DRAFT ENVIRONMENTAL ASSESSMENT

AMENDMENT OF PROJECT LICENSE TO RECONSTRUCT THE LAKE OROVILLE MAIN SPILLWAY, MODIFY THE EMERGENCY SPILLWAY, AND TO RELOCATE A PROJECT TRANSMISSION LINE

FEATHER RIVER HYDROELECTRIC PROJECT
FERC No. 2100
California

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Administration and Compliance
888 First Street, N.E.
Washington, DC 20426

November 2018

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

Advisory Council	Advisory Council on Historic Preservation
APE	Area of Potential Effect
Army Corps	U.S. Army Corps of Engineers
C	Celsius
California DFW	California Department of Fish and Wildlife
California DWR	California Department of Water Resources
California SHPO	California State Historic Preservation Officer
California SWRCB	California State Water Resources Control Board
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commission or FERC	Federal Energy Regulatory Commission
CWA	Clean Water Act
DO	dissolved oxygen
DPS	Distinct Population Segment
DSOD	Division of Safety of Dams
D2SI	Division of Dam Safety and Inspections
EA	Environmental Assessment
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FWS	U.S. Fish and Wildlife Service
HPMP	Historic Properties Management Plan
IPaC	Information for Planning and Consultation
kV	kilovolt
licensee	California Department of Water Resources
msl	mean sea level

MW	megawatt
NRHP	National Register of Historic Places
NAHC	California Native American Heritage Commission
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NTU	nephelometric turbidity units
OWA	Oroville Wildlife Area
PA	Programmatic Agreement
PG&E	Pacific Gas and Electric Company
RCC	Roller compacted concrete
Regional Water Board	Central Valley Regional Water Quality Control Board
RGP	Regional General Permit
Section 106	Section 106 of the National Historic Preservation Act
Section 401	Section 401 of the Clean Water Act
Section 7	Section 7 of the Endangered Species Act
THPO	Tribal Historic Preservation Officer
401 certification	Water Quality Certification under section 401 of the Clean Water Act

ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Administration and Compliance
Washington, DC

Feather River Hydroelectric Project
FERC No. 2100-185

1.0. APPLICATION

Application Type:	Amendment of Project License
Dates Filed:	January 29, 2018, and supplemented February 13, July 16, and August 1, 2018
Applicant's Name:	California Department of Water Resources
Water Body:	Feather River
County and State:	Butte County, California
Federal Lands:	The project occupies federal lands administered by the U.S. Forest Service and Bureau of Land Management

2.0 PURPOSE OF ACTION

The California Department of Water Resources (California DWR or licensee), licensee for the Feather River Hydroelectric Project (Feather River Project), requests an amendment to its project license to reconstruct and modify its main and emergency spillways at Lake Oroville Dam. The project's spillways were damaged by flooding in February 2017, and the reconstruction and modifications are required to allow high inflows to pass downstream of Oroville Dam. California DWR also proposes to implement various measures to support the initial response to the spillway failure and proposes to implement additional actions to support the subsequent recovery efforts. The main spillway rebuild would be an in-kind replacement while the emergency spillway modifications and the transmission line relocation would be incorporated into the project via a license amendment.

3.0. BACKGROUND

In February 2017, abnormally heavy precipitation resulted in high flows in the Feather River basin that caused extensive erosion and damage to the main spillway and emergency spillway area at the Feather River Project's Oroville Dam. California DWR first observed major damage to the main spillway on February 7, 2017, which included a large area of foundation erosion and concrete chute loss in the mid-section of the main spillway. Upon discovery of the main spillway damage, California DWR initiated consultation with the Commission's Division of Dam Safety and Inspections (D2SI) and the California Division of Safety of Dams (California DSOD) to coordinate appropriate response actions. Due to high inflows into Lake Oroville (the project reservoir), and reduced outflow capacity on the main spillway, Lake Oroville overtopped the adjacent emergency ogee spillway on February 11, 2017, and caused back-cutting erosion below the emergency spillway. The back-cutting erosion threatened the stability of the emergency spillway's crest structure. Unavoidable increased operation of the damaged main spillway led to the loss of the lower portion of the main spillway chute and caused significant erosion under and adjacent to the main spillway. Since that time, California DWR has implemented numerous emergency actions including temporarily relocating transmission lines away from the damaged main spillway, dredging in the diversion pool below the spillways, removing sediment near the main spillway, establishing site access, and initiating reconstruction of the main spillway and fortification of the emergency spillway.

The actions that followed the spillway failures are divided into two periods: the "response" period that took place immediately after the discovery of the main spillway failure on February 7, 2017, and the "recovery" period that covers the timeframe generally associated with the construction activities at the spillways. The response period spanned the weeks after the main spillway failure when emergency actions needed to ensure public safety and environmental protection such as dredging, stabilization activities, establishing site access, and equipment staging. Because the main spillway failure was a progressive event that continued to degrade the spillways up until their last use, we generally consider the response period to have concluded when the main spillway was shut down on May 19, 2017, at which time the recovery actions began.

The recovery period is ongoing at this time and is expected to continue until January 26, 2019 (California DWR 2018a). The recovery period includes all activities involving permanent reconstruction of the damaged facilities, along with the supporting activities needed to facilitate that reconstruction. Recovery activities began after the closure of the main spillway on May 19, 2017. Recovery activities include reconstruction of the main spillway, augmentation of the emergency spillway and adjacent cutoff wall, relocation of a buried transmission line, and all activities necessary to support those efforts.

Situations involving immediate threats to human health or safety, or immediate threats to valuable natural resources, must consider whether there is sufficient time to follow the procedures for environmental review established in the National Environmental Policy Act. Because the response and recovery actions needed to be taken immediately due to the severity of the emergency, an environmental assessment (EA) could not be completed in advance of those activities. This EA, therefore, looks retroactively at the environmental effects of the response and recovery activities that preceded California DWR's filing on January 29, 2018. It also looks prospectively at the potential environmental effects associated with the continuation of the recovery activities proposed in the licensee's January 29, 2018 filing.

This EA does not investigate the structural adequacy or engineering elements of the proposed construction activities, which are being assessed separately by the Commission's D2SI. This EA also does not re-analyze the resources affected by relicensing activities. Nevertheless, there may be some overlap between the resources affected by California DWR's proposal and relicensing activities. Those resources are examined here to the extent the response and recovery activities affected them.

3.1 Feather River Project Description

The Commission issued a 50-year license for the Feather River Project on February 11, 1957,[1] which expired on January 31, 2007. The project has been operating on an annual license since February 1, 2007.[2] The project is located on the Feather River in Butte County, California, and encompasses 41,540 acres (Figure 1). The project includes three power plants, two on-river impoundments, and two off-river impoundments. California DWR's proposal to rebuild and modify its spillways would occur near the 770-foot high Oroville Dam, with additional supporting activities to occur in the vicinity of the Thermalito Diversion Pool. Flows pass out of Lake Oroville in one of four ways: through the six-unit, 645-megawatt (MW) Hyatt Pumping-Generating Plant; through the gated main spillway; over the ungated emergency spillway; or through the low-level river outlet valve. Flows pass into the 320-acre Thermalito Diversion Pool, which is impounded by the 143-foot-high Thermalito Diversion Dam, located about four miles downstream. Other project features include: the Thermalito Power Canal leading off-river to the Thermalito Forebay and Forebay Dam; Thermalito Pumping-Generating Plant, and Thermalito Afterbay and Afterbay

[1] Order Issuing License (17 FPC 262).

[2] *See* Notice of Authorization for Continued Project Operation, issued February 1, 2007 in Project No. 2100-000.

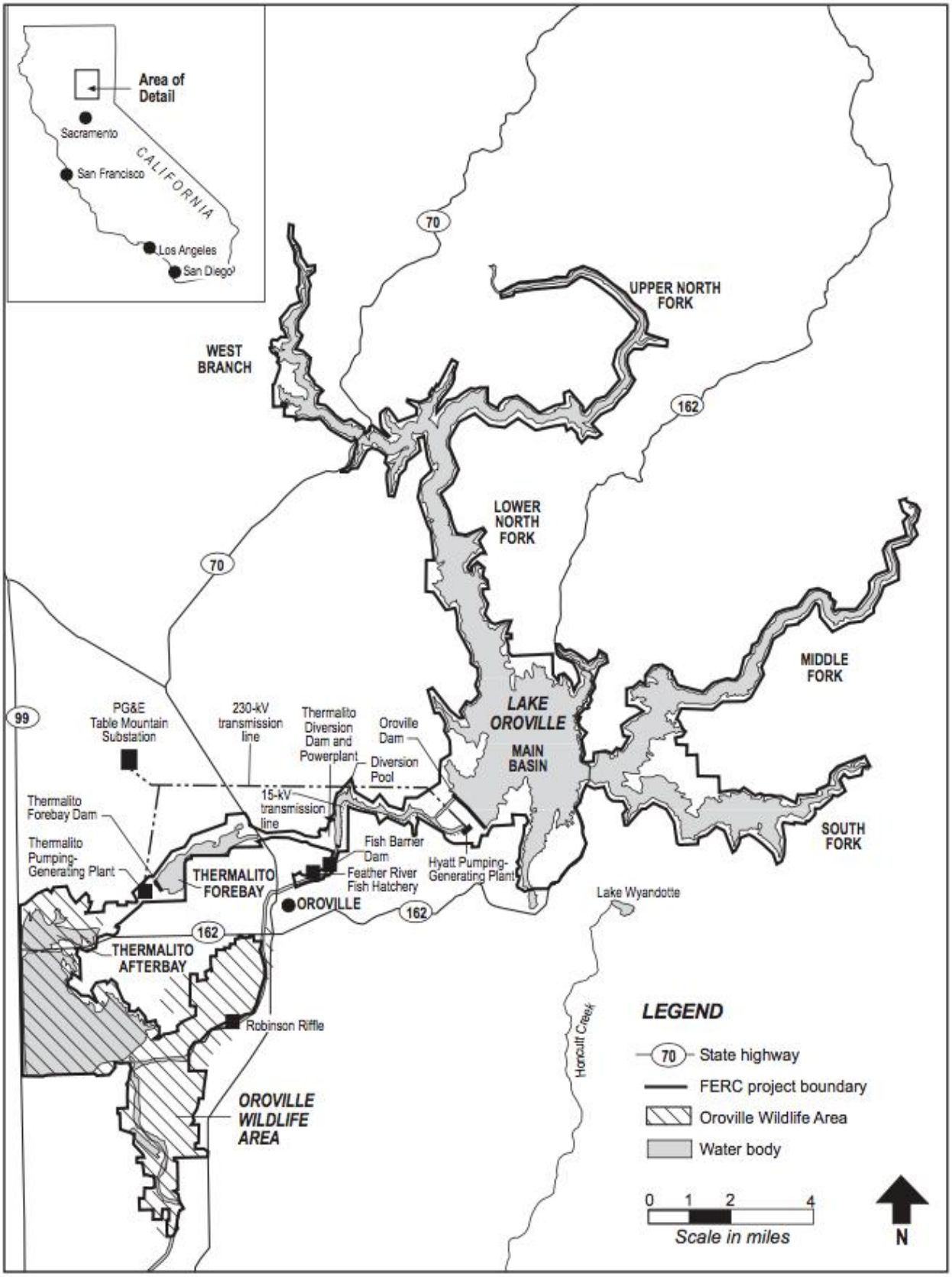

Figure 1. Location Map of the Feather River Hydroelectric Project (source: FERC 2007)

Dam; the Feather River Fish Hatchery and fish barrier dam; the Oroville Wildlife Area (OWA); transmission lines, and various recreational facilities. [3]

3.2 Project Operation

The project facilities are part of the State Water Project, a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the State Water Project 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 project facilities are also operated for flood management, power generation, water quality improvement in the Sacramento-San Joaquin Delta, and recreation and fish and wildlife enhancement.

Winter and spring runoff, to the extent available, is stored in Lake Oroville for release to the Feather River, as necessary, to meet downstream water demands and minimum instream flow requirements. Water can also be stored in Lake Oroville and the other project impoundments over a shorter time frame (over days or hours) to meet power objectives. Typically, under normal and wetter conditions, Lake Oroville is filled to its normal maximum annual surface elevation of 901 feet mean sea level (msl) in June and then lowered as needed to meet downstream requirements until reaching its minimum level in December or January. During and following dry years, the reservoir may be drawn down more, and may not fill to desired levels the following spring. During wetter hydrologic conditions, Lake Oroville is managed to control downstream flooding. The U.S. Army Corps of Engineers (Army Corps) requires Lake Oroville to be operated to maintain up to 750,000 acre-feet of storage space to capture significant inflows for flood control.

The project is also designed to use water in excess of the downstream flow requirement for pumping water back into the Thermalito Forebay, and then into Lake Oroville during off-peak hours. This water is then released again during on-peak hours when power values increase. The project operates in a pump-back mode year-round, and this operation can cause Lake Oroville to fluctuate 1 to 2 feet daily. Weekly fluctuations in Lake Oroville range from 2 to 6 feet and may be as great as 9 to 11 feet over a several week period.

Because the Thermalito Forebay, Power Canal, and Diversion Pool below Lake Oroville are all designed to share the same operating water level (and are essentially the same hydraulic system), the water levels in each of these facilities rise and subside in unison. The system does not typically fluctuate much on a daily basis. During the

[3] See a detailed description of the project's facilities and operation in the Final Environmental Impact Statement for the Oroville Facilities Project, issued May 18, 2007, in Project No. 2100-052, at pages 13 through 25 (FERC 2007).

summer over a longer period of time, the water level is generally cycled down 2 to 4 feet during the middle of the week and then refilled by the weekend. During the winter, it may fluctuate more.

The Thermalito Afterbay is operated to meet multiple requirements, including regulating inflow from the Thermalito Pumping-Generating Plant, providing water for withdrawal during pump-back operation, and releasing water through the Thermalito Afterbay outlet to the Feather River. The Thermalito Afterbay is also the location where diversions are made to meet the Feather River service area irrigation entitlements.

3.3 Initial Response Actions

Following the initial observation of damage and erosion at the main spillway on February 7, 2017, California DWR took various actions to secure the project facilities and to minimize effects to environmental resources. Specifically, on February 8, 2017, California DWR, in preparation for the potential need to use the emergency spillway, cleared the area below the spillway of trees, rocks, and debris. In preparation for flows over the emergency spillway, California DWR also grouted and installed rocks and shotcrete in some areas below the emergency spillway. In association with increased inflows into Lake Oroville on February 9, 2017, California DWR increased releases through the main spillway, causing additional damage to the main spillway chute and significantly eroding the hillside. Due to the elevated turbidity levels in the Feather River, California DWR assisted the California Department of Fish and Wildlife (California DFW) in relocating juvenile Chinook salmon and steelhead from the downstream Feather River Fish Hatchery, which was compromised by the elevated turbidity in its water supply system from the river. The juvenile fish were relocated to the Thermalito Afterbay Hatchery Annex and were released into the Feather River and San Francisco Bay in 10 events extending from March through May 2017. California DWR also fortified the Hyatt Power Plant to prevent backwatered areas from flooding and compromising the powerhouse. California DWR ceased powerhouse operations on February 9, 2017, due to backwater effects from debris accumulation below the main spillway.

On February 11, 2017, increasing inflow to Lake Oroville caused reservoir levels to exceed the emergency spillway elevation and water began passing over the emergency spillway for the first time in project history. Flows passing over the emergency spillway caused significant erosion to the bare hillside below the emergency spillway. This was coupled with ongoing erosion of the main spillway since the initial February 7, 2017 observation, thereby filling in portions of the Thermalito Diversion Pool with additional sediment. The sediment deposition in the spillway caused the Thermalito Diversion Pools to rise above safe operating levels for the Hyatt Power Plant, rendering it out of service and prompting California DWR to fortify the powerhouse to prevent flooding.

In response to rapidly progressing uphill erosion below the emergency spillway and the potential for emergency spillway failure, residents downstream of Oroville Dam were ordered to evacuate the area on February 12, 2017. After using both spillways to reduce reservoir levels, the mandatory evacuation order was reduced to an evacuation advisory warning on February 14, 2017, and downstream residents were allowed to return to the area.[4] On February 16, 2017, California DWR began intense efforts to remove debris and sediment from the Diversion Pool. The removal efforts were implemented using land-based and barge-based excavators. In addition, California DWR graded, fortified, and placed shotcrete on a large area of the eroded hillside below the emergency spillway.

As inflows and lake levels receded, California DWR ceased operation of the main spillway to facilitate sediment removal and inspect damage. The most notable of these reductions occurred on February 27, 2017, when spillway releases decreased from 60,000 cubic feet per second (cfs) to 0 cfs. Due to the abrupt flow reductions in the Feather River and potential environmental impacts, California DWR conducted operations to rescue stranded fish in collaboration with California DFW. Additional fish rescues occurred in the Feather River following subsequent flow reductions when the main spillway was taken out of service. Additional abrupt flow reductions occurred four times until May 19, 2017, when the main spillway was taken out of service for the remainder of the year.

The Hyatt Power Plant returned to service on March 3, 2017 and was used in conjunction with the main spillway to more fully manage Lake Oroville storage levels, until being taken out of service on May 19, 2017. California DWR also reactivated its river valve operation capability at the base of Oroville Dam, which added additional flow release capacity. In a separate proceeding, California DWR proposed to permanently relocate its primary above-ground transmission line from the Hyatt Power Plant to the Table Mountain Substation. California DWR had been utilizing a temporary transmission line due to potential erosion concerns to the transmission line towers in the vicinity of the main spillway. California DWR's application was approved on August 23, 2017.[5] The California DWR transmission line was relocated concurrently with a Pacific Gas and Electric Company (PG&E) above-ground transmission line in the same area. PG&E filed its request to relocate its transmission line, with the Commission for approval on June 23, 2017. The Commission approved the request on August 2, 2017.[6]

---

[4] The evacuation advisory warning was later lifted on March 21, 2017.

[5] Order Amending License, Revising Project Description, and Amending Project Boundary (160 FERC ¶ 62,168).

[6] Order Approving Non-Project Use of Project Lands and Amending License (160

Concurrently, at the Commission's direction and with its approval, California DWR convened an independent Board of Consultants to design and assess remedial options for the main and emergency spillways, and to develop measures to reliably operate the project during the emergency situation and reduce risk.[7] At the Commission's direction, California DWR also convened an independent forensic review team to investigate the cause of the spillway failure. The Commission worked closely with California DWR and Board of Consultants to develop a new design for the two spillways, and with the independent forensic team to identify the causes of the spillway failure. The independent forensic team issued its final report on January 5, 2018. Among the findings of the report, the team concluded:

> "There was no single root cause of the Oroville Dam spillway incident, nor was there a simple chain of events that led to the failure of the [main] spillway chute slab, the subsequent overtopping of the emergency spillway crest structure, and the necessity of the evacuation order. Rather, the incident was caused by a complex interaction of relatively common physical, human, organizational, and industry factors, starting with the design of the project and continuing until the incident."[8]

FERC ¶ 62,118).

[7] *Cal. Dep't of Water Res*., Docket No. P-2100-000 (Feb. 13, 2017) (delegated letter order) (requiring that a board of at least five independent technical experts review then-current measures and conditions; risk reduction measures; all proposed remedial options for both spillways; long-term, permanent modifications and project operations; and other issues); *Cal. Dep't of Water Res*., Docket No. P-2100-000 (Feb. 21, 2017) (delegated letter order) (approving five-member board and further specifying the board's responsibilities).

[8] France, J.W., A.A. Alvin, P.A. Dickinson, H.T. Falvey, S.J. Rigbey, J. Trojanowski. (2018). Independent Forensic Team Report – Oroville Dam Spillway Incident, issued January 5, 2018.

4.0 PROPOSED ACTION AND ALTERNATIVES

4.1 Action Alternatives

California DWR developed its proposed action in consultation with the independent Board of Consultants, the California DSOD, and the Commission's D2SI. During the development of alternatives, California DWR considered various options for the location and design of spillway structures to pass high inflows out of the project's Lake Oroville to ensure public safety for residents downstream of the project. While several alternatives were considered, the emergency nature of the situation was not conducive to developing detailed plans for each alternative. California DWR's development of a final alternative, described in section 4.2 below represents the final design after the continuous elimination of infeasible main and emergency spillway design alternatives, and was constrained by California DWR's inability to select, prepare, and develop a new main spillway site in an expeditious manner.

Among the elements considered during the design phase were current engineering standards, conveyance capacity, site location, geological conditions, material use, seismic stability, cost, construction time, and environmental concerns. At the main spillway, California DWR opted to use the existing spillway gate structure as a starting point for its design, primarily due to the excessive time required to build a new gate structure at an alternate site. Once it decided to utilize the footprint of the existing main spillway, California DWR considered various designs and materials for bypassing flows past the large eroded area created by the main spillway failure and constructing a functional spillway chute. Similarly, the enhancements proposed to the emergency spillway were designed to adequately pass high inflows, while being able to be constructed in a reasonable timeframe.

As demonstrated by regular construction authorization letters from the Commission's D2SI, Commission staff concur that the California DWR's proposal outlined below represents the preferred alternative for restoring the project to its operational capacity. The action alternative allows for expeditious repair of the main spillway by using the existing footprint and orientation of the damaged main spillway, and adheres to modern engineering standards. In a like manner, the emergency spillway enhancements allow for its continued use, while adhering to modern engineering standards.

Nevertheless, we note that in its January 12, 2018 letter to the Commission's D2SI, California DWR states that it is initiating a Comprehensive Needs Assessment to identify additional measures to bolster the safety and reliability of Oroville Dam and the appurtenant structures. Among the tasks of the assessment, California DWR and an Independent Review Committee would review: alternatives to restore spillway design capacity to pass the probable maximum flood; operational needs to support development

of alternative reservoir outflow enhancements; flood control outlet enhanced reliability; alternatives for the low-level outlet; Oroville Dam embankment reliability and improvements; and instrumentation and monitoring for the Oroville Dam complex. California DWR states that this effort would conclude by December 31, 2019, resulting in a list of prioritized dam safety and operational reliability needs. California DWR further states that it may identify projects that significantly benefit public safety and reduce risk. California DWR would submit its identified projects for Commission and other agency review and authorization. The 2018-2019 Comprehensive Needs Assessment is beyond the scope of this EA.

4.2 Proposed Action

California DWR proposes to implement a set of response and recovery actions with the end goals of rebuilding the main spillway and modifying the emergency spillway. The analysis below discusses several actions under each end goal. California DWR also proposes to implement measures to prevent or mitigate for any adverse effects to environmental resources. Altogether, California DWR proposes to rebuild the main spillway and modify the emergency spillway in two phases, and completing work by January 2019. Due to the emergency nature of the spillway failure, California DWR completed urgent repairs to the main spillway by reconstructing it back to a temporarily functional state prior to the start of the winter season in November 2017.[9] California DWR would subsequently complete restoration of the main spillway and additional enhancements to the emergency spillway by January 2019.

California DWR would also relocate a buried transmission line between the Hyatt Power Plant and Thermalito Diversion Powerhouse. The main spillway rebuild would be an in-kind replacement, while the emergency spillway modifications and the transmission line relocation would be incorporated into the project via a license amendment. This EA retroactively examines the urgent work completed during 2017, but also analyzes the proposed work during the 2018 construction season.

4.2.1 Initial Response Actions

As defined above, the initial response period included the actions that California DWR implemented to respond to the unanticipated main spillway failure and erosion of the emergency spillways. The response period encompassed the February 7 to May 19, 2017 period and included California DWR's efforts to: stabilize the main spillway; prepare for use of the emergency spillway; temporarily relocate transmission lines; dredge eroded material from the Thermalito Diversion Pool; manage inflow to the

[9] The 2017 construction work was developed and authorized in consultation with the Commission's D2SI.

project; construct access roads; and implement other supporting activities. These activities are described in detail below.

Preparation and Use of the Emergency Spillway

Shortly following the initial discovery of erosion at the main spillway on February 7, 2017, California DWR began preparing for potential use of the emergency spillway, located west and adjacent to the main spillway. To prevent additional material from washing into the Thermalito Diversion Pool, California DWR cleared the hillside below the emergency spillway of trees, vegetation, rock, and debris, and used the cleared hillside and seasonal streambed to convey flows over the emergency spillway. In total, California DWR cleared approximately 40 acres in preparation for the use of the emergency spillway.

Following the use of the emergency spillway, California DWR constructed new access roads below the emergency spillway to replace those washed out from use of the emergency spillway. In the extensive areas where erosion had occurred, California DWR filled scour holes with large diameter rock at a rate of 1,200 tons of material per hour, using helicopters and heavy construction equipment.[10] California DWR also graded and excavated the eroded hillside, followed by the placement of approximately 107,000 cubic yards of concrete to prevent any future additional erosion.

Temporary Transmission Line Relocation

Because of the threat of erosion and collapse of the transmission line towers near the main spillway and the potential to lose operational ability of the Hyatt Power Plant, California DWR needed to immediately reroute its Oroville-Table Mountain Transmission Line. California DWR's original Oroville-Table Mountain Transmission Line ran from the Hyatt Pumping-Generating Plant, in a northwest direction, across Thermalito Diversion Pool and the faces of both spillway areas. The original Oroville-Table Mountain Transmission Line then turned due west toward the Table Mountain substation, located approximately 7 miles away (Figure 2). California DWR constructed a temporary (shoofly) transmission line alignment that deviated from its original alignment midway across the spillways, to an area immediately below the main spillway gates where it then continued in a northwest direction, until it rejoined the original Oroville-Table Mountain Transmission Line (Figure 2). The temporary DWR transmission line was approximately 1.4-miles-long, and resulted in a denuded corridor approximately 200 feet wide.

[10] https://www.water.ca.gov/What-We-Do/Emergency-Response/Oroville-Spillways/Background (accessed June 20, 2018).

Similarly, PG&E's Table Mountain-Palermo Transmission Line was in the path of the emergency spillway flow and would have been damaged from water flows if the emergency spillway was used extensively. PG&E's original Table Mountain-Palermo Transmission Line ran in a primarily north-south direction before turning west towards the Table Mountain substation, west of the main spillway. The PG&E transmission line was located on land within the project boundary through an existing easement between the two entities. PG&E temporary transmission line deviated from its permanent alignment at a point on the south bank of the diversion pool near the main spillway confluence, and was relocated further away from the spillways before rejoining the original Table Mountain-Palermo line alignment (Figure 2). The PG&E temporary shoofly transmission line was approximately 0.9-miles-long and resulted in a mostly denuded corridor approximately 100 feet wide. Both the California DWR and PG&E also constructed short access roads and work pads to facilitate installation of transmission towers or electrical poles.

Main Spillway Response

At the main spillway, California DWR implemented urgent actions to stabilize the damaged spillway and to create access to the spillway site. California DWR established a network of construction access roads to the spillway site, which primarily consisted of short (less than ¼-mile long) branches off the previously existing access roads near the main spillway. In the process of road construction, California DWR removed trees and vegetation in an approximately 30-foot wide road corridor. California DWR also constructed crane pads along the main spillway to facilitate the mobilization of equipment to the main spillway site, resulting in 0.83 acres of land disturbance. As flow releases from the main spillway subsided, California DWR blasted and graded unstable slopes near the main spillway. This occurred primarily along the left (eastern portion) of the main spillway, along an approximately 1,300-foot length of eroded hillside parallel to the main spillway. During the temporary spillway outages, California DWR installed shotcrete and anchors at the end of the damaged spillway slab to prevent further erosion of the underlying spillway material.

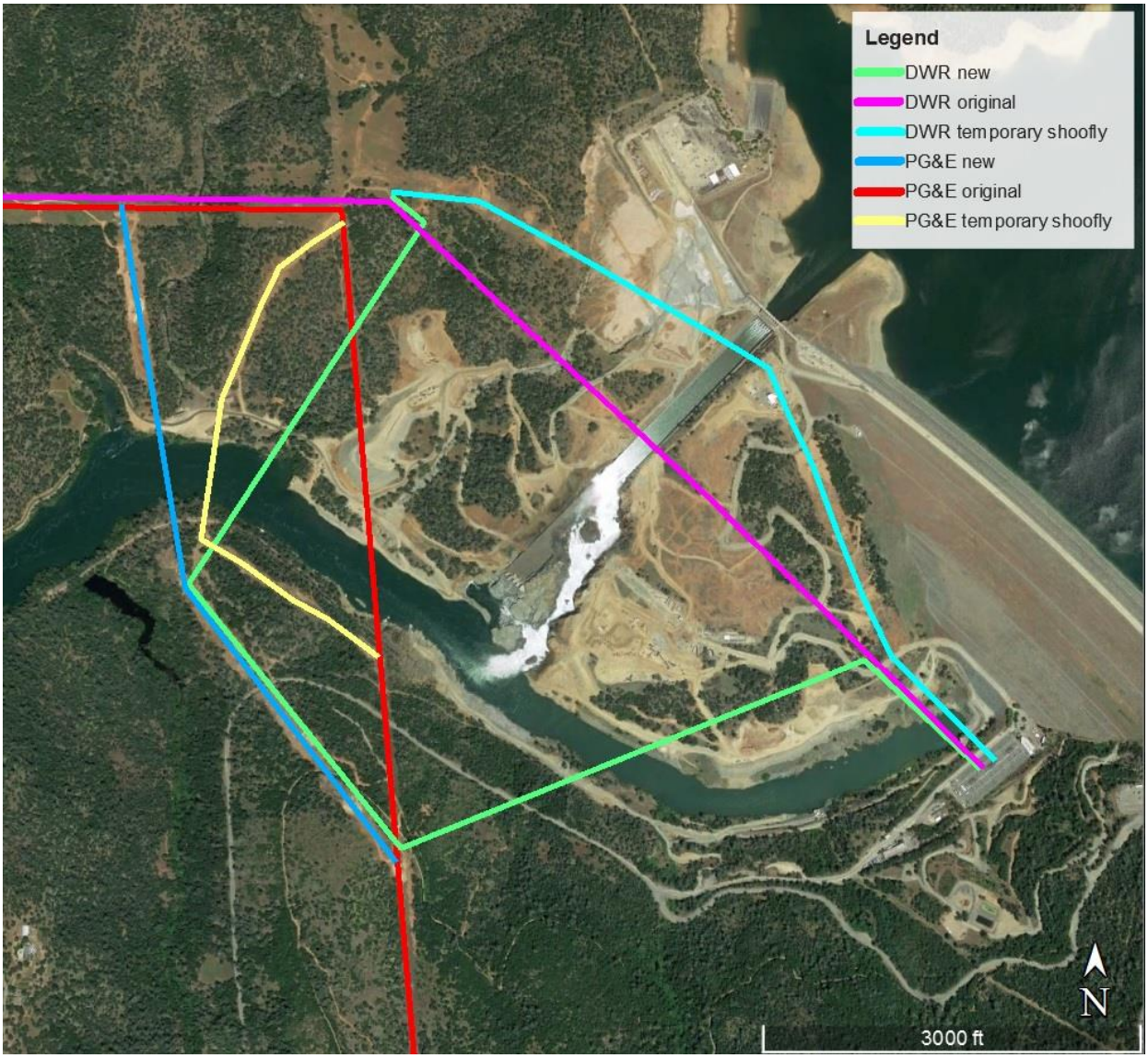

Figure 2. Transmission lines in the vicinity of Oroville Dam and spillways (source: Commission staff)

Dredging

Severe erosion ensued after the failure of the main spillway and use of the emergency spillway. Near the main spillway, a large erosion gully emerged just east of the spillway. Most of this material settled in the Thermalito Diversion Pool. Similarly, the area downhill of the emergency spillway was severely eroded, and the material deposited in the Thermalito Diversion Pool. The material deposited in the diversion pool caused water levels to rise in the diversion pool, concurrently backing up water against the Hyatt Power Plant and South Feather Water and Power's Kelly Ridge Powerhouse (FERC Project No. 2088), impairing operations of both facilities. California DWR

dredged eroded material from Thermalito Diversion Pool in the areas where outflow from the main and emergency spillways occur. California DWR dredged the material from several barge-based excavators and from the shore of the diversion pool using long-armed excavators beginning on February 15, 2017, and continued through the recovery phase (discussed below), concluding in fall 2017. The material was deposited in three prominent areas including a laydown area immediately west of the Thermalito Diversion pool spillway, a new spoil pile area southwest of the emergency spillway, and a historical spoil pile along the Thermalito Diversion Pool area across from the Hyatt Power Plant tailrace. California DWR estimates that approximately 2.2 million cubic yards of rock, concrete fragments, and hillside were eroded and deposited in the diversion pool. During the initial response phase, approximately 1.4 million cubic yards of debris was removed from the diversion pool.

Flow Management

As part of its February 7 to May 19, 2017 response activities, California DWR managed flow releases from the main spillway for the purpose of passing inflows and preserving the structural integrity of the remaining portion of the main spillway. Due to the uncertainty associated with main spillway releases exacerbating erosion of the spillway, California DWR implemented a range of spillway flow releases. Releases from the main spillway were also critical, due to California DWR's inability to release water from the Hyatt Power plant, which was offline until March 3, 2018.

During the response period, California DWR released flows from the main spillway up to 100,000 cfs, and as low as 0 cfs (Figure 3). California DWR also varied the ramping rate associated with the releases from small incremental steps to as much as 60,000 cfs per hour when dropping flows to zero.[11] The large sharp flow reductions occurred to prevent the lower spillway releases from head-cutting remaining portions of the main spillway. Downstream of the Oroville Dam, California DWR managed flow releases from the Thermalito Diversion Dam and Thermalito Afterbay Dam to pass flows from high flow spillway releases and to maintain flows for aquatic resources in the Feather River during reduced or no flow releases from Oroville Dam.

During the response period, there were four periods in which California DWR ceased releases from the main spillway. The first main spillway outage occurred during February 28 to March 16, 2017. During this time, California DWR provided minimum flows to the lower Feather River from water stored in the Thermalito Diversion Pool. This occurred until March 3, 2018, when Hyatt Power Plant came back online.

[11] For reference purposes, the mean daily flow in the Feather River is approximately 500-2,100 cfs, depending on the month (FERC 2007). The highest main spillway release occurred during exceptionally high inflows in 1997, during which flows through the main spillway were approximately 150,000 cfs.

California DWR also exercised two additional main spillway outages on March 28 to April 13, 2017 and May 2-9, 2017. During these final two outages, California DWR met minimum flow requirements using the Hyatt Power Plant, which was back online. California DWR also made releases from the main spillway, in its damaged state, on February 7-27, March 17-27, April 14-May 1, and May 10-19, 2017. By using the turbines to control the reservoir level, the main spillway would remain unused through completion of construction.

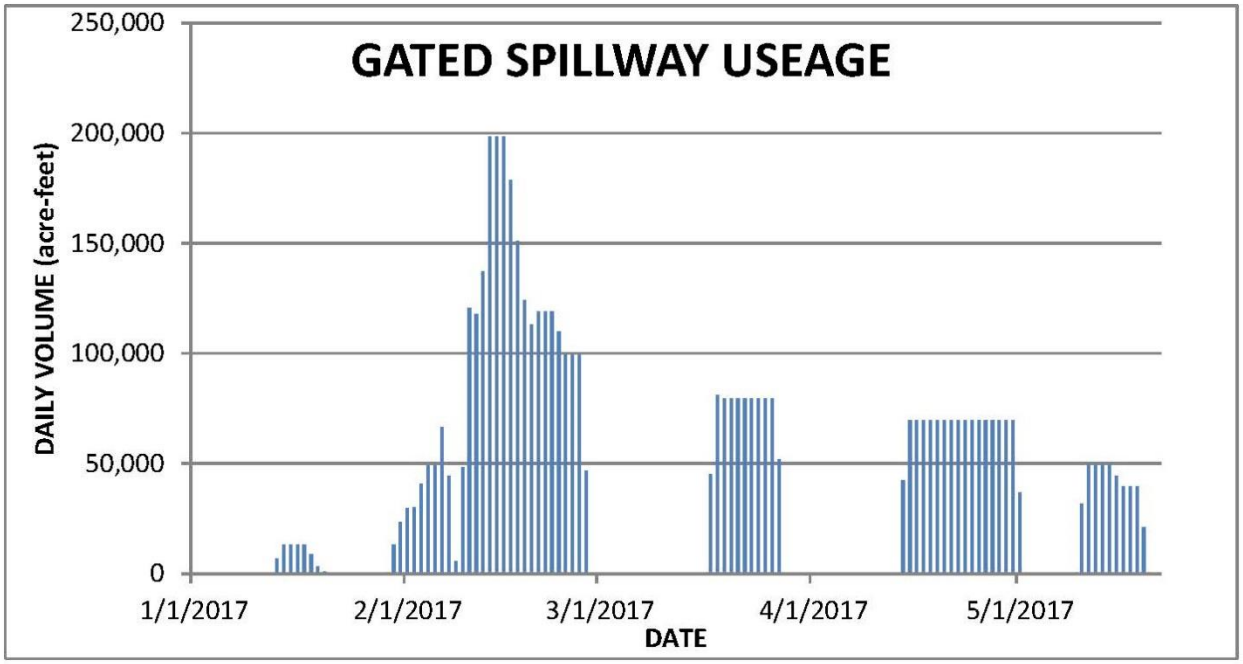

Figure 3. Main spillway releases during 2017, including intermittent zero release periods (source: California DWR 2018)

Roads

In addition to the roads used for access to the immediate main and emergency spillway areas, California DWR utilized or enhanced existing roadways in the project area to facilitate initial response efforts. Among the existing roads, California DWR utilized roads under the control of the City of Oroville and Butte County. These roadways were primarily located between state highway 70 and the main spillway site to the east. These existing roadways were used to transport construction materials and equipment, and for site access. California DWR provided a detailed list of roadways affected, including estimates for repairs from impacts associated with travel by construction equipment. California DWR also included specifications for a temporary traffic control plan in its filing, which it would require its contractors to implement as part of its construction efforts. The impacts of construction transportation in the project area are discussed further in *section 6.13-Transportation.*

4.2.2 Recovery Actions

Main Spillway Repairs

California DWR proposes to reconstruct the main spillway in two phases over two construction seasons. The first phase of construction in 2017 included construction activities on the entirety of the main spillway, except the uppermost 730-foot section below the spillway gates (Figure 4). During this first construction phase (May to November 2017), the subsequent 870-foot portion of the upper spillway section was demolished, excavated, and replaced with a reinforced structural concrete floor and walls. The 1,050-foot portion of the middle spillway chute was also partially reconstructed to a functional status during 2017. Construction activities on the middle spillway portion during 2017 included: blasting, demolition, and excavation for roller-compacted concrete (RCC) fill; constructing concrete backfill and RCC foundation for the reinforced concrete chute; and constructing RCC walls. California DWR reconstructed the 350-foot lower portion of the main spillway by removing the remaining portions of the spillway, constructing cutoff walls, and installing structural concrete. In addition to the removal of damaged concrete, California DWR laterally excavated soil and weathered rock along the right and left sides of the spillway (which were unstable), due to the severe erosion from the main spillway failure. Preparation work for the repairs on the main spillway included selective demolition and removal of the damaged spillway, soil, rock, grout and shotcrete. California DWR also conducted controlled blasting of the damaged spillway. In addition, California DWR cleaned the spillway foundation with pressure washers and compressed air, prior to the addition of dental concrete, leveling concrete, RCC, structural concrete, and a drainage network.

The second phase of construction would consist of replacement of the remaining 730-foot portion of the upper spillway during the 2018 construction season (May 2018 to November 2018). The upper spillway would be removed and replaced with structural concrete and secured to the underlying hillside. The replaced spillway portion would follow the same alignment as the previous spillway, and would be replaced all the way to the spillway radial gate area. In addition, California DWR would remove the RCC walls from the 1,050-foot section of the middle spillway and replace them with structural walls. California DWR would also remove the surface layer of RCC on the middle spillway, and install structural concrete on the reduced RCC surface. Finally, California DWR would hydro-blast and resurface the energy dissipaters (dentates) at the bottom of the main spillway.

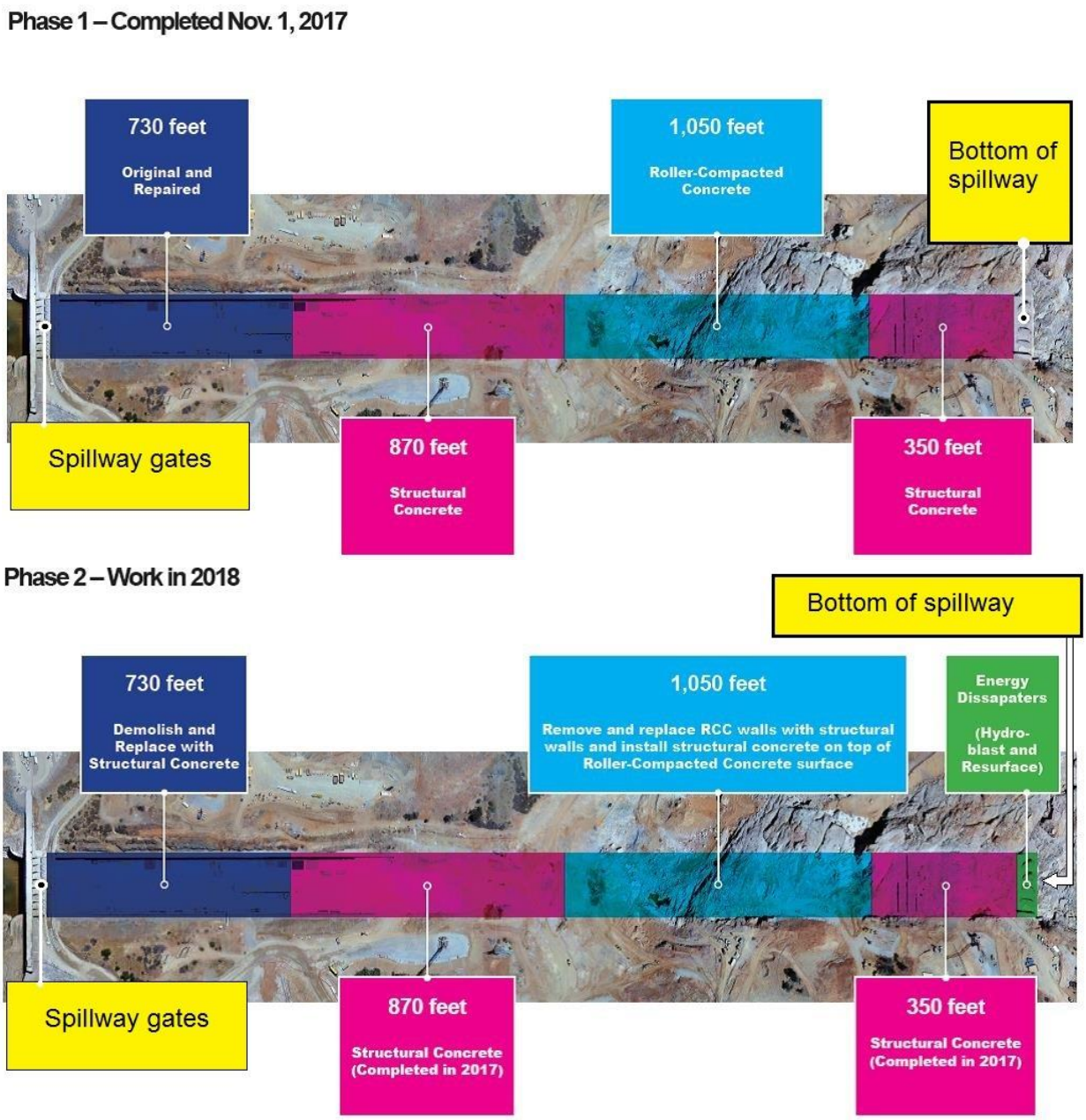

Figure 4. Schematic of Phase 1 and 2 reconstruction plans for the main spillway repairs (source: California DWR, as modified by Commission staff)

Emergency Spillway Repairs

California DWR proposes to leave the majority of the existing emergency overflow spillway in place, and to install additional measures to fortify the existing structure and prevent downstream erosion during any future use. California DWR would leave the existing ogee spillway comprising the eastern portion of the spillway in place, along with the downstream shotcrete armoring. California DWR would fortify the ogee

overflow spillway by installing a RCC concrete buttress and splash pad on the downstream side of the emergency spillway (Figure 5). The RCC buttress would be a curved topped berm with a drainage system, placed against the emergency spillway monoliths to increase stability. California DWR would also remove and replace the broad-crested weir (or crest cut-off wall), comprising the western portion of the emergency spillway. The western structure would be removed and replaced with a new 10-foot deep, 2½-foot-wide reinforced concrete cutoff wall. Construction activities associated with the cutoff wall include: selective asphalt demolition and removal of the previous broad-crested weir; excavation of a 10 x 2.5-foot ditch; cleaning the trench of loose material; steel lattice reinforcement; and concrete pouring and shaping.

In addition to the improvements along the emergency spillway, California DWR would install a RCC splash pad behind the buttress and emergency spillway consisting of a 5-10-foot-thick RCC apron. The RCC splash pad would be stair-stepped to dissipate energy, and would be contoured to direct flows to a main armored drainage channel. Additionally, California DWR would install a vertical secant pile cutoff wall at the downhill end of the splash pad, and approximately 750-feet downslope of the emergency spillway. Secant pile wall construction would involve selective demolition of the previous emergency rock slope protection, drilling holes for secant piles, concrete reinforcement installation, and steel reinforcement above the secant piles. The emergency spillway modifications commenced during the 2017 season, and would be completed during the 2018 construction season.

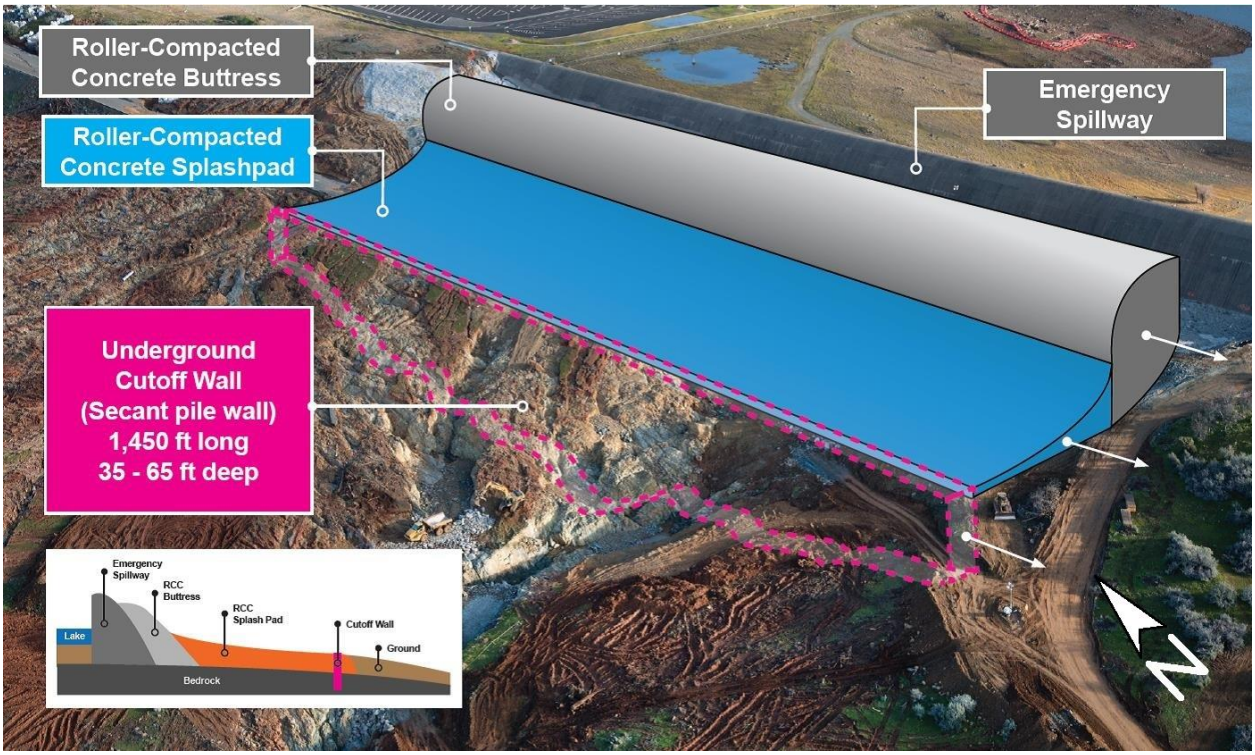

Figure 5. Conceptual design of new Oroville emergency spillway (source: California DWR, as modified by Commission staff)

Relocate Buried 13.8 kV Powerline and Buried Fiber Optic Communication System

California DWR proposes to relocate a portion of its buried 13.8-kV transmission line,[12] located between the Hyatt Power Plant switchyard and the Thermalito Diversion Dam Powerhouse. California DWR would also relocate a portion of a buried fiber optic communications line, which runs parallel to the transmission line. California DWR would abandon in place, an approximately 3.5-mile buried section of the transmission line. As a replacement, it would relocate an approximately 3.8-mile section of the buried line starting at the Hyatt Power Plant, and continue almost to the Thermalito Diversion Power Plant, where it would join with a pre-existing section of buried line approximately 0.8 miles north of the powerhouse. The new buried fiber optic communications line would be co-located with the relocated buried transmission line along the entirety of the route, and would span the entire distance between the Hyatt and Thermalito Diversion

[12] The project license refers to this transmission line as a 15-kV line, but we use the 13.8-kV specification provided by California DWR, which also corresponds with the current typical voltage for such a facility. *See* Order Amending License, Revising Project Boundary, and Amending Project Boundary (160 FERC ¶ 62,168), issued August 23, 2017.

Power Plants. Part-way between the Hyatt and Thermalito Diversion Power Plants, the buried fiber optic line would diverge south outside of the project boundary, where it would connect to the Oroville Field Division facility, located approximately 2 miles to the south.[13] Construction activities involved with the installation would include the use of excavators, trenching equipment, shoring equipment, loaders, and dump trucks.

Permanent Relocation of PG&E and DWR Transmission Lines and Removal of the Temporary (shoofly) lines

In separate Commission proceedings, California DWR[14] and PG&E[15] permanently relocated their transmission lines that were re-routed temporarily during the response phase. Following the activation of its re-routed 230-kV Table Mountain–Palermo Transmission Line, PG&E removed its temporary line and 13 temporary steel poles by helicopter. In addition, PG&E crews removed rock at each tower location that was used as backfill, and hauled it offsite. Similarly, California DWR removed the towers supporting its temporary transmission lines after reactivating its Oroville-Table Mountain Transmission Line. California DWR utilized helicopters, cranes, bulldozers, and excavators to facilitate the removal process, with California DWR creating temporary earthen crane pads to remove concrete footings.

Radial Gate Repair

California DWR proposes to repair components of the Oroville and Thermalito Diversion Dam radial gates that were damaged during the spillway failure. Repair activities would include repair of the radial gates and replacement of tension rods, seals,

[13] The divergent fiber optic line leaves the project boundary at this point, and is being analyzed and permitted separately by California DWR. Therefore, it is not given consideration in this analysis.

[14] The Oroville-Table Mountain Transmission Line has since been permanently rerouted outside of the response and recovery area. *See* Order Amending License, Revising Project Description, and Amending Project Boundary, 160 FERC ¶ 62,168 (issued August 23, 2017).

[15] The Table Mountain-Palermo Transmission Line has since been permanently rerouted away from the response and recovery area. *See* Order Approving Non-Project Use of Project Lands and Amending License, 160 FERC ¶ 62,118 (issued August 2, 2017).

and other hardware.[16] In order to facilitate repairs, California DWR would create or improve access roads on the lakeside of the main spillway.

4.2.3 Supporting Facilities

In order to support the spillway repair work, California DWR would install transportation facilities, material preparation facilities, laydown areas, and construction support facilities. The following describes those various facilities that have been, or will be used to support the response and recovery efforts.

Roads

In addition to the road construction and enhancement activities in the response phase, California DWR enhanced Burma Road, located along the north side of the Thermalito Diversion Pool. Specifically, the existing Burma dirt road was widened to a width of 28 feet to accommodate larger trucks and heavy equipment, which includes a 22-foot wide roadbed and flanking V-ditches. California DWR also fortified Burma Road along two stream crossings, where multiple box culverts were installed and filled over with road base to allow heavy equipment and materials to access the spillway repair area. The road construction along Burma Road also necessitated the replacement of several culverts under the roadway for seasonal streams, vegetation trimming, and rock enhancement to the roadbed. Based on construction needs, California DWR further proposes to widen the roadway to 30 feet around curves, extend existing culverts, trim additional vegetation, and place additional fill to accommodate large vehicles around tight curves along Burma Road. Finally, California DWR proposes to pave, widen, or perform maintenance at roadways leading to Burma Road, including Power Canal and Cherokee Road. In all instances above, California DWR would utilize excavators, dump trucks, graders, bulldozers, water trucks, pavement equipment, rollers, and chainsaws to construct or enhance access to the spillway site. In total, California DWR estimates that a total of 28.31 miles of roads would be utilized for site access during the response and recovery phases.

Concrete Batch Plants

Work on the spillways would be supported by the use of a rock processing plant and multiple on-site concrete plants. California DWR created a rock processing plant, located east of the main spillway and which, primarily utilizes rock and soil dredged from the Thermalito Diversion Pool to provide aggregate products for RCC production.

---

[16] The radial gate repairs at the Thermalito Diversion Dam were previously proposed under a separate filing, dated July 17 and August 22, 2017. By letter dated September 1, 2017, these activities were approved as regular maintenance by the Commission's Division of Dam Safety and Inspections.

California DWR also constructed a RCC batch plant on site to utilize material dredged from the Thermalito Diversion Pool, to the extent possible. The RCC batch plant is located in the spillway boat ramp parking lot, but RCC production operations would later shift downhill to the vicinity of the emergency spillway construction area. In addition, California DWR created a structural concrete batch plant on site, which utilizes material dredged from the Thermalito Diversion Pool. The structural concrete batch plant is located on the east side of the main spillway, near the bottom portion of the spillway. The structural concrete plant is also co-located with the aggregate rock processing plant, which includes the processing plant, crushing operations, conveyors, and rock washing facilities. California DWR states that following the completion of aggregate production, California DWR would restore the rock processing plant area to pre-construction contours. Finally, California DWR states that it would utilize an off-site plant to produce additional concrete for various construction needs. In total, California DWR estimates that it would utilize 7.47 acres of land for the concrete batch plants.

Laydown/Staging/Support Areas

To facilitate logistical support, California DWR would utilize existing project facilities or designate new areas for storage and staging of equipment and temporary office deployment. California DWR converted the spillway boat ramp recreation area and parking lot into a temporary worker support facility, with trailered offices for California DWR, contractor, and other agency staff. Similarly, California DWR is utilizing the Oroville Dam Overlook Day Use Area as a temporary equipment staging area. California DWR also expanded an existing laydown area just to the east of the main spillway gates to a 7-acre site for staging of construction materials and equipment. Finally, California DWR is utilizing the Thermalito Diversion Pool Day Use Area as a staging area primarily for equipment associated with dredging activities. The site is also being used as a deposit area for material dredged from the diversion pool.

Additional Dredging

California DWR continued debris removal efforts during the recovery phase of work, primarily through in-water debris removal efforts. As of November 2017, California DWR had removed approximately 2 million cubic yards of material from the Thermalito Diversion Pool. Nonetheless, California DWR estimates that approximately 320,000 cubic yards of deposited material would remain in the diversion pool.[17]

[17] The material deposited in the Diversion Pool is an estimated volume and when saturated, is approximately 20 percent greater than the material originally situated in the hillside adjacent to the main spillway.

Borrow Areas

California DWR is utilizing on-site and off-site locations as borrow areas for concrete production activities. The primary borrow area is located to the east of the main spillway. At this location, California DWR would remove approximately 380,000 cubic yards of material, resulting in a project footprint of 80 feet vertical depth and an area of 7.1 acres. However, California DWR is also using material dredged from the Thermalito Diversion Pool and stored at the spoil pile west of the emergency spillway for concrete production. Finally, California DWR would import approximately 25,000 cubic yards of gravel from a local commercial vendor to use as pervious backfill material in the reconstruction of the main spillway. The material would be sourced from a commercial quarry located on Table Mountain Boulevard in Oroville, CA, and transported to state highway 70, and continue to Oro Dam Boulevard and Canyon Drive, before arriving at the worksite (Figure 6). The material would be hauled during both day-time and night-time hours, beginning in in late August 2018 through January 2018, and would involve approximately 1,400 round-trips. To mitigate impacts to noise, air quality, and transportation resources, California DWR would: cover vehicle to prevent dust; install track out plates where vehicles exit the construction site onto paved roads; limit truck idling to no more than 5 minutes when not in use; schedule material hauling to off-peak hours, when possible; implement required asbestos control measures; comply with applicable air quality permits; and adequately maintain all hauling trucks.

Other Supporting Work

California DWR implemented other miscellaneous activities to support the response and recovery effort. Along the northern portion of the Thermalito Diversion Pool, California DWR installed a barbed wire boundary fence to prevent cattle from entering the work area and to ensure safe use of Burma Road. As part of the work, the California DWR selectively removed or trimmed trees and vegetation within a 6-foot-wide section of project land, across from the spillway boat ramp to Morris Ravine. California DWR also shored bridges, conducted geological monitoring for construction activities, installed an intake water system, and set up wheel wash stations for construction vehicles to prevent introduction of noxious weeds.

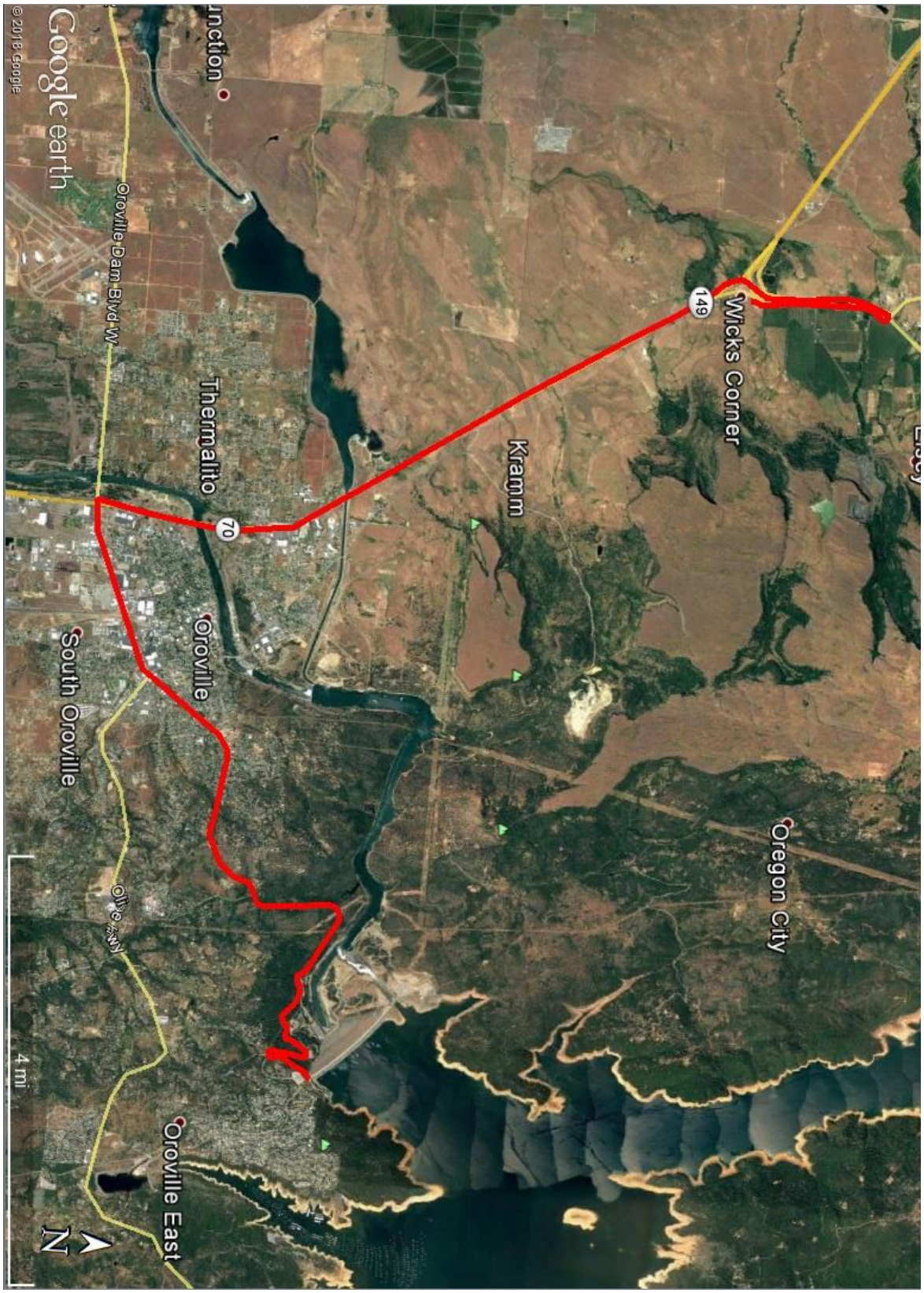

Figure 6. Proposed haul route (red) for additional pervious material from local commercial quarry (source: Commission staff)

4.2.4 Schedule

Due to the urgent public safety concerns associated with the main spillway failure and emergency spillway area degradation, California DWR implemented the above response actions between February and May 2017 (prior to the completion of this analysis). California DWR also began the first of two phases of recovery effort construction during 2017 by bringing the main spillway back to a functional (but partially reconstructed) status on November 1, 2017. This included construction of a temporary RCC section in the middle span of the main spillway and full reconstruction of an additional portion of the middle and lower main spillway. California DWR also began fortifications to the emergency spillway area in July 2017. The second phase of construction would occur in 2018, during which California DWR would reconstruct the upper portion of the main spillway and complete full replacement of the middle RCC main spillway section with structural concrete. During the second phase of construction, California DWR would also complete work on the emergency spillway. Specifically, California anticipates completion of construction of the project spillways by January 26, 2019. Though not stated in California DWR's application, we expect additional closeout activities and demobilization to occur during early 2019.

4.3 No-Action Alternative

Under the no-action alternative, California DWR would have left the main spillway in its damaged state, prior to the initial recovery efforts. Its utility in passing high inflows would have been temporary in nature, due to its continually failing state. Similarly, the emergency spillway area would have remained in an eroded state, subject to additional erosive forces with any subsequent future use. As evidenced by the mandatory evacuation of the project area, the possibility of full failure of either project feature presents an unacceptable risk to public safety. Due to serious public safety concerns associated with failure of the project spillways and the high hazard potential of Oroville Dam, the No-Action Alternative does not merit further consideration in this analysis.

5.0 STATUTORY COMPLIANCE AND CONSULTATION

California DWR and the Commission have pursued informal and formal consultation with federal resource agencies, state resource agencies, and applicable tribes since the February 7, 2017 failure of the main spillway. The Commission has delegated some of its responsibilities to California DWR for day-to-day matters, but it remains ultimately responsible to ensure that its actions comply with the federal statutes discussed below.

On March 2, 2017, California DWR established a work group to discuss environmental issues related to the spillway failure. This work group included the

Commission, Army Corps, California State Water Resources Control Board (California SWRCB), Central Valley Regional Water Quality Control Board (Regional Water Board), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (FWS), California DFW, and the Federal Emergency Management Agency (FEMA). On May 8, 2017, California DWR established an additional work group to discuss cultural resource issues. This work group included the Commission, California State Historic Preservation Officer (California SHPO), and FEMA.

By letter dated March 31, 2017, the Commission designated California DWR as its non-federal representative for informal consultation with the FWS and NMFS pursuant to section 7 of the Endangered Species Act (ESA). In the same letter, the Commission also designated California DWR as its non-federal representative for informal consultation with the California SHPO to implement section 106 of the National Historic Preservation Act (NHPA).

The applicable statutes and respective consultations are discussed below.

Section 10 of the Rivers and Harbors Act & Section 404 of the Clean Water Act

Permits from the Army Corps are required under section 10 of the Rivers and Harbors Act of 1899 for structures or work in or affecting navigable waters of the United States and under section 404 of the Clean Water Act (CWA) for the discharge of dredged or fill material in waters of the United States. California DWR obtained multiple permits under Regional General Permit 8 (RGP 8), created for emergency actions that would trigger these statutes,[18] to support the response and recovery work associated with the Oroville spillway failure. By letter dated February 24, 2017, the Army Corps issued an RGP 8 for dredging work near the main and emergency spillway discharge points to the Thermalito Diversion Pool.[19] By letter dated March 28, 2017, the Army Corps issued an RGP 8 for discharge of fill material and placement of four culverts associated with expansion of Burma Road.[20] This permit was subsequently amended on June 1, 2017, to include the temporary discharge of fill within Lake Oroville. The February 24, 2017 RGP 8 was amended on June 7, 2017, to include additional dredging work in the Thermalito Diversion Pool, including the excavation of 1,720,000 cubic yards of sediment. The Army Corps issued an additional RGP 8 for road improvements at the lakeside spillway and construction on July 25, 2017.[21] This permit was later followed by

[18] http://www.spk.usace.army.mil/Portals/12/documents/regulatory/gp/RGP-08/RGP-8-EmergencyActions09_29_2015.pdf.

[19] RGP 8 Permit No. SPK-2017-00153.

[20] RGP 8 Permit No. SPK-2017-00264.

[21] RGP 8 Permit No. SPK-2017-00444.

a section 404-Nationwide Permit 33 for continued improvements and construction at that location.

Section 401 of the Clean Water Act

Under section 401 the CWA, an applicant for a federal license or permit must obtain a Water Quality Certification (401 certification) for any proposed activity that may result in a new discharge into navigable waters. The 401 certification is a verification by the state that a proposed project would not violate water quality standards. As discussed above, California DWR obtained multiple RGP 8 authorizations from the Army Corps for emergency activities at the site. By letter dated December 15, 2014, the California SWRCB issued a broad 401 certification for the RGP 8 program.[22] Among the conditions of the RGP 8 permits, all permittees are required to implement measures for spill prevention and response, erosion control and runoff, construction debris management, and revegetation.

California DWR also obtained several permits from the Regional Water Board for specific response and recovery actions in the Sacramento District of the Army Corps, which includes the project area. Specifically, California DWR obtained section 401 certifications from the Regional Water Board for activities associated with: in-water debris removal,[23] modifications to Burma Road along the north side of the Thermalito Diversion Pool,[24] spillway road improvement and construction on the lakeside of Lake Oroville,[25] and continued lakeside spillway road improvements.[26] Under the Regional Water Board's certifications, California DWR is required to monitor turbidity, dissolved oxygen, and pH in the Thermalito Diversion Pool and Lake Oroville. Commission staff consider the response and recovery activities resulting in a material discharge (primarily through dredging and erosion) to be covered under the RGP 8 permits and the section 401 certifications from the Regional Water Board.

---

[22] http://www.spk.usace.army.mil/Portals/12/documents/regulatory/gp/RGP-08/WQC-CA-WQCB-%2017-DEC-2014_Part%20I%20.pdf

[23] Application at 59 (Section 7.7.4 In-Water Debris Removal) (citing authorization WDID#5A04CR00265).

[24] *Id*. at 57-58 (Section 7.7.2 Access Roads, Work Pads, Staging Areas and Spoil Sites) (citing authorization WDID# 5A04CR00266)

[25] *Id*. (citing authorization WDID#5A04CR00269a).

[26] *Id*. (citing authorization WQC 5A04CR00278).

The National Historic Preservation Act

Under section 106 of the NHPA,[27] and its implementing regulations,[28] federal agencies must take into account the effect of any proposed undertaking on properties listed or eligible for listing in the National Register of Historic Places (NRHP) and must afford the Advisory Council on Historic Preservation (Advisory Council) a reasonable opportunity to comment on the undertaking.

California DWR's initial consultation with the California State Historic Preservation Officer (California SHPO) began with the Army Corps' RGP 8 process for the aforementioned dredge and fill work. By letter dated March 31, 2017, the Commission designated California DWR as the Commission's non-federal representative for consultation with the California SHPO. California DWR initiated consultation with the California SHPO by a hand-delivered letter on April 24, 2017. California DWR consulted with the SHPO on multiple proposals including relocation of one project transmission line and one non-project transmission line, fortification of an existing cultural site affected by construction activities, expansion of the emergency spillway, and rebuilding of the main spillway.

Consultations with the California SHPO were originally conducted under the Advisory Council's emergency provisions at 36 C.F.R. § 800.12(b)(2), which require the California SHPO to respond within a 7-day period. The California SHPO advised California DWR that the emergency process is time-limited and would apply only to actions implemented prior to May 31, 2017.[29]

The Commission requested a 30-day extension of the expedited review period (until June 30, 2017) from the Advisory Council to allow time for Commission staff to develop a two-party Programmatic Agreement (PA) with the California SHPO. The PA addresses and formalizes a mutually agreeable expedited process for cultural resource reviews of California DWR's activities while conducting the long-term stabilization and repair efforts (undertaking). The final PA was executed on July 5, 2017, with the Commission and California SHPO as signatories, FEMA as an invited signatory, and California DWR, California Office of Emergency Services, and the Enterprise Rancheria Estom Yumeka Maidu Tribe as concurring parties. The PA was amended on September 25 and October 19, 2017.

[27] 54 U.S.C. § 300101 et seq. (2012).

[28] 36 C.F.R. pt. 800 (2018).

[29] Application at 128; *see* 18 C.F.R. § 800.12(d) (2018) (limiting the emergency procedures to undertakings that will be implemented within 30 days after the disaster or emergency has been formally declared).

For activities after May 31, 2017, all consultations about the effects of the undertaking on historic properties were and are considered pursuant to the PA's outline of roles and responsibilities for the Commission, the California SHPO, FEMA, and California DWR. California DWR has hosted regular teleconferences to update the agencies on California DWR's stabilization and repair efforts, both under the emergency provision and the PA, beginning on May 1, 2017, and continuing until the undertaking is complete. California DWR's proposed modifications to the Area of Potential Effect (APE), as well as recommendations for determinations of eligibility and findings of effect for activities conducted as part of the undertaking, were filed with the Commission. Consultations have resulted in several letters from the Commission concurring with the California DWR's determinations and findings.[30] Under the PA, California DWR has also completed quarterly reports, documenting any effects to cultural resources. Further information related to NHPA compliance is discussed in *section 6.9-Cultural and Historic Resources.*

On February 8, 2017, California DWR, with assistance from the California Department of Parks and Recreation, immediately contacted four federally recognized tribes in the Oroville vicinity. These tribes included the Berry Creek Rancheria of Maidu Indians, the Estom Yumeka Maidu Tribe of the Enterprise Rancheria, the Mechoopda Indian Tribe of Chico Rancheria, and the Mooretown Rancheria of Maidu Indians. Additionally, Greenville Rancheria, another federally recognized tribe, and two non-recognized tribes (Konkow Maidu and Tsi-Akim Maidu) were contacted following a response from the California Native American Heritage Commission (NAHC) on March 29, 2017.

Enterprise Rancheria has participated in tribal cultural resource identification and monitoring of response and recovery activities since mid-February 2017. Daily tribal monitoring by Enterprise Rancheria members began on February 27, 2017. California DWR initially met with the Enterprise Tribal Council on March 7, 2017, and with tribal elders in the field on March 17, 2017. Consultation with Enterprise includes their Tribal Historic Preservation Officer (THPO), and is on-going. The last formal meeting with the Tribal Council was held on August 28, 2017. The Enterprise Rancheria were invited as a concurring party to the aforementioned July 5, 2017 PA for management of cultural resources affected by the response and recovery efforts, but did not provide a response.

[30] The Commission issued letters on August 29, 2017, October 23, 2017, November 7, 2017, December 1, 2017, December 7, 2017, December 14, 2017, February 5, 2018, April 6, 2018, June 13, 2018, June 14, 2018, August 8, 2018, August 28, 2018, and October 4, 2018.

The Endangered Species Act & the Bald and Golden Eagle Protection Act

Section 7 of the Endangered Species Act (ESA) requires federal agencies to ensure their actions are not likely to jeopardize the continued existence of federally listed threatened or endangered species, or result in the destruction or adverse modification of the critical habitat of such species. Several federally listed species are known to use or could potentially be affected by the Feather River Project, including: central valley spring-run Chinook salmon; central valley steelhead; southern distinct population segment (DPS) North American green sturgeon; delta smelt; Butte County meadowfoam; hairy orcutt grass; Hartweg's golden sunburst; Greene's tuctoria; Hoover's spurge; slender orcut grass; Layne's ragwort; giant garter snake; California red-legged frog; Sierra Nevada yellow-legged frog; vernal pool fairy shrimp; Conservancy fairy shrimp; vernal pool tadpole shrimp; and valley elderberry longhorn beetle.

On February 24, 2017, NMFS sent a letter to the Commission providing twelve recommendations to minimize the effects on federally listed fish species, and their critical habitat below fish barrier dam from dredging and flow fluctuations during the initial response. These fish species included central valley spring-run Chinook salmon, central valley steelhead, and southern distinct population segment (DPS) North American green sturgeon. The letter also recommended that the Commission initiate formal consultation with NMFS as soon as the emergency had stabilized. On February 27, 2017, the Commission discussed the recommendations with NMFS and California DWR, which included ramping rate recommendations, minimum flow maintenance, dredging guidance, water quality maintenance at the Feather River Fish Hatchery, fish monitoring and salvage, water quality monitoring, water release recommendations, turbidity minimization measures, agency coordination, and data reporting. California DWR implemented the conditions to the extent possible, but was limited in its ability to meet NMFS' recommendations for ramping rate reductions, due to its conflicting efforts to maintain and observe the structural integrity of the remaining portion of the main spillway.

By letter dated March 31, 2017, the Commission designated California DWR as its non-federal representative to conduct informal consultation with NMFS and the FWS pursuant to section 7 of the ESA. Since that time, California DWR and the Commission have regularly consulted on planned flow changes, monitoring, and construction activities, primarily through regular conference calls. California DWR's consultation with these agencies has been ongoing.

The only species pertinent to the spillway failure and the FWS authority is the valley elderberry longhorn beetle which is listed as threatened. California DWR has consulted informally with the FWS on the relocation of elderberry bushes affected by construction activities. The FWS has also been a participant in regular conference calls with California DWR, the Commission, and the resource agencies. By letter dated

December 14, 2017, the Commission confirmed that it would be entering into formal consultation with the FWS under the emergency provisions of the ESA, including the preparation and submission of a biological assessment for the effects of the response and recovery efforts.[31] California DWR has also consulted informally with the FWS about the potential for construction activities to disturb the nest of a bald eagle, which is protected under the Bald and Golden Eagle Protection Act.

The Commission, California DWR, NMFS, and the FWS have been consulting informally on the development of draft biological evaluations for aquatic and terrestrial resources. Both NMFS and FWS have provided verbal comments on the draft biological evaluations, followed by additional revision by the California DWR. By letter dated June 29, 2018, California DWR filed a biological evaluation with the Commission on the effects to the fish species under the jurisdiction of NMFS. By letter dated July 5, 2018, the Commission adopted the biological evaluation as its biological assessment and sent it NMFS, and requested the initiation of formal emergency consultation. Similarly, California DWR filed a biological evaluation with the Commission on July 16, 2018 and supplemented on August 1, 2018, on the effects of terrestrial resources under the jurisdiction of FWS. By letter dated August, 14, 2018, the Commission issued a biological assessment and requested the initiation of formal emergency consultation with the FWS. By letter dated September 10, 2018, the FWS concurred with the Commission's determination that the emergency actions related to the spillway failure may have affected, but did not likely adversely affect the federally-listed valley elderberry longhorn beetle. The FWS did not require any additional conditions to its determination.

6.0 ENVIRONMENTAL ANALYSIS

6.1. Scope of the Analysis

The geographic scope of this analysis includes the entire project area including Lake Oroville, the Thermalito Diversion Pool, Thermalito Forebay, Thermalito Afterbay, Fish Barrier Dam Pool, Feather River Fish Hatchery, OWA, and the Feather River from the Fish Barrier Dam to its confluence with the Sacramento River near Verona, CA. As discussed above, the temporal scope of this environmental assessment begins with the response efforts that occurred from February 7, 2017, through May 19, 2017, and continues through the ensuing recovery period from May 20, 2017 to completion of main

[31] The Commission had been previously consulting informally with the FWS on a proposal to utilize the OWA as a borrow area for construction activities. The December 14, 2017 letter was in response to the FWS' December 12, 2017 letter providing conservation recommendations for use of the OWA. However, California DWR has since retracted its proposal to utilize the OWA as a borrow area.

and emergency spillway construction activities anticipated on January 26, 2019. The resources potentially affected by this proposal include geology and soils, water quantity and flow, water quality, fisheries and aquatic resources, terrestrial resources, threatened and endangered species, cultural and historic resources, recreation, land use and aesthetic resources, air quality, transportation, and noise. Because of the emergency nature of the response actions and the 2017 recovery actions, this EA looks retroactively at environmental effects of activities that preceded California DWR's filing on January 29, 2018, and looks prospectively at potential environmental effects of activities to occur after the date of the filing.

6.2 General Description of the Project Area

The project is located on the Feather River in Butte County, California, in the foothills of the Sierra Nevada and Sacramento Valley. Oroville Dam is located 5 miles east of the city of Oroville, CA, and about 65 miles north of Sacramento, CA. The Oroville facilities were developed as part of the State Water Project, a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the State Water Project 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 facilities are also operated for flood management, power generation, water quality improvement in the Sacramento-San Joaquin Delta, recreation, and fish and wildlife enhancement.

The proposed work area associated with the proposed spillway repairs is heavily disturbed. Following the failure of the main spillway beginning February 7, 2017, the area near the lower portion of the spillway experienced major erosion, with the majority of an estimated 2.2 million cubic yards of sediment deposited in the Thermalito Diversion Pool. Similarly, the area immediately downstream of the emergency spillway experienced significant erosion following its first-ever use on February 11, 2007. The immediate area below the spillway was also cleared of vegetation immediately before activation of the emergency spillway to avoid trees and vegetation from being washed into the Thermalito Diversion Pool and disrupting the operation of the downstream project works. Finally, during the initial response activities California DWR has stockpiled a considerable amount of sediment from dredging operations near the proposed work area, has graded hillsides adjacent to the main spillway, and has constructed various access and haul routes. Thus, the proposed work area has experienced numerous recent disturbances resulting from the initial response to the spillway failure.

6.3 Geology and Soils

6.3.1 Affected Environment

The project is located in the western foothills of the Sierra Nevada mountain range, at the eastern edge of California's Central Valley. Bedrock within the area is composed of folded, metamorphosed sedimentary and igneous rocks, overlain by strata of volcanic and sedimentary origin. Oroville Dam is located within an area of bedrock dominated by metamorphic amphibolite. Within the approximately five miles of the Feather River below the dam, the bedrock transitions to scattered sedimentary and volcanic deposits.

Soils within the project area are comprised of weathered igneous and sedimentary bedrock found near the project. Below Oroville Dam, soils found on level land are comprised of alluvium and mining debris, and are dominated by fine sandy loam, loamy sand, and loam to silty loam. Less common soil types include those containing clay, silt, and gravel. Soil depth ranges from shallow to very deep, but are generally moderately deep to very deep. Sediment from historic gold mining activities, either as tailings or fine-grained deposits from upstream hydraulic mining, known as slickens, comprise approximately 35 percent of the riverbank below Oroville Dam.

During its recovery activities, California DWR's contractor analyzed samples of rock from the area of the main spillway for characteristics such as pH and constituents including heavy metals and other substances harmful to environmental resources, if mobilized. The contractor's analysis indicated that native rock located at the downstream end of the main spillway contains copper pyrite, which includes copper, iron, and sulfur.

6.3.2 Environmental Effects

Following initial use of the emergency spillway, California DWR graded, deposited rip-rap, and applied approximately 107,000 cubic yards of shotcrete to the emergency spillway apron to reduce the amount of soil and rock lost if the emergency spillway needed to be used again. During the response activities, California DWR also constructed a large number of unpaved access roads and staging areas across the hillside below the dam. At the main spillway, California DWR constructed crane pads and removed bedrock with explosives to eliminate unstable slopes at the site of the spillway failure. Furthermore, California DWR dredged 1.4 million cubic yards of eroded material from the Thermalito Diversion Pool during the response phase, which it deposited in three spoil piles within the project area. One pile is located northwest of the Thermalito Diversion Dam, one is located below the emergency spillway, and one is located on the right bank of the Thermalito Diversion Pool below the main dam. California DWR estimates that the placement of the crane pads and spoil piles affected approximately 42 acres of land.

As described previously, during the emergency response phase, California DWR initiated rapid down-ramping rates of the main spillway to facilitate inspections and emergency repairs, while reducing additional erosion of the spillway foundation. These rapid drops in spillway flows, though attenuated within the river channel, were also experienced further down the Feather River, below Oroville Dam. The abnormally high flows, followed by rapid decreases in river elevation below the project, had the potential to produce sloughing, in which high water saturates the river bank which then migrates down into the river under its own weight once the river falls and no longer supports the saturated soils. The likelihood of such sloughing occurring would be dependent upon the proximity to Oroville Dam, topography, previous disturbance, and soil type. Soil water content and pressure are also important factors in bank stability, which can reduce shear strength, increase the weight of bank material, provide a destabilizing force through water present in tension cracks, and provide additional seepage forces (Rinaldi and Darby 2008). Rinaldi et al. (2004) also found that bank failures occur primarily during down-ramping events.

Following the aforementioned flow reductions during the response phase, Commission staff were informed of areas in the Feather River where portions of the streambank sloughed off into the Feather River (Gallagher et al. 2017). The Commission's review of the available facts and flow data indicates that the sharp flow reductions were likely a main factor in the reported bank sloughing. However, other factors likely contributed to the observed streambank failures, including the existence or manipulation of riparian vegetation, the natural soil moisture content from precipitation, or preceding erosion from high flows during the extremely wet hydrologic year. Commission staff also reviewed satellite images of the entirety of the Feather River below the Fish Barrier Dam from before (August 22, 2016) and after (May 18, 2017) the spillway failure (Google Earth 2018). Though not intended to be a robust final analysis, staff's review does not indicate that bank sloughing was widespread, and was likely localized in nature. Nonetheless, any potential streambank sloughing theoretically would be visually obscured from high flows on May 18, 2018, when the latest satellite photo is available. Consequently, the locations of the sloughing or the volume and area of soil affected is unknown, because of the lack of reliable pre and post-event information.

Following the termination of its emergency response actions and during its initial recovery operations, California DWR added an additional 600,000 cubic yards of dredge material to the spoil piles. California DWR intends to process the spoils and use suitable material as aggregate for its concrete batch plants. However, California DWR expects that it would require an additional 380,000 cubic yards of aggregate, which it plans to obtain from a borrow area to the left of the main spillway, and approximately 1,000 feet upstream from where the spillway discharges into the Feather River. This borrow area would cover 7.1 acres, with a depth of 80 feet. California DWR also states that it would need approximately 25,000 cubic yards of pervious fill for reconstruction of the main

spillway. This material would be imported from a local commercial supplier, located approximately 17 road miles northeast of the dam site.

In conjunction with other recovery activities, California DWR's proposal to replace the 13.8-kV Hyatt-Thermalito Transmission Line and communication cable would directly, though temporarily, impact a narrow trench, approximately 3.8 miles long. Like the other construction activities related to the proposal, this disturbance would displace soils and make them more vulnerable to wind and water erosion. The proximity of the transmission line to the Thermalito Diversion Pool also creates the potential for runoff, possible adversely affecting water quality within the river during and following construction.

Through construction of temporary roads, excavation within the project area, deposition of dredged spoils, and work conducted on the emergency spillway, California DWR exposed and disturbed several hundred acres of soil and rock. As such, the probability of this material being eroded through wind and rain action increases. Erosion and sedimentation of exposed soils also impacted water quality (see also *section 6.5-Water Quality*). The risk of erosion would have been greater during the response activities, when rainfall was more likely, and the emergency dictated that installation of erosion control measures take a lower priority. However, where possible, throughout its response and recovery activities, California DWR indicates it has graded spoil piles and excavations to reduce the possibility of erosion. California DWR has also protected disturbed soils by applying seed mixtures, gravel, or pavement. California DWR states that following construction, it will conduct additional grading, seeding, or planting that will be described in its proposed area-wide Restoration Plan.

California DWR's actions had a significant, permanent, and adverse effect on geology and soil resources at the project. Through California DWR's actions, hundreds of thousands of cubic yards of material were extracted from areas near the Oroville Dam during the response activities, and California DWR is proposing to use some of that material for spillway construction. These actions permanently changed the topography in these locations. Furthermore, despite its control efforts, California DWR's actions disturbed and exposed many acres of soils, likely leading to the loss of unquantified amounts of soils and rock through erosion from the project site. Additionally, its rapid down-ramping events likely contributed to sloughing and erosion of riverbanks well below the project.

In conclusion, much of the impact on geology and soils from California DWR's actions were or are unavoidable, particularly during the response activities. However, California DWR's measures to reduce erosion, along with staff's recommended measures, will help mitigate the adverse effects to geological and soil resources.

6.3.3 Staff Recommendations

California DWR proposed an area-wide Restoration Plan but did not identify the particular aspects of its plan. Commission staff recommends California DWR be required to prepare a plan that describes California DWR's specific rehabilitation efforts to restore disturbed areas following construction, including the borrow area and spoil piles. The plan should also include a protocol for monitoring and reporting progress on the restoration activities to the Commission.

As a result of the ambiguous nature of downstream sloughing possibly caused by California DWR's response activities, Commission staff recommends California DWR be required to analyze the Feather River conditions below the Oroville Dam. The analysis should include a survey of the river banks and channel to identify areas of mass wasting resulting from the flow reductions at the main spillway and associated deposition of sediment within the waterway. The analysis should compare pre and post-event conditions, to the extent possible and should document any impaired areas that were the result of the sharp flow reductions. California DWR should be required to provide a plan for directly or indirectly mitigating the impaired locations.

6.4 Water Quantity and Flow

6.4.1 Affected Environment

The project utilizes the Feather River Basin to generate electricity and to supply water, with a drainage area of 3,624 square miles. The Feather River Basin has mild, dry summers and heavy winter precipitation, with mean annual precipitation ranging from 11 inches in the driest years in the driest areas to 90 inches in mountainous regions near Mount Lassen. The majority of the precipitation in the basin headwaters is in the form of snow during November through March, with much of the snowpack melting by mid-April in the mid-range elevations (3,000-5,000 feet). Accordingly, California DWR manages project storage and releases, based on the annual hydrologic patterns typical of the Feather River Basin.

Flows below Oroville Dam are managed through a combination of releases from Hyatt Power Plant, river valve releases at Oroville Dam, spillway flows, and releases from the Thermalito Diversion and Thermalito Afterbay. The Hyatt Power Plant has a maximum release capability of 16,950 cfs, with release through the power plant typically peaking during the spring and summer to meet water and energy demands. The river valve (low level outlet works), located adjacent to the Hyatt Power plant has a release capacity of 5,400 cfs (4,000 cfs at the time of the main spillway failure), and was out of service between 2009 and 2017, due to safety concerns with its operation. The Oroville main spillway has a maximum flow capacity of 250,000 cfs, and is generally used during

the wet winter months to ensure adequate storage space in Lake Oroville for flood control purposes.

During normal and wet water years, Lake Oroville is filled to its maximum annual elevation of 901 feet msl in June, and is then lowered to meet downstream requirements, until reaching its lowest annual level in December or January. During dry years, the reservoir may be drawn down further, and not reach desired levels in the spring. In addition, the Army Corps requires that the lake be operated to maintain up to 750,000 acre-feet of storage space to capture inflows for flood control. Since the project began operation in 1967, the minimum elevation at Lake Oroville occurred on 2014, when the reservoir was at 645.11 feet msl, corresponding to a reservoir content of 882,395 acre-feet. This was at the end of one of the most severe droughts in recorded California history. The maximum reservoir elevation occurred on February 12, 2017, when the reservoir was at 902.59 feet msl, corresponding to a reservoir content of 3,578,686 acre-feet.

Rates of release to the Feather River are also constrained by non-license ramping rate requirements. Under a separate 1983 agreement with the California Department of Fish and Game[32] and in 2002 and 2004 Biological Opinions by NMFS for the State Water Project, California DWR is required to provide minimum flows and to implement prescribed ramping rates in the high and low flow channels. Specifically, under the 1983 agreement, California DWR is required to limit 24-hour down-ramping rates in the Feather River to: 200 cfs if flows are less than 2,500 cfs; 500 cfs if flows are between 2,500 and 3,500 cfs; 1,000 cfs if flows are between 3,500 and 6,500 cfs; and 2,000 cfs if flows are greater than 6,500 cfs. Under the biological opinions, California DWR is required to limit 24-hour down-ramping rates in the Feather River to: 200[33] cfs if flows are between 600 and 2,500 cfs; 500 cfs if flows are between 2,501 and 3,500 cfs; 1,000 cfs if flows are between 3,501 and 5,000 cfs; and 2,000 cfs if flows are greater than 6,500 in the low flow channel. Similarly, flow increases are limited to 5,000 cfs per hour; regardless of flow during the previous hour. Finally, license Articles 29 and 53 require a year-round minimum flow of 600 cfs in the low flow reach and between 1,000 and 1,700 cfs in the high flow channel, depending on the season and water year type.

The downstream Thermalito Diversion Pool and Thermalito Forebay are hydraulically connected, and are operated in tandem. The two impoundments experience minor daily fluctuations, but may cycle down 2-4 feet during the course of a week, and then refill by the weekend. The Thermalito Afterbay is operated to meet multiple

[32] Now the California Department of Fish and Wildlife.

[33] NMFS states this value is 200 cfs while California DWR maintains that this value is 300 cfs. The Commission's Final Environmental Impact Statement (FERC 2007) assumes it is the NMFS value of 200 cfs.

requirements, including regulating inflow from pump-storage hydropower operations, providing water for withdrawal for irrigation needs, and providing minimum flows in the Feather River. As a result, the Thermalito Forebay typically fluctuates between 2-6 feet during a week, but may fluctuate between 9 and 11 feet, due to seasonal operations.

The Feather River downstream of Oroville Dam includes a low-flow bypass section below the Thermalito Diversion Pool and Fish Barrier Dam. It also includes a high-flow channel below the Thermalito Afterbay, where it meets the low-flow channel. Mean flow releases from the Thermalito Afterbay fluctuate throughout the year, based on upstream hydrologic conditions, environmental needs, and water demand. Typical average flows are lowest in October at 1,942 cfs and peak in March, with an average flow of 5,499 cfs. Mean flow releases in below the fish barrier dam are typically the lowest in September with an average flow of 522 cfs, and peak in February at an average of 2,155 cfs.

6.4.2 Environmental Effects

During the initial response period, California DWR lost its ability to make reliable flood flow releases from the main spillway. While the main spillway was still partially functional, low flow releases through the spillway were avoided to prevent water from undercutting the main spillway. Thus, elevated spillway releases were made to propel water beyond the end of the damaged main spillway and to avoid further erosion of the material underlying the main spillway.[34] In addition, high spillway releases in excess of 100,000 cfs were also avoided to prevent further erosion of the main spillway and the adjacent hillside, thus limiting main spillway releases to a preferred range of flows. The inability to release a full range of flows was further exacerbated by the sediment deposited below the main spillway causing water to back up to the Hyatt Power Plant. This rendered the powerhouse inoperable, thus preventing it from releasing water from Lake Oroville through generation. Consequently, California DWR's ability to release a full range of flows was temporarily impaired until Hyatt Power Plant operations were restored on March 3, 2017, and to a greater degree when the main spillway was restored to a functional state, but not fully repaired, on November 1, 2017.

[34] Review of flow records for the response period indicates that the smallest sharp reduction was from 25,000 cfs to zero, which occurred on May 19, 2017 (California Data Exchange Center, http://cdec.water.ca.gov/dynamicapp/QueryF?s=ORO, accessed June 21, 2018).

California DWR's use of the main spillway on an intermittent basis during the response phase resulted in large atypical flow fluctuations in the Feather River. Due to the necessity of passing large inflows from Lake Oroville and the constraints of an eroding main spillway, California DWR implemented large main spillway releases, followed by abrupt reductions. While heightened spillway releases are a normal part of project operations during the winter months, the abrupt cessation of flows following these releases is atypical. The modified spillway flows implemented by California DWR exceeded the above ramping rates, by reducing spillway releases instantaneously from as much as 60,000 cfs to zero. These sharp main spillway releases caused short-term reductions on four occasions during the response phase in the low-flow section of the Feather River, and to a slightly lesser extent the high-flow section of the river (Figure 7). In spite of these large flow fluctuations, California DWR managed flow releases and preserved storage in the Thermalito Diversion Pool to meet the license-required minimum flow of 600 cfs in the low-flow channel during the response period.

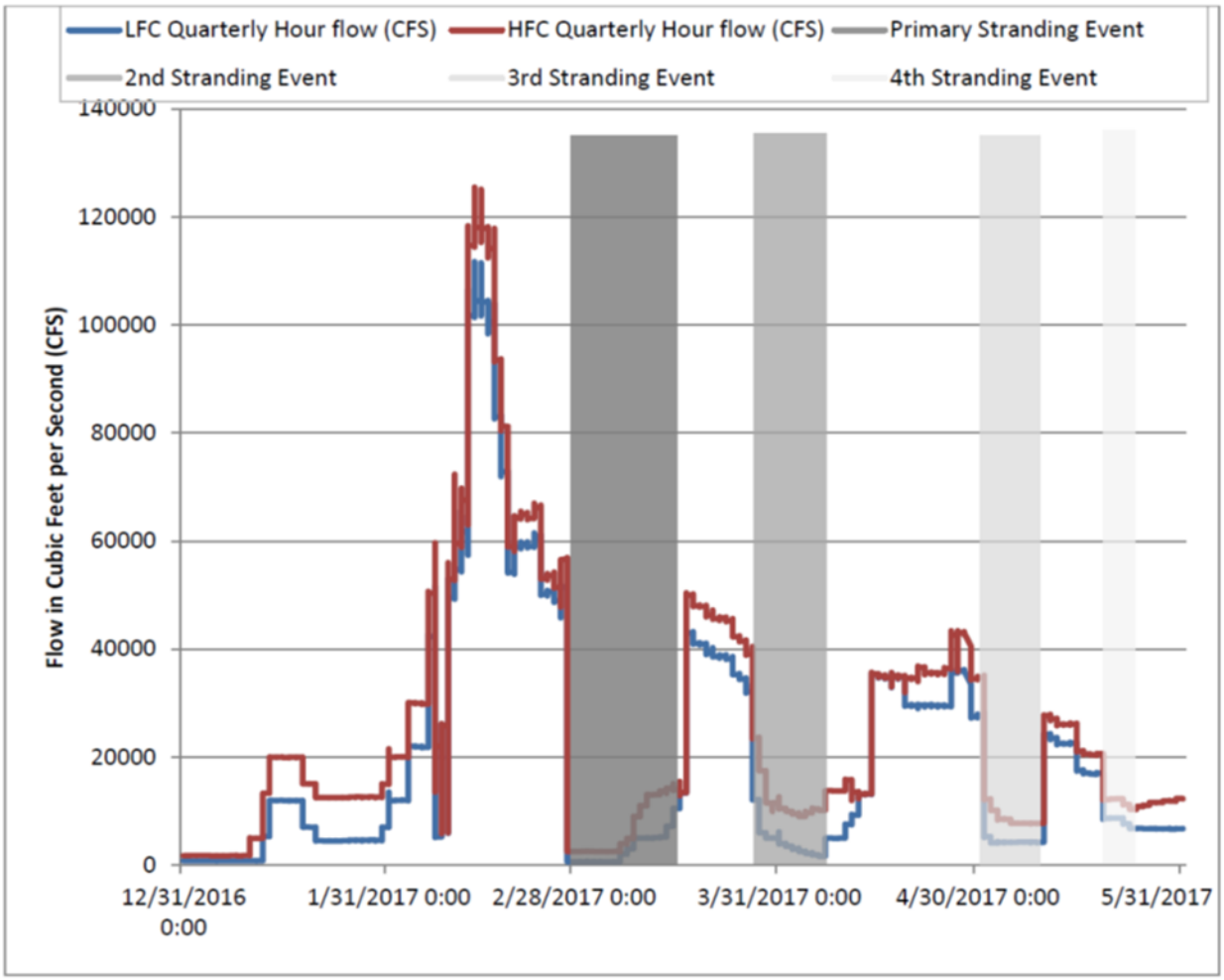

Figure 7. Observed flows and sharp reductions (shaded) in the lower Feather River during the 2017 response period (source: California DWR 2018b).

During the ensuing recovery phase, California DWR has managed Lake Oroville storage levels to avoid use of the spillway, and would continue to do so to facilitate reconstruction efforts during its recovery efforts. During 2017, California DWR managed Lake Oroville levels to avoid additional use of the spillways, to the extent possible, while also maintaining an adequate flood storage buffer. California DWR would thereafter reduce Lake Oroville levels to avoid water levels coming into contact with the spillway gates and to provide an adequate buffer for inflows in Lake Oroville while spillway reconstruction efforts are in progress. In order to meet these objectives, California DWR managed Lake Oroville levels to reach 700 feet msl by November 1, 2017. These levels are below storage levels in the reservoir that would otherwise have been maintained during the 2016-2017 record-high year of precipitation. In addition, California DWR would maintain depressed reservoir levels during the 2017-2018 water year to avoid using the main spillway (Figure 8, California DWR 2018c).

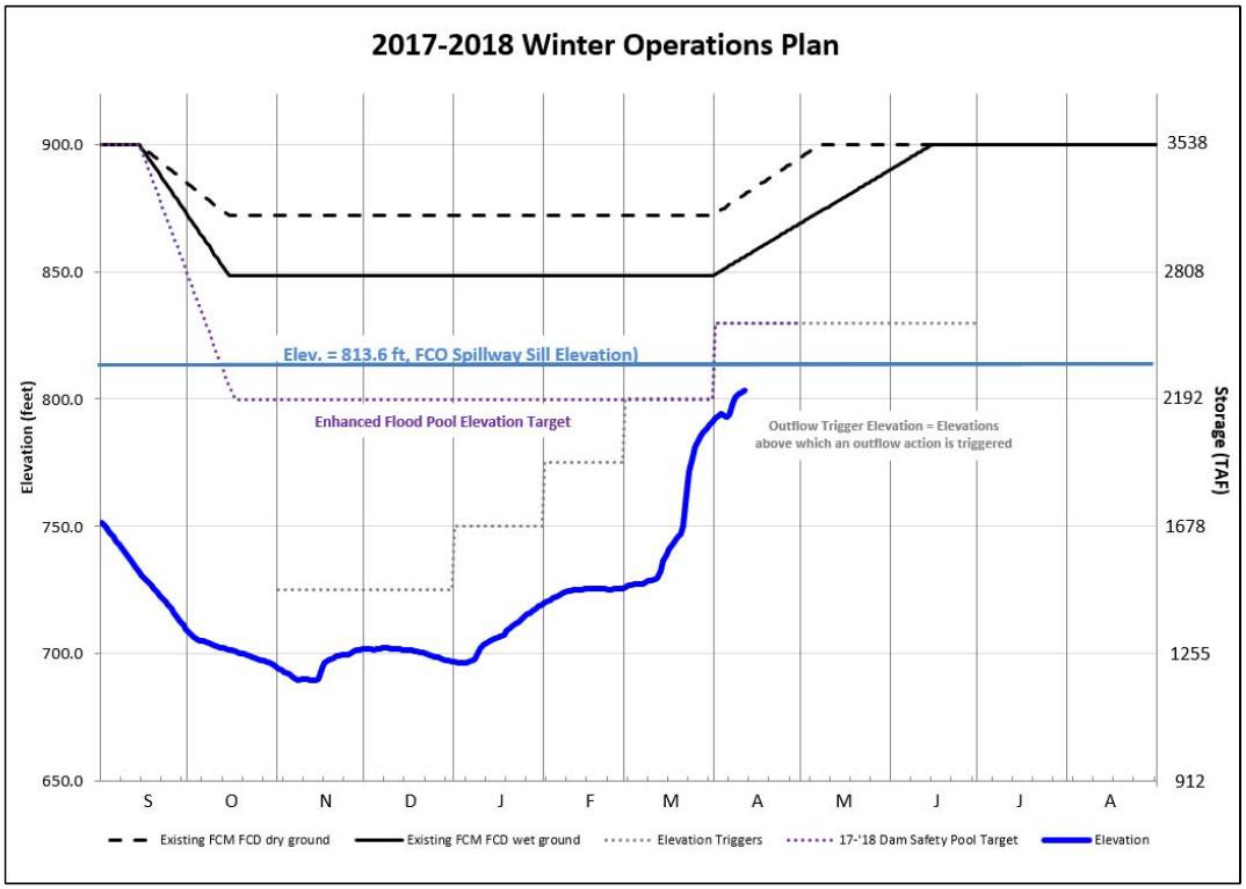

Figure 8. 2017-2018 Lake Oroville Winter Operations Plan (source: California DWR 2018c)

According to its April 17, 2018 flood operations plan, California DWR would continue to proactively manage Lake Oroville storage levels for the 2017-2018 flood control season to safely pass flows. However, due to the partial reconstruction of the main spillway, California DWR would manage Lake Oroville levels so that they do not exceed the interim main spillway release capacity of 100,000 cfs and also meet existing flood requirements. Specifically, California DWR would manage lake levels by releasing flows through the Hyatt Power Plant to maintain lake levels below 725 feet in November and December 2017, 750 feet during January 2018, 775 feet in February 2018, 800 feet in March 2018, and 830 feet in April through June 2018. If forecasts indicate that lake elevation would increase beyond the spillway floor elevation of 813.6 feet, then California DWR would assess whether use of the main spillway is necessary. Use of the spillway during 2017 and 2018 should not result in any abnormal flow releases or curtailments similar to the sharp flow reductions that occurred during spring 2017. However, the 830-foot maximum storage limit will result in slightly further depressed reservoir elevations than would have been present without the restriction, and are typically of below-normal water years (such as the current 2017-2018 water year).

In summary, California DWR's proposal resulted in short-term irregular flow releases to the Feather River during the February to May 2017 response period, but would return to normal operations during the entirety of the May 2017 to January 2019 recovery period. California DWR's proposal will also result in short-term reductions to Lake Oroville during the 2017-2018 recovery period to facilitate response and recovery actions. However, Lake Oroville water levels will return to normal seasonal cycles thereafter.

6.4.3 Staff Recommendations

California DWR has managed, and would continue to manage water levels in Lake Oroville and the Feather River to facilitate response and recovery efforts. These effects to water quantity are temporary in nature and therefore, Commission staff do not recommend any mitigative actions.

6.5 Water Quality

6.5.1 Affected Environment

Water quality in the project area is generally good, and is influenced by water quality in the upstream tributaries. Consequently, the water quality in the downstream impoundments and Feather River is largely determined by the water quality released from Oroville Dam. Nonetheless, the lower Feather River, downstream of Oroville Dam to its confluence with the Sacramento River, is listed on the U.S. Environmental Protection Agency's approved list of waters as being impaired by mercury, certain pesticides, and toxicity of unknown origin. A total maximum daily load for the pesticide diazinon was

also established for this reach in 2004. The Regional Water Board's Basin Plan also has several water quality objectives for the Oroville Facilities, including temperature, turbidity, dissolved oxygen, pH, settleable solids, chemical constituents, sediment, conductivity, and fecal coliform bacteria. Among these objectives, California DWR and California DFW entered into a 1983 agreement to maintain suitable water temperatures in the Feather River below the Thermalito Diversion Dam and Afterbay for fall-run Chinook salmon during the fall, and for shad, striped bass, and other warm water species from May through August. This generally results in mean water temperatures between 53 and 65 degrees F (11.7. to 18.3 C) in the Feather River from June to October. Water temperatures drop however, to around 45 degrees F (7.2 C) during cooler winter months.

Water temperature in the Thermalito Diversion Pool is generally a function of flow releases from Oroville Dam and Hyatt Power Plant. Water temperatures in the Diversion Pool are generally cool and undergo very little stratification, because of nearly constant flow releases from Oroville Dam and Hyatt Power Plant. Water temperature in the downstream Thermalito Afterbay is generally warmer by a few degrees and increases in the spring and summer, reaching about 76 degrees F in the northern part of the Thermalito Afterbay during the warmer months.

Dissolved Oxygen (DO) concentrations and pH levels at the project generally comply with water quality objectives of the Basin Plan, with the majority of exceedances being observed at either the bottom of Lake Oroville or the Thermalito Afterbay. Specifically, DO concentrations less than the Basin Plan's objectives generally occur in Lake Oroville when the reservoir is stratified in the summer or in the Feather River when decomposing salmon carcasses are present. pH levels also generally remain above (i.e., less acidic than) the Basin Plan objective of 6.5 at the project.

During normal operation, turbidity levels in the project area are also generally low, due to the majority of sediments settling out in Lake Oroville before reaching the Feather River and Thermalito Diversion Dam, Forebay, and Afterbay below Oroville Dam. Studies conducted during relicensing of the project indicate that turbidity levels within Lake Oroville are generally less than 10 nephelometric turbidity units (NTU), with levels in the Thermalito Complex[35] generally remaining below 8 NTU. Downstream of the Thermalito Complex, turbidity levels generally increase, likely as a result of sediment inputs from Feather River tributaries and high flow from storm events.

Metal concentrations in the project area are primarily a result of abandoned mining practices and development of municipal and industrial land uses. Consequently, monitoring activities have detected excessive levels of aluminum, arsenic, iron, mercury, manganese, and lead; with Basin Plan exceedances in the Feather River increasing in

[35] The Thermalito Diversion Dam, Forebay, and Afterbay are collectively referred to as the Thermalito Complex

frequency downstream of the project boundary. Agricultural activities in the area have also accounted for occasional elevated levels of pesticides in the project area. Monitoring efforts at the projects however, have not routinely resulted in elevated levels of conductivity and mineral concentrations, petroleum-based products, nutrients, or pathogens.

6.5.2 Environmental Effects

California DWR's response and recovery actions have the potential to affect water quality in the Feather River downstream of Oroville Dam, Thermalito Diversion Pool, Thermalito Forebay, and Thermalito Afterbay. The primary activities that could affect water quality include flow management, dredging, and construction activities. As a condition of its permits for dredging activities during the initial response phase, California DWR monitored turbidity, total suspended solids, settleable solids, dissolved oxygen, water temperature, conductivity, and pH at 7 location in Lake Oroville and the Thermalito Diversion Pool (Figure 9). As a condition of its permits for recovery actions, California DWR developed a water quality sampling plan, which included a total of six continuous monitoring stations in the diversion pool, power canal leading to the Thermalito Forebay, fish barrier pool, and in Lake Oroville (Figure 10). Among the parameters of the plan, California DWR would continuously monitor turbidity, DO, water temperature, conductivity, and pH. Additional discrete monitoring would also occur for water temperature, pH, dissolved oxygen, specific conductance, turbidity, total suspended solids, and settleable solids. The following is a discussion of the results of this early monitoring, and the anticipated effects to individual water quality parameters during the remainder of the 2018 recovery phase.

Turbidity

Among the events that transpired during the response phase, the erosion in the area of the main and emergency spillways had the most pronounced adverse effect on water quality, depositing 2.2 million cubic yards of material into the Thermalito Diversion Pool. Monitoring conducted under during the initial response phase indicates that turbidity was very high during the initial erosion of the main spillway, with California DWR reporting levels as high as 974 NTU in the Feather River shortly following the initial main spillway failure. California DWR's continued use of the degraded main spillway, in lieu of the inoperative power plant and river valve outlet, had severe short-term adverse effects to turbidity levels in the Feather River and Thermalito Complex.

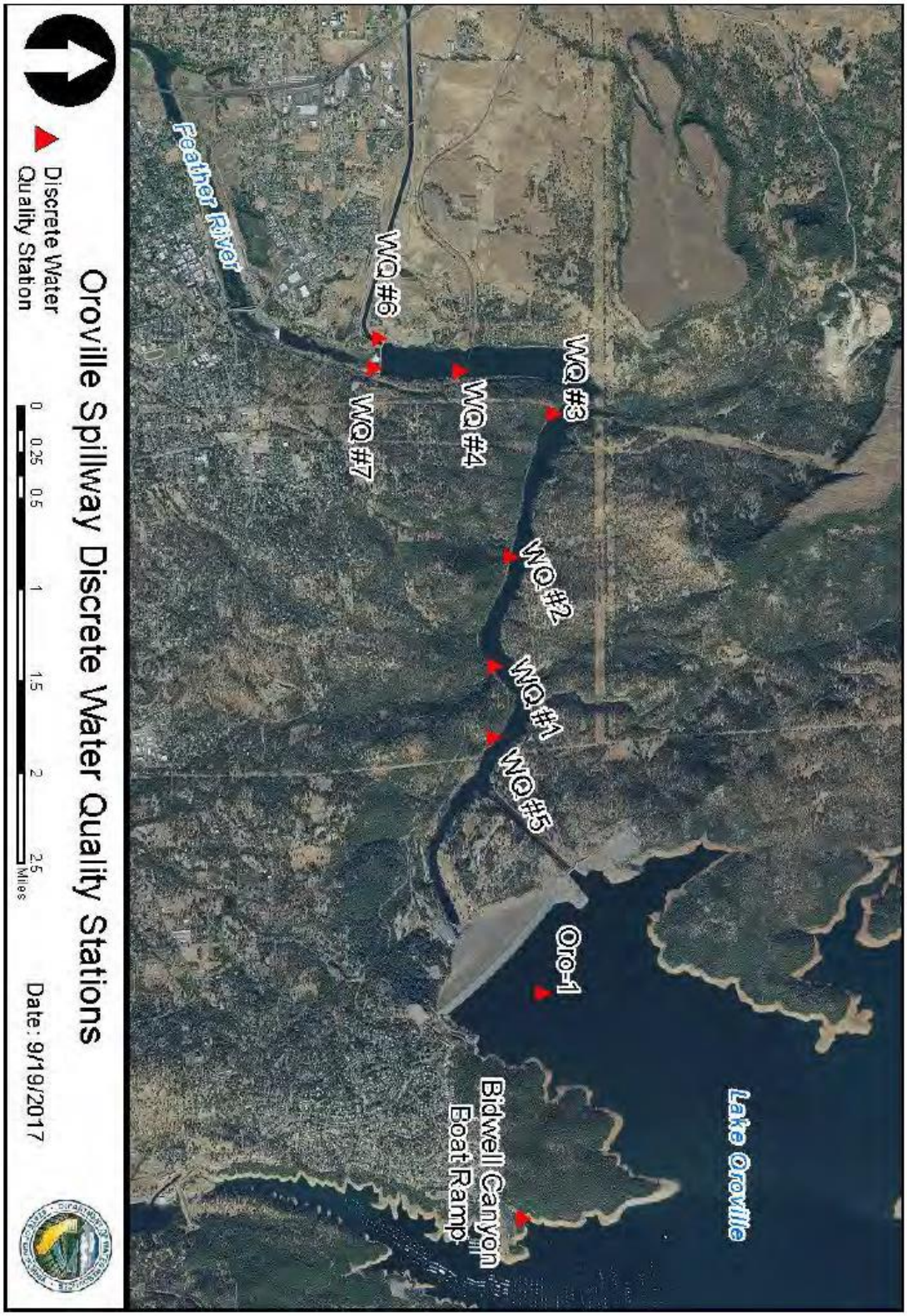

Figure 9. Response-period water quality monitoring stations in the Thermalito Diversion Pool (source: DWR 2018b)

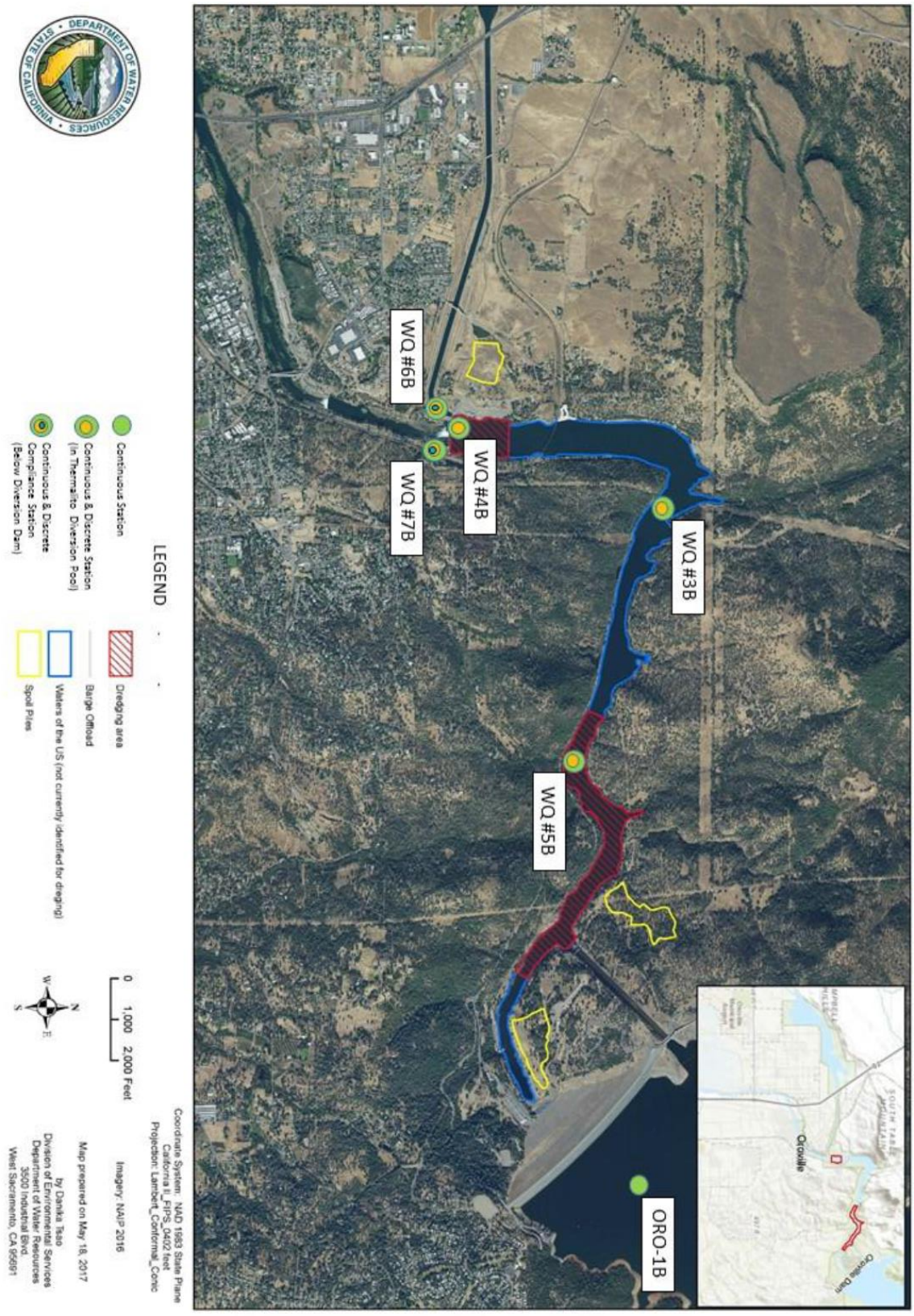

Figure 10. Continuous recovery-period water quality monitoring locations (source: California DWR 2018b)

Turbidity levels also increased temporarily with dredging activities in the Thermalito Diversion Pool. Elevated turbidity levels from spillway erosion and dredging were the highest in the Thermalito Diversion Pool near recovery activities, and dissipated downstream as sediments settled out in downstream impoundments, or diminished by combining with less turbid tributaries further downstream. For example, elevated turbidity levels were as high as 963 NTU in the Thermalito Diversion Pool between February 27 and March 12, 2017 during dredging activities (Table 1). Much of the sediment introduced into the Thermalito Diversion Pool was medium to large-sized material that settled out in the Thermalito Diversion Pool, until later being removed by dredging activities. However, the fine silt and clay-sized particles that were transported downstream caused short-term high turbidity levels in the Feather River and likely settled out in lower velocity areas, such as eddies, backwaters, and low-gradient areas near the confluence with the Sacramento River. This sediment should remain in the lower gradient areas until a subsequent high flow event mobilizes the material or is mechanically removed from the river. No additional dredging is proposed after fall 2017, and therefore should not result in elevated turbidity during the remainder of the recovery phase.

Table 1. Results of turbidity moniting in the Thermalito Diversion Pool, condcuted between February 14-August 18, 2017 (source: California DWR 2018b).

Reporting Period	Bidwell Canyon		WQ #5 *		WQ #1		WQ #2		WQ #3		WQ #4		WQ #6		WQ #7	
	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max
February 14 - February 26	20.7 NTU	37.8 NTU			38.6 NTU	58.4 NTU	36.8 NTU	48.6 NTU	36.2 NTU	49.1 NTU	39.3 NTU	61.4 NTU	Sampling of these stations initiated on June 15, 2017			
February 27 - March 12**	18.1 NTU	38.4 NTU	136.6 NTU	963 NTU	62.5 NTU	269 NTU	67.3 NTU	135 NTU	55.9 NTU	114 NTU	40.8 NTU	81.5 NTU				
March 13 - March 26	16.9 NTU	34.9 NTU	29.7 NTU	125 NTU	34.2 NTU	131 NTU	37.8 NTU	117 NTU	44.9 NTU	217 NTU	37.4 NTU	152 NTU				
March 27 - April 9	10.0 NTU	22.4 NTU	15.4 NTU	38.5 NTU	20.9 NTU	40.0 NTU	21.6 NTU	48.9 NTU	23.6 NTU	36.5 NTU	19.4 NTU	32.0 NTU				
April 10 - April 24	5.9 NTU	7.5 NTU	9.8 NTU	15.0 NTU	12.7 NTU	20.6 NTU	14.7 NTU	24.5 NTU	21.4 NTU	55.1 NTU	14.8 NTU	40.6 NTU				
April 25 - May 8	3.8 NTU	5.2 NTU	6.5 NTU	11.4 NTU	8.8 NTU	25.5 NTU	9.9 NTU	28.5 NTU	12.1 NTU	21.9 NTU	9.4 NTU	26.2 NTU				
May 9 - May 21	5.8 NTU	12.1 NTU	6.1 NTU	19.3 NTU	5.8 NTU	14.1 NTU	6.9 NTU	19.6 NTU	8.2 NTU	23.3 NTU	7.5 NTU	32.8 NTU				
May 22 - June 5	5.4 NTU	12.1 NTU	6.1 NTU	6.7 NTU	5.7 NTU	17.6 NTU	6.0 NTU	9.7 NTU	8.5 NTU	23.1 NTU	4.6 NTU	7.4 NTU				
June 6 - June 18	7.5 NTU	13.3 NTU	3.1 NTU	4.7 NTU	4.3 NTU	7.3 NTU	5.1 NTU	12.5 NTU	8.1 NTU	15.6 NTU	3.8 NTU	4.6 NTU	4.0 NTU	4.5 NTU	4.3 NTU	6.0 NTU
June 19 - July 4	5.6 NTU	14.5 NTU	3.0 NTU	6.6 NTU	4.6 NTU	10.5 NTU	4.6 NTU	6.9 NTU	6.3 NTU	18.6 NTU	3.6 NTU	5.6 NTU	3.9 NTU	5.6 NTU	4.3 NTU	6.4 NTU
July 5 - July 18	7.6 NTU	18.3 NTU	2.5 NTU	3.9 NTU	5.8 NTU	11.5 NTU	5.0 NTU	9.7 NTU	7.2 NTU	20.1 NTU	3.3 NTU	6.2 NTU	3.5 NTU	6.6 NTU	3.8 NTU	4.7 NTU
July 19- July 30	8.1 NTU	17.3 NTU	3.1 NTU	4.6 NTU	5.7 NTU	9.3 NTU	5.4 NTU	15.2 NTU	8.7 NTU	23.7 NTU	4.4 NTU	8.5 NTU	4.4 NTU	6.5 NTU	4.7 NTU	5.8 NTU
July 31 - August 18	6.2 NTU	18.7 NTU	6.5 NTU	22.3 NTU	5.3 NTU	9.6 NTU	4.9 NTU	8.6 NTU	7.1 NTU	16.6 NTU	4.1 NTU	6.0 NTU	4.4 NTU	7.9 NTU	4.8 NTU	6.9 NTU

* WQ #5 Discrete sampling initiated on March 1, 2017

** First period included in two-week WQ reports to CVRWQCB

Ongoing spillway construction activities during the recovery phase are unlikely to result in direct impacts to turbidity. Work activities in the main and emergency spillway areas include blasting, excavation, rock crushing, pressure washing, grading, and vegetation clearing, and all have the potential to contribute high levels of sediment to surface waters without proper management and protection measures. Spoil piles lacking erosion control barriers or disrupted ground surfaces impacted by precipitation events are also likely to contribute to increased turbidity. However, California DWR has proposed to implement best management practices, such as straw wattle installation, hydroseeding, creating settling ponds, and creating erosion barriers to prevent any adverse effects to turbidity. Monitoring conducted by California DWR indicates that these measures have been effective in reducing construction-related impacts and remained low during the early recovery phase from May to August 2017 (Figure 11). Therefore, turbidity levels as a direct result of construction activities should remain low during the remainder of the recovery phase ending in January 2019.

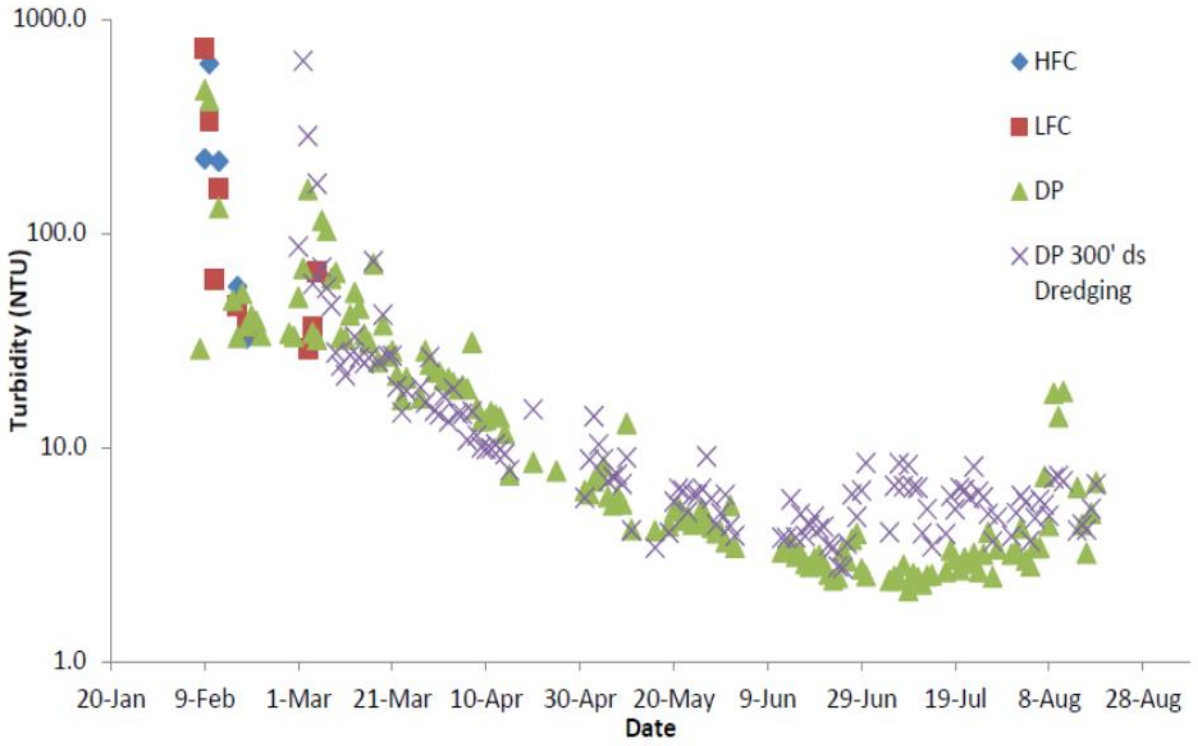

Figure 11. 7.10-2. Turbidity (in Nephelometric Turbidity Units) measured in the Feather River in the high flow channel (HFC), low flow channel (LFC), Diversion Pool (DP), and DP 300 ft. downstream of the dredging in 2017. Note log scale on y-axis for turbidity (source: California DWR 2018b).

Nonetheless, construction activities are likely to result in indirect short-term adverse effects to water quality without proper erosion control. During the recovery phase, California DWR proposes to install and utilize multiple concrete batch plants. The operation of the batch plants, along with the heavy use of concrete and grout during construction is likely to result in short-term adverse effects to water quality if not properly contained, or if any concrete materials come into contact with surface waters. California DWR also proposes to direct wastewater associated with construction activities to settling ponds for construction-related wastewater, which are located at the base of the main spillway. California DWR has an operational protocol for the ponds, which includes monitoring and managing water levels and regularly removing water from the pools for dust control activities during recovery-phase construction activities. However, California DWR did not provide any information on the long-term disposition of the ponds, and a subsequent breach of the dike from use of the main spillway after the completion of construction is likely to cause a spike in turbidity or an exceedance in other water quality parameters. Accordingly, California DWR should be required to file a plan for final disposition of the ponds and what measures it will implement to prevent contaminated water from the settling pools at the base of the main spillway from being discharged to the Thermalito Diversion Pool once construction has been completed.

Finally, after construction activities conclude, there are likely multiple construction-use locations where sediment is likely to be introduced into surface waters. Notably, the large spoil piles in the spillway area and near the Thermalito Diversion Dam, along with the rock crushing site and bare hillsides and roads all feature exposed surfaces prone to erosion and elevated turbidity in the project area. Therefore, California DWR should also be required to develop a post-construction water quality protection plan. The plan should include measures to prevent erosion at any area impacted by construction efforts. At a minimum, the plan should contain measures for long-term disposition of the spoil piles, disrupted soil surfaces, and any other sediment sources. This plan should be combined with California DWR's plans for the final disposition of the settling pond below the main spillway.

Dissolved Oxygen

Monitoring conducted by California DWR during its response and recovery actions did not show any indication of adverse dissolved oxygen levels. Specifically, monitoring conducted by California DWR during the response phase illustrates relatively robust dissolved oxygen levels between 9.53 and 20.5 mg/L in the Thermalito Diversion Pool (FERC 2018). The high dissolved oxygen levels noted during the response period are likely the result of turbulence and aeration caused by water cascading over the main and emergency spillways. Following the end of spillway use on May 20, 2017, the project resumed normal flow release operations. Therefore, there should be no effect to dissolved oxygen levels during the recovery phase, and any fluctuations in dissolved

oxygen levels will be the result of normal project operations or normal seasonal fluctuations.

pH

Monitoring conducted during the response period indicates that pH levels were generally near-neutral (FERC 2018). Aside from construction materials meeting surface waters, algal blooms, decomposition, or interactions with local geology affect pH levels at the project naturally. Algal blooms typically occur in the warmer summer months, followed by decomposition in the fall and winter, and may be affected by water levels or flow. California DWR does not anticipate reducing water levels to critically low levels in any project impoundments or the Feather River and thus, is unlikely to have an appreciable effect on pH levels.

During the recovery phase, construction activities are likely to cause short-term adverse effects to pH levels without proper protection measures. The reconstruction of both the main and emergency spillways relies on concrete production and placement at the site. Consequently, any water that comes into contact with wet concrete or concrete wash will result in elevated pH levels. California DWR has proposed to contain concrete and concrete wash activities with the use of settling ponds at the recovery site. Two small settling ponds near the emergency spillway would be lined with plastic, thereby limiting their ability to affect water quality at the site. As previously discussed, an additional pair of settling ponds would be located at the base of the main spillway, and separated from the diversion pool by an earthen berm. In order to prevent the formation of high pH levels within the ponds, California DWR has proposed to agitate the water with sprinklers to neutralize high pH, and monitor water quality at this location within, and outside of the settling pond to ensure that water quality is not adversely affected in the diversion pool. Nonetheless, a breach of the two settling ponds from spillway operation or construction demobilization would cause short-term adverse effects to pH levels. As California DWR has not outlined a definitive plan for the ultimate fate of the tainted water at this location; it should be required to provide a plan for the ultimate disposition of wastewater and spoiled material associated with the use of the settling ponds.

Water Temperature

Water temperature below Oroville Dam is directly correlated with reservoir releases, and is managed to maintain compliance with the requirements of a biological opinion from the National Marine Fisheries Service (2004) for operation of the State Water Project. Water quality monitoring conducted during the first two months of the response phase indicates that water temperatures in the Thermalito Diversion Pool remained cool between 6.8 and 13.9 Celsius (C). Similarly, water temperature in the

low-flow channel during the response period remained cool between 7.9 to 14.6 C, which is consistent with seasonal temperature patterns (Figure 12).

Following the response period, California DWR should resume its normal cycle of flow releases, and related water temperatures are expected to follow normal patterns associated with project operations. Therefore, the response and recovery actions should not result in significant changes to water temperature at the project.

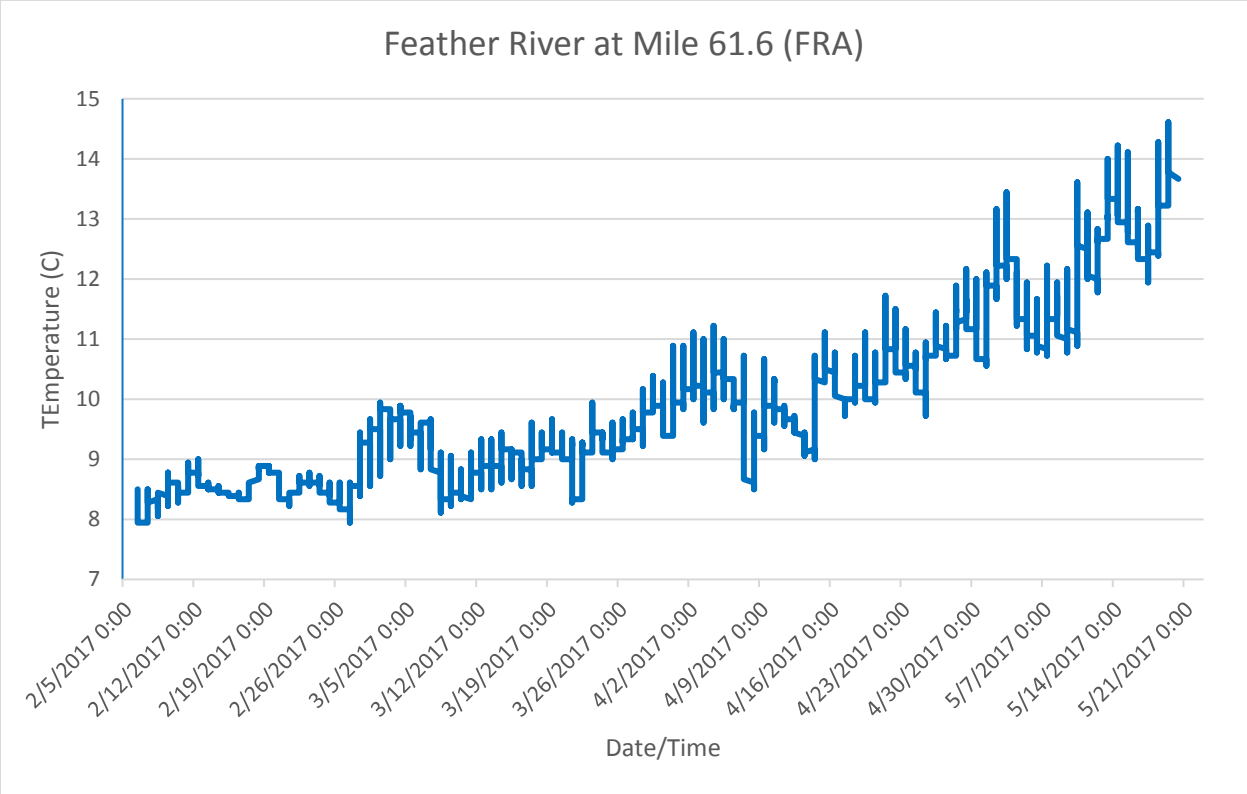

Figure 12. Water temperatures in the Feather River low-flow channel during the response period (Source: California Data Exchange Center 2018, as modified by Commission staff).

Other Parameters

Finally, intermittent and heightened releases from the spillway and reconstruction activities likely resulted in short-term elevated levels of metals and minerals, due to erosion of the spillway area and mobilization of settled sediments in the Feather River during high flows. Specifically, California DWR's water quality monitoring during the response phase noted elevated levels of copper. However, these effects were short-term, and subsided with the cessation of erosion and dredging activities. California DWR's remaining recovery phase activities should not result in any further elevated metal or mineral levels. Due to already low background levels of conductivity, petroleum-based

products, nutrients, and pathogens, there should be no departures from background levels as a result of California DWR's response or recovery actions.

6.5.3 Staff Recommendations

In order to prevent short-term adverse effects to turbidity after recovery-phase construction is completed, California DWR should be required to file a plan for final disposition of the settling ponds below the main spillway. The plan should detail what measures California DWR will implement to prevent contaminated water from being introduced into the Thermalito Diversion Pool once construction has been completed. California DWR should also be required to develop a post-construction water quality protection plan. The plan should include measures to prevent erosion at any area impacted by construction efforts. At a minimum, the plan should contain measures for long-term disposition of the spoil piles, disrupted soil surfaces, and any other unstable areas that are known to contribute to increased turbidity. These two plans should be combined into a post-construction water quality protection plan.

6.6 Fisheries and Aquatic Resources

6.6.1 Affected Environment

California DWR's response and recovery efforts has the potential to affect aquatic resources in Lake Oroville, the Thermalito Complex, Feather River, and the OWA. The Lake Oroville fishery is comprised of both cold water and warm water species. The cold water fishery is managed as a put-and-grow fishery, with chinook salmon being planted regularly, and joining an existing coho salmon, rainbow trout, and brown trout community. The warm water fishery however, is self-sustaining, and is primarily comprised of black bass (spotted bass, largemouth bass, smallmouth bass), catfish, crappie, bluegill, green sunfish, carp, wakasagi, and threadfin shad. Terrestrial vegetation along the reservoir shoreline provides spawning habitat, nursery habitat, and refugia for warm water fishes, but becomes unavailable to fish as the reservoir is drawn down during the summer months.

Downstream, the Thermalito Diversion Pool is predominantly a cold water fishery, consisting of rainbow trout, brook trout, brown trout, and Chinook salmon. The diversion pool also contains several native and non-native species, including common carp, golden shiner, Sacramento pikeminnow, Sacramento sucker, wakasagi, prickly sculpin, bluegill, black crappie, largemouth bass, smallmouth bass, and tule perch. The diversion pool also has contained a relict coho salmon population from prior stocking events in Lake Oroville that have passed downstream. However, the diversion pool fish community and abundance thereof was likely altered by the exceptionally high flows and turbidity levels following the main spillway failure. The Thermalito Forebay and Fish Barrier Pool exhibit similar fish communities.

The Thermalito Afterbay provides habitat for cold water and warm water fish, and is stocked occasionally with surplus steelhead from the Feather River Hatchery. Other fish species observed in the Thermalito Afterbay include largemouth bass, smallmouth bass, rainbow trout, brown trout, bluegill, redear sunfish, black crappie, channel catfish, carp, and large schools of wakasagi. The Thermalito Afterbay provides good habitat and forage for black bass, but recruitment is limited, due to reservoir elevation fluctuations from pump-back operations.

The Feather River Fish Hatchery consists of the Fish Barrier Dam, fish ladder, holding tanks, hatchery buildings, and raceways. The hatchery was constructed tin 1967 to compensate for the loss of salmonid spawning habitat upstream of Oroville Dam. The hatchery is operated by the California DFW, which annually produces approximately 8 million fall-run Chinook salmon, 5 million spring-run Chinook salmon, and 400,000 steelhead. The hatchery utilizes cool water from the Thermalito Diversion Pool, which is managed and monitored to maintain compliance with a 1983 operating agreement with the California DWR and California DFW. Salmon and steelhead raised in the hatchery are transported and releases into the downstream Feather River, Sacramento River, Lake Oroville, Thermalito Afterbay, other California Reservoirs, San Pablo Bay, and most recently, the San Joaquin River.[36]

The Feather River, downstream of the Fish Barrier Dam is primarily managed to benefit cold water fisheries, and is designated in two distinct reaches known as the low-flow and high-flow sections. The low-flow section of the Feather River has a minimum flow requirement of 600 cfs, and starts at the fish barrier dam and continues downstream to the confluence with the Thermalito Afterbay outflow. The high-flow section consists of the portion of the Feather River downstream of the Thermalito Afterbay confluence, and contains higher flows, which are supplemented from the afterbay releases and contributions from the downstream Yuba River, Bear River, and Honcut Creek. Water temperature in the low-flow section is also generally cooler than that of the high-flow section.

Habitat in Feather River below the fish barrier dam is generally sediment-starved, as a result of sediment in the upper watershed settling out in Lake Oroville. Consequently, the riverbed is increasingly coarse in the upper portions of the low-flow section of the river, which results in reduced formation of riparian vegetation in the upper, low-flow section. In similar manner, the Feather River below the project has a limited amount of large woody debris for fish habitat, which is trapped by Lake Oroville upstream.

---

[36] San Joaquin River Restoration Program: http://www.restoresjr.net/?wpfb_dl=2012

Fish species of primary management concern present in the Feather River include spring-run Chinook salmon, fall-run Chinook salmon, Central Valley steelhead, rainbow trout, brown trout, brook trout, green sturgeon, striped bass, river lamprey, American shad, hardhead, Sacramento splittail, largemouth bass, smallmouth bass, and spotted bass. Chinook salmon are very abundant in the Feather River; as an estimated 30,000 to 170,000 Chinook salmon spawn in the Feather River annually. Fall-run Chinook salmon enter the Feather River in late summer and fall, and typically spawn in late September through December. Spring-run Chinook salmon normally begin migrating in March and continue through early September, and hold in cold water pools until ready to spawn in the fall. The spring-run evolutionarily significant unit (ESU) is listed as threatened under the ESA, and is discussed further in *section 6.8-Threatened and Endangered Species*. The fall-run ESU qualifies as a species of concern and is considered significantly depressed from historic levels.

Rainbow trout/steelhead are native to the Feather River, with the anadromous form (steelhead) being federally-listed as threatened under the ESA. The Feather River contains both resident rainbow trout and the anadromous steelhead form. Most rainbow trout spawn between February and June, with the steelhead form migrating to the project area between September and November, and spawning in late December. Two species of sturgeon (white sturgeon and green sturgeon) are also found within the project area, with white sturgeon being more common of the two. Both sturgeon species begin upstream spawning migrations between February and June, with spawning occurring between April and June. White sturgeon are known to spawn in the Feather River, but the presence of green sturgeon in the Feather River has historically, been contested. Additional discussion regarding ESA-listed Central Valley steelhead and green sturgeon is provided in *section 6.8-Threatened and Endangered Species.*

The Feather River in the project area contains striped bass, American shad, and two lamprey species, including river lamprey and Pacific lamprey. Striped bass is an introduced migratory fish, which spawns in the project area from April through June, and is an important recreational fishery in the Feather River. Similarly, American shad are an introduced migratory species, which migrates to the Feather River primarily in May and June. Juvenile American shad are present in the Feather River through mid-December, with emigration peaking in August and September. Among the two lamprey species, Pacific lamprey are more common in the Feather River than river lamprey. Both species reside in freshwater for 3-4 years as ammocoetes, before metamorphosing to the adult form, and migrating to the ocean. River lamprey then reside just upstream of saltwater for 4 months, and then spend an additional 3 months in saltwater before returning to freshwater to spawn in the fall. Pacific lamprey migrate to the ocean in the fall, where they reside for 3.5 years, before returning to freshwater in April through June, residing in the river over winter, and spawning the following spring. Additional species present in upstream impoundments, such as black bass, minnows, suckers, sunfish, forage fish,

catfish, perch, and crappie are also present in the Feather River, but make up only a small portion of the Feather River fish community.

The OWA downstream of the fish barrier dam contains more than 75 ponds and sloughs, along with wetland and riparian areas, totaling about 12,000 acres. The ponds are replenished by Feather River seepage, and floods into the area during high flow events. The OWA ponds, sloughs and wetlands are inhabited by channel catfish, white catfish, bluegill, green sunfish, carp, white crappie, black crappie, and Sacramento sucker. The ponds are also inhabited seasonally by Chinook salmon after high flow events, but typically do not survive the warmer late spring and summer water temperatures.

6.6.2 Environmental Effects

Aquatic resources in the project area have the potential to be affected through high flows, ramping rates, habitat alterations, and water quality changes associated with the response and recovery efforts. These effects are discussed below at each of the fisheries affected by the response and recovery efforts, which include the Feather River, Lake Oroville, Thermalito Diversion Pool, Feather River Fish Hatchery and the OWA.

Feather River

Habitat Quality and Sediment-Feather River

The initial failure of the main spillway and erosion of the emergency spillway contributed a significant amount of fine sediment to the lower Feather River. While sediment transport is an important factor in fluvial morphology, excessive sediment has the can adversely affect aquatic resources through habitat loss, habitat alteration, shifting of aquatic species, and degradation of spawning habitat. During the response period, larger-sized sediment particles and coarse debris settled into the Thermalito Diversion Pool. However, smaller silt-sized particles continued downstream below the Thermalito Diversion Pool, causing immediate adverse impacts to the lower Feather River, as demonstrated by the high turbidity levels observed during the response period.

Initially high sediment loads during the response period likely had a short-term adverse effect on aquatic species through spawning habitat degradation. Substrate spawning species, such as salmonids (trout, salmon, and steelhead) and cyprinids (suckers and minnows) were likely adversely affected by sediment covering spawning substrate or active redds. These effects were likely more pronounced in the low-flow section of the Feather River, where suitable spawning substrate is available. Conversely, broadcast spawning species, such as American shad, striped bass, and sturgeon do not use the substrate directly for spawning activities. Although fertilized eggs or larvae from broadcast spawners can settle in lower velocity areas (and would be adversely affected by

sediment settling on top of eggs and juveniles), these species were not likely adversely affected by sediment deposition, due to later spawning times in April and May, when sediment levels in the Feather River had subsided.

Subsequent high flow pulses with lower sediment loads later in the response period likely transported some of this sediment into lower reaches of the Feather River, where it settled out in slow-water habitats. Sediment settling out in the lower reaches of the Feather River likely altered the habitat dynamic through creation of sediment bars and islands in the channel, thereby altering aquatic habitat in the lower river. These sediment accumulations would eventually be colonized by riparian species, but would also reduce overall available aquatic habitat. This sediment accumulation and creating of additional riparian habitat likely occurred in low-velocity sections of the Feather River and in the lower gradient reaches of the Feather River near the confluence with the Sacramento River.

In addition to the sediment introduced from erosion of the main spillway, elevated sediment levels were also likely introduced into the Feather River from streambank erosion or from the reported streambank failures along the Feather River. Consequently, there was likely an adverse impact to aquatic habitat through a reduction of riparian and aquatic habitat along the river margins, but also from habitat degradation in downstream areas where sediments settled out. As discussed in section 6.3-*Geology and Soil Resources*, it is unclear to what extent streambank failure occurred in the Feather River. It is also unclear to what degree to what degree that sediment deposition in the lower Feather River occurred as a result of the main spillway failure, use of the emergency spillway, and any streambank degradation. In order to assess the severity of these impacts, California DWR should be required to develop a Sedimentation and Erosion Assessment and Mitigation Plan. The plan should investigate the degree of sediment deposition in the lower Feather River and its effect on the aquatic habitat availability and aquatic habitat quality by comparing pre-and post-response effects. The plan should also assess the extent of any streambank loss during the response period. Finally, the plan should propose measures to mitigate for adverse effects to the lower Feather River from sediment deposition and streambank degradation.

Stranding-Feather River

During the response period, California DWR implemented four intermittent flow pulses in February through May 2017 to pass inflows from Lake Oroville, and to preserve the integrity of the remainder of the main spillway. The proposed high flow events by themselves, were within the range of normal project operations during a wet hydrologic year. High flow events redistribute sediment and introduce or relocate large woody debris throughout much of the Feather River. As a result of its timing, the high flow events displaced juvenile Chinook salmon and steelhead in the Feather River. This displacement had mixed effects, as it encouraged downstream migration to productive

floodplain and estuarine rearing areas. However, a portion of the salmonids displaced were entrained and perished in isolated areas disconnected from the Feather River. The magnitude of these effects is discussed below.

While the high flow releases that occurred during the response period are typical of wet water years, the abrupt flow decreases were atypical, and adversely affected fishery resources through stranding. California DWR implemented four sharp flow reductions, with the largest decrease from the main spillway dropping from 60,000 cfs to 0 cfs almost instantaneously on February 28, 2017 (Figure 15). The four flow reductions were partially attenuated by flows from storage in the Thermalito Diversion Pool, but still resulted in significant water level reductions in both the low-flow and high-flow sections of the Feather River (Figure 13). Consequently, the high flows in the Feather River initially displaced juvenile salmonids, followed by many becoming terminally stranded along stream margins in standing water that became disconnected from the main channel. Juvenile salmonids and other small fish with poor swimming ability were the most adversely affected by the flow reductions, but a subset of other species and life stages were also adversely affected by the flow reductions.

In coordination with the project operation staff, California DWR staff, together with state and federal fish and wildlife agencies, conducted fish rescue operations as spillway flows decreased. Monitoring conducted by the California DWR indicates that a large variety of fish species were adversely affected by the aforementioned flow reductions in February-May 2017 (Table 2). While an extrapolation of these data to actual amount of fish mortality is difficult due to small sample size, inconsistencies in representative sites, and sampling inefficiency; the data indicate that the four sharp flow reductions had an adverse effect on the Feather River fishery.

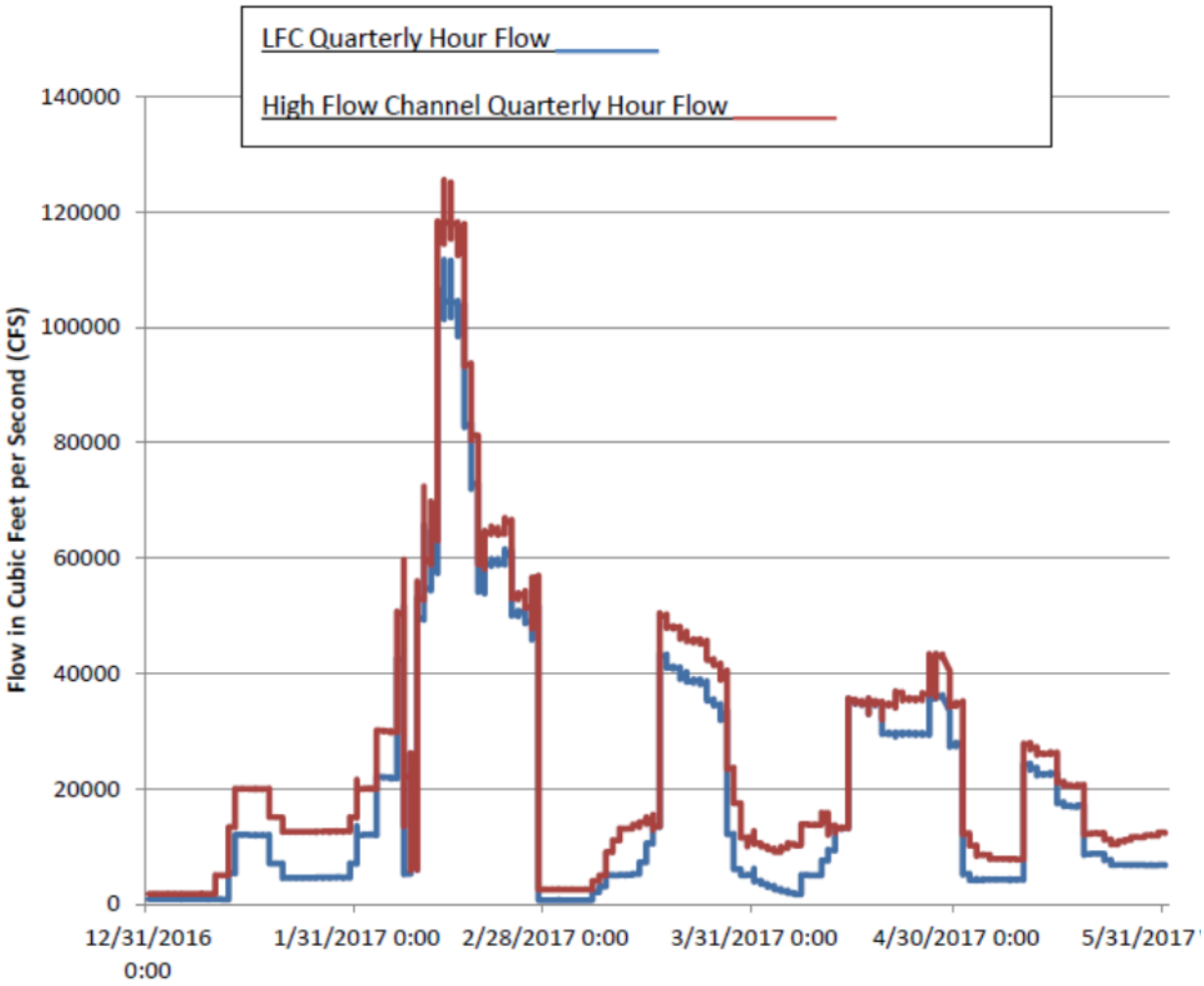

Figure 13. Hydrograph showing flows in the Feather River during the response period (Source: California DWR 2018)

The most abundant species of fish stranded in isolated pools included Sacramento sucker, sculpin, various cyprinid minnows, wakasagi (pond smelt), and juvenile Chinook salmon. Of the more abundant mortalities observed during stranding surveys, the represented taxa are relatively common native in the Feather River (sculpin, cyprinid minnow) or non-native (wakasagi). California DWR's mortality and rescue numbers also indicate that 12.6 percent of observed fall-run Chinook juveniles, 4.2 percent of the observed spring-run Chinook, and 41.4 percent of observed stranded steelhead perished during the sharp flow reductions (Table 2). Additionally, California DWR estimates that 267,894 to 346,469 fall-run Chinook juveniles were stranded during rapid flow decreases during the response period. Though other species perished during the event, these three salmonids are those most actively-managed by state and federal resources agencies and warrant mitigation for any losses. The effects to federally-listed species are discussed in greater detail in *section 6.8-Threatened and Endangered Species*,

Table 2. Count of all fishes rescued (live), mortalities (dead), and the Total catch at all stranding sites between February 27 and March 15, 2017, organized by Family. The total of each column is summarized in the bottom row (Source: White et al. 2017).

Family	Common Name	Scientific Name	Native	Live	Dead	Total
Catostomidae: Suckers	Sacramento Sucker	*Catostomus occidentalis*	Yes	200	266	466
Centrarchidae: Sunfishes/Basses	Green Sunfish	*Lepomis cyanellus*	No	1	0	1
	Warmouth	*Lepomis gulosus*	No	20	0	20
	Bluegill Sunfish	*Lepomis macrochirus*	No	138	23	161
	Redear Sunfish	*Lepomis microlophus*	No	19	0	19
	Unidentified Sunfish (Juv.)	Unidentified Centrachid (Juv.)	--	10	43	53
	Unidentified Sunfish (Adult)	Unidentified Centrarchid	--	0	12	12
	Small Mouth Bass	*Micropterus dolomieu*	No	4	1	5
	Largemouth Bass	*Micropterus salmoides*	No	3	0	3
	Unidentified Crappie	*Pomoxis* sp.	No	1	0	1
	Unidentified Bass (Juv.)	Unidentified Centrarchid (Juv.)	No	6	0	6
Cottidae: Sculpins	Prickly Sculpin	*Cottus asper*	Yes	34	0	34
	Unid Sculpin (Juv.)	*Cottus* sp. (Juv.)	Yes	450	1,655	2,105
Cyprinidae: Minnows	Common Carp	*Cyprinus carpio*	No	4	0	4
	Hitch	*Lavinia exilicauda*	Yes	8	2	10
	Hardhead	*Mylopharodon conocephalus*	Yes	76	0	76
	Golden Shiner	*Notemigonus crysoleucas*	No	21	3	24
	Sacramento Squawfish	*Ptychocheilus lucius*	Yes	25	19	44
	Hardhead / Sacramento Squawfish (Adult)	Unidentified Cyprinid spp. (Adult)	Yes	0	6	6
	Unid Minnow (Juv.)	Unidentified Cyprinid spp. (Juv.)	--	336	1,016	1,352
	California Roach	*Hesperoleucus symmetricus*	Yes	4	0	4
Embioticidae: Surfperches	Tule Perch	*Hysterocarpus traski*	Yes	145	32	177
Ictaluridae: Bullhead Catfishes	Bullhead Catfish	*Ameiurus* sp.	No	1	0	1
	Unid Catfish (Juv.)	Ictaluridae spp. (Juv.)	No	0	3	3
Osmeridae: Smelts	Wakasagi	*Hypomesus nipponensis*	No	3,129	1,736	4,865
Percidae: Darters	Bigscale Logperch	*Percina macrolepida*	No	0	1	1
Petromyzontidae: Lampreys	River Lamprey	*Lampetra ayresi*	Yes	0	200	200
	Unid Lamprey (ammocete)	*Lampetra* sp.	Yes	36	105	141
Poeciliidae: Live Bearers	Western Mosquitofish	*Gambusia affinis*	No	120	0	120
Salmonidae: Salmonids	CHNF: Chinook Salmon (Fall)	*Oncorhynchus tshawytscha*	Yes	3,853	554	4,407
	CHNLF: Chinook Salmon (Late Fall)	*Oncorhynchus tshawytscha*	Yes	13	8	21
	CHNS: Chinook Salmon (Spring)	*Oncorhynchus tshawytscha*	Yes	68	3	71
	CHNW: Chinook Salmon (Winter)	*Oncorhynchus tshawytscha*	Yes	2	0	2
	CHN-A: Chinook Salmon (Adult)	*Oncorhynchus tshawytscha*	Yes	1	4	5
	RBTC-Y: Steelhead (FRFH Yearling)	*Oncorhynchus mykiss*	Yes	16	4	20
	RBTC-A: Steelhead (FRFH Adult)	*Oncorhynchus mykiss*	Yes	4	12	16
	RBTS-F: Steelhead (Wild Fry)	*Oncorhynchus mykiss*	Yes	1	0	1
	RBTS-Y: Steelhead (Wild Yearling)	*Oncorhynchus mykiss*	Yes	20	11	31
	RBTS-A: Steelhead (Wild Adult)	*Oncorhynchus mykiss*	Yes	10	9	19
			Total	***8,780***	***5,728***	***14,508***

Comparison of the stranding estimates to the number of hatchery-released fish in 2017 indicates that stranding played a small, but significant part of the 2016-2017 hatchery-produced juvenile salmonid population; representing about 3.1 percent of the nearly 11 million fall-run juveniles likely produced during 2016-2017. California DWR states that any losses to Chinook salmon would be offset by high flows that transported juveniles downstream to productive rearing areas on the Sutter and Yolo Bypasses. California DWR also states that prolonged high flows provided localized floodplain habitat in the Feather River that is beneficial for rearing. California DWR also explains that subsequent re-inundation of many ponded areas in the Feather River during high flow events after the initial flow reduction in late-February, likely re-inundated many ponded areas, and liberated the great majority of stranded fish. Finally, California DWR states that fall-run Chinook salmon losses would also be offset by the additional 2 million juveniles produced by the hatchery and released during 2018, and extraordinary efforts to document and salvage fish during the late winter and spring of 2017. Commission staff concur with California DWR's assertion that fall-run Chinook mortality was adequately mitigated by these factors.

In addition to the above salmonid species, the Feather River hosts a robust population of white sturgeon, striped bass, and American shad. White sturgeon are expected to be present in the Feather River during the response and recovery period, and were detected by sonar surveys at several location throughout the Feather River. However, no white sturgeon were observed during fish stranding surveys or in subsequent environmental DNA (eDNA) sampling of remaining pools in the high and low flow channels. Spawning white sturgeon are also favor areas of high water velocity and large substrate (Parsley et al. 1993), which is uncharacteristic of the habitat along the river margins where stranding of other fish species occurred. Therefore, white sturgeon present in the Feather River during the flow reductions were unlikely to have been affected through stranding of adult spawning individuals.

Striped bass migrate to the Sacramento River near the project area in April and May, just before spawning, with actual spawning dependent on water temperatures (Stevens et al. 1987). Similarly, American shad migrate to the project area in April and May, followed by spawning in May to July, but are also dependent on water temperatures (Stevens et al. 1987). Review of California DWR's fish stranding data does not include any observations of either species. As noted above, the final flow reduction was in mid-May, when both species were likely arriving in the Feather River. However, arrival and spawning was likely delayed in 2017, due to low water temperatures associated with exceptionally high flows. As a result, it is unlikely that there was any significant level of stranding on striped bass or shad. California DWR resumed normal project operations in mid-May and any juveniles produced by either species were not likely not have been adversely affected through flow manipulations.

With regard to the remaining native and non-native fish observed during standing surveys, California DWR's stranding surveys noted high numbers of wakasagi and sculpin, and unidentified minnows. These species are considered somewhat prevalent in the project area, and as in the case of wakasagi, are non-native and compete with and /or hybridize with native species for resources (Fisch et al. 2014). Among the sensitive species (hardhead and hitch), observed mortality levels appear to be relatively low (0 and 2, respectively), and when qualitatively extrapolated for river-wide losses, should not represent a significant loss to the fishery community.

Mitigation Activities-Feather River

California DWR has undertaken various actions to minimize or mitigate for the loss of fall-run Chinook during the response period, such as fish rescues, habitat improvements, and additional hatchery production. As part of the stranding surveys, California DWR returned fish to main channel of the Feather River. Among the salvaged fish, California DWR returned all observed stranded fish to the Feather River. Though not detailed in California DWR's filing, in the fall of 2017, California DWR undertook a habitat restoration project by releasing 5,000 cubic yards of spawning gravel into the Feather River near the hatchery and excavating a river side channel to restore river flow in the key spawning area. California DWR estimated that several hundred Chinook salmon utilized the restored habitat during fall 2017.[37] In addition, the California DFW increased production from the Feather River Hatchery, in collaboration with California DWR. California DWR reports that it plans to release an additional 2 million juvenile fall-run Chinook in in 2018. The additional fish are on schedule for release during spring 2018, with 1 million juveniles each to be released in the San Francisco Bay and the Feather River. These activities should adequately offset the direct effects to fall-run Chinook salmon losses from stranding during 2017, but also benefit other species such as spring-run Chinook salmon, steelhead, and resident rainbow trout.

Oroville Wildlife Area

The high flows observed during the response period likely had mixed effects to fishery resources in the ponds located in the OWA. The high flows likely recharged some of the ponds and pools located close to the main river with water high in dissolved oxygen, but also deposited sediment in those same ponds and pools. Additionally, high flow likely displaced some warm water species from the OWA ponds, which were later observed in stranding surveys in the Feather River; some of which were stranded in diminishing pools and perished. The same flows however, were likely to have introduced forage species (wakasagi) and provided refuge and beneficial rearing habitat for juvenile salmon; some of which likely remained permanently isolated, and some of which were

[37] https://www.water.ca.gov/News/Blog/All-Blog-Posts/Update---Feather-River-Salmon-Spawning-Restoration-Project (accessed March 13, 2018).

later reintroduced to the main Feather River during subsequent flow increases during the response period. No additional effects to fishery resources in the OWA should occur during the recovery period; as flows should not reconnect to the ponds, and no construction activities would occur near OWA ponds.

Feather River Fish Hatchery

Following the initial failure of the main spillway, high turbidity levels and sediment in the Feather River entered the Feather River Hatchery water supply system. In an effort to protect fish located in the hatchery, the California DFW began to relocate juvenile fish to the Thermalito Annex Fish Facility, located just west of the Thermalito Afterbay. This extraordinary effort resulted in approximately 2 million spring-run Chinook salmon and 4.2 million fall-run Chinook salmon being transferred to the additional facility. At the Feather River Hatchery, the California DFW also implemented various measures to preserve the fish that remained on site, including: creating a sediment settling basin within the hatchery rearing channel; developing an alternate water source using a filtration system and domestic water from a fire hydrant; cleaning out mud in the incubation stacks and inland ponds; monitoring and maintaining turbidity and water quality, using medicated and probiotic feed; adding salt to prevent disease; and cleaning raceways.

The actions of the California DFW preserved many fish, but the overall event, including elevated turbidity and sedimentation in the hatchery resulted in delayed development and mortality. California DWR states that the Feather River Hatchery collected and raised additional salmon and steelhead for release during the 2018 season. Review of the projected numbers for salmon and steelhead released during 2018 illustrates that 670,000 yearling steelhead are scheduled for release during 2018. This figure is approximately 300,000 more than required for Oroville Dam mitigation. For Chinook salmon, the California DFW has a production goal of 6-7 million fall-run smolts and 2 million spring-run smolts annually. In 2017, approximately 5 million fall-run and 1.7 million spring-run Chinook salmon were released; representing a deficit of 1-2 million fall-run and 300,000 spring-run smolts. California DWR states that in 2018, an additional 2 million fall-run Chinook would be released from the hatchery (in addition to the normal 6 million fall-run quota).

Review of the hatchery loss and production data indicate that any hatchery losses of fall-run Chinook salmon would be mitigated with increased production in 2018. Nonetheless, there is still a deficit of 300,000 juvenile spring-run Chinook from 2017 hatchery losses. Consequently, California DWR should be required to mitigate for this loss of spring-run Chinook. Staff recommended mitigation measures include increased hatchery production in a subsequent year, habitat improvements, or capital investment in fishery projects. Any mitigation should be combined with other important fishery mitigation or improvements required in this proceeding. Additional effects to federally-

listed fish in the Feather River Hatchery are discussed in *section 6.8-Threatened and Endangered Species.*

Lake Oroville

In Lake Oroville, any impacts to aquatic resources are likely to result from management of lake elevations for public safety, and to facilitate construction efforts. As noted above in *section 6.5-Water Quantity*, California DWR would lower the Lake Oroville elevation/storage levels during the 2017 and 2018 construction seasons to reduce the probability of having to exercise the main spillway. Without the reservoir drawdown, Lake Oroville would have remained high for much of 2017 and 2018, but gradually depleting for minimum flow releases, water deliveries, water quality, and downstream delta habitat requirements. The reduced water levels would in turn, reduce habitat for aquatic species in Lake Oroville; particularly those that utilize habitat along the lake margins, such as black bass and sunfish. Although these reductions would be substantial, they are within the operational range of a dry water year, and would still be well above the drought conditions that preceded the wet water years that led up to the spillway failure. Therefore, no mitigation should be required at this time for fishery impacts to Lake Oroville.

Thermalito Diversion Pool

The fishery in the Thermalito Diversion Pool was adversely affected through high flows, habitat loss, and high sediment/turbidity load. At its highest point, releases over the main spillway during the response period were in excess of 100,000 cfs. These high flows likely displaced fish from the Thermalito Diversion Pool and into the Feather River or to the Thermalito Forebay. This displacement was evidenced by the several adult Chinook salmon found out of season during stranding surveys that appeared to have been landlocked in Lake Oroville and/or the Thermalito Diversion Pool, but were displaced with high flows.

Similarly, high sediment load and construction activities likely had an adverse effect to aquatic resources in the Thermalito Diversion Pool and beyond. Initially high sediment loads, such as those caused by excessive erosion of the spillway areas would have forced fish to avoid the area and seek refuge in areas of lesser turbidity. The additional dredging activities and flow pulses likely further exasperated those effects. In consideration of the high flows, high turbidity, and dredging activities in the Thermalito Diversion Pool, there were adverse effects to fishery and other aquatic resources in the diversion pool. Notably, any fishery that was present in the immediate area of the project spillways and dredging areas was likely displaced downstream by high flows or obliged to emigrate from the area to avoid high turbidity levels. Similarly, fish residing in the small tributaries to the diversion pool (primarily native cyprinids) were likely displaced during construction activities associated with culvert replacements along Burma Road

Since the fishery in the diversion pool and its tributaries is not actively managed through fish stocking or habitat improvements, the fish community therein is a function of individuals introduced from Lake Oroville during spill events and from the pre-existing fish community in Thermalito Diversion Pool and the connecting Thermalito Forebay. Thus, we expect that any impacts to the fish community in the diversion pool and its tributaries will be mitigated as individuals immigrate from the Thermalito Forebay or are displaced from Lake Oroville during spill events, and also through natural reproduction of remaining species in the diversion pool.

Ongoing Construction Effects

During response activities, California DWR designated an area west of the Thermalito Diversion Pool for mobilizing watercraft and dredging equipment, along with removing and hauling dredged material to an adjacent spoil pile. As part of these activities, California DWR installed vertical pilings and expanded an equipment utilization area, just upstream of the railroad bridge. Unfortunately, the expansion of the shoreline area resulted in the partial fill of a permanent pond, just west of the staging area. With the completion of dredging activities, California DWR should be required to restore the pond to pre-project conditions, including removing the material that was introduced to facilitate dredging efforts. This measure should be incorporated into the project-area-wide Restoration Plan discussed in *section 6.7-Terrestrial Resources.*

There should not be any additional significant adverse effects to fishery resources as a result of ongoing construction efforts in 2018. The above discussion notes some potential, but minor effects to Lake Oroville aquatic resources through reduced reservoir elevations, but is considered within historic operating patterns. Similarly, we expect minor to no effects to aquatic resources in the Thermalito Diversion Pool during the recovery phase through some ongoing dredging in 2017, but not in 2018. Finally, there should not be any adverse effects to fishery resources in the Feather River Hatchery or Feather River during the recovery phase, as project operations and river conditions should remain within the normal range of operating conditions.

6.6.3 Staff Recommendations

In summary, failure of the main spillway and use of the emergency spillway resulted in substantial adverse effects to fishery resources in the Feather River. Adverse effects occurred in the Thermalito Diversion Pool, Feather River Fish Hatchery, and the downstream Feather River through exceptionally high sediment loads, sharp flow reductions, and degraded habitat quality. California DWR has implemented immediate measures to offset these effects, but also plans additional future mitigative measures. To fully mitigate for potential outstanding effects to fishery resources, California DWR should be required to develop a Sedimentation and Erosion Assessment and Mitigation

Plan. The plan should investigate the degree of sediment deposition in the lower Feather River and its effect on the aquatic habitat availability and aquatic habitat quality by comparing pre-and post-response effects. The plan should also assess the extent of any streambank loss during the response period, and should propose measures to mitigate for adverse effects to the lower Feather River from sediment deposition and streambank degradation. Finally, California DWR should be required to restore the pond located west of the Thermalito Diversion Pool railroad bridge to pre-project conditions.

6.7 Terrestrial Resources

6.7.1 Affected Environment

The project is located within the Sacramento Valley and Sierra Nevada Foothills on land designated as a State Recreation Area. Vegetation in this area differs with elevation changes from the valley floor (elevation 100 feet msl at the lower end of the OWA) to the upper elevation of the mountain range (about 1,200 feet above msl). The vegetation changes from valley grasslands to foothill woodlands (characterized by blue-oak /foothill pine woodlands with varying amounts of chaparral) to mixed conifer forests in the higher elevations.

Botanical Resources

At the time of relicensing, botanical field investigations included surveys for vegetation mapping, noxious weeds, special-status plant species, and riparian and wetland resources. Surveys were conducted during 2002, 2003, and 2004. The study area for the vegetation community/land use mapping included the area within the project boundary, a 1-mile-area beyond the boundary, and the Feather River floodplain (within the FEMA 100-year floodplain) downstream of the project boundary.

Seven natural vegetative community types were identified in the study area: upland forest/woodland; upland herbaceous; upland shrub/scrub; riparian forest/woodland; riparian shrub/scrub; wetlands; and aquatic/submerged vegetation. Other areas were mapped based on land uses, such as disturbed, agriculture, urban (or as rock outcrop), and open water.

The majority of vegetation around Lake Oroville and the Thermalito Diversion Pool consists of a variety of native mixed oak woodlands, foothill pine/mixed oak woodlands, and oak/pine woodlands with a mosaic of chaparral. Primary species include interior and canyon live oaks, blue oak, and foothill pine. The open areas within the woodlands consist of annual grassland species. Also found around the Thermalito Diversion Pool is scrub vegetation, consisting of mostly chaparral vegetation, which is characterized by evergreen, tough waxy leaves. Common chaparral species include whiteleaf manzanita, buckbrush, toyon, and scrub oak. Downstream of Oroville Dam and

the Thermalito Diversion Pool, vegetation around open waters of the Thermalito Complex include emergent wetland types with annual grasslands on the surrounding slopes.

Invasive and Noxious Weeds

A total of 219 species of non-native plants were identified within the project boundary during relicensing surveys conducted in 2002 and 2003. Of these species, 39 are identified as noxious or invasive plants by the California Department of Food and Agriculture, California Invasive Plant Council, U.S. Department of Agriculture, and the Plumas National Forest. The largest concentration of noxious or invasive species is located within the OWA. However, noxious and invasive species also occur in areas with existing land disturbance near roads, trails, and in the immediate vicinity of the spillway and power facilities.

California DWR notes that the species of greatest concern to native riparian and wetland plant communities and wildlife habitat in the areas associated with the proposed actions include giant reed, tree of heaven, scarlet wisteria, parrots feather, and Himalayan blackberry. Tree of heaven is intermingled with the valley elderberry shrub, which serves as habitat for the federally-threatened valley elderberry longhorn beetle in about 250 acres in the OWA.

Riparian and Wetland Habitat

About 3,238 acres of riparian forest/woodland occur within the project boundary. More than 2,450 acres of Fremont cottonwood forest occurs within the area studied at the time of relicensing; most of which occurs in the OWA. Around Lake Oroville, native riparian habitats are restricted to narrow strips along tributaries, consisting mostly of alders, willows, and occasional cottonwoods and sycamores. A small amount of riparian vegetation occurs around the Thermalito Complex. The north shore of Thermalito Forebay is lined with an about 50-foot-wide strip of mixed riparian species (mostly willows) with an understory of emergent wetland vegetation. Cottonwoods and willows occur in scattered areas around the high water elevation of Thermalito Afterbay shoreline. During relicensing studies, 215 acres of riparian shrub habitat were mapped. These shrub associations occur almost entirely along the Feather River directly upstream and downstream of the Thermalito Afterbay outlet. They include a mix of species but are predominately arroyo willow and sandbar willow. Non-native species, such as giant reed and scarlet wisteria, are prominent in the riparian shrub community along the Feather River upstream of the Thermalito Afterbay outlet in the low flow channel.

A total of 912 acres of wetland vegetation were mapped at the time of relicensing, most of which occurs around Thermalito Afterbay. Less than 7 acres of wetland vegetation occurs around Lake Oroville and the Thermalito Diversion Pool, mostly

associated with seeps and springs that are a natural part of the landscape above the high water line (Table 3). About 42 acres of emergent wetland vegetation occur along the edges of ponds in the OWA. Emergent wetland habitats are dominated by short, erect, rooted hydrophytes (e.g., cattail, tule, bulrush), and occur in waters less than 6 feet deep. Seasonal flooding restricts species diversity to those species adapted to anaerobic soil conditions. Emergent wetland habitat, ranging from strips less than 50 feet wide to areas over 0.5 mile wide, are found around Thermalito Afterbay, Thermalito Forebay, within dredger ponds in the OWA, and in backwater areas along the Feather River. Emergent wetlands are generally absent within the drawdown zone of Lake Oroville or within the steeper drainages upslope from the reservoir.

Table 3. Total acres of wetland habitat found at project facilities

	Thermalito Afterbay	**Thermalito Forebay**	**Thermalito Diversion Pool**	**Lake Oroville**	**Oroville Wildlife Area**
Bulrush	<1	0	0	0	0
Cattail	<10	0	0	0	<1
Mixed emergent	234	10	0	<1	42
Rush	381	<1	0	<1	0
Rush/verbena	201	0	0	0	0
Verbena	36	<1	0	0	0
Seep/wet area	0	0	<1	6	0
Totals	852	11	<1	6	42

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

Wildlife Resources

California DWR used the California Wildlife Habitat Relationships database to determine that roughly 330 wildlife species may occur within the project boundary. Generally, the project area provides seasonal or year-round habitat for a variety of wildlife including mountain lions, bobcat, raccoons, beaver, mink, badger, gray fox, weasels, coyotes, tree and ground squirrels, rabbits, deer, skunks, ringtails, bears, and many species of waterfowl and birds native to the area. The project area provides year-round habitat for several species of migratory birds, as well as non-native vertebrates including bullfrog, house sparrow, bobwhite quail, ring-necked pheasant, rock dove, wild

turkey, European starling, opossum, black rat, Norway rat, house mouse, muskrat, red fox, and feral pig.

California DWR notes that the Thermalito Complex provides resting and foraging habitat for open water and diving waterfowl species such as the ruddy duck, bufflehead, scaup, ring-necked duck, common goldeneye, and common merganser, which generally does not occur in surrounding agricultural areas. Due to water level fluctuations and recreational high-speed boat use at the project, habitat for nesting and brooding waterfowl and nesting grebes, is limited in the Thermalito Afterbay.

The number of wildlife species located within the actual emergency project areas will vary based on the work location, amount of previous disturbance, and the amount of previous human activity.

Commission staff accessed FWS's Information for Planning and Consultation system on May 9, 2018, and generated the following list of birds protected under the Migratory Bird Treaty Act that are likely to occur within the proposed response and recovery areas:

Table 4. Birds protected under the Migratory Bird Treaty Act in the project area.

Common Name	Scientific Name	Season(s)
Bald Eagle	*Haliaeetus leucocephalus*	Year-round
Black Rail	*Laterallus jamaicensis*	Breeding
Black Swift	*Cypseloides niger*	Breeding
Burrowing Owl	*Athene cunicularia*	Year-round
California Spotted Owl	*Strix occidentalis*	Year-round
Calliope Hummingbird	*Stellula calliope*	Breeding
Flammulated Owl	*Otus flammeolus*	Breeding
Fox Sparrow	*Passerella iliaca*	Wintering
Green-tailed Towhee	*Pipilo chlorurus*	Breeding
Lewis's Woodpecker	*Melanerpes lewis*	Wintering
Loggerhead Shrike	*Lanius ludovicianus*	Year-round
Long-billed Curlew	*Numenius americanus*	Wintering
Nuttall's Woodpecker	*Picoides nuttallii*	Year-round
Oak Titmouse	*Baeolophus inornatus*	Year-round
Olive-sided Flycatcher	*Contopus cooperi*	Breeding
Peregrine Falcon	*Falco peregrinus*	Wintering
Rufous Hummingbird	*Selasphorus rufus*	Migrating
Rufous-crowned Sparrow	*Aimophila ruficeps*	Year-round
Short-eared Owl	*Asio flammeus*	Wintering
Snowy Plover	*Charadrius alexandrines*	Breeding

Common Name	Scientific Name	Season(s)
Swainson's Hawk	*Buteo swainsoni*	Breeding
Western Grebe	*Aechmophorus occidentalis*	Wintering
Williamson's Sapsucker	*Sphyrapicus thyroideus*	Year-round
Yellow-billed Magpie	*Pica nuttalli*	Year-round

There is an active bald eagle nest (Glen Pond Nest territory) located outside of the project boundary, but in close proximity to areas as part of the response and recovery efforts. The Glen Pond nesting territory was previously addressed as part of the approved new alignment of the 230kV powerlines.[38] The occupied nesting tree was determined to be hazardous and thus removed.[39] California DWR was required to make a reasonable attempt to relocate the nest to a suitable tree within the eagle pair's territory.[40] In coordination with the FWS and the California DFW, California DWR installed a total of four surrogate nest structures. In mid-January 2018, the Glen Pond nesting pair relocated and built a new nest to the north side of the Thermalito Diversion Pool, in the same general vicinity as their old territory.

Oroville Wildlife Area

The OWA is located west of the city of Oroville and is managed by the California DFW, guided by the 1978 OWA Management Plan, as well as applicable state laws and regulations. The OWA includes 6,000 acres including and surrounding the Thermalito Afterbay, and the 5,000 acres adjacent to and spanning 12 miles of the Feather River. The riparian habitat present within the OWA is the largest remaining block of riparian habitat along the Feather River with further details discussed above, and provides breeding habitat for a variety of neotropical migrant birds.

Habitats within the OWA differ from the other land associated with the emergency work, as the area includes: lacustrine, riverine, freshwater emergent, valley foothill riparian, and annual grassland and dryland grain/seed crops. Wildlife species are relatively similar to the remaining project area and include: coyote, deer badger, fox, bobcat, porcupine, squirrel, rabbit, osprey, white-tailed kite, egrets, woodpeckers, warblers, dove, quail, and waterfowl.

---

[38] Order Amending License, Revising Project Description, and Amending Project Boundary (160 FERC ¶ 62,168), issued August 23, 2017.

[39] California DWR Biologists requested an eagle take permit for Health and Safety Reasons (Permit No MB22883C-0) to remove the primary nest and fell the nest tree.

[40] Through coordination with the California Department of Parks and Recreation, an Eagle Nest Exhibit Permit was received and the intact nest is on display at the Lake Oroville Visitor Center.

6.7.2 Environmental Effects

During the response phase, high flow releases from Oroville Dam; particularly in February 2017, adversely affected wetland areas within the OWA. Specifically, high flows not only inundated fringe wetlands along the mainstem Feather River, but also recharged many wetland ponds along the Feather River, and within in the OWA. The high flows also redistributed and/or introduced varying levels of sediment to these wetland areas, thereby providing an influx of nutrients to the system. In a separate filing, California DWR notes that some of the inflow and outflow conveyances to wetlands within the OWA were degraded during high flows, and requests Commission approval to allow the Sutter Butte Flood Control Agency to repair, augment, or install structures that would improve floodplain connectivity, reduce flood stage, promote fish and wildlife habitat, enhance recreation, and reduce operation and maintenance costs.[41] This proposal was the subject of a separate Commission proceeding, and authorized on June 21, 2018.

California DWR also previously requested and received approval for rerouting the project's primary transmission line,[42] and for allowing PG&E to reroute a portion of its transmission line across the project land near the Thermalito Diversion Pool.[43] The clearing and construction actions required by the two projects, in combination with California DWR's current proposal, cumulatively had a significant adverse effect on the above-mentioned resources. Given the duration of the response and recovery efforts, there will continue to be mid-term, long-term, and permanent effects to vegetation, wildlife, and wildlife habitat. The majority of the land clearing and loss of habitat is temporary and will be mitigated over time through revegetation and other measures described below.

The majority of the adverse environmental effects on terrestrial resources associated with California DWR's subsequent recovery phase is a result of the cumulative impact of the vegetation and land clearing required for the construction of access roads, work pads, staging areas, spoil sites, and other supporting facilities; and the specific proposals to construct the emergency spillway's RCC splash pad; install the PG&E and California DWR emergency shoofly transmission lines; replace the 13.8-kV powerline and fiber optic communication system; and install the boundary cattle fencing. Vegetation and land clearing activities will have a direct and significant effect on nesting birds, animal burrows, and habitat. The clearing of the natural and existing environments

---

[41] In an April 2, 2018 filing, California DWR requests Commission approval to permit the Sutter Butte Flood Control Agency to implement the Flood Stage Reduction Project within the OWA.

[42] Ibid.160 FERC ¶ 62,168.

[43] Ibid. 160 FERC ¶ 62,118.

increases noise, vibration, dust, and pollution, and introduces the possibility of vehicle/wildlife collisions and other human interactions with wildlife. The loss of vegetation will temporarily compound some of these effects.

Construction activities during the recovery phase of the Oroville Spillway emergency will also temporarily and permanently disturb land, vegetation, and wildlife resources within the project and surrounding area. California DWR estimates that more than 300 acres of terrestrial habitat have, or will be impacted within the proximity of the spillways. For the proposed borrow area, 380,000 cubic yards of material would be coming from the spillway area. California DWR provided an estimate of disturbance area totals for major project activities as shown in Table 5 below.

Table 5. Estimated disturbance area for major project activities

Feature Type	Size (in acres or miles)
Access Roads	28.31 miles
Spoil Piles	41.17 acres
Crane Pads	0.83 acres
Concrete Batch Plants	7.47 acres
Kiewit Areas[44]	314.9 acres

In addition, the natural hillside used as part of the emergency spillway would be replaced with a 5- to 10-foot-thick splash pad or apron of RCC, permanently removing the natural woodland habitat that existed prior to the emergency event. However, sufficient habitat exists in the areas immediately surrounding the project construction area such that the majority of wildlife and avian species are expected to temporarily disperse to less disruptive locations. With proper mitigation efforts implemented, construction-specific effects would be minimized.

The above actions will increase vehicular traffic and necessitate the use of heavy machinery such as excavators, bulldozers, front-end loaders, dump trucks, helicopters, coring and drilling equipment, and explosives. The use of the facilities and equipment increases human presence, noise, and pollution which has secondary minor short-term adverse effects to the wildlife and birds and their habitats. Disturbance and removal of existing vegetation for any of the proposed construction activities and the increased vehicular traffic and human interaction in the proposed environments will also create conditions conducive to the introduction and spread of invasive plant species. The introduction and spread of these species will allow for the displacement of native vegetation, thereby reducing biodiversity and altering compositions of existing native

[44] Kiewit Areas include the entirety of the FCO and Emergency Spillways, access, staging, spoils, offices, *etc*. This is a general footprint for their project area.

communities, further adversely affecting existing botanical and wildlife habitat. If proper mitigations techniques are implemented and the various work areas are restored to their pre-emergency conditions this affect will be short-term; failure to do so will result in long-term harm to the area.

The 2018 recovery-phase activities are also located near, but not directly within the current Glen Pond nesting eagle territory. However, due to the fly over range and foraging habits of the bald eagle, the proposed activities are likely to have a moderate short-term adverse effect on the eagle pair as their food source will be displaced and the area will have increased human activity. Bald eagles have been removed from the list of threatened and endangered species since 2007, but are still protected at the federal level under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. As detailed in the Commission's Final Environmental Impact Statement (FEIS) for relicensing the Feather River Project, California DWR previously implemented conservation measures as a result of its draft programmatic biological assessment for terrestrial species (FERC 2007). California DWR should continue to implement these measures to prohibit human activity near the nests as the response and recovery efforts take place and to ensure the protection of the Glen Pond eagle nesting territory.

California DWR has made efforts to reduce the environmental impact of required support facilities by locating them in previously disturbed areas, such as license-required recreation sites (see also *section-6.10 Recreation Resources*). If implemented, the best management practices for construction and mitigation efforts identified by California DWR and the fulfillment of permit requirements should reduce the overall effect on terrestrial resources within the proposed project area. Additionally, in its recently approved Revegetation, Planting, and Monitoring Plan[45] for the 230-kV powerline relocation, California DWR notes that it intends on creating a broader Oroville Emergency Response and Recovery Project Area Restoration Plan to be completed and implemented following the termination of construction activities.

6.7.3 Staff Recommendations

California DWR has implemented various construction-specific best management practices to mitigate environmental effects, including: environmental pre-project surveys; concurrent environmental monitoring; and staff environmental awareness training; delineated exclusionary areas; implementing site specific speed limits; and site stabilization, habitat restoration, and revegetation. California DWR should continue these and other practices provided in its January 29, 2018 filing, throughout the remaining recovery work.

[45] Order Approving Revegetation, Planting, and Monitoring Plan (162 FERC ¶ 62,176), issued March 26, 2018.

As discussed above, the machinery and vehicles used during land-clearing activities have the potential to introduce and spread invasive or noxious plant species. California DWR and its contractors should use best management practices to reduce these potential effects during both the response and recovery phases. Best management practices include but are not limited to: assessing activity areas for existing invasive species to avoid further spread, following decontamination procedures for equipment, vehicles, and contractors entering and exiting work areas; preserving existing vegetation and revegetating as soon as possible where feasible, and reducing soil disturbance and potential erosion where feasible; etc. California DWR's use of post-construction mitigation measures to restore cleared areas to pre-construction conditions, where appropriate, will also aid in alleviating short- and long-term adverse effects on the vegetative environment (including minimizing the spreading of invasive species) and wildlife habitat.

Given the extensive land clearing associated with this proposal (*see* Table 5) and cumulatively with the relocation of the PG&E and California DWR primary transmission lines, staff agrees with California DWR that a comprehensive Restoration Plan should be completed for the project. As such, staff recommends that California DWR develop separately, or as part of that comprehensive plan, a Revegetation and Invasive Species Mitigation Plan to include revegetation activities, mitigation for the spread of invasive species, and monitoring of revegetation efforts. Implementing a comprehensive Revegetation and Invasive Species Mitigation Plan will minimize long-term adverse effects to surrounding vegetation and wildlife habitat, minimize the spread of noxious weeds, promote the establishment of native communities, and protect identified special status species from construction-related disturbances (*see section 6.8-Threatened and Endangered Species*).

California DWR should also continue to implement the following measures to prohibit human activity as the response and recovery efforts take place and to ensure the protection of the Glen Pond eagle nesting territory, including implementation of: (1) an administrative closure of land and shoreline areas to human entry during the nesting season around the bald eagle nest territories; (2) signage, patrol, and enforcement of the aforementioned closure; (3) nest and population surveys; (4) habitat improvement measures; and (5) limitations on current and future habitat disturbance.

While the proposed response and recovery actions would likely result in mid-to long-term adverse effects on the Feather River Project's terrestrial and botanical resources, implementing the best management practices described in the January 29, 2018 filing, the required mitigation outlined in the various permits obtained to perform the construction work, and the above staff recommended measures, will lessen both the direct and indirect effects. If implemented, the mitigation measures will ensure that California DWR's actions have minimal disturbance to the areas at the time of

construction and where disturbance is unavoidable efforts to restore wildlife habitat are taken in a timely manner.

6.8 Threatened and Endangered Species

6.8.1 Affected Environment

The California DWR's January 29, 2018 filing includes a list of the federally-listed threatened and endangered species that may occur in the project area. This list was compiled using information from the relicensing proceeding, and supplemented with data from the California Natural Diversity Database and from a September 2017 search of the FWS' online Information for Planning and Consultation database (IPAC). Commission staff accessed the FWS' IPAC database on January 30, 2018, and did not find any additional species known, or with the potential, to occur within the project area. Table 6 below provides a list of the federally-listed species that may occur in the proposed project boundary and those with identified critical habitats.

Table 6. Federally-listed species that may occur in the project area.

Common Name	Scientific Name	Federal Status
Birds		
Southern Bald Eagle	*Haliaeetus leucocephalus*	Delisted
Yellow-Billed Cuckoo[46]	*Coccyzus americanus*	Threatened
Least Bell's Vireo	*Vireo bellii pusillus*	Endangered
Reptiles		
Giant Garter Snake	*Thamnophis gigas*	Threatened
Amphibians		
California Red-Legged Frog[47]	*Rana draytonii*	Threatened
California Tiger Salamander	*Ambystoma californiense*	Threatened
Sierra Nevada Yellow-Legged Frog	*Rana sierra*	Endangered
Fish		
Delta Smelt	*Hypomesus transpacificus*	Threatened
California Central Valley Distinct Population Segment (DPS) Steelhead	*Oncorhynchus mykiss*	Threatened
Central Valley DPS Spring-Run Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened

[46] Designated critical habitat is located in the project area.

[47] Designated critical habitat is located in the project area.

Common Name	Scientific Name	Federal Status
Southern DPS North American Green Sturgeon	*Acipenser medirostris*	Threatened
Insects		
Valley Elderberry Longhorn Beetle	*Desmocerus californicus dimorphus*	Threatened
Crustaceans		
Conservancy Fairy Shrimp	*Branchinecta conservatio*	Endangered
Vernal Pool Fairy Shrimp	*Branchinecta lynchi*	Threatened
Vernal Pool Tadpole Shrimp	*Lepidurus packardi*	Endangered
Flowering Plants		
Butte County Meadowfoam	*Limnanthes floccosa* ssp. *Californica*	Endangered
Green's Tuctoria	*Tuctoria greenei*	Endangered
Hairy Orcutt Grass	*Orcuttia pilosa*	Endangered
Hoover's Spurge	*Chamaesyce hooveri*	Threatened
Layne's Ragwort	*Senecio layneae*	Threatened
Slender Orcutt Grass	*Orcuttia tenuis*	Threatened
Hartweg's golden sunburst	*Pseudobahia bahiifolia*	Endangered
Pine Hill Flannelbush	*Fremontodendron decumbens*	Endangered

The FWS issued a Biological Opinion on April 9, 2007 that addressed the effects of issuing a new license for the Feather River Project on federally-listed threatened and endangered species.[48] The National Marine Fisheries Service issued a separate Biological Opinion on December 5, 2016, which identified critical habitat for Central Valley DPS of spring-run Chinook salmon, California Central Valley DPS of steelhead, and the Southern DPS of North American green sturgeon in the Feather River extending upstream to the fish barrier dam, but no farther.[49]

California DWR conducted habitat surveys during the relicensing process for the Feather River Project, and a review of those surveys was performed to determine the potential for threatened and endangered species habitat to occur within the emergency response and recovery project area. The emergency response and recovery project area does not contain vernal pools. As such, Commission staff will not consider the following species in the environmental analysis of the emergency response and recovery action: conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, California Tiger salamander, Butte County Meadowfoam, Greene's Tuctoria, Hair Orcutt

[48] The FWS's Biological Opinion was filed with the Commission on April 16, 2007, under Project No. 2100-000.

[49] The NMFS's Biological Opinion was filed under Project No. 2100-134.

Grass, Hoover's Spurge, and Hartweg's Golden Sunburst. Habitat for the following species does exist within the project boundary: the Layne's Ragwort, Pine Hill Flannelbush, yellow-billed Cuckoo, and Giant Garter Snake; however, there is no potential for disturbance to habitat for these species within the emergency response and recover project area. Lastly, California Red-legged Frog, Sierra Nevada Yellow-legged Frog, Delta Smelt, and the Least Bell's Vireo are either not known to occur within, or have not been found within the project boundary. Consequently, Table 7 provides a list of the federally-listed species, with identified critical habitat, that may occur in the emergency response and recovery project area.

Table 7. Federally-listed species potentially affected by the response and recover actions.

Common Name	Scientific Name	Federal Status
Birds		
Southern Bald Eagle	*Haliaeetus leucocephalus*	Delisted
Fish		
California Central Valley Distinct Population Segment (DPS) Steelhead	*Oncorhynchus mykiss*	Threatened
Central Valley DPS Spring-Run Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened
Southern DPS North American Green Sturgeon	*Acipenser medirostris*	Threatened
Insects		
Valley Elderberry Longhorn Beetle	*Desmocerus californicus dimorphus*	Threatened

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle was listed as a threatened species on August 8, 1980, and if afforded full protection under the federal ESA.[50] The current range of the valley elderberry longhorn beetle extends throughout the Central Valley from approximately Shasta County in the north to Fresno County in the south, and includes the valley floor and lower foothills. Valley elderberry longhorn beetle habitat consists of elderberry thickets located in riparian woodlands, oak woodlands, or grasslands. Adult valley elderberry longhorn beetles deposit their eggs in the bark of living elderberry plants and larvae bore into the pith of stems. The beetles' use of elderberries is not readily apparent; often the only exterior evidence is an exit-hole created by the larva just prior to pupation. A variety of branch sizes are used for larval

[50] *See* Federal Register 45: 52803-52807.

development and pupation; although, stems 2-4 inches in diameter at the exit hole have been reported to be used most often. Infrequently, exit holes have been found in smaller branches less than 1.5 inches in diameter, but generally not in branches less than 1.0 inch in diameter. Thus, larvae appear to be distributed primarily in large, mature plants with stems greater than 1.0 inch in diameter near ground level.

At the time of relicensing, California DWR mapped and surveyed elderberry shrubs using the FWS protocol. Survey results found that approximately 95 acres of valley elderberry shrubs were delineated within the project boundary, with 0.402 acre around Lake Oroville, 2.255 acres in the area downstream from the Oroville Dam and north of Highway 162, and 91.831 acres in the OWA south of Highway 162 and Larkin Road. Forty-five elderberry shrub stems greater than 1 inch in diameter (preferred size of the valley elderberry longhorn beetle) were mapped along the Feather River corridor between Oroville Dam and the Fish Barrier Pool and along the Thermalito Power Canal, elderberry shrubs with stems greater than 5 inches in diameter in high density were located along the levees within the portion of the OWA bordering the Feather River.

California Central Valley DPS Steelhead, Central Valley DPS Spring-Run Chinook salmon, and Southern DPS North American Green Sturgeon

Adult California Central Valley spring-run Chinook salmon typically begin their upstream migration in late January and early February, and arrive at the Feather River Fish Hatchery between late April and June (NMFS 2016). The spring-run Chinook salmon hold in large pools, especially in the low flow channel, upon arrival and through the summer before spawning in the fall (NMFS 2016). A small number of spring-run Chinook salmon remain in the Lower Feather River before emigrating in April and an even smaller number appear to emigrate in the winter as yearlings (Bilski and Kindopp 2009). Spring-run Chinook salmon often selecting holding pools that have a large bubble curtain at the head, underwater rocky ledges, and shade cover throughout the day. Spawning, however, occurs in gravel beds less than 5 feet in depth in stream reaches characterized by low gradient pool-riffle hydrology. Gravel size in spawning habitats is typically 1 to 4 inches with less than 5 percent of fine material present (CDFG 1998).

The Feather River downstream of Oroville Dam is also listed as critical habitat for California Central Valley DPS steelhead. In the project vicinity, most natural steelhead spawning occurs in the low flow channel near Hatchery Ditch, a side change between river miles 66 and 67, and additional spawning habitat is used below the Thermalito Afterbay outlet. Juvenile steelhead emigrate beginning in February; however peak emigration typically occurs in March or April. Adult California Central Valley steelhead typically enter the Feather River from September to November, hold until spawning, and begin spawning in the Lower Feather River in late December, peaking in late January (NMFS 2016). Spawning is complete by the end of March (Cavallo et al. 2003). Spawning typically occurs from late December through March, with subsequent egg

incubation occurring from December through April (NMFS 2016). Alevin emergence occurs during March through May (NMFS 2016). Additional measures had previously been implemented to increase the quality and complexity of salmonid spawning and rearing habitat within the Feather River, via structural enhancements in the mainstem, in existing side channels, and through the development of additional side channels. Gravel supplementation projects have also been implemented to improve salmonid spawning habitat downstream of Oroville Dam. Southern DPS North American green sturgeon spawn in the Klamath and Sacramento Rivers (Moyle 2002), although there have been intermittent reports of spawning in the Feather River (Seesholtz et al. 2014). The timing of the spawning, however generally occurs between April and June (Adams et al. 2002).

The Feather River Fish Hatchery is an anadromous fish hatchery that was built in 1967 to mitigate for the loss of spawning grounds and rearing areas for returning salmonids that resulted from the construction of Oroville Dam and water diversions in the Sacramento-San Joaquin Delta. It is one of four Central Valley hatcheries producing and releasing steelhead, and it is the only Central Valley hatchery producing and releasing Central Valley DPS spring-run Chinook salmon. The Oroville Reservoir provides the hatchery supply water and implements flow release measures to control water temperatures and to operate the fish ladder, which allows for upstream migrating salmonids to enter the hatchery for egg-taking or fertilization.

6.8.2 Environmental Effects

Valley Elderberry Longhorn Beetle

During the initial emergency response activities, California DWR biologists surveyed the project area for elderberry shrubs suitable for valley elderberry longhorn beetle habitat. On March 21, 2017, six elderberry shrubs were identified within the action area (i.e., two at spillway left, one near Hyatt, one along Burma Road, and two near the vicinity of Spoil Pile 3). The areas were flagged with 25-foot buffer zones and construction crews were instructed to avoid the plants as much as possible.

On March 28, 2018, California DWR began to clear areas for emergency access and staging to repair the damaged FCO spillway. California DWR informed the FWS that one of the six previously identified shrubs was located in an area to be used at the spillway left as a helipad. The 1-inch stemmed elderberry shrub did not have evidence of exhibit holes, but needed to be relocated. California DFW removed the elderberry shrub from this location and transplanted it to a location near the Thermalito Afterbay on March 29, 2017. This location was chosen due to the existence of elderberry shrubs in the area, California DWR fee ownership of the property, and because the area is managed by the California DFW.

On April 13, 2017, California DWR contacted the FWS concerning a second identified elderberry shrub found within the spillway left area that required transplanting.

The FWS responded on April 18, 2018, acknowledging the emergency situation at the project and requesting that the California DWR contact them again to coordinate the long-term management of the transplanted elderberry shrubs. The spillway left shrub was relocated to the OWA in close proximity to existing elderberry shrubs.

Both relocated plants are being monitored and are known to have survived through the 2017 summer months. The remaining four identified elderberry shrubs are located within non-riparian areas, are not located near other elderberry shrubs, and none displayed exist holes.

California DWR worked with the California DFW to relocate the two shrubs immediately and to locations that would not be affected by the actions taken. The locations chosen are existing riparian habitats where known clumps of elderberry shrubs exist. While there were direct impacts to the relocated elderberry shrubs individually at the time of transplantation, it is not likely that the valley elderberry longhorn beetle species were affected given the isolation of the plants, their location in a non-riparian habitat, and the lack of exist holes.

Where avoidance and minimization measures outlined in its amendment application are not possible for any future valley elderberry shrubs, California DWR states it is developing an Elderberry Relocation Plan (utilizing comments received from the FWS on November 30, 2017) to move elderberry shrubs to an already identified mitigation site. The relocation plan would include planting additional elderberry shrubs and associated species utilizing the FWS's most recent *Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle* from 2017.[51] California DWR states it would monitor the plants for up to five years using the defined success criteria and implementation measures, should it not meet success criteria.

California Central Valley DPS Steelhead, Central Valley DPS Spring-Run Chinook Salmon, and Southern DPS North American Green Sturgeon

Hatchery

The February 2017 spillway failure and associated emergency response efforts potentially affected federally-listed California Central Valley DPS steelhead, Central Valley DPS spring-run Chinook salmon, and Southern DPS North American green sturgeon. As discussed in *section 6.6-Fisheries and Other Aquatic Resources*, impaired water quality and sediment build-up from spillway-area erosion specifically affected the Feather River Fish Hatchery. Approximately 2 million spring-run Chinook salmon that were located at the hatchery had to be transferred to the Thermalito Annex during the onset of the spillway failure. California DWR and hatchery staff took measures to

[51] *See* https://www.fws.gov/sacramento/documents/VELB_Framework.pdf

minimize mortality and to minimize impacts to the hatchery. As a result of hatchery mortalities, the California DFW fell short of its 2017 stocking goals. In 2017, California DWR stocked 1.7 million spring-run Chinook salmon, representing approximately 85 percent of the production goal. Even after accounting for increased hatchery production in 2018, there remains a shortfall of approximately 300,000 juvenile spring-run Chinook salmon. California DWR should be required to mitigate for this deficit.

The incident also compromised approximately 750,000 California Central Valley steelhead eggs at the hatchery, as the eggs were too fragile to attempt to relocate and the associated water filtration system failed during the event. The hatchery was able to treat and use water from a fire hydrant in combination with its source water to decrease water temperature and increase oxygen to the eggs, which resulted in minimal egg mortality. Nonetheless, the hatchery increased steelhead production and stocking in 2018, and in February 2018, the California DFW released 500,000 yearling California Central Valley DPS steelhead into the Feather River and 170,000 yearlings into the Thermalito Afterbay, which exceeded California DWR's corresponding mitigation criteria by approximately 300,000 fish.

Feather River

Following the spillway failure on February 7, 2017, California DWR consulted with NMFS and California DFW regarding eroded debris and sediment. California DWR proposed to shut down the flood control outlet spillway to allow the eroded material to be removed via barge-mounted excavators. However, in doing so, California DWR implemented rapid flow reductions and dredging activities. On February 24, 2017, NMFS expressed concern regarding potential effects to special status species, and recommended specific measures to be implemented during flow reductions. However, California DWR indicates that it was unable to conform to all of the NMFS' recommendations, citing the extensive emergency work that had to be done in a short amount of time and its conflicting efforts to maintain and observe the structural integrity of the remaining portion of the main spillway. The rapid flow reductions were implemented on February 27, March 27, May 1, and May 18, 2017. California DWR was able to provide minimum flows for in-river fish, implement protection measures for fish housed at the hatchery, conduct stranding pool surveys, and perform fish rescues. California DWR included its stranding survey results in its filing (Table 8). California DWR however, was not able to reduce flows as slowly as requested, due to the risk of increased head cut erosion. Based on its observations within the surveyed area, Table 8 also provides an estimate of the total numbers of fish standings in the affected areas.

The stranding surveys demonstrated short-term adverse impacts to steelhead in the Feather River. California DWR estimates impacts to as many as 87 fry, 1,355 yearling, and 676 adult steelhead were affected by stranding in the lower Feather River. As discussed in *section 6.8*, these effects would be offset in part, by increased steelhead

stocking in 2018, and through completed and planned habitat improvement efforts. In addition, the stranding surveys estimates noted as many as 5,380 juvenile spring-run Chinook salmon were stranded during the flow reductions. This lower amount (when compared to the 1.7 million released to the river) likely represents the high proportion of fish that had already out-migrated in 2017. Therefore, staff concludes that stranding from sharp flow reduction did not likely play a large role in spring-run Chinook salmon population reductions.

No adult or juvenile green sturgeon strandings were observed after flow reduction events. Although juvenile green sturgeon juveniles were observed in May 2017 spawning surveys, no juveniles were noted in any of the fish stranding surveys. Spawning green sturgeon typically inhabit deep fast water areas (Moyle 2002), and would not have been as affected by the drawdowns as side channels and tributaries. The smaller scale of the May flow reductions would have also contributed to the absence of green sturgeon in stranding surveys, which were likely closer to the main channel areas of the river. Conversely, the small number of green sturgeon present in the river contributed to the lack of observed strandings. Therefore, any impacts to green sturgeon populations as a whole would have been minor, based on the few individuals in the impacted area and the lack of any observations in stranding surveys.

Table 8. Observed and extrapolated numbers of special status species stranded in wet pools during the Oroville Dam Spillway incident (source: California DWR 2018b).

Life Stage	**Target Species**	**Observed stranded**	**Extrapolated range stranded**
Juvenile	fall-run Chinook Salmon	3,938	26,7894 - 34,6469
Juvenile	late fall-run Chinook Salmon	13	260 - 884
Juvenile	spring-run Chinook Salmon	71	4817 - 5380
Juvenile	winter-run Chinook Salmon	2	NA -0
Adult	Chinook Salmon	2	136 - 136
Yearling	hatchery CCV steelhead	19	1,289 - 1,631
Adult	hatchery CCV steelhead	4	58 - 268
Fry	wild CCV steelhead	1	70- 87
Yearling	wild CCV steelhead	20	575 - 1,355
Adult	wild CCV steelhead	10	145 - 676
Juvenile	Green Sturgeon	0	NA
Adult	Green Sturgeon	0	NA

With regard to habitat quality, the Feather River downstream of Oroville Dam is designated as critical habitat for Central Valley spring-run Chinook salmon. The spring-run salmon typically begin migrating during March. The most likely effect to any early migrating adults would be delayed migration as the salmon would have sought out refuge from the turbidity (Bash et al. 2001), though the turbidity also likely impaired foraging success (Sigler et al. 1984). The effects of the accumulation of fine sediment were also likely seen across fish species, as it can decrease macroinvertebrate prey availability (Colas et al. 2013). This likely also contributed to a shift in benthic invertebrates from grazers to burrowers, which are less available as a food source for fish, and increased fish foraging activity as a result of lower prey abundance (Suttle et al. 2004).

Decreased water quality and increased sedimentation from the spillway failure was unlikely to directly impact adult spring-run Chinook salmon, as few would have been expected to be in the river at the time of the initial spillway incident. As noted above, California DWR observed stranded juvenile spring-run Chinook salmon, but did not observe any adult spring-run Chinook salmon strandings, likely because the event occurred before any migrating salmon reached the affected area. Fine sediment added to the river resulted in a short-term reduced in available spawning area. However, spawning sized gravels also would have been added and transported throughout the river downstream of Oroville Dam, and normal flows redistributed fine sediments.

Within the days following the spillway failure, the license measured turbidity as high as 974 NTU and total suspended solids as high as 753 milligrams per liter (mg/L) at Auditorium Riffle in the Feather River low flow channel. California DWR monitored turbidity and total suspended solids throughout its emergency response, and it reported that turbidity fell to and remained below 20 NTUs by April 1, 2017. Accordingly, elevated turbidity and sedimentation also affected survival rates among California Central Valley DPS steelhead egg, fry, and larval fish. Prolonged sedimentation effects also have the potential to alter spawning areas downstream of the dam. These negative impacts have been mitigated to some extent, by the additional steelhead yearling stocking in 2018. Nonetheless, it is unclear whether there was a net gain or loss in spawning and rearing habitat in the Feather River, without actual observations.

6.8.3 Staff Recommendations

Commission staff initiated formal consultation with the FWS on August 14, 2018 regarding effects to the valley elderberry longhorn beetle from the response actions. By letter dated September 10, 2018, the FWS concurred with the Commission's determination that the emergency actions related to the spillway failure may have affected, but did not likely adversely affect valley elderberry longhorn beetle. The FWS did not require any additional conditions to its determination. The Commission also initiated formal emergency consultation with the NMFS on July 5, 2018, regarding impacts to California Central Valley DPS steelhead, Central Valley DPS spring-run

Chinook salmon, and Southern DPS North American green sturgeon. Commission staff anticipates that consultation with NMFS will result in additional mitigation measures; however, these measures have not yet been determined and cannot therefore be discussed in the EA. If the Commission approves the proposed response and recovery actions, it should require the California DWR to comply with any measures recommended by the agencies for the protection of the various species. California DWR should also be required to provide a schedule for implementing any of these agency conditions, once they have been issued.

Commission staff finds that the proposed actions may affect, but are not likely to adversely affect the valley elderberry longhorn beetle. The locations chosen for the relocated elderberry shrubs are existing riparian habitats where known clumps of elderberry shrubs exist. While there were direct impacts to the relocated elderberry shrubs individually at the time of transplantation, it is not likely that the valley elderberry longhorn beetle species were affected given the isolation of the plants, their location in a non-riparian habitat, and the lack of exist holes. California DWR's use of buffer zones, coordinating work where feasible outside of the flight season of the valley elderberry longhorn beetle, measures will assist in reducing the likelihood and/or mitigate for any additional impacts.

Staff also agrees with California DWR's proposal to create an Elderberry Relocation Plan. The creation and implementation of the plan will effectively protect elderberry shrubs and any valley elderberry longhorn beetles located within the response and recovery areas and those potentially located elsewhere within the project boundary. California DWR should review the FWS's Valley Elderberry Longhorn Beetle Conservation Guidelines (FWS 1999) and consult with the FWS, prior to submitting the plan for Commission approval.

Commission staff finds that the response and recovery actions adversely affected California Central Valley DPS steelhead and Central Valley DPS spring-run Chinook salmon. Staff also finds that the above actions are not likely to have adversely affected the southern DPS North American green sturgeon. However, many of the effects to federally-listed fish can be offset by mitigating actions. The California DFW, in coordination with California DWR, increased its fish stocking numbers in to offset the hatchery fish lost during the incident and installed habitat improvements in the lower Feather River. However, California DWR should be required to mitigate for the deficit of 300,000 spring-run Chinook from 2017 hatchery losses. Staff recommended mitigative actions include an increase to hatchery production in a subsequent year, habitat improvements, or capital investment in fishery projects.

Staff recommends the California DWR prepare a plan and schedule, in consultation with the California DFW, FWS and NMFS, to conduct a habitat survey in the lower Feather River to determine whether the sediment loading that occurred as a

result of the event and emergency response, had long-term effect on the river substrate. The survey should document changes in the availability of spawning and rearing habitat, and to determine whether additional mitigation is necessary. As such, the survey will better inform salmonid and sturgeon management actions in the future, further mitigate for fish losses at the hatchery, to offset any fish losses from stranding during the recovery efforts. The plan should also be combined with the monitoring elements discussed in *section 6.3-Geology and Soil Resources* and *section 6.6-Fisheries and Other Aquatic Resources*.

6.9 Cultural and Historic Resources

6.9.1 Affected Environment

Cultural resources are defined as prehistoric and historic-era archaeological sites, Traditional Cultural Properties, sites of religious and cultural significance, and architectural properties (e.g., buildings, dams, and structures). This definition includes historic properties as defined by the NHPA. The initial APE for the undertaking includes prehistoric and historic archaeological resources, ethnographic and ethnohistoric resources, and historic structures located entirely within the existing project boundary and within the overall geographic scope of this EA. It includes: areas upstream of, adjacent to, and downstream of Oroville Dam (including a portion of Lake Oroville located approximately 0.5 miles upstream of Oroville Dam); Oroville Dam and adjacent damaged areas and project features; and the segment of the Feather River (Thermalito Diversion Pool) extending downstream from the dam to the Thermalito Diversion Dam, Thermalito Power Canal, and Fish Barrier Dam. The APE for the undertaking has been expanded twice to include six recreation sites and additional acreage within the OWA, all of which are located within the existing project boundary.

On February 8, 2017, the day after erosion was observed on the main spillway, California DWR began working to identify known cultural resources situated in close proximity to the spillway and its potential overflow area. Data from the baseline cultural resources surveys completed by the California DWR as part of the Oroville facilities relicensing process were used for this task and later, to complete pre-construction conditions assessments. Review of the data revealed 17 previously recorded archaeological sites or features in the vicinity. Five prehistoric sites were directly downhill from the emergency spillway. Two of the sites were bedrock mortars; the other three were dual-component occupation sites first recorded in the 1960s and updated with additional information during the 2002 relicensing surveys. California DWR prepared a map showing sensitive areas to be avoided to guide decisions in planning access roads and other ground-disturbing activities. California DWR archaeologists used the map to find and flag known cultural resources for avoidance. When water flowed over the emergency spillway for the first time in the history of the reservoir on February 11, 2017,

severe erosion occurred downslope and crews with heavy equipment worked 24 hours a day to repair damage caused by the runoff.

Due to safety concerns, California DWR's archaeologists were not able to access the APE until February 19, 2017. The initial fieldwork consisted of relocating previously recorded sites on the hillside below the emergency spillway, and along Burma Road to assess whether the release of water over the emergency spillway caused any damage to or loss of known archaeological sites. All previously recorded sites were found, including sites situated on the hillside in the direct path of the water release. During the field visits, the sites were flagged with caution tape. The tape was replaced later with barbed wire fencing or K-rail. California DWR then began identifying potentially-affected sites by clearing areas for stock pile locations and installation of temporary shoofly transmission lines. Archaeological village and occupation sites were given the highest priority for protection among recorded cultural resources.

California DWR hired consulting archaeologists, who arrived on March 14, 2017, to assist them and conduct intensive pedestrian surveys throughout the APE for various activities related to the undertaking. During the response period, the surveys occurred either prior to, or shortly after the commencement of work in a given location to confirm the presence or absence of prehistoric and historic-era archaeological sites, multi-component sites, and historic-era structures. Locations of recovery period activities were surveyed ahead of any work. Pre-construction condition documentation included relocating and photographing previously identified features, recording existing natural or construction related impacts, updating site forms for each previously recorded resource, and recording new site forms for newly discovered resources.

All surveys were conducted under the supervision of archaeologists meeting the Secretary of the Interior's Professional Qualifications Standards for Archaeology. Estom Yumeka Maidu Tribe (Enterprise Rancheria) representatives were present during most of the surveys. The intensive pedestrian surveys included walking the ground surface in systematic parallel transects spaced at no greater than 20 meters apart and using Global Positioning System equipment to collect field data. Future surveys for ongoing recovery work would be conducted in a similar manner.

California DWR archaeologists screened proposed work activities to determine when construction monitoring was needed. Activities involving ground disturbance in sediment not obviously disturbed by modern activities or involving ground disturbance near recorded cultural resources were monitored. Enterprise Rancheria representatives accompanied California DWR and consultant archaeologists during monitoring activities. Typically monitored work activities included grading, cutting, geotechnical borings, mechanized vegetation removal, crane pad construction, and transmission line and tower wreck outs. California DWR would conduct construction monitoring for future recovery work when needed.

Existing historical structures associated with the Oroville facilities include the dams, powerplants, reservoirs, and canals associated with the hydroelectric facilities, along with the Lake Oroville Visitors Center, the Feather River Fish Hatchery, and the California DWR's Oroville Field Division facility on Glen Drive. Two of these resources, Oroville Dam and the Hyatt Pumping-Generating Plant, appear to be eligible for inclusion in the NRHP as individual properties and they, along with 12 additional facilities, are all considered contributing elements to a proposed Oroville Division Historic District under criteria A and C, as defined in NRHP. Elements of the built environment not directly associated with the hydroelectric facilities, such as campgrounds, marinas, roads, and trails, were built following construction of the hydroelectric system. No structures located within the APE have been formally determined to be historic properties, including those associated with the Oroville facilities. However, all historic resources within the APE were treated as NRHP-eligible for all response and recovery activities performed as part of the undertaking.

Documented cultural resources within the APE consist mostly of resources identified during relicensing studies. However, new discoveries have been made during recent surveys, especially following the clearing of vegetation. Based on the review of the previous studies and the results of fieldwork conducted following the spillway incident, over 200 cultural resources have been identified within the APE; a little more than half of which, fall within identified project components.

The existing resource types include prehistoric sites, prehistoric isolates, historic sites, multicomponent sites, built environment features, historic districts, and a tribal resource. Several effects to sites that predate the undertaking were noted; these are either from earlier construction or maintenance activities in the APE or through damage done during the water releases. These effects come mostly from grading and dozing access roads, pedestrian trails for the construction and maintenance projects, and substantial erosion, including cuts deep into underlying bedrock from the water releases. Ten previously recorded sites were found to no longer exist, due to adverse effects that have occurred over the past 50 or so years from the construction of the dam, erosion, or other means before the spillway incident.

There have also been unanticipated discoveries, including site OPL-BD-FEA-015, described as an alignment of stacked rock and a lumber flume. California reported the unanticipated discovery to the PA parties on August 31, 2017, which the California SHPO acknowledged the following day. A month earlier, on July 28, 2017, the California DWR reported the discovery of Oroville 13, a bedrock mortar, to the PA parties. These finds were discussed in the EA and Commission order for the permanent transmission line reroute. An isolated bowl mortar in rock fill was also discovered on May 9, 2018 near Oroville Dam during construction efforts near the main spillway. California DWR notified the PA parties by electronic message, which included a report,

on May 11, 2018. The California SHPO provided initial comments on the discovery in a May 14, 2018 letter to California DWR. California DWR had stopped work in the area following the discovery, but resumed activities after it was characterized in the field. In consultation with the Enterprise Rancheria, the resource was collected by an archaeologist and tribal monitor and placed in a secure facility for future repatriation following the conclusion of construction. Based on a review of the resource, California DWR recommended that it not be eligible for listing in the National Register on the basis that it is not associated with any events or persons; is not an exceptional or unique example of its type; and is a commonly found artifact. We concurred with that determination of eligibility by letter to the California SHPO dated August 8, 2018. The California SHPO concurred with our determination in a letter to the Commission dated August 14, 2018.

Table 9 provides a tally of the individual resources across the project components. It should be noted that some resources exist within areas where project components overlap. As a result, adding up the resources by component produces an inflated number of resources. Below is a breakdown of the distribution of resources within various project components:

Table 9. Tally of Resource Types within Project

Components	Number
Prehistoric	18
Historic	81
Multicomponent	11
Tribal	1
Built Environment	6
Total	**117**

- Burma Road Improvements – There are 40 known resources associated with the Burma Road component of the project. They include prehistoric resources, historic resources, tribal resources, and built environment features. The historic-era materials likely span from the 1850s and 60s to the late historic era (1950s-1960s).

- Dredging – There are 18 known resources associated with the Dredging component of the project. They include prehistoric resources, historic resources, and tribal resources.

- Emergency Spillway Initial Water Release – There are seven known resources associated with the Emergency Spillway Initial Water Release component of the project. These resources consist of prehistoric resources, historic resources, and built environment features.

- Emergency Spillway Improvements – There are 11 known resources associated with the Emergency Spillway Improvements component of the project. These resources consist of prehistoric resources, historic resources, and built environment features.

- Erosion and Sediment Control – There are 33 known resources associated with the Erosion and Sediment Control component of the project. These resources consist of prehistoric resources and historic resources.

- Boundary Fence – There are 20 known resources associated with the Boundary Fence component of the project. These resources consist of prehistoric and historic resources.

- Fiber Optic and 13.8-kV Powerline – There are 21 known resources associated with the Fiber Optic and 13.8-kV Powerline component of the project. These resources include prehistoric resources, historic resources, and built environment features. This component follows the alignment of the Western Pacific Railroad grade and terminates at the Hyatt Power Plant Switchyard.

- 230-kV Powerlines Eagle Nest – Four trees chosen for surrogate eagle nest structure installations are located within or near three known historic-era resources.

- PG&E Shoofly Powerline – There are eight known resources within the footprint of the PG&E Shoofly component of the project. These resources are all from the historic era.

- California DWR's Shoofly Powerline – There are three known resources associated with the California DWR's Shoofly Powerline component of the project. These resources include prehistoric and historic resources.

- California DWR's Lattice Tower Wreck Out – There are three known historic resources within the footprint of the Lattice Tower Wreck Out component of the project.

- Spillway Reconstruction – There are 20 known resources associated with the footprint of the Spillway Reconstruction component of the project. These resources include prehistoric resources, historic resources, and built environment features.

- Spoils Piles – There are three known historic resources within the footprint of the Spoils Piles component of the project.

6.9.2 Environmental Effects

As described above, the work performed by California DWR to stabilize and remediate the damaged spillway facilities broadly falls into two actions: initial response and recovery. Most of the construction activity for both actions occurred on the slopes adjacent to the spillways. The initial response actions include: main spillway releases; construction of access roads, stockpiles and staging areas; stabilization of the main and emergency spillways; in-water and land-based debris removal; and installation of emergency shoofly powerlines for both the California DWR and PG&E lines. The recovery actions include reconstruction of the main and emergency spillways (with the addition of a secant pile wall); continued in-water debris removal; permanent reroute of both the California DWR and PG&E primary transmission lines (previously analyzed in separate EAs prepared by the Commission in August 2017); wreck-outs of California DWR and PG&E shoofly lines and original transmission line lattice towers; installation of a 13.8-kV powerline and associated fiber optic communication system; repair of radial gates; improvements to access roads, including Burma Road; construction of work pads, staging areas and spoils sites; and activities at the Feather River Fish Hatchery.

Effects to cultural resources from the initial response and the subsequent ongoing recovery operations have varied depending on the activity. The initial response consisted of clearing vegetation from the sides of the main spillway and downstream of the emergency spillway for better observation of spillway conditions, and to remove trees and other debris that could wash down and accumulate against the Thermalito Diversion Dam. Roads were also excavated and graded to allow access to various parts of the spillways, and to the Thermalito Diversion Dam staging area. The access road to the spillway recreation area was washed out when the emergency spillway was used for the first time in February 2017. The parking lot is now a command center for the undertaking, while Burma Road and sections of the Dan Beebe and Brad Freeman Trails have become haul routes.

As the initial response phase transitioned to the recovery phase, the potential for adverse effects to cultural resources increased. In addition to the grading of numerous access and haul roads to facilitate construction, there was active excavation and blasting of soil and rock to stabilize the lower chute of the main spillway. Other landscape-altering activities included tree and vegetation removal, rock crushing operations to produce aggregate for concrete, the building of cement batch plants, and the creation of soil and rock stockpiles from rock and sediment dredged from the Thermalito Diversion Pool.

The project components within the APE that could affect cultural resources are described below. Please note that the Area of Direct Impact for some of these activities overlap.

- Burma Road Improvements – Overall this includes the widening of, and improvements to, Burma Road along the north side of the Thermalito Diversion Pool. Specifically, it includes: clearing and grubbing vegetation; cutting, filling, and grading; installation of box culverts; installation and replacement of metal pipe culverts; road compaction; placement of aggregate base road surface; and paving with asphalt. There was also new construction to accommodate large vehicles and large loads on Power Canal Road and Cherokee Road, which included paving and additional widening. Of the 40 known resources within the Burma Road component, five historic-era resources and two resources, with each having prehistoric and historic-era elements, have been directly affected and three historic-era resources, one prehistoric resource, and one resource with both prehistoric and historic-era elements have been indirectly affected. The direct effects include damage from culvert installations, widening of Burma Road, creation of a spoils pile and utility terrain vehicle (UTV) tire tracks. There were also indirect adverse effects from fences crossing over linear features, clearing and grubbing activities, and wave action erosion.

- Dredging – This component includes the removal of sediment from the Thermalito Diversion Pool by barge-mounted excavators. The dredged material is then off-loaded at barge landings and transferred to spoil piles locations set up within the APE. The ability for the Thermalito Diversion Pool to convey adequate flow may require continued in-water debris removal. Of the 18 known resources within the Dredging component, one historic-era resource, a fence, was directly affected and no longer exists. Indirect, minor, adverse effects from inundation, wave action erosion, or the crossing of a fence, affected one prehistoric resource, one historic-era resource, and two resources with both prehistoric and historic-era elements.

- Emergency Spillway Initial Water Release – This component includes the scouring of the hillside due to the initial release of water over the Emergency Spillway, which was followed by deliberate vegetation removal. Of the seven known resources within the Emergency Spillway Initial Water Release component, one historic-era resource, a fence, was directly affected and no longer exists (the same fence listed above under Dredging). A resource with both prehistoric and historic-era elements was also severely eroded. Another historic-era resource was affected through the conversion of a haul road. In addition, the slope below the emergency spillway was eroded.

- Emergency Spillway Improvements – This component pertains to the stabilization of emergency spillway area. Specifically, it involves: clearing and grubbing of vegetation; cutting and grading; creation of new access roads; geotechnical testing; staging areas and work pads; placement of rock and concrete on slope immediately below spillway to armor the slope; and installation of a secant cut-off wall, crest cut-off wall and splash pad. Of the 11 known resources within the Emergency Spillway Improvements component, three historic-era resources were directly affected. A segment of one of those resources, a fence, was destroyed by a spoil pile. The other two, a prospect pit and a stone dam, were also destroyed. There were also indirect, minor effects caused by clearing and grubbing occurred in the vicinity of two prehistoric sites and one historic-era site.

- Erosion and Sediment Control – This involves stabilization of on-site sediment primarily on the hillside adjacent to the main spillway. The work consisted of placement of hydroseed, hydromulch, mulch, and fiber rolls; installation of concrete aggregate base and sediment traps at laydown, parking, and crane pad areas; creation of drainage swales; regrading roads and installation of V-ditches and compacted berms adjacent to roads; and culvert installation and maintenance. Of the 33 known resources within the Erosion and Sediment Control component, 14 historic-era resources, including roads, ditches and fences, and one resource with both prehistoric and historic-era elements, have been directly affected and either are heavily damaged, some from conversion into haul roads, or no longer exist. There were also indirect, minor effects caused by clearing and grubbing in the vicinity of two prehistoric resources and one historic-era feature.

- Boundary Fence – This includes the installation of a fence line along the property boundary above Burma Road. The fencing consists of three to five-strand barbed-wire with T-post and wood post supports. Activities conducted to install the fence included vegetation removal and the use of the existing, unimproved dirt paths by all-terrain vehicles. Of the 20 known resources within the Boundary Fence component, three historic era resources and one resource with both prehistoric and historic-era elements have been directly affected with portions of these resources damaged by road widening, a spoils pile and UTV tires. Indirect, minor effects occurred to five historic-era resources, two resources with both prehistoric and historic-era elements, and one prehistoric site, mostly from the construction of the fence.

- Fiber Optic and 13.8-kV Powerline – There was an installation of a new underground fiber optic line and a new 13.8-kV electric transmission line, with both overhead and underground components. The work consisted of clearing and grubbing vegetation; grading for associated access roads; trenching for

underground lines; installation of conduit; and stringing of fiber optic cable on 230-kV transmission structures. Of the 21 known resources within the footprint of the Fiber Optic and 13.8-kV Powerline component, future construction is likely to directly, adversely affect seven historic-era resources, one prehistoric resource, and one resource with both prehistoric and historic-era elements. Overall, 17 historic-era resources, three resources with both prehistoric and historic-era elements, and one prehistoric resource, could be affected, either directly or indirectly, by future construction of this component.

- 230-kV Powerlines Eagle Nest – There were four trees chosen for surrogate nest structure installations after an eagle nest was identified and removed by permit from a felled hazard tree. The work involved carrying equipment and materials to the selected trees and climbing the trees to install materials. The three known historic-era resources surrounding and/or near the trees were avoided or minimally affected by walking in to get to the trees.

- PG&E Shoofly Powerline – This includes installation and removal of a PG&E-owned temporary electric transmission line. Specifically, the work consists of clearing and grubbing vegetation; grading for associated access roads; cutting and grading for transmission tower construction; transmission tower construction (including excavation for piers), line stringing; and the removal of existing transmission lines and towers. Of the eight known resources within the PG&E Shoofly component, six of them were directly and adversely affected. The other two were avoided. All are historic-era resources and reflect the transportation, settlement and mining themes.

- California DWR Shoofly Powerline – This includes the installation and removal of the California DWR-owned temporary electric transmission line. The work is the same as described above for the PG&E Shoofly Powerline. Of the three known resources within the California DWR Shoofly Powerline component, the two historic-era fence lines have been directly and adversely affected by the work. Effects to a prehistoric resource were avoided.

- California DWR Lattice Tower Wreck Out – This involves the removal of the original California DWR-owned lattice transmission towers near the main spillway. The work involved is the same as that for PG&E Shoofly Powerline. Of the three known resources within the Lattice Tower Wreck Out component, the historic-era fence line, and one of the two roads, have been directly and adversely affected. The other road may have been affected by the work, however its current condition is unknown.

- Spillway Reconstruction – This includes the demolition and reconstruction, in the same location, of the main Spillway. The work includes blasting, demolition and removal of existing concrete spillway; geotechnical testing;

clearing and grubbing vegetation; cutting, filling, and grading for access roads, staging areas, and concrete batch plants; quarrying aggregate for RCC, concrete backing and other uses; placement of new concrete and associated reinforcement; and establishment of temporary ancillary facilities (e.g., dewatering, etc.). Additionally, the radial gates on both the FCO Spillway and the Thermalito Diversion Dam were damaged. Both sets of radial gates would be returned to their original functions. For the gates, the work involves the repair and replacement of hardware. Of the 20 known resources within the Spillway Reconstruction component, nine historic-era resources, including the FCO Spillway, and one resource with both prehistoric and historic-era elements, have been directly and adversely affected or no longer exist due to construction activities noted above. There was also an indirect, minor effect to one prehistoric site from clearing and grubbing.

- Spoil Piles – This includes the placement of dredged sediment from the Thermalito Diversion Pool in large piles and involves clearing and grubbing of vegetation; cutting, filling, and grading for initial site; and placement of dredged sediment. All three of the known historic-era resources within the Spoil Piles component have been directly and adversely affected. A portion of the fence line, the prospect pit, and the road no longer exist, due to the creation of a spoils pile.

Avoidance and Minimization, and Mitigation

Avoidance is generally the preferred method for effects to cultural resources. The California DWR has been coordinating directly with the California SHPO, Commission staff, FEMA, California Office of Emergency Services, and local Native American tribes to address potential effects to cultural resources and to ensure that avoidance of cultural resources is implemented whenever possible.

Additionally, measures to minimize effects to cultural resources have been implemented throughout the life of the undertaking. These measures include physical barriers, such as barbed wire fencing, K-rail, and caution tape; the use of hand tools and barring of mechanical clearing and grubbing within 50 feet of cultural resources; coordination with contractors to identify work staging and set up areas that avoid cultural resources; and the designation of Environmentally Sensitive Areas that are monitored by both archaeologists and tribal monitors when construction activities occur nearby. Other measures include the implementation of a monitoring and discovery plan; preparation of detailed, updated site forms with photographs, archival data and feature drawings; conducting a post-construction condition assessment of the sites; and implementation of a data recovery plan in the event that archaeological or tribal monitors identify information-bearing deposits. These protective measures are consistent with the Historic

Property Management Plan (HPMP) that was developed as part of the compliance with section 106 of the NHPA for the relicensing of the Oroville Facilities. Prior to most ground disturbance activities, training was provided to construction personnel to provide education on the sensitivity of the APE, the kinds of resources that might be encountered, and the appropriate response to the inadvertent discovery of cultural resources.

The California DWR conducted daily construction monitoring throughout the summer months of 2017 for activities that included ground disturbance in sediment not obviously disturbed by modern activities, or, activities including ground disturbance near recorded cultural resources. The California DWR would continue construction monitoring on an as-needed basis for future work. Also, tribal monitors from Enterprise Rancheria accompanied consultant archaeologists during monitoring activities, with oversight by a California DWR archaeologist. The California DWR and tribal representatives monitored work that included grading, cutting, geotechnical borings, mechanized vegetation removal, transmission line tower pad construction, and transmission line pull areas.

Overall, California DWR -implemented measures to lessen or avoid effects to cultural resources fall under several broad categories:

- Grading – This work involved leveling and smoothing of the ground surface using heavy equipment and was conducted during road widening and staging area preparation activities. Excess soils either remain on-site as fill or are transported elsewhere to be used or stored. The California DWR had archaeological and tribal monitors present during grading at any area determined to be sensitive for containing cultural resources and flagged or fenced off known cultural resources to keep equipment and construction personnel away from the resources.

- Vegetation Removal – This included the cutting of brush and trees, followed by stump removal. The vegetation was then crane-lifted out or dragged away by a backhoe, bulldozer, or bobcat and either stored nearby or trucked elsewhere within the APE. To avoid effects to cultural resources, the California DWR had archaeological and tribal monitors present during vegetation cutting and clearing in areas where heavy equipment or clearing crews were likely to encounter cultural resources. Also, hand clearing was prescribed for locations near known cultural resources, which were fenced off or flagged to keep equipment and construction personnel away from the resources.

- Placement of Fill Material – This included placement of fill quarried from other areas of the APE or dredged from the Thermalito Diversion Pool directly below the main spillway. The fill was used for the repair of flood damage and erosion, to level areas out for driving or staging, and to backfill construction. Large

quantities of fill material were temporarily stored in the APE for anticipated repairs. The California DWR had archaeological and tribal monitors present during the quarrying of materials when in sediment, but not when quarrying bedrock. Additionally, monitoring took place during the placement of fill at any area determined to be sensitive for containing cultural resources. Dredging and loading operations were not monitored. Known cultural resources were fenced off or flagged to keep equipment and construction personnel away from the resources.

- Construction – This included installation of infrastructure for the emergency spillway and main spillway reconstruction. The work usually involved some form of ground disturbance, such as preparing building pads, drilling for footings, or the cutting of slopes for drainage. The California DWR had archaeological and tribal monitors present during all ground disturbing activities when they occurred within soils, but not when quarrying bedrock. Additionally, monitoring took place during the placement of fill at any area determined to be sensitive for containing cultural resources. The California DWR fenced off or flagged known cultural resources to keep equipment and construction personnel away from the resources.

- Multiple Effects – Pre-project effects to sites combined with erosion from the spillway release and rapid post-event recovery and stabilization efforts in some cases resulted in the destruction of or severe damage to cultural sites. The California DWR noted prior damage to sites and archaeological and tribal monitors were present during all ground disturbing activities occurring within soils. Known cultural resources were fenced off or flagged to keep equipment and construction personnel away from the resources.

- Partial or complete erosion – Both known and undiscovered sites may have been adversely affected after the water release that led to the main spillway failure. The landscape was stripped down to bedrock and in many places erosion cut several feet into the bedrock. Existing drainages were scoured and the material transported into the Thermalito Diversion Pool. Previously recorded sites that were lost were recorded as such, and no further action was taken at these locations. Additionally, partially damaged sites were assessed and fenced or flagged and archaeological and tribal monitors were present during all earth-moving activities at these locations.

- Vehicle tracks – Operating heavy equipment over cultural resources sometimes created impacts to individual features or soil disturbance, depending on the moisture content of the soil and the type of equipment. The California DWR fenced off or flagged known cultural resources to keep equipment and

construction personnel away from the resources. Archaeological and tribal monitors were present during ground disturbing activities that occurred within soils.

Findings of Effect under Section 106

Pursuant to the terms of the PA, California DWR submits effect recommendations for historic properties to the Commission, who is responsible for making all findings of effect and for the resolution of adverse effects and disputes. The PA may be amended to include the resolution of effects to resources prior to its execution. The potential for adverse effects to cultural resources from the implementation of the above component activities was assessed in the context of each component's Area of Direct Impact. Project impacts, as well as pre-project impacts, were noted during site assessments conducted prior to construction. Additionally, California DWR plans to conduct post-construction assessments as well.

In accordance with the PA, all cultural resources in the APE not previously evaluated for NRHP-eligibility are assumed NRHP-eligible for the purposes of the undertaking. Some resources may also be contributing elements to one of two proposed historic districts – the Forks of the Feather River Historic District and the Oroville Division of the State Water Project Historic District. One historic-era site that previously did not appear to be a contributor to the Forks of the Feather River Historic District, P-04-001926, was re-evaluated during the current project as part of a finding of effect effort following project impacts. The resource, a dirt road, was not found to be individually eligible for the NRHP or a contributor to the historic district. On October 17, 2017, the California SHPO concurred with the Commission that the resource was not eligible and on October 23, 2017, Commission staff issued a finding of no historic properties affected for the creation of a rock quarry. Another historic-era resource, site P-04-002609, was previously identified as a contributor to the Forks of the Feather River Historic District, but a re-evaluation concluded that the resource was not eligible for the NRHP individually or as a contributor to the historic district, as it did not meet NRHP criteria. The determination allowed Commission staff to make a finding of no historic properties affected by the removal of an existing transmission tower by letter dated November 7, 2017.

Additionally, California DWR prepared finding of effect documents for two built-environment elements of the proposed Oroville Division of the State Water Project Historic District, the Spillway (filed with the Commission on July 21, 2017), and the Radial Gates (filed on July 26, 2017). In both cases, California DWR determined that project would not result in an adverse effect or substantial adverse change to any character-defining features or contributing elements. The Commission concurred with California DWR's determination in a letter dated August 29, 2017, however the effects of the work would be re-assessed if there are significant design changes. To date, there

have not been any significant design changes. California DWR also recommended a finding of no adverse effect on the FCO Spillway for the construction of a RCC platform, filed with the Commission on November 3, 2017. Commission staff agreed with California DWR's no adverse effect finding for the RCC platform by letter dated December 1, 2017. On December 4, 2017, California DWR filed a recommendation for a finding of no adverse effect for the installation of platforms for alternative eagle nest locations. Commission staff concurred with California DWR's finding by letter dated December 7, 2017. On December 15, 2017, California DWR filed a recommendation for a finding of no adverse effect for the conversion of a temporary drainage crossing near Tower 4 of the project's existing 230-kV electrical transmission line to a permanent crossing. Commission staff concurred with California DWR's finding by letter dated February 5, 2018. On March 6, 2018, California DWR filed a recommendation of no adverse effect for the removal of a storage building located on the left side of the Oroville spillway at the western end of Bone Yard Road. In a letter dated April 6, 2018, Commission staff concurred with California DWR's finding since the storage building did not meet the age requirements for listing in the National Register of Historic Places, nor did it meet any of the criteria for listing of resources less than 50 years old. On June 15, 2018, California DWR filed a recommendation for a finding of no adverse effect for the installation of two temporary air quality monitoring stations, one of which would be installed in a portion of a previously recorded archaeological resource. Based on the protective measures proposed by California DWR, Commission staff concurred with California DWR's finding by letter dated August 8, 2018. On August 1, 2018, California filed a recommendation for a finding of no adverse effect for two previously-recorded cultural resources and one new cultural resource located in or adjacent to areas affected by the removal of temporary transmission towers installed during the spillway incident. Based on the protective measures proposed by California DWR, Commission staff concurred with California DWR's finding by letter dated August 28, 2018.

Prior to implementation of the PA, the California DWR-owned transmission line reroute work had a finding of effect documentation prepared by California DWR. By a letter dated June 16, 2017, the California SHPO did not object to California DWR's finding of no adverse effect for the work.

The combination of effects to site CA-BUT-1105H (a large mining/habitation site) from recent and proposed future construction would likely constitute an adverse effect to site CA-BUT-1105H. California DWR is currently preparing a finding of effect for consultation with the PA parties. Additionally, California DWR intends to prepare finding of effect documents for new project components before the end of calendar year 2018. Within these documents, California DWR proposed mitigation measures would be included, as necessary, based on the findings.

6.9.3 Staff Recommendations

As discussed above, there were several cultural sites directly and adversely affected by erosion from the spillway release and the subsequent response and recovery efforts. Although no mitigation for the adverse effects has been formally proposed, California DWR has been discussing potential measures with the California SHPO and other parties to the PA. Staff recommends that after these discussions are complete, California DWR develop and submit a mitigation plan to the PA parties for review and comment. California DWR should address those comments before filing the final plan for Commission approval.

Additionally, staff recommends California DWR continue to implement measures to avoid and minimize potential effects to cultural and historic resources during the recovery phase of the work. These measures include avoiding known resource locations, installing physical barriers, use of hand tools where necessary, training contractors, designating sensitive areas, and conducting monitoring by both archaeologists and tribal monitors when construction activities occur near sensitive sites. Pursuant to the executed PA, DWR should also continue consulting with the California SHPO, tribes, and other PA parties for determinations of eligibility and findings of effect arising from the ongoing recovery activities.

6.10 Recreation

6.10.1 Affected Environment

The project includes a variety of recreational facilities (Figure 14), with about 28,000 of the 41,540 acres within the project boundary included in the Lake Oroville State Recreation Area. This includes all of the recreational facilities at Lake Oroville, the Thermalito Diversion Pool, and the Thermalito Forebay. Recreation is also provided at the Thermalito Afterbay, the OWA, and along the Feather River. Undeveloped public land around Lake Oroville is abundant and available for general public use. However, steep slopes are common above the Lake Oroville shoreline and generally limit public access to a few areas.

Recreational activities at Lake Oroville include high- and low-speed boating, non-motorized boating, fishing, swimming, bicycling, equestrian use, hiking, hunting, bird watching, and developed and primitive camping. In addition to the license-required recreation, the project includes visitor information areas providing cultural and project facility displays. License-required recreation sites/facilities at the Feather River Project include (Table 10):[52]

[52] *See* Table 43 and Figure 18 in the FEIS at pages 207-213 for a complete listing of facilities and amenities (FERC 2007).

Table 10. Summary of license-required recreation facilities

Lake Oroville Visitors Center	Bidwell Canyon Boat Ramp and Day Use Area
Lime Saddle Boat Ramp and Day Use Area	Loafer Creek Boat Ramp and Day Use Area
Oroville Dam Day Use Area	Spillway Boat Ramp and Day Use Area
Enterprise Boat Ramp	Thermalito Afterbay Boat Launch and Day Use Areas
North Thermalito Forebay Recreation Area	South Thermalito Forebay Recreation Area
Thermalito Diversion Pool Day Use Area	The Oroville Wildlife Area Afterbay outlet camping area
Car-top Boat Launch Ramps are located at: Dark Canyon, Foreman Creek, Nelson Bar, Stringtown, and Vinton Gulch	
Campgrounds are located at: Bidwell Canyon, Lime Saddle, Loafer Creek, North Thermalito Forebay RV, and Area Afterbay outlet camping area	
Float In and Boat in Campsites and other Miscellaneous Day Use Areas	
Trails (hiking, biking, equestrian): Brad Freeman Trail, Dan Beebe Trail, Kelly Ridge Trail, and Saddle Dam Trailhead	

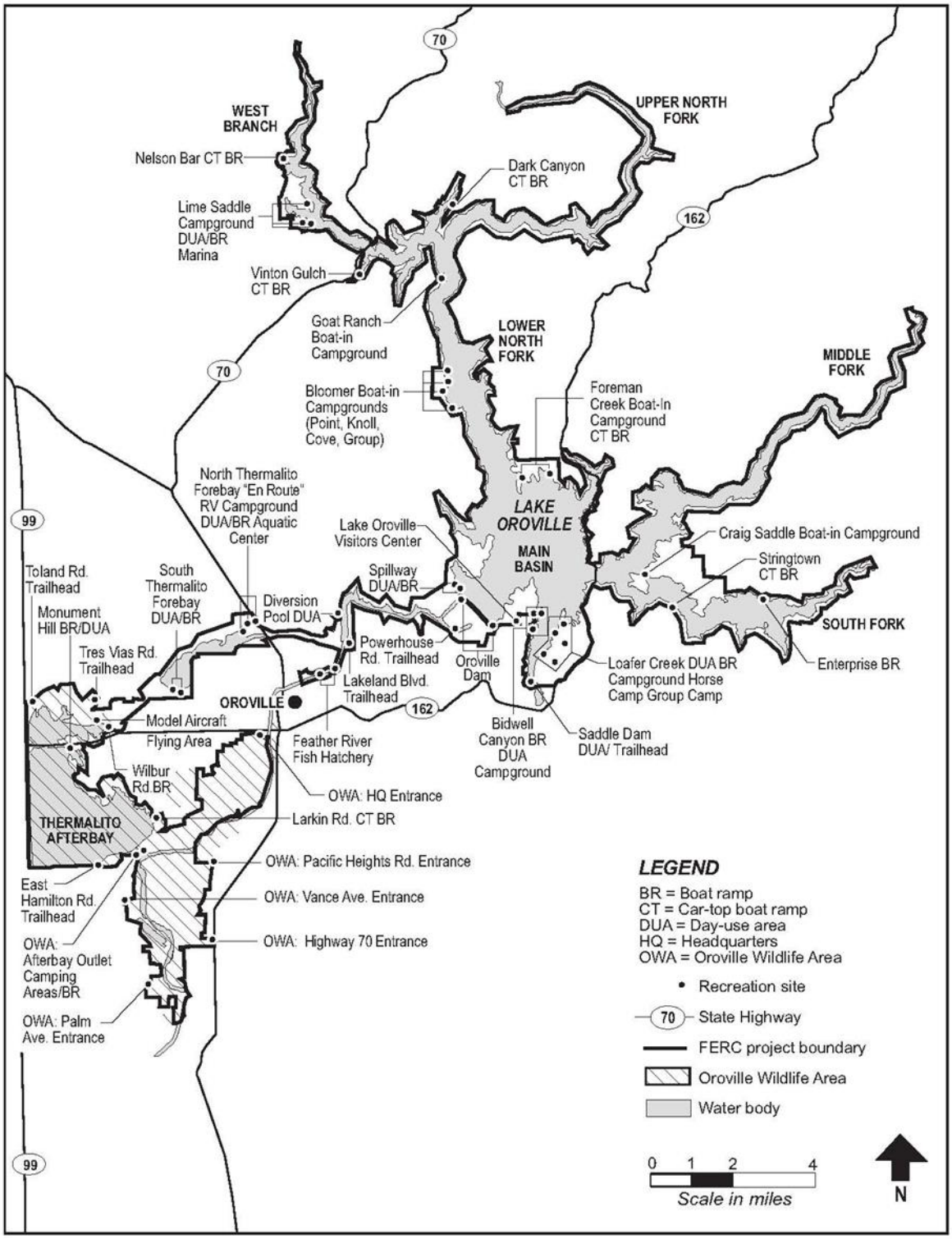

Figure 14. Lake Oroville Recreational Sites and Facilities (FERC 2007)

Project recreation sites directly affected by the February 7, 2017 spillway emergency include: the Spillway Boat Ramp and Day Use Area, the Oroville Dam Day Use Area, the Thermalito Diversion Pool Day Use Area, and several trails. The preexisting conditions of these sites are further described below.

Spillway Boat Ramp and Day Use Area

The Spillway Boat Ramp and Day Use Area is located adjacent to the right abutment of the Oroville Dam. The recreation site includes two multi-lane boat ramps, one with eight lanes used during low to medium water levels and the other with 12 lanes used during medium to high water. The upper parking lot includes 118 single-vehicle parking spaces (8 are Americans with Disabilities Act accessible)[53] and 350 vehicle/trailer parking spaces, 40 for self-contained recreational vehicle camping. The main ramp allows for a maximum of 75 vehicle/trailer parking spaces. Also located at the site are six flush toilets (two are Americans with Disabilities Act accessible), drinking water, a fish cleaning station, and picnic sites including six tables, shade trees, and a sun shelter. Lastly the site includes trailheads for the Brad Freeman and Dan Beebe Trails, and access to Potter's Ravine and Potter's Point.

Oroville Dam Day Use Area

The crest of the Oroville Dam can be used for driving, sightseeing, walking, jogging, bicycling, rollerblading, horseback riding, and fishing. The Oroville Dam Day Use Area is located at the east and west ends of the dam. The east day use area includes picnic tables, drinking water, four flush toilets (one is Americans with Disabilities Act accessible), and parking for approximately 20 vehicles. The west day use area is only open when water is below the sill of the spillway gates for security reasons, and includes picnic tables. While there are approximately 400 parking spaces across the crest of the dam (two are Americans with Disabilities Act accessible), parking has been prohibited, due to increased security following September 11, 2001. The Upper Overlook is located on the east side of Canyon Drive and includes an interpretive display, bench seating, picnic tables, a shade structure, and parking for approximately 20 vehicles. Trailheads from these day use areas include those for the Brad Freeman, Dan Beebe, and Kelly Ridge Trails.

---

[53] California DWR has indicated that specific recreation facilities are, or will be constructed in accordance with the Americans with Disabilities Act design standards. Pursuant to its license requirements, California DWR has considered the needs of persons with disabilities. California DWR's obligation to comply with the Americans with Disabilities Act exists independent of its project license, and the Commission has no statutory role in implementing or enforcing the Americans with Disabilities Act as it applies to its licensees. *See* 78 FERC ¶ 61,363.

Thermalito Diversion Pool Day Use Area

The Thermalito Diversion Pool is located below the Oroville Dam and above the Thermalito Diversion Dam. The day use area is located along Burma Road. It is open for fishing, non-motorized boating, trail use, and picnicking. The site includes a vault toilet building and a gravel car-top boat launch. The Powerhouse Road Trailhead is south of the Hyatt Power plant and connects to the Brad Freeman Trail along the south shoreline of the Thermalito Diversion Pool. Burma Road is a corridor/trail head for the Brad Freeman Trail, which runs along the north shoreline of the Thermalito Diversion Pool.

Designated Trails

The Brad Freeman Trail is a multi-use trail providing recreation for hikers, bikers, and equestrian trail riders. The Brad Freeman Trail circles the off-river Thermalito Forebay and Thermalito Afterbay, follows the northern shore of the Thermalito Diversion Pool, crosses the crest of the Oroville Dam, and turns back to follow the southern shore of the Thermalito Diversion Pool. The full trail is approximately 41 miles long and is predominantly dirt or gravel, with only a short paved section. The Dan Beebe Trail is a 14.6-mile-long multi-use trail for equestrians and hikers. The Dan Beebe Trail parallels the southern shore of the Thermalito Diversion Pool a short distance upland from the Brad Freeman Trail. The Kelly Ridge Trail is a non-motorized trail from Oroville Dam area to the Bidwell Canyon Recreation Area.

6.10.2 Environmental Effects

Following the February 2017 spillway failure and during response and recovery actions, California DWR closed or is implementing modifications to several project recreation facilities located primarily near the Oroville Dam and around the Thermalito Diversion Pool. Closures of specific recreation sites and facilities were implemented for various reasons, such as damage to recreation site access roads, concern for public safety, and for the construction required by various response and recovery actions, including: the clearing for, and creation of roads; installation of the 13.8-kV powerline and associated fiber optic communication system; concrete batch plants; and laydown, staging, and miscellaneous support areas. Site closures are expected to have short-term and but significant adverse effect on recreational activities at the project. However to mitigate for the adverse effects, California DWR is expanding parking capacity and boat ramp lengths at some sites to accommodate the recreation seasons during the response period, which will provide additional recreation for a long-term beneficial effect to the boating community. Land clearing performed during the response and recovery phases will both directly and indirectly effect recreation sites, trails, and the user's aesthetic experience, depending on the proximity of the clearing to the recreational amenities. The

impact will occur following the completion of the construction activities during the demobilization and restoration efforts performed post recovery efforts. California DWR has provided timeframes for which some sites may reopen, and has made commitments towards selected restoration.

Approved Recreation Amendments

California DWR took steps to offset the negative impacts to recreation sites and trails that were closed, and to mitigate for low water levels following the February 2017 incident by requesting to implement certain recreation improvements proposed as part of Settlement Agreement negotiations for the relicensing proceeding, and ahead of new license issuance.[54] California DWR filed proposals on June 1, 2017, August 3, 2017, and December 8, 2017, to amend the existing project's Recreation Plan.[55] To help offset the temporary closures of the Lake Oroville spillway facilities and the Thermalito Diversion Pool and to account for the lower than normal pool elevation, during the emergency response and recovery activities, California DWR proposed to implement certain permanent recreation improvements immediately, and to provide additional recreational capacity as soon as possible. The Commission approved California DWR's proposals by Orders issued July 12, 2017,[56] September 13, 2017,[57] and February 1, 2018.[58]

Improvements would be made at the Lime Saddle Boat Ramp and Day Use Area, Bidwell Canyon Boat Ramp and Day Use Area, Enterprise Boat Ramp, Saddle Dam, and Loafer Creek Boat Ramp and Day Use Area (Figure 15). The completion of these facilities would result in a net increase in available parking spaces and boat ramps, the extension of existing boat ramps, improved trailheads, and improved marina access during times of low lake levels at Lake Oroville. The addition of these facilities at Lake Oroville will mitigate for the above described site closures and provide a long-term beneficial effect regarding boating opportunities particularly during times of lower lake levels, down to approximately 700 feet msl. By extending various boat launches in spring and winter 2018, the public would have additional access to the reservoir

---

[54] *See* Settlement Agreement filed on March 24, 2006, under Project No. 2100-052.

[55] Order on Revised Recreation Plan (68 FERC ¶ 61,358), issued September 22, 1994; Order Approving Amendment to Recreation Plan (124 FERC ¶ 62,182), issued September 10, 2008.

[56] Order Amending Recreation Plan (160 FERC ¶ 62,021).

[57] Order Amending Recreation Plan (160 FERC ¶ 62,226).

[58] Order Amending Recreation Plan (162 FERC ¶ 62,077).

throughout the 2018 and 2019 recreation seasons, given the various elevations encountered throughout the recovery efforts. Table 11 provides a listing of available boat ramp lanes, around the lake, at specified lake elevation levels as approved by the Commission.[59]

Table 11. Summary of Oroville Boat Ramp Useable Lake Elevation Data

Site Name	Lane Total	Elevation
Lime Saddle Boat Ramp	2	900 – 702 feet msl
	1	900 – 762 feet msl
	1	900 – 801 feet msl
	1	900 – 853 feet msl
Spillway Boat Ramp	12	900 – 816 feet msl
	6	821 – 729 feet msl
	2	821 – 695 feet msl
	1	665 – and below
Bidwell Canyon Boat Ramp	1	900 – 850 feet msl
	1	900 – 802 feet msl
	5	900 – 735 feet msl
	5	745 – 700 feet msl
	3	717 – 660 feet msl
	1	665 – and below
Loafer Creek Boat Ramp	3	900 – 800 feet msl
	2	900 – 775 feet msl
	3	810 – 700 feet msl
	5	810 – 640 feet msl
Enterprise	2	900 – 750 feet msl
California DWR Service Area	2	900 – 730 feet msl
Stringtown Car-top	1	900 – 869 feet msl
Dark Canyon Car-top	1	900 – 847 feet msl
Nelson Bar Car-top	1	900 – 854 feet msl
Vinton Gulch Car-top	1	900 – 849 feet msl
Forman Creek Car-top	2	900 – 730 feet msl

[59] Additional lane extensions are proposed at the Bidwell Canyon and Spillway boat ramps as part of the relicensing Settlement Agreement but these actions are pending in the relicensing proceeding.

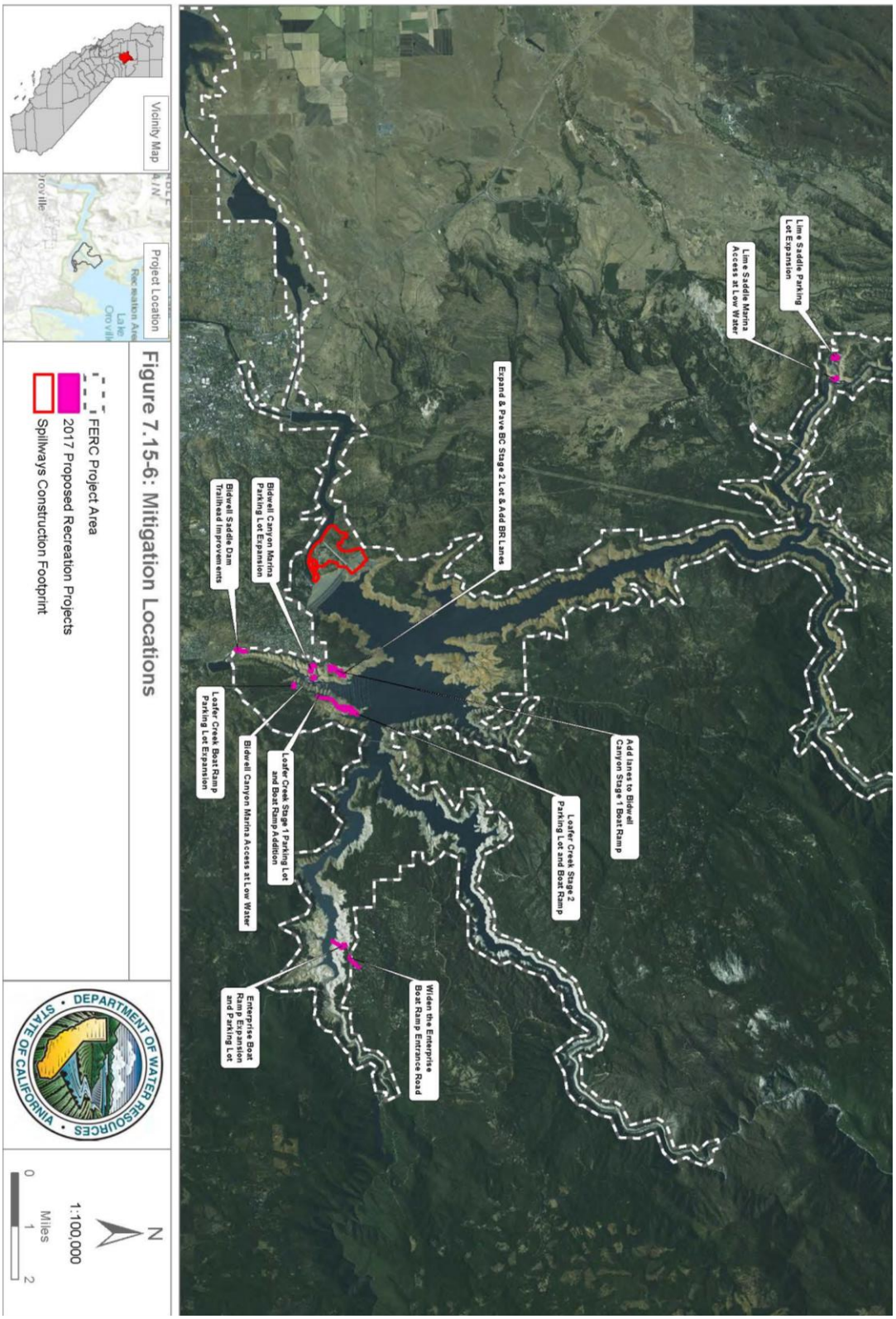

Figure 15. Recreation Mitigation Locations (source: California DWR 2018b)

Ongoing Recreation Effects

Closed Project Recreation Sites

The February 7, 2017 incident washed out the roads used to access the Spillway Boat Ramp and Day Use Area, restricting the public's access to the site. Since that time, California DWR has been using the parking lot associated with the boat ramp and day use area as an emergency response command center. California DWR also constructed a RCC Plant in the boat ramp parking lot. California DWR anticipates that the Spillway Boat Ramp and Day Use Area would be closed for two years. Following the emergency, California DWR also closed the Oroville Dam Overlook Day Use Area and is utilizing the adjacent parking lots for construction staging areas. Similarly, the Thermalito Diversion Pool Day Use Area was fully closed, and is being used as a staging area primarily for equipment associated with dredging activities. Currently portions of the Thermalito Diversion Pool southern shoreline are open to the public.

The closures of the recreation sites required by the incident response and recovery actions and their utilization for purposes other than for public recreation, as described above, will have a direct and significant effect on the physical sites and their users. Specifically these sites have and will continue to be used solely as construction zones, with added support buildings, trailers, and laydown areas to aid both the response and recovery efforts. The duration of these effects are still unknown as the timing to complete the recovery efforts continues to evolve and the reopening of individual sites will be dependent on their proximity to the ongoing work and California DWR's ability to and timeline for restoring them to their pre-emergency conditions. Until such time that the sites are reopened to the public, recreationalist will be temporarily displaced and need to locate alternative sites in the surrounding area to use.

Closed Trails and Trailheads

Sections of the Dan Beebe, Brad Freeman, Kelly Ridge, Potter's Ravine, and Burma Road trails are closed. Several trailheads in the vicinity of the project are also closed including, but not limited to, those located at the day use areas mentioned above, and Potter's Ravine and Potter's Point, Powerhouse Road, Burma Road, and Lakeland Boulevard (Figure 16). These closures will directly adversely affect the community and visiting recreationalists in the area and will cause some to seek other opportunities at the project and in the surrounding area. Because of this, there is the potential for crowding on the open trails and the potential for clashes between the various trail users (i.e., hikers, bikers, equestrians, etc.). While the negative effects will be direct on the user experience, they will be short-term, as California DWR expects to reopen the trails once the response construction is complete.

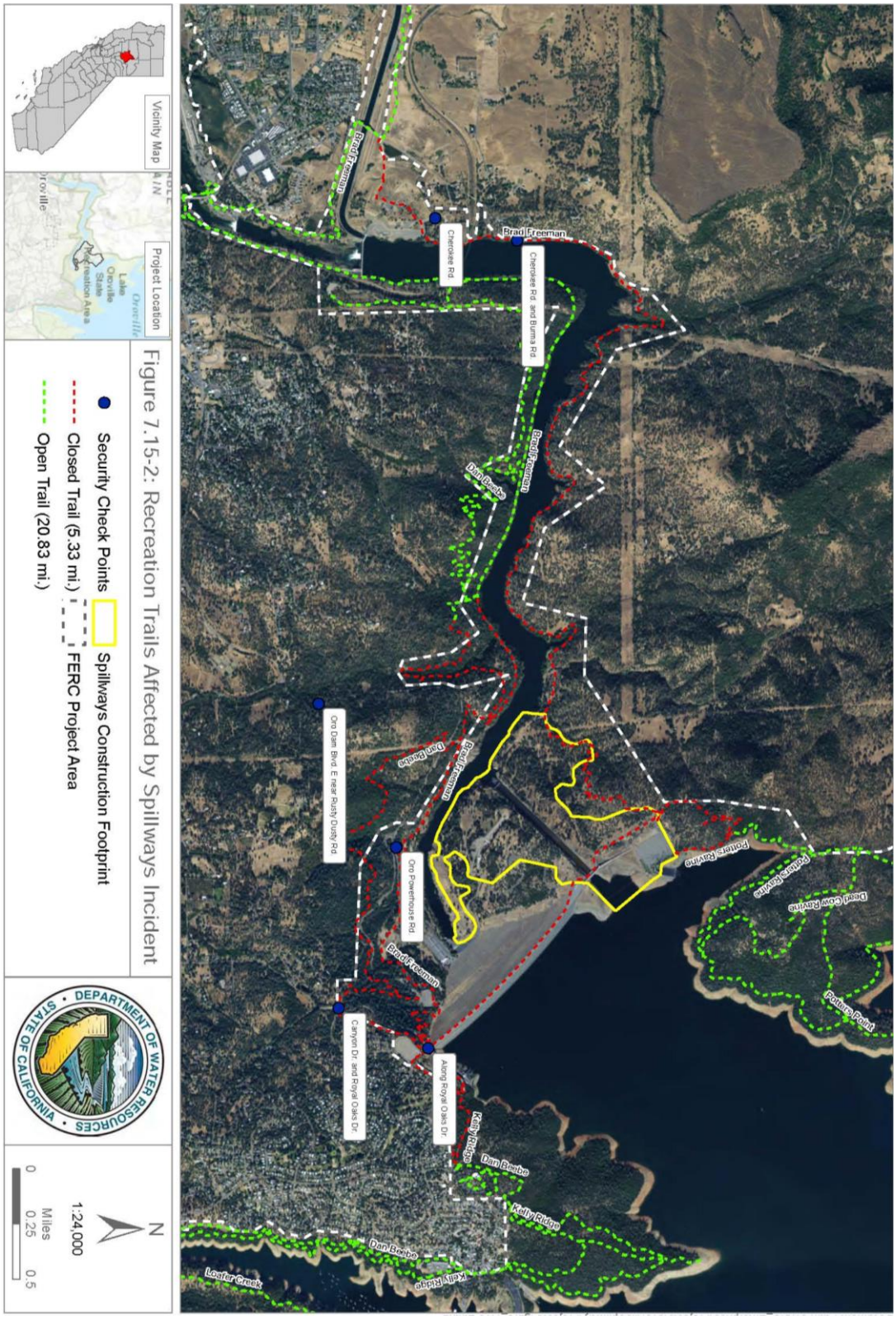

Figure 16. Recreation Trails Affected by the Spillway Incident (source: California DWR 2018b)

Effects to Recreation Outside of Response and Recovery Areas

California DWR notes that there are recreation facilities outside of the response and recovery work areas, not directly affected or closed as a result of the Spillway emergency, that have been impacted. Specifically, the Bidwell Canyon Boat Ramp and Day Use Area, the Loafer Creek Boat Ramp and Day Use Area, and the Lime Saddle Boat Ramp and Day Use Area have seen an increase in recreational use. During Memorial Day and Independence Day 2017, these sites either reached, or were close to reaching maximum capacity.

Sites that were directly affected by the response and recovery actions, and closed for the duration of recovery efforts, have unintentionally compelled recreationists to use other project and non-project recreation sites; thus increasing recreational use at those locations that remain open. The increased use not only has the potential to overcrowd recreation sites but has the potential to add operational and maintenance burdens on those staffing and maintaining them. Therefore, additional indirect, moderate, adverse effects will occur to the user recreational experience and the facilities at recreation sites that remain open until such time that the closed sites are restored and open for public use.

6.10.3 Staff Recommendations

California DWR reports the recreation site closures to the public through various avenues, including the California DWR's Oroville Spillway Incident webpage[60] as well as on the California Department of Parks and Recreation Lake Oroville State Recreation Area webpage.[61] Due to the changing status of site availability, staff recommends that California DWR continue to use the webpages to provide information to the public about available recreation, including informing the public as it completes the recreation improvements approved in the July 12, 2017, September 13, 2017, and February 1, 2018 Recreation Plan amendment orders. California DWR should continue to utilize and update its website until such time that the recovery efforts are complete and all license-required recreation is open to the public.

During the relicensing process, it was determined that recreational use at the project was at or approaching the capacity at some of the developed recreation sites. The closure of project recreation sites due to the spillway emergency event has had direct and significant adverse effects on recreational opportunities in the area. For this reason, and because the duration of the recovery work, demobilization, and potential site restoration affecting these areas is unknown, staff recommends that California DWR monitor project

[60] https://www.water.ca.gov/oroville-spillway

[61] https://www.parks.ca.gov/?page_id=462

recreation during the 2019 and 2020 recreation seasons to determine if they are adequately meeting public needs. This monitoring, will help the California DWR manage the changes in recreational demand and use patterns, and provide a structure to evaluate the adequacy of project recreational facilities to meet future recreational needs.

As part of this monitoring California DWR should file reports with the Commission no later than December 31, 2019 and December 31, 2020, with the potential to extend the reporting requirement dependent on the recovery actions and their impact to recreation sites post year 2019. The monitoring reports should include: 1) documentation of the effects that the closed sites are having on the remaining project-required recreation, for example, whether the closed sites are driving increased use of open sites at or above use capacity, if increased use is requiring additional maintenance and how that is being handled, any increased public safety issues, etc.; 2) a plan and schedule to mitigate for any above-capacity recreation demand; 3) an update on the use of Burma Road; 4) an updated timeline of when closed sites may begin to be restored and opened for public use. Based on the results of this monitoring and any new conditions of the project area (i.e., aesthetic changes, recreation use patterns, changes to project recreation sites and trails as a result of construction, etc.). Staff recommends that California DWR update the project's existing Recreation Plan by December 30, 2021, to incorporate the approved changes in the above mentioned amendment orders and to incorporate any changes needed as a result of the previous two years of monitoring. The updated Recreation Plan should be developed in consultation with, at a minimum, the project's Recreation Advisory Committee.

Finally, staff recommends that California DWR incorporate components into its comprehensive Revegetation and Invasive Species Mitigation Plan (as introduced in *Section 6.7-Terrestrial* Resources) that will address the revegetation and restoration of the individual recreation sites and trails affected by the response and recovery actions. This should include details on the revegetation proposed to restore disturbed areas at each site and trail, the removal of any invasive species introduced any site or trail during the proposed work, and a plan and schedule by which California DWR will monitor and report on the revegetation and restoration efforts. The measures outlined in the plan should aim to restore the recreation environment, at all affected sites and trails, to pre-emergency conditions to the greatest extent possible.

While the emergency, response, and recovery actions will have short-term adverse effects on recreation resources at the project, implementation of the above staff recommended measures will minimize both the duration and severity of those effects. Additionally, requiring California DWR to update its Recreation Plan will ensure that progress is made towards restoring and opening license required recreation, inform the Commission and the public of any continued adverse effects (i.e., continued closures, changes to required amenities, etc.), and allow interested stakeholders and the Recreation

Advisory Committee the opportunity to comment and participate in the restoration of recreation in the area.

6.11 Aesthetics

6.11.1 Affected Environment

The Oroville Facilities are in Butte County and can be placed into five aesthetically distinct geographic areas: Lake Oroville; the Thermalito Diversion Pool and Thermalito Forebay; the Thermalito Afterbay; the low flow channel; and the OWA. The eastern half of Butte County includes Lake Oroville and the spillways and the Thermalito Diversion Pool. This eastern part of the county is largely undeveloped and retains much of its natural character, with some scattered rural residences and small communities. Vegetative cover in the foothills area includes chaparral, mixed foothill pine/oak woodland, and mixed coniferous forest. The western half of Butte County includes the Thermalito Forebay and Afterbay. This western part of the county is primarily flat, and land use is largely agricultural with scattered areas of development ranging in intensity from scattered rural residential to suburban to urban.

Lake Oroville is impounded by Oroville Dam, a massive earthfill structure that rises 770 feet above the floor of the Feather River Canyon and is about 1.3 miles in length. Oroville Dam is a major visible feature in the Oroville area. Its scale, shape, texture, and color contrast with the surrounding landscape. The face of the dam is composed of gravel and rock, and supports some plant life such as annual grasses, forbs, and small shrubs. However, during most of the year it remains brown in color. The dam's concrete and metal spillway, spillway control gates, and emergency spillway weir are located at the north end, and are visually important elements of the Oroville Dam complex that contrast with the earthfill portion of the dam. The visually prominent 178-foot wide concrete spillway chute extends from the top of the slope more than 3,000 feet down the spillway headworks and into the plunge pool at the canyon bottom. Because of the size of Oroville Dam and its southwest orientation toward the city of Oroville and the Sacramento Valley, it is a prominent visual landmark.

6.11.2 Environmental Effects

The various response and recovery efforts conducted by California DWR have and will alter the landscape and viewshed temporarily and permanently, depending on the action(s) in the vicinity of the Oroville Dam and spillways. The altered viewshed will be noticeable to residents, recreationalists, and those passing through on the surrounding highways. The construction proposed for the emergency's response and recovery combined with the previous transmission line construction for California DWR and PG&E will also have a – major and long-term adverse effect on aesthetic resources,

primarily as a result of permanent vegetation removal along the transmission line corridor.

During the response and recovery efforts, the project area will be dominated by construction, heavy machinery, demarcated and/or closed areas, and a flurry of human activity, affecting the natural landscape, the public's view of the project area, and a recreationist's aesthetic experience. These effects will be short-term and will not have lasting impacts on the aesthetic environment, as they will be removed once the construction activities are complete.

The introduction of construction supporting facilities and access roads, and the increase in traffic including the movement of contractors and haul routes for the recovery efforts will add development and congestion to an otherwise rural and natural area. However, traffic will return to normal conditions following completion of the recovery activities.

Multiple proposed actions require land clearing and grubbing. California DWR notes that this will occur in more than a 300-acre areas within the proximity of the spillways and the borrow area creating a visual disturbance around the project.

The trench required for the 13.8-kV Hyatt-Thermalito Transmission Line and communication cable would impact the aesthetic appeal for hikers utilizing the Dan Beebe Trail. Revegetation of disturbed areas will help to minimize any the effects had on several previously discussed resources and the adverse aesthetic effects. However, the time it will take to restore the land to pre-emergency conditions is unknown and dependent on the time it takes to reestablish vegetation.

The repaired main and emergency spillways will exist in the same physical footprint, however the emergency spillway which was previously an undeveloped slope will be replaced with the use of roller compacted concrete apron to the secant pile wall. The change from a natural slope to a concrete wall will change the public's view of the Oroville project area. While not yet defined by California DWR, there will likely be constructed roads and spoil piles that may also remain a permanent addition to the previously natural landscape.

6.11.3 Staff Recommendations

It is unclear if and how California DWR intends to restore roads and supporting facilities that will no longer be needed following the recovery phase. It is also unclear if and/or how the borrow area and spoil piles would be restored. For that reason, staff cannot fully evaluate the full extent of the adverse effect the spillway response and recovery work will have on aesthetic resources.

However, staff agrees with California DWR that its proposed Restoration Plan will be necessary for the protection of several resources and the restoration of the pre-emergency aesthetic environment where feasible. A comprehensive Restoration Plan for the project, should further describe California DWR's rehabilitation efforts of disturbed areas following construction including but not limited to: the removal and restoration of specific support facilities, roads, borrow area, and spoil piles; and as discussed above recreation sites and trails. The plan should be developed in coordination with or as a component of the Revegetation and Invasive Species Mitigation Plan discussed further in the sections above; demonstrating that California DWR has taken into consideration the cumulative effects of its proposed actions to the various resources including a discussion within the plan on how its proposed measures collectively will restore or improve the aesthetic environment for the public. While the cumulative effects have and will continue to significantly affect the viewshed of the project during construction; if implemented, the Restoration Plan should reduce the overall adverse visual effects to the project area in the long-term.

6.12 Air Quality

6.12.1 Affected Environment

The project area is generally rural in nature, with localized areas of residential development near the project giving way to higher levels of commercial and industrial development as one travels downstream from the project towards the city of Oroville. As a result, airborne pollutants are generally lower than the California average, and comparable to the average across these United States. However, nearby wildfires can infrequently, but severely impair air quality in the region, most notably by increasing concentrations of particulate matter, nitrogen oxides, and volatile organic compounds, and resulting in ground level ozone production and smog.

The metamorphosed volcanic bedrock of the project area contains asbestiform actinolite, which, when disturbed and made airborne, is a respiratory health hazard. There are no known surveys of background airborne asbestiform mineral levels for the area. However, the amount of vegetation, relatively limited amount of ground disturbance, and periodic rainfall likely limited significant amounts of airborne asbestiform minerals to locally disturbed sites, existing dirt roads, or barren areas under high wind conditions.

6.12.2 Environmental Effects

The activities associated with the response activities, including clearing of vegetation, construction of new roads, and mobilization of large construction equipment, resulted in moderate adverse effects to air quality. Activities related to the removal of vegetation from areas within the emergency spillway directly increased dust emissions,

and the denuded surfaces resulted in a greater likelihood to produce airborne particulates in the future. The airborne particulates caused by disturbance of native rock and soils also contained asbestiform minerals. As response actions took place in late winter, levels of soil moisture would have been greater, reducing the magnitude of dust generation caused by California DWR's activities. Furthermore, California DWR also utilized water trucks to spray areas where generation of dust would have been more likely, to reduce impacts on the resource area. Additionally, much of the dust generated during response activities would have remained within the project area, or immediately downwind of the site, and would have either settled or dispersed before travelling a significant distance.

During the response, California DWR directed its contractors to mobilize all available equipment and transport it to the project area. These vehicles were in addition to the background level of traffic that occurs in the area, and their use increased the concentration of particulate matter, organic compounds, and nitrogen oxides at the spillway sites and in the adjacent areas used to access the project. The expansive and various routes used by these vehicles resulted in exhaust emissions throughout the region, and included normally heavily travelled roads, as well as those located in residential areas.

The recovery activities similarly will result in significant impacts on air quality, but on a greater scale. The establishment of a borrow area at the site east of the main spillway, the addition of material to the three spoils piles, and rock crusher operation for the production of concrete, will increase the number of sources for dust, and intensify the release of airborne asbestiform minerals. Furthermore, reduced soil moisture levels in the summer and autumn, when much of the recovery activities would take place, will raise the capacity of the area to produce airborne dust. Air sampling during early recovery activities indicated the presence of asbestiform minerals within, and at the perimeter of the spillway construction area. The sampling results showed that concentrations of asbestiform minerals at most locations around the project site were below the permissible exposure limit established by the U.S. Occupational Safety and Health Administration. However, air samples taken near active rock crusher operations exceeded the limit and required the use of respiratory protection.

California DWR proposes to haul 25,000 cubic yards of pervious fill approximately 17 miles from a commercial quarry to the main spillway. California DWR has indicated that, to transport the material, it would use the route shown in Figure 6 above. This route travels, at least part of the way, through commercial and residential areas, and will expose visitors and residents to unusually high amounts of dust emissions from the payload, as well as diesel exhaust emissions including particulates, nitrogen oxides, and odorous fumes.

The licensee has proposed a number of methods to reduce its impacts on air quality. California DWR would continue to operate sprayer trucks, which moisten

unpaved roads, spoil piles, and other barren areas, to reduce dust emissions. California DWR would also direct its contractors to limit vehicle speeds across unpaved roads and staging areas, as well as require vehicular access to all areas of spoil piles near residences so the entire surface could be treated with water. Furthermore, California DWR would install rumble strip where unpaved roads meet paved routes to limit the amount of dust incidentally transported out of the construction area. During blasting, California DWR proposes to place a moistened soil overburden atop the blast area, utilize blasting mats, and avoid blasting during high winds. While processing material for aggregate production, California DWR would moisten material conveyed into rock crushing or screening devices, and monitor the intensity of dust plumes generated by such activities. California DWR also intends to limit impacts from hauling bulk material by installing track-out plates between paved and unpaved areas, washing or moistening the payload, placing tarpaulins on haul trucks, maintaining an adequate freeboard within the cargo bed, and inspecting belly-dump truck seals to prevent spillage. Additionally, California DWR intends to protect bare surfaces by applying gravel or seeding where applicable.

California DWR's response and recovery actions have had, and will likely continue to have a detrimental impact on air quality. Owing to the unique geology of the area, dust generation could result in release of asbestiform minerals, well known to cause chronic respiratory disease. However, previous air quality sampling indicates most personnel and the general public would not be adversely impacted by the release of asbestiform minerals. Those personnel that are involved with rock crusher operations would be provided adequate respiratory protection, and California DWR would monitor dust generation and curtail rock crushing activities if the dust plume becomes excessive or migrates to unprotected areas. Furthermore, though trucking material through neighborhoods could expose the public to harmful airborne dust, California DWR's plan to wash or wet the material and enclose it should reduce any risk to the public to acceptable levels. Though construction would have an adverse, moderate, and short-term effect on air quality at the project site and along routes used to transport material and equipment, the protection and mitigation methods described above should reduce the impact to a permissible level during construction.

6.12.3 Staff Recommendations

California DWR has not extensively indicated the methods it would use to limit impacts on air quality following construction activities. Though California DWR has discussed a project area restoration and a planting/revegetation plan, it has not indicated what would be included in the plans or provided an outline for them. We recommended that these plans include provisions to identify how California DWR would restore disturbed and barren lands, either through vegetation or other methods, to prevent the construction site and other affected areas from contributing to continued adverse effects on air quality.

6.13 Transportation

6.13.1 Affected Environment

The project is located in a rural area served by roads maintained by the state, Butte County, the City of Oroville, and California DWR. Two major state highways, route 162 (travelling generally east-west across the project area), and route 70 (travelling south to the Sacramento area) provide access to the region. Various county and City of Oroville roads provide access to the immediate project area, some of which are used exclusively by project visitors. California DWR also maintains a number of roads to gain access to project lands and facilities. These roads are generally paved, in good condition, and the state of the roads was not a determining factor in limiting the type or volume of traffic, within reason. However, some of the less utilized access routes are unpaved and in poorer condition. These included roads used to access informal recreation sites, and car-top boat launches.

State Highway 162 passes approximately 1.5 miles south of the Oroville Dam and, from the highway, the dam is most readily accessed via Canyon Drive, owned and maintained by Butte County. Canyon Drive passes the dam at its east side, where it intersects with Oroville Dam Road, which travels across the crest of the dam allowing access to the east side of the main spillway. A second road, Oro Powerhouse Road, crosses the toe of the dam, and similarly allows access to east side of the main spillway. Oroville Dam Road also provides vehicular access to the west side of the main spillway, the emergency spillway, and various recreational facilities via a bridge crossing the main spillway adjacent to the gate structure. Additionally, a 4.8-mile-long, single-lane unpaved road, known as the Burma Road, follows the north and west shoreline of the Thermalito Diversion Pool between the west side of the Oroville Dam emergency spillway area and the Thermalito Diversion Dam. This road was constructed for access during initial construction of the project but is otherwise unimproved and used as a recreational hiking, biking, and horseback riding trail as well as for safety patrols using passenger vehicles.

Due to its rural nature, vehicular traffic in the project area is comparatively low and congestion is generally rare. However, heavy use of marinas, parking lots, and other recreational facilities related to the project has resulted in localized short-term impacts during peak holiday periods. In the FEIS, Commission staff estimated that non-resident visitors to the project frequently use approximately 35 miles of county-maintained road, resulting in an annual additional maintenance cost of $10,010 (FERC 2007).

6.13.2 Environmental Effects

Immediately after becoming aware of the severity of the February 2017 incident, California DWR established an emergency contract and required its contractors to

expeditiously mobilize all available equipment and necessary material to the site. As such, California DWR did not conduct a baseline review of road and traffic conditions, and chose access routes without considering the effects on the infrastructure or other road users.

Subsequently, California DWR retained the services of a geotechnical and survey contractor to assess the magnitude and scope of physical damage to the roads caused by vehicular traffic related to the response and initial recovery activities. The contractor conducted a survey on March 2, 2017 to identify damage California DWR and its contractors were causing, with a follow-up survey on June 20, 2017, to evaluate the rate at which damage was progressing. California DWR reviewed the findings of the surveys to conduct a post-impact analysis and determine what repairs would be needed for the roadways.

The survey results indicate the use of public roads in relation to response and ongoing recovery activities have heretofore, likely damaged 17 roads owned and maintained by Butte County, nine roads owned and maintained by the City of Oroville, and one road, Highway 162, owned and maintained by the state (Figure 17). Such damage includes rutting, potholing, and alligator cracking. California DWR estimates the cost to repair damage to the city roads at $342,095, and the cost to repair roads owned and maintained by the county at $3,844,989. Canyon Drive, owned by Butte County, suffered significant adverse damage and California DWR fully reconstructed the road. Butte County and California DWR also mitigated significant adverse damage to several other roads by making repairs and adding steel plates to the road surface.

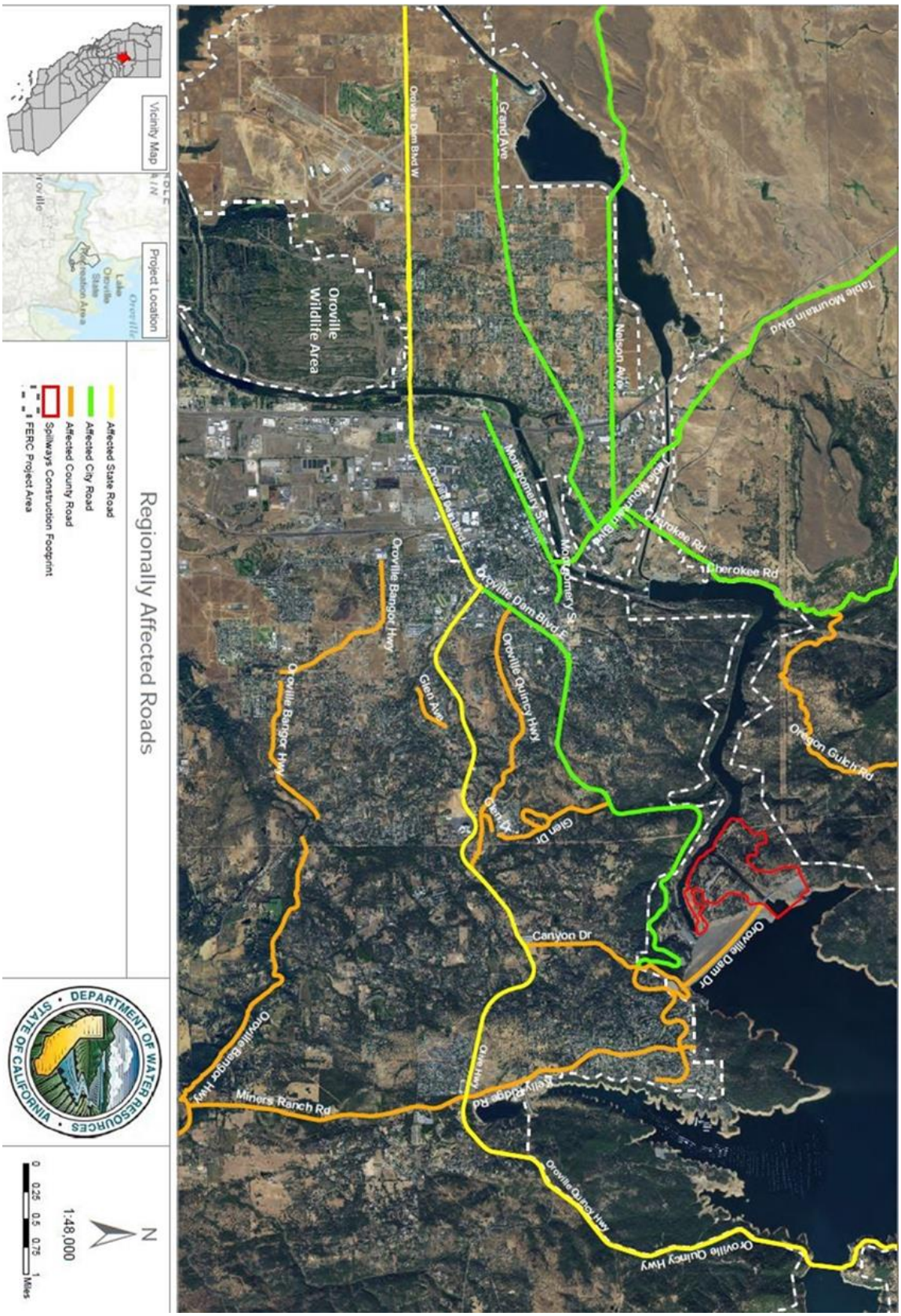

Figure 17. Regionally Affected Roads. (source: California DWR 2018b)

During the response and initial recovery activities, California DWR directed its contractors to develop and implement a temporary traffic control plan. The plan is required to include provisions to install temporary railing, barricades, illuminated signage, road markings, and to make use of flaggers to direct traffic through and around construction access areas. The contractors, through the plan, would also be required to consider needs of the public by establishing designated haul routes and public notification thereof, and avoiding residential streets, to the extent possible. California DWR's requirements for the plan stipulates that it follow California Department of Transportation methodology, and would also conform to best management practices as requested by the Commission in a December 14, 2017 letter. Furthermore, to improve safety, California DWR coordinated with local law enforcement to ensure compliance with safe and legal driving practices. California DWR also closed approximately 3 miles of Oro Dam Boulevard, located immediately southeast of the spillway and dam area, used extensively by project related traffic. Similarly, the closure of recreational areas near the spillways and dam, would indirectly improve road safety by reducing the number of visitors to the site, and decrease the possibility of vehicular conflicts.

During the response activities, California DWR constructed a number of roads to access the emergency spillway and prepare it for use. Following use of and damage to both spillways, California DWR constructed additional roads to replace access corridors lost to erosion. This includes a road constructed within the waters of the Thermalito Diversion Pool, identified as the lower haul road. Additionally, noting that heavy vehicle access to the west side of the main spillway and emergency spillway was limited to the bridge across the main spillway, California DWR improved the Burma Road as an alternate access route. California DWR widened the road by up to 9 feet, resulting in a minimum road width of 28 feet, including flanking drainage ditches. California DWR cut into hillsides and added fill to low areas and drop offs to widen the road. Additionally, California DWR also installed new box culverts at two stream crossings, replaced pipe culverts in various other locations, trimmed vegetation, and added rock to the road bed.

Following the completion of response activities and transition to recovery actions, California DWR intends to continue using the myriad roads constructed near the spillways for the initial emergency response. California DWR would use these roads to deliver materials to the concrete batch plants, transport material to and from spoil piles, truck concrete to the spillway areas, and provide access for the erection of cranes and other heavy equipment. California DWR also proposes to use nine public roads as haul routes during recovery activities. Moreover, California DWR proposes further improvements to the Burma Road and interconnected routes which include paving, widening to 30 feet around curves, placement of additional fill, vegetation removal, and extension of culverts.

As noted above, California DWR would obtain approximately 25,000 cubic yards of pervious fill from an off-site quarry. Delivering this material to the spillway area would require approximately 1,400 round trips using standard, commercially available dump trucks. The haul route for these trips would use Table Mountain Boulevard, state highway 70, Oro Dam Boulevard, and Canyon Drive. California DWR indicates trucking this material from the quarry to the main spillway would take about 5 months, resulting in an average of nine round trips per day. California DWR also indicates the trucking would take place during the day as well as night, as required by constraints, but would be preferentially scheduled to occur during off-peak hours.

To help mitigate for the damage to public roads caused by transporting material and equipment to the project site, California DWR has entered into road damage agreements with Butte County and the City of Oroville. These municipalities have also sought reimbursement from FEMA for the costs of road repair. California DWR states that under the agreements, it would provide reimbursement only in cases where the city or county have made a claim and scheduled an inspection with FEMA. Additionally, the agreements would apply to the nine identified haul routes whereas damage to the 17 roads used for project purposes but not classified as haul routes would be repaired under agreements California DWR has with its contractors. Overall, California DWR estimates that 28.31 miles of road would be impacted by recovery activities.

California DWR's activities have resulted in significant, and sometimes severe impacts to transportation resources in the project area. The extensive use of heavy vehicles, especially on roadways not intended to support such equipment has, and would likely result in meaningful and detrimental effects on the roads and other users for a period of several years. Additionally, activities following completion of construction would include demobilization and associated transportation of the concrete batch plants and cranes.

California DWR's activities resulted in significant adverse effects to area roads. However, some of the adverse impacts to public roadways have already been mitigated, as California DWR and Butte County have rebuilt or repaired several roads. Additionally, California DWR's proposal to enter into road damage agreements with local municipalities should, following completion of all activities, result in the return of the affected roads to a condition at least comparable to that before the initial response activities and ensure the adverse effects do not continue in the long term.

6.13.3 Staff Recommendations

Although California DWR has proposed to enter into road damage agreements with Butte County and the City of Oroville, California DWR has not indicated that it intends to file these agreements with the Commission for review. To ensure that California DWR mitigates the damage caused to public roads as a result of its actions, staff recommends the Commission require California DWR to prepare and file a Road Mitigation Plan that would indicate the nature by which California DWR intends to repair affected roads, staging areas, and parking lots through its contractors or reimburse local municipalities for repairs to their respective roads damaged by trucking related to the proposed action.

Additionally, in the course of the response and recovery activities, California DWR has, or would construct new access roads or improve existing roads, notably replacement roads to the spillway sites and the Burma Road and its adjoining roads. California DWR has not yet indicated the future disposition of these roads, but we support the restoration of most access roads constructed adjacent to the spillways following construction. However, because of the potential future usefulness of the improved Burma Road, California DWR would likely maintain it as a redundant access route to the emergency spillway area and possibly return it to use as part of the Dan Beebe recreational trail. Commission staff recommends California DWR be required to indicate its plan for these roads within the aforementioned area-wide Restoration Plan, and describe through what processes it would restore any temporary roads to the original condition or retain or further improve more permanent roads.

6.14 Noise

6.14.1 Affected Environment

The project is located in a rural, undeveloped, natural setting, and noise from the project during normal operation was limited to buzzing or humming from electrical equipment and transmission lines, employee's vehicles, and noise from occasional spill events. Recreational users within the area also produced various amounts of noise, from boats, generators at campsites, visitor's vehicular traffic, and conversations. Wildlife calls were also audible in the vicinity. The immediate project area lacks permanent residences, though the Kelly Ridge development, located about 1 mile southeast of the main project area, houses approximately 2,700 persons.

To the west of the project, within the City of Oroville, the type and volume of noise is typical of a small, suburban city. Generated noise is most frequently related to vehicular traffic, light industry, and household equipment. In this environment, noise production is greatest during the day, as the number of sources falls significantly at night.

6.14.2 Environmental Effects

The response activities required the use of earth-moving equipment and tools to remove vegetation. As a result, the response activities resulted in significantly more noise than would otherwise be found in the project area, and such activities would have become the primary source of noise. Additionally, California DWR conducted its response activities throughout the day and night. Although those most impacted would have been the personnel operating or directing the equipment themselves, the Kelly Ridge residential development is close enough that some of the noise would have been audible from the residences. Furthermore, during the response activities, California DWR made use of helicopters over the main and emergency spillways. California DWR used the upper parking lot, adjacent to the Kelly Ridge development, as site for the aircraft to retrieve erosion control materials and to stage other equipment. California DWR conducted helicopter flights during daylight only, though other activities at the upper parking lot would have taken place day and night. As the housing development is at a moderate distance, and located approximately 400 to 500 feet higher in elevation than the work area, much of the noise generated by the earth moving and vegetation clearing activity would have been attenuated by the time it reached the residences. However, the helicopter flights and activity at the parking lot would have had led to a greater amount of noise within the Kelly Ridge residential area. Although the amount of noise from the response activity decreased at night, it still would have been detectable to the residents, though not necessarily intrusive.

As stated previously, California DWR requested that all available equipment in its vicinity be transported to the project during the response activities. The emergency nature of the work necessitated a schedule that required travel during day and night. Many of the routes used to access the project were through residential areas which did not typically include this type of traffic. As such, these residences and areas were temporarily exposed to a type and magnitude of noise atypical for the locations.

During recovery operations, the amount of noise generated at the project site would be similar to that produced during the response activities. The constant use of heavy trucks, rock crushers, excavators, and other equipment would result in an amount of noise and ground vibrations that far exceeds that which is typical to the area. However, California DWR states it intends to reduce the impact by proposing that idling vehicles have their engines turned off, equipment such as drills be used rather than impact tools where possible, mufflers be installed on equipment, and preference be given to hydraulic or electrically operated equipment over pneumatic equipment.

California DWR would use explosives to remove parts of the existing main spillway and prepare the foundation for its replacement. Though blasting would be intermittent, it would cause air pressures and vibrations much greater than other construction activities. However, California DWR states it would place crushed stone

over the explosives in the blast holes to reduce pressures and fly rock. California DWR would also limit blasting events to daylight hours, when noise would be less disturbing to the nearest residences.

During the recovery activities, California DWR proposes to reduce the number of haul routes it would use, but would continue to transport material and equipment during both day and nighttime hours. Additionally, several of the remaining haul routes are located in residential areas. To reduce the amount of noise from vehicles passing through these normally quiet areas, California DWR intends to install and/or maintain vehicle mufflers, direct drivers to reduce speed, and avoid engine braking when feasible.

Generally, California DWR's actions have and would continue to significantly increase the amount of noise at the construction site, and in adjacent areas used to transport material and equipment to and from the spillway area. Though the duration of the noise would be finite, cumulatively, California DWR's activities would result in a noise impact for approximately two years. Noise at the construction site and upper parking lot would be audible in the Kelly Ridge residential development, and would be considerably greater than the amount of noise prior to February 2017. However, the distance and topography of the area would reduce the intensity of noise heard in the development. Furthermore, limiting particularly loud actions such as helicopter flights and blasting to day time hours would reduce the amount of noise generated at night, when it would be particularly detrimental.

Outside of the immediate construction area, noise generated from vehicles would impact normally quiet residential areas, day and night, when it would have the greatest effect. Although California DWR has proposed to implement a number of measures to mitigate for this noise, it would still moderately adversely affect those residences along the active haul routes in the short term.

6.14.3 Staff Recommendations

Due to the limited noise effects and California DWR's proposed mitigative measures, Commission staff does not recommend any further measures.

6.15 Cumulative Impacts

The Council on Environmental Quality's regulations for implementing the National Environmental Policy Act indicate that an action may cause cumulative impacts on the environment if its effects overlap in space or time with the effects of other past, present, or reasonably foreseeable future actions, regardless of the agency, company, or

person undertaking the action.[62] Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time.

We conclude that the proposed action is likely to have a cumulative adverse effect on geology and soil resources, water quality, fishery and aquatic resources, terrestrial resources, and aesthetic resources. California DWR's response and recovery actions had a significant, permanent, and adverse effect on geology and soil resources at the project through material removal near Oroville Dam and potentially due to riverbank sloughing and erosion. However, California DWR's measures to reduce erosion, along with staff's recommended measures below, would help mitigate the adverse effects to geological and soil resources.

The impaired water quality from repeated use of the damaged spillway and use of the emergency spillway created adverse conditions for fishery resources in the Feather River and by extension, in the Feather River Fish Hatchery. The impaired water quality, combined with repeated flow reductions, caused significant mortality of fish in the Feather River and in the Feather River Fish Hatchery. In addition, federally-listed spring-run Chinook salmon and Central Valley steelhead were adversely impacted by the impaired water quality and sharp flow fluctuations. These losses would be mitigated below a significant cumulative impact by the additional measures described below.

Regarding terrestrial resources, we conclude that the response and recovery actions would have a both short and long-term significant adverse effects, when combined with earlier land disturbance associated with California DWR and PG&E transmission line relocation activities. However, sufficient habitat exists in the areas surrounding the project construction and disturbance area, such that the majority of wildlife and avian species are expected to disperse to less disruptive locations. The response and recovery actions may affect but are not likely to adversely affect the valley elderberry longhorn beetle. Similarly, previously approved and the proposed construction disturbances would have an adverse effect to aesthetic resources. The effects to terrestrial and aesthetic resources would be offset to the extent possible, through required mitigation activities, including the development and implementation of the Oroville Emergency Response and Recovery Project Area Restoration Plan and an Elderberry Relocation Plan.

Regarding recreation resources, the response and recovery actions are expected to result in temporary closure of project recreation facilities. California DWR's effort to mitigate recreation impacts by improving and expanding recreation facilities in other locations on Lake Oroville indicates that the response and recovery actions will have a minor temporary adverse impact to recreationalists. With the reopening of recreation sites and implementation of its Recreation Plan, the response and recovery actions will

[62] 40 C.F.R. § 1508.7 (2018).

not have a lasting cumulative impact to recreation resources. In addition, the construction and expansion of boat ramps will provide a long-term beneficial effect to the area by providing additional opportunities that were not available prior to the emergency event.

Regarding cultural resources, the initial response activities and recovery efforts have resulted in major and minor adverse effects to cultural and historic resources at the project. However, implementation of the executed PA, ongoing consultation with the California SHPO and tribes, implementation of avoidance and minimization measures (such as the presence of archeological and tribal monitors during construction near sensitive areas), and carrying out the agreed-upon mitigation and data recovery measures at affected archeological sites would negate any cumulative impacts to cultural resources from recovery activities.

Finally, water quantity, air quality, transportation, or noise resources, the response and recovery actions should not have a significant cumulative effect either due to the temporary and minor effects to these resources from the proposal or because there are no other actions that may affect the resource.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Comprehensive Development and Staff-Recommended Measures

We conclude that the no-action alternative (leaving the damaged spillways in place) is not feasible. The no-action alternative would impair project operations and would impede California DWR from passing a full range of project inflows downstream, creating an unacceptable risk to public safety. California DWR also considered numerous scenarios to urgently restore the full operational capacity of the main and emergency spillways due to public safety concerns. In this consideration, California DWR consulted with, and continues to consult with, the Commission's D2SI and the California DSOD. The final design represents the preferred alternative for quickly restoring full operational capability at Oroville Dam. The proposal would result in adverse effects to aquatic, terrestrial, cultural, transportation, noise, and recreation resources. These effects would be mitigated, to an extent, by California DWR's proposed protective measures, by staff's recommended protective measures below, and by the process and measures prescribed in the PA with the California SHPO for protection of cultural resources.

7.1.1 Staff-Recommended Measures

(1) California DWR should be required to file a post-construction Water Quality Protection Plan. The plan should include measures to prevent erosion at any areas impacted by construction efforts. At a minimum, the plan should contain measures

for long-term water quality protection at disrupted soil surfaces, spoil piles, and any other unstable sources of turbidity. The plan should also contain measures for the ultimate disposition of the spoil piles and measures that California DWR will implement to prevent contaminated water from the settling pools at the base of the main spillway from being discharged to the Thermalito Diversion Pool after construction ends.

(2) California DWR should be required to take actions to mitigate for the deficit of 300,000 spring-run Chinook from 2017 hatchery losses. Staff recommended measures include an increase to hatchery production in a subsequent year, habitat improvements, or capital investment in fishery projects. Any mitigation could be combined with other important fishery mitigation or improvements required in this proceeding.

(3) To mitigate for the effects to terrestrial, recreational, and aesthetic resources, California DWR should develop a comprehensive Revegetation and Invasive Species Mitigation Plan. At a minimum the plan should include measures to: 1) maintain and monitor replanted vegetation for a minimum of five years or until the vegetation reaches a survival rate of 70 percent and invasive plants are not present in the revegetated area; (2) with the exception of areas designated for recreational use parking, revegetate the staging, laydown areas, and other applicable areas used for construction support and/or disturbed by construction activities; as well as the areas disturbed by the installation of the 13.8-kV Powerline and Fiber Optic Communication System along the Dan Beebe Trail; (3) use native vegetation management planting methods (e.g., use of certified weed-free straw and native plant species) to revegetate the disturbed areas; (4) establish a schedule that specifies when monitoring will occur during the calendar year and what monitoring methods will be used; (5) file annual progress reports by March 1 of the subsequent year, for at least the first five years to describe both the progress of revegetation efforts as compared to the specified benchmark survival rate of 70 percent and, if benchmarks are not met, any needed modifications to management of planted seedlings; (6) implement best management practices to prevent the introduction and spread of invasive plant species; and (7) create a plan to address invasive and noxious weeds should they be found during the course of the monitoring effort.

(4) To ensure continued protection of the Glen Pond nesting territory occupied by a bald eagle pair, California DWR should continue to implement the following measures to prohibit human activity as the response and recovery efforts take place: (1) administrative closure of land and shoreline areas around the bald eagle nest territories to human entry during the nesting season; (2) signage, patrol, and enforcement of closure; (3) nest and population surveys; (4) habitat improvement measures; and (5) limitations on current and future habitat disturbance. As detailed in the Commission's FEIS for the relicensing, California DWR prepared and implemented bald eagle territory management plans for four bald eagle nest territories which were active on or within 0.25 miles of project lands (FERC 2007).

(5) To mitigate for the potential to affect the valley elderberry longhorn beetle, California DWR proposed, and staff agrees, that it should develop an Elderberry Relocation Plan for Commission approval. California DWR should consult with the FWS, and the plan should include at a minimum comments and measures previously discussed with the FWS and should incorporate measures, as applicable, from the FWS's 2017 *Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle.*

(6) California DWR should be required to implement any terms or conditions resulting from the pending consultation with NMFS. Once the terms and conditions have been issued (if any), California DWR should be required to file a schedule for implementing these requirements.

(7) To keep the Commission and the public informed about the available recreation at the project and the completion of approved recreation facilities, and to ensure the recreation needs of the public are being met, staff recommends that California DWR provide Recreation Monitoring Reports for 2019 and 2020, at a minimum. The monitoring reports should include: 1) documentation of the effects that the closed sites are having on the remaining project-required recreation, for example, whether the closed sites are driving increased use of open sites at or above use capacity, if increased use is requiring additional maintenance and how that is being handled, any increased public safety issues, etc.; 2) a proposal, plan, and schedule for mitigation if recreation use at open sites exceeds their use capacity; 3) an update on the use of Burma Road; and 4) an updated timeline of when closed sites may begin to be restored and opened. Based on the results of this monitoring and any new conditions of the project area (e.g., aesthetic changes, recreation use patterns, changes to project recreation sites and trails as a result of construction, etc.), staff recommends that California DWR update the project's existing Recreation Plan by December 30, 2021, to incorporate the approved changes in the 2017 and 2018 recreation plan amendment orders and to incorporate any changes needed as a result of the previous two years of monitoring. Any ensuing revision to the Recreation Plan should also be developed in consultation with the project's Recreation Advisory Committee.

(8) To describe rehabilitation efforts of disturbed areas following construction, the California DWR proposed, and staff recommends, a project-area-wide Restoration Plan. The plan should: (1) identify which features developed exclusively for response and recovery activities, including but not limited to roads, borrow area, and spoil piles, would be restored to pre-construction conditions; (2) precisely describe the methods by which the disturbed areas would be restored at the spillways, including methods to make the restored areas aesthetically congruent with the surrounding, undisturbed landscape; (3) identify those facilities that had been built or improved to aid construction which would remain and identify the purposes of such facilities; (4) provide details as to how this plan will work and be consistent with the project Recreation Plan and the proposed

Revegetation and Invasive Species Mitigation Plan, (5) restore the pond located west of Thermalito Diversion Pool railroad bridge to pre-project conditions, (6) develop a protocol for monitoring and filing progress reports with the Commission, and (7) include an implementation schedule.

(9) To identify how California DWR would mitigate the damage it caused to public highways and to ensure such mitigation occurs, staff recommends that the California DWR prepare and file a Road Mitigation Plan. The plan should: (1) include the specifications of its road maintenance agreements with Butte County and the City of Oroville, identifying the roads to which the agreements apply; (2) describe the stipulations of its contracts through which a third party would repair roads damaged through California DWR's actions; (3) include details on the disposition of Burma Road and other construction roads; (4) include details on the repaving of damaged parking and staging areas where blacktop damage was caused by construction equipment; (5) and include an implementation schedule.

(10) To mitigate for effects to cultural resources arising from the spillway failure and subsequent response and recovery efforts, staff recommends that California DWR continue discussions with the parties to the PA to develop a mitigation plan. Once the mitigation plan is developed and distributed to the PA parties for review and comment, California DWR should file it with the Commission for review and approval. Also, to avoid and minimize effects to cultural resources arising from ongoing recovery work, staff recommends California DWR continue to implement measures such as avoiding known resource locations, installing physical barriers, use of hand tools where necessary, training contractors, designating sensitive areas, and conducting monitoring by both archaeologists and tribal monitors when construction activities occur near sensitive sites. In addition DWR should continue to implement the executed PA and consult with the California SHPO, tribes, and other PA parties as necessary.

(11) To further analyze any adverse effects to soil resources through streambank sloughing and to aquatic habitat in the lower Feather River from sedimentation, staff recommends that California DWR prepare and file a Sedimentation and Erosion Assessment and Mitigation Plan. The plan should conduct a broad assessment of effects to soil resources, riparian habitat, and the streambed in the lower Feather River, by comparing pre- and post-event conditions. If the analysis identifies any significantly degraded areas of mass soil wasting from flow reductions or identifies any areas of significant sediment deposition from the spillway failure, California DWR should also include details in its plan for directly or indirectly mitigating those effects. California DWR should develop the plan in consultation with the California DFW, NMFS, and FWS and should file the plan for Commission review and approval prior to implementation.

7.2 Consistency with Comprehensive Plans

Section 10(a)(2) of the FPA (16 U.S.C. § 803(a)(2)(A)) requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed thirteen qualifying comprehensive plans that are applicable to the proposed action at the Feather River Project No. 2100. We determined that the proposed action does not conflict with the following plans:

1. California Advisory Committee on Salmon and Steelhead Trout (1988). Restoring the balance: 1988 Annual Report. Sausalito, CA.
2. California Department of Fish and Game (1990). Central Valley salmon and steelhead restoration and enhancement plan. Sacramento, CA. April.
3. California Department of Fish and Game (1993). Restoring Central Valley streams: a plan for action. Sacramento, CA. November.
4. California Department of Fish and Game (1996). Steelhead restoration and management plan for California. February.
5. California–The Resources Agency (1989). Upper Sacramento River fisheries and riparian habitat management plan. Sacramento, CA. January.
6. California Department of Parks and Recreation (2012). Public opinions and attitudes on outdoor recreation in California. Sacramento, CA. January 2014.
7. California Department of Parks and Recreation (2009). California outdoor recreation plan–2008.
8. California Department of Water Resources (2014). The California water plan: Investing in Innovation and Infrastructure-2013. Bulletin 160-13.
9. State Water Resources Control Board (1999). Water quality control plans and policies. Adopted as part of the State Comprehensive Plan.
10. Central Valley Joint Venture (2006). Central Valley habitat joint venture implementation plan – Conserving Bird Habitat. U.S. Fish and Wildlife Service, Sacramento, CA.
11. U.S. Department of the Interior, Environment Canada, Environment and Natural Resources-Mexico (2012). North American waterfowl management plan; People Conserving Waterfowl and Wetlands.
12. Fish and Wildlife Service (1989). Fisheries U.S.A: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, DC.
13. National Park Service (1982). The nationwide rivers inventory. U.S. Department of the Interior. Washington, DC.

8.0 FINDING OF NO SIGNIFICANT IMPACT

In review, the unanticipated failure of the Lake Oroville main spillway and degradation of the area below the emergency spillway had unintended consequences to public safety and environmental resources. The preceding analysis examined the effects of the California DWR's efforts to respond to, and stabilize the emergency situation created by the main spillway failure and degradation of the emergency spillway area. The analysis also examined California DWR's proposed recovery efforts to reconstruct the main spillway, fortify the emergency spillway, and to re-route a project transmission line. California DWR has taken measures, and proposes additional measures to mitigate for the environmental effects from the response and recovery efforts. The Commission has also recommended additional measures to mitigate for the effects to environmental resources from California DWR's response and recovery actions. Based on information, analysis, and evaluations contained in this EA, we find that approval of California DWR's proposal to reconstruct the main and emergency spillways and to relocate a project transmission line, along with implementation of the mitigative actions described above for the response and recovery effort, would not constitute a major federal action significantly affecting the quality of the human environment.

9.0 LITERATURE CITED

Adams, P.B., C.B. Grimes, J.E. Hightower, S.T. Lindley, and M.L. Moser (2002). Status Review for North American Green Sturgeon, *Acipenser medirostris*. National Marine Fisheries Service.

Bash, J., C. Berman, and S. Bolton (2001). Effects of turbidity and suspended solids on salmonids. Center for Streamside Studies, University of Washington, Seattle, WA.

Bilski, R. and J. Kindopp (2009). Emigration of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in the Feather River, 2005-2007, State of California Department of Water Resources, Division of Environmental Services.

California Data Exchange Center (CDEC) - Feather River at Mile 61.6 (2018). http://cdec.water.ca.gov/dynamicapp/staMeta?station_id=FRA (accessed March 15, 2018).

California Department of Fish and Game (CDFG) (1998). A status review of the spring-run Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River drainage. Candidate Species Report 98-01.

California Department of Water Resources (2017). Letter to Federal Energy Regulatory Commission regarding Oroville Wildlife Area Borrow Material Excavation. Filed December 12, 2017.

California Department of Water Resources (2018a). Construction Quality and Inspection Plan-Spillways Specification No. 17-09. Filed May 30, 2018.

California Department of Water Resources (2018b). Application for license amendment. Filed January 29 and February 13, 2018.

California Department of Water Resources (2018c). 2018 Seasonal FCO Gate Closure Plan for Lake Oroville. Filed April 17, 2018.

Cavallo, B., R. Kurth, J. Kindopp, A. Seesholts, and M. Perrone (2003). Distribution and habitat use of steelhead and other fishes in the Lower Feather River, 1999-2000, interim report for the Department of Water Resources Division of Environmental Services.

Colas, F., J. Baudoin, M. Danger, P. Usseglio-Polatera, P. Wagner, and S. Devin (2013). Synergistic impacts of sediment contamination and dam presence on river functioning, Freshwater Biology, 58, 320-336.

Federal Energy Regulatory Commission (2007). Final Environmental Impact Statement (FEIS) for Hydropower License, issued May 18, 2007.

Federal Energy Regulatory Commission (2017). Environmental Analysis for Relocating Primary Transmission line, issued August 23, 2017.

Federal Energy Regulatory Commission (2018). April 13, 2018 memorandum, providing water quality monitoring data collected by the California Department of Water Resources, and sent to state and federal resource agencies following an April 10, 2017 environmental coordination meeting.

Fisch, K.M, B. Mahardja, R.S. Burton, B. May (2014). Hybridization between delta smelt and two other species within the family Osmeridae in the San Francisco Bay-Delta. Conservation Genetics 15:489-494

Fox, W. 1951. Relationships among the garter snakes of the *Thamnophis elegans Rassenkreis*. University of California Publications in Zoology 50:485–530.

France, J.W., A.A. Alvin, P.A. Dickinson, H.T. Falvey, S.J. Rigbey, J. Trojanowski. (2018). Independent Forensic Team Report – Oroville Dam Spillway Incident., issued January 5, 2018.

Gallagher, Assemblyman James; Senator Jim Nielsen; Oroville Chamber of Commerce; Oroville Recreation Advisory Committee; Town of Paradise; American Whitewater; Oroville Downtown Business Association; Citizens for Fair and Equitable Recreation; Feather River Low Flow Alliance; Oroville Rotary Club; Lake Oroville Bicyclists Organization; Butte County; Sutter County; City of Marysville; City of Gridley; City of Wheatland; City of Yuba City; City of Live Oak; Norcal Fishing Guides and Sportsmen's Association; California Sportfishing Protection Alliance; Friends of the River; Yuba-Sutter Chamber of Commerce; Yuba-Sutter Economic Development Corp.; Oroville Association of Realtors; Sutter Yuba Association of Realtors; Sacramento Valley Landowners' Association; Yuba Sutter Farm Bureau; Live Oak District Chamber of Commerce; South Yuba Citizens League; AquAlliance; Christopher Tellis; Victoria Smith; Janet Goodson; Linda Draper; Plumbers; Pipefitters and HVAC LU228; City of Biggs (2017). Comments on Pending License Issuance, filed with the Federal Energy Regulatory Commission on August 8, 2017.

Google Inc. (2018). Google Earth Pro (Version 7.1.5.1557) [Software]. Available from https://www.google.com/earth/desktop/

Hansen, G. and J.M. Brode (1980). Status of the giant garter snake. Inland Fisheries Endangered Species Program Special Publication Report No. 80-5. California Department of Fish and Game.

Moyle, P. (2002). Inland Fishes of California. University of California Press-Berkeley, CA.

National Marine Fisheries Service (2016). California Central valley Steelhead Distinct Population Segment 5-year review: summary and evaluation. NMFS Central Valley Office, Sacramento, CA.

Parsley, M.J., L.G. Beckman, & G.T. McCabe Jr. (1993). Spawning and Rearing Habitat Use by White Sturgeons in the Columbia River Downstream from McNary Dam. Transactions of the American Fisheries Society 122:217-227.

Rinaldi, M., Casagli, N., Dapporto, S., Gargini, A. (2004). Monitoring and modelling of pore water pressure changes and riverbank stability during flow events. Earth Surface Processes and. Landforms. 29 (2), 237–254.

Rinaldi, M and S.E. Darby (2008). Modelling river-bank-erosion processes and mass failure mechanisms: progress towards fully coupled simulations. Gravel-Bed Rivers VI: From Process Understanding to River Restoration. H. Habersack, H. Piégay, M.

Rossman, D. and G. Stewart. 1987. Taxonomic reevaluation of Thamnophis couchii (Serpentes: Columbridae). Occasional Papers of the Museum of Zoology, No. 63. Louisiana State University, Baton Rouge, LA.

Seesholtz, A., M. Manuel, J. Van Eenannaam (2014). First Documented Spawning and Associated Habitat Conditions for Green Sturgeon in the Feather River, California. Environmental Biology of Fishes. 98, 905-912.

Sigler, J. T. (1984). Effects of chronic turbidity on density and growth of steelheads and coho salmon. Transactions of the American Fisheries Society, 113, 142-150.

Stevens, D.E., H.K. Chadwick, R.E. Painter (1987). American Shad and Striped Bass in California's Sacramento-San Joaquin River System

Suttle, K. B., M.E. Power, J. M. Levine, and C. McNeely (2004). How fine sediment in riverbeds impairs growth and survival of juvenile salmonids, Ecological Applications, 14, 969-974.

U.S. Fish and Wildlife Service (1997). Programmatic formal consultation for U.S. Army Corps of Engineers 404 permitted projects with relatively small effects on the giant garter snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties. U.S. Fish and Wildlife Service, Sacramento, CA.

U.S. Fish and Wildlife Service (1999). Conservation guidelines for the valley elderberry longhorn beetle. U.S. Fish and Wildlife Service, Sacramento, CA. July 9, 1999. 13p.

White, J.S.S., K. Lentz, and J. Kindopp (2017). Stranding of Chinook salmon (*Oncorhynchus tshawytscha*) and Steelhead (*Oncorhynchus mykiss*) in the lower Feather River, 2017. Final Report. Department of Water Resources, Division of Environmental Services, Oroville, CA.

10.0 LIST OF PREPARERS

John Aedo – Team Lead, Water Quantity, Water Quality and Aquatic Resources (Fishery Biologist; M.S. Integrative Biology; B.S. Integrative Biology)

Alicia Burtner – Threatened and Endangered Species (Fish Biologist; M.E.M. Ecosystem Science and Conservation; B.S. Environmental Science)

Kurt Powers – Cultural and Historic Resources (Wildlife Biologist; M.S. Environmental Science and Engineering; B.A. Environmental Science and Foreign Affairs)

Steven Sachs, P.E. – Geology and Soils, Air Quality, Transportation, Noise (Civil Engineer; B.S. Environmental Systems Engineering)

Krista Sakallaris – Terrestrial Resources, Threatened and Endangered Species, Recreation Resources, and Aesthetics (Environmental Protection Specialist; M.S. Environmental Science and Policy)