6.6 Fisheries

6.6 Fisheries

This section describes the warmwater and coldwater fisheries in the waters associated with the Upper North Fork Feather River Hydroelectric Project (UNFFR Project) and analyzes the effects of the operation of the UNFFR Project under a new Federal Energy Regulatory Commission (FERC) license on native, game, and special-status fish and their habitat. The environmental setting section of this chapter is largely excerpted from FERC's *Final Environmental Impact Statement (EIS) for the Upper North Fork Feather River Project* that was completed in 2005, with additional information summarized from the *Evaluation of the Biological Performance of Potential Alternatives to Improve Compliance with Temperature Objectives of the Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, which was prepared to support this Environmental Impact Report (EIR) and is included as Appendix F.

The following topic is not discussed in this section for the reason noted:

- **Local Plans or Policies for Fisheries:** No watershed-specific habitat conservation plans or fishery management plans have been adopted for fisheries in the UNFFR Project vicinity.

6.6.1 Environmental Setting

Overview of Aquatic Habitat and Fisheries in the Watershed

Aquatic Habitat

The main waters associated with the UNFFR Project include Lake Almanor, Butt Valley reservoir, Belden forebay, North Fork Feather River, and Butt Creek (see Figure 3-1 for geographic setting and Figure 3-2 for hydrologic relationships).

The UNFFR Project waters support warmwater and coldwater fisheries, with Lake Almanor supporting both types of fisheries and the other UNFFR Project waters supporting primarily coldwater fisheries. The North Fork Feather River historically was dominated by coldwater fishes, including the Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), which is listed under the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA); Central Valley steelhead (*O. mykiss irideus*, the anadromous form of rainbow trout), which is listed under the federal ESA; and Central Valley fall-run Chinook salmon, which is a federal species of concern. Man-made alterations to the North Fork Feather River, however, have created barriers to both upstream and downstream migration of anadromous fish (Yoshiyama et al. 2001). Therefore, anadromous fish no longer inhabit the North Fork Feather River.

The first human influences on fish habitat, including fish migration barriers in the Feather River basin, were likely associated with mining operations. Hydraulic mining altered the river's geomorphic and hydrologic processes, resulting in dewatered river beds, increased sediment loading, and physical alteration of gravel and cobble streambeds, all of which likely affected salmon populations. The construction of Big Bend dam in 1910 upstream of present-day Lake Oroville probably blocked most migratory fish from accessing the North Fork Feather River and its tributaries. Additional migratory barriers in the upper Feather River were created by the construction of Canyon dam in 1914, a second dam that replaced it in 1927, Rock Creek dam in 1950, Cresta dam in 1950, Poe dam in 1958, and Oroville dam in 1963.

The alterations in physical habitat caused by the construction and operation of the hydropower diversion dams, inundation of the river channel behind the dams, and alteration of streamflows, including effects on the river's water temperature regime, have long been identified as important factors limiting the coldwater fishery of the North Fork Feather River (Wales and Hanson 1952, Pacific Gas and Electric Company 1979, Moyle et al. 1983, Wixom 1989). Changes in the relative diversity, abundance, and distribution of native coldwater species in the river are attributable to these physical habitat alterations as well as other watershed factors, including changes in flow and temperature regimes, sedimentation, hydromodification, and introduction of non-native species.

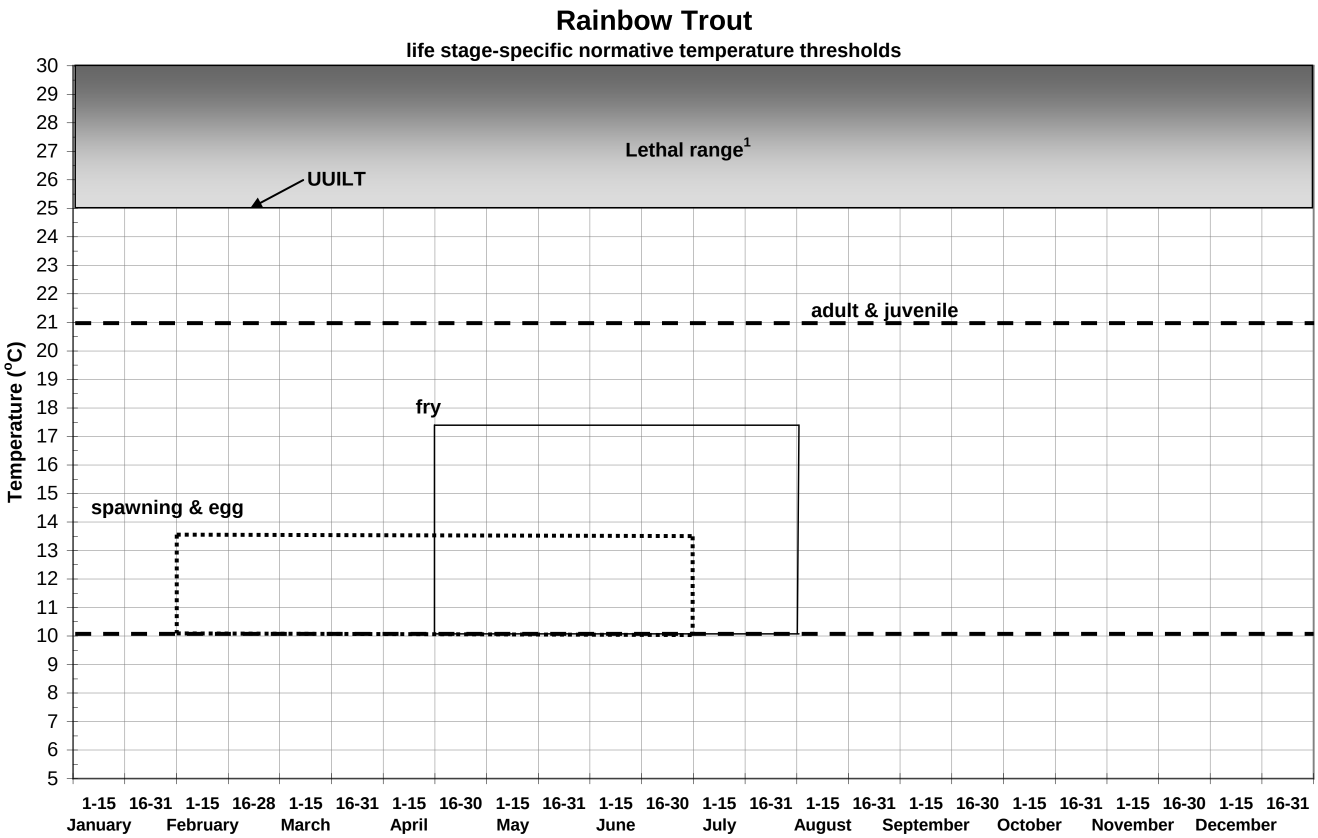
The adverse impacts of water temperature impairment to the cold freshwater fishery were noted to become progressively more significant downstream of the UNFFR Project through the Rock Creek–Cresta and Poe hydroelectric project reaches, where summer maximum water temperatures are highest (State Water Resources Control Board 2006). As a result of historic and current uses, the beneficial uses of the North Fork Feather River, as designated in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (Basin Plan) (Central Valley Regional Water Quality Control Board 2011) include cold freshwater habitat, spawning and rearing habitat for coldwater fisheries, and water-dependent wildlife habitat (see Table 2-1). For water quality management purposes, these aquatic life uses represent important and valued resources supported by the North Fork Feather River, the characteristics and qualities of which are sensitive to water quality degradation. Coldwater fish habitat, particularly for salmonids, represents the beneficial use most sensitive to water temperature.

Habitat for coldwater stream fishes consists of the physical, chemical, and biological constituents of the stream and adjacent riparian areas that provide for feeding, sheltering, behavioral interactions, reproduction, rearing, and in-river migrations (Bjornn and Reiser 1991, Griffith 1999, McCullough 1999, Moyle 2002). Water quality affects the physical and chemical aspects of aquatic habitat for fish and aquatic invertebrates. Of the many constituents of water quality, water temperature is one of the most important factors determining the geographic distributions, productivity, and survival of fish and aquatic invertebrates (Gerking 1980, Cech et al. 1990, Vannote and Sweeny 1980, Ward and Sanford 1982, Hawkins et al. 1997).

For coldwater fishes, especially trout and salmon, the timing of reproductive cycles is closely correlated with seasonal water temperature patterns. Thermal tolerances and physiological optimum ranges for growth and survival vary over a species' life cycle. Fish species are partially dependent on an individual's cumulative thermal exposure history and nutrition and health status, but generally are bounded by ultimate lethal maximum and minimum temperatures (Brett 1952, Armour 1991, Myrick and Cech 2000). The lethal and optimal temperature ranges vary by species, life stage, genetic characteristics, nutritional and health status, ecological conditions, and the timing and duration of temperature exposure (Brett 1952, Myrick 1998, McCullough 1999, Cech and Myrick 1999, Railsback and Rose 1999, Myrick and Cech 2000, Sullivan et al. 2000).

Coldwater salmonids are considered a sensitive aquatic life species with regard to water temperatures and are a general indicator species of good water quality and aquatic habitat condition (McCullough 1999, Sullivan et al. 2000). Based on information found in Wixom (1989), juvenile and non-spawning adult life stages of the rainbow trout are considered the most important life stages for evaluating the sensitivity of coldwater fishes in the North Fork Feather River during the summer (refer to Appendix F for additional details). Key temperature thresholds above which some level of physiological impairment can occur are generally found to occur over a temperature range of from 18°C to 21ºC for rainbow trout for chronic exposures, typically measured as the daily mean temperature over a time frame of one week or more (Hokanson et al. 1977, Wurtsbaugh and Davis 1977, Bell 1990, McCullough 1999, Myrick and Cech 2000, Sullivan et al. 2000, McCullough et al. 2001). Figure 6.6-1 displays the temperature range for rainbow trout lifecycles in streams draining the west slope of the Sierra Nevada, based on published temperature data (Leitritz and Lewis 1976, Piper et al. 1982, Wixom 1989, Bell 1990, Bjornn and Reiser 1991, McCullough 1999, Myrick and Cech 2000a, Moyle 2002). Aquatic habitat is considered suitable for trout and other coldwater fishes if water temperatures do not regularly exceed 20ºC and dissolved oxygen (DO) content is at least 80 percent of saturation with a concentration of at least 5 milligrams per liter (mg/L) (Bjornn and Reiser 1991).

Figure 6.6-1. Typical Life Cycle Timing For Rainbow Trout in Streams Draining the West Slope of the Sierra Nevada



1 Range between ultimate upper incipient lethal temperature and critical thermal maximum
Sources: Moyle 2002; Bjornn and Reiser 1991; U.S. Environmental Protection Agency 1999; Myrick 1998; Myrick and Cech 2000

Fish Community

The North Fork Feather River watershed supports a diverse assemblage of native and nonnative fish species, many of which provide a forage base for game fish and avian predators (Table 6.6-1). The coldwater fishery in the Seneca and Belden reaches is dominated by rainbow trout. The rainbow trout population depends on adequate year-round instream flows, suitable water temperatures, suitable spawning gravels, and access to tributaries that provide high-quality spawning areas and juvenile rearing habitat. Hardhead (*Mylopharodon conocephalus*) and Sacramento perch (*Archoplites interruptus*) are both special-status fish species in California that are known to occur in UNFFR Project waters. Introduced fish species, such as smallmouth bass (*Micropterus dolomieui*), largemouth bass (*Micropterus salmoides*), wakasagi (Japanese pond smelt) (*Hypomesus nipponensis*), and brown trout (*Salmo trutta*), have exploited the lentic environment of the reservoirs associated with the UNFFR Project, establishing self-sustaining populations (Pacific Gas and Electric Company 2002).

The historical fish community of the North Fork Feather River likely included anadromous spring and fall runs of Chinook salmon (Yoshiyama et al. 2001). Steelhead (*Oncorhynchus mykiss*), the anadromous form of rainbow trout, may have occurred as far upstream as the UNFFR Project reaches, but the actual extent of their original range is uncertain (Pacific Gas and Electric Company 2002). Although the majority of anadromous salmon may have been blocked by a set of naturally occurring falls near the town of Seneca, reports exist of salmon ascending the entire length of the North Fork Feather River through the area now inundated by Lake Almanor and into surrounding tributary streams (Yoshiyama et al. 2001).

Table 6.6-1. Fish Species Documented in the Upper North Fork Feather River and Reservoirs

COMMON NAME	SCIENTIFIC NAME	GAME/NON-GAME
Native Species		
Rainbow trout	*Oncorhynchus mykiss*	Game
Sacramento perch	*Archoplites interruptus*	Game
Sacramento sucker	*Catostomus occidentalis*	Non-game
Tahoe sucker	*Catostomus tahoeensis*	Non-game
Sacramento pikeminnow	*Ptychocheilus grandis*	Non-game
Tui chub	*Gila bicolor*	Non-game
Baird sculpin*	*Cottus bairdii*	Non-game
Riffle sculpin	*Cottus gulosus*	Non-game
Prickly sculpin	*Cottus asper*	Non-game
Hardhead	*Mylopharodon conocephalus*	Non-game
Hitch	*Lavinia exilicauda*	Non-game
Introduced Species		
Brown trout	*Salmo trutta*	Game
Brook trout*	*Salvelinus fontinalis*	Game
Chinook salmon	*Oncorhynchus tshawytscha*	Game
Kokanee salmon	*Oncorhynchus nerka*	Game
Silver salmon*	*Oncorhynchus kisutch*	Game
Chum salmon*	*Oncorhynchus keta*	Game
Smallmouth bass	*Micropterus dolomieui*	Game
Largemouth bass	*Micropterus salmoides*	Game
Bluegill*	*Lepomis macrochirus*	Game
Green sunfish	*Lepomis cyanellus*	Game
Redear sunfish	*Lepomis microlophus*	Game
Brown bullhead	*Amerius nebulosus*	Game
Channel catfish	*Amerius punctatus*	Game
Wakasagi (Japanese pond smelt)	*Hypomesus nipponensis*	Non-game
Carp	*Cyprinus carpio*	Non-game
Lahontan redside*	*Richardsonius etregius*	Non-game

Source: Pacific Gas and Electric Company 2002

*Species reported by the California Department of Fish and Game (1962) to be in Lake Almanor, but may no longer be present.

Aquatic Habitat and Fisheries in UNFFR Project Reservoirs

Lake Almanor

At normal maximum pool— about 4,500 feet (PG&E datum) above mean sea level—Lake Almanor stores approximately 1,142,000 acre-feet (AF) of water, with an average depth of about 40 feet and a maximum surface area of 26,275 acres (California Department of Water Resources 1974, Jones and Stokes 2004, Stetson Engineers 2009). Lake Almanor generally reaches its highest seasonal elevation around the end of May and declines through the summer as water is released for hydroelectric generation (California Department of Water Resources 1974, Gast 2004). Lake Almanor stratifies during the summer months, forming a warm surface layer (epilimnion) and colder bottom layer (hypolimnion), usually beginning in mid-May, with a deepening of the epilimnion and maximum heat storage achieved around mid-August (California Department of Water Resources 1974, Stetson Engineers Inc. 2009). Thermal stratification begins to break down with cooling nighttime temperatures during September, and the temperature profile of Lake Almanor becomes nearly uniform in the fall months (Jones and Stokes 2004, Stetson Engineers 2009). During thermal stratification, DO concentrations in the hypolimnion can decline to near zero in the deepest portions of the lake, especially in the vicinity of Canyon dam (California Department of Water Resources 1974, Jones and Stokes 2004, Stetson Engineers Inc. 2009).

Suitable physical habitat in Lake Almanor for both warmwater and coldwater fish varies throughout the year. During most of the year, water temperatures and DO levels are within normative ranges for coldwater fish (California Department of Water Resources 1974). Suitable conditions exist for reproduction of warmwater fish within the epilimnion along littoral (near-shore) zones of the lake when surface water temperatures warm during the spring and summer months. In fact, smallmouth bass, considered a warmwater species, dominated fish samples in the littoral zone of the lake during PG&E's relicensing studies in August 2000 (Pacific Gas and Electric Company 2002). During the peak of the summer, high water temperatures may limit trout distributions in the epilimnion and low DO may limit their distribution in the hypolimnion, effectively restricting the zone of suitable temperature and DO to the narrow band between the epilimnion and hypolimnion of large lakes (Olson et al. 1988, Rowe and Chisnall 1995, Baldwin et al. 2002, Barwick et al. 2004). Lake Almanor's large underwater springs have also been anecdotally reported to be localities where trout and salmon may congregate during the summer, when coldwater habitat is limited. However, it is not known what portion of the lake's coldwater fish population may use these spring areas as a thermal refuge (Gast 2004).

Lake Almanor supports popular coldwater and warmwater fisheries (Pacific Gas and Electric Company 2002, Gast 2004, Central Valley Regional Water Quality Control Board 2011). Thirteen species of fish were identified in Lake Almanor during surveys conducted by PG&E between 1996 and 2002. Primary game fish occurring in the reservoir include rainbow trout, brown trout, Chinook salmon, smallmouth bass, and largemouth bass. Since 1933, the California Department of Fish and Wildlife (CDFW; formerly known as the California Department of Fish and Game) has stocked a variety of game and panfish in the reservoir to supplement the sport fishery. A creel survey conducted by PG&E in 2000 revealed that the angler catch is dominated by rainbow trout and smallmouth bass, collectively consisting of 93 percent of the total recorded catch of participating anglers (EA Engineering, Science, and Technology, Inc. 2001). The primary warmwater fishery is for smallmouth bass and largemouth bass (Pacific Gas and Electric Company 2002). These warmwater sport fishes were first introduced in the 1950s and 1960s to diversify the fishery and as an attempt to compensate for the largely unsuccessful effort at that time to revitalize a robust trout fishery through stocking (California Department of Water Resources 1974).

Since the raising of Canyon dam in 1927, coldwater fishery management has been challenged by balancing reservoir operations; competition with non-game species, such as carp (*Cyprinus carpio*); and selecting and balancing compatible populations of forage fish with salmonid species (California Department of Water Resources 1974). Thermal stratification, along with the warm surface temperatures and associated effects on DO profiles during the summer, has long been thought to be a limiting factor for the coldwater fishery in Lake Almanor (California Department of Water Resources 1974, Gast 2004). However, no mention of historic observations of mass fish die-offs during the summer was found in information in the FERC application or by inquiry to CDFW reservoir biologists. Additionally, no studies or data on seasonal fish distributions and other factors that may be limiting coldwater fish in the lake were revealed through inquiry to CDFW reservoir biologists. Currently, the coldwater fishery includes Eagle Lake-strain rainbow trout, brown trout (*Salmo trutta*), and Chinook salmon (*Oncorhynchus tshawytscha*), which are all stocked in Lake Almanor by CDFW and a non-profit sportfishing association to supplement natural production in tributary streams and springs, which is not sufficient by itself to support the reservoir fishery (Pacific Gas and Electric Company 2002, Gast 2004;). The Eagle Lake-strain rainbow trout used for this stocking program are derived from a trout strain that evolved in nearby Eagle Lake (Lassen County). The Eagle Lake-strain rainbow trout is known for its tolerance of high alkalinity (Moyle 2002) and warm temperatures up to 22°C, while maintaining normal feeding, metabolism, and growth patterns (see Appendix F and Myrick and Cech 2000). Annual stocking of catchable and sub-catchable trout and fingerling salmon in combination has ranged from 150,340 to 323,500 since 2001 (Table 6.6-2).

Wakasagi, which were introduced in the early 1970s, provide an important forage base for piscivorous (fish-eating) fish in Lake Almanor. This species tends to aggregate at or below the thermocline in Lake Oroville, and it is likely that a similar behavioral pattern occurs in Lake Almanor (Hydroacoustic Technology, Inc. 2002, Lee 2005). Wakasagi become entrained in the Prattville intake and are transported to downstream reservoirs and riverine reaches, where they likely provide an important forage base for piscivorous fishes and avian predators.

Table 6.6-2. Fish Stocking Records for Lake Almanor, 2001 through 2011

SPECIES	SIZE	YEAR											TOTAL
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
Brown trout	Catchable	64,100	44,240	59,000	32,860	19,200	39,000	38,000	41,600	62,670	57,195	30,400	**488,265**
	Subcatchable	0	0	0	0	0	0	0	0	0	21,350	0	**21,350**
	Fingerling	0	0	0	0	0	0	0	0	0	0	0	**0**
	Subtotal	**64,100**	**44,240**	**59,000**	**32,860**	**19,200**	**39,000**	**38,000**	**41,600**	**62,670**	**78,545**	**30,400**	**509,615**
Chinook salmon	Catchable	0	0	0	0	0	0	0	0	0	0	0	**0**
	Subcatchable	0	0	0	0	0	0	0	0	0	0	0	**0**
	Fingerling	163,800	100,008	0	176,100	60,420	43,560	60,270	59,994	33,792	60,000	65,030	**822,974**
	Subtotal	**163,800**	**100,008**	**0**	**176,100**	**60,420**	**43,560**	**60,270**	**59,994**	**33,792**	**60,000**	**65,030**	**822,974**
Eagle Lake rainbow trout	Catchable	95,600	36,400	40,055	55,460	70,800	35,400	56,100	65,960	54,690	57,750	52,400	**620,615**
	Subcatchable	0	50,556	36,875	49,781	50,295	50,229	49,992	50,400	49,970	49,979	34,450	**472,527**
	Fingerling	0	0	14,410	0	0	0	0	0	0	0	0	**14,410**
	Subtotal	**95,600**	**86,956**	**91,340**	**105,241**	**121,095**	**85,629**	**106,092**	**116,360**	**104,660**	**107,729**	**86,850**	**1,107,552**
Rainbow trout (var)	Catchable	0	0	0	0	0	0	0	0	0	24,047	0	**24,047**
	Subcatchable	0	0	0	0	0	0	0	0	0	0	0	**0**
	Fingerling	0	0	0	0	0	0	0	0	0	0	0	**0**
	Subtotal										**24,047**		**24,047**
TOTAL		**323,500**	**231,204**	**150,340**	**314,201**	**200,715**	**168,189**	**204,362**	**217,954**	**201,122**	**270,321**	**182,280**	**2,464,188**

Source: Linda Radford, California Department of Fish and Wildlife, Statewide Hatchery Database – Provisional data, which are subject to change.

Butt Valley Reservoir

Butt Valley reservoir is 4.75 miles long and an average of 0.75 mile wide and has a maximum depth of about 50 feet. The maximum surface area of the reservoir is 1,600 acres. Under normal operating conditions, Butt Valley reservoir can fluctuate about ±1 foot per day and ±3 to 5 feet weekly during the summer months, and has an annual varial zone of about 10 feet. The reservoir is thermally stratified during early summer, with temperatures near 20°C at the surface and less than 12°C at depths of 20 feet or more (Pacific Gas and Electric Company 2002). The duration of thermal stratification is influenced by the operation of the Caribou No. 1 unit (a deeper intake unit that drafts colder water). Due to use of Caribou No. 1 early in the summer, by mid-July and August, the volume of cold water in Butt Valley reservoir is typically at its minimum and the reservoir is weakly stratified.

Butt Valley reservoir, which receives water from Lake Almanor through the Prattville diversion, also supports coldwater and warmwater fishes (Pacific Gas and Electric Company 2002). Butt Valley reservoir provides coldwater and warmwater habitat and supports a trophy rainbow and brown trout fishery, with trout greater than 17 inches constituting a substantial portion (33 percent) of angler catch. The “trophy” trout fishery that occurs in Butt Valley reservoir is attributed to the prey base provided by wakasagi that have been entrained from Lake Almanor and discharged into Butt Valley reservoir at the Butt Valley powerhouse (Pacific Gas and Electric Company 2002). Wakasagi are also reported to reproduce in the Butt Valley powerhouse tailrace and at the mouth of Butt Creek (Lee 2005). The primary warmwater fishery is for smallmouth bass and largemouth bass (Pacific Gas and Electric Company 2002). The coldwater and warmwater fisheries are supported by natural production in the reservoir and Butt Creek and partially by entrainment through the Prattville diversion. There is no fish stocking program for Butt Valley reservoir or upper Butt Creek.

Other fish species in Butt Valley reservoir include Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento perch, Sacramento sucker (*Catostomus occidentalis*), and tui chub (*Gila bicolor*). Fish habitat diversity in the reservoir is limited, since the reservoir occupies a fairly confined valley. The lake bed of Butt Valley reservoir is composed of mud and shale, and most of the shoreline consists of shallow water with little or no aquatic vegetation. In 1996 and 1997, fish habitat enhancement structures (targeted at smallmouth bass) were constructed within the reservoir as mitigation for seismic remediation of the dam. The structures included 63 smallmouth bass cover and spawning modules in the reservoir and 25 boulder clusters grouped at three locations: (1) upper Butt Creek; (2) the powerhouse tailrace; and (3) the main body of the reservoir. The effectiveness of these habitat enhancement structures has not been investigated.

Upper Butt Creek, the only major tributary entering Butt Valley reservoir, is an unregulated stream, flowing approximately 21 miles from its headwaters to Butt Valley reservoir. Average monthly flows in upper Butt Creek range from 40 to 188 cubic feet per second (cfs), with an average annual flow of 99 cfs for water years 1970–1999. The aquatic habitat in upper Butt Creek is dominated by a boulder and cobble creek bed, with pockets of gravel that provide spawning, rearing, and foraging habitat for rainbow and brown trout. The creek has a moderate gradient with riffle-run and step-run habitat contained in a well-defined stream channel approximately 30 to 50 feet wide (Pacific Gas and Electric Company 2002).

Rainbow and brown trout are the only game fish present in upper Butt Creek; riffle sculpin (*Cottus gulosus*) and Sacramento sucker are also present. Angler harvest data revealed that 64 percent of all trout caught in upper Butt Creek were 14 inches or longer. Rainbow trout from

Butt Valley reservoir enter upper Butt Creek during early spring (March through April) to spawn, while brown trout enter and spawn in the creek during the fall (October through November). Juvenile rainbow and brown trout have both been documented in the creek during fishery surveys conducted in 2000 and 2001 in support of PG&E's relicensing efforts (ECORP Consulting Inc. 2003).

Belden Forebay

Belden forebay, with a surface area of 42 acres, is located on the North Fork Feather River downstream of the Seneca reach. The reservoir's daily water surface elevation can fluctuate between 5 and 10 feet, depending on power-generating operations. Flow into the forebay comes from the Caribou No. 1 and Caribou No. 2 powerhouses and the Seneca reach of the upper North Fork Feather River.

Fish species inhabiting Belden forebay include rainbow trout, brown trout, smallmouth bass, Sacramento sucker, and wakasagi. The presence of wakasagi is most likely due to its entrainment in the intakes of Caribou No. 1 and No. 2 powerhouses at Butt Valley reservoir. None of the fishery monitoring data, to date, suggests that wakasagi reproduce or reside in Belden forebay for prolonged periods.

Aquatic Habitat and Fisheries in North Fork Feather River

Seneca Reach of North Fork Feather River

The Seneca reach of the North Fork Feather River begins at the base of Canyon dam and extends 10.8 miles to Caribou No. 1 powerhouse at the upper end of Belden forebay. A year-round minimum flow of 35 cfs is released into this reach from Canyon dam under the current FERC license. Additional inflow occurs from lower Butt Creek, the only major tributary that enters the Seneca reach, and spring seepage occurs in the uppermost 0.5 mile of lower Butt Creek. The Seneca reach has an average stream gradient of two percent (2%), with varying aquatic habitat composed of low-gradient riffles, runs, high-gradient riffles, cascades, pools, step-runs, and pocket water. The lower 1.25 miles of the Seneca reach, from the lower Butt Creek confluence to the Caribou No. 1 powerhouse, contains a higher quality, more complex habitat than the upstream portions of the reach. The lower portion has a greater number of pools and additional flow from lower Butt Creek. The predominant fish species in the Seneca reach are riffle sculpin, rainbow trout, and prickly sculpin (*Cottus asper*) (ECORP Consulting Inc. 2003). Less abundant fish species include Sacramento sucker and brown trout. The trout population in the Seneca reach is considered to be self-sustaining, and the reach is not currently stocked with hatchery-raised fish. PG&E estimated the rainbow trout spawning density in the Seneca reach to be 128 redds per mile (Thomas R. Payne and Associates 2002). Annual recruitment appears to be high since the rainbow trout population in the Seneca reach is dominated by age 1 and younger trout (ECORP Consulting Inc. 2003).

Belden Reach of North Fork Feather River

The Belden reach of the North Fork Feather River is 9.3 miles long, extending from Belden dam to its confluence with Yellow Creek. The current minimum flow in this reach is 140 cfs from the last Saturday in April to Labor Day and 60 cfs during the rest of the year. Aquatic habitat in the upper 7-mile section of the Belden reach between Belden dam and its confluence with the East Branch of the North Fork Feather River is varied, with riffles, runs, pools, pocket water, and a 0.25- to 0.5-mile long section of split channels and shallow riffles. The lower section of the Belden reach, from the East Branch confluence to the Yellow Creek confluence, is substantially wider (150 to 200 feet) than the upper section and has a much greater volume of uncontrolled flow due to inflows from the East Branch, which is a large unregulated tributary. The habitat in this lower section of the Belden reach consists primarily of riffles, runs, and pocket water. Yellow Creek, a tributary upstream that enters the North Fork Feather River near the Belden powerhouse tailrace, is a CDFW-designated wild trout stream that contributes inflows ranging from 40 to 170 cfs from June to September.

The fish community inhabiting the Belden reach is mostly composed of riffle sculpin, rainbow trout, Sacramento sucker, and prickly sculpin. Other less abundant species include Sacramento pikeminnow and hardhead, which are United States Department of Agriculture, Forest Service (USFS) sensitive species and a California species of special concern. Angling pressure throughout the Belden reach is high due to several private and public campgrounds and easy access along Caribou Road. Rainbow trout naturally produce in the Belden reach, with spawning densities estimated at 23 redds per mile; however, this natural production is insufficient to meet angling demand. To increase angling opportunities, CDFW annually stocks the Belden reach with hatchery-raised rainbow trout. The Belden reach of the North Fork Feather River has undergone a State-required pre-stocking evaluation protocol and has been approved for stocking of catchable-sized rainbow trout (California Department of Fish and Wildlife 2012).

The Gansner Bar fish barrier is located on the Belden reach about 0.2 river mile upstream of its confluence with the East Branch of the North Fork Feather River. The Gansner fish barrier is a five-foot-high concrete-topped gabion rock barrier that extends across the river. The barrier was constructed in 1975 by PG&E at the request of CDFW. PG&E is responsible for maintaining the structure. The barrier was designed to prevent upstream migration and spawning of Sacramento sucker and other non-game fish species in the North Fork Feather River above this point. In 1971, prior to the construction of the barrier, CDFW chemically treated the Belden reach from Belden dam to the East Branch confluence, which killed approximately 46,000 pounds of suckers and 300 to 500 pounds of rainbow trout. Following the treatment, CDFW restocked the Belden reach with 483 rainbow trout that had been removed by electrofishing prior to the treatment and 10,000 hatchery-reared sub-catchable rainbow trout. The chemical treatment and the construction of the Gansner Bar fish barrier have been ineffective in completely removing the non-game fish from the Belden reach. Additionally, during several site visits in spring 2001, PG&E staff observed a number of rainbow trout repeatedly attempting to jump over the barrier without success (Pacific Gas and Electric Company 2002). The removal of this barrier would allow rainbow trout and other fish species in the lower Belden reach and Rock Creek reservoir to access and use the habitat in the upper areas of the Belden reach.

Downstream of Belden Powerhouse

Three additional hydropower diversion dams, features of the Rock Creek–Cresta and Poe hydroelectric projects, occur on the North Fork Feather River downstream from the Belden powerhouse, creating three sequential regulating forebay reservoirs and riverine bypass reaches (Pacific Gas and Electric Company 2005). The Rock Creek–Cresta bypass reaches are confined channels with a 1.2 to 2.2 percent gradient and many bedrock-formed, slow-flowing deep pools connected by relatively short riffles and runs (Federal Energy Regulatory Commission 2001, Allen and Gast 2007). The river bed is dominated by boulders and cobbles in these reaches. Finer substrates, including suitable spawning-sized gravels, are generally limited to gravel deposits on tributary deltas and behind large boulders. Due to the limited trout spawning habitat in these reaches of the North Fork Feather River, the coldwater fishery is heavily dependent on tributary streams for trout reproduction and recruitment (Wixom 1989). The Poe bypass reach, downstream of the Rock Creek–Cresta reaches, is characterized as a wide channel with a relatively low gradient; it has a narrow, steep canyon dominated by bedrock canyon walls and large boulders just above Bardee's Bar (Federal Energy Regulatory Commission 2006).

Fish species diversity in the North Fork Feather River downstream of Belden powerhouse is similar to that of the Seneca and Belden reaches, with increasing proportions of warmwater and warmwater-tolerant fishes. This longitudinal shift in fish assemblage is typical for west slope Sierra Nevada streams in the Central Valley zoogeographic sub-province (Moyle 2002, Allen and Gast 2007). However, the creation of the reservoirs, along with flow reduction in the bypassed reaches and increased water temperatures, changed the North Fork Feather River's aquatic habitat to favor the nongame species rather than trout (U.S. Fish and Wildlife Service 1962, Moyle et al. 1983, Pacific Gas and Electric Company 1979 as cited in Federal Energy Regulatory Commission 2001). Before construction of the Rock Creek–Cresta Project in 1950, an excellent sport fishery for rainbow trout and brown trout existed in the North Fork Feather River reach that is now bounded by the Rock Creek development. The rainbow trout fishery was considered to be of "trophy" stature (Hazel et al. 1976 as cited in Federal Energy Regulatory Commission 2001).

Contemporary fish surveys indicate that the dominant fish species observed in the Rock Creek and Cresta reaches of the North Fork Feather River during 2006 included rainbow trout, hardhead, Sacramento pikeminnow, largemouth and smallmouth bass, and Sacramento sucker. Ten species of fish are known to occur in the Poe reach, including those listed for the Rock Creek–Cresta reaches and riffle sculpin, speckled dace (*Rhinichthys osculus*), brown trout, and common carp. The Rock Creek and Cresta forebays include those species listed for the Rock–Cresta reaches, but also include wakasagi and brown bullhead catfish (*Ameiurus nebulosus*). Native minnow and sucker were the dominant fish species in these reservoirs, with rainbow trout constituting less than two percent (2%) of the catch (Li and Enplan 1994).

Special-Status Fish Species

The hardhead and Sacramento perch, which both occur in water bodies associated with the UNFFR Project, are designated as USFS sensitive species and California species of special concern. Other regional special-status species, such as Central Valley steelhead and Central Valley spring-run Chinook salmon, historically occurred in the North Fork Feather River; however, their present distribution is limited to the Feather River downstream of Oroville Dam, which prevents the upstream migration of all migratory fishes (Federal Energy Regulatory Commission 2001, National Marine Fisheries Service 2009).

Hardhead

Hardhead was documented in the tailrace of the Belden powerhouse during an entrainment study conducted on behalf of PG&E (ECORP Consulting Inc. 2003) and may occur in the lower portion of the Belden reach up to the Gansner Bar fish barrier (Pacific Gas and Electric Company 2002). This fish is an omnivorous species that feeds on plankton, aquatic plants, and invertebrates. Hardhead are typically most abundant in larger, middle- and low-elevation, well-oxygenated stream reaches, where summer temperatures typically exceed 20°C (Moyle 2002). The fish requires clear, deep pools in undisturbed perennial channels. Hardhead can colonize reservoirs, but persist only if exotic species, especially centrarchid (sunfish) basses, are not present. Hardhead have not been documented above the Belden powerhouse, and entrainment of this species by UNFFR Project facilities is not expected to be an issue (ECORP Consulting Inc. 2003).

Sacramento Perch

Sacramento perch, the only centrarchid native to California, is known to occur in the North Fork Feather River above Belden powerhouse. Historically, Sacramento perch were widespread in the Sacramento, San Joaquin, Pajaro, and Salinas rivers and in Clear Lake (Lake County), but it has been extirpated from most of its historic range (Moyle 2002). Today, Sacramento perch are restricted to farm ponds or reservoirs, where they have been introduced. Preferred habitat consists of beds of rooted and emergent aquatic plants in the shallow littoral zones, which are critical for food and cover for juveniles. The species was introduced by an unknown source into the North Fork Feather River and was most recently documented in Lake Almanor in 2000 and in Butt Valley reservoir between 1996 and 1998. This species is not expected to be entrained by UNFFR Project facilities because of its habitat preferences and the lack of suitable habitat around the intake structures in Lake Almanor and Butt Valley reservoir (ECORP Consulting Inc. 2003).

6.6.2 Environmental Impacts and Mitigation Measures

Methodology

Impacts on fisheries were analyzed using a combination of quantitative and qualitative methods and professional judgment. Studies prepared for PG&E in support of its relicensing application were used to establish the baseline conditions for the discussion of the environmental setting and to characterize the warmwater and coldwater fisheries of the UNFFR Project waters, including the presence of special-status fish species. Additional literature and studies were used to supplement the information from PG&E.

The analysis of environmental impacts is based on the Final FERC EIS, as well as a technical study (North State Resources, Inc. 2012) that evaluates the anticipated water quality and fisheries impacts of the various combinations of water quality measures considered in Stetson Engineers' (2009) *Level 3 Report: Analysis of Temperature Control Alternatives Advanced from Level 2 Designed to Meet Water Quality Requirements and Protect Cold Freshwater Habitat Along the North Fork Feather River* (Appendix E, Level 3 Report). The North State Resources, Inc. (2012) study, included as Appendix F to this EIR, provides additional detail on the methodology used to analyze impacts and assumptions used in the analysis. In summary, the study considered how water temperatures and DO levels would change with implementation of the various alternatives and what the resulting effect would be on coldwater habitat. The study focused on changes in the frequency and duration of exceedances of critical chronic and acute upper temperature tolerances and requirements of non-spawning adult and juvenile rainbow trout during the period of maximum summer water temperatures. The results of the North State Resources, Inc. (2012) analysis were compared to the supplemental modeling of Alternatives 1 and 2 to determine the range of impacts on fisheries resources discussed in this EIR.

For the purposes of this fisheries resource impact analysis, the methodology for assessing impacts to cold and warm freshwater habitat is described in Section 6.5, Water Quality, and supported by the supplemental modeling in Appendix E1 and detailed analysis included in Appendix F. As described in Section 6.5, the most suitable summer coldwater refugial habitat in UNFFR Project reservoirs was defined as water with temperatures lower than 20ºC and DO levels greater than 5 mg/L. Additionally, 21º and 22ºC were selected as secondary thermal refuge criteria for this evaluation because suitable habitat meeting the 20°C primary criteria and containing sufficient DO can be absent at times in Lake Almanor even under the baseline conditions (Jones and Stokes 2004). The spatial limits of the analysis encompass the activity areas and immediate vicinity with respect to construction impacts and the North Fork Feather River system from Lake Almanor to the Poe reach with respect to operational impacts.

Thresholds of Significance

Impacts on fisheries would be significant if the Proposed UNFFR Project, Alternative 1, or Alternative 2 would:

- substantially affect, either by direct take or through habitat degradation (e.g., adverse changes in flow or deterioration of water quality), a special-status fish species;
- substantially interfere with the movement of any resident or migratory fish species;
- cause a fish population to drop below self-sustaining levels; or
- substantially affect native or introduced fish species, resulting in a reduction in the quality of the recreational fishery provided by Lake Almanor, Butt Valley reservoir, and the North Fork Feather River.

Impacts and Mitigation Measures

This section discusses the anticipated impacts of the Proposed UNFFR Project and each alternative on special-status fish and the recreational fishery in the North Fork Feather River and identifies mitigation measures for significant impacts. Table 6.6-3 compares the final level of significance of each impact (with incorporation of mitigation measures, if appropriate) associated with the Proposed UNFFR Project and the two alternatives.

Table 6.6-3. Summary of Fishery (FS) Impacts

IMPACT	PROPOSED UNFFR PROJECT	ALTERNATIVE 1	ALTERNATIVE 2
Impact FS-1: Construction activities associated with the UNFFR Project would affect fish populations in Lake Almanor, Butt Valley reservoir, and the North Fork Feather River through direct and indirect impacts on individuals or habitat.	Less than significant with mitigation	Less than significant with mitigation	Less than significant with mitigation
Impact FS-2: Implementation of the UNFFR Project would alter aquatic habitat conditions in Lake Almanor.	Less than significant	Less than significant with mitigation	Less than significant with mitigation
Impact FS-3: Implementation of the UNFFR Project would alter aquatic habitat conditions in Butt Valley reservoir.	Less than significant	Less than significant (beneficial)	Less than significant (beneficial)
Impact FS-4: Implementation of the UNFFR Project would alter cold freshwater habitat conditions in the North Fork Feather River over the long term.	Less than significant	Less than significant (beneficial)	No impact (beneficial)
Impact FS-5: Implementation of the UNFFR Project would adversely affect the recreational fishery of Butt Valley reservoir as a result of reduced forage fish in the reservoir.	Less than significant	Less than significant	Less than significant

Impact FS-1: Construction activities associated with the UNFFR Project would affect fish populations in Lake Almanor, Butt Valley reservoir, and the North Fork Feather River through direct and indirect impacts on individuals or habitat.

Proposed UNFFR Project

Pages 3-222 to 3-239 of Section 3.3.5 of the Final FERC EIS contain descriptions of the 30 recreational facilities and improvements to be implemented under the Proposed UNFFR Project. These descriptions, without FERC's environmental effects analysis, are hereby incorporated into this EIR by reference. The 30 recreational facilities and improvements make up the majority of the construction activities associated with the Proposed UNFFR Project; most of these are outside the three activity areas. The construction activities associated with these recreational facilities and improvements will be located near Lake Almanor, Butt Valley reservoir, and various reaches of the North Fork Feather River. The amount of detail provided for each of these proposed recreational facilities or improvements is insufficient to allow for the accurate assessment of environmental impacts. In reviewing these proposals, the State Water Board must be conservative in making its determination in order to ensure the continued protection of water quality objectives and designated beneficial uses.

In addition to these recreational facilities and improvements, PG&E has also proposed the removal of the Gansner Bar fish barrier and possibly the NF-9 gage weir as part of the Proposed UNFFR Project. The Gansner Bar fish barrier is located in the Belden reach of the North Fork Feather River approximately 0.2 miles upstream of the confluence with the East Branch of the North Fork Feather River. The NF-9 gage weir is located in lower Butt Creek between Butt Valley dam and the creek's confluence with the North Fork Feather River. PG&E proposed the removal of the Gansner Bar fish barrier as a condition of a new FERC license. A monitoring plan will be developed, in consultation with the CDFW, the State Water Board, USFS, and United States Fish and Wildlife Service, to determine if the NF-9 gage weir blocks fish passage. If the monitoring efforts determine that the NF-9 gage weir is blocking fish passage, PG&E has agreed to remove or modify it in order to provide passage. The amount of detail provided for each of these proposed construction activities is insufficient to allow for the accurate assessment of environmental impacts. As previously stated, the State Water Board must be conservative when reviewing these proposed projects in order to ensure the continued protection of water quality objectives and designated beneficial uses.

Due to the proximity of the Proposed UNFFR Project sites to the waters of Lake Almanor, Butt Valley reservoir, and the North Fork Feather River and the potential for earth-disturbing activities, the construction impacts on individual fish populations or habitat within waterbodies is considered **significant without mitigation**.

Alternatives 1 and 2

Construction activities associated with the thermal curtains at the Prattville and Caribou intakes under both Alternatives 1 and 2 and modification of the Canyon dam outlet structure under Alternative 1 only would disturb aquatic habitat and could affect fish in Lake Almanor and Butt Valley reservoir. No impacts to hardhead, a special-status species, are anticipated because the species is not known to occur above Belden powerhouse. Construction-related impacts on Sacramento perch, another special-status species, are also not anticipated because suitable habitat for this species is not present around the Prattville and Caribou intakes and the Canyon dam outlet structure where in-water construction activities would take place.

In-water construction activities for installation of the thermal curtain at Lake Almanor would be restricted to an approximately 45-acre area around the Prattville intake, including the bin walls, which would extend approximately 300 feet offshore. In-water activities for installation of the thermal curtain at Butt Valley reservoir would be restricted to an approximately 50-acre area around the Caribou intakes, including the bin walls, which would extend approximately 200 feet offshore. In-water construction activities for the thermal curtains would take place when the reservoirs are drawn down, typically from late September through April. On-land construction could occur any time of the year. It is anticipated that construction would take place over two seasons. Temporary disturbance to shallow, near-shore (littoral) lake bed habitat would occur during installation of the bin walls and thermal curtains at Lake Almanor and Butt Valley reservoir and could result in temporary increases in turbidity around the construction areas. These underwater activities could also incidentally result in direct impacts to individual fish, although most fish would be expected to disperse from the activity area at the onset of the disturbance. A small but long-term reduction in lake bed littoral habitat would also result from installation of the thermal curtains, as discussed under Impacts FS-2 and FS-3.

The bin walls would not require excavation because of the use of geotechnical grids or geotextile fabrics on the lake bed, which would minimize disturbance to lake bed habitat. They would, however, require placement of fill material into the reservoirs for the foundation, which could temporarily increase turbidity, as discussed in Section 6.5, Water Quality. The turbidity of a water body is related to the concentration of suspended solids. Suspended solids and turbidity generally do not acutely affect aquatic organisms unless they reach extremely high levels (i.e., levels of suspended solids reaching 25 mg/L) (Alabaster and Lloyd 1980). At these high levels, suspended solids can adversely affect the physiology and behavior of aquatic organisms and may suppress photosynthetic activity at the base of food webs, affecting aquatic organisms either directly or indirectly (Cordone and Kelley 1961, Iwamoto et al. 1978, Alabaster and Lloyd 1980). Based on the expected levels of disturbance during bin wall installation and the sizes of Lake Almanor and Butt Valley reservoir, a turbidity barrier is not expected to form or to impede fish migration through the construction area. Suspended sediment would not be expected to significantly affect primary production or settle on active spawning beds. As described in Chapter 4, Project Alternatives, PG&E would be required to implement appropriate management practices and other water quality measures during in-water construction activities to minimize water quality impacts. With the implementation of these measures and compliance with the water quality certification, construction-related impacts on fish or aquatic habitat during installation of the thermal curtains would be **less than significant**.

Under Alternative 1, modification of the Canyon dam outlet tower gates would be accomplished using divers and underwater construction techniques, including a barge-mounted crane and diving platform or floating walkway to install pre-fabricated steel bulkheads with built-in slide gates to the existing outlet tower. This activity would be confined to the vicinity of the outlet tower, which is located in deep water near the dam, and would not disturb lake bed littoral habitat. Fish and other aquatic organisms would be minimally disturbed by this activity, and any fish in the vicinity would likely disperse away from the area during most of the construction activities.

Spills of fuels, lubricants, and hydraulic fluids could occur on the crane barge. These materials are hazardous to aquatic life and could cause adverse effects if even small quantities were to enter the lake. As described in Chapter 4, PG&E would be required to implement appropriate management practices and other water quality measures during in-water activities to prevent and manage spills to ensure rapid and effective clean up and minimize water quality impacts. Construction activities at the Canyon dam outlet tower may affect instream flow releases and cause flow fluctuations within the Seneca reach on a short-term, intermittent basis. Such fluctuations could result in the dewatering of fish habitat, which could negatively impact fish populations. Therefore, construction-related impacts on fish during modification of the Canyon dam outlet structure have the potential to be **significant without mitigation**.

Additionally, both Alternatives 1 and 2 would also include the construction activities contained in the Proposed UNFFR Project, for which potential impacts on fish populations and habitat in Lake Almanor, Butt Valley reservoir, and downstream water bodies is considered **significant without mitigation.**

Mitigation Measures

Mitigation Measures Geology, Geomorphology, and Soils (GGS)-1: Approval of Construction Activities by the State Water Board (Turbidity and Total Suspended Solids) and Water Quality (WQ)-8: Approval of Construction Activities by the State Water Board (Hazardous Materials)

See Sections 6.2.3 and 6.5.2 for mitigation measures associated with construction activities related to the Proposed UNFFR Project and alternatives.

Mitigation Measure FS-1: Minimum instream flows at Canyon dam during construction activities

PG&E will maintain the minimum instream flow requirement of 35 cfs in the Seneca reach below Canyon dam during construction of modifications to the low level outlet. If a pump or siphon is needed to divert flows from Lake Almanor to the Seneca reach, it would be equipped with an appropriately designed fish screen to prevent small fish from being entrained in the pump or siphon system. Upon completion of construction, the minimum instream flow requirements put forth in the water quality certification will become required.

Significance after Mitigation

Implementation of Mitigation Measures GGS-1, WQ-8, and FS-2 would reduce the impact to a **less than significant** level.

Impact FS-2: Implementation of the UNFFR Project would alter aquatic habitat conditions in Lake Almanor.

Proposed UNFFR Project

Implementation of the Proposed UNFFR Project would require increased instream flow releases from Canyon dam, as outlined in the 2004 Settlement Agreement. These releases, along with an equivalent decrease in the Prattville intake diversion, have the potential to affect warmwater and coldwater habitat conditions in Lake Almanor during the period of summer thermal stratification. The effects on thermal stratification as a result of the increased withdrawal of hypolimnetic water from the Canyon dam lower gate outlet structure were described by Stetson Engineers (2009, 2012) (Appendix E, E1). Increased withdrawal of hypolimnetic water could reduce the volume of cold water in the hypolimnion and induce a small amount of movement of the hypolimnetic water. As a result, some mixing of the hypolimnion and the thermocline is expected at their interface.

Lake Almanor's thermal structure and DO profiles during the summer months are determined in large part by the thermocline. The depth of the thermocline delineates the relative amounts of habitat preferred by coldwater and warmwater aquatic species that are available during the summer. Increased withdrawals of cold, hypolimnetic water through use of the lower gates of the Canyon dam outlet would draw the depth of the thermocline downward by up to three feet during one to two weeks in late September and early October in normal and drier water years, including critical dry water years, compared with current conditions (see Appendix E1– Tables 7 and 8 and Figures 9 and 10); at other times, the depth of the thermocline would not be affected. An increase in the depth of the thermocline would result in an increase in the relative thickness of the warm epilimnion and a corresponding increase in the volume and area of Lake Almanor with water temperatures preferred by warmwater species. There would be a corresponding decrease in the volume and area of Lake Almanor with suitable cooler temperatures and sufficient DO concentrations (5 mg/L and higher) preferred by coldwater species. However, since water temperatures of the entire lake are normally below 20°C by late September, the increase in the depth of thermocline would have little effect on coldwater species.

Under all water year types, the suitable coldwater habitat volumes in Lake Almanor (i.e., water equal to or less than 20ºC with DO of 5 mg/L or greater) would be similar to current conditions. In general, Lake Almanor has the least suitable coldwater habitat volume in August under both current and Proposed UNFFR Project conditions.

In a **normal water year**, implementation of the Proposed UNFFR Project may reduce the suitable coldwater habitat volume in August by up to about 3,490 AF (7.9 percent reduction), from about 44,400 AF to 40,910 AF (see Appendix E1 **–** Table 9 and Figure 11). This change in suitable coldwater habitat in Lake Almanor would be a minor impact seasonally because of the availability of suitable coldwater habitat and because of the relatively small change in suitable coldwater habitat volume and the short duration.

In a **critically dry water year**, the lake appears to be absent of suitable coldwater habitat volume (i.e., water equal to or less than 20ºC with DO of 5 mg/L or greater) in August under both current and Proposed UNFFR Project conditions (see Appendix E1 **–** Table 12 and Figure 14). The coolest refugial habitat that would be available at such times would be restricted to water strata of 21ºC and 22ºC with DO concentrations of 5 mg/L and greater. Accordingly, the impact assessment was conducted using the marginal water temperature criterion of 21ºC. With the marginal temperature criterion of 21ºC, implementation of the Proposed UNFFR Project may reduce the marginal coldwater habitat volume in August by up to about 3,010 AF, from about 23,260 AF to 20,250 AF (12.9 percent reduction) (see Appendix E1 **–** Table 13 and Figure 15). This change in marginal coldwater habitat volume is considered a minor seasonal impact because of the availability of marginal coldwater habitat and because of the relatively small change in marginal coldwater habitat volume and the short duration.

Under all water year types, the Proposed UNFFR Project may increase the volume of suitable coldwater habitat in September and early October, although this increase may not be seen as an important benefit because the suitable coldwater habitat volume at this time is already adequate and available. On a lake-wide basis, the Proposed UNFFR Project may result in a reduction of less than one percent of suitable habitat volume relative to the total reservoir storage in some summer months.

Based on the above discussions, the impact of the Proposed UNFFR Project on aquatic habitat conditions in Lake Almanor would be **less than significant**.

Alternative 1

Installation of the bin walls and thermal curtain at the Prattville intake would result in a minor loss of lake bed littoral habitat. At Lake Almanor, available fish habitat maps do not indicate the presence of concentrated spawning habitat for warmwater fish at the location of the Prattville intake, and the bin walls and curtain would not be expected to result in a significant loss of suitable spawning habitat. Modification of the Canyon dam outlet structure would not affect lake bed habitat in Lake Almanor.

Operation of a thermal curtain at the Prattville intake and increased water releases through Canyon dam of up to 250 cfs from mid-June through mid-September, with an equivalent decrease in the Prattville intake diversion, would affect warmwater and coldwater habitat conditions in Lake Almanor during the period of summer thermal stratification. The effects on thermal stratification as a result of the withdrawal of hypolimnetic water, both from the Prattville intake with use of a thermal curtain and from the Canyon dam low-level outlet structure once it is modified to allow flows of up to 250 cfs, were described by Stetson Engineers (2009). Increased withdrawal of hypolimnetic water would reduce the volume of cold water in the hypolimnion, much of which is not effective habitat in the late summer because of low DO levels. It would also simultaneously induce a small amount of movement of the hypolimnetic water, resulting in some mixing of the hypolimnion and thermocline water strata at their interface. This, in turn, would increase the depth of the thermocline and DO levels in upper portions of the hypolimnion.

Lake Almanor's thermal structure and DO profiles during the summer months are determined in large part by the thermocline. The thermocline delineates the relative amounts of warmwater and coldwater habitat available during the summer. Increased withdrawals of cold, hypolimnetic water that would occur through use of a thermal curtain and lower elevation gates on Canyon dam would cause the depth of the thermocline to increase by up to three feet during two to four weeks from July through August, when coldwater habitat can be limiting, in normal and drier water years, compared with current conditions (see Appendices E, E1, and F for details).

An increase in the depth of the thermocline periodically during July and August would increase the relative thickness of the warm epilimnion and effectively increase the area of littoral habitat, with temperatures preferred by warmwater fish. Smallmouth and largemouth bass, the predominant warmwater species in Lake Almanor, typically spawn before mid-July; therefore, the primary effect of an increased thermocline depth would be a transient and modest increase in preferred temperature habitat for rearing and foraging, but not for spawning, of warmwater fishes. Warmwater rearing and foraging habitat has not been identified as limiting in Lake Almanor, and the resulting change in the epilimnetic habitat area at this time of year for warmwater species is not expected to substantively affect their populations. Therefore, the effects on warmwater habitat would be **less than significant**.

In a normal water year, suitable coldwater habitat volumes (i.e., water equal to or less than 20ºC with DO of 5 mg/L or greater) would be similar to current conditions, except for about a two-week period in mid-August, when the volume of coldwater habitat would decrease by up to 10,420 AF from a total current habitat volume of about 44,400 AF to 33,980 AF (23.5 percent reduction) (Appendix E1– Table 9 and Figure 11). On a lake-wide basis, the percentage of the lake's total volume suitable for coldwater habitat would be reduced from 5 percent to 4 percent of the total lake volume in the worst case. During the same period, the ratio of metalimnion surface area (the area at the top of the thermocline, a thermal feature where trout tend to congregate during the summer) to total lake surface area would decline by up to five percent from a current ratio of about 63 percent to 58 percent between mid-July and mid-August (Appendix E1 – Table 15 and Figure 17). These changes in suitable coldwater thermal refugia would be considered minor seasonal impacts during a normal water year because of the large pool of suitable coldwater habitat that is available. These changes in suitable coldwater habitat volume and area and the duration of these changes would be **less than significant**.

In a critically dry water year, the most suitable coldwater refugial habitat volume (i.e., water equal to or less than 20ºC with DO of 5 mg/L or greater) would continue to become severely limited by mid-July and decline to zero during much of August, which is the same as under current conditions (Appendix E1 – Table 12 and Figure 14). The coolest refugial habitat that would be available at such times would be restricted to water strata ranging in temperature from just above 20ºC to 22ºC with DO concentrations of 5 mg/L and greater. The volume of the remaining thermal refugial habitat under Alternative 1 would be similar to the current condition, except in late August, when the thermal refugia water volume with temperatures less than 21°C would be reduced by 11,530 AF from 23,260 AF to 11,730 AF (a 49.6 percent reduction) (Appendix E1–Tables 13 and 14 and Figures 15 and 16). On a lake-wide basis, the percentage of the lake's volume with suitable (<20°C) coldwater refugia habitat would be reduced from 6 percent to 5 percent during mid-July, and the percentage of coolest available (<21°C) coldwater refugia would be reduced from 4 percent to 2 percent in mid-August under the worst case. However, this effect would be short-lived because surface waters begin to cool into the suitable range during September. During July and August, the ratio of metalimnion surface area to total lake surface area would decline by up to 6 percent from a current ratio ranging from 62 percent to 68 percent during July and August (Appendix E1 – Table 16 and Figure 18). The response of Lake Almanor's coldwater fish population to restricted thermal refugial habitat even under current conditions in critically dry years is uncertain due to a lack of information on fish distributions; there are no historic records of fish health issues or mortality during these conditions. However, because of the nearly 50 percent reduction in the volume of remaining marginally suitable coldwater refuge habitat during August under Alternative 1, the effects on the coldwater fishery would be **significant without mitigation**.

Without thermal curtains, the effect of increased Canyon Dam releases of up to 250 cfs on Lake Almanor coldwater habitat would be similar to that of the Proposed UNFFR Project and would be **less than significant**. This conclusion is based on the Level 3 Report, which analyzed the effect of increased Canyon Dam releases of up to 600 cfs on Lake Almanor coldwater habitat and found the effect to be similar to the Proposed UNFFR Project.

Alternative 2

Under Alternative 2, use of the thermal curtain at the Prattville intake would have effects on warmwater and coldwater habitat in Lake Almanor similar to those of Alternative 1, with a small difference in suitable or marginal coldwater habitat volume, even without increased withdrawals through Canyon dam during the summer months, because the total hypolimnetic discharge would be the same. This small difference in suitable or marginal coldwater habitat volume between Alternative 1 and Alternative 2 is the result of different hydrodynamics in Lake Almanor under the two alternatives.

Compared to the current or baseline conditions, Alternative 2 would result in:

- an increased depth of the thermocline by up to three feet in late July to early August of normal water years and in July of critically dry water years (Appendix E1 – Tables 7 and 8 and Figures 9 and 10);

- a decrease in coldwater habitat volume (i.e., water equal to or less than 20ºC with DO of 5 mg/L or greater) by up to 9,370 AF from the total current habitat volume of about 44,400 AF to 35,030 AF (21.1 percent reduction) during mid-August in normal water years. In the worst case, this decrease would change the percentage of suitable coldwater habitat from 5 percent to 4 percent of the total lake volume (Appendix E1 – Table 9 and Figure 11);

- a decrease in the volume of the remaining marginal (<21°C) coldwater refugial habitat by up to about 8,530 AF, from about 23,260 AF to 14,730 AF (a 37 percent reduction) during mid-August of critically dry water years; this would occur after the disappearance of the most suitable <20°C thermal refugial habitat. However, this effect would be short-lived because water temperatures would begin to cool to suitable levels throughout the surface waters of the lake during September (Appendix E1 – Table 13 and Figure 15); and

- a decline in the ratios of metalimnion surface area to total lake surface area by up to 3 percent to 5 percent from current ratios (ranging from 60 percent to 68 percent) during July and August of normal and drier water years (Appendix E1 – Tables 15 and 16 and Figures 17 and 18).

Due to uncertainty about Lake Almanor's coldwater fishery responses to occurrences of restricted thermal refuge habitat conditions in critically dry years even under current conditions and the 37 percent reduction in an already limited volume of the remaining marginally suitable (<21°C) thermal refugial habitat under Alternative 2, the effects on the coldwater fishery would be **significant without mitigation**. With mitigation, the potential impact would be less than significant.

Mitigation Measure

<u>Mitigation Measure WQ-1 (Alternatives 1 and 2): Implement Temperature Monitoring and Operations Coordination and Augment Stocking of Coldwater Fishery following Critically Dry Water Years</u>

See Section 6.5.2 for mitigation measures associated with the protection of aquatic habitat conditions in Lake Almanor under both alternatives.

Significance after Mitigation

Mitigation Measure WQ-1 would: (1) reduce the uncertainty associated with summer coldwater habitat estimates for Lake Almanor by increasing the base of monitoring information for improved understanding of coldwater habitat conditions; and (2) improve the ability of the coldwater fishery to recover after critically dry water years. Implementation of this mitigation measure would reduce the impact to a **less than significant** level.

Impact FS-3: Implementation of the UNFFR Project would alter aquatic habitat conditions in Butt Valley reservoir.

Proposed UNFFR Project

Under the Proposed UNFFR Project, the water temperature and DO concentrations in Butt Valley reservoir would be very similar to those experienced under baseline conditions. The Proposed UNFFR Project contains operational changes, as outlined in the 2004 Settlement

Agreement, and decreased inflow to Butt Valley reservoir through the Prattville intake. The inflow temperatures and DO concentrations of the Butt Valley powerhouse and the outflow temperatures and DO concentrations of the Caribou No.1 and Caribou No. 2 powerhouses would be similar to baseline conditions. The hydrodynamics within Butt Valley reservoir would also be similar to baseline conditions because the change in inflows and outflows would be small (about 3 percent on average) compared to baseline operations. Therefore, the impact of the Proposed UNFFR Project on aquatic habitat conditions of Butt Valley reservoir would be **less than significant**.

Alternatives 1 and 2

Installation of the bin walls and thermal curtain at the Caribou intakes would result in a loss of lake bed littoral habitat in Butt Valley reservoir. However, the lake bed habitat near the Caribou intakes is not considered suitable littoral habitat for warmwater fishes because of the steepness of the nearshore zone (Federal Energy Regulatory Commission 2005). The bin walls and curtain would not result in a loss of suitable spawning habitat. The thermal curtain at the Caribou intakes would also not have a substantial effect on the volume of coldwater habitat in the reservoir because of the minimal stratification of the reservoir, small storage volume, and relatively short hydraulic residence time (about two weeks) (see Appendix D for details). Withdrawals through the Caribou intakes would not increase with the thermal curtain in place, but more hypolimnetic water would be withdrawn and released downstream into the Belden forebay. The withdrawal of hypolimnetic water would not affect the development of a thermocline because the hypolimnetic water of Butt Valley reservoir would be replenished by the coldwater inflow from the Butt Valley powerhouse. Changes in the volume of suitable coldwater habitat in the reservoir would be influenced more by the Prattville intake thermal curtain (see Appendix E for details).

With the Prattville thermal curtain in place, discharge through the Butt Valley powerhouse into Butt Valley reservoir would be cooler and contain lower DO levels during certain periods of the summer. As discussed below, this change would affect both the trout fishery in the powerhouse tailrace and the overall volume of suitable coldwater habitat across the reservoir. Under Alternative 1, the added withdrawals through Canyon dam would require an equivalent reduction in the discharge through the Prattville intake to maintain lake levels in Lake Almanor. This effect would create a slightly smaller change in coldwater habitat in Butt Valley reservoir than would occur under Alternative 2, but the differences between the two alternatives would be quite small and, therefore, only the impacts for Alternative 2 are discussed in this section. However, graphical and tabular comparisons of the effects of the alternatives are available in Appendix E1.

With a thermal curtain at the Prattville intake, DO levels would decrease in the Butt Valley powerhouse discharge in July and August during normal and critically dry water years because the hypolimnetic water coming from Lake Almanor will have reduced DO levels of 2 mg/L to 4 mg/L compared to existing conditions of 6 mg/L to 7 mg/L. There is a concern that trout in the powerhouse tailrace may respond to decreases in DO levels by either dispersing from the tailrace to areas with higher DO levels or making brief forays into the tailrace to feed and then returning to adjacent areas with higher DO levels. However, DO levels would increase with the oxygen reaeration that occurs with discharges from the Butt Valley powerhouse. Oxygen reaeration under existing conditions would not be expected to be high because the Prattville intake mainly withdraws epilimnion water, which has relatively high DO concentrations. However, if a thermal curtain near the Prattville intake is used to cause cold water withdrawal (with low DO) from the hypolimnion, oxygen reaeration would be more pronounced. This was evidenced during the 2006 summertime special test (Stetson Engineers and PG&E 2007a). During the special test, the Butt Valley powerhouse discharge was reduced to about 500 cfs to cause selective withdrawal of hypolimnion cold water at the Prattville intake. Measurements of water temperature and DO in the discharge channel of the Butt Valley powerhouse demonstrated that oxygen aeration at the powerhouse discharge outlet would increase the DO concentration from about 4.5 mg/L to more than 8.0 mg/L (see Section 6.5). Therefore, the impacts on the water quality of the tailrace and the coldwater fishery in the tailrace, which is a trophy rainbow and brown trout fishery, would be **less than significant**.

The changes in temperature and DO concentrations of the powerhouse discharge would also alter the temperature and DO depth profiles along the length of Butt Valley reservoir (Appendix D), resulting in changes in the volume of suitable coldwater habitat. The degree to which the availability of suitable coldwater habitat during the summer is currently limiting coldwater habitat uses and the trout fishery in Butt Valley reservoir is not completely known, but has not been reported to be a problem. Analysis results showed that Alternative 1 and Alternative 2 would increase the suitable cold freshwater habitat volume (i.e., water equal to or less than 20ºC with DO of 5 mg/L or greater) in Butt Valley reservoir in all water year types (Appendix E1–Tables 17 and 20 and Figures 19 and 22). This increase would be due to the low temperature produced by the Prattville intake thermal curtain at the Butt Valley powerhouse discharge, which, overall, would cool the reservoir and increase the volume of water cooler than 20°C. Therefore, the impact of Alternative 1 and Alternative 2 on aquatic habitat in Butt Valley reservoir would be **less than significant** and would, in fact, be beneficial overall for the cold freshwater habitat of the reservoir.

Without thermal curtains, the effect of increased Canyon Dam releases of up to 250 cfs on Butt Valley reservoir aquatic habitat conditions would be similar to that of the Proposed UNFFR Project and would be **less than significant**.

Impact FS-4: Implementation of the UNFFR Project would alter cold freshwater habitat conditions in the North Fork Feather River over the long term.

Proposed UNFFR Project

The proposed minimum flow schedule for the Seneca and Belden reaches incorporated into the Proposed UNFFR Project would only have a minimal effect on water temperature in these reaches. The amount of usable habitat for all life stages of rainbow trout would be similar to existing conditions. These flows would not significantly improve the temperature conditions of the Upper North Fork Feather River. Habitat for rainbow trout would continue to be limited by temperature during summer months. When compared to baseline conditions, the impact of the Proposed UNFFR Project on cold freshwater habitat in the Upper North Fork Feather River would be considered **less than significant**.

Alternative 1

The State Water Board staff alternate minimum flow schedule for the Seneca and Belden reaches would, by itself, have only a minimal effect on water temperatures in these reaches. The amount of usable habitat for all life stages of rainbow trout would be similar to or greater than the existing condition and would be generally similar to those minimum flows incorporated into the Proposed UNFFR Project during months when different minimum flow levels are proposed (see Tables 4-1 and 4-2 in Chapter 4, Project Alternatives). The combined effects of the changes in minimum flow, increased summer releases from Canyon dam, and use of the two thermal curtains are discussed below.

A release of up to 250 cfs from mid-June to mid-September from the Canyon dam outlet structure into the Seneca reach would decrease water temperatures and increase streamflow compared to the baseline condition. This release would increase suitable habitat area for adult trout but decrease it for juvenile trout by 17 to 23 percent from that provided by the minimum flows under the 2004 Settlement Agreement. The maximum weekly average temperature (MWAT), which already remains well below 20°C under the baseline condition, would be reduced by up to 2.5ºC in the Seneca reach when flows of 250 cfs are released from Canyon dam (Appendix E1 – Figures 1 to 4). The lower temperatures during the summer would result in somewhat slower growth rates for rainbow trout in this reach, but the change in growth rates is likely to be minor because the existing temperature regime is already relatively cold in most years. Since no evidence was provided in the FERC EIS record that either juvenile trout habitat area or growth rates are considered to be currently limiting trout populations in the Seneca reach, this effect is considered to be **less than significant**.

Water temperatures farther downstream in the Belden reach would also be reduced from MWATs that range from 21.5°C to 23°C in most years during July and August to MWATs remaining below 20ºC. This water temperature reduction of as much as 3ºC below current conditions results in a much reduced frequency of daily temperatures exceeding 20°C (Appendix E1 – Figures 5 to 8). These temperature reductions would result from the combination of the increased Canyon dam discharges and the operation of thermal curtains in Lake Almanor and Butt Valley reservoir. A 0.7-mile segment between the East Branch of the North Fork Feather River confluence and Belden powerhouse would continue to experience warmer temperatures than the rest of the reach because of the warmer temperatures of the East Branch discharges. Below Belden powerhouse in the Rock Creek and Cresta reaches, MWATs would be similarly reduced from the 21.5°C to 23°C range to remain below 20ºC in normal to dry water years. The MWATs would exceed 20ºC, by up to 0.5°C – 1°C, along portions of the Rock Creek and Cresta reaches in critically dry water years when the weather is warm. The reduction in MWAT with increased Canyon dam releases would be about 2°C to 2.5ºC in the Rock Creek and Cresta reaches. Water temperatures in the Poe reach would be reduced from MWATs ranging from 21°C to 25°C by about 1°C to 2ºC. More than half of the Poe reach would remain above 20ºC during warmer summer months of dry and critically dry water years.

Historically, a maximum instantaneous diel temperature of 24°C, 24°C, 24°C, and 26.7°C was reported for the Belden, Rock Creek, Cresta, and Poe reaches, respectively. The Poe reach exhibited a maximum instantaneous temperature exceeding 25°C, the ultimate upper incipient lethal temperature[1] for rainbow trout. Alternative 1 would not be sufficient to completely eliminate the occurrence of the exceedance of the 25°C diel maximum temperature in the Poe reach during warm summer months of dry and critically dry water years, but would reduce the frequency of diel fluctuations reaching and exceeding 25ºC. The overall effect of Alternative 1 would be to prevent thermal conditions from exceeding normative temperatures for rainbow trout throughout much of the North Fork Feather River downstream through the Cresta reach. Growth, disease resistance, and ecological interactions contributing to coldwater fish survival would be expected to significantly improve compared to current conditions. As a result, the

[1] The ultimate upper incipient lethal temperature is the highest temperature to which the species can be acclimated; above this temperature, all temperatures are lethal regardless of previous thermal exposure (Jobling 1981).

effects of the increased Canyon dam releases and the thermal curtains on the North Fork Feather River would be **less than significant** and would, in fact, be beneficial overall for trout and other coldwater-dependent aquatic species.

The reduced water temperatures in the North Fork Feather River below Belden powerhouse would slightly reduce the length of river with temperatures preferred by hardhead, which is found primarily downstream of Rock Creek dam, based on the thermal preferences of hardhead (>20°C for growth, 24°C to 28°C for optimal physiological performance) reported by Moyle (2002). However, water temperature conditions downstream of the Belden powerhouse would still provide a gradient and a diversity of thermal conditions within the temperature range tolerated and preferred by hardhead. Additionally, each of the downstream hydroelectric projects provides deep, slow-current habitat and thermally diverse pools preferred by hardhead at their diversion dams. Hardhead would be expected to continue to move seasonally, as they do under current conditions, to preferred physical and thermal habitats within the various hydropower project reaches during the summer months (Moyle et al. 1983, Moyle 2002). Effects on hardhead in the North Fork Feather River would, therefore, be **less than significant**.

Without thermal curtains, the effect of increased Canyon Dam releases of up to 250 cfs on North Fork Feather River coldwater habitat would be an improvement to the Proposed UNFFR Project and would be **less than significant**. Specifically, mean daily temperatures and MWAT in the Seneca reach, which already remain well below 20°C under the baseline condition, would be reduced by up to 2.5ºC. Mean daily temperatures in July and August in the Belden, Rock Creek, Cresta, and Poe reaches would be reduced by up to 0.6ºC, 0.4ºC, 0.4ºC, and 0.3ºC, respectively. MWAT in July and August in the Belden, Rock Creek, Cresta, and Poe reaches would be reduced by up to 1.0ºC, 0.8ºC, 0.7ºC, and 0.5ºC, respectively.

Alternative 2

Alternative 2 would provide a benefit for coldwater fish habitat in the North Fork Feather River, but at a somewhat lower level than Alternative 1. Beneficial thermal effects from the Prattville and Caribou intakes thermal curtains without the increased Canyon dam release under Alternative 2 would result in less temperature reduction than Alternative 1. Daily mean water temperatures would be expected to remain between 12°C and 16ºC in the Seneca reach under the State Water Board staff alternative minimum stream flows (Table 4-1) without the 250 cfs Canyon dam release. No significant differences in trout growth or survival would be expected compared to current conditions. The amount of usable habitat for all life stages of rainbow trout would be similar to or greater than the existing condition and would be generally similar to that of the Proposed UNFFR Project minimum flows during months when alternative minimum flow levels are proposed.

In the Belden reach, the thermal curtains would result in MWATs remaining below 20ºC in July and August of normal water years, with reductions in temperatures between 1.5°C and 3ºC below current conditions (21.5°C to 23°C) (Appendix E1 – Figures 5 to 8). Similar changes would be expected farther downstream in the Rock Creek and Cresta reaches, with MWATs remaining near or below 20ºC in normal water years, but exceeding 20ºC by no more than 0.5°C to 1°C along most of these reaches in dry and critically dry water years during warm weather. These MWATs would be 1°C to 2ºC cooler than existing conditions (21°C to 23°C) in these reaches. In the Poe reach, MWATs would be 0.6°C to 2ºC cooler than existing conditions (21°C to 25°C); however, more than half of the Poe reach would remain above 20ºC during July and August in normal years and the entire reach would exceed 20ºC in dry and critically dry water years. The temperature reductions along the Poe reach would be sufficient only in the upper half of the segment to reduce the frequency of diel fluctuations from reaching and exceeding 25ºC in most water years.

The reduction in water temperatures during July and August would prevent thermal conditions from exceeding rainbow trout normative temperatures throughout much of the North Fork Feather River downstream through the Cresta reach in normal years. In dry and critically dry water years during warm weather, the water temperatures could result in diel fluctuations that reach or exceed lethal levels in the Poe reach. Growth, disease resistance, and ecological interactions contributing to coldwater fish survival would be expected to improve under Alternative 2 compared to existing conditions. As a result, the thermal curtains would have **no** (adverse) **impact** on the fisheries resources of the North Fork Feather River and would, in fact, be beneficial.

Impact FS-5: Implementation of the UNFFR Project could adversely affect the recreational fishery of Butt Valley reservoir as a result of reduced forage fish in the reservoir.

Proposed UNFFR Project

Under the Proposed UNFFR Project, the operational transfer of water from Lake Almanor to Butt Valley reservoir would be very similar to current baseline conditions. Under the Proposed UNFFR Project, no structural modifications would be made to the Prattville intakes. Diversions would be reduced somewhat as a result of equivalent increased releases from Canyon dam, as outlined in the 2004 Settlement Agreement. This change in the diversion rate would be relatively small and would not be expected to greatly change the entrainment and transfer of forage fish from Lake Almanor to Butt Valley reservoir. Therefore, the impact of the Proposed UNFFR Project on the forage fish population and recreational fishery of Butt Valley reservoir would be **less than significant**.

Alternatives 1 and 2

Installation of a thermal curtain at the Prattville intake in Lake Almanor was identified by Gast (2004) as potentially reducing the entrainment of wakasagi, a forage fish, in the intake, thereby reducing its transport to, and abundance in, Butt Valley reservoir. Large numbers of wakasagi, but very few other species, currently become entrained at the Prattville intake and are conveyed by the Butt Valley tunnel to the Butt Valley powerhouse tailrace (Pacific Gas and Electric Company 2002). These entrained fishes are thought to support the presence of a trophy trout fishery, which preys on the wakasagi, in the Butt Valley powerhouse tailrace and reservoir. Gast (2004) hypothesized that installation of a thermal curtain could reduce entrainment of wakasagi at the Prattville intake, reducing the prey base in Butt Valley reservoir for trophy trout and increasing the wakasagi abundance in Lake Almanor. Gast subjected this hypothesis to a modeling exercise that used simple assumptions on wakasagi distribution and vulnerability to entrainment along with PG&E data and modeling on withdrawal strata profiles, with and without a thermal curtain, to determine relative differences in wakasagi entrainment under these scenarios. In the absence of definitive data on wakasagi distributions and associated environmental conditions for Lake Almanor, Gast made a reasonable assumption that wakasagi are distributed throughout the water strata with suitable temperatures and DO concentrations and are entrained in proportion to volumes of water containing wakasagi withdrawn into the intake. Gast adopted a maximum temperature threshold of 22ºC and minimum DO thresholds of 5 mg/L and 6 mg/L, which confined the wakasagi to the metalimnion and much of the epilimnion for the summer period. This modeling concluded that, in normal water years, wakasagi entrainment could be reduced by up to 95 percent to 99 percent in July and August and by less than 30 percent in June and September. In critically dry water years, entrainment could be reduced by 86 percent to 99 percent from June to September. Using a habitat suitability index analysis, the same monthly patterns but slightly lower levels of entrainment resulted.

Documents reviewed as part of the relicensing record do not provide adequate evidence neither for nor against Gast's hypothesis concerning the potential for a significant change in wakasagi entrainment at the Prattville intake or its impact on the Butt Valley reservoir fishery. The only information on wakasagi depth distributions in the vicinity of the Prattville intake is from PG&E (2002), which was obtained using hydroacoustic surveys in August 2001 as part of the relicensing studies. This survey indicated that wakasagi schools occurred at depths of 10 to 14 meters (33 to 46 feet) and were mostly near the lake bottom (Gast 2004). This depth would place fish within the withdrawal zone of the thermal curtain. However, at the time of this survey, low lake levels put the top of the thermocline near the elevation of the thermal curtain opening, which may have affected fish distribution (Gast 2004). Nonetheless, the PG&E surveys are consistent with reports of wakasagi congregating in and just below the thermocline in Lake Oroville (Lee 2005), which suggests that while wakasagi will congregate in water strata surrounding the thermocline, they may not be as restricted to the epilimnion during the summer as presumed by Gast (2004).

Additionally, wakasagi have spread and are abundant throughout the entire North Fork Feather River system from Lake Almanor to Lake Oroville, including Butt Valley reservoir. Wakasagi populations in all reservoirs along the North Fork Feather River have increased dramatically since their initial stocking in Lake Almanor in 1972–1973 (Moyle 2002). Their broad thermal and salinity tolerances and ability to spawn in sand and small gravel on the beds of feeder streams and along the shorelines of ponds, lakes, and reservoirs has likely led to their adaptability and expanding range throughout California (Moyle 2002). It is probable that wakasagi have established self-sustaining populations in Butt Valley reservoir and any reduction in wakasagi entrainment at the Prattville intake as a result of the thermal curtain is not expected to have a significant effect on the presence of a suitable forage fish in the reservoir. This impact would therefore be **less than significant**.

Without thermal curtains, the effect of increased Canyon Dam releases of up to 250 cfs on Butt Valley reservoir's recreational fishery would be similar to that of the Proposed UNFFR Project. The impact would be **less than significant**.