
State of California
The Resources Agency
Department of Water Resources

**SP-G2: EFFECTS OF PROJECT OPERATIONS
ON GEOMORPHIC PROCESSES DOWNSTREAM
OF OROVILLE DAM**

TASK 1.1 – RESOURCES AND REFERENCES

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



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FERC Project No. 2100**

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

REPORT SUMMARY

The construction of Oroville Dam has altered the hydraulic, geomorphic, and sediment transport regimes of the Feather River. Study Plan G2 is designed to identify and evaluate ongoing effects of altered downstream hydrology and sediment retention in Lake Oroville on channel morphology and sediment transport in the Lower Feather River. Specifically, the study plan addresses the following components:

1. Determine sediment conditions and sediment transport requirements.
2. Evaluate sediment sources (including tributaries) and conditions.
3. Map major sediment deposits.
4. Evaluate stream channel stability.
5. Evaluate project-affected sediment regimes.
6. Evaluate timing, magnitude, and duration of project-affected flows in relation to geomorphic effects.
7. Determine the effect of the project on fluvial geomorphologic features.
8. Evaluate erosional effects on farmland (private and public trust resources).

Results from these components will be used to identify limiting factors (impacts associated with biological effects) and develop a comprehensive sediment management plan for the purposes of protection, mitigation and enhancement measures to improve river form and function in the Feather River. The study results will also be used to help assess the Oroville facilities ongoing effects on downstream water quality, aquatic and riparian resources, and protection of private lands and public trust resources.

The study plan is organized into individual tasks and sub-tasks that are addressed in separate reports because of the amount and complexity of the data. These are:

- Task 1.1 - obtain, review, and summarize existing resource data and references;
- Task 1.2 – prepare a general description of the lower Feather River and watershed, including mesohabitat typing and large woody debris characterization;
- Task 2 - map and characterize spawning riffles;
- Task 3 - evaluate changes to the channel morphology by re-establishing historic cross-section surveys and photo points;
- Tasks 4, 6 - assess current channel characteristics and monitor selected cross-sections for significant changes to those characteristics; establish bank erosion monitoring sites

- Task 5 - determine project effects on river hydraulic and geomorphic parameters;
- Task 7 - model sediment transport and channel hydraulics; make predictions

This task report fulfills the requirements for “Task 1.1 – Resources and References”. The report presents the sub-tasks, methodology, and results completed to date. It presents and organizes the available resources and references. In effect it is the data foundation on which the other study plan tasks and corresponding reports are based, especially for “Task 7 – Modeling of Sediment Transport with Fluvial-12”. Note that specific cross-section locations, various sampling locations, and photographic reference points are included in the atlases appended with other task reports, especially “Task 2 – Spawning Riffle Characteristics” and “Task 3- Channel Cross-sections and Photography”.

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1.0 INTRODUCTION

Study Plan G2 was designed to evaluate Feather River geomorphic changes resulting from the construction of Oroville Dam. The study reach begins at the Fish Barrier Dam near Oroville and extends to the mouth of the Feather River at Verona, a river distance of about 70 miles. The study plan investigates the hydraulic, geomorphic, and sediment transport changes that have occurred. The effect of these changes on salmonid spawning riffles, flooding, riparian vegetation, riparian habitat, and river habitat was also considered.

Changes in sediment transport were evaluated by use of a sediment transport model. This model will also be used to predict changes in sediment transport and channel meandering resulting from various proposed flow regimes. Based on the results of the study, we will identify needs for protection, mitigation or enhancement activities. The study results will also be used by other studies to help assess and predict the Oroville Facilities ongoing effects over the next 25 and 50 years on downstream water quality, aquatic and riparian resources, and protection of private lands and public trust resources.

This report, *Task 1.1 – Resources and References* is one of eight reports that fulfill the scope of work for study planG2.

1.1 BACKGROUND INFORMATION

The Feather River is an important resource for salmonid spawning habitat in California, second only to the Sacramento River. The completion of Oroville Dam in 1967 reduced this habitat by blocking access to upstream reaches. This includes 25 miles to Miocene Dam on the West Branch, 21 miles to Poe Powerhouse on the North Fork, 19 miles to Curtain Falls on the Middle Fork, and 8 miles to Ponderosa Dam on the South Fork. This loss of spawning habitat was mitigated by the Feather River Fish Hatchery. The Hatchery provides an artificial spawning and rearing facility for Chinook salmon and steelhead.

Oroville Dam also affects hydrology and sediment transport characteristics, altering the movement of water, sediment, and woody debris in the river. The primary function of the dam is to store winter and spring runoff for release into the river as necessary for project purposes. This results in an altered hydrologic regime that includes changes to the yearly, monthly, and daily stream flow distributions; bankfull discharge, flow exceedance, peak flow, and other hydraulic characteristics.

The reservoir along with other hydroelectric projects on the feather river captures most of the sediment eroded from the upper feather watershed. This changes patterns of sediment transport and deposition, scour, mobilization of sediment, and levels of

turbidity. These changes can result in the coarsening of spawning gravel on riffles, which in turn may adversely affect salmon and steelhead.

These changes to the river hydrology and sedimentation patterns also alter the channel morphology. These can include changes to the channel shape, meandering, and capacity.

These potential impacts may extend downriver from Oroville Dam to the junction with the Sacramento River or beyond. These are further complicated by a long history of a variety of land uses along the Feather River including hydraulic mining, gravel mining, gold dredging, timber harvesting, water diversions, and urbanization.

1.1.1 Study Area

The Lower Feather River flows about 72 miles from Oroville Dam to the Sacramento River at Verona. The river flows past distinctive geographic and geomorphic features. These are shown in Table 1.1-1

Table 1.1-1. River Miles, Valley Miles and Related Geographic Features of the Feather River

RIVER MILE (1997 USACE)	RIVER MILE (USGS)	VALLEY MILE	GEOGRAPHIC FEATURE
71.5			Oroville Dam
67.2	67.8		Thermalito Diversion Dam
66.5	67.2		Fish Barrier Dam
66.3	67.0		Table Mountain Bridge
65.0	65.6		Highway 70 Bridge
58.7	59.0		Confluence with Thermalito Afterbay Outflow
50.6	50.8		Gridley Bridge
44.3	44.0		Confluence with Honcut Creek
42.5	42.3		Live Oak
27.9	28.5	24.9	Yuba City and Marysville
27.1	27.5	24.4	Confluence with Yuba River
N/A	25.4	22.6	Upstream End of State Cutoff (1909)
N/A	22.5	20	Downstream End of State Cutoff (1909)
N/A	19.5	17.4	Abbot Lake
N/A	18.8	16.7	Star Bend
N/A	17.0	15.7	O'Conner Lakes

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RIVER MILE (1997 USACE)	RIVER MILE (USGS)	VALLEY MILE	GEOGRAPHIC FEATURE
N/A	13.0	12.3	Lake of the Woods
N/A	12.5	11.6	Confluence with Bear River
N/A	9.6	9.1	Town of Nicolaus
N/A	9.3	8.9	99 Bridge (Garden Highway)
N/A	8.2	8	Upstream End of State Cutoff (post-1911)
N/A	7.5	7.3	Confluence with Sutter Bypass; Downstream End State Cutoff (post-1911)
0.0	0.0	0	Verona, Confluence with Sacramento River

More effort was spent on the 39-mile reach from the Fish Barrier Dam to Yuba City (Figure 1.1-1). Below Yuba City, the Yuba and Bear Rivers join the Feather, and the overall effect of Oroville Dam is reduced and obscured. The study boundary extends laterally to the edge of the 500- year floodplain as defined by the USACE (1997).

The study reach is further divided into four subreaches based on differences in the hydrologic flow regime. The first (the Low Flow Reach) is the 8-mile stretch between the Fish Barrier Dam and the Thermalito Afterbay outflow. The second is the 39-mile reach between the Afterbay outflow and the Yuba River. The third, is the 15 miles from the confluence of the Yuba River to the confluence of the Bear. The fourth, about 12 miles long, begins at the confluence with the Bear and ends at the confluence of the Feather and the Sacramento River at Verona.

Most of the SP-G2 study effort was on the salmon spawning reach between the Fish Barrier Dam and Honcut Creek. The activities included in this reach are: FLUVIAL-12 modeling, sediment sampling, permeability, dissolved oxygen, and temperature measurements. Below Honcut Creek, geomorphic and mesohabitat typing was done, including bank erosion, bank composition, habitat, geology, soils and woody debris.

1.1.2 Description

The Feather River watershed is mainly in the northern Sierra Nevada geomorphic province. The river drains the western slope of the Sierra Nevada and is tributary to the Sacramento River. Some of the headwaters also lie within the Basin and Range geomorphic province, containing both steep forested mountains and large intermountain valleys. The climate is Mediterranean, with mostly dry summers and wet winters. Annual precipitation ranges from 75 inches in the upper watershed to 30 inches in the lower watershed near Oroville Dam.

The Feather River is underlain by resistant metamorphic, volcanic, and plutonic rocks in

the 4-mile reach downriver of Oroville Dam to the Fish Diversion Dam. It is incised into these rocks, forming steep canyon walls.

Below the town of Oroville, the Feather River emerges from the Sierra Nevada into the foothills of the Sacramento Valley. At about three quarters of a mile below the Diversion Dam, at the first major spawning riffle, bedrock is still exposed in the channel. Below Bedrock Park, the river begins to flow in an alluvial channel incised into dissected older alluvial uplands.

The Oroville Wildlife Area, consisting of dredger tailings and borrow pits, occurs from a few miles below Oroville to a few miles above Gridley. Below the dredger tailings, the river meanders through hydraulic mining debris, floodplain deposits, and older terrace deposits.

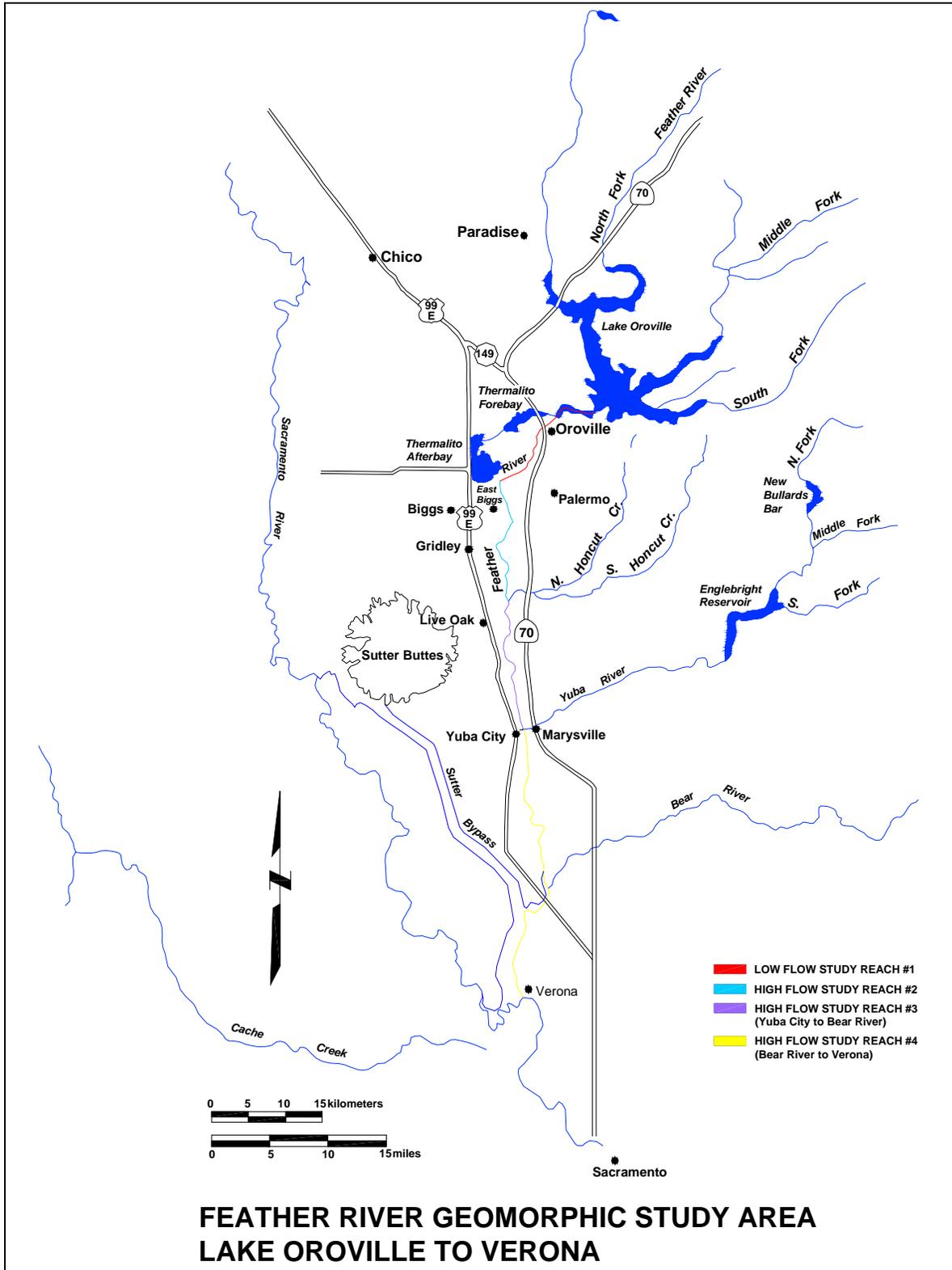


Figure 1.1-1. SP-G2 Geomorphic Study Area and Subreaches, Lake Oroville to Yuba City

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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. A background of the operational design of the facilities is provided as Figure 2.

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. Figure 3 shows an overview of these facilities and the FERC Project boundary. 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.

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 are 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 hydrologic conditions are drier than expected or water 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

2.1 PURPOSE AND SCOPE

A naturally functioning channel in dynamic equilibrium is capable of transporting the water and sediment delivered to it without significantly changing its geometry, streambed composition, or gradient through time. The flow conditions that promote this stability can be described as geomorphically significant flows (bankfull). These flows do the majority of the sediment transport and are considered most responsible for channel form. A natural flow regime typically includes flow ranges responsible for in-channel clearing and overbank flows to support riparian vegetation, along with channel-forming flows.

Project -related structures and operations alter flow regimes, which can impact the occurrence of geomorphically significant flows. Potential adverse effects include loss of undercut banks, increased fine sediment from loss of flushing flows, loss of channel capacity, reduced sediment transport capability, channel scour, armoring, and impairment of the ability of the stream to maintain functional riparian and instream habitat.

This geomorphic investigation compares historic and current conditions to help identify ongoing project effects to the downstream reaches. It will be used by other studies to help assess the Oroville Facilities effects on plant, fish, animal, and riparian resources caused by hydrologic, channel, and sediment routing changes.

3.0 STUDY OBJECTIVE(S)

3.1 APPLICATION OF STUDY INFORMATION

The objective is to determine the ongoing effects of altered downstream hydrology and sediment retention in Lake Oroville on channel morphology and sediment transport below Lake Oroville.

The study will determine the ongoing Oroville Project effects on river flows and morphology downstream of Oroville Dam. Specifically, the study will address the following components:

1. Determine sediment conditions and sediment transport requirements.
2. Evaluate sediment sources (including tributaries) and conditions.
3. Map major sediment deposits.
4. Evaluate stream channel stability.
5. Evaluate project-affected sediment regimes.
6. Evaluate timing, magnitude, and duration of project-affected flows in relation to geomorphic effects.
7. Determine the effect of the project on fluvial geomorphologic features.
8. Evaluate erosional effects on farmland and public trust resources.

This Task 1.1 report details the resources and references available to the other SP-G2 task reports. The physiographic setting of the Feather River and its watershed is presented elsewhere as the Task 1.2 report.

Study results will be used to identify limiting factors and biological effects. The information will be used to develop a comprehensive sediment and flow regime management plan to improve form and function in the Feather River. The study results will also be used by other studies to help assess the Oroville Facilities ongoing effects on downstream water quality, aquatic and riparian resources, and protection of private lands and public trust resources.

4.0 STUDY ORGANIZATION

4.1 STUDY DESIGN

The original seven individual tasks and sub-tasks specified in the SP-G2 study plan have been re-organized into the following reports:

- Task 1.1 - obtain, review, and summarize existing resource data and references.
- Task 1.2 – prepare a general description of the lower Feather River and watershed.
- Task 2 - map and characterize spawning riffles.
- Task 3 - evaluate changes to the channel morphology by re-establishing historic cross-section surveys and photo points.
- Tasks 4, 6 - assess current channel characteristics and monitor selected cross-sections for significant changes to those characteristics; establish bank erosion monitoring sites.
- Task 5 - determine project effects on river hydraulic and geomorphic parameters.
- Task 7 - model channel hydraulics and sediment transport and make predictions for future project related changes.
- Task 8 - summary statement with conclusions, recommendations

Each of these bulleted items is a separate report.

This report fulfills the requirements for Task 1.1 to obtain, review and summarize existing resource data and references.

4.2 HOW AND WHERE THE STUDIES WERE CONDUCTED

DWR Northern District – Geology staff has worked on SP-G2 for the last year. Office work has focused on researching and collecting references and data sets from library, internet, and archive searches. The work included compilation of maps and aerial photographs, and cataloguing cross-sections and geomorphic data. The work has been geared to providing data for development of the Fluvial-12 sediment transport model and the other task reports.

Previous work on the Feather River was compiled using the State Resources Agency Library and extensive in-house publications. Cross-section locations are plotted on an aerial photo atlas that is an appendix to another task report.

5.0 STUDY RESOURCES AND REFERENCES

5.1 AERIAL PHOTOGRAPHY

The available photography was compiled and sorted by date. The historical photography is a valuable resource for charting changes in stream morphology, vegetation, land use, and other data. The 1998, 1986, 1967, 1962 and 1956 aerial photography of the Low and High Flow reaches were rectified by DWR-Photogrammetry and compiled into working AutoCad base files by DWR-Northern District, as listed in Table 5.1-1. River meanders have also been digitized from this photography by DWR-Central District and presented separately in the Task 6 report and appendices. This rectification process was also done for the 1909 Debris Commission plates. Numerous other data sets are available. Most of these are listed in Table 5.1-2.

Table 5.1-1. Lower Feather River – Rectified Historical Aerial Photography and Topographic Maps

Photaset Description		Coverage		Image Data				
Photograph or Survey Dates	Source of Photaset	upstream river mile	downstream river mile	Original Scale of photo (or plate)	Final Resolution	Color / BW	Overall Quality	Variance from DOQQ (m)
8/98 to 7/99	USGS DOQQ	71.52	0.00	1:40,000	1 m	BW	fair	standard
Nov-86	DWR Photogrammetry	71.52	11.20	1:24,000		BW	fair/poor	up to 10
Dec-67	DWR Photogrammetry	69.05	27.10	1:12,000		BW	good	up to 6
Mar-62	DWR Photogrammetry	69.15	53.50	1:12,000		BW	good	up to 35
May-56	DWR Photogrammetry	62.10	24.50	1:24,000		BW	fair	up to 15
9/09 to 10/09	Debris Commission Survey	66.40	0.00	1:4,800 upper 1:9,600 lower		BW	good	up to 20

Table 5.1-2. Index of Historical Aerial Photography for the Lower Feather River

Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1858	DWR-ND	Boca Ranch Survey	Oroville to Verona	Hard Copy			in DWR 1982 report
1870	DWR-ND	Huber Grant Survey	Oroville to Verona	Hard Copy			in DWR 1982 report
3/1/1907	FLOOD - 230,000 cfs						
9/10/1909	DWR-ND	USADC	Oroville to Verona	Scanned hard copies			E-plates from CSUC
3/1/1928	FLOOD - 185,000 cfs						
11/2/1937	USDA	USDA				--	
11/27/1937	USDA	USDA				--	
12/1/1937	FLOOD - 185,000 cfs						
12/13/1937	USCE	USCE	Nicholas to Hamilton			1"=833'	
1937	DWR-CD			Slides	Ed Morris		
1937	Commercial			Black and White		1:20,000	Historical Photos
1937	UC-Davis				UCD		Index only
1937	DWR-ND		Feather River : AAX				
4/1938	USCE	USCE	Oroville to Nicolaus			1"=833'	
10/26/1941	Whittier	Whittier	Marysville-Gridley Area			--	
1941	Commercial			Black and White		1:18,000	Historical Photos
4 and 5 1945	USCE, ND	USCE	Feather River--Oroville to Marysville			1"=1000'	
7/20/1945	USBR	USBR	Verona to Oroville			--	
1945	Commercial			Black and White		1:12,000	Historical Photos
1946	Commercial			Black and White		1:24,000	Historical Photos
1946	Commercial			Black and White		1:48,000	Historical Photos
2/22/1947	NASA		Feather River Region			1:28,400	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
6/13/1947	NASA		Feather River Region			1:23,600	
7/10/1947	NASA		Feather River Region			1:23,600	
7/22/1949	USCE	USCE	Feather River-- Hamilton Bend & Vicinity			1"=800'	
1949	Commercial			Black and White		1:20,000	Historical Photos
9/1/1951	Whittier	Whittier	Sacramento Valley			--	
1951	Commercial			Black and White		1:20,000	Historical Photos
1951	Commercial			Black and White		1:69,996	Historical Photos
6/1/1952	USDA	USDA	Sacramento-San Joaquin Valley Counties			--	
6/26/1952	DWR		Feather River			1"=1925'	DWR-AAZ-2K
6/26/1952	NASA	NASA	Feather River East of Live Oak			--	
7/1/1952	USDA	USDA	Sacramento-San Joaquin Valley Counties			--	
8/1/1952	USDA	USDA	Sacramento-San Joaquin Valley Counties			--	
8/22/1952	USDA	USDA	Marysville to Honcut Creek			--	
9/1/1952	USDA	USDA	Sacramento-San Joaquin Valley Counties			--	
9/18/1952	DWR		Oroville: Vic. of Butte County (West of Feather River)				
9/18/1952	NASA	NASA	Feather River Region			1:15,673	
1952	DWR-CD			Slides			
1952	DWR-CD		Butte	Slides			

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1952	Commercial			Black and White		1:20,000	Historical Photos
1952	Commercial			Black and White		1:57,673	Historical Photos
1952	UC-Davis		Oroville Area		UCD	1:1667	partial photo set
1952	--	--	Relocation: Oroville-Feather Falls County Highway			1:800	
1952	--	--	Oroville Dam Site Area			1:2000	
1/28/1953	--	--	Western Div. Canal to Honcut Creek			1"=800'	
11/12/1955	USCE	USCE	Feather River from Mouth to Oroville			1"=1000'	
12/1/1955	FLOOD - 203,000 cfs						
1/16/1956	USCE	USCE	Verona to Oroville			1"=1000'	
5/1956	DWR		Feather River: Thermalito to Verona			1:24000	
8/1956	DWR		Upper Feather River			1:6,000 1:12000 1:20:000	
9/22/1956	DWR-PHOTO		: Upper Feather River Service Area, Plumas Co.			1:6,000 1:12000 1:20:000	
3/23/1957	DWR-CD		Feather River	photos+scans			no other references, misc.frames
3/23/1957	DWR		Oroville: Vic. of Butte County (West of Feather River)				
5/27/1957	DWR		Upper Feather River Area			1:6,000 1:24,000	
6/20/1958	DWR--CD	DWR--CD	Feather River			--	
1958	DWR-CD			Slides			
1958	Commercial			Black and White		1:20,000	Historical Photos
1958	UC-Davis						Photo set

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1958	--	--	Butte County (partial) *			1:1667	
3/10/1959	Central District		Feather River	photos+scans		1:9,000	misc. frames
3/10/1959	NASA	NASA	DWR 150268-- Feather River, U-2			--	
5/16/1961	DWR	DWR	DWR -1-365, Verona to Oroville			--	
8/29/1961	Caltrans	Caltrans	Yuba City to Thermalito			--	
1961	DWR-CD			Color Slides			
1961	Commercial			Black and White		1:36,000	Historical Photos
1961	DWR-ND	DWR- PHOTO	Feather River: Oroville Fish Facilities	Scanned Mylars			
2/1962	DWR, NASA		Feather River: Seepage Investigation			1:24000	
5/30/1962	DWR		Feather River: Seepage Investigation			1:24000	
10/15/1962	DWR		Oroville: Feather Falls Road Relocation			1:9,000	
10/1962	DWR		Feather River: Seepage Investigation			1:24000	
1962	Commercial			Black and White		1:20,000 1:41,000	Historical Photos
1962	UC-Davis				UCD		Photo set
1962	DWR-ND		Feather River: 752243				
1/1/1963	FLOOD - 191,000 cfs						
2/1/1963	USCE	USCE	Nelson Bend to Oroville			1"=400' 1"=200'	
2/22/1963	DWR-PHOTO		Feather River: Seepage Investigation			1:24000	
2/22/1963	NASA, DWR	NASA	Verona to Sutter Butte Dam, U-2			--	
2/28/1963	USGS	USGS	Verona to Oroville			--	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
4/1963	NASA, DWR		Feather River: Seepage Investigation			1:24000	
5/27/1963	NASA, DWR		Feather River: Seepage Investigation			1:24000	
6/1/1963	DWR		Feather River: Seepage Investigation			1:24000	
9/1/1963	DWR-ND		Lower Feather River				
9/20/1963	DWR		Feather River: Channel Characteristics - Verona to Rock Piles			1:12000	
23274	DWR-ND	DWR	Feather River: Oroville Fish Facilities	Scanned Mylars			
9/20/1963	NASA	NASA	DWR-752838, Verona to Oroville, U-2			1:12,000	
10/18/1963	NASA	NASA	Verona to Sutter Butte Dam, U-2			--	
1963	DWR-CD		Feather River	B/W Photos		1:20K ?	
1963	Commercial			Black and White		1:36,000	Historical Photos
1963	DWR-ND		Feather River: 752838-2				
1963	--	--	Feather River, Simmerly Slough, Nelson Bend to Oroville			1"=400'	
2//1964	USCE	USCE	Mouth of Feather River to below Oroville			1"=1000'	
3/7/1964	USCE	USCE	Mouth of Feather River to below Oroville			1"=1000'	
5/6/1964	DWR		Feather River: Yuba River Simmerly Slough			1:20000	
5/23/1964	USDA, PMA		Feather River			--	
6/19/1964	DWR		Feather River: South Fork Bridge			1:3,000	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
6/1964	DWR		Feather River:			1:6,000 1:9,000 1:24000	
6/28/1964	USDA		Honcut Creek to Hamilton Bend and Wyman Ravine			--	
23585	DWR-ND	DWR-PHOTO	Feather River: Oroville Borrow Area	Scanned Mylars			
9/11/1964	DWR		Feather River: South Fork			1:8,250	
12/1/1964	FLOOD - 158,000 cfs						
1964	Commercial			Black and White		1:20,000	Historical Photos
1964	UC-Davis				UCD		Photo set
1964	--	--	Butte County (partial)			1:1667	
2/1965	DWR, NASA		Feather River: Seepage Investigation			1:4,800 1:24000	WR-J, 1470
2/26/1965	DWR		Feather River: Sutter County			1:4,800	WR-K
3/3/1965	DWR, NASA		Yuba City to Oroville			1:3,000 1:24,000	WR-N
4/1965	DWR, NASA		Feather River Flood			1:12000 1:6,000	
5/8/1965	USCE	USCE	Feather River--Mouth of Honcut to Sacramento River			1"=500'	
1965	DWR-ND		Feather River: 754168				WR-S
6/2/1966	DWR-PHOTO		Feather River: Nelson Bend			1:12000 1:24000 1:3,000	WR-AAB
8/10/1966	DWR-PHOTO		Thermalito Afterbay: Outlet Structure, Feather River			1:3,000	WR-AAG
8/24/1966	DWR-PHOTO		Upper Feather Service Area			1:24000	
6/16/1967	NASA	NASA	DWR--Verona to Oroville			1:24,000	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
10/11/1967	Western Aerial	Western Aerial	Thermalito Forebay Western Aerial			--	
11/2/1967	Western Aerial	Western Aerial	Thermalito Forebay Western Aerial			--	
11/2/1967	NASA	NASA	DWR--Sutter Butte Dam to Fish Barrier Dam			1:6000	
11/1967	DWR-CD, NASA		Butter Butte Dam to Fish Barrier Dam	photos+scans		1:6,000	WR-AAZ
12/1967	DWR, NASA		Feather River: Verona to Oroville			1:12000	WR-ABA
12/27/1967	DWR-CD NASA	NASA	Thermalito Borrow Area, 3150, U-2			1:6000	WR-AAZ
1967	DWR-CD			Color Slides			
1967	--	--	Verona to Oroville--infrared photos			1"=100'	
1967	--	--	Thermalito Forebay			1"=400'	
1/18/1968	DWR-CD NASA			photos+scans		1:6,000	WR-AAZ
1/23/1968	DWR-CD NASA	NASA	Western Canal to Fish Barrier Dam			1:6000	WR-AAZ
3/1968	DWR, NASA		Oroville Dam to Thermalito Diversion Dam			1:6,000	WR-ABF
5/1/1968	DWR, NASA	NASA	DWR--1968 River Atlas			--	
5/1968 6/1968	DWR		Feather River			1:60,000 1:24000	WR-ABI
5/26/1968	DWR-PHOTO		Feather River			1:60000	WR-ABI
6/24/1968	DWR-PHOTO		Feather River			1:24000	WR-ABI
1968	Commercial			Black and White		1:20,000 1:30,000	Historical Photos
1968	--	--	Sacramento-Feather Rivers			1"=2000'	
1/22/1969	DWR	DWR	DWR 3683--Oroville Diversion Dam to Sacramento City			--	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1/23/1969	DWR	DWR	DWR 3683--Oroville Dam to Nelson Bend			--	
1/29/1969	DWR, NASA		Verona to Oroville	INFRARED		1:12,000	WR-ABM-1
3/4/1969	NASA	NASA	Thermalito Afterbay	U-2		--	
4/29/1969	DWR, NASA		Verona to Oroville	INFRARED		1:12000	WR-ABM-2
4/29/1969	NASA	NASA	DWR--Verona to Thermalito Afterbay			1:12,000	
6/17/1969	DWR, NASA		Honcut Creek to Thermalito Afterbay Outlet			1:6,000	WR-ABX
7/13/1969	NASA	NASA	Feather River Region,	U-2		1:20,700	
8/1969	NASA	NASA	Feather River Region, U-2			1:30,000	
1969	DWR-CD			Color Slides			
1969	Commercial			Black and White		VARIOUS	Historical Photos
1969	USGS		Feather River Area	USGS topo quads			
1969	--	--	Honcut to Thermalito			1"=500'	
1969	--	--	Vicinity of Davis, Marysville, Sacramento, Roseville			1"=5200'	
1/1/1970	FLOOD - 56,000 cfs						
1/27/1970	DWR, NASA	NASA	Verona to Oroville	U-2		1:12,000	WR-ABM-3
8/4/1970	D. Young	D. Young	Feather River at Honcut Creek, Thermalito Afterbay			--	
8/7/1970	DWR	DWR-Rec Board	Live Oak to Oroville			1:6000	2926
9/26/1970	DWR		Oroville Airport to Oroville				2956

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
10/13/1970	DFG	F & G	Honcut Creek to Feather River Hatchery			--	
11/5/1970	D. Young	D. Young	Marysville to Hamilton Bend and West Side of Thermalito Afterbay			--	
1970	DWR-CD			Color Slides			
1970	Commercial			Black and White		1:40,000 1:60,000	Historical Photos
1970	Commercial			Color Infrared		1:60,000	Historical Photos
1970	Commercial			Color Infrared		1:60,035	Historical Photos
1970	UC-Davis				UCD		Index only
1970	USGS		Feather River:	USGS topo quads			
1970	--	--	Feather River-- Salmon Spawning Section			1"=200'	
1/20/1971	DWR, NASA		Verona to Oroville	INFRARED		1:12000 1:2,000	WR-ABM-4 WR-ABM-5
3/29/1971	NASA	NASA	Verona to Oroville			1:12,000	
9/1971 10/1971	NASA	NASA	Feather River	U-2		1:450,000 1:130,000	
12/1971	NASA	NASA	Feather River Region,	U-2		1:450,000	
1971	Commercial			Black and White		1:20,000	Historical Photos
1971	UC-Davis				UCD		Index
1/31/1972	NASA	NASA	Feather River Region	U-2		1:488,000	
2/1972	DWR, NASA		Oroville Area	U-2		1:6,000 1:16,000	WR-AAZ
3/4/1972	DWR		Sacramento River & Tributaries inc. Feather River			1:24000	3265

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
3/1972	DWR, NASA		Sacramento River & Tributaries inc. Feather River	U-2		1:24000 1:450,000	3265
3/11/1972	DWR-PHOTO		Feather River Flood				
3/27/1972	NASA	NASA	Feather River Region, U-2			1:450,000	
4/19/1972	DWR		Verona to Oroville			1:24000	3265 FEA
5/2/1972	NASA	NASA	Feather River Region, U-2			1:450,000	
5/1972 6/1972	NASA	NASA	Feather River Region, U-2	U-2		1:450,000	
8/2/1972	D. Young	D. Young	DWR--Feather River			--	
10/3/1972	NASA	NASA	Feather River Region,	U-2		1:130,000 1:450,000	
1972	Commercial			Black and White		1:24,000	Historical Photos
1972	UC-Davis		Plumas National Forest		UCD		
1972	--	--	Sacramento River-- Keswick Dam to Collinsville			1"=2000'	
1/26/1973	DWR		Feather River: Fremont Weir to Nicolaus				3441
1/26/1973	DWR-Rec. Board	DWR-Rec Board	DWR--2495 Series, Freemont Landing			--	
2/16/1973	NASA	NASA	Feather River Region	U-2		1:430,000 1:32,000	
3/12/1973	NASA	NASA	Feather River Region,	U-2		1:130,000	
3/23/1973	DWR-PHOTO		Feather River: Oroville & South			1:2,400	WR-ADC
26746	DWR-ND	DWR-PHOTO	Hatchery to Robinson Riffles	Scanned Mylars			
4/2/1973	NASA	NASA	Feather River Region,	U-2		1:130,000 1:400,000	
4/11/1973	DWR		Feather River: Oroville & South			1:6,000	WR-ADC
5/7/1973	NASA	NASA	Feather River Region,	U-2		1:128,000	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
5/1973	DWR-PHOTO		Feather River: Verona to Oroville	U-2		1:12000 1:130,000	WR-ABM-7
6/3/1973	NASA	NASA	Feather River Region	U-2		1:64,588	
6/11/1973	NASA	NASA	Feather River Region	U-2		1:127,000 1:32,000	
7/1/1973	NASA	NASA	Feather River Region	U-2		1:30,000 1:130,000	
8/12/1973	NASA	NASA	Feather River Region	U-2		1:120,000	
9/12/1973	NASA	NASA	Feather River Region	U-2		1:60,000 1:120,000	
10/10/1973	NASA	NASA	Feather River Region,	U-2		1:130,000 1:30,000	
1973	DWR-CD		Butte Co.	Slides	Ed Morris		
1973	Commercial			Black and White and infrared		1:30,000 1:60,000	Historical Photos
1/1974	NASA, DWR	NASA	Feather River Region	U-2		1:30,000 1:130,000	WR-ABM
2/22/1974	NASA	NASA	Feather River Region	U-2		1:130,000 1:30,000 1:450,000	
4/3/1974	NASA	NASA	Feather River Region	U-2		1:32,000	
4/17/1974	NASA	NASA	Feather River Region	U-2		1:450,000 1:130,000	
6/11/1974	D. Young	D. Young	DWR #73-111--- Marysville to Gridley Bridge			--	
8/1/1974	NASA	NASA	Feather River Region	U-2		1:130,000	
9/25/1974	NASA	NASA	Feather River Region	U-2		1:130,000	
10/10/1974	DWR		Feather River			1:6,000	WR-ADZ
11/5/1974	NASA	NASA	Feather River Region	U-2		1:30,000 1:130,000	
1974	Commercial			Black and White		1:32,000	Historical Photos
1974	Commercial			Black and White		1:33,000	Historical Photos
1974	Commercial			Black and White		1:35,000	Historical Photos

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1974	Commercial			Black and White Infrared		Various	Historical Photos
3/26/1975	NASA	NASA	Feather River Region	U-2		1:30,000 1:130,000	
4/27/1975	DWR		Feather River below Yuba City			1:24000	WR-AEI-2 WR-AEI-1
5/6/1975	DWR-CD			photos+scans			WR-ABM
5/6/1975	DWR, NASA		Feather River : Mouth to River mi 60 (dredging)			1:24000	WR-ABM-9
5/29/1975	CH2M Hill, Redding	CH2M Hill, Redding	Verona to North of Gridley			--	
6/13/1975	NASA	NASA	Feather River Region	U-2		1:130,000	
7/9/1975	NASA	NASA	Feather River Region	U-2		1:3000 1:12,000	
8/6/1975	NASA	NASA	Feather River Region	U-2		1:130,000	
9/29/1975	NASA	NASA	Feather River Region, U-2			1:32,000 1:130,000	
1975	Commercial			Black and White, infrared		1:24,000 1:30,000	Historical Photos
1/16/1976	NASA	NASA	Feather River Region	U-2		1:33,000	
2/10/1976	DWR-CD		Feather River	photos+scans			
3/25/1976	NASA	NASA	Feather River Region	U-2		1:130,000 1:30,000	
5/20/1976	NASA	NASA	Feather River Region	U-2		1:131,000	
6/1976	CH2M Hill, Redding	CH2M Hill, Redding	DWR--CH2M Hill, Marysville to Gridley Bridge			--	
7/1976	NASA	NASA	Feather River Region	U-2		1:130,000	
8/9/1976	NASA	NASA	Feather River Region, U-2			1:129,000	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
8/9/1976	NASA	NASA	Feather River Region	U-2		1:127,000	
1976	DWR-CD			Color Slides			
1976	Commercial			Black and White, Infrared		1:30,000	Historical Photos
5/16/1977	NASA	NASA	Feather River Region	U-2		1:130,000	
6/14/1977	DWR		Feather River			1:12000	F.R. (CIR)
6/14/1977	DWR, CH2M Hill, Redding	CH2M Hill, Redding	Marysville to Gridley Bridge			--	
6/23/1977	NASA	NASA	Feather River Region	U-2		1:78,000	
7/27/1977	NASA	NASA	Feather River Region	U-2		1:130,000	
10/7/1977	DWR		Feather River: Oroville			1:3,000	WR-AGV (BP)
28405	DWR-ND	DWR	Feather River Recreation Sites	Scanned Mylars			
10/7/1977	NASA	NASA	Feather River Recreation at Oroville			--	
1977	Commercial			Black and White		1:78,000	Historical Photos
6/15/1978	DWR, CH2M Hill		Marysville to Gridley			--	
7/11/1978	NASA	NASA	Feather River Region	U-2		1:80,000	
1978	DWR-CD			Color Slides			
1978	Commercial			Black and White, Infrared		1:32,000	Historical Photos
1978	UC - Berkeley library		Oroville and Feather River	Color photos	UCB	1:32,500 1:80,000	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1/16/1979	NASA	NASA	Oroville			--	
6/1979	D. Young	D. Young	Feather River			--	
6/27/1979	NASA	NASA	Feather River Region	U-2		1:130:000	
1979	Commercial			Black and White		1:40,000	Historical Photos
1979	Stanford			Color	Stanford	1:130,000	map-file ref #G4361.A43 1979 .A5
1979	UC-Davis	--	Feather River			1"=2,000'	
1/1/1980	FLOOD - 70,000 cfs						
1/14/1980	DWR	DWR	Nelson Bend to Oroville			--	
1/1980	DWR	DWR	Oroville Dam to Verona			1:12000 1:130,000	WR-AKB
2/22/1980	DWR		Feather River Flood: Nicolaus			1:12000	WR-AKB-2
6/9/1980	NASA	NASA	Feather River Region	U-2			
6/10/1980	CH2M Hill, Redding	CH2M Hill, Redding	Yuba City to Gridley			1:12,000	
6/26/1980	NASA	NASA	Feather River Region, U-2			1:80,000	
1980	Commercial			Black and White, Color, Infrared		1:80,000 1:24,000 1:65,000	Historical Photos
1980	--	--	Feather River--Flood			1"=1,000'	
3/27/1981	DWR		Thermalito Afterbay Thermalito Diversion Dam:			1:3,600 1:6,000	WR-ALY WR-ALX
6/3/1981	DWR-PHOTO		Feather River: Honcut Creek to Oroville Dam			1:12000	WR-AMC
6/15/1981	DWR	DWR	Feather River Spawning Gravel Baseline Study			1"=1,000'	

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1981	DWR-CD		Butte	Slides			
1981	Commercial			Black and White, Color, Infrared		various	Historical Photos
1981	UC-Davis				UCD		Photo set and Index
1981	DWR-ND		Feather River:				WR-AMC
4/1/1982	FLOOD - 57,000 cfs						
1983	Commercial			Black and White		Various	Historical Photos
1984	DWR-CD			Color Slides			
1984	Commercial			Black and White, Color		various	Historical Photos
1984	UC-Davis				UCD		Photo sets
1985	Commercial			Color, Infrared		1:50,000 1:66,000	Historical Photos
2/1/1986	FLOOD - 134,000 cfs						
2/1986	DWR		Verona to Oroville			Various	WR-AQP-2 WR-AQR-2 WR-AQQ
3/14/1986	DWR		Gridley Bridge to Oroville Bridge			1:12000	WR-AQR-3-C
11/1986	DWR		Feather River: Sacramento River to Oroville Dam			1:24000	WR-ASL
11/25/1986	DWR-PHOTO		Feather River: Sacramento River to No. of Marysville			1:54000	WR-ASI
1986	Commercial			Black and White, Color, Infrared		1:12,000 1:30,000	Historical Photos

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1986	UC-Davis		Feather River: Oroville Dam to Sac River		UCD		
1/13/1987	DWR		Feather River: Sacramento River to Oroville Dam			1:24000	WR-ASL
6/30/1987	USGS		Afterbay				
6/30/1987	USGS		Oroville Dam to Verona	Color Infrared			
10/26/1987	DWR		Feather River: Mi. 54 to Oroville Dam			1:12000	WR-ATO-C
1987	Commercial			Color Color Infrared		Various	Historical Photos
8/8/1988	USGS		Oroville west	CIR			
8/18/1988	USGS		Oroville	CIR			
1988	Map Mart - Intrasearch		Oroville Reservoir to Thermolito Afterbay	CIR		1:40,000	94.09% coverage
1988	Commercial			Black and White, Color, Infrared		Various	Historical Photos
1988	UC-Davis				UCD		NAPP Photo Set
4/4/1989	DWR		Yuba River: Feather River to Daguerra Pt. Dam			1:12000	WR-AVU
1989	Map Mart - Intrasearch		Oroville Reservoir to Thermolito Afterbay			1:40,000	16.6% coverage
1989	Commercial		Feather River	Black and White, Color Infrared		Various	Historical Photos
10/19/1990	DWR		Feather River: Honcut Creek to Oroville Dam			1:4,800	WR-AYE
10/29/1990	DWR		Feather River: Honcut Creek to Oroville Dam			1:4,800	WR-AYE
1990	DWR-CD			Color Slides			
1990	Commercial			Black and White Color Infrared		Various	Historical Photos
1990	DWR-ND		Feather River:				WR-A4D-C
1/1/1991	DWR-ND		Feather River:				WR-A4D-C

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1991	Commercial			Black and White Color Infrared		1:28,000	Historical Photos
1991	USGS		Feather River:	USGS DOQQ's			
1992	Commercial			Color Infrared		1:62,500	Historical Photos
6/15/1993	USGS		Yuba City to Oroville	B/W			
7/28/1993	USGS		Oroville	B/W	USGS		
7/30/1993	USGS		Oroville west	Black and White			
1993	Map Mart - Intrasearch		Oroville Reservoir to Thermolito Afterbay	Black and White		1:40,000	100% coverage
1993	Commercial			Black and White		1:12,000	Historical Photos
1994	Commercial			Color Color Infrared		Various	Historical Photos
4/25/1995	DWR		Feather River: Oroville			1:12000	WR-BFF-C
11/29/1995	DWR		Feather River Salmon Beds: Honcut Creek to Fish Barrier Dam			1:3,000	WR-BGV-C
12/26/1995	DWR		Feather River Salmon Beds: Honcut Creek to Fish Barrier Dam			1:3,000	WR-BGW
1995	DWR-CD			Black and White			
10/14/1996	DWR		Feather River Salmon Beds: Honcut Creek to Fish Barrier Dam			1:3,000	WR-BIE-CIR
1996	DWR-ND		Feather River				: WR-BHA-C
1/1/1997	FLOOD - 161,000 cfs						
1/3/1997	DWR		Feather River Flood: Bear River to Honcut			1:9,000	WR-BIN
1/3/1997	DWR		Oroville Dam to Sacramento River			1:12000	WR-BIN
1/3/1997	DWR		Feather River Flood: Oroville Dam to Sacramento River			1:12000	WR-BIN

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1/3/1997	DWR		Yuba River Flood (Lines 11 & 12): Hallwood Rd. to Feather River			1:12000	WR-BIN
1/4/1997	DWR		Bear River Flood: Western Pacific R.R. to Feather River			1:12000	WR-BIV
5/1/1997	USCE		Feather River	Topographic Map			
5/30/1997	DWR		Feather River: Levee Repair			1:6,000	WR-BJX-C
5/30/1997	DWR		Feather River: Mile 54 to Oroville			1:12000	WR-BJW-C
7/17/1997	DWR		Feather River: Mile 20 - 21			1:6,000	WR-BKG-C
7/17/1997	DWR		Feather River: Nicolaus to Marysville			1:12000	WR-BKF-C
7/25/1997	DWR		Feather River: Levee Repair			1:6,000	WR-BKE-C
10/13/1997	DWR		Feather River: Vegetation Study			1:12000	WR-BKL-CIR
12/1/1997	DWR		Feather River: Salmon Beds			1:3,000	WR-BKP
1997	DWR-CD			Photos			
8/18/1998	USGS		Oroville-Yuba City	Black and White			
8/21/1998	USGS		Afterbay to Sunset Pumps	Black and White			
9/1998	USGS		Oroville to Sunset Pumps	Black and White			
10/21/1998	DWR		Fish Barrier Dam to Verona			1:3,000	WR-BMX
11/20/1998	DWR		Fish Barrier Dam to Honcut Creek			1:3,000	WR-BMX-2
1998	DWR-CD			B/W Photos		1:20,000	
1998	DWR-CD		Butte				
1998	Map Mart - Intrasearch		Oroville Reservoir to Thermolito Afterbay	B&W		1:40,000	100% coverage

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Date	Available From	Source	Geographic Coverage	Film/ Drawing Type	Contact	Scale	Comments
1998	Map Mart - Intrasearch		Oroville Reservoir to Thermolito Afterbay	Black-and-White		1 Meter Pixel	100% coverage
1998	Commercial - Intrasearch			Black-and-White		1:39,600	
1998	DWR-ND	USGS	Feather River:	USGS DOQQ's			
7/28/1999	USGS		Sunset Pumps -Yuba City	B/W			
9/29/1999	DWR		: Fish Barrier Dam to Honcut Creek			1:3,000	WR-BOE
10/26/1999	DWR		Fish Barrier Dam to Honcut Creek			1:3,000	WR-BOE-2
11/2/1999	DWR		Yuba River Salmon Beds: Englebright Reservoir to the mouth of the Feather River			1:2,400	DFG-BOC-3
12/7/1999	DWR		Feather River: Fish Barrier Dam to Honcut Creek			1:2,000	WR-BOE-3
1999	Commercial - Intrasearch			B&W		1:40,000	
1999	Commercial - Intrasearch			Black-and-White		1 Meter Pixel	
1999	DWR-ND Land Use			color photos		1:24,000	4 meter resolution
1999	DWR-ND		Feather River				WR-BOK-C
2000	Map Mart - Intrasearch		Feather River	Color Satellite		15 Meter Pixel	100% coverage
10/31/2001	DWR		Feather River			1:7,200	WR-BQS-C
11/1/2001	DWR		Feather River			1:7,200	WR-BQS-C
11/1/2001	DWR-ND		Lower Feather River				
2001	Commercial - Intrasearch			Color		2 Foot Pixel	

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5.2 TOPOGRAPHIC AND GEOLOGIC MAPS

A set of base maps were obtained for plotting the data. A set of these maps is in the DWR map library. Other maps have also been catalogued. These maps vary in scale, age, and quality.

An aerial photo atlas published by DWR also shows spawning riffle and cross-section locations. These are useful for quantifying historic river channel changes and ongoing project effects.

Geologic maps available for the area were tabulated. Maps of the Lake Oroville and lower Feather River area were prepared.

Table 5.2-1. Index of USGS Topographic Quadrangles for the Lower Feather River

Quad Name	USGS Code	Scale	Year Flown	Year Revised	Other Years Available*
Shippee	39121-E6	1:24000	1969	1969	
Oroville	39121-E5	1:24000	1970	1970	
Oroville Dam	39121-E4	1:24000	1970	1970	
Biggs	39121-D6	1:24000	1970	1970	
Palermo	39121-D5	1:24000	1970	1970	
Bangor	39121-D4	1:24000	1989	1994	
Gridley	39121-C6	1:24000	1973	1973	
Honcut	39121-C5	1:24000	1973	1973	
Loma Rica	39121-C4	1:24000	1989	1995	
Sutter	39121-B6	1:24000	1973	1973	
Yuba City	39121-B5	1:24000	1973	1973	
Browns Valley	39121-B4	1:24000	1973	1973	
Gilsizer Slough	39121-A6	1:24000	1973	1973	
Olivehurst	39121-A5	1:24000	1973	1973	
Wheatland	39121-A4	1:24000	1973	1973	
Sutter Causeway	38121-H6	1:24000	1973	1992	
Nicolaus	38121-H5	1:24000	1992	1992	
Sheridan	38121-H4	1:24000	1992	1992	
Knights Landing	38121-G6	1:24000	1981	1992	
Verona	38121-G5	1:24000	1978	1978	
Pleasant Grove	38121-G4	1:24000	1981	1992	
* available in the California State Library					

Table 5.2-2. Alphabetic Index of Geologic Mapping Resources for the Feather River

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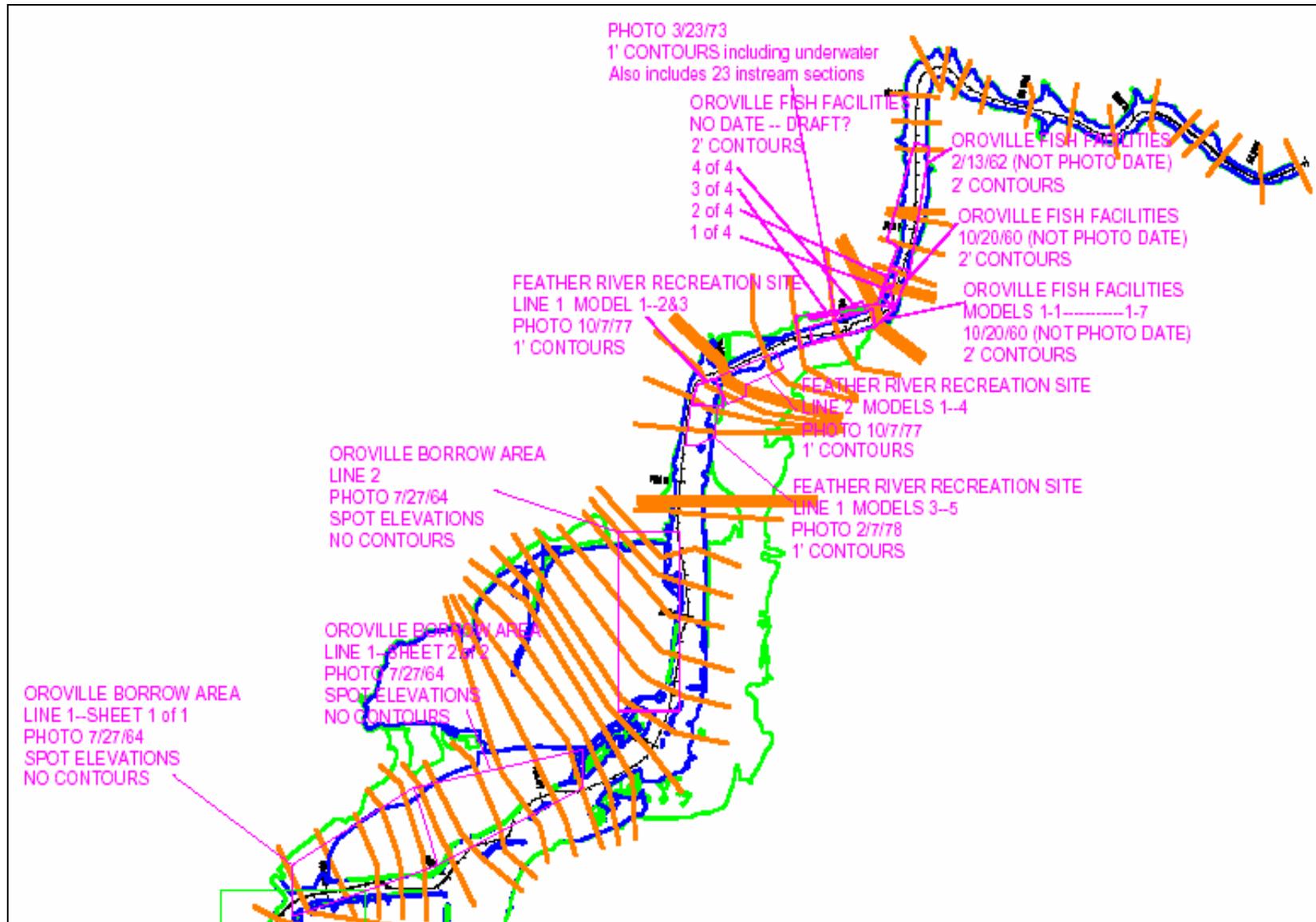


Figure 5.2-1. Index of Site-specific Topographic Surveys along the Lower Feather River showing related cross-sections

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5.3 SURVEY DATA AND CROSS-SECTIONS

A number of agencies have sounded and surveyed the lower Feather River since 1909 (see Table 5.3-1). These surveys were performed for a variety of reasons including quantifying the sedimentation resulting from hydraulic mining (USADC 1909); determining navigable passage; assessing baseline conditions concurrent with construction of Oroville Dam (DWR 1965); analyzing sedimentation rates (USGS 1971) and as part of a floodplain model (USACE 1997). Table 5.3-1 shows a list of surveys that were found during this project.

Table 5.3-1 Chronology of Lower Feather River Surveys, 1909 - 1997

	DATE	AGENCY	SUBJECT	River mile (start)	River mile (end)	# of cross-sections
pre-Oroville Dam	1909*	United States War Dept and United States Army Corps of Engineers	Feather River	0.0	67.0	331
	1924	USACE	"	6.9	24.5	13
	1925	USACE	Sacramento River, revision of flood control project, showing profiles			
	1939	USACE	Preliminary examination			
	1965	DWR	Determination of the channel capacity of the Feather River	16.0	50.5	37
post-Oroville Dam	1968	USACE, Sacramento District and California State Reclamation Board	Flood plain information, Feather and Yuba Rivers			
	1968	USACE and California. Reclamation Board	Flooded areas, Nicolaus			
	1968	USACE and California. Reclamation Board	Floods, Maryville-Yuba City			
	1968	DWR-CD	Progress report of documentation of the Feather River floodplain conditions	11.5	53.2	10
	1972	DWR-CD	Feather River : safety			
	1972	United States Geological Survey	Determination of channel changes in the Feather River	44.7	67.2	71
	1978	USGS	Sediment transport in the Feather River			
	1981	DWR	Spawning gravel study	49.6	66.8	158

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1983	DWR	Spawning gravel study (Moe's Ditch)	66.5	66.8	42	
1986	USACE	Feather River : Oroville Dam to Sacramento River				
1990	USACE	Yuba River Investigation	5.0	29.3	37	
1991*	DWR-ND	IFIM Study (unpublished data)	45.5	66.6	34	
1992	USACE		6.9	27.3	15	
1994*	DWR-CD	IFIM Study (unpublished data)	0.5	44.0	6	
1998	USACE	Yuba River Basin investigation, California : final feasibility report and appendixes				
1999*	USACE	Sacramento River Comprehensive Study - UNET Data				
2002*	DWR-ND	Re-surveys of IFIM cross-sections (unpublished data)	44.7	67.2	12 of 34	
* data set to be used with Fluvial-12 sediment transport model						

Table 5.3-2. Index of Lower Feather River Surveys by River Mile, 1909 – 1997

USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/ Cross Section	Code	Purpose	Comments
67.21				Fish Diversion Dam			Start of DWR 1981 Study
67.21	1972	USGS	20	cross-section	68		
67.19	1972	USGS	20	cross-section	67.1		
66.98				Table Mountain Blvd. Bridge			
66.95	1972	USGS	20	cross-section	67		
66.79	Aug-82	DWR - ND	135	cross-section	A	spawning channel changes	Hatchery Riffle; survey to water edge

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/ Cross Section	Code	Purpose	Comments
66.77	Aug-82	DWR - ND	135	cross-section	B	"	"
66.75	Aug-82	DWR - ND	135	cross-section	C	"	upstream end Moe's Ditch; survey to water edge
66.75	Sep-82	DWR - ND	135	cross-section	C	"	"
66.75	Apr-83	DWR - ND	135	cross-section	C	"	"
66.74	Aug-82	DWR - ND	135	cross-section	D	"	Moe's Ditch; survey to water edge
66.74	Sep-82	DWR - ND	135	cross-section	D	"	"
66.74	Apr-83	DWR - ND	135	cross-section	D	"	"
66.71	Aug-82	DWR - ND	135	cross-section	E	"	"
66.71	Sep-82	DWR - ND	135	cross-section	E	"	"
66.71	Apr-83	DWR - ND	135	cross-section	E	"	"
66.71	Jul-81	DWR - ND	110	Hatchery Riffle		"	
66.68	Aug-82	DWR - ND	135	cross-section	F	"	"
66.68	Sep-82	DWR - ND	135	cross-section	F	"	"
66.68	Apr-83	DWR - ND	135	cross-section	F	"	"
66.66	Aug-82	DWR - ND	135	cross-section	G	"	"
66.66	Sep-82	DWR - ND	135	cross-section	G	"	"
66.66	Apr-83	DWR - ND	135	cross-section	G	"	"
66.65	Aug-82	DWR - ND	135	cross-section	H	"	"
66.65	Sep-82	DWR - ND	135	cross-section	H	"	"
66.65	Apr-83	DWR - ND	135	cross-section	H	"	"
66.63	Aug-82	DWR - ND	135	cross-section	I	"	"
66.63	Sep-82	DWR - ND	135	cross-section	I	"	"
66.63	Apr-83	DWR - ND	135	cross-section	I	"	"
66.61	Aug-82	DWR - ND	135	cross-section	J	"	"
66.61	Sep-82	DWR - ND	135	cross-section	J	"	"
66.61	Apr-83	DWR - ND	135	cross-section	J	"	"
66.60	Jul-91	DWR-ND	145	cross-section	HATCHERY 1		
66.58	Aug-82	DWR - ND	135	cross-section	K	"	"
66.58	Sep-82	DWR - ND	135	cross-section	K	"	"
66.58	Apr-83	DWR - ND	135	cross-section	K	"	"
66.57	1972	USGS	20	cross-section	66	"	"
66.56	Aug-82	DWR - ND	135	cross-section	L	"	"
66.56	Sep-82	DWR - ND	135	cross-section	L	"	"
66.56	Apr-83	DWR - ND	135	cross-section	L	"	"
66.53	Aug-82	DWR - ND	135	cross-section	M	"	"
66.53	Sep-82	DWR - ND	135	cross-section	M	"	"

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66.53	Apr-83	DWR - ND	135	cross-section	M	"	"
66.52	Jul-81	DWR - ND	110	Moe's Ditch		"	"
66.51	Aug-82	DWR - ND	135	cross-section	N	spawning channel changes	at downstream end of Moe's Ditch; survey to water edge
66.51	Sep-82	DWR - ND	135	cross-section	N	"	"
66.51	Apr-83	DWR - ND	135	cross-section	N	"	"
66.49	Aug-82	DWR - ND	135	cross-section	O	spawning channel changes	at Auditorium Riffle; survey to water edge
66.49	Sep-82	DWR - ND	135	cross-section	O	"	"
66.49	Apr-83	DWR - ND	135	cross-section	O	"	"
66.46	Aug-82	DWR - ND	135	cross-section	P	"	"
66.42	Jul-81	DWR - ND	110	Auditorium Riffle			
66.40	Jul-91	DWR-ND	145	cross-section	Auditorium 3	IFIM Study	
66.40	Jul-91	DWR-ND	145	cross-section	Auditorium 2	IFIM Study	
66.40	Jul-91	DWR-ND	145	cross-section	Auditorium 1	IFIM Study	
66.19	1972	USGS	20	cross-section	65		
65.81	Jul-81	DWR - ND	110	Bedrock Park Riffle			
65.79	1972	USGS	20	cross-section	64		
65.70	1972	USGS	20	cross-section	63.1		
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	Resurvey USGS	
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	"	
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	"	
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	"	
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	"	
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	"	
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	"	
65.68	Jul-81	DWR - ND	110	cross-section	B - B'	"	
65.68				Highway 70 Bridge			

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65.67	1972	USGS	20	cross-section	63		
65.62	1972	USGS	20	cross-section	62		
65.31	1972	USGS	20	cross-section	61		
65.29	Jul-81	DWR - ND	110	cross-section	C - C'	resurvey USGS	just downstream of USGS location
65.00	Jul-91	DWR-ND	145	cross-section	HWY 162 Bridge	IFIM study	
64.94	1972	USGS	20	cross-section	60		
64.88	Jul-81	DWR - ND	110	cross-section	D - D'	resurvey USGS	
64.65	1972	USGS	20	cross-section	59		
64.61	Jul-81	DWR - ND	110	cross-section	E - E'	resurvey USGS	
64.48	Jul-81	DWR - ND	110	cross-section	F - F'	resurvey USGS	
64.48				Highway 162 Bridge			
64.46	1972	USGS	20	cross-section	58		
64.39	Jul-81	DWR - ND	110	cross-section	G - G'	resurvey USGS	
64.39	1972	USGS	20	cross-section	57		
64.21	Jul-81	DWR - ND	110	cross-section	H - H'	resurvey USGS	
64.17	1972	USGS	20	cross-section	56		
64.00	Jul-91	DWR-ND	145	cross-section	MATHEWS 3	IFIM Study	
64.00	Jul-91	DWR-ND	145	cross-section	MATHEWS 2	"	
63.90	Jul-91	DWR-ND	145	cross-section	MATHEWS 1	"	
63.81	Jul-81	DWR - ND	110	Mathews Riffle			
63.66	Jul-81	DWR - ND	110	cross-section	A - A'	resurvey USGS	
63.64	Jul-81	DWR - ND	110	cross-section	I - I'	"	
63.58	1972	USGS	20	cross-section	55		
63.50	Jul-91	DWR-ND	145	cross-section	ALECK 3	IFIM Study	

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/ Cross Section	Code	Purpose	Comments
63.45	Jul-91	DWR-ND	145	cross-section	ALECK 2	IFIM Study	
63.40	Jul-81	DWR - ND	110	Aleck Riffle			
63.40	Jul-91	DWR-ND	145	cross-section	ALECK 1	IFIM Study	
63.33	Jul-81	DWR - ND	110	cross-section	J - J'	resurvey USGS	
63.29	Jul-81	DWR - ND	110	cross-section	Aleck Riffle		
63.23	1972	USGS	20	cross-section	54		
63.00	Jul-91	DWR-ND	145	cross-section	GREAT WESTERN RIFFLE	IFIM Study	
62.81	1972	USGS	20	cross-section	53		
62.72	Jul-81	DWR - ND	110	Great Western Riffle			
62.67	1972	USGS	20	cross-section	52		
61.94	1972	USGS	20	cross-section	50		
61.72	1972	USGS	20	cross-section	51		
61.60	Jul-91	DWR-ND	145	cross-section	ROBINSON 3	IFIM Study	
61.59	1972	USGS	20	cross-section	49		
61.50	Jul-91	DWR-ND	145	cross-section	ROBINSON 2	IFIM Study	
61.50	Jul-91	DWR-ND	145	cross-section	ROBINSON 1	IFIM Study	
61.24	1972	USGS	20	cross-section	48		
61.11	Jul-81	DWR - ND	110	Robinson Riffle		spawning riffle	
60.98				Levee Break			
60.85	1972	USGS	20	cross-section	47		
60.81	Jul-81	DWR - ND	110	Steep Riffle		spawning riffle	
60.57	Jul-81	DWR - ND	110	Weir Riffle		spawning riffle	
60.50	Jul-91	DWR-ND	145	cross-section	WEIR 2	IFIM Study	
60.50	Jul-91	DWR-ND	145	cross-section	WEIR 1	IFIM Study	
60.25	Jul-81	DWR - ND	110	Gateway Riffle		spawning riffle	

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/ Cross Section	Code	Purpose	Comments
60.06	1972	USGS	20	cross-section	46		
59.60	1972	USGS	20	cross-section	45		
59.01	1972	USGS	20	cross-section	44		
58.98				Thermalito Spillway			
58.55	1972	USGS	20	cross-section	43		
58.51	Jul-81	DWR - ND	110	Sutter Butte Riffle		spawning riffle	
58.17	1972	USGS	20	cross-section	42		
57.88	1972	USGS	20	cross-section	41		
57.70				Big Hole			
57.70	1972	USGS	20	cross-section	40		
57.60	Jul-91	DWR-ND	145	cross-section	CONVEYOR BLT 2	IFIM Study	
57.60	Jul-91	DWR-ND	145	cross-section	CONVEYOR BLT 1	IFIM Study	
57.45	Jul-81	DWR - ND	110	Conveyor Belt Riffle		spawning riffle	
57.37	1972	USGS	20	cross-section	39		
57.02	1972	USGS	20	cross-section	38		
56.80	1972	USGS	20	cross-section	37		
56.50	Jul-91	DWR-ND	145	cross-section	HOUR 3	IFIM Study	
56.50	Jul-91	DWR-ND	145	cross-section	HOUR 2	"	
56.50	Jul-91	DWR-ND	145	cross-section	HOUR 1	"	
56.41	1972	USGS	20	cross-section	36		
56.34	Jul-81	DWR - ND	110	Hour Riffle		spawning riffle	
56.09	1972	USGS	20	cross-section	35		
55.81	1972	USGS	20	cross-section	34		
55.55	1972	USGS	20	cross-section	33.1		

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/Cross Section	Code	Purpose	Comments
55.38	1972	USGS	20	cross-section	33		
55.05	1972	USGS	20	cross-section	32		
55.00	Jul-91	DWR-ND	145	cross-section	GOOSE 3	IFIM Study	
54.90	Jul-91	DWR-ND	145	cross-section	GOOSE 2	IFIM Study	
54.77	Jul-81	DWR - ND	110	Keister Riffle		spawning riffle	
54.75	Jul-91	DWR-ND	145	cross-section	GOOSE 1	IFIM Study	
54.75	1972	USGS	20	cross-section	31		
54.59	Jul-81	DWR - ND	110	Goose Riffle		spawning riffle	
54.40	Jul-91	DWR-ND	145	cross-section	BIG 3	IFIM Study	
54.37	1972	USGS	20	cross-section	30		
54.05	1972	USGS	20	cross-section	29		
54.00	Jul-91	DWR-ND	145	cross-section	BIG 2	IFIM Study	
53.79	1972	USGS	20	cross-section	28		
53.75	Jul-91	DWR-ND	145	cross-section	BIG 1	IFIM Study	
53.68	Jul-81	DWR - ND	110	Big Riffle		spawning riffle	
53.48	1972	USGS	20	cross-section	27		
53.20	1968	DWR - CD	140	cross-section	1A	Floodplain study	confidential
53.18	1972	USGS	20	cross-section	26		
52.86	1972	USGS	20	cross-section	25		
52.59	1972	USGS	20	cross-section	24		
52.50	1968	DWR - CD	140	cross-section	1B	Floodplain study	confidential
52.29	1972	USGS	20	cross-section	23		
52.19	Jul-81	DWR - ND	110	---		spawning riffle	
51.96	1972	USGS	20	cross-section	22		
51.60	1972	USGS	20	cross-section	21		

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/ Cross Section	Code	Purpose	Comments
51.30	1972	USGS	20	cross-section	20		
51.02	1972	USGS	20	cross-section	19		
50.96				Gridley Highway Bridge			
50.96	1972	USGS	20	cross-section	18		
50.87	1972	USGS	20	cross-section	17		
50.79	1972	USGS	20	cross-section	16		
50.55	1972	USGS	20	cross-section	15		
50.30				Gridley Riffle			
50.23	1972	USGS	20	cross-section	14		
49.68	1972	USGS	20	cross-section	13		
49.57	Jul-81	DWR - ND	110	---		spawning riffle	
49.06	1972	USGS	20	cross-section	12		
48.31	1972	USGS	20	cross-section	11		
47.98	1972	USGS	20	cross-section	10		
47.76	1972	USGS	20	cross-section	9		
47.24	1972	USGS	20	cross-section	8		
47.10	Jul-91	DWR-ND	145	cross-section	Shallow 3	IFIM Study	
47.00	1968	DWR - CD	140	cross-section	7A	Floodplain study	confidential
47.00	Jul-91	DWR-ND	145	cross-section	Shallow 2	IFIM Study	
46.92	1972	USGS	20	cross-section	7		
46.90	Jul-91	DWR-ND	145	cross-section	Shallow 1	IFIM Study	
46.71				Herringer Riffle			

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/Cross Section	Code	Purpose	Comments
46.39	1972	USGS	20	cross-section	6		
46.03	1972	USGS	20	cross-section	5		
46.00	Jul-91	DWR-ND	145	cross-section	Herringer 3	IFIM Study	
45.73	1972	USGS	20	cross-section	4		
45.50	Jul-91	DWR-ND	145	cross-section	Herringer 1	IFIM Study	
45.47	1972	USGS	20	cross-section	3		
45.03	1972	USGS	20	cross-section	2		
45.00	1968	DWR - CD	140	cross-section	11	Floodplain study	confidential
44.66	1972	USGS	20	cross-section	1		
44.66				Honcut Creek			End of DWR 1981 Study
44.20	1968	DWR - CD	140	cross-section	16	Floodplain study	confidential
44.0	May-94	DWR-LRW	95	cross-section			survey from levee to levee
40.0	May-94	DWR-LRW	95	cross-section			survey from levee to levee
37.20	1968	DWR - CD	140	cross-section	20A	Floodplain study	confidential
35.0	May-94	DWR-LRW	95	cross-section			survey from levee to levee
34.50	1968	DWR - CD	140	cross-section	23	Floodplain study	confidential
32.00	1968	DWR - CD	140	cross-section	26	Floodplain study	confidential
30.0	May-94	DWR-LRW	95	cross-section			survey from levee to levee
29.30	(1990)	RCE	15	cross-section			
29.25	(1990)	RCE	15	cross-section	FR-1	RCE field survey	Used USGS quad sheet for overbank area
28.872	(1990)	RCE	15	cross-section			Estimated from field survey (FR-1)
28.87	(1990)	RCE	15	Route 20 Bridge			"
28.86	(1990)	RCE	15	cross-section			"
28.858	(1990)	RCE	15	cross-section			"
28.80	1912	CDC	15	cross-section			
28.69	(1990)	RCE	15	cross-section			Estimated from field

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/ Cross Section	Code	Purpose	Comments
							surveys (FR-2 and FR-1)
28.522	(1990)	RCE	15	cross-section			"
28.52	(1990)	RCE	15	5th Street Bridge			"
28.51	(1990)	RCE	15	cross-section			"
28.508	(1990)	RCE	15	cross-section			"
28.13	(1990)	RCE	15	cross-section			"
27.60	(1990)	RCE	15	Yuba River			Estimated from cross section 27.4
27.50	1912	CDC	15	cross-section			
27.50	1924	RCE	15	cross-section			
27.40	(1990)	RCE	15	cross-section	FR-2	RCE field survey	Used USGS quad sheet for overbank area
27.30	1992	RCE	15	cross-section			
26.00	1912	CDC	15	cross-section			
25.80	1992	RCE	15	cross-section			
25.75	(1990)	RCE	15	Shanghai Bend	FR-3	RCE field survey	Used USGS quad sheet for overbank area
25.70	1912	CDC	15	cross-section			
25.00	1912	CDC	15	cross-section			
24.80	(1990)	RCE	15	Crest of Knickpoint			Estimated from field survey (FR-4) and profile survey
24.50	(1990)	RCE	15	cross-section	FR-4	RCE field survey	Used USGS quad sheet for overbank area
24.50	1924	COE	15	cross-section			
24.50	1992	RCE	15	cross-section			
23.00	1968	DWR - CD	140	cross-section	34	Floodplain study	confidential
23.00	1924	COE	15	cross-section			
23.00	1992	RCE	15	cross-section			
23.00	(1990)	RCE	15	cross-section	FR-5	RCE field survey	Used USGS quad sheet for overbank area
22.90	1912	CDC	15	cross-section			
21.80	1912	CDC	15	cross-section			
21.80	1992	RCE	15	cross-section			
21.70	(1990)	RCE	15	cross-section	FR-6	RCE field survey	Used USGS quad sheet for overbank area
21.70	1924	COE	15	cross-section			
20.70	1912	CDC	15	cross-section			
20.40	(1990)	RCE	15	cross-section	FR-7	RCE field survey	Used USGS quad sheet for overbank area
20.40	1992	RCE	15	cross-section			
19.70	1912	CDC	15	cross-section			
19.60	1924	COE	15	cross-section			

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19.50	(1990)	RCE	15	cross-section	FR-8	RCE field survey	Used USGS quad sheet for overbank area
19.50	1992	RCE	15	cross-section			
18.30	1912	CDC	15	cross-section			
18.30	1924	COE	15	cross-section			
18.30	1992	RCE	15	cross-section			
18.30	(1990)	RCE	15	Star Bend	FR-9	RCE field survey	Used USGS quad sheet for overbank area
17.50	1912	CDC	15	cross-section			
17.50	1924	COE	15	cross-section			
17.50	1992	RCE	15	cross-section			
17.45	(1990)	RCE	15	cross-section	FR-10	RCE field survey	Used USGS quad sheet for overbank area
16.50	1924	COE	15	cross-section			
16.40	(1990)	RCE	15	cross-section	FR-11	RCE field survey	Used USGS quad sheet for overbank area
16.40	1912	CDC	15	cross-section			
16.40	1992	RCE	15	cross-section			
15.10	1912	CDC	15	cross-section			
15.10	1924	COE	15	cross-section			
15.10	1992	RCE	15	cross-section			
15.10	(1990)	RCE	15	cross-section	FR-12	RCE field survey	Used USGS quad sheet for overbank area
12.90	1912	CDC	15	cross-section			
12.90	1924	COE	15	cross-section			
12.90	1992	RCE	15	cross-section			
12.90	(1990)	RCE	15	cross-section	FR-13	RCE field survey	Used USGS quad sheet for overbank area
12.30	1924	COE	15	cross-section			
12.20	1912	CDC	15	cross-section			
12.20	1992	RCE	15	cross-section			
11.50	1968	DWR - CD	140	cross-section	38	Floodplain	confidential
10.50	1912	CDC	15	cross-section			
10.50	1924	COE	15	cross-section			
10.40	(1990)	RCE	15	cross-section	FR-15	RCE field survey	Used USGS quad sheet for overbank area
10.40	1992	RCE	15	cross-section			
10.06	(1990)	RCE	15	cross-section			Estimated from field survey (FR-16)
9.342	(1990)	RCE	15	cross-section			"
9.34	(1990)	RCE	15	Nicolaus Bridge			"
9.33	(1990)	RCE	15	cross-section			"
9.328	(1990)	RCE	15	cross-section			"
8.80	1924	COE	15	cross-section			

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USGS River Mile	Cross Section Date	Agency	Ref. #	Riffle/Feature/Cross Section	Code	Purpose	Comments
8.80	1992	RCE	15	cross-section			
8.80	(1990)	RCE	15	cross-section	FR-16	RCE field survey	Used USGS quad sheet for overbank area
8.70	1912	CDC	15	cross-section			
7.95	(1990)	RCE	15	cross-section		RCE field survey	Used USGS quad sheet for overbanks
7.50	(1990)	RCE	15	cross-section			Estimated from adjacent cross sections
7.5	May-94	DWR-LRW	95	cross-section			survey from levee to levee
6.90	1912	CDC	15	cross-section			
6.90	1924	COE	15	cross-section			
6.90	1992	RCE	15	cross-section			
6.90	(1990)	RCE	15	Sutter Bypass	FR-17	RCE field survey	Used USGS quad sheet for overbank
6.00	(1990)	RCE	15	cross-section		2D study for Sutter Bypass	
5.00	(1990)	RCE	15	cross-section		2D study for Sutter Bypass	
0.5	May-94	DWR-LRW	95	cross-section			survey from levee to levee
0.00				Junction w/ Sacramento River			
15 20 95 110 140							

5.4 HYDROLOGIC DATA

Hydrologic data available in electronic format was compiled and arranged in Excel spreadsheets for the Feather River at Oroville, Thermalito Outfall to the Feather River, Feather River near Gridley, Feather River at Yuba City, and Feather River near Nicolaus gages. These data sets are available from the DWR-ND.

Figure 5.4-1 (USGS website) diagrams the hydrologic network of releases, diversions and gaging stations between Lake Oroville and Gridley. This schematic is by no means complete.

Additional hydrologic resources are listed in Table 5.4-1 and may be accessed electronically on the USGS Water Resources Data website and/or the DWR California Data Exchange Center (CDEC). Also shown in the table are other hydrologic data sets, including bathymetry, climate data, reservoir elevations, water routing, and others.

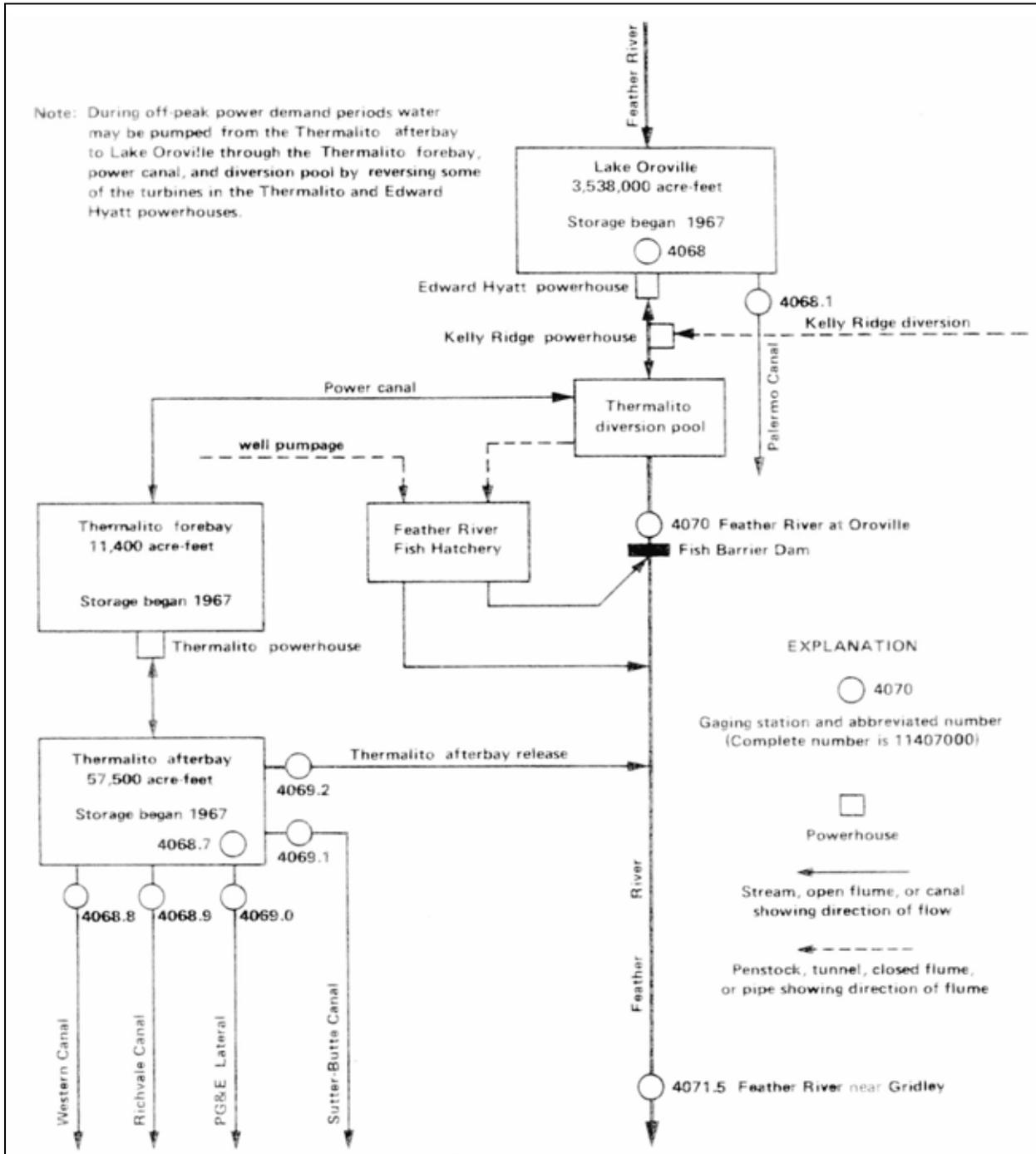


Figure 5.4-1. Schematic Diagram of Feather River at Lake Oroville Diversions and Storage.

Table 5.4-1. Index of Hydrologic and Meteorologic Data

Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
Lake Oroville	Bathymetry	-	-	-	Bathymetry map	Fish 'n Map CO.	-	-	-	-	X
		-	-	-	Area capacity table	DWR	-	-	-	-	X
	Geometry	-	-	-	Palermo Outlet-section-Oroville Dam	DWR	-	-	-	-	X
		-	-	-	Flood control outlet cross- section, Oroville Dam	DWR	-	-	-	-	X
		-	-	-	Flood control outlet plan and elevation, Oroville Dam	DWR	-	-	-	-	X
	Mean daily Flow Data	10	1967	1968	Computed inflow to Lake Oroville	USGS	11406798	39:32:06	121:28:26	X	-
		10	1967	1974	Computed inflow to Lake Oroville	USGS	11406799	39:32:06	121:28:26	X	-
		11	1970	1971	Edward Hyatt Powerplant Nr Oroville	USGS	11406821	39:32:01	121:29:12	X	-
		11	1970	1971	Edward Hyatt Powerplant Nr Oroville	USGS	11406822	39:32:01	121:29:12	X	-
		10	1970	now	Hyatt Ph Nr Oroville	USGS	11406820	39:32:08	121:28:27	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
		10	1974	now	Hyatt Ph Power Release Nr Oroville	USGS	11406818	39:32:08	121:28:27	X	-
		10	1974	now	Hyatt Ph Pumpback Nr Oroville	USGS	11406819	39:32:08	121:28:27	X	-
		10	1974	1975	Hyatt Powerplant Power Release Near Oroville	USGS	11406817	39:32:08	121:28:27	X	-
		10	1967	now	Lk Oroville Nr Oroville	USGS	11406800	39:32:00	121:28:25	X	-
		11	1968	now	Palermo Cn A Oroville Dam	USGS	11406810	39:31:59	121:28:55	X	-
	Precip. Accum.	12	1/1/1984	now	Oroville Dam - Hourly	CDEC	ORO	39:31:59	121:31:01	X	-
		-	10/1/1939	9/1/1991	Oroville RS - Monthly	CDEC	ORS	-	-	X	-
	Precipitation, Incremental	12	1/1/1987	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
	Reservoir Elevation	12	2/14/1985	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
		12	1/1/1984	now	Oroville Dam - Hourly	CDEC	ORO	39:31:59	121:31:01	X	-
	Reservoir Releases	-	-	-	-	-	-	-	-	-	-
	Reservoir Storage	12	2/13/1985	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
		12	1/1/1984	now	Oroville Dam - Hourly	CDEC	ORO	39:31:59	121:31:01	X	-
		12	10/1/1967	now	Oroville Dam - Monthly	CDEC	ORO	39:31:59	121:31:01	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
	Reservoir, Storage Change	12	10/1/1993	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
	Evaporation, Lake Computed	12	10/1/1994	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
		-	10/1/1985	now	Oroville-Thermalito - Monthly	CDEC	ORT	-	-	X	-
	Reservoir Inflows	12	1/1/1994	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
		12	1/23/1997	now	Oroville Dam - Hourly	CDEC	ORO	39:31:59	121:31:01	X	-
		-	1/1/1973	1/1/1979	Oroville Dam - Daily	DWR	-	-	-	-	X
		-	1/1/1979	now	Oroville Dam - Daily	DWR	-	-	-	X	-
	Reservoir Outflows	12	1/5/1987	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
		12	2/6/1998	now	Oroville Dam - Hourly	CDEC	ORO	39:31:59	121:31:01	X	-
	Reservoir, Top Conserv. Storage	12	10/20/2000	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
	Discharge, Control Regulating	12	2/5/1998	now	Oroville Dam - Hourly	CDEC	ORO	39:31:59	121:31:01	X	-
	Flow, Full Natural	12	4/21/1985	now	Oroville Dam - Daily	CDEC	ORO	39:31:59	121:31:01	X	-
	Air Temperature	-	4/1/2002	now	Max/Min - Daily	DWR	-	-	-	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
	Water Temperature	-	4/1/2002	now	Max/Min - Daily	DWR	-	-	-	X	-
		-	1/1/1997	now	Oroville Dam - Hourly	DWR	-	-	-	X	-
		-	3/1/2002	now	HY1 power plant cooling water supply	DWR	-	-	-	X	-
		-	3/1/2002	now	HY2 cooling water supply	DWR	-	-	-	X	-
		-	3/1/2002	now	HY3 cooling water supply	DWR	-	-	-	X	-
		-	3/1/2002	now	HY4 cooling water supply	DWR	-	-	-	X	-
		-	3/1/2002	now	HY5 cooling water supply	DWR	-	-	-	X	-
		-	3/1/2002	now	HY6 cooling water supply	DWR	-	-	-	X	-
		-	3/1/2002	now	Lateral Canal	DWR	-	-	-	X	-
		-	3/1/2002	now	Lake Oroville 612 ft. elev.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 630 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 649 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 668 ft.	DWR	-	-	-	X	-
Oroville	Water Temperature	-	3/1/2002	now	" 686 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 705 ft.	DWR	-	-	-	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
		-	3/1/2002	now	" 723 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 742 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 751 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 761 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 770 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 779 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 789 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 798 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 807 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 816 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 826 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 835 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 844 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 854 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 863 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 872 ft.	DWR	-	-	-	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
		-	3/1/2002	now	" 882 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	" 891 ft.	DWR	-	-	-	X	-
		-	3/1/2002	now	Hyatt Powerhouse Tailrace #2	DWR	-	-	-	X	-
		-	3/1/2002	now	Osw Hyatt powerhouse Tailrace	DWR	-	-	-	X	-
	Diversion Flows	-	-	-	-	-	-	-	-	-	-
	Accretion / Depletion	-	-	-	-	-	-	-	-	-	-
Thermalito Diversion Pool	Bathymetry	-	-	-	Area Capacity Table	DWR	-	-	-	-	X
	Geometry	-	-	-	Thermalito Diversion Dam-Cross Section	DWR	-	-	-	-	X
	Mean Daily Flow Data		1970	1971	Thermalito Diversion Pool near Oroville,	USGS	11406825	39:31:46	121:32:44	X	-
	Precipitation Accum.	-	-	-	-	-	-	-	-	-	-
	Precipitation, Incremental	-	-	-	-	-	-	-	-	-	-
	Reservoir Elevation	-	-	-	-	-	-	-	-	-	-
	Reservoir Releases	-	-	-	-	-	-	-	-	-	-
	Reservoir	19	10/1/1969	now	Thermalito Diversion	CDEC	THD	39:27:29	121:38:17	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
	Storage				Pool - Monthly						
	Reservoir Inflows	-	-	-	-	-	-	-	-	-	-
	Reservoir Outflows	-	-	-	-	-	-	-	-	-	-
	Water Temperature	-	3/1/2002	now	Diversion Pool Water Temp.	DWR					
	Diversion Flows	-	-	-	-	-	-	-	-	-	-
	Accretion / Depletion	-	-	-	-	-	-	-	-	-	-
Thermalito Forebay	Bathymetry	-	-	-	Area Capacity Table	DWR	-	-	-	-	X
		-	-	-	Area Capacity Curve	DWR	-	-	-	-	X
	Geometry	-	-	-	Thermalito Forebay Dam-Typical Embankment Section	DWR	-	-	-	-	X
	Mean Daily Flow Data	16	1970	now	Thermalito Ph near Oroville	USGS	11406850	39:30:53	121:37:43	X	-
		16	1974	now	Thermalito Ph Pumpback	USGS	11406849	39:30:53	121:37:43	X	-
		16	1974	now	Thermalito Power Release	USGS	11406848	39:30:53	121:37:43	X	-
		16	1974	1975	Thermalito Powerplant Power Release	USGS	11406847	39:30:53	121:37:43	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy	
			Start	End				Latitude	Longitude			
	Reservoir Elevation	-	-	-	-	-	-	-	-	-	-	
	Reservoir Releases	- -	-	-	-	-	-	-	-	-	-	
Thermalito Forebay	Reservoir Storage	16	10/1/1969	now	Thermalito Forebay - Monthly	CDEC	TFB	39:27:29	121:38:17	X	-	
		16	1971	now	Thermalito Forebay @2400	USGS	11406840	39:30:56	121:37:44	X	-	
	Reservoir Elevation	-	-	-	-	-	-	-	-	-	-	
	Reservoir Releases	-	-	-	-	-	-	-	-	-	-	
	Reservoir Inflows	-	-	-	-	-	-	-	-	-	-	
	Reservoir Outflows	-	-	-	-	-	-	-	-	-	-	
	Water Temperature	-	3/1/2002	now	TH1 Cooling Water Supply	DWR	-	-	-	-	X	-
		-	3/1/2002	now	TH2 "	DWR	-	-	-	-	X	-
		-	3/1/2002	now	TH3 "	DWR	-	-	-	-	X	-
		-	3/1/2002	now	TH4 "	DWR	-	-	-	-	X	-
-		3/1/2002	now	THP "	DWR	-	-	-	-	X	-	
-	3/1/2002	now	THP Tailrace	DWR	-	-	-	-	X	-		

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
		-	3/1/2002	now	TPC_Power Canal	DWR	-	-	-	X	-
		-	3/1/2002	now	R O Canal	DWR	-	-	-	X	-
		-	3/1/2002	now	W C Canal	DWR	-	-	-	X	-
	Flow, Canal Diversion	16	10/1/1985	now	Thermalito Forebay	CDEC	TFB	39:27:29	121:38:17	X	-
	Accretion / Depletion	-	-	-	-	-	-	-	-	-	-
Thermalito Afterbay	Bathymetry	-	-	-	Area Capacity Table	DWR	-	-	-	-	X
		-	-	-	Area Capacity Curve	DWR	-	-	-	-	X
	Geometry	-	-	-	Miscellaneous Facilities	DWR	-	-	-	-	X
		-	-	-	Tail Channel	DWR	-	-	-	-	X
		-	-	-	Richvale - Western Outlet	DWR	-	-	-	-	X
		-	-	-	P.G.& E Outlet	DWR	-	-	-	-	X
		-	-	-	Sutter- Butte Outlet	DWR	-	-	-	-	X
		-	-	-	Feather River Outlet	DWR	-	-	-	-	X
	Mean Daily Flow Data	19	1967	now	Thermalito Afterbay Release To Feather R	USGS	11406920	39:27:23	121:38:10	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
		18	1968	now	PG&E Lateral A Intake near Oroville	USGS	11406900	39:29:22	121:41:12	X	-
		17	1968	now	Richvale Cn A Intake near Oroville	USGS	11406890	39:30:19	121:41:06	X	-
		20	1967	now	Sutter Butte Cn A Intake near Oroville	USGS	11406910	39:27:02	121:39:26	X	-
	Reservoir Elevation	-	-	-	-	-	-	-	-	-	-
	Reservoir Releases	-	-	-	-	-	-	-	-	-	-
	Reservoir Storage	19	1/1/1985	now	Thermalito Afterbay - Daily	CDEC	TAB	39:27:29	121:38:17	X	-
		19	10/1/1967	now	Thermalito Afterbay - Monthly	CDEC	TAB	39:27:29	121:38:17	X	-
		19	10/1/1969	now	Thermalito Total - Monthly	CDEC	TMT	39:27:29	121:38:17	X	-
		19	1967	now	Thermalito Afterbay Nr Oroville @2400	USGS	11406870	39:27:30	121:38:17	X	-
	Reservoir Inflows	-	-	-	-	-	-	-	-	-	-
	Reservoir Outflows	-	-	-	-	-	-	-	-	-	-
	Air Temperature	-	4/1/2002	now	Max/Min - Daily	DWR	-	-	-	X	-
	Water Temperature	-	4/1/2002	now	Max/Min - Daily	DWR	-	-	-	X	-
		-	3/1/2002	now	Sutter Butte Canal	DWR	-	-	-	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
	Diversion Flows	-	-	-	-	-	-	-	-	-	-
	Accretion / Depletion	-	-	-	-	-	-	-	-	-	-
Thermalito Diversion Dam	Bathymetry	-	-	-	Area Capacity Curve	DWR	-	-	-	-	X
	Geometry	-	-	-	Isometric Plan	-	-	-	-	-	X
		-	-	-	Cross Section	-	-	-	-	-	-
	Mean Daily Flow Data	-	-	-	-	-	-	-	-	-	-
	Water Elevation	-	-	-	-	-	-	-	-	-	-
	Water Releases	-	-	-	-	-	-	-	-	-	-
	Diversion Flows	-	-	-	-	-	-	-	-	-	-
	Water Temperature	-	-	-	-	-	-	-	-	-	-
Accretion / Depletion	-	-	-	-	-	-	-	-	-	-	
Fish Barrier Dam	Bathymetry	-	-	-	-	-	-	-	-	-	-
	Geometry	-	-	-	-	-	-	-	-	-	-
	Mean Daily Flow Data	14	1973	now	Div. To Feather R Fish Hatchery near Oroville	USGS	11406930	39:31:13	120:32:48	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy	
			Start	End				Latitude	Longitude			
	Precipitation Accum.	15	10/1/1989	5/1/1994	Oroville Fish Hatchery - Monthly	CDEC	ORF	39:31:01	121:33:00	X	-	
	Water Elevation	-	-	-	-	-	-	-	-	-	-	
	Water Releases	-	-	-	-	-	-	-	-	-	-	
	Diversion Flows	-	-	-	-	-	-	-	-	-	-	
	Water Temperature	-	3/1/2002	now	FBD Fish Barrier Canal	DWR	-	-	-	-	X	-
		-	3/1/2002	now	FBD Fish Barrier Canal	DWR	-	-	-	-	X	-
		-	3/1/2002	now	F_H	DWR	-	-	-	-	X	-
	Accretion / Depletion	-	-	-	-	-	-	-	-	-	-	
Feather River Channels	Bathymetry	-	-	-	-	-	-	-	-	-	-	
	Geometry	-	-	-	-	-	-	-	-	-	-	
	Mean Daily Flow Data	29	1967	1973	Combined Flow Fall R Plus Sucker Run W B Feather	USGS	11405301	39:47:12	121:33:42	X	-	
		3	1967	1973	Combined Flow Feather R Merrimac Plus S F Feather	USGS	11396351	39:42:30	121:16:10	X	-	
		30	1967	1983	Combined Flow N F	USGS	11404901	39:47:39	121:27:03	X	-	

Feather R. Pulga +
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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
					Poe Power house						
		27	1942	1985	Feather R near Nicolaus	USGS	11425000	38:54:01	121:35:00	X	-
		27	1974	1984	Feather R near Nicolaus Routed Flow	USGS	11425001	38:54:01	121:35:00	X	-
		9	1911	1964	Feather R @ Bidwell Bar Ca	USGS	11397500	39:33:15	121:26:15	X	-
		14	1901	now	Feather R @ Oroville	USGS	11407000	39:31:13	121:32:48	X	-
		14	1973	now	Feather R @Oroville R Only	USGS	11406999	39:31:13	121:32:48	X	-
		23	1964	1984	Feather R @ Yuba City	USGS	11407700	39:08:20	121:36:17	X	-
		9	1911	1955	Feather R @ Bidwell Bar At Enterprise + Palermo	USGS	11397501	39:33:15	121:26:15	X	-
		25	1969	1980	Feather R @ Shangai Bend Nr Oliverhurst	USGS	11421700	39:04:44	121:36:08	X	-
		25	1976	1984	Feather R @ Shanghai Bend Nr Oliverhurst	USGS	11421701	39:04:44	121:36:08	X	-
		21	1964	1997	Feather R near Gridley	USGS	11407150	39:22:00	121:38:46	X	-
		42	1910	1927	MF Feather R @ Sloat	USGS	11393000	39:51:25	120:43:05	X	-
		41	1941	1962	MF Feather R below Sloat	USGS	11393500	39:52:00	120:46:15	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
		43	1925	1979	MF Feather R near Clio	USGS	11392500	39:45:14	120:35:42	X	-
		3	1951	1986	MF Feather R near Merrimac	USGS	11394500	39:42:30	121:16:10	X	-
		40	1923	1932	MF Feather R near Nelson Point	USGS	11394000	39:51:10	120:52:20	X	-
		-	1968	1980	MF Feather R near Portola	USGS	11392100	39:43:13	120:26:26	X	-
		2	1905	1910	NF Feather R @ Big Bend	USGS	11405000	39:42:52	121:28:05	X	-
		30	1911	now	NF Feather R @ Pulga	USGS	11404500	39:47:39	121:27:03	X	-
		38	1968	now	NF Feather R below Belden Dam	USGS	11401112	40:04:17	121:09:49	X	-
		32	1978	now	NF Feather R below Grizzly C	USGS	11404330	39:51:09	121:23:29	X	-
		31	1975	now	NF Feather R below Poe Dam	USGS	11404400	39:48:25	121:26:05	X	-
		36	1978	now	NF Feather R below Rock C Div. Dam	USGS	11403200	39:58:49	121:16:33	X	-
Feather River Channels	Mean Daily Flow Data	-	1906	now	NF Feather R near Prattville	USGS	11399500	40:10:06	121:05:31	X	-
		-	1911	1966	SF Feather R @ Enterprise	USGS	11397000	39:32:15	121:20:45	X	-
		-	1911	1961	SF Feather R @ Enterprise, Palermo	USGS	11397001	39:32:15	121:20:45	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
					Canal						
		7	1962	1989	SF Feather R above Ponderosa Dam	USGS	11396350	39:32:52	121:18:11	X	-
		35	1960	1979	SF Feather R above Little Grass Valley Res.	USGS	11394800	39:45:07	120:57:26	X	-
		4	1960	now	SF Feather R below Div. Dam near Strawberry Valley	USGS	11395200	39:38:51	121:07:04	X	-
		5	1962	now	SF Feather R below Forbestown Dam	USGS	11396200	39:33:05	121:12:30	X	-
		34	1927	now	SF Feather R below Little Grass Valley Dam	USGS	11395030	39:46:26	121:01:16	X	-
		6	1957	1961	SF Feather R near Forbestown	USGS	11396300	39:33:08	121:16:49	X	-
		33	1986	now	WB Feather R below Hendricks Div. Dam	USGS	11405200	39:56:03	121:31:43	X	-
		37	1993	1994	WB Feather R below Snag Lk near Jonesville	USGS	11405085	40:04:24	121:27:08	X	-
		29	1957	1986	WB Feather R near Paradise	USGS	11405300	39:47:12	121:33:42	X	-
		1	1930	1963	WB Feather R near Yankee Hill	USGS	11406500	39:41:55	121:33:38	X	-
		3	1/1/1993	now	Feather River at	CDEC	MER	39:42:32	121:16:12	X	-

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Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
					Merrimac						
		21	1/1/1993	now	Feather River near Gridley	CDEC	GRL	39:22:01	121:38:46	X	-
	River Stage	26	10/2/1997	now	Feather River at Boyd's Landing - Hourly	CDEC	FBL	39:02:42	121:36:40	X	-
		22	10/7/1997	now	Feather River at Live Oak - Hourly	CDEC	FLO	39:14:53	121:38:10	X	-
		3	1/5/1984	now	Feather River at Merrimac - Hourly	CDEC	MER	39:42:32	121:16:12	X	-
		24	1/1/1984	now	Feather River at Yuba City - Hourly	CDEC	YUB	39:07:59	121:36:00	X	-
		21	1/1/1984	now	Feather River near Gridley - Hourly	CDEC	GRL	39:22:01	121:38:46	X	-
		28	1/1/1984	now	Feather River near Nicolaus - Hourly	CDEC	NIC	38:53:28	121:36:14	X	-
		30	3/18/1998	now	North Fork Feather River at Pulga - Hourly	CDEC	PLG	39:47:38	121:27:04	X	-
		Precipitation Accum.	28	10/1/1962	now	Feather River near Nicolaus -Monthly	CDEC	NIC	38:53:28	121:36:14	X
	Water Content, Snow	-	4/1/1930	now	Feather River Meadow - Monthly	CDEC	FEM	40:21:18	121:25:19	X	-
	Snow Depth	-	4/2/1930	now	Feather River Meadow - Monthly	CDEC	FEM	40:21:18	121:25:19	X	-
	River Discharge	3	1/5/1984	now	Feather River at Merrimac - Hourly	CDEC	MER	39:42:32	121:16:12	X	-

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

Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
		21	1/1/1984	now	Feather River near Gridley - Hourly	CDEC	GRL	39:22:01	121:38:46	X	-
		30	3/18/1998	now	North Fork Feather River at Pulga - Hourly	CDEC	PLG	39:47:38	121:27:04	X	-
	Flow, Full Natural	30	10/1/1925	8/1/1992	Feather MF near Clio - Monthly	CDEC	FTC	39:45:14	120:35:42	X	-
		3	10/1/1907	9/1/1970	Feather MF near Merrimac - Monthly	CDEC	FTM	39:42:32	121:16:12	X	-
		30	10/1/1900	now	Feather NF at Pulga - Monthly	CDEC	FPL	39:47:38	121:27:04	X	-
		39	2/1/1905	now	Feather NF near Prattville - Monthly	CDEC	FPR	40:10:08	121:05:28	X	-
		14	10/1/1905	now	Feather R - Monthly	CDEC	FTO	39:31:19	121:32:49	X	-
		-	10/1/1900	now	Feather SF at Ponderosa - Monthly	CDEC	FTP	-	-	X	-
	Flow, Monthly Volume	43	10/1/1925	10/1/1925	Feather MF near Clio	CDEC	FTC	39:45:14	120:35:42	X	-
		3	10/1/1907	10/1/1907	Feather MF near Merrimac	CDEC	FTM	39:42:32	121:16:12	X	-
		30	1/1/1990	now	Feather NF at Pulga	CDEC	FPL	39:47:38	121:27:04	X	-
		14	1/1/1905	now	Feather R - Monthly	CDEC	FTO	39:31:19	121:32:49	X	-
		-	1/1/1990	now	Feather SF at Ponderosa	CDEC	FTP	-	-	X	-
		39	1/1/1905	now	Feather NF near Prattville	CDEC	FPR	40:10:08	121:05:28	X	-

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

Facilities	Data Description	Map ID	Date		Notes	Sources	Gage ID	Gage Location		Electronic	Hardcopy
			Start	End				Latitude	Longitude		
	Flow, Canal Diversion	-	10/1/1905	now	Feather River - Monthly	CDEC	FTT	-	-	X	-
		14	3/1/2001	now	Feather R - Daily	CDEC	FTO	39:31:19	121:32:49	X	-
	Flow, Irrig&Consumpt .	30	1/1/1990	now	Feather NF at Pulga - Monthly	CDEC	FPL	39:47:38	121:27:04	X	-
		14	10/1/1985	now	Feather R - Monthly	CDEC	FTO	39:31:19	121:32:49	X	-
	Discharge, Control Regulating	-	9/21/1999	now	Total Release-Feather R below Thermalito - Daily	CDEC	THA	39:31:59	121:31:01	X	-
		-	2/5/1998	now	Total Release-Feather R below Thermalito - Hourly	CDEC	THA	39:31:59	121:31:01	X	-
	Water Elevation	-	-	-	-	-	-	-	-	-	-
	Water Temperature	-	-	-	-	-	-	-	-	-	-
	Accretion / Depletion	-	-	-	-	-	-	-	-	-	-

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

5.5 SEDIMENT DATA

Several agencies and consultants have collected sediment samples along the lower Feather River at point bars and banks. The Department of Fish and Game assessed spawning gravels in the 1950s as part of a pre-dam assessment of baseline spawning gravel conditions. DWR performed bulk gravel sampling and Wolman counts in 1982, 1996 and 2003 between Lake Oroville and Honcut Creek as part of their spawning gravel investigations. The USGS collected suspended sediment data at the Oroville, Gridley, Yuba City, and Nicolaus gaging stations (USGS 1978). Water Engineering and Technology (1990, 1991) also sampled sediments under contract with the USACE. They collected bulk samples and performed Wolman pebble counts on gravel bars. They also collected soil samples from eroding banks.

Studies related to spawning gravel quantity and quality began before construction of Oroville Dam. DWR (1965) studied pre-dam channel characteristics, and then DWR (1969) and the USGS (1972) conducted studies to document channel changes. In 1977 DF&G studied the interim impacts of the dam on salmonid escapement.

DWR (1982) prepared the Feather River Spawning Gravel Baseline Study to determine post dam spawning gravel conditions. The report presented spawning gravel sampling results and identified factors resulting in loss of spawning gravel quality. These include the lack of gravel recruitment from areas above Oroville Dam and the effect of scouring flood flows. A follow-up habitat restoration project was conducted by DWR and DF&G in 1983 at the riffle sites adjacent to the Hatchery. These sites were identified in the baseline study as having undergone significant post-dam degradation.

Geology staff catalogued existing references in the Northern District offices. The State Library was queried and an extensive list of references compiled. Those not available at the Northern District were requested from the State Library. Many of these were received and copied, but some remain outstanding that are only available through inter-library loan. All of these references are indexed. Pertinent publications that are available are listed in the bibliography at the end of this report.

No recent sediment data were available on the internet.

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APPENDIX A – REVIEW AND ABSTRACTS OF SELECTED REFERENCES

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

A-1

Bechtel Corporation. 1953. *Engineering, Economic and Financial Aspects of the Feather River Project.* The California State Legislature. San Francisco, California.

The Legislature of the State of California contracted with Bechtel Corp. to examine the engineering, economic and financial aspects of moving ahead with the Feather River Project. The report presents chapters on water studies, engineering feasibility and cost estimates, power generation, water demand, financial feasibility, and recommendations. (We only have a copy of the Table of Contents and Introduction. The original document is in the Bureau of Reclamation Library, Rm W1522 of the Fed. Bldg. on Cottage Way, Sacramento, CA.)

Birnbaum, S. E. 1991. *Clean Water Act Section 401 Provides the Key to Stream Protection in Hydropower Licensing.* Rivers. V. 2. Pp. 148-153.

In spite of the recent Supreme Court decision which upheld the FERC federal preemption of state instream flow requirements, the states can still require protection of state waters in the course of hydro power development by using a separate fed. authority, sect. 401 of CWA. (Available: Northern District)

California Debris Commission. 1911. *Map of Feather River, California: From Oroville to Southerly Limit of Gold Dredging Grounds.* Sacramento, California.

In a study of hydraulic mining debris on the Feather and Yuba rivers, the California Debris Commission contracted with the USACE to survey the Feather River, including the Oroville to Honcut Creek study reach. DWR scanned, ortho-rectified, and georeferenced these survey maps and entered the data into a Geographic Information System. The maps were then used to establish 1907 channel locations and geomorphic information to compare with more recent aerial topography and surveys.

Chang, H. H. 1998. *Generalized Computer Program FLUVIAL-12 Mathematical Model for Erodible Channels*. Users Manual. San Diego, CA. 44 pp. with figures.

The users manual provides information on river channel modeling, theoretical basis of the model, and instructions for using the model. River channel changes simulated by the model include channel bed scour and fill, width variation, and changes in bed topography induced by the curvature effect. These are calculated in the model for each time step. Model inputs and outputs are described in detail.

-----1993. *Test and Calibration Study Using Data from the Feather River in Northern California: Numerical Modeling for Sediment-Pass Through Operations of Reservoirs on North Fork Feather River*. Prepared for Pacific Gas and Electric Company. San Francisco, California.

This report on the Feather River above Lake Oroville was part of the FERC relicensing of the Rock Creek and Cresta power generating facilities. The report details the sediment transport of this part of the Feather River, and models sediment pass-through facilities for both reservoirs.

Creely, R.S. 1965. *Geology of the Oroville Quadrangle, California*. California Division of Mines and Geology. San Francisco, California. 86 pp.

This is a basic geologic map of the Oroville 15-minute quadrangle. It includes most of the Lake Oroville area, and a short section of the Lower Feather River downstream. The report includes a description of the geologic units, fossils, faulting, and geologic history of the western foothills of the Sierra Nevada.

DeHaven, R. W. 1977. *Striped Bass Ecology in the American and Feather Rivers, California*.

An angling study of a total of 48 bass, mostly adult, were caught between July 31 and Nov. 18, 1976. Fish were caught from a boat between the Hwy 70 Bridge in Oroville downstream about 21 km to the Gridley Highway Bridge. Most fish were caught at the Thermalito Forebay outlet. Some fish were tagged and released, while others were examined for stomach contents, sex, and reproductive condition. (Available:

Northern District)

Department of Fish and Game. 1994. *Central Valley Anadromous Sport Fish Annual Run-Size, Harvest, and Population Estimates, 1967 through 1991.* (Revised 2/94 & 8/94). Sacramento, California.

This report was prepared as supportive documentation required for implementation of Public Law 102-575, the Central Valley Project Improvement Act (CVPIA) of 10/30/92. The Law requires the Sect. of Interior to implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long term basis, at levels not less than twice the average levels attained between 1967 and 1991. (Available: Northern District)

--- 1990. *Predation on Feather River Steelhead Yearlings.*

Large flocks of cormorants were seen feeding on recently released steelhead yearlings along the Feather River. Cormorants are known to eat about two pounds of fish per day. Worst case scenario would assume cormorants were eating nothing but planted steelhead, 150 birds eating 300 pounds (1,200 yearlings) /day. Assuming that level of predation goes on for the 60 days that the yearlings are in the river, the cormorants would eat 72,000 fish or about 16% of the total annual plant. (Available: Northern District)

--- 1985. *Summer-Run Steelhead Experiments in the Feather and American Rivers.*

Summer-run steelhead, from the Washougal River, WA were introduced into the Feather and American Rivers during the period 1970 through 1981 in an attempt to provide a steelhead fishery June through September. Returns from these experiments did not justify continuation of efforts to establish a summer-run steelhead fishery. (Available: Northern District)

---- 1981-1985. *Seining Study, Chinook Salmon Fry, Steelhead, & Rainbow, Feather River.*

In spring of 1981, DFG undertook a seining study on king salmon in the Feather River in order to find out more about their life history. Young salmon were collected at two locations (Bedrock Park in the low flow channel and just upstream from the boat launching ramp 1/2 mi downstream from the Gridley Bridge in the high-flow section) using a 50' x 1/4" mesh seine, anesthetized, measured to the nearest mm fork length and returned to the river.

Despite a good adult spawning run, smolt production from the Feather this year will be poor due to slow growth, restricted nursery area, high water temps, and late emigration with attendant high predation losses including problems at diversions. Another seining study was undertaken in March of 1985. The stations were located at Bedrock Park and Weir Riffle. This study was looking at how temperature effects fish growth. It was found that growth rates varied significantly between Bedrock Park and Weir Riffle stations (bimodal curve at 42 mm and 52 mm, at Weir Riffle as compared to a unimodal figure, 38.5, mm at Bedrock). Water temperature was similar at both stations. Larger CHIN-f at the Weir Riffle is believed to be due to lower intra-specific competition. (Available: Northern District)

---- 1981. *Spring/Fall Salmon Runs - A Survival Comparison.* Oroville, California.

A two-year study was undertaken in order to compare the survival, return to the fishery, and return to the river of spring-run and fall-run yearling king salmon from the Feather River Hatchery. About 100,000 king salmon of spring- and fall-run stock were coded-wire tagged, held to yearling size and planted in the Feather River. Fall-run return better to the ocean fisheries. Spring-run provide better river returns. Spring-run do not home in on Feather River Hatchery as well as fall-run and many stray to other rivers. (Available: Northern District)

---- 1977. *An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River*. Sacramento, California.

DFG, with funding from DWR, undertook an 8 year study (1967-75) to evaluate the effects of the Oroville Dam on fish populations and fisheries in the Feather River. Thirty-five fish species from thirteen fish families were encountered. (Available: Northern District)

---- 1972. *King (Chinook) Salmon Spawning Stocks in California's Central Valley, 1970*. Menchen, ed.

This report covers the 18th Annual Central Valley king salmon spawning-stock inventory. These Annual Reports enumerate the spring and fall run salmon entering the Feather River Hatchery. In addition, the reports estimate the stocks spawning naturally in two reaches of the Feather River; (1) between the Oroville Fish Barrier and the Thermalito Afterbay Outlet, and (2) from the Outlet to Gridley Bridge (and later, to Evans-Reimer Road). (Available: Northern District)

---- June 2, 1971. *Amount of Used Spawning Gravel in Three Sections of River: Honcut to Gridley Bridge -32,000 sq. feet, Gridley to Thermalito Afterbay from River Outlet – 246,800 sq. feet, Thermalito Afterbay River Outlet to Hatchery – 152,200 sq. feet; Memorandum Report*.

This is a memorandum is one page, basically a measurement of the used spawning gravel between the Feather River Fish Hatchery and Honcut Creek.

---- 1970. *King Salmon (O. tshawytscha) Spawning Stocks of the California Central Valley, 1953-1969*. J. Alexander Petrovich.

The paper lists counts and estimates of king salmon spawning escapements in the Sac-San Joaquin River System from 1953 through 1969. Methods used are discussed. (Available: Northern District)

---- 1966 to 1993/94. *Feather River Hatchery, Annual Reports*. Oroville, California.

These reports summarize the operation of the Feather River Hatchery and its annex from July 1966 to June 1994. Tables present water temperatures, numbers of Chinook salmon and steelhead trout entering the hatchery, number of eggs taken and received, and numbers of fish released. (Available: Northern District)

---- 1963. *A Reconnaissance Report on the Lower Feather River with Special Reference to the Effects of Water Development on Fish, Wildlife and Recreation*. Sacramento, California.

This report presents a reconnaissance-level documentation of the lower Feather River and its flood plain, as related to fish, wildlife, and recreation. The investigation revealed that the entire valley portion of the river and its flood plain would be profoundly changed by the construction and operation of Oroville Dam and its related facilities. (Available: Northern District)

---- 1955. *Studies on the Downstream Migration of Young Salmon in the Feather River*. 15pp., 5 with text, 10 figures.

In January, 1955, the Marine Fisheries Branch initiated a fyke net study on the Feather River to determine, if possible, what percentage of the total population of young seaward migrant salmon was produced in the spawning areas upstream from Oroville. Such information would supplement incomplete estimates of the adult salmon population utilizing this portion of the river. The investigation was also planned to supply data on the duration and intensity of the migration, which would be of value in planning flow release schedules when the dam was put in. (Available: Northern District)

California Department of Fish and Game and U. S. Fish and Wildlife Service. 1960. *King Salmon Spawning Stocks of the California Central Valley, 1940-1959*.

The paper lists the best available counts and estimates of king salmon spawning runs in the Sacramento-San Joaquin River system from 1940-1959. Counts and estimates were made by CDFG & USFWS using instream fish blocks, aerial surveys,

and tag and recover methods. Earlier counts were suspect. The paper documents spring, summer, and fall runs in major stem portions and tributaries. (Available: Northern District)

Department of Water Resources. December 1997. *Feather River Gravel Study- Fish Diversion Dam to Honcut Creek; Memorandum Report.* 38 pp.

This report was prepared by the Northern District for DWR's Environmental Services Office to document changes in gravel size distribution on Feather River spawning riffles. The report summarized gravel sampling done during the summer of 1996 and compared the sampling data to from a similar study completed in 1982. The report data suggested that riffles were becoming coarser, and that riffle armoring was prevalent.

-----, 1996. *Draft Study Plan for Feather River Emigration Study.* Oroville, California.

This study proposed to examine the timing and magnitude of out-migration of Feather River fish species relative to different physical conditions. Major focus is on Chinook salmon, but data on steelhead, splittail, American shad, sturgeon, and striped bass may also be collected. Fish will be collected by using two rotary screw fish traps installed at the lower end of each of two study reaches for a 6 month period (Jan - June). In addition, supplemental sampling with fyke traps or beach seines will be performed to provide additional information about rearing and out-migration behavior, and to collect juvenile fish to estimate trap efficiencies.

---- 1995. *Study Plan for Feather River Spawning Survey.*

In cooperation with CDFG, the DWR is initiating a number of studies on the lower Feather River to support relicensing of the Oroville complex by FERC. F. R. studies conducted in 1991 indicated that spawning peaks at a depth of 1.3ft, which is similar to a number of other Central Valley locations. However, these data were collected in the low flow channel at 600 cfs and the reach below Thermalito Afterbay at approx. 4,500 cfs--it is not certain how spawners will respond at higher flows. Data will be collected in

two separate years with 1,600 cfs flows in order to see if there are any effects on spawning success and production of fry and juvenile salmon between 600 and 1,600 cfs. (Available: Northern District)

---- 1994. *Feather River IFIM Study*. Sacramento, California.

The report describes the initial results of a field survey to develop habitat criteria for Chinook salmon spawning. The Study included examination of habitat utilization, availability and preferences of Chinook salmon. Distribution of spawning activity, depth, velocity, and substrate were also looked at. (Available: Northern District)

---- 1994. *1993-1994 Lake Oroville Siltation Study*. State of California. Northern District.

This report presents the findings of the 1993-1994 Lake Oroville Siltation Study. The purpose was to determine the amount of sediment deposited within the main part of the reservoir since a siltation study was done in 1971. Eight cross-sections were surveyed March 6 to 12, 1993, which showed that only a small amount of deposition and erosion occurred between the 1971 and 1993 surveys. An additional nine cross-sections were surveyed from April 31 to May 12, 1994.

It was concluded that an average depth of about 15 feet of sediment deposition has occurred in the lake for a total volume of about 18,000 acre-feet.

---- 1994. *North Fork and Middle Fork Feather River Watershed Report*. State of California. Northern District. 77pp.

The watershed erosion investigation is a compilation of data from a number of sources such as DWR, USFS, NRCS, and Coordinated Resource Management Districts. Data included landslides, geology, land use, management activities, hydrology, and soil erosion. The report present a good summary of conditions in the upper part of the Feather River watershed.

---- 1992. *Proposed Study Plan for the Lower Feather River*. Sacramento, California.

The lower Feather River supports aquatic resources of biological, recreational and economical significance. In 1990, the Department of Water Resources proposed a water transfer with Yuba County Water Agency to provide increased flexibility in the operation of the State Water Project. In response to this proposal, the State Water Resources Control Board requested that DWR prepare a study plan to examine the potential impacts of the diversions in the Feather River drainage on the above resources. The Study Plan includes Objectives and Proposed Methods resulting in an in depth study of the entire system. (Available: Northern District)

---- July 1983. *Monitoring Spawning Habitat, Feather River, California; Memorandum Report.* State of California. Northern District. 20pp.

The report follows the restoration of salmon spawning habitat on the Feather River near Oroville. It states that the restoration was "highly successful". The added riffle areas provided room for approximately 600 more salmon pairs. The spring '83 site survey and field examination showed that late winter flow releases damaged portions of the restoration site. The timing of these releases - after the young salmon had hatched and emerged from the gravel- was a key factor in the survival of the fall spawn. Because of the success of the restoration, the report recommends that DWR repair the '83 damage, build some berms to slow flow velocities, install monitoring devices, and continue observing the site. (Available: Northern District)

---- 1983. *Potential for Salvaging Water Through Vegetation Management in the Lower Feather River Watershed.* State of California. Central District.

The California Water Commission asked DWR to develop a vegetation management plan as an alternative method for increasing water supplies for the SWP. The plan was developed in conjunction with an advisory committee composed of local agency and landowner representatives. from the Feather River watershed. Vegetation management, i.e., prescribed burning, is seen as a means of dealing with wildfire hazard, wildlife habitat deterioration, and lowered rangeland forage values. The plan includes periodic evaluation and analysis and a long-time commitment from participating

parties. (Available: Northern District)

---- 1982. *Atlas of Feather River, An Appendix to: Feather River Spawning Gravel Baseline Study- 1982.*

The atlas contains locations of cross-sections, spawning areas, riffles, and other fisheries and geomorphic data

---- 1982. *Feather River Spawning Gravel Baseline Study.* State of California. Northern District. 142pp. with Plates and Figures.

In spite of the loss of upriver spawning habitat since the closure of the Oroville Dam, 20,000 to 70,000 salmon annually still spawn naturally in the lower Feather River. Maintenance and enhancement of the river habitat are the focus of this study. The report contains cross-sections, riffle survey data, and gravel sampling data. (Available: Northern District)

---- 1982. *Upper Feather River Instream Flow Study.* State of California. Northern District. 35pp .

Three streams in the upper Feather River: Little Last Chance Creek, Big Grizzly Creek, and Middle Fork, were examined as representative of trout habitat in creeks. The usable area of spawning, adult, juvenile, and fry habitat was calculated for rainbow and brown trout.

Maximum usable area for spawning, juvenile, and fry habitat on LLCC occurred at stream flows of 0.4 to 0.8 m³/s. Usable area for adult rainbow and brown trout habitat increased with flow on both LLC and BGC. Usable area for juvenile and fry habitat of both species on BGC reached a peak near 0.4 m³/s. Optimum flows were near 1.0 m³/s on the MF for all habitat types except adult rainbow trout. Usable area for adult trout continued to increase with flow on the Middle Fork. No substrate suitable for spawning was present at this station.

Based on these data, a year-round release of 0.56 m³/s was recommended from Lake Davis. This would increase trout habitat in BGC, and reduce the frequency of

reservoir spills, without measurably changing summer lake levels or affecting reservoir recreation. (Available: Northern District)

---- February 1979. *The August 1, 1975 Oroville Earthquake Investigations*. State of California. 669 pp with supplements and appendixes. Bulletin 203-78 and the supplementary Bulletin 203-88.

These reports provide the results of an extensive geologic and engineering investigation resulting from the August 1, 1975 earthquake that occurred about 7.5 miles southwest of Oroville Dam. The earthquake awakened scientists to the reality of earthquake risk in the Sierra Nevada foothills, long considered to be of low seismic risk. The report contains geologic information, results of subsurface exploration, and a summary of the geology of the area, as well as detailed evaluation of seismic stability of Oroville facilities.

---- 1977. *Final Environmental Impact Report: Feather River Enhancement Project*. State of California. 240 pp.

Chapter 1023 of the Statutes of 1976 (AB 2620, Chappie) authorizes DWR to construct a recreation project in the vicinity of Oroville along the Feather River pending EIR results.

The major components of the recommended alternative include major improvements to the City of Oroville's Bedrock Park and an extensive bicycle and hiking trail. (Available: Northern District)

---- 1971. *Lower Feather River Water Quality, 1970; Memorandum Report*. State of California. 96pp.

This report described the water quality sampling program, evaluated the current water quality in the Lower Feather River and tributary agricultural drains at the time, and made projections of anticipated water quality of the river in the future. The basic objective of the data collection program was to gain additional and more detailed data on the current (at the time) level of nutrients, as measured by nitrogen and phosphorus

in the Lower Feather River and tributary drains.

Water quality studies included temperature, turbidity, electrical conductivity, nutrients, pesticides and herbicides. Water quality in the river downstream of the dam was excellent in 1970. Water in agricultural drainage areas was generally of poorer quality. Projected future mineral quality in the river was thought to remain excellent for 20 years. (Available: Northern District)

---- 1969. *Progress Report of Documentation of the Feather River Floodplain Conditions*. Oroville, California.

The purpose of the report was to describe the work during the 67-68 and 68-69 fiscal years in documenting the past and present physical conditions in the Feather River floodplain from Thermalito Afterbay to the mouth of the Feather River. Each section of this report described each physical condition and how they were documented. The data collected consisted of ground water levels, water surface elevations, profiles of the rivers' cross sections across the river, bottom profile of the river channel, sediment sampling, soils, land use, crop conditions, aerial photographs, and topographic mapping. Excellent maps and cross-sectional profiles help to illustrate findings. Recommendations are included at the end of the report. (Available: Northern District)

-----, 1965. *Establishment of Feather River Channel Characteristics*. Sacramento, California. 9pp.

The purpose of this report is to describe the work done during the 63-64 fiscal years to document the Feather River channel from its confluence with the Sacramento River to the start of the dredger tailings below the town of Oroville.

The work was done to ascertain the Feather River channel characteristics before the construction of Oroville Dam and would later be compared with physical measurements taken after completion of the dam in an effort to ascertain any changes which may have taken place. (Available: Northern District).

----- Division of Mines and Geology. 1966. *Geology of Northern California*. Bulletin 190. San Francisco.

This bulletin is a compendium of Northern California geology and is widely referenced as a source of mapping, geologic units, and geologic topics. The report predates the new Plate Tectonics. The chapter on the “Geology of the Sierra Nevada” by Paul Bateman provides an excellent history of geologic exploration and mapping, as well as a description of the geologic units.

Durrell, Cordell. 1987. *Geologic History of the Feather River Country, California*. University of California Press. Berkeley California. 337 pp.

This book is a description of the Northern part of the Sierra Nevada, particularly the area around Johnsville, Plumas-Eureka State Park in Mohawk Valley. The book is a result of many years of summer field work, and includes detailed description of geologic units, history, mining, and structure of the upper Feather River watershed.

Gilbert, G. K. 1917. *Hydraulic Mining Debris in the Sierra Nevada*. U. S. Geological Survey Professional Paper 105.

Probably one of the most influential papers in fluvial geomorphology, Grove Karl Gilbert’s treatise on hydraulic mining provides information on changes to Sierran river systems from the vast amount of debris washed out of the mountains during the gold mining days. From 1853 to 1884, unregulated hydraulic mining caused severe aggradation of river channels within the Sierra Nevada with the release of over 1.6 billion cubic yards. About 200 million came down the Feather above the confluence with the Yuba River.

James, A. 1989. *Sustained Storage and Transport of Hydraulic Gold Mining -Sediment in the Bear River, California*. M. S. Thesis. Annals of the Association of American Geographers. V. 79(4). Pp. 570 - 592.

This Masters Thesis documented hydraulic mining debris in the Bear River, a tributary to the Feather. Mapping showed that much of the hydraulic mining debris still remains stored in the watershed. The sediments are subject to sustained remobilization during major floods.

Kelley, R. 1989. *Battling the Inland Sea: Floods, Public Policy and the Sacramento Valley*. University of California Press. Berkeley, Los Angeles, London.

This book is the story of the Sacramento Valley, from the uncontrolled floods of the 1800s and early 1900, to the struggle to tame the mighty Sacramento River with levees, bypasses, and dams. The book is a historical account of flooding, levee breaks, and the intense political debates and events leading to the Sacramento River Flood Control System.

McEwan, T. S. D. 1995. *Feather River Fisheries Studies*. Newsletter, IEP for the Sac-San Joaquin Estuary. Autumn 1995. 1p.

This half page article presents a concise overview of the F.R. Study. (Available: Northern District)

Mount, J. F. 1995. *California Rivers and Streams: The Conflict Between Fluvial Process and Land Use*. University of California Press, Berkeley and Los Angeles. University of California Press, London, England. 359pp.

This book examines the way rivers work in California and the manner in which our land use practices interact with dynamic river processes. Part I provides an overview of the physical and biological processes that shape the rivers and watersheds of California. Basic principles of hydraulics and fluvial geomorphology along with the driving forces of climate and plate tectonics are reviewed and applied directly to the

understanding of California's river systems. Part II evaluates selected land use practices that affect, or are affected by, California's rivers.

Schweickert R. and D. Cowan. 1975. *Early Mesozoic Tectonic Evolution of the Western Sierra Nevada, California.* Geol. Soc. Am. Bull. V. 86. Pp. 1329-1336.

One of several key articles delineating the tectonic evolution of the Sierran Foothills, this paper essentially described the oceanic nature of the volcanic basement rocks. Incorporating the new Plate Tectonics theory, the article postulated subduction along the western margin of the North American plate, and the collision of an island arc at the end of the Jurassic Period.

State Water Resources Board. 1951. *Report on Feasibility of Feather River Project and Sacramento - San Joaquin Delta Diversion Projects Proposed as Features of the California Water Plan.* State of California. 127pp.

We only have a copy of the Table of Contents and Intro. The original document is in the Bureau of Reclamation Library, Rm W1522 of the Fed. Bldg. on Cottage Way, Sac.CA.

The Nature Conservancy. 2001. *Indicators of Hydrologic Alteration, User's Manual.* The Nature Conservancy and Smythe Scientific Software. 53pp.

The IHA analysis has recently become popular because of the thorough coverage of changes in 33 hydraulic variables. The analysis is particularly useful where large changes in hydrology have occurred, such as dams and diversions. The user's manual is available on The Nature Conservancy website and include detailed instructions for using the computer program and interpreting the results.

U. S. Army Corps of Engineers. 2002. *Sacramento and San Joaquin River Basins California Comprehensive Study; Draft Interim Report.* Sacramento District. Sacramento, California. 79pp.

This report is an overview of ongoing activity for the Sacramento and San Joaquin River Basins Comprehensive Study. The study has developed a framework and set of guidelines for problem analyses and solution development to integrate flood damage reduction and ecosystem restoration. The project developed floodplain maps and HEC-2 analyses for the Feather River system.

---- 1997. *Topographic Maps and Cross-Sections.* Prepared for the Sacramento and San Joaquin River Basins Comprehensive Study. Sacramento District.

These two-foot contour interval topographic maps are available in electronic form from the USACE. The maps are a key resource for this investigation, since they provide river channel topography as well as the floodplain. Cross-sections developed from these maps were used in FLUVIAL-12 computer analyses, and were used to develop cross-section comparisons with earlier cross-sectional data.

U. S. Geological Survey. 1989. *Late Cenozoic Stratigraphy of the Feather and Yuba Rivers Area, California, with a Section on Soil Development in Mixed Alluvium at Honcut Creek.* USGS Bulletin 1590-G. Denver, Colorado. 132 pp.

This report describes a sequence of alluvial deposits in the Feather and Yuba Rivers area of California and these deposits are correlated with existing stratigraphic units to the south in the northeastern San Joaquin Valley. Soils were examined to establish a soil chronosequence to evaluate the systematic changes in soil profile properties with increasing age of the deposits and to evaluate the use of soils as correlation and dating tools for deposits of the upper Cenozoic. Studies of relict and exhumed soils are described formed on six of these deposits at Honcut Creek. Systematic change in soil properties over 1.6 million years estimated the age span of the chronosequence and that this provides insight into near-surface weathering processes.

---- 1987. *Late Cenozoic Tectonism of the Sacramento Valley, California*. USGS Professional Paper 1359. 46 pp.

The study essentially contours the surface of the Pleistocene Red Bluff Formation to determine areas where deformation has occurred. Using this technique, the study identifies numerous areas in the valley where late Cenozoic, and possibly active, tectonism has occurred.

---- 1985. *Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, California*. MF-1790.

This Miscellaneous Field Study consists of a series of maps and a short description of geologic units in the Sacramento Valley and Sierra foothills. The project mapped Tertiary and Quaternary to Recent sedimentary and volcanic deposits. The maps, in conjunction with field work for this project, were the principal sources of geologic data for the SP-G2 Report.

---- 1980. *Sediment Transport of Streams Tributary to San Francisco, San Pablo, and Suisun Bays, California, 1909-66*. USGS Water – Resources Investigations 80 – 64. 92pp.

Sediment transported to the Sacramento-San Joaquin Delta and San Francisco Bay system in California significantly affects navigation, water quality, construction, and other developmental activities. Hydraulic mining was largely responsible for debris discharge in streams and after mining ceased, the effects on streams continued.

In 1917, G. K. Gilbert estimated that sediment transport to the delta averaged about 2 million cubic yards annually prior to gold discovery and increased to about 18 million cubic yards annually during 1849 – 1914. In the present study, sediment was transported to the entire San Francisco Bay system at an average rate of 8.6 million cubic yards per year. About 7.4 million cubic yards, or 86 percent, of this sediment was derived from the Sacramento-San Joaquin River basins upstream from their confluence in the delta region near Antioch.

----- 1978. *Sediment Transport in the Feather River, Lake Oroville to Yuba City, California*. Water Resources Investigations 78-20. 73pp.

Regulation of the Feather River by Oroville Dam and reservoir (beginning in 1967) changed the streamflow and sediment discharge downstream from the dam. Changes in channel geometry to adjust to the new regimen were still in progress in 1975. Streamflow and sediment concentration and discharge had decreased. Median streamflow at Feather River near Gridley and Feather River at Yuba City, 27 and 49 miles downstream from the dam, had not changed, although the frequency of flow rates less than median increased and the frequency of flow rates greater than median, which transport most sediment, decreased. Sediment-transport data indicate an increase in sediment yield (tons per square mile) from the 1965-67 period to the 1968-75 period in the basin downstream from Gridley to Yuba City, although the quantity of sediment transported was reduced owing to removal of sediment by storage behind Oroville Dam and to reduced streamflow. The increase in yield, assuming no change in tributary inflow, may be attributed partly to channel erosion accelerated by the clear-water releases and partly to the change in frequency and magnitude of flow rates. (Available: Northern District)

---- 1972. *Determination of Channel Capacity of the Feather River Between Oroville and Honcut Creek, Butte County, California*. Menlo Park, California. 54pp.

This study evaluates the capability of a 22-mile reach of the Feather River between the fish barrier and Honcut Creek to convey flood flows including the design flood release of 150,000 cfs from Oroville Dam. The study was made to determine the water surface profiles that would result from selected flood releases ranging from 40,000 to 160,000 cfs. For most of the lower reach, the natural banks along the main channel will not contain the design discharge of 150,000 cfs. Computed water-surface elevations indicate that discharges less than 68,000 cfs will be contained within the natural and leveed channel between cross sections 6 and 68. Higher discharges will cause overbank flooding on the left-bank flood plain between cross sections 6 and 30.

Flooding of the left-bank flood plain between cross sections 1 and 6 will occur whenever the discharge of the Feather exceeds 43,000 cfs or during periods of high flow on Honcut Creek. Inflow from Thermalito Afterbay (upstream from cross sect. 43) will increase the stage by as much as 3.4 feet on the river; the effect may extend as far as 3.5 miles upstream to cross sect. 53. (Available: Northern District)

Water Engineering and Technology. 1991. *Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River, Feather River, Yuba River, Bear River, and American River.* Fort Collins, Colorado. 327pp.

This study was performed for the Third Phase of the Sacramento River Bank Protection Project and contains the results of a geomorphic study that was conducted to determine the dynamics of the studied rivers and sloughs with the objective of developing a geomorphically-based framework upon which bank protection methods could be evaluated and overall protection strategies formulated.

Included within the study are changes that have affected the study reaches, a summary of the geology of the northern Great Valley, and bank protection techniques. It also covers geomorphic analysis results of the selected rivers and an evaluation of proposed bank protection.

---- 1990. *Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River (RM 78-194) and Feather River (RM 0-28).* 1990. Fort Collins, Colorado. 278 pp.

This study was performed for the Third Phase of the Sacramento River Bank Protection Project. It provides a detailed geomorphic analysis and analyzes bank protection alternatives for the Sacramento River from Verona (RM 78) to Glenn (RM 178) and the Feather River from Verona (RM 0) upstream to the confluence with the Yuba River (RM 28). It includes a limited investigation of the Butte Basin (RM 178 to RM 194).

A general bank protection plan has been formulated for each study area. A design matrix has been created to aid in the determination of the most effective form of

bank protection for a given site. A decision matrix is included for use in conjunction with the design matrix to account for considerations other than method effectiveness, such as environmental considerations. The matrices promote the incorporation of site-specific geomorphic characteristics into the bank protection method selection process.

Wildman, N. A. 1981. *Episodic Removal of Hydraulic-Mining Debris, Yuba and Bear River Basins, California*. Masters Thesis. Department of Earth Resources. Colorado State University. Fort Collins, Colorado. 107 pp.

The report is a study of hydraulic mine tailings in the Yuba and Bear Rivers. Streams have downcut through the deposits, resulting in reduced stream gradients. Terrace deposits of debris flank the streams. This is most evident in the upper reaches of the river systems. The rivers with high gradients have cleaned their channels, but the lower gradient sections and smaller creeks still contain considerable deposits. Floodplain incision has been episodic, in response to major flood events, and differs from location to location.

William Lettis and Associates. 2002. *Seismotectonic Evaluation - Phase II Fault and Seismic Hazards Investigation – North of Delta Offstream Storage Investigation*. Report Prepared for the Department of Water Resources.

The results of extensive surface and subsurface fault and seismic studies for the Sites Offstream Storage Project is presented in this report. The report also includes an up-to-date regional seismotectonic description of Northern California.