
State of California
The Resources Agency
Department of Water Resources

**SP-F5/7 TASK 2 REPORT: ACHIEVEMENT OF
CURRENT STOCKING GOALS**

**Oroville Facilities Relicensing
FERC Project No. 2100**



SEPTEMBER 2004

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Preliminary Information – Subject to Revision – For Collaborative Process Purposes Only

REPORT SUMMARY

This report is Task 2 of 3 for the study plan *SP-F5/7 Evaluation of Fisheries Management on Project Fisheries*, and it evaluates whether the current stocking goals for Lake Oroville and the Thermalito Forebay have been achieved.

Completion of Task 2 was accomplished by conducting a literature review of Department of Water Resources (DWR) and Department of Fish and Game (DFG) files, as well as interviews with DFG biologists and fish hatchery personnel. Lake Oroville and the Thermalito Forebay are the two Oroville Project waters with fish stocking programs, and they were both identified, along with their goals. This review also identified the existing fishery monitoring data for the current stocking activities, and this data was compared with the management goals to determine the level of success of the stocking programs.

The two primary documents used to identify the Fishery Management Plans for Lake Oroville and the Thermalito Forebay are the 1999 Lake Oroville Annual Report of Fish Stocking and Fish Habitat Improvements (DWR 2000), and the DFG prepared Strategic Plan for Trout Management (DFG 2003), respectively. These documents discuss the goals and success criteria for each of these programs.

The current Lake Oroville stocking program goal is to annually stock approximately 170,000 coho salmon as part of a “put-and-grow” management strategy. This program is meeting the established growth criteria as well as being highly regarded by the coldwater angling community, and therefore, is deemed successful in achieving its stocking goals.

The current Forebay stocking program consists of the DFG annually stocking approximately 30,000 catchable rainbow trout as part of a “put-and-take” management strategy. This program is achieving the goals specified in the Strategic Plan for Trout Management by providing an attractive angling opportunity to the public, with a high degree of angler satisfaction, and in a way that is consistent with contemporary California recreational fishery management.

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1.0 INTRODUCTION

This study identifies and evaluates the fish stocking programs for Lake Oroville and the Thermalito Forebay. These programs support sport fishing, one of the primary recreational activities occurring at the Oroville Facilities and an important component to local tourism. The California Department of Fish and Game exclusively managed these fisheries from 1968-1993, and since that time the Department of Water Resources has become a partner in this management. By evaluating the existing fish stocking programs, this study will be a useful tool in developing the fish stocking components of a recreational fishery management plan, and other potential protection, mitigation and enhancements (PM&Es) (resource actions) for the project.

1.1 STUDY AREA

The study area for this report is Lake Oroville and the Thermalito Forebay.

1.2 DESCRIPTION OF FACILITIES

The Oroville Facilities were developed as part of the State Water Project (SWP), a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the SWP is to store and distribute water to supplement the needs of urban and agricultural water users in northern California, the San Francisco Bay area, the San Joaquin Valley, and southern California. The Oroville Facilities are also operated for flood management, power generation, to improve water quality in the Delta, provide recreation, and enhance fish and wildlife.

FERC Project No. 2100 encompasses 41,100 acres and includes Oroville Dam and Reservoir, three power plants (Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Power Plant, and Thermalito Pumping-Generating Plant), Thermalito Diversion Dam, the Feather River Fish Hatchery and Fish Barrier Dam, Thermalito Power Canal, Oroville Wildlife Area (OWA), Thermalito Forebay and Forebay Dam, Thermalito Afterbay and Afterbay Dam, and transmission lines, as well as a number of recreational facilities. An overview of these facilities is provided on Figure 1.2-1. The Oroville Dam, along with two small saddle dams, impounds Lake Oroville, a 3.5-million-acre-feet (maf) capacity storage reservoir with a surface area of 15,810 acres at its normal maximum operating level.

The hydroelectric facilities have a combined licensed generating capacity of approximately 762 megawatts (MW). The Hyatt Pumping-Generating Plant is the largest of the three power plants with a capacity of 645 MW. Water from the six-unit underground power plant (three conventional generating and three pumping-generating units) is discharged through two tunnels into the Feather River just downstream of Oroville Dam. The plant has a generating and pumping flow capacity of 16,950 cfs and

5,610 cfs, respectively. Other generation facilities include the 3-MW Thermalito Diversion Dam Power Plant and the 114-MW Thermalito Pumping-Generating Plant.

Thermalito Diversion Dam, four miles downstream of the Oroville Dam creates a tail water pool for the Hyatt Pumping-Generating Plant and is used to divert water to the Thermalito Power Canal. The Thermalito Diversion Dam Power Plant is a 3-MW power plant located on the left abutment of the Diversion Dam. The power plant releases a maximum of 615 cubic feet per second (cfs) of water into the river.

The Power Canal is a 10,000-foot-long channel designed to convey generating flows of 16,900 cfs to the Thermalito Forebay and pump-back flows to the Hyatt Pumping-Generating Plant. The Thermalito Forebay is an off-stream regulating reservoir for the 114-MW Thermalito Pumping-Generating Plant. The Thermalito Pumping-Generating Plant is designed to operate in tandem with the Hyatt Pumping-Generating Plant and has generating and pump-back flow capacities of 17,400 cfs and 9,120 cfs, respectively. When in generating mode, the Thermalito Pumping-Generating Plant discharges into the Thermalito Afterbay, which is contained by a 42,000-foot-long earth-fill dam. The Afterbay is used to release water into the Feather River downstream of the Oroville Facilities, helps regulate the power system, provides storage for pump-back operations, and provides recreational opportunities. Several local irrigation districts receive water from the Afterbay.

The Feather River Fish Barrier Dam is downstream of the Thermalito Diversion Dam and immediately upstream of the Feather River Fish Hatchery. The flow over the dam maintains fish habitat in the low-flow channel of the Feather River between the dam and the Afterbay outlet, and provides attraction flow for the hatchery. The hatchery was intended to compensate for spawning grounds lost to returning salmon and steelhead trout from the construction of Oroville Dam. The hatchery can accommodate 15,000 to 20,000 adult fish annually.

The Oroville Facilities support a wide variety of recreational opportunities. They include: boating (several types), fishing (several types), fully developed and primitive camping (including boat-in and floating sites), picnicking, swimming, horseback riding, hiking, off-road bicycle riding, wildlife watching, hunting, and visitor information sites with cultural and informational displays about the developed facilities and the natural environment. There are major recreation facilities at Loafer Creek, Bidwell Canyon, the Spillway, North and South Thermalito Forebay, and Lime Saddle. Lake Oroville has two full-service marinas, five car-top boat launch ramps, ten floating campsites, and seven dispersed floating toilets. There are also recreation facilities at the Visitor Center and the OWA.

The OWA comprises approximately 11,000-acres west of Oroville that is managed for wildlife habitat and recreational activities. It includes the Thermalito Afterbay and surrounding lands (approximately 6,000 acres) along with 5,000 acres adjoining the

Feather River. The 5,000 acre area straddles 12 miles of the Feather River, which includes willow and cottonwood lined ponds, islands, and channels. Recreation areas include dispersed recreation (hunting, fishing, and bird watching), plus recreation at developed sites, including Monument Hill day use area, model airplane grounds, three boat launches on the Afterbay and two on the river, and two primitive camping areas. California Department of Fish and Game's (DFG) habitat enhancement program includes a wood duck nest-box program and dry land farming for nesting cover and improved wildlife forage. Limited gravel extraction also occurs in a number of locations.

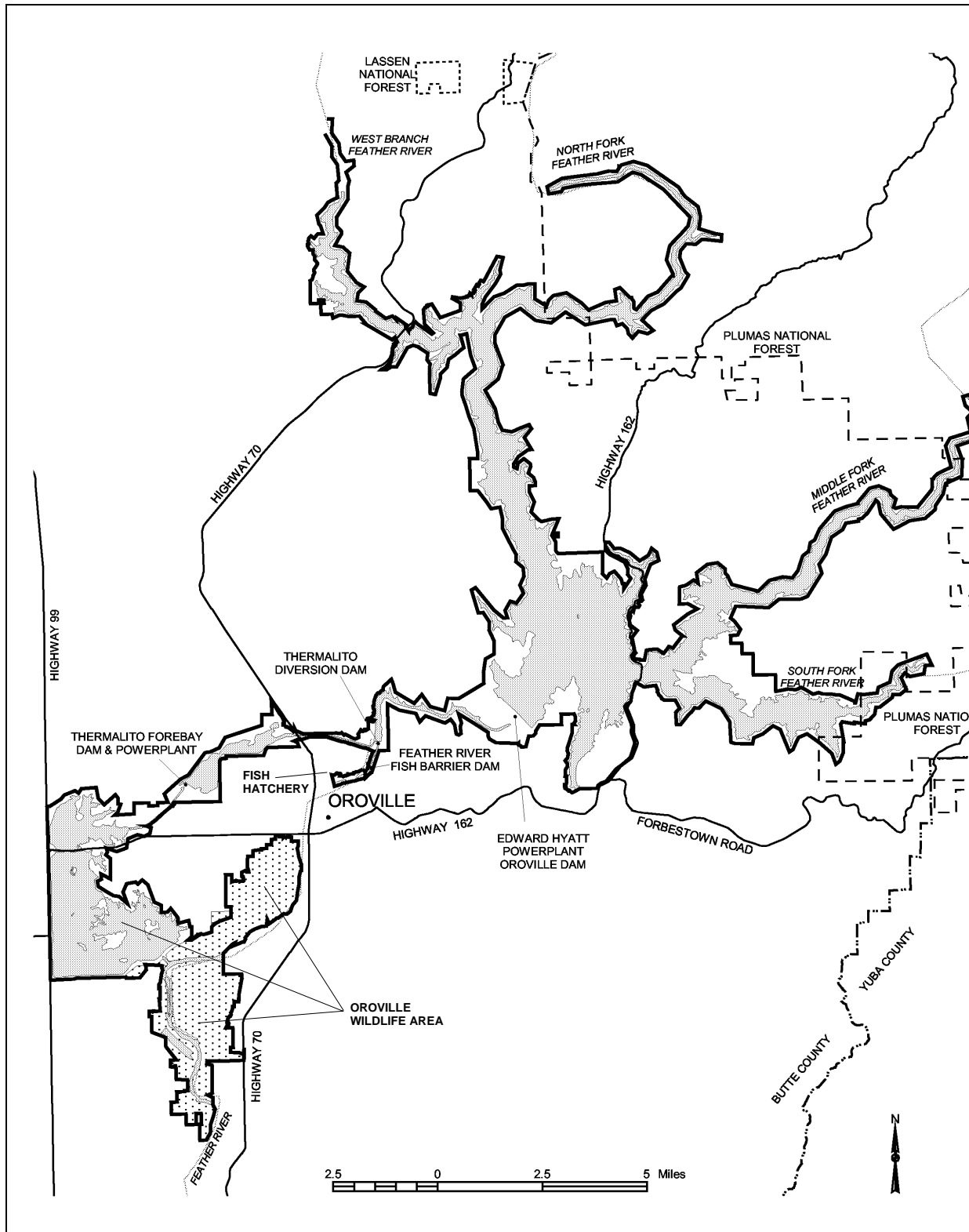


Figure 1.2-1. Oroville Facilities FERC Project Boundary

Preliminary Information – Subject to Revision – For Collaborative Process Purposes Only

1.3 CURRENT OPERATIONAL CONSTRAINTS

Operation of the Oroville Facilities varies seasonally, weekly and hourly, depending on hydrology and the objectives DWR is trying to meet. Typically, releases to the Feather River are managed to conserve water while meeting a variety of water delivery requirements, including flow, temperature, fisheries, recreation, diversion and water quality. Lake Oroville stores winter and spring runoff for release to the Feather River as necessary for project purposes. Meeting the water supply objectives of the SWP has always been the primary consideration for determining Oroville Facilities operation (within the regulatory constraints specified for flood control, in-stream fisheries, and downstream uses). Power production is scheduled within the boundaries specified by the water operations criteria noted above. Annual operations planning is conducted for multi-year carry over. The current methodology is to retain half of the Lake Oroville storage above a specific level for subsequent years. Currently, that level has been established at 1,000,000 acre-feet (af); however, this does not limit draw down of the reservoir below that level. If hydrology is drier than expected or requirements greater than expected, additional water would be released from Lake Oroville. The operations plan is updated regularly to reflect changes in hydrology and downstream operations. Typically, Lake Oroville is filled to its maximum annual level of up to 900 feet above mean sea level (msl) in June and then can be lowered as necessary to meet downstream requirements, to its minimum level in December or January. During drier years, the lake may be drawn down more and may not fill to the desired levels the following spring. Project operations are directly constrained by downstream operational constraints and flood management criteria as described below.

1.3.1 Downstream Operation

An August 1983 agreement between DWR and DFG entitled, "Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife," sets criteria and objectives for flow and temperatures in the low flow channel and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement: (1) establishes minimum flows between Thermalito Afterbay Outlet and Verona which vary by water year type; (2) requires flow changes under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood management, failures, etc.; (3) requires flow stability during the peak of the fall-run Chinook spawning season; and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the later spring/summer for shad and striped bass.

1.3.1.1 Instream Flow Requirements

The Oroville Facilities are operated to meet minimum flows in the Lower Feather River as established by the 1983 agreement (see above). The agreement specifies that Oroville Facilities release a minimum of 600 cfs into the Feather River from the

Thermalito Diversion Dam for fisheries purposes. This is the total volume of flows from the diversion dam outlet, diversion dam power plant, and the Feather River Fish Hatchery pipeline.

Generally, the instream flow requirements below Thermalito Afterbay are 1,700 cfs from October through March, and 1,000 cfs from April through September. However, if runoff for the previous April through July period is less than 1,942,000 af (i.e., the 1911-1960 mean unimpaired runoff near Oroville), the minimum flow can be reduced to 1,200 cfs from October to February, and 1,000 cfs for March. A maximum flow of 2,500 cfs is maintained from October 15 through November 30 to prevent spawning in overbank areas that might become de-watered.

1.3.1.2 Temperature Requirements

The Diversion Pool provides the water supply for the Feather River Fish Hatchery. The hatchery objectives are 52°F for September, 51°F for October and November, 55°F for December through March, 51°F for April through May 15, 55°F for last half of May, 56°F for June 1-15, 60°F for June 16 through August 15, and 58°F for August 16-31. A temperature range of plus or minus 4°F is allowed for objectives, April through November.

There are several temperature objectives for the Feather River downstream of the Afterbay Outlet. During the fall months, after September 15, the temperatures must be suitable for fall-run Chinook. From May through August, they must be suitable for shad, striped bass, and other warmwater fish.

The National Marine Fisheries Service has also established an explicit criterion for steelhead trout and spring-run Chinook salmon. Memorialized in a biological opinion on the effects of the Central Valley Project and SWP on Central Valley spring-run Chinook and steelhead as a reasonable and prudent measure; DWR is required to control water temperature at Feather River mile 61.6 (Robinson's Riffle in the low-flow channel) from June 1 through September 30. This measure requires water temperatures less than or equal to 65°F on a daily average. The requirement is not intended to preclude pump-back operations at the Oroville Facilities needed to assist the State of California with supplying energy during periods when the California ISO anticipates a Stage 2 or higher alert.

The hatchery and river water temperature objectives sometimes conflict with temperatures desired by agricultural diverters. Under existing agreements, DWR provides water for the Feather River Service Area (FRSA) contractors. The contractors claim a need for warmer water during spring and summer for rice germination and growth (i.e., 65°F from approximately April through mid May, and 59°F during the remainder of the growing season). There is no obligation for DWR to meet the rice

water temperature goals. However, to the extent practical, DWR does use its operational flexibility to accommodate the FRSA contractor's temperature goals.

1.3.1.3 Water Diversions

Monthly irrigation diversions of up to 190,000 (July 2002) af are made from the Thermalito Complex during the May through August irrigation season. Total annual entitlement of the Butte and Sutter County agricultural users is approximately 1 maf. After meeting these local demands, flows into the lower Feather River continue into the Sacramento River and into the Sacramento-San Joaquin Delta. In the northwestern portion of the Delta, water is pumped into the North Bay Aqueduct. In the south Delta, water is diverted into Clifton Court Forebay where the water is stored until it is pumped into the California Aqueduct.

1.3.1.4 Water Quality

Flows through the Delta are maintained to meet Bay-Delta water quality standards arising from DWR's water rights permits. These standards are designed to meet several water quality objectives such as salinity, Delta outflow, river flows, and export limits. The purpose of these objectives is to attain the highest water quality, which is reasonable, considering all demands being made on the Bay-Delta waters. In particular, they protect a wide range of fish and wildlife including Chinook salmon, delta smelt, striped bass, and the habitat of estuarine-dependent species.

1.3.2 Flood Management

The Oroville Facilities are an integral component of the flood management system for the Sacramento Valley. During the wintertime, the Oroville Facilities are operated under flood control requirements specified by the U.S. Army Corps of Engineers (USACE). Under these requirements, Lake Oroville is operated to maintain up to 750,000 af of storage space to allow for the capture of significant inflows. Flood control releases are based on the release schedule in the flood control diagram or the emergency spillway release diagram prepared by the USACE, whichever requires the greater release. Decisions regarding such releases are made in consultation with the USACE.

The flood control requirements are designed for multiple use of reservoir space. During times when flood management space is not required to accomplish flood management objectives, the reservoir space can be used for storing water. From October through March, the maximum allowable storage limit (point at which specific flood release would have to be made) varies from about 2.8 to 3.2 maf to ensure adequate space in Lake Oroville to handle flood flows. The actual encroachment demarcation is based on a wetness index, computed from accumulated basin precipitation. This allows higher levels in the reservoir when the prevailing hydrology is dry while maintaining adequate flood protection. When the wetness index is high in the basin (i.e., wetness in the

watershed above Lake Oroville), the flood management space required is at its greatest amount to provide the necessary flood protection. From April through June, the maximum allowable storage limit is increased as the flooding potential decreases, which allows capture of the higher spring flows for use later in the year. During September, the maximum allowable storage decreases again to prepare for the next flood season. During flood events, actual storage may encroach into the flood reservation zone to prevent or minimize downstream flooding along the Feather River.

2.0 NEED FOR STUDY

This report is Task 2 of 3 for the study plan *SP-F5/7 Evaluation of Fisheries Management on Project Fisheries*, and it was drafted to evaluate whether the current stocking goals have been achieved. This report is necessary because project operations may have an affect on recreational fishing at the Oroville Facilities. In addition, fish stocking at Lake Oroville is a component of DWR's FERC required Recreation Plan. An analysis of the success of this program, as well as DFG's Forebay stocking program, may be used in the development of future Resource Actions related to fish stocking at the project.

Section 4.51(f)(3) of 18 CFR requires reporting of certain types of information in the FERC Application for License for major hydropower projects, including a discussion of the fish, wildlife and botanical resources in the vicinity of the project. The discussion needs to identify the potential impacts of the project on these resources, including a description of any anticipated continuing impact for on-going and future operations of the project.

3.0 STUDY OBJECTIVE(S)

The objective of this study is to evaluate the success of the current fish stocking programs at the Oroville Facilities, and determine the impacts, if any, on these programs from project operations.

3.1 APPLICATION OF STUDY INFORMATION

The information obtained from SP-F5/7 Task 2 will be used to determine the success of the current fish stocking programs at the project, and to identify whether project operations may be affecting those programs. This information will be combined with SP-F5/7 Task 1 Evaluation of Potential Effects of Fisheries Management Activities on ESA-Listed Fish Species, and SP-F5/7 Task 3 Evaluation of the Potential Interactions Between the Lake Oroville Fishery and Upstream Tributary Fisheries, in order to provide an overall analysis of the current fisheries management practices at the project and how this affects the project's fisheries.

3.1.1 Department of Water Resources/Stakeholders

This Task 2 report will assist DWR and the Relicensing stakeholders in assessing the status of the current fish stocking programs, and their level of success. This information will be useful in the possible development and implementation of Resource Actions relating to fish stocking and monitoring.

3.1.2 Other Studies

This report is Task 2 of the 3 tasks identified in the study plan *SP-F5/7 Evaluation of Fisheries Management on Project Fisheries*. This information will be combined with SP-F5/7 Task 1 Evaluation of Potential Effects of Fisheries Management Activities on ESA-Listed Fish Species, and SP-F5/7 Task 3 Evaluation of the Potential Interactions Between the Lake Oroville Fishery and Upstream Tributary Fisheries, in order to provide an overall analysis of the current fisheries management practices at the project and how this affects the project's fisheries. Other relicensing studies used in the completion of this report include *SP-R9 Existing Recreation Use* and *SP-R13 Recreation Surveys*.

3.1.3 Environmental Documentation

In addition to Section 4.51(f)(3) of 18 CFR, which requires reporting of certain types of information in the FERC application for license of major hydropower projects (FERC 2001), it may be necessary to satisfy the requirements of the National Environmental Policy Act (NEPA) as well as the ESA. Because FERC has the authority to grant an operating license to DWR for continued operation of the Oroville Facilities, discussion is required to identify the potential impacts of

the project on many types of resources, including fish, wildlife, and botanical resources. In addition, NEPA requires discussion of any anticipated continuing impact from on-going and future operations. To satisfy NEPA and ESA, DWR is preparing a Preliminary Draft Environmental Assessment (PDEA) to attach to the FERC license application, which shall include information provided by this study plan report.

4.0 METHODOLOGY

4.1 STUDY DESIGN

Completion of Task 2 was accomplished by conducting a literature review of DWR and DFG files, as well as interviews with DFG biologists and fish hatchery personnel. Lake Oroville and the Thermalito Forebay are the two Oroville Project waters with fish stocking programs, and they were both identified, along with their goals. This review also identified the existing fishery monitoring data for the current stocking activities, and this data was compared with the management goals to determine the level of success of the stocking programs.

4.2 STUDY METHODOLOGY

This report will provide a history of the fishery management activities that have occurred over the history of the Oroville Facilities, but will focus on the management programs that have existed in the last several years. This history will describe the evolution of these stocking programs, and this will be useful when using this report in the development of future actions.

Fishery management programs are often a result of a mixture of the originally drafted fishery management plan along with numerous supplemental activities, agreements, and adjustments that are made along the way. Therefore, letters, memos, meetings summaries, and other supplement documentation were considered when describing the fishery management programs at the Oroville Facilities.

The two primary documents used to identify the Fishery Management Plans for Lake Oroville and the Thermalito Forebay are the 1999 Lake Oroville Annual Report of Fish Stocking and Fish Habitat Improvements (DWR 2000), and the DFG prepared Strategic Plan for Trout Management (DFG 2003), respectively. These documents discuss the goals and success criteria for each of these programs and this will be detailed in the "Study Results" section of this report.

The fishery data used to evaluate the success of the Lake Oroville stocking program was collected intensively by DFG from July of 1993 through June of 1999 as part of its Lake Oroville Fishery Evaluation, and from 2000 through the present time as part of its general fishery monitoring program for Central Valley reservoirs. Techniques primarily consisted of angler surveys and boat electrofishing. Some additional information was gathered by DWR during 2002-2003, using boat electrofishing, gill netting, and hook and line sampling.

The fishery data used to evaluate the success of the Thermalito Forebay stocking program was collected by DWR from May 15, 2002 through May 15, 2003, as part of

the recreational surveys conducted for the Recreation and Socioeconomic Workgroup. In addition, DFG conducted a tagging study from 2000 - 2004 to assess angler returns.

This data will be compared against the success criteria established in the fishery management plans to evaluate the success of these programs in the Analysis section of this report. If the stocking goals are not being achieved, a discussion of the impacts of project operations will occur in this section.

5.0 STUDY RESULTS

5.1 LAKE OROVILLE

5.1.1 Lake Oroville Stocking Program History

The literature search identified a variety of different salmonid species, strains, and sizes that have been stocked in Lake Oroville since its creation in 1968 (Table 5.1.1). During Lake Oroville's first decade, rainbow trout, brown trout, and coho salmon were the primary species being stocked, with periodic plants of kokanee salmon. Catchable-sized (10-12 inches long) fish were emphasized, which provided immediate angler returns in addition to larger trophy-sized fish if they survived over the winter and were available for a second and even third year in the lake. As is common with newly created reservoirs, fish growth was very high and Lake Oroville quickly became one of the most popular reservoir fisheries in California for all four of these species (John Hiscox pers. comm. 1993). In 1972, DFG introduced wakasagi smelt into Lake Almanor to provide a forage base for the Almanor coldwater fishery. Lake Almanor is located upstream of Lake Oroville on the North Fork of the Feather River, and by 1976 the wakasagi had passed down into Lake Oroville where they became established (Moyle 2002). They directly competed with the kokanee salmon in Lake Oroville since they both feed primarily on zooplankton in the cooler, deeper waters. This competition reduced the kokanee growth rate to a point where DFG ceased stocking kokanee after 1977 and this program has never been revived.

During Lake Oroville's second decade, rainbow trout stocking was phased out due to decreasing angler returns as a result of the presence of *Ceratomyxa shasta*, a myxosporean parasite that is lethal to most varieties of rainbows, and competition with wakasagi smelt (DWR 1993). Coho stocking was reduced due to egg supply and hatchery rearing problems (DWR 1993). The stocking of catchable-sized brown trout was increased, and Chinook salmon stocking became a regular occurrence, both at the fingerling (3-4 inches long) and yearling (6-8 inches long) size ranges. DFG experimented with lake trout, but this was abandoned due to egg supply difficulties and concerns that lake trout may compete or predate on the lake's warmwater fisheries.

By the beginning of the 1990s, brown trout and Chinook salmon had become the dominant coldwater species stocked in Lake Oroville, and except for a small group of coho salmon fingerlings stocked by a private fishing organization in 1991, this continued throughout the decade. Catchable-sized fish were phased out as the stocking management shifted toward a "put-and-grow" type of program, where smaller hatchery-produced salmonids (3-8 inches long) are stocked with the anticipation that they will increase substantially in size and survive for more than one season. DFG and DWR conducted a fishery study from 1993 through 1999, to update the fishery management plan and establish optimum stocking rates for the lake. Chinook yearlings were stocked in increasing amounts each year for several consecutive years to study the effects this would have on Chinook growth. The baseline amount of Chinook yearlings was

60,000/year, and this was increased to 350,000/year in the fifth year of the study. During this same period, the numbers of Chinook fingerlings was about 100,000/year, and brown trout averaged about 60,000/year. DFG set minimum growth criteria for the Chinook salmon of 13 inches at 18 months of age, and 16 inches at 24 months of age. This growth criteria was met until the stocking exceeded 170,000 yearlings per year, so ultimately this stocking level was recommended for Chinook salmon at Lake Oroville (DWR 2000). Although the angler catch of brown trout were very low (DWR 2000), DFG decided to continue stocking brown trout because their presence provided additional angler interest in the Lake Oroville fishery.

5.1.2 Current Lake Oroville Stocking Program

The current Lake Oroville stocking program goal is to annually stock approximately 170,000 coho salmon in order to provide a satisfactory coldwater fishery. This recent program developed as a result of a severe outbreak of Infectious Hematopoietic Necrosis (IHN) virus in the FRH that began in 2000, and was traced back to the presence of IHN in Lake Oroville salmonids. Lake Oroville forms the water supply for the FRH and DFG was concerned that diseased fish in the lake could infect the hatchery. Therefore, DFG issued a moratorium on stocking any salmonids in Lake Oroville until they completed testing on the IHN susceptibility of various salmonid species and varieties. DFG found that Chinook salmon and brown trout, the two species being stocked up to that time, were capable of transmitting IHN and therefore should no longer be stocked in the lake. DFG found that coho salmon were resistant to IHN and recommended that they be stocked to provide for the Lake Oroville coldwater fishery (DFG 2000). In late 2001, DWR located a private aquaculture facility in Washington State (Aquaseed Corporation) that could be used as a source for coho salmon eggs, and subsequently stocked 178,529, and 172,792 coho salmon in 2002 and 2003, respectively. Coho were scheduled for stocking during 2004, however DFG did not allow the importation of the Aquaseed coho eggs because they failed DFG's disease certification process due to a bacterial disease (*Renibacterium*) that was found in some of Aquaseed's broodstock. Subsequently, DFG advised Aquaseed on better procedures to address the *Renibacterium* problem, and it is anticipated that coho stocking will resume in 2005. The coho stocking levels have loosely been based upon those for Chinook salmon, however this may be adjusted somewhat as this new program is being implemented and more information becomes available.

Table 5.1.1 Lake Oroville Salmonid Stocking History¹

	RBT	BN	CHIN	COHO	KOK	BKT / LT	TOTAL
1968	110,1922	93,035			60,000		1,254,957
1969	185,004	643,400		42,700			871,104
1970	31,200	101,600		60,900	164,200		357,900
1971	24,209	20,500		16,461			61,170
1972	89,006	31,230		89,556			209,792
1973	57,750	31,205		67,320	275,200		431,475
1974	40,705	15,000		37,500			93,205
1975	54,990	21,800		65,460	300,495	2,000	444,745
1976	40,101	18,400	48,280	67,510	230,000		404,291
1977	40,000	34,801		60,013	181,440		316,254
1978	140,000	27,000					167,000
1979	113,314	45,430	22,400				181,144
1980	278,180	20,650					298,830
1981	34,400	51,000					85,400
1982	40,484	37,400	100,225				178,109
1983	10,000	15,000	165,670				190,670
1984		57,700	125,410			54,255	237,365
1985		40,200	197,610	100,000		31,200	369,010
1986	7,400	65,920	43,250	130,000			246,570
1987		68,630		107,205			175,835
1988	221	44,200	55,040	38,500			137,961
1989		28,700	62,305				91,005
1990		57,400					57,400
1991		33,838	203,850	54,000			291,688
1992		68,956	122,980				191,936
1993		131,455	163,235				294,690
1994		50,004	159,610				209,614
1995		65,400	191,923				257,323
1996		88,602	256,276				344,878
1997		67,403	355,000				422,403
1998		55,000	459,133				514,133
1999		50,008	287,040				337,048
2000		155,700	28,600				184,300
2001							0
2002				178,529			178,529
2003				172,792			40,075
TOTAL	2,288,886	2,336,567	3,047,837	1,328,521	1,211,335	87,455	10,300,601

¹ RBT = rainbow trout, BN = brown trout, CHIN = Chinook salmon, COHO = coho salmon, BKT/LT = brook trout/lake trout.

5.2 Thermalito Forebay

5.2.1 Forebay Stocking Program History

The Forebay stocking program began in 1981 and has been much less complicated than Lake Oroville, almost exclusively involving catchable (8 to 12 inches long) rainbow trout and brook trout, with rainbows being the primary species stocked (Table 5.2.1). The brook trout stocking increased during the 1990s to about 25% of the total allotment. In 2003, DFG ceased the stocking of brook trout due to disease concerns at the Feather River Hatchery. No fish barrier exists between the Forebay and the Diversion Pool, so fish can migrate easily between the two water bodies. The water intake for the FRH begins in Diversion Pool, and DFG pathologists were concerned that brook trout, which are fall spawners, may shed IHN virus when they develop reproductive parts in the fall of the year, which is the same time that salmon spawning and early rearing is occurring in the FRH (pers. comm. William Cox, 2004). This decision has not affected the rainbow trout stocking, since rainbows are spring spawners.

5.2.2 Current Forebay Stocking Program

Currently, the Forebay stocking program consists of the Department of Fish and Game stocking approximately 30,000 catchable rainbow trout on an annual basis. This program is implemented as a component of DFG's statewide "put-and-take" fisheries program, as described in the plan DFG released in 2003 entitled, *Strategic Plan for Trout Management, a plan for 2004 and beyond* (Strategic Plan). A put-and-take fisheries program is described in the Strategic Plan as consisting of hatchery trout measuring 10 to 12 inches long being stocked into easily accessible, public water, where the recreational angling demand is high. This program is used in waters where salmonid natural production and growth are inadequate to maintain populations capable of supporting fishing. Presently this program occurs in about 780 miles of streams in California, and 300 coldwater lakes and reservoirs (DFG 2003a). The California Fish and Game Commission has maintained a policy where this program is to be implemented in waters where at least 50% by number or weight of the stocked trout will be caught by anglers, however this policy may be revisited in the future.

DFG periodically conducts tag return studies in order to evaluate the return rate of their catchable trout programs, and this was done for 16 lakes and reservoirs in DFG's Sacramento Valley Central Sierra Region from 2000-2004 periods. The Forebay return rate was 22%, ranking 6th out of 16, the highest being 32% at Sugar Pine Reservoir in Placer County (Table 5.2.2).

Angler use at the Forebay was evaluated in the relicensing studies *SP-R9 Existing Recreation Use* and *SP-R13 Recreation Surveys* that occurred from May 2002 – May 2003. Angling accounted for 24% of the total recreation use of the Forebay, second only to picnicking (32%). Over 90% of the angling at the Forebay was targeting salmonids,

and the vast majority of this was bank fishing due to the easy access at multiple locations, relatively shallow morphology, and lack of significant water level fluctuations. A total of 32,110 recreation days of bank fishing effort occurred, second only to Lake Oroville. Lake Oroville had more bank fishing effort at 48,149 recreation days, though it is 25 times bigger than the Forebay.

Table 5.2.1 Forebay fish stocking history

Year	RBT	BKT	BN	CHIN	Total
1980	NO FISH STOCKED THIS YEAR				0
1981	38,347				38,347
1982	24,765			3,025	27,790
1983	34,922	22,750			57,672
1984	31,346				31,346
1985	58,405				58,405
1986	41,380				41,380
1987	127,435				127,435
1988	76,310				76,310
1989	54,548				54,548
1990	55,150				55,150
1991	54,440				54,440
1992	45,180				45,180
1993	32,190	14,640	7,400		54,230
1994	77,400	5,760			83,160
1995	40,240				40,240
1996	NO FISH STOCKED THIS YEAR				0
1997	29,300	10,660			39,960
1998	18,380	10,150			28,530
1999	28,450	9,740		25,000	63,190
2000	24,700	8,840			33,540
2001	22,400	8,600			31,000
2002	32,350	9,340			41,690
2003	29,830				29,830
2004	14,540				14,540
Total	915,288	91,140	7,400	28,025	1,127,913
RT = Rainbow trout (Combination of all strains)					
BN = Brown trout (Combination of all strains)					
BKT = Brook trout					
CHIN = Chinook salmon					

Table 5.2.2 Angler returns-Central Valley Sierra Region 2000-2004*

Water	Tot. fish released	No. tagged fish released	No. tags returned	Mean day at large	Return rate
Sugar Pine	20,140	1,194	379	943	32%
Fuller	20,050	1,126	344	74	31%
Red	7,800	905	267	43	30%
Scott's Flat Upper	11,800	699	185	113	26%
Ice House	5,500	399	101	43	25%
Thermalito Forebay	8,800	797	173	83	22%
Jenkinson	22,100	1,194	247	89	21%
Folsom	22,575	1,295	239	551	18%
Rollins	10,900	798	137	167	17%
Boca	23,500	1,200	183	706	15%
Donner	108,600	1,899	243	718	13%
Union Valley	5,500	400	49	56	12%
Jackson Mdws.	12,700	299	28	26	9%
Bucks	2,640	500	45	90	9%
Loon	8,950	400	35	58	9%
Stampede	35,000	1,691	90	509	5%

*Data provided by Walt Beer, California Department of Fish and Game, Inland Fisheries Branch

6.0 ANALYSES

6.1 LAKE OROVILLE

The current stocking program for Lake Oroville consists of stocking coho salmon, and this program is in its infancy. Because there are no established criteria currently in place to measure the success of this program, this determination will be based on the best available information, which currently is the criteria developed during the DFG/DWR fishery study conducted from 1993-1999, as well as DFG's *Strategic Plan for Trout Management, a plan for 2004 and beyond* (Strategic Plan). In addition, the definitive test of a successful recreational fishery program will also be applied, that of angler satisfaction.

The modern day concept of stocking coho salmon in an inland water body is not specifically addressed in the Strategic Plan since this document had already been drafted as the coho stocking activities began. However, of the 8 different statewide trout management programs, the coho program best fits within the Inland Salmon Program, which currently only identifies kokanee and Chinook salmon. These programs are managed as "put-and-grow" fisheries in inland lakes and reservoirs, which are described in the Strategic Plan as follows:

"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."

The Strategic Plan states that its overall goal for recreational angling is to manage the trout (and inland salmon) resources for the use and enjoyment of the public, by providing angling opportunities to a diverse angling community, properly addressing angler preferences, while practicing sound fishery and ecosystem management (DFG 2003a). Currently there are 34 lakes in the Strategic Plan's Inland Salmon Program (DFG 2003a). The salmon stocked in this program typically achieve growth to about 14 inches and 16 inches long at 24 months of age, for kokanee and Chinook, respectively. This growth criterion for Chinook reflects that which was learned during the 1993-1999 Lake Oroville fishery study, and provides a suitable tool for evaluating the success of the coho program. In addition, the annual stocking level developed for Chinook salmon at Oroville (170,000) was used for the coho. So far, the coho have exceeded all of the growth criteria used for Chinook. During 2003, numerous coho salmon were caught by anglers that measured over 15 inches long at 18 months of age (DWR unpublished data, 2003) and coho exceeding 22 inches long were caught by DFG electrofishing crews after 24 months of age (DFG unpublished data, 2003b).

Regarding angler satisfaction, the Lake Oroville coho program has been very popular with local anglers (Carson 2003a; ORAC 2004; Reighley 2004) as well as coldwater anglers across California (Carson 2003b). The statewide interest and enthusiasm for this program is a result of the uniqueness of the fishery, since Lake Oroville is the only inland water in California with a coho stocking program, as well as its quality (pers. comm. Steve Carson, 2003). According to anglers at the lake, coho are easier to catch than the Chinook, and their fast growth and well known fighting ability is highly attractive to the angling public (DFG 2001). Numerous requests have been made to continue this program, and inquiries have made about expanding this program to other waters (pers. comm. Steve Carson, 2003b).

The current coho stocking program is meeting the established growth criteria as well as being highly regarded by the coldwater angling community, and therefore, the coho program should be deemed successful in achieving its stocking goals.

As described in the Study Plan SP-F5/7, this program is achieving its stocking goals so a discussion of project operational effects is unnecessary. However, the reliability aspect of this program should be addressed. As previously explained, no coho will be stocked in 2004 due to the aforementioned broodstock disease problem, and this likely will reduce fishing success in 2005. Efforts to alter the current program should be directed at ensuring more reliability in the egg supply, and DFG and DWR are currently in the process of accomplishing this task. Alternative coho hatchery facilities are being investigated, and DWR and DFG will be initiating studies during the fall of 2004 to explore the possibility of using Lake Oroville's adult coho as a brood source. In addition, NOAA Fisheries has expressed concern that stocking coho salmon in Lake Oroville may have negative impacts on Central Valley anadromous salmonids, as well as coastal coho populations if Lake Oroville coho pass downstream of the reservoir. These issues are currently being addressed by DWR, DFG, and NOAA Fisheries, a final determination should be made by the end of 2004.

6.2 THERMALITO FOREBAY

The Thermalito Forebay is ideal for a put-and-take fisheries program because it meets virtually every criteria described in the Strategic Plan. It has easy public access in multiple locations, including handicapped fishing access, ample shoreline availability, improved boat launching facilities for both motorized and non-motorized boats, has high angler use, and it remains a coldwater reservoir all year though it lacks sufficient habitat to support natural production. As a result, the fishery management at the Forebay has required very few changes over its history, and it remains today a very popular fishery.

The Strategic Plan identifies the Fish and Game Commission policy for catchable-sized trout where stocking will occur in waters where at least 50% by number or weight will be caught by anglers. Although the Forebay return rate of 22% falls below that Commission

policy, none of the 16 waters where tag return studies have recently been conducted in DFG's Central Valley-Sierra Region have met this policy (Table 5.2.2), and this is common among many of the put-and-take fisheries across California. This policy was adopted in the late 1950s or early 1960s, and although is still on the books, it is commonly believed by many DFG biologists that this policy is in need of review and modification to reflect modern day fisheries management conditions.

Angler satisfaction is high at the Forebay. According the SP-R13 Recreation Surveys Report, 80% of the anglers surveyed express their satisfaction with the Forebay fishery, which was the second highest for the entire project. Only the Diversion Pool had a higher percentage of satisfied anglers (91%), though this reflected a relatively small amount of angler use (4,371 recreation days).

The current Forebay stocking program appears to be achieving most of the goals specified in the Strategic Plan. It provides attractive angling opportunities to the public, with a high degree of angler satisfaction, and is managed to minimize disease impacts on the Feather River Hatchery by not stocking fall spawning fish. Although it does not meet the Fish and Game Commission's 50% return rate, as explained this antiquated policy may no longer be appropriate in contemporary California recreational fishery management, and is likely to be revised.

As explained in the Study Plan SP-F5/7, a discussion of project operational effects is unnecessary because this program is achieving its stocking goals.

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