform samples greater than 200 organisms per 100 milliliter (mL) and together these two sites produced nine results that exceeded the 5-day geometric mean threshold used by the Basin Plan. DHS recommends that beaches be posted or closed to protect public health when total coliform bacteria exceed 10,000 organisms, fecal coliform bacteria exceed 400 organisms, or enterococcus bacteria exceed 61 organisms per 100 mL of water sample. DHS recommended levels of bacteria contamination to trigger beach posting or closure were exceeded at least once at each recreation area monitored in 2003. Table 25 shows the number of samples that exceeded either the Basin Plan or DHS fecal coliform criteria. Bacteria contaminations were elevated during both seasonal peak recreational activity and non-recreation periods when numerous waterfowl were present indicating that both humans and waterfowl may be sources of contamination. Testing to determine the source of pathogens (human or animal) was not conducted.

Table 25. Number of exceedances of either the Basin Plan and/or DHS fecal coliform thresholds based on 10 samples collected at recreation sites in June through August 2003. (Source: DWR, 2004g, as modified by staff)

Location	Number of Samples Exceeded: Basin Plan Objectives[a]	Number of Samples Exceeded: DHS Criteria	Maximum Number/ 100 mL	Month of Maximum
Foreman Creek beach access	0	1	>1,600	June
Loafer Creek swim area	0	2	>1,600 (twice)	June
Monument Hill swim area	0	1	500	July
North forebay swim area (beach)	6	7	>1,600 (twice)	June and July
North forebay swim area (cove)	3	3	22,000	August
North forebay swim area (mouth)	0	2	>1,600	August
South forebay boat ramp	1	4	>1,600 (twice)	July and August
South forebay swim area	0	2	>1,600 (twice)	July and August
Stringtown boat ramp	0	1	>1,600 (twice)	July

Note: DHS – California Department of Health Services

[a] No more than 200 per 100 mL based on geometric mean of 5 samples per 30 days.

[b] Single sample maximum of 400 per 100 mL.

Aquatic Toxicity Tests

DWR's license application summarizes aquatic toxicity study results that were compiled using EPA's standardized freshwater acute and chronic toxicity tests using fathead minnow and zooplankton

[46] Redrock Park is part of the Feather River Recreation and Parks District and is located on the south side of the Feather River in the city of Oroville between 4th and 5th Streets, outside of the project boundary.

(*Ceriodaphnia dubia*). Water samples from nine Lake Oroville tributary sites were collected bimonthly in the summer, following the first flush in the fall, following winter dormant spraying in February, and during the high runoff period in April or May. Water samples from eight 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 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 (DWR, 2004g).

The tributaries to Lake Oroville had positive reproductive toxicity to zooplankton 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 zooplankton was generally absent. Survival toxicity to fathead minnows in filtered samples occurred for all but one of the Lake Oroville tributary sites, with frequency of toxicity per site ranging from 0 to 20 percent of sampling dates.

The Feather River sites had reproductive toxicity to zooplankton on 21 to 58 percent of the sampling dates, which is similar to the range of frequencies for the Lake Oroville tributary sites. However, survival toxicity to zooplankton was detected more frequently at the Feather River sites than at the Lake Oroville tributary sites, ranging from 4 to 33 percent of sampling dates. The hatchery settling pond and the Feather River downstream of the hatchery had the two highest reproductive toxicity and survival toxicity rates. Zooplankton 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 tested 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 the 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 zooplankton and fathead minnows. The toxicity identification 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 the cause-and-effect relationships for specific contaminants or sample locations could not be determined. The results from the toxicity analysis suggest that waters within the project area contain toxins that affect the survival and reproduction of the fathead minnow (test organism), which may also be affecting other larger organisms. Targeted Toxicity Identification Evaluations were preformed on several samples in 2003 and 2004 in an attempt to identify the contaminants. Results from this analysis did not identify a pattern other than identifying the toxic as metal or non-polar organic.

Groundwater Quality

DWR monitored the quality of groundwater around the Thermalito forebay and Thermalito afterbay by sampling groundwater from 18 wells in the vicinity of these reservoirs (two sampled wells were upgradient from the Thermalito 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. Groundwater samples were collected and 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 (DWR, 2004g). Results from the two 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.

Hazardous Materials

Hazardous materials are defined in Section 66260.10, Title 22 of the California Code of Regulations 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 search of available environmental databases has indicated that there are 36 sites within the FERC project boundary for which 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.

DWR reports that 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.

3.3.2.2 Environmental Effects

Water Quantity

This section discusses the effects of the Proposed Action on flow regimes in river reaches affected by project facilities, operations, flood control, instream flows, ramping rates, and water rights.

Flow/Temperature to Support Anadromous Fish (Proposed Article 108)

Proposed Article A108.1, *Flow/temperature to Support Anadromous Fish*, would establish a new minimum flow of 700 cfs in the low flow channel during part of the year, but the minimum flow would be increased to 800 cfs during the Chinook salmon spawning season from September 9 through March 31. Additionally, a river valve[47] would be replaced or refurbished under Measure B108, *Flow/Temperature to Support Anadromous Fish*. The modification would likely occur prior to issuance of a new license. Ramping rates would continue as set by a 1983 agreement between DWR and DFG.

DWR proposes to maintain a minimum flow in the high flow channel, based on the April through July unimpaired runoff of the Feather River near Oroville of the preceding water year (October 1 through September 30). The minimum flow required in the high flow channel would be the same as that currently required (see table 2), provided that such releases would not cause Lake Oroville to be drawn down below elevation 733 feet (approximately 1,500,000 acre-feet).

The Settlement Agreement also contains low flow and high flow provisions for the high flow channel. If the April 1 runoff forecast in a given water year indicates that, under normal operation of the project, Lake Oroville would be drawn to elevation 733 feet msl (approximately 1,500,000 acre-feet), minimum flows in the high flow channel could be diminished on a monthly average basis, in the same

[47] The two river valve systems are located just downstream of the plug in Diversion tunnel no. 2. Each valve can discharge water up to 2,700 cfs into the tunnel through a 72-inch spherical guard valve and 54-inch fixed-cone dispersion valve via two 72-inch-diameter steel conduits located inside the plug. The combined capacity is 5,400 cfs under rated conditions of 428 feet of head. Diversion tunnel no. 2 is located in the left side of Oroville dam and to the right of the Hyatt pumping-generating plant.

proportion as the respective monthly deficiencies imposed on deliveries for agricultural use from the project; however, in no case would the minimum flow releases be reduced by more than 25 percent. If, between October 15 and November 30, the highest total 1-hour flow were to exceed 2,500 cfs, DWR would maintain a minimum flow within 500 cfs of that peak flow, unless such flood flows or an inadvertent equipment failure or malfunction caused the flow exceedance.

Ramping requirements are summarized in tables 3 and 4, and no changes from the current conditions are proposed.

Staff Analysis

The current minimum flow in the low flow channel is 600 cfs. We note that the Chinook spawning season, the period when the 800-cfs flow requirement would be in effect, covers a period of 204 days per year and the 700-cfs requirement would exist for the remaining 161 days of the year. Establishing a minimum flow of 700 cfs from April 1 through September 8 would increase the targeted flow by 16.7 percent from current conditions. Similarly, the targeted flow during the Chinook spawning season would represent a 33.3 percent increase over existing conditions. Higher flows would correlate with higher stages and the channel would experience a wider wetted top width under this proposal. Higher flows in the low flow channel would negatively affect generation, and we assess those effects in section 4.0, *Developmental Analysis.*

Higher flows in the high flow channel are not proposed under the Settlement Agreement; however, the Settlement Agreement contains a provision to implement facility modifications to achieve water quality objectives under the existing high flow channel flow requirements after a 5-year testing period, if water quality objectives are not achieved. Because this measure would primarily affect aquatic resources (section 3.3.3) and water quality (discussed later this section), we provide additional analysis of these measures in those sections.

Flood Control and Early Warning System (Proposed Articles A130 and A131)

DWR operates Lake Oroville to maintain up to 750,000 acre-feet of storage space to capture significant inflows for flood control under the direction of the Corps. This operation provides storage space for springtime flood waters and provides for subsequent flows releases to meet minimum targets of 150,000 cfs downstream of Lake Oroville, 180,000 cfs upstream of Yuba River, 300,000 cfs downstream of Yuba River, and 320,000 cfs downstream of Bear River. The Corps has not recommended any changes to project flood control measures under this proceeding. Lake Oroville would continue to be operated in accordance with the Corps' 1970 Reservoir Regulation Manual.[48]

Under Proposed Article A130, *Flood Control*, DWR would operate the project in accordance with the rules and regulations prescribed by the Corps pursuant to section 204 of the Flood Control Act of 1958. This is consistent with the existing license requirements.

Under Proposed Article A131, *Early Warning System*, DWR would improve communication and coordination with affected agencies by developing and filing for Commission approval an early warning plan for flood events. The plan would describe how DWR would communicate and coordinate project operations with the Corps, the California Office of Emergency Services, and the Butte County Office of Emergency Services before and during flood emergency events. DWR already communicates and coordinates with these entities regarding flood events, but would formalize communication and

---

[48] The 1970 Reservoir Regulation Manual implements the rules and regulations that are prescribed pursuant to section 204 of the Flood Control Act of 1958. Specifically, Article 32 of the original license states that "the Licensee shall collaborate with the Department of the Army in formulating a program of operation for the project in the interest of flood control.

coordination through the early warning plan. The plan would be developed and filed with the Commission within 1 year following license issuance. DWR would consult with the Corps, the U.S. Bureau of Reclamation, the California Office of Emergency Services, and the Butte County Office of Emergency Services in developing this plan. Upon Commission approval, DWR would implement the plan, including any changes required by the Commission and the Commission would have the right to make further changes to the plan.

Section 4.10 of the Settlement Agreement acknowledges that DWR would comply with the rules and regulations prescribed by the Corps and that the Settlement Agreement Parties reserve the right to present evidence or argument relative to the effects posed by any flood control proposal raised by any intervenor or otherwise before the Commission or the Corps.

Butte County, Sutter County et al.,[49] Friends of the River, and Anglers Committee, in their letters dated April 26, 2006, April 26, 2006, October 17, 2005, and December 15, 2005, respectively, recommend that additional measures be undertaken with respect to flood control.

Butte County recommends that DWR should be directed to work with the County to address potential flood risks by providing additional security at the Oroville dam and relocate the Butte County Emergency Operations Center outside of the project flood plain in order to ensure that DWR would have an appropriate emergency action and dam safety plan in place.

Sutter County et al. recommend that DWR address the following critical flood protection and control issues as outlined in their Amended Motion to Intervene:

- Make a formal request to the Corps for the agency to immediately develop a revised operational plan for Oroville to establish flood-control management on the Feather River System that accounts for the absence of Marysville dam and full regulation of the Yuba River without the necessity for surcharge operations of or at the project above the ungated spillway.
- Investigate the adequacy and structural integrity of Oroville dam's ungated auxiliary spillway that may currently pose a risk to the project facilities and downstream levees in Sutter County in the event extreme flood releases are required, as recently experienced in flood release events of 1986 and 1997, and take all necessary actions to correct any identified deficiencies, in this regard.
- Investigate the adequacy and structural integrity of levees on the Feather River, in the context of its hydroelectric, water supply, and flood control operations and repair, replace, and maintain those levees to provide appropriate levels of flood protection, in light of project operations.

Friends of the River recommend that DWR work with the Corps and other interested parties, such as the Work Group,[50] to develop revisions to the Oroville dam reservoir regulation manual concerning surcharge, forecast, and coordinated operations.

The Anglers Committee et al. recommend that the Oroville dam emergency spillway deficiency be corrected by DWR to protect public safety in the downstream areas downstream of Oroville dam.

Plumas County, in its March 15, 2006, Motion to Intervene, recommends that a new license for the Oroville Facilities address flood planning to protect downstream communities and give consideration to the open questions and uncertainty about levee improvements and future land use decisions. As one

[49] The Sutter County Intervenors include Sutter County, the City of Yuba City, and Levee District Number 1 of Sutter County.

[50] This refers to the Yuba Feather Work Group that is not connected to the Oroville relicensing. We note that DWR has participated in this work group and provided grant funding.

component of the flood control solution, it recommends that the licensee should continue the pilot program it initiated as part of the Plumas Watershed Forum, with the new license incorporating a program of upstream reinvestment in projects that restore natural infrastructure to attenuate flood flows.

Plumas County also recommends that DWR address the possibility of climate change impacts on water supply and flood control. Because of its relatively low elevation, the Feather River Watershed would be one of the first areas to experience a reduced snowpack and altered hydrograph as a result of rising temperatures. For that reason, according to Plumas County, the new license should provide the opportunity to review changing conditions and make operational adjustments to respond to changes in the quantity and timing of flows into Lake Oroville.

In its May 26, 2006, filing with the Commission (DWR, 2006a), DWR states its opposition to Butte county's recommendation to relocate the Butte County Emergency Operations Center. It also states that the project provides significant flood control benefits to Butte County and that many of Butte County's requests are redundant with what is already contained in the Settlement Agreement.

The State Water Contractors and the Metropolitan Water Districts of Southern California (Metropolitan) in their joint May 26, 2006, filing (SWC and Metropolitan, 2006) state that global warming could be addressed under the Commission's ongoing regulatory role, including a possible license reopener. They also recommend issues related to the emergency spillway be addressed under the Commission's Part 12 process and/or by the Corps. Similarly, they recommend that any changes in flood control operations be addressed by the Corps. They also recommend rejecting the transfer of levee maintenance costs to DWR.

Staff Analysis

DWR would continue to operate the project for the purpose of flood control as directed by the Corps. Any modification of the project's flood control operation would be the responsibility of the Corps. To the degree that modifications would potentially affect dam safety, the Commission's Division of Dam Safety and Inspections and DWR's California Division of Safety of Dams would also be involved in the review process. Reservoir regulation manuals are strictly maintained and revised by the Corps, although DWR could be consulted by the Corps. If major operational revisions to the project are required as a result of future changes in hydrology, those could be addressed through the standard license reopener article.

Article 50 of the existing license states "The operation of the project in the interest of flood control as provided in Article 32 of the license shall be in accordance with the rules and regulations to be prescribed by the Secretary of the Army pursuant to Section 204 of the Flood Control Act of 1958 (Order amending license-major, Issued January 22, 1964)." Article 32 of the existing license states "The licensee shall collaborate with the Department of the Army in formulating a program of operation for the project in the interest of flood control (Order issuing license-major, December 14, 1956)." Continuation of the flood control stipulation of articles 32 and 50 into a new license would ensure that DWR operates the project consistent with Corps mandates.

Any dam safety issues associated with the emergency spillway are properly addressed through the Commission's ongoing dam safety program, not the relicensing process.

We encourage voluntary efforts by DWR to continue the pilot program it initiated as part of the Plumas Watershed Forum. The Oroville Facilities currently contribute up to 750,000 acre-feet of storage without compensation for the purpose of attenuating flood flows. We consider that providing additional attenuation upstream of Lake Oroville and outside the project boundary represents a discretionary, rather than an obligatory, measure on the part of DWR. We reviewed the bylaws for the Plumas Watershed Forum (Plumas County, 2006) and note that DWR is included as a participant. According to the bylaws, the Plumas Watershed Forum is a locally driven program. As such, we consider that imposing a federal obligation would seem contrary to its mission.

Formalizing communication and coordination with the affected flood control agencies through an early warning plan would improve flood safety and communication during emergencies. Staff considers that Sutter and Yuba counties could also be included in this process. Because any changes to flood control operations could affect Sutter and Yuba counties, and would use USGS data, these entities should be included in the development of communication protocols.

We analyze the recommendation for relocating the Butte County Emergency Operations Center in section 3.3.10, *Socioeconomic Resources.*

Additional Gaging (Measure B103)

Under Measure B103, *Additional Gaging*, DWR would evaluate and potentially implement additional stage and/or precipitation gaging locations to improve flood forecasting and monitoring.

Butte County recommends that, within 1 year following license issuance, DWR prepare a compliance and monitoring plan for existing project and non-project gages and submit to the Commission for its approval. Butte County recommends that DWR evaluate the existing project and non-project gages located within and upstream of the project boundaries, but within the Feather River Watershed, that measure precipitation, snow, reservoir stage, and stream flow. DWR's evaluation would determine the location and type of additional telemetered gages that would be needed to improve project flood flow forecasting, monitoring, and emergency management. Additionally, Butte County recommends that DWR install all such gages within 2 years of Commission approval of the plan and that all such gages be telemetered to the California Data Exchange Center real-time network. It recommends that the plan be developed in coordination and consultation with the Corps; USGS; and Butte, Yuba, and Sutter counties.

Staff Analysis

Stream gaging and forecasting (including other weather stations such as precipitation gages and snow pack measurement sites) aid the ability to forecast flood behavior and coordinate flood response. We have reviewed the existing stream gaging at the project[51] and find that it is adequate to ensure operational compliance with existing and proposed license articles. However, we recognize the concerns about flood control and would encourage DWR's efforts to coordinate with other agencies in developing plans, including additional stream gaging, to improve forecasting in the case of severe flood events as intended in Measure B103, *Additional Gaging*. We see an advantage in linking the compliance monitoring to the flood communications and coordination plan[52] for purposes of consultation. We do not see Butte County's recommendation and Measure B103 as mutually exclusive because preparing a compliance plan for gages both within the project boundary and outside the boundary would appear to support this measure.

Water Rights

The Anglers Committee et al. in their December 15, 2005, letter recommend that DWR obtain a water right permit to divert the underflow of the Feather River in the area of the Thermalito afterbay.

---

[51] The existing USGS gaging stations that provide compliance information about instream flows and ramping rates within the project boundary are Lake Oroville near Oroville, CA (11406800), Feather River at Oroville, CA (11407000), Thermalito Afterbay Release to Feather River near Oroville, CA (11406920), and Thermalito Afterbay near Oroville, CA (11406870).

[52] According to appendix D of the preliminary draft environmental assessment (see page D-8), DWR installed a siren at Oroville dam as an Interim Project to alert recreationists and others in the diversion pool area downstream of Oroville dam that spillway releases are imminent. We are not aware of any information on this system that has been filed with the Commission.

Additionally, the Anglers Committee recommends that DWR provide proof that it is only storing and diverting the amount of water authorized for Lake Oroville and other project facilities in accordance with the State of California water right permitting process. Finally, the Anglers Committee recommends that DWR submit to the Commission a report that shows the amount of water stored and diverted by the licensee at the Oroville Facilities, including the water right permits that authorized said storage and diversion.

Staff Analysis

Water rights in California are regulated under the Water Board's Division of Water Rights. The Commission does not have jurisdictional authority to resolve California's water rights issues. We summarize DWR's water rights related to the Oroville Project in section 3.3.2.1, *Affected Environment,* in *Water Quantity and Quality*

Water Quality

In general, waters in the project area meet applicable water quality standards for temperature, DO, nutrients, pH, and other pollutants in the majority of samples DWR collected. In the few instances in which Basin Plan objectives were not met, exceedances can be attributed to non-project sources (e.g., natural conditions and runoff from roads and parking areas) and are not related to project operations. However, operational changes agreed upon in the Settlement Agreement, as well as facility upgrades, such as the proposed minimum instream flows, facility modifications, Feather River Fish Hatchery temperature requirements, and monitoring plans are designed to manage the quality of project waters. Therefore, we further consider water quality issues pertaining to instream flows and temperatures, Feather River Fish Hatchery temperatures, and monitoring.

Flow/Temperature to Support Anadromous Fish (Proposed Article A108)

Low Flow Channel—Water releases from the Hyatt powerhouse flow into the Thermalito diversion pool. From here, most water is diverted to the Thermalito Complex for additional hydropower generation and a smaller quantity of water is released into the low flow channel. This comparatively lower volume of water released into the low flow channel is susceptible to warming, potentially compromising the water quality and other resources. Currently, DWR is required to release 600 cfs to the low flow channel under the existing license. Under Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*, the minimum instream flows in the low flow channel would be increased to 700 and 800 cfs, depending on the time of year (see bulleted items titled Low Flow Channel—Instream Flow in section 2.2.2, *Proposed Project Operations*), to improve the aquatic habitat and resources in these areas. Although these flow releases would primarily be provided to enhance aquatic habitat, the releases are also designed to meet certain proposed temperatures objectives in the receiving reaches. To ensure the project would consistently meet the proposed flow and temperature objectives presented in the Settlement Agreement for the low flow and high flow (if possible, as this is a second priority) channels, DWR proposes to study the feasibility of making structural modifications to the project, which, at a minimum, would include one of the following: (1) Palermo Canal improvements, (2) Hyatt intake extensions, (3) replacement of the river valves with valves specifically designed to incrementally control water releases, (4) construction of a diversion canal around or through the Thermalito afterbay, and (5) construction of an alternative Thermalito afterbay outlet and channel in the OWA to the Feather River. DWR has committed to implementing one or more facility modifications or other actions that the feasibility study suggests are most effective in terms of meeting low and high flow temperatures (shown in section 2.2.2, *Proposed Project Operations*) and cost.

Before physically modifying the facility, DWR would perform, in consultation with resource agencies, a comprehensive reconnaissance study, and prepare both a feasibility report and an implementation plan for modifying the facility to improve temperature conditions in the low flow and high flow channels and allow DWR to meet other water resource obligations (e.g., anadromous fish needs, flood control, recreational needs, water deliveries). The study plan, feasibility report, and implementation plan as well as documentation of consultation would be filed with the Commission within 3 years of license issuance.

Plumas County, in its March 15, 2006, letter to the Commission, recommends that DWR maintain sufficient coldwater reserves within Lake Oroville to support the habitat needs of the endangered species in the Feather River. The Anglers Committee et al., in their December 12, 2005, letter filed with the Commission recommend that whenever the elevation of Lake Oroville drops below the bottom outlet shutter at Oroville dam, DWR release water from the river outlet to maintain coldwater temperatures in the Feather River downstream of the dam for the protection of anadromous fish resources. The Feather River Diverters, in their February 13, 2006, letter filed with the Commission, recommend the temperatures in the Thermalito afterbay be sufficiently warm enough (equal to or greater than 65°F during the 4-week planting season, and warmer than 59°F during the rest of the season until harvest or October 31) to ensure continued use of diverted water to irrigate rice crops in the service area.

Staff Analysis

DWR suggests several alternative facility modifications that could be implemented to supply temperature appropriate water to both the low flow and high flow channels; however, without knowing which of the facility modifications would be implemented at this time, staff can only analyze the effects that would exist under the interim and post-facility modification temperature requirements. Under the Proposed Action, the minimum flows in the low flow channel would be 100–200 cfs higher than current conditions, and the temperature objective in the low flow channel would be cooler than the existing maximum of 65°F stated in the NMFS 2002 and 2004 Biological Opinions. The periods for specific proposed temperature objectives are more refined (e.g., down to 2-week intervals) and include a not-to-exceed maximum water temperature, which is not included in the existing requirements. Although the interim temperature objectives would be considered targets and exceedances would not be violations of the license, DWR would operate the project so that temperatures would be lower than what currently exists in the low flow channel at Robinson Riffle.

During drier years, the coldwater pool in Lake Oroville could become exhausted, making it difficult to meet the temperature objectives. Allowing the temperature objectives to be considered targets that DWR would seek to attain during the interim period would provide DWR sufficient time to transition to post-facility modification operations. Although this operational flexibility would allow warmer temperatures to exist within the low flow channel, the duration of such effects would likely be temporary. Because the temperature objectives would become license requirements after facility modifications were completed or after 10 years, whichever occurs first, this potential condition would not exist beyond year 10 of any new license issued.

Until the facility modifications are completed, increased flows to the low flow channel would likely originate from the Thermalito diversion pool, which could also improve other water quality conditions in the Feather River. Increased flows to the low flow channel could flush out the decomposing salmon carcasses present at the end of the spawning season which could have been responsible for the reported low DO concentration (see 3.3.2.1, *Affected Environment* in *Water Quantity and Quality*). Increased flows would also provide more water to mix with the fish hatchery effluent. As such, implementation of the proposed temperature objectives and slightly higher flow regime would result in cooler temperatures in the low flow channel as measured at Robinson Riffle than those that exist under current conditions. The biological effects of the proposed temperature regime are discussed in greater detail in section 3.3.3.2, *Effects on Aquatic Resources*.

Although the proposed minimum instream flows for the high flow channel are the same as under current operations, DWR proposes to meet certain temperature objectives (see low flow and high flow channels table in section 2.2.2, *Proposed Project Operations*). Establishing and achieving these temperature targets downstream of the project would increase the amount and extent of cool water in the Feather River to support anadromous fish resources beyond existing conditions.

Temperatures of project waters are also of interest to the irrigators and rice farmers who receive their water from the Thermalito afterbay. Water in the Thermalito afterbay can be used for pump-back operations, releases to the Feather River, and/or releases to the Feather River service area. Under the Proposed Action, DWR would increase flow in the low flow channel to accommodate aquatic resource requirements. It is difficult to project the effects of the Proposed Action in terms of the temperature of the water delivered to irrigators and rice farmers due to the absence of operational and temperature modeling, the dynamic nature of pump-back operations and the impending facility modifications. Even if less water would need to be released from the Thermalito afterbay to meet temperature objectives in the high flow channel and other operational aspects of the projects were not drastically changed, water temperature in the Thermalito afterbay would likely be very similar to what currently exists. Overall, we expect temperatures of water delivered to the agricultural diversion under the Proposed Action to be similar to current conditions. It is likely that any positive effects would be most pronounced during drought years when DWR's ability to make releases above the minimum flows would be compromised, allowing for additional warming.

Under the Proposed Action, increased minimum flows in the low flow channel would result in about 17 percent more water in the low flow channel from April 1 to September 9 (the growing season), resulting in a corresponding reduction in water needed to meet the minimum instream flows in the high flow channel (assuming temperature requirements are being met) since that water would already be in the river. Because the volume of the power canal is so large relative to the amount of additional water proposed to be released to the low flow channel, this would result in less than 1 percent change in the volume reaching the Thermalito afterbay. As such, if DWR does not select a facility modification involving the Thermalito Complex, the irrigators could expect water temperatures at least similar to existing conditions. Changes in temperatures of the water delivered would depend on climatic factors (e.g., air temperatures, water year types, etc.) that would affect how DWR operates to meet minimum flow requirements; however, staff expects that overall, any changes in temperature would be modest. The effects of the Proposed Action on the irrigators and subsequently county tax revenues are discussed in section 3.3.9.2, *Effects on Socioeconomic Resources*.

Feather River Fish Hatchery—DFG currently operates the Feather River Fish Hatchery in conjunction with DWR to meet anadromous salmonid production goals under the existing license. Sufficiently cool water temperatures throughout the hatchery complex are required for successful fish rearing at the hatchery. Under Proposed Article A108, *Flow/Temperature to Support Anadromous Fish,* DWR would continue working with and operating the fish hatchery with DFG and develop a comprehensive management plan to set forth certain temperature goals and other items. DWR proposes interim and post-facility modification temperature objectives for the Feather River Fish Hatchery as measured hourly at the intake/aeration tower at the fish barrier dam. The proposed temperature objectives for both the interim and post-facility modifications are presented in section 2.1.2.4, *Minimum Instream Flows*, and 2.2.2, *Proposed Project Operations*.

During the interim period, DWR would attempt to meet the temperature objectives at the fish hatchery through either (or in combination) releases from the river outlet at the base of Oroville dam, eliminating pump-back operations, or removing stoplogs at the Hyatt intake structure. Upon completion of the facility modifications, DWR reserves the right to develop new hatchery temperature requirements that would be at least as protective as the pre-facility modification temperature objectives described in section 2.2.2. New temperature objectives would be developed in consultation with FWS, NMFS, DFG, the Water Board, and the Regional Board and filed with the Commission.

Staff Analysis

The proposed (interim) temperature objectives for the fish hatchery during the pre-facility modification period would be similar to existing conditions. Because they would be set at or below the maximum temperature objectives in the current agreement with DFG, staff expects DWR to use the river outlet to meet the temperature objectives at the fish hatchery until at least the facility modifications are completed. However, coldwater reserves within Lake Oroville could be diminished at low lake elevations and the river outlet may not be able to supply enough cold water to the fish hatchery to meet the temperature targets under all circumstances. DWR's proposal to allow exceedances of the temperature objectives prior to completing facility modifications would allow DWR to pass warmer water to the fish hatchery without violating a condition of the license. Even if DWR makes every attempt to meet the temperature objectives using releases from the river outlet or by curtailing pump-back operations, the potential to exceed the objectives exists, which could also affect water temperatures in the Feather River downstream of the fish hatchery. Exceedances of the interim targets have the highest probability to occur during drought years, when the coldwater pool within Lake Oroville is diminished.

Once facility modifications are completed, the maximum temperature objectives would be the same as those listed in the existing 1983 agreement between DWR and DFG.

Releases from the river outlet originate in Lake Oroville between the depths of about 350 feet and 90 feet, at normal full and normal minimum pools, respectively. Water passed from the river outlet would exhibit similar characteristics as deep water in the reservoir which, during the summer when the reservoir is stratified, is low in DO. If the river outlet were used as a source to provide coldwater increases under extreme conditions, water with low concentrations of DO from the bottom of the reservoir could pass to the Thermalito diversion pool. An aeration device at the fish hatchery intakes would prevent DO-deficient water from entering the facility, and water passing over the fish barrier dam would become aerated through natural mixing. DWR reports that, since project development, there have been no DO-related issues recorded at the Fish Hatchery.

The quality of water within the Thermalito diversion pool could also influence water quality in the low flow channel. However, it is unlikely that water with low DO concentrations would enter the low flow channel because the proportion of water entering the Thermalito diversion pool from the river outlet is quite small compared to the overall volume of the impoundment. Depending on the generation mode, water in the Thermalito diversion pool consists of a combination of waters from Lake Oroville from the depth of the intake shutters; the river outlet; the Kelly Ridge powerhouse; and during pump-back operations, from the Thermalito Complex. As such, the Thermalito diversion pool is usually well mixed, diminishing the risk of passing low DO water from the river outlet to the low flow channel.

Fish Weir Program (Proposed Article A105)

Under Proposed Article A105, *Fish Weir Program*, DWR would install one or potentially two fish weirs near the Thermalito afterbay. This measure is described in detail in section 3.3.5.2, *Threatened and Endangered Species*.

Staff Analysis

While the purpose of the proposed fish weirs is related to management of salmonid fishery stocks, construction of these weirs could affect water quality. We conclude that implementation of best management practices during construction would minimize potential effects on water quality.

Comprehensive Water Quality Monitoring Program (Proposed Article A112)

Although the overall water quality of the project is meeting the Basin Plan objectives, the numerous facility developments outlined in the Proposed Action and extensive recreational use at the project have the potential to negatively affect the water quality throughout the term of a new license. Pathogen monitoring studies performed by DWR in 2003 and 2004 indicated that bacteria levels in project waters exceeded Basin Plan objectives at public recreational sites, requiring occasional public postings or beach closures.

Under Proposed Article A112, *Comprehensive Water Quality Monitoring Plan*, DWR would design and implement a comprehensive water quality monitoring plan. The objective of the plan would be to track potential changes in water quality associated with the project and collect data necessary to develop a water quality trend assessment through the life of the new license. The sampling plan would include components to sample water chemistry, fish tissue, petroleum product concentrations, water temperatures, bioassays, and aquatic macroinvertebrate monitoring. Interior's and DFG's 10(j) recommendation no. 9 are consistent with this proposed article. Fish tissue sampling and consumption advisories are discussed in greater detail in subsequent sections.

To address the high pathogen monitoring results, DWR proposes to monitor fecal coliform, enterococcus bacteria, and/or other bacterial indicators between June 1 and September 30 at developed and popular undeveloped swim areas within the project boundary at the North forebay recreation area, South forebay recreation area, Loafer Creek recreation area, Monument Hill recreation area, Lime Saddle recreation area, Foreman Creek boat launch, Stringtown boat launch, and One Mile Pond as shown in figure 17. Monitoring would be performed in a manner consistent with the Basin Plan criteria. If indicator bacteria levels exceed the Basin Plan standards, DWR would notify the appropriate public agencies and take measures to educate the public about bacteria levels in project waters and post beach closures as appropriate.

The comprehensive water quality monitoring plan would be developed in consultation with the Ecological Committee, including specifically FWS, NMFS, DFG, the Water Board, Regional Board, and Butte County Health Department. DWR would file summary reports of its findings in each of the first 5 years of the initial program with the Ecological Committee and a summary report to the Commission. DWR would develop a final comprehensive water quality monitoring plan based on the results of the first 5 years of sampling and consultation with interested parties. Pathogen monitoring would be performed in consultation with the Butte County Health Department, DHS, DPR, the Water Board, the Regional Board, and any other appropriate public agency.

Butte County, in its letter to the Commission dated April 24, 2006, states that DWR's proposal to post human-health warnings and close recreational areas would be an inadequate way to protect human health. Instead, it recommends that DWR work with Butte County Health Department, the Water Board, and the Regional Board to develop mitigation options that would improve the water quality specifically at the North forebay swim area and cove. Butte County recommends exploring improvements to water circulation within the forebay, channel improvement to deliver more water into certain areas increasing circulation near the public swim areas, or another method. The Anglers Committee et al., in its December 12, 2005, letter to the Commission suggest that children swimming at Bedrock Park are at risk of high bacterial counts due to project operations.

In its comments on the draft EIS, the Water Board states that alternatives that avoid or reduce the effect of poor water quality at the project swim areas, due to high levels of pathogens, should be developed and included in the final EIS. Butte County makes a similar suggestion in its comments on the draft EIS, stating that the Commission should require DWR to substantively address every water quality problem that poses a threat to public health and safety.

Staff Analysis

Currently, DWR regularly monitors water quality for a few constituents throughout the project. Developing a comprehensive water quality monitoring program that includes additional types and numbers of water quality parameters and increases the sampling frequency would develop a thorough record, which would be more valuable than the existing sampling program. The proposed comprehensive monitoring program would allow the DWR to assess water quality from upstream areas, within project waters, and outflow downstream of the project boundary. Collecting enough data to develop a water quality trend assessment throughout the term of any new license issued would establish a large, detailed water quality record providing DWR and the Ecological Committee with data sufficient for adaptive management of the various resources.

DWR's proposal to monitor the water quality is prudent and appropriate because the Proposed Action would include developing new facilities and modifying existing facilities, structures, flow, temperature regimes, and river channels. Installing permanent temperature monitoring devices at the fish hatchery, Robinson Riffle, Thermalito afterbay outlet, and southern project boundary as well as providing real-time flow information would improve DWR's ability to protect the resources within the project. Regular reporting to the Ecological Committee and Commission would allow for adaptive measures to be developed if proposed operations threaten to fail the proposed temperature requirements and the Basin Plan objectives.

A permanent pathogen monitoring program would address the high bacterial counts recorded in DWR's relicensing studies and protect public health. The North forebay swim area is one of the most popular swim areas within the Thermalito Complex because of its easy access and proximity to Oroville. Monitoring results for the swim area had the greatest number of exceedances and the highest levels of bacteria out of the popular recreational areas. Because the swim beach is in a small bay with a very narrow opening to the main North forebay, the exchange of water between the two waterbodies is severely limited. The configuration makes for a swim area protected from the river current, which appeals to families with children, but it also provides suitable conditions for bacteria to thrive. Developing and implementing a pathogen monitoring plan would be an appropriate first step in understanding risks to public health because such a plan would require that exceedances currently occurring at specific recreational sites be monitored. A regular monitoring plan with monthly reporting would provide the public with important information to assist in making recreation-based decisions. If unsafe bacteria levels are recorded, public notices posted by DWR would alert the public to the potential hazard and trigger consultation with relevant public health agencies to determine if a companion public education program to inform the public about potential bacteria sources in the water would be necessary.

Multiple closures of the beach throughout the recreational season could severely limit swimming opportunities within the North forebay. If monitoring results in multiple closures of the swim area and consultation with the appropriate agencies then investigating and implementing improvements would reduce or possibly eliminate beach closures.

Public education and deterring waterfowl presence at the swim area could reduce bacteria loading. Public education efforts should start immediately as the proposed monitoring program could evaluate whether educational efforts improve water quality conditions.

The swim area at Bedrock Park,[53] specifically constructed for that purpose, is protected from the main channel by an extension of the shoreline that extends from the south shore upstream from Bedrock Park into the river, turns and runs parallel with the river blocking off the main channel from the shoreline. DWR monitoring results from 2002 show fecal coliform counts were high on Labor Day weekend in the swim area (332 colonies per 100 mL), which is just below the DHS single sample criteria. However, samples collected directly upstream of the swim area exhibited bacterial levels below 10 colonies per 100 mL during the same period. The configuration of the swim area and its isolation from the main channel create an environment supportive of high bacterial counts (i.e., stagnant, warmer water used for swimming), rather than operation of the project as suggested by the Anglers Committee et al.

---

[53] Bedrock Park is part of the Feather River Recreation & Parks District and is located on the south side of the Feather River in Oroville between 4th and 5th streets outside the project boundary.

Public Education Regarding Fish Contamination (Proposed Article 114)

Land disturbances within the watershed upstream of the project (e.g., natural resource extraction practices, residential development) have released metals and other contaminants into the waters, and these contaminants make their way into the project area and subsequently into the food chain. One waterbody upstream of Oroville dam is listed as impaired under Section 303(d) of the Clean Water Act. The North Fork Feather River below Lake Almanor is listed for temperature and mercury. The Feather River downstream of Oroville dam to its confluence with the Sacramento River is listed on the 303(d) list of waters as impaired by sources of mercury, certain pesticides, and unknown toxicity. A TMDL has been established for the pesticide Diazinon for the Feather River below Oroville dam to the confluence with the Sacramento River. Sport anglers who harvest their catch from project waters are susceptible to exposure to potentially harmful toxins by eating fish with elevated concentrations of contaminants. Under Proposed Article A114, *Public Education Regarding Fish Contamination*, DWR proposes a public education campaign to post notices at all boat ramps and any other locations specified by OEHHA about health issues associated with consuming fish taken from project waters. The reporting would be developed in consultation with OEHHA, the Water Board, Regional Board, and Butte County Health Department. Compliance reports would be filed annually with the Commission.

Staff Analysis

Results from the DWR fish tissue sampling study performed during the relicensing studies indicate that metal concentrations in tissue samples are occasionally elevated as compared to recommended guidelines from various regulatory agencies. Proposed fish tissue sampling performed under the comprehensive water quality monitoring program would supply the data necessary to initiate posting advisory notices related to fish consumption. Further monitoring, agency consultation and the postings would alert the public to the hazards associated with the consumption of fish caught from project waters. Educating the public would serve to minimize the consumption of fish with high levels of contaminants. DWR's proposed long-term monitoring program would help determine if contaminant concentrations in fish tissue change over time and would determine the need for future public fish consumption advisories.

3.3.2.3 Cumulative Effects

Water Quantity

Since construction of the Oroville Facilities and other FERC-licensed projects upstream of the Oroville Facilities, project operations have affected water quantity throughout much of the Feather River Basin. No dedicated flood control exists in the upper basin. However, typically hydroelectric projects will refill during the spring runoff period and may provide incidental flood control. The Integrated Regional Water Management Plan (Ecosystem Sciences Foundation, 2005) does include flood control as one of seven strategy elements and this may eventually result in improved flood flow management in the Upper Feather River Watershed.

The Proposed Action would slightly increase flows in the low flow channel; however, such changes would not be expected to produce a major shift in flows downstream of the Oroville Facilities. Under all the alternatives, we would expect average annual Feather River service area deliveries under existing conditions and year 2020 conditions[54] to remain 994,000 acre-feet, and average annual South Delta deliveries to increase from the existing 3,051,000 acre-feet to 3,247,000 acre-feet in year 2020. Although the annual flows in the Feather River downstream of Thermalito afterbay would remain similar over time, there is a seasonal change in flow distribution with higher flows occurring from May through

[54] DWR bases its water use projections presented in its application using the year 2020.

August and lower flows occurring from September through April under year 2020 conditions as compared to existing conditions.

We view Feather River flood control activities as cumulative effects because flood control at the Oroville Facilities is the responsibility of the Corps. The Corps is currently involved in several studies and reports that were summarized in *SP-E4: Flood Management Study* and appended to the final license application. We summarize briefly the conclusions and status of several of these flood related items.

The Feather River Floodplain and Water Surface Profiles report presents, for the Feather River from Oroville Dam to the mouth of the Yuba River, maps of floodplains for the floods with 1 percent and 0.2 percent probability of exceedance, floodway boundaries for the flood with 1 percent probability of exceedance, and water surface profiles for the floods with 10 percent, 2 percent, 1 percent, and 0.2 percent probability of exceedance. It also includes various input parameters and was performed to FEMA specifications to support federal flood insurance purposes.

The Yuba Feather Supplementary Flood Control Project began in 1997. Its goal is to define and implement as soon as possible a cost-effective, practicable program of measures to achieve a reliable level of protection against floods from the Feather and Yuba Rivers. Five measures for probable implementation include a storage increase at New Bullards Bar Reservoir, enlargement of outlets at New Bullards Bar Reservoir, tailwater depression at New Colgate Power Plant, forecast-based operations at New Bullards Bar Reservoir and Lake Oroville, and levee setback on the Feather River. In the opinion of Yuba County Water Authority, these measures collectively fall short of meeting the stated goal, therefore, YCWA is considering additional projects in the future.

The Yuba River Basin Project Feasibility Report and Final EIS and EIR were completed in April 1998. Congress authorized the project in the Water Resources Development Act of 1999, and the Record of Decision was signed in June 2000. The authorized project included specific levee modifications on 6.1 miles of the left bank of the Yuba River upstream of the confluence with the Feather River; 10 miles of levee on the left bank of the Feather River downstream of the confluence of the Yuba River; and 5 miles of the Marysville ring levee. The levee modification work as authorized was intended to bring the level of protection for these levees up to about a 200-year level of protection. On March 17, 2004, a notice of Intent to Prepare a Draft Supplemental EIS and EIR for the Yuba River Basin Project was posted in the Federal Register, with the Corps as the lead federal agency. A Supplemental Draft EIS, an EIR, was noticed on January 19, 2006, in the Federal Register. The proposed action would be a general reevaluation of the authorized project and other alternative plans to provide the level of flood protection previously planned and to restore riparian and aquatic habitats in the project area.

Another Corps regional study with an interim report was issued in December 2002 and was focused on the Sacramento and San Joaquin river basins. The goal of the *Sacramento and San Joaquin River Basins Comprehensive Study* is to develop an approach for projects on those rivers and their major tributaries that will solve flooding and ecosystem problems more effectively than present methods do.

A third major regional Corps study involves Sutter County. The notice of Intent to Prepare a Joint EIS and EIR for the Sutter County Feasibility Study, Sutter County, CA was published in the Federal Register on September 12, 2001. The objective of the Sutter County Feasibility Study is to present the purpose and status of alternatives to reduce future flood damages on the Sacramento River, the Feather River, the Sutter Bypass, and other watercourses in Sutter County. The study focuses on the integrity of the facilities of the Sacramento River Flood Control Project, particularly at those locations where flooding problems have been most likely to occur. The Sutter County Feasibility Study will also investigate opportunities to integrate ecosystem restoration measures and will produce an environmental document." The Corps, Reclamation Board, and Sutter County are all participants in the study. Some of the alternatives under consideration in this study include (1) enlarging existing levees along the Feather and Sacramento Rivers, and the Natomas Cross Canal; (2) realigning levees along the Feather, Bear, and Sacramento Rivers; (3) constructing a ring levee to the east of Yuba City; (4) constructing a channel or levee intercepting flows above Yuba City; (5) reoperating Feather and Yuba River upstream reservoirs; (6) adopting a local flood plain management plan; (7) removing sediment from the Sutter Bypass, Feather and Sacramento River, and canal systems; (8) reoperating state pumps and drain lines; (9) improving levees along the Sutter Bypass; and (10) modifying the Tisdale Bypass to convey higher flows sooner.

Water Quality

None.

3.3.2.4 Unavoidable Adverse Effects

Water Quantity

None.

Water Quality

Extractive land use practices in the watershed upstream of Lake Oroville are expected to continue throughout the term of a license, and could continue to release metals into the Feather River and Lake Oroville. Many of the metals are associated with sediments, and staff expects sediment metals to increase over the term of a license because the dam traps much of the settleable material within Lake Oroville. DWR would sample fish tissue, as proposed under the comprehensive water quality monitoring plan, to detect any threats to sport anglers who ingest contaminated fish. This practice would trigger fish consumption advisories. Long-term monitoring would also allow DWR to assess how metal concentrations change over the term of a license.

3.3.3 Aquatic Resources

3.3.3.1 Affected Environment

Aquatic environments associated with the Oroville Facilities include the upper Feather River tributaries, Lake Oroville, the Thermalito diversion pool, Thermalito forebay, Thermalito afterbay, the fish barrier pool, the Feather River Fish Hatchery, OWA ponds, and the Feather River. Lake Oroville and its tributaries, together with the Thermalito Complex, support warmwater and coldwater recreational fisheries.

Fish species of primary management concern found in the project area include the following:

- Species listed as threatened under the California Endangered Species Act or federal Endangered Species Act (ESA): Spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley steelhead (*O. mykiss*), and green sturgeon (*Acipenser medirostris*);
- State species of special concern: Fall-run Chinook salmon, Sacramento splittail (*Pogonichthys macrolepidotus*), river lamprey (*Lampetra ayresi*), and hardhead (*Mylopharodon conocephalus*); and
- Species that are recreationally or commercially important: Fall-run Chinook salmon, Central Valley steelhead, American shad (*Alosa sapidissima*), coho salmon (*O. kisutch*), striped bass (*Morone saxatilis*), and four species of black bass.

Table 26 summarizes the overall fish species composition within the project study area, identifies species of primary management concern related to the Oroville Facilities, 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.

Table 26. List of fish species within the study area. (Source: DWR, 2005a, 2001b)

Common Name *Scientific Name*	**Regulatory Status**[a]	**Primary Management Concern Species**[b]	**California Native or Introduced**	**Location Within Study Area**[c]	**Abundance/Mgmt Status**[d]
Pacific lamprey *Lampetra tridentata*	FSC	No	Native	LFR	DFG watch list
River lamprey *Lampetra ayresi*	CSC FSC	Yes	Native	LFR	DFG watch list
Green sturgeon *Acipenser medirostris*	CSC FT	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	Infrequently observed
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	DFG watch list
Hitch *Lavinia exilicauda*	--	No	Native	TA, LFR	DFG watch list
Sacramento pikeminnow *Ptychocheilus grandis*	--	No	Native	UT, LO, TF, DP, TA, LFR	Stable or increasing
Sacramento splittail *Pogonichthys macrolepidotus*	CSC[f] 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

Common Name *Scientific Name*	Regulatory Status[a]	Primary Management Concern Species[b]	California Native or Introduced	Location Within Study Area[c]	Abundance/Mgmt Status[d]
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
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[g]	Yes	Native	FRFH, LFR	DFG watch list
Spring-run Chinook salmon *Oncorhynchus tshawytscha*	ST FT	Yes	Native	FRFH, LFR	Threatened or endangered
Coho salmon *Oncorhynchus kisutch*	CSC FT[h]	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

Common Name ***Scientific Name***	**Regulatory Status**[a]	**Primary Management Concern Species**[b]	**California Native or Introduced**	**Location Within Study Area**[c]	**Abundance/Mgmt Status**[d]
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	DFG 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
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

[a] FT – listed as threatened under ESA; ST – listed as threatened under the California Endangered Species Act; FE – federally listed as endangered; FC – candidate for listing under ESA; FSC – federal species of concern; CSC – California species of special concern.

[b] 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 the ESA or California Endangered Species Act, candidate species for listing under ESA or the California Endangered Species Act, and California species of special concern.

[c] Frequently or infrequently observed in the following: UT – upstream tributaries; LO – Lake Oroville; DP – Thermalito diversion pool; TF – Thermalito forebay; TA – Thermalito afterbay; FRFH – Feather River Fish Hatchery; OWA – Oroville Wildlife Area ponds; LFR – Lower Feather River.

[d] As defined in Moyle (2002).

[e] However, on April 6, 2005, after reviewing new and updated information about the status of green sturgeon and considering whether green sturgeon is in danger of extinction now or in the foreseeable future throughout all or a significant portion of its range, NMFS published a proposed Federal Register Rule (70 FR 17386 to list the Southern Distinct Population Segment of green sturgeon as threatened under the ESA), but reaffirmed its earlier finding that the Northern Distinct Population Segment does not warrant listing under the ESA at this time. They did, however, recommended that it remain on NMFS Species of Concern List (69 FR 19975) due to remaining uncertainties about its status and threats.

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

[g] 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 NMFS received a petition for listing. Pursuant to that review, NMFS found that the species did not warrant listing as threatened or endangered under ESA, but sufficient concerns remained to justify addition to the candidate species list. On April 15, 2004, NMFS 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, NMFS 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 NMFS’ April 15, 2004, interpretation of ESA provisions, the Central Valley ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977).

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

Description of Project Area Waters

Tributaries to Lake Oroville

Lake Oroville has four main tributaries: the North Fork, West Branch, Middle Fork, and South Fork (see figure 2). The Middle Fork is designated as a National Wild and Scenic River and a Heritage Trout Water, and it is designated by DFG as a Wild Trout River through the Trout and Steelhead Conservation and Management Planning Act of 1979. Trout management in the Middle Fork includes rainbow trout and brown trout.

Habitat in the tributary reaches upstream of Lake Oroville is mountain trout stream habitat and has the potential to support salmonid spawning and rearing. Generally, DFG manages the tributaries upstream of Lake Oroville for coldwater fish species. The Oroville Facilities and operations do not affect flow and water temperature in the tributaries upstream of Lake Oroville.

The Oroville Facilities and operations prevent fish passage upstream of the fish barrier dam. Fish species in the tributaries upstream of Lake Oroville and downstream of the first impassable fish barrier on those tributaries include rainbow trout and brown trout, bluegill, brown bullhead, carp, largemouth bass, redeye bass, roach, smallmouth bass, spotted bass, Sacramento pikeminnow, Sacramento sucker, roach, and sculpin. Of the game fish observed, only rainbow trout are considered native to the drainage. PG&E confirmed the presence of hardhead, largemouth bass, and brown bullhead in the North Fork during surveys conducted prior to 2002. Of these three species, only hardhead are native to California.

Fish species of primary management concern observed in upstream tributaries were not unique to the tributaries; all have been previously observed in Lake Oroville or downstream reaches of the Feather River (DWR, 2005a, appendix G). Historical records indicate that Chinook salmon were present in all four major branches of the Feather River upstream of the present location of Oroville dam, but their specific distribution and abundance among the smaller tributaries are largely unknown. Spring-run Chinook salmon usually spawned in higher streams and headwaters than fall-run Chinook salmon, which prefer lower regions of tributaries and mainstem river areas for spawning. Early documentation of historical salmon abundance rarely mentions steelhead distribution or abundance in the Feather River Basin. Because steelhead have similar spawning habitat preferences as spring-run Chinook salmon, they are believed to have occupied the same areas as the spring-run Chinook (DWR, 2003a).

Lake Oroville reservoir operations influence the accessibility of the upstream tributaries to fish species within Lake Oroville through the stage elevation of the reservoir. Although currently unavailable to anadromous species due to downstream barriers to migration, the four major tributaries generally provide suitable habitat for all life stages of Chinook salmon and steelhead. The fish barrier dam was constructed during the early 1960s as part of the Oroville Facilities. Located upstream of the Feather River Hatchery and 5 miles below Oroville dam, the fish barrier dam is identified as the first impassible salmonid migration barrier on the Feather River (DWR and USBR, 2000; Yoshiyama et al., 1998).

Historically, the upper Feather River watershed provided habitats for anadromous and resident salmonids. Spring-run Chinook salmon and steelhead were reported to ascend the very highest, accessible streams and headwaters of the Feather River Watershed, while fall-run Chinook salmon occupied the lower foothill reaches (DWR and USBR, 2000; Yoshiyama et al., 1998). Prior to the construction of Oroville dam, the upstream extent of fish passage was limited by natural fish barriers and previously constructed hydroelectric projects. PG&E maintained a seasonal flashboard dam downstream of the current Highway 162 bridge until the Oroville Facilities were constructed. Hydropower development was preceded by aggressive mining techniques in the 1800s that included complete diversion of the North Fork Feather River through a pipeline that blocked river access for migratory fishes, so that the miners could access the riverbed.

Currently, the first impassable fish barriers in the upstream tributaries are identified as the falls downstream of Big Kimshew Creek for the West Branch, Curtain Falls for the Middle Fork, and Ponderosa dam for the South Fork. Big Bend dam on the North Fork may be passable during some high reservoir elevations; if so, the next upstream barrier would be Poe dam (figure 9 shows these fish barriers). Figure 15 (from DWR, 2004) shows the historical extent of anadromous salmonid spawning habitat in the upper Feather River watershed above the Oroville Facilities as defined by Yoshiyama et al. (1998) and the current habitat potential upstream of the fish barrier dam. Figure 15 also shows the current geographic scope for cumulative effects analysis.

Thalweg bathymetric surveys indicate substantial deposits of sediment in the middle-upper portions of all four major tributary arms (DWR, 2004k, appendix c). These deposits are located straddling the boundary between the fluctuation zone (those reservoir elevations from 640 feet to 900 feet msl) and the reservoir storage zone (below 640 feet[55]). Hence, channel reaches above the 900-foot elevation are never inundated by the lake and are always subject to fluvial conditions; those channel reaches below the full pool level (i.e., within the fluctuation zone) experience repeated inundations and alternate from fluvial to lentic (i.e., still water) conditions.

Updates from the *Interim Report to the Final Report for SP F3.1: Task 1A* include an evaluation of the Lake Oroville sediment wedges as potential fish passage barriers. Results indicate that during some years, anadromous salmonid passage could be impeded by the sediment wedges in each of the four major tributaries to Lake Oroville (DWR, 2004q). The sediment wedges are shown in figure 9.

Elevations of the upstream ends of the sediment wedges ranged from 700 to 720 feet at the time of the bathymetric survey (June 2003). Elevations of the downstream ends ranged from 530 feet (North Fork arm) to 630 feet (South Fork arm). All four sediment wedges had a long, nearly level upper portion that ranged from about 4,300 feet (South Fork arm) to 11,200 feet (North Fork arm) in length (see figure 9). All sediment wedge profiles displayed a series of slope breaks downstream of the upper nearly level portion.

Although the greater bulk of sediment currently resides below the 720-foot elevation, some minor sediment features (lag deposits) still reside above 720 feet along the tributary channels within the fluctuation zone. Lateral gravel and sand deposits along the edges of the exposed river channel were observed in the West Branch, Middle Fork, and South Fork arms. These deposits are remnant portions of the sediment wedge material and are generally located in the wider portions of the former river channel where stream energy tended to erode only the center portion of the channel. The sediment characteristics are similar to materials in the sediment wedge but have a greater amount of cobble-sized material.

Channel morphology and movement of sediment wedge material within the exposed fluctuation zone vary according to several key criteria, including reservoir water level elevation, the rate of decline or increase of that water level elevation; sediment wedge elevation; tributary discharge quantity; and the incoming sediment volume. Because of this, channel morphology in one location can range markedly over time. For example, a channel at a specific site can go from a braided, sand-bedded channel to a relatively steep, cobble-dominated plane-bed channel several weeks later when reservoir levels are declining.

55 The reservoir storage zone has been inundated ever since the initial filling of Lake Oroville in 1967. The lowest lake levels that have been attained to date were 645.11 feet on September 7, 1977, and 651.48 feet on January 30, 1991.

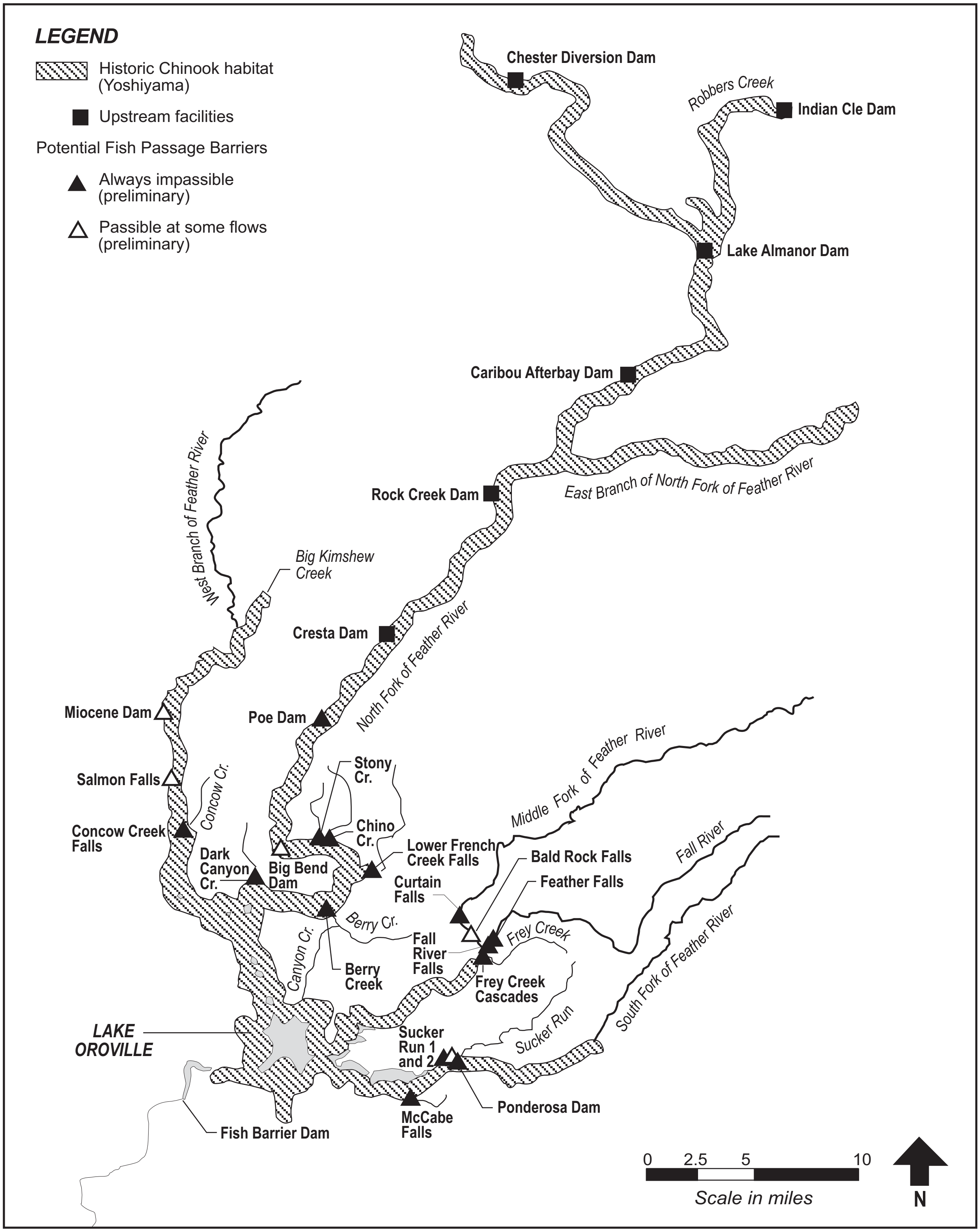


Figure 15. Historical Chinook salmon spawning distribution (Yoshiyama et al., 1988) and current expected geographic scope of the cumulative effects analysis for fish passage. (Source: DWR, 2004, as modified by staff)

When Lake Oroville is at high water surface elevation (typically in the spring), fish can pass over the sediment wedges that exist within the fluctuation zone of Lake Oroville and access the reaches of the tributaries upstream of Lake Oroville's high water mark (figure 9). When Lake Oroville is at low water surface elevation (typically in the fall), low water levels in the tributaries within the fluctuation zone may be low enough to prevent access to tributaries above Lake Oroville's high water mark. In this case, fish cannot access the spawning areas in the regions of the tributaries above Lake Oroville's high water mark.

Lake Oroville

Lake Oroville has a maximum surface area of 15,810 acres at elevation 900 feet msl, 167 miles of shoreline, and a normal maximum seasonal drawdown of 260 feet. The reservoir typically thermally stratifies into three layers beginning in the spring, begins to de-stratify in the fall, and remains relatively uniform throughout the winter (see section 3.3.2.1). Because of this stratification regime, Lake Oroville supports 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 de-stratifies in the fall, the two fishery components mix in their habitat use. Project operations influence fish habitat in Lake Oroville through manipulation of the amount of cold water for downstream releases into the Feather River and changes in Lake Oroville's water surface elevation necessary for flood control, power generation, and water releases downstream. Cold water is taken from Lake Oroville's hypolimnion for releases to the downstream fishery in the main channel of the Feather River, thereby potentially limiting the amount of cold water available for salmonids in Lake Oroville.

The Lake Oroville coldwater fishery is managed as a put-and-grow fishery, meaning that hatchery raised fish are stocked in Lake Oroville as juveniles, with the intent that they will grow in the lake before being caught by anglers. The coldwater fishery is sustained by hatchery stocking because natural recruitment to the Lake Oroville coldwater fishery is very low due to a lack of spawning and rearing habitat in the reservoir and accessible tributaries, and natural and artificial barriers to migration into those upstream tributaries with sufficient spawning and rearing habitat (DWR, 2001b). From 1993 through 2000, Chinook salmon and brown trout were the only salmonid species stocked in the lake (table 27).

IHN (see more detailed discussion under *Fish Diseases*) is a viral disease that affects salmon, first recognized in the 1950s. IHN outbreaks at the Feather River resulted in significant mortality at the Feather River Fish Hatchery; in 1998, 2000, 2001, and 2002, several million juvenile Chinook salmon died or had to be destroyed because of IHN. DFG attributed the source of the IHN to Oroville salmonids and water from Lake Oroville entering the hatchery (letter from R.A. Torres, Acting Deputy Director, DWR, Sacramento, CA, to the Commission, dated October 25, 2005). The outbreaks prompted DFG to halt stocking Chinook salmon and brown trout in Lake Oroville because of their susceptibility to IHN. However, stocking may resume in the future if IHN is eradicated.

Because coho salmon are less susceptible to IHN, coho salmon were stocked as a replacement for Chinook salmon and brown trout from 2002 to 2003. However, a bacterial kidney disease outbreak in the source aquaculture facility in Washington State prohibited procurement of additional coho salmon eggs in 2004 and 2005. Also, NMFS requested that coho salmon stocking be halted pending a risk assessment of the potential effects associated with stocking out-of-basin anadromous salmon upstream of Oroville dam. In August 2005, DFG issued revised coho disease testing procedures, and if source coho pass these tests, coho may be stocked in Lake Oroville (letter from R.A. Torres, Acting Deputy Director, DWR, Sacramento, CA, to the Commission, dated October 25, 2005.). In late November 2005, DWR began stocking 13,000 coho smolts a week, with a goal of stocking 65,000 coho by the end of 2005. The stocking goal for Lake Oroville for 2006 and 2007 is 170,000 yearling or yearling-equivalent coho raised in the Feather River (letter from R.A. Torres, Acting Deputy Director, DWR, Sacramento, CA, to the Commission, dated November 21, 2005).

Table 27. Salmonid stocking activities in Lake Oroville (1993–2005). (Source: DWR, 2003b; letter from R.A. Torres, Acting Deputy Director, DWR, Sacramento, Ca, to the Commission, dated October 25, 2005)

Year	BN-FING	BN-SUB	BN-CAT	ChS-FING	ChS-YEAR	CoS-FING	CoS-YEAR
1993	0	123,655	7,800	102,585	60,650	0	0
1994	0	50,004	0	104,410	55,200	0	0
1995	0	65,400	0	101,922	90,001	0	0
1996	8,402	80,200	0	105,841	150,435	0	0
1997	0	67,403	0	105,000	250,000	0	0
1998	0	55,000	0	106,163	352,970	0	0
1999	0	50,008	0	128,750	158,290	0	0
2000	0	155,700	0	0	28,600	0	0
2001	0	0	0	0	0	0	0
2002	0	0	0	0	0	50,249	128,280
2003	0	0	0	0	0	39,222	133,570
2004	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	65,000[a]

Notes: BN – Brown trout
CAT – Catchable
ChS – Chinook salmon
CoS – Coho salmon
FING – Fingerling
SUB – Subcatchable
YEAR – Yearling

[a] Goal.

The Lake Oroville warmwater fishery is a self-sustained fishery. The black bass fishery is significant, in terms of both angler effort and economic effect on the area. 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, and both channel and white catfish are present. White and black crappie are also found in Lake Oroville, although populations fluctuate widely from year to year. Bluegill and green sunfish are the two primary sunfish species in Lake Oroville, and redear sunfish and warmouth are present in low numbers. Although common carp are considered by many to be a nuisance species, they are abundant in Lake Oroville (DWR, 2001b). The primary forage fish present 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, 2001b). The population of threadfin shad has dwindled since the early 1990s, which may be a result of poor overwinter survival, or perhaps interspecific competition with wakasagi, Lake Oroville's primary forage fish.

Terrestrial vegetation along the reservoir shoreline provides spawning and nursery habitat for warmwater fishes, offers protection from predation, and results in increased food availability (DWR, 2001b; DWR and BOR, 2000). This terrestrial vegetation is inundated at higher lake levels but gradually becomes unavailable to fish as the reservoir is drawn down during the summer months.

Some species (e.g., rainbow trout, Chinook salmon, Sacramento pikeminnow, smallmouth bass) were established in the reservoir because of the impoundment of Feather River when Oroville dam was constructed in the early 1960s. Although rainbow trout and Chinook salmon were present previously, these species were stocked along with brown trout, largemouth bass, and spotted bass; wakasagi were unintentionally introduced. Illegal introductions have no doubt occurred as well. Movement of fish, such as rainbow trout, into Lake Oroville from the tributaries occurs on a regular basis, and the potential exists for fish to be moved from the Thermalito diversion pool into Lake Oroville via pumpback operations.

Anadromous salmonids play an important in role in the transport of marine-derived nutrients and organic matter into the freshwater aquatic ecosystems where they spawn. The majority of their body mass is accumulated during their time in the ocean as they mature. After the salmon migrate upstream to their natal streams, spawn and die, their carcasses enter the stream ecosystem. Essential nutrients, such as nitrogen, phosphorous, and dissolved organic matter, leach from the carcasses leading to their colonization by microbes and formation of biofilms on the surrounding stream substrates (Bilby et al., 1996; Wipfli et al., 1998). Salmon also supply inorganic nitrogen to the ecosystem during their upstream migrations via excretion of ammonia and other nitrogenous compounds (Mathisen et al., 1988). The Oroville dam, the Thermalito diversion dam, and fish barrier dam prevent the migration of Chinook salmon and steelhead to the historical spawning grounds in the tributaries of the Feather River located upstream of Lake Oroville, therefore eliminating the contribution of marine-derived nutrients to these streams.

To estimate the potential losses of anadromous salmonid biomass and associated nutrients and organic matter due to construction of the Oroville Facilities, DWR conducted a study that used estimates of spawning habitat availability in the historical Feather River tributaries upstream of Oroville reservoir. The estimated potential losses of nutrients and organic matter were found to be substantial, but the significance of the losses was difficult to evaluate because of limitations in the available information, including imprecision of the estimates for potential spawning densities and insufficiently low detection levels of measured nutrient concentrations in the upstream tributaries. Additional studies found periphyton and macroinvertebrate communities in the tributaries to Lake Oroville that were indicative of healthy ecosystems (DWR, 2004g). Comparisons of the periphyton and macroinvertebrate communities in the upper tributaries with communities in the low flow channel and other streams do not indicate that the upstream tributaries suffer from nutrient deprivation due to the blockage of salmonid spawning in the upper tributaries caused by Oroville dam.

Feather River Downstream of Oroville Dam

Oroville Facilities releases primarily are managed to benefit coldwater fisheries. Fish species of primary management concern present in the 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. Chinook salmon are very abundant in the Feather River as an estimated 30,000 to 170,000 Chinook salmon spawn in the Feather River annually.

Minimum flows and ramping criteria in the Feather River were established in the August 1983 agreement between DWR and DFG (DWR, 1983). The agreement specifies that DWR release a minimum of 600 cfs into the Feather River from the Thermalito diversion dam for fisheries purposes. Therefore, the low flow channel is operated at 600 cfs all year with variations in flow occurring rarely, only during flood control releases, or in the summer to meet downstream temperature requirements for salmonids.

Flows in the high flow channel are maintained between the minimum flow and a flow no greater than 2,500 cfs from October 15 through November 30 to prevent Chinook salmon redd dewatering in the event that flows were to decrease during the egg incubation period. The flow regime in the reach of the

Feather River extending from the Thermalito afterbay outlet (RM 59) to the confluence of the Feather and Sacramento rivers (RM 0) varies depending on runoff and month. Flows in this reach of the Feather River typically vary from the minimum flow requirement up to a flow of 7,500 cfs (DWR, 2003e). Small flow contributions from Honcut Creek and the Bear River and larger flow contributions from the Yuba River also influence flow in this segment (figure 2). Shanghai Bench, a clay riffle located between RM 26 and RM 25, has been identified as the most likely physical, flow-related impediment to upstream migration in the Feather River (DWR, 2002d).

Ramping criteria established in the 1983 agreement are discussed in section 3.3.2.1. These ramping rates were implemented to minimize stranding of juvenile spring-run Chinook salmon in the high flow channel.

Water temperatures tend to be coldest in the upper-most portions of the Feather River near the fish barrier dam, and they warm progressively moving downstream during the spring, summer, and fall. The low flow channel water temperatures have been managed to comply with terms of the October 2004 NMFS' biological opinion (see section 3.3.2.1, *Water Quality*) about the effects of the long-term operations, criteria, and plan of the Central Valley Project in coordination with operations of the State Water Project, which superseded all previous biological opinions regarding the Central Valley Project and State Water Project long-term operations, criteria, and plan (NMFS, 2004).

Thermalito Diversion Pool

The water temperature requirements (see section 3.3.2.1, *Water Quality*) create primarily coldwater fishery habitat in the Thermalito diversion pool, which is dominated by coldwater salmonids, including rainbow trout, brook trout, brown trout, and Chinook salmon (DWR, 2001b, 2002b). Although the Thermalito diversion pool is not currently stocked with fish, the lack of barriers between the Thermalito diversion pool and Thermalito forebay allows fish stocked in Thermalito forebay to migrate freely into the Thermalito diversion pool (DWR, 2001b, 2002b).

Thermalito Forebay

The Thermalito forebay is an open, cold, shallow reservoir with a high surface area-to-volume ratio with small water surface elevation fluctuations. Thermalito forebay remains cold throughout the year because it is supplied with water from the Thermalito diversion pool, although pumpback operations from Thermalito afterbay can increase water temperatures in the forebay. Additional information about water temperature in the Thermalito Forebay is provided in section 3.3.2.1, *Water Quantity and Quality.*

The Thermalito forebay provides habitat primarily for coldwater fish, although the same warmwater fish species found in Lake Oroville are believed to exist in the forebay in low numbers. DFG manages Thermalito forebay as a put-and-take trout fishery, and about 30,000 catchable rainbow trout are stocked annually (DWR, 2001b, 2002b). Surplus inland Chinook salmon from Lake Oroville stocking efforts have been stocked twice in Thermalito forebay (table 28).

Thermalito Afterbay

The Thermalito afterbay provides habitat for both coldwater and warmwater fish. This 4,300 surface-acre reservoir has gently sloping banks with vast areas of rooted aquatic vegetation along its upper margins. Depths rarely exceed 20 feet. Changes in flow rates, pumpback operations, and water surface elevations resulting from project operations affect water temperatures and the quality, quantity, and distribution of fish habitat in the Thermalito afterbay. The operational range of surface elevation fluctuations is 12 feet, although the normal fluctuation range is between 4 and 8 feet. As discussed in section 2.2.1, *Project Description and Operation*, the water surface elevation can fluctuate rapidly and frequently, resulting in a high degree of variability in water levels from day-to-day and from week-to-week, depending on project operation.

Table 28. Thermalito forebay fish stocking history. (Source: DWR, 2004h)

Year	Rainbow Trout	Brook Trout	Brown Trout	Chinook Salmon
1980	0	0	0	0
1981	38,347	38,347	0	0
1982	24,765	3,025	27,790	0
1983	34,922	22,750	57,672	0
1984	31,346	31,346	0	0
1985	58,405	58,405	0	0
1986	41,380	41,380	0	0
1987	127,435	127,435	0	0
1988	76,310	76,310	0	0
1989	54,548	54,548	0	0
1990	55,150	55,150	0	0
1991	54,440	54,440	0	0
1992	45,180	45,180	0	0
1993	32,190	14,640	7,400	54,230
1994	77,400	5,760	83,160	0
1995	40,240	40,240	0	0
1996	0	0	0	0
1997	29,300	10,660	39,960	0
1998	18,380	10,150	28,530	0
1999	28,450	9,740	25,000	63,190
2000	24,700	8,840	33,540	0
2001	22,400	8,600	31,000	0
2002	32,350	9,340	41,690	0
2003	29,830	29,830	0	0
2004	14,540	14,540	0	0
Total	992,008	770,656	375,742	117,420

Fish species observed in the Thermalito afterbay include largemouth bass, smallmouth bass, rainbow trout, brown trout, bluegill, redear sunfish, black crappie, channel catfish, carp, and large schools of wakasagi. Salmonids have not been stocked in Thermalito afterbay and it is unlikely that they spawn in tributaries of Thermalito afterbay. Therefore, rainbow trout and brown trout that occur in the afterbay likely passed through the Thermalito pumping-generating plant from the Thermalito forebay. A review of the literature by DWR concluded the Thermalito afterbay likely provides good habitat for black bass species, and large schools of wakasagi provide a good source of forage fish. Bass nest dewatering from reservoir fluctuations likely limits juvenile recruitment in the afterbay. Based on DWR analysis (DWR, 2004i), it is likely that black bass populations in the Thermalito afterbay will persist unless changes in operations create additional water surface level or water temperature fluctuations during spawning periods.

Fish Barrier Pool

Species occurring in the fish barrier pool are likely similar to those in the upstream Thermalito diversion pool, although no stocking or sampling has been conducted. The fish barrier dam diverts upstream-migrating salmon and steelhead into the fish ladder that leads to the Feather River Fish Hatchery. The flow over the dam maintains fish habitat in the low flow channel between the dam and the Thermalito afterbay outlet and provides attraction flow for the fish hatchery.

Feather River Fish Hatchery

The Feather River Fish Hatchery facilities include the fish barrier dam, a fish ladder, holding tanks, hatchery buildings, and raceways. DWR constructed the Feather River Fish Hatchery in 1967 to compensate for salmonid spawning habitat lost with construction of Oroville dam, and DFG operates the hatchery. The fish hatchery uses water diverted from the Thermalito diversion pool, which receives cold, hypolimnetic water (which rarely exceeds the mid to high 50s [°F]) from Lake Oroville. The hatchery water intake temperatures are monitored for operational compliance with the 1983 Oroville Operating Agreement between DWR and DFG (see section 3.3.2.1, *Water Quality*).

The fish ladder gates are opened on or about September 1 to allow adult spring-run Chinook salmon to enter the hatchery and early entrants are typically ready for spawning in October. DFG has recently initiated a program to mark the progeny of all early returning Chinook and is incorporating only the early run fish into the Feather River Fish Hatchery spring-run Chinook stock. A small percentage of these marked early run hatchery fish (i.e., those that do not return to the hatchery or are not harvested) spawns naturally in the Feather River (70 FR 37,160). Fish entering the hatchery after September 15 are considered fall-run. When the gates are open, upstream migrating fish can move into the 0.5-mile-long ladder leading to the hatchery. All salmon adults entering the hatchery are retained for egg taking or fertilization. About 9,000 to 18,000 salmon and 2,000 steelhead are artificially spawned annually, producing 8 million fall-run Chinook salmon, 5 million spring-run Chinook salmon, and 400,000 steelhead (NMFS, 2004).

Salmon and steelhead are raised at the hatchery; transported in oxygenated, temperature-controlled tanks; and released in the Feather and Sacramento rivers, Lake Oroville, other California reservoirs, and San Pablo Bay near San Francisco Bay. Chinook salmon are released from the hatchery as young-of-the-year smolts, while steelhead are released to the Feather River as yearlings.

As discussed previously, the DWR has implemented disease control procedures that minimize both the outbreak of disease in the hatchery and the possibility of disease transmission to wild fish populations (DWR, 2004j). Hatchery operating procedures, such as periodic examinations by fish pathologists and disinfecting procedures are designed to control disease in hatchery stocks.

Historical Chinook and steelhead returns to the Feather River Fish Hatchery are presented in figure 16.

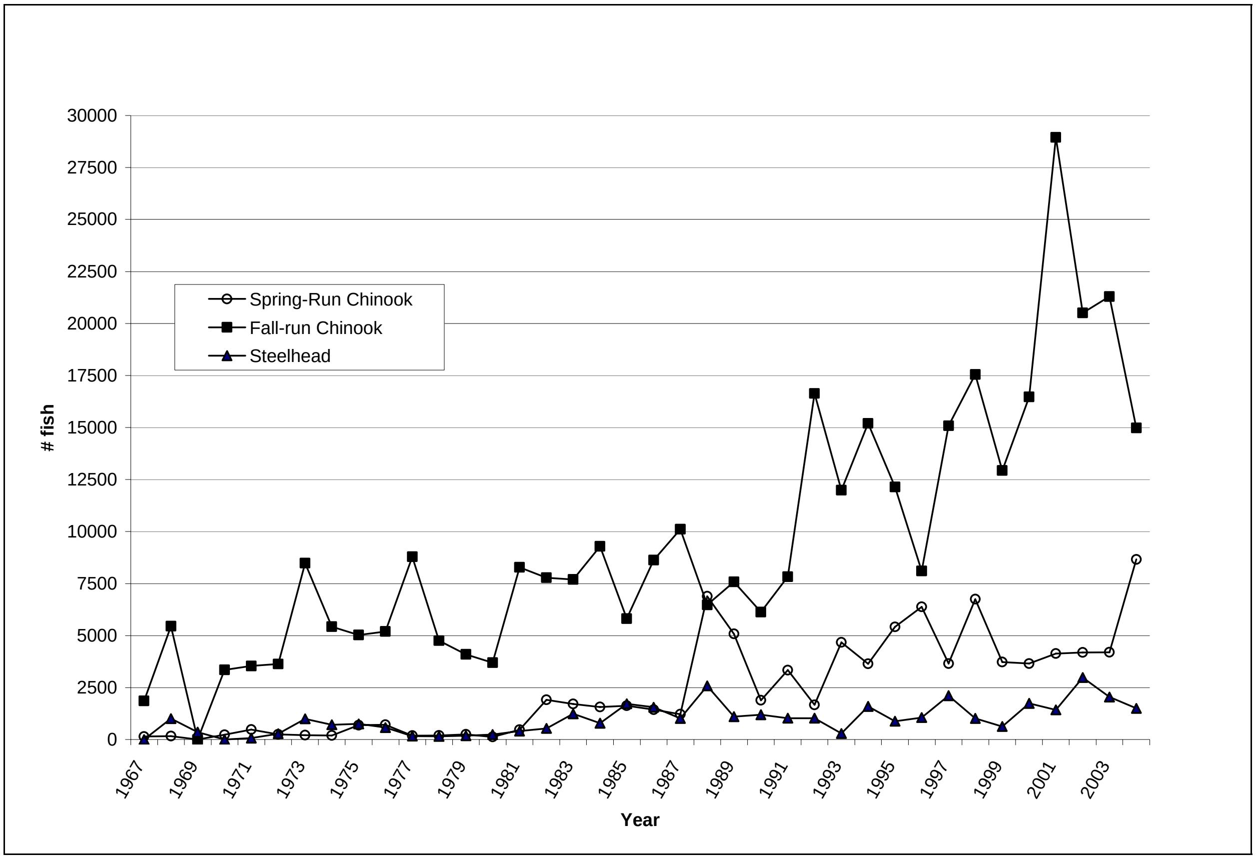


Figure 16. Feather River Fish Hatchery returns from 1967 to 2005. (Source: DFG, 2005)

Feather River

Oroville dam, Thermalito diversion dam, and the fish barrier dam (see figure 8) block gravel contribution to the Feather River. High flow releases from the Oroville Facilities mobilize smaller substrate particle sizes. The smaller substrate sizes are not replaced by upstream gravel, resulting in a gradual coarsening of the particle size distribution of the substrate in the upper portions of the Feather River. Coarsening and armoring of the substrate size can affect the quality of spawning habitat and the distribution of spawning salmonids and other fishes. In general, the reach of river with the highest proportion of coarse substrate components is the upstream-most portion of the Feather River downstream of the fish barrier dam and above the Thermalito afterbay outlet.

DWR's study results show that an estimated 97 percent of the sediment from the upstream watershed is trapped in Lake Oroville, resulting in sediment starvation downstream (see section 3.3.1, *Geology, Soils, and Paleontological Resources*, for additional information about sediment recruitment). Only very fine sediment is discharged from Lake Oroville to the river below. Depletion of the sediment load in the 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 LWD site contributions. Soft sediment substrates also contribute to the capture and retention of LWD.

LWD is an important functional component in the development and maintenance of habitat diversity and contributes to instream cover complexity (DWR, 2002b). Logs, rootwads, 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. The project dams block the downstream movement of LWD. LWD can have a substantial effect on river channel morphology by sediment trapping, creating turbulence, diverting flows, and creating scour holes in the channel and enhance aquatic habitat by creating gravel bars for use as spawning habitat by anadromous salmonids (Lassettre and Harris, 2001). The size of LWD relative to the size of the channel is important in the degree to which LWD can affect channel morphology. For the purposes of inventories conducted for this proceeding, LWD was defined as woody material measuring at least 4 inches (10 centimeters) diameter and 6.5 feet (2.0 meters) in length. In order to be functional (i.e., substantively function to change channel morphology) in the Feather River, wood of this relatively small size would need to accumulate or entangle with a much larger piece of LWD, known as a "key piece." Analysis of survey data indicates that LWD is unevenly distributed in the Feather River. The low flow channel contains the lowest amount (28.5 pieces per mile on average). This area is also downstream of Oroville dam, which captures the vast amount of LWD. From the Thermalito afterbay outlet to Honcut Creek, the river has a moderate amount of LWD, averaging 104.4 pieces per mile. The reach downstream of Honcut Creek to the Yuba River contains a significantly higher amount of LWD, with 238.5 pieces per mile on average. The amount of LWD in the mile downstream of Honcut Creek is double the amount of LWD in the mile of river upstream of Honcut Creek, suggesting that Honcut Creek (free of major dams) is a major source of LWD. The reach of river downstream of the Yuba River has a low abundance of LWD (an average of 48.1 pieces of LWD per mile, over 28 miles). Long stretches of riverbank in this farthest-downstream 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.

Study results show that the characteristics of most of the LWD pieces were not readily identifiable due to submersion, inaccessibility, or the degraded condition of the piece. Of those pieces that were identifiable, orchard trees (64 percent) dominated, while cottonwoods and oaks made up another 20 percent. The remainder—willows and sycamores—were a minor component at just 4 percent. Coniferous LWD was not observed in the Feather River, although that does not preclude its presence.

Survey results state that of the LWD surveyed, approximately 10 percent of the pieces was classified as "large" diameter.[56] During the June 2005 FERC site visit, staff observed very few large pieces of LWD and saw no instances of LWD influencing channel morphology in this large channel. Study results indicate that virtually all of the pieces had a rootwad or a remnant of a rootwad, with only 6 percent lacking one.

The Oroville Facilities and the sediment wedges (see figure 9) currently block the upstream migration of anadromous salmonids into historical spawning habitat in upstream tributaries. Blocked access to historical spawning grounds in the upper watershed causes spring-run Chinook salmon to spawn in the same lowland reaches of the Feather River that fall-run Chinook salmon use as spawning habitat. The overlap in spawning sites, combined with a slight overlap in spawning timing (Moyle, 2002) and temporally adjacent runs, may be responsible for inter-breeding between spring-run and fall-run Chinook salmon in the Feather River (Hedgecock et al., 2001).

Low Flow Channel and High Flow Channel

The majority of in-river spring-run Chinook salmon spawning is concentrated in the uppermost 3 miles of accessible habitat in the Feather River downstream of the Feather River Fish Hatchery (DWR, 2001b). NMFS (2004) referred to the high flow channel as a migratory corridor for adult spring-run Chinook salmon because most adults do not hold or spawn there. However, in 2000 through 2003, surveyors found 16 to 26 percent of the spawned-out Chinook salmon carcasses in the high flow channel, compared to 75 to 84 percent in the low flow channel (DWR, 2004). The study plan report does not indicate whether or not some of the carcasses that were counted in the high flow channel had washed

[56] The range of diameters included in the large diameter size class is not provided in the study report.

down from the low flow channel, although that would be expected, and spring-run fish could not be distinguished from fall-run fish.

Physical habitat simulation analysis conducted by DWR in 2002 indicates that Chinook spawning habitat in the low flow channel reaches a maximum between 800 and 825 cfs, and in the high flow channel, it reaches a maximum at 1,200 cfs. The steelhead spawning habitat index in the low flow channel has no distinct optimum over the range of flow between 150 and 1,000 cfs. In the high flow channel, there is a maximum at a flow just under 1,000 cfs (DWR, 2004r).

Most of the natural steelhead spawning and rearing 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 between the Table Mountain Bicycle Bridge and Lower Auditorium Riffle. Limited steelhead spawning also occurs downstream of the Thermalito afterbay outlet. The smaller substrate size and greater amount of cover (compared to the main river channel) also 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, 2001b).

Oroville Wildlife Area Ponds

The OWA contains more than 75 warmwater ponds and sloughs, along with complexes of emergent marsh and flooded cottonwood, willow, and sycamore trees, totaling about 12,000 acres (11,200 acres within the project boundary). 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. There are at least four overflow weirs into the OWA in Reach FR-10 between RM 53.5 and 64.0 (table 8).

After the Feather River floods in 1997, DWR repaired a levee in the OWA, Area D. The repairs included a levee notch to allow overflow during flood events; there is no direct surface water connection between the OWA and the Feather River. The outside (upstream side) of the repaired levee is bordered by a pond which discharges into the low flow channel of the Feather River. Sometime after the levee repair, beavers dammed the outlet and elevated the water level of the pond by several feet. This elevated water level then percolated through the levee and contributed to increased standing water elevations within that portion of the OWA (beaver dams within the OWA also contributed); however, this is not a permanent condition. High flows in 2006 altered the pond outlet channel and water elevations in the OWA have dropped correspondingly. Therefore, the pond elevations within this portion of the OWA are in dynamic transition as a result of both physical and biological events, and water surface elevations are not a fixed state. Invasive aquatic plants in the ponds, particularly water primrose (*Ludwigia peploides peploides*) are growing to densities that reduce the quality of, or eliminate, potential fish habitat.

Largemouth bass, channel catfish, white catfish, bluegill, green sunfish, and carp are all abundant in the OWA ponds, along with populations of black and white crappie. Electrofishing on Robinson Borrow Pond (also called Granite Pond) in April 2003 collected carp, Chinook salmon, largemouth bass, and Sacramento sucker.

The OWA ponds and wetland areas become too warm during the late spring to sustain salmonids, so any salmonids that are present at this time typically do not survive. The extent of this periodic salmonid presence and the stranding effect has not been determined.

The most significant issue affecting OWA fisheries in the last decade has been the invasion of water primrose (*Ludwigia peploides peploides*) in the OWA on the east side of the Feather River. The primrose has covered the perennial, fish-bearing ponds to depths of more than 1 meter above the pond surface. DWR biologists, DFG personnel, and anglers have estimated that 80 percent of the fish-bearing ponds in this area have been covered with water primrose, and this condition is increasing annually (DWR, 2005a, appendix G).

Fish Species Overview

This section presents brief overviews of fish species found in the project area. Two additional species, Chinook salmon and steelhead, are discussed in section 3.3.5, *Threatened and Endangered Species*.

Black Bass

Black bass species within the project area include spotted bass, largemouth bass, smallmouth bass, and redeye bass. None of these species of black bass are native to California; however, all are considered important recreational game fish. Bass are predators and prey on native fishes (Moyle, 2002).

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 and spawning continues until water temperatures exceed 75.2°F (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 deep near shore and has been observed as deep as 20 feet in clear water (Davis and Lock, 1997). In California, with changing reservoir levels, spawning has been observed at water depths up to 13.1 to 16.4 feet (Moyle, 2002).

Black bass species are found throughout the project area, including tributaries upstream of Lake Oroville (DWR, 2003c), Lake Oroville (DWR, 2003b), Thermalito forebay (DWR, 2003b), Thermalito afterbay, and the Feather River from the mouth of the Thermalito afterbay outlet to the confluence with the Sacramento River (DWR, 2003d). 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 waters: channel catfish and white catfish. Neither species is native to California; however, both are popular game fish. When adult channel catfish are in a river environment, they 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, 2003b).

In California, channel catfish generally spawn from April through June, while white catfish spawn slightly later during June through July (Moyle, 2002). Channel catfish require water temperatures ranging from 69.8 to 84.2°F, with 78.8 to 82.4°F being the optimum water temperature range for spawning (Moyle, 2002). Channel catfish typically construct nests in cave-like structures, and such structures have been constructed in Lake Oroville to promote the channel catfish fishery (DWR, 1997b). In large impoundments, nests generally occur among rubble and boulders along protected shorelines at depths of 6.6 to 13.2 feet (McMahon and Terrell, 1982). White catfish construct nests in shallow depressions in sand or gravel near cover or use cave sites similar to channel catfish (Moyle, 2002).

Crappie

Both white and black crappie inhabit the project waters. Although neither species is native to California, both are popular game fish. Mature crappie seem to prefer water temperatures ranging from 80.6 to 84.2°F (Moyle, 2002). Black crappie are more frequently observed in Lake Oroville, but both species are present (DWR, 2003b).

Both species of crappie spawn in late spring and early summer, with white crappie tending to begin spawning a little earlier, although there is substantial overlap. Crappie spawn in water temperatures ranging from 62.6 to 68°F, at a depth of 3.3 to 23 feet (Moyle, 2002). Males of both species construct nests using 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 and wakasagi. Neither species is native to California. Both were introduced to serve 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 and are frequently observed in both Lake Oroville and Thermalito forebay (DWR, 2003b).

Wakasagi spawn after their first year during the spring in small tributaries where eggs adhere to rocks or submerged vegetation (Aasen et al., 1998). Few survive 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 are native to tributaries to the Gulf of Mexico and the Mississippi River, were introduced into California in 1953 as forage for game fishes (Moyle, 2002). Threadfin shad typically inhabit open waters of reservoirs, lakes, and large ponds, and they can tolerate high salinities, although high salinities may impair their reproduction. In reservoirs, these plankton feeders prefer areas near inlets of small streams or steep surfaces of dams (Moyle, 2002). Optimal growth occurs when summer temperatures exceed 72 to 75°F; however, prolonged periods of cold water (39°F) will cause mortality (Moyle, 2002). Threadfin shad are broadcast spawners,[57] and fertilized eggs adhere to submerged logs or vegetation. Threadfin shad have been infrequently observed in Lake Oroville since the early 1990s (DWR, 2003b).

Minnows

Four species of minnow are commonly found in the project area: Sacramento pikeminnow, hardhead, hitch, and Sacramento splittail. All four species are native to the Sacramento River drainage (Moyle, 2002).

Sacramento pikeminnow are a common species of native fish in the Feather River. Spawning generally takes place from April through June (Moyle, 2002). This species generally inhabits waters with summer temperatures between 64 to 82°F (Moyle, 2002). In reservoirs, pikeminnow have been observed spawning in very shallow water (a few inches deep), 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 common in the Sacramento River and lower main stems of the American and Feather rivers. 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 (Cech et al., 1990; Moyle, 2002; Wang, 1986).

Hitch is a Class 3 Watch List species as designated by DFG (Moyle, 2002). This species is a broadcast spawner and normally spawns between March and June. Spawning hitch select 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, 2003d).

Sacramento splittail were designated as a threatened species under ESA by FWS on February 8, 1999 (64 FR 5,963–5,981). Splittail were listed as threatened throughout their entire range, which

---

[57] Broadcast spawners release their eggs in the water column.

includes the Feather River (64 FR 5,963–5,981). However, on September 22, 2003, FWS issued a Notice of Remanded Determination (50 FR (17):55,140–55,166), removing the Sacramento splittail from the endangered species list. DFG still considers them a species of special concern.

Sacramento splittail use the Feather River for spawning, egg incubation, and initial rearing from February through May. Splittail use shallow flooded vegetation for spawning and are infrequently observed in the Feather River from the confluence with the Sacramento River up to Honcut Creek. The majority of spawning activity in the Feather River is thought to occur downstream of the Yuba River confluence; the highest spawning density is in the Sutter bypass during high flow events.

No directed studies of splittail abundance have been conducted in the project area. However, there have been incidental observations of splittail in the Feather River (Seesholtz et al., 2003; FWS 1995a).

Spawning can occur between late February and early July, although peak spawning generally occurs in March and April (Moyle, 2002). Sacramento splittail spawning generally occurs in water with a depth of 3.0 to 6.6 feet over submerged vegetation (Moyle, 2002; Wang, 1986). This same habitat is used for initial juvenile rearing. Splittail have a wide thermal tolerance during this period, and temperatures may range from 48 to 75°F (Moyle, 2002; Sommer et al., 1997; Wang, 1986). Juvenile splittail begin appearing at the fish screening facilities for the Delta pumps in April and their numbers 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, 2003).

Sacramento Sucker

The Sacramento sucker is common in the project area and is native to California (Wang, 1986). 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, with water depths of 11.8 inches or more (Moyle, 2002). Sacramento suckers are infrequently observed in Lake Oroville. They are common in Thermalito forebay (DWR, 2003b) and in the Feather River (Seesholtz et al., 2003).

Smelt

Two species of smelt, delta smelt, and longfin smelt, are native to California (Moyle, 2002) and common in the Delta. Neither of these species is found within the project area.

FWS listed delta smelt as a threatened species under ESA in March 1993 (58 CFR 12,854), and critical habitat for delta smelt has been designated within the Delta and adjoining waterbodies. Delta smelt also is listed as threatened under the California Endangered Species Act.

Striped Bass

Striped bass is an introduced game fish that spawns in the project area from April through June (Bell, 1991; Hassler, 1988; Hill et al., 1989; Moyle, 2002; Wang, 1986). Striped bass have also been reported in Thermalito forebay (DWR, 2003b), which may indicate a small landlocked breeding population.

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 about between 59 and 68°F (Bell, 1991; Hassler, 1988; Hill et al., 1989; Moyle, 2002).

Sunfish

Three species of sunfish, bluegill, green sunfish, and redear sunfish, are common in the project area. None of these species are 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, only the traits of bluegill are discussed herein. In California, spawning occurs throughout the summer, with peak spawning in June and July as water temperatures exceed 68°F (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, 2003b). Bluegill, green sunfish, and redear sunfish are also common in the OWA ponds (DWR, 2003b) and in the Feather River (Seesholtz et al., 2003).

Tule Perch

Tule perch are native to California, including the Sacramento River System. Tule perch prefer moving-water habitats with temperatures less than 71.6°F and are reportedly not found in temperatures greater than 77°F (Moyle, 2002). Beds of emergent 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). Young are released among tule marshes and other types of vegetation (Wang, 1986). A few tule perch have been observed in Thermalito forebay (DWR, 2003b), and they are common in the Feather River (Seesholtz et al., 2003).

American Shad

Native to the Atlantic coast, the anadromous American shad was introduced to the Sacramento River between 1871 and 1881 (Moyle, 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, 2003d). The Sacramento River supports large runs of shad in late May and early June during their upstream spawning migration, and the Feather River is a main summer nursery area (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 for spawning (Moyle, 2002), but elsewhere they have been reported to spawn in water temperatures between 46 and 79°F (Painter et al., 1979; FWS, 1995b; 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).

Trout

Brown trout, brook trout, and lake trout 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, 2001b). Brook trout and lake trout are not true trout but actually members of the char family.

Brook trout have not been stocked in Thermalito forebay since 2004. Lake trout were stocked in Lake Oroville during 1984 and 1985, and a few lake trout are still observed in Lake Oroville (DWR, 2003b), suggesting the possibility of a small breeding population. Brown trout were stocked in Lake Oroville as recently as 2000 (DWR, 2001b).

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., 1986). The water temperature tolerance range for trout is 32 to 80.6°F, although the preferred water temperature for trout is reportedly from 53.6 to 68°F (Raleigh et al., 1986).

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. 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).

Chinook Salmon

Chinook salmon are native to California rivers, including the Feather River, and have a varied life history. Within the Sacramento River system, four different runs and three ESUs of Chinook salmon are recognized based on the time of year that upstream migrations begin. The spring-run ESU salmon normally begin migration during March and continues through the beginning of September, holding in coldwater pools until ready to spawn. The spring-run ESU is listed as threatened under ESA, and is addressed in section 3.3.5, *Threatened and Endangered Species.*

Fall-run and late-fall-run Chinook salmon are part of the same Central Valley ESU (179 FR 50394). The fall-run fish begin upstream migration in the summer and last until December; late-fall-run fish migrate upstream October through April in the Sacramento River system (Yoshiyama et al., 1998). Fall-run Chinook salmon enter the Feather River in late summer and fall and typically spawn shortly after arriving on the spawning grounds in late September through December (Sommer et al., 2001; Yoshiyama et al., 1998).

A small winter-run of Chinook salmon also exists within the Sacramento River system, with upstream migration beginning in December (DWR, 2004f, 1982; 64 FR (179)50,394–50,415; Moyle, 2002; Sommer et al., 2001). However, the winter-run ESU does not occur in the project area, and is not addressed further.

In 1999, the Central Valley Chinook salmon ESU underwent a status review after NMFS received a petition for listing. NMFS found that the fall-run/late-fall-run did not warrant listing as threatened or endangered under ESA, but sufficient concerns remained to justify addition to the candidate species list. On April 15, 2004, NMFS published a notice in the Federal Register that included the announcement of the Central Valley fall-run/late-fall-run Chinook salmon ESU change in status from a candidate species to a species of concern. Therefore, the Central Valley fall-run/late-fall-run ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977). The late-fall-run portion of this ESU does not occur in the project area, and is not addressed further.

Before widespread European settlement, most of the major tributaries had both spring and fall Chinook salmon runs; streams that lacked adequate summer flows to support spring-run fish had a fall-run (Yoshiyama et al., 1998). In recent decades, the vast majority of Central Valley Chinook salmon production, including the Feather River, has been fall-run fish, heavily supported by hatchery production. Fall-run Chinook salmon have been less affected by hydropower development than spring and winter runs because the fall-run probably spawned at lower elevations in the valley floor and foothills, historically (Yoshiyama et al., 1998). At this time, Central Valley fall-run Chinook salmon are considered significantly depressed from historic levels, but relatively secure (Yoshiyama et al., 1998).

Coho Salmon

Coho salmon are native to California and while no wild populations currently exist in the Feather River, they are stocked in Lake Oroville (DWR, 2001b). The Central California Coast evolutionarily significant unit (ESU) of coho salmon was listed as threatened under ESA on December 2, 1996. Coho salmon also is designated as a state species of special concern. However, these special-status species designations pertain only to coho salmon within their native habitats, and not to the coho stocked in project area waters. The coho salmon that occur in the project area are from stocking programs and are managed for their recreational importance only.

California coho salmon generally exhibit a 3-year life cycle with about half of their life cycle spent in freshwater and half in saltwater (Moyle, 2002). Coho salmon from central California enter rivers in late December or January and spawn immediately afterwards (Weitkamp et al., 1995). Coho salmon use similar spawning habitat as Chinook salmon and steelhead (Moyle, 2002).

Juvenile coho salmon show pronounced shifts in habitat with season, especially in California streams. During winter, juvenile coho salmon select habitats with low water velocity. During spring, juveniles are widely distributed through riffles and runs and during summer juveniles concentrate in deeper pools or runs (Moyle, 2002). Juvenile coho salmon tend to rear in cool tributaries in contrast to Chinook salmon, which reportedly stay in warmer main rivers. The diet of juvenile coho salmon consists mainly of aquatic insect larvae and terrestrial insects, although small fish are taken when available. Juvenile coho salmon rear for 12 to 24 months before beginning seaward migration as smolts (Moyle, 2002). The majority of coho salmon remain at sea for 16 to 18 months before returning to freshwater to spawn (Moyle, 2002). Some males may return as “jacks” after only 6 months at sea (Moyle, 2002).

Rainbow Trout/Steelhead

Rainbow trout are native to the upper Feather River and are the most popular and widely distributed gamefish in California (Moyle, 2002). Rainbow trout are currently stocked in the Thermalito forebay (DWR, 2001b), and naturally spawning populations of rainbow trout currently exist in the tributaries upstream from Lake Oroville (FERC, 2005). Rainbow trout were experimentally stocked in Lake Oroville by DFG during the 1970s and 1980s (DWR, 2001b).

Most wild rainbow trout generally spawn in the spring between February and June (Moyle, 2002). Rainbow trout normally spawn by constructing redds in coarse gravel substrate, 0.5 inch to 5.1 inches in diameter, in the tail of a pool or riffle (Moyle, 2002). Most spawning is observed when water temperatures are between 46 and 52°F in water flowing at from 0.2 foot/second to 3.6 feet/second (FWS, 1995b). Water temperatures above 63°F reportedly are lethal to developing rainbow trout embryos (Moyle, 2002). Eggs normally hatch in 3 to 4 weeks. For the first year of life, juvenile rainbow trout normally inhabit cool, fast-flowing streams and rivers where riffles predominate over pools and where riparian vegetation and undercut banks provide cover (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 in the winter to 80.6°F in the summer, although 73.4°F is reportedly lethal for unacclimated fish (Moyle, 2002).

Steelhead and rainbow trout are the same species (*O. mykiss*), with steelhead being the anadromous form. Additional discussion regarding Central Valley steelhead is provided in section 3.3.5, *Threatened and Endangered Species*.

Sturgeon

Two species of sturgeon, white sturgeon and green sturgeon, are found within the project area. White sturgeon are more commonly observed in the Feather River than green sturgeon (DWR, 2003d). Green sturgeon were listed as threatened under ESA in 2006 and are addressed in section 3.3.5, *Threatened and Endangered Species*.

Both species are native to California, and begin an upstream spawning migration between February and June, with spawning occurring between April and June (Beamesderfer and Webb, 2002; Moyle, 2002). Sturgeon passage may be impeded at Shanghai Bend (RM 25) and Sunset Pumps on the

Feather River, particularly at lower flows in the spring and fall. Sturgeon do not typically enter the mouth of the Feather River at flows lower than about 5,000 cfs (DWR, 2005b, appendix G).

White sturgeon are known to spawn in the Feather River (Moyle, 2002). A few white sturgeon have been observed in Lake Oroville.

The occasional capture of larval green sturgeon in salmon out-migrant traps suggests that green sturgeon spawn in the Feather River (Moyle, 2002); however, NMFS reports that evidence of green sturgeon spawning in the Feather River is unsubstantiated (70 FR 17,386). Sampling efforts using 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 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). Sturgeon passage may be impeded at Shanghai Bench (RM 25) and Sunset Pumps on the Feather River, particularly at lower flows in the spring and fall. Sturgeon do not typically enter the mouth of the Feather River at flows lower than about 5,000 cfs (DWR, 2005b, appendix G).

Lamprey

Two species of lamprey, river lamprey and Pacific lamprey, are found within the project area. Pacific lamprey are more frequently observed in the Feather River than river lamprey (DWR, 2003d). Both species are native to California and are on the DFG Watch List (Moyle, 2002), and 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 (Moyle, 2002). The ammocoetes burrow tail first into soft mud or sand in low velocity and edgewater areas where they filter feed on organic matter and algae off the substrate (Moyle, 2002). Rapid or prolonged drawdowns that dewater edgewater habitat are the greatest risks to larval lamprey (Beamish, pers. comm. May 1994). High water temperatures, degraded water quality, and extremely high migration barriers are additional risk factors.

River lamprey congregate upstream of saltwater for 4 months as young adults, rapidly grow to 9.8 to 12.2 inches and enter the ocean in late spring (Moyle, 2002). After about 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. Lamprey construct gravel nests and spawn at water temperatures of 55.4 to 56.3°F (Wang, 1986).

Juvenile Pacific lamprey migrate to the ocean in the fall where they spend about 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 (Moyle, 2002).

Fish Diseases

Fish diseases known to occur in the project area include IHN, ceratomyxosis, coldwater disease, bacterial kidney disease, and whirling disease. Each of these diseases has been shown to infect stocked species (brook trout, rainbow trout, and coho salmon) and native salmonids in the project area; however, these diseases are not known to infect non-salmonids. Of the fish diseases occurring in the Feather River basin, those that are main contributors to fish mortality at the Feather River Fish Hatchery (IHN and ceratomyxosis) are of highest concern for fisheries management in the region (DWR, 2004s).

Infectious Hematopoietic Necrosis

IHN is a major cause of mortality in Chinook salmon, sockeye salmon, and steelhead in freshwater (Noga, 1996). As high as 100 percent mortality can occur in these species when fish are less than 6 months old, while older fish have lower mortality and may not display clinical signs of the disease. Clinical signs include lethargy, abdominal distension and a darkening of abdominal tissue (Noga, 1996). Coho salmon, brown trout, brook trout, and cutthroat trout are generally considered immune to the disease (Noga, 1996). Noga (1996) reports that water temperature plays an important role in IHN epidemics with peak mortality occurring at 50°F (10°C), and lower mortality above 50°F (10°C). Noga (1996) did not report specific percentages of mortalities; however, he did cite Amend (1975) as stating that no documented mortalities above 59°F (15°C) have been reported. The Feather River hatchery uses water temperatures in excess of 59°F (15°C) to reduce mortalities during IHN outbreaks.

During epidemics, IHN is readily transmitted from one individual to another. Ectoparasites (e.g., leeches) and insects are considered reservoirs for the virus (Noga, 1996). Water disinfection and quarantine are currently the only proven methods of controlling IHN epidemics (Noga, 1996).

DWR contracted with University of California at Davis and FWS fish pathologists to examine the potential effects of the IHN virus on Feather River and other Central Valley salmonids. The study was conducted because of the severe IHN problems at the Feather River Fish Hatchery in 2000 and 2001. The genetic study showed that in the Central Valley, IHN has evolved from the original strain to several different strains, with the Feather River acting as the site of much of this activity. The strains did not appear to be developing into more virulent forms of the virus. Field surveys indicated that IHN was not present in juvenile salmonids or other fish in either the Yuba or Feather River watersheds. Adults returning to both watersheds were infected with IHN, with 28 percent (average of samples from 3 locations) and 18 percent, respectively, for the Yuba and Feather Rivers (Brown et al., 2004). There were no clinical signs of disease in these fish. Because stocking of Chinook salmon in the reservoir have been discontinued, no additional epizootics have been observed, although it is not known whether this measure will prevent future IHN outbreaks at the Feather River Fish Hatchery (DWR, 2004j).

Ceratomyxosis

Ceratomyxosis is caused by *Ceratomyxa shasta (C. shasta)*, an endemic myxosporean parasite that is lethal only to salmonids. The parasite is prevalent in both the waters of the Thermalito Complex and Lake Oroville (DWR, 2001b). Ceratomyxosis can cause up to 100 percent mortality among juveniles and is a cause of pre-spawning mortality in salmon (Noga, 1996). Rainbow trout, Chinook salmon, and chum salmon (*O. keta*) are the species most susceptible to ceratomyxosis, while coho salmon, brown trout, and brook trout are less susceptible (Noga, 1996). Transmission of the disease occurs when fish are exposed to the infectious stage of *C. shasta*. There is no known record of transmission between fish and the necessity of an intermediate host is strongly suspected (Noga, 1996).

Salmonid populations that are native to rivers where *C. shasta* naturally occurs appear to have developed varying degrees of resistance to infection (Noga, 1996). The strains of rainbow trout stocked in the Thermalito forebay are particularly sensitive to *C. shasta* infections.

Coldwater Disease

Another potential disease of concern for Oroville Facilities waters is coldwater disease (*Flavobacterium psychrophilum*). This disease exists at temperature of 65°F or less. More serious losses occur near the bacterium’s growth optimum of about 60°F.

Flavobacterium psychrophilum is a bacterium known to affect wild and hatchery populations of virtually all salmonid species. This bacterium can cause mortality of up to 50 percent among young salmonids. Outbreaks of coldwater disease generally occur at temperatures below 61°F.

Bacterial Kidney Disease

Bacterial kidney disease is a chronic disease that is economically significant to hatcheries, particularly those raising Pacific salmon, because of its widespread distribution in both freshwater and saltwater environments. The disease is caused by *Renibacterium salmoninarium* and only occurs in salmonids. Although any age fish is susceptible to the disease, losses do not typically occur until the fish are over 6 months old (Noga, 1996). Even fish with severe infections may have no external signs (Noga, 1996). The disease is transmitted both horizontally and vertically.[58] Vertical transmission is particularly problematic because the bacterium resides within the yolk and is protected from antiseptics (Evelyn et al., 1984, as reported in Noga, 1996).

There are no proven methods to eradicate bacterial kidney disease infection in fish (Noga, 1996). However, injection of female broodstock with erythromycin can prevent vertical transmission of the disease (Moffitt, 1992). As mentioned above, the presence of bacterial kidney disease in source stock for coho prevented stocking of coho in Lake Oroville in 2004 and 2005.

Whirling Disease

Whirling disease, a European disease introduced into North America in the late 1950s, is caused by the metazoan parasite, *Myxobolus cerebralis*. To date, whirling disease has caused severe damage primarily to wild rainbow trout populations in Montana and Colorado, but it affects hatchery salmonids as well. *Myxobolus cerebralis* was first detected in California in 1966 and is now found in many Central Valley drainages, including the Feather River. Although present in several watersheds in California, no adverse effects on salmon or trout populations have been observed in California (Modin, 1998). Native North American salmonids are more susceptible than European salmonids to the disease. Brown trout, which originated in Europe, have developed some resistance and may carry the parasite without succumbing to the disease.

Currently, hatcheries can only eliminate whirling disease by water disinfection, quarantine, and re-population with pathogen free stock. Raising fish in concrete raceways is also a helpful prevention measure because the intermediate host for the organism is the sludge worm (*Tubifex tubifex*) (Noga, 1996).

Predation

Current fish stocking practices in the project area include stocking of catchable-size brook trout and rainbow trout in the Thermalito forebay and, when cleared of bacterial kidney disease, stocking coho salmon in Lake Oroville. These introduced fish have the potential to prey on fish species of concern in the project area and downstream from the project. An examination of available reports by DWR (DWR, 2004j) indicated that few stocked fish escape from the reservoirs in which they are stocked. A review of the literature on competition and predation with emphasis on the species that are stocked indicates that the potential for competitive or predatory interactions with fish species of concern in the Feather River are minimal, as current stocking practices minimize the likelihood of significant emigration of stocked fish from the reservoirs. For example, only catchable size fish are stocked in the Thermalito forebay, and the stocking protocols for coho salmon in Lake Oroville are designed to minimize the stocking of fingerlings during the spring when higher flows may cause significant numbers of fish to escape the reservoir over the spillway.

---

[58] Horizontal transmission occurs from fish to fish. Vertical transmission is from fish to egg.

Macroinvertebrate Populations

Aquatic macroinvertebrates consist primarily of insects, snails, clams, shrimp, and zooplankton. Aquatic macroinvertebrates and plankton are important components of the biological foodweb in any aquatic ecosystem. Many invertebrate species are important to the recycling of nutrients in aquatic systems. They also are an important food source for fish, and their community structure and diversity are important factors in determining general ecosystem conditions. DWR conducted studies to describe the condition of aquatic macroinvertebrate and plankton communities present in both the impounded and free-flowing freshwater habitats within the project boundary of the Oroville Facilities. Findings from DWR (2004t) are presented in tables 29 through 31.

Table 29. Metrics used to describe benthic macroinvertebrate samples collected following the California Stream Bioassessment Procedure. (Source: DFG, 2007)

Metric	Description	Expected Response to Impairment
Richness Measures		
Cumulative taxa	Total number of individual organisms	Decrease
EPT taxa	Number of taxa in the Ephemeroptera, Plectoptera, and Trichoptera insect orders	Decrease
Ephemeroptera taxa	Number of mayfly taxa (genera)	Decrease
Plectoptera taxa	Number of stonefly taxa (genera)	Decrease
Trichoptera taxa	Number of caddisfly taxa (genera)	Decrease
Composition Measures		
EPT Index	Percent composition of mayfly, stonefly, and caddisfly larvae	Decrease
Sensitive EPT Index	Percent composition of mayfly, stonefly, and caddisfly larvae with tolerance values of 0 through 3	Decrease
Shannon Diversity Index	General measures of sample diversity that incorporates richness and evenness	Decrease
Tolerance/Intolerance Measures		
Tolerance value	Value between 0 and 10 weighed for abundance of individuals designated as pollution tolerant (lower values)	Increase
Percent intolerant organisms	Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1, or 2	Decrease
Percent tolerant organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9, or 10	Increase
Percent Hydropsychidae	Percent of organisms in the caddisfly family Hydropsychidae	Increase
Percent Baetidae	Percent of organisms in the mayfly family Baetidae	Increase
Percent Chironomidae[a]	Percent composition of midge larvae	Increase

Metric	Description	Expected Response to Impairment
Percent dominant taxa	Percent composition of the single most abundant taxon	Increase
Functional Feeding Groups		
Percent collectors	Percent composition of taxa that collect or gather fine particulate organic matter	Increase
Percent filterers	Percent composition of taxa that filter fine particulate organic matter	Increase
Percent scrapers	Percent composition of taxa that graze upon periphyton	Variable
Percent predators	Percent composition of taxa that feed on other organisms	Variable
Percent shredders	Percent composition of taxa that shreds coarse particulate matter	Decrease

[a] This metric is described as “percent ‘true’ fly family – Diptera” in DWR (2004t).

Aquatic Macroinvertebrates

Generally, macroinvertebrate diversity was consistent with expectations for large rivers in the watershed of the Sacramento–San Joaquin Rivers. The macroinvertebrate community at all the field stations included taxa that are important prey of the fish species in the river (DWR, 2004t). Immature life stages (larvae or nymphs) of true flies, mayflies, and caddis flies were the most prevalent organisms sampled from all sites combined, and collectors, filterers, and grazers were the most dominant functional feeding groups in the study area from all sites combined.

Generally, the highest taxa richness occurred in tributaries to Lake Oroville, while the lowest taxa richness occurred at the collection site in the Lake Oroville inundation zone, the Feather River site upstream of the Feather River Fish Hatchery, and at several Feather River sites between the Thermalito afterbay outlet and Honcut Creek (tables 30 and 31).

Phytoplankton and Zooplankton

Phytoplankton from 9 taxonomic groups were identified from 14 collection sites. Overall, phytoplankton communities sampled were dominated by diatoms (57 percent), green algae (16 percent), cryptomonads (9 percent), and blue-green algae (9 percent). Five other taxonomic groups accounted for the remaining 9 percent.

Diatoms were the most abundant algae type found in Lake Oroville, the Thermalito Complex, and the fish barrier pool, while green algae were dominant in the OWA. Zooplankton from three taxonomic groups were identified from six collection sites. Rotifers were the most prevalent group observed at all Lake Oroville stations, followed by copepods and cladocerans. Thermalito afterbay samples were dominated by copepods, followed by cladocerans and rotifers.

The benthic macroinvertebrate community downstream of the fish barrier dam and in areas upstream of Lake Oroville had high percentages of filterers, suggesting that the abundance of plankton (i.e., the preybase for filter feeders) is not a limiting factor either upstream or downstream of Oroville dam.

Table 30. Summary information by geographic area for macroinvertebrates collected by DWR and CSU-Chico with a kick screen and metal frame in fall 2002 and spring 2003. (Source: DWR, 2004t)

	Entire Study Area	Stream Reaches Upstream of Lake Oroville Inunda-tion Zone	Lake Oroville Inunda-tion Zone	Feather River between Fish Barrier Dam and Thermalito Afterbay Outlet	Feather River between Fish Barrier Dam and Thermalito Afterbay Outlet[a]	Feather River Downstream from Thermalito Afterbay Outlet to Honcut Creek	Feather River Downstream from Thermalito Afterbay Outlet to Honcut Creek[a]	Oroville Wildlife Area	Lower Feather River downstream of Honcut Creek
Number of sites	33	7	1	6	8	3	4	1	3
Cumulative taxa	16–49	31–49	19	20–32	20–35	16–24	18–28	28	22–24
EPT taxa	4–29	12–29	4	7–11	6–14	7–13	8–13	10	10–15
EPT Index (%)	5–95	10–68	47	5–69	11–81	67–84	46–95	72	68–84
Shannon Diversity Index	0.9–2.7	2.0–2.7	1.8	0.9–2.4	1.5–2.2	1.6–2.0	1.7–2.1	2.3	1.6–2.1
Tolerance value	3.0–6.0	3.9–5.7	4.6	4.7–6.0	3.1–4.8	4.4–4.7	3.0–4.4	4.6	4.5–4.7
%Hydropsychidae	0–48	0–21	38	1–25	0–35	45–48	10–41	19	3–26
% Baetidae	3–57	3–27	7	1–42	7–55	14–31	11–47	30	42–57
% Chironomidae	3–83	9–54	30	10–83	3–54	8–18	3–48	14	8–24
% Collector	26–95	37–68	42	35–90	53–95	33–42	26–86	57	60–88
% Filterer	0–73	1–36	43	6–40	0–46	46–51	13–73	21	4–30
% Grazer	0–46	9–44	2	0–46	0–35	6–17	0–3	19	6–8
% Predator	0–12	0–12	12	3–10	0–2	1–2	not found	5	1–5
% Shredder	0–6	0–6	Not found	None found	0–2	Not found	0–4	Not found	Not found

[a] Data obtained from CSU at Chico in 2003.

Table 31. Summary information by geographic area for macroinvertebrates collected by DWR with a ponar grab in fall 2002 and spring 2003. (Source: DWR, 2004t)

	Entire Study Area	**Low Flow Channel**	**Oroville Wildlife Area**	**Lower Feather River downstream of Honcut Creek**	**Sacramento and Yuba Rivers**
Number of sites	6	1	1	2	2
Cumulative taxa	3–15	10	6	3	3–15
EPT taxa	0–3	1	1	0–1	0–3
EPT Index (%)	0–30	1	2	0–2	0–30
Shannon Diversity Index	0.5–1.8	1.3	1.0	0.5–0.8	0.7–1.8
Tolerance value	5.8–6.4	6.4	5.8	5.9–6.0	5.8–5.9
%Hydropsychidae	0–1	1	Not found	Not found	Not found
% Baetidae	Not found	Not found	Not found	Not found	Not found
% Chironomidae	1–79	1	61	13–37	19–79
% Collector	15–94	78	94	15–37	75–86
% Filterer	0–85	17	Not found	58–85	0–14
% Grazer	0–5	Not found	Not found	0–5	0–1
% Predator	0–24	5	6	Not found	0–24
% Shredder	Not found	Not found	Not found	Not found	Not found

3.3.3.2 Environmental Effects

This section discusses the effects of the Proposed Action on aquatic resources in the river reaches affected by project facilities, operations, flood control, and compliance monitoring. The effects of the Proposed Action on water quantity, water quality, channel geomorphology, and riparian habitat are discussed in other sections.

Several of the proposed measures are conservation measures that would benefit ESA-listed spring-run Chinook salmon and steelhead. These include the Gravel Supplementation and Improvement Program (Proposed Article A102), the Lower Feather River Channel Improvement Program (Proposed Article A103), and the Flow/Temperature to Support Anadromous Fish (Proposed Article A108). These measures are addressed in section 3.3.5.2*, Threatened and Endangered Species*.

Lower Feather River Structural Habitat Supplementation and Improvement Program (Proposed Article A104)

The Oroville dam blocks LWD in the watershed upstream of Lake Oroville from moving downstream into the Feather River, contributing to a reduction in structural habitat complexity in the Feather River, particularly the low flow channel. DWR's study results indicated that the low flow channel does not have sufficient LWD.

Under Proposed Action A104, *Lower Feather River Structural Habitat Supplementation and Improvement Program*, within 2 years of license issuance, DWR would develop and file for Commission approval a Structural Habitat Supplementation and Improvement Program Plan to provide additional salmonid rearing habitat in the Lower Feather River. The Proposed Action would create additional cover, slow-water/edge-water habitat, and channel complexity in the Feather River through the addition of LWD, boulders, and other native objects. As proposed, the LWD would be multi-branched trees at least 12 inches in diameter at breast height and a minimum of 10 feet long and preferably at least 20 feet long or longer. At least 50 percent of the trees would have attached rootwads. A minimum of two pieces of LWD, boulders, or other material would be placed per riffle in the low flow and high flow channels from RM 54.2 to 67.2. Additional pieces may be placed as appropriate. The Structural Habitat Supplementation and Improvement Program Plan would also include a recreational safety analysis, addressed in section 3.3.6.2, *Recreational Resources*.

The plan, including a map of existing LWD, riparian habitat, and recruitment potential, would be developed in consultation with the Ecological Committee within 2 years of licensing and implemented within 2 years of Commission approval. Structural placements would be monitored after high flows (to be defined), or at least once every 5 years in the absence of high flows. An annual report would include monitoring and implementation results.

DWR (2005a) evaluated a LWD Recruitment Program; however, it did not include as many types of structural materials as the program outlined in Proposed Article A104, *Structural Habitat Supplementation and Improvement Program Plan*. Regardless, the concept of improved instream cover and increased channel complexity is consistent with the LWD program analyzed in the preliminary draft environmental assessment (DWR, 2005a). DWR determined the LWD supplementation would be beneficial and "likely to provide significant improvements in the quality and quantity of salmonid habitat in the Feather River with negligible adverse effects for warmwater species."

Staff Analysis

The Oroville Facilities have eliminated the upstream supply of LWD. The proposed LWD supplementation and boulder placements would benefit all aquatic resources by providing substrate for the algae and macroinvertebrates that are the basis of the foodchain, creating pools and structures that are velocity breaks during high flows, increased channel complexity (e.g., substrate sorting, gravel retention, cover, and pool development), and increased spawning habitat. Adult Chinook salmon and steelhead hold in large pools during spawning migrations; spring-run Chinook salmon hold in pools longer than fall-run fish; and all salmonids typically spawn in pooltail crests (the downstream end of a pool where it breaks into a riffle) that structural elements, such as LWD and boulders, create.

Pools formed by LWD and boulders are also important juvenile steelhead and resident fish habitat. Increased habitat complexity creates more cover and rearing habitat for territorial and piscivorous fishes, such as juvenile steelhead. Numerous studies show that high fish densities are associated with LWD. When anadromous fish populations thrive, the aquatic community benefits from the increased productivity and addition of marine-derived nutrients into the freshwater ecosystem.

The Proposed Action would require at least 50 percent of the trees to have attached rootwads to provide complex habitat with long-term stability. Study results indicate that 94 percent of the LWD observed in the Feather River had a rootwad or a remnant rootwad attached. These results indicate that the trees without attached rootwads would have a low probability of being retained and would have a high probability of being flushed downstream during high flows.

Given the current conditions in the low flow and high flow channels (i.e., low levels of LWD and no natural recruitment) and size of the river, the proposed minimum size of the supplemental LWD (i.e., 10 feet long) would likely be insufficient for substantial fisheries habitat enhancement or long-term retention. The proposed LWD supplementation is at the rate of a minimum of two pieces of LWD, boulders or other material per riffle. With an average of one to four riffles per mile, this translates to a minimum of two pieces to eight pieces per mile. At a minimum level of augmentation (two to eight pieces per mile), fisheries habitat would not substantially improve over current conditions, unless certain steps are taken to limit LWD movement. Studies have documented downed, natural LWD traveling an average of 6 miles downstream in approximately 1 year (see section 3.3.1.1, *Affected Environment* in *Geology, Soils, and Paleontological Resources)*. Therefore, LWD with the proposed characteristics would likely move out of the low flow and high flow channels relatively quickly were it not arranged properly or integrated into existing LWD. The proposed monitoring and maintenance program every 5 years would enable DWR to assess the effectiveness of the proposed approach and to adjust the amount and size of LWD if the proposed approach is not adequate to achieve the intended habitation benefits.

Lower Feather River structural habitat supplementation would probably have no effect on green sturgeon, as they are not known to occur in the project area. If larval or juvenile sturgeon do use the project area, the proposed habitat improvements may be beneficial.

Water quality-related effects could occur during implementation of this measure, including sedimentation, turbidity and petrochemical contamination that have the potential to adversely affect all fish species. Best management practices would be implemented to minimize these potential adverse effects; however, short-term sediment and turbidity plumes would occur as a result of these activities.

Riparian and Floodplain Improvement Program (Proposed Article A106)

Historically, the Central Valley System, including the Sacramento River System, was the source of most of the Pacific salmon produced in California (Yoshiyama et al., 1998). The Central Valley System was typified by low gradient, complex channels, wetlands, and interconnected floodplains with extensive riparian vegetation.

The Feather River and its associated riparian vegetation have been affected by disruption of natural geomorphic processes, including disconnected floodplains, flow regulation that alters the timing, magnitude and duration of peakflows and baseflows, dams that block sediment transport, wetland and side-channel filling, hydraulic mining that creates coarse tailings, and streambanks that are riprapped to prevent channel migration (see section 3.3.1.1, *Affected Environment* in *Geology, Soils, and Paleontological Resources*).

Under Proposed Article A106, *Riparian and Floodplain Improvement Program*, within 6 months of license issuance, DWR would develop and file for Commission approval a plan for a phased program to enhance riparian and other floodplain habitats for associated terrestrial and aquatic species. The plan would address reconnecting portions of the floodplain in the low flow channel and the high flow channel within the OWA and specify areas where gravel could be extracted to improve fish and wildlife habitats. Higher priority would be given to projects that benefit a variety of resources. The effects on terrestrial species are discussed in section 3.3.4.2, *Environmental Effects* in *Terrestrial Resources*.

Riparian and floodplain improvement projects and gravel value and extraction processes would be developed, assessed, and recommended to the Ecological Committee within 1 year of licensing (Phase 1). Within 8 years of licensing, DWR would complete final designs and commence implementing the approved alternative (Phase 2). DWR would fully implement Phase 2 within 15 years of license issuance.

In addition, DWR would evaluate other feasible projects identified in Phase 1 and recommend an alternative for implementation (Phase 3) within 15 years of license issuance. DWR would implement the approved Phase 3 alternative within 25 years of licensing (Phase 4). The Riparian and Floodplain Improvement Program would be developed in consultation with the Ecological Committee. An annual report would include monitoring and implementation results.

DWR did not evaluate a Riparian and Floodplain Improvement Program in the preliminary draft environmental assessment (DWR, 2005a). However, the riparian, wetland, and floodplain study plan (DWR, 2002e) indicated that such a plan would be beneficial to native fishes.

Interior (on behalf of FWS), and DFG filed 10(j) recommendations consistent with Proposed Article A106, *Riparian and Floodplain Improvement Program*.

Staff Analysis

Implementing riparian habitat and floodplain connectivity projects would be beneficial to both warmwater and coldwater aquatic communities. Aquatic and terrestrial macroinvertebrates that are the prey base for many fish species depend on riparian vegetation during their life cycles so that an increase in riparian zone vegetation would increase macroinvertebrate production. Increased riparian vegetation would also provide: (1) streambank stability to reduce erosion and trap overland sediment before it enters waterways, (2) streamshade to moderate daily water temperature fluctuations, (3) LWD recruitment potential, (4) overhead cover, and (5) velocity breaks for juvenile and small fishes during high flow. Increased floodplain connectivity would decrease the force of peakflows that can displace fish downstream, scour redds, and erode streambanks. Floodplain connectivity also traps and stores sediment to replenish riparian vegetation and protect aquatic habitat. These effects would improve the abundance and health of fish populations.

Floodplain inundation provides more abundant and diverse warm, shallow-water habitat, and favorable water velocities than riverine habitat (Sommer et al., 2004; 2001a; 2001b). Sommer et al. (2004) found greater phytoplankton biomass and higher densities (up to an order of magnitude) of Diptera and other terrestrial macroinvertebrates in the Sacramento River floodplain than in the river. These trophic foodwebs respond quickly to floodplain inundation and even short periods of floodplain connectivity may provide ecosystem-level benefits (Sommer et al., 2004).

The most abundant group of Diptera found in the Sacramento River study was chironomids, which may be a “key link” to fisheries production, including Chinook salmon and steelhead (Sommer et al., 2004). Most young-of-the-year Chinook salmon emigrate from the project area within days of emergence. Sommer et al. (2001b) found floodplains represent one of the most important rearing habitats for juvenile Chinook during downstream migration; high densities of chironomids were determined to be a major reason for enhanced salmon growth and survival.

Chironomids are also a primary food sources for juvenile Sacramento splittail. Therefore, the frequency and duration of floodplain inundation may also be directly linked to the year class strength of splittail (Sommer et al., 1997). Feather River studies that show flow and duration of inundation are highly correlated with splittail year-class strength support these conclusions. The strongest year classes in 21 years are correlated to high flows; the weakest year classes are correlated with low flows (DWR, 2005j).

Dredger tailings form large piles of gravels and cobbles that unnaturally elevate the level of the floodplain, and coupled with the altered flow regime function to adversely affect inundation (and substrate) required for establishment and growth of riparian vegetation. These are important on-going processes that set the trends of current and future floodplain conditions. Flood/pulse flows that exceed the current bankfull stage are needed to restore and maintain floodplain connectivity, channel function, aquatic habitat (e.g., to break up armored substrate), and riparian vegetation, such as cottonwood, requires periodic scouring to regenerate and maintain a variety of age classes over time (see section 5.3.2.3, *Geology, Soils, and Paleontological Resources*).

Considering the quantity and quality of existing riparian, floodplain, and aquatic habitats and the time it would take for riparian vegetation to mature after project implementation, the proposed 25-year schedules for full implementation of the Riparian and Floodplain Improvement Program projects may not provide timely protection of beneficial uses, particularly anadromous fish habitat. Under the Proposed Action, riparian and floodplain conditions would remain degraded or continue to decline for at least 15 years until the first measures would be implemented.

High flow releases that increase nitrogen gas saturation, such as occurred at the Nimbus Fish Hatchery in 2006, can cause physiological stress and increase the risk of IHN, and sediments stirred up by increased flows may also spread IHN (Bacher, 2006). If so, increased incidences of IHN may occur as a result of flood/pulse flows, if such flows were implemented.

Lake Oroville Warmwater Fishery Habitat Improvement Program (Proposed Article A110)

Angling for non-native, warmwater game fish is an important component of Lake Oroville recreation mitigation (to compensate for loss of coldwater fisheries) under the current license. Proposed Article A110, *Lake Oroville Warmwater Fishery Habitat Improvement Program*, would be similar to the program DWR implements under the current license.

Under the Proposed Action, DWR would develop a plan to improve the warmwater fisheries habitat in Lake Oroville and file it for Commission approval within 1 year of license issuance. The plan, which would be developed in consultation with the Ecological Committee and specified consultees, would provide for constructing, operating, and maintaining projects to improve warmwater fisheries spawning and rearing habitat within the reservoir fluctuation zone. Boulders, Christmas trees, weighted pipes, riprap, LWD, native flood-tolerant woody vegetation, and annual grasses would be used to created structural habitat.

The projects would be implemented in 7-year intervals, except for the final interval, which would occur before the license expires. DWR would spend approximately $40,000 annually, or a total of $280,000 per each 7-year program interval. Of this amount, 75 percent would be spent to construct, operate, and maintain warmwater fisheries habitat improvements. The remaining 25 percent would be spent to monitor the success of fisheries improvements and to cover overhead expenses. An average of 15 habitat units ($2,000 expenditure is equivalent to one unit) would be constructed annually.

The monitoring program would include angler creel surveys, electrofishing, and spring snorkel surveys to measure the success of habitat improvements. Habitat units may be modified based on monitoring results, need, or technology improvements within annual cost limits. DWR could modify the implementation measures within the scope of the approved plan, in consultation with the Ecological Committee and specified consultees. The Commission would need to approve modifications outside the scope of the plan. DWR would file a report of monitoring, implementation, and maintenance results with the Commission annually and at the end of each 7-year interval. DWR (2002f) indicated continuing the current warmwater fisheries program with additional action items would benefit the Lake Oroville warmwater fish community.

Staff Analysis

Black bass, particularly largemouth bass, would be the target species that would benefit from the proposed habitat structures. The black bass species in Lake Oroville have stable or expanding populations. The focus of the Lake Oroville Warmwater Fishery Habitat Improvement Program would be to continue to increase existing bass habitat for these recreationally important game fishes. Brush shelters would be installed in clusters in back coves with shallow sloping banks where black bass commonly spawn. The shelters would be placed between elevation 775 to 875 feet msl because juvenile bass can be found down to a depth of 25-feet during the summer and fall, when the surface elevation of the lake typically ranges are 800 to 900 feet. These types of structures would protect bass nests from wave action and increase post-spawn survival.

Channel catfish typically spawn in cave-like structures; these types of structures have been constructed in Lake Oroville as part of the current program. In large reservoirs, nests generally occur at depths of 6.6 to 13.2 feet (McMahon and Terrell, 1982). Sections of 9 to 18-inch diameter concrete and PVC pipe would be used to create artificial channel catfish spawning habitat. Culverts, steel pipe, buckets, rock rubble, and other items could also be used to create cave-like structures. These structures would be placed in the same areas and elevations described for the black bass brush shelters and would provide good channel catfish spawning habitat.

Native, flood-tolerant trees would be planted in the fluctuation zone between elevation 850 and 890 feet msl. Willow, buttonbrush, and other species can survive periodic inundation and subsequent drying, after they become established. Elevation 850 feet msl would be the lower limit due to the possibility of year-round inundation. The back coves and shallow slopes of the fluctuation zone that would be ideal fish habitat for planting are hot and dry when they are exposed from approximately mid-July to mid-October. During the first 2 years after the trees are planted, irrigation would be needed to significantly reduce mortality and improve growth rates. The trees that survive and become established would provide complex, long-term habitat and benefit the Lake Oroville warmwater recreational fishery.

Largemouth bass, smallmouth bass, striped bass, spotted bass, and other non-native, warmwater game fish that prey on native species of special concern, including Chinook salmon and steelhead, are common or expanding in the Feather River Watershed as the result of past stocking programs (see table 26). The Lake Oroville warmwater fishery is self-sustaining, and fish stocked in the lake escape downstream over the spillway at high flow and upstream when the tributaries are passable. Warmwater habitat has been created in the Feather River, in the OWA ponds, and in the tributaries upstream of Lake Oroville due to cumulative effects of the Oroville Facilities and other projects. The warmwater habitat and the transition zones between the warmwater and coldwater habitats favor predatory, warmwater game fish with adverse effects on native fishes and amphibians. Increasing the amount of warmwater fish habitat would increase the warmwater, non-native game fish populations, which in turn would increase the negative impacts on the coldwater fish community. The effects of introduced non-native, game fish predation on native amphibians are addressed in section 3.3.4, *Terrestrial Resources.*

Lake Oroville Coldwater Fishery Habitat Improvement Program (Proposed Article A111)

Lake Oroville does not have suitable habitat to support self-sustaining populations of coldwater sportfish that require cold, flowing water and clean spawning gravel; there is some seasonally accessible habitat with these characteristics in the tributaries above the lake. However, three species that are no longer stocked, rainbow trout, brown trout, and lake trout are still caught infrequently (DWR, 2003b).

Under Proposed Article A111, *Lake Oroville Coldwater Fishery Habitat Improvement Program*, a plan for a coldwater, recreational fishery in Lake Oroville would be developed and filed for Commission approval within 1 year of licensing. The plan would be developed in consultation with the Ecological Committee and other specified consultees.

The plan would provide for stocking 170,000 yearling salmon or equivalents per year, plus or minus 1 percent. The cost of the program would not exceed $75,000 annually. Of this amount, $68,000 would be spent on the stocking costs and $7,000 would be spent on monitoring.

The plan would focus on the first 10 years after licensing, and would be revised every 10 years. A report including monitoring and implementation results would be filed with the consultees for review and recommendations every 2 years.

Interior (on behalf of FWS) and DFG filed 10(j) recommendations consistent with Proposed Article A111, *Lake Oroville Coldwater Fishery Habitat Improvement Program*.

Other Recommendations

The Anglers Committee et al. letter dated December 12, 2005, recommends that a coldwater fish disease management plan be developed and implemented in Lake Oroville. The letter also recommends that DWR: (1) conduct studies to determine the source of disease(s) in rainbow trout stocked in the lake;

(2) prepare a coho monitoring, stocking, and sterilization plan; (3) develop a Chinook salmon and brown trout stocking program; and (4) upgrade the water sterilization system.

The Anglers Committee et al. also recommend that DWR conduct studies to determine the amount of silt deposited and the amount of silt that would be deposited for the life for the project in the North Fork arm downstream of Big Bend dam. The study would disclose and evaluate the effects of fish diseases related to sediment, among other things. The study would be submitted for public review and comment. A similar study would be conducted on the West Branch arm upstream of the Lime Saddle Marina. According to the Anglers Committee, the Commission would require DWR to remove the silt from all areas of the reservoir as determined by the Commission and other water quality enforcement agencies.

In its response to the recommendations, terms, and conditions, prescriptions, and settlement comments dated May 26, 2006, DWR states that the Anglers Committee et al. and Plumas County[59] concerns regarding coldwater fish diseases have been addressed by the Settlement Agreement.

Staff Analysis

Fish Diseases

The history of disease associated with the Feather River Fish Hatchery has been addressed in section 3.3.3.1, *Affected Environment*, in *Aquatic Resources*. Oroville Facilities and operations, including the fish hatchery and stocking program, have produced environmental conditions that are more favorable to pathogens than historical conditions.

Fish diseases in Feather River hatchery fish may have been influenced primarily by species and stock origin (DWR, 2004s). The combination of mixing fish species, stocking of fish species susceptible to disease, water quality conditions, and elevated water temperature in the summer may also increase the potential for disease outbreaks in Lake Oroville (DWR, 2004s).

Generally, hatchery fish are more susceptible to disease than wild fish because of crowded conditions in the hatchery. Other factors affecting fish diseases in project waters are water quality problems (e.g., high temperatures, low DO), introduction of new diseases from fish management practices, water transfers, and the fish barrier dam that concentrates spawning fish and increases their exposure to pathogens.

The DWR fish disease study (DWR, 2004s) evaluated the effects of ongoing and future project operations on the establishment, transmission, extent and control of IHN, bacterial kidney disease, and other significant fish diseases causing substantial losses to fish populations in the Feather River watershed. Endemic salmonid pathogens occur in the Feather River watershed that cause a number of diseases, including IHN, ceratomyxosis, coldwater disease, bacterial kidney disease, and whirling disease have infected stocked species (brook trout, rainbow trout, and coho salmon) and native salmonids in the project area; however, these diseases are not known to infect non-salmonids.

While these pathogens occur naturally, the Oroville Facilities, non-project reservoirs, water diversions, agriculture, and silviculture may have produced environmental conditions that are more favorable to these pathogens as compared to historic conditions (DWR, 2004s). For instance, impediments to fish migrations may have altered the timing and the duration of exposure of anadromous salmonids to certain pathogens. Fish management practices, such as introductions of exotic fish species, hatchery production, and out-of-basin transplants, have inadvertently introduced foreign diseases. Water management activities such as transfers, pumpback operations, and flow manipulation can result in water temperature changes and/or increased fish density, which potentially increase the risk of disease.

[59] We could not find any reference to disease concerns in the Plumas County filing.

Conversely, project facilities and their operations may also have reduced the transmission and extent of some fish diseases. During the late spring and summer, the project releases cooler water into the Feather River low flow channel than existed historically. This may have suppressed outbreaks of ceratomyxosis in the steelhead populations in the river, as cool water temperatures suppress the onset of ceratomyxosis. However, cool water temperatures can be favorable for other diseases such as IHN.

Little is known about diseases and pathogens of non-hatchery fish in the Feather River watershed. The Feather River fish disease study area extended from the confluence of the Feather and Yuba rivers, upstream to the impassable fish passage barriers above Lake Oroville (DWR, 2004s). Current information provides no evidence to suggest that disease outbreaks or disease-related fish kills have ever occurred downstream of the project. Moreover, fish that were captured at the screw traps in the lower Feather River downstream of the project did not indicate that captured fish were infected with significant diseases of concern, although several environmental stressors exist downstream of the project that potentially influence outbreak of fish diseases downstream.

Of the fish diseases occurring in the watershed, the main contributors to fish mortality at the Feather River hatchery are IHN and ceratomyxosis, and these diseases are of highest concern for fisheries management in the region. Although other pathogens associated with disease may occur in Feather River fish, they do not necessarily lead to significant fish mortality or threaten fish populations because many fish disease organisms co-exist with the host species and natural populations without causing regular or significant outbreaks, and/or wide spread mortality (Plumb, 2002, in DWR, 2004s). However, if environmental conditions become unfavorable for the host and some stressor(s) compromises individual immune systems or natural resistance, disease outbreaks may result.

IHN and ceratomyxosis are the main causes of fish mortality at the Feather River Fish Hatchery. DWR has implemented disease control procedures, such as cooler water temperatures, to minimize the outbreak of disease in the hatchery (DWR, 2004j) and stocking coho salmon instead of Chinook salmon or brown trout in Lake Oroville. DWR replaced the stocking of these species in 2002 and 2003 with coho salmon to reduce the risk of infecting native salmonids with IHN because they are less susceptible to the disease, although some coho salmon stocks are susceptible to ceratomyxosis.

Pumpback operations in the Thermalito Complex are generally thought to warm project waters during the May through August irrigation season. This may have reduced this incidence of IHN, which is limited by warmer water, but may be favorable to ceratomyxosis, which is more common in warmer temperatures. However, this mechanism is poorly understood in the project waters.

Ceratomyxosis and minor incidence of IHN have been reported from the Thermalito annex fish facility. The minor incidence of IHN was due to infected fish being transferred from the main Feather River Hatchery, and it is believed that the higher water temperature in the Thermalito annex fish facility has slowed the spread of IHN since the disease is more problematic at cooler water temperatures. The annex is also used to reduce overall fish density at the hatchery which results in reduced stress, enhanced growth, and generally fewer disease problems (DWR, 2004s). Warmer water also can reduce the probability of outbreaks of other diseases that are more virulent in colder waters, such as bacterial kidney disease.

Steelhead and rainbow trout mortalities due to ceratomyxosis at the annex were attributed to water from Thermalito afterbay (DWR, 2004s). It is possible that ceratomyxosis outbreaks at the hatchery were related to amplification of *C. shasta* in rearing waters due to the stocking of susceptible salmonid species and stocks in the Thermalito forebay and Lake Oroville tributaries (DWR, 2004s). The progression of ceratomyxosis is also influenced by water temperature. Rainbow trout and steelhead are normally highly susceptible to ceratomyxosis, while Chinook and coho salmon are less susceptible. Mortality generally occurs when water temperatures exceed 50°F (10°C); however, fish can become infected at temperatures as low as 39°F (3.9°C) (Bartholomew, 2001, in DWR, 2004s). Therefore, cooler water temperatures at the hatchery would reduce the risk of ceratomyxosis outbreaks. Because *C. shasta* is found naturally in the Feather River, native salmonids exhibit some natural resistance to ceratomyxosis, and the risk of *C. shasta* transmission to fish populations in the Feather River below the hatchery is considered minimal (DWR, 2004s).

Under the Proposed Action, DWR would maintain current practices and stock 170,000 yearling salmon or equivalents in Lake Oroville. Coho salmon compete with and prey on other salmonid species, particularly Chinook salmon, steelhead, and cutthroat, and may be a major cause of mortality (Moyle, 2002). The more aggressive coho typically dominate in competitive interactions with these species. Fingerling coho have escaped over the spillway during high spring flows, although the potential for competitive or predatory interactions with other fishes in the Feather River is considered minimal because coho are not typically stocked in the spring when higher flows may cause significant numbers of fish to escape the reservoir over the spillway. However, if non-native coho continue to be stocked in Lake Oroville, this species may prey on other species in Lake Oroville as well as downstream.

Under the Proposed Action, DWR would analyze the feasibility of installing a new hatchery water disinfection system and continue to address disease issues associated with hatchery fish. The disinfection system would protect hatchery production from catastrophic disease loss.

The Feather River Fish Hatchery Improvement Program (Proposed Article A107) specifies that a new water disinfection system would be installed prior to any upstream releases of anadromous salmonids above the hatchery, or if the current system is determined to be insufficient to address disease issues. Providing a new water disinfection system would reduce the risk of a coldwater fish stocking program transmitting diseases to ESA-listed Chinook salmon and steelhead, and other native salmonids from the coho salmon that are stocked in Lake Oroville.

However, Lake Oroville is not a closed system and stocked fish could potentially spread diseases to wild, native salmonids despite management precautions. The sediment wedges in the tributaries could reduce the transfer of disease by decreasing the rate of immigration and emigration from the lake. Silt removal, as proposed by the Angler Committee et al., could actually increase the incidence of IHN and other fish diseases by facilitating fish passage and releasing pathogens stored in the sediment. Other potential effects of silt removal are discussed in section 3.3.1, *Geology, Soils, and Paleontological Resources*.

Genetic Introgression

Genetic introgression between introduced hatchery stocks and wild or naturally spawned fish (e.g., rainbow trout and steelhead) is also a concern. DWR cites University of California Davis and Oregon State University studies that determined Feather River steelhead may be "at least somewhat segregated" into hatchery and naturally spawning fish (DWR, 2005k).

The University of California Davis and Oregon State University studies cited by DWR also determined all Central Valley fall-run Chinook salmon are genetically identical and that Feather River spring-run and fall-run Chinook salmon are genetically similar and most closely related to Central Valley fall-run Chinook. The genetic introgression of these runs is probably the result of fisheries management and hatchery practices, and the current timing of these runs is probably a phenotypic rather than genetic difference (DWR, 2005k).

Under the Lake Oroville Coldwater Fishery Plan, DWR would identify primary and secondary sources of hatchery salmonids, including Chinook salmon, for lake stocking. The Anglers Committee et al. also recommend that DWR develop a lake Chinook salmon stocking program. Any future Chinook salmon stocking[60] would probably have no additional affect on genetic introgression. However, the genetics management plan that is part of the proposed Feather River Fish Hatchery Improvement Program

[60] Chinook salmon stocking is not proposed at this time.

(Proposed Article A107) and the Fish Weir Program (Proposed Article A105) would address the conservation and management of Feather River spring and fall Chinook salmon runs in more detail.

Non-native Species

Under the Proposed Action, DWR would continue to stock catchable-size brook trout in the Thermalito forebay. Naturalized brown trout from past stocking programs are also found in Thermalito afterbay. These non-native species probably escape from the forebay through the Thermalito pumping-generating plant to other project waters, and populations of brook trout and brown trout are currently widespread and stable in the watershed.

Under the Proposed Action, the Lake Oroville Coldwater Fishery Plan would also identify primary and secondary sources of hatchery salmonids, including brown trout, for lake stocking. The Anglers Committee et al. also recommend that DWR develop a lake and brown trout stocking program. Brook and brown trout prey on and compete with native salmonids, including ESA-listed Chinook salmon and steelhead. Brook and brown trout would prey on and compete with native salmonids, including ESA-listed Chinook salmon and steelhead if they were stocked in project waters. The effects of introduced trout predation on native amphibians are addressed in section 3.3.4, Terrestrial Resources.

Oroville Wildlife Area Management Plan (Proposed Article A115)

Proposed Article A115, *Oroville Wildlife Area Management Plan*, is discussed in detail in section 3.3.5, *Terrestrial Resources*.

The OWA contains more than 75 warmwater ponds and sloughs that have direct connections to the Feather River. Between RM 53.5 and 64.0, at least four overflow weirs flow into the OWA (see section 3.3.1, *Geology, Soils, and Paleontological Resources*). In the draft EIS, we suggested that there may be a direct connection between the Feather River and the OWA. However, based on DWR's comments, we now understand that there is no surface water connection between the lower Feather River and the OWA, except for a single culvert outlet in the high flow channel. The water draining out of the OWA at this area functions essentially as a very small tributary and is not screened. Salmonids could volitionally enter the OWA ponds through this culvert, but there is no evidence to suggest that this occurs or that it is a significant problem under normal (i.e. non-flood) conditions. Otherwise, salmonids only enter the OWA during extreme flow events that overtop levees separating the OWA from the river.

During extreme flow events, salmonid stranding and mortality in the OWA undoubtedly does occur, but this is beyond the licensee's control. The extent of salmonid trapping and mortality within the OWA as a result of flood events has not been determined; however, some Chinook salmon were found in Robinson Borrow Pond (also called Granite Pond) in the OWA during April 2003, and because of periodic flooding, it should be assumed that any species present in the adjacent section of the Feather River could also be found in the OWA (DWR, 2003b). There is no suitable coldwater fisheries habitat in the OWA because predation by non-native, warmwater fishes is high; high flows create ephemeral ponds with no outlets; and high, seasonal water temperatures would be lethal to salmonids.

Staff Analysis

Chinook and steelhead are found in the OWA ponds, and the inlets to the OWA are adjacent to or just downstream of the high flow and low flow channels that are the primary, existing anadromous fish habitat in the Feather River. However, the OWA Management Plan does not address the effects of these inlets on anadromous fish and other special status fish species.

3.3.3.3 Cumulative Effects

Past and present cumulative effects on aquatic resources in the Feather River Watershed result from hydropower development and operations, irrigation withdrawals, agricultural and urban development, extensive mining activities, recreational use and development, timber harvesting; road building and maintenance, sport and commercial fisheries, and hatchery management.

These actions have caused adverse water quality and aquatic habitat effects, such as increased erosion and sedimentation, chemical and bacterial contamination, decreased floodplain connectivity, decreased riparian zones and LWD recruitment potential, altered peakflows and baseflows, altered sediment transport, wetland and side-channel filling, riprapping to control channel migration, decreased aquatic habitat complexity, creation of migration barriers, changes in anadromous run timing and genetics, decreased MDN and productivity, and non-native fish and noxious/invasive weed introductions (see also *Cumulative Effects* in section 3.3.1, *Soils, Geology, and Paleontological Resources*).

The Settlement Agreement includes conservation measures to improve coldwater fisheries habitats and increase the populations of ESA-listed Chinook salmon and steelhead within the project area. These measures include the formation of an Ecological Committee, a Gravel Supplementation and Improvement Program, Channel Improvement Program, Structural Habitat Supplementation and Improvement Program, Fish Weir Program, Riparian and Floodplain Improvement Program, Feather River Fish Hatchery Improvement Program, Flow/Temperature to Support Anadromous Fish, and a Comprehensive Water Quality Monitoring Program that have been previously discussed. These fisheries conservation measures would reduce the cumulative effects associated with the operation of Oroville Facilities, and benefit all native, coldwater fishes (not just anadromous fishes) by improving the quality of coldwater habitat in the Feather River.

3.3.3.4 Unavoidable Adverse Effects

The dam will continue to block anadromous fish passage to higher quality spawning and rearing habitat in the upper watershed, and block the downstream transport of sediment and LWD from the upper watershed. Oroville Facilities operations alter natural flow regimes, adversely affecting the quality and quantity of coldwater fish habitat in the Feather River. Changes in the timing, magnitude, and duration of peakflows and baseflows, and loss of sediment and LWD recruitment from the upper watershed would continue to adversely affect channel morphology and aquatic habitat in the Feather River.

The proposed conservation measures would reduce some of these effects to varying degrees, particularly gravel and LWD supplementation, increased flows and decreased water temperatures, and riparian/floodplain restoration. However, many of the current adverse effects (e.g., migration barriers, introduced fish species and diseases, and loss of marine-derived nutrients in the upper watershed) would continue as unavoidable adverse effects, particularly on native, coldwater fishes.

3.3.4 Terrestrial Resources

3.3.4.1 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 (elevation 100 feet at the lower end of the OWA) to the upper elevation of the mountain range (about 1,200 feet), 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.

Botanical Resources

A variety of factors influences botanical resources in the project vicinity. Vegetation patterns correspond with elevational changes and depend on precipitation, temperature, soils, aspect, slope, and disturbance history (SNEP, 1996). Unique geologic and geomorphic conditions exist that also determine 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 Upper North Fork arms of the reservoir and gabbro-derived soils located along the South Fork arm of the reservoir. Vernal pools and swale complexes are a common part of the valley grassland habitats downstream of Lake Oroville. These pools are of the northern hardpan type that occurs in areas of hummocky ground on terrace-alluvial derived Redding soils (DFG, 1998b). These formations tend to support a number of endemic and rare plant species.

Botanical field investigations included surveys for vegetation mapping, noxious weeds, special-status plant species, and riparian and wetland resources. Surveys were conducted during 2002, 2003, and 2004.

The study area for the vegetation community/land use mapping included the area with the project boundary, a 1-mile-area beyond the boundary, and the Feather River floodplain (within the Federal Emergency Management Area 100-year floodplain) downstream of the project boundary. Vegetation community/land use types and acreages are identified in table 32.

Table 32. Vegetation/land use within the study area. (Source: DWR, 2005a)

	Within FERC Project Boundary		1 Mile Outside FERC Project Boundary		Feather River Floodplain	
Community Type	**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[a]**	**98**	**99,525**	**97**	**31,878**	**97**

[a] This value has been rounded to 41,540 elsewhere in this document.

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 41,540 acres within the project boundary are surface waters.

The majority of vegetation around Lake Oroville and the Thermalito 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. Downstream of Oroville dam and the Thermalito 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 study 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 photographs, soils and geologic maps, and field surveys.

Riparian and Wetland Habitat

Riparian Forest/Woodlands—About 3,238 acres of riparian forest/woodland occur within the project boundary. More than 2,450 acres of Fremont cottonwood forest occurs within the study 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 tributaries, 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 an about 50-foot-wide 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 shoreline.

Riparian Shrub/Scrub—During relicensing studies, 215 acres of riparian shrub habitat were mapped within the study area. These shrub associations occur almost entirely along the Feather River directly upstream and downstream of the Thermalito afterbay outlet. They include a mix of species but are predominately Arroyo willow and sandbar willow. Non-native species, such as giant reed and scarlet wisteria, are prominent in the riparian shrub community along the Feather River upstream of the Thermalito afterbay outlet in the low flow channel.

Wetlands—A total of 912 acres of wetland vegetation were mapped in the study area (table 33), most of which occurs around Thermalito afterbay. Less than 7 acres of wetland vegetation occurs around Lake Oroville and the Thermalito diversion pool, mostly associated with seeps and springs that are a natural part of the landscape above the high water line. About 42 acres of emergent wetland vegetation occur along the edges of ponds in the OWA. Emergent wetland habitats are dominated by short, erect, rooted hydrophytes (e.g., cattail, tule, bulrush) and occur in waters less than 6 feet deep. Stands tend to be dense and structurally simple. Seasonal flooding restricts species diversity to those species adapted to anaerobic soil conditions. Emergent wetland habitat, ranging from strips less than 50 feet wide to areas over 0.5 mile wide, 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.

Table 33. Acreages of wetland vegetation types for major project features. (Source: DWR, 2005a)

	Thermalito Afterbay	Thermalito Forebay	Thermalito Diversion Pool	Lake Oroville	Oroville Wildlife Area
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**

Ninety-four percent of the wetland vegetation occurs around Thermalito afterbay, where a lower band of mixed emergent species is supported. Waterfowl brood ponds constructed in inlets of Thermalito afterbay support emergent vegetation along much of their shores.

Aquatic/Submerged—A total of 443 acres of aquatic/submerged vegetation, 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, was mapped in the study area. About 400 acres consist of water primrose, which primarily occurs along the margins of ponds, waterways, and backwaters of the Feather River. Free-floating plants include mosquito fern, duckweed, and watermeal, which occur primarily in the smaller ponds or canals in the OWA.

Unique Habitat

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.

About 49 acres of vernal pools and ephemeral swales were mapped within the study area. These pools range in size from very small (less than 3 feet in 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 was identified in vernal pools in the study area. Eleven of these species (18 percent) are non-native species. In comparison, 39 percent of the species found in the study area, excluding vernal pools and swales, are non-native species.

Serpentine and Gabbro-derived Soils—Vegetation types that occur on soils derived from serpentinitic and gabbroic rock types include sparse grassland, chaparral, and woodlands. These soil types support unique assemblages of plant species with many endemic species, including a high number of special-status plant species, and they support a high level of plant diversity. Serpentine and gabbro soils in the study area are potential and suitable habitat for the federally listed Layne's ragwort (*Senecio layneae*) (see section 3.3.5, *Threatened and Endangered Species*).

About 172 acres of serpentinite and serpentine-derived soils occur in the study area. Numerous northwest to southeast trending bands of serpentine occur in the Upper 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*), which are discussed below.

About 64 acres of gabbro and gabbro-derived soils occur in the study area along the South Fork arm. 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 and is discussed below.

Invasive and Noxious Weeds

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 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, 2001). 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, 2004).

Sixty-four species of noxious or invasive plant species listed by the California Department of Food and Agriculture, the California Invasive Plant Council, the U.S. Department of Agriculture, and the Plumas National Forest have potential to occur within the study area. During relicensing surveys conducted by DWR, all non-native species were identified in the study 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 study area during 2002 and 2003 (table 34). Of these, 20 were the highest rated target weed species. Overall, 219 species of non-native plants, not all of which are classified as noxious or invasive weeds, were identified in the study area.

Table 34. Target weed species identified in the study area. (Source: DWR, 2005a)

Common Name ***Scientific Names***	**Cal-IPC List**[a]	**DFA List**[b]	**Around Lake Oroville**	**Downstream of Oroville Dam**
Tree of heaven *Ailanthus altissima*	A-2	--	x	x
Giant reed *Arundo donax*	A-1	--	--	x
Foxtail chess *Bromus madritenis* ssp. *rubens*	A-2	--	x	x
Yellow starthistle *Centaurea solstitialis*	A-1	C	x	x
Skeleton weed *Chondrilla juncea*	--	A	x	--
Pampas grass *Cortaderia selloana*	A-1	--	--	x
Scotch broom *Cytisus scoparius*	A-1	C	--	x

Common Name *Scientific Names*	**Cal-IPC List**[a]	**DFA List**[b]	**Around Lake Oroville**	**Downstream of Oroville Dam**
Blue-gum eucalyptus *Eucalyptus globules*	A-1	--	--	x
Edible fig *Ficus carica*	A-2	--	x	x
Fennel *Foeniculum vulgare*	A-1	--	x	x
French broom *Genista monspessulana*	A-1	C	x	x
Purple loosestrife *Lythrum salicaria*	Red Alert	B	--	x
Pennyroyal *Mentha pulegium*	A-2	--	--	x
Parrot feather *Myriophyllum aquaticum*	B	--	--	x
Eurasian milfoil *Myriophyllum spicatum*	A-1	--	--	x
Himalayan blackberry *Rubus discolor*	A-1	--	x	x
Chinese tallow tree *Sapium sebiferum*	Red Alert	--	x	--
Bouncing-bet *Saponaria officinalis*	A-2	--	--	x
Scarlet wisteria *Sesbania punicea*	Red Alert	--	--	x
Spanish broom *Spartium junceum*	B	--	x	--
Medusahead *Taeniatherum caput-medusae*	A-1	C	x	x

Notes: -- – species not present in the study area or not on agency list
DBW – California Department of Food and Agriculture

x – species present in study area

[a] 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.

[b] DFA List of Noxious Weeds:
List A: Most invasive wildland pest plants, eradication, containment, or other holding action at the state and 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.

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 were found downstream of Oroville dam in the OWA and in and around the Thermalito Complex. Eleven species were found around Lake Oroville.

Species of greatest concern near the Thermalito Complex include purple loosestrife, giant reed, tree of heaven, yellow starthistle, and scarlet wisteria. Within the surrounding grasslands, yellow starthistle and medusahead are most widespread. About 85 of the 852 acres of wetland/riparian margin of Thermalito afterbay contain varying densities of purple loosestrife.

Noxious weed species in the study 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, and Himalayan blackberry. Tree of heaven is intermingled with the valley elderberry, habitat for the federally threatened valley elderberry longhorn beetle (discussed in section 3.3.5, *Threatened and Endangered Species*) in about 250 acres of the OWA.

Water primrose is an aquatic plant species that occurs along the margins of ponds, waterways and in 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.

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; French, Spanish, and Scotch brooms; Himalayan blackberry; and tree of heaven. Other species include edible fig and starthistle.

Special-Status Plant Species

Species identified as special-status species include rare plants that are currently listed by the Forest Service and/or BLM as Sensitive or Special Interest Species and taxa on the California Native Plant Society Lists 1, 2, and 3. Federally listed threatened or endangered species are discussed in section 3.3.5, *Threatened and Endangered Species*. All California-listed species with potential to occur in the project boundary are also federally listed species and therefore are discussed in section 3.3.5.

DWR developed a list of 51 special-status plant species with the potential to occur in the project boundary, based on information compiled from FWS (1999 and 2002); the DFG (2002/2003), California Natural Diversity Database records; the CNPS (2001); Plumas National Forest Sensitive and Special Interest Plant list (Forest Service, 2003); DFG's Special Plants List (DFG, 2001); and the Forest Service Pacific Southwest Region Sensitive Plant list (Forest Service, 1998). Botanical surveys were conducted in accordance with standard guidelines issued by DFG (2000), FWS (1996), and the CNPS (2001). The study area for these surveys included all lands that could be affected by project activities within the project boundary and the lower Feather River floodplain downstream of the fish barrier dam to the Sacramento River. Federal lands within the study area, adjacent federal lands outside the study area, and state lands within the study area adjacent to federal lands were surveyed for BLM and Forest Service sensitive and special interest species. Relicensing studies conducted by DWR identified the presence of suitable habitat within the project area for 41 vascular plant species, 2 bryophytes (mosses), and 1 lichen species (table 35).

DWR located 14 special-status plant species, identified in table 34, within the study area during relicensing studies. 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 Thermalito 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.

Table 35. Special-status plant species with potential for occurring within the study area. (Source: DWR, 2005a)

Common Name ***Scientific Name***	**Status: FWS[a]/CNPS[b]/ Plumas National Forest[c]**	**Habitat (elevation)**	**Found in Study Area**
Vascular Plants			
Henderson's bent grass *Agrostis hendersonii*	SC/3/--	Valley and foothill grassland (mesic), vernal pools (70–305 meters)	
Jepson's onion *Allium jepsonii*	SC/1B/--	Cismontane woodland, lower montane conifer forest/ serpentinite or volcanic (300–1,160 meters)	
Sanborn's onion *Allium sanbornii* var. *sanbornii*	--/4/SI-1	Chaparral, cismontane woodland, lower montane conifer forest/ usually serpentinite, gravelly (260–1,410 meters)	
Large-flowered sandwort *Arenaria "grandiflora"*	--/4/SI-1	Granite sand on road banks and openings in woods (500–1,000 meters)	
Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	--/1B/SI-1	Chaparral, cismontane woodland, valley and foothill grassland / sometimes serpentinite (90–1,400 meters)	
Butte County calycadenia *Calycadenia oppositifolia*	--/1B/S	Chaparral, cismontane woodland, lower montane conifer forest, meadows and seeps, valley and foothill grassland/ volcanic or serpentinite (215–945 meters)	Yes
Butte County morning glory *Calystegia atriplicifolia* ssp. *buttensis*	SC/1B/--S	Lower montane conifer forest (600–1,200 meters)	
Dissected-leaved toothwort *Cardamine pachystigma* var. *dissectifolia*	--/3/SI-1	Chaparral, lower montane conifer forest/ usually serpentinite, rocky (255–2,100 meters)	Yes
Fox sedge *Carex vulpinoidea*	--/2/--	Marshes and swamps (freshwater), riparian woodland (30–1,200 meters)	Yes
Pink creamsacs *Castilleja rubicundula* ssp. *rubicundula*	--/1B/--	Chaparral (openings), cismontane woodland, meadows and seeps, valley and foothill grassland/ serpentinite (20–900 meters)	
Brandegee's clarkia *Clarkia biloba* ssp. *brandegeae*	--/1B/S	Chaparral, cismontane woodland/ often roadcuts (295–885 meters)	Yes
White-stemmed clarkia *Clarkia gracilis* ssp. *albicaulis*	--/1B/S	Chaparral, cismontane woodland/ sometimes serpentinite (245–1,085 meters)	Yes

Common Name *Scientific Name*	**Status: FWS[a]/CNPS[b]/ Plumas National Forest[c]**	**Habitat (elevation)**	**Found in Study Area**
Golden-anthered clarkia *Clarkia mildrediae* ssp. *lutescens*	--/4/SI-1	Cismontane woodland, lower montane conifer forest (openings)/ often roadcuts (275–1,750 meters)	
Mildred's clarkia *Clarkia mildrediae* ssp. *mildrediae*	--/1B/SI-1	Cismontane woodland, lower montane conifer forest/ sandy, usually granitic (245–1,710 meters)	
Mosquin's clarkia *Clarkia mosquinii*	SC[d]/1B/S	Cismontane woodland, lower montane conifer forest/ rocky, roadsides (185–1,170 meters)	Yes
Clustered lady's slipper *Cypripedium fasciculatum*	SC/4/S	Lower montane conifer forest, north coast conifer forest/ usually serpentinite seeps and stream beds (100–2,435 meters)	
Dwarf downingia *Downingia pusilla*	--/2/--	Valley and foothill grassland (mesic), vernal pools (1–445 meters)	
Four-angled spikerush *Eleocharis quadrangulata*	--/--/2/--	Marshes and swamps (freshwater) (30–500 meters)	Yes
Butte County fritillary *Fritillaria eastwoodiae*	SC/3/S	Chaparral, cismontane woodland, lower montane conifer forest (openings)/ sometimes serpentinite (50–1,500 meters)	Yes
Adobe-lily *Fritillaria pluriflora*	SC/1B/--	Chaparral, cismontane woodland, valley and foothill grassland/ often adobe (60–705 meters)	
Rose-mallow *Hibiscus lasiocarpus*	--/2/--	Marshes and swamps (freshwater) (0–120 meters)	
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	SC/1B/--	Valley and foothill grasslands (mesic) (30–100 meters)	
Red Bluff dwarf rush *Juncus leiospermus* var. *leiospermus*	--/1B/--	Chaparral, cismontane woodland, meadows and seeps, valley and foothill grassland, vernal pools/ vernally mesic (35–1,020 meters)	
Cantelow's lewisia *Lewisia cantelovii*	--/1B/S	Broadleaved upland forest, chaparral, cismontane woodland, lower montane conifer forest/ mesic, granitic, serpentinite seeps (385–1,370 meters)	
Humboldt lily *Lilium humboldtii* ssp. *humboldtii*	--/4/SI-1	Chaparral, lower conifer forest/ openings (30–1,800 meters)	Yes
Quincy lupine *Lupinus dalesiae*	--/1B/S	Chaparral, cismontane woodland, lower/ upper montane conifer forest, openings, often in disturbed areas (855–2,500 meters)	

Common Name *Scientific Name*	Status: FWS[a]/CNPS[b]/ Plumas National Forest[c]	Habitat (elevation)	Found in Study Area
Shield-bracted monkeyflower *Mimulus glaucescens*	--/4/SI-1	Chaparral, cismontane woodland, lower montane conifer forest, valley and foothill grassland/serpentinite seeps (60–1,240 meters)	Yes
Veiny monardella *Monardella douglasii* ssp. *venosa*	SC/1B/--	Cismontane woodland, valley and foothill grassland (heavy clay) (60–410 meters)	
Little mousetail *Myosurus minimus* ssp. *apus*	SC/3/--	Valley and foothill woodland, vernal pools (alkaline) (20–640 meters)	
Ahart's paronychia *Paronychia ahartii*	SC/1B/--	Cismontane woodland, valley and foothill grassland, vernal pools (30–510 meters)	Yes
Closed-throated beardtongue *Penstemon personatus*	SC/1B/S	Chaparral, lower/upper montane conifer forest, metavolcanic (1,065–2,120 meters)	
Bacigalupi's yampah *Perideridia bacigalupii*	--/4/SI-1	Chaparral, lower montane conifer forest/ serpentinite (450–1,000 meters)	
California beaked-rush *Rhynchospora californica*	SC/1B/--	Bogs and fens, lower montane conifer forest, meadows and seeps, marshes and swamps (freshwater) (45–1,010 meters)	
Brownish beaked-rush *Rhynchospora capitellata*	--/2/SI-1	Lower/upper montane conifer forest, meadows and seeps, marshes and swamps, mesic (455–2,000 meters)	
Sanford's arrowhead *Sagittaria sanfordii*	SC/1B/--	Marshes and swamps (assorted shallow freshwater) (0–610 meters)	Yes
Feather River stonecrop *Sedum albomarginatum*	--/1B/S	Chaparral, lower montane conifer forest/ serpentinite (260–1,785 meters)	
Cut-leaved ragwort *Senecio eurycephalus* var. *lewisrosei*	--/1B/S	Chaparral, cismontane woodland, lower montane conifer forest/ serpentinite (550–1,470 meters)	Yes
Butte County checkerbloom *Sidalcea robusta*	SC/1B/--	Chaparral, cismontane woodland (90–1,600 meters)	
Long-striped catchfly *Silene occidentalis* ssp. *longistipitata*	SC/1B/SI-1	Chaparral, lower/upper montane conifer forest (1,000–2,000 meters)	
Butte County golden clover *Trifolium jokerstii*	--/1B/SI-1	Valley and foothill grassland (mesic), vernal pools (50–385 meters)	
Columbian watermeal *Wolffia brasiliensis*	--/2/--	Marshes and swamps (assorted shallow freshwater) (30–100 meters)	Yes
Bryophytes			
Bolander's bruchia moss *Bruchia bolanderi*	--/2/S	Lower/upper montane conifer forest, meadows and seeps, damp soil (600–1,700 meters)	

Common Name *Scientific Name*	Status: FWS[a]/CNPS[b]/ Plumas National Forest[c]	Habitat (elevation)	Found in Study Area
Elongate copper moss *Mielichhoferia elongata*	--/2/SI-1	Cismontane woodland (metamorphic rock, usually vernally mesic) (500–1,300 meters)	
Lichens			
Waterfan *Hydrothyria venosa*	--/--/S	Attached to rocks in cool mountain brooks and streams; submerged	

[a] FWS: SC – federal species of concern.

[b] 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

[c] Plumas National Forest: S – Sensitive
SI-1 – Special Interest Category 1 (Survey and recommend conservation measures).

[d] FWS recognizes two subspecies of *clarkia mosquinii*, ssp. *mosquinii* and ssp. *xerophila*, both as SC.

Surveys located nine special-status species in upland habitats around the Thermalito 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.

Wildlife Resources

DWR conducted field investigations for relicensing in 2002, 2003, and 2004. These studies were conducted in the same study area as the vegetation mapping: the area within the project boundary, a 1-mile area beyond the boundary, and the Feather River floodplain (within the Federal Emergency Management Area 100-year floodplain) downstream of the project boundary.

Twenty-four habitat types (using the California Wildlife Habitat Relationships classification system) occur within the study area as listed on table 36. 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 study area. Tree-dominated habitats cover about 36 percent of the study area. Riparian woodlands along the Feather River that are 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 study area.

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 migrant birds. These habitats also serve as nursery areas for many wildlife species including two large mixed heron/egret rookeries.

Table 36. Summary of wildlife habitat acreages within the study area. (Source: DWR, 2005a)

California Wildlife Habitat Relationships Database Habitat Type	Total Acres Within Study area	Percentage of Study 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

The OWA, west of the city of Oroville, is managed by 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 the Thermalito afterbay and the 5,000 acres adjacent to and straddling 12 miles of the Feather River.

Wildlife Species

DWR used the California Wildlife Habitat Relationships database was to predict wildlife species occurrence within study area habitats. DWR also made note of species observed during relicensing studies. Modeling results indicate that 334 wildlife species may occur within the size and density classes of habitat types present within the study area, including 13 amphibians, 22 reptiles, 235 birds, and 64 mammals as well as 6 federally listed species, 1 candidate species, 14 non-native species, and 55 recreationally and/or commercially important species.

The study 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 study area. Black-tailed deer are an important recreational harvest species in eastern Butte County. The study 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. Numerous furbearers including badger, mink, beaver, raccoon, gray fox, weasels, muskrat, bobcat, and opossum may occur in the study area.

Waterfowl are the most productive 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. Portions of the OWA within the project boundary are managed by DFG to provide habitat for nesting and wintering waterfowl. About 3 percent of the recreational use of this area is related to hunting. 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. Habitat for nesting and brooding waterfowl and nesting grebes, however, is limited in the Thermalito afterbay due to water level fluctuations and recreational high-speed boat use.

As part of an agreement with DWR, DFG conducts a regular habitat enhancement program in the OWA that includes the planting of upland nesting cover and foraging vegetation for waterfowl, along with thinning/removal of vegetation around the Thermalito afterbay brood ponds and dredging ponds in the preserve. The thinning/removal activities are conducted to provide improved access for waterfowl. About 200 acres of land are tilled and planted each year and remain as suitable nesting/foraging habitat for about 5 years before beginning to revert to the existing grasses. In addition, DFG thins and removes vegetation in and around ponds and rock piles to provide recreational access to the various habitats.

Upland game species, including mourning dove, wild turkey, ring-necked pheasant, and several species of quail, are found within the study area and provide hunting opportunities on adjacent private lands as well as on some public lands, including the OWA.

Non-native Wildlife Species

Fourteen non-native vertebrate wildlife species may occur within the study area including six birds, seven mammals, and one amphibian (table 37). Several of these species were introduced by DFG as harvest species, or are currently managed as harvest species.

Table 37. List of non-native vertebrate wildlife potentially found within the study area. (Source: DWR, 2005a)

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*	--

Common Name	Scientific Name	Status
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

Note: -- – No status

Special Status Wildlife Species

Seven state-listed wildlife species may occur within the project vicinity (table 38). Species protected under both the state and federal ESAs (e.g., bald eagle, giant garter snake, and yellow-billed cuckoo) are addressed separately in section 3.3.5, *Threatened and Endangered Species*.

Table 38. State-listed wildlife species potentially occurring in the study area. (Source: DWR, 2005a)

Wildlife Species	Scientific Name	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

Other Special-Status Species—Several other special status species have the potential to occur within the project vicinity. These other special status wildlife species include state species of concern, federal species of concern, Forest Service sensitive species, and BLM sensitive species (see table 39).

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 Forest Service sensitive species. 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 by DWR and entered into a geographic information system database. Further, more intensive surveys of all federal lands in the study area were completed for Forest Service 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 study area, as indicated in table 39.

Table 39. Other special-status species with the potential to occur in the project vicinity. (Source: DWR, 2005a)

Special-Status Species	Scientific Name	Status	Found in the Study Area
American bittern	*Botaurus lentiginosus*	FSC	Yes
American white pelican	*Pelecanus erythrorhynos*	CSC	Yes
Barrow’s goldeneye	*Bucephala islandica*	CSC	Yes
Bell’s sage sparrow	*Amphispiza belli belli*	FSC, CSC	No
Black swift	*Cypseloides niger*	FSC, CSC	No
Black tern	*Chilidonas niger*	CSC	Yes
Black-crowned night heron	*Nycitcorax nycticorax*	BLM	Yes
California gull	*Larus californicus*	CSC	No
California horned lark	*Eremophila alpestris actia*	CSC	No
California spotted owl	*Strix occidentalis caurina*	FSC, CSC, FS, BLM	No
California thrasher	*Toxostoma redivivum*	FSC	No
Common loon	*Gavia immer*	CSC	No
Cooper’s hawk	*Accipiter cooperi*	CSC	No
Double-crested cormorant	*Phalacrocorax auritus*	CSC	No
Ferruginous hawk	*Buteo regalis*	FSC, CSC, BLM	No
Golden eagle	*Aquila chrysaetos*	CSC, FSC, BLM	No
Lark sparrow	*Chondestes grammacus*	FSC	No
Lawrence’s goldfinch	*Carduelis lawrencei*	FSC	No
Lewis’s woodpecker	*Melanerpes lewis*	FSC	Yes
Loggerhead shrike	*Lanius ludovicianus*	FSC, CSC	Yes
Long-billed curlew	*Numenius americanus*	FSC, CSC	Yes
Long-eared owl	*Asio otus*	CSC	No
Merlin	*Falco columbarius*	CSC	No
Northern goshawk	*Accipiter gentilis*	FSC, CSC, FS	No
Northern harrier	*Circus cyaneus*	CSC	No
Nuttall’s woodpecker	*Picoides nuttallii*	FSC	Yes
Oak titmouse	*Parus inornatus*	FSC	Yes
Osprey	*Pandion haliaetus*	CSC	Yes
Prairie falcon	*Falco mexicanus*	FSC, CSC	Yes
Purple martin	*Progne subis*	CSC	No
Red-breasted sapsucker	*Sphyrapicus rubber*	FSC	Yes
Rufous hummingbird	*Selasphorus rufus*	FSC	No
Sharp-shinned hawk	*Accipiter striatus*	CSC	Yes

Special-Status Species	Scientific Name	Status	Found in the Study Area
Short-eared owl	*Asio flammeus*	CSC	Yes
Tricolored blackbird	*Agelaius tricolor*	FSC, CSC, BLM	Yes
Vaux's swift	*Chaetura vauxi*	FSC, CSC	No
Western burrowing owl	*Athene cunicularia*	FSC, CSC, BLM	Yes
Western least bittern	*Ixobrychius exilis*	CSC	No
Yellow warbler	*Dendroica petechia brewsteri*	CSC	Yes
White-tailed kite	*Elanus leucurus*	FSC	Yes
White-faced ibis	*Plegadis chihi*	FSC, CSC	Yes
Yellow-breasted chat	*Icteria virens*	CSC	Yes
Foothill yellow-legged frog	*Rana boylii*	FSC, CSC, BLM, FS	Yes
Western spadefoot	*Scaphiopus hammondii*	FSC, BLM	No
California horned lizard	*Phrynosoma coronatum*	CSC, BLM	No
Northwestern pond turtle	*Clemmys marmorata marmorata*	FSC, CSC, FS	Yes
Western mastiff bat	*Eumops perotis*	FSC, CSC, BLM	No
Fringed myotis	*Myotis thysanodes*	FSC, BLM	No
Long-eared myotis	*Myotis evotis*	FSC, BLM	No
Long-legged myotis	*Myotis volans*	FSC	No
Marysville kangaroo rat	*Dipodomys californicus eximus*	FSC, CSC, BLM	No
Occult little brown bat	*Myotis occultus*	CSC	No
Pale big-eared bat	*Corynorhinus townsendii pallescens*	FSC, CSC, BLM, FS	No
Pallid bat	*Antrozous pallidus*	CSC	No
River otter	*Lontra canadensis sonorae*	CSC, BLM	No
San Joaquin pocket mouse	*Perognathus inornatus inornatus*	FSC, BLM	No
Small-footed myotis	*Myotis ciliolabrum*	FSC, BLM	No
Spotted bat	*Euderma maculatum*	FSC, CSC, BLM	No
Townsend's big-eared bat	*Corynorhinus townsendii townsendii*	CSC, FS, BLM, FSC	No
Western red bat	*Lasiurus blossevillii*	FS	No
Yuma myotis	*Myotis yumanensis*	BLM	No

Notes: BLM – BLM Sensitive Species
CSC – California Species of Special Concern
FSC – Federal Species of Concern
FS – Forest Service Sensitive Species

3.3.4.2 Environmental Effects

Various Measures Affecting Waterfowl and Grebe Habitat

The Thermalito Complex provides resting and foraging habitat for waterfowl. Water level fluctuations and recreational high speed boat use in the Thermalito afterbay, however, limit habitat quality and availability for nesting and brooding waterfowl and nesting grebes.

DWR proposes several environmental measures designed to provide habitat for waterfowl in the Thermalito afterbay portion of the OWA. DWR proposes to develop and implement a plan to construct four waterfowl brood ponds by creating a small earthen berm across an inlet in the Thermalito afterbay (Proposed Article A122, *Construction and Recharge of Brood Ponds*). This plan would be developed in conjunction with DFG and in consultation with the Ecological Committee, which includes FWS. One brood pond would be constructed every 5 years over a 20-year period beginning upon license issuance. Subsequently, DWR would maintain the brood ponds by filling them no later than April 15 of each year and ensure, through monitoring the ponds on a weekly basis, that the water surface level of the ponds would not fluctuate more than 1 foot throughout the primary waterfowl brooding season of April 15 through July 31. If fluctuations greater than 1 foot were found, DWR would report it to DFG within 48 hours and disclose what DWR has done or would do to remedy the situation. DWR would file an annual report with the Commission, DFG, and FWS with the water elevation monitoring.

DWR also proposes to provide upland food for upland game birds and wintering waterfowl by preparing and planting a total of 60 to 70 acres of upland cover/forage crops on an annual basis within the Thermalito afterbay portion of the OWA (Proposed Article A123, *Provision of Upland Food for Nesting Waterfowl*). Additionally, DWR proposes to actively manage 240 acres of waterfowl nest cover in Thermalito afterbay, including preparing and planting 60 acres and maintaining an additional 180 acres annually, on a rotational basis (Proposed Article A124, *Provision of Nest Cover for Upland Waterfowl*). These measures would be implemented in coordination with DFG. DWR also proposes to install and structurally maintain 100 wildlife nesting boxes within the OWA within 1 year of license issuance (Proposed Article A125, *Installation of Wildlife Nesting Boxes*).

The Explanatory Statement of the Settlement Agreement (DWR, 2006a) states that the proposed OWA Management Plan (Proposed Article A115) would include measures to: (1) minimize Thermalito afterbay water level fluctuation to minimize effects on nesting grebes and (2) maintain and enforce the existing 5-mile-per-hour boat speed limit in the Thermalito afterbay north of Highway 162 to minimize effects on lacustrine and wetland wildlife species.

Interior's (on behalf of FWS) 10(j) recommendation nos. 10, 16, 17, 18, and 19 and DFG's 10(j) recommendation no. 3 are consistent with these proposed articles.

Staff Analysis

Water level fluctuations up to 12 feet occur on a weekly basis in the Thermalito afterbay. Although the fluctuations expose mudflats, which provide habitat to a variety of migratory shorebirds, nesting and brooding waterfowl and nesting grebes can be negatively affected. Waterfowl nest and brood in the wetland margins and grebes' nests float on top of the water in shallow water areas. Waterfowl require emergent wetland cover in proximity to aquatic habitat. Sudden or periodic increases in water levels can flood waterfowl nests resulting in the loss of eggs and forcing nesting hens to establish new nests in upland locations. The existing upland nesting habitat has less nesting cover than that which exists within the wetland margin, potentially causing increased predation of nesting waterfowl that have been forced to use this habitat because of flooding.

To improve waterfowl brooding habitat in the Thermalito afterbay, DWR, DFG, the California Waterfowl Association, and other stakeholders constructed five waterfowl brood ponds in and around the afterbay during the last 15 years. These brood ponds are not subject to Thermalito afterbay water level fluctuations and provide a more consistent water surface elevation with adjacent vegetative cover. The brood ponds are recharged directly from the Thermalito afterbay by raising the water level to a minimum surface elevation of 134.1 feet for a 12-hour period (DWR, 2004y). As water levels decrease within the brood ponds due to evaporation, seepage, and evapotranspiration, the distance between the aquatic habitat and adjacent vegetative cover increases, exposing waterfowl to predation. Brood ponds require recharge once every 3 weeks during the waterfowl brooding season (April 15 through July 31) for them to remain functional as brood habitat.

DWR proposes to develop and implement a plan to construct four additional waterfowl brood ponds within the Thermalito afterbay within 20 years of the issuance of any new license. Additionally, DWR proposes to maintain adequate water surface elevations within the existing and future brood ponds by filling them by the start of the brood season and recharging the ponds with a frequency that would ensure the surface water elevation would not fluctuate more than 1 foot throughout the brooding season. Increasing the amount of waterfowl brooding habitat and maintaining the ponds at the surface water elevation needed to provide the best habitat would replace brooding habitat lost as a result of Thermalito afterbay fluctuations.

The frequency of recharging the ponds is not established in DWR's proposal because brood ponds also provide habitat to the federally listed giant garter snake, which requires the ponds to be recharged less frequently (monthly as opposed to every 3 weeks) but for a longer period (April 1 through October 31 for the garter snake). The giant garter snake is further discussed in section 3.3.5, *Threatened and Endangered Species*. Recharging the brood ponds every 3 weeks within the waterfowl brooding season (April 15 through July 31) and monthly during the remainder of the time period required for the giant garter snake would maintain the appropriate habitat for all species.

DWR also proposes to provide upland food and nest cover for nesting waterfowl. DWR's proposal to plant and fertilize 240 acres of waterfowl nest cover within the Thermalito afterbay would improve upland waterfowl nesting cover from existing conditions. As such, it would replace high quality nesting habitat lost as a result of Thermalito afterbay water fluctuations. DFG currently plants and fertilizes wildlife forage crops (e.g., safflower, barley, or milo) in upland areas around the Thermalito afterbay for upland game species and migratory and resident waterfowl. Although DFG would continue this practice, DWR's proposal to plant 60 to 70 acres of upland cover and forage crops annually would increase the availability of cover and forage crops to upland game birds and wintering waterfowl. Increased availability of high-quality forage species would likely increase the density and productivity of these species. Additionally, installing and maintaining 100 wildlife nesting boxes would also provide nesting habitat for cavity nesting birds such as wood ducks.

Drawdowns of the Thermalito afterbay can strand floating grebe nests on mudflats, leading to an increased risk of predation or abandonment. Other effects on nesting grebes and other waterfowl include: (1) boat wakes swamping nests, (2) boating disturbance causing nest abandonment and displacement of incubating adults, and (3) direct mortality from ski, propeller, and boat strikes. Surveys conducted in 2003 indicated, however, that no abandonment or predation losses were identified and grebe production per pair in the Thermalito afterbay was the second highest level (1.41 young per brood) recorded in the statewide survey (DWR, 2004y). As such, the drawdowns of Thermalito afterbay do not appear to affect the overall grebe population in the project area. DWR's proposed OWA Management Plan would include provisions to continue to enforce a 5-mile-per-hour boating speed limit on the Thermalito afterbay north of Highway 162, which would limit the potential effects of recreational boating on nesting waterfowl.

Invasive Plant Management (Proposed Article A126)

Noxious and invasive species currently exist in nearly all plant communities within the project. These species crowd out native species, altering native ecosystems and potentially placing populations of special-status plant species at risk. Project operations including water level fluctuations and maintenance activities can promote the proliferation of invasive plant species throughout the project boundary.

DWR proposes (in Proposed Article A126, *Invasive Plant Management*) and the Forest Service preliminary 4(e) condition no. 18 specifies that DWR develop and file with the Commission for approval within 1 year of license issuance a plan to manage and reduce native and non-native invasive species populations within the project boundary. The plan would be developed in conjunction with the Forest Service, BLM, DFG, and DPR, and in consultation with the Ecological Committee, including FWS. Prior to filing the plan with the Commission for approval, DWR would submit the portion of the plan to the Forest Service, BLM, DFG, and DPR that pertains to the land each entity owns. DWR would include with the filing of the plan copies of the comments and recommendations made during consultation and would implement the plan upon Commission approval. As part of the plan, DWR would: (1) specify areas/acreages, treatment/control methods, best management practices, needs for multiple-year treatments and monitoring, and annual inspection; (2) modify implementation measures contained within the plan without Commission approval to the extend the measures are within the scope of the approved plan; (3) file with the Commission for approval any modification to the implementation measures that are not within the scope of the approved plan; (4) coordinate the plan and ongoing efforts with applicable federal, state, and local agencies and take into consideration state and federally listed species; (5) re-evaluate the plan after 5 years since initial implementation in consultation with the Forest Service, BLM, DFG, and DPR to consider the need to treat other invasive plant species, as well as alternative or additional control methods that may be implemented; and (6) file a compliance report annually with the Commission that is prepared in coordination with the Forest Service, BLM, DFG, and DPR.

Interior's (on behalf of FWS) 10(j) recommendation no. 20 and DFG's 10(j) recommendation no. 11 are consistent with this provision.

Butte County, in its letter dated April 26, 2006, recommends that DWR's proposed invasive species plan include additional treatment areas designated by the Butte County Agricultural Commissioner for aquatic plants that originate within the project boundaries and then invade downstream irrigation canals and agricultural lands that are outside the project boundaries. Butte County also recommends that it be included as a consulted party in the development of the plan because the County has a strong interest in the regulation of these invasive plants. In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation to include additional treatment areas outside the project boundary.

Staff Analysis

A total of 219 species of non-native plants, not all of which are classified as noxious or invasive weeds, were identified within the project boundary during surveys conducted in 2002 and 2003. Thirty-nine of these species are target species identified as noxious or invasive plants by the California Department of Food and Agriculture, California Invasive Plant Council, USDA, and the Plumas National Forest. Although noxious and invasive weed species are found throughout the project boundary, they are mostly concentrated in the OWA.

Noxious weeds and invasive species thrive in water fluctuation zones and areas of ground disturbance. The survey results presented in the *Project Effects on Noxious Terrestrial and Aquatic Plant Species* (DWR, 2004z) are consistent with this statement. In the project boundary, although a large number of invasive and noxious weed species occur in upland areas, the wetland margins and riparian areas tend to be the most heavily infested. Fluctuating water levels in the Thermalito Complex and Lake Oroville and managed flows in the low flow channel and Feather River encourage the proliferation of noxious and invasive species in the fluctuation zone and adjacent areas. In particular, the water level fluctuations in the Thermalito afterbay have created suitable conditions for purple loosestrife. This species occupies about 85 of the 852 acres of wetland/riparian margin (DWR, 2004z). The presence of purple loosestrife and other noxious and invasive weeds limits the presence of native vegetation and reduces the amount of wintering waterfowl nesting habitat.

Noxious and invasive species also occur in areas with land disturbance. Around Lake Oroville, these species occur in areas near roads, trails, facilities, and in the immediate vicinity of the spillway and power facilities. Continuing and proposed project maintenance and land disturbing activities, including the proposed recreational facility enhancements discussed in section 3.3.6, *Recreation Resources,* the proposed aquatic habitat enhancements and fish weir installation discussed in section 3.3.3, *Aquatic Resources*, vehicular traffic, and recreational use would contribute to the spread of invasive and noxious species. The spread of noxious and invasive weeds within the project boundary could affect special-status plant and wildlife species by out-competing native vegetation and altering required habitat components, especially within the OWA where both invasive and special-status species are plentiful.

The invasive species plan proposed by DWR and specified by the Forest Service would control, manage, and reduce noxious and invasive species within the project boundary. The plan would target these populations in the Thermalito Complex, OWA, selected lands around Lake Oroville, and along the low flow channel with the goal to reduce target plant populations and when necessary replace them with appropriate native plant species. The plan would target those species with the greatest potential to affect native plant and wildlife populations, including purple loosestrife, giant reed, tree of heaven, scarlet wisteria, parrot feather, Himalayan blackberry, and aquatic water primrose within OWA ponds. Because the invasive species plan would target those areas and species with the greatest potential to affect native species including waterfowl and special-status plants and wildlife, the plan would likely improve habitat conditions for those species and limit future habitat loss.

One of the goals of the proposed invasive species plan would be to eradicate and/or control invasive and noxious species to reduce the number of seeds and/or plants that are flushed into downstream irrigation canals, the Feather River channel, and ultimately the San Francisco Bay delta that have the potential to invade other sensitive resources and habitats as well as downstream agricultural lands. As such, the proposed invasive species plan appears to satisfy Butte County's recommendation to add treatment areas for aquatic plants that originate within the project boundaries and then invade downstream irrigation canals and agricultural lands that are outside the project boundaries. During the public process of plan development, Butte County would have the opportunity to provide input on the invasive species plan.

Oroville Wildlife Area Management Plan (Proposed Article A115)

The OWA contains important habitat for waterfowl, special-status plants and wildlife, and a wide-variety of other species. Water level fluctuations, recreational use, and maintenance activities have the potential to affect OWA vegetation and wildlife.

DWR proposes to develop and file for Commission approval a management plan for the OWA (Proposed Article A115), including the Thermalito afterbay, within 2 years of license issuance. The plan would be developed in conjunction with the DFG and DPR and in consultation with the Ecological Committee, including FWS, NMFS, the Water Board, and the Regional Board. DWR would implement the plan including any changes required by the Commission, following Commission approval and obtaining all necessary permits. The plan would include the following elements: (1) conservation measures required by final federal biological opinions; (2) resource actions included in any license that may affect the OWA; (3) strategies to minimize current and future conflicts between wildlife and recreation; (4) wildlife management goals and objectives; (5) recreation management goals and objectives that are consistent with the recreation measures outlined in the Recreation Management Plan; (6) other best management practices, including fuel load management for the reduction of fire risk to nearby properties and human life; (7) certain common elements of the Lower Feather River Habitat Improvement Plan; (8) actions designed to improve conditions for special status species and their habitats; (9) an implementation schedule; (10) monitoring and reporting requirements; (11) a provision for periodic updates to the plan as needed; and (12) agency management and funding responsibilities. This plan would be re-evaluated every 5 years in consultation with DFG. Additionally, the Recreation Advisory Committee would provide input to ensure the compliance with the Recreation Management Plan, discussed in section 3.3.6, *Recreation Resources*. DWR would notify the Commission if any changes to the plan are beyond the objectives, activities, or schedules identified in the plan. DWR would implement the plan upon Commission approval. Aspects of the proposed OWA Management Plan that address geology, threatened and endangered species, recreation, and land use are discussed in sections 3.3.1, 3.3.5, 3.3.6, and 3.3.7, respectively.

As discussed in section 3.3.1, *Geology, Soils, and Paleontological Resources*, DWR also proposes to develop and implement a Riparian and Floodplain Improvement Program to enhance riparian and floodplain habitats for associated terrestrial and aquatic species.

Butte County, in its letter dated April 26, 2006, recommends that it be included as a consulted party in the development of an OWA Management Plan because Butte County is responsible for law enforcement and public safety issues within the OWA, which are components of managing this area. In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation that it be included as a consulted party in the development of an OWA Management Plan.

Staff Analysis

The OWA, including the Thermalito afterbay, provides diverse habitat to a variety of special-status plant and wildlife species and waterfowl. The margins of the Thermalito afterbay have extensive wetland vegetation and unique mudflat habitat. The OWA, includes approximately 11,000 acres of land, most of which is inside the project boundary. A large percentage of the OWA is covered with gravel and cobble spoil piles left behind by historical dredging. The hill/swale complex from the spoil piles along with vernal pools found within the OWA provide habitat for rare species such as the federally listed valley elderberry longhorn beetle, giant garter snake, vernal pool invertebrates, and several plant species, all of which are discussed in section 3.3.5, *Threatened and Endangered Species*.

DFG currently manages the OWA, with assistance from DWR, to maximize the amount and quality of habitat available for fish and wildlife while also allowing compatible recreational use. Project operations and maintenance (O&M) activities conducted by DWR, DFG, and DPR affect plant and wildlife within the OWA. As discussed previously, water level fluctuations in the Thermalito Complex and the Feather River affect waterfowl, grebes, invasive species, and riparian habitat. Spoil piles in the OWA currently are harvested for gravel, which can alter habitat to either the benefit or detriment of wildlife species. Maintenance activities by DWR and DFG within the OWA for things such as roads and parking lots, levees, trails, plantings for waterfowl, and fire suppression can remove or alter habitat, promote the establishment of invasive species, and cause the displacement or loss of wildlife.

Ongoing and proposed recreational use, including boating, hunting, fishing, off-highway vehicle (OHV) use, and camping, also affects vegetation and wildlife with the OWA. DWR proposes the modification, improvement, and expansion of recreational facilities within the OWA, as discussed in section 3.3.6, *Recreation Resources*. Specific locations include the Thermalito afterbay outlet camping area, and a day-use area near the Feather River at the OWA Thermalito afterbay outlet; numerous boat ramps would also be modified. Recreational activity can affect vegetation and wildlife either through direct loss of habitat, habitat modification, or displacement and disturbance.

The proposed OWA Management Plan would allow all continuing and proposed measures related to the OWA to be managed under one plan and integrated with the proposed Recreation Management and Lower Feather River Habitat Improvement plans. As proposed, the OWA Management Plan would ensure that the OWA is managed to the optimum benefit to vegetation, wildlife, riparian habitat, and special-status species, as well as recreation. Including Butte County as a consulted party in development of the management plan would ensure that concerns with law enforcement, public safety, and local issues are considered.

The Riparian and Floodplain Improvement Program proposed by DWR would implement projects designed to improve riparian habitat and connect portions of the Feather River to its floodplain within the OWA. Riparian and floodplain habitat is important to wildlife because it provides habitat diversity, travel corridors, and cover to protect species from predation. Under this program, DWR would also identify where gravel harvesting can take place to improve wildlife habitat. DWR (2004aa) reports that the limited cottonwood recruitment in the Feather River is an effect of project operations that prevent initial seedling survival, longer-term establishment of seedlings, or both. The study results indicate that the frequent occurrence of scouring flows in the high flow channel also affects cottonwood survival. The proposed improvement program would identify and implement possible riparian/floodplain improvement projects. These measures would be designed to improve and expand riparian and floodplain habitat, including cottonwoods, benefiting wildlife.

Other Environmental Measures Affecting Terrestrial Resources

Project facilities and modifications proposed for aquatic and recreational resources also have the potential to affect terrestrial resources. Construction, expansion, and improvements of aquatic and recreational facilities could result in the disturbance and loss of vegetation. Conversely, some proposed fishery enhancement measures have the potential to benefit riparian and wildlife habitat.

Fisheries measures proposed by DWR, as discussed in section 3.3.3, *Aquatics Resources*, that have the potential to affect terrestrial resources include: (1) Channel Improvement Program (Proposed Article A103); (2) Structural Habitat Supplementation and Improvement Program Plan (Proposed Article A104); and (3) Fish Weir Program (Proposed Article A105). Recreation measures proposed by DWR,[61] as discussed in section 3.3.6, *Recreation Resources*, that have the potential to affect terrestrial resources include: (1) the modification, improvement, and/or expansion of campgrounds; (2) improvements to boat ramps; (3) improvements and development of day-use areas; and, (4) trail and trailhead improvements.

Staff Analysis

Construction of two fish barrier weirs would have minor short-term and long-term effects on vegetation and wildlife because of necessary vegetation clearing. Clearing vegetation and disturbing soils would also create a favorable environment for the introduction and proliferation of invasive weed species. The construction of two fish weirs in the low flow channel would result in the permanent loss of less than 1 acre of riparian vegetation. No special-status species are known to occur in the area of the proposed fish weirs, so no effects on special-status species would be expected.

Construction activities to improve Moe's and Hatchery ditches and create five side channels (Proposed Article A103, *Channel Improvement Program*) would temporarily disturb vegetation. Placing LWD and boulders in the channel (Proposed Article A104, *Structural Habitat Supplementation and Improvement Program Plan*) would result in the temporary disturbance of some vegetation, but, overall, this program would likely benefit riparian and wetland vegetation. LWD would trap sediment, which would potentially allow new areas of riparian vegetation to become established. Additionally, LWD could prevent scouring of existing riparian vegetation by providing protection from high flows.

Several recreational measures could also result in the loss of vegetation and increase the risk of establishing and spreading invasive plant species. The two recreational measures that would result in the most vegetation loss are the proposed modifications at Bidwell Canyon and Loafer Creek recreation

[61] DWR proposes specific recreational measures in the Settlement Agreement Recreation Management Plan, dated March 2006.

areas. Enhancements at the Bidwell Canyon Recreation Area would require the removal of approximately 7 acres of vegetation—2 acres of open/disturbed blue oak/foothill pine woodland and 5 acres of dense mixed oak/foothill pine. Loafer Creek recreation area enhancements would require the removal of approximately 10 acres of mixed oak/foothill pine vegetation. Proposed modifications at the Enterprise boat ramp, Foreman Creek, Saddle dam, Thermalito diversion pool, Thermalito forebay, and Thermalito afterbay would require the removal of less than 1 acre of vegetation at each location. The loss of large areas of vegetation, as at Bidwell Canyon and Loafer Creek recreation areas, would likely have minor effects on wildlife from loss of habitat and displacement; however, these areas have already been heavily modified by extensive recreation, which has lessened their habitat value. The vegetation lost at the remaining areas is minimal and would be unlikely to affect wildlife.

3.3.4.3 Cumulative Effects

Riparian communities in the Sacramento Valley have been adversely affected by the development of numerous hydroelectric and reservoir projects, mining, water diversions, channelization, and levee construction. Project facilities and operations contribute to the loss of riparian communities downstream of the project by reducing sediment discharge and floodflows.

Flow management and project maintenance, along with recreational use, land development, agriculture, and fire suppression contribute to the loss of upland plant communities and wetlands and the spread of invasive species. Loss of vegetation would occur, as a result of the proposed project aquatic and recreational measures, as well as non-project related land management, development, and agriculture. Water level fluctuations and project recreational use contribute to the loss of waterfowl and grebe nesting habitat; however, the proposed brood ponds and improved cover and forage habitat, in addition to existing activities by the DFG, would be a beneficial effect on Sacramento Valley waterfowl.

Existing and proposed activities, in addition to management and development of lands adjacent to the project boundary, would also increase the potential for invasive species proliferation. The proposed invasive species plan, however, would result in a cumulative beneficial effect on native plant communities and wildlife because it would manage for, control, and eradicate invasive species, particularly in areas of special-status species and commercially and recreationally important species.

3.3.4.4 Unavoidable Adverse Effects

More than 20 acres of vegetation would be permanently lost as the result of proposed aquatic and recreational measures. As a result, some wildlife would be displaced, and small, less mobile species could be lost.

3.3.5 Threatened and Endangered Species

3.3.5.1 Affected Environment

Fish Species

Central Valley Spring-run Chinook Salmon

On September 19, 1999, NMFS listed the Central Valley spring-run Chinook salmon ESU as threatened under ESA, and the listing was reaffirmed on June 28, 2005. The Central Valley spring-run Chinook salmon ESU is also listed as endangered under the California Endangered Species Act. The ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries in California, including the Feather River, as well as fish from the Feather River Hatchery spring-run Chinook program. NMFS' Central Valley Technical Recovery Team believes that the existing spring-run population in the Feather River, including the hatchery fish, may be the only remaining representative of this important ESU component and that the Feather River Hatchery spring-run Chinook stock may play an important role in the recovery of spring-run Chinook in the Feather River Basin as efforts progress to restore natural spring-run populations in the Feather and Yuba rivers (70 FR 37,160).

A final critical habitat designation was published on September 2, 2005, with an effective date of January 2, 2006. NMFS identified the Feather River downstream of Oroville dam as critical habitat for Central Valley spring-run Chinook salmon. NMFS further ruled that it is premature to include areas upstream of Oroville dam until ongoing recovery planning efforts in the central valley identify above-dam unoccupied areas that are essential for conservation of these ESUs (70 FR 52,630).

Historically, spring-run Chinook salmon were reported to have ascended to the very highest streams and headwaters in the Feather River Watershed while they completed gonadal maturation (DFG, 1998a). The fish barrier dam downstream of Oroville dam now denies fish passage to historical spawning grounds at higher elevations (DFG, 1998a). As previously stated, the Oroville Facilities and seasonal sediment wedges (see figure 9) currently block the upstream migration of anadromous salmonids into historical spawning habitat in upstream tributaries. Blocked access to historical spawning grounds in the upper watershed causes spring-run Chinook salmon to spawn in the same lowland reaches of the Feather River that fall-run Chinook salmon use as spawning habitat. The overlap in spawning sites and in spawning timing (Moyle, 2002) may be responsible for inter-breeding between spring-run and fall-run Chinook salmon in the Feather River (Hedgecock et al., 2001).

In the Feather River, it has been reported that adult spring-run Chinook salmon enter the river from March through June (Sommer et al., 2001), and spawn from August through October (DFG, 1998a; DWR and BOR, 2000; Moyle, 2002). Fall-run Chinook salmon typically spawn in late September through December. Suitable water temperatures for spawning are 42 to 58°F (5.6 to 14.4°C). Incubation may extend through March; suitable incubation temperatures are 48 to 58°F (8.9 to 14.4°C) (DWR, 2006). Feather River spring-run and fall-run Chinook salmon appear to migrate out of the project area within days of emergence.

Water temperature strongly influences the timing of adult Chinook salmon spawning activity. When daily average water temperatures decrease to about 60°F, 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). Most juvenile Chinook salmon emigrate from the Feather River within a few days of emergence, and 95 percent of the juvenile Chinook have typically emigrated from the Oroville Facilities area by the end of May. Chinook exhibiting the typical spring-run life history are found holding at the Thermalito afterbay outlet and the fish barrier dam as early as April.

Water temperatures reported to be optimal for rearing of Chinook salmon fry and juveniles are between 45 and 65°F (NMFS, 2002; Rich, 1987; Seymour, 1956). Juvenile fall-run Chinook salmon normally rear for 1 to 7 months in freshwater before migrating to the ocean (Yoshiyama et al., 1998), and normally spend 4 to 5 years in the ocean (Moyle, 2002). Juvenile Chinook salmon in the Feather River have been reported to emigrate from about mid-November through June, with peak emigration occurring from January through March (DWR, 2002c; Painter et al., 1977).

Central Valley Steelhead

Steelhead are native to California rivers. On March 19, 1998, NMFS listed the naturally spawned Central Valley steelhead as threatened under the ESA (63 FR 13,347). In June 2005, NMFS determined that hatchery stocks are to be included in a steelhead Distinct Population Segment if they are no more than moderately diverged from local, native populations in the watershed(s) in which they are released.

In its final listing determination published January 6, 2006 (71 CFR 834), NMFS concluded that the threatened Central Valley Steelhead Distinct Population Segment includes all naturally spawned populations of steelhead (and their progeny) below natural and manmade barriers in the Sacramento and San Joaquin rivers and their tributaries. The listing excludes steelhead from San Francisco and San Pablo bays and their tributaries, and includes steelhead from Feather River Fish Hatchery.

Critical habitat for Central Valley steelhead was designated by NMFS in September 2005 (70 FR 52,488), and includes the Feather River downstream of Oroville dam.

Most of the natural steelhead spawning in the Feather River occurs in the low flow channel, particularly in its upper reaches near Hatchery Ditch, a side-channel located between RM 66 and 67. 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 (DWR, 2005a). The lower velocities, 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, 2001b). Juvenile steelhead in the Feather River emigrate from about February through September, with peak emigration occurring from March through mid-April. However, empirical and observational data suggest that juvenile steelhead potentially emigrate during all months of the year in the Feather River.

Southern DPS North American Green Sturgeon

Following completion of a comprehensive ESA status review and update for the North American green sturgeon, NMFS published a Proposed Rule to list the Southern DPS of green sturgeon, including the Feather River subpopulation, as threatened on April 6, 2005. NMFS issued a Final Rule to list the Southern DPS as a threatened species on April 7, 2006 (71 FR 17757). NMFS is currently considering issuance of protective regulations to provide for the conservation of the species and soliciting information that may be relevant to the analysis of protective regulations and to the designation of critical habitat.

As previously stated in section 3.3.3.1, *Aquatic Resources, Affected Environment*, green sturgeon are anadromous and begin an upstream spawning migration between February and June; spawning occurs between April and June (Beamesderfer and Webb, 2002; Moyle, 2002). Spawning occurs in deep pools (probably deeper than 3 meters) in large, turbulent rivers, and the preferred substrate is probably large cobble with crevices to trap eggs (DWR, 2006). Adults enter the Sacramento River when water temperatures are between 46 and 57°F (7.8 to 13.9°C). Sturgeon eggs have been found in the Sacramento River from mid-February through July. Eggs are slightly adhesive, adhering to substrate and each other; silt is known to prevent adherence. Water temperatures greater than 68°F (20°C) may be lethal to embryos. Larval and juvenile sturgeon remain in freshwater up to 4 years before migrating to the ocean.

Restricted access to potential spawning areas is considered the primary factor for the decline of the Southern DPS green sturgeon (DWR, 2006). The Biological Review Team for listing of the Southern DPS green sturgeon concluded that a viable spawning population no longer exists in the Feather River and was probably lost due to construction of Oroville dam that blocks access to upstream habitat, other upstream passage barriers, and the thermal barrier associated with Thermalito afterbay. Sturgeon passage may be impeded at Shanghai Bend (RM 25) and Sunset Pumps on the Feather River, particularly at lower flows in the spring and fall. Sturgeon do not typically enter the mouth of the Feather River at flows lower than about 5,000 cfs (DWR, 2005b, appendix G).

The occasional capture of larval green sturgeon in salmon out-migrant traps suggests that green sturgeon spawn in the Feather River (Moyle, 2002); however, NMFS reports that evidence of green sturgeon spawning in the Feather River is unsubstantiated (70 FR 17386). The goal of SP-F3.2 Task 3A was to determine the distribution, spawning locations and timing, habitat usage, residence time, and emigration patterns of sturgeon in the lower Feather River (DWR, 2005r). However, angling and fyke netting did not capture any sturgeon for the 2003 radio telemetry study and the fyke trap used in the 2004 study season, and the egg and larval survey during the 2003 season did not capture any sturgeon.

However, several sturgeon were seen breaching downstream of Shanghai Bend from June 1-10, 2004, when flows ranged from 3,691 to 5,577 cfs (DWR, 2005r). DWR concluded it was possible, given the size of the individuals and the leaping behaviors observed, that spawning occurred downstream of Shanghai Bend. This area was comparable with other known sturgeon spawning habitats given that it consisted of deep, high velocity waters; however, water temperatures, averaging between 66.6°F (19.2°C) and 71.4°F (21.9°C), were warmer than preferred temperatures indicated by the literature for spawning sturgeon (DWR, 2005r). DWR also concluded that flows above 5,100 cfs seemed unlikely to have prevented passage (DWR, 2005r).

Delta Smelt

The federally threatened delta smelt occur only in the Sacramento-San Joaquin Estuary and have been found as far upstream as the mouth of the American River on the Sacramento River. Delta smelt are found in brackish water and spawn in fresh water. Delta smelt do not occur within the project boundary or within the Feather River.

Plant Species

DWR compiled a list of federally listed plant species with the potential to occur in the study area based upon rare plant descriptions and distributions obtained from California Natural Diversity Database 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.

DWR conducted botanical surveys during 2002, 2003, and 2004 in accordance with standard guidelines issued by DFG (2000), FWS (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). Areas surveyed included valley grasslands around Thermalito afterbay and Thermalito forebay, serpentine soils along the West Branch and Upper North Fork arms, and gabbro soils along the South Fork arm. All plant species encountered during these surveys were identified to the lowest taxonomic status possible.

Relicensing studies indicate that potentially suitable habitat exists within the study area for seven federally listed and state-listed plant species (table 40). 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 study area, potentially suitable habitat does exist for all of the seven listed species.

Table 40. Federally listed plant species with potential to occur in the study area. (Source: DWR, 2005a)

Common Name *Scientific Name*	**Status FWS/ State**	**Habitat (elevation)**	**Found in Study area**
Butte County meadowfoam *Limnanthes floccosa* ssp. *californica*	Endangered/ endangered	Valley and foothill grassland (mesic), vernal pools (50–90 m)	No
Hairy Orcutt grass *Orcuttia pilos*	Endangered/ endangered	Vernal pools (55–200 m)	No
Hartweg's golden sunburst *Pseudobahia bahiifolia*	Endangered/ endangered	Cismontane woodland, valley and foothill grassland/clay (15–150 m)	No
Greene's tuctoria *Tuctoria greenei*	Endangered/ rare	Vernal pools (30–1,070 m)	No
Hoover's spurge *Chamaesyce hooveri*	Threatened	Vernal pools (25–250 m)	No
Slender Orcutt grass *Orcuttia tenuis*	Threatened/ rare	Vernal pools (35–1,760 m)	No
Layne's ragwort *Senecio layneae*	Threatened/ rare	Chaparral, cismontane woodland/ serpentinite or gabbroic (200–1,000 m)	No

Butte County Meadowfoam

This winter annual herb is federally listed as endangered and 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 msl.

Sixteen of the eighteen remaining known 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 four occurrence records for Butte County meadowfoam from about 5 miles north of the Thermalito afterbay in the vicinity of Shippee, California.

Relicensing surveys conducted by DWR did not locate Butte County meadowfoam in the study area. About 49 acres of vernal pools, ephemeral drainages, and pool/swale complexes occur in the study area in the grasslands around the Thermalito Complex. Many of the ephemeral drainages could potentially support Butte County meadowfoam. White meadowfoam is a common early successional inhabitant of ephemeral drainages and depressions within the study area. This species is closely related to the listed Butte County meadowfoam and occurs in similar habitat.

Hairy Orcutt Grass

This annual grass species is federally listed as endangered and occurs in drying vernal pool habitat along the eastern margin of California's Central Valley at elevations ranging from 100 to 400 feet msl. 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 study area.

DWR did not locate any occurrences of hairy Orcutt grass during relicensing surveys within the study area. Many of the larger and deeper vernal pools are associated with clay soils that form a nearly impermeable pool bottom and are suitable habitat for this species.

Hartweg's Golden Sunburst

This annual herb in the sunflower family is federally listed as endangered and closely associated with mima mound topography in annual grasslands and blue oak woodlands.

The type locality for this species historically occurred 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 occurs in two general areas in eastern San Joaquin County. The extirpated Yuba County location is more than 26 miles south of the project boundary.

No occurrences or potential habitat for Hartweg's golden sunburst were found downstream of the study area along the Feather River floodplain. The vernal pools in the grasslands around Thermalito forebay and Thermalito afterbay contain areas of mounded ground that could be potential habitat for this species.

Greene's Tuctoria

Greene's tuctoria is federally listed as an endangered species and is a state-listed 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 project boundary, 1 within 5 miles and another within 10 miles of the project boundary.

DWR did not locate any occurrences of Green's tuctoria during relicensing surveys in the study area. Potentially suitable habitat exists in the larger, deeper vernal pools that are associated with impermeable clay soil bottoms.

Hoover's Spurge

This prostrate annual herb is federally listed as threatened and 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 the current California Natural Diversity Database, 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 Central Valley in Tulare, Merced, Stanislaus, Butte, Glenn, and Tehama counties, where it occurs below elevation 820 feet msl. The majority of occurrences are located near the Butte-Tehama county line in the northern Sacramento Valley. The occurrence of Hoover's spurge that is closest to the project is about 8 miles north of the project boundary.

Although suitable habitat exists within the study area, no occurrences were found within the study area during relicensing surveys.

Slender Orcutt Grass

This annual grass species is federally listed as threatened and 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 study area.

Large, deep vernal pools with clay soils that form a nearly impermeable pool bottom occur in the study area. These deep pools are suitable habitat for this species. Slender Orcutt grass was not found in the study area during relicensing surveys conducted by DWR.

Layne's Ragwort

This perennial herb is federally listed as threatened and 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 California Natural Diversity Database from El Dorado, Tuolumne, and Yuba Counties. Two of the 43 records are in Yuba County, about 5 miles southeast of the South Fork arm.

About 172 acres of serpentine and serpentine-derived soils and 64 acres of gabbro and gabbro-derived soils occur in the study area around Lake Oroville. These serpentine- and gabbro-derived soils with sparse vegetation cover are potential habitat for Layne's ragwort. DWR did not find Layne's ragwort in the study area during relicensing studies.

Wildlife Species

DWR compiled a list of federally listed wildlife species with the potential to occur in the project boundary based upon identification of potential habitats and compilation of information, species occurrence, and life histories from the California Wildlife Habitat Relationship database and the California Natural Diversity Database for the study area and within a 1-mile radius as well as other national, state, and/or county biological survey records and databases, web sites, printed articles, and discussions with local wildlife agency staff.

DWR delineated potential habitats by converting vegetation mapping for the study area (as discussed in section 3.3.4, *Terrestrial Resources*) to the California Wildlife Habitat Relationship habitat classification system. DWR conducted surveys of potential habitats for threatened and endangered species as well as visual surveys for the occurrence of the species in 2002 (valley elderberry longhorn beetle and California red legged frog, bald eagle), 2003 (bald eagle and vernal pools) and 2004 (bald eagle and vernal pools) in accordance with applicable DFG or FWS protocols, where appropriate.

FWS issued a letter on January 28, 2004, which listed species that potentially may occur in the project vicinity. Seven wildlife species protected under the ESA have the potential to occur within the project vicinity: vernal pool tadpole shrimp, Conservancy fairy shrimp, vernal pool fairy shrimp, bald eagle, giant garter snake, California red-legged frog, and valley elderberry longhorn beetle (see table 41). No designated or proposed critical habitat occurs within the project boundary for federally listed species. Surveys conducted during relicensing located the presence of or occurrence of potentially suitable habitat within the study area for the seven species identified by FWS in its letter issued January 28, 2004.

DWR entered into informal consultation with FWS to resolve terrestrial listed-species issues prior to the initiation of formal consultation. FWS recommended several measures for early implementation (under the existing FERC license) to minimize or avoid take of a federally listed species related to ongoing project activities. Species-specific measures are discussed below; however, in addition, DWR has designated a listed-species coordinator within DWR to implement and regulate implementation of conservation measures.

Table 41. Federally listed species occurring in the project vicinity. (Source: DWR, 2005a)

Wildlife Species	Scientific Name	Federal Status
Vernal pool tadpole shrimp	*Lepidurus packardi*	Endangered
Conservancy fairy shrimp	*Branchinecta conservatio*	Endangered
Vernal pool fairy shrimp	*Branchinecta lynchi*	Threatened
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Giant garter snake	*Thamnophis couchi gigas*	Threatened
California red-legged frog	*Rana aurora draytonii*	Threatened
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened

Bald Eagle

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., 1990). 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. About 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.

Four active bald eagle nest territories currently exist within the project boundary, with one additional active nest territory present on the North Fork upstream of the project boundary. Three active nests are along the shoreline of Lake Oroville and one is on the Feather River in the southwest portion of the OWA. Population monitoring (2002 through 2004) indicates that reproduction (1.0 fledgling/active nest) meets the FWS' Bald Eagle Pacific Recovery Plan goals (FWS, 1986). Winter bald eagle surveys indicate that Lake Oroville receives extensive wintering use by both adult and immature eagles; however, other project aquatic habitats receive relatively minor wintering bald eagle use (DWR, 2004bb).

DWR has implemented conservation measures as a result of the draft programmatic biological assessment. These include measures designed to protect bald eagle nesting territories by prohibiting human activity near the nests. These measures include the following: (1) administrative closure of land and shoreline areas to human entry during the nesting season around the four bald eagle nest territories; (2) signage, patrol, and enforcement of closure; (3) nest and population surveys; (4) habitat improvement measures; and (5) limitations on current and future habitat disturbance. DWR also has prepared and implemented bald eagle territory management plans for the four bald eagle territories currently active on or within 0.25 mile of project lands.

Giant Garter Snake

The giant garter snake is endemic to the wetlands of the Central Valley of California. Historical 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. 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) and 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 follows: (1) adequate water during the snakes' active season (early spring through mid-fall) to support dense populations of prey; (2) the 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 project boundary. About 4,280 acres of suitable habitat have been identified within the study area. DWR observed no giant garter snakes during the course of the relicensing studies. DWR conducted habitat surveys in the areas of potential project affects near recreational developments and other project facilities, and non-protocol level field surveys were conducted during 2 weeks in August 2002 (DWR, 2004bb). However, unconfirmed sightings of this species have been received historically from biologists working near Robinson Borrow Pond (adjacent to the 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 within the project boundary 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 located primarily on private property and outside of the project boundary. Rice fields and agricultural ditches provide habitat for most of the existing populations of the giant garter snake (FWS, 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. State Route 99 serves at least as a partial barrier to this dispersal habitat.

California Red-Legged Frog

The California red-legged frog can occur from sea level up to about elevation 5,000 feet msl, with most known populations occurring below elevation 3,500 feet msl. This species uses a variety of aquatic habitats for reproduction including streams, deep pools, backwaters, ponds, marshes, sag ponds, dune ponds, and lagoons (FWS, 2000). Breeding adults are generally associated with deep (greater than 2 feet), slow moving water bordered by dense, low riparian or emergent vegetation (FWS, 2000). Upland areas near breeding locations can also be used extensively during the summer (FWS, 2000). The California red-legged frog has been extirpated from about 70 percent of its former range with only two known populations remaining east of the Coast Range.

The California red-legged frog is not currently known to exist within the project boundary. However, the largest remaining population within the Sierra Nevada range is within 1 mile of the project boundary in the North Fork drainage. DWR conducted California red-legged frog habitat surveys during 2 weeks in August 2002. All accessible wetland areas within the Oroville facilities boundary were surveyed on foot and wetlands within 1-mile of the project boundary without access permission were surveyed using binoculars and a spotting scope. The results of these survey efforts were submitted to FWS for review and comment, and FWS suggested that documentation of potential habitat was adequate for effect assessment (DWR, 2004bb). Suitable California red-legged frog habitat was identified by DWR within portions of Thermalito forebay, Thermalito afterbay, and the OWA. Neither Lake Oroville nor the portion of the reservoir's tributaries within the study area contain suitable habitat.

Vernal Pool Invertebrates

The study area is known to be within the range of three federally listed eubranchiopod species: the vernal pool fairy shrimp, Conservancy fairy shrimp, and 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 reportedly occurs in Butte County. The tadpole shrimp, an omnivorous species, generally forages on the bottoms of pools in dense vegetation. Tadpole shrimp tend to be slow growing and usually produce eggs after the vernal pool has been ponded for 30 days.

The Conservancy fairy shrimp is federally listed as an endangered species. This species reportedly occurs in large (>1.2 acres) and deep (>6 inches) turbid alkaline pools. This species of fairy shrimp has an extremely disjunct distribution, known to occur in Tehama and Butte Counties, the northern part of the Sacramento Valley, Solano County at the Jepson Prairie, Merced County, the San Joaquin Valley near Haystack Mountain, and an isolated occurrence from northeastern Ventura County (Eriksen and Belk, 1999). No suitable habitat for this species occurs within the project boundary.

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 lives in neutral to slightly alkaline vernal pools throughout the Central Valley and in rock outcrop pools along the Interior Coast Ranges, south of the Sacramento River 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 have more stable DO levels. Further, deep pools will pond long enough to allow the shrimp to complete their life cycle.

None of these three invertebrate species are known to occur within the study area. Vernal pool fairy shrimp, however, are documented to occur at two locations immediately adjacent to the project boundary (DFG, 2004). According to FWS's biological opinion (letter dated April 9, 2007), 72.3 acres of suitable vernal pool fairy shrimp and vernal pool tadpole shrimp habitat occur within the project boundary, mainly occurring in the grasslands around Thermalito afterbay and Thermalito forebay. DWR currently conducts vernal pool surveys in the spring of each year, and will continue to do so until 2009 at which point DWR will conduct surveys every other year for the length of its license.

DWR has implemented conservation measures as a result of the draft programmatic biological assessment. These measures are designed to protect vernal pool invertebrate habitat, including the following: (1) signage and fence maintenance to prevent illegal OHV use in areas containing vernal pools; (2) implementation of actions to prevent sediment or contaminate discharge into vernal pools; and (3) monitoring to determine conservation measure effectiveness. The sediment-trapping program uses 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. Initially, this is an experimental program. DWR plans that, 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. Additionally, DWR abandoned and then revegetated, one road segment located near vernal pools that DWR determined is no longer necessary and needed to facilitate project operations or management.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle's known distribution has greatly increased through additional survey efforts, which have located additional populations since its initial listing in 1980. FWS 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 (FWS, 1984).

The beetle primarily inhabits riparian habitat and adjacent uplands. The valley elderberry longhorn beetle depends on its host plant the elderberry throughout its life cycle. Valley elderberry longhorn beetles, which spend most of their 2-year life cycle boring within the stem in a larval stage, emerge from March through June as adults to lay eggs, completing the life cycle (Barr, 1991).

DWR mapped and surveyed elderberry bushes using the FWS protocol within 100 feet of all project features within the project boundary, including roads, levees, campgrounds, and trails. No protocol level surveys were conducted within the portion of the OWA bordering the Feather River and downstream of the Feather River. In these areas, elderberry shrubs were mapped, and the valley elderberry longhorn beetle's presence was assumed based on prior sampling (DWR, 2004bb). Elderberry bushes are one of the most common shrub species in high terrace habitats within the portion of the OWA bordering the Feather River. More than 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 study area between Oroville dam and Table Mountain Boulevard.

3.3.5.2 Environmental Effects

Fish Species

Gravel Supplementation and Improvement Program (Proposed Article A102)

DWR's studies indicate that the Oroville dam traps an estimated 97 percent of all sediment, including gravels. As a result, the current spawning habitat in the low flow channel has deteriorated due to a lack of suitable spawning gravel. In response to the current situation, DWR would plan for and implement gravel supplementation within 5 years after license issuance (Proposed Article A102, *Gravel Supplementation and Improvement Program*). At least 8,300 cubic yards of gravel suitable for spring-run Chinook salmon and steelhead would be distributed at up to 15 locations in the low flow or high flow channels.

Within 2 years of license issuance, DWR would develop a gravel supplementation and improvement program for the ongoing and future management of the Feather River. DWR would conduct a physical assessment of the spawning riffles between RM 54.2 and 67.2 and develop a sediment budget for the low flow channel. At 5-year intervals after the initial supplementation period, DWR would monitor and maintain a minimum of 10 of the 15 riffle complexes on a rotating basis in the low flow channel so that approximately 80 percent of the spawning gravels randomly sampled in the riffle complexes would be in the median size range preferred by Chinook salmon or steelhead. If and when the need arises, but no sooner than ten years after license issuance, DWR, in consultation with the Ecological Committee, would determine the need for additional gravel supplementation activities to be conducted in the high flow channel and DWR would prepare a gravel budget for supplementation activities in the high flow channel.

DWR evaluated the effects of the Gravel Supplementation and Improvement Program in the preliminary draft environmental assessment (DWR, 2005a) and determined it would be beneficial because an increase in the quantity and quality of suitable spawning habitat downstream of the fish barrier dam would be expected to reduce the rates of redd superimposition and associated egg mortality, as well as reduce competition for spawning habitat.

Staff Analysis

Historically, Chinook salmon and steelhead spawning occurred upstream of the Oroville dam; however, the Oroville Facilities prevent their access to higher quality spawning habitat in the upper watershed. As a result, all Chinook salmon and steelhead spawning currently takes place downstream of the fish barrier dam, where competition for spawning is unnaturally concentrated and there is no spatial segregation of the spring-run and fall-run Chinook salmon. In addition to redd superimposition/egg mortality, there is increased pre-spawning mortality and interbreeding between the Chinook salmon spring and fall runs.

From 2000 through 2003, there were high annual Chinook salmon pre-spawning mortalities in the low and high flow channels (42.5 and 39.7 percent, respectively). In September, pre-spawn mortality rates ranged from 70 to 100 percent (DWR, 2005l). The study report attributes the high mortalities to stress from elevated water temperature, low river flows, disease, high spawning returns of hatchery progeny (competition), and recreational angling. Elevated water temperature, low river flows, and disease are addressed later in this section in our analysis of Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*.

Currently, the majority of the natural Chinook salmon spawning takes place in the low flow channel, downstream of the fish barrier dam, with the balance taking place in the high flow channel. The low flow channel has been managed to comply with the term of the October 2004 NMFS Biological Opinion (see section 3.3.2.1, *Water Quality*), and this reach has the coldest water temperatures, which makes it most suitable for Chinook salmon spawning. Competition for limited spawning habitat disproportionately affects the earlier spawning spring-run Chinook salmon due to redd imposition by the later spawning, fall-run Chinook salmon.

Steelhead spawning occurs in the winter from December to March, and peaks in late January when temperatures are suitably cold everywhere in the lower Feather River. Incubation extends from December through May, and highest egg survival occurs when water temperature is under 55°F (12.8°C) (DWR, 2006). Most of the natural steelhead spawning also takes place in the low flow channel, particularly near the Hatchery Ditch side-channel (RM 66 to 67); limited steelhead spawning also occurs downstream of the Thermalito afterbay outlet. The best explanation for the distribution of steelhead spawning appears to be affinity for the Feather River Fish Hatchery and/or for upstream areas (DWR, 2004cc).

The colder water temperature in the low flow channel, and the smaller substrate size and greater amount of cover (compared to the main river channel) make Hatchery Ditch more suitable for juvenile steelhead rearing. DWR snorkel surveys (SF-F10, Task 3B) conducted from March through August in 1999, 2000, and 2001 indicate that the majority of young-of-year steelhead was in the upper mile of the low flow channel. Less than 1 percent of the young-of-year steelhead were observed downstream of the Thermalito afterbay outlet (DWR, 2004cc). Between RM 64 and 68, the Feather River has a confined, bedrock-controlled channel with cobble and boulder substrate (see section 3.3.1 *Soils, Geology, and Paleontological Resources*). Approximately 10,000 cubic yards of spawning gravel have been placed in this reach since the mid-1980s, but effectiveness monitoring has been anecdotal. It is likely that proposed gravel supplementation in this reach would have a limited, long-term, beneficial effect in this reach because sediment is rapidly transported through this type of channel.

Gravel supplementation would be likely to have long-term, beneficial effects for anadromous salmonids, particularly if it were implemented in conjunction with the Channel Improvement Program (see Proposed Article A103, *Channel Improvement Program*, below). Most of the natural anadromous spawning in the Feather River occurs in the upper low flow channel, particularly near the Hatchery Ditch side-channel. Hatchery Ditch is also heavily used by rearing juvenile steelhead. High flow velocities are lower in side-channel habitat than in the main channel, so gravel retention time would be higher in these locations. Therefore, Hatchery Ditch and the other side-channels would be good locations for gravel supplementation.

A minority of steelhead and Chinook salmon also spawn in the mainstem of the high flow channel. The high flow channel is less confined than the mainstem of the low flow channel, so gravel retention would be more likely in this location (see section 3.3.1, *Geology and Geology, Soils, and Paleontological Resources*).

Consultation with the Ecological Committee during development of the plan and effectiveness monitoring would determine the best locations to provide long-term benefits from the proposed gravel supplementation. This would result in less competition between spawning adult salmonids, less redd imposition, and improved egg survival over time.

As proposed, placing a minimum of 8,300 cubic yards over 5 years, would have limited and short-term channel morphology/spawning habitat benefits because of a high rate of downstream sediment transport. The level of enhancement proposed (average 550 cubic yards per each of the 15 riffle sites) would be greater than under existing conditions. For more information, see section 3.3.1, *Geology, Soils, and Paleontological Resources*.

The substrate is coarsening downstream of Oroville dam due to capture of sediment upstream of the dam. Some of the riffles downstream of the dam currently exceed the DFG criteria for Chinook salmon spawning habitat because more than 30 percent of the surface particles are cobble size or larger (i.e., $\geq$64 mm diameter). There are a variety of definitions of optimum particle size that would benefit salmon and steelhead. This measure would be most effective if a common definition were developed to guide implementation.

Gravel supplementation, in combination with increased minimum flows, would provide some additional quality Chinook salmon spawning substrate over current conditions. Increased flows would reduce the redd superimposition problem that currently exists in the low flow channel because the dam blocks upstream migration to historical spring-run spawning habitat and concentrates Chinook salmon spawning below the dam.

Pacific and river lamprey are also anadromous species, spawning and rearing in freshwater. The females build crude nests in gravel substrate. The proposed gravel supplementation, in combination with the proposed side-channel habitat improvements and additions (A103) would benefit Pacific lamprey and river lamprey by providing additional spawning habitat. There is no slow velocity, edgewater habitat with sand or mud substrate for larval lamprey in the low flow channel; the side-channels may provide these habitat conditions. Lamprey use smaller spawning substrate than Chinook salmon or steelhead, so there would be no direct competition for spawning habitat.

Gravel supplementation would have no effect on green sturgeon which spawn in large, deep pools, and are not known to occur within the project area. Water quality-related effects could occur during implementation of this measure including sedimentation, turbidity, and petrochemical contamination and have the potential to affect all fish species. Best management practices would be needed to minimize these effects; however, short-term sediment and turbidity plumes would occur as a result of these activities.

Channel Improvement Program (Proposed Article A103)

Oroville dam, the sediment wedges, and associated project facilities block anadromous fish migration to approximately 67 miles of higher quality spawning and rearing habitat in the upper watershed (see figure 9). DWR (2002g) identified small side-channels in the Feather River as primary rearing habitat for juvenile steelhead. Under the Proposed Action, a Channel Improvement Program would be developed within 3 years of license issuance to increase the quality and complexity of salmonid spawning and rearing habitat in two existing side-channels. The program would also require DWR to develop five additional side-channels (total 2,460 feet) within 10 years of license issuance. The side-channels would be created adjacent to existing riffle-glide complexes and would have flows between approximately 10 and 75 cfs. All side-channels would be monitored for target species utilization, primarily steelhead and incidentally spring-run Chinook salmon. DWR would submit annual reports to the Ecological Committee for review and consultation.

DWR evaluated the Moe's Ditch and Hatchery Ditch Channel Improvement Program in the preliminary draft environmental assessment (DWR, 2005a) and determined that it would be beneficial. In their respective comment letters, Interior (on behalf of FWS) and DFG state that the side-channel improvements would increase in the quality and quantity of Chinook salmon and steelhead spawning and rearing habitat.

Staff Analysis

Side-channel habitat is currently less than 1 percent of the available habitat[62] in the low flow channel (DWR, 2001b). Improvements at Moe and Hatchery ditches would increase side-channel habitat by 800 linear feet. Improving an additional five side-channels would further increase available side-channel habitat by a minimum of 2,460 linear feet, for a total side-channel improvement of 3,260 (or more) linear feet.

DWR's studies confirm that adult steelhead spawning and juvenile rearing are associated with the side-channels adjacent to the low flow channel, particularly in Hatchery Ditch between RM 66 and 67 (DWR, 2005m; 2005n). Nearly half of all steelhead redds were constructed in this area and had a density of 36 redds per mile, 10 times more than any other section of river.

The smaller substrate and abundant instream and overhead cover in Hatchery Ditch provide better juvenile steelhead rearing habitat than the main channel. We assume that gravel supplementation would be incorporated into the side-channel improvements and construction to benefit steelhead by enhancing and/or creating more of this type of habitat.

The highest percentage of Chinook salmon spawning also occurs in the low flow channel. The side-channels may provide additional spawning habitat and juvenile Chinook salmon rearing habitat.

Lamprey ammocoetes spend 3 to 4 years in freshwater where they burrow into soft sand or gravel substrate in low velocity areas and filter feed. The proposed side-channel habitat improvements and additions would also benefit Pacific lamprey and river lamprey by providing more low velocity, rearing habitat than currently exists.

The side-channel improvement and construction would probably have no effect on green sturgeon, which are not known to occur within the project area. If larval or juvenile sturgeon do use the project area, the proposed habitat improvements would be beneficial since sturgeon use low velocity areas with fine substrate.

Water quality-related effects could occur during implementation of this measure including sedimentation, turbidity, and petrochemical contamination that have the potential to adversely affect all fish species. Best management practices would be needed to minimize these potential adverse effects; however, short-term sediment and turbidity plumes would occur as a result of these activities.

[62] DWR does not provide the measured amount (linear feet) of habitat that comprises the 1 percent of available habitat. This does not allow direct comparison between the existing and proposed amount of habitat (about 3,260 linear feet).

Structural Habitat Supplementation and Improvement Program (Proposed Article A104)

Actions taken under Proposed Article A104, *Structural Habitat Supplementation and Improvement Program*, would benefit the entire aquatic ecosystem, including ESA-listed spring-run Chinook salmon and steelhead, and are discussed in section 3.3.3, *Aquatic Resources*.

Fish Weir Program (Proposed Article A105)

Yoshiyama et al. (1998) attribute the extensive decline of California Central Valley Chinook salmon runs to several factors: overfishing; blockage and degradation due to mining; and reduction of habitat and streams flows due to dams and water diversions. Historically, different run timing and habitat use were part of the success and environmental plasticity of this species.

Habitat access prior to the development of the hydroelectric dams on the Feather River and its tributaries allowed for spatial separation of the spring and fall Chinook salmon runs (DWR, 2001b; 2002l; 2002m; 2002n). Spring-run fish returned to the river earlier than fall-run fish and were able to access suitable spawning habitat higher in the watershed.

Oroville dam, the other dams upstream, and their associated facilities block the passage of migratory fishes, including Chinook salmon and steelhead. Consequently, spring and fall-run Chinook now spawn in the same habitat downstream of the fish barrier dam and are no longer spatially separated creating the potential for the spring and fall-runs to interbreed at an increased level than would naturally occur. Recent genetic studies indicate Feather River spring-run Chinook salmon genetically overlap with fall-run fish but may have some distinct spawning characteristics. Inbreeding may affect genetic integrity and inherent life history plasticity of the stocks (i.e., spawn timing and locality).

Competition for limited spawning habitat in the Feather River disproportionately affects the earlier spawning, spring-run Chinook salmon due to redd imposition by the later spawning, fall-run Chinook salmon and may increase pre-spawn mortality.

In a phased approach, DWR would construct an anadromous fish-monitoring weir upstream of Thermalito afterbay to monitor the timing of Chinook salmon and steelhead runs in the low flow channel (phase 1) and construct a fish barrier weir that would spatially separate the spring-run and fall-run Chinook salmon in the low flow channel (phase 2). DWR would develop the Fish Weir Program and monitoring plan in consultation with the Ecological Committee and would develop an annual report that would include monitoring and implementation results. The weir plan would be consistent with project biological opinion(s) and the plan would include a recreational safety plan that is addressed in section 3.3.6.2, *Environmental Effects* in *Threatened and Endangered Species*.

The fish-monitoring weir would be constructed within 3 years of license issuance. Data collected from the monitoring weir, carcass surveys, and other fish counts would be used to determine the timing and abundance of the early-returning fish. This information would be used to monitor the success of programs to improve spawning and rearing habitat, as well as development and installation of the segregation weir. In the interim, the monitoring weir may be used for spatial or temporal separation of the runs.

The segregation weir would be built within 12 years of license issuance as part of Phase 2. Phase 2 would also evaluate installing an egg-taking station to collect fall-run Chinook salmon eggs for the Feather River Fish Hatchery.

DWR evaluated a fish barrier weir to segregate the spring and fall Chinook salmon runs, similar to the Phase 2 segregation weir proposed in the Settlement Agreement. It did not evaluate a monitoring weir (Phase 1). They determined the segregation weir would be beneficial in terms of reducing interbreeding, redd superimposition and prespawning mortality.

Staff Analysis

The Feather River Fish Hatchery has attempted to reproductively isolate or maintain the genetic integrity of the spring and fall-run Chinook salmon stocks. Recently, DFG initiated a program to mark all the early returning adults (fish that arrive in May and June) and is using only those fish in the hatchery's spring-run Chinook salmon stock. Tagged Chinook salmon returning after September 15 are considered to be fall-run fish.

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 Feather River. NMFS (2004) and the University of California Davis and Oregon State University studies cited by DWR also conclude that Feather River spring-run and fall-run Chinook salmon are genetically similar and most closely related to Central Valley fall-run Chinook salmon. Therefore, the current timing of these runs is probably a phenotypic rather than a genetic difference (DWR, 2005k).

Recent results indicate a significant percentage of the early run Feather River Fish Hatchery fish spawn naturally in the low flow channel. The Phase 1 monitoring weir data and the Feather River Genetic Management Program (a component of Proposed Article 107, *Feather River Fish Hatchery Improvement Program*, see section 3.3.3, *Aquatic Resources)* would determine the potential benefit, if any, that a segregation weir could have on the conservation of the Central Valley spring-run Chinook salmon ESU in the Feather River. DWR would develop the Phase 2 segregation weir plan in consultation with the Ecological Committee, which includes NMFS, as new genetic information becomes available Completion of the segregation weir would not be required until 12 years after licensing. If a segregation weir were identified as an important component of preserving Feather River spring-run Chinook salmon genetics, a more timely implementation would be needed to ensure the likelihood of success.

Currently, the Central Valley spring-run Chinook salmon are listed as threatened and fall-run Chinook salmon populations are significantly depressed from historical levels; however, the Feather River contains a Chinook salmon population that well exceeds pre-project levels. The fall-run Chinook salmon in the Sacramento River System, including the Feather River, have been heavily influenced by hatchery production, and all Central Valley fall-run Chinook salmon are genetically identical. An egg-taking station would be used for artificial propagation, if needed, to perpetuate Feather River fall-run Chinook salmon stock.

The fish weirs would have no effect on green sturgeon, which are not known to occur in the low flow channel.

The monitoring and segregation weir would operate during the Chinook salmon spawning season (late summer/fall), and would not be expected to affect other species.

Riparian and Floodplain Improvement Program (Proposed Article A106)

Proposed Article A106, *Riparian and Floodplain Improvement Program*, would benefit the entire aquatic ecosystem, including ESA-listed spring-run Chinook salmon and steelhead, and is discussed in section 3.3.3, *Aquatic Resources*.

Feather River Fish Hatchery Improvement Program (Proposed Article A107)

The Feather River Fish Hatchery began operation in 1967 to mitigate for habitat lost from constructing and operating the Oroville Facilities. As many as 8,000 to 20,000 spring-run Chinook salmon adults may have occupied the Feather River above the current Oroville dam annually prior to European settlement (Moyle, 2002). Annual estimates of spring-run Chinook salmon run in the lower Feather River were down to 500 to 4,000 fish between 1946 and 1963, prior to Oroville dam construction (DWR, 2006). After the dam was built, between 1992 and 2002, the average number of Chinook salmon returning to the hatchery by September (assumed to be spring-run fish) was 4,727 (DWR, 2006).

The hatchery is one of five major Central Valley hatcheries producing fall-run Chinook salmon; one of three producing steelhead; and the only hatchery producing spring-run Chinook salmon (DWR, 2005a). The low tagging rates of Feather River Chinook in the salmon coded wire tag recovery program does not provide quantitative data on the number of tagged fish in the spawning population, so it is not possible to obtain reliable estimates of the hatchery percentage of the spawning run. However, DFG estimates 30 to 50 percent of the Feather River runs are fish produced by the hatchery; a smaller, also unquantifiable percentage are fish from other Central Valley hatcheries (DWR, 2005k).

The Feather River hatchery, managed by DFG in close collaboration with DWR, has been successful in meeting coldwater fisheries production goals and the conservation of Feather River fall-run Chinook salmon and steelhead stocks. For example, the 1998 Feather River fall-run Chinook salmon cohort contributed an estimated 90,000 fish to the ocean's recreational and commercial fisheries from 2000 through 2003 (DWR, 2005k). Smolts released from this brood-year into San Pablo Bay represented 13.3 and 9.3 percent of the coastal recreational and commercial fisheries, respectively.

However, hatchery operation and the Oroville Facilities have adversely affected Chinook salmon through genetic mixing of spring-run and fall-run stocks, altered run timing, caused a loss of spawning habitat, and created high spawning fish densities downstream of the fish barrier dam. As a result, Feather River spring Chinook salmon are genetically similar to fall-run Chinook salmon.

Hatchery operations may affect water quality such as temperature, dissolved oxygen, and pH, which may affect the incidence or severity of fish disease occurrences in the hatchery and in the Feather River (DWR, 2005a). DWR (2005a) states that fish species, holding densities, and the presence and amount of pathogens in the environment may also be related to the frequency and severity of occurrence and spread of fish diseases, and hatchery-produced fish have the potential to adversely affect naturally spawning salmonid runs through competition for food and habitat, potential transmission of diseases, predation, and genetic introgression. The following elements of Settlement Agreement Article A107 are proposed to address current hatchery facilities and management issues.

Hatchery Fish Production Program—DFG, which currently operates the Feather River Fish Hatchery in conjunction with DWR, has been successful in meeting production goals under the current license. Under the Proposed Action, DWR would continue to operate the Feather River Fish Hatchery in cooperation with DFG for the production of anadromous salmonids, such as spring and fall-run Chinook salmon, steelhead, and other salmonids. These fishes may be stocked from license issuance until completion and implementation of the Feather River Fish Hatchery Improvement Program.

Hatchery Water Temperature—Upon license issuance, DWR would seek to achieve the pre-facility modifications temperatures (see section 3.3.2.2, *Water Quality*). The temperature objectives are maximum mean daily temperatures that would be measured year-round at the hatchery intake/aeration tower. The proposed interim[63] temperatures objectives are lower than the temperature objectives evaluated in the preliminary draft environmental assessment (DWR, 2005a).

DWR would implement operational changes and would consider releases from the river valve up to a maximum of 1,500 cfs to meet the temperature objectives, provided these flows not exceed the actual flows in the high flow channel. In no event would the high flow channel flows be less than the flows specified in the Flow/Temperature to Support Anadromous Fish Plan (Proposed Action A108). However, DWR would not be in violation of the license article if operational changes were to be implemented and the temperature objectives were not met prior to completion of the proposed facility modifications.

DWR would complete facility modifications within 10 years of license issuance. When the facilities modifications are completed, the post-facilities water temperature objectives, as discussed in

[63] The interim period refers to the time between license issuance and either the point in time when facility modifications are completed or 10 years thereafter, whichever occurs first.

section 2.2.2, *Proposed Project Operations* (also see section 3.3.2.2, *Water Quality*), would become requirements, except in conference years. During conference years, DWR would consult with FWS, NMFS, DFG, and the Water Board to determine the proper temperature and disease management goals.

The licensee may develop a new table of hatchery temperature requirements that are at least as restrictive as the temperatures shown in the fish hatchery temperature table in section 2.2.2, *Proposed Project Operations*, when the facilities modifications are completed. The new temperatures would be developed in consultation with FWS, NMFS, DFG, the Water Board, and Regional Board for the Commission's approval.

Hatchery Management Program—A Feather River Hatchery Plan would be developed within 2 years of license issuance. The plan would be developed in consultation with the Ecological Committee, the Regional Board, and the Feather River Technical Team.[64] Development of the plan would include a review and consideration of the recommendations for the hatchery in the *Joint Hatchery Review Committee Final Report on Anadromous Salmonid Fish Hatcheries in California* (referenced in the Settlement Agreement Proposed Article A107.3b).

The plan would include:

- Hatchery and genetics management plans for each anadromous fish species;
- Adaptive management protocols for hatchery production including egg taking, spawning, incubation, hatching, rearing, and stocking;
- A methodology to implement appropriate form(s) of tagging or marking for the hatchery artificial propagation programs and recovery methods;
- A methodology to study hatchery management effects on salmonids, and the interaction between natural and hatchery produced salmonids;
- A methodology to study phenotypic (physical) or genotypic (genetic) traits that may be lost due to management actions or the adverse effects of the facilities if existing literature does not sufficiently address these topics;
- Development of a disease management methodology to reduce the incidence of disease outbreaks in the hatchery, and monitoring and reporting requirements;
- A methodology to work with other Central Valley hatcheries to improve integrated operations, marking/recovery, and data management;
- A methodology to minimize straying of hatchery produced fish;
- A methodology to for the release of spring and fall-run Chinook salmon; and
- A methodology to use the results of studies, monitoring, and other information to make changes in hatchery operations.

Within a year of plan approval, DWR would annually collect data, including information related to new disease control measures, and report results to the Ecological Committee. DWR and the consultees would re-evaluate the program every 5 years. Adaptive management would be used for spring-run Chinook salmon until the Hatchery Genetics and Management Plans are completed. An annual hatchery management report would be issued beginning in the year following licensing.

Hatchery Water Supply Disinfection System—DWR would install a new water disinfection system prior to any upstream releases of anadromous salmonids above the hatchery, or if the current

[64] We cannot find an explanation of what entities constitute the Feather River Technical Team.

system is determined to be insufficient to address disease issues. The new system would be developed in consultation with FWS, NMFS, DFG, the Water Board, and Regional Board. The Proposed Article A107, *Feather River Fish Hatchery Improvement Program*, states that the Commission reserves the right to make changes to the plan.

Feather River Fish Hatchery Annual Operation and Maintenance—DWR would complete a comprehensive facility assessment within 2 years of licensing along with a subsequent assessment at least once every 5 years. The results would be included in the annual Lower Feather River Habitat Improvement Plan Report (Proposed Article A101, *Lower Feather River Habitat Improvement Plan*).

DWR evaluated an adaptive management program for the hatchery and a disease management and marking program (an element of Alternative 2) in the preliminary draft environmental assessment (DWR, 2005a). DWR determined that these programs would be beneficial.

Interior (on behalf of FWS) and DFG filed 10(j) recommendations consistent with Proposed Article 107, *Feather River Fish Hatchery Improvement Program*.

Other Recommendations

The Anglers Committee et al. letter dated December 12, 2005, recommends that DWR develop and implement a coldwater fish disease management plan in Lake Oroville. The letter also recommends DWR conduct a study to determine the source of disease(s) in rainbow trout stocked in the lake; develop Chinook salmon and brown trout stocking programs; and upgrade the water sterilization system. These recommendations are addressed under Proposed Article A111, *Lake Oroville Cold Water Fishery Habitat Improvement Program*, below.

In its response to the recommendations, terms and conditions, prescriptions, and settlement comments dated May 26, 2006, DWR states that the Anglers Committee et al. and Plumas County[65] concerns regarding coldwater fish diseases are addressed in the Settlement Agreement.

Staff Analysis

Continuing current hatchery operations until the Feather River Fish Hatchery Management Plan is completed is expected to meet coldwater fisheries production goals and conserve Feather River Chinook salmon and steelhead stocks.

Hatchery Water Temperature—The interim temperature objectives are the same temperature objectives required in the current project license and are the upper (warmer) limits of the 1983 agreements between DWR and DFG. Generally, the water temperature data recorded at the hatchery comply with the objectives in the 1983 agreements. Historical data indicate that when the fish hatchery temperature objectives are met, Robinson Riffle objectives are almost always met.

The proposed Fish Hatchery Improvement Program would benefit coldwater fishes in the long-term by implementing more restrictive (cooler) water temperatures requirements than the current baseline conditions. Changing the temperature objective measurement from a maximum mean daily value to an hourly value would also ensure that cooler water would be delivered to the fish hatchery on a continuous basis.

Cooler water is one of the most important methods of regulating diseases at the hatchery, and possibly in the Feather River. Therefore, a reliable supply of cooler water would reduce the incidence and spread of diseases that are caused by physiological stress due to elevated temperatures (e.g., ceratomyxosis and IHN).

---

[65] We could not find any reference to disease concerns in the Plumas County filing.

Cooler temperatures are also correlated with better growth and survival rates of coldwater species due to improved physiological conditions.

Hatchery Management Program—The proposed Genetics Management Plan would aid in the preservation of the Feather River spring-run Chinook salmon stock, unless the genetic differences between the spring and fall stocks have already been lost due to historical hatchery practices. To be effective, this plan would need to be coordinated and implemented concurrently with the monitoring weir, and completed prior to the implementation of a spring and fall-run segregation weir (Proposed Article A105, *Fish Weir Program*) to determine if a segregation weir is needed.

Proposed Article A105, *Fish Weir Program*, does not specify when the individual components of the Feather River Fish Hatchery Management Program would be implemented, and the hatchery facilities modifications would not likely occur until 10 years after licensing. The open timetable for implementation of the plan elements and a number of optional adaptive management protocols in the plan, such as a new water supply disinfection system, may not provide adequate and timely protection for anadromous salmonids and other fisheries managed by the hatchery.

Flow/Temperature to Support Anadromous Fish (Proposed Article A108)

Oroville dam, other project facilities, and associated operations have altered instream flow and water temperature, adversely affecting anadromous salmonids in the Feather River. Elevated water temperatures in the low and high flow channels in the late summer have had adverse effects on anadromous salmonids and other coldwater fishes. In general, water temperatures have met the terms of the NMFS Biological Opinion (NMFS, 2004) that specify mean daily temperatures not exceed 65°F from June 1 to September 30 in the low flow channel at Robinson Riffle. However, during July and early August, temperatures have ranged from 61 to 69ºF in the low flow channel and 71 to 79ºF in the high flow channel.

Under Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*, operational changes would increase the minimum instream flow from the current 600 cfs to 700 cfs in the low flow channel during most of the year to increase the amount of available anadromous spawning habitat and decrease water temperatures. During the Chinook salmon spawning season, September 9 through March 31, the minimum instream flows in the low flow channel would be increased to 800 cfs (bulleted item titled Low Flow Channel—Instream Flow in section 2.2.2, *Proposed Project Operations*, and section 3.3.2, *Water Quality*).

The proposed minimum flow in the high flow channel would be based on the preceding April to July unimpaired runoff, as it was and would continue to be, as specified in the 1983 DWR and DFG agreement. The preceding year's unimpaired runoff will be reported in the Licensee's Bulletin 120, *Water Conditions in California, Fall Report*. "Normal" in this case is defined as the April through July 1911-1960 mean, unimpaired runoff near Oroville of 1,942,000 acre-feet. The high flow channel minimum flows would be maintained as long as the releases to meet flow objectives would not cause Lake Oroville to draw down below elevation 733 feet msl. The proposed temperature objectives are lower than current water temperature requirements at Robinson Riffle, which would also result in decreased water temperatures at the hatchery prior to the implementation of the facilities modification(s).

If the pre-facility modification temperatures (see low flow and high flow channels table in section 2.2.2, *Proposed Project Operations*) were not attained, operations would be modified as specified in Proposed Article A108.1(b) to try to achieve temperature objectives. However, DWR would not be in violation of the license article if temperature objectives were not met prior to facilities modifications, so long as operations comply with other requirements listed in Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*. Upon completion of the facilities modifications, meeting the temperature objectives in the low flow channel would become a license requirement. Meeting the temperature objectives in the high flow channel would not be a license requirement.

DWR would also develop a Feasibility Study and Implementation Plan to find the most cost effective way to improve water temperatures for spawning, egg incubation, juvenile rearing, and holding habitat for anadromous fish in the low flow and high flow channels. The plan would include recommended temperatures for the high flow channel based on preliminary modeling. DWR would attempt to meet, but would not be required to meet the high flow channel water temperature objectives under the license.

Although not specifically stated in the proposed article, the explanatory statement indicates that facility modifications would, if approved by the Commission, be completed within 10 years of license issuance. A 5-year testing period would follow the facilities modifications to test the adequacy of modifications to achieve water temperature objectives, and the test period may be extended with approval of the Commission. During the testing period, DWR would not be in violation of the license if flow and temperature requirement were not met.

After completion of the facilities modifications, DWR would consult with the Ecological Committee and prepare strategic plans to meet water temperature objectives prior to May 1 during any year the Oroville Temperature Management Index is equal or less than 1.35 million acre-feet. These conditions would constitute a "Conference Year" when DWR would not be in violation of the license if water temperature objectives were not met.

If DWR were unable to meet temperature objectives due to an event or circumstances beyond reasonable control, DWR would file a notice with the Commission describing the situation. If the Commission finds there is a pattern of exceedances that could result in adverse effects on coldwater fisheries, DWR may be required to file a plan that identifies feasible measures or modifications to the license requirements to address exceedances.

DWR evaluated year-round minimum instream flows of 600 cfs[66] and 800 cfs[67] in the low flow channel in the preliminary draft environmental assessment (DWR, 2005a). Minimum instream flows included in Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*, represent a compromise between the settling parties to meet resource goals and project operations. The settling parties concluded the agreed-upon measures would substantially benefit anadromous fishes.

Interior (on behalf of FWS) and DFG filed 10(j) recommendations consistent with Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*.

Staff Analysis

Chinook Salmon and Steelhead

DWR's instream flow investigations using instream flow incremental methodology and physical habitat simulation models determined that current minimum instream flows of 600 cfs in the low flow channel, where most Chinook salmon and steelhead spawning occur, provide most but not all of the maximum area of suitable spawning habitat for Chinook salmon. DWR determined that the maximum weighted useable area for Chinook salmon spawning would occur at approximately 800 cfs (figure 17).

Therefore, increasing minimum instream flows to 800 cfs during Chinook salmon and steelhead spawning, in combination with the spawning gravel supplementation plan (Proposed Article A102, *Gravel Supplementation and Improvement Program*) would maximize the amount of suitable Chinook salmon and steelhead spawning habitat in the low flow channel. Ramping rates established in the 1983

[66] This flow was part of the proposed action analyzed in the PDEA (DWR, 2005a).

[67] This flow was part of Alternative 2 analyzed in the PDEA (DWR, 2005a).

agreement between DWR and DFG are expected to minimize potential beach stranding of juvenile salmonids.

Water temperature is a key factor in the timing of anadromous spawning migrations. Under current conditions, project operations primarily control cooler water in the lower river. Coolwater holding habitat is particularly important for early run, spring Chinook salmon that sought out cooler water, higher in the watershed prior to construction of the fish barrier dam. Spring-run Chinook salmon migrate into freshwater and hold in large, deep pools in freshwater longer than other anadromous fishes prior to spawning while they complete gonadal maturation. Oroville studies found that during 2003, approximately 66 percent of the mean water temperature profile in 15 pools in the Feather River exceeded an index value of 60ºF. In another 11 pools, 48 percent of the temperature profile exceeded an index value of 64ºF. Nine percent of the temperature profile in 10 pools exceeded an index value of 68ºF (DWR, 2005p). These index values were defined by various detrimental biological effects that could occur due to elevated temperatures.

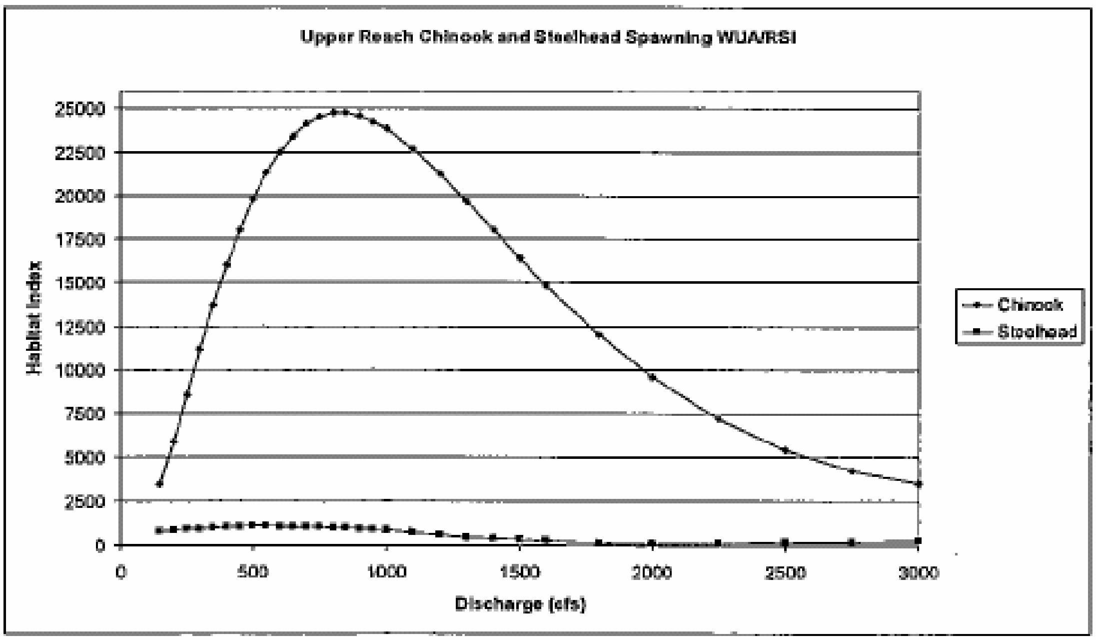


Figure 17. Low flow channel Chinook salmon spawning weighted useable area. (Source: DWR, 2005a)

As previously stated in section 3.3.2 *Water Quantity and Quality*, Feather River temperatures generally meet Basin Plan objectives for the high and low flow channels. The average monthly water temperatures in the low flow reach (fish barrier dam to the Thermalito afterbay outlet) range from 47°F (8.3°C) in winter to 65°F (18.3°C) in the summer (DWR, 2003f). Water temperatures in the high flow channel (below Thermalito afterbay outlet) are generally warmer, with the maximum mean daily water temperature at the Thermalito afterbay outlet reaching approximately 70°F (21.1°C) in the summer (DWR, 2003f).

In SP-F10, Task E, water temperatures used by pre-spawning adult Chinook salmon in the Feather River were compared to a recommended migration temperature of 60.8°F (16°C) and an estimated maximum thermal limit of 68°F (20°C) to determine the frequency in which they were exceeded (DWR, 2005p; 2004f). Chinook salmon radio telemetry and water temperature archival tag data from 2003 indicated water temperatures used by individual fish (sample size = 6) ranged from 55 to 69.4°F (12.8 to 20.8°C), but most of the six observations occurred between 60.8 and 68°F (16 to 20°C). Five of the six fish were typically found in waters between the recommended migration temperature and a suggested upper water temperature limit, while one fish regularly frequented waters that were cooler than the recommended migration temperature. Three of the six fish were recorded in water above the estimated maximum thermal limit 3 to 6 percent of the time. Overall, the tagged Chinook salmon traveled in waters between temperatures of 12.8-20.8ºC.

The 2003 and 2004 gaging station data illustrated that the Robinson Riffle compliance point in the low flow channel fell within recommended water temperatures. However, at Thermalito outlet and Gridley in the high flow channel recommended water temperatures were exceeded approximately 3 to 5 percent and 10 to 16 percent of the time, respectively. In June of both years, the water temperatures at Gridley exceeded the suggested maximum thermal limit until flows exceeded 5,500 cfs. In 2003, over 90 percent of the final Chinook salmon locations and assumed spawning sites occurred upstream of Gridley (DWR, 2004f).

The thermograph data that DWR collected in the Feather River show water temperatures that may increase incidence of disease and mortality, in-vivo egg mortality, and developmental abnormalities occurring during spawning migrations and pre-spawning holding in some areas of the river during part of the immigration and holding periods (DWR, 2005p). DWR attributes high annual Chinook salmon pre-spawning mortalities in the low and high flow channels to stress caused by elevated water temperature, low river flows, disease, high fish densities, and angling pressure (angling is concentrated at Thermalito afterbay outlet). The proposed recreation enhancements have the potential to increase recreational angling and adversely affect listed salmonids (DWR, 2006).

DWR also reports that the effects of increased water temperatures on rearing salmonids range from behavioral modifications to physical/physiological changes and decreased disease resistance to increased vulnerability to predation to mortality (numerous studies cited in DWR, 2005o). The type and severity of effects are related to the magnitude and duration of exposure to elevated water temperatures. The Proposed Action would provide increased flow and cooler water in the Feather River compared with current conditions. As a result, the rate of Feather River fish straying into the Sacramento River (DWR, 2005p) may decrease; the quality of pre-spawning, holding habitat for anadromous fish would be improved; and pre-spawn mortalities related to low flow, high temperatures, and disease would decrease, and the amount of suitable spawning habitat would increase.

Elevated water temperatures during incubation can cause larval fish to emerge from the gravel prematurely (DWR, 2005q). Fish with a smaller size at emergence are more likely to succumb to predation and have reduced competitive fitness. Providing optimal water temperatures, as proposed, would likely increase survival rates by producing larger, earlier out-migrating smolts that are better able to compete and avoid predation.

In 2003, juvenile steelhead grew faster in the lower section of the low flow channel than in the upper section. DWR suggests that the slightly warmer temperatures in the lower section during this time provided better growing conditions and that Feather River Fish Hatchery and naturally spawned steelhead prefer temperatures between 62 and 68ºF (DWR, 2005q). However, the recorded water temperatures were approaching the limits of steelhead physiologic tolerance.

In 2003 no juvenile steelhead were observed in the high flow channel below Thermalito afterbay outlet where maximum daily water temperatures reach 70ºF (21.1ºC) in the summer months (DWR, 2003f). High summer water temperature is the most likely limiting factor, and as a result, the amount of steelhead rearing habitat has been reduced in the lower river.

We expect the proposed measures in the Flow/Temperature to Support Anadromous Fish Program (Proposed Article A108) would improve water quality except under the most extreme conditions (see section 3.3.2.2, *Water Quality*). The proposed increases in minimum flow and the decreased maximum temperature objectives would benefit coldwater fishes and meet the spawning requirements for ESA-listed Chinook salmon and steelhead.

Green Sturgeon

Green sturgeon are not known to occur within the project boundary. Although it is possible they occasionally occur within the Feather River, downstream of the project, DWR studies indicate low flows and channel modifications, unrelated to the Oroville Facilities, may be migration barriers at Shanghai Bench and Sunset Pumps. These sites are passable at higher flows; however, the proposed project would not increase flows at Shanghai Bench and Sunset Pumps. The proposed increase in minimum flows to benefit anadromous salmonids in the low flow channel would have no effect on the minimum flows in the high flow channel or on flows downstream of the project. As such, the project would have no effect on green sturgeon downstream of the project.

Delta Smelt

Delta smelt do not occur within the project boundary or within the Feather River. The proposed project would not affect surface water quantity in the Sacramento-San Joaquin Estuary, where delta smelt occur. As a result, the proposed project is not likely to adversely affect the delta smelt.

Other Coldwater Fishes

Increased minimum instream flows would also increase the quantity of coldwater fisheries habitat in the Feather River for other species. Lamprey ammocoetes burrow into edgewater habitat where they are especially vulnerable to rapid and prolonged changes in water levels. Increased year-round minimum instream flows would increase the amount of habitat available to Pacific and river lamprey ammocoetes in the low flow channel. If monitoring results indicate there is a potential benefit to green sturgeon from increased minimum flows in the low flow channel, then it is likely that white sturgeon would also benefit.

Reservation of Section 18 Authority (Proposed Article A109)

Proposed Article 109, *Reservation of Section 18 Authority*, reserves authority for NMFS and Interior to prescribe the construction, operation, and maintenance of fishways at Lake Oroville, including measures to determine, ensure, or improve the effectiveness of prescribed fishways that may be part of a future DWR and PG&E Habitat Expansion Agreement.

Interior (on behalf of FWS) and DFG filed 10(j) recommendations consistent with Proposed Article A109, *Reservation of Section 18 Authority*.

Plumas County in its March 15, 2006, Motion to Intervene is concerned that the draft Habitat Expansion Agreement cited in Proposed Article A109, *Reservation of Section 18 Authority*, would direct anadromous fisheries restoration efforts upstream of Lake Oroville without consulting the County.

The Anglers Committee et al. in their letter dated December 12, 2005, recommend that DWR fund and comply with the NMFS recommendations to restore spring-run Chinook salmon and steelhead populations in the North Fork and Middle Fork of the Feather River upstream of Oroville dam.

Staff Analysis

The draft *Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and Central Valley Steelhead*[68] is for settlement discussion purposes only (DWR, 2006a). A final habitat expansion agreement would be subject to DWR and PG&E reaching a separate license relationship

[68] The draft Habitat Expansion Agreement is included in appendix F of the Settlement Agreement (DWR, 2006a).

agreement, and the Signatories would be PG&E, DWR, NMFS, FWS, DFG, the Forest Service, Arthur G. Baggett,[69] American Rivers, and the State Water Contractors, Inc.

Any anadromous habitat expansion agreement would have to be finalized, signed, and submitted to the Commission before the Commission acts on this article. Therefore, the draft habitat expansion agreement for anadromous habitat above Lake Oroville is not within the scope of this analysis.

Plant Species

No federally listed plant species were located during surveys conducted in 2002, 2003, and 2004; however, potentially suitable habitat does exist for all of the seven listed species that were identified to potentially occur in the project area. Five of seven of these species, Butte County meadowfoam, Hoover's spurge, Green's tuctoria, hair Orcutt grass, and smooth Orcutt grass, occur in vernal pool habitats. Hartweg's golden sunburst occurs in upland grasslands, with only land that has a low potential to provide habitat found in the study area in the hummocks bordering vernal pools. Potential habitat for the remaining species, Layne's ragwort, is found in serpentine and gabbro substrates around Lake Oroville.

DWR does not propose any specific environmental measures that would directly protect or enhance federally listed plant species; however, it proposes several measures for vernal pools, discussed below under *Vernal Pool Invertebrates*, that are designed to protect or enhance potential habitat for vernal pool invertebrates. According to the draft biological assessment, presence/absence surveys would be conducted prior to any future actions in areas of potential habitat. If any future actions could affect federally listed plant species, DWR would consult with FWS prior to implementing these actions.

Staff Analysis

Project activities could potentially affect potential federally listed plant species' habitat. Project O&M, such as the use of herbicides, water fluctuations, soil disturbance leading to sedimentation, OHV and other recreational uses, and upland habitat enhancements for waterfowl, could affect vernal pool habitat. DWR has implemented several conservation measures and proposes to implement several additional conservation measures, which are included in the draft programmatic biological assessment. These conservation measures are designed to protect vernal pool invertebrate habitat and therefore would protect federally listed plant habitat. The effects of the project on vernal pools and the proposed measures are discussed more thoroughly below under *Vernal Pool Invertebrates*. Because none of the federally listed plant species were found within the project boundary and because of recently implemented and proposed vernal pool conservation measures, the project would have no effect on the federally listed plant species that occur within or adjacent to vernal pools.

Many of the areas of potential habitat for Layne's ragwort have steep slopes that are infrequently accessed by hikers and boaters; however, potential habitat is also found near Nelson Bar car top boat launch, Lime Saddle recreation sites on the West Branch arm and Springtown car-top boat launch on the south side of Lake Oroville, all of which have roaded access. There is also potential habitat along the north side of the North Fork arm by a dirt road that is open to public use. In these areas, OHV and other recreational use, and vegetation maintenance activities could affect potential habitat. Fluctuations of Lake Oroville water level could also affect potential habitat that occurs near the high water level by causing erosion. Under the Proposed Action, the Nelson Bar and Springtown car-top boat launches and the Lime Saddle recreation site would be modified. During these construction activities, vegetation would be removed and soil would be disturbed, potentially affecting Layne's ragwort habitat. However, because Layne's ragwort was not located during botanical surveys conducted in 2002, 2003, and 2004,

[69] Mr. Baggett would sign the Anadromous Habitat Expansion Agreement as a recommendation to the Water Board, not as a Party to the Agreement.

there would be no effect on this species. DWR's proposal to conduct additional surveys prior to any future activities that could affect federally listed plant species and consult with FWS would ensure that if any of these species become established in the future, appropriate protection activities would be considered.

Wildlife Species

Bald Eagle

Five bald eagle nesting territories are located partly or wholly within the project boundary: (1) Crystal Hill nesting territory located on the Middle Fork arm of Lake Oroville; (2) Potter Ravine nesting territory located along the southern shore of Potter Ravine, approximately 1.3 miles north of the Oroville dam; (3) Bloomer nesting territory located along the western shore of the North Fork of Lake Oroville approximately 3.5 miles north of the Oroville dam; (4) Thermalito diversion pool nesting territory located on the southern ridge of the Thermalito diversion pool south of the Morris Ravine cove; and (5) Palm Avenue nesting territory located on the Feather River within the OWA. Human disturbance to bald eagle nests could affect bald eagle productivity; however, exclusion zones around the nests during nesting season could potentially limit or eliminate these effects.

Under Proposed Article A118, *Minimization of Disturbances to Nesting Bald Eagles*, DWR would implement conservation measures required by FWS's biological opinion and file any bald eagle nest territory plans with the Commission for approval. DWR would implement the plans, including any changes required by the Commission, evaluate the conservation measures in accordance with the biological assessment, and implement modifications deemed necessary. Modifications outside the scope of the biological opinion would be filed with the Commission for approval prior to implementation. These conservation measures (FWS, 2007) include (1) the development and adoption of bald eagle nest territory management plans for all active nest territories; (2) annual written notice to other land management agencies of the conservation measures contained in each nest territory management plan; (3) disclosure of new bald eagle nest territories to DFG and FWS within 10 working days of discovery; (4) development of draft bald eagle nest territory management plans within 30 calendar days of discovery of a new nest territory and submittal to DFG and FWS; (5) one interagency meeting annually to evaluate and discuss the effectiveness of conservation measures contained in bald eagle nest territory management plans, including DFG, DPR, the Forest Service, FWS, BLM, and other agencies or organizations with a direct interest in bald eagle management; (6) annual evaluations of bald eagle nesting success and the effectiveness of conservation measures contained in the nest territory management plans, including active searches for new bald eagle nest territories and a written summary to DFG and FWS of annual bald eagle production; (7) survey of mid-winter bald eagle every other year in coordination with statewide and nationwide mid-winter counts and submit results to DFG and FWS; and (8) enhancement of foraging conditions around each active bald eagle nesting territory by installing a fish habitat structure in the reservoir within foraging areas as defined in the management plan for the nesting territory. Bald eagle nest territory management plans are currently implemented for all known bald eagle nest territories in the project boundary. Interior's (on behalf of FWS) 10(j) recommendation no. 12 and DFG's 10(j) recommendation no. 9 are consistent with Proposed Article A118, *Minimization of Disturbances to Nesting Bald Eagles*.

FWS, in its April 9, 2007, biological opinion makes a conservation recommendation that any transmission lines constructed as part of the project should be constructed in a manner to prevent raptor electrocution and existing transmission lines should be modified to prevent raptor electrocution using methods recommended in the Avian Power Line Interactions Committee's Suggested Practices for Raptor Protection on Powerlines: The State of the Art in 2006 (APLIC, 2006).

Staff Analysis

Bald eagles are highly susceptible to human disturbance during nesting season (February through August), which can lead to abandonment of nests and failure to fledge young. Project-related recreational activity near nests or foraging areas during nesting season near Lake Oroville and in the Thermalito Complex and OWA could cause disturbance, especially at the Potter Ravine nesting territory where a hiking trail is located within 0.33 mile of the nest. Primary and secondary zones have been established, as part of the bald eagle nest territory management plans, within all five nesting territories, limiting activities during nesting season and year-round. Human activity, including recreational activity, has been prohibited during nesting season within the primary zones within the Crystal Hill, Potter Ravine, and Bloomer nesting territories.

The primary bald eagle foraging areas in the project area include Potter Ravine, Spillway Cove, Foreman Creek, the area within 1 mile of the Oroville dam and Thermalito diversion pool, Middle Fork arm, McCabe Creek on the South Fork arm, Sycamore Creek, Kennedy Ravine, Bloomer Cove, Feather River, and Thermalito afterbay (DWR, 2004m). Many of these areas have high levels of seasonal recreation use, which appears to be tolerated by the eagles based upon their successful reproduction. Increased recreation and a temporary increase in human disturbance during the construction of waterfowl brood ponds and habitat improvements could discourage bald eagles from foraging in these areas; however, foraging habitat is plentiful in the project area and project-area bald eagles seem to be acclimated to some human disturbance. Initial monitoring has not indicated recreational activity affects nesting or foraging bald eagles in the Thermalito diversion pool and Palm Avenue nesting territories; however, the bald eagle nest territory management plans indicate recreational closures would occur if future monitoring indicates it were warranted.

Approximately 11.3 miles of 230-kV transmission lines lie within the project boundary. The lines associated with the project are spaced greater than the 5-foot spacing recommended by Avian Power Line Interaction Committee guidelines to minimize potential raptor electrocution (DWR, 2004m), which limits the risk of bald eagle electrocution. The vertically configured transmission lines could pose a collision hazard to bald eagles; however, raptors rarely collide with transmission lines because they have good vision, they are adept flyers, and their flight is relatively slow. The transmission lines near the shoreline of the Thermalito diversion pool pose the greatest collision risk because the lines are near the shoreline and in some cases cross over the water. Occurrences of bald eagles being electrocuted or colliding with transmission lines in the project boundary have not been documented (DWR, 2004m). Transmission lines of this voltage typically do not pose a hazard to raptors. If unforeseen electrocutions occur, the standard reopening clause would be used and raptor protection measures could be implemented at that time.

All five nesting territory plans prohibit major habitat manipulations such as tree removal, road, trail, and levee construction or maintenance, and new recreational developments within the primary zones around the nests. Within the primary zones at all five nesting territories, all proposed activities would have to be reviewed by FWS, DFG, DPR, BLM, and PG&E, and then DWR would need to consult with FWS, to determine compatibility with bald eagle management. Under Proposed Article A118, *Minimization of Disturbances to Nesting Bald Eagles*, DWR would identify any new bald eagle nesting territories as well as any project-related effects on existing or newly located nesting territories. Any newly identified bald eagle nests would therefore receive the same level of protection as the existing nests and management practices would be altered to reduce any observed project-related effect on all nesting bald eagles.

Managing other resources would not affect bald eagles because the bald eagle nest territory management plans all prohibit activities that would alter habitat within nesting territories or disturb nesting eagles. All construction-related activities would be scheduled after nesting season. Expanded recreational developments would not be located within the primary zones around the bald eagle nests.

Some aquatic measures would benefit bald eagles. Fish habitat improvement measures, discussed in section 3.3.3, *Aquatic Resources*, and waterfowl brood, cover, and forage habitat improvements, described in section 3.3.4, *Terrestrial Resources*, would increase bald eagles' prey base, improving foraging conditions.

The bald eagle nest territory management plans provide protection and monitoring actions, which would be beneficial to bald eagle productivity. Overall, however, the project, with the proposed measures, may be likely to adversely affect the bald eagle.

Giant Garter Snake

Giant garter snakes were not found in the project boundary during surveys conducted in 2002; however, potentially suitable habitat occurs in the Thermalito Complex, and giant garter snakes are known to occur in proximity to the project. Rice fields and canals on the western border of the Thermalito afterbay, outside the project boundary, offer suitable habitat and habitat connectivity to potentially suitable habitat in the OWA and Thermalito Complex. Large stands of emergent vegetation adjacent to exposed basking areas and rodent burrows for refugia provide habitat in the Thermalito afterbay and forebay; waterfowl brood ponds in the eastern portion of the Thermalito afterbay also provide suitable habitat. Recreational activity in the Thermalito forebay, high water fluctuations within the Thermalito afterbay and high densities of invasive species within the OWA such as Eurasian milfoil and aquatic primrose could limit the suitability of this habitat for giant garter snakes.

Under Proposed Article A119, *Protection of Giant Garter Snake*, DWR would implement conservation measures required by FWS's biological opinion and DWR would, in consultation with FWS, annually evaluate and report the effectiveness to the Commission. The conservation measures would be revaluated in the spring every other year for the term of any new license. If the conservation measures are deemed to be unsuccessful in protecting giant garter snake habitat, DWR would coordinate with FWS to develop and implement additional or alternative conservation measures to protect the giant garter snake habitat. Modifications outside the scope of the biological opinion would be filed with the Commission for approval prior to implementation. The conservation measures (FWS, 2007) include: (1) notification and consultation with FWS prior to initiating any activities in certain areas of the OWA that would significantly affect the quality or extent of giant garter snake wetland habitat; (2) minimization of activities that disturb, destroy, fragment, or otherwise modify habitat in upland habitat within 200 feet of giant garter snake wetland habitat; (3) avoidance of rodent control activities of any kind in designated giant garter snake wetland habitat, except in certain circumstances; (4) restricted removal of non-native or noxious weeds; (5) a continuing public education program would be developed and implemented with a goal of preventing giant garter snakes from being intentionally harmed or killed; and, (6) restriction of dog-training field exercises in the Thermalito afterbay. In addition, if giant garter snake habitat is affected by the proposed project, DWR would compensate for the effects by either purchasing credits from a conservation bank or conducting onsite habitat preservation. DWR also proposes to develop and implement an OWA Management Plan which, according to the Explanatory Statement (DWR, 2006a), would include the public education and dog-training restrictions mentioned above. Interior's (on behalf of FWS) 10(j) recommendation no. 13 and DFG's 10(j) recommendation no. 9 are consistent with Proposed Article A119, *Protection of Giant Garter Snake*.

DWR also proposes to construct and recharge waterfowl brood ponds in the Thermalito afterbay, as described in section 3.3.4, *Terrestrial Resources*. These ponds would also provide habitat for giant garter snakes. DWR would construct four brood ponds within the afterbay and recharge existing and proposed ponds at least monthly for the giant garter snake between April 1 and October 31 of each year and more frequently, every 3 weeks, within the waterfowl nesting season of April 15 through July 31.

Staff Analysis

Several project-related activities could potentially affect giant garter snake habitat. Project maintenance could affect potential giant garter snake habitat by disturbing soil, clearing vegetation, and applying herbicides and pesticides. Water level fluctuations in the Thermalito Complex expose large expanses of mudflats, which isolate aquatic foraging habitat from emergent and upland vegetation cover. Increasing the distance between forage and cover could increase predation. Elevated water levels also inundate shoreline basking habitat and could flood the rodent burrows used for escape cover. Existing recreational use could also degrade giant garter snake cover by trampling vegetation, crushing rodent burrows, and compacting soil. Finally, gravel mining in the OWA could degrade giant garter snake habitat in the immediate area of the mining and displace any snakes present. As part of the existing license, DWR planned to review, by December 31, 2006, all of its existing gravel-mining operations, which are in or within 200 feet of giant garter snake habitat and identify modifications necessary to be more garter snake "friendly."

Several measures proposed by DWR for the protection and enhancement of aquatic, terrestrial, and recreational resources could affect giant garter snake habitat. Proposed aquatic measures, described in section 3.3.3, *Aquatic Resources,* such as the Gravel Supplementation and Improvement Program (Proposed Article A102), Channel Improvement Program (Proposed Article A103), and Fish Weir Program (Proposed Article A105) would occur within or adjacent to giant garter snake habitat and could destroy or degrade habitat and displace individual snakes during construction. The Riparian and Floodplain Improvement Program (Proposed Article A106) could also degrade giant garter snake habitat by increasing dense riparian vegetation, which would limit emergent vegetation and decrease basking habitat due to the increase in shade. The proposed Structural Habitat Supplementation and Improvement Program (Proposed Article A104), however, could improve giant garter snake habitat by providing more cover in the low flow channel.

Proposed terrestrial measures to construct additional brood ponds, recharge existing and future brood ponds (Proposed Article A122, *Construction and Recharge of Brood Ponds*), and conduct invasive species control (Proposed Article A126, *Invasive Plant Management*), described in section 3.3.4, *Terrestrial Resources*, could affect giant garter snake habitat. The existing waterfowl brood ponds provide a more stable water elevation than the Thermalito afterbay and provide giant garter snake cover adjacent to aquatic habitat which reduces predation. The construction of four additional proposed brood ponds would increase the amount of suitable giant garter snake habitat in the Thermalito afterbay where fluctuating water levels decrease the suitability of existing shoreline habitat. Recharging all brood ponds by raising afterbay water levels with a frequency needed to keep brood pond water elevations close to the adjacent cover is necessary for these ponds to continue to provide habitat. DWR proposes to recharge existing and proposed brood ponds by April 15 of each year and every 3 weeks between waterfowl brooding season (April 15 through July 31) and at least monthly for the giant garter snake between April 1 and October 31. As such, the existing and proposed brood ponds would provide beneficial giant garter snake habitat. Implementing measures to control invasive species could benefit giant garter snake habitat by reducing the species that limit the quality of potential habitat. Invasive species control measures could also degrade habitat by introducing pesticides and herbicides to giant garter snakes' environment.

Increased recreational use as a result of proposed recreation measures, described in section 3.3.5, *Recreation Resources*, could result in habitat degradation and loss of individual giant garter snakes, if they are present. Development of additional facilities at the Thermalito North Forebay aquatic center, construction of additional trails at the Thermalito forebay, and the development of a swim beach at the Larkin Road car-top boat ramp adjacent to the Thermalito afterbay could all result in vegetation trampling, crushing of rodent burrows, and soil compaction both during construction and from increased recreational use.

Proposed giant garter snake protection measures would minimize or eliminate many of the proposed project's effects on giant garter snake habitat. Under Proposed Article A119, *Protection of Giant Garter Snake*, DWR would notify and consult with FWS prior to initiating activities in areas of the OWA that would affect giant garter snake habitat and the minimize activities that would modify habitat in uplands within 200 feet of giant garter snake wetland habitat. These actions would limit many of the activities discussed above from occurring in giant garter snake habitat, thereby eliminating potential effects. Avoiding rodent control activities in giant garter snake wetland habitat would protect their escape cover habitat. Restricting invasive species control methods to hand removal, hand tools, or through individual treatment of appropriate herbicides within snake habitat would keep toxins from decreasing habitat and potentially killing snakes if they were present. A public education program with signage and restricting dog-training activities would minimize the harming or killing of giant garter snakes associated with recreational use. Finally, if unanticipated adverse effects on giant garter snake habitat occur, the compensation requirements contained within FWS's biological opinion would maintain baseline habitat conditions.

Overall, the project, with the proposed protection and enhancement measures, would be beneficial to giant garter snakes by prohibiting or restricting habitat disturbing activities, however, the project may be likely to adversely affect the giant garter snake.

California Red-legged Frog

There are no known California red-legged frogs, a federally threatened species, within the project boundary; however, potential suitable habitat exists. Project operations, maintenance, and recreational use could potentially affect California red-legged frog habitat.

Under Proposed Article A121, *Protection of Red-legged Frogs*, DWR would implement conservation measures required by FWS's biological opinion and evaluate the effectiveness of those conservation measures in accordance with the biological opinion. DWR would, in consultation with FWS, annually evaluate and report the effectiveness to the Commission. The conservation measures would be revaluated in the spring every other year for the term of any new license, in accordance with the biological opinion. If the conservation measures are deemed to be unsuccessful in protecting California red-legged frog habitat, DWR would coordinate with FWS to develop and implement additional or alternative conservation measures to protect California red-legged frog habitat. Modifications outside the scope of the biological opinion would be filed with the Commission for approval prior to implementation. These conservation measures are consistent with those proposed for the giant garter snake (Proposed Article A119), discussed above. Interior's (on behalf of FWS)'s 10(j) recommendation no. 15 and DFG's 10(j) recommendation no. 9 are consistent with Proposed Article A121, *Protection of Red-Legged Frogs*.

Staff Analysis

No California red-legged frogs are known to exist in the project boundary; however, the closest known population is approximately 1 mile from the project, in the French Creek drainage pond. Potentially suitable habitat for the California red-legged frog occurs in the project boundary around the Thermalito forebay, Thermalito afterbay, and within the OWA; however, predators, such as crayfish, bass, and bullfrogs, limit the habitat suitability within all these locations. According to FWS (letter dated March 31, 2006), several small, isolated patches of backwater habitat along the Feather River provide suitable habitat for the California red-legged frog. The potential effects of the project on California red-legged frog habitat and the proposed measures are the same as those discussed for the giant garter snake above. As with the giant garter snake, the potential project effects on California red-legged frog habitat would be minimized. Because there are no known California red-legged frogs in the project area and California red-legged frog habitat would benefit from the implementation of these habitat protection measures; the proposed project is not likely to adversely affect the California red-legged frog.

Vernal Pool Invertebrates

DWR originally mapped 253 vernal pools totaling 18.3 acres in the project boundary, of which 173 are located around the Thermalito afterbay and 80 are located around the Thermalito forebay. These pools range in size from <0.002 to 3.9 acres and 67 percent are human made as the result of roads, berms, weirs, or levees. FWS reported (2007) that based on further studies, 645 individual vernal pools or vernal swales, totaling 72.3 acres occur within the project boundary. Although the three vernal pool branchiopods—Conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp—are not known to occur within the project boundary, protocol level surveys were not conducted. Occurrences of vernal pool fairy shrimp and vernal pool tadpole shrimp are known to occur within 3 miles of the project boundary, and it is assumed that all three species could occur in the vernal pools on project lands. Conservancy fairy shrimp are unlikely to occur in the project area because suitable habitat does not exist.

Under Proposed Article A117, *Protection of Vernal Pools*, DWR would implement conservation measures required by FWS's biological opinion and evaluate the effectiveness of those conservation measures in accordance with the biological opinion. DWR would, in consultation with FWS, annually evaluate and report the effectiveness to the Commission. The conservation measures would be revaluated in the spring every other year for the term of any new license, in accordance with the biological opinion. If the conservation measures are deemed to be unsuccessful in protecting vernal pool habitat, DWR would coordinate with FWS to develop and implement additional or alternative conservation measures to protect the vernal pool habitat. Modifications outside the scope of the biological opinion would be filed with the Commission for approval prior to implementation. These conservation measures (FWS, 2007) include: (1) installing and maintaining signage in coordination with DPR and DFG to prevent illegal OHV use in areas containing vernal pools; (2) inspecting and prompting maintenance of vehicular barriers (primarily existing fences) in coordination with DPR and DFG; and, (3) continuing existing patrol and enforcing vehicular closures in coordination with DFG and DPR. In addition, if vernal pool habitat is affected, DWR would compensate for the effects by a combination of habitat creation/restoration and habitat preservation. Interior's (on behalf of FWS) 10(j) recommendation no. 11 and DFG's 10(j) recommendation no. 9 are consistent with Proposed Article A117, *Protection of Vernal Pools*.

Staff Analysis

Potential habitat for two species of vernal pool invertebrates, one federally listed endangered species, and one federally listed threatened species occurs in the project boundary in the vernal pools within the Thermalito Complex. Project operations, maintenance, and project-related recreational use could potentially affect these species of vernal pool invertebrates and their habitat. Construction of new facilities and regular maintenance of recreation sites can disturb soil and vegetation. Earth moving activities can alter hydrology and affect how a vernal pool holds water and drains. Current and proposed upland habitat enhancements, such as those discussed in section 3.3.4, *Terrestrial Resources*, for waterfowl, can disrupt the impermeable hardpan soil layer or affect surface water flows, which could alter vernal pool hydrology. As a result, vernal pool habitat and vernal pool invertebrates can be lost. Herbicides and pesticides used for project maintenance, and the proposed invasive species management, can be toxic to vernal pool plants and invertebrates. Sedimentation and siltation from road run off and unauthorized OHV use can cause increased water turbidity or fill vernal pools which would alter habitat and could suffocate invertebrates. OHV traffic and other recreational use can compact soils, potentially altering overland flow patterns; degrade habitat suitability for vernal pool plant species; and/or encourage algae growth. DWR proposes additional recreational developments, such as the Thermalito forebay trail development and additional day-use facilities at the Larkin Road car-top boat ramp, discussed in more detail in section 3.3.6, *Recreational Resources*, which could increase recreation-related effects on vernal pools. Compacted soils are unsuitable for sustainability of vernal pool ecology. Unauthorized OHV use could also crush or damage adult and cyst vernal pool invertebrates.

As previously mentioned, DWR has implemented conservation measures as a result of the draft programmatic biological assessment under the current license and DWR proposes to implement FWS's conservation measures contained in the final biological opinion. These conservation measures include installing additional signage, continuing to provide maintenance to vehicular barriers such as fences, and continuing to patrol and enforce vehicle closures to keep OHV use away from vernal pools. These measures address many of the potential project-related effects on vernal pools and vernal pool invertebrates. Closing the areas of vernal pools to OHV use would prevent invertebrate crushing, soil disturbance and sedimentation. Sedimentation would be further minimized by the current sediment-trapping measures being assessed by DWR. Monitoring conservation measure effectiveness would identify continuing effects and provide a mechanism for consultation with FWS and development of additional or alternative conservation measures. As a result, it is likely the proposed conservation measures would be successful in minimizing the effects of OHV use and sedimentation on vernal pool invertebrates.

Some potential project-related effects on vernal pool invertebrates and their habitat are not addressed by the proposed measures. The conservation measures that DWR discusses in the Settlement Agreement do not include prohibiting earth moving activities and herbicide and pesticide use near vernal pools. As discussed in the draft biological assessment prepared by DWR and contained in the biological opinion, the following measures would protect vernal pool invertebrates and their habitat from altered hydrology and toxins: (1) conduct earth moving activities in a manner that does not alter the hydrology to the vernal pools and swales in the project boundary; (2) do not conduct disking closer than 100 feet from vernal pool edges and inform other land management agencies of this requirement; and (3) avoid the use of any herbicide for weed control and/or fuel control within 200 feet of vernal pools to the extent practical. Implementing these measures, as recommended in FWS's biological opinion would protect vernal pool invertebrates from habitat degradation and loss. In addition, the habitat compensation requirements contained within FWS's biological opinion would maintain baseline habitat conditions in the event of unanticipated habitat effects.

Overall, DWR's existing and proposed vernal pool conservation measures would be beneficial to vernal pool invertebrates by protecting their habitat from soil disturbing activities; however, the project may be likely to adversely affect vernal pool fairy shrimp and vernal pool tadpole shrimp. Because potential habitat does not occur within the project boundary, the project is not likely to adversely affect Conservancy fairly shrimp.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle, a federally listed threatened species, is found in elderberry shrubs and is one of the most common shrub species in high terrace habitats in portions of the OWA bordering the Feather River. Approximately 95 acres of elderberry shrubs (the host plant for the valley elderberry longhorn beetle) were delineated within the project boundary, with 0.402 acre around Lake Oroville, 2.255 acres in the area downstream from the Oroville dam and north of Highway 162, and 91.831 acres in the OWA south of Highway 162 and Larkin Road. Forty-five elderberry stems greater than 1 inch in diameter (preferred size of the valley elderberry longhorn beetle) were located along the Feather River corridor between Oroville dam and the Fish Barrier Pool and along the Thermalito power canal, elderberry shrubs with stems greater than 5 inches in diameter in high density were located along the levees within the portion of the OWA bordering the Feather River.

Under Proposed Article A120, *Protection of Valley Elderberry Beetle*, DWR would implement conservation measures required by FWS's biological opinion and evaluate the effectiveness of those conservation measures in accordance with the biological opinion. DWR would, in consultation with FWS, annually evaluate and report the effectiveness to the Commission. The conservation measures would be revaluated in the spring every other year for the term of any new license, in accordance with the biological opinion. If the conservation measures are deemed to be unsuccessful in protecting valley elderberry longhorn beetle habitat, DWR would coordinate with FWS to develop and implement additional or alternative conservation measures to protect valley elderberry longhorn beetle habitat. Modifications outside the scope of the biological opinion would be filed with the Commission for approval prior to implementation. These conservation measures include maintenance of the same amount and quality of valley elderberry longhorn beetle habitat that now exists within the project boundary and implementation of best management practices and other protective measures to ensure that elderberry plants are not inadvertently damaged during project maintenance activities. In addition, if adverse effects to habitat occur, DWR would compensate for these effects by either purchasing credits from a conservation bank or conducting onsite habitat preservation. Interior's (on behalf of FWS) 10(j) recommendation no. 14 and DFG's 10(j) recommendation no. 9 are consistent with Proposed Article A120, *Protection of Valley Elderberry Beetle*.

Staff Analysis

Several project-related activities have the potential to affect elderberry bushes, and subsequently, valley elderberry longhorn beetles. Project maintenance, such as road grading and vegetation removal, pesticide use, vegetation trimming and control of transmission-line rights-of-ways, and levee repair could all damage or remove elderberry shrubs. OHV use and other recreational use could also damage elderberry shrub habitat. Gravel harvesting on OWA levees could also destroy shrubs or alter habitat. Construction of the fish habitat and channel improvement measures, fish barrier weirs, and placing spawning gravel, as discussed in section 3.3.3, *Aquatic Resources*, could cause disturbance within the Feather River floodplain where elderberry shrubs are present. The proposed invasive species control measures could benefit elderberry shrubs if competing invasive species such as giant reed and Chinese tree of heaven were controlled.

Existing valley elderberry longhorn beetle protection measures and habitat locations limit the potential for these effects. In the Lake Oroville area, pesticide use is restricted within 100 feet of mapped elderberry stems and DWR maintains a 25-foot buffer around elderberry shrubs during ground-disturbing activities. Elderberry shrubs in the vicinity of Lake Oroville occur in areas where OHV use is controlled such as the Thermalito power canal or in steep or rocky areas where OHV use does not occur. In the Thermalito Complex and the OWA, OHV use is also limited in areas of elderberry shrubs because of steep levee slopes. DWR currently requires dust abatement during road maintenance activity and does not use pesticides or herbicides around elderberry shrubs.

DWR's proposal to maintain the 95 acres of elderberry shrubs and implement best management practices during project maintenance, recreational facility development, and the implementation of the proposed measures would be likely to limit or eliminate the potential effects of these activities on elderberry shrubs and the valley elderberry longhorn beetle. As described in the DWR's draft biological assessment and FWS's biological opinion, DWR would conduct maintenance and compensate for any elderberry shrub losses following FWS's *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (1999) or subsequent FWS guidelines.

Overall, DWR's existing and proposed vernal pool conservation measures would be beneficial to vernal pool invertebrates by protecting their habitat from soil disturbing activities; however, the project may be likely to adversely affect the valley elderberry longhorn beetle.

3.3.5.3 Cumulative Effects

The cumulative effects on geomorphic, floodplain, riparian, and aquatic resources listed in sections 3.3.3 *Soils, Geology, and Paleontological Resources*, and 3.3.3, *Aquatic Resources*, have adversely affected and led to ESA-listing of Chinook salmon and steelhead in the Feather River. DWR's Proposed Action includes nine conservation measures to improve coldwater fisheries habitat and increase the populations of ESA-listed Chinook salmon and steelhead within the project area. These measures include the formation of an Ecological Committee, a Gravel Supplementation and Improvement Program, Channel Improvement Program, Structural Habitat Supplementation and Improvement Program, Fish Weir Program, Riparian and Floodplain Improvement Program, Feather River Fish Hatchery Improvement Program, Flow/Temperature to Support Anadromous Fish, and a Comprehensive Water Quality Monitoring Program that have been previously discussed.

DWR developed the coldwater fisheries conservation measures in the Proposed Action in cooperation with NMFS and other entities to reduce the cumulative effects associated with the Oroville Facilities and its operation and to improve the quality of coldwater habitat in the Feather River and operations of the Feather River Fish Hatchery. These measures are expected to increase the listed Central Valley Chinook salmon and steelhead populations in the Feather River, and conserve the spring-run of Chinook salmon, which is consistent with the Anglers Committee et al. recommendations. However, genetic introgression of hatchery and wild stocks and of spring-run and fall-run Chinook, potential disease transfer between hatchery and wild salmonids, redd superimposition, and pre-spawning mortality would still occur (albeit to a lesser degree than current conditions) due to the intense competition for limited spawning and rearing habitat, hatchery supplementation and other fisheries management practices (e.g., stocking fish from another basin) that are intended to compensate for the loss of high quality, anadromous habitat.

Perhaps, the most significant adverse cumulative effect is the loss of anadromous access to higher quality, coldwater habitat in the upper watershed due to Oroville facilities and other unrelated, upstream facilities. The Reservation of Section 18 Authority (Proposed Article A109) would maintain the option of restoring steelhead passage via fishways at Oroville dam (as per the Anglers Committee recommendations) if a Habitat Expansion Agreement between DWR and PG&E to restore anadromous fish populations above Lake Oroville is finalized. However, a possible Habitat Expansion Agreement is not a license requirement and is outside the scope of this analysis.

3.3.5.4 Unavoidable Adverse Effects

The dam blocks anadromous fish passage to higher quality spawning and rearing habitat in the upper watershed, and blocks the downstream transport of sediment and LWD from the upper watershed. Project operations alter natural flow regimes, which adversely affects the quality and quantity of coldwater fish habitat in the Feather River.

The proposed conservation measures, particularly gravel supplementation (Proposed Article A102), Channel Improvement (Proposed Article A103), LWD supplementation (Proposed Article A104), and increased flows and decreased water temperatures (A108) including our staff recommendations (see section 5.2, *Comprehensive Development and Recommended Alternative*) would reduce some of these effects by improving and/or increasing Chinook salmon and steelhead spawning and rearing habitat in the Feather River to varying degrees.

Overall, the Oroville facilities and operations would continue to adversely impact Chinook salmon and steelhead populations in the Feather River. However, the proposed conservation measures in the Settlement Agreement and our staff recommendations (see section 5.2, *Comprehensive Development and Recommended Alternative*) would ameliorate many of these unavoidable adverse effects as compared to current conditions.

With the proposed protection and enhancement measures, no unavoidable adverse effects on plant and wildlife threatened and endangered species would be expected to occur.

3.3.6 Recreational Resources

3.3.6.1 Affected Environment

The Oroville Facilities are located at the edge of the foothills of the Sierra Nevada and on the eastern margin of the Sacramento Valley. Lake Oroville sits above the city of Oroville and is surrounded by steep slopes with oak woodlands and mixed conifers. 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 15,810 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.

Other impounded waterbodies of the Oroville Facilities that have recreational importance, listed in order from upstream to downstream, include Thermalito diversion pool, Thermalito forebay, and Thermalito afterbay. The Thermalito diversion pool winds 4.5 miles through steep wooded hillsides below Oroville dam. The next reservoir in the series of project impoundments is the Thermalito forebay, which is a 630-acre hourglass-shaped reservoir sitting at the base of low-lying grass covered hills. Thermalito afterbay, the lowest elevation impoundment in the project, is a 4,300-acre broad and shallow reservoir surrounded by a low earthfill dam on two sides and flat to gently rolling grasslands surrounding the remaining landscape.

Water not routed through Thermalito forebay and Thermalito afterbay from the Thermalito diversion pool passes to the low flow channel of the Feather River, which is the 9-mile-long section of the Feather River upstream of the Thermalito afterbay outlet. The first 0.5 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 and passes near downtown Oroville and residential areas before entering the OWA. The main management unit of the OWA consists of more than 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 Thermalito afterbay and surrounding lands are managed as a part of the OWA. The project boundary terminates about 5 miles downstream of the Thermalito afterbay outlet, at the southern end of the OWA.

Regional Setting

Reservoirs of various sizes are numerous in northern California, offering recreationists many choices in destinations, settings, and activities. The two largest reservoirs (in terms of surface area) in the state are within a 2-hour 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, State Water Project Upper Feather River reservoirs (Antelope, Frenchman, and 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 two large and well known natural lakes: Lake Tahoe (122,200 acres) and Clear Lake (40,000 acres).

Many of these lakes and reservoirs provide facilities similar to those at Lake Oroville and offer similar recreational experiences, activities, and opportunities. All of these regional water bodies have boat launching facilities and campgrounds. However, Lake Oroville is unique in offering floating campsites and equestrian trail riding combined with equestrian camping. The proximity of Lake Oroville to the city of Oroville is also unique because no other reservoir of similar size in California is located adjacent to a population center the size of the city of Oroville (population 12,000). The two reservoirs closest to population centers are Shasta Lake, which is located about 12 miles from the city of Redding (population 66,000), and Folsom reservoir, which is located about 20 miles from the city of Sacramento (population 370,000). Lake Almanor is located adjacent to the town of Chester (population 2,000).

Specially Designated Areas in the Project Vicinity

The following federally designated areas are all located outside of the FERC project boundary in the vicinity of Lake Oroville:

Feather Falls Scenic Area and National Recreation Trail

The Feather Falls Scenic Area is a 15,000-acre area managed by the Plumas National Forest. The scenic area is 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 and is available to hikers and mountain bicyclists. Feather Falls is located on the Fall River, which flows into the Middle Fork less than 1 mile from the northeast corner of Lake Oroville. The trailhead is a 35-mile drive from the city of Oroville and has restrooms, campsites, and parking. Feather Falls, at 640 feet, is the sixth highest waterfall in the contiguous United States and fourth highest in California. The trail provides excellent views of the falls as well as across the canyon of the Middle Fork 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 Feather River National Scenic Byway, dedicated by the Forest Service in 1998, follows State Route 70 from the north end of Lake Oroville along the canyon of the North Fork. Travelers enjoy spectacular views and many points of cultural, geologic, and historical interest along the 130-mile route which ends at the junction of State Route 70 and U.S. Highway 395.

Middle Fork Feather Wild and Scenic River

The Middle Fork was designated a National Wild and Scenic River in 1968. The Plumas National Forest administers the Middle Fork Wild and Scenic River, which extends from near Beckwourth to Lake Oroville. The designated reach totals 77.6 miles, including 32.9 miles designated as Wild River, 9.7 miles designated as Scenic River, and 35 miles designated as Recreational River. The lower part of the Middle Fork flows through a deep canyon with numerous large boulders, narrow steep canyon walls, and some impassable waterfalls. Rafting and kayaking opportunities in the lower section of the Middle Fork are considered to be for experts only (Class V), but the upper stretches are gentler with easy access.

Pacific Crest Trail

The Pacific Crest trail is one of eight 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 Pacific Crest Trail was eventually designated one of the first scenic trails in the National Trails System by Congress in 1968 and was dedicated in 1993. The Pacific Crest Trail generally runs in a north-south direction, east of the Oroville Facilities. The Pacific Crest Trail crosses the Middle Fork and State Route 70 near the town of Belden, about 40 miles northeast of the Oroville Facilities.

Other Areas of Recreational Importance in the Project Vicinity

The Plumas National Forest offers access to a range of activity opportunities, such as camping, boating, hiking, bicycling, and OHV use. There are many miles of system roads and uninventoried low standard roads, including dirt roads, logging roads, and four-wheel drive tracks and trails available on the Plumas National Forest. All of the roads and trails on the Plumas National Forest are open to horses and mountain bicycles, with the exception of the Pacific Crest Trail and trails within the Bucks Lake Wilderness, which are closed to mountain bicycle use. The Forest Service provides a series of route sheets (available from ranger stations) describing recommended mountain bicycle rides (Fragnoli and Stuart, 2000). Table 42 identifies some examples of trails just beyond Lake Oroville.

Table 42. Regional riding and hiking trails within 100 miles of the Feather River Project. (Source: Fragnoli and Stuart, 2000; Brown, 2002)

Name/Location	Trail Type	Trail Mileage	Managing Entity
Feather Falls Loop/Oroville	Single track dirt	9.6	Plumas National Forest
Upper Bidwell Park/ Chico	Dirt road, single track, and pavement	17.6	City of Chico
Mt. Hough “Huff-n-Puff”/Quincy	Dirt roads	20	Plumas National Forest

One of the closest recreational opportunities to the Oroville Facilities that is located on the Plumas National Forest is the Feather Falls trail. Boaters may also hike to the base of the falls from the upper reaches of the Middle Fork arm when the reservoir water level is high. A few additional sites within the Plumas National Forest offer recreational opportunities and facilities in the immediate vicinity of the project but are outside the FERC project boundary.

Bidwell Park, located about 20 miles northwest of the Oroville Facilities in Chico, offers a 17.6-mile-long route for walking and bicycling that extends through the lower section of the park on a paved road and continues on a dirt road through the upper section of the park.

Whitewater boating opportunities are available upstream of the Oroville Facilities on the North Fork at PG&E’s Poe and Rock Creek-Cresta projects and on the Middle Fork. On the North Fork, boaters occasionally boat the 8-mile Poe bypassed section, which is immediately upstream of the Oroville Facilities on the Upper North Fork arm. The upper 3.57-mile run between Poe dam and Bardee’s Bar is rated class V[70] with possible portages around two class V–VI rapids. The 4.41-mile-long section extending from Bardee’s Bar (an informal recreation access site located on PG&E-owned land) to the Poe powerhouse is rated class III. Flows suitable for whitewater boating in the Poe bypassed reach typically occur in the spring and early summer but they are erratic and difficult to predict.

70 The American Whitewater Scale of River Difficulty: Class I, Easy—Fast moving water with riffles and small waves; Class II, Novice: Straightforward rapids with wide, clear channels which are evident without scouting; Class III, Intermediate—Rapids with moderate, irregular waves which may be difficult to avoid and which can swamp an open canoe; Class IV, Advanced—Intense, powerful but predictable rapids requiring precise boat handling in turbulent water; Class V, Expert—Extremely long, obstructed or very violent rapids which expose a boater to added risk; Class VI, Extreme and Exploratory—These runs have almost never been attempted and often exemplify the extremes of difficulty, unpredictability, and danger.

An additional hydroelectric development, PG&E's Rock Creek-Cresta Project, is located upstream from the Poe dam. Conditions in the Rock Creek-Cresta license require PG&E to provide recreational flows in the two bypassed reaches (Rock Creek and Cresta) of the North Fork for whitewater boating one weekend a month during the summer and early fall months.[71] The Rock Creek reach is an 8-mile-class III-IV boating run with a section of class V. The Cresta reach is a 5-mile run of mostly class III difficulty with a class V section at higher flows. Flows have been provided since 2002 and the use levels have been high with the estimated number of boaters exceeding the triggers on many occasions, especially in August and September.

On the Middle Fork, the Bald Rock Canyon run begins outside of the project boundary at Milsap Bar, 6.5 miles north of the tip of the Middle Fork arm. This 6.5 mile-long class V run ends at Lake Oroville and is suitable for expert-level whitewater boaters.

Riverbend Park and the adjacent Bedrock Park, located on the low flow channel on the west side of the city of Oroville, are owned and managed by the Feather River Recreation and Parks District. These parks are accessed from State Route 70, Oroville Dam Boulevard, Montgomery Street, and Feather River Boulevard. 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. Parking and restroom facilities are provided at the Feather River fish ponds, which are adjacent to Riverbend Park. At this location, visitors may fish from the pond banks and piers. The piers and restrooms meet the guidelines for accessibility under the American with Disabilities Act (ADA). Bedrock Park is a smaller facility that provides pedestrian access to the river, shaded picnic sites, an irrigated lawn area, and restrooms. Bedrock Park is separated from Riverbend Park by State Route 70, but the two parks are connected by a paved bike and walking trail.

The Clay Pit State Vehicular Recreation Area is located 3 miles southwest of the city of Oroville adjacent to the OWA and is accessed from State Route 162 and Larkin Road, south of the Oroville Municipal Airport. This location provides a riding area for OHV enthusiasts and is managed by DPR. The clay used to build Oroville dam was taken from this area, resulting in a large shallow pit ringed with low hills, providing about 220 acres of riding area for motorcycles and OHVs. A well-marked entrance road leads to a paved staging area used for loading and unloading OHVs. Parking is available for about 20 vehicles. Aside from the paved staging area and the entrance road, the entire site is one large open dirt area where OHVs are used.

The Rabe Road Shooting Range, managed by DFG, is an unstaffed public shooting area with unmarked backstops (places to place paper targets), a graded and graveled parking area, seven concrete picnic tables, and a vault toilet. It is technically a rifle range, but pistol use commonly occurs there as well. The shooting range is directly adjacent to the Clay Pit State Vehicular Recreation Area and is accessed from State Route 162, Larkin Road, and Rabe Road. A small sign on Rabe Road indicates "public shooting area."

Access to the Oroville Facilities

The western boundary of the Oroville Facilities is located about 38 miles east of Interstate 5, which extends north from San Diego, California, through Sacramento, California, and then to Blaine, Washington. Major highways providing road access to the Oroville Facilities include State Routes 70, 99, and 162. State Route 70 is a two- and four-lane highway, which roughly parallels Interstate 5 north

[71] Flows ranging from 800 cfs to 1,600 cfs (depending on month and water year type) are provided from June to September in dry and critically dry water year types and from June to October in normal and wet water year types. Recreational flows for the Cresta and Rock Creek reaches are released on Saturdays and Sundays, respectively, on one weekend per month. License conditions include triggers to adjust the number of days per month recreational flows are provided.

from Sacramento to the city of Oroville, then turns northeast a few miles north of Oroville. State Route 70 crosses the West Branch arm before continuing north to Quincy. State Route 99 is a two- and four-lane highway, which roughly parallels State Route 70 and Interstate 5, providing an additional route between the cities of Sacramento, Chico, and Red Bluff. State Route 99 forms the western side of the Thermalito afterbay. State Route 162 is a two-lane highway extending east from Interstate 5, crossing the Thermalito afterbay and dividing it into north and south parts, continuing east through the city of Oroville, before turning north and crossing Lake Oroville at the mouth of the Middle Fork arm of the reservoir. Generally, the major recreational areas on Lake Oroville are easily accessible from these highways; however, the limited public road network makes vehicular access to the arms of Lake Oroville more difficult. To encourage increased visitation at Lake Oroville, DWR recently provided funding to the Oroville Chamber of Commerce for billboards along State Route 99 and Pentz Road to direct people to existing recreational facilities at Lake Oroville.

The Thermalito diversion pool is accessible via Cherokee Road off Table Mountain Boulevard and State Route 70. A gravel road, known locally as Burma Road, parallels the north 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. The Thermalito forebay is accessible via State Route 70, with the North Thermalito forebay day-use area and boat ramp 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 State Route 99 and State Route 162. State Route 162, along with Larkin Road along the east side of the Thermalito afterbay, provides immediate access to the three developed recreational facilities on the Thermalito afterbay. The OWA is accessible via gravel roads off State Route 162 to the north, State Route 70 and Pacific Heights Road to the east, and Larkin Road to the west. No paved roads enter the OWA; all roads are graveled and generally run atop elevated levees and former railroad beds.

Recreation within the Project Boundary

The existing Oroville Facilities include a wide variety of recreational facilities. About 28,000 of the 41,540 acres within the FERC project boundary are included in the Lake Oroville State Recreation Area, which includes all of the recreational facilities at Lake Oroville, the Thermalito diversion pool, the Thermalito forebay, and the associated waters and land. Recreation is also provided at the Thermalito afterbay, the OWA, and along the Feather River. Nearly 14 miles of the Feather River downstream of the Thermalito diversion pool is also within the Oroville Facilities project boundary. The upper 9 miles of this section of the Feather River is the low flow channel, which extends from the Thermalito diversion pool to the Thermalito afterbay outlet. Nearly 5 miles of the river downstream of the outlet are also within the project boundary. Table 43 lists the existing recreational facilities within the project boundary, and figure 18 shows their locations.

Lake Oroville

Lake Oroville is one of the largest reservoirs in California, with more than 15,810 surface acres and 167 miles of shoreline at a maximum pool elevation of 900 feet msl. Annually, the reservoir elevation is drawn down an average of 112 feet from the maximum surface elevation (900 feet msl). During the peak recreation season, the reservoir drawdown ranges from 50 to 75 feet. Typically, Lake Oroville is filled to its maximum level in June and the minimum reservoir level (about 700 feet msl) occurs in December or January. During and following dry years, the reservoir may not fill to desired levels the following spring. In dry water years, the minimum reservoir elevation has been as low as elevation 645 feet msl. See section 2.1.1 for additional information on reservoir operations.

Major recreational facilities are located at Lime Saddle, Loafer Creek, Bidwell Canyon, and at the Oroville dam spillway. The Lime Saddle area is located on the western shoreline of the West Branch arm of the reservoir. The Loafer Creek Recreation Area is the largest, oldest, and most diverse recreational complex on the reservoir, located directly across Bidwell Cove from the Bidwell Canyon area. Bidwell Canyon is located at the southern end 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. These developments are shown on figure 18. The recreational developments at Lake Oroville are included within the Lake Oroville State Recreation Area and are managed by the DPR. DFG management in the Lake Oroville State Recreation Area 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. A description of management responsibilities in the Lake Oroville State Recreation Area is included in section 3.3.7. Undeveloped public land around Lake Oroville is abundant and available for general public use. However, steep slopes are common above the Lake Oroville shoreline and generally limit public access to only a few areas.

DPR and DWR remove floating debris on Lake Oroville. Boats are used to collect floating debris and deliver it to coves with debris containment booms, where it is removed from the shore after the reservoir recedes, typically in the late summer or fall. DPR is also responsible for carrying out boat safety inspections and providing safety patrols at Lake Oroville.

Within the project boundary and within the Lake Oroville State Recreation Area, there are several fragmented parcels of public land managed by the Forest Service located along the North, Middle, and South Fork arms of Lake Oroville. The Forest Service allows DPR to manage recreational use on National Forest System lands that are within the Lake Oroville State Recreation Area. All of these National Forest System lands slope sharply upward from the shoreline of Lake Oroville and include relatively inaccessible steep and rugged terrain.

BLM manages about 3,852 acres of land in scattered, non-contiguous parcels along the West Branch, the North, Middle, and South Fork arms about half of which are submerged under Lake Oroville. Currently, BLM does not actively manage recreation on any lands within the project boundary.

Project Recreation Facilities at Lake Oroville

As shown in table 43 and figure 18, numerous facilities provide public recreational access to Lake Oroville. Recreational facility construction began as early as 1965. Some of the original project recreational facilities have been reconstructed or upgraded and additional facilities have been constructed throughout the term of the existing license. These efforts created additional capacity, provided additional amenities for visitors, and implemented changes to facilities to make them accessible to persons with disabilities. Recreational activities at Lake Oroville include high- and low-speed boating, non-motorized boating, fishing, swimming, bicycling, equestrian use, hiking, and camping.

Campgrounds provide a spectrum of visitor conveniences at locations that require different forms of access. At one end of the spectrum there are family and group campgrounds with paved access, potable water, tables, fire rings, grills, RV hookups, flush restrooms, and showers. These are the types of facilities that are available at Loafer Creek, Bidwell Canyon, and Lime Saddle recreational developments and constitute the majority of the developed overnight capacity available at the project. Additional developed overnight capacity exists in the form of boat-in family and group campgrounds which typically only have tables, fire rings, and vault restrooms. Ten floating campsites are provided at various locations around the reservoir, each with restroom, table, fire grill, and sleeping area; this type of facility is unique to Lake Oroville. See table 43 for detailed descriptions of the campground facilities at Lake Oroville. User fees are required to camp at these developments.

Table 43. Recreation facilities at Lake Oroville, Thermalito Complex, low flow channel, and OWA. (Source: DWR, 2005a, appendix I, as modified by staff)

Facility	Capacity	Boat Launch Availability[a]	Facility Components/Comments
Lake Oroville, West Branch, Upper and Lower North Fork Arms			
Campgrounds			
Lime Saddle campground	44 family campsites, each with a table and fire ring with a grill		Full RV hookups at 16 sites; RV dump station with 2 stalls; 2 shower buildings, each with 6 flush restrooms and 4 showers; potable water; gray water sumps; and trash dumpsters
Lime Saddle group campground	6 family campsites (8 people at one time/site)		Sites located in 2 groups; 3 sites accessible,[b] central parking area with 16 spaces (2 accessible); shower building with 3 accessible flush restrooms and 2 accessible showers; shade structures, potable water, tables
Goat Ranch campground	5 family campsites, each with a table and fire ring with a grill		Boat-in access, 2 pit restrooms, 2 vault restrooms, 5 trash receptacles
Bloomer Point campground	25 family campsites, each with a table and fire ring with a grill		Boat-in access, 2 pit restrooms, 2 vault restrooms, 14 trash receptacles
Bloomer Knoll campground	6 family campsites, each with a table and fire ring with a grill		Boat-in access, 2 pit restrooms, 4 trash receptacles
Bloomer Cove campground	5 family campsites, each with a table and fire ring with a grill		Boat-in access, 2 pit restrooms, 6 trash receptacles
Bloomer Group campground	1 group campsite (75 people at one time)		Boat-in access, 2 pit restrooms, 9 trash receptacles, several shared barbecue cooking grills
Foreman Creek campground	26 family campsites, each with a table and fire ring with a grill		Boat-in access, 2 pit restrooms, 2 vault restrooms, 16 trash receptacles, self-registration pay station

Facility	Capacity	Boat Launch Availability[a]	Facility Components/Comments
Day-use Areas			
Lime Saddle day-use area	13 picnic sites (4 accessible)	4 lanes, medium to high 2–3 lanes, low	Boat launch, marina, fish cleaning station, 4 accessible flush restrooms, 7 shade structures, potable water, telephone, 11 trash receptacles, 45 car parking spaces (3 accessible), 131 car/trailer parking spaces (7 accessible), 70 car/trailer overflow parking spaces
Nelson Bar boat launch		1 lane, high	Intended for car-top launching but trailer launching possible at high reservoir elevations, 20 car/trailer parking spaces, vault restroom, 2 trash receptacles
Dark Canyon boat launch		2 lanes, all reservoir levels	About 15–30 car parking spaces
Vinton Gulch boat launch		1 lane, high	No designated parking area but space along roadside available for about 10 vehicles, vault restroom, 2 trash receptacles
Foreman Creek boat launch		2 lanes, all reservoir levels	About 15 to 30 car/trailer parking spaces (at high pool only 7 spaces along roadside), closed at night when reservoir is below elevation 800 feet msl to protect cultural resources, 1 trash receptacle
Lake Oroville, Middle and South Fork Arms			
Campgrounds			
Craig Saddle campground	18 family campsites, each with a table and fire ring with a grill		Boat-in access, 2 pit restrooms, 2 vault restrooms, 19 trash receptacles
Day-use Areas			
Lake Oroville scenic overlook			Unknown capacity, interpretive signage; located at Highway 162/Middle Fork arm
Enterprise boat launch		2 lanes, medium to high	40 car/trailer parking spaces, 1 vault restroom, 3 trash receptacles, boat ramp closed when reservoir is below elevation 830 feet msl to protect cultural resources
Stringtown boat launch		1 lane, all reservoir levels	1 vault restroom, 1 trash receptacle, 6 car/trailer parking spaces, difficult access below elevation 866 feet msl

Facility	Capacity	Boat Launch Availability[a]	Facility Components/Comments
Lake Oroville, Main Basin			
Campgrounds			
Loafer Creek campground	137 family campsites (6 accessible), each with a table, fire ring with a grill, tent pad, and shade trees		20 flush restrooms, (12 accessible); 16 hot water showers; potable water; 12 gray water sumps; telephone; amphitheater; trail access
Loafer Creek group campground	6 group campsites (25 people at one time/site), each with several tables, a sink with running water, shade trees, five large tent pads, nearby water spigots, and parking spaces for 8 vehicles.		8 flush restrooms (4 accessible); 8 accessible showers; potable water; trail access
Loafer Creek equestrian campground	15 family campsites, each with a table, fire ring with a grill, and horse trailer parking		Stall/feeder at each site; 2 flush restrooms (1 accessible); 2 showers (1 accessible); potable water; horse washing stall; round exercise pen; trail access
Bidwell Canyon campground	75 family campsites with full RV hookups, each with a table and fire ring with a grill		4 accessible sites; 2 flush restrooms, potable water, 6 showers
Spillway RV campground	40 spaces		Overnight use allowed for self-contained RVs in parking area adjacent to the day-use area
Floating campsites	10 campsites (15 people at one time/campsite)		Gas cooking grill, vault restroom, sink (non-potable water), table, sleeping area, shelves, storage room, and cabinets

Facility	Capacity	Boat Launch Availability[a]	Facility Components/Comments
Day-use Areas			
Loafer Creek day-use area	30 picnic sites (some accessible)	8 lanes, medium to high 2 lanes, low	Boat launch, boarding dock, playground, swimming beach, 10 accessible flush restrooms, potable water, 2 showers, 17 barbecue grills, telephone, 251 car parking spaces (5 accessible), 192 car/trailer parking spaces (6 accessible), trail access
Bidwell Canyon day-use area and boat launch	21 picnic sites	7 lanes, high 5 lanes, medium 2–4 lanes, low	Boat launch, marina, boarding dock, fish cleaning station, 8 flush restrooms (2 accessible), potable water, telephone, gray water sump, undetermined no. car parking spaces, 279 car/trailer parking spaces (2 accessible), 30 car/trailer overflow parking spaces, interpretive display (historical Bidwell Bar Bridge and Tollhouse), trail access
Floating restrooms	7 restrooms		Two vault stalls/restroom, various locations on Lake Oroville
Oroville dam overlook day-use area	8 picnic sites		Parking on east side of dam with 20 spaces, 4 flush restrooms (1 accessible), potable water, interpretive display
Spillway day-use area	6 picnic sites	12 lanes, high to medium 8 lanes, medium to low 2 lanes, low	Boat launch, 3 boarding docks, fish cleaning station, 6 flush restrooms (2 accessible), potable water, shade structures, 118 car parking spaces in upper lot (8 accessible), 350 car/trailer parking spaces in upper lot (8 accessible), 264 car/trailer parking spaces in lower lot, trail access
Interpretation/Education			
Lake Oroville Visitor Center	18 picnic sites (10 accessible)		Interpretive displays and presentations of project construction, native culture and natural resources, viewing tower, telephone, gift shop, potable water, 6 flush restrooms (accessible), trail access (Chaparral interpretive trail and Dan Beebe trail), 90 car parking spaces, 17 car/trailer or bus parking spaces
Thermalito Diversion Pool, Thermalito Forebay and Low Flow Channel			
Campgrounds			
North Thermalito forebay RV campground	15 spaces		Overnight use allowed for self-contained RVs in the parking area adjacent to the day-use area

Facility	Capacity	Boat Launch Availability[a]	Facility Components/Comments
Day-use Areas			
Thermalito diversion pool day-use area			1 vault restroom, trail access, graveled area for hand launching small boats
North Thermalito forebay day-use area	117 picnic sites	2 ramps; one with 2 lanes and one with 3 lanes	2 boat launches, 2 boarding docks, 6 flush restrooms (4 accessible), potable water, 251 car parking spaces (3 accessible) 26 car/trailer parking spaces (1 accessible), sandy beach and swimming area, shared barbecue grills, telephone, trail access, aquatic center with non-motorized boat rentals and classes, interpretive displays
South Thermalito forebay day-use area	10 picnic sites (8 accessible)	2 lanes	Boat launch, boarding dock, fish cleaning station, 10 barbecue grills, 1 vault restroom, undetermined number of parking spaces, trail access, interpretive displays
Interpretation/Education			
Feather River day-use area	Undetermined number of picnic sites (1 accessible)		Sun shelters, interpretive displays, trail and river access
Feather River Fish Hatchery	1 picnic site		Viewing platform and windows, 2 flush restrooms, potable water, trash receptacles, entire facility is accessible, 100 car parking spaces
Thermalito Afterbay and OWA			
Campgrounds			
Thermalito afterbay outlet campground	Undetermined number of primitive campsites (places to park an RV or stake a tent) adjacent to the afterbay outlet		Area is not formalized and is also used for day-use, 3 vault restrooms (accessible), several trash receptacles

Facility	Capacity	Boat Launch Availability[a]	Facility Components/Comments
Day-use Areas			
Monument Hill day-use area	10 picnic sites	2 lanes	Boat launch, boarding dock, fish cleaning station, swimming area with beach, 9 barbecue grills, 4 flush restrooms (1 accessible), 8 trash receptacles, telephone, 10 car parking spaces (1 accessible), 39 car/trailer parking spaces (3 accessible), 30 to 40 car/trailer overflow parking spaces
Model Aircraft Flying facility	6 picnic sites		1 barbecue grill, 2 shade structures, 1 vault restroom, 350-by-300 foot paved runway, 20 car parking spaces, 1 informational/interpretive panel
Shoreline hunting blinds (afterbay)			Unknown
Thermalito afterbay outlet boat launch		1 lane	Unsurfaced area used for launching boats into river, no designated parking area but space for about 5–10 vehicles
Unimproved boat launches in OWA			Several unpaved areas used for launching boats into the river
Wilbur Road boat launch		2 lanes	Boarding dock, 1 vault restroom, 1 trash receptacle, 14 car/trailer spaces (1 accessible), other undeveloped nearby locations also used for launching
Larkin Road boat launch		1 ramp	1 vault restroom (accessible),trash dumpster, approximately 20 car/trailer parking spaces, 4 other undeveloped nearby locations also used for launching

Note: NA – not applicable

[a] Only for boat launches that provided access at Lake Oroville. Low pool = below elevation 800 feet msl; medium pool = elevation 800 to 850 feet msl; high pool = above elevation 850 feet msl.

[b] When used in this context, the term accessible refers to a facility that meets ADA accessibility standards.

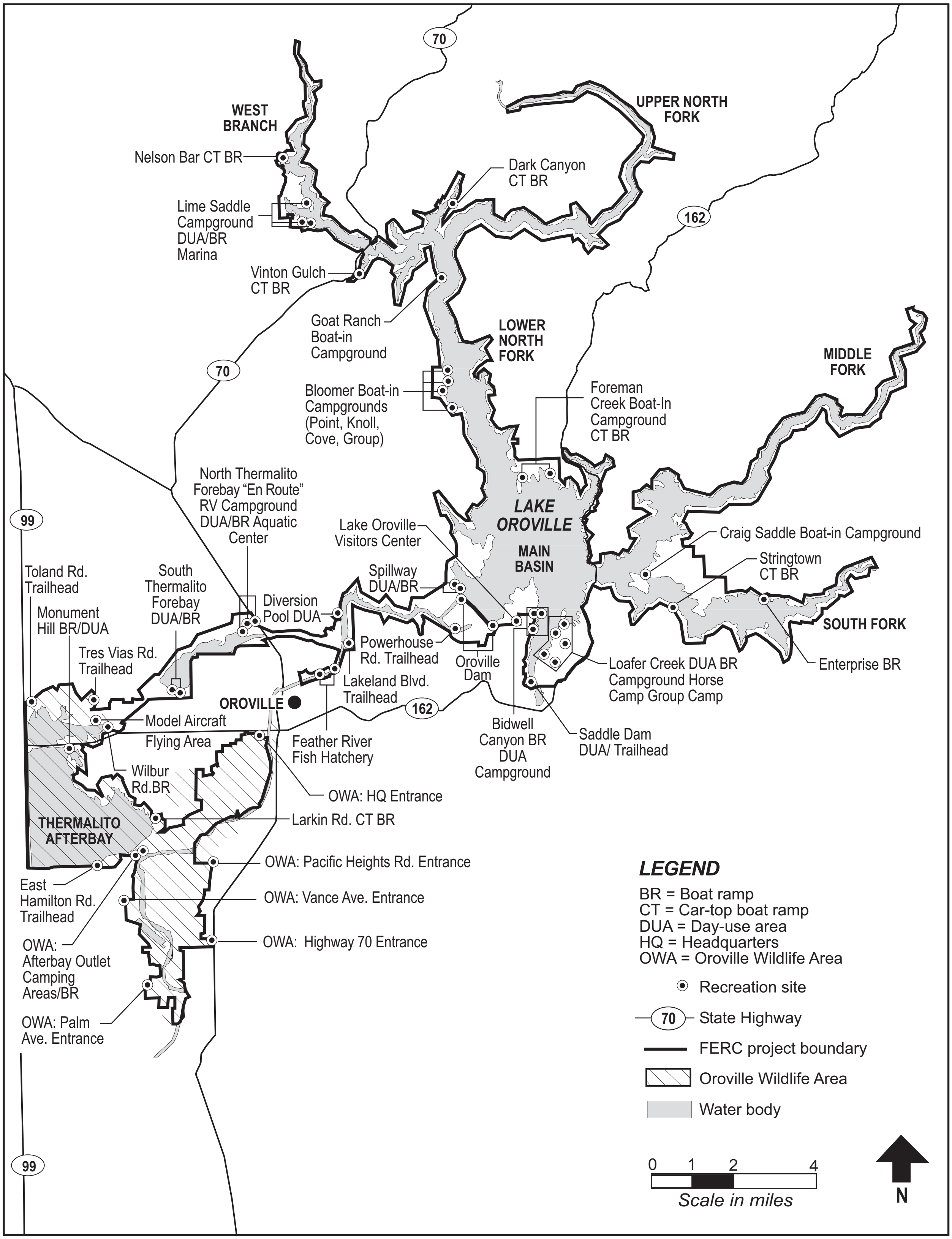


Figure 18. Lake Oroville recreational sites. (Source: DWR, 2005a)

The largest developed facilities for recreational day-use are located at the Spillway, Lime Saddle, Bidwell, and Loafer Creek recreational developments. Fees are required for visitors to use these developments. Each of these areas has a boat launch with multiple lanes, expansive parking areas, and boarding docks. Marinas providing gasoline, moorings, docks, and boat rentals are available at Bidwell and Lime Saddle recreational developments. The number of lanes and usable elevations for each boat launch at these four areas are shown in table 43. These developments also provide amenities for day-use activities, including, parking areas, flush restrooms, picnic tables, cooking grills, potable water, shade structures, and fish cleaning stations; Loafer Creek has the only designated swimming beach on Lake Oroville.

Additional boat launches that do not have developed day-use facilities are also located around Lake Oroville. One of these, the Enterprise boat launch, provides parking for 40 cars with trailers, a vault restroom, and 3 trash receptacles. DWR refers to the other five boat launches (Enterprise, Dark Canyon, Foreman Creek, Nelson Bar, Stringtown, and Vinton Gulch) as car-top boat launches; however, in most cases, visitors can use these areas to launch trailered watercraft. These five boat launches typically have a vault restroom and a graveled parking area with no designated spaces. None of these boat launches provides accessible[72] facilities.

The Lake Oroville Visitor Center has interpretive and education opportunities for visitors, picnic facilities, and an interpretive trail. Interpretive opportunities and day-use facilities are also provided at Oroville dam and Lake Oroville scenic overlook. These locations are shown on figure 18 and the amenities provided are listed in table 43. These developments do not require a user fee.

Dispersed Recreation at Lake Oroville

DWR identified seven dispersed use sites at Lake Oroville. A dispersed-use site is an area that is clearly defined by its size, and evidence of use and often has an obvious access point. These locations provide visitors with free access to the Lake Oroville shoreline.

The Old Nelson Bar Road dispersed site is located off of Old Nelson Bar Road across the West Branch arm from Nelson Bar car-top boat ramp. The site varies in size depending upon reservoir level. Shoreline use, such as sightseeing, hunting, picnicking, bank fishing, and swimming, occurs at the site, and OHV use is apparent at lower reservoir levels.

The Parish Cove dispersed site is located near the Lime Saddle recreation area. Visitors access the site by parking in a gravel lot on the east side of Pentz-Durham Road just north of the access road leading to the Lime Saddle day-use area and boat ramp and then walking under the flume on the north side of the parking lot. Shoreline use occurs at the site, including swimming. At lower reservoir levels, the site becomes less attractive for shoreline users as the swim area becomes smaller and the distance to the water increases. During scoping, DWR determined that stakes (used to hold down Christmas trees) and tires that have been dumped in Parish Cove pose a boating and wading hazard. Once the reservoir has receded, the standing water in the tires attracts mosquitoes, which are of concern.

The West Branch Bridge dispersed site is located on the west side of the State Route 70 Bridge over the West Branch arm. Access to the site is provided by parking in a small area about 200 yards west of the bridge on the north side of the highway and then walking down a barricaded road to the shoreline. An outcropping of limestone at the site is used by swimmers to jump into the water at certain reservoir levels.

The Canyon Creek Bridge dispersed site is located on the west side of the Canyon Creek Bridge on State Route 162. Visitors park in a small area on the north side of the highway about 100 yards

72 When used in this context, the term accessible refers to a facility that meets ADA-accessibility standards.

beyond the bridge and then access the shoreline by several steep, user-defined trails. Visitors fish and swim at this site.

The Bidwell Bar Bridge dispersed site is located off of State Route 162 on the north side of the bridge. Visitors park in a relatively large area on the west side of State Route 162 and then walk down an old road from the north side of the parking area to the water. Shoreline use is possible at most times, depending on reservoir level.

The Ponderosa dam dispersed site is located near the Ponderosa dam, which is located at the eastern end of the South Fork arm. Visitors access the site via Ponderosa Way, a steep gravel road off Lumpkin Road, then cross Ponderosa dam and drive west until the road is no longer passable. From this point, the Lake Oroville shoreline is accessed by walking down the road.

The McCabe Cove dispersed site is located on the south side of the South Fork arm about 0.5 mile south of the Enterprise Bridge. McCabe Cove is one of the collection points for the Lake Oroville floating debris removal program. A dirt road off Lumpkin Road provides access to this site, which is primarily used for firewood collection.

Most other shoreline day use at Lake Oroville occurs in the vicinity of the car-top boat ramps, where non-boating visitors have access to the shoreline to picnic, swim, and fish.

Whitewater Boating Use at Lake Oroville

A limited amount of whitewater boating activity occurs on the Upper North Fork arm when Lake Oroville reservoir pool levels are sufficiently low to expose several miles of river. The Big Bend run, as it is known, begins outside of the Oroville Facilities project boundary on PG&E-owned property at the Poe powerhouse. The Big Bend run is a Class III+ to IV intermediate play run. About 0.75 mile downstream from the launch site at the Poe powerhouse is the Big Bend dam, an element of the Big Bend run that makes it unique since boaters enjoy boating over the Big Bend dam. Boaters using the Big Bend run must also paddle across flat water to reach the take out location at the Dark Canyon car-top boat ramp, making the entire run about 14 miles long. The amount of whitewater and flat water in the Big Bend run varies, depending on the level of Lake Oroville. At a reservoir elevation 730 feet msl, the whitewater portion of the run actually terminates about 0.5 mile downstream of French Creek, providing slightly less than 6 miles of whitewater and slightly more than 8 miles of flatwater. At a reservoir elevation 650 feet msl, there are 7 miles of whitewater in the Big Bend run and 7 miles of flat water. 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. DWR reported that most boaters determine when conditions are right for boating the Big Bend run only by word-of-mouth because no predictive or real-time flow information for the North Fork is currently available.

The Bald Rock Canyon run begins outside of the project boundary at Milsap Bar, 6.5 miles north of the tip of the Middle Fork arm. This 6.5 mile-long Class V run is suitable for expert-level whitewater boaters. The run ends where the flowing Middle Fork enters the flat water of Lake Oroville. There is no developed or maintained public road access to the Middle Fork arm. Currently, all roads leading to the shoreline of the Middle Fork arm of the reservoir are privately owned. Boaters 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. Occasionally, boaters take out at one of two private roads, Eckards Lane or Island Bar Hill Road, or at Forest Service Road 20N59 near Feather Falls. However, DWR reported that access to the water from Forest Service Road 20N59 is currently unsuitable for vehicles, and the road is overgrown. These three roads are closer to the end of the whitewater run.

Thermalito Diversion Pool

The Thermalito diversion pool covers a 4.5-mile stretch of the Feather River from Oroville dam to the Thermalito diversion dam. The narrow pool covers 320 acres at maximum water surface elevation 225 feet msl, winds between steep wooded hillsides, and provides opportunities for visitors to enjoy quiet, uncrowded conditions. The Thermalito diversion pool and the lands and recreational facilities surrounding the Thermalito diversion pool are part of Lake Oroville State Recreation Area. The access road to the Thermalito diversion pool is open only during daylight hours and the area is closed to overnight use.

Project Recreation Facilities at the Thermalito Diversion Pool

The Thermalito diversion pool and its shoreline are open for day-use activities such as swimming, fishing, non-motorized boating, trail use, and picnicking. Only non-motorized boats or boats with electric motors are allowed on the Thermalito diversion pool. The Thermalito diversion pool day-use area, completed by DWR in 1996, is located along Burma Road, which runs on the north and west sides of the Thermalito diversion pool. The day-use area has an ADA accessible vault toilet and a small shoreline access point where gravel was placed at the shoreline to provide a level bench just below the waterline to facilitate car-top boat launching. Additionally, a former DWR storage yard near the Thermalito diversion dam has been cleared, graded, and graveled for use as a staging area for equestrian and other events. Burma Road is also used as a trail corridor for the Brad B. Freeman trail. Recreational facilities are listed in table 43 and shown on figure 18.

Thermalito Forebay

At a maximum water surface elevation of 225 feet msl, Thermalito forebay is a 630-acre hourglass-shaped reservoir that is divided into north and south sections at a point where the pool narrows at the Nelson Avenue Bridge crossing. The Thermalito forebay and the lands and recreational facilities surrounding the forebay are part of the Lake Oroville State Recreation Area. The north forebay area includes about 300 surface acres of the Thermalito forebay and provides non-motorized boating, which is popular for small sailboat and paddle craft uses, and other recreational opportunities, such as fishing and swimming. The south forebay includes the remaining 330 surface acres of the Thermalito forebay and provides opportunities for power boating, fishing, and swimming. DPR prohibits the operation of power boats within 50 feet of the boundaries of designated swimming areas, as marked by buoys placed 50 feet apart (and by signs on the shore). DPR also prohibits boating on the forebay from sunset to sunrise; the water surface of the Thermalito forebay is day-use only. The Thermalito forebay is stocked regularly with trout and is popular with local shore anglers. Some boat angling also occurs on both portions of the forebay. Recreational facilities are listed in table 43 and shown on figure 18.

Recreational Facilities at the Thermalito Forebay

Day use is the primary form of recreational use at the Thermalito forebay, but DWR reserves 15 parking spaces for self-contained RV camping at the North Thermalito forebay day-use area. This day-use area, located just west of State Route 70 and accessed from State Route 70 and Garden Drive, is suitable for family or large-group picnics with 117 picnic tables, barbecue grills, shade trees, and a large sandy beach and swim area designated with buoy lines on a shallow lagoon connected to the main body of the forebay. This lagoon is one of the only two formally designated swimming areas within the project boundary. An aquatic center located at the North Thermalito forebay day-use area provides boat rentals and instruction for boating clubs, educational institutions, and individual members of the public. The 1,200 square-foot facility was constructed in 1995 to provide area sailing and rowing clubs with a boathouse and an area for holding classes. Operations of the North Thermalito forebay day-use area began on October 11, 1967, when water was allowed to flow from the diversion pool into the power canal and then into the forebay. DWR constructed a new restroom and provided utilities and improvements to this day-use area in 1997. DWR began renovating the parking area in 2000, and finished in 2001. At the southern end of the Thermalito forebay, the South Thermalito forebay day-use area, which provides 10 picnic tables, is accessed from State Route 70 and Grand Avenue. DWR recently renovated the interpretive displays at this location.

Thermalito Afterbay

The Thermalito afterbay is a shallow reservoir in the southwest corner of the Oroville Facilities project boundary with 17 miles of shoreline and 4,300 surface acres of water at maximum operating storage, which occurs at maximum water surface elevation 136.5 feet msl. Unlike Lake Oroville, the elevation of the Thermalito afterbay fluctuates on a weekly cycle during much of the year, with 4 to 6 feet of elevation change during a typical week. The typical daily elevation change is 1 to 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 throughout the 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. The diverse temperature structure of the Thermalito afterbay provides suitable habitat for both coldwater and warmwater fish, including a popular largemouth bass fishery. Fishing in the Thermalito afterbay occurs both from the shore and from boats. Boating, swimming, picnicking, and limited hunting (waterfowl and upland game) also occur at the Thermalito afterbay, but there are no opportunities for camping. The reservoir surface and shoreline are within the OWA.

DFG allows both motorized and non-motorized boats on the Thermalito afterbay. According to California regulations, boating speeds in state-managed wildlife areas are not supposed to exceed 5 miles per hour. However, Thermalito afterbay is popular with personal watercraft users and water-skiers, who normally exceed this speed when operating their watercraft. Current boating use is not consistent with the DFG 5 miles per hour speed restriction.

Project Recreational Facilities at the Thermalito Afterbay

As shown in table 43 and figure 18, recreational facilities are provided at many locations on Thermalito afterbay. Day use is the primary form of recreational use at the Thermalito afterbay. Three boat launches provide access to the afterbay: Wilbur Road, Larkin Road, and Monument Hill. In addition to these locations informal boat launching occurs at several unimproved areas between Wilbur Road and State Route 162. These informal boat launching areas are often accessed with trailers, yet some are only suited for car-top launching. There are also day-use facilities provided at the Monument Hill development. Day-use facilities provide for picnicking and include flush restrooms, tables, cooking grills, potable water, shade structures, parking areas, a swimming beach, and a fish cleaning station. Nearby, there is a 350- by 300-foot paved runway for model aircraft take-offs and landings. The site is mainly used by Oroville Model Airplane Club members, with other access occasionally arranged for special groups, activities, or events. No developed overnight facilities are provided. However, an undeveloped area delineated by signs is available for overnight camping in the vicinity of the Thermalito afterbay outlet.

Oroville Wildlife Area

DFG manages the OWA, guided by the 1978 Oroville Wildlife Area Management Plan, as well as applicable state laws and regulations. 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. DFG is responsible for operating and maintaining recreational facilities, posting and maintaining boundary signage and fencing, enforcing codes, and patrolling for illegal uses such as refuse dumping and OHV use. 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 at the Oroville Facilities to ensure that regulations are enforced in the OWA.

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 public use and enjoyment. 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 primarily for dispersed types of recreation, such as hunting, fishing, and bird watching, under a series of agreements with DWR, and developed facilities are minimal. No user fees are currently collected by DFG for camping or any other use of the OWA.

The OWA, not including the Thermalito afterbay described above, includes about 5,700 acres of land 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 historical gold dredging in the river. There are numerous small willow and cottonwood-lined ponds in areas where this material has been removed, adjacent to the Feather River. The Feather River runs through the center of the OWA and has several channels; the OWA is adjacent to or straddles about 10 miles of the Feather River. Fishing, hunting, nature study, and river-associated recreation are the primary activities at the OWA. The Thermalito afterbay releases water into the Feather River at the Thermalito afterbay outlet; the outlet is one of the most popular river fishing areas at the Oroville Facilities and in California, particularly during salmon runs. Bicycling is permitted in the OWA, but only on roads open to vehicles. Horses are allowed within the OWA on roads open to vehicles and within 25 feet of any exterior boundary fences. Horse drawn carriages are restricted to roads open to vehicles. OHVs are not permitted in the OWA; however, DWR reported that impacts related to illegal OHV use are a concern within the OWA, especially near shoreline and wetland areas.

Project Recreation Facilities at the Oroville Wildlife Area

Although there are a few vault restrooms, trails, and unimproved boat launches that provide access to the Feather River, there are no formalized recreational facilities located in the OWA. Recreational use at this area is dispersed in nature and relates to access to the Feather River and hunting.

Feather River

The first 1.5 miles of the low flow channel are within the Oroville Facilities project boundary. 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 next 1.25 miles of the low flow channel, before it enters the OWA, are outside of the FERC project boundary. The FERC project boundary terminates about 5 miles downstream of the Thermalito afterbay outlet, at the southern end of the OWA.

Project Recreation Facilities at the Feather River

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 and is accessed from State Route 70, Grand Avenue, and Table Mountain Boulevard. Anadromous fish migration up the Feather River is stopped at the fish barrier dam where salmon climb the fish ladder into the hatchery and DFG selects fish for breeding. 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. Windows are also provided along the spawning building to allow visitors to watch the spawning process. A visitor observation area is provided at the gathering and holding tanks, and tours of the hatchery are offered to the public. Recreation and public use facilities on the north bank of the Feather River at the hatchery include a visitor area with a landscaped parking lot for 100 vehicles, two restrooms with flush toilets (ADA accessible), riverbank benches, drinking water, trash receptacles, a telephone, and an observation platform overlooking the fish barrier dam and its flow over the dam. ADA-accessible ramps provide access to the viewing platform, viewing window, and the gathering tank at the top of the fish ladder. For more information on the Feather River Fish Hatchery, see section 3.3.3, *Aquatic Resources*.

Day use of the east side of the fish barrier pool has recently been improved to include a pedestrian trail (Sewim Bo trail) and a day-use area adjacent to the Feather River Nature Center with picnic tables, sun shelters, and interpretive signs. One picnic site is ADA accessible with parking and an access route.

A few motorized and non-motorized boaters use the low flow channel. Few developed boat access facilities are provided, particularly at the upstream end where non-motorized boaters would most desire to launch. Non-motorized boats, however, are occasionally hand launched from the riverbank near the Feather River Fish Hatchery.

The Sewim Bo trail is a half-mile-long trail primarily used for hiking, but also used by equestrians and bicyclists, located in the vicinity of the Feather River Nature Center on the opposite side (eastern bank) of the Feather River from the Feather River Fish Hatchery and extending upstream to the Diversion dam. Much of this trail (and the Feather River Nature Center) is located outside the current project boundary. The trail was created in conjunction with the Feather River Nature Center in 2003 and 2004. The trail leads to the day-use area adjacent to the Feather River Nature Center; the day-use area is a project feature, the nature center is not.

Informal walking paths exist where visitors may access the Feather River from roadside parking areas. Paved (street) segments of the Brad B. Freeman trail are located near the east riverbank of the low flow channel from the OWA to the Thermalito Diversion dam, linking Riverbend Park and the Feather River Nature Center. Recreation facilities are listed in table 43 and shown on figure 18.

Trail and Trailheads

There are about 90 miles of non-motorized trails and 5 trailheads are distributed throughout the project boundary. Each trail is designated for one or more types of use (e.g., hiking, bicycling, equestrian use). The trail locations are shown on figure 19, and table 44 lists trail lengths, designated uses, and other pertinent information. About 52 miles of these trails are located in the Lake Oroville State Recreation Area, of which, 36 miles are located at Lake Oroville and 12 miles of the trails at Lake Oroville are accessible to persons with disabilities. Trails also provide access to project lands and waters at the Thermalito diversion pool, Thermalito Complex, and OWA.

Bicyclists using the Brad B. Freeman trail cross Oroville dam, travel along the north side of the Thermalito diversion pool and the north side of the North Thermalito forebay before crossing the Nelson Avenue Bridge and traveling along the east and south sides of the South Thermalito forebay, then wind around the Thermalito afterbay to and through the OWA and along the Feather River to the south side of the Thermalito diversion pool, and travel in an easterly direction back to the Oroville dam. On the south side of the Thermalito diversion pool near the spillway, there is a 1,700-foot section where the Dan Beebe trail and the Brad B. Freeman trail follow the same alignment. This section of trail is considered multiple use and is clearly marked as such at both ends of that trail section. Approximately 15 miles of the trail is paved. The Bidwell Canyon trail begins at the east end of the Saddle dam, which is located on the south arm of Lake Oroville, travels north through Bidwell Canyon to the Lake Oroville Visitor Center, and down to the southern end of the Oroville dam connecting to the Brad B. Freeman trail. Bicyclists may also use fire roads and designated trails at the Loafer Creek area. A fire road starts at the Saddle dam parking area, crosses the dam, and continues to the horse camp. Bicycles must stay on the gravel road to the main campground.

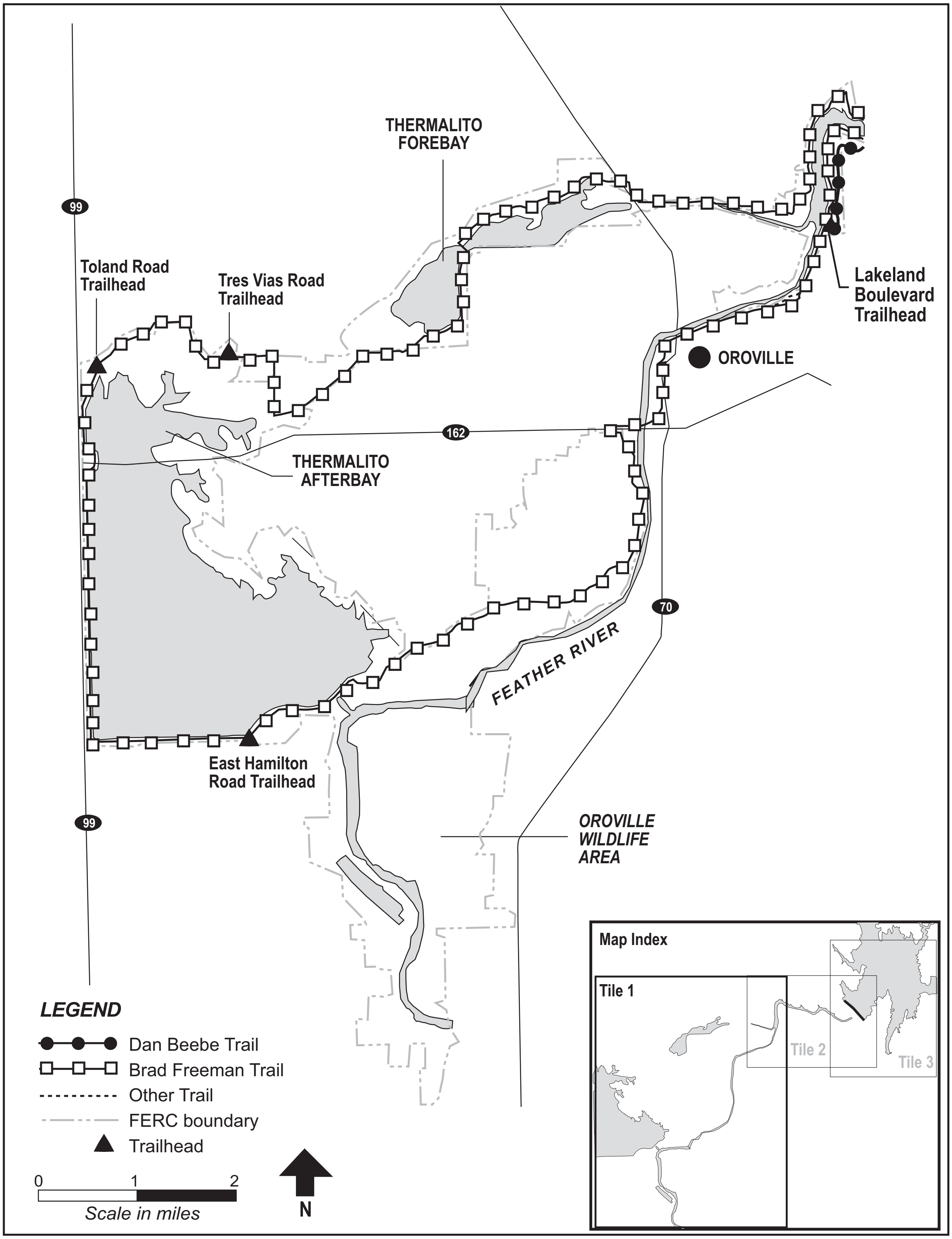


Figure 19. Lake Oroville trails. (Source: DWR, 2005a). Page 1 of 3

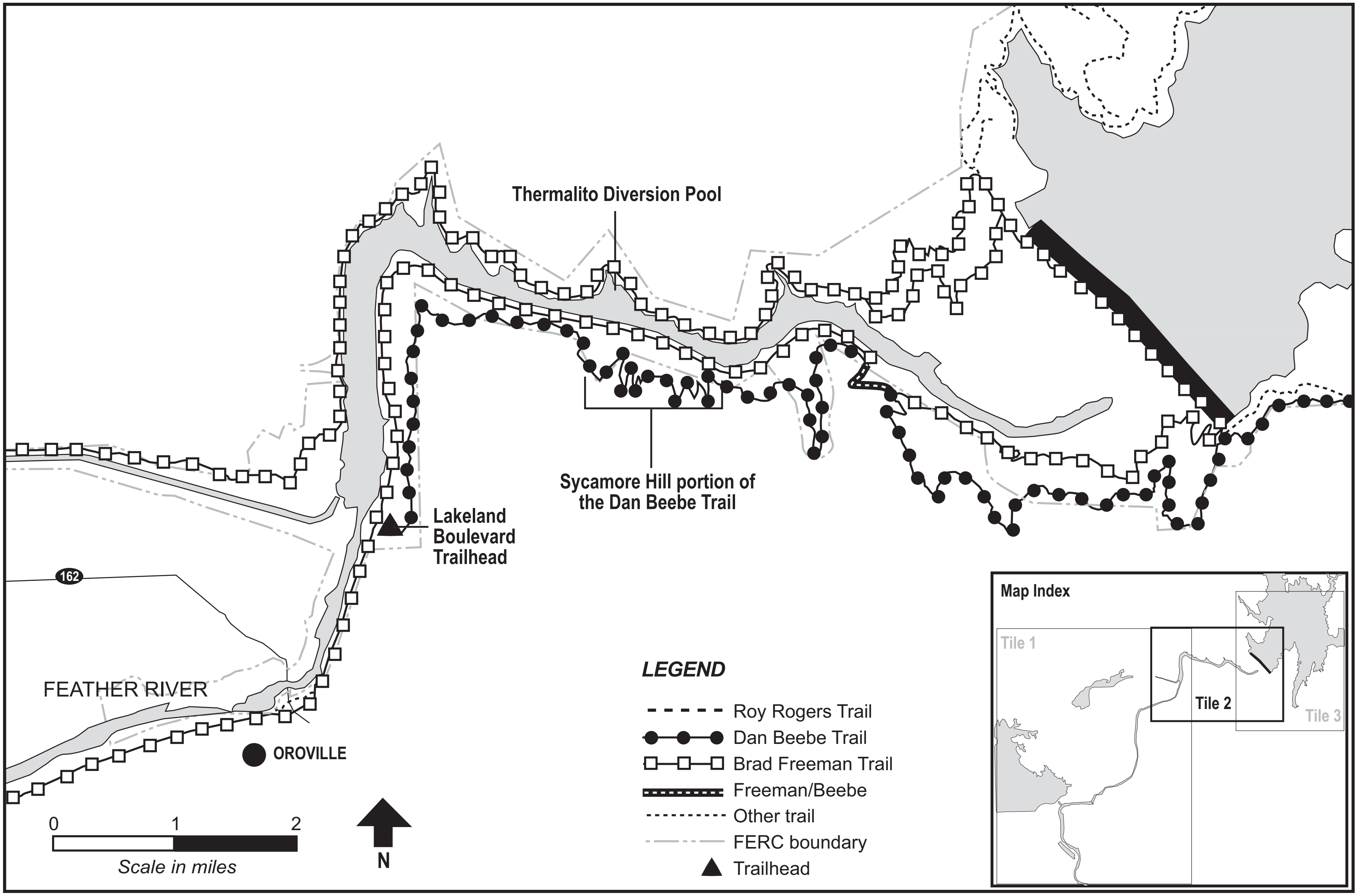


Figure 19. Lake Oroville trails. (Source: DWR, 2005a) Page 2 of 3

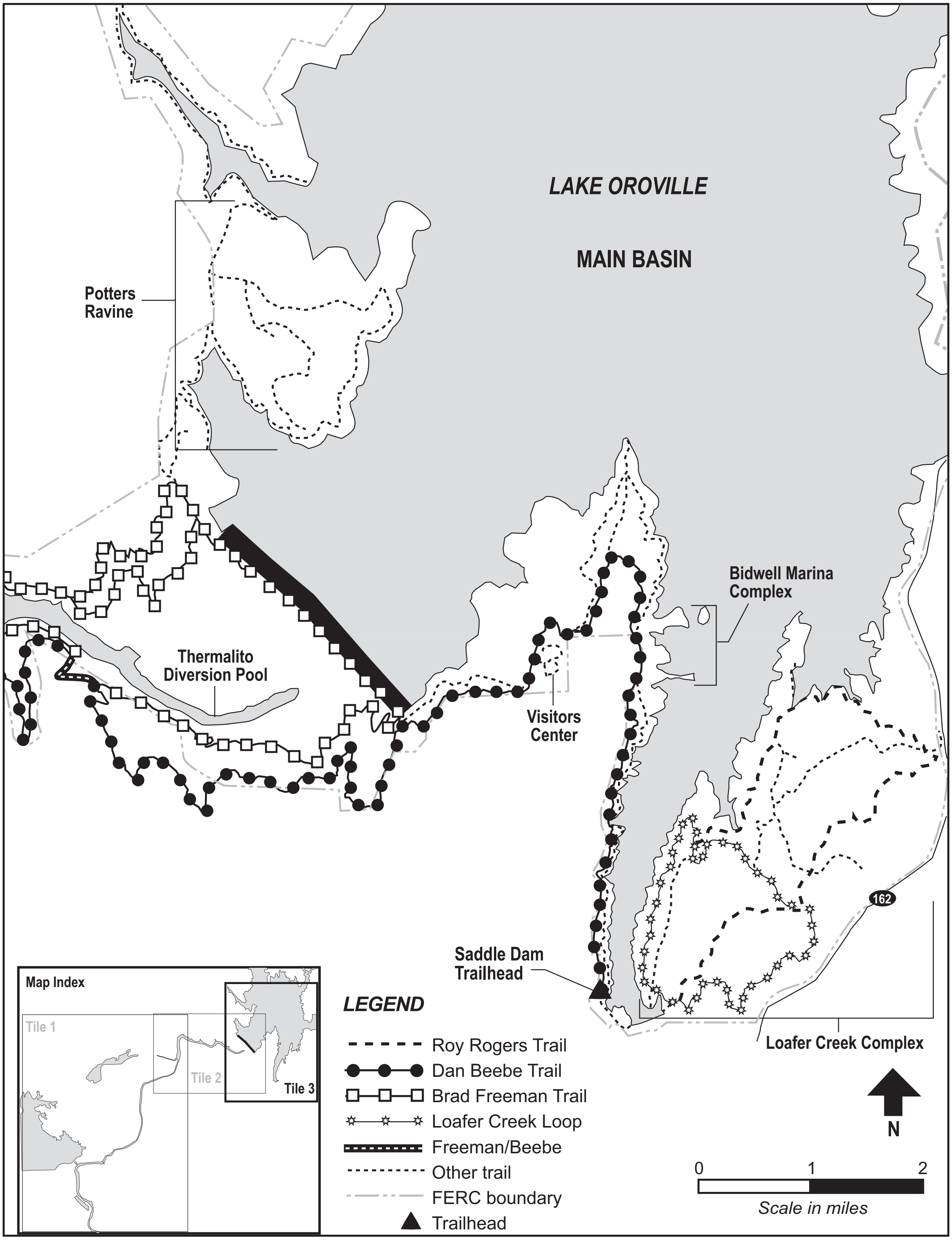


Figure 19. Lake Oroville trails. (Source: DWR, 2005a) Page 3 of 3

Table 44. Trails and trailheads at and near the Oroville Facilities. (Source: DWR, 2005a, appendix I, as modified by staff)

Name of Trailhead or Trail	Use: Miles of Trail	Use: Allowable Uses	Access: Vehicle and Vehicle/Trailer Parking Spaces	Health & Safety: Restrooms	Health & Safety: Trash Receptacles
Trailhead Access Sites					
East Hamilton Road trailhead access	--	--	About 5 vehicles	0	0
Toland Road trailhead access	--	--	Undesignated; about 10 vehicles	0	0
Tres Vias Road trailhead access	--	--	Undesignated; about 10 vehicles	0	0
Lakeland Boulevard trailhead access	--	--	Undesignated; about 30 vehicles, about 10 vehicle/trailers	1 (portable)	0
Saddle dam trailhead access	--	--	Undesignated; about 40 vehicles, about 15 vehicle/trailers	1	1
Trails					
Bidwell Canyon trail[h]	4.9	Bicycles, hiking	477[a]	2[a]	3[a]
Brad B. Freeman trail	44.7	Bicycles, hiking[b]	Various	--	--
Chaparral Interpretive trail	0.3	Pedestrian	107[c]	2[c]	6[c]
Dan Beebe trail	14.6	Equestrian, hiking	Various	--	--
Loafer Creek day-use/campground trail	1.6	Hiking only	251[d]	2[d]	2[d]
Loafer Creek loop trail	7.1	Equestrian, hiking[e]	251[f]	1[f]	11[f]
Sewim Bo trail	0.5	Multiple-use	25 (2 accessible)	0[i]	0[i]
OWA trails	Unknown	Multiple-use	Various	0	0
Potter's Ravine trail	10.0	Multiple-use	468[g]	2[g]	1[g]

Name of Trailhead or Trail	Use		Access	Health & Safety	
	Miles of Trail	Allowable Uses	Vehicle and Vehicle/Trailer Parking Spaces	Restrooms	Trash Receptacles
Roy Rogers trail	5.7	Equestrian, hiking[e]	251[d]	2[d]	2[d]
Wyk Island trail	0.7	Hiking only	477[a]	4[a]	3[a]

Note: -- — there is no facility or that the category does not apply.

[a] In the Bidwell Canyon area.

[b] Horses currently allowed on some segments, proposed for others.

[c] At the Lake Oroville Visitor Center.

[d] In the Loafer Creek day-use area.

[e] Portions proposed to be multiple-use.

[f] In the northern Loafer Creek area.

[g] At the Spillway area (upper parking area).

[h] Proposed to be multiple use (including equestrians).

[i] Facilities are provided at the Feather River Nature Center, which is outside of the project boundary.

Equestrians using the Dan Beebe trail may access the trail from the west at the Lakeland Boulevard trailhead, travel east along the south bank of the Thermalito diversion pool to the south of the Oroville dam, and then travel to Kelly Ridge point and south to the west side of Saddle dam. The Roy Rogers trail, originating to the east of Saddle dam, provides equestrians with a flat loop trail that passes by the Loafer Creek day-use area, the Loafer Creek group camping area, and many historical sites, including an old settler's cabin and the remains of an old water flume. Equestrians may also use the Loafer Creek Loop trail, which circumnavigates the Loafer Creek area passing the group campsites and the horse camp.

Recreational Use at the Oroville Facilities

Historical Use Levels

Official DPR estimates of visitation at the Lake Oroville State Recreation Area are available on a fiscal year basis (July through June) for the period 1974–1975 to 2000–2001. Lake Oroville State Recreation Area is 1 of 13 widely separated units in DPR's Northern Buttes District. The estimates represent a compilation of daily use data from various park units into monthly and fiscal year totals, and therefore are comparable to recreation day (which represents participation in recreation at a site during a single calendar day by one person for any length of time) estimates of current use. Lake Oroville State Recreation Area encompasses the majority of the land and waters within the project boundary and includes all of the Lake Oroville, Thermalito diversion pool, and Thermalito forebay recreation sites and surrounding lands and waters. The visitor use data also includes visitation at the Clay Pit State Vehicular Recreation Area since fiscal year 1996 to 1997. Historical visitation 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 visitation across the 27 years for which data are available was about 650,000 recreation days. Although considerable variation is seen in the data, for most years, total visitation to the Lake Oroville State Recreation Area was between 500,000 and 700,000 recreation days. Attendance peaked during fiscal year 1980 to 1981 at over 950,000 recreation days and was over 700,000 recreation days for several years around that time. The lowest attendance was recorded for fiscal year 1983 to 1984 with just over 320,000 recreation days. However, investigation of the very low attendance estimate for fiscal year 1983 to 1984, 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 fiscal year 1997 to 1998, and attendance was only slightly higher for fiscal year 1991 to 1992 with about 477,000 visits. Fiscal year 1991 to 1992 fell in the midst of a multi-year drought, which had severely reduced the water levels in Lake Oroville. Statistical modeling performed for the Projected Recreation Use Study 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 fiscal year 1997 to 1998.

2002–2003 Estimated Annual Use

The existing recreational use study estimated recreational use at the Oroville Facilities by site and divided use at each site by activity (DWR, 2004u). The following describes the total amount of use by each activity at each major geographic area within the project boundary according to the popularity of each activity. Estimates of use by activity were made based mainly on observational data;[73] professional

[73] Traffic counter data from 24 recreational sites, trail counter data from 10 locations and 651 spot counts were conducted at developed recreational facilities over the 1 year period on holidays, weekend, and weekdays during the recreational season and in the off-season.

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 was the most popular activity in the project boundary. At Lake Oroville, 45 percent or about 411,011 recreation days were reported as boating. Boating was also popular at the Thermalito afterbay, where 52,557 recreation days, or about 56 percent of use at the afterbay, was boating access. Boating was not as popular at the Thermalito forebay (10 percent of use/14,234 recreation days), at the Feather River or ponds within the OWA (8 percent of use/25,021 recreation days), or at the Thermalito diversion pool (4 percent of use/729 recreation days) as it was at Lake Oroville or the 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 Oroville Facilities. Bank angling was extremely popular in the OWA compared to the rest of the geographic areas within the project boundary. About 67 percent of the use within the OWA was estimated to be bank angling, equivalent to 213,709 recreation days. Almost one-quarter (24 percent) of use at the Thermalito forebay was estimated to be bank angling, equaling about 32,110 recreation days. About one-fifth of the use, or 4,371 recreation days, at the Thermalito diversion pool was estimated to be from bank angling. Bank angling accounted for less than 10 percent of total use at Lake Oroville (5 percent/48,145 recreation days) and at the Thermalito afterbay (4 percent/3,992 recreation days).

Trail Use—Use of specific trail segments by number of people and trail use at trailheads were estimated by DWR. Data were collected using infrared trail counters and DWR, in some cases, used professional judgment to adjust these data. The report states there was not enough data to determine the proportional use attributed to different types of trail use (e.g., bicycling, equestrian, hiking). DWR reports some data collection methods and equipment provided incomplete or inaccurate data, resulting in compromised accuracy and reliability. Some of the circumstances DWR encountered included: (1) August 2002 data included only 8 days of data; (2) trail counters were relocated because of vandalism and theft; (3) some of the recorded use could have been attributed to animals where specific conditions required installing instruments close to the ground; and (4) some recorded use could have been attributed to shoreline campers and boaters rather than trail users. DWR also reports that they assumed all trailhead use was attributable to trail use even though some visitors also engaged in other activities such as fishing or picnicking.

In addition, during the study period 2002 to 2003, some trails were designated for uses that were not consistent with the approved project recreation plan. DPR changed some of the trail designations from hiking and equestrian-use only or hiking and bicycle-use only to multiple-use on March 1, 2002. Consequently, the trail use data was collected under different conditions than what is allowed under the project recreation plan and what currently exists on the ground. In 2003, DWR filed a request to amend its approved project recreation plan to reflect the modified trail use designations. The Commission received hundreds of letters from recreational trail users, some opposed to and other supportive of the trail use modifications. In an order issued August 17, 2004, the Commission denied DWR's request and this action returned the trails to their original designations. Generally, DWR characterized the trail use in the study area as relatively low. 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 5 people per hour, a relatively low level of use as compared to other activities. 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 recreation days) and the Thermalito afterbay (891 recreation days). However at the Thermalito diversion pool, half of the use was estimated to be from trail use (10,403 recreation days). Trail use accounted for about 3 percent of total recreation days within the Oroville Facilities.

General Day Use—DWR estimated the levels of use attributed to three general day-use activities including picnicking, sightseeing, and swimming. Sightseeing was the second-most popular activity within the Oroville Facilities, 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 attributed to general day-use activities (160,395 recreation days). General day-use activities were also very popular at the Thermalito forebay, where 62 percent of total use, or 85,034 recreation days, accounted for these activities, owing in part to the very popular swimming lagoon at the North Thermalito Forebay day-use area. This lagoon is one of the only two formally designated swimming areas within the FERC project boundary. Over one-third of the use at Lake Oroville (36 percent/ 328,109 recreation days) and the Thermalito afterbay (38 percent/35,928 recreation days) was attributed to picnicking, sightseeing, and swimming. One-quarter of total use, or 5,100 recreation days, at the Thermalito diversion pool consisted of these three activities. At the OWA, 22 percent of total use was estimated to be from these general day-use activities, equivalent to 70,866 recreation days.

Camping and Other Overnight Use—Camping primarily occurs at Lake Oroville, where all of the developed campgrounds are located. Only 7 percent of the total use at Lake Oroville was estimated to be from camping, equivalent to about 62,300 recreation days. There was also low use of the en-route RV camping at the North Thermalito Forebay day-use area (39 recreation days) and the Spillway day-use area (91 recreation days, included in Lake Oroville total). Overall, camping was the sixth most popular activity at the Oroville Facilities, accounting for 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 at the Oroville Facilities occurs in the OWA, including the Thermalito afterbay portion of the OWA. Hunting access at these areas occurs at three main locations: the west and east levee roads in the south portion of the OWA, and at the three trailheads near the Thermalito afterbay, including the South Wilbur Road trailhead, the Toland Road trailhead, and the Tres Vias Road trailhead. Hunting accounted for 27 percent, or 4,995 recreation days, of total use at these trailheads. Within the OWA, hunting only accounted for 3 percent of total use, or 8,866 recreation days. 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 the Lake Oroville State Recreation Area away from developed recreational areas. However, DWR reports that the level of hunting activity is low there because not much land is available for hunting within the generally narrow band of the Lake Oroville State Recreation Area surrounding the lake. Most hunting likely occurs on adjacent public and private land.

Walking use tends mostly to occur at the Oroville dam overlook day-use area and North Thermalito Forebay day-use area. Because of 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, and bicycle. There were an estimated 56,930 recreation days associated with walking, jogging, and bicycling across the dam. At the North Thermalito Forebay day-use area, 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 recreation days from walkers at the North Thermalito Forebay day-use area.

Oroville Facilities Visitor and Visit Characteristics

Most visitors to the Oroville Facilities are regular visitors to the area (three or more visits per year) and most visit during the spring and fall, as well as summer. Greater than 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 camping facilities are located, were fairly evenly divided between day and overnight users. In contrast, 60 to 90 percent of visitors to other parts of the Oroville Facilities were day users. Most overnight visitors stayed 2 or 3 days, and most stayed in campgrounds or with family and/or friends. Nearly 90 percent of visitors from Butte County and the adjacent counties were day users, with visits averaging 4 to 6 hours in length, while most visitors from more distant locations were overnight visitors. About one-quarter of visitors surveyed at Lake Oroville also planned to visit other portions of the Oroville Facilities, and about 30 to 45 percent of visitors to most downstream areas planned to visit Lake Oroville sites.

Group sizes at most areas averaged 2 to 4 people. Large groups were more common at the 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 Oroville Facilities, while fishing opportunities were the predominant reason among OWA visitors. Oroville Facilities 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 the Thermalito diversion pool and the Feather River, were trail walking/hiking, biking, and horseback riding. Sightseeing, picnicking, and general relaxing were also important at many areas.

Existing Recreation Capacity

Boating—Results of the Reservoir Boating Study 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 (DWR, 2004v). Study results also determined that the typical length of time boaters wait to use the ramps is not excessive, although waits of 20 to 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, averaging about 9 minutes in length. Corresponding with these conditions, boaters' perceptions of crowding and conflict problems on the project reservoirs were 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 recreational 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 insufficient marina parking at Bidwell Canyon Marina, where marina boaters park their vehicles in parking spaces for vehicles with boat trailers in the boat ramp parking lot. This problem is particularly acute when reservoir pool levels are high as 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 three 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 those with boats moored at the marina. As observed at Bidwell Canyon, parking spaces for vehicles with trailers 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 before the entrance kiosk.

Camping—Average of campgrounds during summer recreational season weekends, the peak use period,[74] generally was not high during the relicensing study period, averaging about 50 to 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 below 35 percent during the summer recreational season. Equestrian campground occupancy was higher during the spring and fall, when trail riding conditions were more favorable. Occupancy at 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 at the Oroville Facilities was generally moderate, and crowding problems were not found. However, use of the largest day-use area on Lake Oroville, the Loafer Creek day-use area, was greatly reduced during the study period by low reservoir water levels. Use of the North Thermalito Forebay day-use area, the largest such facility at the Oroville Facilities, exceeded parking capacity only occasionally during peak holiday periods, which included Memorial Day, Independence Day, and Labor Day weekends.

Angling—Boating activity on Lake Oroville is generally low during the off-season,[75] which is the period when most angling occurs. Anglers on the project reservoirs had few complaints about crowding; however, bank and boat anglers in the OWA and on the 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—DWR reports that most of the trail use 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 their perceptions of crowding were very low.

Visitors' Experience, Perceptions, and Preferences

Lake Oroville State Recreation Area

DWR conducted visitor surveys for a 1-year period (2002–2003) to investigate visitor experiences, perceptions, and preferences by collecting 2,583 onsite surveys and 1,071 mail-back surveys. Lake Oroville State Recreation Area visitors indicated they were satisfied with their overall recreational 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 recreational sites, about 67 percent of the visitors to the Thermalito forebay, 70 percent of the visitors to Lake Oroville, and over 90 percent of the visitors to the Thermalito diversion pool rated their perception of crowding between "not at all crowded" to "slightly crowded."

Boating—In general, the recreational surveys indicated that boaters enjoy a high level of satisfaction with their boating experiences in the Lake Oroville State Recreation Area, with about 74 percent stating that 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 and/or conflicts between boaters was more than a slight

[74] The peak use period is on Friday and Saturday nights from May 15 until September 15.

[75] The off-season is from September 16 until May 14.

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. 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 boarding 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, Lake Oroville State Recreation Area 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 Thermalito diversion pool anglers stated that 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 of anglers at the Thermalito forebay, 76 percent of anglers at Lake Oroville, and 100 percent of anglers at the Thermalito diversion pool considering these areas to be not at all crowded to slightly crowded. The majority of Lake Oroville State Recreation Area visitors felt the number of fish cleaning stations was adequate, except at the Thermalito diversion pool.

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. Approximately 66 percent of visitors to Lake Oroville, approximately 63 percent of visitors to Thermalito diversion pool, and approximately 74 percent of visitors to the Thermalito forebay considered the number of paved and unpaved bike trails, hiking trails, and equestrian trails to be adequate. However, at the Thermalito diversion pool, only 54 percent of trail users believed that the number of equestrian trails was adequate while 43 percent thought that there were too few. About 40 percent of trail users at Lake Oroville and the Thermalito diversion pool felt the number of signs indicating trail locations was too few.

Hiking and walking were the most popular trail use of visitors to the Lake Oroville State Recreation Area except at the Thermalito diversion pool, where the overwhelming use was equestrian. Table 45 shows the primary types of trail use by visitors to the Lake Oroville State Recreation Area.

Table 45. Primary types of trail use by visitors to the Lake Oroville State Recreation Area.

Trail Use Type	Lake Oroville (%)	Thermalito Diversion Pool (%)	Low Flow Channel (%)	Thermalito Forebay (%)
Hiking/walking	69.9	14.8	68.1	74.4
Equestrian	15.2	64.8	5.3	0.8
Bicycle	11.3	20.4	25.5	18.4
Other	1.8	0	1.1	4
Multiple types	1.8	0	0	2.4

In general, few Lake Oroville State Recreation Area trail users (6 to 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 bicycle 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. Related to this is the finding that from one-half to two-thirds of Lake Oroville and Thermalito diversion pool visitors felt the number of swim areas and developed day use or picnic areas along the 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 providing these types of shoreline developments at Lake Oroville.

An additional issue related to swimming involved water quality at the popular swim beach at the North Thermalito Forebay day-use area. Water quality testing done for environmental technical studies indicated that bacteria levels were elevated during both seasonal peak recreational activity and non-recreational periods when numerous waterfowl were present, indicating that both humans and waterfowl may be sources of contamination.

In regard to other types of day-use facilities, the majority of Lake Oroville State Recreation Area visitors felt the number of group picnic sites, equestrian facilities, and restrooms was adequate.

Oroville Wildlife Area

Most OWA visitors indicated they were satisfied with their overall recreational experience. About 64 percent of OWA visitors and 69 percent of visitors to the afterbay indicated they were satisfied, very satisfied, or extremely satisfied with their trip to the area. Regarding crowding at recreational sites, about 67 percent of Thermalito afterbay visitors rated their perception of crowding between not at all crowded and 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.

Areawide Issues—Three issues appear to be affecting recreational 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 washboarded 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, the level of recreational 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 Lake Oroville State Recreation Area, 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 nonexistent 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 the Monument Hill day-use area), 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. Those surveyed believe that the invasion of exotic weeds in many of the ponds used for waterfowl hunting is 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 said there are too few interpretive programs and educational opportunities.

Boating on Thermalito Afterbay—Use of powerboats and personal watercraft at speeds greater than 5 miles per hour is 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 personal watercraft riders, have been constructed in recent years and a water-ski slalom course was installed. Essentially, boating speeds are not enforced on the 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.

Feather River

The following discussion on the Feather River is limited to sites on the low flow channel portion of the river, upstream of the OWA. Other Feather River sites are included within the OWA discussion because all of the recreational 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 recreational 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 recreational sites, about 76 percent of visitors said they were "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 recreational 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 said there were not enough restrooms. 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 Issues

DWR identified a few issues pertinent to recreation across the entire Oroville Facilities. One issue identified by DWR is the need for a comprehensive trails plan to resolve issues around multiple use of trails and trail safety, as well as issues surrounding needs for trail expansion, trail maintenance, development of more loop trails, and the potential for specially designed, single-track mountain bike trails. In addition, DWR 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.

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 Feather River Recreation and Parks District 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 or more frequent basis 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 completely or partially within the Oroville Facilities project boundary. Specific interest has been identified in new or enhanced facilities to support these and other events.

3.3.6.2 Environmental Effects

Recreation Management Plan (Proposed Article A127)

Under Proposed Article A127, *Recreation Management Plan*, DWR would implement, upon license issuance, the Settlement Agreement Recreation Management Plan dated March 2006 to guide and facilitate existing and future recreational resource management associated with the Oroville Facilities.

DWR developed an earlier version (2005) of the Recreation Management Plan in consultation with the Recreation and Socioeconomics Work Group and other stakeholders. The Recreation and Socioeconomics Work Group included representatives of federal and state agencies, Butte County, the City of Oroville, the City of Paradise, local residents and landowners, and other resource and recreation stakeholders. Settlement negotiations resulted in DWR's March 2006 version of the Recreation Management Plan. The six programs identified in the Recreation Management Plan are designed to comply with 18 CFR 4.51(f)(5) which outlines Recreation Management Plan requirements for FERC hydro projects. These programs include: (1) Recreation Facility Development Program, (2) Recreation O&M Program, (3) Recreation Monitoring Program, (4) Resource Integration and Coordination Program, (5) Review and Revision Program, and (6) Interpretation and Education (I&E) program.

Proposed Article A127 is consistent with Interior's section 10(a) recommendation no. 4 and a DFG 10(a) recommendation. In their motions to intervene, American Rivers, American Whitewater, and Chico Paddleheads state that they support the Settlement Agreement measures. Further, we note that representatives of several recreation-related organizations[76] also signed the Settlement Agreement indicating their support for the Recreation Management Plan.

Our analysis of Proposed Article A127, *Recreation Management Plan*, is presented in two sections: (1) an evaluation of the 6 Recreation Management Plan programs relative to the Commission's regulations pertaining to project recreation management plans (18CFR4.51(f)(5)), and (2) an evaluation of the need for individual developments or programs included in the Recreation Management Plan.

Recreation Management Plan Programs

Recreation Facility Development Program—This program identifies new recreational facilities, modifications to existing facilities (e.g., extended boat ramps) and would provide for reconstructing all recreational facilities to meet existing and future recreational facility needs identified in the project area. DWR would upgrade existing recreational facilities and construct new recreational facilities, based on demonstrated need and associated monitoring results. The Recreation Management Plan identifies: (1) proposed recreational facility developments and upgrades in the project area, (2) locations and conceptual layouts of the proposed recreational facilities or use area improvements, (3) recreational facility design guidelines and approval process, (4) how DWR would bring recreational facilities into ADA compliance, (5) a commitment to complete necessary environmental review (e.g., NEPA, California Environmental Quality Act [CEQA]) and secure any necessary permits, (6) an agency and public review process for planned recreational development, and (7) DWR's responsibility for facility construction, coordination, and scheduling along with an explanation of the five 10-year phases that would be used to plan recreational improvements. DWR would implement several recreational improvements in the first 10 years following license issuance to address immediate needs. As described below under *Individual Recreation Developments and Programs,* DWR proposed improvements at 11 sites at Lake Oroville, 3 sites at the Thermalito diversion pool, 2 sites at the Thermalito forebay, and 5 sites at the OWA, which includes the Thermalito afterbay. Additional improvements would be implemented in phases based on ongoing monitoring results and demonstrated needs.

In its comments on the settlement agreement filed with the Commission on April 26, 2006, Butte County recommends that DWR develop standards providing that management options other than construction of new facilities would only be pursued if there is a lack of space available for new facilities or if construction of new facilities would result in significant adverse environmental effects.

---

[76] California State Horsemen's Association; California State Horsemen's Association, Region II; Citizens for Fair and Equitable Recreation; Feather River Recreation and Parks District; International Mountain Bicycling Association; Lake Oroville Bicyclist Organization; Oroville Parks Commission; and Oroville Recreation Advisory Committee.

In its motion to intervene filed with the Commission on March 30, 2006, Butte County points out that DWR does not propose any new facilities in several locations and only proposes modest facility expansions in other locations. Butte County acknowledges that these are useful improvements but insufficient to meet future demand. Butte County also asserts that existing recreational facilities would be degraded by overuse and overcrowding. Butte County recommends that DWR: (1) provide reasonable swimming facilities at the project, (2) develop water skiing facilities, and (3) consider the feasibility and socioeconomic effects of a whitewater park to offset the loss of whitewater opportunities at the project due to development of the project.

In its motion to intervene filed with the Commission on December 16, 2005, the Anglers Committee et al. recommend that DWR: (1) develop a plan to provide sandy beaches at the Oroville Facilities campgrounds located adjacent to a reservoir to address public safety and provide obstacle-free wading opportunities; (2) prepare a plan addressing accessibility pursuant to the ADA for all public facilities at the Oroville Facilities; (3) make all public facilities accessible, including restrooms, campgrounds, day-use areas, parking areas, boat ramps, and boat piers; (4) maintain an ADA-compliant daily shuttle service at the Lime Saddle marina and Spillway boat ramps (i.e., service between the parking areas and ramps); (5) prepare a detailed recreation plan addressing short-term and long-term recreation planning needs and submit it to the Commission; and (6) comply with the needs of the community of Oroville when funding recreational facilities in the future.

In its May 26, 2006, filing with the Commission, DWR points out that the Recreation Management Plan provides for additional beach and swim area improvements. DWR also states that the Recreation Management Plan incorporates ADA-compliance measures into the improvement and expansion of recreational facilities, including its proposal to upgrade several trails to meet ADA-accessibility standards for slope and surface, which would result in approximately 12 miles of ADA accessible trails within the project boundary. DWR points out that all new facility construction proposed in the Recreation Management Plan would comply with the ADA.

Staff Analysis

Numerous existing recreational facilities at the project provide for day and overnight recreational use. DWR's studies indicate the need for additional facilities, necessary upgrades to existing facilities, and the eventual replacement of both new and existing facilities at the end of their useful lives during the term of the license. All of the facility improvements identified in the Recreation Management Plan are within the project boundary or provide access to recreational opportunities that are within the project boundary. DWR identified proposed developments in the Recreation Management Plan in consultation with a number of appropriate parties as a part of settlement discussions.

DWR's implementation schedule is presented in five 10-year planning cycles. The first 10-year cycle targets high-priority needs, including ecological and safety concerns, insufficient recreational site capacity, ADA needs, and distribution of access sites around the reservoir shorelines. The schedule does not indicate when improvements would be scheduled within the first 10-year planning period; however, DWR would provide this schedule within 1 year of license issuance. Reviewing the list of proposed improvements (see the following section, *Individual Recreation Developments and Programs*), it appears that addressing the most immediate recreational and ecological needs would be achieved within 10 years of license issuance.

We note that under the Proposed Action, all recreational facilities would not be ADA compliant until 10 years after license issuance.[77] Although this may seem like a long time, this is a reasonable time frame for two reasons. First, the major recreational complexes at Lime Saddle, Loafer Creek, and Bidwell Canyon, which constitute the majority of the developed capacity, have accessible facilities. Accordingly, accessible recreational facilities are generally available at the project at this time. Second, waiting to implement ADA upgrades until a particular facility is remodeled or reconstructed is consistent within the ADA guidelines. DWR commits to a public and agency review process for recreational development and to follow ADA guidelines in the design of recreational developments. These two components of the Recreation Management Plan would ensure new accessible opportunities are identified and that facilities would be built to ADA standards. The number of accessible recreational facilities at the project would gradually increase over the course of 10 years as new facilities are built and existing sites are remodeled. In this manner, the Proposed Action would address the recommendations of the Anglers Committee et al. and provide accessible recreational facilities.

As described below in *Individual Recreation Developments and Programs*, DWR proposes additional swimming facilities throughout the project area. DWR would conduct a swimming and day-use feasibility study at Lime Saddle and at Loafer Creek to address the need for additional swimming opportunities at Lake Oroville; the Loafer Creek area has priority over other sites to provide a new swimming venue. At the Thermalito forebay, DWR would improve the swimming areas at both the north and south forebay day-use areas. At Thermalito afterbay, DWR would designate a swimming area at the Larkin Road boat launch. As such, DWR's would accommodate Butte County's recommendation. Sandy beaches are currently provided at the Loafer Creek, North Thermalito forebay, and Monument Hill day-use areas. DWR is investigating additional swimming opportunities at Lake Oroville and proposes to provide sand at the South Thermalito forebay day-use area and the Larkin Road boat launch. It may not be possible to place sand along the Lake Oroville shoreline because it has steep slopes. Nevertheless, the Proposed Action would sufficiently investigate options for locating and providing new swimming opportunities.

Boating, including boat fishing, personal watercraft use, motorboating, houseboating, and water skiing, was the most popular activity identified at the project. Boat launches provide adequate public access for these activities; however, providing a water-ski course, as Butte County recommends, would not be necessary for visitors to water ski on the reservoir. We do not find that the need for this facility corresponds to any identified issue or concern regarding public access or recreational use related to the project.

Recommendations from Butte County regarding whitewater boating in the Feather River relate to the effects of the original project construction. It would not be appropriate to consider these recommendations because the existing project serves as the environmental baseline and the Commission does not require mitigation for original project development. However, we note that Butte County's recommendation may be addressed by implementation of Measure B101, *Feather River Whitewater Boating Opportunity Feasibility Study,* in appendix B of the Settlement Agreement (DWR, 2006a). DWR would initiate and fund a whitewater boating opportunity and recreation feasibility study to assist the Fund Steering Committee of the Supplemental Benefits Fund in determining whether to fund the construction and operation of such a project, or to cost share on such a project somewhere in the region, pursuant to their funding criteria.

[77] Section 2.7(b) of the Commission's regulations requires a project licensee to consider the needs of the physically disabled in the design and construction of public recreational facilities on project lands and waters, including public access to such facilities. Although the Commission has no statutory role in implementing or enforcing the ADA as it applies to its licenses, we reviewed DWR's approach to ADA compliance to disclose the effects of the proposed action on accessibility.

Currently, the developed recreational facilities appear to have adequate capacity. Survey results show that visitors do not feel crowded during their visit and that they believe the existing facilities are adequate. Although the maximum occupancy is reached at some facilities on holidays and peak weekends, this is typically the case at most recreational facilities in California during the summer and is not unique to this project. At all other times, the existing occupancy rates indicate the recreational facilities have capacity for additional future use. Even though the existing facilities can absorb some increased use, DWR's proposed improvements within the first 10 years of license issuance include additional capacity for overnight and day use. We find that this additional capacity would provide certainty that future demand would be met throughout the licensing period. DWR would provide identified additional facilities based on monitoring results, ensuring that DWR provides such improvements necessary for public use.

The Proposed Action includes developing a schedule for recreational developments over the first 10 years of the project and the Recreation Management Plan lays out potential developments for 50 years, consistent with the recommendation of the Anglers Committee et al.

DWR proposes to conduct periodic workshops to update the community on the progress of projects associated with the project license. The purpose would be to inform the community on the progress of projects associated with license requirements, reservoir conditions, operations, and other issues related to implementation of the Recreation Management Plan. Interested citizens and members of the public would be encouraged to discuss recreation-related items and issues during these meetings. In addition to the general public, representatives of Butte County, City of Oroville, and other affected cities, local agencies, and non-governmental organizations (NGOs) would be invited to participate. This opportunity for community participation would meet the needs identified in the recommendation of the Anglers Committee et al.

Recreation Operations and Maintenance Program—DWR would allocate most of the day-to-day recreational facility management responsibility for most sites within the project boundary to DPR under the terms of a new Memorandum of Agreement.[78] DWR recognizes that it retains ultimate responsibility for compliance with all license terms and conditions and states that DPR's authority would be consistent with its responsibilities described in the California Public Resources Code. We interpret this to mean that DWR intends to provide sufficient O&M funding to DPR to adequately manage the facilities, even though this is not expressly stated in the Recreation Management Plan. Recreational facility O&M would include: (1) providing ongoing O&M of recreational facilities appropriate to the level of development, density of visitor use, resource protection needs, and recreational activity, (2) providing reasonable and safe public access to the project shoreline (at elevations between 900 and 640 feet msl), (3) providing adequate visitor public health and safety on project lands and waters by working with DPR, DFG, California Highway Patrol, Butte County Sheriff's Office and/or City of Oroville police, as appropriate, and (4) charging appropriate recreational user fees at DPR-managed recreational sites within the project boundary to partially offset ongoing O&M costs and new facility upgrade costs at these sites. DWR would review and assess fees consistent with day-use and camping fees at other, comparable units of the State Park System.

In its comments on the Settlement Agreement, filed with the Commission on April 26, 2006, Butte County expresses its concerns with the current user fees at Lake Oroville. Butte County points out that a season pass for annual boat-launching privileges on Lake Oroville for the 2006 recreation season costs $200, while a similar pass at Lake Shasta costs $60 to $80. Butte County suggests that DWR consider the benefits it derives from the project when calculating user fees on project lands.

[78] DWR proposes finalizing the new MOU between it and DPR following issuance of a new license for the Oroville Facilities. DWR proposes appending the new MOU to its final Recreation Management Plan.

In its motion to intervene filed with the Commission on December 16, 2005, the Anglers Committee et al. state that the fees charged by DWR to launch boats into Lake Oroville are illegal and inconsistent with the public trust policy of the State of California. The Anglers Committee et al. recommend that DWR provide free public access to the boat launches at the Spillway and Lime Saddle day-use areas. The Anglers Committee et al. recommend that if DWR continues to charge launch fees to boaters, it should hold annual public meetings to develop and finalize the boating fee schedule and that the fees should be approved by the Commission. The Anglers Committee et al. recommend that any documents supporting DWR's fee schedule at the Spillway and Lime Saddle boat launches should be provided to the public.

In its May 26, 2006, filing with the Commission, DWR states that the Commission's regulations allow licensees to charge reasonable fees for recreation without the necessity of Commission approval of such fees and that this practice has been upheld by the U.S. Court of Appeals. DWR also states that the public trust policy of the State of California does not preclude the assessment or collection of such fees. DWR points out that it provides free access to the boat launches at the Thermalito afterbay and other areas of the OWA, including the Feather River, and to unimproved parts of Lake Oroville. DWR explains that while it does require fees in other areas at the Oroville Facilities, the fees are commensurate with those charged at comparable state-owned recreational facilities such as other units of the state park system. DWR further explains that DPR establishes fees at state recreational areas, usually within a prescribed range commensurate with the facilities and services provided and that the fees charged at the Lake Oroville State Recreation Area are at or near the lower end of this statewide range for virtually all facilities and services. DWR states that the fees are non-discriminatory and apply to all residents of California and visitors, but that discounts are available for senior citizens and the disabled.

In the same filing, DWR also points out that DWR and DPR have already implemented enhanced debris removal at the Lake Oroville State Recreation Area in response to debris removal concerns expressed during the relicensing meetings. DWR also states that the Recreation Management Plan provides for the heightened effort of debris removal to continue throughout the term of the new license.

In appendix A of its comments on the draft EIS, DWR points out that the annual pass for parking and launching at Lake Oroville now costs $165, not $200 as stated by Butte County. DWR also notes that an annual pass for parking and launching at Lake Oroville may also be used for parking and launching at about 95 other state parks. We also checked the website providing information on Shasta Lake (www.shastalake.com) and found that an annual pass for accessing boat launching facilities there costs $65 if purchased between January 1 and March 1 and $90 from March 1 until December 31; the pass is good for the calendar year and expires on December 31. Infrequent or one-time visitors to Lake Shasta also need not pay an annual fee but may pay a one time fee of $8 for parking and launching. Additional fees for camping are charged at both Lake Oroville and Shasta Lake.

In its motion to intervene, the Anglers Committee et al. also assert that DWR has a duty and responsibility to protect boaters from navigation and public safety problems, such as floating debris, at Lake Oroville. They recommend that DWR prepare and implement a management plan for removing dangerous debris from the reservoir and that DWR be held liable for harm and damage to private boats and equipment by securing a bond of $1 billion or a feasible amount for the entire recreation season.

In the May 26, 2006, filing, DWR also points out that DWR and DPR have already implemented enhanced debris removal at the Lake Oroville State Recreation Area in response to debris removal concerns expressed during the relicensing meetings. DWR also states that the Recreation Management Plan provides for the heightened effort of debris removal to continue throughout the term of the new license.

Staff Analysis

Ongoing and adequate O&M of existing and future recreational facilities are critical to visitor enjoyment and effective recreation resource management. A continued partnership between DWR and DPR for O&M of project recreational facilities would be beneficial for a number of reasons. As the manager of the Lake Oroville State Recreation Area, DPR is the primary provider of recreational opportunities and facilities within the Oroville Facilities. DPR's core programs, linked directly to the agency's mission, include resource protection; education and interpretation; facilities; public safety; and recreation. DPR staff monitors visitation; cleans and maintains restrooms; services trash receptacles; maintains campgrounds, day-use areas, boat ramps, courtesy docks, and trails; monitors and maintains buoys and vessels; and maintains recreational area grounds and landscaping. DPR is also responsible for carrying out boat safety inspections and providing safety patrols at Lake Oroville. DPR also maintains approximately 21 miles of road, all project utilities (including electrical, water, and wastewater facilities), and provides capital improvements at all recreational facilities. DPR annually hires additional seasonal support staff in the summer to operate entrance stations and carry out basic facility maintenance tasks. DWR currently works with DPR to remove floating debris on Lake Oroville, thus addressing the concerns of the Anglers Committee et al. We do not consider whether DWR should be required to secure a bond for liability because they would remove debris from the reservoir surface, and they should not be accountable for the actions of potentially irresponsible boaters.

The Commission's regulations (18 CFR §2.7) state that the "Commission will not object to licensees and operators of recreational facilities within the boundaries of a project, charging reasonable fees to users of such facilities in order to help defray the cost of constructing, operating, and maintaining such facilities." DPR staff collects entrance fees and camping fees at some of the facilities within the Lake Oroville area. User fees collected by DPR are used by the agency to offset the cost of operating recreational facilities at the Oroville Facilities, including boat launching, day-use and camping fees. DWR's current practices related to charging user fees (indirectly collected through DPR) are consistent with this regulation and are comparable to the practices at other Commission-licensed projects, such as Lake Shasta.

Recreation Monitoring Program—The Recreation Monitoring Program would include using: (1) management units as a monitoring framework for assessing conditions in more discrete geographical areas, rather than just at a reservoir-wide or project-wide level, (2) monitoring indicators and standards specific to each of the management units and at selected sites, and (3) program components, such as methods and tools, monitoring frequency, reporting requirements, and decision-making logistics.

DWR would prepare periodic assessment reports for each management unit per FERC Form 80 reporting requirements, which would document data collection and statistical methods used to analyze monitoring data, success of developed recreation visitor management efforts, recreational facility use levels and counts, trends in recreational facility use, and projected needs based on monitoring indicators and standards. DWR proposes to prepare the FERC Form 80 report in consultation with the Recreation Advisory Committee and submit it to the Commission every 6 years after license acceptance.

In its comments on the settlement agreement filed April 26, 2006, Butte County recommends that DWR conduct comprehensive recreational use surveys every 5 years beginning October 1, 2007. Butte County recommends that DWR develop a plan for conducting recreational use surveys in consultation with the Recreation Advisory Committee, and that in its surveys, DWR use a sample size twice the size as the one used in its 2002–2003 recreational surveys. Butte County also contends that even though the description of monitoring protocols and standards (triggers) is comprehensive and the carrying capacity standards are well defined, the monitoring and trigger provisions are vague, providing so many management options that it seems highly unlikely that new facilities would be built when existing recreational facilities become overcrowded.

In its May 26, 2006, filing with the Commission, DWR states that Butte County makes an unfounded claim that the recreational monitoring proposed in the Recreation Management Plan is inadequate. DWR further states that the monitoring program proposed in the Recreation Management Plan is a comprehensive program with an interactive approach to decision-making that incorporates feedback mechanisms to evaluate actions and incorporate new information as it becomes available. DWR points out that implementation plans at new or expanded recreational facilities would be further developed by DWR and DPR, based on the results of periodic monitoring and identified recreational needs.

Staff Analysis

The proposed monitoring plan provides methodology, opportunities for public and agency review and recommendations, and regular reporting to interested parties as well as the Commission. This program includes sufficient detail to adequately assess the recreational facilities, the effects of recreational use on the project area's resources, and recreational-use capacity issues, and it provides the opportunity for consulting with interested parties and adjust recreational facility development and management over the term of a new license. Establishing the sample size for visitor survey is appropriately a matter determined prior to monitoring. However, it would not be appropriate to set a visitor survey sample size at this point in time, as Butte County recommends, because the sample size could not be adjusted to consider changing use patterns and population or new recreational developments that emerge during the license term. It would be appropriate to consult with the Recreation Advisory Committee to develop statistically valid sample sizes for each monitoring effort that collects visitor survey data.

Whereas Butte County recommends visitor surveys every 5 years, the Recreation Management Plan indicates visitor surveys would be conducted every 10 to 12 years. DWR's proposed survey frequency is adequate because DWR would collect and report other user information on a biennial and 6-year frequency (see table 7.3-1 of the Recreation Management Plan). This interim information would provide a basis for determining trends in the level of recreational use, facility conditions, and any recreational use effects on natural resources. Both data sets (biennial and 6-year) would also provide information that would be used to determine needs for additional recreational facility capacity that may arise in the future. Considering that visitor surveys are not the only data sources that drive recreation management decisions, surveying visitors once every 10 to 12 years would be sufficient and this information would be reported in every other Form 80 filed with the Commission. Periodic assessment reports on the recreational monitoring would allow the Commission to review the proposed recreational facilities as they are planned or as modifications are required over the license term.

Resource Integration and Coordination Program—DWR would make coordinated, timely, and informed decisions related to implementing the Recreation Management Plan and other project-related resource management plans through formal and informal communications regarding simultaneous activities by various resource groups and resource agencies. DWR would encourage greater involvement by the general public through: (1) hosting community workshops designed to share information; (2) maintaining a web-based bulletin board; and (3) implementing a dispute resolution process.

Staff Analysis

A number of parties have oversight for and an interest in various natural resources, commercial interests, and community interests that may be affected either positively or negatively by recreational pursuits. Measures included in this program would meet the need to coordinate among various interested parties and agencies.

Recreation Management Plan Review and Revision Program—DWR proposes to update the Recreation Management Plan not less than every 12 years based on consultation with other parties during monitoring and coordination meetings and through other appropriate sources to address potential unforeseen recreational needs at the project, changes in visitor preferences and attitudes, and new recreational technologies that may occur over the term of the license (table 46).

Table 46. Recreation Management Plan revision schedule. (Source: Recreation Management Plan)

	Frequency of Potential Revisions		
Plan Components	**Annually**	**6 Years**	**12 Years**
Recreation Management Plan Sections 1 through 8	If needed by DWR		X
FERC Form 80, as amended		X	
Proposed recreational measures, estimated costs, and recreational site conceptual plans(Recreation Management Plan appendices A to D, if needed)	If needed by DWR		X
Baseline recreational information, whenever new report data are developed			X

In its comments on the Settlement Agreement filed April 26, 2006, Butte County recommends that DWR provide a Recreation Management Plan update every 5 years, beginning October 1, 2008. Butte County recommends that DWR would update the Recreation Management Plan in consultation with the Recreation Advisory Committee, which would include Butte County. Butte County recommends that DWR allow consulted parties a minimum of 30 days to review and comment on the updated Recreation Management Plan before filing it with the Commission. Butte County also recommends that DWR file all of the comments and recommendations it receives on the revised Recreation Management Plan with the Commission, as well as reasons why it did not adopt a specific recommendation.

In its motion to intervene filed with the Commission on December 16, 2005, the Anglers Committee et al. recommend that DWR not file any proposed recreational amendments with the Commission until they have been reviewed and agreed upon by the public.

In its May 26, 2006, filing with the Commission, DWR points out that the Recreation Management Plan embraces a flexible approach to provide updates when needed and explains that potential revisions to the plan to clarify potential conflicts or ambiguity or to address changing conditions may occur when necessary, or at least every 12 years to coincide with FERC Form 80 reporting. DWR believes that Butte County’s stringent 5-year rule could result in unnecessary filings with the Commission, is inconsistent with the Commission’s Form 80 6-year cycle, and should be rejected.

Staff Analysis

Updating the Recreation Management Plan at 12-year intervals would allow for two FERC Form 80 reporting periods to take place before any changes to the plan would occur. Additionally, meeting every 6 years to review the data provided in the FERC Form 80 report would provide DWR and interested stakeholders the opportunity to identify and assess changes and trends that have occurred or are occurring over time, and to distinguish them from simple annual variability. Therefore, any changes to the Recreation Management Plan would be appropriate and would address needed changes in the direction of the program. The proposed stakeholder consultation, monitoring, and reporting would ensure that the needs of the public are met throughout the term of the license, thus addressing Butte County’s concerns about future demand. The Recreation Management Plan specifically states that DWR would consult with the Recreation Advisory Committee in determining the frequency for updating the Recreation Management Plan and Butte County would be invited to participate in community workshops where recreation-related issues would be discussed. As proposed, this Recreation Management Plan program would accommodate most recommendations by Butte County and the Anglers Committee et al. We find that the consultation and public review processes outlined in the Recreation Management Plan would provide sufficient opportunity for public involvement, and it would not be necessary to require DWR to seek any further public approval before submitting recreation-related changes in the project to the Commission, as the Anglers Committee et al. recommend.

Interpretation and Education Program—DWR would provide information to enhance recreational experiences and encourage appropriate resource protection, cooperative and safe behaviors to benefit all project area recreational resources and visitors. DWR proposes developing an Information and Education (I&E) Program for the Oroville Facilities in consultation with DPR and DFG to complement their current interpretation and education efforts at the project. The I&E Program would include themes, media, media design, prioritized sites, and prioritized services. Potential themes include natural resources, Maidu culture and history, American settlement period, the water project, recreational opportunities, environmental and cultural stewardship, and interpretive collections. The program DWR proposes would include improvements, such as interpretive or informational signs, kiosks, brochures, and pamphlets.

Staff Analysis

With an estimated 1.73 million people visiting the project each year, there is a need to inform visitors of the recreational opportunities available at the project, safety factors (e.g., boating use, campfires, and access) and potential effects of recreational use on sensitive project area resources. As evidenced by high use levels at the Oroville Visitor Center, educational programs, which provide local history and cultural and natural resource interpretation, are important to visitors. The program appropriately includes providing information and education specifically related to the project. This program would provide a means to disseminate information regarding project area resources, facilities, and management issues to members of the public who currently use the project area and to members of the public who may be interested in using the area.

Individual Recreation Developments and Programs

Proposed Recreation Facilities and Improvements at Lake Oroville (Within 10 Years of License Issuance)—DWR would complete several recreational enhancements in the first 10 years following issuance of a new license to address existing ADA inadequacies, ecological, and safety concerns, immediate recreational site capacity needs, and the distribution of shoreline access sites around the reservoirs.

DWR proposes the following recreational improvements and actions in the first 10 years following license issuance at Lake Oroville (table 47). The locations of these facilities are shown on figure 18.

Table 47. Proposed recreational improvements and actions in the first 10 years following license issuance at Lake Oroville.

Facility	Improvement or Measure	Purpose/Comments
Nelson Bar boat launch	Install sign, barrier, or gate at end of road	Public safety
Lime Saddle campground	Construct 10 new RV campsites at or adjacent to the Lime Saddle campground	Expand capacity
Lime Saddle group campground	Construct one new six-unit group (50 people at one time) RV campsite	Expand capacity
Lime Saddle day-use area	Replace 13 existing picnic tables and 7 existing shade structures; provide pole stoves/grills	ADA compliance

Facility	Improvement or Measure	Purpose/Comments
	Provide 60 additional paved car/trailer parking spaces adjacent to the existing parking area at the boat ramp/marina	Expand capacity
	Install one new floating dock and new anchor system	Expand capacity/coordinate with DBW
	Conduct swimming and day-use feasibility study in the Parish Cove area (between the Lime Saddle marina and campground)	Meet need for additional swimming opportunities
	Investigate feasibility of providing a concessionaire operated activity center and store/snack bar	Meet need for services
	Coordinate with DPR to provide a fee-based whitewater boating shuttle service for whitewater (next concessionaire contract)	Meet need for services/shuttle from a take-out location on the North Fork arm to Lime Saddle marina
	Provide daily river flow information on releases from Poe Project into Lake Oroville	Provide whitewater flow information/coordinate with PG&E (Poe Project)
	Programmatic actions: ensure adequate adjustment of boarding docks, ensure adequate and timely debris removal at the boat ramp, coordinate with DPR and the concessionaire to improve ADA accessibility at the marina and boat ramp area	Public safety and access, ADA compliance
	Programmatic action: seek fee title land acquisition of the adjacent surplus PG&E property	Expand capacity of marina and boat ramp/ toxicity issues need to be resolved
	Programmatic action: provide boaters with information about substitute boating facilities and reservoir conditions	Public safety and meet visitor needs
Dark Canyon boat launch	Replace vault restroom and install directional signs along access road	Deteriorated facility condition and visitor access
Foreman Creek boat launch	Install vault restroom, 5 to 10 picnic tables with shade ramadas, and interpretive signs; possibly install pole stoves	ADA compliance, fire safety
	Redirect visitor use at this site (restrict usage boat ramp use to a designated area, potentially relocate the access road) and provide site protection for culturally sensitive areas	Avoid recreational use in culturally sensitive areas
Enterprise boat launch	Develop a low-water ramp, install 10 picnic tables, pole stoves/grills, gravel parking area (near elevation 750 feet msl) with 10 cars/trailer spaces, new floating dock and cable system	Expand capacity, meet visitor need to launch when reservoir level is low/coordinate with DBW and protect nearby cultural resources
	Install fencing, barriers, and/or signs	Protect sensitive resources
	Programmatic action: ensure adequate adjustment of the boarding dock	Public safety and access

Facility	Improvement or Measure	Purpose/Comments
Stringtown boat launch	Install sign, barrier, and/or gate at the terminus of the boat ramp during lowered reservoir elevations, provide directional signs, place sand and/or gravel at launch	Public safety and visitor access
Lake Oroville scenic overlook	Provide trash receptacle and removal service, minor grading improvements (filling larger holes) at the head of the old construction road	Public health and safety/coordinate with the Berry Creek Citizen's Association
Saddle dam trailhead access	Install 10 picnic tables and a stock watering trough, construct 1 or 2 additional access trails from the trailhead/parking area to the Lake Oroville shoreline, and provide additional security if and when needed; evaluate feasibility of extending the existing underground water system in order to pipe water to the watering trough and an outdoor handwashing basin with a French drain	Meet visitor needs, public health and safety
Loafer Creek campground	Construct 15 new RV campsites (contingency for Bidwell Canyon development)	Expand capacity/alternate site for campsites displaced at Bidwell Canyon
Loafer Creek group campground	Complete ADA upgrades, construct 2 group RV/tent campsites (25 people at one time) near existing group campsites, construct a combination shower/restroom near the new group sites	Expand capacity, ADA compliance
Loafer Creek equestrian campground	Complete ADA upgrades	ADA compliance
Loafer Creek day-use area	Install fish cleaning station, replace the portable restroom at Brooks Orchard with a new vault restroom, construct a hardened ADA-accessible path from the parking area and restrooms to the lower picnic area, swimming beach and cove, install one to two new floating dock(s)	Deteriorated facility condition (restroom), ADA compliance, access/coordinate with DBW
	Programmatic action: provide boaters with information about substitute boating facilities and reservoir conditions	Public safety and meet visitor needs
	Conduct swimming and day-use feasibility study (swimming lagoon or pool onsite or at an alternative location) to address times when the reservoir level is below elevation 850 feet msl	Meet need for additional swimming opportunities/priority for a new swimming venue over other sites
	Investigate feasibility of providing a concessionaire operated activity center and store/snack bar	Meet need for services
	Widen, grade, and place gravel on existing dirt service road to approximately elevation 750 feet msl and open this gated service road to the public when the boat launch is dewatered	Public safety and access
	Programmatic actions: ensure adequate adjustment of boarding docks and adequate and timely debris removal at the boat ramp	Public safety and access

Facility	Improvement or Measure	Purpose/Comments
Bidwell Canyon campground	Construct a new campground loop (30–38 campsites) adjacent to existing loop, relocate an existing trail	Replace capacity lost due to expanded marina parking area
	Programmatic action: make the existing underused group meeting facility available for use as a concessionaire operated campground activity center and store/snack bar	Meet visitor needs/coordinate with DPR
Bidwell Canyon day-use area	Construct a new marina parking lot with approximately 90 single-vehicle spaces, install one or two new floating docks, extend at least 3 lanes of the boat ramp down to elevation 640 feet msl, provide approximately 45 parking spaces at the top of the new Bidwell boat ramp located at approximately 750 feet and additional parking along the length of ramp, resurface existing gravel lot at Bidwell boat ramp 2 (elevation 700 feet msl) with concrete to provide 80 additional parking spaces	Expand capacity, access/coordinate with DBW
	Coordinate with DPR to provide a fee-based whitewater boating shuttle service for whitewater (next concessionaire contract)	Meet need for services/shuttle from a take-out location on the Middle Fork arm to Bidwell Canyon Marina
	Programmatic actions: ensure adequate adjustment of boarding docks, ensure adequate and timely debris removal at the boat ramp, coordinate with DPR and the concessionaire to improve ADA accessibility at the marina and boat ramp area, support safe and effective options for a new shuttle service (or other feasible options) to operate between the parking facilities and the marina possibly during peak use periods and during low pool periods	Public safety and access
	Programmatic actions: support options, such as state right-of-way via a lease or similar mechanism, to include additional dry boat storage in a new DPR concessionaire contract when it is renewed	Expand capacity
	Programmatic action: provide boaters with information about substitute boating facilities and reservoir conditions.	Public safety and meet visitor needs
Lake Oroville Visitor Center	Provide an I&E Program, upgrade existing facilities	Meet visitor needs, ADA compliance
Spillway day-use area	Determine optimum number and configuration of boarding docks and if feasible, install an additional boarding dock	Expand capacity/coordinate with DBW
	Programmatic actions: ensure adequate boat dock capacity for non-peak recreational season special events, such as fishing tournaments; ensure adequate adjustment of boarding docks; ensure adequate and timely debris removal at the boat ramp; and provide boaters with information on substitute boating facilities	Public safety, access

Facility	Improvement or Measure	Purpose/Comments
Oroville dam overlook day-use area	Install 4 picnic tables with shade ramadas, construct 100-spaces parking area on the terrace to the south of the dam, improve the surface of the walkway connecting the parking lot on the terrace to the south of the dam to dam crest level, provide interpretive panels at the scenic overlook, and modify the existing parking spaces near the south abutment of the dam and the existing restroom	Expand capacity, ADA compliance
Lake Oroville floating campsites	Install 3 additional new floating campsites in Lake Oroville: 2 in the Lime Saddle area and 1 in either the West Fork or North Fork arms of the reservoir	Expand capacity
Lime Saddle trail	Construct a new 3.5-mile trail for hikers and bicyclists from the Lime Saddle campground to the Lime Saddle day-use area	Meet visitor needs, access
Potter's Ravine north fork shoreline trail	Extend the multiple-use trail 2 miles to provide access to additional, remote portions of the Lake Oroville shoreline	Meet visitor needs, access
Loafer Creek loop trail	Change trail designation to allow bicycle use on most of the trail except for a segment near the Loafer Creek equestrian campground	Meet visitor needs, access
	Open an existing graded dirt access and service road that extends from just east and south of the Loafer Creek equestrian campground south to the Saddle dam trailhead to bicycle use to provide bicycle access from the Loafer Creek campground to the Saddle dam area, where the Bidwell Canyon trail begins	Meet visitor needs, access
Roy Rogers trail	Change trail designation to allow bicycle use on the segment connecting the Loafer Creek campground to the service/access road	Meet visitor needs; access
Saddle dam trailhead access	1 or 2 additional access trails from the trailhead/parking area to the Lake Oroville shoreline	Meet visitor needs, access
Bidwell Canyon trail	Relocate a segment of the trail to accommodate other modifications at the Bidwell Canyon complex and change trail designation to allow equestrian use on the entire trail	Meet visitor needs, access
Brad B. Freeman trail	Realign a section to eliminate security concerns due to its proximity to the Hyatt power plant switchyard, construct and designate the new section of trail to multiple-use standards, and allow equestrian use on certain segments of the trail	Meet visitor needs, access
Dan Beebe trail	Change trail designation to allow bicycle use on most of the trail, with the exception of a steep segment over Sycamore Hill	Meet visitor needs, access

Notes: ADA – Americans with Disabilities Act
DBW – California Department of Boating and Waterways

In its comments on the Settlement Agreement filed with the Commission on April 26, 2006, Butte County states its concerns with both the current recreational visitor-use data provided by DWR and

DWR's estimated projected use of the project facilities. Butte County states that the facility upgrades DWR proposes at Lake Oroville are not designed to accommodate current and realistic projections of recreational demand during the new license term but would only allow DWR to comply with ADA. Butte County believes that DWR should construct more facilities, such as campgrounds and marinas, and should provide more docking/moorage.

In its motion to intervene filed with the Commission on March 30, 2006, Butte County recommends that DWR improve the facilities and services offered at the Bidwell Canyon and Lime Saddle marinas.

In their motion to intervene filed with the Commission on March 31, 2006, George Weir, Vicki Hittson-Weir, and Pathfinder Quarter Horses et al. recommend that DWR:

- construct an enclosed multiple-use events center on Lake Oroville State Recreation Area land with grandstands, concessions, support offices, facilities, and parking to be used for events such as sporting events, concerts, conventions, livestock expositions, and fair expositions by 2013;
- provide new marina facilities and a boat ramp at Potters Ravine by 2010;
- improve the Saddle dam trailhead access by providing (1) lighting in the parking area, (2) two vault restrooms with hand washing sinks, (3) 10 concrete picnic tables, (4) shade trees, (5) piped potable water, (6) two water tanks for horses with outlet valves, and (7) tie rails between the picnic tables and at the restrooms by 2009. Allow overnight parking for equestrians during special events by 2009;
- build a new equestrian group campground at Loafer Creek with central water availability, 2 restrooms, washing facilities with showers, parking for 15 vehicles with horse trailers and 15 self-contained RV horse trailers, by 2009;
- coordinate with DPR, Corps, the Forest Service, and volunteers to build the Lake Oroville Rim trail primarily for equestrians and hikers, for sections meeting safety guidelines, and for shared-use with mountain bikers by 2012; and
- annually provide $10,000 for stocking bass in Lake Oroville and making a donation to the local bass tournament.

In their comments on the draft EIS, George Weir, Vicki Hittson-Weir, and Pathfinder Quarter Horses explain that their recommended equestrian facility with boarding stables and a 1,000-seat amphitheater would be located in the Loafer Creek area and was a facility discussed at the time the original license for the Oroville Facilities was issued. They further illustrate that the continuous multiple-use loop trail they recommended providing around Lake Oroville with smaller sections of trails was from the study conducted by Pete Dangermond in 2003.

In its response filed May 26, 2006, DWR asserts that Lake Oroville provides one of the best lake-based bass fisheries in California. DWR states that requiring it to fund a bass tournament would be tantamount to ordering compensation, in clear violation of long-standing precedent. DWR also asserts that the Commission is not empowered to require payment for an alleged loss of fisheries resources where there is no evidence that fish populations are adversely affected.

Staff Analysis

As proposed, the recreational improvements and measures scheduled for completion within the first 10 years at Lake Oroville would reduce identified environmental and health and safety concerns, improve access to project waters, and increase accessibility and respond to the need for additional day and overnight developed capacity. For the most part, DWR's prioritization seems to accurately reflect:

(1) facility and site condition survey results; (2) the need for providing adequate access to project lands and waters[79]; (3) the need to meet the existing and future recreational demand; (4) the need to accommodate existing and potential types of project-related recreational uses at the project; (5) a commitment to provide accessible recreational opportunities; and (6) a demonstrated nexus between the proposed development and the project. However, we note the following exception at Foreman Creek.

The development planned for Foreman Creek is outlined in the Recreation Management Plan, and Proposed Article A129, *Improve and Redirect Recreation Usage to Specific Areas at Foreman Creek*, includes additional guidance as to how the development should take place to protect cultural resources. As explained in section 3.3.8.2, *Cultural Resources*, we find that the development at Foreman Creek, as proposed, would adequately protect cultural and historical resources at the project. The effects of DWR's proposed development on recreational resources at Foreman Creek are presented later in this section under analysis of Proposed Article A129.

DWR visitor-use data indicate capacity issues at boat launches and parking areas, and campgrounds. DWR proposes increasing capacity at each of these types of facilities across the project. The Proposed Action appears to be consistent with Butte County's recommendation to provide additional capacity at project recreational facilities. However, there may be a shortage of space at boat moorings, docks, and storage at commercial marinas at Lake Oroville. These improvements would not be necessary to provide public access to project waters, but rather they would facilitate the publics' use of project waters. We do not find that the need for this facility corresponds to any identified issue or concern regarding public access or recreational use related to the project. Further, we consider that such facilities provide convenience to the public rather than addressing a project effect.

Pathfinder Quarter Horses et al. recommend that DWR construct an enclosed multiple-use events center on Lake Oroville State Recreation Area land in the Loafer Creek area with grandstands, concessions, support offices, facilities, and parking to be used for events such as sporting events, concerts, conventions, livestock expositions, and fair expositions by 2013. This facility would be available to a variety of user groups. Pathfinder Quarter Horses et al. also did not indicate how this facility is linked to the hydroelectric project or if it would even be located within the project boundary. Pathfinder Quarter Horses et al. did not clarify how this facility would address or resolve specific project effects. We do not find that this recommendation has a project nexus.

Pathfinder Quarter Horses et al. recommend that by 2009, DWR provide new marina facilities and a boat ramp at Potters Ravine, which is located on the west side of the main body of Lake Oroville within the project boundary on land currently managed by DPR. The Butte County General Plan includes Potters Ravine under its Policy 5, which provides for development to serve the recreation-minded public (such as parking areas, camping areas, picnicking sites, boat ramps, comfort stations, sales of food, gasoline, oil, and water, observation points, and other facilities). The cove at Potters Ravine is attractive for recreational use because it is protected from high winds and associated waves. Also, the relatively gentle shoreline topography in this location is conducive to dispersed shoreline recreational activities, including shore fishing, picnicking, and swimming. Currently, two full-service marinas are located on Lake Oroville: one at Lime Saddle and the other in Bidwell Canyon. Each marina provides several hundred mooring buoys for long-term rental, primarily for houseboats, along with a smaller number of covered and uncovered boat slips. Only 35 to 38 percent of the respondents to DWR's recreational surveys reported the need for additional boat ramps and marinas and more than 60 percent thought that the number of marinas at the Oroville Facilities was sufficient. We note that DWR implements closures in this area to protect bald eagles during nesting season (see analysis of Proposed Article A118, *Minimization of Disturbances to Nesting Bald Eagles*, later in this section) and placement of a marina in

[79] Specifically, many boat launches would be improved (e.g., resurfaced, additional boarding docks) and boat ramps extended to accommodate access at low reservoir levels.

this location, as Pathfinder Quarter Horses et al. recommend, may conflict with other resource management objectives.

The Pathfinder Quarter Horses et al. recommendation for installing 10 picnic tables at the Saddle dam trailhead access is consistent with DWR's proposal at this site. Pathfinder Quarter Horses et al. also recommend that DWR provide lighting, 2 additional restrooms with hand washing sinks, shade trees, piped potable water, 2 water tanks for horses with outlet valves, and tie rails between the picnic tables and at the restrooms. DWR proposes evaluating the feasibility of extending the existing underground water system to pipe potable water to the watering trough and an outdoor handwashing basin with a French drain. Providing potable water at this location with water tanks for horses and a hand-washing sink would further enhance this development. This site receives more use in the spring and fall when air temperatures are cooler and amount of daylight diminishes. Even though it is a day-use site, providing lighting in the parking area, as proposed by Pathfinder Quarter Horses et al., would increase public safety for equestrians loading horses and gear in the late afternoon as the sun is going down. Accommodating equestrians who prefer to use the trails during the cooler months when there is less daylight would probably increase the number of visitors who would use this facility. Providing 1 or 2 additional restrooms at this site would also provide for visitor needs and avoid health and safety concerns, particularly since picnic tables are also proposed at this location. Creating designated, hardened areas for tying horses would eliminate potential soil compaction and vegetation damage that can occur when horses are tied indiscriminately to trees throughout an area. Furthermore, tying horses to trees in this area is prohibited by California Public Resources Code Section 4359(b).

Loafer Creek is a popular location for equestrian access to project lands and the Lake Oroville shoreline. Pathfinder Quarter Horses et al. recommend building a new equestrian group campground at Loafer Creek, doubling the existing capacity available to camping equestrians and their horses. Under the Proposed Action, DWR would monitor use at this site and consider various management actions when certain capacity thresholds have been reached, including expanding the existing equestrian campground. Because equestrian use is typically higher in the off-season, it would be appropriate to establish triggers that reflect this use pattern. Considering the existing high use levels and comparing future monitoring data to a trigger that reflects seasonal use may result in additional development in the near future. This would be consistent with the recommendation of Pathfinder Quarter Horses et al.

Pathfinder Quarter Horses et al. recommend that DWR coordinate with DPR, the Corps, the Forest Service, and volunteers to build the Lake Oroville Rim trail primarily for hikers and equestrians. Our review of the Recreation and Socioeconomics Work Group meeting summaries determined that in 2003 a multiple-use loop trail system around Lake Oroville, with smaller sections of trails, was contemplated by a trails subgroup. However, little information about the proposed location of this trail is available on the project record. Undeveloped public land around Lake Oroville is abundant and available for general public use. However, steep slopes are common above 167 miles of the shoreline, and this condition would probably limit the ability to create a trail or, at a minimum, require substantial site modification to avoid soil erosion.

Pathfinder Quarter Horses et al. also recommend that DWR annually provide $10,000 to enhance bass fishing at Lake Oroville by stocking bass in the reservoir and donating to the local bass tournament. As discussed in section 3.3.3, *Aquatic Resources*, the Lake Oroville warmwater fishery is currently a self-sustained fishery, and its black bass fishery is significant, both in terms of angler effort and economic effect on the area. Because the bass population is self-sustaining and habitat would be enhanced through the Lake Oroville Warm Water Fishery Habitat Improvement Program (Proposed Article A110), stocking would be unnecessary. Considering the existing health of the warmwater fishery, this recommendation would not respond to an effect caused by the project.

Proposed Recreation Facilities and Improvements at Thermalito Diversion Pool (Within 10 Years of License Issuance)—DWR proposes completing the following recreational enhancements in the first

10 years following license issuance at the Thermalito diversion pool (table 48). The locations of these facilities are shown on figure 18.

Table 48. Proposed recreational enhancements in the first 10 years at Thermalito diversion pool.

Facility	Improvement or Action	Purpose/Comments
Diversion pool day-use area	Install 10 concrete picnic tables and pole stoves/grills along Burma Road upstream of the diversion dam, place additional gravel at the existing boat launch, and possibly construct an ADA accessible fishing platform or pier	Meet visitor needs, access, ADA compliance
Lakeland Boulevard trailhead access	Relocate and/or construct a new road to access the lower old railroad grade trail, provide a gravel parking area with space for vehicles pulling small trailers, install a vault restroom, install 10 picnic tables with pole stoves/grills, construct pedestrian access trail to the water, provide a gravel car-top boat launch, install fencing to separate the access road and proposed day-use facilities from the railroad tracks, install stock watering trough at the existing gravel parking area, and consider feasibility of extending the existing underground water system in order to pipe water to the watering trough and an outdoor handwashing basin with a French drain	Access, public health, and safety
Feather River Fish Hatchery	Place gravel at shoreline to improve existing non-motorized boat launch site at the Feather River Fish Hatchery and provide signage and vehicle barriers	Access/coordinate with DBW
Brad B. Freeman trail	Change trail designation to allow equestrian use	Access
	Programmatic actions: trail crossing of Thermalito diversion pool feasibility study	Access
Dan Beebe trail	Change trail designation to allow bicycle use, on most of the trail (exception is a steep segment over Sycamore Hill)	Access
Demonstration mountain bicycle trail	Evaluate feasibility of a new mountain bicycle trail beginning at Lakeland Boulevard trailhead access and if determined feasible, construct 2- to 4-mile trail connecting to Dan Beebe trail at a westward point. After trail construction close the parallel portion of the Dan Beebe trail to bicycle use	Access, resolve potential user conflicts
Feather River Fish Hatchery	Construct a paved trail from the Feather River Fish Hatchery parking/viewing area downstream to the project boundary	ADA compliance, access/contingent on an adjoining trail being built by others

Note: ADA – Americans with Disabilities Act
DBW – California Department of Boating and Waterways

In their motion to intervene filed with the Commission on March 31, 2006, George Weir, Vicki Hittson-Weir, and Pathfinder Quarter Horses et al. recommend that DWR:

- purchase 83 acres of privately owned land adjacent to the Thermalito diversion pool for a regional equestrian park by 2010 with: (1) a covered 125 foot by 250 foot arena with grandstands; (2) two outdoor arenas; (3) a round pen; (4) access to trails; (5) two concession building; (6) parking for 50 horse trailers; (7) camping for individuals or groups; and (8) RV parking. The park would be the home of the Oroville Pageant Riders, with leasing privileges to other equestrian associations, and used for municipal events, special events, and horse stabling;
- improve the Lakeland Boulevard trailhead access by 2009, with: (1) lighting in the parking areas; (2) two vault restrooms with hand-washing sinks; (3) 20 concrete picnic tables, (4) shade trees; (5) piped potable water; (6) two water tanks for horses with outlet valves; and (7) tie rails in between picnic tables and next the restrooms. Allow overnight parking for equestrians during special events (also recommended in their comments filed with the Commission on April 15, 2006).

In its response filed May 26, 2006, DWR states that its recreational needs studies did not identify a need for the grandstands and other facilities requested by Pathfinder Quarter Horses et al. DWR points out that Pathfinder Quarter Horses et al. did not provide any evidentiary support for its recommendation and also fails to demonstrate any nexus to the project.

Staff Analysis

As proposed by DWR, the recreational improvements and actions scheduled for completion within the first 10 years at Thermalito diversion pool would reduce identified environmental and health and safety concerns, improve access to project waters, increase accessibility, and respond to the need for additional day-use developed capacity. DWR's prioritization seems to accurately reflect: (1) facility and site condition survey results, (2) the need for providing access to project lands and waters; (3) the need to meet the existing and future recreational demand; (4) the need to accommodate existing and potential types of project-related recreational uses at the project; (5) a commitment to provide accessible recreational opportunities; and (6) a demonstrated nexus between the proposed development and the project.

Pathfinder Quarter Horses et al. recommend that DWR purchase 83 acres of privately owned land adjacent to the Thermalito diversion pool for a regional equestrian park. Pathfinder Quarter Horses et al. did not specify a location for this facility, so it is not clear if it would be located within the project boundary. Pathfinder Quarter Horses et al. also did not indicate how this facility is linked to the hydroelectric project or clarify how this facility would address or resolve specific project effects. We do not find sufficient information to determine that this recommendation has a project nexus.

The other recommendations of Pathfinder Quarter Horses et al. would double the number of picnic tables DWR proposes at the Lakeland Boulevard trailhead access. Pathfinder Quarter Horses et al. also recommend that DWR provide lighting, two additional restrooms with hand washing sinks, shade trees, piped potable water, two water tanks for horses with outlet valves, and tie rails between the picnic tables and at the restrooms. DWR proposes to evaluate the feasibility of extending the existing underground water system to pipe potable water to the watering trough and an outdoor handwashing basin with a French drain. Providing potable water at this location with water tanks for horses and a hand-washing sink would enhance this development. This site receives more use in the spring and fall when air temperatures are cooler and amount of daylight diminishes. As stated previously, providing lighting in the parking area as recommended by Pathfinder Quarter Horses et al. would increase public safety for equestrians loading horses and gear in the later afternoon as the sun is going down. Accommodating equestrians who prefer to use the trails during the cooler months when there is less daylight would probably increase the number of visitors who would use this facility. Currently, a portable restroom is available at this site and DWR had proposed installing a vault restroom; providing one or two restrooms would provide for visitor needs and would avoid potential health and safety concerns, particularly since picnic tables are also proposed at this location. Creating designated, hardened areas for tying horses would eliminate potential soil compaction and vegetation damage that can occur when horses are tied indiscriminately to trees throughout an area. Furthermore, tying horses to tress in this area is prohibited by California Public Resources Code Section 4359(b).

Proposed Recreation Facilities and Improvements at Thermalito Forebay (Within 10 Years of License Issuance)—DWR proposes completing the following recreational enhancements in the first 10 years following license issuance at the Thermalito forebay (table 49) (figure 18 shows the location of these facilities):

Table 49. Proposed recreational enhancements in the first 10 years at Thermalito forebay.

Facility	Improvement or Action	Purpose/Comments
North Thermalito forebay day-use area	Install a fish cleaning station	Meet visitor needs, public health and safety
	Programmatic actions: evaluate methods for warming the water in the swimming lagoon and monitor water quality in the swimming lagoon	Public health and safety, meet visitor needs
South Thermalito forebay day-use area	Place approximately 6 inches of sand along about 100 linear feet of shoreline between 220 and 230 feet elevation; install 5 to 10 picnic tables, pole stoves, and shade ramadas; landscape with shade trees and shrubs; construct accessible fishing platform or pier; and designate swimming area by placing buoys	Public safety, meet visitor needs, protect vernal pools/coordinate with DPR
	Programmatic action: monitor water quality at swimming cove	
Brad B. Freeman trail	Change trail designation to allow equestrian use along Thermalito forebay	Access
Thermalito forebay	Create short trails between the existing Brad B. Freeman trail and shoreline and construct a 1-mile-long, hiking-only loop trail near the shoreline of the North forebay	Access, protect vernal pools/coordinate with DPR
	Programmatic action: evaluate feasibility of providing two new multiple-use trails around the south side of the North forebay and around the north side of the South forebay, creating a loop around the entire forebay and connecting to Brad B. Freeman trail	Access, protect vernal pools and giant garter snakes and their habitat/coordinate with DPR

In its comments on the Settlement Agreement filed on April 26, 2006, Butte County points out that DWR's proposal to close swimming areas that do not meet water quality standards for the protection of human health is inadequate to address water quality problems. In its response filed May 26, 2006, DWR points out that its proposed feasibility analysis of additional swimming areas at the Oroville Facilities addresses the need to mitigate potential health hazards through improving water circulation or other methods to improve water quality. We discuss water quality standards and the current status of water quality at the project swimming areas in section 3.3.2, *Water Quantity and Quality*.

Staff Analysis

As proposed, the recreational improvements and actions scheduled for completion within the first 10 years at Thermalito forebay would reduce identified environmental, health and safety concerns, improve access to project waters, increase accessibility, and respond to the need for additional day-use developed capacity. DWR's prioritization seems to accurately reflect: (1) facility and site condition survey results; (2) the need for providing access to project lands and waters; (3) the need to meet the existing and future recreational demand; (4) the need to accommodate existing and potential types of project-related recreational uses at the project; (5) a commitment to provide accessible recreational opportunities; and (6) a demonstrated nexus between the proposed development and the project.

Proposed Recreation Facilities and Improvements at Thermalito Afterbay and Oroville Wildlife Area (Within 10 Years of License Issuance)—DWR proposes completing the following recreational enhancements in the first 10 years following license issuance at the Thermalito afterbay (table 50) (figure 18 shows the location of these facilities):

Table 50. Proposed recreational enhancements in the first 10 years at Thermalito afterbay.

Facility	Improvement or Action	Purpose/Comments
Wilbur Road boat launch	Install directional signs along the roadside to the site	Meet visitor needs
Larkin Road boat launch	Place approximately 6 inches of sand along about 100 linear feet of shoreline between 125 and 132 feet msl; install 5 to 10 picnic tables, pole stoves and shade ramadas; landscape with shade trees and shrubs; construct accessible fishing platform or pier; and designate swimming area by placing buoys	Meet visitor needs, public safety, protect vernal pools and giant garter snakes and their habitat
Thermalito afterbay outlet area	Construct 20-site campground north of outlet channel (tables, graveled spurs, vehicle control barriers)	Meet visitor needs, protect special status species and their habitat
	Construct 5 to 10 day-use area sites south of outlet channel (gravel access roads, vehicle control barriers, signage); revegetate disturbed areas; install 1 to 2 additional vault restrooms, if needed; install directional signs; upgrade existing boat ramp surface with concrete; and pave the access road and parking area at the boat ramp	Meet visitor needs, protect special status species and their habitat
OWA dispersed use sites	Install 2 accessible watchable wildlife sites with trash receptacles, vehicle barriers, signs, and gravel shoulder parking and evaluate site hardening versus closure; improve 2 existing non-motorized boat launch sites (place gravel in small area of shoreline, signage, vehicle barriers, minor grading and graveling the roadway or access trail); and possibly develop a river trail[a]	Access, meet visitor needs, protect special status species and other resources, provide accessible opportunities
	Programmatic action: maintain and enhance existing access opportunities for traditional uses such as hunting and fishing in OWA	Access/coordinate with DFG

[a] The term "river trail" refers to a navigable route of travel along the river with designated points of shoreline access.

In its motion to intervene filed with the Commission on December 16, 2005, the Anglers Committee et al. recommend that DWR construct additional public boat launching facilities into the navigable water of the Feather River downstream of the fish barrier dam and downstream of the Thermalito afterbay outlet for public access to the waters of the Feather River. The Anglers Committee et al. also recommend that DWR fund the maintenance of garbage cans for trash at all public facilities in the OWA.

In its response filed May 26, 2006, DWR points out that it has agreed to construct additional launching facilities in its Recreation Management Plan, even though its recreational needs studies did not specifically identify additional launching facilities as a project-wide need.

Staff Analysis

As proposed, the recreational improvements and actions scheduled for completion within the first 10 years at Thermalito afterbay and OWA would reduce identified environmental, health and safety concerns, improve access to project waters, increase accessibility and respond to the need for additional day-use developed capacity. DWR's prioritization seems to accurately reflect: (1) facility and site condition survey results; (2) the need for providing access to project lands and waters; (3) the need to meet the existing and future recreational demand; (4) the need to accommodate existing and potential types of project-related recreational uses at the project; (5) a commitment to provide accessible recreational opportunities; and (6) a demonstrated nexus between the proposed development and the project.

The Proposed Action includes additional boat launch development at the OWA, which would accommodate the recommendation of the Anglers Committee et al. to provide additional public access to the Feather River. We note that appendix B of the Settlement Agreement also includes a measure to provide funding to manage the OWA, which would accommodate the recommendation of the Anglers Committee et al. related to trash cans and collection.

Proposed Recreation Facilities and Improvements Beyond 10 Years of License Issuance—Under the recreational facility development program in the Recreation Management Plan, DWR would complete other recreational improvements after the first 10 years of a new license. The decision to construct new facilities would be based on capacity threshold monitoring and demonstrated need as revealed by monitoring results. DWR expects new facilities, such as campsites, parking areas, and swim areas, may be needed after the first 10 years of a new license at Lime Saddle campground, Lime Saddle group campground, Lime Saddle day-use area, Loafer Creek campground, Loafer Creek group campground, Lake Oroville Visitor Center, and Wilbur Road boat launch (figure 18 shows the location of these facilities). Beyond year 10 of the license, DWR also anticipates replacing or refurbishing facilities and structures that have reached the end of their life expectancy and would be in need of replacement.

Staff Analysis

DWR states that additional recreational facilities, including campsites, parking areas, and swim areas, at Lime Saddle campground, Lime Saddle group campground, Lime Saddle day-use area, Loafer Creek campground, Loafer Creek group campground, Lake Oroville Visitor Center, and Wilbur Road boat launch would likely be needed over the term of the license. Monitoring recreational use would provide relevant information about visitors' needs and capacity issues throughout the license term. DWR could use this monitoring information to take timely and appropriate action to build new facilities and correct problems that may arise. DWR would not construct unwanted or unneeded facilities because the decision to provide additional facilities would be based periodic analysis of monitoring results that would reflect actual conditions.

DWR would not begin replacing or refurbishing[80] existing recreational facilities until, at least, 10-years after license issuance. This is an appropriate time frame for recreational facilities that have been recently constructed or reconstructed. However, some of the older facilities may require attention sooner than 10 years. In particular, the boat-in campgrounds (Goat Ranch, Bloomer, and Craig Saddle) appear to have some environmental and health and safety concerns (e.g., erosion, wildland fire potential, and deteriorating facility components) that are consistent with criteria used to determine the recreational improvements that would be scheduled within the first 10-year planning cycle of the Recreation Management Plan. If the boat-in campgrounds were not replaced until the second 10-year planning cycle, existing erosion problems would not be corrected and health and safety concerns associated with aging infrastructure and fire safety would persist.

Trails and Trail Management—Although DWR identified relatively low trail use and a high level of satisfaction with the trails during its user surveys, DWR proposes a comprehensive non-motorized trails program as part of its Recreation Management Plan. This program would change existing trail designations, as listed in table 51, and additional trails would be built changing the level of access to project lands and waters for all user groups. To balance public access and recreational needs or desires with management requirements, DWR would do more trail planning and design assessment before implementing the program to address resource protection and public safety. Before changing the trail use designation along an existing trail, particularly a change to multiple use, DPR and/or DWR would assess whether the proposed change was safe or appropriate for multiple use by checking for adequate trail sight distance, slope, width, tread, signage, etc. and addressing any issues identified.

Table 51. Current and proposed trail designations for project trails. (Source: DWR, 2006e and DWR, 2005a)

Name of Trail	Miles of Trail	Current Allowable Uses	Proposed Allowable Uses
Existing Trails			
Roy Rogers trail	5.7	Equestrian, hiking	Equestrian, hiking[a]
Dan Beebe trail	14.6	Equestrian, hiking	Multiple use[b]
Loafer Creek loop trail	7.1	Equestrian, hiking	Multiple use[c]
Chaparral interpretive trail	0.3	Hiking only	Hiking only
Loafer Creek day-use/campground trail	1.6	Hiking only	Hiking only
Wyk Island trail	0.7	Hiking only	Hiking only
Bidwell Canyon trail	4.9	Bicycles, hiking	Multiple use
Brad B. Freeman trail	44.7	Bicycles, hiking[d]	Multiple use[e]
Sewim Bo trail	0.5	Multiple-use	Multiple use
Potter's Ravine trails	10.0	Multiple-use[f]	Multiple use[f]

80 We distinguish between *installing new infrastructure* and *replacing or refurbishing* an existing recreational site. Installing new infrastructure would include actions such as (1) improving a boat ramp and installing a new bathroom at an existing development and (2) constructing new campgrounds, day-use areas or trails. Replacement or refurbishment would entail redesigning and reconstructing an entire existing facility when it has reached the end of its useful life. Replacement or refurbishment would include actions such as (1) redesigning the development (e.g., campground), if necessary; (2) constructing new infrastructure, such as restrooms and access roads; (3) reconstructing tent pads and spurs; and (3) installing new signs, vehicle control barriers, and gates throughout.

Name of Trail	Miles of Trail	Current Allowable Uses	Proposed Allowable Uses
Proposed Trails			
Saddle dam shoreline access	<0.1	Proposed, not yet constructed	Hiking only
Thermalito forebay shoreline access	0.1–0.5	Proposed, not yet constructed	Hiking only
Service road bicycle access to Saddle dam	0.7	Currently closed to the pubic	Hiking, bicycles
Lakeland Boulevard-Sycamore Hill demonstration trail (parallel to Dan Beebe trail)[g]	2.0–4.0	Proposed, not yet constructed	Hiking, bicycles
North and South Forebay loop trails (new segments connecting to Brad B. Freeman trail)	2.0–3.0	Proposed, not yet constructed	Multiple use
Potter's Ravine (extension of existing trail system)	2.0	Proposed, not yet constructed	Multiple use

[a] A segment of this trail connecting the campground to the service/access road would be opened to bicycle use.

[b] The Sycamore Hill segment would remain closed to bicycle use.

[c] The segment of this trail south of the equestrian campground and parallel to the service/access road would remain closed to bicycle use.

[d] Currently, some portions of the Brad B. Freeman trail outside of the Lake Oroville State Recreation Area are open to equestrian use.

[e] Additional segments of the Brad B. Freeman trail on the north shore of the Thermalito diversion pool and around Thermalito forebay would be open to equestrian use.

[f] All but a short pedestrian-only segment near spillway cove is multiple use.

[g] The Sycamore Hill section of the Dan Beebe trail would be closed to bicycle use, if this trail were constructed.

During settlement negotiations, DWR convened a Trails Focus Group that developed the following objectives for the project trails: (1) provide some separate-use trail segments predicated on widely recognized safety concerns (Sycamore Hill portion of Dan Beebe trail); (2) maintain connectivity of project recreational areas for all trail users, to the degree practicable; (3) make much of the project's trail resources available to as many public trail users as possible; (4) provide some equestrian-only trail segments associated with the unique equestrian campground in the Loafer Creek area (much of the Roy Rogers trail and a portion of the Loafer Creek loop trail); and (5) develop a monitoring plan to protect natural and cultural resources associated with trail routing and maintenance. Using these objectives, DWR developed a trail program that would modify the designations of most of the existing 90 miles of trails (table 51, figure 20).

In addition to trail designation changes, DWR proposes to maintain the project trails according to the standards and frequency that are already established. Trails are maintained every 3 years according to the standards set in DWR's 1996 *Vegetation Management Guidelines for Trails and Roads* (DWR, 1996) and the 1991 DWR Trail Handbook (DWR, 1991). These standards address safety issues, aesthetic considerations, and accessibility for various types of skill levels and activities. The standard equestrian/hiker trail is at least 4 feet wide and has a 10-foot overhead clearance. Bicycle trails have the same widths and clearances as the equestrian/hiker trails, but the sight distance is increased to allow for cyclists to see oncoming users and safely pass on the trail. Multiple-use sections of trails are wider, with increased lines of sight (letter from Raymond D. Hart, Deputy Director, DWR, to David Boergers, Secretary, Federal Energy Regulatory Commission, dated August 31, 2001).

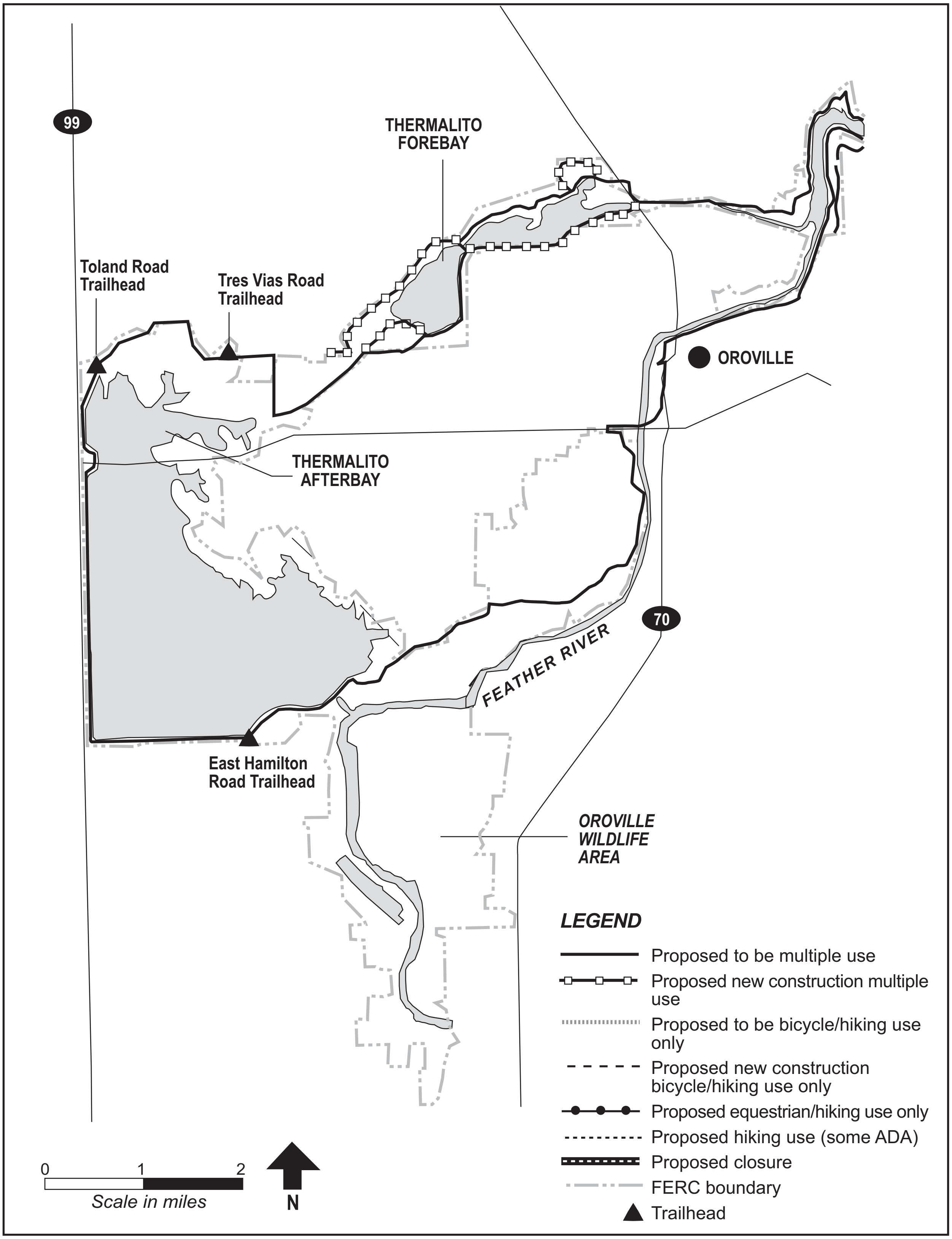


Figure 20. DWR's proposed trails and trail designations for Oroville Facilities. Page 1 of 2

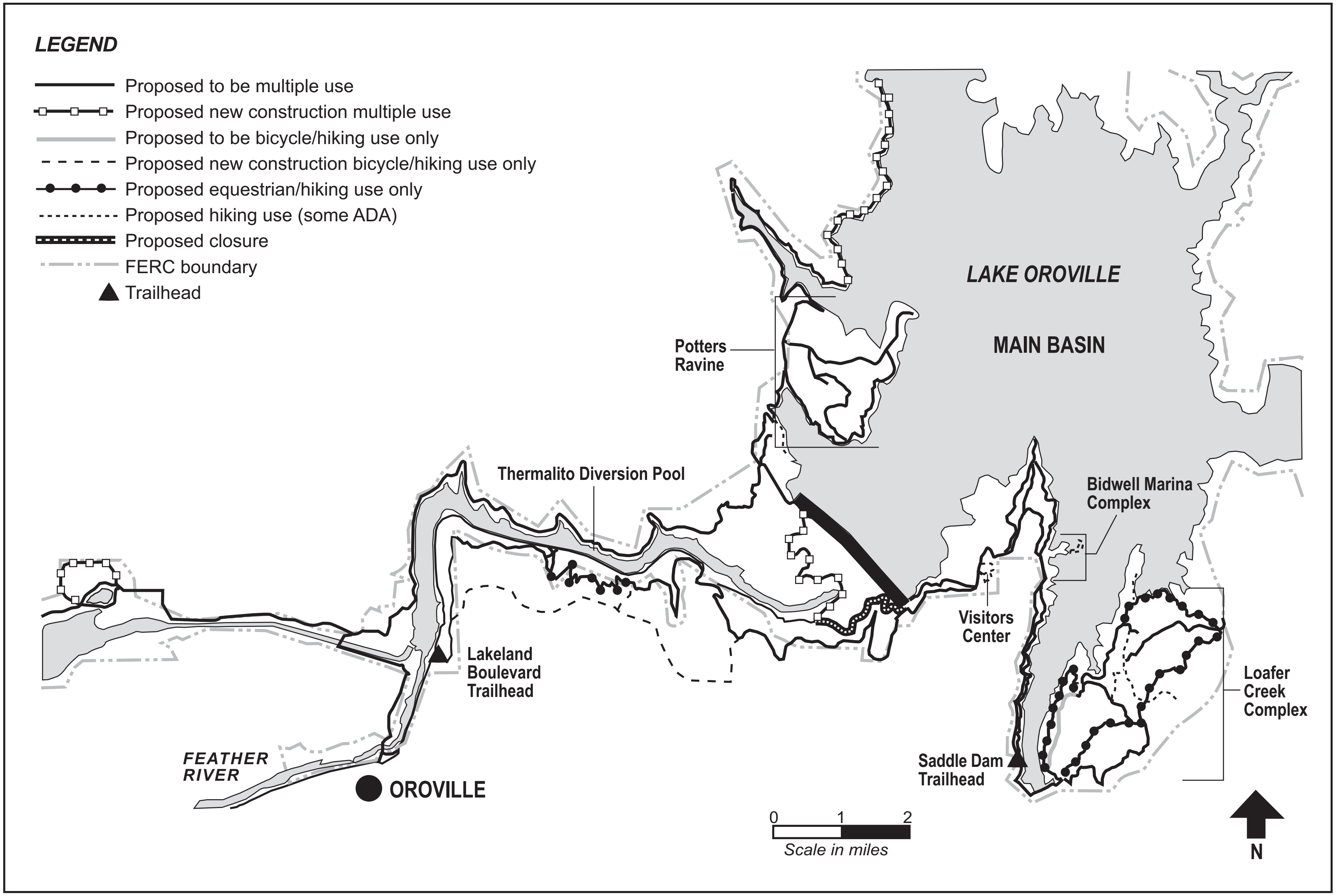


Figure 20. DWR's proposed trails and trail designations for Oroville Facilities. Page 2 of 2

According to the 1991 Trail Handbook, the Oroville Facilities trails are Class I trails. Class I trail beds are a minimum of 36 inches wide with a preferred width of 48 inches. The trail tread surface varies from 30 inches to 48 inches, depending on the surrounding terrain, trees, and vegetation. During trail maintenance activities, the trail tread surface is maintained to provide an adequate walking or riding surface, free from obstacles or hazards. Additionally, the trail is cleared to allow access, and brush is cut to define and protect the established tread.

Several organizations representing both bicycle and equestrian users signed the Settlement Agreement and 102 comment letters were filed in support of the proposed draft trail designations in the Recreation Management Plan. Although DWR's proposed comprehensive non-motorized trails program has considerable support, many oppose it: 37 comment letters were filed in opposition. The key concerns raised in these 37 filings include (1) the lack of a demonstrated need for multiple-use trails, (2) safety/user conflicts, (3) resource damage, (4) the process that DWR used to develop the proposed designated uses, (5) historical use, and (6) accessibility.

Although there were many filings related to trails, only a few entities provided recommendations. The Anglers Committee et al. recommend that DWR maintain the current trail designations as described in the project recreation plan[81] and not allow bicycles on trails designated for horses.

In its motion to intervene filed with the Commission on March 30, 2006, Butte County recommends that DWR improve trails in the project area in response to the high demand for trail use by hikers, equestrians, and bicyclists.

In its motion to intervene filed with the Commission on March 31, 2006, the Action Coalition of Equestrians recommends that DWR preserve and protect the traditional single-track hiking and equestrian trails as a unique resource and not maintain or modify the trails by widening them beyond their current single-track configuration.[82] It recommends that DWR protect hikers and equestrians using the trails by supervising trails, posting signs, and erecting barriers to inappropriate and unsafe mountain bicycle use.

In their motion to intervene filed with the Commission on March 31, 2006, George Weir, Vicki Hittson-Weir, and Pathfinder Quarter Horses et al. recommend that DWR:

- adopt California Equestrian Trails and Land Coalition Safety Guidelines[83] for all multiple-use trails at the Oroville Facilities by 2007 (also recommended in their comments filed with the Commission on April 15, 2006);

[81] On September 22, 1994, the Commission approved a revised recreation plan for the project.

[82] The Dan Beebe Trail was originally designed as a narrow, single-track trail, where two horses could not travel side by side (April 1, 2002, Oroville Recreation Advisory Committee Meeting Notes).

[83] These guidelines, which were filed with the Commission by both the California State Horsemen's Association and Pathfinder Quarter Horses, support multiple-use trails where appropriate and include trails where the terrain and slope do not limit safe passage between equestrian and bicycle users. The California Equestrian Trails and Land Coalition suggests several standards for consideration in multiple-use trail design: (1) visual clearance—switchbacks and curves should have 50 feet of visual clearance to allow users to see oncoming users, (2) trail width—a minimum of 6 feet to allow equestrians and bicyclists to safely pass, (3) trail slope—less than 12 percent if possible to allow for safe passing and visibility, and (4) separate trails —where terrain is steep, visibility is limited, and safe passage is hazardous consider having separate parallel trails. The California Equestrian Trails and Land Coalition also addresses safety associated with a slippery trail surface and safe speeds on multiple-use trails. The California Equestrian Trails and Land Coalition recommends adopting the classic triangle yield sign along with a right-of-way protocol where equestrians have the primary right of way, hikers next, and then bicyclists.

- maintain existing hiking/equestrian trails, according to the Oroville Recreation Advisory Committee's recommendations (in its letter filed with the Commission on March 31, 2003, the Oroville Recreation Advisory Committee stated that it supports multiple-use trails and is in favor of building additional trails but does not support the conversion of the Dan Beebe trail, the Loafer Creek trail, and the Roy Rogers trail to multiple-use);
- allow equestrians on all trails identified as dirt roads and trails that meet the California Equestrian and Land Coalition Safety Guidelines;
- complete the loop trails and water crossings as discussed during settlement negotiations by 2009; and
- permanently classify the Dan Beebe, Loafer Creek Loop, and Roy Rogers trails as Lake Oroville and state of California historical equestrian and hiking trails by 2007 (also recommended in their comments filed with the Commission on April 15, 2006).

In their comments filed with the Commission on April 15, 2006, George Weir, Vicki Hittson-Weir, and Pathfinder Quarter Horses et al. recommend that DWR:

- Recognize and adopt the California Riding and Hiking Trail laws at the Oroville Facilities;
- Provide separate and equal equestrian and hiking trails;
- Repair and maintain the historical Dan Beebe equestrian and hiking trail to its original condition (with watershed erosion prevention) and as a footpath;
- By 2011, cooperate with California Department of Parks and Recreation and the Plumas National Forest to extend the equestrian and hiking trail from the Dan Beebe trail to Feather Falls village and trail and then to the Pacific Crest Trail, according to the California Riding and Hiking Trail laws.

In his motion to intervene filed with the Commission on March 31, 2006, Ronald E. Davis recommends that the Dan Beebe, Roy Rogers, and Loafer Creek Loop trails, which were built for foot traffic, continue to be managed as vehicle-free footpaths and only for hiking and equestrian use. Mr. Davis states that the recreation studies have not identified the need to include bicycles on these trails and that DWR has not cooperated with stakeholders to sufficiently analyze data or to develop alternatives. Mr. Davis states that DWR refused to negotiate with stakeholders in planning new trails, developing trail maintenance standards, enforcing regulations, controlling noxious weeds along the trails, and expanding wheelchair access opportunities.

In her comment letter filed on April 26, 2006, regarding the Settlement Agreement, Annette Kolkey recommends making improvements at the Loafer Creek equestrian campground to accommodate larger vehicles and trailers to reduce congestion. She also recommends DWR build, enhance, and expand stable and arena facilities and retain the equestrian/hiker-only trail designation for the Dan Beebe trail.

In the 102 filings in support of the proposed trail designations proponents explained that: (1) multiple-use trails would provide equal access for trail users and ensure the maximum trail use opportunities for hikers, bicyclists and equestrians, (2) decisions regarding trail uses should be made by local land managing agencies because the Commission's expertise lies elsewhere and (3) the proposed trail designations would increase the loop trail opportunities at the project for both equestrians and bicyclists. Concerns raised in these filings also include: (1) safety, (2) equal access for trail users, (3) the fact that environmental effects of bicycle use on trails are similar to those caused by hikers, and (4) future funding opportunities afforded by a united trails community.

Equestrians who support the proposed trail designations cite the proposed changes for the Bidwell Canyon trail as examples of the improved access that would be provided for all trail users. Currently, half of this loop trail is accessible to bicyclists/hikers with the other half accessible to equestrians/hikers only.

Consequently, neither user group has the opportunity to travel the entire loop because of the "out-and-back" route of travel. In addition, the portion of the trail leading to the shoreline is not accessible to equestrians. Under DWR's proposed designations, bicyclists and equestrians would have loop trail opportunities and equestrians could access the shoreline from this trail.

In its May 26, 2006, filing with the Commission, DWR states that it along with DPR would manage all project trails pursuant to the cited policies of the California Recreational Trails Committee.[84] DWR points out that its relicensing studies concluded that existing relatively low-use project trails provided the opportunity for increased use and enhanced loop opportunities through multiple-use designation. DWR believes that the extensive existing trails network of more than 75 miles did not warrant vast expansion through construction of additional trails to maintain full user segregation. DWR points out that it proposes to retain 6 miles of trail for exclusive use by hikers and equestrians and that it also proposes to expand equestrian opportunities in the project by designating many more miles of relatively low use trails as multiple use. DWR contends that it is committed to preserving an "equestrian-only" experience and has preserved and expanded equestrian trails, in addition to providing the Loafer Creek equestrian campground. DWR also states that it is pursuing a right-of-way outside of the project boundary to construct a new mountain bicycle trail and, if successful, it would revert an additional 3- to 5-mile trail segment back to equestrian/hiker-only status.

In the same filing, DWR asserts that the proposed segregated and multiple-use trails can be operated safely and points out that fewer than 2 percent of project hikers and equestrians surveyed during the period of multiple-use trails reported any perception of risk when encountering bicyclists on the trails. DWR also contends that it relicensing studies concluded that the project facilities, including trails and trailheads, were in good condition. DWR states that the trails would be maintained pursuant to established standards and trail conditions and any additional need for special maintenance.

In Appendix A of its comments on the draft EIS, DWR also notes that that the demonstration mountain bicycle trail originally nominated as an interim project was dismissed by the Interim Projects Task Force because it did not meet its screening criteria. DWR notes that in order to complete the demonstration mountain bicycle trail, it needs to acquire rights-of-way outside of the project boundary which may affect the timing of its development. DWR also points out that it has proposed investigating the feasibility of constructing a new 2 to 4 mile-long trail. Construction of the trail, if feasible, may occur with some supplemental benefits funds for trail segments outside the project boundary, but is contingent upon topographic, jurisdictional, and ownership/easement constraints.

Staff Analysis

Both trail use designation and related trail maintenance have been controversial subjects at the Oroville Facilities for many years. As we show in figure 19 and table 51, the current trail use at the project consists of 2.6 miles of hiking trails, 27.4 miles of equestrian/hiking trails, and 60.1 miles of bicycling/hiking trails (some segments of these trails are also open to equestrians). Overall, equestrians and bicyclists do not share trails at the Oroville Facilities, and it is these two groups that are the most vocal about trail-use designations here. Bicyclists can currently access four main trails in addition to fire roads and other designated areas: the Brad B. Freeman (portions closed to equestrian use) and Bidwell Canyon trail (closed to equestrian use), and the multiple-use Sewim Bo and Potter's Ravine trails. Equestrians can access three main trails closed to bicycle use: the Dan Beebe, Roy Rogers and Loafer Creek Loop trails. About half of the bicycling/hiking trails are on flat gradient near the Thermalito forebay and afterbay; the trail surface for about half of these trails is paved and the other half is graveled. The remaining bicycle/hiking trails and all of the equestrian/hiking trails are in the hills surrounding the Thermalito diversion pool and Lake Oroville; about half of the bicycle/hiking trails in this area are

[84] Staff could not locate these policies on the record or in any publicly available source.

graveled with the remaining trails either paved or dirt. The vast majority of the equestrian/hiking trails are dirt paths; only a small amount are paved or graveled. Bicyclists, equestrians, and hikers may access a small amount of the west side of Lake Oroville from the Potter's Ravine trail.

Under DWR's Proposal, bicyclists and equestrians would gain access to more miles of trail but would have fewer miles of exclusive access[85] than under current conditions. Bicyclists would be able to travel along the Dan Beebe and Loafer Creek Loop trails (approximately 21 additional miles), and equestrians would gain access to the Bidwell Canyon trail and all of the Brad B. Freeman trail (approximately 50 additional miles). This would result in 2.6 miles of trails being available only to hikers, just over 6 miles of trails being available only to hikers and equestrians, and the remaining 81 miles of trails being available to hikers, bicyclists, and equestrians. DWR's Proposal also includes the construction of 0.7 mile of bicyclist/hiking trail and 2 to 5 miles of multiple-use trails. It also proposes to construct 2 to 4 miles of bicycling/hiking trail and then close a portion of the Dan Beebe trail to bicyclists. These additions would create more route options by connecting existing trails to create a looped trail system.

Several entities have recommended that DWR provide separate equestrian and hiking trails instead of creating multi-use trails. Our review of the Recreation and Socioeconomics Work Group meeting notes indicates that several participants actively promoted the development of a mountain bicycle trail parallel to the Dan Beebe trail. In fact, in May 2001, this proposed trail was the second item on the list of high priority items proposed as interim projects at the Oroville Facilities and also appeared in an October 2003 report on the Lake Oroville Trails System. In its Recreation Management Plan, DWR proposes to construct a demonstration mountain bicycle trail from Lakeland Boulevard to Sycamore Hill and upon its completion, closing the Dan Beebe trail to bicycle use. However, DWR contemplates constructing this trail sometime after the first 10 years of the new license. Because this proposed development has had continuous support from so many individuals during the relicensing proceeding, this schedule would not be consistent with DWR's goal of completing high-priority projects within 10 years of relicensing. Furthermore, conversion of the Dan Beebe trail to multiple use, constructing the bicycle trail, and then closing the Dan Beebe trail to bicycle use would result in a change to the physical characteristics of the single-track equestrian trail in order to meet multiple-use standards. While this would allow bicyclists to access portions of the Dan Beebe trail for a period of 10 years, the conversion would have permanent effects, including the expansion of the trail tread width, which would be undesirable to equestrians.

Several equestrian users, who support the proposed trails program, have cited the opportunity to use the Bidwell Canyon loop trail as one improvement that would benefit multiple-user groups. Some bicyclists have also pointed out that a united trails community, including mountain bicyclists and other trail groups, can be a powerful, effective voice for increased funding for federal, state, and local recreational trails.

The many supportive filings for the proposed trail designations conclude that the Proposed Action provides the most public benefit because it opens more trails to more types of use. While bicyclists would gain access to more unpaved trails in the hills and equestrians would be able to travel throughout the project, DWR would do so by opening more than 17 miles of trails to bicycle use where it historically has not been allowed. This change would result in about a 68 percent reduction in the length of trails where equestrians could ride without encountering bicyclists. As a result, many comments focused on the fundamental need for trail use changes and the quality of the recreational experience, as well as for safety and maintenance.

85 Exclusive access in this sense means access without the other user group. Both equestrians and bicyclists already share trails with hikers.

Demand: DWR and DPR convened various trail user groups in an effort to achieve a compromise on trail-use designations; it appears this effort was based on the premise that there is insufficient trail access for bicycling at the project. We recognize a considerable number of filings by bicyclists stating that they want to have increased access to project lands and waters and that regional demand data indicate bicycling is increasing in popularity. We also recognize that the existing trails are appealing to bicyclists and that some may be suitable for this type of use. However, we cannot find adequate documentation (e.g., adequate recreational use data for the project) to form a solid justification for this premise. DWR's mailback survey data[86] indicate existing latent demand for different types of trails. Table 52 shows the percentage of respondents who said there were too few unpaved bicycle and equestrian trails in various locations of the project. Whereas these data show variation in demand between different areas of the project, at Lake Oroville, where most of the trail use occurs, there may be only slightly greater demand for more bicycle trails than equestrian trails. In analyzing the responses regarding Thermalito diversion pool, which is where the Proposed Action would eliminate approximately half of the equestrian-use only type of trail, it appears that more visitors would like to see equestrian trails as compared to bicycle trails. We note that the survey question responses do not distinguish between the need for single-use as opposed to multiple-use trails. However, these data indicate that there is almost equivalent existing demand for bicycle and equestrian trails at the project.

Table 52. DWR mail-back survey responses indicating need for additional types of trails. (Source: DWR, 2004w)

	Percent of Respondents Who Marked 'Too Few' on the Survey					
Type of Trail	**Lake Oroville**	**Thermalito Diversion Pool**	**Low flow Channel**	**Thermalito Forebay**	**Thermalito Afterbay**	**Oroville Wildlife Area**
Unpaved bicycle trail	32.6	31.8	8.0	20.9	26.3	51.9
Equestrian trails	28.1	42.9	7.7	13.3	31.3	28.6

We scrutinize the details of trail demand because on April 1, 2003 DWR filed an application for amendment to the project recreation plan to request approval to change trail designations to multiple-use. In a final environmental assessment and order issued August 17, 2004, the Commission stated that converting project trails to multiple use would adversely change the recreational experience for equestrian users primarily because it may increase the potential for user conflicts and necessitate more trail maintenance and modifications to accommodate the multiple uses. Further, the Commission's research of trails and trail uses in the region identified many trails available to mountain bikers, and it states the approved recreation plan designated special-use trails for equestrians to provide a unique recreational experience. Considering this finding and that there is almost equivalent demand for equestrian and bicycle trails at the project, the fact that existing trails appeal to bicyclists is not necessarily sufficient rationale for reducing the existing opportunity for a unique recreational experience where equestrians can ride without encountering bicycles. Due to the character of project trails we cannot necessarily apply regional recreation-demand data to project recreation.

It is also important to note that DWR's recreational data were, in some cases, inaccurate or incomplete (e.g., counters moved or malfunctioned during data collection period) and the data were collected in 2002-2003, at a time when the trails were managed for multiple use instead of their approved designation. Several equestrian trail users filed letters with the Commission indicating that they no longer used the trails that bicycles were using when the trail designations were changed in 2002. On this basis,

[86] DWR collected 1,071 mailback surveys (2002 to 2003).

the trail use estimates may not reflect the estimated use at the project as it is currently licensed. In addition, DWR states in its report that the data, as collected, did not allow it to accurately determine the proportion of each type of trail use, which leads us to question the proportional trail use estimates presented in the preliminary draft environmental assessment.

Quality of Experience: Equestrians opposed to the proposed trail designations identify some site-specific drawbacks with DWR's proposal. If implemented they state the remaining equestrian/hiker-only routes would consist of three disconnected trail sections that could only be accessed by traveling on multiple-use trails. Further, they point out that some of the proposed loop trail opportunities would not be desirable to many equestrians because they have paved sections. They also point out that planned changes to the Brad B. Freeman trail would create a new route crossing below the Oroville dam leading to the top of the spillway. Once here, equestrians would need to travel over the spillway with two-way vehicular traffic, putting bicyclists and pedestrians in a relatively narrow space, which would deter many equestrians and potentially create safety problems. As such, the Proposed Action would not actually provide the intended benefit of increasing loop trail opportunities for equestrians.

Converting the Dan Beebe trail to multiple-use designation would eliminate the longest equestrian/hiker-only trail at the project. Under the Proposed Action, bicycle use would not be allowed on trails with widely recognized safety concerns, including the Sycamore Hill segment of the Dan Beebe trail. Equestrians would have to use multiple-use trails to access this equestrian/hiking-only segment of the trail unless a parallel trail were constructed at this location. Consequently, equestrians who do not want to ride trails where bicycles are allowed would not be able to use this trail segment. Similarly, bicyclists would not have a continuous route along the Dan Beebe trail because their travel would end at the equestrian/hiker-only portion of the trail, from either direction (see figure 19).

Safety: In addition to site-specific drawbacks, equestrian groups state that poor trail conditions can contribute to accidents and that bicycle use causes more erosion on trails, degrading their condition, impairing user safety, and harming natural resources. Use of the trails by hikers, equestrians, or bicyclists has the potential to harm natural resources if the trails are not properly designed or maintained. On January 27, 2007, DWR filed its year 2 progress report on Recreational Facilities and Operations Effects on Water Quality – Recreational Trails (SP-W3) with the Commission. This report provides detailed information on the composition of the surfaces of the project trails, documents the locations of erosion problems on the trails, and provides and explanation of the causes of the erosion. The information provided in this report is summarized in table 53. This information could be used as a starting point for a trail condition inventory and provide a basis for trail planning.

Table 53. Locations of trails with obvious erosion problems and their causes (Source: DWR, 2006f)

Location of Trails ***Names of Trails***	**Trail Surfaces**	**Problems Observed**
Potters Ravine *Dead Cow Ravine* *North Fork* *Potter Point* *Potter Ravine*	Dirt – 10 miles	Several erosion events related to 74 uncontrolled (i.e., no bridge or culvert) stream crossings 6 sites with erosion caused by steep grades, low spots, or seeps (visitor induced damage in these areas included ATV tire tracks, deep horse prints, bicycle tire tracks, and foot traffic damage)

Location of Trails *Names of Trails*	**Trail Surfaces**	**Problems Observed**
Loafer Creek *Loafer Loop* *Roy Rogers* *Day-use Area* *Campfire Center*	Dirt – 13.2 miles Paved – 1.2 miles	47 sites with obvious erosion due to both natural causes and human activities: uncontrolled (i.e., no bridge or culvert) intermittent stream or swale crossings or high gradient slopes, :
Kelly Ridge *Bidwell Canyon* *Dan Beebe* *Bidwell Bar Bridge/Wyk Island* *Visitors Center*	Dirt – 12.2 miles Gravel – 0.2 miles Paved – 0.4 mile Wood - 0.05 mile	40 sites with obvious erosion primarily associated with uncontrolled (i.e., no bridge or culvert) intermittent stream crossings (high amount of human traffic from the Kelly Ridge neighborhood and the Bidwell Canyon campground)
Thermalito diversion pool *Dan Beebe* *Brad Freeman*	Dirt – 9 miles Gravel – 14.3 miles Paved – 5.7 miles	107 sites with erosion, particularly along the steeper trails where hikers, bicyclists, and equestrians take shortcuts across switchbacks thus developing new overly (some near vertical) steep trails. Also, mountain bicyclists, motorcyclists, and ATV users cut new detour trails by driving off the established trails, destroying the already-scant vegetation and exposing more soils.
Thermalito forebay *Brad Freeman*	Gravel – 5.9 miles Paved – 1.6 miles	Few sites with erosion on the north side of the forebay
Thermalito afterbay *Brad Freeman*	Dirt – 1.7 miles Gravel – 1.6 miles Paved – 7.75 miles	8 sites with erosion in area with graded native soil including roadside sedimentation and culvert scour. Also some off-road vehicle damage
Riverbend Park *Brad Freeman*	4.4 miles – mostly paved with some buried gravel/cobble or dirt	Minor damage due to off-road vehicles

In their filings, equestrians opposed to the proposed trail designations provided case histories documenting user conflicts between equestrians and bicyclists. Circumstances such as excessive speed, uncontrolled bicycle descents, sudden encounters at narrow trail sections or blind corners and bicyclists failing to yield to equestrians can spook horses and potentially cause accidents. Although we do not debate whether user conflicts would or would not occur, we find that the proposed trail designations, at a minimum, could create the potential for conflicts. DWR rebuts the equestrian's assertion that user conflicts currently exist based on its recreational survey data. However, as stated earlier, we find that DWR's data may be inadequate and it should not necessarily be relied upon to fully assess whether user conflicts are occurring. Proper trail design, maintenance, patrols, and enforcement on multiple-use trails could minimize potential user conflicts but they would not entirely eliminate them because discourteous and inappropriate trail behavior cannot be addressed through these management actions. We also find that equestrian/hiking-only use trails provide a safer environment for equestrians with disabilities.

Maintenance: Pathfinder Quarter Horses et al. recommend that DWR adopt the California Equestrian Trails and Land Coalition Safety Guidelines for all multiple-use trails at the Oroville Facilities by 2007. Although a trail may be designated for a particular use or uses, improper trail maintenance can render the trail unsuitable for such use(s) and create user conflicts. Trails should provide a safe environment for all users, including those disabled individuals who use stock animals, such as horses or mules, to provide access to the outdoors. DWR, in its comments on the draft EIS, states that it is more appropriate to use the trail guidelines developed by DPR.

We note that Pathfinder Quarter Horses et al.'s recommended standards differ from those currently applicable to project trails. The existing project trail maintenance standards were developed more than 10 years ago, and these state of California standards are currently being updated (personal communication from F. Green, Recreation Specialist, Berger, Tallassee, AL, with S. Musillami, State Trails Coordinator, Sacramento, CA, on June 23, 2006). Incorporating DWR's standards into the Recreation Management Plan or providing them as an appendix, would make this information readily available to those participating on the Recreation Advisory Committee and provide a consistent measure for monitoring purposes. It would be reasonable to replace the 1991 Trails Handbook with DWR's updated version when it becomes available.

Pathfinder Quarter Horses et al. recommend that DWR recognize and adopt the California Riding and Hiking Trail laws at the Oroville Facilities. Approximately 7 miles of the Dan Beebe Trail was constructed as part of legislation passed in 1944 that established the California Riding and Hiking Trails Project, the purpose of which was to initiate the development of a statewide trails system (Equestrian Land Conservation Resource, 2005). In 1955, the California Riding and Hiking Trails Act was amended to permit the establishment and construction of secondary trails to provide better use and access from communities to the trail. By the early 1960s 1,060 miles of the trail had been completed, including approximately 7 miles of the Dan Beebe trail, which was intended as one of the secondary trails. In 1974 the act was repealed, amended, and renamed the California Recreational Trails Act (Equestrian Land Conservation Resource, 2005). This act required that the Department of Parks and Recreation prepare California's first comprehensive plan for trails. The 1978 California Recreational Trails Plan supported the creation of trail corridors and provided a general guide for the future growth of California's trail system. The California Recreational Trails Plan was updated in 2001, and in that document DPR proposed evaluating the status of previously secured easements for the California Riding and Hiking Trail and evaluating the feasibility for continuance of the trail's expansion (DPR, 2001). The proposed project would retain access for riding and hiking along this trail, which is consistent with California's trail plan.

Pathfinder Quarter Horses et al. also recommend that DWR classify the Dan Beebe, Loafer Creek Loop, and Roy Rogers trails as Lake Oroville and state of California historic equestrian and hiking trails. The Dan Beebe trail was originally constructed as part of the California Riding and Hiking trail. DWR evaluated historic resources at the project and did not report any historic significance for these trails. We can find no evidence on record to support historic designation as Pathfinder Quarter Horses et al. recommends.

Pathfinder Quarter Horses et al. recommend that DWR cooperate with California Department of Parks and Recreation and the Plumas National Forest to extend the equestrian and hiking trail from the Dan Beebe trail to Feather Falls village and trail and then to the Pacific Crest Trail, according to the California Riding and Hiking Trail laws. It appears that this recommendation was part of the original plan for the California Riding and Hiking trail. This recommended trail extension would not provide access to project lands and waters and does not have a nexus to the project.

License Coordination Unit—Within 6 months of license issuance, DWR would establish a License Coordination Unit in Oroville to manage the terms and conditions of the new license. This unit would: (1) manage the recreational, environmental, and other terms and conditions of the license; (2) ensure compliance with the regulatory framework defined by the Commission and other regulatory agencies; and (3) provide a local point of contact for the community. As proposed, the License Coordination Unit would encourage and facilitate more local awareness and involvement in implementation of the terms and conditions of a new license through biannual community workshops and a web-based bulletin board with project status reports, community workshop notes, and other information related to the new license. The License Coordination Unit would also investigate and evaluate disputes associated with the new license and recommend a course of action to resolve each dispute. It would also be responsible for coordinating with PG&E to provide daily flow release information from the Poe Project via a web link and/or a flow phone.

In its motion to intervene filed with the Commission on March 30, 2006, Butte County recommends that DWR provide adequate funding, staffing and facilities to support public safety patrols, project O&M, information and interpretive services, and other reasonable expected services. These recommendations are analyzed in section.3.3.10.2, *Socioeconomic Resources.*

Staff Analysis

Providing DWR staff whose sole responsibility would be implementing the new license at the Oroville Facilities would provide a centralized point of contact within DWR for license compliance. Locating staff in Oroville would provide a local DWR presence, allowing the community to interact with DWR staff on a more frequent basis to discuss any concerns with the current project operations. Biannual community workshops would provide a forum for citizens with concerns or comments on the Oroville Facilities to share their thoughts and opinions.

Recreation Advisory Committee—Within 6 months of license issuance, DWR would establish and convene a Recreation Advisory Committee for the purpose of advising DWR on Recreation Management Plan implementation, reviewing recreational use data, and recommending modifications to the plan throughout the term of the new license. As proposed, the Recreation Advisory Committee meetings would be held in Oroville, meeting announcements and agendas would be posted on DWR's web site and noticed in the local paper, and meeting summaries would be posted on its web site and made available at the Butte County library or other suitable location. In addition, members of the Recreation Advisory Committee would cover their own costs to attend meetings, meetings would be open to the public, and the public would be allowed to ask recreation-related questions and provide potential solutions to issues at Recreation Advisory Committee meetings.

Section 4.4 of the Recreation Management Plan states that Recreation Advisory Committee members must be signatories to the Settlement Agreement and include representatives of DWR, DPR, DFG, California Department of Boating and Waterways (DBW), SWC, Butte County, Feather River Parks and Recreation Department, the city of Oroville, the city of Paradise, the Oroville Chamber of Commerce, American Rivers, one Native American representative who is collectively selected by agreement among the tribes in the project vicinity, and two at-large public representatives who are chosen by the Recreation Advisory Committee from lists of candidates supplied by Butte County and the city of Oroville. The at-large public representatives would serve a 2-year term.

DWR, through its License Coordination Unit, would arrange, administer, and permanently chair the Recreation Advisory Committee meetings. DWR would provide a facilitator during meetings if the Recreation Advisory Committee determines a need for one. DWR would provide an annual report on attendance and other monitoring of project recreational facilities to the Recreation Advisory Committee to the Commission. Every 2 years, DWR would provide project recreational use monitoring data and reports, along with a record of all of the recommendations made by the Recreation Advisory Committee to the Commission.

As proposed, the Recreation Advisory Committee would meet at least 3 times per year during the first 2 years of the new license and a minimum of 2 times per year thereafter; however, the Recreation Advisory Committee could recommend and request additional meetings in writing as necessary to address license conditions and to make recommendations to DWR.

As proposed, the Recreation Advisory Committee would: (1) advise DWR on Recreation Management Plan compliance and implementation and other recreational license requirements, including priorities, schedules, public workshops, and operational issues associated with recreation, (2) review and assess monitoring results and recreation studies and provide recommendations to the License Coordination Unit, (3) recommend goals and objectives regarding recreational resources to the License Coordination Unit, (4) assist with addressing comments/issues raised in the community workshops through recommendations to the License Coordination Unit, and (5) periodically review the Recreation Advisory Committee operations, and modify them if needed.

In its comments on the Settlement Agreement filed April 26, 2006, Butte County points out that it and some other key stakeholders who, because they are not signatories to the Settlement Agreement, would be excluded from participating in the Recreation Advisory Committee. Butte County states that the Oroville Facilities are located entirely in Butte County and DWR depends on Butte County for many governmental services, including fire protection and law enforcement. Butte County contends that it can speak for all of the directly affected public and effectively represent their interests. Butte County is concerned that it would not be a consulted party during the implementation of a new license and would not receive the license compliance reports. Butte County also recommends that DWR consult with the Recreation Advisory Committee during the implementation of Proposed Articles A104, *Structural Habitat Supplementation and Improvement Program Plan*, and A110, *Lake Oroville Warm Water Fishery Habitat Improvement Program*.

In its motion to intervene, filed with the Commission on March 30, 2006, Butte County states that it should be a consulted party with respect to the project's recreational activities and recommends that the existing Recreation Advisory Committee be continued under the new license.

In its motion to intervene filed with the Commission on December 16, 2005, the Anglers Committee et al. recommend that (1) DWR and the Commission should, without prejudice, decide which parties should be members of the Recreation Advisory Committee, (2) the Recreation Advisory Committee should include at least three NGOs, (3) citizens be allowed to file applications to become members of the Recreation Advisory Committee, (4) DWR should hold Recreation Advisory Committee meetings at least 6 times a year at locations in Oroville at an accessible facility, (5) the Recreation Advisory Committee should develop and implement by-laws and protocols for conducting business, (6) the Recreation Advisory Committee should develop a complaint process allowing citizens to file complaints against DWR and/or the Recreation Advisory Committee, (7) the Recreation Advisory Committee should not discriminate against anyone filing comments or complaints with the Recreation Advisory Committee, (8) DWR should develop both a mailing list and a web site to advise the public of Recreation Advisory Committee meetings and provide meeting agendas and minutes, (9) DWR should prepare an annual report detailing the Recreation Advisory Committee activities for submission to the

Commission and for public review, and (10) DWR should fund all Recreation Advisory Committee business activities.

In its motion to intervene filed with the Commission on March 31, 2006, the Action Coalition of Equestrians recommends removing the following provisions from the Recreation Management Plan related to the Recreation Advisory Committee: (1) only parties signing the Settlement Agreement may be members of the Recreation Advisory Committee, (2) a signatory may not consider material new evidence, particularly such material provided through NEPA, CEQA, or other environmental reviews, (3) a signatory may not withdraw from the Settlement Agreement, and (4) a signatory may not criticize the Settlement Agreement or any of the management plans to the Commission or any other agency.

In their motion to intervene filed with the Commission on March 31, 2006, and in comments filed with the Commission on April 15, 2006, George Weir, Vicki Hittson-Weir, and Pathfinder Quarter Horses et al. recommend that the existing Oroville Recreation Advisory Committee[87] remain in place to receive community recommendations, oversee feasibility and environmental studies, and advise, on a quarterly basis, the Oroville Joint Powers Authority of recommended projects. Pathfinder Quarter Horses et al. recommend that the existing committee oversee DPR management of the project recreational facilities. Pathfinder Quarter Horses et al. also recommend establishing the Oroville Joint Powers Authority, whose members would include Butte County supervisors representing the cities of Oroville, Richvale, and Paradise, three Oroville City Council members, and the mayor of Paradise. Pathfinder Quarter Horses et al. recommend that the Oroville Joint Powers Authority would serve as trustee for the Lake Oroville Enhancement Trust, which would be created from 30 percent of the value of the hydropower revenues in a given year, beginning January 31, 2008, with the 2007 revenue value. Pathfinder Quarter Horses et al. recommend that the Oroville Joint Powers Authority would administer this trust for all recreational facilities for the duration of the license.

In his motion to intervene filed with the Commission on March 31, 2006, Ronald E. Davis states that restricting participation on the Recreation Advisory Committee to signers of the Settlement Agreement is a violation of public trust. Mr. Davis contends that the Feather River and Lake Oroville are navigable waterways and are subject to the Public Trust Doctrine. Mr. Davis believes that committees, such as the Recreation Advisory Committee, which are relevant to the operation plan of navigable waterways, should be open and not restricted to only those who have promised to agree with state government.

In its May 26, 2006, filing with the Commission, DWR points out that the Oroville Recreation Advisory Committee was a concept proposed by DWR under the current license, not a unilateral mandate by the Commission. DWR states that the Recreation Management Plan establishes the Recreation Advisory Committee for the purpose of advising DWR on implementation of the components of the plan, reviewing recreational use data for project facilities, and periodically recommending modifications to the plan at prescribed milestones throughout the term of the new license. DWR also explains that only allowing parties to the Settlement Agreement to serve on the Recreation Advisory Committee was a provision specifically negotiated by settlement parties and is wholly consistent with Commission precedent.

Staff Analysis

Recreation management has been one of the most contentious issues raised during DWR's relicensing effort. Entities with an interest in recreation management at the Oroville Facilities include federal, state, and local agencies; a multitude of user groups; and many individuals. In essence, there is extensive public and agency interest in recreation management at the project. Under the current license,

---

[87] The Oroville Recreation Advisory Committee is the name of the *existing* oversight committee. The Recreation Advisory Committee is the name of the *proposed* oversight committee.

the Commission approved the licensee's revised recreation plan on September 22, 1994. The revised recreation plan includes a provision for convening the Recreation Advisory Committee, which comprises representatives of the following entities: DFG, DPR, DBW, the city of Oroville, Butte County, the Oroville Chamber of Commerce, the California Sportfishing Alliance, the Enhancement Committee, Butte County Citizens, the Butte Sailing Club, Citizens for Fair Use, the State Water Contractors, and DWR. The Oroville Recreation Advisory Committee has met on a monthly basis since its inception in 1994 and is charged with reviewing existing recreational facilities in the project area and use at the Oroville Facilities and assessing the need for any additions or improvements, including the type, quantity, location, and installation schedule of additional facilities. The Oroville Recreation Advisory Committee also discusses operating schedules and procedures, management and maintenance issues, and the need for changes to such practices. DWR participated in the monthly Oroville Recreation Advisory Committee meetings until March 2003, including three meetings in 2003. In March 2003, DWR informed the Commission of its decision to limit its participation to two meetings a year, (letter from Raymond D. Hart, Deputy Director, DWR, to Magalie R. Salas, Secretary, Federal Energy Regulatory Commission, on March 18, 2003). DWR indicated that its workload had increased significantly with relicensing and other projects and that recreational issues were also being addressed by the Recreation and Socioeconomics Work Group and the Oroville Joint Powers Authority.

As part of a new license for the Oroville Facilities, DWR proposes to replace the Oroville Recreation Advisory Committee with the Recreation Advisory Committee. Consulting with various entities regarding the implementation of the Recreation Management Plan would efficiently ensure that the intent of the various terms and conditions would be met. Under the process outlined in the Recreation Management Plan, the Recreation Advisory Committee would receive community recommendations, as Pathfinder Quarter Horses et al. recommend. We note the Oroville Recreation Advisory Committee is a signatory to the Settlement Agreement, which indicates its support for the Settlement Agreement, including the proposed Recreation Advisory Committee.

We find that the Recreation Advisory Committee would be the appropriate entity to provide advice, guidance to DWR on matters involving project recreation management. It is not appropriate to establish a Joint Powers Authority that would administer recreational facilities, as Pathfinder Quarter Horses et al. recommend. Such an entity may implement recreation management actions that are not consistent with DWR's ultimate responsibility to provide adequate recreational facilities at the project.

Several entities do not agree with the Recreation Advisory Committee membership provision to be a signatory to the Settlement Agreement. DWR proposes that Recreation Advisory Committee members be signatories to the Settlement Agreement because the voting structure of the Recreation Advisory Committee represents months of settlement negotiations. Further, DWR cites relicensing proceedings whereby the Commission determined that entities with decisional roles regarding a Settlement Agreement should be bound by the terms of the Settlement Agreement. Recreation Advisory Committee membership requirements, as proposed, would be consistent with prior Commission findings.

Regarding specific Recreation Advisory Committee organizational recommendations from the Anglers Committee et al., we find that the process outlined in the Recreation Management Plan would provide: (1) sufficient number of meetings per year, (2) adequately outlined protocols, (3) a dispute resolution process, (4) an open and accessible public participation process, (5) a forum for reporting on matters related to project recreation, and (6) citizen membership.[88] As proposed, the Recreation Management Plan would accommodate all but one of the recommendations made by the Anglers Committee al. Contrary to the recommendation of the Angler Committee et al., DWR would not fund

[88] The Proposed Action provides for two at-large public members selected from lists of candidates suggested by the city of Oroville and Butte County.

member participation for the Recreation Advisory Committee. Such reimbursement is not a licensee's responsibility and could create a conflict of interest.

We recognize Butte County's role as it relates to the project and that there may be several matters during the course of the license term that may affect its interests whether or not Butte County becomes a signatory to the Settlement Agreement in the future.[89] The County could still participate with the Recreation Advisory Committee through its public participation process. Further, all compliance reports filed for the project are accessible to the public through eLibrary located on the Commission's web site, and Butte County could participate in matters involving Proposed Articles A104, *Structural Habitat Supplementation and Improvement Program Plan*, and A110, *Lake Oroville Warm Water Fishery Habitat Improvement Program*, through the proposed License Coordination Unit public workshops.

Action Coalition of Equestrians expressed its concern that the Recreation Advisory Committee may not consider material new evidence, particularly such material provided through NEPA, CEQA, or other environmental reviews. We agree that new information should be considered by the Recreation Advisory Committee and our understanding is that the Recreation Advisory Committee would review and assess usage surveys and monitoring results and provide recommendations to the License Coordination Unit.

Action Coalition of Equestrians is also concerned that a signatory may not criticize the Settlement Agreement or any of the management plans to the Commission or any other agency. We understand that DWR proposes to resolve disputes through its administrative and dispute resolution process but also recognize that any entity may file a complaint with the Commission at any time.

Oroville Recreation Coordinating Agencies—To ensure that recreational opportunities at the Oroville Facilities are adequately and efficiently provided to the public, local staff from DWR, DPR, DFG, DBW, and California Highway Patrol would continue to meet regularly to address project and non project interagency management through a forum called the Oroville Recreation Coordination Agencies (ORCA). As proposed, ORCA would meet periodically as needed during each year and throughout the license term to facilitate short- and intermediate-term interagency and inter-departmental operations coordination and planning.

In its comments on the Settlement Agreement, filed April 26, 2006, Butte County expresses its concern with ORCA, as proposed. Butte County does not believe that infrequent meetings would be effective for meeting the project's recreational needs.

Staff Analysis

ORCA would provide a means for clarifying the roles of DWR, DPR, DFG, DBW, California Highway Patrol, and other responsible entities in managing, maintaining, and developing project area recreational resources. ORCA would provide a forum for agencies with jurisdiction in the project area to clarify its recreational resource related financial, managerial, legal, security and patrol, development, and maintenance responsibilities at the Oroville Facilities. This would have a beneficial effect on recreation by providing more efficient, effective, and coordinated recreation management within the project area.

A set ORCA meeting schedule could be filed with the Commission for informational purposes and to inform the Commission staff members responsible for license compliance of its immediate and short-term plans at the Oroville Facilities. Although DWR is ultimately responsible for actions under the project license, we recognize that other agencies have jurisdiction in the project area. DWR could use the reporting component of the Recreation Management Plan to report the ongoing and agreed-upon responsibilities of these other agencies.

---

89 Section 4.4 of the Recreation Management Plan already lists Butte County as a member of the Recreation Advisory Committee.

Fourth of July Fireworks—DWR would cooperate with local groups to plan the annual fireworks presentation at Lake Oroville on or about the fourth of July and provide an estimated $210,000 to support this event.

Staff Analysis

We understand DWR's long-standing commitment to supporting the popular Fourth of July event. DWR has not identified the effect of the project that creates the need for this measure. Accordingly, we cannot determine that this measure has a project nexus and determined that its implementation would not mitigate any project effect(s). We recognize the value of this event to the local community, and DWR may choose to continue to support this effort outside of the project license.

Recreation Implementation Plan—Within 1 year of license issuance and following consultation with the Recreation Advisory Committee, DWR would file a Recreation Implementation Plan with the Commission for approval. DWR would include in this plan an implementation schedule for the first 12 years, any comments or recommendations made during consultation, and an explanation of why any comment or recommendation was not adopted. DWR recognizes that the Commission may change the Recreation Management Plan and/or the Recreation Implementation Plan. DWR would implement the plan approved by the Commission.

Staff Analysis

In its Recreation Management Plan, DWR would provide a schedule for completing its proposed recreational facilities developments to would ensure these improvements would be completed in a timely manner.

Structural Habitat Supplementation and Improvement Program Plan (Proposed Article A104)

Under Proposed Article A104, *Structural Habitat Supplementation and Improvement Program Plan*, DWR would provide additional salmonid rearing habitat in the Feather River by adding structural habitat, including LWD, boulders, and other objects. The LWD used in this program would include multi-branched trees at least 12 inches in diameter at chest height and at least 10 feet long, but preferably 20 feet or longer. See section 3.3.3.2, *Aquatic Resources*, for a detailed description of this proposed article.

Staff Analysis

Nearly 14 miles of the Feather River downstream of the Thermalito diversion pool is within the project boundary. The OWA is adjacent to or straddles 12 miles of the Feather River. Bank fishing is the most popular recreational activity along the Feather River, and a few motorized and non-motorized boaters use the low flow channel. Adding structural habitat to the Feather River channel would improve habitat for salmonid fish species and would likely have a beneficial effect on recreation by increasing the number of fish in the river. Catch rates would likely increase with more fish in the river, improving angling opportunities. It is possible that adding structures in the channel could impede navigation and create hazards for river users. However, DWR's Proposed Article A103, *Channel Improvement Program*, includes completing a safety analysis and modifying any planned projects to ensure that issues relating to human safety are adequately addressed.

Fish Weir Program (Proposed Article A105)

Under proposed Article A105, *Fish Weir Program*, DWR would develop and implement a plan to install and operate a monitoring fish weir in the Feather River upstream of the Thermalito afterbay outlet within 3 years of license issuance. DWR would also install and operate an anadromous fish segregation weir in the Feather River upstream of the Thermalito afterbay outlet within 12 years of license issuance. See section 3.3.5.2, *Threatened and Endangered Species*, for detailed description of this proposed article.

Staff Analysis

Providing fish weirs in the Feather River channel would likely have a temporary adverse effect on recreation if angling closures or restrictions are required when either installing the fish weirs or seasonally operating them. Additionally DFG may impose fishing closures around the weirs to reduce the opportunity for poaching or inadvertently catching spawning Chinook salmon due to increased Chinook densities below the weir. Boating recreation activities may also be adversely affected by both the installation and operation of the fish weirs.

Flow/Temperature to Support Anadromous Fish (Proposed Article A108)

Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*, specifies minimum instream flow releases in the low and high flow channels. During most of the recreational season, the target temperature in the low flow channel would be 63ºF; the target temperature during the last week of the recreational season would be 58ºF. DWR anticipates meeting specific temperature targets with the specified flows. However, if DWR does not meet the temperature targets, it would increase flow releases in the low flow channel up to 1,500 cfs. Minimum flow releases would not result in the elevation of Lake Oroville going below elevation 733 feet msl. DWR also proposes to possibly modify some of the Oroville Facilities to lowering temperature conditions in the low flow and high flow channels for anadromous fish. See section 3.3.2, *Aquatic Resources*, for a detailed description of this proposed article.

Staff Analysis

DWR currently provides a 600-cfs minimum flow in the Feather River to support occasional kayaking and floating. The marginal increase would not create a noticeable difference in the boating conditions in the Feather River, so it is likely that the same level of boating activity would occur under the proposed flow regime. This measure could have a beneficial effect on recreational by increasing spawning and potentially, in the long term, increasing the number of fish in the Feather River.

Further, DWR proposes to increase flow releases in the low flow channel up to 1,500 cfs if it does not meet its temperature targets, which could have a mixed effect on recreation. Under this contingent operation, the flow regime would only occasionally occur because of the conditional nature of this measure and because DWR would only need to release sufficient water *up to* 1,500 cfs. In the event DWR releases the maximum required release of 1,500 cfs, it would more than double the current minimum flow in the low flow channel. This flow would increase the boating difficulty by creating new, but infrequent, boating opportunities in the Feather River. This higher flow would occasionally present difficult conditions for wading anglers. Motorized boating use does not usually occur in the low flow channel, so these users would not be affected by any of the flow releases.

Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*, would not likely affect swimming in the low flow and high flow channels within the project boundary. We note that there is a public, non-project swimming beach in the low flow channel upstream of Highway 70. The area is enclosed by a berm that provides calm water for swimmers. This berm has retained its function even during high flow events in the past. We would expect this swimming area would continue to be protected from the river current, despite the proposed increase in minimum instream flows.

Water temperatures in the low and high flow channels may be slightly lower under the Proposed Action. Since the existing swimming use is already low because of cool water temperatures, further lowering water temperature, albeit slightly, would not affect many swimmers. Also, most swimming at the project occurs at Lake Oroville, Thermalito forebay, and Thermalito afterbay, and swimming in these areas would not be affected by increased minimum instream flows downstream of Lake Oroville.

Lake Oroville Warmwater Fishery Habitat Improvement Program (Proposed Article A110)

Under Proposed Article A110, *Lake Oroville Warm Water Fishery Habitat Improvement Program*, DWR would develop a plan to improve the warmwater fishery spawning and rearing habitat in Lake Oroville. The plan would be implemented in 7-year intervals and would include constructing, operating, and maintaining projects to improve the warmwater fishery habitat within the reservoir or fluctuation zone; constructing specific habitat units in the first 7 years of the license; conducting a monitoring program, including angler creel surveys; and modifying habitat units based on monitoring results, need, or improvements in technology. See section 3.3.3.2, *Aquatic Resources*, for a detailed description of this proposed article.

Staff Analysis

As discussed in section 3.3.3.1, *Affected Environment* in *Aquatic Resources*, the Lake Oroville warmwater fishery is self-sustaining and includes warmwater sport fish, such as bass species (spotted, largemouth, redeye, and smallmouth bass), catfish species (channel and white catfish), and white and black crappie. Terrestrial vegetation along the reservoir shoreline provides spawning and nursery habitat for warmwater fisheries, offers protection from predation, and results in increased food availability. This terrestrial vegetation is inundated at higher lake levels but gradually becomes unavailable to fish as the reservoir is drawn down during the summer months. DWR currently increases and/or improves the structural complexity of habitat for warmwater fish species in Lake Oroville by constructing reefs of recycled Christmas trees, weighted pipes, riprap, LWD, and boulders, and placing them in the fluctuation zone. Continuing to improve habitat for warmwater fish species in Lake Oroville would likely increase the number of warmwater fish in the reservoir and increase catch rates for anglers.

Considering the shortage of suitable swimming areas at Lake Oroville, it appears likely that there would be considerable overlap between suitable areas for swimming and habitat enhancement (e.g., shallow slopes in the inundation zone). The warmwater habitat structures, as proposed, could introduce safety hazards to swimmers, if such improvements were placed in areas where swimming occurs at depths where swimmers could not see these structures and strike them or become entangled.

Lake Oroville Coldwater Fishery Improvement Program (Proposed Article A111)

Under Proposed Article A111, *Lake Oroville Cold Water Fishery Habitat Improvement Program*, DWR would develop a plan to provide a coldwater fishery in Lake Oroville primarily for the purpose of recreational fishing. The plan would provide for the stocking of 170,000 yearling salmon or equivalents per year in Lake Oroville. See section 3.3.3.2, *Aquatic Resources,* for a detailed description of this proposed article.

Staff Analysis

As discussed in section 3.3.3.1, *Affected Environment,* in *Aquatic Resources*, the Lake Oroville coldwater fishery is managed as a put-and-grow fishery, meaning that hatchery raised fish are stocked in Lake Oroville as juveniles, with the intent that they will grow in the lake before they are caught by anglers. The coldwater fishery is sustained by hatchery stocking because natural recruitment to the Lake Oroville coldwater fishery is very low (e.g., project blocks natural migration and inundates spawning habitat). DWR's stocking goal for Lake Oroville for 2006 and 2007 would be 170,000 yearling or yearling-equivalent coho raised in the Feather River. Continuing to stock coldwater fish species in Lake Oroville would benefit recreation by maintaining the current number of catchable coldwater fish for anglers in the reservoir. Coldwater angling opportunities would likely remain the same as those that currently exist at the project.

Comprehensive Water Quality Monitoring Program (Proposed Article A112) and Public Education Regarding Risks of Fish Contamination (Proposed Article A114)

Under Proposed Article A112, *Comprehensive Water Quality Monitoring Program*, DWR would develop and implement a water quality monitoring program at the Oroville Facilities. DWR would develop and implement a fish tissue bioaccumulation monitoring plan for metals and organic compounds and a recreational site water quality monitoring plan for monitoring pathogens, petroleum products, and soil erosion. Under this plan, DWR would conduct bacteriological monitoring during the summer at 12 to 16 locations throughout the project, including developed beach areas, marinas, boat launch areas, and high use dispersed beach and shoreline locations. The North Thermalito forebay swimming lagoon and the South Thermalito forebay swimming area would be sampled every year, and sampling other project sites would occur on a rotating schedule. DWR would also monitor 6 project sites, including Lime Saddle marina, Foreman Creek boat-in campground, Spillway day-use area (including the boat ramp), Bidwell Canyon marina, Oroville dam, and Monument Hill day-use area throughout the summer for the presence of petroleum projects. Finally, DWR would inspect trails to identify soil erosion in the spring and at the conclusion of the summer recreational season. See section 3.3.2.2, *Water Quantity and Quality*, for a detailed description of this proposed article.

Under Proposed Article A114, *Public Education Regarding Risks of Fish Consumption*, DWR would post notices at all boat ramps and other locations specified by OEHHA within the project boundary, notifying the public about health issues associated with consuming fish taken from project waters. DWR would also provide funding to OEHHA to facilitate publishing written materials notifying the public about health issues associated with consuming fish taken from project waters. DWR would file an annual compliance report with the Commission. See section 3.3.2.2, *Water Quantity and Quality*, for a detailed description of this proposed article.

Staff Analysis

Sampling of fish tissue at the Oroville Facilities has shown occasional elevated metal concentrations based on comparison to recommended guidelines from various regulatory agencies (see section 3.3.2.1, *Water Quantity and Quality*). Monitoring metals and organic compounds in fish taken from the Oroville Facilities throughout the term of the license would inform DWR and the angling public of the safety of fish taken for human consumption.

In 2003, DWR detected coliform bacteria at several recreational sites at Lake Oroville, the Thermalito forebay, and the Thermalito afterbay, and bacteria levels were high enough to trigger beach posting or closure at 9 sites (see section 3.3.2.1, *Water Quantity and Quality*). DWR also investigated the presence of MTBE, oils, greases, or waxes because of the potential for these compounds to be released into Lake Oroville through boating use, fuel pumping, and fuel storage activities at or near marinas or along the Lake Oroville shoreline. DWR found only a small amount of MTBE (a concentration well below the allowable maximum contaminant level) in the Thermalito diversion pool. The presence of bacteriological pathogens and/or petroleum products in recreational waters used by swimmers and/or waders is a human health hazard. Considering contaminants have recently been detected in project waters, DWR would monitor for their presence in project waters throughout the license term to ensure public safety.

The level of total suspended solids is currently low in all of the project waterbodies. However, monitoring trails for soil erosion would ensure that trails are maintained to appropriate standards and would eliminate a potential source of sediment in the reservoirs and the Feather River.

Monitoring of Bacteria Levels and Public Education (Proposed Article A113)

Under Proposed ArticleA113, *Monitor Bacteria Levels and Provide Public Education and Notification*, DWR would monitor fecal coliform, enterococcus bacteria, or other bacterial indicators as required by the Basin Plan from June 1 until September 30 at developed and popular undeveloped swimming areas within the project boundary, including the Lime Saddle, Loafer Creek, and Monument Hill day-use areas, the Foreman Creek and Stringtown boat launches, the North and South Thermalito forebay swimming areas, and One Mile Pond. DWR would provide the monitoring information to the appropriate public agencies and the Recreation Advisory Committee. If directed to do so by a public agency, DWR would post notices notifying the public if unsafe levels of bacteria are present in the water. DWR would also post notices educating the public on sanitary measures designed to prevent or minimize contamination of water. DWR would also consult with the Butte County Health Department, DHS, the Water Board, and the Regional Board to determine if a public education program is needed to inform visitors to the project about water quality and the risk of recreating in contaminated waters. If needed, DWR would develop the public education program in consultation with the above agencies. DWR would file an annual compliance report with the Commission. We analyze the effects of this measure on water quality in section 3.3.2.2, *Water Quantity and Quality.*

Staff Analysis

DWR's studies revealed sufficiently high levels of coliform bacteria at several recreational sites at Lake Oroville, the Thermalito forebay, and the Thermalito afterbay to trigger beach posting or closure at nine sites. Continuing to post notices of unsafe levels of bacteria in the water would safeguard human health and safety. Providing information to the public about sanitary measures to prevent or minimize contamination of water may eliminate some of the causes of the bacterial contamination, which would then protect human health and safety. Incorporating a public education program about the risks of recreating in contaminated waters into the I&E Program component of the Recreation Management Plan would enhance the efficiency of such a program.

Oroville Wildlife Area Management Plan (Proposed Article A115)

Under Proposed Article A115, *OWA Management Plan*, DWR would develop and implement a management plan for the OWA, including the Thermalito afterbay. The plan would address strategies for minimizing current and future conflicts between wildlife and recreation, recreation management goals and objectives, and actions designed to improve conditions for special status species and their habitats. Among other things DWR would re-evaluate the plan every 5 years after initial implementation. The Recreation Advisory Committee would have an opportunity to provide input to the original plan and during the subsequent reevaluations of the plan. See section 3.3.4.2, *Terrestrial Resources*, for a detailed description of this proposed article.

In Appendix A of its comments on the draft EIS, DWR suggests coordinating the schedule for reevaluating the plan with updates required by DFG to avoid having multiple plans in place for the same area at the same time. DWR notes that DFG has a 2 to 3 year cycle for regulation changes and DWR suggests using this shorter recurring period so that it would also coincide with staff's recommendation to re-evaluate the OWA Management Plan every 6 years.

Staff Analysis

DWR's studies found areas of conflict between recreational and wildlife resources in the OWA. For example, unmanaged OHV use has caused soil compaction and altered water flow to vernal pool habitat. In addition, there are multiple entities with management responsibility for this area which have differing mandates. Defining priorities and responsibilities would assist with resolving existing conflicts between wildlife management objectives and recreational activities in the OWA and would lead to more efficient and accountable recreation management.

As proposed, the OWA Management Plan would be reevaluated every 5 years, including an opportunity for Recreation Advisory Committee to provide input, whereas the Recreation Management Plan would be reevaluated every 12 years. Considering the overlap between these two plans, it would be most efficient to synchronize the schedule for re-evaluating these plans by re-evaluating the OWA Management Plan every 6 years. DWR has more recently proposed reevaluating the OWA plan every 2 to 3 years as required by DFG. Reevaluating the OWA Management Plan every 3 years would still allow the Recreation Advisory Committee to synchronize its updates of the 2 plans; therefore, we recommend the plan be reevaluated every 3 years.

Protection of Vernal Pools (Proposed Article A117)

Under Proposed Article A117, *Protection of Vernal Pools*, DWR would implement conservation measures set forth by the FWS final biological opinion to protect the vernal pool invertebrate habitat within the project boundaries. See section 3.3.5.2, *Threatened and Endangered Species*, for more information about the biological opinion and its requirements with respect to vernal pools.

Staff Analysis

At the Oroville Facilities, vernal pools are found primarily near the Thermalito forebay, the Thermalito afterbay, and the OWA; over half of the vernal pools found at the project are at the south end of Wilbur Road and around the boat ramp at the South Thermalito forebay. As proposed in the draft biological assessment, DWR would protect vernal pools by excluding OHV traffic near these features by increasing signage, increasing patrols and providing public education related to OHV use, increasing enforcement, and if necessary, installing fencing in locations where other measures have failed. Signage would be focused in areas of current observed vehicular effects on vernal pools. These measures would not reduce OHV access to project lands because these areas are generally dispersed use areas where vehicular use is, in some cases, already prohibited.

Minimization of Disturbance to Nesting Bald Eagles (Proposed Article A118)

Under Proposed Article A118, *Minimization of Disturbances to Nesting Bald Eagles*, DWR would include the conservation measures required by the FWS final biological opinion in any bald eagle management plan(s). If additional bald eagle nest territories were identified within the project boundary, DWR would either amend the current plan(s) or develop additional management plan(s). See section 3.3.5.2, *Threatened and Endangered Species*, for more information about the biological opinion and its requirements with respect to bald eagles.

Staff Analysis

The bald eagle territory at Potters Ravine is the only territory located completely within the project boundary. Other bald eagle nest territories are located partially within the project boundary. The Potters Ravine trails are the only developed recreational facilities in this area, and DWR closes portions of them seasonally to protect nesting bald eagles from human disturbance. Recreational access would be temporarily diminished by closing trails to protect bald eagles. Posting signs describing the need for the trail closure would likely minimize a hiker’s negative reaction to the closure.

Protection of Giant Garter Snake (Proposed Article A119)

Under Proposed Article A119, *Protection of Giant Garter Snake*, DWR would implement conservation measures set forth by the FWS final biological opinion to protect the giant garter snake within the project boundary. See section 3.3.5.2, *Threatened and Endangered Species*, for more information about the biological opinion and its requirements with respect to giant garter snakes.

Staff Analysis

Habitat for the giant garter snake primarily occurs at the Thermalito forebay, the Thermalito afterbay, the OWA, and along the Feather River where backwater areas and side channels exist. The best habitat is located along the northern and eastern edges of the Thermalito forebay near recreational development such as boat ramps, picnic areas, and fishing access areas. As proposed in its draft biological assessment, DWR would maintain existing amounts and quality of snake habitat. This could limit recreational development and trail expansion along the shoreline of the North and South Thermalito forebay and the Thermalito afterbay. Actions in giant garter snake upland habitat that would be considered deleterious include trails, roads and other permanent recreational features which could disturb, destroy, fragment, or otherwise modify the uplands. Giant garter snake habitat conservation measures may therefore limit additional shoreline access at the North Thermalito forebay and a connecting trail around the South Thermalito forebay may not be feasible. DWR also proposes a public education program consisting of signs describing the sensitive nature of the giant garter snake and the need to avoid harming it. Dog training would also be restricted in these locations thereby reducing this recreational opportunity.

Protection of California Red-legged Frogs (Proposed Article A121)

Under Proposed Article A121, *Protection of Red-Legged Frogs*, DWR would implement conservation measures set forth by the FWS final biological opinion to protect the California red-legged frog within the project boundary. See section 3.3.5.2, *Threatened and Endangered Species*, for more information about the biological opinion and its requirements with respect to California red-legged frogs.

Staff Analysis

Approximately 4,281 acres of potentially suitable habitat for California red-legged frogs occurs within the Thermalito forebay, the Thermalito afterbay, the OWA, and along the Feather River. Measures proposed by DWR in its draft biological assessment to conserve the giant garter snake and vernal pool wildlife species would be implemented to protect and conserve potential California red-legged frog habitat for possible future reintroduction or natural recolonization at the Oroville Facilities. As described above, these measures would have little effect on recreational use and access in the project area; there may be a beneficial effect on recreation by providing more wildlife for viewing.

Construction and Recharge of Brood Ponds (Proposed Article 122), Provision of Upland Food for Nesting Waterfowl (Proposed Article A123), Provision of Nest Cover for Upland Waterfowl (Proposed Article A124) and Installation of Wildlife Nesting Boxes (Proposed Article A125)

Under Proposed Article A122, *Construction and Recharge of Brood Ponds,* DWR would construct one waterfowl brood pond every 5 years over a 20 year period by creating a small earthen berm across an inlet in the Thermalito afterbay; DWR would maintain the brood ponds by filling them no later than April 15 of each year and ensuring that the water surface level of the ponds would not fluctuate more than 1 foot during the primary waterfowl brooding season of April 15 through July 31.

Under Proposed Article A123, *Provision of Upland Food for Nesting Waterfowl*, DWR would annually prepare and plant a total of 60 to 70 acres of upland cover/forage crops to support upland game birds and wintering waterfowl within the Thermalito afterbay portion of the OWA on a rotational basis.

Under Proposed Article A124, *Provision of Nest Cover for Upland Waterfowl*, DWR would actively manage 240 acres of waterfowl nest cover, including preparing and planting 60 acres and maintaining and additional 180 acres annually within the Thermalito afterbay portion of the OWA.

Under Proposed Article A125, *Installation of Wildlife Nesting Boxes*, DWR would install and structurally maintain 100 wildlife nesting boxes within the OWA within 1 year of license issuance.

See section 3.3.4.2, *Terrestrial Resources*, for a detailed description of these proposed articles.

Staff Analysis

The OWA provides hunting and viewing opportunities for waterfowl within the project boundary. Providing forage, food, nesting boxes, and brood ponds for upland game birds and waterfowl would encourage these species to visit the project area and thus could have a beneficial effect on recreation by providing more wildlife for viewing and hunting.

Improve and Redirect Recreation Usage to Specific Areas at Foreman Creek (Proposed Article A129)

Under Proposed Article A129, *Improve and Redirect Recreation Usage to Specific Areas at Foreman Creek*, DWR would develop and implementing a plan to protect cultural resources at Foreman Creek while continuing to provide recreation at that location. The plan would include measures to restrict the usage of the existing boat launch and to develop facility improvements to encourage recreational use at Foreman Creek in designated areas, including picnic tables and restrooms. See section 3.3.8.2, *Cultural Resources*, for a detailed description of this proposed article and its effects on cultural and historic resources.

In motions to intervene filed with the Commission on February 9, 2006, and March 30, 2006, the Tyme Maidu Tribe of the Berry Creek Rancheria and the Mooretown Rancheria of Maidu Indians recommend that DWR protect cultural resources in the Foreman Creek area by precluding or severely limiting public access to this site. Both entities point out that cultural resources at this location have been and continue to be disturbed due to recreational use and vandalism. The Tyme Maidu Tribe states that it does not object to DWR operating the project in the Foreman Creek area for the purposes of water supply and power generation.

In joint comments of the Berry Creek and Mooretown rancherias filed with the Commission on April 26, 2006, the Tribes recommend closing Foreman Creek to recreational and other public use. They assert that allowing recreational use to continue in the Foreman Creek area would cause further, irreversible damage to the cultural resources there and recommend reserving the area for cultural resources protection and permitting recreation throughout the rest of the project area.

In its May 26, 2006, filing with the Commission, DWR states that it believes that it would be inappropriate for the Commission to impose additional requirements at Foreman Creek or to take any action that would undermine the progress made in section 106 and settlement negotiations.

Staff Analysis

Cultural resources in the Foreman Creek area have been and continue to be disturbed by recreational use and vandalism. DWR proposes to install interpretive and informational signs to educate visitors about the cultural resources in the area and to redirect visitor use at this site away from culturally sensitive areas, as well as providing site protection for culturally sensitive areas. As proposed, recreational capacity would be maintained but redirected, and planned restrooms and picnic tables would be installed.

Informing visitors that sensitive resources are located at this location would increase visitor awareness and may minimize disturbance and damage to cultural resources. However, it is also possible that visitors with little or no regard for cultural resources could use this information to harm or destroy cultural resources.

The Berry Creek and Mooretown rancherias recommend closing this site to recreational and other public use. Closing the site to public use would eliminate most of the risks to cultural resources at the site, but this action would eliminate a project boat launch with 15 to 30 parking spaces and 26 campsites. Also, Foreman Creek is an unimproved access area that does not require a fee to access. Those living close to Foreman Creek would be particularly affected because there are no nearby alternative day-use areas. Because overnight use and site capacity is low, only a few visitors would need to relocate to other boat-in campgrounds if the site were closed.

3.3.6.3 Unavoidable Adverse Effects

Under Proposed Article A127, *Recreation Management Plan*, recreational facility reconstruction and some facility maintenance activities would require sites to be closed for public safety, causing a temporary decrease in developed capacity at the project that could displace and inconvenience visitors. Scheduling reconstruction outside of the summer season would minimize these effects.

Under Proposed Article 122, *Construction and Recharge of Brood Ponds*, the water surface elevation of the Thermalito afterbay would need to be drawn down to allow construction of a brood pond, causing a greater drop in the water surface there. However, the elevation of the Thermalito afterbay fluctuates regularly and only one brood pond would be constructed every 5 years so the effects would be intermittent and temporary.

Under Proposed Articles A123, *Provision of Upland Food for Nesting Waterfowl*, and A124, *Provision of Nest Cover for Upland Waterfowl*, preparing the site and planting the crops may temporarily disturb the recreational setting in the OWA for some visitors, causing a short-term adverse effect on recreation.

3.3.7 Land Use and Management

3.3.7.1 Affected Environment

Land Ownership

The Oroville Facilities are located on the Feather River in the Sierra Nevada foothills in Butte County, California (figure 21). The project boundary encompasses about 41,540 acres, which includes all of the Oroville Facilities. All land within the project boundary is publicly owned, with about 14 percent (5,900 acres) of the land owned by the federal government and 86 percent (35,300 acres) owned by the state.

DWR, on behalf of the state of California, has fee-title to (i.e., is the controlling agency for) about 29,200 acres and DFG has fee-title to about 5,700 acres of state-held lands within the project boundary. In addition, DWR owns and manages about 2,200 acres of land in noncontiguous parcels east of Oroville dam and along the banks of the Thermalito power canal in specific areas both inside (400 acres) and outside (1,800 acres) the project boundary. DWR compiled land ownership and management information in collaboration with the Land Use, Land Management, & Aesthetics Work Group, which adopted a study area that extended 0.25 mile beyond the project boundary.

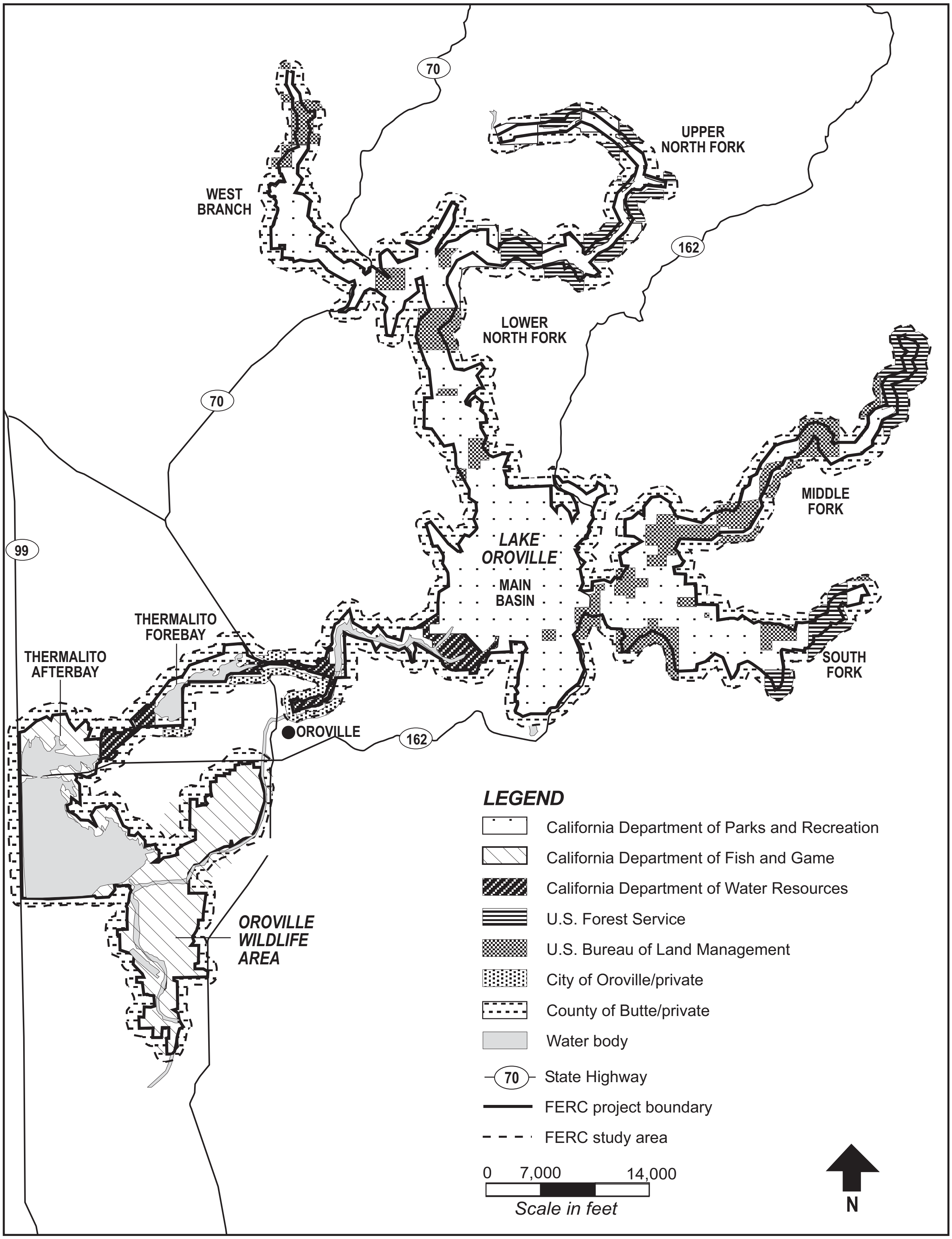


Figure 21. Primary land management responsibility. (Source: DWR, 2005a)

Land management in the study area is diverse, as illustrated by the multiple public land owners/managers shown in table 54 and described in greater detail in the following section. In addition, substantial private property interests are located inside the study area, but outside the project boundary. Land management direction for most lands within the project boundary emphasizes recreation, wildlife conservation, and public facilities. Lands adjacent to the project boundary within the study area have different management objectives, such as agricultural/rural residential development, timber preserve, conservation, recreation, and scenic lands.

Land Management

Federal

As noted above, federal lands managed by two federal agencies (Forest Service and BLM) account for about 15 percent (6,240 acres) of the area within the project boundary (table 54).

Forest Service—The Forest Service manages about 4 percent (1,620 acres) of the area within the project boundary. About 95 percent of the Forest Service lands are contained within the Plumas National Forest. The remaining 5 percent of Forest Service lands are located in the Upper North Fork arm, and although these lands are included within the boundary of the Lassen National Forest, they are managed by the Plumas National Forest.

Table 54. Summary of public entity land management. (Source: DWR, 2005a)

	Acres of Management			
Public Entities	**Inside Project Boundary (acres)**	**Percent of Area Inside Project Boundary**	**Study Area (acres)**	**Percent of Total Study Area**
Federal				
Forest Service[a]	1,620	5	5,100	7
BLM	4,620	9	5,800	8
Subtotal	6,240	14	10,900	15
State				
DWR	2,000	5	2,200	3
DPR	22,100	54	23,000	32
DFG	11,200	27	12,000	17
Subtotal	35,300	86	37,200	52
Local Jurisdictions				
Butte County	0	0	21,300	31
City of Oroville	0	0	1,100	2
Subtotal	0	0	22,400	33
Total	**41,540**	**100**	**70,500**	**100**

[a] Includes all management authority except for recreation and law enforcement, which was transferred to DPR.

Management of Forest Service lands in the study area and project boundary is guided by the following management plans and documents:

- Plumas National Forest Land and Resource Management Plan,
- Herger Feinstein Quincy Library Group Forest Recovery Act Environmental Impact Statement, and
- Sierra Nevada Framework Record of Decision.

The Forest Service's Land and Resource Management Plan contains directives for the lands in the study area and project boundary that primarily emphasize resource conservation, provision of high quality recreational opportunities, and protection of visual resources. All public lands administered by the Plumas National Forest are managed through specific land use designations called Management Prescriptions. Each Management Prescription comprises appropriate standards and guidelines to meet a particular need (such as special habitat protection, recreation, recreation quality enhancement, or timber production) while allowing for other compatible activities. This direction supplements the Forest-wide Standards and Guidelines.

Some Forest Service-managed public lands in the study area and project boundary (along the North Fork and South Fork) have Management Prescriptions that would allow for varying degrees of timber harvest. However, some of the public lands are located in areas that might support timber harvest if not for steep terrain and difficult access, and many of these lands have been classified as unproductive or unsuitable for timber harvest. Because of resource protection concerns and difficult access, many of the Forest Service-administered public lands in the study area and project boundary have been managed in the past as de facto resource conservation lands. Under current Forest Service direction, these lands are being evaluated to determine if they constitute a fire danger to nearby urbanized areas.

The Forest Service does not actively manage facilities or activities on most lands within the study area and project boundary. The Forest Service and DPR have an agreement concerning management of Forest Service-administered public lands within the project boundary that are part of the Lake Oroville State Recreation Area. The agreement, dated March 16, 1978, allows DPR to conduct law enforcement activities on Forest Service-administered public lands. The Forest Service does, however, provide law enforcement to address illegal activities, such as illegal dumping of trash and hazardous materials, drug production lab debris, and vandalism of cultural resource sites, and the Forest Service retains all other authorities. In the agreement, the Forest Service "transferred interest" in National Forest System 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 recreational purposes and, to the extent permissible, to enforce all applicable laws and regulations thereon." DWR states that the Forest Service is not interested in changing or terminating the agreement at this time but will re-evaluate the agreement during the next Forest Plan revision. Currently, any development planned in conjunction with the Oroville Facilities on Forest Service-administered public lands, including construction of any facilities or infrastructure within the National Forest, must be approved by the Forest Service prior to implementation.

Bureau of Land Management—Federal lands managed by BLM are scattered throughout the region, primarily in the northern reaches of the West Branch, within the main body of the reservoir, and in the Middle and South Forks. In total, BLM manages about 11 percent (4,620 acres) of lands within the project boundary. Most of these lands are noncontiguous, scattered parcels, some of which are submerged under Lake Oroville.

BLM manages lands in the study area under the direction of the 1993 Redding Resource Management Plan. Lands managed by BLM in and around the study area are designated as "undeveloped public lands."

At an operational level, BLM has prioritized the following three management objectives for lands in and near the study area:

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-administered public 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. This area is of great cultural interest to the four recognized tribes in the Oroville area. BLM-managed public lands within the study area are designated for transfer to the state of California.

State of California

The state of California (i.e., DWR) owns and manages about 53 percent (37,200 acres) of land in the study area and 86 percent (35,300 acres) of land within the project boundary. DWR and DFG have fee title to all of the state-owned land within the project boundary and have a mandate to manage these lands for public recreation and fish and wildlife preservation and enhancement in connection with the State Water Project. 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 project boundary to DPR. These lands constitute the majority of the Lake Oroville State Recreation Area. DPR is charged with designing, constructing, operating, and maintaining public recreational facilities on these lands. In 1961, DWR transferred about 12,000 acres of land within the project boundary to DFG. These lands constitute much of the OWA, reserving any interests necessary to construct, operate, and maintain the State Water Project. DFG is charged with state-wide management of fish and wildlife habitats and associated recreational facilities. The following sections discuss the state agencies with land and resource management responsibilities within the study area and project boundary.

California Department of Water Resources—As the owner, manager, and operator of the Oroville Facilities, which includes all dams, powerhouses, and transmission facilities located within the project boundary, DWR has direct management responsibility for about 2,000 acres within the project boundary that are not managed by DPR as part of the Lake Oroville State Recreation Area 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 about 2,200 acres in the study area. Management of the Oroville Facilities is based on the terms of the existing license and existing biological opinions and biological assessments (DWR, 2004m; NMFS, 2002; BOR, 2004) for the Feather River downstream of Oroville dam. Day-to-day operations of the facilities are the responsibility of DWR. DWR has leased several parcels totaling about 700 acres to private groups or individuals in locations where DWR has primary management authority, as well as in locations within the OWA and Lake Oroville State Recreation Area. These leases are generally located on scattered, noncontiguous parcels west of Oroville dam and within the OWA and are summarized in table 55.

Table 55. DWR third-party leases. (Source: DWR, 2005a)

Purpose	Type	Acres	Lessee	Term
Cattle grazing	Private	417	John Campbell	Renewed after September 30, 2004
Community recreation	Local public	44	Feather River Recreation and Park District	November 1, 1997, to October 31, 2015
Cemetery	Private	23.7	Cemetery[a]	No lease
Site for flying model airplanes	Private	Not Known	Model Aircraft Flying Facility	--
Shooting range	Local public	9	Butte College	August 15, 2001 to August 14, 2016
Rock removal	Local public	10	Joint Water Districts Board	April 26, 1988, to April 26, 2018
Gravel extraction	Private	50	Mathews Ready Mix	June 22, 1987, to June 22, 2037
Gravel extraction	Private	100	Granite Construction	June 18, 1991, to June 18, 2041
Game bird raising	Private	77	K & L Quail Rancha	May 1, 1997, to April 30, 2007

[a] Outside project boundary but within the 0.25-mile study area.

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 Lake Oroville State Recreation Area 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 recreation management responsibility for most of the land underlying and surrounding Lake Oroville and its facilities, including lands that comprise the Lake Oroville State Recreation Area. DPR coordinates management of the Lake Oroville State Recreation Area with DWR, DBW, DFG, California Department of Forestry and Fire Protection (CDF), Butte County, California Highway Patrol, Forest Service, volunteer organizations, and other groups and agencies. Although DPR manages the majority of Lake Oroville State Recreation Area's recreational aspects, DWR bears the ultimate responsibility under the current FERC license for ensuring funding, development, and management of current and potential future additional recreational facilities. The Davis-Dolwig Act (Water Code Sections 11910–11925) requires DWR to plan for and acquire land for recreation in conjunction with all State Water Project facilities. In keeping with its responsibility, DWR works with DPR and DFG to provide for recreational opportunities and funding throughout the project boundary and Lake Oroville State Recreation Area.

DPR has management responsibility for about 54 percent (22,100 acres) of the land within the project boundary, all of which is located in the Lake Oroville State Recreation Area. DPR's management responsibilities for the Lake Oroville State Recreation Area include public safety, facilities maintenance, and overall visitor management for all recreational activities. DPR coordinates these activities, when appropriate, with DWR, DBW, DFG, CDF, Butte County, California Highway Patrol, volunteer organizations, and other groups and agencies.

The Lake Oroville State Recreation Area is managed under the guidance of the Lake Oroville State Recreation Area General Plan, 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 General Plan 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 in 1993 as the recreation plan for the Lake Oroville State Recreation Area. The Amended Recreation Plan was adopted by the FERC Order of September 22, 1994, and supersedes the 1966 Plan, Bulletin 117-6. DWR developed the Amended Recreation Plan for the Lake Oroville State Recreation Area to address public concerns associated with the recreational developments associated with the project. The 1993 Amended Recreation Plan describes a number of improvements and DWR commitments to construct specific facilities and take actions to address the fisheries and recreational needs at the project; additional improvements and actions deemed necessary by FERC were included in the September 22, 1994, Order. The 1993 Amended Recreation Plan also detailed the timeframe for completing additional proposed recreational facilities. DWR acknowledges in the Amended Recreation Plan that as the licensee, it is responsible for funding specific improvements. The Amended Recreation Plan describes the fish and wildlife resources, facilities, local area, user patterns, operation of Lake Oroville State Recreation Area and OWA facilities, economic considerations, recreation plan, and the fisheries management plan. The Amended Recreation Plan puts forth recommendations for facility expansion and modification in light of these findings. Facility expansion and modifications set forth in the Amended Recreation Plan have been implemented.

California Department of Fish and Game—DFG manages 11,200 acres of land (or about 27 percent of the land) within the project boundary and about 800 acres within the study area but outside the project boundary. DFG manages fish and wildlife habitat and associated recreational use for both surface water and dry lands within the OWA. In addition, DFG manages and operates the Feather River Fish Hatchery (a project facility). Most of the land area for which DFG provides day-to-day management is within the OWA and is located within the project boundary. The OWA includes Thermalito afterbay and a wide swath of wildlife habitat on both sides of the Feather River downstream of Oroville dam, which is south and west of the city of Oroville.

DFG manages the OWA 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 Lake Oroville State Recreation Area, DFG is also responsible for managing fish and wildlife resources and recreational 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), although, due to budget constraints, DFG has done no habitat management of the OWA for several years. DFG intends to revise the Management Plan in the near future.

Remote areas exist within the OWA that are accessible by road, but have been susceptible to illegal activities, such as dumping, fires, and lawless behavior. Consequently, some access restrictions have been implemented by DFG.

Local Entities

Butte County—All lands in the study area owned by Butte County are located outside the project boundary. County-owned properties generally reflect administrative uses for government services. In total, Butte County owns about 100 acres of land, which represents less than 1 percent of the study area. Butte County has land management jurisdiction over about 21,300 acres of private lands within the study area, which represents about 31 percent of the entire study area. There are no privately owned lands within the project boundary. All private development in Butte County is subject to the policies detailed in the Butte County General Plan and Zoning Ordinance.

The majority of private land under Butte County jurisdiction outside of and adjacent to the project boundary is designated Unclassified, consisting primarily of road rights-of-way or river channels that require minimal oversight.

City of Oroville—The city of Oroville owns about 150 acres of land in the study area. 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 Thermalito diversion pool, Thermalito forebay, Thermalito afterbay, the low flow channel, and the OWA. In total, roughly 1,100 acres (or 2 percent of the total study area) are located within the city limits. The city of Oroville does not own any land within the project boundary.

All development and activity within the city of Oroville are subject to the policies outlined in the city's General Plan and Zoning Ordinance. The objectives detailed in the General Plan 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 General Plan designates areas near the project facilities as Medium Density Residential and Parks.

Oroville General Plan 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.

Feather River Recreation and Park District—The Feather River Recreation and Park District is another local entity that owns and administers lands in the study area. The Feather River Recreation and Park District was established in 1953 and provides a variety of park and recreational services to residents of southeast Butte County. Its holdings in the study area include Riverbend Park located west of State Route 70 at Montgomery Street and consisting of 50-owned and 100 DFG -leased acres, as well as Nelson Avenue Park, which includes roughly 18-owned acres and 34 acres leased from DWR.

Other Local Districts/Agencies—A set of public agencies, including local districts, also owns property in the study area. Aside from the Feather River Recreation and Park District described above, the following entities own land within the study area but outside the 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 about 156 acres of land in the study area, representing less than 1 percent of the study area total.

Private Ownership—No private interests own lands within the project boundary; however, private interests own about 29 percent of lands in the study area (specifically land outside the project boundary). PG&E, one of the larger private landowners in the study area, primarily uses lands in the study area for transmitting power. In general, management of private lands must comply with the current land use planning guidelines (i.e., general plans) and regulations (i.e., zoning ordinances) of Butte County and the city of Oroville.

Other Ownership—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 about 1,200 acres of other-owned land, representing nearly 2 percent of the study area total.

Land Use

DWR, in consultation with the Land Use, Land Management & Aesthetics Work Group, established a land use study area within 0.25 mile of the project boundary. Existing land uses in the study area have been organized into eight major land use classifications. Table 56 summarizes the respective major land use classifications within the project boundary and in the study area.

Table 56. Land uses in the study area. (Source: DWR, 2005a)

	Project boundary		Study Area[a]	
Land Use	**Acres[b] (approx.)**	**Percent**	**Acres[b] (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[c]	18,900	46	19,300	27
Total[d]	**41,540**	**100.0**	**70,500**	**100.0**

[a] Includes lands within the project boundary and non-project lands adjacent to and within 0.25 mile of the project boundary.

[b] Acres are approximate and rounded to the nearest 100.

[c] Measured at full pool elevation (including all project water features).

[d] Numbers may not add up to 100 percent due to rounding.

Gravel Harvesting

Gravel harvest currently occurs within the portion of the OWA that straddles the Feather River. Piles of barren gravel/cobble, called dredger piles, are remnants of hydraulic mining in the 1800s and provide a large source of gravel. Dredger piles cover about 615 acres within the OWA. These areas are all located within the floodplain of the Feather River and provide significant gravel resources for projects throughout the surrounding area in the county, including the Oroville Facilities. DWR maintains leases with local companies for extracting gravel within the OWA and these leases evolved from a land transfer between DFG and local commercial gravel interests that occurred many years ago. DWR regulates this land use.

Fuel Load Management

CDF, one of the primary agencies responsible for fire suppression in the project area, has developed a fuel assessment method that uses models to describe current fuel load conditions and rank fuel hazard situations. This information assists CDF and other entities in targeting critical areas for fuel treatment. The fuel ranking method assigns ranks based on current flammability of a particular fuel and includes variables such as slope, ladder fuels (fuel that connects ground fire with tree crowns), and crown density. The models use geographic information system technology to build and analyze the data. The results of the fuel hazard ranking model for lands in the project area show that about 53 percent of the project area was classified with a hazard score of Moderate, 23 percent High, and 15 percent Very High. The highest concentration of lands classified as Very High is along the South Fork and Middle Forks, with other areas scattered along the North Fork and West Branch of the North Fork.

The lands surrounding the project are prone to wildfire because of the terrain, vegetation, climate patterns, and residential development. Accordingly, a number of agencies have developed policies, plans, and programs to address the threat of wildfire and deal with fuel loading. The Forest Service, CDF, and DPR are responsible for the primary fire management programs on lands immediately surrounding the study area. BLM, DFG, Butte County, and the city of Oroville also have lands within the vicinity that are governed by policies on fire management or suppression. Relevant fire management plans are shown by responsible entity in table 57. 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 to provide education to local residents relating to issues associated with wildfires, such as reducing fuel loading. These organizations work closely with CDF's local Butte Unit in outreach and educational programs.

Table 57. Fire management policies and plans in the study area. (Source: DWR, 2005a)

Agency	**Document Title**	**Year**
Department of Agriculture	Healthy Forest Initiative	2002
Forest Service	Sierra Nevada Forest Plan Amendment, Record of Decision	2001
Forest Service	Plumas and Lassen National Forests, Proposed Administrative Study	2002
BLM	Redding Resource Management Plan	1993
CDF and State Board of Forestry	The California Fire Plan	1996
CDF	Butte Unit Fire Management Plan	2002
DPR	Wildfire Management Planning: Guidelines and Policy	2002
DPR	Loafer Creek Prescribed Fire Management Plan	1999
DFG	Oroville Wildlife Area Management Plan	1978
City of Oroville	General Plan	1995
Butte County	General Plan	1996

Between 1990 and June 2003, 13 fires burned more than 50 acres each within the project boundary. CDF has kept records of all known fire ignitions in Butte County, regardless of size, since 1990. The most frequent ignitions have occurred in the urbanized areas around Oroville, Thermalito, and other communities; the Clay Pit State Vehicular Recreation Area; and along roadways. Although not all of these areas are within the study area, fires that start in the region can move into the study area. The most common cause of ignitions within the study area was use of equipment (24 percent). Unidentified and miscellaneous causes each made up about 15 percent, while arson was the fourth most frequent cause of ignitions (14 percent).

DWR mapped vegetation types and canopy cover classifications in the study area. The canopy cover is mostly dense (60 to 100 percent), especially in the area around Lake Oroville and the Thermalito diversion pool, which is dominated by various oak, pine, and chaparral type communities. Grasslands are most abundant in the Thermalito forebay and afterbay areas (32 percent of area), but small areas (2 to 3 percent) are present in the Lake Oroville area and in the OWA.

Vehicular Access and Roads

DWR, in consultation with the Recreation & Socioeconomics Work Group, assessed the adequacy of vehicular access routes to the Oroville Facilities recreation areas. In general, transportation routes to project area recreational sites are without constraints to vehicular access. Principal and minor arterial roads (e.g., state highways, Grand Avenue, Kelly Ridge Road, Oroville Dam Boulevard, etc.) leading to areas that receive the highest use are paved and in good condition. Recreation areas that receive average and low use are also accessed by paved roads in good condition; however, some low use areas are located in areas where roads are closed or in poor condition. Locations with these conditions include the following: (1) lands in the vicinity of the North Fork arm of the reservoir where many roads are closed due to steep topography, (2) the OWA where many of the dirt/gravel roads are in poor condition, and (3) access roads to various car-top boat ramps that are in need of maintenance.

Car-top boat ramps and informal recreational sites that have closed or compromised access roads resulting from gates or lake levels include Big Bend access[90] (unpaved, poor road condition), Nelson Bar (limited ability to launch at low lake elevations), Enterprise boat ramp (shoreline driving eliminated), Foreman Creek (shoreline driving eliminated), Bald Rock Canyon[91] (unpaved, unmaintained access), Stringtown boat ramp (boat ramp road and ramp in poor condition at lower levels), and Vinton Gulch car-top ramp (unpaved access and limited parking). Access roads to the recreational sites located at the other project facilities (e.g., other than Lake Oroville) are generally passable with some maintenance needs for unpaved roads within the OWA; in their current condition, their use is limited to four wheel drive/high clearance vehicles. These access roads are typically native-surfaced collector streets or local roads.

3.3.7.2 Environmental Effects

Effects on Land Ownership, Management, and Use

The proposed management plans and associated land management strategies and implementation measures could affect land use and land management within the project over the term of a new license.

OWA Land Management

Land use and management conflicts exist between resource protection needs and visitor use and management of this area that is located within the project boundary. The OWA also has the need for relatively high levels of law enforcement related to visitor use and illegal dumping activities that currently occur within the OWA. Under Proposed Article A115, *OWA Management Plan*, DWR proposes to develop and implement a management plan for the OWA. The OWA Management Plan would include measures for resource protection and management, affecting land use and management within this area. The proposed OWA Management Plan would identify resource conservation and management actions, strategies to minimize current and future conflicting resource management goals, recreation management goals and strategies for the OWA (to be consistent with the proposed Recreation Management Plan),

---

[90] This site is not provided by a California state agency. Pacific Gas and Electric Company manages this access road.

[91] This site is not provided by a California state agency. The Forest Service and private entities manage these access roads.

monitoring requirements, and agency management responsibilities. The proposed OWA Management Plan would be developed in consultation with DFG, DPR, and the Ecological Committee, including specifically FWS, NMFS, the Water Board, and the Regional Board. Under Proposed Article B111, *Oroville Wildlife Area Funding*,[92] DWR proposes to provide annual funding to DFG for managing the OWA and implementing continuing tasks associated with the project. For further description of the proposed measures associated with the OWA Management Plan, please refer to section 3.3.4, *Terrestrial Resources*. Interior's (on behalf of FWS) 10(j) recommendation no. 10 and DFG's 10(j) recommendations no. 2 and 3 are consistent with this proposed article.

Butte County states that the DWR should immediately remove all existing trash, abandoned vehicles, and other unlawfully dumped material from the OWA, and Butte County should be included as a consulted party in the development of the OWA Management Plan (letter from C.A. Smoots, Attorney for Butte County, Perkins Coie LLP, Washington, DC, to the Commission, dated April 26, 2006). Butte County states that the county has been required to provide a range of local governmental services to the project area without any reimbursement, including coordinating the region's response to flood control events, responding to medical emergencies, providing sheriff department patrol, and responding to calls for assistance, fire and emergencies, and providing roadway construction and maintenance services. Specific to OWA management, Butte County states that it is responsible for responding to law enforcement and public safety issues within the OWA, particularly related to illegal dumping of trash and abandoned vehicles. Please refer to section 3.3.10, *Socioeconomics*, for further discussion of issues related to provision of governmental services.

DWR responds that Proposed Article A115, *OWA Management Plan*, would address recreation management goals and objectives, including public safety concerns. It points out that it has a contract[93] with the County Sheriff's Department to provide law enforcement for the Thermalito afterbay and portions of the OWA. DWR also states that Butte County would have an opportunity to provide input into the OWA Management Plan through the state public consultation process (letter from M.A. Swiger, Attorney for DWR, Van Ness Feldman P.C., Washington, DC, to the Commission, dated May 26, 2006).

Staff Analysis

The proposed OWA Management Plan would include the means for the development and implementation of comprehensive management strategies for the OWA. The proposed OWA Management Plan would also help to develop and implement land use management strategies that would address potential conflicting resource needs. In addition, the identification of agency management responsibilities would help to coordinate the responsibilities of land management within the OWA. Monitoring, reporting, and periodically updating the OWA Management Plan would help to address potential changing resource needs and land management actions associated with the OWA. All of these measures would help to ensure that resource and land use needs within the OWA are coordinated for the best overall management of resource protection, land use, and public access needs over the term of a new license. Furthermore, including Butte County as a consulting party in the development of the OWA would help ensure coordination of law enforcement measures and land management within the OWA. We note that under Proposed Article B111, *Oroville Wildlife Area Funding*, DWR would provide funding to DFG for actions associated with the management of the OWA. However, because this measure is included in appendix B of the Settlement Agreement, DWR does not propose to include this in the project license. We acknowledge that the funding, although not included as part of the project license, would be

---

[92] Included in appendix B of the Settlement Agreement as part of the measures the Settlement parties agreed to, but propose to be outside of the terms and conditions associated with a new license for the project.

[93] Estimated at $190,000 per year.

beneficial to implement land management measures for the OWA and would help to implement future measures developed as part of the OWA Management Plan. We discuss the proposed measures associated with the OWA Management Plan and the potential effects of these measures in more detail under section 3.3.4, *Terrestrial Resources*, and section 3.3.6, *Recreation Resources*.

Bald Eagle Nesting Protection Measures

Restricting or alternating public access near bald eagle nesting sites could influence land use and public use and access at the project. Under Proposed Article A118, *Minimization of Disturbances to Nesting Bald Eagles*, DWR proposes to develop additional or amend current Bald Eagle Management Plans to include biological opinion measures, as recommended by Interior, for the protection of bald eagle nesting sites. Interior (under 10(j) recommendation no. 12) and DFG recommend measures consistent with the proposed article. For further description of these proposed measures, please refer to section 3.3.4, *Terrestrial Resources*.

Staff Analysis

Existing recreational use could potentially affect the territory associated with the bald eagle nesting site located at Potters Ravine. Measures for the protection of the nesting site may lead to restricting recreational access in this area and altering the existing land use that currently occurs in this area. Coordination between the proposed Recreation Management Plan and the measures developed for the protection of the bald eagle nesting site would help to ensure that land use and resource protection measures for these areas are managed in a consistent manner. We discuss the proposed measures associated with minimizing Bald Eagle nesting disturbance and the potential effects of these measures in more detail under section 3.3.5, *Threatened and Endangered Species*, and section 3.3.6, *Recreation Resources*.

Fuel Load Management

Under Measure B102, *Development of a Fuel Load Management Plan*,[94] DWR proposes to develop and file for Commission information within 1 year of license issuance a Fuel Load Management Plan for the project lands to be developed in coordination with the Forest Service, BLM, CDF, and Fire Protection Butte Unit, DPR, DFG, Paradise Fire Department, Butte County Fire Safe Council, Butte County Resource Conservation District, State Water Contractors, Native American Tribes and other appropriate agencies and associated public process. DWR states that the plan would be consistent with the OWA Management Plan and would include identification of the issues, prioritization, and recommended actions to address fuel load management. The Forest Service, under 4(e) condition no. 19, recommends that DWR develop a Fuel Load Management Plan for National Forest System lands located within the project area. The Forest Service specifies that the Fuel Load Management Plan identify fuel management issues, prioritization, and recommended actions to address them. In its comments on the draft EIS, DWR states that Measure B102 would include Forest Service lands consistent with the Forest Service 4(e) condition no. 19.

Staff Analysis

The lands surrounding the project are prone to wildfire because of the terrain, vegetation, climate patterns, and residential development. As stated by the Forest Service, relicensing stakeholders have expressed concerns that land use practices and fire suppression activities result in increased fuel loads and

[94] Included in appendix B of the Settlement Agreement as part of the measures the Settlement parties agreed to but propose to be outside of the terms and conditions associated with a new license for the project.

an increased risk of wildfires. As stated previously, multiple agencies in the project area are responsible and have developed fire management policies, including the Forest Service, CDF, and DPR who are responsible for the primary fire management programs on lands immediately surrounding the study area, and BLM, DFG, Butte County, and the city of Oroville also have lands within the vicinity that are governed by policies on fire management or suppression.

Over the term of a new license, the buildup of vegetation would cause fuel load accumulation, thereby increasing the potential for wildfire occurrence and making suppression increasingly difficult. As fuel loading would increase without treatment, recreational use and public access to project facilities would continue to increase the risk of wildfire ignitions within the project area. A Fuel Load Management Plan would provide the means to manage the land resources within the project to reduce fuel loading in the wildland/urban interface and improve future related interagency planning, management, and coordination for wildfire protection measures. Implementing a Fuel Load Management Plan would improve fuel load management on project lands and lead to an associated reduction in the occurrence and suppression of wildfires in the future.

Effects of Proposed Recreation Enhancements and Management Measures

Recreation Management Plan

The proposed recreation enhancement measures associated public recreational access and proposed recreation management measures can affect land use and land management of the project. Under Proposed Article A127, *Recreation Management Plan*, DWR would implement the Recreation Management Plan that includes measures for the development of recreational enhancement and management of recreational resources at the project (see section 3.3.6.2, *Recreational Resources*). Elements of the Recreation Management Plan that pertain to land use and management of the project would include measures to continue interagency coordination in the management of the recreational resources associated with the project and the development of the FERC License Coordination Unit that would manage the recreational, environmental, and other terms and conditions of a new license; help ensure regulatory compliance; and provide a local point of contact for the community. The Recreation Management Plan also identifies six geographic management units that represent different distinct geographic areas and recreational experiences for visitors to the project for the purposes of long-term recreational planning and monitoring of the project's recreational resources.

Interior 10(a) recommendation no. 4 and a DFG 10(a) recommendation also recommend the development of the Recreation Management Plan, consistent with this proposed article.

Staff Analysis

The proposed recreational facility enhancements specified in the Recreation Management Plan would provide enhancements to existing recreational facilities and would also provide for some new recreational areas, such as the Thermalito afterbay outlet camping area. These facilities would result in minor land use changes and enhanced public access within the project. The FERC License Coordination Unit and the interagency coordination specified in the Recreation Management Plan would help provide measures for coordinated management of actions associated with recreational and land use and management of the project over the term of a new license. This coordination would help ensure resolution of any potential interagency or resource management conflicts that arise. We discuss proposed recreational facility and management measures in more detail in section 3.3.6, *Recreational Resources*.

Foreman Creek Area

Under Proposed Article A129, *Improve and Redirect Recreation Usage to Specific Areas at Foreman Creek*, DWR proposes to develop a plan, in consultation with federally recognized Native

American Tribes located in Butte County, the KonKow Valley Band of Maidu, and the Recreation Advisory Committee, to protect cultural resources at Foreman Creek while continuing to provide recreational use at that location. The plan would include measures to restrict the usage of the existing car-top boat ramp and develop facility improvements to encourage recreational use at Forman Creek in designated areas, including the installation of a restroom and picnic tables. The plan is also recommended by Interior under 10(a) recommendation no. 6, which is consistent with the proposed article.

The Berry Creek Rancheria and the Mooretown Rancheria (collectively referred to as the Tribes), in comments on the Settlement Agreement (dated April 26, 2006), stated that the Foreman Creek area should not be exposed to further disturbance by the public, particularly as a result of recreational use, and that the area should be protected and set aside from public use, including recreation and any other use that is inconsistent with protection of cultural resources and unnecessary for the operation and management of the project. Specifically, the Tribes are concerned that the area would remain open to the public during the development of the plan specified in Proposed Article A129 and would remain open to the public over the term of a new license for recreational activities that would adversely affect cultural resources in this area. The Tribes recommend that the Commission require DWR to grant a cultural resource easement that would transfer rights to the Berry Creek Rancheria to visit the Foreman Creek Area and manage and restore cultural resources there, with all remaining rights retained by DWR. Also, the Berry Creek Rancheria seeks a determination from the Commission that public access should not be allowed in the Foreman Creek area.

DWR states that the Tribes' proposed easement transfer would not allow for multiple-use management of the project lands in the Foreman Creek area and that the Commission should not require granting such an easement. Furthermore, DWR states that Proposed Article A129, completing section 106 consultation and implementing the Settlement Agreement provisions, would protect cultural resources in the Foreman Creek area (letter from M.A. Swiger, Attorney for DWR, Van Ness Feldman P.C., Washington, DC, to the Commission, dated May 26, 2006).

Staff Analysis

The proposed plan for public use and management the Foreman Creek area and the HPMP (see section 3.3.8, *Cultural Resources*) would help to provide measures to resolve existing conflicts associated with the current land use and management of the Foreman Creek area. However, until the development of the plan and associated land and resource management measures, potential adverse effects on cultural resources could occur as a result of the continued recreational use of the project lands within this area. Temporarily closing the site until the management plan is developed and approved by the Commission, and resource protection measures are implemented, would help to limit the potential adverse effects of the existing land use conflicts in this area and help to ensure that the cultural resources in this area would be adequately protected. The proposed plan and HPMP would be developed in consultation with the Tribes and would, therefore, would provide the means to help address the Tribes concerns for resource protection in the Foreman Creek area. Land use management actions, such as closing culturally sensitive areas, implementing cultural resource protection and mitigation measures, and/or redirecting recreational use in this area could provide adequate resource protection for this area. See also sections 3.3.6, *Recreational Resources*, and section 3.3.8, *Cultural Resources*, for further discussion.

Screening of Material Storage Area

Proposed Article A132, *Screening of Material Storage Area*, stipulates that DWR would plant vegetation to screen the storage/staging area located northwest of the emergency spillway from view of Oroville Dam Boulevard. Interior's 10(a) recommendation no. 9 is consistent with this proposed article.

Staff Analysis

The proposed screening would result in minimal changes in land use and management of the project, but would afford aesthetic benefits as a result of the screening of the storage/staging area. See section 3.3.9, *Aesthetic Resources,* for further discussion.

3.3.7.3 Unavoidable Adverse Effects

None.

3.3.8 Cultural Resources

3.3.8.1 Affected Environment

A comprehensive overview of cultural resources located within the project area, including the prehistory and history of the Feather River and Lake Oroville can be found in the license application (DWR, 2005a,b) along with other supporting documents.

Section 106 of the National Historic Preservation Act of 1966, as amended, requires that the Commission evaluate the potential effects on properties listed or eligible for listing in the National Register of Historic Places (National Register). Such properties listed or eligible for listing in the National Register are called historic properties. In this document, we also use the term “cultural resource” for properties that have not been evaluated for eligibility for listing in the National Register. Cultural resources represent objects, structures, places, or archeological sites that can be either prehistoric or historic in origin. In most cases, cultural resources less than 50 years old are not considered historic. Section 106 also requires that the Commission seek concurrence with the State Historic Preservation Officer (SHPO) on any finding involving effects or no effects to historic properties, and allow the Advisory Council on Historic Preservation an opportunity to comment on any finding of effects to historic properties. If Native American (i.e., aboriginal) properties have been identified, section 106 also requires that the Commission consult with interested Indian tribes that might attach religious or cultural significance to such properties. In this case, the Commission must take into account whether any historic property could be affected by a proposed new license within the project’s area of potential effects (APE) and allow the Advisory Council on Historic Preservation an opportunity to comment prior to issuance of any new license for the project.

Area of Potential Effects

The APE is the geographic area within which an undertaking may directly or indirectly cause alterations in the character or use of National Register-eligible sites (36 CFR 800.16[d]).

For prehistoric and historic archaeological resources, the limit of the APE for the Oroville Facilities was defined as being the existing FERC project boundary, which encompasses about 41,540 acres. The APE established for the evaluation of historic structures also was equivalent to the FERC project boundary and expanded to include the DWR Oroville Field Division facility.

Ethnographic and ethno-historic 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 an ethnographic village, and general areas such as a mountain that is a central element of myth or legend. For this project, the APE for ethnographic resources was expanded beyond the FERC project boundary to include Stringtown Mountain and Bald Rock Canyon to the base of Bald Rock Dome.

Archaeological Research and Background Investigations related to the development of the Oroville Facilities

As reported by the Anthropological Studies Center (DWR, 2005f), early archaeological efforts within the project area were carried out in conjunction with the development and operation of the Oroville Facilities and focused primarily on Native American or prehistoric physical remains. These investigations included a 2-month, university-sponsored program in 1952 led by Adan Treganza focused on seven watersheds in central and northern California under consideration for hydropower development. Treganza (1953) documented 30 archaeological sites within the study area. Beginning in 1960, Francis Riddell of the State Indian Museum conducted preliminary surveys of prospective sites for the Oroville Facilities and, joined by William Olsen, more extensive investigations of the Feather River. The most extensive inventory effort of the project area was conducted by Eric Ritter and Joseph Chartkoff, who documented 153 prehistoric archaeological sites in 1966. Two more field seasons of extensive investigations by Ritter and Chartkoff established the prevailing prehistoric temporal framework for the project area.

Following completion of the Oroville Facilities in 1971, DPR conducted surveys in support of ongoing recreational development during the 1970s, 1980s, and 1990s. The systematic survey of the Lime Saddle Recreation Area (1976 and 1977) documented six additional sites including three sites that were the first historic era resources formally recorded within the project boundary. In response to concerns about the effects of public use, specifically looting, vandalism, and unauthorized OHV use, on cultural resources, DWR conducted various site assessments in the 1980s and 1990s. Inventories of artifact collections associated with human remains from the project area have been conducted by DPR (1992) and Kautz and Taugher (1987).

Investigations Related to DWR’s Relicensing Effort

DWR completed three technical cultural resources investigations in support of the relicensing of the Oroville Facilities and is continuing work on subsequent studies related to the evaluation of documented cultural resources. The Anthropological Studies Center at Sonoma State University and the Archaeological Research Center of the California State University at Sacramento conducted a joint archaeological and historical resources inventory (DWR, 2005f). They identified 897 prehistoric and historic archaeological properties. The Far Western Anthropological Research Group conducted an ethnographic and ethno-historic inventory of Konkow Maidu cultural places (DWR, 2004n). They identified 144 ethnographic locations within the project boundary of or close to the Oroville Facilities. JPR Historical Consulting completed an historic properties inventory and evaluation of Oroville facilities, Butte County, California (DWR, 2004o). It identified 16 buildings and structures, including 12 historic properties that contribute to the Oroville Field Division Historic District and two individual historic properties associated with the historic district. The Archaeological Research Center also prepared a report for the public to explain the goal, objectives, and findings of the archaeological and historical resources inventory.

Prehistoric Archeological Chronology and Background

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, 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.

Oroville Vicinity

The basic outline of prehistoric cultural chronology in the project vicinity was first developed by Olsen and Riddell (1963) and later expanded and elaborated by Ritter (1968, 1970) and Kowta (1988). Prior to about 5,000 years before present (BP), there is little direct evidence of human occupation in the Lake Oroville vicinity, although surrounding areas show indications of human presence. Sometime prior to 11,000 BP, people entered the New World and occupied western North America. The interval between 11,000 BP and 8,000 BP is characterized by the presence of the Fluted Point and Stemmed Point traditions in California. Conventional wisdom holds that these Late Pleistocene/Early Holocene traditions reflect lifeways focused upon hunting big-game mammals.

These traditions are followed between 8,000 BP and 5,000 BP by as-yet poorly defined Early Archaic traditions. Cultural assemblages at this time are typified by the occurrence of handstones and milling slabs, presence of Pinto and Borax Lake series dart points, and infrequent use of obsidian for the manufacture of flaked stone tools. This evidence is assumed to indicate the existence of a subsistence base emphasizing the gathering hard seeds and other vegetables and hunting. Sometime after 5,000 BP, the Middle Archaic tradition emerges, and the Lake Oroville locality shows its first indications of intensive occupation.

The earliest securely dated archaeological complex in the Lake Oroville area is the Mesilla Complex, which has been dated between about 3,000 and 2,000 BP. Kowta (1988) has described this as the Butte County foothills variant of the regional Martis tradition. Manos and metates (i.e., hand-held stones or rollers and stone blocks with a shallow concave surface) were used for grinding vegetables and grinding and preparing hard seeds. Pestles and bowls were present but rare. This complex is defined by variations of Martis series points, including leaf-shaped, stemmed, and side notched points made from basalt, slate, and chert. *Haliotis* and *Olivella* beads, charm stones, and bone pins and spatulae are also part of the Martis Complex assemblages. This complex may represent sporadic, possibly seasonal occupation of the northern Sierra foothills by local bands and task groups.

The subsequent Bidwell Complex (2,000 to 1,200 BP) continued the use of basalt and slate dart points. People probably lived in relatively permanent villages that included formal cemetery areas. These peoples hunted; collected freshwater shellfish; fished with nets held in place by grooved, notched sinker stones; and gathered acorns to be processed on milling slabs and wooden mortars. Steatite vessels were used for cooking. The initial development of tribelets is associated with this period.

The Sweetwater Complex (1,200 to 500 BP) is associated with the first use of the bow and arrow. Tipped arrows with small, lightweight, stemmed and corner-notched projectile points were used. Mortars and pestles were the principal grindstone tools. Steatite vessel use became more elaborate with cups, platters, bowls, and tubular smoking pipes. The period is associated with a large variety of bone artifacts and an expanded inventory of marine-shell artifacts. The acorn complex appeared well developed, and a tribelet form of political organization probably prevailed.

The Oroville Complex (500 to 150 BP) represents the protohistoric Maidu-Konkow. Acorn processing became focused as bedrock mortars and desert series projectile points predominated. Diagnostic artifacts included small, tubular bone beads, incised bird-bone tubes and whistles, bone gorge hooks, gaming bones, awls, tubular steatite pipes, and clamshell disk beads. People constructed circular dance houses, and other large structures, and continued to dwell in caves and rock shelters. During this period the acorn complex reached its greatest development; political organization continued to be tribelets; and population density reached its highest levels.

Southern Cascades

North of the Lake Oroville areas, a more temporally limited cultural chronology was first formulated by Baumhoff (1955, 1957) and subsequently elaborated on by Johnson (unpublished manuscripts) for the Yana territory. The Deadman Complex (4,500 to 2,500 BP) largely corresponds to the earlier part of the Martis tradition. Use of basalt for the manufacture of flaked-stone tools predominated over the use of obsidian and chert. Assemblages are dominated by large, side-notched projectile points along with large, unifacially flaked, leaf-shaped points and stemmed forms.

The Kingsley Complex (2,500 to 1,500 BP) corresponds to the later part of the Martis tradition. Use of basalt continues with the addition of other lithic tools including small, well-shaped scrapers, and cobble core tools. A variety of groundstone tools are present, and spatulate bone tools, *Olivella* shell beads, and flat *Haliotis* beads also occur. The remains of multi-family houses are present.

The Dry Creek Complex (1,500 to 500 BP) is characterized by the preference for obsidian over basalt and chert for flaked-stone tool manufacture. Introduction of the bow and arrow is indicated by the presence of projectile points similar to Columbia Plateau corner-notched and Gunther series points. Diagnostic shell beads and ornaments include M series and spire-hopped *Olivella* beads and disc-shaped *Haliotis* ornaments and perforated freshwater shellfish ornament. Deer ulna awls and flakers are also present. Tight flexed burials are interred in prepared grave pits.

Northern Sierra Nevada

The prevailing prehistoric cultural chronology for the northern Sierra Nevada was initially developed during the 1950s by Elsasser (1960) and Heizer and Elsasser (1953) and expanded upon by Elston (1971 and 1979) and others. The Late Pleistocene/Holocene cultural chronology for this region includes the Washoe Lake Phase (from before 10,000 BP). It is the earliest known manifestation of human presence in the broader region and is represented by isolated fluted points. The subsequent Tahoe Reach Phase (10,000 to 8,000/7,500 BP) is distinguished by the presence of large, stemmed, edge-ground projectile points, usually made from basalt, which still generally occurred as isolated finds. Finds from this phase suggest highly mobile groups. The Spooner Phase (8,000/7,500 to 5,000 BP) is poorly known and lacks diagnostic projectile points.

The Early (5,000 to 3,000 BP) and Late (3,000 to 1,300 BP) Martis Phases are characterized by the presence of large numbers of ground stone artifacts, and the occurrence of pit houses and storage pits that suggest long-term residence, intensive seed processing, and food storage. The Early Martis Phase is distinguished by Martis contracting-stem, split-stem, and Steamboat diagnostic projectile points and the Late Martis Phase is typified by Martis corner-notched, Elko corner-notched, and Elko-eared diagnostic projectile points. The Early Kings Beach Phase (1,300 to 700 BP) sees the introduction of the bow and arrow, tipped with Rosegate and Gunther-series projectile points. Chert is the preferred toolstone with obsidian somewhat important, and the use of basalt uncommon. Tool size is reduced and more specialized, and bedrock mortars are introduced, likely related to acorn processing. Fishing probably played a greater role than large game in diets. The Lake Kings Beach Phase (700 to 150 BP) is typified by Desert-series projectile points.

Summary

The investigations and chronologies give insights into the occupation of the Feather River region by Native American peoples for at least 3,000 years and continued up to and beyond the arrival of European-American 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.

Prehistoric peoples of the Feather River region resided in an area containing a suite of habitats embedded within grasslands, scrublands, deciduous woodlands, and coniferous forests. Over time, the people developed subsistence adaptations increasingly focused upon the gathering and use of fish, large mammals, 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 (e.g., obsidian and marine-shell ornaments) over long distances. 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.

Ethnographic Background

The Lake Oroville area is within the territory of the Konkow peoples occupied at the time of contact with the EuroAmericans through the present. The Konkow peoples are sometimes referred to as the Northwestern Maidu, one of the three major divisions of linguistically related groups identified as Maidu, the other two being the Mountain Maidu to the northeast and the Nisenan to the south (DWR, 2004n). Residents of the project area spoke four 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.

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. The Feather River fishery offered an abundant and reliable food source, particularly the seasonal salmon runs. Konkow Maidu continue to take salmon from the Feather River and still hold an annual salmon ceremony reflecting the importance of salmon in Konkow life. The Konkow people had detailed knowledge about the distribution and usefulness of plants in their territory. Families moved to strategic locations at harvest times to gather desired foods, which included various greens, tubers and roots, seeds, nuts, and berries. Pine nuts were also highly valued, but the most important of these foods were acorns from oak, particularly black oak in the higher elevations beyond the APE and at the Enterprise area within the APE. Acorns, along with many other foods, were gathered, dried, and stored for winter use.

Trade with neighboring tribes was used to supplement the locally available resource base and to foster intertribal relationships. Konkow Maidu traded arrows, bows, deer hides, salmon, foothill pine nuts, acorns, and other foods for beads, obsidian, and green-dye pigment from neighbors to the north. They also received abalone shell and clam shell disc beads from the coast through their Patwin neighbors to the west. The trade network both east-west and north-south across California was extensive so that materials from different ecozones moved considerable distances, with many tribes acting as middle men (DWR, 2004n). 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 affected the fishery and disrupted the lifeways of Native American inhabitants. Some Native Americans began working for miners, ranchers, or settlers. Because of land use conflicts, treaties were negotiated by the federal government in 1851. One of these treaties would have given the Maidu a substantial reservation stretching from Chico to Oroville. However, the Senate refused to ratify the treaty and many of the Maidu were sent to the Nome Lackee Reservation in Tehama County, only to return shortly thereafter because of poor conditions. 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 in Mendocino County. During this devastating march, the Maidu suffered heavy losses, particularly among the very young and older populations. Ultimately, the Maidu lost 80 to 90 percent of their population and virtually all of their lands as a result of European-American colonization. The Maidu continued to practice traditional lifeways, but they did not have a secure land base until the turn of the twentieth century when several small Rancherias were created. Several tribes obtained federal recognition, but others did not.

In 1964, the land on which one of the Rancherias was located, Enterprise #2 Rancheria, was sold to the state of California for the construction of the Oroville Facilities and the Rancheria was terminated. Construction of the dam inundated many places that Konkow Maidu people visited and altered the salmon runs, such that they no longer go up the North Fork, West Branch, Middle Fork, or South Fork of the Feather River to spawn.

Today, several federally recognized and unrecognized Maidu Tribes and unaffiliated members of the Native American community reside within the project area. 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 Background

On the far northeastern frontier of Spanish California, the Feather River area was first explored by the Spanish in the early nineteenth century and later exploited by fur trappers in the 1820s and 1830s. The Mexican rancho period in northeastern California began in the 1840s, but it was soon interrupted, first by the American acquisition of California in 1848 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 mining areas across the West. The earliest settlements along the Feather River were at the sites of gold discoveries at Bidwell Bar, Long Bar, Hamilton, and Thompson’s Flat. By 1850, there were 214 mining camps on the Feather River and its tributaries, and more than 6,000 people, mostly men, lived in Butte County. The majority of these men pursued the relatively easily worked surface placer deposits. The miners quickly outnumbered the sparse Mexican population and the much larger indigenous population inhabiting the area and began to reshape the landscape. The Chinese played an important role in mining on the Feather River. The Chinese had a reputation for reworking apparently unsuccessful or played-out digging and finding gold. They specialized in placer mining and were skilled at water management. For a 10-year period from 1872 to 1882, the largest Chinese mining settlement in the United States existed a few miles south of Oroville. At the height of this period, there were 5,000 to 8,000 Chinese living in several mining camps in the area known locally as the lava beds. By the 1880s, as hydraulic mining activities decreased, mining towns were abandoned. Butte County maps of 1877, 1886, and 1901 show only the small communities of Springtown and Enterprise, in addition to the towns in the project area, Bidwell Bar and Oroville, which became the county seat in 1856. Where other towns disappeared, Oroville’s gradual development as a trading center first for mining and then for lumbering and agriculture, along with arrival of the railroad in 1864, reinforced its position. Oroville had a large Chinese population as well.

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. In 1898, a form of mining newly developed in New Zealand was first used successfully in California on the Feather River. Dredge mining left vast fields of cobble tailings that still dominate the landscape of the Feather River south of Oroville. About 8,000 acres of the project area within the OWA is a dredge field. These tailings provided much of the material used to construct Oroville dam. Mining remained an important part of the economy along the Feather River well into the twentieth century, a fact that is reflected in the local archaeology as one-quarter of the historic era sites identified during cultural resource surveys involve mining. More than 17 miles of ditches were recorded in the Oroville project area, demonstrating the importance of water supply to the mining operations and illustrating the grand scale of the industry.

The influx of miners also saw the development of trails and mule trains in the early years followed rapidly by ferries at Hamilton and Long Bar in 1850 and then at Oroville and Bidwell Bar, and county road plans in 1853. However the high flows of the Feather River made both ferry and road crossing dangerous. To provide safe passage over the Feather River, the suspension bridge at Bidwell Bar was built in 1856. By 1886, there were bridges at Oroville, Bidwell Bar, Springtown, and on the West Branch northeast of Cherokee. The arrival of the railroad in the 1860s improved the Feather River's area connection to the larger state and national transportation network. The California Northern Railroad, the first in the area, was completed from Marysville to Oroville in 1864. The coming of the railroad also increased the development of roads in the area.

Following the influx of miners to the region and the construction of railroads,, 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 in the nearby forests 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 twentieth century, the area became an important source of hydroelectric power and a vital source of water for California. During the first decade of the twentieth century, there was considerable interest in the rights to the waters of the Feather River, especially the North Fork, for hydropower use. Mines had been among the first users of hydropower. Frank McLaughlin's Big Bend Tunnel Project used a water-generating plant to provide electric power for the pumps and hoist. The Spring Valley Mine used electric power to provide light for its around-the-clock operations. The dredges also used electric power. Great Western Power, comprising a powerful group of California and New York investors, was engaged in developing hydropower in the area, once they acquired the rights to Big Meadow in Plumas County on the North Fork, which they would flood to create Lake Almanor. Great Western Power remained the dominant hydropower company in northern California until it was acquired by PG&E in 1930, which then took over the Big Bend powerhouse and Las Plumas. Both the powerhouse and the community of Las Plumas were razed for the creation of Lake Oroville.

In 1951, the state proposed the construction of a dam across the Feather River above Oroville to control floods, collect run-off for delivery along a 750-mile route, and generate hydropower. Construction of the Oroville dam as part of the State Water Project began in 1962 and was completed in 1967, creating Lake Oroville. Oroville dam, at 770 feet, is the highest dam in the United States. The construction of Oroville Facilities and the reservoir created many recreational opportunities.

Cultural Resources Identified within the Project's Area of Potential Effect

The cultural resources inventories involved extensive background research, the collection of oral histories, and a five-part field strategy. The multi-phase field strategy included the following: (1) the re-recording of 276 previously identified prehistoric and historic archaeological sites in the APE; (2) a complete prehistoric and historic archaeological inventory of the Lake Oroville 9,554-acre fluctuation zone between 690 and 900 feet above msl that was accessible in 2002 and 2003; (3) a probabilistic sample survey of about 4,800 acres above the maximum pool elevations; (4) a focused inventory of 58 historically sensitive areas; and (5) the inventory of about 2,000 acres associated with existing and proposed recreational facilities.

A cultural resources record search was conducted at the Northeast Information Center for sites within a 5-mile radius beyond the project boundary. This research identified 276 previously recorded sites within the project area. The previously recorded sites include 182 prehistoric sites, 35 historic era sites, 54 multi-component sites, and 5 ethnographic sites.

The prehistoric and historic archaeological inventory covered about one-half of the 31,000 accessible (i.e., non-inundated or steeply sloped) acres within the fluctuation zone and above the maximum pool elevations within the APE. This inventory included 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, 67 homestead proofs, and 21mining claims within or adjacent to the project area. 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 and preparation of updated inventory forms.

The intensive archaeological survey of the accessible portion of the fluctuation zone around Lake Oroville (between about 690 and 900 feet msl) was conducted in 2002 and 2003 to examine the area subject to regular inundation and exposure from fluctuations in reservoir levels. The goal of this survey was to completely cover the 9,554-acre area to ensure that no sites that might be affected by the project were inadvertently overlooked. Despite the lower than usual reservoir levels during the field season, parts of the fluctuation zone remained submerged throughout the year and only about 7,500 acres were inventoried. DWR remains committed to inventorying outstanding parts of the fluctuation zone as future conditions allow. The field techniques and site-recording procedures within the fluctuation zone were identical to those used in upland archaeology survey.

The remaining portions of the APE located above the maximum pool elevation were sampled based on a probabilistic model using three natural habitat zones to gather information that could be used to portray the area as a whole. These zones included grasslands (2,096 acres surveyed), oak woodland (1,793 acres surveyed), and coniferous forests (918 acres surveyed). The total area surveyed as part of the probabilistic inventory (4,807 acres) represents approximately 22 percent of the accessible acreage. Areas that were too steep to survey safely 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 stream courses 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 about one site for every 40 acres examined.

The prehistoric and historic archaeological inventory, which was conducted with the participation of trainees representing each of three federally recognized Maidu Tribes from the Mooretown, Berry Creek, and Enterprise Rancherias, involved about 15,500 acres of land. Surveyors adhered to California standards and accepted professional standards in defining prehistoric sites as three or more artifacts or other cultural items in direct association and/or any isolated feature, such as bedrock mortars, house depressions, hearths, or hunting blinds that reflects an intensive level of cultural activity. The survey resulted in the recording of 803 archaeological and historic resources and 391isolated finds consisting of 341 prehistoric, 48 historic-era, and 2 multi-component isolated finds. Table 58 presents the survey results by strategy. The survey report (DWR, 2005f) includes a complete listing of all the sites and isolated finds recorded during the survey. All archaeological and historic resources were recorded using the appropriate DPR forms.

Table 58. Survey results by strategy. (Source: DWR, 2005f, as modified by staff)

Strategy	Acres	Percent of APE	Number of Sites Recorded
Re-record 276 known sites in APE	--	--	129[a]
Fluctuation zone (9,554 acres between 640 and 900 feet msl	7,492	18	293[b]
Probabilistic sample	4,807	12	223
Targeted HSAs	1,104	3	33
Management-specific parcels	2,073	5	125
Subtotals for acres surveyed	15,476	38	803
Total for APE	41,540	100	897[c]

[a] Excludes 34 sites not relocated; 27 known sites subsumed within 8 large sites.

[b] Includes 43 sites that extend above maximum pool.

[c] Includes 94 known sites below the year-2002 minimum reservoir elevations.

Surface collection protocols were developed with the understanding that all collected materials would be permanently curated at a facility in the Oroville area, preferably managed by interested tribal groups or under the joint control of the Maidu Tribes and appropriate agencies (DPR and/or DWR). Under these protocols, surveyors retrieved any and all time-sensitive (diagnostic) artifacts, retrieved a small number of artifacts at each site for dating and provenance (source) purposes, and, for the fluctuation zone survey, retrieved samples of other artifacts (e.g., bifaces, pestles, stone bowls) that are subject to loss from shoreline erosion or looting.

The probabilistic survey was intended to provide information on the general density and distribution of the full range of potential cultural resources rather than focusing on specific historic era remains that often occur in particular kinds of settings. To ensure that historical resources were not inadvertently overlooked, a separate investigation was undertaken of specially targeted locations that appeared to have particular historical interest based on the archival research, including places on which homestead or mining claims had been filed. A total of 58 additional historically sensitive locations, including 42 homesteads and 16 mining patents, that had a reasonable possibility of containing historic-era resources were assessed and any historic sites identified were recorded.

Finally, the inventory strategy included inspecting 15 management-specific parcels where campground, recreational, and marina improvements; access and trail development; habitat restoration; project maintenance; and future land use practices might affect significant cultural resources. Locations included Lime Saddle recreation area; the multiple utility and road networks at the confluence of the West Branch and North Fork, including Dark Canyon; Goat Ranch recreation area; Bloomer boat-in campgrounds; Bidwell Canyon recreation area; Loafer Creek recreation area; the canal and road system located on the south side of the South Fork, from McCabe Creek to Ponderosa dam; facilities directly downstream of Oroville dam, including parking, roads, the sewage treatment plant, and the substation; the road system along the south side of the Thermalito division pool; the Feather River Fish Hatchery; North Thermalito forebay recreation area; South Thermalito forebay recreation area and nearby generating station; Wilbur Road boat launch; Rabe Road shooting range and Monument Hill day-use area; and Larkin Road boat launch.[95] Surveys of these parcels included buffer areas ranging from 500 to 2,000 feet, depending on the extent of development and the relation to surrounding topography and the APE.

[95] The Enterprise boat ramp and Foreman Creek recreation area were also inventoried along with other boat-in campgrounds and are discussed in greater detail under Ethnographic Resources.

Prehistoric Archaeological Sites

The inventory identified 325 archaeological sites containing materials from the prehistoric past—93 of which are multi-component sites. This total includes 94 sites that were previously recorded in areas that were inundated and could not be revisited. The prehistoric archaeological sites were assigned to one of seven site categories, based on the limited information available from surface inventories. The site categories include bedrock milling sites, open-air residential sites, limited lithic scatters, caves and rock shelters, rock art, quarries and workshops, and cemetery areas.

Sites assigned to the open-air residential category often contain several different types of tools and other artifacts, as well as evidence of semi-subterranean house features and/or midden deposits.[96]

Bedrock milling sites are generally associated with oaks or other seed-producing trees, both in association with occupation sites and in isolation. These sites are ubiquitous throughout northern California and can occur as single cups or outcrops with 50 mortar holes or more. Open-air residential sites are also sometimes referred to as villages or base camps. The larger versions are more commonly called villages, smaller ones, temporary camps. Typically, these sites may include communal ceremonials structures, midden deposits, houses, or storage pits, cooking features, groundstone, and a generally wide variety of artifacts. These sites tend to be located near creeks and streams; many open-air residential sites lie within the inundated portions of Lake Oroville. Limited lithic scatter sites are those sites that contain a sparse deposit of flakes that may be from one or more parent material. Frequently, these have been identified as temporary camps or secondary workshop areas. Because of their nature (i.e., small and sparse), these sites can be easily overlooked during archaeological field surveys. The majority of sites were assigned to these three categories.

Cave and rock shelter sites are occupation sites protected by a cave or rock overhang. Preservation of organic materials is more likely at these protected sites. These types of sites also lend themselves to the creation of rock art. Rock art sites are locations were a suitable outcrop surface has been decorated with one or more petroglyphs. These sites are frequently associated with larger occupation areas and near water courses. Quarry and workshop sites are locations where raw lithic materials, such as chert, basalt, or steatite, have been extracted and, frequently, processed to some degree before transportation to another location. Cemetery areas, locations containing evidence of multiple human burials, are generally located within or in proximity to residential sites, but can occur as isolated resources. Native American cemeteries are unmarked and therefore are difficult to locate unless they are exposed during planned excavations, by erosion, or by the activities of looters. Far fewer sites were assigned to these four categories.

Table 59 summarizes the number and approximate percentage of each of the main site categories identified during the inventory.

Table 59. Number and percentage of prehistoric archaeological sites by categories within the APE. (Source: DWR, 2005f, as modified by staff)

Site Category	**Number and Percentage of Total Prehistoric Sites**
Bedrock milling	150 sites; 36 percent
Open-air residential	135 sites; 33 percent
Limited lithic scatters	125 sites; 30 percent
Caves and rock shelter	2 sites; less than 1 percent

[96] The definitions of the archaeological and historical site categories are taken from the draft historic properties management plan (DWR, 2006b).

Site Category	Number and Percentage of Total Prehistoric Sites
Rock art	2 sites; less than 1 percent
Quarries and workshops	2 sites; less than 1 percent
Cemetery areas	2 sites; less than 1 percent
Total	418 sites; 100 percent

Historic-Era Archaeological Sites

The archaeological inventory resulted in the recording of 572 historic-era archaeological sites within the APE that were assigned to one of six site categories. The historic era archaeological sites categories include transportation, settlement, mining, water conveyance systems, industry and commerce (e.g., logging), and agricultural development. Some historical-era 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. Ninety-three of the sites include both historic era and prehistoric-era components.

Transportation properties, such as trail systems, road systems, and railroads, all have left marks on the landscape. More ephemeral locations, such as ferry crossings, may be identified through documentary sources, but stone walls, tracks, watering troughs, bridges, trestles, tunnels, and the like could mark portions of a transportation system. Settlement properties are those sites containing the remains of residences, shelters, other structures, or refuse deposits containing domestic debris. Other evidence of settlement can include features, such as fences, or landscaped elements, such as gardens and orchards. Mining properties include a wide range of features and structures left behind by exploration, extraction, or processing activities. Physical indications of mining activity could include exploration pits, trenches, claim markers, historic artifact deposits, camp remains, adits, shafts, waste material piles, mining tools, ditches or flumes, or milling equipment. Miners and settlers moving into the area established water systems. The collection, storage, and transportation of water began on a small scale to meet the needs of individuals, were enlarged for subsequent mining and agricultural operations, and grew to become the hydroelectric generation facilities that are a large part of the landscape today. Wells, pumps, cisterns, ponds, reservoirs, ditches, flumes, gates, dams, and transmission lines are all features associated with the collection and use of water. The vast majority of sites were assigned to these four categories.

Industrial/commercial properties might include commercial quarries, mills, kilns, smithies, or other processing structures. Sites containing evidence of commercial timber harvesting also are within this category. Remnants of telephone and telegraph lines can be found connecting these locations. Agricultural properties were operated on a small scale in the project area until the 1880s, after which more developed commercial practices were instituted. Examples of agricultural properties include houses (or their remains) and outbuildings, harvesting machinery, storage buildings, walls or fences, orchards, corrals, water systems, and refuse dumps.

Based on information obtained from the 572 resources documented, table 60 indicates the number and approximate percentages of the dominant historical themes represented in the APE.

Table 60. Historic-era archaeological sites within the area of potential effects. (Source: DWR, 2005f, as modified by staff)

Primary Historic Theme	**Number and Percentage of Total Historic-era Sites**
Transportation	184 sites; 32 percent
Settlement	166 sites; 28 percent
Mining	125 sites; 22 percent
Water systems	75 sites; 11 percent
Industry and commerce	11 sites; 2 percent
Agricultural development	4 sites; 1 percent
Other	7 sites; 2 percent
Total	**572 sites; 100 percent**

DWR has initiated, but not reported any results for the resource evaluations to determine which of prehistoric and historic-era archaeological sites, including trails, meet the National Register criteria.

Ethnographic Resources

The investigation into ethnographic and ethno-historic resources for this project was conducted in consultation and collaboration with the Maidu Advisory Council and members of local Konkow Maidu Tribal groups. The inventory was based on published and unpublished archival materials and 88 interviews with knowledgeable local Native Americans from the fall of 2002 through the fall of 2004. These interviews were held with numerous local tribal elders who were born and raised in the project area, including members from the Oroville-based Berry Creek Rancheria (Tyme Maidu), Enterprise Rancheria (Estom Yumeka Maidu), and Mooretown Rancheria, and the KonKow Valley Band of Maidu as well as the Mechoopda Indian Tribe of Chico Rancheria. 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.

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.

The ethnographic and ethno-historic inventory led to the identification of 144 locations in or close to the APE for ethnographic resources. These locations of ethnographic and/or ethno-historic 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, reflect 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.

Although 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 61.

Table 61. Ethnographic and ethno-historic site categories within the APE. (Source: DWR, 2004n)

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

The ethnographic sites also were assigned to one of six zones in the project area: West Branch, North Fork, Main Reservoir, Middle Fork, South Fork, and downstream of the dam. These zones contain from 15 to 30 sites. Zone 5 (South Fork) includes more locations not only because the APE includes more land above the maximum pool elevation than other zones but also because it includes the significant early settlement at Enterprise, a major focus of the Konkow Maidu community.

Zones 3 (Main Reservoir) and 4 (Middle Fork) contain slightly fewer locations than Zone 5, but they are very different from each other. The Forman Complex in Zone 3 is of particular importance because of the large cemetery, a sacred place for the Maidu Tribes, which has been and continues to be vulnerable to vandalism. The Foreman Complex was an important residential base and ceremonial location and displays more site categories than any other zone. Zone 4 is an essential area to the Konkow Maidu because of its concentrated and unique mythological values not available at any other area and the number and location of fishing sites. The number, geographic distribution, and the variety of locations reveal the importance of the project area to the local Maidu peoples. DWR has initiated but not reported any results for the resource evaluations to determine which of the 144 ethnographic locations meet the National Register criteria.

Historic Properties within the Project's Area of Potential Effects

DWR conducted an evaluation of the Oroville Facilities in 2004 (DWR, 2004o). Historic structures associated with the Oroville Facilities that may be eligible for listing in the National Register include the dams, power plants, reservoirs, and canals associated with the hydroelectric facilities, along with the Lake Oroville Visitor 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 old, the regulations implementing Section 106 of the National Historic Preservation Act (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]).

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 were used to help develop the historic context for these resources. Each of the involved historic structures was then inspected in the field, photographed, and documented on standard DPR forms. Elements of the built environment not directly associated with the hydroelectric facilities, such as campgrounds, marinas, roads, and trails, were not included in the investigation of the Oroville facilities 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).

As indicated in table 62, a total of 16 historical structures associated with the Oroville Facilities were documented and evaluated against the National Register 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 National Register 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 Field Division Historic District under National Register 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.

Table 62. Historical structures within the area of potential effects. (Source: DWR, 2004o)

Resource	**Date Built**	**Individually Eligible**	**Contributing Element to the Historic District**
Lake Oroville Visitor 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

A district derives its importance from being a unified entity, even though it is often composed of a wide variety of resources. The identity of a district results from the interrelationship of its resources, which can convey a visual sense of the overall historic environment or be an arrangement of historically or functionally related purposes. As a significant component of the State Water Project, the proposed Oroville Field Division Historic District, with contributing elements listed in table 62, appears to meet this definition and is recommended as eligible to the National Register under Criteria A, C, and G (DWR, 2004o).

The Oroville Facilities appear to be eligible under Criterion A for their contribution to broad patterns of our history as part of the State Water Project to water resource development within California and as a rare example of a popularly supported and approved state public works project. The State Water Project is the largest state-built, multi-purpose water project in the nation. The first of its kind, the State Water Project has been a major factor in profoundly altering the distribution of scarce water resources across California. The State Water Project also served as the model for future state water development in the arid west.

The Oroville Facilities appear to be eligible under Criterion C as a project of almost unprecedented scale for the state of California. Although the Oroville Facilities did not employ any radically new technologies, some aspects of the project were quite innovative. Among these were the following: (1) the ability of operators to control the temperature of water entering the intake structure through an innovative intake design; (2) the design and construction of an embankment dam to unprecedented height; (3) inclusion of a level of scientific instrumentation not previously employed in such projects; and (4) development and use of a sophisticated, highly efficient materials handling program for use during construction that handled in excess of 77,000,000 cubic yards of fill needed to build the massive dam.

In addition, the project was built to conform to architectural guidelines developed for the State Water Project. DWR, in consultation with the State Offices of Architecture and Construction, instituted guidelines for the architectural stylistic unification of the State Water Project facilities in 1964. Design motifs include aluminum pipe railings used at a variety of support facilities throughout the system; uniform color schemes of grays, blacks, and whites contrasted with accent colors of turquoise and red; simplified tower designs using welded structural shapes and landscaping emphasizing the control of dust; and the use of low-maintenance plantings compatible with local vegetation and trees for windscreens and living fences. As such, it embodies a specific type, period, and method of construction. It is noteworthy that the American Society of Civil Engineers has named the Oroville Facilities one of the 100 greatest American engineering achievements in the last century and in 2001 named the State Water Project a "Civil Engineering Monument of the Millennium."

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.

Existing Threats to the Integrity of Historic Properties

The cultural resources surveys documented the effects of reservoir level fluctuations, O&M activities, and public use on the condition and integrity of the archaeological and historic resources, ethnographic and ethno-historic resources, and historic structures within the APE. During these surveys, archaeological crews used site management data to record their observations on various activities that have affected cultural resources. The categories of activities include development, public use, vandalism, looting, OHV use, cyclical inundation, sheet erosion, and shoreline erosion. Forms were completed for 721 of the 897 sites (90 percent) identified through the five inventory strategies.

Archaeological sites and ethnographic resources located within the fluctuation zone of Lake Oroville (i.e., at elevations between 640 and 900 feet msl) have been periodically subjected to inundation, exposure to the air, and the effects of water movement, including waves from wind or boats since the construction of the project. Water-level fluctuations have caused sheet erosion, shoreline erosion, siltation, and the decomposition of exposed organic remains contained in some archaeological sites.

Depending on soil conditions, the degree of slope, and the location of a resource relative to wave action and river currents, archaeological sites may be experiencing substantial erosion, mild erosion, or siltation. 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. Archaeological sites at higher elevations are inundated only when the reservoir is near capacity. Archaeological sites 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. Archaeological sites containing organic material are highly susceptible to the effects of inundation, exposure, and wave action, whereas sites containing isolated bedrock mortars remain reasonably intact in spite of regular inundation. At lower elevations, some archaeological sites have probably been buried under silt accumulating in the reservoir. Forty-three and forty percent of the observed sites are affected by sheet erosion and shoreline erosion, respectively. 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.

Activities associated with the routine operation and maintenance of the Oroville Facilities, the recreational facilities in the Lake Oroville State Recreation Area, and wildlife management within the OWA and elsewhere have affected cultural resources. These activities 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, and the maintenance of recreational facilities that overlap with archaeological sites. These development activities have affected, to some degree, nearly 39 percent of the observed sites.

Public use of the facilities and the lands within the APE has affected cultural resources. These activities include the use of OHVs, the use of motorized boats (discussed under reservoir level fluctuations), looting, and vandalism. Overall, public use has affected greater than 50 percent of the observed sites. Specifically, OHV use has affected almost 20 percent of the documented resources and continues to be a threat to archaeological sites at or near places that provide easy vehicular access. Five of the eleven sites where field crews observed effects of OHV use on archaeological sites are located within the vicinity of Foreman Creek. Surveys documented evidence of looting and vandalism at about 20 percent of the recorded archaeological sites, also concentrated at locations readily accessible to the public.

3.3.8.2 Environmental Effects

Continued operation of the Oroville Facilities without protective measures could adversely affect both known and yet-to-be-identified historic properties. Many of the known archaeological sites are within the Lake Oroville fluctuation zone, where they can be affected by the rise and fall of pool levels as well as by the erosive effects of waves. Archaeological sites near campgrounds, fishing access spots, and other areas of public use are vulnerable to the erosive effects of human traffic, pedestrian or vehicular, as well as the effects of unauthorized artifact collectors. Although project operations could beneficially affect historic project facilities through continued use and maintenance, upgrades and major modifications to existing structures could diminish the character-defining attributes that qualify these structures for inclusion in the National Register. The presence and expansion of recreational facilities, including campgrounds, would continue to affect sites and plant resources of significance to Indians and would continue to affect the ability of Indian people to use these resources.

Historic Properties Management Plan

As described under Proposed Article A128, *Historic Properties Management Plan*, DWR would implement the HPMP as approved by the Commission. DWR's proposal is consistent with Interior's recommendation to implement the HPMP. Forest Service's preliminary 4(e) condition no. 16 stipulates that DWR file a final HPMP within 1 year following the issuance of any license for the project. DWR filed a draft HPMP with the Commission in April 2006. The HPMP was developed in consultation with the SHPO; Forest Service; BLM; DPR; the Enterprise, Berry Creek, and Mooretown Rancherias; Maidu Advisory Council (which included members of the three aforementioned rancherias, as well as members of the Mechoopda Indian Tribe of Chico Rancheria, KonKow Valley Band of Maidu, and others associated with the local Maidu community); and other members of the Cultural Resources Work Group.

The four federally recognized Tribes (Enterprise Rancheria, Mooretown Rancheria, Berry Creek Rancheria, and the Mechoopda Tribe of Chico Rancheria) in comments on the Settlement Agreement request that DWR pay the costs associated with restoring and re-burying the artifacts and remains previously removed from the area.

In the draft HPMP, DWR would:

- Implement measures to protect historic properties (once evaluations are completed) including: (1) a tiered program of routine site monitoring, assisted by the members of the California Archaeological Site Stewardship Program, consisting of 15-year cycles for sites where no effects have been identified, 5- to10-year cycles for monitoring sites where effects have been identified, and more frequent supplemental monitoring by DWR where site-specific monitoring requirements have been developed as a component of a treatment plan; (2) effect avoidance involving revising existing management direction (modifying maintenance procedures, altering public access) to avoid or reduce ongoing effects on cultural resources; (3) protection and stabilization where effect avoidance is not feasible through the use of physical measures to protect historic properties, including placement of restrictive or protective signage, installation of fencing, berms, plants, barriers, or otherwise physically blocking access, moving or modifying facilities, such as boat ramps or access roads, and stabilizing eroding surfaces within archaeological sites using protective covers, vegetative plantings, or engineering modification to slopes; and (4) recovery of data where ongoing substantial effects on historic properties cannot be adequately reduced through effect avoidance, site protection, or stabilization measures, based on DWR's determination that loss is imminent and consisting of removal of sufficient information relevant to scientific research values in the case of sites, or photo documentation and detailed recordation in case of structures.

- Establish a local curation facility that meets federal guidelines (36 CRF 79) to house archaeological materials collected in conjunction with data recovery or resource evaluations and consult with federal agencies on the curation of artifacts collected from federally managed lands.

- Implement protocols for future actions involving exempt actions as described in appendix D to the draft HPMP and four classes of non-exempt actions updated annually in consultation with appropriate agencies and entities based the status of the inventory, occurrence of historic properties, and effects.

- Complete the cultural resources inventory of about 15,000 acres of other lands in the APE within 5 years (about 3,000 acres per year), and the inventory of about 2,000 acres of lands within Lake Oroville (lands below elevation 690 to 640 feet msl) subject to accessibility.

- Complete formal National Register evaluations the 144 ethnographic sites, for sites subject to ongoing project-related effects and for 20 percent of the prehistoric archaeological sites identified within the APE within 3 years of approval of the HPMP, if not accomplished before that time.

- Focus resource evaluations to address the ongoing project-related effects in high priority areas, including McCabe Creek, Foreman Creek, Enterprise, and boat-in campgrounds.
- Develop a public interpretation plan in consultation with appropriate agencies and entities within 1 year of approval of the HPMP and implement the plan within 2 and 5 years of approval of the HPMP.
- Consider opportunities to set aside, enhance, or develop areas suitable for the collection of traditionally used plants by the Native American community.
- Implement protocols for inadvertent discoveries, the treatment of human remains, and emergency situations.
- Provide annual project view lists and annual reports on HPMP activities through the term of any license issued, conduct annual project review meeting during the first 10 years, and provide a formal HPMP review meeting at 5-year intervals for the first 10 years and every 10 years thereafter.
- Employ a cultural resources administrator with the primary responsibility at the license coordination unit level (DWR) for implementation of the HPMP and meeting any other cultural resource-related license conditions and employ a cultural resources coordinator with professional qualifications standards established by Interior to coordinate with the administrator and oversee technical components of HPMP implementation.
- Establish a Cultural Resources Consultation Group to allow for continued coordination with agencies responsible for cultural resources management and local federally recognized and unrecognized Maidu Tribes.

The Forest Service specifies that the final HPMP be developed in consultation with itself, the SHPO, Native American Tribes, and other applicable agencies and communities and that the HPMP: (1) accurately define the APE including the effects of implementing section 4(e) final conditions, Native American traditional values, and project-induced recreational effects on archaeological properties on or affecting National Forest System lands; (2) include measures to mitigate the identified effects, including a monitoring program and management protocols for the ongoing protection of archaeological properties; and (3) provision to immediately cease work if prior to or during ground-disturbing activities or as a result of project operations, items of potential cultural, historical, archaeological, or paleontological value are reported or discovered or a known deposit of such items is disturbed on National Forest System lands.

Staff Analysis

The APE provided in the draft HPMP is consistent with the APEs adopted in the cultural resource inventory and appears to include all lands that would be affected by the continued operation of the project.

DWR's proposes measures to (1) complete the inventory within 5 years of license issuance, (2) address the ongoing effects of project operations on high priority sensitive locations, (3) complete resource evaluations, and (4) implement management protocols for the routine and non-routine management of cultural resources, with appropriate staff. Reporting would be implemented under the purview of the Cultural Resources Consultation Group. These measures would preserve and protect the majority of historic properties and as yet-to-be identified historic properties within the project's APE.

DWR indicates in the draft HPMP that resource evaluations of the 144 ethnographic and ethno-historic locations, a 10-percent sample of the historic-era archaeological sites, and a limited number of prehistoric archaeological sites subject to ongoing project effects are underway, but DWR does not provide a list of the resources to be evaluated or a timetable for the completion of these evaluations. DWR's proposal to complete formal resource evaluations of about 20 percent of the prehistoric sites located in the APE leaves open the question of when and whether the remaining 80 percent of the sites would be evaluated and whether this percentage includes the sites in the Lake Oroville fluctuation zone.

The survey observations show that about 40 percent of the sites are currently affected by project-induced shoreline fluctuation. The draft HPMP does not provide for resource evaluations of all the sites within the fluctuation zone that are subject to project-related effects. As discussed in the Affected Environment section above, public uses, vandalism, looting, and OHV use affect about 40 percent of the 721 sites. We would expect that a majority of the sites affected by various public uses could be protected through DWR's proposed the impact avoidance and protection protocols.

The draft HPMP lists McCabe Creek, Foreman Creek, Enterprise, and boat-in-campgrounds as four high priority areas for resource evaluations and the implementation of measures to address project-related effects, but it is unstated how many identified sites within these four high priority areas would be evaluated for National Register eligibility. The draft HPMP does not include site management recommendations and resource evaluation (National Register) status or a timetable for the completion of resource evaluations for sites on federally managed land.

Establishment of a curation facility meeting federal curation facility standards to house cultural materials from studies associated with relicensing studies and from resource evaluations and data recovery associated with implementation of the HPMP would protect this information. DWR's ability to return the cultural materials to the federally recognized and unrecognized Maidu Tribes if such a facility is not built, as a proposed contingency, would depend on whether these entities have appropriate depositories for cultural materials. DWR is currently negotiating with the federally recognized Tribes to identify lands for reburial of remains previously removed from the area. DWR would develop site-specific treatment plans in consultation with the agencies and Tribes that would specify the treatment and disposition of human remains encountered during archaeology inventory and excavation efforts. The requirements of the Native American Graves Protection and Repatriation Act would be followed if human remains or objects of cultural patrimony were discovered on federally managed lands.

Maidu people continue to reside in the project area and carry on traditional practices that include the use of traditional plants. Efforts to protect locations where traditional plants occur and to provide access to these locations to members of the recognized and unrecognized Maidu Tribes and the local Maidu community would enable the continuation of traditional practices over the term of any license issued for the project.

Public information programs would help to inform the public about the culture history of the project area as well as the importance of protecting sites from vandalism and looting.

Finalizing and implementing DWR's HPMP (in consultation with the SHPO, federally recognized and unrecognized Maidu Tribes and other members of the local Maidu community, Forest Service, and BLM) and including site-specific management recommendations and the schedule for site-specific resource evaluations would ensure that adverse effects on historic properties arising from project operations or project-related activities over the term of the license would be avoided or satisfactorily resolved. Proposed Article A128, *Historic Properties Management Plan,* is consistent with Forest Service preliminary 4(e) no. 16.

In the event of relicensing and pursuant to the National Historic Preservation Act, the Commission would execute a programmatic agreement with the SHPO and the Advisory Council on Historic Preservation (should they chose to participate) to implement a final HPMP within 1 year of license issuance as a condition of any license for this project. DWR, the federally recognized and unrecognized Maidu Tribes, and the Forest Service would be invited to participate in this programmatic agreement as consulting parties.

Foreman Creek

As described under Proposed Article A129, *Improve and Redirect Recreation Usage to Specific Areas at Foreman Creek*, and consistent with Interior's recommendation 10(a) no. 6, DWR would develop and file with the Commission within 1 year of the issuance of any license for the project a plan to protect cultural resources at Foreman Creek while continuing to provide recreation at that location. DWR would consult with the federally recognized Native American Tribes located in Butte County, the KonKow Valley Band of Maidu, and the Recreation Advisory Committee (consultees) in developing the plan. The plan would include measures to restrict the usage of the existing car-top boat ramp and develop facility improvements to encourage recreational use at Foreman Creek in designated areas, including the installation of a restroom and picnic tables. DWR would review the plan with the consultees annually over the first 5 years and as necessary thereafter.

The Enterprise Rancheria (Estom Yumeka Maidu Tribe), Mooretown Rancheria (Concow Maidu), and Berry Creek Rancheria (Tyme Maidu Tribe), in comments filed on the Settlement Agreement all state that DWR's Proposed Action does not provide the necessary protection of cultural resources in the Foreman Creek area. They point to the high concentration of cultural resources in an area that constitutes only one percent of the total project area. They request that DWR: (1) protect and set aside the Foreman Creek area from public use, including recreation and any other use that is inconsistent with protection of cultural resources and unnecessary for the operation and management of the project; and (2) grant a cultural resources protection easement over the Foreman Creek area to Berry Creek Rancheria, who along with other local, federally recognized Maidu Tribes, would have the primary management authority over the cultural resources in that area. The Mechoopda Indian Tribe of Chico Rancheria in comments filed on the Settlement Agreement also request that a culturally appropriate and accepted mitigation plan is adopted for the protection of Foreman Creek.

Staff Analysis

Based on both the archaeological and ethnographic survey results, Foreman Creek is a locus of Maidu culture and is currently subject to vandalism, looting, and damage from public use, including the use of OHVs. The Foreman Creek recreation area is a large, isolated, relatively flat and open area that attracts OHV users. OHV is characterized in the survey reports as one of the most destructive public activities that occur in the project's APE. Unregulated OHV use has damaged and continues to damage areas (including tribal burial grounds) that contain cultural material of significance to the Maidu Tribes. DWR recognizes the project-related effects and has included Foreman Creek among the high priority locations for the implementation of resource evaluations and management protocols. DWR's proposed plan and protective strategies may help to separate public use from the locations identified sites, but adding new facilities would likely increase use and opportunities to damage sites of concern to the Maidu Tribes. Although the plans for recreational development are very specific, the plans for how best to protect significant cultural material are not well developed. In the draft HPMP and in reply comments to the Maidu Tribe, DWR indicates that impact avoidance is a priority, and one means of protecting an historic property is to modify management direction and restrict public access to threatened sites. As discussed in section 3.3.6, *Recreational Resources*, the recreational facilities at Foreman are 1 of 35 developments available for public recreational use in the project area. Only about 4 percent of the recreational use at the Oroville Facilities occurs at Foreman Creek. A short-term, or even long-term, closure would affect people who use the facility for recreation, especially those who live close to the facility. Nevertheless, we recommend that Foreman Creek be temporarily closed until a detailed site plan for recreation has been developed. However, we conclude it is premature for DWR to grant a cultural resource protection easement over the Foreman Creek area until a detailed site plan has been developed.

3.3.8.3 Cumulative Effects

The Oroville Facilities is one component in the State Water Project and only one of several other hydroelectric projects in central California that affect prehistoric and historic archaeological resources located along the Feather River and its tributaries. These projects attract recreational use around the reservoirs. The increased recreational use resulting from the availability of large lakes has contributed to the inadvertent or intentional destruction of prehistoric and historic archaeological resources. While continued erosion and recreational use of the Feather River area would be expected to continue to affect prehistoric and historic archaeological resources, the measures included in HPMPs being developed or implemented at the Upper North Fork Feather River Project and the Poe Project, among others, taken in combination with the measures included in the HPMP for the Oroville Facilities would cumulatively reduce the rate of destruction of these cultural resources.

3.3.8.4 Unavoidable Adverse Effects

Under the Proposed Action, the continued operation of the project would continue to adversely affect some archaeological sites in the fluctuation zone. The execution of the programmatic agreement and implementation of the final HPMP would ensure proper protection and management of significant cultural resources within the project’s APE and would also provide satisfactory resolution of any project-related adverse effects.

3.3.9 Aesthetic Resources

3.3.9.1 Affected Environment

Lake Oroville is located in the eastern portion of Butte County; the Oroville Facilities are located in Butte County. The eastern half of the county begins near the foothills of the Sierra Nevada Mountains and continues east to the range’s upper slopes. This part of the county is largely undeveloped and retains much of its natural character, with scattered. Scattered rural residences and small communities are located throughout this the area. Vegetative cover in the foothills area includes chaparral, oak woodland, and mixed coniferous forest. Lake Oroville is located in the eastern portion of Butte County.

The western half of Butte County is situated along the eastern edge of the Sacramento 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 influenced by human development activities; however, it retains 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 afterbay are located in the western portion of Butte County.

Overview

The Oroville Facilities can be placed into five aesthetically distinct geographic areas: Lake Oroville, the Thermalito diversion pool and Thermalito forebay, the Thermalito afterbay, the low flow channel, and the OWA. DWR identified key observation points within and near the FERC boundary to represent views of the aesthetic environment of the Oroville Facilities and assess the aesthetic resources of the project. The aesthetic environment encompasses visual resources, noise, and odor. During the scoping process, DWR identified only visual resource issues associated with the Oroville Facilities and determined that there are currently no concerns with noise or odors.

Lake Oroville

Lake Oroville is impounded by Oroville dam, a massive earthfill structure that rises 770 feet above the floor of the Feather River Canyon and is about 1.3 miles in length. Oroville dam is a major visible feature in the Oroville area. Its scale, shape, texture, and color contrast with the surrounding landscape. The face of the dam is composed of gravel and rock, and supports some plant material such as annual grasses, forbs, and small shrubs. Recently, California poppy seeds were broadcast across the downstream face of Oroville dam. During most of the year the face of the dam is brownish in color. The dam's concrete and metal spillway, spillway control gates, and emergency spillway weir are located at the north end and are visually important elements of the Oroville dam complex that contrast with the earth-filled portion of the dam. The visually prominent 178-foot wide concrete spillway chute extends from the top of the slope more than 3,000 feet down the spillway headworks and into the plunge pool at the canyon bottom. When the dam is spilling water into the spillway, mist from the water crashing into the spillway's base creates a spectacle that attracts viewers and media attention.

Because of the sheer size of Oroville dam and its southwest orientation toward the city of Oroville and the Sacramento Valley, it is a prominent visual landmark. The most imposing views of the dam are from its crest. The two lane paved road and walking areas along the crest are used by people for driving, walking, and bicycling. People participating in these activities can look down upon the sloping face of the dam and out at the extensive vista. Other areas that offer viewers relatively close foreground and middleground views of the face of the dam include Oroville Dam Boulevard in the Feather River canyon and portions of the reservoir upstream from the dam. Areas within and near the city of Oroville and some areas along State Route 70 have background views of the dam. From these locations, the dam is seen as a large, linear feature on the face of the hills, whose horizontal lines and bare, light gray-brown surface contrast with the darker colors and more undulating lines of the vegetated foothill backdrop. The duration of viewing Oroville dam from these areas ranges from very brief for motorists, to extended periods for people viewing the dam from their homes.

The dam's ancillary facilities (substation, equipment yards, roads, etc.) are somewhat visible and have a moderate degree of contrast with the landscape. The Edward Hyatt power plant is located in a cavern constructed underneath the reservoir and is not visible from around the dam. However, several of the features that are ancillary to the power plant, such as the switching station located at the base of the dam, and a storage yard, located on land west of the power plant and above the river, have some degree of visibility, particularly when viewed from the crest of the dam. Other components that are visible to the public include the penstock (and its cleared right-of-way), the siphon, and the two blue cylindrical structures that are part of the temperature control intake structure. The penstock has been painted a dark green and is briefly visible to drivers on the winding portion of Oroville Dam Boulevard. The siphon, which is located on a hill, has also been painted a dark green and is visible to people driving either Canyon Drive or Royal Oaks Drive and from some nearby Kelly Ridge residences. Painting both structures a dark green has reduced their visibility from some vantage points, although the siphon can be clearly seen rising above nearby vegetation. The temperature control intake structure is located along the shore of the reservoir and is quite visible from the crest of the dam, and the portion of the reservoir near the dam.

Three 230-kV overhead transmission lines extend about 9 miles from the Hyatt power plant switchyard to PG&E's Table Mountain substation. The lines are located on the hillsides above and to the north of the upper portion of the Thermalito diversion pool. The transmission lines have three visible components that affect the visual environment. They are the support towers, the conductors (which are cables that are commonly referred to as "lines"), and the cleared rights-of-way underneath transmission lines. The most visible components of the transmission lines that connect the Hyatt power plant switchyard to the Table Mountain substation are the steel support towers. Support towers introduce strong vertical elements into the landscape that, depending on the screening by topography and vegetation, can be highly visible. Some of the project support towers are located so that they are silhouetted against the sky and introduce contrasting shape, form, and color into the viewed landscape, making these towers very visible. Other towers are "in front" of the hillsides they cross and are not silhouetted against the skyline. These towers do not contrast as much as the towers that are silhouetted, but still contrast in color, texture, and shape with their surroundings. Conductors are also visible, but to a lesser extent than the towers. The transmission line is quite visible from the Thermalito diversion pool area and Cherokee Road. About 2.5 miles of the transmission line can readily be seen in this part of the project before it disappears from sight as it goes over nearby hills on its way to the Table Mountain substation. Cleared rights-of-way are often the most visible component of transmission facilities. However, this is not the case along most of the transmission lines at the Oroville Facilities. In addition to the project transmission lines, there are other visible transmission lines in the project vicinity. Although these other transmission lines are not part of the Oroville Facilities, they may be perceived by some members of the public as being project facilities.

Lake Oroville is a major regional aesthetic resource. At maximum operating storage capacity (elevation 900 feet msl), the reservoir's surface area is about 15,810 acres in size with about 167 miles of shoreline. Lake Oroville comprises five main "arms" and the large, centrally located main basin of the reservoir, which gives the lake a spider-like configuration formed by the four main tributaries to the reservoir. These portions of the reservoir are the West Branch and Upper North Fork arms, which come together to form the lower North Fork arm, the Middle Fork arm, and the South Fork arm. These arms range in width from as much as 1 mile in the lower portions of the North Fork arm, to less than 100 feet at their upstream ends. The terrain adjacent to the arms is typically steep, and the arms become narrow and canyon-like toward their upstream ends. The straight line distance between Oroville dam and the farthest reaches of both the West Branch and Middle Fork is about 12 miles. Views along the straight parts of the arms can be extensive (about 7 miles in the 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.

Because of the 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. Some of the individuals surveyed by DWR during the relicensing recreation studies indicated that garbage was a problem at some of the facilities on Lake Oroville. Another large group of people who view Lake Oroville are the motorists who observe it when they drive over the bridges on State Route 70, State Route 162, 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 upstream end of the West Branch (see figures 1 and 18).

The water level of Lake Oroville fluctuates throughout the year and influences the 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 at different locations at Lake Oroville with the upper ends of the arms being 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 upstream ends of the arms where the water is shallow.

DWR 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 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. Looking at start of month elevations since water year 1971, the Lake Oroville levels on October 1, which is the beginning of the water year, ranged from elevation 648 feet msl to 850 feet msl and averaged 793 feet msl.

The exceedance data in table 63 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 (elevation 900 feet msl) are not common events, whereas an elevation of 830 feet has a good chance of occurring or being exceeded during most water year types (85 to 75 percent). The elevation 710 feet was selected to represent very low elevations. The likelihood of an elevation of 710 feet 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 feet 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 conditions that exist at the three elevations.

Table 63. Lake Oroville exceedance data at three elevations.[a] (Source: DWR, 2005a)

	Elevation		
Month	**900 feet msl**	**830 feet msl**	**710 feet msl**
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%

[a] 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, for example, the likelihood of Lake Oroville being at or below that elevation would be 5 percent.

Elevation 900 feet msl (Full Pool)—Full pool (elevation 900 feet) is not a common occurrence at Lake Oroville and only occurs during wet water year types. The likelihood of an elevation of 900 feet 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 feet msl—Lake Oroville reaches or exceeds this elevation with great regularity during the spring months of most water year types. The likelihood of this elevation being met or exceeded in April, May, or June is about 85, 80, and 75 percent, respectively. During the summer months, the likelihood of this elevation being met or exceeded is less, about 45 percent in July, and 30 percent in August and September. At elevation 830 feet, the exposed shoreline at many locations becomes an apparent 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 contrast 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 feet msl—An elevation of 710 feet is almost 200 feet 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, between April and October, is about 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. During 1991, 1992, and 1993, (1991 and 1992 were dry years), the minimum elevations were 651 feet, 702 feet, and 723 feet, respectively.

Thermalito Diversion Pool and Thermalito Forebay

The 4.5-mile-long Thermalito diversion pool follows the river bed of the Feather River, beginning about 0.5 mile downstream from the Oroville dam and extending to the Thermalito diversion dam. The 50- to 200-foot-wide Thermalito diversion pool has a riverine character as it meanders through thickly vegetated hillsides. Views from within the Thermalito diversion pool are confined and directed by the adjacent steep hillsides.

Only the upstream face (about 15 feet) of the 1,300-foot-long Thermalito diversion dam is visible from the Thermalito diversion pool. The linear form of the Thermalito diversion dam, along with its color and texture, contrasts with the nearby landscape, particularly when viewed from downstream. When viewed from upstream near the Thermalito diversion pool, the dam is much less visible.

From the Thermalito diversion dam, the 10,000-foot-long Thermalito power canal connects the Thermalito diversion pool to the Thermalito forebay. The Thermalito power canal is one of the least visible major project features. The public gets quick glimpses of the canal and the water in it from the Cherokee Road, State Route 70, and Table Mountain Boulevard which cross over the canal.

The Thermalito forebay begins at the west end of the power canal and extends about 3 miles southwest to the Thermalito forebay dam. The downstream edge of the reservoir is formed by a low earthfill dam (91 feet from the base of the dam) that extends for more than 3 miles along the Thermalito forebay's southern edge. With its irregular 10 miles of largely undeveloped shoreline, the forebay has a generally natural appearance and blends in well with the surrounding landscape.

Because the Thermalito 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 feet during the middle of the week and then refilled by the weekend. During the winter, it may fluctuate more for varying reasons.

Thermalito Afterbay

The 4,300-acre Thermalito afterbay is formed by a 39 foot tall (from the base of the dam), "L"-shaped earthfill dam. The afterbay dam is one of the most visible project features. Its linear form, shape, and uniform texture contrast highly with the surrounding landscape. Another conspicuous feature is the Thermalito afterbay outlet which is a 600-foot-long spillway where water is released from the afterbay into the river below.

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.

Low Flow Channel

The upper portion of the low flow channel below the Thermalito 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. DWR recently planted shade trees and assorted native plants and grasses, and installed picnic facilities at the Feather River Fish hatchery. The fish barrier dam (and its waterfall) and the fish barrier pool are generally visually compatible with their surroundings. 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. Viewers of 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 State Route 70 Bridge are much less developed than those adjacent to the upper part, next to the center 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 feet in height. Various vegetation communities, such as riparian and oak woodlands, have become established in 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 within the OWA, from State Route 70, or from the Thermalito afterbay outlet, as well as from other undeveloped access points.

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 the 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 provides limited camping, a one-lane boat ramp, several unimproved boat ramps, and a number of unpaved 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 State Vehicular Recreation Area, which is outside of 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 State Vehicular Recreation Area is dispersed, and views of project features occur throughout these areas. Following the relicensing recreation studies, DWR reported that a considerable amount of garbage was strewn about the OWA in 2000 and in 2003.

During scoping, DWR determined that invasive species affect the appearance of project lands. Water primrose is a native and invasive aquatic plant that is currently found along the margins and backwaters of the Feather River both upstream and downstream of the OWA. Water primrose has been increasing in abundance since the mid-1990s and has invaded the areas of standing water to the east of the Feather River. Current mapping indicated that water primrose dominates 398 acres in this area.

Project Area Management

Forest Service

As described in section 3.3.7, *Land Use and Management,* management of all National Forest System lands within the project boundary is guided by several documents including the Plumas National Forest Land and Resource Management Plan. All of the project lands and lands influenced by project operations that are managed under the Plumas National Forest Land and Resource Management Plan fall within one of four management areas designated by the plan: the French Creek, Galen, Kellogg, and Feather Falls Management Areas. The management direction for aesthetics in the French Creek, Galen, and Kellogg Management Areas is to maintain pleasing visual corridors. The Feather Falls management area includes National Forest System lands along the South Fork arm. The management direction for aesthetics in this management area is to protect unique scenic values.

The Plumas National Forest Land and Resource Management Plan provides guidelines for the preferred Visual Quality Objectives of each management area. Visual Quality Objectives are based on the degree of acceptable alteration permitted within the natural characteristic landscapes and are applied to all project proposals and activities on National Forest System lands. The Visual Quality Objectives prescribed by the Plumas National Forest Land and Resource Management Plan for the National Forest System lands within the Oroville Facilities boundary are retention, which provides for a natural-appearing landscape where management activities are not visually evident, and partial retention, which provides for a natural-appearing landscape by assuring that management activities remain visually subordinate to their natural landscape. The Forest Service does not prohibit the occurrence of any specific management activities on lands with prescribed Visual Quality Objectives of retention or partial retention.

In 1998, the Forest Service officially designated a 130-mile segment of State Route 70, beginning about 8 miles north of the city of Oroville, as the Feather River National Scenic Byway. National Forest System lands that the byway passes through and that may be seen from the byway are frequently assigned Visual Quality Objectives such as retention and partial retention to protect the scenic qualities of the byway. The Forest Service may consider adopting aesthetic guidelines including a recommended color palette for development improvements located within the scenic byway viewshed.

Bureau of Land Management

Most of the BLM-managed lands in the project boundary are noncontiguous, scattered parcels, some of which are submerged under Lake Oroville. Visual Resource Management by BLM is based on the agency's Visual Resource Management system, which involves inventorying scenic values and establishing management objectives for those values through the resource management planning process. The Visual Resource Management system assigns one of four visual resource "Inventory Classes" to parcels of land, each of which has objectives that differ in terms of allowable changes to the visual conditions of those parcels of land. BLM lands in the Oroville Facilities area have been designated as Class II lands. The management objective for Class II lands is to retain the existing character of the landscape. BLM administered public lands in the Oroville Facilities area have been given this designation to insure that the visual character of these lands is retained by BLM until potential land transfers are completed. See section 3.3.7, *Land Use and Management,* for more discussion on these potential land transfers.

California Department of Transportation

The California State Scenic Highway Program is part of the California Streets and Highways Code, which is administered by the California Department of Transportation. 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, and noise barriers) affect the “scenic corridor.” The only eligible state scenic highway in the vicinity of the project is a portion of State Route 70 north of the main basin of Lake Oroville. A designation of “eligible” indicates that the route is shown on the Master Plan of State Scenic Highways but does not mean that it is nominated. While eligible, the segment of State Route 70 crossing the project near Vinton Gulch is not currently protected by a state-approved, county-developed plan.

Butte County

The Oroville Facilities are located entirely in Butte County. 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 Butte 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 scenic highways in the project area. However, the Butte County Zoning Plan has assigned the zoning designation of “Scenic Highway” to portions of four roadways in the vicinity of the project. 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 (located west of the West Branch arm);
- State Route 162 (along the east side of the main basin from the Canyon Creek area to south of the Bidwell Bar Bridge);
- State Route 70 (on the south side of the West Branch arm near Vinton Gulch); and
- Lumpkin Road (located at the east end of the South Fork arm).

3.3.9.2 Environmental Effects

Flow/Temperature to Support Anadromous Fish (Proposed Article A108)

Under Proposed Article A108, *Flow/Temperature to Support Anadromous Fish*, minimum instream flows in the low and high flow channels would increase above current license requirements and contingencies to provide additional flows are also included in this measure to meet temperature objectives. See section 3.3.5, *Threatened and Endangered Species*, for a detailed description of this proposed article.

Staff Analysis

Additional minimum flows would be provided from Lake Oroville and the amount of water that would be necessary to meet these license requirements is considered minimal (see section 3.3.2.2, *Water Quality and Quantity*). Further, minimum instream flows would only be required as long as this would not cause Lake Oroville to be drawn down below elevation 733 feet msl. The effects of this operational measure would not cause a noticeable difference in the expected reservoir elevations at Lake Oroville (see section 3.3.9.1, *Aesthetic Resources*, which describes the reservoir exceedance probabilities).

Screening of Storage Area (Proposed Article A132)

Under Proposed Article A132, *Screening of Material Storage Area*, DWR would plant appropriate vegetation to screen the storage/staging area located northwest of the emergency spillway from view of Oroville Dam Boulevard and maintain the vegetation. DWR would use native plants to the extent practicable.

In their motion to intervene, American Rivers, American Whitewater, and Chico Paddleheads state that they support the Settlement Agreement measures.

Staff Analysis

The storage area is visible from the highly traveled Oro Dam Boulevard and Oroville dam and the facility sharply contrasts with the surrounding landscape. Planting trees and other vegetation to screen material stored at the material storage area located north of the Oroville dam emergency spillway would block views of the storage area when viewed from the walkway on top of the dam and from Oro Dam Boulevard. Screening the storage area would enhance aesthetics at the project by eliminating the view of the storage area.

Seeding the Face of the Oroville Dam (Interim Measure)

The face of Oroville dam is a prominent, contrasting project feature on the landscape that is visible from many locations in the city of Oroville as well as from distant locations such as Highway 70. Sightseeing was the second-most popular day-use activity at the Oroville Facilities. DWR recently broadcast California poppy seeds across the downstream face of the Oroville dam. In its comments on the draft EIS, DWR notes that it has made previous unsuccessful attempts to seed the face of the Oroville dam and has concluded that California poppies are not adequately self-sustaining in this location to produce the desired effect, primarily because much of the face of the dam is rock, and lacks sufficient soil for efficient poppy seed germination. DWR notes that the diversity of wildflowers on the dam was not successfully displaced in 2003; despite aerial distribution of about 800 pounds of California poppy seed, germination and establishment was minimal and unimpressive. DWR states that continued natural reproduction of low numbers of poppies has recurred annually since then and is supplemented by several other species of both weedy and native flowering plants. DWR also states that the cost of this Interim Measure was approximately $10,000 due to the necessity of using helicopters and other strategies for seeding the dam.

Staff Analysis

Continuing to provide some form of cover on the face of the dam throughout the license term would enhance the view of this project feature for visitors to the area.

3.3.9.3 Unavoidable Adverse Effects

Project operations would continue to draw down Lake Oroville on a seasonal basis, exposing a contrasting, devegetated margin of land encircling the reservoir as it recedes.

3.3.10 Socioeconomics

3.3.10.1 Affected Environment

The Oroville Facilities are located in Butte County, which is situated in the northern portion of California's Central Valley and Sierra Nevada foothills. The economic history of the region is founded on resource extraction industries, including mining and lumber processing, and ancillary industries, such as railroad transportation. Once the local irrigation infrastructure and large-scale water projects (i.e., Central Valley Project and State Water Project) were in place, the agricultural industry became more prominent in Butte County. Currently, the backbone of the regional economy is based on businesses that grow, store, process, and market a diverse range of agricultural commodities and products. In the greater Oroville area, agriculture (primarily orchard and rice production), local and state government, and recreation and tourism–serving businesses dominate the local economy. These businesses are part of the service industry that gained prominence after construction of Oroville dam in the late 1960s.

Several indicators show that the project area is not economically prosperous. Results of the 2000 census indicate that Butte County is above regional, state, and national averages with respect to the percent of its population (19.8 percent) below the federally established poverty level (U.S. Census, 2000). In 2001, the county ranked 40th of 58 California counties in terms of average per capita income (Counting California, 2001). Butte County reports chronic fiscal problems, and has been designated a "Distressed County" by the state of California three times since 1990 (McIntosh, 2006).

Population

The Sacramento Valley region includes the counties of Butte, Colusa, Glenn, Placer, Sacramento, Shasta, Sutter, Tehama, Yolo, and Yuba. Between 1960 and 2000, the population of Butte County increased from about 82,000 to 207,200, an average annual increase of about 3.8 percent, or a total increase of roughly 150 percent during the period since construction of Oroville dam. Neighboring Sacramento Valley agricultural counties, such as Colusa, Glenn, and Tehama, have all grown more slowly overall than Butte County, although the population of Colusa and Tehama counties grew more rapidly than Butte County between 1980 and 2000 (figure 22). Placer County in the Sacramento metropolitan area has grown very rapidly over the entire period. Shasta County's rapid growth is linked to its strong diversified economic base and the geographically large trade area of Redding.

From 1980 to 2000, the Butte County population grew from 143,851 to 207,200, an increase of 44 percent (about 2.1 percent) annually. Butte County's growth rate has slowed down perceptibly from 1990 to the present; its population grew by 11.3 percent from 1990 to 2000, or about 1 percent per year (U.S. Census, 2000).

During the next 40 to 50 years, the Sacramento Valley population is expected to grow by about 74 percent, or 2.25 million people (California Department of Finance, 2004). At the same time, Butte County is projected to double in population (California Department of Finance, 2002). In comparison, the state of California is projected to grow by 170 percent during the same time frame. Although the population growth rate in Butte County is not projected to be as high as some of its neighboring counties, the population growth rate in Butte County is projected to be higher than the regional average.

The racial makeup of the Butte County population is more uniform than that of the state, with American Indians/Alaska Natives the only minority population that makes up a higher proportion of the local (1.9 percent) than of the state (1.0 percent) population. The proportion of American Indians/Alaska Natives is even higher in the city of Oroville (3.9 percent); nearly four times the state average. Based on survey data collected as part of recreation studies for relicensing, the ethnicity of visitors to the Oroville Facilities is predominantly White/Anglo/non-Hispanic (about 80 percent); Latinos/Hispanics are the second most populous ethnicity (between 3 and 16 percent, depending on recreation resource area).

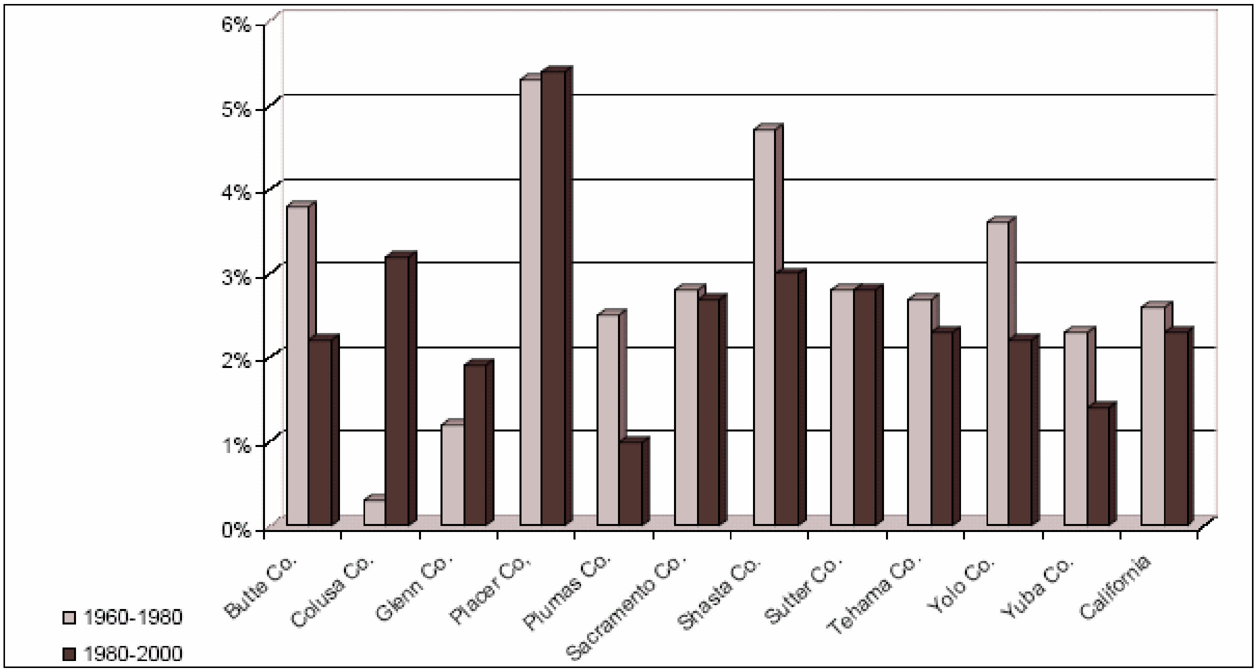


Figure 22. Average annual population growth in the Sacramento Valley region and Plumas County from 1960 through 2000, by county. (Source: DWR, 2005a)

Employment and Economic Base

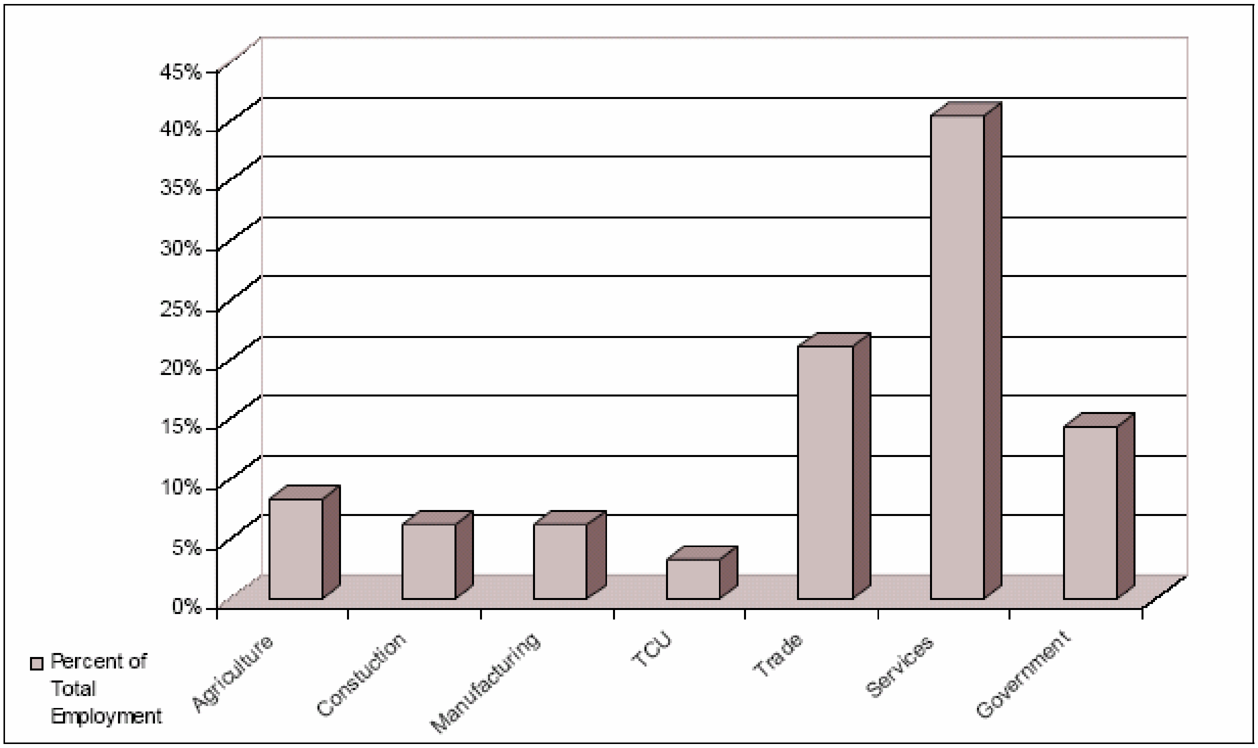
Table 64 shows historical data on key economic indicators for Butte County between 1980 and 2000. As shown, per capita income has increased from $11,240 in 1980 to $17,517 in 2000. The unemployment rate decreased from 10.1 percent in 1980 to 7.0 percent in 2000, while the labor force rose from 63,300 in 1980 to 87,933 in 2000.

Table 64. Historical data on economic indicators in Butte County 1980–2000. (Source: U.S. Census, 2000).

	1980	1990	2000
Per Capita Income	$11,240	$12,083	$17,517
Unemployment Rate	10.1%	8.3%	7.0%
Labor Force	63,300	79,100	87,933

The average income of residents of Butte County is significantly below regional, state, and national averages. In 2000, Butte County had the lowest median household income ($31,924) in the Sacramento Valley region. Its household income level was 67 percent of the California median household income ($47,493), and also was well below the national median ($41,994). Based on the survey data, the household income levels for Oroville recreationists are fairly evenly distributed. The majority of visitors (about 75 percent) had a total household income that was higher than median income level for Butte County in 2000.

As shown in figure 23, the largest segment of employment in Butte County is in the services sector, which accounts for 41 percent of total employment countywide. The services sector includes business services, personal services, educational services, and social services. Wage rates are relatively low in Butte County, particularly in Oroville where food service jobs at low wage scales comprise a relatively large share of employment.

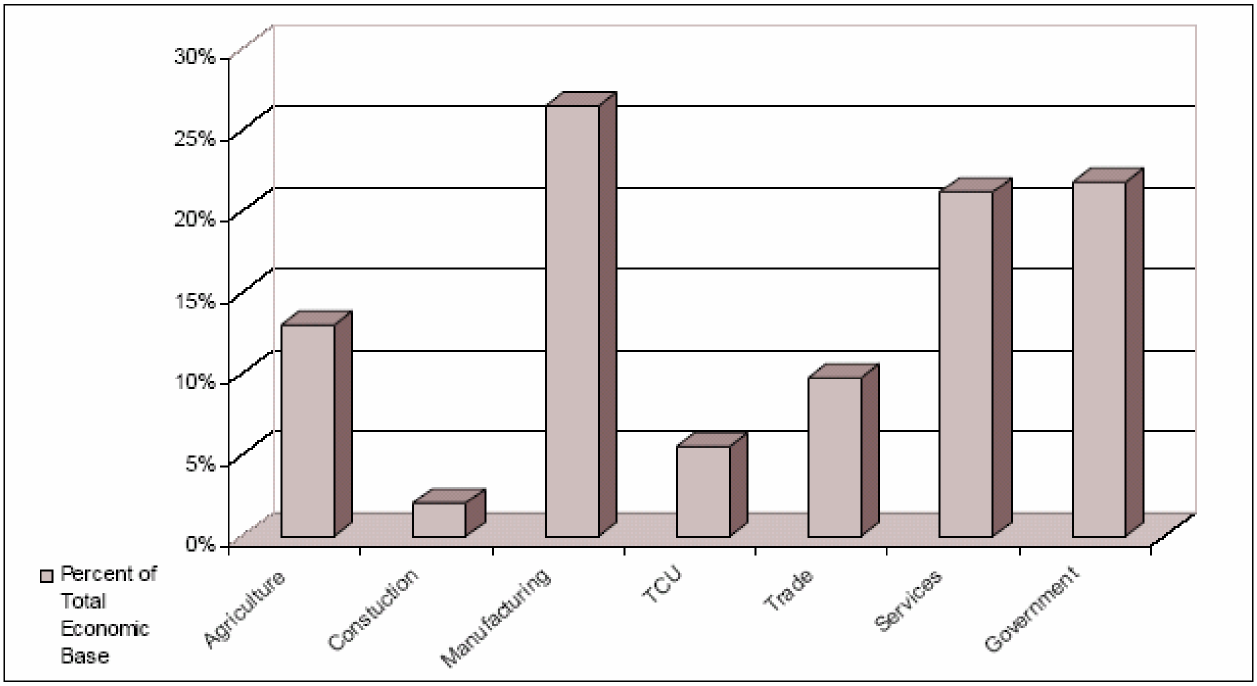


Notes: Agriculture – agriculture and agricultural services sectors
Construction – new construction and maintenance and repair sectors
Manufacturing – all manufacturing, including food processing, wood processing, and light industry
TCU – transportation, communication and utilities sectors
Trade – retail and wholesale trade sectors
Services – business, personal, educational, and medical services sectors
Government – federal, state, and local government sectors

Figure 23. Butte County employment by industry. (Source: DWR, 2005a)

Butte County has a high proportion of employment in educational services (28 percent), which reflects the presence of California State University at Chico and Butte College; the only county in the Sacramento Valley region with a higher proportion is Yolo County, reflecting the presence of the University of California at Davis. Counties that do not have a local college or university typically have less than 20 percent employment in educational services. Butte County is also high in recreation services (lodging, amusement, and associated tourism services), with 9.2 percent of employment servicing the tourism and recreation industries. The only two counties in the region with a higher proportion of employment in recreation services are Shasta County (9.5 percent) and Plumas County (11 percent), reflecting the extensive national forests and reservoirs within those counties. Butte County is close to the regional average in its proportion of employment in business services, with 7.4 percent of its employment in this area. Butte County compares favorably to agricultural counties, such as Colusa and Glenn Counties, but does not have proportionally as much employment in the business services sector as metropolitan counties such as Sacramento County (10.3 percent) or Placer County (10 percent).

The economic base of Butte County includes those industries that bring money into the region. Virtually all manufactured goods produced in the county are exported, and manufacturing accounts for 27 percent of the economic base in Butte County (figure 24). Agriculture and agricultural services is another key component of the economic base (13 percent). The combined trade and services sector also is strong in the county, reflecting Chico’s role as a regional trade center. A small portion of the economic base is in the government sector and reflects the role of California State University at Chico and Butte College in providing services to residents from other parts of the state.



Notes: Agriculture – agriculture and agricultural services sectors
Construction – new construction and maintenance and repair sectors
Manufacturing – all manufacturing, including food processing, wood processing, and light industry
TCU – transportation, communication and utilities sectors
Trade – retail and wholesale trade sectors
Services – business, personal, educational, and medical services sectors
Government – federal, state, and local government sectors

Figure 24. Butte County economic base. (Source: DWR, 2005a)

Income

Butte County is well above regional, state, and national averages with respect to the percent of its population (19.8 percent) below the federally established poverty level (U.S. Census, 2000). In nearby Shasta County, about 15 percent of the population is below the poverty level.

Butte County residents receive roughly 60 percent of their income from wage and salary earnings. The other sources of income for Butte County are interest, dividends, and rent (8 percent); government transfer payments (13 percent); retirement income (8 percent); and self-employment income (10 percent). The percent of income from wages and salaries is low compared to neighboring counties and to the California average. Counties, such as Sacramento and Yolo, with more high-paying jobs rank significantly higher than Butte County on this measure. Conversely, Butte County ranks high in the percent of total income derived from government transfer payments (social security payments, supplemental security payments, and public assistance). These government transfer payments do not include Farm Service Agency payments, which are included as business income.

Butte County also leads other counties in the region in income from other retirement sources, with about 8 percent of all income coming from retirement programs other than social security. When retirement income from all sources is combined, about 25 percent of all income in Butte County is attributable to retirement income (social security, other retirement sources, and property income). Butte and Tehama counties lead the region in this measure of dependence on retirement income.

Fiscal Condition of Butte County

As noted above, income levels in Butte County are much lower than the state average and the number of persons living below the poverty level is higher than average. This condition extends to the County government, which has been determined to be in “acute fiscal distress” three times since 1990. In his comments on the draft EIS, Butte County Chief Administrator Paul McIntosh submitted a copy of the Commission on State Mandates’ latest (June 13, 2005) such finding (Commission on State Mandates, 2005). The finding, which cited $17.5 million in unmet needs in the public safety department, health and human services, and general government, noted that even with a $320.9 million budget in FY 2004 -2005, the County had no appreciable flexibility in its discretionary expenditures and had to contend with many factors outside its control, including increasing retirement benefit contributions, increasing CDF contract costs, and reduced reimbursements funded through state mandate claims. Although several California counties filed for this status in the mid-1990s, Butte County is the only California county that has filed for and been granted this finding in recent years (personal communication, N. Patton, Assistant Executive Director of Commission on State Mandates, Sacramento, CA, and E. Hall, Louis Berger, Boise, ID, February 7, 2007).

Sales Tax Revenue of Local Jurisdictions

Levels of sales tax revenues generated within cities and counties over time are influenced by numerous factors, including regional and national economic trends, income growth, local and regional population growth, and the breadth and diversity of a community’s retail trade sector. Spending by visitors, including recreation users, is one factor that may affect levels of sales tax revenues within an area. The current sales tax rate in Butte County and all incorporated areas is 7.25 percent, of which 1 percent is returned to the jurisdiction where taxable sales occur (the 1 percent local share has remained in effect over the fiscal year 1960–61 through fiscal year 1998–99 period). The data reveal several trends, as summarized in the following points:

- During fiscal year 1998–99, Chico and Oroville led all jurisdictions in the region, including Redding, in per capita sales tax revenue. During that year, per capita revenues were as follows: Chico, $199; Oroville, $197; Redding, $178; Gridley, $142; Paradise, $50; Butte County, $34; and Biggs, $11. Large population centers exist just outside the city boundaries of Oroville and Chico, which contribute to the relatively high per capita sales tax revenue in these communities.
- Oroville’s per capita sales tax revenues have exceeded Redding’s in every year since fiscal year 1976–77, when Redding annexed the unincorporated Enterprise (Shasta County) area. During fiscal year 1998–99, Oroville’s per capita revenue was $197 compared to $178 for Redding. Oroville’s ability to maintain relatively strong sales tax revenue levels indicates an ability to capture its share of regional transactions and to pull in taxable sales from people residing outside of its city limits.
- Beyond the above examples, the sales tax revenue data do not provide a clear indication that the development of Lake Oroville facilities had an immediate effect on sales tax revenue levels in nearby communities. Between the fiscal years of 1965–66 and 1975–76, which includes the period during which the dam, forebay, afterbay, and most recreation facilities were completed, Oroville’s real per capita sales tax revenue increased by an average 3.2 percent annually, which exceeded Chico’s 1.6 percent average annual growth but was virtually the same as Redding’s 3.1 percent average annual growth. Real revenue growth over this period, however, was relatively strong in Gridley, unincorporated Butte County, and Biggs, annually averaging 5.8 percent, 5.4 percent, and 4.7 percent, respectively. These figures suggest that factors other than visitation to Lake Oroville and Lake Shasta play important roles in determining levels of sales tax revenues for these communities.

State Agency Expenditures at Oroville Facilities

State agency expenditures on the development, operation, and maintenance of the Oroville Facilities affect both regional economic conditions (such as employment and income levels) and fiscal conditions (such as sales tax revenues). To the extent that these expenditures are made within Butte County and local communities, expenditures made over time serve as an indicator of historical economic activity generated by the Oroville Facilities. The estimates of total expenditures by agency shown in Table 65 are annual averages derived from budget data provided by the state agencies for the period between fiscal years 1995–96 and 2003–04, as reported by DWR (2004p). The allocation of the total agency expenditures to the model areas is based on data obtained from DWR, DPR, and DFG concerning the residency of its employees and on estimates of the percentage of non-payroll expenses that are made within Butte County. Payroll expenditures are the largest component of direct state expenditures associated with the Oroville Facilities. Table 65 indicates that, of an average annual $15.4 million dollars spent for project-related operation and maintenance, $9.8 million (63.6 percent) accrues to businesses and employees living in the City of Oroville, with lesser percentages accruing to other communities. About $3.1 million (20 percent) accrues to people outside the county.

Table 65. Estimates of annual operations and maintenance expenditures by state agencies related to the Oroville Facilities. (Source: DWR, 2004p)

	DWR				
Area	**Recreation-Related**	**Other**	**DPR**	**DFG**	**Total**
Oroville	6,965,700	1,030,300	1,529,500	289,500	9,805,900
Paradise	806,600	119,500	145,600	71,600	1,141,200
Biggs-Gridley	347,700	51,400	12,100	214,000	630,000
Chico	493,500	73,000	84,900	60,400	713,600
Out-of-county	2,602,300	384,900	12,100	131,500	3,136,500
Total	11,216,800	1,659,100	1,784,200	767,000	15,427,200

Notes: DFG – California Department of Fish and Game
DPR – California Department of Parks and Recreation
DWR – California Department of Water Resources

Recreation User Spending at the Project

DWR, in consultation with the Recreation & Socioeconomic Work Group, performed surveys and developed an economic model to estimate recreation-related spending by project visitors and potential effects within Butte County. For modeling purposes, the communities where project-related recreational spending might occur were designated as being part of the Oroville, Chico, Paradise, or Biggs-Gridley Model Areas. The Recreation Activity, Spending and Associated Economic Impacts Study (DWR, 2004p) reports that visitor spending is estimated to range from about $1.4 million annually in the Biggs-Gridley Model Area to about $20.4 million in the Oroville Model Area (table 66). Countywide, spending associated with current recreational activity at the Oroville Facilities is estimated to total $30.7 million annually, with $11.9 million being spent by recreation users who reside outside of Butte County.

Table 66. Summary of current recreation-related spending in Butte County by county residents and out-of-county visitors to the Oroville Facilities (in thousands of nominal dollars). (Source: DWR, 2004p)

Study Impact Area	Butte County Residents[a]		Out-of-County Residents		Total Spending
	Amount	Percent of Total	Amount	Percent of Total	
Oroville	$10,163.8	54.1	$10,265.9	86.3	$20,429.7
Paradise	$4,182.7	22.3	$634.2	5.3	$4,817.0
Biggs-Gridley	$761.9	4.1	$597.0	5.0	$1,358.9
Chico	$3,674.3	19.6	$392.4	3.3	$4,066.6
Butte County Total	$18,782.7	100.1	$11,889.5	99.9	$30,672.2

[a] Spending by Butte County residents in each community includes spending by residents of the community and spending by other Butte County residents in that community.

Recreation- and O&M-Related Employment and Earnings

Local project-related economic effects primarily result from recreation activity and O&M spending for the Oroville Facilities. As recreation-related spending levels vary in relation to use, local employment and earnings generated by retail sales, hotel and motel stays, fuel purchases, and other expenditures by visitors also change. Similarly, changes in O&M expenditures by state agencies also generate economic activity in local areas. The Recreation Activity, Spending and Associated Economic Impacts Study (DWR, 2004p) reports that project-related spending annually supports about 1,053 jobs and $25.8 million in earnings in the county (tables 67 and 68).

Table 67. Summary of jobs generated by recreation-related spending and operation and maintenance of the Oroville Facilities. (Source: DWR, 2004p)

	Recreation Spending Induced		Operation and Maintenance Induced		Total	
Study Impact Area	Number of Jobs[a]	Percent of Total	Number of Jobs	Percent of Total	Number of Jobs	Percent of Total
Oroville	453	68.4	319	64.1	772	66.6
Paradise	37	5.6	37	7.4	74	6.4
Biggs-Gridley	22	3.3	17	3.4	39	3.4
Chico	150	22.7	125	25.1	275	23.7
Butte County Total	555 [a]	100.0	498	100.0	1,053[a]	100.0

[a] Effects on jobs generated by recreation spending reflect spending in community areas by all persons who live outside the community, including persons who live elsewhere in Butte County and those who live outside Butte County. The Butte County total includes only those jobs generated by those living outside the county.

Table 68. Summary of earnings generated by recreation-related spending and operation and maintenance of the Oroville Facilities (in thousands of nominal dollars). (Source: DWR, 2004p)

	Recreation Spending Induced		Operation and Maintenance Induced		Total	
Study Impact Area	**Earnings[a]**	**Percent of Total**	**Earnings**	**Percent of Total**	**Earnings**	**Percent of Total**
Oroville	8,598.3	67.0	10,600.4	69.9	19,198.7	68.6
Paradise	725.7	5.7	1,138.3	7.5	1,864.0	6.7
Biggs-Gridley	364.4	2.8	505.5	3.3	869.9	3.1
Chico	3,144.6	24.5	2,927.3	19.3	6,071.9	21.7
Butte County Total	10,600.0[a]	100.0	15,171.5	100.0	25,771.5[a]	100.0

[a] Effects on earnings generated by recreation spending reflect spending in community areas by all persons who live outside the community, including persons who live elsewhere in Butte County and those who live outside Butte County. The Butte County total includes only those earnings generated by those living outside the county.

Combined, recreation and O&M activities account for an estimated 772 jobs in the Oroville Model Area, or 4.2 percent of the area's total employment. Earnings associated with these activities ($19.2 million) account for 4.7 percent of the Oroville Model Area's total earnings. Current levels of recreation activity and O&M expenditures have relatively smaller effects on the economies in the Chico, Paradise, and Biggs-Gridley Model Areas. Although out-of-area visitor spending and O&M expenditures annually support about 275 jobs and $6.1 million in earnings in the Chico Model Area, this level of economic activity accounts for less than 1 percent of total jobs and earnings in the area. Similarly, the number of jobs and earnings in the Paradise and Biggs-Gridley Model Areas generated by recreation activity of out-of-area visitors and O&M expenditures account for less than 1.0 percent of all jobs and earnings in these areas. For Butte County as a whole, the figures in tables 67 and 68 represent about 1.2 percent of jobs in the county and 1.3 percent of earnings.

Public Services

Project-related public services in the project area are provided by Butte County as well as the City of Oroville and federal and state agencies. The responsibility of service providers is described below by type of service.

Law Enforcement

In California, the Sheriff is the chief law enforcement officer in the county in which he or she is elected. Thus, the Butte County Sheriff's Office has the overall responsibility for the safety of persons residing in or visiting the county. In the project area, law enforcement duties fall to the Sheriff's office; the city of Oroville Police Department; DPR (the lead law enforcement agency for the Lake Oroville State Recreation Area); the California Highway Patrol (on non- Lake Oroville State Recreation Area 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 (Forest Service and BLM) on federal lands located in the FERC project boundary.[97] In its comments on the draft EIS, DWR indicates that the California Highway Patrol provides regular patrols of Oroville dam and other critical project facilities and that DWR has a special payment arrangement with the Butte County Sheriff's Office to patrol the water surface portion of the Thermalito afterbay. The amount of that payment has been given as $191,000 annually (Butte County, 2006a), although the amount could vary and could be terminated in the future. In its comments on the draft EIS, Butte County notes that the County provides additional services to the project area related to law enforcement, including services of the coroner; criminal investigators; the District Attorney's office, which is responsible for criminal prosecutions referred by the other agencies; and other criminal justice services related to the probation department, public defender, and county jail.

Fire Protection and Emergency Services

Fire protection and emergency medical services to the greater Oroville area are provided by the Butte County Fire-Rescue Department, Oroville Fire-Rescue Department, and CDF. According to DWR, 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. In its comments on the draft EIS, Butte County indicates that the County has the primary responsibility for most fire protection and emergency services, although the County agrees that the noted agencies cooperatively respond to calls. Butte County notes that the County develops and implements plans each year for providing emergency services for the Fourth of July and other special events, and provides hazardous materials (HazMat) services at the project.

Traffic and Road Maintenance

Maintenance of local roadways in the project area is the responsibility of the Butte County Public Works Department. As described in the Vehicular Access Study, traffic levels in the Oroville area are generally low; however, recreational 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. These services include water, wastewater treatment, power, and solid waste disposal.

3.3.10.2 Environmental Effects

As noted in section 1.3, *Scoping Process*, DWR issued Scoping Document 1 on September 20, 2002. That document identified the following socioeconomic issues related to the Oroville Facilities: (1) effects of project operations and recreation, including recreation developments, on socioeconomic opportunities and economic development; (2) the socioeconomic impacts of the Oroville Facilities and their operation on local governments, residents, agriculture, businesses, and other interests within Butte County; and (3) the economic feasibility of economic development through lower local utility rates and/or

---

[97] The Forest Service and DPR have an agreement concerning management of Forest Service lands within the FERC project boundary that are part of the Lake Oroville State Recreation Area. The agreement, dated March 16, 1978, allows DPR to conduct law enforcement activities on National Forest System lands. However, the Forest Service provides law enforcement to address illegal activities that take place on National Forest System lands, such as illegal dumping of trash and hazardous materials, drug production lab debris, and vandalism of cultural resource sites).

other available economic options related to project resources. We address those issues below, and also consider project effects on minority and low income populations.

Socioeconomic Effects of Project Operations

In section 3.3.10.1, *Affected Environment*, *Recreation- and O&M-Related Employment and Earnings*, we indicate that project-related spending annually supports about 1,053 jobs and $25.8 million in earnings in Butte County, with 66.6 percent of the jobs and 68.6 percent of the earnings occurring in the City of Oroville (see tables 67 and 68). Those figures derive from average annual spending of $15.4 million for operation and maintenance of the Oroville Facilities (see table 65) and $11.9 million in recreational spending by non-county residents (see table 66). Implementing new environmental measures would also have direct and indirect benefits for employment and earnings in Butte County and beyond.

Staff Analysis

Table 72 (see section 4.3.1, *Economic Comparison for the Oroville Facilities*) indicates that either the Proposed Action or the Proposed Action with Staff Modifications would increase the annualized cost of environmental measures at the project by $11.8 million and $11.7 million, respectively, which reflects more than about $180 million in capital costs and more than about $4 million in annual O&M costs. Capital cost estimates include, for example, an estimated $60 million for facilities' modification(s) to improve temperature conditions for anadromous fish (Proposed Article A108) and more than $77 million for recreational facility improvements (Proposed Article A127). Such investments would provide a substantial number of construction-related jobs, many of which could be filled by county residents. The increase in annual O&M expenditures associated with almost all of DWR's proposed measures would also create employment opportunities for county residents. Additionally, improvements in recreation facilities such as campgrounds, boat ramps, day-use areas, and trails would likely lead to increased visitor use and visitor spending, as well as improving the quality of the recreation experience. Increased visitor spending would in turn lead to an increase in local project-related employment and earnings.

Butte County Recommendations

Given that the preponderance of project-related spending occurs in Oroville (see tables 65 and 66), project-related spending has different fiscal effects on Oroville, other communities, and Butte County. In its license application, DWR estimates that the project provides net fiscal benefits (that is, project-related benefits in excess of project-related costs) for the City of Oroville and other local communities. However, DWR also estimates that Butte County experiences a net annual fiscal deficit of $503,800 because the County's project-related expenditures exceed project-related County revenues. Estimates of fiscal effects on Butte County indicate that the County's costs would exceed revenues associated with all three elements of project-related economic activity, including non-residents of unincorporated Butte County visiting the Oroville Facilities for recreation (-$149,500), operation and maintenance related to the project (-$114,200), and indirect growth attributable to the population supported by visitor spending and related economic activity (-$240,100) (DWR, 2004x).

In its March 30, 2006, filing with the Commission, Butte County recommends that the Commission include in any new license for the Oroville Facilities seven articles related to socioeconomic conditions in Butte County. The recommendations address: (1) a law enforcement and public safety plan; (2) a road construction and maintenance plan; (3) an early warning plan; (4) the Emergency Operations Center; (5) payments in lieu of taxes; (6) a low-cost power allocation; and (7) periodic socioeconomic and recreation measure implementation reports. The County's recommendations encompass most of the socioeconomic topics addressed by any party in this proceeding, and we have used the seven topics to present our analysis of project effects on Butte County socioeconomics. We include a final section that addresses the net fiscal effect on the County, which summarizes several aspects of our analysis.

Law Enforcement and Public Safety Plan

Butte County, among others, provides a number of services to the Oroville Facilities, including law enforcement, fire protection and rescue, and a communication system relied on by project employees and visitors. Butte County recommends that DWR invite state and local law enforcement personnel to a meeting or meetings for the purpose of developing a law enforcement and public safety plan that would provide a means for coordinating the activities of law enforcement and emergency personnel with jurisdiction in the project area, including the Lake Oroville reservoir area and the OWA. The County recommends that DPR; DFG; the City of Oroville Police Department; and the Butte County Sheriff's Office, Fire Department, and Central Communications Division be invited to participate. As recommended by Butte County, the plan would include provisions for law enforcement presence, fire and rescue services, other types of public contact personnel presence, enhanced emergency communication and response procedures, health and human services, and public safety and security protection measures for facilities, natural resources, recreation resources, and heritage resources in the project area.

Butte County additionally recommends that DWR fund the plan in the following amounts (in 2005$), at a minimum:

1. $2,035,416 annually to Butte County to provide for law enforcement and criminal justice services in the project area;
2. $393,267 annually to Butte County to provide for fire and rescue services in the project area;
3. $1,837,983 annually to Butte County to provide health and human services related to the project;
4. a one-time payment of $1,032,000 to Butte County to fund improvements to law enforcement/criminal justice services;
5. a one-time payment of $351,143 to Butte County to cover upgrades to the county's communication system; and
6. a one-time payment of $1,309,478 to Butte County to fund improvements to fire and rescue services.

Butte County recommends that any funds not expended in 1 year be carried over to the following year, that the funds be subject to an annual cost of living adjustment, and, in the event a plan is not prepared within the recommended time frame (8 months following license issuance), that DWR place the funds in an interest-bearing reserve fund until the plan is completed.

In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation (DWR, 2006c). The State Water Contractors (SWC) and the Metropolitan Water Districts of Southern California (Metropolitan) state a similar position in their May 26, 2006, joint filing (SWC and Metropolitan, 2006).

Staff Analysis

There are many ways to conduct economic and fiscal analysis of project effects on local governments and communities. Given the substantive nature of DWR's initial socioeconomic analysis, Butte County's subsequent analyses, and the work of consultants who performed related analyses, we reviewed and verified the information submitted by those parties and looked at other revenue information in the record but not included in table 69. Information on the record includes vastly different estimates of the Oroville Facilities' effect on the fiscal circumstances of the Butte County government. Table 69 summarizes the estimates of DWR and Butte County, as well as the staff estimate, indicating net deficit estimates ranging from $503,800 to $4.8 million annually. The differences are accounted for by differences in the expense and revenue categories that were considered by each party and differences in the methods that were applied in each category. In each category, the staff estimate represents our conclusion with respect to the appropriateness of including the category in our estimate (that is, whether the cost category is truly related to the project) and the appropriate method for making the estimate.[98]

Law Enforcement, Criminal Justice, and Crucial Asset Protection Expenses—Butte County recommends that DWR fund the county's project-related law enforcement, criminal justice, and crucial asset protection activities in the sum of $2,035,416 annually, plus a one-time payment of $1,032,000. Averaging the one-time payment over a 50-year license and adding it to the annual payment yields an annual estimate of $2,056,056 (table 69). The County provides detailed calculations supporting its recommendation in a report entitled *Operational Impacts of the Oroville Facilities Project on Butte County* (Butte County, 2006a).

Table 69. Oroville Facilities fiscal effects on Butte County.

Service Sector	**Butte County Estimate**[a]	**Applicant's Original Estimate**[b]	**Applicant's Revised Estimate**[c]	**Staff Estimate**[d]
Law Enforcement, Criminal Justice, and Crucial Asset Protection Expenses				
Law enforcement expenses—visitor driven	$681,670	$146,600	$146,600	$146,600
Law enforcement expenses—indirect (growth-related)	Not estimated	$334,900	$334,900	$334,900
Law enforcement expenses—O&M related	Not estimated	$228,300	$228,300	$228,300
Training and equipping law enforcement personnel—visitor driven	$10,840[e]	Not estimated	Not estimated	0
Criminal justice expenses—visitor driven	$664,585	Not estimated	$216,400	$216,400
Lake Oroville dam patrol	$689,161	Not estimated	Not estimated	0
Hiring and training personnel for Lake Oroville dam patrol	$9,800 [e]	Not estimated	Not estimated	0
Total law enforcement, criminal justice, and crucial asset protection expenses	$2,056,056	$709,800	$926,200	$926,200
Fire and Rescue Expenses				
Visitor driven—fire and rescue services	$393,267	$202,400	$202,400	$202,400

98 Our estimate of project-related costs should not be interpreted as a recommendation that DWR reimburse the county for those costs. It is simply an acknowledgement that the County does incur expenses that are related to the project, and indicates our conclusions with respect to appropriate methods for estimating those expenses. Our recommendations appear in section 5, *Comprehensive Development*.

Service Sector	Butte County Estimate[a]	Applicant's Original Estimate[b]	Applicant's Revised Estimate[c]	Staff Estimate[d]
Visitor driven—fire station replacement	$18,430[e]	Not estimated	$6,720	$6,720
Visitor driven—fire and rescue equipment replacement	$7,760[e]	Included in estimate of annual expenses	Included in estimate of annual expenses	Included in estimate of annual expenses
Visitor driven—police, fire, and rescue communications	$35,114[e]	Not estimated	$11,800	$8,200
Indirect (growth-related) expenses	Not estimated	$81,200	$81,200	$81,200
O&M related expenses	Not estimated	$55,300	$55,300	$55,300
Total Fire and Rescue Expenses	$454,571	$338,900	$357,420	$353,820
Other Expenses				
Health and human services	$1,837,983	Not estimated	Not estimated	$0
Other expenses—indirect (growth-related)	Not estimated	$131,700	$131,700	$131,700
Other expenses—O&M related	Not estimated	$90,000	$90,000	$90,000
Total Other Expenses	$1,837,983	$221,700	$221,700	$221,700
Road Maintenance Expenses				
Road maintenance expenses on county-maintained roads—visitor driven	$357,714	$20,900	$41,900	$10,010
One-time paving of county-maintained roads—visitor driven	$106,122[e]	Not estimated	Not estimated	0
Road maintenance on county-maintained roads—visitor driven	$433,637	Not estimated	Not estimated	$8,670
Improvement needs on state-owned and maintained highways	Not estimated	Not estimated	Not estimated	Not estimated
Road maintenance expenses—indirect (growth-related)	Not estimated	$108,100	$108,100	$108,100
Road maintenance expenses—O&M related	Not estimated	$73,700	$73,700	$73,700
Total Road Maintenance Expenses	$897,473	$202,700	$223,700	$200,480
Move Emergency Operations Center				
Move Emergency Operations Center	$50,910[e]	Not estimated	Not estimated	0
Total Expenses	$5,296,993	$1,473,100	$1,729,020	$1,702,200
County Revenue				

Service Sector	Butte County Estimate[a]	Applicant's Original Estimate[b]	Applicant's Revised Estimate[c]	Staff Estimate[d]
Sales tax—visitor driven	$297,487	$217,100	$217,100	$217,100
Sales tax—O&M related	Not estimated	$32,900	$32,900	$1,000
Lodging tax—visitor driven	$9,185	$3,300	$3,300	$3,300
Lodging tax—O&M related	Not estimated	$200	$200	$200
Property tax—indirect (growth-related)	Not estimated	$97,400	$97,400	$97,400
Property tax—O&M related	Not estimated	$104,200	$104,200	$104,200
Other—indirect (growth-related)	Not estimated	$318,400	$318,400	$318,400
Other—O&M related	Not estimated	$195,800	$195,800	$195,800
Contract with DWR	$191,000	Not included in expenses or revenue	Not included in expenses or revenue	$191,000
Total Revenue	$497,672	$969,300	$969,300	$1,128,400
Summary				
Total expenses	$5,296,993	$1,473,100	$1,729,020	$1,702,200
Total revenue	$497,672	$969,300	$969,300	$1,128,400
Net fiscal effect	–$4,799,322	–$503,800	–$759,720	-$573,800
FY 2002 to 2003 budget	$275,124,000	$275,124,000	$275,124,000	$275,124,000
Net effect as % of budget	–1.7%	–0.2%	–0.3%	–0.2%
FY 2002 to 2003 General Fund budget	$24,709,000	$24,709,000	$24,709,000	$24,709,000
Net effect as % of General Fund budget	-19%	-2%	-3%	-2%

Note: FY – fiscal year

[a] Source: FMY Associates, 2006.

[b] Source: DWR, 2004x.

[c] Source: TCW Economics, 2006.

[d] Source: Staff estimate.

[e] Staff divided the original estimate of one-time cost by 50 to represent annual cost over a 50-year license.

The County states that it responds to hundreds of calls for service within the project area each year from residents, nonresident visitors, and agencies that include the California Highway Patrol, DPR, and DFG (Butte County, 2006a). The County indicates that from October 2004 to October 2005, County sheriff's deputies responded to more than 40 calls for back-up or other assistance in the project area, in addition to providing regular patrols and responding to visitor calls. The County estimates that approximately 50 percent of the calls that come in to DPR annually are referred to the County Sheriff's Office, with the percentage being higher in the off-season when DPR and other agency staffing is reduced and lower in the peak visitor season when DPR staffing is also at its peak (Butte County, 2006a). Examples of calls for service in the project area include theft; car, watercraft, and aircraft accidents; reports of damaged property; public drunkenness; family disturbances; acts of vandalism; disturbance of the peace; battery; drunk driving; search and rescue; coroner investigations; criminal assault; trespassing; vehicle recovery; illegal discharge of firearms; burglary; evidence and body recovery; homicide; and explosive ordnance disposal (Butte County, 2006a).

Butte County indicates that the County has to provide significant law enforcement services at the OWA, where there has been a relatively high, ongoing amount of criminal activity that includes four gang rapes in 1997–98; an assault with a deadly weapon in 2005; and numerous drug offenses, assaults, batteries, and other criminal activity. Butte County attributes this situation to the fact that DWR has not provided any funding to DFG to manage the OWA (Butte County, 2006a). Under Measure B111, *Oroville Wildlife Area Funding*, in appendix B of the Settlement Agreement (DWR, 2006a), DWR proposes to provide funding to DFG to manage the OWA. The funding is estimated at $350,000 annually to support 5.5 full-time positions to address public safety, recreational management, facilities management and protection, and fish and wildlife resource protection; $232,000 to purchase equipment; and $82,500 annually to be spent by DFG for expenses related to managing the OWA. We conclude that this proposed measure would reduce this aspect of Butte County's fiscal issue because the additional funding provided to DFG would likely lead to a reduction in the demand for Butte County law enforcement services at the OWA.

As summarized in table 69, the County's recommendation includes reimbursement for providing law enforcement services associated with project visitors; training and equipping law enforcement personnel to provide a higher level of service; providing criminal justice services associated with project visitors; providing round-the-clock patrols at Lake Oroville dam to protect the community from any threat to that facility; and hiring and training personnel to perform the Lake Oroville dam patrols.

Citing a study that Metropolitan commissioned by CH2M HILL (2006), SWC and Metropolitan state that the County's methods for calculating its law enforcement costs overestimate the project's effects on the County's law enforcement expenses. CH2M HILL concludes that the overstatement results from (1) using "recreation days" rather than "visitor days" to estimate the visitor population being served; (2) using the average peak number of recreation days (weekend days during the summer) instead of the year-round daily average to estimate the visitor population; (3) using an assumption of above-average lake levels to adjust the visitor population estimate upward; (4) using a level-of-service standard for law enforcement and criminal justice services that is much higher than the County actually provides to the project or the rest of the county; and (5) assuming that the County should provide and be reimbursed for patrol services at the Lake Oroville dam.

DWR commissioned TCW Economics (2006) to evaluate the report relied on by the County in its law enforcement reimbursement recommendation. TCW Economics' evaluation makes some of the same points raised in the CH2M HILL report (2006), including the issues of using peak rather than average visitor numbers and using higher-than-actual service levels. TCW Economics indicates that the County's estimate of the nonresident visitor population (5,270) is almost three times as high as the 1,910 figure used in DWR's license application studies (DWR, 2004x). We conclude that the County's methods do indeed overstate the cost of providing services to nonresident visitors for the reasons listed above, and for that reason our staff estimate of visitor-related costs ($146,600) is taken from the applicant's estimate, which is appropriately based on average visitor numbers.

TCW Economics and Economic Modeling Specialists, Inc. prepared the fiscal impact assessment (DWR, 2004x) that DWR submitted with its license application. As summarized in table 69, the fiscal impact assessment estimated project-related law enforcement expenses by Butte County equaling $709,800 per year, including the cost to provide law enforcement services to nonresident visitors, the permanent population resulting from nonresident visitor spending in the unincorporated area of the County, and the permanent population resulting from project-related O&M spending in the unincorporated area of the County. The latter two estimates are the products of an input-output model (IMPLAN) that was used to estimate the direct and indirect effects of the project on population, employment, and fiscal conditions in Butte County, the City of Oroville, and several other local jurisdictions (DWR, 2004x).

Butte County (2005a) has submitted the comments of Dr. Jon Ebeling, stating that the model and/or DWR's use of the model and its output were flawed for several reasons, including (1) providing only a single estimate of project impacts rather than including an upper and lower range; (2) providing a static rather than dynamic estimate that takes into account changing future conditions such as changes in the price of gasoline, increases in population, and changes in population demographics; (3) "cleaning" the data in a way that is not satisfactorily explained; (4) not satisfactorily explaining the way in which indirect population estimates were made; (5) accepting a low response rate to visitor surveys; (6) using potentially biased or counterintuitive estimates of visitor spending; and (7) basing budget estimates on only 1 year of data (Ebeling, 2005). Dr. Ebeling also makes a number of recommendations that would no doubt improve the model's application. However, Dr. Ebeling does not provide evidence that the model was used in a way that would systematically overestimate or underestimate the project's fiscal impacts, and our review of the model did not discern any such systematic bias.[99] Thus, while we understand that the model's application could be improved upon, we conclude that its application in this case is adequate to the task at hand, and we therefore include the applicant's estimate of annual growth- and O&M-related impacts ($334,900 and $228,300, respectively) in our staff estimate.

Based on their review of Butte County's law enforcement cost estimates, TCW Economics (2006) revised its initial estimate of project fiscal effects to include impacts on the criminal justice system, recognizing that any arrest made by the Sheriff's Office in the project area also entails criminal justice services such as intake, jail, prosecution, probation, and sometimes, public defender services (Butte County, 2006a). As shown in table 69, TCW Economics' revised estimate for project-related law enforcement and criminal justice service expenses by Butte County equals $926,200, including $216,400 for the criminal justice component (TCW Economics, 2006). Because it appears to be a legitimate project-related cost to the county, we include that component in the staff estimate as well.

In making the staff estimate, we did not include the cost to train and equip additional law enforcement personnel because Butte County's justification for this cost is based on a higher level of service than the Sheriff's Office actually provides throughout the County. We do not include the costs to hire and train additional officers to patrol Lake Oroville dam and conduct those patrols because, as indicated by SWC and Metropolitan, DWR retains a private security contractor to provide that service and the additional services of Butte County have not been requested by DWR or by the state or federal Departments of Homeland Security (SWC and Metropolitan, 2006). Thus, our total estimate of the cost to Butte County to provide project-related law enforcement and criminal justice services is $926,200 (table 69).

Fire and Rescue Service Expenses—Butte County recommends that DWR fund the county's project-related fire and rescue services in the sum of $393,267 annually, plus a one-time payment of $351,143 to upgrade the county's communication system and a one-time payment of $1,309,478 to fund improvements to fire and rescue services. Averaging the one-time payments over a 50-year license and adding them to the annual payment yields an annual estimate of $454,571 (table 69).

The County states that it provides emergency medical assistance, rescue, public assistance, and fire protection services; responds to vehicle accidents; and provides specialized rescue services through its hazardous materials, drowning accident, vehicle extraction, and critical incident teams (Butte County, 2006a). Additionally, the County must maintain fire stations, fire trucks, and the infrastructure needed to provide those services. Although DWR states that CDF has the primary responsibility for fire fighting activities at the project (DWR, 2006c), it is nonetheless true that the County incurs costs to provide fire and rescue services to the project and its visitors.

---

[99] See appendix A for our review of DWR's socioeconomic model.

Our analysis of the County's estimated costs for providing project-related fire and rescue services is based on the same rationale and the same documents cited above in our analysis of law enforcement costs. Again, we accept the IMPLAN model results for annual growth- and O&M-related expenses ($81,200 and $55,300, respectively), and accept the IMPLAN model results for annual visitor-related expenses ($202,400) rather than the County's estimate because the County figure relies on an overestimate of the nonresident visitor population that must be served. Similarly, we include in our estimate the project-related share of the cost of fire station replacement ($6,720) and communication system upgrades ($8,200) based on a lower estimate of nonresident visitors. The County indicated that the communication system serving the public safety agencies in the project area would need to be upgraded every 7 to 10 years, and we assumed a 10-year interval in our estimate. Given these assumptions, we estimate the County's project-related fire and rescue service costs at $353,820 annually (table 69).

Health and Human Services—Butte County recommends that DWR pay $1,837,983 annually to Butte County to provide health and human services to a population that the County believes to be related to the project (Butte County, 2006b). That figure represents 5 percent of the County's share of health and human services funding in fiscal year 2004–05 (Butte County, 2006a). The County states that the project has brought and continues to bring a substantial number of low income residents to the County that rely on the County's health and human services department. The County states further that this pattern was established when project construction ended and thousands of construction worker houses were either abandoned or sold at very low prices, attracting low income residents who found few jobs available and became dependent on health and human services. According to the County, this problem is exacerbated by the low-paying and seasonal jobs created by the project and project-related tourism (Butte County, 2006a).

TCW Economics (2006) provides a counterpoint to the County's position, summarizing the project's positive effects on local income and employment. These benefits include project-related recreational spending that supports an estimated 555 jobs and $10.6 million in earnings, and project-related O&M spending that supports an estimated 498 jobs and $15.2 million in earnings. We do not find the County's statements to be persuasive in attributing any share of health and human services spending to the project, and do not include any cost for these services in our cost estimate (table 69).

Conclusion—Based on the foregoing analysis, plus DWR's estimate of growth-related and O&M-related road maintenance expenses ($108,100 and $73,700, respectively; see table 69), we estimate the County's project-related expenses for law enforcement, criminal justice, and fire and rescue services at $1,280,020 annually. This amount may be wholly or partially offset by project-related revenue accruing to the County, which we discuss below under the heading *Net Fiscal Effects.*

Road Construction and Maintenance Plan

The Butte County Public Works Department has identified three types of project-related impacts on the local transportation infrastructure, including increased road maintenance required on county roads due to project-generated vehicle trips, air quality and water quality degradation associated with project-generated vehicle trips on dirt and gravel roads owned by the County but used exclusively by project visitors, and inadequate capacity and maintenance of certain state-owned highways that lead to the project (Butte County, 2006a). DWR does not propose any measures designed to address road management or to compensate the County for its road management expenses.

Butte County (2006b) recommends that DWR:

1. prepare a road construction and maintenance plan, in consultation with the Butte County Public Works Department, to identify capital improvements and a construction and maintenance schedule for roads within an area that Butte County refers to as the project's Area of Highest Use;

2. Establish a road construction and maintenance fund of $5,306,136 and disburse those funds to Butte County in years 2 through 6 following license issuance to provide for the construction of roads in the Area of Highest Use; and

3. Provide $791,351 to Butte County annually to fund road maintenance within the Area of Highest Use.

Under Butte County's recommendation, the payment amounts would be subject to an annual cost of living adjustment. Averaging the one-time payment of $5,306,136 over a 50-year license and adding that amount to the recommended annual payment yields an annual estimate of $897,473 for road construction and maintenance (table 69).

In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation (DWR, 2006c). SWC and Metropolitan state a similar position in their May 26, 2006, joint filing (SWC and Metropolitan, 2006).

Staff Analysis

In the supporting documentation for its recommendation, Butte County identifies an Area of Highest Use that is defined by the arterial and collector roads that lead to the project area (Butte County, 2006a). Using peak recreation visitor days to estimate the percentage of road maintenance costs attributable to the project (8.52 percent), 293.56 miles of arterial and collector roads in the Area of Highest Use, and average road maintenance costs of $14,302 per mile, the County estimates the project-related expenses at $357,714 annually (table 69).

DWR's initial estimate of project-related road maintenance expenses was based on the average, rather than peak, nonresident visitor population; 144 miles of county-maintained roads used by nonresident visitors; and average road maintenance costs of $6,670 per mile. As shown in table 69, this yields an estimate of project-related road maintenance expenses of just $20,900 annually (DWR, 2004x). A recently filed DWR estimate (TCW Economics, 2006) revised that figure upward to $41,900 (table 69), based on the County's road maintenance cost estimate of $14,302 per mile. Although not reflected in TCW Economics' revised estimate, we note that DWR issued an addenda and errata document in January 2005 that indicates only about 35 miles of county-maintained road in the Area of Highest Use are likely used frequently by non-county residents (DWR, 2005h). Using that mileage estimate, the project-related road maintenance costs in the Area of Highest Use would be reduced to $10,010 annually. This is the figure we include in the staff estimate.

SWC and Metropolitan also oppose the County's recommendation, stating that compelling DWR to pay the County's road maintenance costs would be contrary to the Commission's long-standing precedent of holding licensees responsible for road maintenance only within the project boundary (SWC and Metropolitan, 2006). We note that road maintenance responsibilities are limited to roads within the project boundary, with the added provision that roads used exclusively for project access must be brought into the project boundary.

The County also recommends that DWR make a one-time payment of $5,306,136 to cover the cost of paving 30.32 miles of gravel/dirt roads used by project visitors and $433,637 annually to cover the County's cost of maintaining those roads. While the County states that these roads are used exclusively by project visitors to access the project, we conclude that such is not the case, based on our review of the record and our site visit. Additionally, we find that only about 1.5 miles of the 30.32 miles are currently within the project boundary. Given that most of these road miles are not within the project boundary and none of the roads are used exclusively to access the project, we conclude that responsibility for paving and/or maintaining the roads would not be wholly project-related. Applying the same assumptions we used above to estimate the project-related maintenance costs of county maintained roads in the Area of Highest Use, we estimate the project-related costs of maintaining the 1.5 miles of road in the project boundary at $8,670 annually, and we include that cost in our staff estimate (table 69). For the reasons stated above in our analysis of law enforcement costs, we also include the IMPLAN model estimates of growth- and O&M-related road maintenance expenses.

Based on the foregoing analysis, we estimate the County's project-related expenses for road maintenance at $200,480 annually. This amount may be wholly or partially offset by project-related revenue accruing to the County, which we discuss below under the heading which we discuss below under the heading *Net Fiscal Effects.*

Early Warning Plan

DWR coordinates and communicates with the Corps, BOR, and the California and Butte County Offices of Emergency Services regarding flood events. Proposed Article A131, *Early Warning System*, is proposed to improve communication and coordination among these parties by developing an early warning plan for flood events. The plan would describe how DWR would communicate with the other parties and coordinate project operations before and during flood emergencies. The plan is proposed to be consistent with California's Standardized Emergency Management System, and would describe the measures DWR would take before and during greater-than-normal operational releases and during flood events, including, at a minimum, a listing of the agencies to be consulted, a description of emergency response procedures, including dam operations; and a schedule for implementing and evaluating the plan. Butte County (2006b) makes the same recommendation.

Staff Analysis

SWC and Metropolitan state that the County's recommendation is duplicative of the ongoing requirement imposed on DWR to develop and file for Commission approval an Emergency Action Plan under Part 12 of the Commission's regulations (18 CFR, Part 12, Subpart C). Even though these entities indicate that the County's plan is not needed, we note that this plan is virtually identical to Proposed Article A131 of the Settlement Agreement that was signed by both SWC and Metropolitan. Despite apparent agreement among these parties, we conclude that the appropriate vehicle for this plan is part 12 of the Commission's regulations and not a specific license article.

Emergency Operations Center

Butte County provides an Emergency Operations Center and staff to prepare for and respond to natural disasters in the county, including floods, earthquakes, acts of terrorism/sabotage, and other emergencies (Butte County, 2006a). DWR does not propose any measures associated with the County's Emergency Operations Center or emergency services.

Butte County (2006b) recommends that DWR prepare an Emergency Operations Center relocation plan in consultation with the Butte County Sheriff's Office, and include in the plan designs, specifications, and a construction schedule to accomplish relocation of the Emergency Operations Center. The County also recommends that DWR provide a one-time payment of $2,545,495 to the County to fund construction of the new Emergency Operations Center. Averaged over a 50-year period, this would equal $50,910 annually (table 69).

In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation (DWR, 2006c). SWC and Metropolitan state a similar position in their May 26, 2006, joint filing (SWC and Metropolitan, 2006).

Staff Analysis

The County states that the Emergency Operations Center faces a flood risk: (1) in the event of failure or overflow of the Oroville dam, and (2) from overflow of the Thermalito power canal. In its comments, DWR notes that the Emergency Operations Center is not in either the 100-year or 500-year floodplain, and the actual risk of complete dam failure is not "even remotely plausible." SWC and Metropolitan make the same points in their comments. We agree and conclude that there is no appreciable risk to the Emergency Operations Center from dam failure.

With respect to flood risk associated with the power canal, which is located near (about 150 yards) but at a lower elevation than the Emergency Operations Center, the County states that water not sent down the Feather River is diverted via the Thermalito power canal, and that "[d]uring a flood event, excess water from uncontrolled release from the Dam will flow through the canal. Since no flow controls exist on the canal, the Emergency Operations Center faces significant risks in any major flood event" (Edell, 2005, as cited by Butte County, 2006a). Butte County also states that on January 3, 1997, DWR advised the County that the Emergency Operations Center would be under water by the next morning due to flood-related uncontrolled releases from the project. In the end, the flow into the Thermalito power canal did not overtop the canal and the building was not flooded. However, the County indicates that the threat of flooding and the potential need to evacuate the building caused significant operational problems in the Emergency Operations Center and demonstrated to the County that the facility should be relocated.

In support of its position that DWR should provide funds for moving the Emergency Operations Center, Butte County states that when the project was licensed, DWR anticipated constructing the Marysville dam, which would have enabled DWR to lower its water release rate from Lake Oroville during high water or flood events. Marysville dam was never constructed, however, and the County states that DWR must therefore increase release rates at Oroville dam during high water periods such as the 1996 and 1997 floods. It was those floods that made the County aware of the risk exposure of the Emergency Operations Center, a risk exposure that the County believes would not have occurred if the Marysville dam had been constructed as envisioned when the Oroville Facilities were licensed.

DWR's comments do not mention the County's statement concerning the 1997 flood events. However, SWC and Metropolitan state that the County is in error concerning a lack of controls on the power canal. SWC and Metropolitan indicate that the inlet to the Thermalito power canal is regulated, and provide a copy of a DWR bulletin indicating that the inlet to the canal can be closed by lowering three radial gates installed for the purpose of keeping flood flows from entering the power canal (DWR, 1974).

We note that DWR uses the emergency spillway to help pass only the major flood events and that the power canal is controlled by gates. Butte County has not established what threat the operation of the power canal poses to the Emergency Operations Center or what the flooding conditions would have been during the 1997 flood without the presence of the Oroville Project. We are not convinced that DWR's operation of the power canal or that DWR's operation of the Oroville Project during flood events has increased the flood risk for the Emergency Operations Center. Even during the 1997 flood, a low probability event, the flow into the Thermalito power canal did not overtop the canal and the Emergency Operations Center was not damaged. This low probability, in combination with the fact that the inlet to the Thermalito power canal can be regulated by three radial gates and the fact that the Emergency Operations Center is at a higher elevation than the power canal, suggests that operation of the project helps alleviate downstream flooding and does not increase the flood threat to the Emergency Operations Center.

Payments in Lieu of Taxes

As a state entity, DWR is not required to pay of any state, local, or federal taxes associated with the Oroville Facilities.

In its March 30, 2006, filing with the Commission, Butte County recommends that the Commission include a license article in any new license for the project that would require DWR to establish a reserve fund entitled "Butte County Payment in Lieu of Taxes Fund (PILOT Fund)" in an amount necessary to provide annual payments to the County and to provide such annual payments in an amount equal to $6.8 million in 2005 dollars, adjusted annually as specified in appendix B of the County's Operational Impacts Report (Butte County, 2006a).

In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation (DWR, 2006c). SWC and the Metropolitan state a similar position in their May 26, 2006, joint filing (SWC and Metropolitan, 2006). Butte County reiterates its position in various subsequent filings, including those of June 26, December 18, and December 26, 2006.

Staff Analysis

In providing a description of the Oroville Facilities' background, Butte County (2006b) cites the 1952 application for the project (California Water Project Authority, 1952) as saying that "[p]rovision will be made to make payment for or replace improvements destroyed or injured by the proposed works." Butte County goes on to state that this compensation has not occurred, and that on the contrary, the project has been a source of significant and ongoing negative effects on the County's ability to provide public services both to the project and to the county's 210,000 residents.

Butte County states that it has lost and continues to lose a substantial amount of tax revenue annually because of the inundation of the Big Bend Project, previously operated by PG&E,[100] and the loss of potential tax revenue associated with the developable land that was also inundated by the Oroville Facilities. As noted in section 2.0, *Proposed Action and Alternatives,* the current conditions described in the *Affected Environment* sections of this EIS define the No-action Alternative and serve as the baseline against which the other alternatives are compared. Existing conditions, rather than pre-project conditions, serve as the baseline for considering socioeconomic effects.

The County's Socioeconomic Impacts Report (FMY Associates, 2006) estimates the lost tax revenue (in 2004$) at $631,151 annually for the Big Bend Project and $2,634,337 annually for the remainder of the developable property,[101] for a total of $3,265,488 lost revenue annually or $268.0 million over the course of a 50-year license, assuming a 2 percent annual escalation in land values (and tax revenue). The same report estimates that if the Oroville Facilities had been developed by a private third party rather than DWR, that party would pay an estimated county tax of $6,870,535 annually (in 2004$), or $343.5 million over a 50-year license term. Of the two estimates of annual tax losses, $3.3 million and $6.9 million, the County used the latter annual figure as the basis for its recommended PILOT of $6.8 million dollars annually.

Citing a study that Metropolitan commissioned by CH2M HILL (2006), SWC and Metropolitan state that FMY Associates' methods for calculating lost tax revenue both overstate the tax revenue that the County would have received if the Oroville Facilities had not been built and understate taxes and other economic benefits that accrue to the County because of the project (SWC and Metropolitan, 2006). The CH2M HILL study does not address FMY Associates' estimate of the potential tax revenue associated with the Big Bend Project if it were still operating ($631,151 annually) or the potential tax revenue associated with a private owner of the Oroville Facilities ($6.9 million annually). It does address the estimated foregone tax revenue associated with the land inundated by the Oroville Facilities. CH2M HILL estimates that the assessed value of inundated property would be about $3,430 per acre rather than $9,300 per acre because the appropriate assessed value would include land only rather than land plus

[100] PG&E paid property taxes for the Big Bend Project prior to its inundation by the Oroville Facilities. After the site was inundated and became part of DWR's Oroville Facilities, it was no longer subject to property taxation.

[101] The estimate for the remainder of the developable property is based on a 1 percent tax rate applied to an average assessed value of $9,300 per acre for 28,324 acres.

improvements, and because much of the land upstream of Oroville dam is steep, remote, and has poor access, making it less developable than other land throughout the county. The CH2M HILL study also cites 2002 figures from the State Controller indicating that Butte County currently receives property tax revenue equaling only 0.13 percent of the assessed value of property in the county, concluding that FMY Associates' assumption of a 1 percent tax rate significantly overstates the County's lost tax revenue. Applying the lower tax rate to 29,240 acres owned by DWR at the Oroville Facilities, CH2M HILL estimates the County's lost tax revenue at $368,716 for land and improvements or just $130,381 annually for the land alone, rather than the $2,634,337, estimated by FMY Associates.

DWR commissioned TCW Economics (2006) to also evaluate the FMY Associates' report relied on by the County in its PILOT recommendation. TCW Economics' evaluation makes many of the same points raised in the CH2M HILL report (2006), including the less developable nature of the land inundated by the Oroville Facilities and the lower tax rate that would apply to the assessed value of property. TCW offers a rough estimate of $390,000 as the County's share of lost annual tax revenue.

In our assessment in the draft EIS, we considered the implications of applying the lower tax rate (0.13 percent) to FMY Associates' estimate of $6.9 million in lost annual revenue associated with a private party owning the Oroville Facilities. Under that assumption, the lost revenue estimate would be $893,170, and we concluded that an estimate of $130,381 (CH2M HILL's estimate of taxes associated with land value alone) to $893,170 offered a likely estimate of tax revenue foregone by the County. In submittals filed in June 2006 (Butte County, 2006c; FMY Associates, 2006b) and in comments on the draft EIS, FMY Associates points out flaws in the CH2M HILL assumptions and in our assessment presented in the draft EIS, in particular indicating that the County would receive the full 1 percent tax rate originally presented in FMY Associates' analysis of foregone revenue associated with the Big Bend Project, because of the particular rules applicable to power plants greater than 50 MW. We took this into account in our assessment for the final EIS, concluding that estimates of lost tax revenue in the range of $1.0 and $6.9 million annually are reasonable estimates of the County's foregone tax revenue.

The estimates discussed above are based on various ways of assessing lost property tax revenue attributable to establishment and continued operation of the Oroville Facilities by a state entity that does not pay property taxes. The project may also provide indirect tax benefits that partially offset the tax losses. Because the following benefit estimates have not been thoroughly studied, but are instead based on more cursory evaluations prepared in response to Butte County's filings, we consider them more conjectural than the information presented in the preceding analyses. These indirect benefits may include the following:

- Flood protection provided by the Oroville Facilities has likely led to more development of the protected lands than would have occurred absent the project, increasing the assessed value and tax revenue associated with the protected area. CH2M HILL presents a case based on the Corp's estimate that the project provides flood protection for about 75,000 acres of urban, rural residential, and agricultural lands in Butte County (Corps, 2002, as cited in CH2M HILL, 2006). CH2M HILL (2006) estimates that if the acreage reached its full development potential and was assessed at the County's average assessed value of $9,300 per acre, as opposed to a lower value of $3,250 per acre that might be applied to lands subject to frequent flooding, it would increase the County's tax revenues by as much as $598,000 annually. Other than this hypothetical example, there is no information on the record concerning the actual level of development that has occurred on the protected acreage. Given the rapid agricultural development that occurred along the Feather River floodway after closure of the dam (Corps, 2002, as cited in CH2M HILL, 2006), it is likely that the land has a lower assessed value than the $9,300 county average for developed parcels, and thus would produce less than $598,000 in additional tax revenue annually. In its comments on the draft EIS, Butte County reiterated the County's position that the Oroville Facilities do not provide any protection from routine flooding in the County, but instead affords such protection only to downstream counties.

- TCW Economics (2006) suggested that the reliable water supply provided by the Oroville Facilities may have been a contributing factor in the increased rice production in the county since the project was built (TCW Economics, 2006), which may have increased the assessed value and tax revenue associated with agricultural lands devoted to rice production. FMY Associates, in a report filed with the Commission in June 2006 (2006b) and in its comments on the draft EIS, noted that the rice farmers in the area have water rights senior to the Oroville Facilities, which indicates that the rice farmers would have an equally or even more reliable water supply if the project had not been built, and therefore any increased assessed value would not be attributable to the project.
- One of the studies commissioned as part of relicensing (Harza/EDAW Team and DWR, 2004) found a positive and statistically significant relationship between property values and proximity to Lake Oroville. Thus, Lake Oroville is an amenity that increases the average value of properties nearer the lake compared to properties farther from the lake. Based on these study results, TCW Economics (2006) presumes that Lake Oroville was an important factor in the development of several large residential areas near the lake, and concludes that enhanced property values have contributed to greater property tax revenues to Butte County and other local taxing entities. FMY Associates, in a report filed with the Commission in June 2006 (2006b) and in its comments on the draft EIS, points out that the same Harza/EDAW Team and DWR study also shows that countywide, real estate values have grown little, lagging behind the growth in real estate values in other counties in California.

Given all the information that we have considered in our analysis, we conclude that construction and continued operation of the Oroville Facilities resulted in an on-going loss of tax revenue associated with the Big Bend Project that has not been offset by any project-related gains in Butte County's annual property tax revenues.

Power Allocation

As we describe in section 1.2, *Need for Power*, the primary operating function of the Oroville Facilities power plants is to provide electricity to State Water Project pumps that move water through the State Water Project system. None of the power is made available in the project vicinity. DWR does not propose to change this allocation under a new license. In its March 30, 2006, filing with the Commission, Butte County recommends that the Commission include a license article in any new license for the project that would require DWR to make available 235 million kilowatt-hours (kWh) of firm power and associated energy annually for sale to Butte County or to entities designated by Butte County to receive such power and energy on its behalf.

In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation (DWR, 2006c). SWC and Metropolitan state a similar position in their May 26, 2006, joint filing (SWC and Metropolitan, 2006).

Staff Analysis

Butte County states that providing the County with an allocation of low cost power from the project would help mitigate for "the long-term adverse impacts of this Project on the community. A power allocation would also assure that one of the poorest communities in the State is finally able to enjoy some of the hundreds of millions of dollars in annual benefits that this Project provides to DWR and others." Butte County cites its Socioeconomic Impacts Report (FMY Associates, Inc., 2006) estimate that local residents lose annual savings of $30.1 million each year purchasing power from outside the area instead of being able to purchase low cost power from the project. FMY Associates' estimate relies on the assumption that if low cost power had been made available locally from the outset, then "significant economic development would have occurred." Given that assumption, the estimate is based on the difference between the wholesale cost of power for the California Independent System Operator from 2002 through 2004 ($0.0496/kWh) and DWR's cost of producing power at the Oroville Facilities ($0.0182), times the number of residential units in the county (85,789), times the average total demand (residential, commercial and industrial loads) for power per residential unit (11,203 kWh) in more developed areas. Using a multiplier of 3.0, FMY Associates estimates that this loss of savings of $30.1 million annually equals a total annual loss of more than $90 million annually to the local economy, or more than $4.5 billion over a 50-year license period.

In its evaluation, CH2M HILL (2006) points out that FMY Associates' estimate of the economic development that might have taken place if low-cost power had been available from the outset likely overstates the potential effect of lower energy rates. CH2M HILL cites census data indicating that across a wide range of industries, including service industries, the purchase of electricity is a small part of total operating expenses (U.S. Census Bureau, 2002 as cited by CH2M HILL, 2006). The census figures indicate that in manufacturing industries, the purchase of electricity accounts for an average 1.3 percent of costs, which is greatly overshadowed by the cost of materials (67 percent) and labor (24 percent). In the services sector, the purchase of utilities, including electricity, ranges from less than 1 percent to a high of 4.7 percent for accommodation and food services. In contrast, labor accounts for 41.3 to 56.4 percent of costs in trucking, professional services, and accommodation and food services. We conclude that the availability of lower cost power would likely not have led to the amount of development cited in the County's support for a low-cost power allocation.

FMY Associates provides another estimate of economic losses due to the absence of low-cost power, using most of the same assumptions described above but using a PG&E average demand figure of 4,553 kWh per residential unit per year. This produces an estimate of approximately $12.2 million in annual losses as a direct result of county residents paying higher electricity rates than they would pay if lower cost power were made available from the project. Using a multiplier of 3.0, FMY Associates estimates a direct and indirect loss to the community of $36.7 million annually, or $1.8 billion over a 50-year license period. We conclude that this method likely still overestimates the potential savings to county residents associated with low-cost project power, since it assumes that the power would be provided at cost, and there is no basis for that assumption.

DWR, in its May 26, 2006, filing, states that the County's recommendation for a low-cost power allocation should be rejected because it would be contrary to established Commission policy, outside the Commission's authority, and contrary to state law, as well as being infeasible because DWR and the State Water Project are not structured to provide retail-level energy service. SWC and Metropolitan make some of the same points, and estimate that the total cost to DWR of providing energy associated with such a power allocation would be approximately $350 million over a 50-year license term, not including associated reductions in dependable capacity and ancillary service values. SWC and Metropolitan do not indicate how they calculated the $350 million figure.

Regardless of the analyses offered by the parties, the allocation of project power is a matter beyond the scope of this EIS.

License Implementation

In its many filings during this relicensing proceeding, Butte County has stated that DWR has not adequately assessed the socioeconomic impacts of the project on the County. DWR has not proposed any additional socioeconomic studies to be undertaken during the term of a new license.

Butte County recommends that DWR prepare a socioeconomic measures implementation report in consultation with Butte County and a recreation measures implementation report in consultation with DFG, DPR, Butte County, the City of Oroville, and the Oroville Recreation Advisory Committee (collectively, the Consulted Parties) every 10 years following issuance of a new license. The implementation reports would describe the status of the socioeconomic and recreation measures undertaken under the license (Butte County, 2006b).

In its May 26, 2006, filing with the Commission, DWR states its opposition to the county's recommendation (DWR, 2006c). SWC and Metropolitan state a similar position in their May 26, 2006, joint filing (SWC and Metropolitan, 2006).

Staff Analysis

Butte County states that the Commission should establish periodic license reopeners to assess compliance with the license, to determine whether changed conditions require reconsideration of license conditions, and to assure that the public interest continues to be served (Butte County, 2006b).

In their comments, SWC and Metropolitan state that this provision is unnecessary for three reasons: (1) Butte County has not shown that the project has been or is likely to be a socioeconomic detriment to the County over the term of a new license; (2) there is no need for a reopener in this case because the Commission does not require licensees to provide mitigation for socioeconomic impacts; and (3) the Commission is always able to reopen a new license consistent with the standard reopener clause included in all new licenses (SWC and Metropolitan, 2006). DWR also notes the standard reopener clause, stating that the clause makes the County's recommendation unnecessary.

It is not clear what the reports would contain, and we do not see a clear indication of why the data or reports are needed. Furthermore, if changes are needed during the term of the license, the standard reopener clause would be available.

Net Fiscal Effects

The foregoing analyses cover the County's estimates of project-related costs and the estimates of other parties, including the staff. As summarized in table 69, the County's total project-related cost estimate is by far the highest at $5.3 million annually, while the DWR and staff estimates, including input from TCW Economics (2006), range from $1.5 to $1.7 million.

As a final aspect of our analysis, we compared these cost estimates to project-related tax revenue estimates. As shown in table 69, DWR's estimate of project-related tax revenue accruing to the County equals $969,300 annually, including sales, lodging, property, and other tax revenue associated with visitor spending, project O&M spending, and indirect growth-related impacts. The staff's estimate equals $1,128,400, because it also includes $191,000 in annual payments made by DWR to the County for patrol services on the Thermalito afterbay and includes a downward adjustment in tax revenue associated with O&M spending.

Given these revenue estimates, the County's estimate of net fiscal impacts is -$4.8 million, an amount equaling 1.7 percent of Butte County's fiscal year 2002 to 2003 budget, and 19 percent of its General Fund budget for that year. By contrast, our staff estimate of the net fiscal deficit (-$573,800) and DWR's revised estimate of net fiscal impacts (–$759,720 annually) would equal about 0.2 to 0.3 percent of Butte County's fiscal year 2002 to 2003 total budget and 2 to 3 percent of its General Fund budget for that year. These estimates do not take account of the indirect tax revenue estimates discussed above in the section about *Payments in Lieu of Taxes,* which include a possible net tax revenue increase of $598,000 associated with the land and developments protected from flooding by the project and a possible positive but unquantified change in tax revenue associated with the increased value of property near Lake Oroville. We note that the tax revenue estimates that we do not include in our estimate are based on less rigorous study than the other information on the record, and do not include any assessment of associated costs to the County.

Effects on Minority and Low-income Communities

The demographic information presented in section 3.3.10.1, *Affected Environment*, indicates that the county has a higher percentage of people living below the poverty level than the regional, state, and national averages, and that county residents receive less of their income from wages and salaries and more of their income from government transfer payments than the California average. The increased spending associated with the Settlement Agreement, by creating additional employment opportunities, would likely have a positive effect on low-income persons in the county. Similarly, the increased employment opportunities and increased spending in the Oroville area would likely have a positive effect on the American Indians/Alaska Natives in that community.

3.3.10.3 Cumulative Effects

Construction of the Oroville Facilities led to the direct loss of tax revenue to Butte County through the loss of property taxes previously paid on project lands and the privately owned Big Bend Project. Continued operation of the project by a state entity that does not pay taxes continues that direct effect, although the direct effect may be offset by project-related indirect increases in tax revenues. The absence of tax or other payments to the county adds to the fiscal hardship of the county, which has been designated by the state of California as a "Distressed County" three times since 1990.

The Settlement Agreement does include a number of measures that would provide funding to other parties; these measures are not proposed for inclusion in the FERC license. They include, for example, funding for 5.5 full-time equivalent positions for DFG's management of the OWA (Measure B111) and $61.3 million for the Project Supplemental Benefits Fund, which would be used to fund projects selected by a steering committee and would be administered by the City of Oroville (Measure B100, *Project Supplemental Benefits Fund*). The Project Supplemental Benefits Fund was designed to allow the benefits of the Oroville Facilities to be extended into the local communities in the vicinity of the project, such as by funding improvements at Riverbend Park and other facilities outside the project boundary, and working to secure grants and other matching funds to augment DWR's contribution. These measures, if implemented, would create employment opportunities for local residents.

3.3.10.4 Unavoidable Adverse Effects

Any negative effects on Butte County's fiscal condition would likely continue.

3.4 NO-ACTION ALTERNATIVE

Under the No-action Alternative, DWR would continue to operate the Oroville Facilities under the terms and conditions of the current license. The environmental measures proposed in the Settlement Agreement would not be implemented, although the existing mitigation and enhancement measures (refer to sections 3.3.3.1, *Affected Environment,* in *Aquatic Resources*, 3.3.4.1, *Affected Environment,* in *Terrestrial Resources*, and 3.3.6.1, *Affected Environment,* in *Recreational Resources*) would continue. Operation of the project under the current license would essentially maintain the natural resources of the Feather River basin in a "status quo" condition with some potential for enhancements in recreational resources as facilities are maintained or improved). The measures associated with the Bald Eagle Nesting sites would still be implemented and some fuel load management actions would still occur, although the benefits of the coordinated approach to fuel load management between various agencies may not occur.

3.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Continued operation of the existing project under any of the alternatives considered, would continue to commit the lands and waters previously developed for energy production. This commitment of resources would not necessarily be irreversible or irretrievable because removal of the project dams and restoration of disturbed areas could return the project areas to near pre-project conditions. However, given the substantial costs and the loss of energy, recreational, and socioeconomic benefits, removal of the project is unlikely in the foreseeable future.

3.6 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Under all alternatives considered, the project would continue to generate power for DWR's customers and provide recreational and socioeconomic benefits for the duration of any new license. The Proposed Action and staff recommended alternative would provide significant long-term protection and enhancement of biological, cultural, and recreational resources in the Feather River Basin, although energy generation at the project would be somewhat reduced.