7.3 Aquatic Resources

7.3.1 Overview

This section discusses aquatic resources in the vicinity of Nevada Irrigation District's (NID or Licensee) Yuba-Bear Hydroelectric Project (Project). Section 7.3 is divided into six major sections including this overview.

Section 7.3.2 provides a brief history of aquatic resources in the Project Vicinity.

Section 7.3.3 provides information regarding fish, including: 1) factors that affect fish distribution in the Project Vicinity; 2) the current distribution of fishes; 3) a list of special-status fish; and 4) fish management programs. Section 7.3.3 also includes a description of existing and relevant information, where available, regarding fishes in each Project reservoir and impoundment, and in each stream reach that would likely be affected by continued Project operation and maintenance (O&M).

Section 7.3.4 addresses amphibians, and provides: 1) a general overview of amphibians in the Project Vicinity; 2) a description of each special-status amphibian that has a potential to occur in the Project Area; and 3) the known occurrence of these amphibians in the Project Vicinity.

Section 7.3.5 provides information regarding aquatic reptiles that may be affected by the Project.

Section 7.3.6 discusses aquatic invertebrates in the Project Vicinity.

Section 7.3.7 discusses algae in the Project Vicinity.

For the purposes of this PAD aquatic species listed as threatened or endangered under the federal Endangered Species Act (ESA) or under the State of California Endangered Species Act (CESA) are not considered special-status species. There are no known fish species listed as endangered or threatened under the ESA or CESA within the Project Area. California red-legged frog, a Federally threatened California threatened species, is the only known ESA and CESA listed aquatic species that may occur in the Project Vicinity. Distribution and occurrence of California red-legged frog is addressed in Section 7.3.4. General information on the life histories of this species is provided in Section 7.7, Endangered and Threatened Species. Information related to the regulations and requirements of the ESA and CESA can be found in Section 4.0.

A description of the basins and sub-basins affected by the Project is included in Section 3.0 which includes a list of river reaches that Licensee believes may be directly, indirectly, or cumulatively affected by continued Project O&M. A map of the Project Vicinity is available in Section 6.0.

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7.3.2 History of Aquatic Resources in the Project Vicinity

7.3.2.1 Pre-History

Climatic and geologic forces are the dominant architects of Sierra Nevada ecosystems (SNEP 1997a). The original lakes and streams in the Project Vicinity were most recently formed during the Pleistocene Age from two million to ten thousand years ago. During this time, glaciers periodically covered the high country of the Yuba and Bear river sub-basins, carving out numerous cirque valleys and shallow lake basins. Glacial scouring also created the hanging valleys, steep stream gradients, and numerous barrier falls common in the watersheds, features that prevented fish from colonizing most high elevation lakes and streams after the glaciers receded. This glacial scouring and harsh climate left most soils in the high Sierra thin and nutrient-poor, resulting in nutrient poor conditions in most high lakes and streams (CDFG 2007a.)

The recession of glaciers 10,000 years ago created the Sierra mid and high elevation lakes, most of which were isolated from invasion by downstream fish populations by barrier falls on out-flowing rivers and streams. These extensive fishless habitats were subsequently colonized by a diversity of aquatic species, many of which required fishless habitats for their persistence (Knapp et al. 2001a). The estimated elevation above which most Sierra streams and lakes were fishless ranges between 4,900 and 6,000 feet[1], depending on the drainage (CDFG 2007a and Moyle et al. 1997). Streams above this elevation were dominated instead by amphibians, insects, and other aquatic invertebrates (CDFG 2007a). While some lakes and streams in the high Sierra were accessible to fish (e.g., golden or Lahontan trout), accessible water bodies were few in number (Moyle et al. 1997). Accessible lakes and streams identified by Moyle are not located in the Project Vicinity.

Fish

Sierra Nevada native fish species in accessible lakes and streams of the Sacramento-San Joaquin Drainage would have included 22 taxa; including three abundant anadromous fish – Chinook salmon, steelhead rainbow trout, and Pacific lamprey (Moyle et al. 1997). Fish reaching the highest accessible elevations in the western Sierra Nevada were coastal rainbow trout, although in some circumstances other species were also found at elevations above 4,900 feet. The only native non-trout species found at high elevations on the west side of the Sierra is the Sacramento sucker, which occurred naturally as high as 8,200 feet in the Kern River (Moyle et al. 1997). Native foothill fish included salmonid species (both anadromous and resident), lamprey, hitch, roach, hardhead, pikeminnow, dace, sucker, perch, and sculpin (Moyle et al. 1997).

Historically, salmon and steelhead were abundant in valley and foothill streams below natural barriers; including accessible reaches of the Yuba and Bear rivers and other accessible lowland streams in the Project Vicinity. Salmon runs of the Yuba and Bear rivers were an essential source of food for the native Hill Nisenan, a group of Southern Maidu who lived along both the

[1] All elevation data in this section are in National Geodedic Vertical Datum 1929 (NGVD 29)

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Yuba and American rivers. *"Salmon and other fishery resources on the Central Valley floor were part of a resource base that enabled resident Native American groups to attain some of the highest population densities to occur among the non-agricultural native societies of North America"* (Yoshiyama 1999). Ralph Beals in his 1933 study *Ethnology of the Nisenan*, reports that salmon were a part of the Native American Nisenan diet and *"…at one time came far up the Yuba River"* (http://www.syrcl.org/majorissues/salmonreport.htm).

Table 7.3.2-1. Fish native to the Yuba-Bear Hydroelectric Project Vicinity.

Family/Species	Presence/Trend1	Habitat2	Management Status 3
LAMPREYS (PETROMYZONTIDE)			
Pacific Lamprey (Lampetra tridentata)	Extirpated	Anadromous, foothills, lowlands	-----
CHINOOK SALMON (SALMONIDAE)			
Spring-run (*Oncorhynchus tshawytscha)*	Extirpated/Unknown[4]	Anadromous, mid-elevation, lowlands	CT, FT
Fall-run (*Oncorhynchus tshawytscha)*	Extirpated/Unknown[5]	Anadromous, foothills, lowlands	CSC, FSS
TROUT (SALMONIDAE)			
Resident rainbow trout (*Oncorhynchus mykiss)*	Present/abundant	Resident, foothills, high elevation	MIS
Winter steelhead (*Oncorhynchus mykiss)*	Extirpated/Unknown[5]	Anadromous, lowlands, foothills	FT
MINNOWS (CYPRINIDAE)			
Sacramento hitch (*Lavinia exiilcauda)*	Rare/declining	Lowlands, foothills	-----
Sacramento roach (*Lavinia s. symmetricus)*	Uncommon/stable	Lowlands, foothills	-----
Hardhead (*Mylopharodon conocephalus)*	Unknown/unknown	Lowlands, foothills	CSC, FSS
Sacramento pikeminnow (*Ptychocheilus grandis)*	Common/stable-expanding	Lowlands, foothills	-----
Sacramento speckled dace (*Rhinichthys osculus ssp)*	Common/stable	Lowlands, foothills	-----
SUCKERS (CATASTOMIDAE)			
Western sucker (*Catostomus o. occidentalis)*	Common/stable-expanding	Lowlands, foothills	
SCULPINS (COTTIDAE)			
Riffle sculpin (*Cottus gulosus)*	Uncommon/stable	Lowlands, foothills	-----
Prickly sculpin (*Cottus asper)*	Uncommon/stable	Lowlands, foothills	-----

1/ Tahoe National Forest Fish Species Past/Present. Updated 01/11/2001 (applies only to FS lands)
2/ Moyle et al. 1996
3/ Status: Federal (DOI and USDA) and State Listing. (No listings in Project Vicinity by Bureau of Land Management)
FT = Federal Threatened (USFWS 2007)
FE = Federal Endangered (USFWS 2007)
CT = State Threatened (CDFG 2007f)
CE = State Endangered (CDFG 2007f)
CSC = CDFG Species of Special Concern (CDFG 2007f)
FSS = USFS Sensitive Species (USDA 2001) – applies only to Forest Service lands.
MIS = USFS Management Indicator Species (USDA 2001) – applies only to Forest Service lands.
4/ Extirpated in all sub-basins of the Project Vicinity. Historically inhabited mid-elevation portions of Project Vicinity sub-basins. Lowland portions of sub-basins were mainly used as migratory corridors.
5/ Extirpated in all sub-basins of the Project Vicinity by blockage at Englebright Dam on the Yuba River and Vanjop Diversion Dam on the lower Bear River.

Amphibians

The native amphibian fauna of the watersheds addressed in this PAD is not large, but include representatives of diverse families including Ambystomatidae (mole salamanders); Salamandridae (newts), Plethodontidae (lungless salamanders), Bufonidae (toads), Hylidae (treefrogs), and Ranidae (true frogs). Written accounts describing the distribution or abundance of amphibians at the time of Euro-American settlement are lacking for the Project Vicinity and most general accounts of California amphibians do not pre-date the 1870s (e.g., Lockington

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1879, who remarked on the abundance of native frogs taken for food in the San Francisco area); however, it is likely that most species that are now rare were formerly more abundant and widespread.

Aquatic Invertebrates

Although insects constitute the largest taxon of freshwater invertebrates (that is, the taxon containing the greatest number of species) they are not the only invertebrates present in Sierra waters. Other groups include flatworms, nematodes, segmented worms, snails, clams, and crustaceans (e.g., fairy shrimp, crayfish and isopods) (Erman 1997).

Aquatic invertebrates are the most poorly known of all faunal groups in the Sierra Nevada (Herbst et al. 2003). Data for stream invertebrates are especially incomplete, with most collection records coming from intensively studied locales or taxonomic groups. In California, there are no inventory data on aquatic invertebrates from 200 years ago and inventory data during the present is inadequate (Erman 1997). Specific invertebrate groups in a few geographic areas of the Sierra have been conducted, but a surprisingly small amount of survey information at the species level exists. (Erman 1997).

Researchers assume that changes to the watersheds of the Sierra Nevada in the last 150 years have altered aquatic invertebrate assemblages and populations and have perhaps caused the extirpation of some species. Most of these changes have occurred at unknown and undocumented rates (Erman 1997).

7.3.2.2 Recent History

Beginning with the gold rush in 1848, many significant events have shaped the Yuba and Bear river sub-basins and their aquatic resources. Table 7.3.2-2 is a chronology of some of the more significant events related to aquatic resources in the Yuba and Bear rivers.

Table 7.3.2-2. Time line of developments and other historic events relating to aquatic resources in the Yuba and Bear river sub-basins.

1848	Gold discovered at Sutter's Mill on the American River. The Gold Rush begins.
1851	The first permanent diversion from the Bear River occurred near Colfax via the Bear River Canal, diverted water was used to supply water for hydraulic mining and milling operations.
1852	Start of construction of the Upper Boardman Canal.
1853	Sections of South Yuba Canal constructed.
1859	French Dam constructed by miners on upper Canyon Creek. Jackson Lake constructed on Jackson Creek.
1872	Bowman Lake and Faucherie Lake constructed by miners for hydraulic mining.
1880	100 million cubic yards of mud and gravel estimated to have washed into Middle and South Yuba rivers and Feather River as a result of hydraulic mining.
Late 1880's	Small hydroelectric power generation facilities were being used at mines in the area.
1883	English Lake dam failure on Middle Yuba River causes extensive damage to river, roads, farms, towns, and the loss of many lives.
1884	Sawyer Decision ends release of hydraulic mining debris into the Yuba River.
1892	Earliest version of Lake Spaulding Dam completed on the South Yuba River.
1893	Caminetti Act creates the California Debris Commission to impound hydraulic mining debris with dams.
1900	Mining declined and water supply projects increasingly used for irrigation
Early 1900's	Hydroelectric power development expands to domestic use. The demand for hydroelectric power generation facilities brings many new diversion facilities to the area beginning the extensive interbasin transfer system that would permanently link the Yuba, American, and Bear river systems.
1904	Barrier No. 1 constructed 4.5 miles upstream of the present site of Daguerre Point Dam on the main stem Yuba River.

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Table 7.3.2-2 (continued)

1910	Daguerre Point Dam completed.
1912	Construction of Drum Canal system started
1913	Current version of Spaulding Dam completed.
1916	Halsey power facility on the Bear River Canal becomes operational.
1917	Wise Powerhouse on the Bear River Canal becomes operational.
1920 – 40	NID obtains water rights and purchases numerous mining and power companies for their water rights and water systems and connects these systems with canals and flumes to meet consumptive demands.
1921-24	Construction of Bullard's Bar Dam on the North Yuba River.
1924	Fish ladders installed at Daguerre Point Dam.
1926	South Canal constructed to divert water that previously discharged from Wise Powerhouse into Auburn Ravine and transport this water to Mormon Ravine.
1926-27	NID constructed Milton Diversion Dam, Milton-Bowman Tunnel, Bowman-Spaulding Canal and raised Bowman Reservoir to its current elevation.
1927-28	Daguerre fish ladders washed out in winter storms.
1938	Surveys of salmon and steelhead populations conducted by CDFG.
1941	Englebright Dam completed, blocking all salmon passage into the South, Middle, and North Yuba rivers.
1943	Dutch Flat power system begins diverting the Bear River.
1950-52	New fish ladders installed at Daguerre Point Dam.
1961	Earliest comprehensive report of Chinook abundance in Central Valley streams, covering period from1940-1959. Since then, CDFG has carried out regular surveys of spawning runs.
1963	Yuba-Bear System completed in partnership with PG&E.
1965	NID begins storage of water in Rollins Reservoir.
1965	Chicago Park and Dutch Flat No. 2 Power Plants go on line.
1980	Rollins Power Plant goes on line.
Mid-1980's	Multiple overlays of gunite to reduce leakage in South Canal subsequently reduced the capacity of the Canal to less than the full upstream (Wise Powerhouse and Wise No. 2 Powerhouse) discharge capacity; periodic spill flows into Auburn Ravine begin in order to operate the upstream system at full capacity.
1986	Bowman Power Plant goes on line.
1994	Sacramento winter Chinook run listed as endangered under the U.S. Endangered Species Act.
1998	Central Valley steelhead listed as threatened.
1999	California Central Valley spring Chinook run listed as threatened.
1999	Upper Yuba River Studies Program formed under CalFed's Bay-Delta Program to investigate the feasibility of re-introducing salmon and steelhead into the upper watershed above Englebright Dam.

Source: www.syrcl.org/majorissues/salmonreport.htm, NID, and PG&E.

7.3.3 Fisheries Resources

7.3.3.1 Factors that Affect Fish Species Occurrence and Habitat

Fish resources of the Sierra Nevada have changed dramatically since the influx of Euro-Americans began in 1850 (Moyle et al. 1997). These anthropogenic changes largely determine the existing environment for fish resources in the Sierra Nevada. Moyle et al. (1997) identifies four broad patterns of change:

1. Anadromous fish have been excluded from most of the riverine habitat they once used on the west side of the range;
2. Most resident native fishes have declined in abundance, and the aquatic communities of which they are part have become fragmented; a few have had their ranges greatly expanded as the result of introductions;
3. Thirty species of non-native fish have been introduced into or have invaded most waters of the Sierra Nevada, including extensive areas that were once fishless, mainly at high elevations;
4. Sierra Nevada fisheries have largely shifted from native fish, especially salmon and other migratory fish, to introduced fish.

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Although the causes of fish species declines are multiple and interactive, they can be broken into a few broad categories: 1) introduced species; 2) dams and diversions; 3) changes in aquatic habitat; 4) watershed disturbance; and 5) other factors (Moyle et al. 1997). While the context of these changes described by Moyle is the "greater" Sierra Nevada, all of the changes and causes, to varying degrees, are evident in the Project Vicinity. Each of these patterns of change and possible causes is described below.

Introduced Species

Starting in the mid 1800s, Euro-American settlers began introducing salmonid fishes into lakes and streams of the Sierra Nevada, many of which were fishless since the retreat of the glaciers (Knapp 2001b). Sheep herders, miners, and other settlers moved native trout, which they used as a food source (CDFG 2007a). Beginning in the 1860s, sportsman's groups, the Sierra Club, the United States Army, the California Fish Commission, and individual outdoorsmen introduced trout into fishless areas for recreational fishing opportunities (CDFG 2007a). Among the non-native trout introductions were brook trout from the eastern United States, brown trout from continental Europe and Scotland, and Arctic grayling from Alaska.

In the 1950's, stocking by pack animal gave way to aerial stocking by CDFG. Brook, golden, and rainbow trout have been the most common species planted in high Sierra lakes, while brown, cutthroat, and lake trout have been planted in fewer lakes (CDFG 2007a).

Moyle et al. (1997) describes trout as "generalist predators, consuming whatever prey is available from invertebrates to fish to amphibians". Moyle et al. (1997) further states that: "*For stream and lake biotic communities of invertebrates and amphibians that developed in the absence of a top predator like trout, the effects of trout introductions are potentially devastating. In the Sierra Nevada, introduced trout have had negative effects on native trout, amphibians, and invertebrates"*.

In addition to trout, a wide variety of exotic game, non-game, and forage fish have been introduced into many Project reservoirs. Many of the introductions were authorized fishery planting programs while others were unauthorized intentional plantings or inadvertent bait bucket releases by private citizens. (Moyle et al. 1997).

Dams and Diversions

The following is quoted from Moyle et al. (1997) regarding impacts to fish species due to dams and diversions:.

> *Because of the importance of the Sierra Nevada as a supplier of water for California, virtually every stream of any size has at least one dam or diversion on it [Kattelmann 1996 as cited by Moyle et al. 1997].*
>
> *The changes caused by dams and diversions have been identified as a major cause of the declines of seven of the twenty declining species. Reservoirs generally favor exotic fish, which can then invade both upstream and downstream. Dams on major rivers have*

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blocked access by spring-run Chinook salmon to more than 95 percent of its spawning and holding areas and have greatly reduced access to spawning grounds of other runs of salmon, steelhead, and Pacific lamprey [Moyle et al. 1997].

Changes in Aquatic Habitat

The following is quoted from Moyle et al. (1997) regarding impacts to fish species due to changes in aquatic habitat:

Among the many factors affecting aquatic habitats, the most significant in the Sierra Nevada are road building, channelization, grazing, and mining. Road building and channelization are interrelated because hundreds of miles of Sierran streams have been channelized to support roads on their banks. The major transportation corridors in the Sierra Nevada follow streams and are often located in the riparian zones. The most noticeably altered streams are those that are sandwiched between highways and railroads. However, smaller roads associated with logging, mining, and recreation can also alter streams, especially where they cross; there is a negative correlation between the abundance of roads in a watershed and the integrity of the native stream biota [Moyle and Randall 1996 as cited by Moyle, et al. 1997].

Watershed Disturbances

The following is quoted from Moyle et al. (1997) regarding impacts to fish species due to watershed disturbances:

Cumulative watershed disturbances, as the result of urbanization, logging, grazing, mining, and other factors, have affected most species of fish to some extent, through changes in flow patterns, reductions in flows, and removal of riparian vegetation. Heavy logging and grazing in a drainage, coupled with construction of road and railroad beds across key flowage areas, can result in the lower reaches of a stream becoming dry much sooner and much more frequently than they had historically, denying adult trout access to spawning grounds and juvenile trout access to the lake [Moyle et al. 1997].

Other Factors

The following is quoted from Moyle et al. (1997) regarding impacts to fish species due to other factors:

Other factors affecting fish populations include pollution, exploitation, and disturbance. While pollution has played a relatively minor role in fish declines in recent decades it may play an increasing role in the future, as atmospheric deposition changes water chemistry and adds toxic materials to the water [Cahill et al. 1996 as cited by Moyle, et al. 1997], and as the effects of acid mine drainage and unregulated agricultural pollution (including livestock wastes) accumulate. The presence of salmon and trout of hatchery origin in streams may interfere with the recovery of wild populations, through behavioral

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interactions, genetic swamping, and introduced diseases [Steward and Bjornn 1990 as cited by Moyle, et al. 1997].

7.3.3.2 Current Distribution of Fish

Because of the wide range of habitat types, extensive introductions of native and exotic fishes, and the ability of fish to move from watershed to watershed through Project conduits there is a wide diversity and dispersion of fish species in the Project Vicinity. Species range from both native and non-native trout in cold headwater streams to introduced bass and other warm water species in the lower elevation reservoirs.

With the construction of dams in the Sierra Nevada and the Central Valley, reservoirs have become one of the major fish habitats of the Sacramento-San Joaquin system (Moyle et al. 1976). Reservoirs of the Sierra Nevada vary in nature and fish fauna depending on their elevation, size, location, water quality, and past and present planting programs. According to Moyle et al. (1976) in general, reservoirs are much less productive per surface area than are lakes because their deep, steep-sloped basins and fluctuating water levels greatly limit habitat diversity. Reservoirs typically contain a mixture of native fishes that occupied the streams prior to construction of the dams and exotic fish introduced by man (Moyle et al. 1976). The reservoirs in the Project Vicinity range from large to small and from clear and oligotrophic at high elevations to warmer water and semi-eutrophic at lower elevations.

Stream fish populations in the Project Vicinity are maintained through natural production or recruitment from hatchery plants of upstream or downstream reservoirs. Currently, direct planting of streams is uncommon in the Yuba and Bear river sub-basins (Hiscox 2007).

Often, planted fish will migrate out of an upstream reservoir into accessible inlet and outlet streams or into other conduit-connected reservoirs, sometimes through a long series of reservoirs, conduits and streams into other watersheds. The downstream movement of planted fish to a different reservoir, stream, or canal downstream is referred here-in as “flow-down recruitment.”

Planted fish will also readily emigrate from a lake or reservoir down the natural outflow stream. Adams, et al. (2001) found that brook trout planted in high-elevation Rocky Mountain lakes dispersed downstream through channel slopes as high as 80% with 18-meter-high falls. Adams stated, therefore, headwater stocking provides source populations that may be capable of invading most downstream habitats, including headwater refugia of native fishes and that stocking of a mere handful of headwater lakes could allow nonnative fishes access to nearly an entire stream network.

The foothill rivers and streams in the Project Vicinity tend to be transitional areas, where cold water fisheries overlap with warm water fisheries. The water temperature regimes of these reaches are partially dependent on dam releases, which can have a direct impact on the type of fisheries present. Reservoirs in the foothill region can typically be classified as warm water fisheries. However, at some point above the foothill reservoirs stream temperature regimes become influenced by both snowmelt and higher elevation ambient temperatures. Above this point is where cold water fisheries are typically located. The transition area, between the foothill

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and montane thermal regime cannot be clearly identified as warm or cold water fisheries, and the zone where the change takes place is not always definable. The montane coldwater fisheries assemblage in the Sierra Nevada is typically trout and sculpin. Populations of trout in small high-elevation streams and lakes may be relatively unstable due to slow growth, late maturity, low fecundity, and low survival during harsh winter conditions, and those isolated above barriers cannot be supported or re-colonized by the immigration of fish from other areas (Adams et al. 2001).

Gerstung (1973) conducted a study of 102 trout streams in the northern Sierra Nevada in order to learn more about the trout populations and the factors that influence population size. One finding was that stream gradient appears to have an influence on fish species composition. In stream sections with gradients over 150 feet/mile (2.8%), trout were the most abundant species while gradients of 100 feet/mile (1.8%) or less, were dominated by nongame species. Brown trout were dominate most frequently in stream sections with gradients of 100 feet/mile or less, but were also found in sections of up to 400 feet/mile (7.5%). Meadow sections were the most productive supporting the greatest trout densities followed by forested flats. Canyon sections were the least productive.

Gerstung (1973) found that the effects of competition from non-game species on trout populations varied depending on their size and abundance. In streams where nongame species were small or at populations of less than 50lbs/acre good trout populations were still present. If nongame densities were large, then evidence suggested that trout populations were inhibited, especially at low elevations. In specific studies where nongame fish have been removed, large increases in trout populations have been observed.

Table 7.3.3-1 is a list of species known to occur or possibly occur in the Project Vicinity. While occurrence of most of the species listed is confirmed, presence of other species listed is not certain but is possible based on historic planting or observed occurrence in other water bodies in the Project Vicinity.

7.3.3.3 Fish Management

As discussed above, existing fisheries in the Project Vicinity are largely the result of human influence, past and present. A primary influence today on the composition and distribution of fish in the Project Vicinity is management of the fisheries by CDFG.

> *"The mission of the Department of Fish and Game is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public"* (http://www.dfg.ca.gov/html/stratplan.html#toc).

Fisheries management techniques for a region or a water body are dynamic; they change based on new information such as angler satisfaction, cost/benefit, and biological implications on other resources. Future management of many lakes and reservoirs will be determined by ongoing study (Hiscox 2007).

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Trout Management Techniques

Presently, trout fishery management in California is accomplished using one of the three following techniques (CDFG 2003):

- Self-Sustaining Fisheries. *This management technique applies to most of the trout streams and many lakes in the State. Self-sustaining trout populations consist of naturally spawning wild trout that do not need or require hatchery supplementation. Angler harvest in most of these waters is regulated by the general trout daily bag and possession limits. Self-sustaining fisheries generally require a viable aquatic ecosystem where trout reproduction, growth, and survival are adequate to perpetuate the population, and only habitat protection management strategies are required, in addition to angling regulations. This technique is the preferred type of trout fishery management and is the most widely used [CDFG 2003].*

- Put-and-Grow Fisheries. *These fisheries are supported by hatchery-produced trout stocked at about 3 to 6 inches in length and sometimes, larger. This technique is used in waters where spawning habitat is limited and unable to support a satisfactory sport fishery, but fish habitat otherwise supports suitable trout growth and survival. Many of these fish are expected to increase substantially in size and survive for more than one season, thereby providing large, trophy-sized fish or many pan-sized fish in subsequent years. Stocking or transplanting genetically pure fingerlings from nearby wild native trout populations is also a management technique used to re-establish specific strains of native or wild trout into restored habitat [CDFG 2003].*

- Put-and-Take (Catchable) Fisheries. *This management technique is employed to create trout fisheries where they would not naturally exist, or to maintain fisheries where natural production is inadequate to support fishing demand. It is supported chiefly by hatchery produced trout weighing about one-half pound each and measuring about 10 to12 inches in length. Catchable-sized trout are placed in waters that are easily accessible to the public and where angling demand is high. Of the 3.5 to 4 million pounds of catchable-sized trout produced each year, approximately 75 percent are stocked into lakes and reservoirs, and 25 percent are stocked into rivers and streams [CDFG 2003].*

Management Programs

Trout resources and trout fisheries are currently being managed by the CDFG under the direction of one or more of eight statewide programs (CDFG 2003).

Programs relevant in the Project Vicinity are the Wild Trout Program, the Catch-and-Release Program (Milton Lake only), and the Inland Salmon Program (Bowman Lake and Rollins Reservoir only).

In some circumstances, a water body may not be actively managed by CDFG (Hiscox 2007). Unmanaged fisheries are left to evolve on their own.

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- Wild Trout Program. Management guidelines for wild trout state that, "hatchery-produced strains of wild or semi-wild trout may be used to supplement populations, if necessary, but no stocking of domesticated strains of catchable-sized trout is allowed."
- Catch-and-Release Fisheries. Catch-and-release regulations are employed in waters where trout production and fishing quality is improved by limiting harvest. Catch-and-release is often employed as a management tool in put-and-grow and wild trout managed fisheries."
- Inland Salmon Program. In addition to trout, kokanee and Chinook salmon are planted in some lakes and reservoirs. Salmon are managed as put-and-grow fisheries where they are capable of utilizing food resources more efficiently than trout."

7.3.3.4 Special-Status Fishes

For the purpose of this Pre Application Document (PAD), a special-status fish species is referred to as one that has a reasonable possibility of occurring in the Project Vicinity and is listed as protected on one or more of the following:

- United States Department of Interior (USDOI), Bureau of Land Management's (BLM) list of Sensitive Species (and occurs on federal land managed by the BLM). These species are referred to as BLMSS in this PAD.
- United States Department of Agriculture (USDA), Forest Service list of Sensitive Species and occurs on National Forest System (NFS) land in the Project Vicinity. These species are referred to as FSS in this PAD.
- Forest Service, Tahoe National Forest (TNF) list of Management Indicator Species (MIS), the species is found on land managed by the Forest Service as part of the TNF.
- USDOI, Fish and Wildlife Service (USFWS) or United States Department of Commerce, NOAA Fisheries list of Proposed (ESAP) or Candidate (ESAC) species for listing as endangered or threatened under the ESA, or proposed for delisting (ESAPD) under the ESA.
- CDFG list of Species of Concern (CSC).
- CDFG list of Proposed (CESAP) or Candidate (CESAC) species for listing as endangered or threatened under the CESA, or proposed for delisting (CESAPD) under the CESA.

Based on these criteria, two fishes are considered special-status:

- resident rainbow trout (MIS)
- hardhead (FSS & CSC)

As stated in Section 7.3.1, there are no known fish listed as endangered or threatened under the ESA or CESA within the Project Area.

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7.3.3.5 Fisheries Resources in Project Reservoirs and Impoundments

Existing fisheries resources in Project reservoirs and impoundments originate from self-sustaining lake populations, recruitment from connected streams and reservoirs, and from stocking by DDFG. Stocking records from CDFG (2007g) for the years 2002 through 2007 are shown in Table 7.3.3-2.

Currently, CDFG plants six Project reservoirs and impoundments. The most commonly planted fish is rainbow trout fry followed by rainbow trout catchables. The other species recently planted include brown trout fry and catchables; Eagle Lake rainbow trout catchables; and in Rollins Reservoir, kokanee fry. Table 7.3.3-2 shows there were no plants in French and Sawmill lakes for the period shown from 2002 through 2007. Planting was suspended pending studies of the impacts of trout in these lakes on the Sierra Nevada yellow-legged frog (*Rana Sierrae*). Planting resumed in 2006 following results and fishery management recommendations of the Aquatic Resource Biodiversity Management Plan for the Canyon Creek sub-area (Kundargi 2005).

A wide diversity of species have historically occurred or presently occur in Project reservoirs. Current and historical presence of all fish species in Project reservoirs and impoundments is shown in Table 7.3.3-3. Information on current and historical fish presence was obtained through an intensive literature review and personal interviews of persons with specific knowledge of fisheries resources in the Project Vicinity. Those specifically interviewed on Project reservoirs include Dan Teater of TNF and John Hiscox of CDFG. The most recent sources found that provide fully documented and specific information on fisheries resources include Kundargi (2005) and numerous historical CDFG internal reports.

Following is a brief description of each Project reservoir and impoundment and its fishery, based on obtained information. Lake and reservoir surface area is reported as the normal maximum surface area in acres. Elevation and maximum depth are reported at normal maximum water surface level in feet. Maximum depths were derived from Licensee's Exhibit Drawings or survey data, where available. Note that maximum depth is approximate.

The following diversion dam impoundments are not included due to their small size.

- Wilson Creek
- Bowman-Spaulding
- Texas Creek
- Fall Creek

Also not included in the descriptions below are Dutch Flat Forebay and Chicago Park Forebay because they are off-stream impoundments and small.

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Table 7.3.3-1. Fish species known or suspected to occur in the Yuba-Bear Hydroelectric Project Vicinity.

Common Name	Scientific Name	Origin	Abundance/Trend	Habitat/Elevation	Comment
FAMILY - SALMONIDAE (SALMON AND TROUT)					
Rainbow Trout	*Oncorhynchus mykiss*	I[a]	abundant/stable	streams, lakes, reservoirs, ponds, mid-high elevation	Various strains widely introduced.
Redband Trout	*Oncorhynchus mykiss ssp.*	N[b]	rare/unknown	cold water streams, lakes, reservoirs, ponds, high elevation	Transplanted into some lakes and reservoirs in Project Vicinity. All transplants in Project Vicinity have failed[3].
Brown Trout	*Salmo trutta*	N	common/stable	cool-cold water streams, lakes, reservoirs	Widely introduced and currently planted in some reservoirs in the Project Vicinity[3].
Brook trout	*Salvelinus fontinalis*	N	common/stable	cold water streams, lakes, reservoirs, ponds, mid-high elevation	Widely introduced. Mainly self sustaining in Project Vicinity.
Golden Trout	*Oncorhynchus aguabonita*	N[b]	localized rare/unknown	lakes, high elevation	Introduced in select lakes in the past – all failed in Project Vicinity[3].
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	I[b]	unknown/unknown	Lakes and streams, mid to high elevation	Found in Macklin Creek, a tributary to the Middle Yuba River. [6]
Mountain Whitefish	*Prosopium williamsoni*	N[b]	common/stable	Lahontan lowlands, foothills, high elevation	No current observations in Project Vicinity[3]
Chinook Salmon	*Oncorhynchus tshawytscha*	I[c]	present/unknown[5]	anadromous, lowlands-foothills, low elevation or reservoirs	Anadromous form extirpated in the Project Area. Resident form planted in some reservoirs.
Kokanee	*Oncorhynchus nerka*	N	rare/unknown	cold water streams, (spawning), reservoirs, high elevation	Planted in some reservoirs. Some self sustaining.
Artic Grayling	*Thymallus arcticus*	N	localized rare/unknown	cold water lakes, streams	Planted in past. Incidental observations. Populations not self sustaining
FAMILY - CYPRINIDAE (MINNOWS)					
California Roach	*Lavinia s. symmetricus*	I	common	small lowland streams	Native rather obscure cyprinid inhabiting small foothill streams of the Sacramento- San Joaquin drainage.[4]
Hardhead	*Mylopharodon conocephalus*	I	unknown/unknown	lowlands-foothills, low elevation	Native large cyprinid generally found throughout lower elevation streams of the Sacramento- San Joaquin drainage. [4]
Hitch	*Lavinia exiilcauda*	N	Rare/declining	Lowlands, foothills	Native fish found throughout the Sacramento-San Joaquin drainage. Commonly associated with introduced species especially catfish, centrarchids, and carp.[7]
Sacramento Pikeminnow	*Ptychocheilus grandis*	I	common/stable or expanding	lowlands-foothills, low elevation	Common in lakes and rivers of the Central Valley and foothills. Extremely predatory as it becomes larger. Often associated with hardhead or smallmouth bass. [4]
Tui Chub	*Gila bicolor*	I	common/stable	lowlands, foothills, high elevation	Project Area is western edge of native range. May be non-indigenous in Project Vicinity.

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Table 7.3.3-1. (continued)

Common Name	Scientific Name	Origin	Abundance/Trend	Habitat/Elevation	Comment
FAMILY - CYPRINIDAE (MINNOWS) (continued)					
Lahontan Redside	*Richardsonius egregius*	I[b]	common/stable	Lahontan lowlands, foothills, high elevation	Introduced from eastern Sierras as forage fish or from bait buckets[2]
Sacramento Speckled Dace	*Rhinichthys osculus ssp.*	I	common/stable	lowlands-foothills, low elevation	Small secretive fish found in streams and along lake shorelines. [4]
Common Carp	*Cyprinus carpio*	N	common/stable	warm water rivers, reservoirs, ponds, low-mid elevation	Widely introduced in CA since late 1800's. Considered pest[2].
Golden Shiner	*Notemigonus chrysoleucas*	N	common/stable	warm water rivers, reservoirs, ponds, low-mid elevation	Widely introduced minnow species as forage fish
FAMILY - CATOSTOMIDAE (SUCKERS)					
Western Sucker	*Catostomus o. occidentalis*	I	common/stable or expanding	lowlands-foothills, low elevation	Common species in streams. The are used as forage by predatory fish and are scavenger feeders.[4]
FAMILY - COTTIDAE (SCULPIN)					
Riffle Sculpin	*Cottus gulosus*	I	common/stable	streams, lakes, reservoirs, ponds, low-mid elevation	Common species in cooler streams of the Sacramento-San Joaquin drainage. [4]
Prickly sculpin	*Cottus asper*	I	common/stable	streams, lakes, reservoirs, ponds, low-mid elevation	A bottom dwelling species in wide range of habitats (fresh or salt water and warm and cold streams, lakes and reservoirs)[7].
FAMILY - CENTRARCHIDAE (SUNFISH)					
Largemouth Bass	*Micropterus salmoides*	N	abundant/increasing	warm water rivers, reservoirs, ponds, low-mid elevation	Widely introduced as sport fish. Aggressive predator – may cause extinctions of some native fish and amphibians[2].
Smallmouth Bass	*Micropterus dolomieu*	N	abundant/increasing	warm/cool water rivers, reservoirs, ponds, low-mid elevation	Widely introduced as sport fish. Present in a few reservoirs in Project Vicinity.
Green Sunfish	*Lepomis cyanellus*	N	Abundant/stable	warm water rivers, reservoirs, ponds, low-mid elevation	Accidentally and widely introduced in California. May be responsible for some extinctions of California Roach[2].
Bluegill	*Lepomis macrochirus*	N	abundant/increasing	warm water rivers, reservoirs, ponds, low-mid elevation	Widely introduced as sport fish. Aggressive predators on amphibians[2].
Black Crappie	*Pomoxis nigromaculatus*	N	abundant/increasing	reservoirs, ponds, low-mid elevation	Widely introduced in lowlands as a sport fish. Impacts unknown[2].
White Crappie	*Pomoxis annularis*	N	common/stable	reservoirs, ponds, low-mid elevation	Only one observation in record. Unsubstantiated.
Redear Sunfish	*Lepomis microlophus*	N	uncommon/unknown	warm water rivers, reservoirs, ponds, low-mid elevation	Introduced as sport fish. Impacts - highly molluscivorous species[2].
FAMILY - ICTALURIDAE (CATFISH)					
Brown Bullhead	*Ameiurus nebulosus*	N	uncommon/stable	warm water rivers, reservoirs, ponds, low-mid elevation	One of first introduced fish species in CA (1874). Impacts unknown[2]
Black Bullhead	*Ameiurus melas*		abundant/increasing	warm water rivers, reservoirs, ponds, low-mid elevation	Presence only documented by USFS[1].
Channel Catfish	*Ictalurus punctatus*	N	uncommon/stable	warm water rivers, reservoirs, ponds, low-mid elevation	Widely introduced in CA since late 1800's.[2]

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Table 7.3.3-1. (continued)

Common Name	Scientific Name	Origin	Abundance/Trend	Habitat/Elevation	Other
FAMILY - CLUPEIDAE (HERRING)					
Threadfin Shad	*Dorosoma petenense*	N	abundant/unknown	rivers, reservoirs, ponds, low elevation	Introduced into Sac. River drainage in 1953. Present in some reservoirs in the Project Vicinity.
FAMILY - OSMERIDAE (SMELT)					
Pond Smelt	*Hypomesus transpacificus*	N	abundant/stable	reservoirs, ponds, low- mid elevation	Introduced as forage fish into Lake Spaulding. Has expanded range downstream. Self sustaining[3].
FAMILY - GASTEROSTEIDAE (STICKLEBACKS)					
Threespine stickleback	*Gaterosteus aculeatus*	I	abundant/stable	reservoirs, ponds, low- mid elevation	Small ubiquitous species in streams and lakes in California.

1/ Adopted from USDA/TNF. Fish species past and present (USDA 2001).
2/ USGS Non-indigenous aquatic species data base (USGS 2001).
3/ Hiscox 2007.
4/ http://www.dfg.ca.gov/fishing/html/Publications/Fish/FreshWaterFish_0.htm
5/ CALFED 2000.
6/ Teater 2007
7/ Moyle 1976

Abbreviations: I = Indigenous; N = Non-Indigenous;
a) Several nonnative strains of rainbow trout have been planted into Project waters, or waters that drain into the Project reservoirs.
b) Indigenous to Sierra Nevada but not to the Project Vicinity (transplanted);
c) Native Chinook salmon have been extirpated in all watersheds in the Project Vicinity. Non-migratory Chinook have been planted in some reservoirs.

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Table 7.3.3-2. Daily fish planting record from California Department of Fish and Game for the years 2002 through 2007 for lakes and reservoirs in the Yuba-Bear Project Vicinity (CDFG 2007)

Reservoir	Attributes	2002					2003			2004					
Jackson Meadows Reservoir	Species	RT	ELT	ELT	BN	BK	RT	ELT	BN	RT	RT	RT	ELT	ELT	BN
	# of Plants	5	2	2	1	2	3	1	1	4	1	1	1	2	1
	Size	C	F	C	F	F	C	F	F	C	F	SC	C	F	F
	Total Fish Planted	45,475	61,537	12,600	10,625	86,720	18,600	60,000	10,704	16,700	55,358	21,760	16,720	56,640	10,920
French Lake	Species	RT													
	# of Plants	1													
	Size	F													
	Total Fish Planted	5,000													
Faucherie Lake	Species	RT	BN				RT	BN		RT	BN				
	# of Plants	1	1				1	1		1	1				
	Size	F	F				F	F		F	F				
	Total Fish Planted	6,600	6,800				3,000	5,129		3,495	6,500				
Sawmill Lake	Species														
	# of Plants														
	Size														
	Total Fish Planted														
Bowman Lake	Species	ELT	KOK				ELT	KOK		RT	KOK				
	# of Plants	1	1				1	1		1	2				
	Size	F	F				F	F		F	F				
	Total Fish Planted	20,655	25,650				20,450	24,960		20,590	20,615				
Rollins Reservoir	Species	RT	RT	BN			RT	BN		RT	RT	BN			
	# of Plants	5	1	1			7	1		4	1	1			
	Size	C	SC	C			C	C		C	SC	C			
	Total Fish Planted	9,400	29,700	6,750			11,100	5,400		16,600	36,000	3,100			

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Table 7.3.3-2. (continued)

Reservoir	Attributes	2005			2006			2007			
Jackson Meadows Reservoir	Species	RT	RT		RT	ELT		RT	RT		
	# of Plants	6	1		3	1		3	1		
	Size	C	F		C	F		C	F		
	Total Fish Planted	15,300	50,004		13,400	50,000		19,500	50,290		
French Lake	Species				RT			RT			
	# of Plants				1			1			
	Size				F			F			
	Total Fish Planted				49,950			50,000			
Faucherie Lake	Species	RT	BN		RT	ELT	BN	RT	RT	ELT	BN
	# of Plants	1	1		1	1	1	1	1	1	1
	Size	F	F		C	F	F	C	F	C	F
	Total Fish Planted	5,000	5,000		1,900	5,000	2,000	2,475	5,076	1,125	2,090
Sawmill Lake	Species				RT			RT			
	# of Plants				1			1			
	Size				F			F			
	Total Fish Planted				5,000			5,000			
Bowman Lake	Species	RT	KOK		ELT			RT			
	# of Plants	2005	2005		1			1			
	Size	F	F		F			F			
	Total Fish Planted	20,000	17,123		20,000			20,060			
Rollins Reservoir	Species	RT	BN	KOK	RT	BN	KOK	RT	BN	KOK	
	# of Plants	4	1	1	4	1	3	5	1	1	
	Size	C	C	F	C	C	F	C	C	F	
	Total Fish Planted	7,200	3,200	40,005	6,800	3,600	16,400	8,800	3,000	24,186	

Abbreviations
RT = Rainbow Trout
ELT = Eagle Lake Rainbow Trout
BN = Brown Trout
KOK = Kokanee
CHIN = Chinook Salmon
F = Fry
SC = Sub-catchable
C = Catchable

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Table 7.3.3-3. Current and historical presence of fish species in Yuba-Bear Hydroelectric Project reservoirs.

Family	Common Name	Reservoirs							
		Jackson Meadows	Milton	Jackson Lake	French Lake	Faucherie Lake	Sawmill Lake	Bowman Lake	Rollins
Salmonids	Rainbow Trout	●[1,8]	●[1,6,8]	●[8]	●[5,8]	●[1,8]	●[1,8,9]	●[1,8,9]	●[1,8]
	Brown Trout	●[1,8]	●[1,6,8]		●[8]	●[1,8,9]	●[1,8,9]	●[1,8,9]	●[1,8]
	Brook Trout	●[2,8]				●[8,9]	●[8]		
	Cutthroat Trout	●[3,4,8]	●[3,6,8]						
	Kokanee							●[1,8,9]	●[1,8]
	Artic Grayling	○[6,8]					○[8]		
Minnows	Common Carp								●[1,8]
	Tui Chub	●[4,8]							●[7,8]
	Lahontan Redside	●[4,8]	●[6,8]	●[8]	●[4,8]	●[1]	●[4,8]	●[1,8]	
	Speckled Dace	●[4,8]							●[4,8]
	Golden Shiner		●[6,8]			●[9]		●[4,8]	●[7,8]
Sunfishes	Largemouth Bass								●[1,8]
	Smallmouth Bass								●[1,8]
	Crappie								●[1,8]
	Green Sunfish							◓[4]	●[7,8]
	Bluegill								●[1,8]
	Redear Sunfish								●[1,7]
	White Crappie								○[7]
Catfishes	Brown Bullhead	●[2,8]	●[1,6,8]				●[4,8]	●[1,8]	●[7,8]
	Channel Catfish								●[1,8]
Herrings	Threadfin Shad								●[7,8]
Smelts	Pond smelt								●[7,8]

References: 1=Shafer (2005), 2=Bacher (2002), 3=Trails.com (2007), 4=Gerstung (1970-1975), 5=CDFG (1930-1959), 6=Hiscox (1986-1993), 7=CDFG (1974 and 1983), 8=Hiscox (2007), 9=Kundargi (2005)
Symbols: ● = known to be present, ◓ = possibly present, ○ = historically present likely extirpated.

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7.3.3.5.1 Middle Yuba River Sub-Basin

Jackson Meadows Reservoir

With a surface area of 1,054 acres and a maximum depth of 150 feet, Jackson Meadows Reservoir is the largest reservoir in the Project by surface area and storage capacity. It is located at an elevation of 6,036 feet. The reservoir was created by flooding Jackson Meadows, hence its name. Jackson Meadow Reservoir has an existing required minimum flow release of 5 cfs. Five perennial tributaries feed the reservoir: Middle Yuba River; Woodcamp Creek; Pass Creek; Secret Lake Creek; and one unnamed perennial creek. The Middle Yuba River and Pass Creek are known spawning habitat for rainbow and brown trout (Bacher 2002).

CDFG manages the reservoir as a Trout Put-and-Grow and Catchable fishery with rainbow and brown trout (Hiscox 2007).

According to Gerstung (1970-1975), Jackson Meadows Reservoir is relatively infertile with low dissolved solids and low alkalinity at depth. Nicola and Cordone (1973a as cited by Rogers 1976) characterized the lake as one of the most oligotrophic of 25 Sierra coldwater reservoirs studied. It ranked as one of the coldest at all depths, with higher than average oxygen concentrations and one of the five lowest in primary productivity. A large spawning migration of wild rainbow trout, averaging 11 inches in length, was observed in the inflowing Middle Yuba River during May 1967. The reservoir contains both Lahontan redside and speckled dace. Both possibly existed in the stream prior to inundation (Gerstung 1970-1975). A self-sustaining brown trout population also exists in the lake. In 1970-1973, Lahontan Lake cutthroats made up a small portion of the reported catch (Gerstung 1970-1975). Schaffer (2005) reports that the majority of rainbow and brown trout caught in Jackson Meadows Reservoir weigh between 0.5 to 0.75 pounds. According to Schaffer (2005), there are also thousands of holdovers from one to 3 pounds. Hiscox (1986-1993) reports that the high contribution to the sport fishery from fingerling trout plants indicates that Jackson Meadows Reservoir is a rich ecosystem for fish. Large brown trout are caught in creek inlets during the fall, particularly in Pass Creek. There is a small population of Arctic grayling in Jackson Meadows Reservoir. Origin is uncertain since there are no records of grayling plants in Jackson Meadows Reservoir. Hiscox (2007) indicates that Artic Grayling have not been seen in many years. Bacher (2002) reports that there are populations of brook trout, brown bullheads, and Lahontan redsides in the reservoir.

Milton Diversion Dam Impoundment

With a surface area of 103 acres, Milton Diversion Dam Impoundment is one of the smaller reservoirs in the Project with a gross storage capacity of 295 ac-ft. It is located downstream of Jackson Meadows Reservoir at an elevation of 5,690 feet. Milton Diversion Dam Impoundment is a run-of-river impoundment with an existing required minimum flow release of 3 cfs to the Middle Yuba River. Milton Diversion Dam Impoundment is a shallow reservoir with a maximum depth of 20 feet that was formed by enlarging Milton Reservoir, which was initially formed in 1927 (Table 7.3.2-2). The littoral zone of Milton Diversion Dam Impoundment is well developed and expansive, occupying nearly the entire eastern third of the impoundment and the shoreline of the Middle Yuba River. Two perennial tributaries feed the Impoundment: the

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Middle Yuba River that flows from Jackson Meadows Reservoir; and one unnamed perennial creek.

CDFG manages Milton Diversion Dam Impoundment as a Self-Sustaining Fishery for rainbow and brown trout, and has designated the Impoundment as Wild Trout Water with a size bag limit (Hiscox 2007).

According to Schaffer (2005), Milton Diversion Dam Impoundment is a quality brown trout fishery and has excellent fly-fishing. At one point, the impoundment developed problems with bullhead and was treated by CDFG to remove them. In 1993, when the impoundment was drained to repair the dam and remove silt, CDFG took the opportunity to add habitat and transplanted brown and rainbow trout from Jackson Reservoir. Both brown and rainbow trout reproduce in the Middle Yuba River inlet to Milton Diversion Dam Impoundment. Wiza (2000) states that large (18-22 in) brown trout are common in the impoundment. Hiscox (1986-1993) reports a fish rescue from 1993 recovered rainbow trout, brown trout, cutthroat trout, brown bullhead, Lahontan redside and golden shiner. Hiscox (2007) states that the lake has "flow-down" recruitment from Jackson Meadows Reservoir.

7.3.3.5.2 Canyon Creek Sub-Basin

Jackson Lake

With a surface area of 58 acres and a maximum depth of 50 feet, Jackson Lake is one of the smaller reservoirs in the Project by surface area and storage. It is situated at an elevation of 6,592 feet. The lake has an existing minimum flow release requirement of 0.75 cfs into Jackson Creek that flows into Bowman Lake to the west. Jackson Lake was formed by enlarging the original Jackson Lake, which was formed in 1859 (Table 7.3.2-2). Due to the lake's small and steep watershed, there are no perennial tributaries.

CDFG manages Jackson Lake as Put-and-Grow fishery for rainbow trout with occasional recent plants (Hiscox 2007). Hiscox (2007) reports that Jackson Lake is a low priority for CDFG management due to its remote location.

French Lake

At 6,660 feet elevation and with a surface area of 356 acres, French Lake is the highest elevation and fourth largest reservoir in the Project. The lake has a maximum depth of 60 feet. French Lake was a small natural lake until the dam was built in 1859 (Table 7.3.2-2). French Lake is a storage reservoir with an existing minimum flow release requirement of 2.5 cfs into Canyon Creek. Two unnamed perennial tributaries enter French Lake from the north and south.

CDFG manages French Lake as a Put-and-Grow fishery for rainbow and brown trout and has done so for many years (Hiscox 2007).

CDFG (1930-1959) stocking records show rainbow trout plants from 1930-1953. A 1949 creel survey reports the lake has an irregular annual granite shoreline with a 20-foot water level

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fluctuation. According to Gerstung (1970-1975), Lahontan redside have been found in French Lake. Gerstung also reports that approximately 65 percent of the shoreline is privately owned. The access road is rough and rocky and has been posted with no trespassing signs to discourage camping. Resided shiners are present in the lake, but do not seem to be numerous enough to be considered a management problem. Some natural production does occur. Gerstung (1970-1975) states that, "Warden Jack Witwer has observed significant numbers of spawners in the tributaries during May."

Faucherie Lake

With a surface area of 143 acres and a maximum depth of 40 feet, Faucherie Lake is one of the smaller reservoirs in the Project. It is situated below French Lake on Canyon Creek at an elevation of 6,123 feet. Faucherie Lake was formed in 1872 (Table 7.3.3-2). Faucherie Lake is a storage reservoir with an existing minimum flow release requirement of 2.5 cfs into Canyon Creek. Flow that does leave the lake drains into Sawmill Lake to the northwest. Inlet flow from French Lake by way of Canyon Creek is the lake's only perennial tributary.

CDFG manages Faucherie Lake as a Put-and-Grow and Catchable fishery for rainbow and brown trout (Hiscox 2007).

According to Schaffer (2005), Faucherie Lake has been actively managed for brown and rainbow trout since the early 1920's. From 1945 to 1970, the lake was planted only with fingerling rainbow trout; between 1970 and 1986, the lake was planted with catchable rainbow and brown trout; and from 1986 to present, fingerling rainbow and brown trout have been planted. Fall fishing for brown trout and rainbow trout can be excellent according to Schaffer (2005). There are few if any wild trout in Faucherie Lake due to the lack of inlet spawning habitat. Canyon Creek, the only perennial inlet stream, is blocked by a waterfall just upstream of the mouth by Faucherie Falls (Schaffer 2005). Hiscox (2007) states that the lake has incidental brook trout from flow-down recruitment. Historically, the lake has been Put-and-Grow, Catchable, or a combination - currently it is both.

Sawmill Lake

Sawmill Lake is one of the smaller reservoirs in the Project. It is situated downstream of Faucherie Lake on Canyon Creek at an elevation of 5,860 feet, has a surface area of 79 acres, and a maximum depth of 60 feet. Sawmill Lake was not a natural lake prior to dam construction. Sawmill Lake is a storage reservoir with an existing minimum flow release requirement of 2.5 cfs into Canyon Creek. Flow that does leave the lake drains to Bowman Lake via Canyon Creek. Canyon Creek and South Fork Canyon Creek are the lake's only perennial tributaries.

CDFG manages Sawmill Lake as a Put-and-Grow fishery for rainbow trout and has done so for many years (Hiscox 2007).

Hiscox (2007) states that there were Arctic grayling planted in Sawmill Lake years ago, but they have not been seen in years. Gerstung (1970-1975) reports a gill net survey in 1972 produced rainbow trout, brown trout, Lahonton redside, and brown bullhead. According to Schaffer

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(2005), until 1999 Sawmill Lake was planted with rainbow trout fingerlings. Planting was suspended in response to amphibian predation concerns. Although trout have not been planted in Sawmill Lake since 1999, a small number of rainbow and brown trout persist in the lake. Recent CDFG planting records show that planting has resumed with 5,000 fingerlings planted in 2006 and 2007 (CDFG 2007).

Bowman Lake

With a surface area of 820 acres, Bowman Lake is the second largest reservoir in the Project. It is situated at an elevation of 5,562 feet and has a maximum depth of 160 feet. Bowman Lake was a small natural lake prior to dam construction in 1872 (Table 7.3.3-2). Bowman Lake has an existing minimum flow release requirement of 3 cfs from April through October and 2 cfs from November through May. Three perennial tributaries feed the reservoir: Jackson Creek; Poison Creek; and Canyon Creek. In addition, the Milton-Bowman Tunnel adds water from the Milton Diversion Dam Impoundment.

CDFG manages Bowman Lake as an Inland Fishery and as a Put-and-Grow fishery for rainbow trout, brown trout, and kokanee (Hiscox 2007).

Hiscox (2007) states that the lake was historically managed as a Catchable rainbow and brown trout fishery. According to Schaffer (2005), Bowman Lake is a large system with opportunity for trout to grow. Good habitat structure and Lahontan redside forage are additional factors benefiting trout production and growth in Bowman Lake. Kokanee benefit from a good zooplankton population. Rainbow trout, brown trout and kokanee tend to school up around the tributary inlets and canal at different times of the year. Brown trout as large as 10 pounds have been caught in Bowman Lake (Shaffer 2005). Gerstung (1970-1975) reports Bowman Lake water quality is characterized by high transparency readings, high dissolved oxygen levels, low alkalinity and low total dissolved solid levels. Brown trout appear to be maintaining themselves by natural reproduction in the tributaries

7.3.3.5.3 Bear River Sub-Basin

Dutch Flat Afterbay

With a surface area of 140 acres, Dutch Flat Afterbay is the fourth smallest reservoir in the Project. It is situated at an elevation of 2,741 feet and has a maximum depth of 90 feet. The Dutch Flat afterbay dam was built in 1964/65. Dutch Flat Afterbay is a run-of-river reservoir with an existing required minimum flow release of 10 cfs from May through October and 5 cfs from November through April. There are two perennial tributaries entering Dutch Flat Afterbay: Bear Creek and one unnamed tributary.

CDFG does not manage the fishery in Dutch Flat Afterbay; it is classified by CDFG as an unmanaged fishery (Hiscox 2007).

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Rollins Reservoir

With a surface area of 140 acres, Dutch Flat Afterbay is the fourth smallest reservoir in the Project. It is situated at an elevation of 2,741 feet and has a maximum depth of 90 feet. The Dutch Flat afterbay dam was built in 1964/1965. Dutch Flat Afterbay is a run-of-river reservoir with an existing required minimum flow release of 10 cfs from May through October and 5 cfs from November through April. There are two perennial tributaries entering Dutch Flat Afterbay: Bear Creek and one unnamed tributary.

CDFG manages the reservoir as a Put-and-Grow and Catchable fishery for rainbow and brown trout (Hiscox 2007).

According to Hiscox (2007), Rollins Reservoir is currently managed with approximately 14,000 pounds of rainbow trout and 3,000 to 4,000 pounds of brown trout planted each year. Kokanee are not currently managed, but have been reproducing naturally. in the lake. CDFG (1974-1983) reports that Rollins Reservoir is characterized by steep shorelines, a scarcity of warm surface water, low fertility and low plankton production, rapid water exchange, winter turbidity, scarcity of forage fish, low fishing pressure, and mediocre angling success. Gill net surveys from 1970 through 1973 and 1983 caught brown trout, rainbow trout, smallmouth bass, largemouth bass, channel catfish, redear sunfish, green sunfish, golden shiner, tui chub, pond smelt, white crappie and bluegill. Planting documents mention a plant of threadfin shad and kokanee, but they were not caught by gill net. Brown bullheads have been observed in anglers' creels (CDFG 1974-1983).

7.3.3.6 Stream Reaches Subject to Project Direct/Indirect Effects

Prior to Euro-American settlement, the primary determinants of composition and distribution of fish populations in streams within the Project Vicinity were species endemism, elevation, habitat suitability, and habitat accessibility. Today, there are several additional determinants to composition and distribution of fish populations in the Project Vicinity, including CDFG fish planting programs of upstream reservoirs, inter-basin transport of fish via Project conduits, Project dams, blockages to anadromous fish migration by downstream non-Project dams and altered streamflow and water temperature regimes.

Historically, anadromous salmonids were present below natural barriers in the Yuba and Bear rivers. Today, access to the Upper Yuba River is blocked by Englebright Dam and partially blocked by another downstream dam, Daguerre Point Dam. These two dams were built on the main stem of the Yuba River in the early 1900's by the federal government to trap hydraulic mining sediments. At a height of 260 feet, Englebright Dam has no fish ladders and completely blocks all fish passage to potential spawning grounds in the upper watershed. The much smaller Daguerre Point Dam (less than 30 feet in height) does have fish ladders; however, recent studies show that the dam causes detrimental delays to adult salmon and steelhead migration (ENTRIX et al. 2003).

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Anadromous fish access to Project-affected reaches of the Bear River is blocked by several downstream dams without fish passage facilities including Vanjop Diversion Dam downstream of Camp Far West Reservoir, Camp Far West Dam, and Van Giesen Dam (Lake Combie).

For Project-affected stream reaches current (<10 years old) and quantitative information on species occurrence and distribution in stream reaches affected by the Project is available for only a few watersheds. Most of the stream fish information found by Licensee is qualitative or is pre-1997 stream surveys by CDFG, Forest Service, or others. The most recent sources found that provide fully documented and specific information on fisheries resources include Gast (2005) and CDFG (1988). Information on fish presence was also obtained by a personal interview with Dan Teater a fisheries biologist with the TNF. The other primary source of stream fish presence is assumed immigration of reservoir fish populations from upstream.

Table 7.3.3-4 provides a summary of known and possible distributions of stream fish in river reaches potentially directly or indirectly affected by the Project but is not intended to be a definitive list. For a description of reach segmentation of the following Project reaches, refer to Table 3.5-1. For a detailed summary of stream reach characteristics, geomorphology, hydrology, recreation activities, and presence of amphibian species for each stream reach affected by the Project, please refer to the Preliminary River Reach Matrix on CD (Attachment 7.3A).

Table 7.3.3-4. Summary of fish species documented or potentially occurring in stream reaches directly or indirectly affected by the Yuba-Bear Hydroelectric Project.

Stream	Stream Reach	Common Name								
		Rainbow Trout	Brown Trout	Cutthroat Trout	Lahontan Cutthroat	Brook Trout	Sacramento Sucker	Sacramento Pikeminnow	Hardhead Minnow	Smallmouth Bass
Middle Yuba River	Jackson Meadows Dam Reach	▲[7]	▲[7]	▲[7]		▲[7]				
	Milton Diversion Dam Reach	●[1,4]	●[1,4]	▲[7]	■[8]	●[1]	●[1,4]	●[1,4]	●[4]	●[4]
Wilson Creek	Wilson Creek Diversion Reach									
Jackson Creek	Jackson Lake Dam Reach	●[1]	●[1]							
Canyon Creek	French Lake Dam Reach	▲[7]	▲[7]			▲[5]				
	Faucherie Lake Dam Reach	●[1]	▲[7]			▲[7]				
	Sawmill Lake Dam Reach	●[1]	●[1]			▲[7]				
Clear Creek	Clear Creek Diversion Dam Reach	●[1,2]	▲[7]			●[2]				
Trap Creek	Trap Creek Diversion Dam Reach	●[1]	▲[7]							
Bear River	Dutch Flat Afterbay Dam Reach									
	Chicago Park Powerhouse Reach									

7.3.3.6.1 Middle Yuba River Sub-Basin

Jackson Meadows Dam Reach

Licensee found little definitive information regarding fish in the Jackson Meadows Dam Reach. However, given the high elevation and cool water, Licensee expects the reach supports populations of rainbow, brown, and brook trout. Other species, such as brown bullhead,

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Lahontan redside and golden shiner occur in Jackson Meadows Reservoir or Milton Diversion Dam Impoundment, but Licensee believes it is unlikely that these species have become established in numbers in the reach.

Milton Diversion Dam Reach

This reach of the Middle Yuba River extends 32 miles from the base of Milton Dam (RM 44.8) downstream to the Yuba County Water Agency's (YCWA's) Our House Dam (RM 12.8).

The Upper Yuba River watershed Chinook salmon and steelhead habitat assessment (CDWR 2006) is the most recent and extensive study of salmonid fisheries and habitat in the Middle and South Yuba rivers. While the assessment focuses on the feasibility of reintroduction of salmon and steelhead into the Middle and South Yuba rivers upstream of Englebright Dam, portions of the report are informative on resident fish populations and their habitats in the Middle Yuba River. Of particular value is the 2004 dive count survey for rainbow trout by Gast et al. (2005) included as Appendix G of the CDWR (2006) report. The survey area covered the area of the Middle Yuba River from Englebright Reservoir to Milton Diversion Dam Impoundment (refer to CDWR 2006 for study details.)

According to Gast (2005), the potential distribution of available rearing habitat for anadromous salmonids in the Middle Yuba River was assessed using the distribution and abundance of endemic rainbow trout as a surrogate. The relative distribution and abundance of rainbow trout were assessed in the Middle Yuba River in August and early September 2004 using direct observation (snorkeling) methodologies. Potential migration barriers and thermal refugia for trout were also investigated.

In addition to main stem surveys, qualitative assessments of all accessible significant tributaries were conducted by visually estimating the stream flow, measuring water temperature, photographing, and visually assessing the rearing potential of the lower reaches (Gast 2005). Surveys were conducted in tributaries 1,000 to 2,000 feet upstream of the confluence with the Middle Yuba River, or to the first impassable fish barrier, whichever was encountered first. All potential barriers to fish migration encountered were photographed and qualitatively described, with estimated vertical heights and Global Positioning System (GPS) positions recorded for each barrier.

The following description of results from 2004 snorkel surveys in the Middle Yuba River from Englebright Reservoir to Jordan Creek is based on Gast et al. (2005). Referenced River Miles are based on River Mile 0.0 at the confluence of the Middle and North Yuba rivers. Estimated index densities of rainbow trout in specific habitats varied between none and 1,506 rainbow trout per mile. Generally, trout densities were lower in the warmer, lower section of the river and higher in the cooler, upstream reaches (Table 7.3.3-5). Adult trout densities progressively increased upstream to River Mile 17.1. Densities upstream of this point showed no apparent trend and averaged 204 trout per mile. Adult rainbow trout observations were more frequent in pools than riffles. However, most riffles contained abundant whitewater, fast chutes, and other obstructions, making dive counts difficult and thus observation probabilities were probably lower than in pools. Rainbow trout densities in run habitats were intermediate to the lower densities in

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riffles and higher densities in pools. In the lower reaches, most of the rainbow trout in pools were concentrated at the head of pools. Rainbow trout larger than 14 inches were observed only in runs and pools during the dive counts and only downstream of River Mile 31.0. The index density of rainbow trout fry was variable, but generally increased upstream to River Mile 27.5 where they averaged 343 rainbow trout per mile. A spike (1,218 per mile) in the density of rainbow trout fry at River Mile 39. Excluding that high-density observation, the average fry density in the upper section of the river was 213 rainbow trout per mile. The furthest downstream observations of rainbow trout fry in dive counts was at River Mile 12.6. Rainbow trout fry were, however, observed at non-sampling locations near Oregon Creek (River Mile 4.8). Fry densities were generally highest in riffles as opposed to pools, with runs exhibiting intermediate densities. Fry densities among pools were highest in the cooler upstream reaches.

Other than rainbow trout, fish observed included brown trout, Sacramento sucker , Sacramento pikeminnow, hardhead , smallmouth bass, and various sunfish. No smallmouth bass, adult pikeminnow, or hardhead were observed upstream of Yuba County Water Agency's (YCWA) Our House Dam (River Mile 12.6); however, a few minnow fry were observed a short distance upstream of the dam. Sacramento suckers were observed below Our House Dam. Brown trout were present from Milton Diversion Dam to River Mile 37.5.

According to Gast et al. (2005), tributaries to the main stem, having cooler summertime water temperatures, may provide refuge for salmonids from higher than optimum main stem water temperatures. Oregon Creek, Kanaka Creek, and Wolf Creek, were all cooler than the main stem, appeared to provide good habitat, and were inhabited by juvenile and adult rainbow trout. The North Yuba River, at the confluence with the Middle Yuba River, also provides ample cool-water trout habitat. At the time of observation, water temperature in the North Yuba River at the confluence with the Middle Yuba River was 65.5°F - 8.3°F cooler than the Middle Yuba River water temperature (73.8°F).

Table 7.3.3-5. Distribution of fish relative to river mile and stream temperature observed during 2004 Middle Yuba River snorkel surveys.

River Mile (beginning at head of Englebright Reservoir)	Tributary Inflow	Middle Yuba Water Temperature (°C)	Rainbow Trout	Brown Trout	Pikeminnow Hardhead1	Pikeminnow	Hardhead	Suckers	Smallmouth Bass	Rainbow (Fry Lane)	Non-game (Fry Lane)
0.0			-	-	-	-	-	-	-	-	-
0.1		23.1	●	-	-	●	-	-	●	-	-
1.8	Yellowjacket Creek			-	-	-	-	-	-	-	-
2.6		20.4	●	-	-	●	-	●	●	-	-
4.8	Oregon Creek	21.4	-	-	-	-	-	-	●	-	-
12.6		23.7	●	-	●	●	●	●	●	-	●
13.0		21.8	●	-	●	-	-	-	-	-	-
16.5	Kanaka Creek		-	-	-	-	-	-	-	-	-
17.1		20.8	●	-	-	-	-	-	-	-	-
26.1		17.6	●	-	-	-	-	-	-	●	-
26.9	Wolf Creek		-	-	-	-	-	-	-	-	-
27.5		19.8	●	-	-	-	-	●	-	●	●
30.5		16.8	●	-	-	-	-	●	-	-	-
31.0		17.6	●	-	-	-	-	●	-	-	-
37.5		11.5	●	●	-	-	-	-	-	●	-
37.6		12.4	●	●	-	-	-	-	-	●	-

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Table 7.3.3-5 (continued)

River Mile (beginning at head of Englebright Reservoir)	Tributary Inflow	Middle Yuba Water Temperature (°C)	Rainbow Trout	Brown Trout	Pikeminnow Hardhead1	Pikeminnow	Hardhead	Suckers	Smallmouth Bass	Rainbow (Fry Lane)	Non-game (Fry Lane)
39.1		16.1	●	●	-	-	-	-	-	●	-
39.6		14.3	●	-	-	-	-	-	-	●	-

1: Gast et al. 2005; 2: Pikeminnow and hardhead less than 4" in length not discernible.

Gast et al. (2005) identified four barriers to upstream fish migration. Our House Dam, at River Mile 12.8, is the only man-made barrier (in the survey area) that currently blocks upstream fish migration. There are three natural barriers, two at River Miles 0.2 and 3.2 that would only be low flow barriers to upstream migration of small fish. At River Mile 0.4, there is an estimated 13-foot high cascade that is a major obstacle to upstream migration. Several very large boulders blocking the narrow bedrock channel created this barrier, and sediment has filled in upstream of the boulders forming a dam. Although large fish may be able to pass at certain flows, the height of the cascade and narrowness of the canyon is expected to at least impede passage at all flows.

Table 7.3.3-6. Location and height of migration barriers found on the South Yuba River between Englebright Reservoir and Milton Diversion Dam Impoundment.

River Mile	Barrier Height in Feet
0.2	5
0.4	13
3.2	2
12.7	YCWA's Our House Dam

Source : Gast et al. 2005

Lahontan cutthroat trout (*Oncorhynchus clarki henshawi)* occur in two tributaries to the main stem Middle Yuba River. Small, introduced populations exist in Macklin and East Fork creeks and were probably derived from the now extinct Lake Tahoe population (Coffin and Cowan 1995, as cited by Beedy et al. 2002). CDFG successfully transplanted Lahontan cutthroat trout into East Fork Creek. The Macklin Creek population is believed to have originated via a transfer of fish from Lake Tahoe in the early 1900s (E. Gerstung, CDFG, pers. Comm.. as cited by USFWS 2003). According to USFWS (1975), these are all strong, viable populations.

Macklin Creek enters the Middle Yuba River on the south bank at approximately RM 41.9. The stream rises steeply at 23 percent gradient for the first 0.5 mile. For the remaining 1.6 miles, the stream gradient averages 4.5 percent. The steep gradient in the lower reach of Macklin Creek restricts fish movement from the Middle Yuba River into Macklin Creek. Licensee found no citing in the literature of Lahontan trout in the Middle Yuba River.

East Fork Creek enters the Middle Yuba River on the south bank, approximately 7 miles downstream of Macklin Creek. Licensee was unable to find any information on the Lahontan trout population in East Fork Creek.

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Wilson Creek Diversion Reach

Licensee found little definitive information regarding fish in the Wilson Creek Diversion Reach. However, given the reach's connectivity to the Middle Yuba River, high elevation and cool water, Licensee expects the reach supports populations of rainbow and brown trout. Other species may also be present.

7.3.3.6.2 Canyon Creek Sub-Basin

Licensee found little definitive information regarding fish in the Canyon Creek Sub-basin, which includes Jackson Lake Dam Reach, French Lake Dam Reach, Sawmill Lake Dam Reach, Faucherie Lake Dam Reach, and Bowman-Spaulding Diversion Dam Reach. Given the high elevation, cool water, and fish populations in local impoundments, Licensee expects the reaches to support populations of rainbow, brown, and brook trout. Other species, such as brown bullhead and Lahontan redside may occur in low numbers. For specific species expected among all reaches of the Canyon Creek Sub-basin see Table 7.3.3-4.

7.3.3.6.3 Fall Creek Sub-Basin

Licensee found little definitive information regarding fish in the Fall Creek Sub-basin, which includes Clear Creek Diversion Dam Reach and Trap Creek Diversion Dam Reach. Given the very steep gradient, cool water, and fish populations in local impoundments, Licensee expects the reaches to support populations of rainbow and brown trout. Brook trout have been documented in Clear Creek Diversion Dam Reach (Table 7.3.3-4). Other species may also be present.

7.3.3.6.4 Bear River Sub-Basin

There are two stream reaches potentially directly/indirectly affected by the Project in the Bear River Sub-basin: Dutch Flat Afterbay Dam Reach and Chicago Park Powerhouse Reach.

CDFG conducted quantitative electrofishing surveys of the Bear River in 1987 and 1988 in which eight reaches were sectioned off and sampled for trout. Specific locations of surveys were not obtainable from CDFG. Sample sections ranged from 54 feet to 300 feet in length. Only brown trout and rainbow trout were recorded as captured. Brown trout density averaged 3,850 fish per mile, and rainbow trout averaged 471 fish per mile (CDFG 1988). For specific species expected among all reaches of the Bear River Sub-basin see Table 7.3.3-4.

7.3.3.7 Stream Reaches Subject to Project Cumulative Effects

Table 7.3.3-7 provides a summary of known and possible distributions of stream fish in river reaches potentially cumulatively affected by the Project and other entities in the Project-affected Sub-basins, but is not intended to be a definitive list. For a description of reach segmentation of the following Project reaches, refer to Table 3.5-1. For a detailed summary of stream reach characteristics, geomorphology, hydrology, recreation activities, and presence of amphibian

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species for each stream reach affected by the Project, please refer to the Preliminary River Reach Matrix on CD (Attachment 7.3A).

Table 7.3.3-7. Summary of fish species documented or potentially occurring in stream reaches cumulatively affected by the Yuba-Bear Hydroelectric Project.

Stream	Stream Reach	Common Name														
		Rainbow Trout	Brown Trout	Cutthroat Trout	Lahontan Cutthroat	Brook Trout	Sculpin spp.	Sacramento Sucker	Sacramento Pikeminnow	California Roach	Speckled Dace	Hardhead Minnow	Channel Catfish	Largemouth Bass	Smallmouth Bass	Green Sunfish
Canyon Creek	Canyon creek below Texas Creek Confluence Reach	▲[7]	▲[7]													
Texas Creek	Texas Creek Diversion Dam Reach	▲[5,7]	▲[5,7]			▲[5]										
Fall Creek	Fall Creek Diversion Dam Reach	●[1,2]	●[1,2]			●[1]										
Rucker Creek	Rucker Creek Diversion Dam Reach	▲[5,7]	▲[5,7]													
Unnamed Tributary	Fuller Lake Dam Reach	●[1]	▲[5]			▲[5]										
Jordan Creek	Jordan Creek Diversion Dam Reach	●[1]	▲[5]			▲[5]			▲[5]							
South Yuba River	South Yuba Reach #1 through #6	●[4]	▲[5]			▲[5]		●[4]	●[4]			●[4]				●[4]
Bear River	Drum Afterbay Dam Reach	●[1]	●[1]			▲[5]			▲[5]							▲[5]
	Bear River Canal Diversion Dam Reach	●[6]	●[6]										●[8]	▲[5]		▲[5]

References: 1 = Tahoe National Forrest (Before 1998) , 2 = Tahoe National Forest (1998 to Present) , 3 = PG&E (1989), 4 = Gast (2005), 5 = Sources found in Table 7.3.3-3 from Drum-Spaulding PAD (PG&E 2008), 6 = Shaffer (2005), 7 = Sources found in Table 7.3.3-3, 8 = Teater (2007)

● = Known to be present

■ = Known to be present in tributary to reach

▲ = Fish possibly present in reach that may have originated from upstream lake or reservoir

7.3.3.6.1 Canyon Creek Sub-Basin

Licensee found little definitive information regarding fish in the Canyon Creek Sub-basin, which includes the potentially cumulatively-affected Canyon Creek below Texas Creek Confluence Reach, and Texas Creek Diversion Dam Reach. Given the high elevation, cool water, and fish populations in local impoundments, Licensee expects the reaches to support populations of rainbow, brown, and brook trout. Other species, such as brown bullhead and Lahontan redside may occur in low numbers. For specific species expected in these two reaches of Canyon Creek Sub-basin see Table 7.3.3-7.

7.3.3.6.2 Fall Creek Sub-Basin

Licensee found little definitive information regarding fish in the Fall Creek Sub-basin, which includes the potentially cumulatively-affected Fall Creek Diversion Dam Reach. Given the very steep gradient, cool water, and fish populations in local impoundments, Licensee expects the

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reaches to support populations of rainbow and brown trout. Brook trout have been documented the Fall Creek Diversion Dam Reach (Table 7.3.3-7). Other species may also be present.

7.3.3.6.3 Rucker Creek Sub-Basin

Rucker Creek Diversion Dam Reach is the only Project-affected reach in the sub-basin. Licensee found little definitive information regarding fish of the reach. Given the very steep gradient and fish populations in local impoundments, Licensee expects isolated populations of rainbow and brown trout to occur. Other species may also be present.

7.3.3.6.4 South Yuba River Sub-Basin

Fuller Lake Dam Reach

Fuller Lake Dam Reach, located on Fuller Creek, is 1.0 mile long and extends from the Fuller Lake Dam (RM 1.0) downstream to the confluence of Fuller Creek with Jordan Creek (RM.0.0). Licensee found little definitive information regarding fish of Fuller Lake Dam Reach. Rainbow trout were observed during a Forest Service's stream survey (TNF before 1998). Given the fish populations found in Fuller Lake, brown trout and brook trout may also be present.

Jordan Creek Diversion Dam Reach

Licensee found little definitive information regarding fish of Jordan Creek Diversion Reach. The upper 2,000 feet (above the spill channel from Lake Spaulding) is steep with intermittent flow. Few, if any fish would be expected in this section of Jordan Creek. The lower 1.3 miles of Jordan Creek flows through the Lake Spaulding spill channel. Flow through this section is not continuous (subsurface flow) over its length during the low flow periods. Rainbow trout were observed during a Forest Service's stream survey (TNF before 1998). Given the connectivity of the reach to the South Yuba River below Lake Spaulding, populations of Sacramento pikeminnow, Sacramento sucker, brown trout and brook trout may be present.

South Yuba Reaches #1 through #6

As stated previously, The Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment (CDWR 2006) is the most recent and extensive study of salmonid fisheries and habitat in the Middle and South Yuba rivers. The information from the 2004 dive count survey for rainbow trout by Gast et al. (2005) for the South Yuba River is summarized below. The study was conducted in the exact same manner and same time period as described for the Middle Yuba River previously.

The survey area covered approximately 40 miles of the South Yuba River from Englebright Reservoir to the confluence with Jordan Creek (refer to CDWR (2006) for study detail). This is the full extent of South Yuba Reaches #1 through #6

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The following description of results from 2004 snorkel surveys of the Upper South Yuba is based on Gast et al. (2005). Estimated index densities of rainbow trout in all size classes in specific habitats varied between zero and 1,402 rainbow trout per mile. Generally, these trout index densities were lower in the warmer, lower reaches and higher in the cooler, upstream reaches (Table 7.3.3-7). Densities of adult trout (8 in. and larger) progressively increased upstream to RM 18.1, approximately 1.7 miles upstream of Edwards Crossing. Densities of such larger trout upstream of this point were relatively consistent and showed no apparent trend, averaging 273 trout per mile. Adult rainbow trout observations were more frequent in pools than riffles. However, most riffles contained abundant whitewater, fast chutes, and other obstructions, making dive counts difficult, and thus observation probabilities were probably lower than in pools. Trout densities in run habitats were intermediate to the lower densities in riffles and higher densities in pools. In the lower reaches, most of the trout in pools were concentrated at the heads of pools. Trout larger than 14 inches were observed only in runs and pools during the dive counts and only downstream of RM 28.3, approximately 1.6 miles downstream of Washington Bridge.

The index density of rainbow trout fry (4 in. and less) was variable, but generally increased upstream to RM 27.5, approximately 2.7 miles downstream of Washington Bridge, where they averaged 455 fish per mile. When compared to identical surveys on the Middle Yuba River by Gast et al. (2005), the average fry density in the South Yuba River was approximately twice the Middle Yuba River fry density. The most downstream observations of trout fry in the South Yuba River dive counts were at RM 15.2, approximately 1.2 miles downstream of Edwards Crossing. Trout fry were, however, visually observed from the streambank in the vicinity of Owl Creek (RM 4.2) in the South Yuba River. Fry densities were generally highest in riffles as opposed to pools, with runs exhibiting intermediate densities. Fry densities among pools were highest in the cooler upstream reaches.

Adult hardhead were observed at RM 3.9, approximately 0.3 mile downstream of the confluence of Owl Creek, whereas adult pikeminnow were observed at several locations downstream of RM 10.4, approximately 2.3 miles upstream of the Highway 45 crossing. Fry and juvenile minnows and Sacramento sucker were observed upstream to RM 28.3, approximately 1.6 miles downstream of Washington Bridge. No smallmouth bass or brown trout were observed, but a few sunfish were observed in a shallow backwater pool at RM 5.7, approximately 2.4 miles downstream of the Highway 45 crossing. (Gast et al. 2005). Table 7.3.3-8 below shows the distribution of observed fish in the Upper South Yuba relative to stream mile and stream temperature.

Table 7.3.3-8. Distribution of fish relative to rivermile and stream temperature observed during 2004 South Yuba River snorkel surveys[1].

River Mile (beginning at head of Englebright Reservoir)	Tributary Inflow	South Yuba Water Temperature (°C)	Rainbow Trout	Pikeminnow Hardhead[2]	Pikeminnow	Hardhead	Suckers	Rainbow (Fry Lane)	Non-game (Fry Lane)
0.0									
3.5		25.1		●					●
3.9		23.3	●	●		●			●
4.2	Owl Creek								

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Table 7.3.3-8 (continued)

River Mile (beginning at head of Englebright Reservoir)	Tributary Inflow	South Yuba Water Temperature (°C)	Rainbow Trout	Pikeminnow Hardhead [2]	Pikeminnow	Hardhead	Suckers	Rainbow (Fry Lane)	Non-game (Fry Lane)
5.7		25.1		●			●		●
6.7		23.1			●		●		
10.4		24.0	●	●	●				
12.0		20.7	●	●					●
15.2		22.9	●	●			●		●
16.0	Spring Creek	21.9	●	●			●	●	●
18.1		24.5	●	●			●	●	●
19.7		24.3	●	●					●
20.6	Humbug Creek	22.8	●				●	●	
23.3		22.6	●	●			●	●	
24.5		21.4	●	●				●	●
27.5		20.9	●				●	●	
28.1	McKilligan Creek								
28.3		20.3	●	●			●		●
28.8	Poorman Creek								
35.8		18.1	●					●	
36.0		17.3	●					●	
40.6		17.3	●						

1= Gast et al. 2005
2= Pikeminnow and hardhead less than 4" in length not discernible.

According to Gast et al. (2005), tributaries to the main stem, having cooler summertime water temperatures, may provide refuge for salmonids from higher than optimum main stem water temperatures. Poorman Creek, tributary to the South Yuba River, was cooler than the main stem, appeared to provide good habitat, and was inhabited by juvenile and adult rainbow trout.

Gast et al. (2005) identified three potential barriers to upstream anadromous salmonid migration in the South Yuba River. Two are natural falls or cascades at River Mile 6.2 and 20.0 and one is an abandoned diversion dam at River Mile 10.4 (Table 7.3.3-9).

Table 7.3.3-9. Location and height of migration barriers found on the South Yuba River.

River Mile	Barrier Height (feet)
6.2	6
10.4	< 6 (remnant breached dam)
20	6 to 7

Source: Gast et al. 2005

7.3.3.6.5 Bear River Sub-Basin

There are two stream reaches potentially cumulatively affected by the Project in the Bear River Sub-basin: Drum Afterbay Dam Reach and Bear River Canal Diversion Dam Reach.

CDFG conducted quantitative electrofishing surveys of the Bear River in 1987 and 1988 in which eight reaches were sectioned off and sampled for trout. Specific locations of surveys were not obtainable from CDFG. Sample sections ranged from 54 feet to 300 feet in length. Only brown trout and rainbow trout were recorded as captured. Brown trout density averaged 3,850 fish per mile, and rainbow trout averaged 471 fish per mile (CDFG 1988). While information on

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the species present is limited, it is likely that at some location downstream of the Bear River Canal Diversion Dam, the fish populations become transitional from cool water populations dominated by trout to warmer water populations dominated by hardhead, channel catfish, and sunfish. For specific species expected among all reaches of the Bear River Sub-basin see Table 7.3.3-7.

7.3.4 Amphibian Resources

7.3.4.1 Overview of Amphibian Occurrence

Ten species of amphibians are known to occur in the Project Vicinity and most of these species could potentially occur across a wide range of elevations (Table 7.3.4-1). Three other species were considered, but were not included in this list based on known and expected patterns of occurrence (Table 7.3.4-2) (Jennings and Hayes 1994, Zeiner 1988-1990, Vindum and Koo 1999a, 1999b.)

With the exception of two completely terrestrial species without a free-living larval stage (ensatina and California slender salamander), all of these documented species require still or slow-flowing water in which to breed. The species most likely to occur in aquatic habitats at lower elevations in the Project Vicinity are probably California newt, Sierra treefrog, foothill yellow-legged frog, and bullfrog. At elevations above 5,000 feet, long toed salamander, Sierra treefrog, western toad, and Sierra Nevada yellow-legged frog are the characteristic species, but because of introduced fish and other recent changes to high elevation ecosystems, cannot be assumed to occur.

Table 7.3.4-1. General distribution of amphibian species that have been reported in the Yuba-Bear Project Vicinity.

Species/Status[1]	General Distribution[2]
Long-toed salamander *Ambystoma macrodactylum*	Widespread species, primarily restricted to high elevations in the Sierra Nevada, but there are few known populations. Breeds in ponds and high elevation lakes, where the introduction of fish has adversely affected some populations.
California newt *Tarichan torosa*	Widespread and common species. Breeds in ponds, lakes, reservoirs, and streams mostly at low to middle elevations in forested areas.
Ensatina *Ensatina eschscholtzii*	Widespread and common species; completely terrestrial, associated with forested areas over a broad range of elevations (known from 1,300-5,300 ft).
California slender salamander *Batrachoseps attenuatus*	Widespread and common species; completely terrestrial. Occurs mostly in the forested foothills and chaparral (occasionally to 3,000 ft elevation).
Sierra treefrog (chorus frog) *Pseudacris sierra*[3]	Widespread and common species over a wide range of elevations, and breeding in ponds, lake and reservoir edges, ditches, and slow-moving or still sections of streams. Possibly reduced in abundance at high elevations.
Western toad *Anaxyrus boreas*[4]	Widespread species, breeding in ponds, lake, and reservoir edges, and slow-moving or still sections of streams across a wide range of elevations. In the Sierra Nevada more likely to occur at higher elevations (may have declined in the foothills). May be reduced in numbers but most known populations appear to be extant.
California red-legged frog[FT, CT, FSS] *Rana draytonii*[5]	Nearly extirpated in the Sierra Nevada. Formerly occurred on at least 30 drainages in the foothills (mostly below 3,500 ft elevation). Breeds in slow-moving or still sections of streams and ponds, usually where there is emergent and aquatic vegetation.
Foothill yellow-legged frog [CSC, FSS] *Rana boylii*	Estimated to no longer occur in at least 50 percent of former range in the Sierra Nevada. Occurs on small to large streams and rivers with pools and low-gradient riffles (small streams are probably non-breeding habitat). Most known occurrences are below 5,000 ft elevation.
Sierra Nevada yellow-legged frog[FC, CSC, FSS] *Rana sierrae*[6]	May be absent from more than 80 percent of former range in the Sierra Nevada. Extant populations are often small. Inhabits ponds, lakes, and streams, mostly above 5,000 ft elevation. Introduction of fish to high elevation areas may have eliminated many populations.

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Table 7.3.4-1 (continued)

Species/Status[1]	General Distribution[2]
Bullfrog *Lithobates catesbeianus*[7]	Introduced and well established in slow-moving streams, stock ponds, lakes, and reservoirs to at least 5,000 ft elevation. The presence of bullfrogs may be associated with declines of other native *ranids.*

[1]Status: FT = federal threatened, FC = federal candidate, CT = California threatened, CSC = CDFG California species of special concern, FSS = Forest Service sensitive.
[2]Sources include Jennings and Hayes 1994, Jennings 1996, Vindum and Koo 1999a, 1999b
[3]Previously classified as *Hyla regilla* (Pacific treefrog) (see Recuero et al. 2006a, 2006b). Retention of the common name "treefrog" reflects longstanding, popular usage.
[4]Previously classified as *Bufo boreas* (see Frost et al. 2006)
[5]Previously classified as *Rana aurora draytonii* (see Frost et al. 2006)
[6]Previously classified as *Rana muscosa* (mountain yellow-legged frog) (see Vredenburg et al. 2007).
[7]Previously classified as *Rana catesbeiana* (see Frost et al. 2006)

Table 7.3.4-2. General distribution of amphibian species considered for inclusion, but determined not to occur in the Project Vicinity.

Species/Status[1]	General Distribution
Mount Lyell salamander [CSC] *Hydromantes platycephalus*	A terrestrial species associated with granite outcrops and only known to occur in disjunct alpine and sub-alpine areas well N and SE of the Project Vicinity.
Western spadefoot [CSC] *Spea hammondii*	Primarily found W of the Sierra Nevada foothills and has never been recorded in any of the counties associated with the Project Vicinity.
Northern leopard frog [CSC] *Lithobates pipiens*	Occurs in only a few scattered sites in the Sierra Nevada, the nearest of which are in NE Sierra County and S of Lake Tahoe (populations possibly extirpated).

[1] Status : CSC = CDFG California species of special concern, FSS = Forest Service sensitive.
[2] Previously classified as *Rana pipiens* (see Frost et al. 2006)

7.3.4.2 Special-Status Amphibian Species

The distribution and occurrence of ranid frogs (*Rana* and *Lithobates*) are of particular interest in the Project Vicinity. The three native *Rana* (California red-legged frog, Sierra Nevada yellow-legged frog, and foothill yellow-legged frog) have each experienced major declines in the Sierra Nevada, and an introduced ranid (bullfrog), has been implicated as a factor in the decline of two of these species. The status of native *Rana*, along with other parameters, such as the occurrence of native fishes, is an important component in assessing the biotic integrity (defined as "the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of a natural habitat of the region") of Sierra Nevada watersheds (Moyle and Randall 1998). As stated in section 7.3.1, background information on California red-legged frog, a federally threatened species, is presented in Section 7.7.

Sierra treefrog, a TNF Management Indicator Species (MIS) for meadow habitat, is one of the most common and widespread amphibian species in the Sierra Nevada, and so is not addressed at length below. The MIS designation is used to identify species that may exemplify response to a land management activity by other species with similar habitat requirements.

Sierra Nevada Yellow-Legged Frog

Sierra Nevada yellow-legged frog (SNYLF) is a federal candidate species, with listing "warranted, but precluded" (USFWS 2003a). SNYLF was previously described as the "northern population segment" of the mountain yellow-legged frog (*Rana muscosa*) (the southern

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population segment, which is listed as a federally endangered species [CDFG 2006, USFWS 2002a], retains the name *R. muscosa*) (Vredenburg et al. 2007). Recent surveys suggest that this species has disappeared from more than 80 percent of historically known sites in the Sierra Nevada, and many of the remaining populations are evidently comprised of few individuals (USFWS 2003a). SNYLF populations are believed to be extant in the vicinity of the Project south of Fordyce Lake and east of the Project in the Truckee River watershed (USFWS 2003a). Additional surveys suggest this frog is breeding east of Feeley Lake and southeast of White Rock Lake (TNF 2007a). The decline of the SNYLF appears to be related in large part to the introduction of trout into high elevation lakes and streams where predatory fish did not previously occur (Bradford et al. 1993, Drost and Fellers 1996, Knapp and Matthews 2000b). However, loss and fragmentation of habitat by water projects; and disease (particularly chytridiomycosis), airborne contaminants, and increased levels of Ultra violet-B radiation have also been implicated as factors (USFWS 2003a), possibly interacting with other stressors as has been hypothesized for other species of amphibians (Carey 1993, Blaustein et al. 1994a, 1994b). Historically, SNYLF occurred at sites primarily at elevations above 5,900 feet. Populations are generally associated with lake, pond, and stream complexes in montane or sub-alpine forests and meadows (Knapp and Matthews 2000b, Pope and Matthews 2001, USFWS 2003a). SNYLF are highly aquatic in all life stages (although overland dispersal has been documented, Matthews and Pope 1999), and requires two or more years to complete the larval phase.

Foothill Yellow-Legged Frog

Foothill yellow-legged frog (FYLF) is a stream-adapted species, usually associated with streams with backwater habitats and coarse substrates (Seltenrich and Pool 2001). Compared to the preceding species, the status of FYLF in the northern Sierra Nevada is less perilous, with populations apparently persisting on at least some portions of most previously occupied drainages (Vindum and Koo 1999b, NatureServe 2006b). Nonetheless, this species is absent or uncommon in many areas where it was once abundant, and its continued existence is jeopardized by the spread of introduced fish and bullfrogs, changes to stream hydrology, and loss or fragmentation of habitats (Moyle 1973, Hayes and Jennings 1988, Jennings and Hayes 1994, Lind et al. 1996, Randall 1997). FYLF populations may require both mainstem and tributary habitats for long-term persistence. Streams too small to provide breeding habitat for this species may nonetheless be critical as seasonal habitats (e.g., in winter and during the hottest part of the summer) (VanWagner 1996, PG&E 2001), and there is evidence for which habitat use by young-of-the-year, sub-adult, and adult frogs differs by age-class and changes seasonally (Randall 1997). FYLF breeding tends to occur in spring or early summer on the descending limb of hydrograph, and eggs are laid in areas of shallow, slow-moving, near shore waters. This species is known to occur along portions of the South Yuba and Middle Yuba rivers and on tributaries of both rivers, on at least one tributary of the North Fork American River (Vindum and Koo 1999b), and at least two tributaries of the Bear River (TNF 2007a).

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7.3.4.3 Review of Known Records - Facilities and Stream Reaches Subject to Project Direct/Indirect Effects

The following sections detail known occurrences of amphibians within or near the Project Vicinity. These accounts are based on a review of available records from a variety of sources including searchable, on-line databases maintained by the California Academy of Sciences (CAS 2007) and Museum of Vertebrate Zoology (MVZ 2007), the current version of the California Natural Diversity Database (CDFG 2007), GIS data layers provided by the TNF (TNF 2007a) and data on amphibian occurrence from CDFG (Kundargi and Hanson 2005). These data are understood to include comprehensive surveys of high elevation lakes and streams. The following sections also summarize other relevant reports from the study area.

Because populations of several species are known to have been extirpated from many historically known localities in the Sierra Nevada, records reported herein emphasize relatively recent survey efforts. Interpretation of both museum and site records is sometimes complicated by misidentifications, particularly for native *Rana* (Hayes, personal Communication, 2007). In addition, some species (e.g., bullfrog, Sierra treefrog, and California newt) are undoubtedly under-reported in some areas because they were considered common or were heard, but not collected.

7.3.4.3.1 Middle Yuba River Sub-Basin

Project impoundments in the Middle Yuba River Sub-basin include Jackson Meadows Reservoir and Milton Diversion Dam Impoundment, which have few recorded amphibian occurrences (Table 7.3.4-3). Jackson Meadows Reservoir is deep, cold, and oligotrophic; undergoes substantial (more than 40-ft) annual water surface fluctuations; and lacks associated emergent wetland areas. Most of the lake shoreline is bedrock or upland forest. Rainbow trout and brown trout are stocked for a put-and-grow fishery. These conditions strongly suggest that this reservoir is unsuitable habitat for amphibians. An old (1932) museum record for SNYLF from Pass Creek (population presumably extirpated, Jennings and Hayes 1994) is located approximately 3.0 miles east of the reservoir. Milton Diversion Dam Impoundment is shallow, with emergent or submerged vegetation on the upper third of the impoundment; however, it has well-established trout populations that may render habitats unsuitable for amphibians.

Stream reaches potentially affected by the Project include 33.6 mi of the Middle Yuba River and 0.3 mile of Wilson Creek, for which there are few known amphibian occurrences or surveys (Table 7.3.4-3). The only known recent amphibian record in the vicinity of the Milton Diversion Dam Reach is for foothill yellow-legged frog less than 0.5 mile from the Middle Yuba River between Bear Creek and Wolf Creek. Foothill yellow-legged frog has also been reported on the Middle Yuba River just downstream of Wolf Creek and from three left bank tributaries within 2.0 miles downstream of the mouth of Wolf Creek (TNF 2007a). This reach is generally steep and confined within a deep valley, with a succession of small tributaries (East Fork Creek and Wolf Creek are the largest tributaries). Associated amphibians may be limited to foothill yellow-legged frog, Sierra treefrog, and California newt.

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Table 7.3.4-3. Summary of known amphibian occurrences and surveys in the Vicinity of the Yuba-Bear Hydroelectric Project in the Middle Yuba River Sub-basin.

Reservoirs/Associated Stream Reaches	Amphibian Occurrences and Surveys
MIDDLE YUBA RIVER	
Jackson Meadows Reservoir	Sierra treefrog record near reservoir.
Jackson Meadows Dam Reach	Recent surveys at two locations within 0.1 mi of reach (Sierra Nevada yellow-legged frog protocol); no amphibians found.
Milton Reservoir	Recent survey near lake (Sierra Nevada yellow-legged frog protocol); no amphibians found.
Milton Diversion Dam Reach	Foothill yellow-legged frog: four recent adults within 0.5 mi of reach, one historical record within 0.2 mi of reach. Sierra treefrog near reach.
WILSON CREEK	
Wilson Creek Diversion Reach	No known occurrences or surveys.

7.3.4.3.2 Canyon Creek Sub-Basin

Project facilities within the Canyon Creek Sub-basin include high elevation lakes (Jackson, French, Faucherie, Sawmill and Bowman) and the Bowman-Spaulding Conduit Diversion Impoundment, most of which have no recorded occurrences of amphibians (Table 7.3.4-4). These lakes are generally unlikely to support amphibians because of rocky shorelines and minimal associated emergent vegetation, resident fish, and marked seasonal water level fluctuations. The only species documented is California newt at Bowman Lake (TNF 2007a). However, western toad and, more commonly, Sierra treefrog have been recorded at various ponds in the vicinity of these lakes (Table 7.3.4-4). In addition, SNYLF adults and juveniles have recently been recorded at small lakes 0.2 mile south and 0.9 mile west of French Lake (Kundargi and Hanson 2005).

River reaches affected by the Project include Jackson Lake Dam Reach, French Lake Dam Reach, Faucherie Lake Dam Reach, Sawmill Lake Dam Reach, and Bowman-Spaulding Diversion Dam Reach. These reaches have few recorded amphibian occurrences or surveys (Table 7.3.4-4). Wetlands occur along Jackson Creek in the first 0.6-mile downstream of Jackson Lake Dam. A 10-acre impoundment along Canyon Creek (Weil Lake, not a Project facility) is the only significant wetland on the reach, although there are numerous small wetlands in the vicinity that are potentially suitable for amphibians. However, none of these wetlands are associated with the Project. Sawmill Dam Reach below Sawmill Lake and Canyon Creek downstream of Bowman Lake are mostly high gradient reach sections. SNYLF was historically found (1949) in South Fork Canyon Creek, which connects lakes upstream of Sawmill Lake (cited in Kundargi and Hanson 2005). CDFG has recently conducted surveys of South Fork Canyon Creek to determine whether this population is extant. (Kundargi and Hanson 2005).

Table 7.3.4-4. Summary of known amphibian occurrences and surveys in the vicinity of the Yuba-Bear Project in the Canyon Creek Sub-basin.

Reservoirs/Associated Stream Reaches	Amphibian Occurrences and Surveys
JACKSON CREEK	
Jackson Lake	Recent Fellers and Freel survey on lakeshore; no amphibians found. Also, Sierra treefrog documented near lake.
Jackson Lake Dam Reach	Sierra treefrog record near reach.
CANYON CREEK	
French Lake	Sierra Nevada yellow-legged frog: recent record 0.2 mi S of lake and 0.9 mi W of lake. In addition, long-toed salamander, western toad, and multiple Sierra treefrog records near lake.
French Lake Dam Reach	Multiple Sierra treefrog records near reach.
Faucherie Lake	Sierra treefrog near lake.

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Table 7.3.4-4 (continued)

Reservoirs/Associated Stream Reaches	Amphibian Occurrences and Surveys
CANYON CREEK (continued)	
Faucherie Lake Dam Reach	Recent survey (Fellers and Freel protocol) 0.4 mi from reach; no amphibians found.
Sawmill Lake	Sierra Nevada yellow-legged frog: historical record 1.5 mi upstream of lake. Multiple Sierra treefrog records near lake.
Sawmill Lake Dam Reach	No known occurrences or surveys.
Bowman Lake	Multiple Sierra treefrog records near lake; California newt record from the lake.
Bowman-Spaulding Conduit Diversion Dam Impoundment	No known occurrences or surveys.
Bowman-Spaulding Diversion Dam Reach	No known occurrences or surveys.

7.3.4.3.3 Fall Creek Sub-Basin

There are no Project impoundments located in the Fall Creek Sub-basin. River reaches affected by the Project include Clear Creek Diversion Dam Reach and Trap Creek Diversion Dam Reach. These reaches have no recorded amphibian occurrences or surveys (Table 7.3.4-5).

Table 7.3.4-5. Summary of known amphibian occurrences and surveys in the vicinity of the Yuba-Bear Project in the Fall Creek Sub-basin.

Reservoirs/Associated Stream Reaches	Amphibian Occurrences and Surveys
CLEAR CREEK	
Clear Creek Diversion Dam Reach	No known occurrences or surveys.
TRAP CREEK	
Trap Creek Diversion Dam Reach	No known occurrences or surveys.

7.3.4.3.4 Bear River Sub-Basin

Project facilities within the Bear River Sub-basin include Dutch Flat Forebay, Dutch Flat Afterbay, Little York Basin, Chicago Park Forebay, and Rollins Reservoir, for which there are no known amphibian records (Table 7.3.4-7). An amphibian record identified only as *Rana* sp. is reported by CAS (2007) from approximately 5 miles west of Rollins Reservoir along Rattlesnake Creek near the town of Grass Valley.

Stream reaches affected by the Project in the Bear River sub-basin include parts of the Bear River, for which there are few known amphibian records or surveys (Table 7.3.4-7). According to MVZ (2007) records, CRLF occurred historically (specimens collected in 1916 and 1939) 0.5 mile northeast of Dutch Flat (El. 3,200 ft), presumably on the Little Bear River. Jennings and Hayes (1994, pg 63) depict an occurrence that appears to correspond to this locality and classify it as "extinct based on verified museum record." However, Jennings (1996, pg 936) does not show this record at all on the map for CRLF. USFWS (2002c) does not report an extant population at this site. There are also historical records of western toad in the vicinity of Dutch Flat (MVZ 2007).

Foothill yellow-legged frog is known to occur in the Dutch Flat Afterbay Dam Reach of the Bear River near Dutch Flat and upstream of Chicago Park Powerhouse, and in Dutch Flat Canyon (Jones and Stokes 2006; TNF 2007). At the Bear River sites visual encounter surveys documented successful breeding of foothill yellow-legged frog in three consecutive years in

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areas of low gradient cobble/boulder bars, and established that the egg-laying period occurred in early June (Jones and Stokes 2006).

Table 7.3.4-8. Summary of known amphibian occurrences and surveys in the Vicinity of the Yuba-Bear Hydroelectric Project in the Bear River Sub-basin.

Reservoirs/ Associated Stream Reaches	Amphibian Occurrences and Surveys
Dutch Flat Forebay	No known occurrences or surveys.
Dutch Flat Afterbay	California red-legged frog: historical record 0.5 mi NE of Dutch Flat. Also, bullfrog and Sierra treefrog near reservoir.
Dutch Flat Afterbay Dam Reach	Foothill yellow-legged frog: all life stages found at sites near Dutch Flat and upstream of PG&E's Chicago Park Powerhouse during surveys. Sierra treefrogs and western toads also found.
Little York Basin	No known occurrences or surveys.
Chicago Park Forebay	No known occurrences or surveys.
Chicago Park Powerhouse Reach	No known occurrences or surveys.
Rollins Reservoir	California newt record near reservoir.

7.3.4.4 Review of Known Records for Stream Reaches Subject to Project Cumulative Effects

The following sections detail known occurrences of amphibians in stream reaches potentially subject to cumulative effects from the Yuba-Bear Hydroelectric Project and other entities in the Project Vicinity. These accounts are based on a review of available records from a variety of sources, described above in Section 7.3.4.2.

7.3.4.4.1 Canyon Creek Sub-Basin

River reaches potentially cumulatively-affected by the Project and other entities Texas Creek Diversion Dam Reach, and the Canyon Creek below Texas Creek Confluence Reach. These reaches have no recorded amphibian occurrences or surveys (Table 7.3.4-9).

Table 7.3.4-9. Summary of known amphibian occurrences and surveys in the vicinity of the Yuba-Bear Project in the Canyon Creek Sub-basin.

Reservoirs/Associated Stream Reaches	Amphibian Occurrences and Surveys
CANYON CREEK	
Canyon Creek below Texas Creek Confluence Reach	No known occurrences or surveys.
TEXAS CREEK	
Texas Creek Diversion Dam Reach	No known occurrences or surveys

7.3.4.4.2 Fall Creek Sub-Basin

There are no Project impoundments located in the Fall Creek Sub-basin. The river reach potentially cumulatively affected by the Project is Fall Creek Diversion Dam Reach. Generally, stream reaches within the Fall Creek Sub-basin have few recorded amphibian occurrences or surveys (Table 7.3.4-10). There is a record for FYLF downstream of the Fall Creek Diversion Dam at the confluence of Fall Creek and the South Yuba River (TNF 2007a).

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Table 7.3.4-10. Summary of known amphibian occurrences and surveys in the vicinity of the Yuba-Bear Project in the Fall Creek Sub-basin.

Reservoirs/Associated Stream Reaches	Amphibian Occurrences and Surveys
FALL CREEK	
Fall Creek Diversion Dam Reach	Foothill yellow-legged frog: recent adults and juveniles 0.2 mi from reach.

7.3.4.4.3 Rucker Creek Sub-Basins

Rucker Creek Diversion Dam Reach is the only reach in the Rucker Creek Sub-basin potentially cumulatively affected by the Project. There are no Project impoundments. No known recorded amphibian occurrences or surveys were found for the reach (Table 7.3.4-11).

Table 7.3.4-11. Summary of known amphibian occurrences and surveys in the vicinity of the Yuba-Bear Project in the Rucker Creek Sub-basin.

RUCKER CREEK	
Rucker Creek Diversion Dam Reach	No known occurrences or surveys.

7.3.4.4.4 South Yuba River Sub-Basin

Stream reaches cumulatively affected by the Project include 42.9 miles of stream from Jordan Creek Diversion Reach, Fuller Lake Dam Reach, and six reaches of the South Yuba. The South Yuba reaches extend 40.2 miles from the Jordan Creek Confluence downstream to the Englebright Reservoir. See Table 7.3.4-12 below for recorded amphibian occurrences or surveys.

Table 7.3.4-12. Summary of known amphibian occurrences and surveys in the vicinity of the Yuba-Bear Hydroelectric Project in South Yuba River Sub-basin.

Reservoirs/Associated Stream Reaches	Amphibian Occurrences and Surveys
UNNAMED TRIBUTARY	
Fuller Lake Dam Reach	No known occurrences or surveys.
JORDAN CREEK	
Jordan Creek Diversion Reach	Recent survey (Fellers and Freel protocol) within 0.1 mi of reach., no amphibians detected.
SOUTH YUBA RIVER	
South Yuba Reach #1	Recent survey (Fellers and Freel protocol) at two locations within 0.2 mi of reach, no amphibians detected. Sierra treefrog record near reach.
South Yuba Reach #2	Foothill yellow-legged frog: recent adults and juveniles 0.1 mi from reach (near mouth of Fall Creek). Sierra treefrog record near reach.
South Yuba Reach #3	Foothill yellow-legged frog: historical record 0.1 mi from reach; recent juvenile on reach and recent adults 1.7 mi and 4 mi up Diamond Creek (tributary to reach).
South Yuba Reach #4	Foothill yellow-legged frog: historical adults and juveniles at two locations within 0.25 mi of reach, recent adults at 8 locations within 0.3 mi of reach; 5 recent adults up Scotchman Creek; 1 historical record and 2 recent up Washington Creek, 4 historical records up Poorman Creek. Also, Sierra treefrog record near reach.
South Yuba Reach #5	Foothill yellow-legged frog: historical records from 8 surveys noted a total of 25 adults and 2 juveniles. California red-legged frog: one recent record near a tributary to this reach.
South Yuba Reach #6	Foothill yellow-legged frog: historical records from three surveys from 0.1 to more than 5 mi up Shady Creek recorded 15 adults, 17 juveniles.

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7.3.5 Aquatic Reptiles

Only one special status aquatic reptile, a turtle, is known to occur in the Project Vicinity: western (or Pacific) pond turtle (*Actinemys* [formerly *Emys* or *Clemmys*] *marmorata*). It is expected that the Sierra garter snake (*Thamnophis couchii*), an aquatic specialist, is present in the vicinity but has probably not been specifically documented as it has no special status. Because the Project lies within the zone of introgression between the northern and southern pond turtle taxa (*A. m. marmorata* and *A. m. pallida*, respectively), subspecies names are not used herein. Western pond turtle, a California species of concern (CSC), occurs in a wide variety of aquatic habitats up to about 6,000 feet elevation, particularly permanent ponds, lakes, side channels, backwaters, and pools of streams, but is uncommon in high-gradient streams. Isolated occurrences of western pond turtle in lakes and reservoirs sometimes represent deliberate releases of pets. Although highly aquatic, western pond turtle often over winters in forested habitats and oviposits in summer at upland sites as much as 1,200 feet from aquatic habitats (Storer 1930; Jennings and Hayes 1994). A review of available information revealed few records of occurrence for directly/indirectly and cumulatively-affected stream reaches within the Project Vicinity, which are summarized in Table 7.3.5-1 and Table 7.3.5-2, respectively.

Table 7.3.5-1. Summary of known western pond turtle occurrences in stream reaches directly/indirectly affected by the Yuba-Bear Hydroelectric Project.

Reservoirs/Associated Stream Reaches	Western Pond Turtle Occurrences
MIDDLE YUBA RIVER	
Middle Yuba River Reach from Milton to Our House Dam Reach	One record from 2001 in a pond N of Indian Creek, a tributary to the Middle Yuba River

Table 7.3.5-2. Summary of known western pond turtle occurrences in stream reaches cumulatively-affected by the Yuba-Bear Hydroelectric Project.

Reservoirs/Associated Stream Reaches	Western Pond Turtle Occurrences
SOUTH YUBA RIVER	
South Yuba Reach #5	Four recent records near the reach: two on tributary streams, two near tributary streams.
South Yuba Reach #6	Four studies with 11 records.

7.3.6 Aquatic Invertebrate Resources

Aquatic invertebrates are an important source of food for birds, mammals, amphibians, reptiles, fish, and other invertebrates. Any vertebrate that is found in wet areas in the Sierra Nevada and that is known to eat invertebrates is likely feeding on aquatic invertebrates at some time (Erman 1997).

Aquatic invertebrates are the most poorly known of all faunal groups in the Sierra Nevada. Data for stream invertebrates are especially incomplete, with most collection records coming from intensively studied locales or taxonomic groups (Herbst et al. 2003).

Only two specific studies on aquatic invertebrates could be found for the Project Vicinity. Therefore, a general description of aquatic invertebrate taxa that may occur in the greater Sierra Nevada area is provided below rather than a case-by-case description of each water body. This

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description is not complete, and given the data available, it is a general overview and does not include specific species. Qualitative macroinvertebrate information gathered during USFS stream surveys does exist for some stream reaches affected by the Project (TNF before 1998 and TNF 1998 to Present).

There is essentially no similarity between invertebrate assemblages that occur in running water and those that occur in standing water. The major taxa of many invertebrate groups are found in both general habitat types, and in gradations between them, but the species that live in these two habitats are usually different (Erman 1997). The Project Vicinity contains flowing and still water habitats, and therefore likely occurring taxa can be broken into these two habitat categories.

Flowing habitats in the Project Vicinity would likely contain the invertebrate groups: Ephemeroptera (mayflies), Plecoptera (stoneflies), Tricoptera (caddisflies), Diptera (midges), Coleoptera (beetles), Megaloptera (alderflies), Hemiptera (true bugs), Hirudinea (leaches), Oligocheata (segmented worms), Turbellaria (flatworms), Nematoda (roundworms), Crustacea (scuds, crawfish), Mollusca (clams, snails), Acari (water mites), and Lepidoptera (aquatic moths).

Still water habitats in the Project Vicinity would likely contain the groups: Ephemeroptera (Mayflies) Tricoptera (caddisflies), Diptera (midges), Coleoptera (beetles), Hemiptera (true bugs), Oligocheata (segmented worms), Hirudinea (leaches), Turbellaria (flatworms), Nematoda (roundworms), Crustacea (scuds, crawfish), Mollusca (calms, snails), Odenata (dragon and damsel flies), and Acari (water mites).

The following table is a combination of the taxa found in three studies. Two of the studies were done in the Project Vicinity, one from Fordyce Creek immediately below the dam at Fordyce Lake (Garcia and Associates 2001) and the other on Clear, Fall, Trap, and Rucker Creeks below their interaction with the Bowman-Spaulding Canal (Rose et al. 1995). The results of the latter study are discussed further below. The third study is from first and second order streams in Yosemite National Park between elevations of 4,429 to 9,843 feet. The three studies presented taxa to different levels of classification from order down to species. For consistency in this table, taxa are presented to family. For more detailed classification refer to the specific studies.

Table 7.3.6-1. Families of aquatic macroinvertebrates that were found in three studies of high elevation Sierra Nevada streams: (Herbst 2003), (Garcia and Associates 2001), & (Rose et al. 1995).

Order						
Coleoptera	**Diptera**	**Ephemeroptera**	**Hemiptera**	**Megaloptera**	**Plecoptera**	**Tricoptera**
Elmidae	Chironomidae	Baetidae	Corixidae	Sialidae	Nemouridae	Brachycentridae
Dytiscidae	Empididae	Heptageniidae		Corydalidae	Capniidae	Ryacophilidae
Staphylinidae	Ceretopogonidae	Leptophlebiidae			Chloroperlidae	Hydroptilidae
Tenebrionidae	Tabanidae	Ephemerellidae			Perlodidae	Limnephilidae
Psephenidae	Simuliidae	Ameletidae			Leuctridae	Hydropsychidae
	Tipulidae	Siphlonuridae			Perlidae	Lepidostomatidae
	Hesperoconopa				Peltoperlidae	Phryganaeidae
	Dixidae					Polycentropodidae
	Nymphomyiidae					Philopotamidae
	Stratiomyidae					Sericostomatidae
						Glossosomatidae
						Uenoidae
						Calamoceratidae

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Many endemic species of aquatic invertebrates, known nowhere else in the world, are present in the Sierra Nevada (Erman 1997). There are a few areas in the Sierra where extensive aquatic invertebrate surveys have been done to determine the diversity of some groups and the amount of endemism. The studies are not complete and there is a good possibility that numerous taxa are unrepresented. Results of one such study by Erman (1997) are summarized in Table 7.3.6-2 below.

Table 7.3.6-2. Summary of aquatic invertebrate species collections in the Sierra Nevada (Erman 1997).

Taxon	Total species in Sierra Nevada Range	Number of species endemic to Sierra Nevada Range	Percent species endemic to Sierra Nevada Range
Stoneflies	122	31	25
Alderflies	4	0	0
Dobsonflies	7	?	?
Caddisflies	199	37	19
Net-winged midges	11	1	9
Mountain midges	4	1	25
Snails, clams	40	8	20
Fairy/brine shrimp	10	1	10

Rose et al. (1995) conducted a study on the impacts of the Bowman-Spaulding Canal on four Sierran streams; Clear, Fall, Trap, and Rucker Creeks. Effects on benthic macroinvertebrate communities were addressed. The study found that consistency of trends in benthic macroinvertebrate taxa richness, Shannon diversity, and abundance was greatest between sections of streams with similar flow rather than upstream and downstream reaches with differing flow. Three flow types were observed among the different streams, intermittent, permanent, and artificially permanent. Artificially permanent are streams that would have historically been intermittent without the influence of the Canal. Streams with permanent flow had higher taxa richness, higher Shannon diversity, and a greater number of individuals per sample than intermittent streams (Rose et al. 1995). Of all the taxa collected 55% were opportunistic and could inhabit intermittent and permanent streams, 32% were found in permanent only and the remaining 13% inhabited intermittent streams only (Rose et al. 1995).

Specific findings of individual stream reaches sampled by Rose et al. (1995) show some of the influences that Project operations have had on benthic macroinvertebrate communities. The artificially permanent section of Clear Creek, downstream of the Canal, and Rucker Creek, upstream of the Canal, contained 7 taxa that are found in permanent streams only. This implies that these taxa would not have been present without the artificial manipulation of the stream reaches. Downstream sections of Trap and Rucker creeks were the most impacted streams sampled, with the lowest diversity and numbers of individuals. These reaches had the most severe channel incisions and erosive banks in the study. Extreme variations in flow over short periods of time have been shown to decrease the ecological health of benthic macroinvertebrate communities (Rose et al. 1995). The mechanism for community disturbance of high flows is the physical movement of sediment (Gore et al. 1994 as cited by Rose et al. 1995). During the study this phenomenon was observed on Clear Creek after slightly higher flows were released for Canal maintenance. This distinct disturbance event was followed by lower benthic macroinvertebrate diversity and numbers of individuals (Rose et al. 1995). Rucker Creek upstream of the canal contained a benthic macroinvertebrate assemblage unlike the other streams

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of the study. Taxa of this section of stream resembled what would be found in a lower elevation, warm, higher productivity stream. This difference in taxa is the result of a constant releases of warm water high in organic mater from Rucker Lake (Rose et al. 1995).

Limited benthic macroinvertebrate data has been collected for the Middle Yuba River, Milton Diversion Dam reach. Five samples were collected at two sites (Milton Dam, Our House Dam) over a period of three years (2004-2006) by the South Yuba River Citizens League (SYRCL), using the California Stream Bioassessment Protocol. They collected an average of 33 taxa with a tolerance value of 3.86 over this period. The order Trichoptera had the highest average number of taxa collected (8) during the collection period (SYRCL 2007).

Mussels

Five species of mussels occur in California (Shaul 2007), only one of which is considered special-status for the purpose of this PAD[2]. These are California floater (*Anodonta californiensis),* which is a FSS; Oregon floater (*Anodonta oregonensis*), western ridged mussel (*Gonidea angulata*), western pearlshell (*Margaritifera falcata*), and fingernail clam *(Pisidium ultramontanum*). CDFG's CNDDB does not identify any mussels in the Project Vicinity. The nearest occurrence is the fingernail clam in Eagle Lake near South Lake Tahoe, approximately 35 miles south of the Project Vicinity, and the western ridged mussel in the Sacramento River near the junction of Interstate 5 and Interstate-80, approximately 25 miles west of the Project Vicinity (Bay Science Foundation 2004-2007).

California Floater

California floater is a freshwater mussel known to occur from southern British Columbia to northern Baja California, and as far east as western Wyoming, eastern Arizona, and northwestern Chihuahua (Taylor 1981, 1985). Taylor (1981) states that California floater was originally widespread in California, but is now probably extinct in most of the Central Valley, including the entire Sacramento River and Southern California. It lives in the shallow areas of clean, clear lakes, ponds and large, slow rivers. It prefers lower elevations and a soft, silt substrate into which it burrows. Its common name is derived from the tendency of *Adonata* species to float to the surface of the water after death, which is a result of gas build-up behind their thin shells. The life cycle of a California floater includes a parasitic larval stage (called a glochidium), during which it is dependent upon host fish, usually a member of the Gila genus (minnow), for food and dispersal. Larval California floaters have two hook-like projections within their shells, which they use to attach to the fins of certain species of native fish. The fish hosts form cysts around the glochidia, but remain unharmed. After it reaches a certain size, the glochidium releases itself from its host, undergoes metamorphosis and begins its adult life as a sedentary filter-feeder, straining bacteria, plankton and detritus from the surrounding currents with its gills. It is generally found with the entire shell lying exposed on the bed surface and only the foot buried in substrate. Adults begin to reproduce after reaching 6 to 12 years of age, and can live as long as

[2] As described at page 7.3-14, a special-status species for the purpose of the PAD is one that is listed by CDFG as CSC; listed by either the Forest Service or BLM as Sensitive; listed by the TNF as an MIS, or is proposed or a candidate for listing under either the ESA or CESA. Species listed as endangered or threatened under the ESA or CESA are described in Section 7.7.

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100 years. Although a female floater may release several million larvae during the course of one year, survivorship is extremely low due to the specific requirements of finding and attaching to an appropriate fish host (i.e., minnow). The decline of native host fish species has been identified as one likely cause of decline in populations of this species. In a detailed quantitative survey of a mussel bed in a reach of the Pit River with an overall gradient of less than 2 percent, California floater, was found relegated to the edges of the mussel bed nearest the stream bank (Spring Rivers 2003). As stated above, Licensee did not find any reported occurrence of California floater in the Project Vicinity and the Forest Service does not list it as a FSS for the TNF (www.fs.fed.us/r5/projects/sesitive-species/semsitive-animals.html).

Snails

CDFG's CNDDB includes two snails as occurring in the Project Vicinity: tight coin (Yates' snail) and Button's Sierra sideband. Neither of these snails is special-status.

Great Basin Rams-Horn Snail

One species of aquatic snail, the Great Basin rams-horn (*Helisoma newberryi*) is listed as FSS for the TNF (www.fs.fed.us/r5/projects/sesitive-species/semsitive-animals.html), though it has not been sighted or surveyed for in the TNF, including in the Project Vicinity. According to the Forest Service, the Great Basin rams-horn snail occurs in a highly restrictive distribution, but is locally abundant when found. Historically, the Great Basin rams-horn snail occurred within lakes, though its preferred habitat is larger springs and spring-fed creeks with cold, highly oxygenated water, muddy substrate, and slow flow. It can be found on the muddy margins of larger, slow streams. The snail characteristically burrows in soft mud and may be invisible even when abundant (Taylor 1981), and can occur with *Pisidium ultramontanum*, *Lanx klamathensis*, or several other endemic mollusks (Frest and Johannes 1993). It also occurs with *Juga acutifilosa* and *Fluminicola seminalis*. In California, the snail was known to occur in six local drainages in which the species probably survives in four of these drainages. The nearest reported occurrence to the Project is in Shasta County, California, in the lower Pit River (Nature Serve 2007). Historically, it has been observed in the Truckee River directly downstream of Lake Tahoe.

Affects of Introduced Fish on Invertebrates

One topic that has received a lot of attention in recent years is the effect that introduced fish have on aquatic organisms that live in areas that were previously fishless. Studies done on the interaction of introduced fish with aquatic invertebrates have uncovered some general trends. Most of the studies look at still water habitats, and there is very little information on flowing waters, but similar trends can be expected.

One trend is the elimination of aquatic invertebrates due to over predation. An individual study showed that upon introduction to a previously fishless lake, the fish tripled in weight and doubled in length in their first year. At the same time, they eliminated much of the aquatic invertebrates. After the initial year, the fish population became stunted and grew very little in

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the following years, while the aquatic invertebrates remained nearly eliminated (Reimers 1979 from Pister, 2001).

Other studies have shown that fish introductions cause a change in species composition. The general trend for zooplankton is a shift from large bodied species to small bodied species due to selective predation by fish (Knapp and Matthews 2000a). A study done on the distribution of zooplankton species among 75 alpine and sub-alpine lakes in the central Sierra Nevada found that presence or absence of fish (primarily salmonids) was the most important predictor of species distribution. Large-bodied species were found in fishless lakes and small-bodied species were found in lakes with trout (Stoddard, 1987 from Knapp 1996). In the case of macroinvertebrates, there is a shift from large conspicuous species to ones that burrow and are inconspicuous (Zaret 1980 from Knapp and Mathews 2000a). In the Sierra Nevada, high elevation fishless lakes are typically dominated by several conspicuous taxa of mayfly larvae (Ephemeroptera), caddisfly larvae (Tricoptera), aquatic beetles (Coleoptera), and true bugs (Corixidae). These are rare or absent in lakes that contain introduced trout. (Knapp and Mathews 2000a). Instead, benthic macroinvertebrate communities in trout containing lakes are typically dominated by midge larvae (chironomidae), alderfly larvae (Sialis), aquatic mites (Acari), and fingernail clams (Pisidium). These are all taxa that either burrow into lake bottom sediments or are distasteful (Bradford et. al., Reimers 1958, from Knapp and Matthews 2000a)

The ability of aquatic invertebrates to recolonize after fish removal is not very well documented. In one study, brook trout were introduced into a high alpine lake in 1965 and again in 1966. They were later eliminated in 1997 using gill nets. Results showed a return of zooplankton within weeks, but some species of zooplankton were completely eliminated (Parker et al., 2001). No data is currently available to determine the rate at which benthic macroinvertebrates recolonize lakes after trout disappearance (Knapp 1996).

7.3.7 Algae

Filamentous alga develops as single cells which form long, visible chains, threads or filaments (aquaplant.tamu.edu). When the algae grow in excess, they can form dense mats which rapidly remove nutrients from the water, killing off other organisms. Large algae blooms can be associated with human disturbance, particularly downstream of dams and other flow-regulated water. During the summer months, heavy blooms of the green alga genus *Cladophora* can occur in unspecified sections of the South Yuba River and its tributary, Deer Creek (Cohen, 2001; Shilling, 2003). Additionally, the Dry Creek Conservancy has observed heavy algae growth in several areas of Coon Creek, probably associated with high nutrient loads during the summer (Dry Creek Conservancy, 2006). For Bowman Lake, Nicola and Cordone (1973) detected low concentrations of inorganic nutrients (nitrate and phosphorus) as well as the major ions (sulfate, calcium, magnesium, sodium, potassium, chloride, and TDS). Phytoplankton productivity was calculated to be low at an average of 136 milligrams carbon per meter-cubed (mg C/m^3) and 3.1 mg C/m^3 at different depths. PG&E had problems with filamentous algae in the Bear River Canal from approximately 1989 to 2003.

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7.3.8 List of Attachments

Attachments to this section on compact disk include:

- Attachment 7.3A - Preliminary River Reach Matrix (Microsoft Excel file)
- Attachment 7.3B - Preliminary Report Drum-Spaulding Project and Yuba-Bear Hydroelectric Project Habitat Mapping and Channel Characterization (Microsoft Word file) *on separate DVD*
- Attachment 7.3C – Middle and South Yuba Rainbow Trout (*Oncorhynchus mykiss*) Distribution and Abundance Dive Counts August 2004 (Adobe PDF file)

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