SOUTH SWP HYDROPOWER
FERC PROJECT NO. 2426-227

FINAL LICENSE APPLICATION
VOLUME II OF IV
January 2020

State of California
California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES
Hydropower License Planning and Compliance Office

Los Angeles
DEPARTMENT OF WATER AND POWER

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EXHIBIT E – ENVIRONMENTAL REPORT

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COMMONLY USED TERMS, ACRONYMS & ABBREVIATIONS

¶	paragraph
§	Section
~	approximately
<	less than
>	greater than
-	not sampled
%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
µg	microgram
µg/L	micrograms per liter
µS	microsiemens
µS/cm	microsiemens per centimeter
AAQS	ambient air quality standards
ABAAS	Architectural Barriers Act Accessibility Standards
ACC	Area Control Center
ACHP	Advisory Council on Historic Preservation
acute	Exposures in a single day
ADA	Americans with Disabilities Act of 1990
AF	acre-feet
AF/year	acre-feet per year
AGS	Annual Grassland
AIS	aquatic invasive species
alluvium	A general term for detrital deposits made by streams in recent time.
a.m.	(ante meridiem) before noon
ANF	Angeles National Forest
aquatic	Living in or near water

APE	Area of Potential Effects, which are all lands and facilities within the Federal Energy Regulatory Commission Project boundary, including dams, spillways, powerhouses, recreation areas, and other appurtenant facilities, with the exclusion of non-Project facilities not affected by Project operations and maintenance, and excluding lands overlying the Angeles Tunnel on which Department of Water Resources and Los Angeles Department of Water and Power do not perform any Project-related activities
Application for New License	Licensees' Application for a New License for Major Project – Existing Dam for the South SWP Hydropower, Federal Energy Regulatory Commission Project Number 2426-227
AQMD	Air Quality Management District
ARG	Agricultural Supply
artificially flooded	Areas in which the amount and duration of flooding is controlled by means of pumps or siphons in combination with dikes or dams
ATL	advisory tissue level
Avg	average
AW	American Whitewater
BA	Biological Assessment
BAR	Barren
barren	Areas within a vegetation dominated habitat that are devoid of vegetation
basement rock	The thick foundation of ancient metamorphic and igneous rock that forms the continental crust, often in the form of granite
BCC	Bird of Conservation Concern
Bd	*Batrachochytrium dendrobatidis*
BE	Biological Evaluation
bedrock	The solid rock that lies beneath soil and other loose surface materials
BGEPA	Bald and Golden Eagle Protection Act
BLM	U.S. Department of the Interior, Bureau of Land Management
BLMS	Bureau of Land Management Sensitive Species
BMI	benthic macroinvertebrates

BMP	Best Management Practice
BO	Biological Opinion
BAOT	Boats At One Time
BOD	biochemical oxygen demand
BOP	Blue Oak-Foothill Pine
BOW	Blue Oak Woodland
B.P.	Before Present
BRM	bedrock mortars
BRRTP	Barren Ridge Renewable Transmission Project
BVARA	Buena Vista Aquatic Recreation Area
CA	California
ca.	circa
$CaCO_3$	calcium carbonate
CAISO	California Independent System Operator
CAL FIRE	California Department of Forestry and Fire Protection
Cal-IPC	California Invasive Plant Council
Caltrans	California Department of Transportation
CalVeg	Classification and Assessment with Landsat of Visible Ecological Groupings
canopy	The uppermost layer of vegetation in a plant community. In forested areas, mature trees comprise the canopy layer, while the tallest herbaceous species constitute the canopy layer in a marsh
CARB	California Air Resources Board
CAS	channeled apple snails
C.C.C.	Civilian Conservation Corps
CCR	California Code of Regulations
CD	coefficient of dispersion
CDEC	California Data Exchange Center
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CDP	census designated place

CEDEN	California Environmental Data Exchange Network
CEII	Critical Energy Infrastructure Information
Cenozoic Era	The current geological time period, covering the interval from 66 million years ago to present day; the Cenozoic is composed of Paleogene and Neogene periods
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
chaparral	A shrubland adapted to summer-dry Mediterranean climate by having shrubs with evergreen, leathery leaves, such as chamise, manzanita, or scrub oak species
CI	confidence interval
Cl	Chloride
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
COW	Coastal Oak Woodland
CPUE	Catch Per Unit Effort, fish per minute of electrofisher operation
CRC	Chamise-Redshank Chaparral
CRHR	California Register of Historical Resources
Crk	Creek
CRLF	California red-legged frog
CSC	Coastal Scrub
CSCI	California Stream Condition Index
CTR	California Toxics Rule
CWA	Clean Water Act
CWHR	California Wildlife Habitat Relationships
cy	cubic yard
dBA	sound levels measured using an A-weighted decibel scale
dbh	diameter at breast height
DCU	Deer Conservation Unit
DDE	dichlorodiphenyldichloroethylene

DDT	dichlorodiphenyltrichloroethane
deepwater habitats	Permanently flooded lands lying below the deepwater boundary of wetlands
deformation	General term for folding, faulting, and other processes resulting from shear, compression, and extension of rocks
deposit	Any accumulation of sediment
dikes	Areas that have been created or modified by a man-made barrier or dam which obstructs the inflow or outflow of water
DLA	Draft Application for New License
DNA	deoxyribonucleic acid
dominant species	A plant species that exerts a controlling influence on or defines the character of a community
DPR	California Department of Parks and Recreation
DPS	Distinct Population Segment
drainage	Any channel that carries water
DRI	Desert Riparian
DS	downstream
DSOD	California Department of Water Resources, Division of Safety of Dams
DSW	Desert Wash
DWR	California Department of Water Resources
EA	Environmental Assessment
earthquake	A sudden ground motion or vibration of the Earth, produced by a rapid release of stored-up energy along an active fault
E. coli	*Escherichia coli*
eDNA	environmental deoxyribonucleic acid
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
Elev.	elevation
Emergency	Defined as an event that is reasonably out of the control of the Licensees and requires the Licensees to take immediate action, either unilaterally or under instruction of law enforcement, emergency services, balancing authorities including the California Independent System Operator and Los Angeles Department of Water and

	Power, or other regulatory entity, including actions to prevent the imminent loss of human life, injury to the public or the Licensees' staff, or damage to property. An emergency may include, but is not limited to: natural events such as earthquakes, landslides, storms, or wildfires; vandalism; malfunction, failure, or loss of reliability of the electric grid or Project works; or other public safety incidents.
emergent	Wetlands characterized by erect, rooted, herbaceous hydrophytes (plants adapted to growing in wet conditions), excluding mosses and lichens; this vegetation is present for the majority of the growing season in most years, and most emergent wetlands are dominated by perennial plants
emergent plant	A rooted herbaceous plant species that has parts extending above a water surface
EPA	U.S. Environmental Protection Agency
ephemeral stream	A stream that flows briefly in direct response to precipitation in immediate vicinity, and whose channel is always above the water table
EPT	Ephemeroptera, Plecoptera, Trichoptera
ESA	Endangered Species Act of 1973, as amended
Euro-Americans	Euro-Americans are Europeans who migrated to North America to make their home here
excavated	Areas that occur in a basin or channel that have been dug, gouged, blasted, or suctioned through artificial means
extrusive rock	Igneous rock that cools and solidifies above the Earth's surface (i.e., volcanic igneous rock)
fault	A fracture or fracture zone in the Earth's crust along which one side has moved in relative to the other; sudden movements on faults cause earthquakes
FC	Federal Candidate
FD	Federally Delisted
FE	Federal Endangered
FEIR	Final Environmental Impact Report
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission

FEW	Fresh Emergent Wetland
FGC	California Fish and Game Code
fibers/L	fibers per liter
FLA	Final Application for New License
flooded	A condition in which the soil surface is temporarily covered with flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources
flora	A list of all plant species that occur in an area
fluvial	Term used to describe river or stream-related features or processes; fluvial deposits (alluvium) are sediments deposited by the flowing water of a stream
FMP	Fishery Management Plan for Commercial and Recreational Salmon Fisheries
forest	An area (or vegetation type) in which trees dominate in the overstory where their crowns generally overlap (with greater than 60 percent canopy cover)
formation	A rock formation is a body of rock of considerable extent with distinctive characteristics that allow geologists to map, describe, and name it
FP	California Fully Protected
FPA	Federal Power Act
fps	feet per second
FR	Federal Register
FRRRM	Forest and Rangeland Renewable Resources Planning Act
FSORAG	Forest Service Outdoor Recreation Accessibility Guidelines
FSS	Forest Service Sensitive
ft	feet
FT	Federal Threatened
FYLF	foothill yellow-legged frog
g	gram
GHG	greenhouse gas
GIS	Geographic Information System
gpd	gallons per day

gneiss	A high-grade metamorphic rock that commonly has coarse-grained, foliated alternating bands of light and dark-colored minerals
GPS	Global Positioning System
growing season	The portion of the year when soil temperatures at 19.7 inches below the soil surface are higher than biologic zero (5 ºC). For ease of determination this period can be approximated by the number of frost-free days.
H’	Shannon’s Diversity Index
HAB	harmful algal bloom
herb	A nonwoody individual of a macrophytic species. Seedlings of woody plants (including vines) that are less than 3.2 feet in height are considered to be herbs
herbaceous layer	Any vegetative stratum of a plant community that is composed predominantly of herbs
Holocene	An epoch of the Quaternary Period beginning approximately 11,700 years ago and continuing today
hp	horsepower
HPMP	Historic Properties Management Plan
Hungry Valley SVRA	Hungry Valley State Vehicular Recreation Area
HWY	Highway
Hz	hertz
IHA	Indicators of Hydrologic Alteration
ILP	Integrated Licensing Process
Indian tribes	Indigenous people who lived in the area prior to the arrival of Europeans. Encompasses all indigenous communities potentially interested in or affected by the relicensing, regardless of federal recognition.
impounded	Areas that have been created or modified by a man-made barrier or dam which obstructs the inflow or outflow of water
intermittent stream	A stream that has flowing water during certain times of the year, when groundwater provides water for stream flow; . During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow

intermittent	Describes channels that contain flowing water only part of the year, but may contain isolated pools when the flow stops
intermittently exposed	Areas in which surface water is present throughout the year, except in years of extreme drought
intermittently flooded	Riverine habitats in the arid western portions of the United States. Substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. These habitats are very climate-dependent. Weeks or months or even years may intervene between periods of inundation. Flooding or inundation may come from spring snowmelt or sporadic summer thunderstorms. The dominant plant communities under this regime may change as soil moisture conditions change.
inundation	A condition in which water from any source temporarily or permanently covers a land surface
IPaC	Information for Planning and Conservation
ISR	Initial Study Report
ITA	Indian Trust Assets
IVMP	Integrated Vegetation Management Plan
JST	Joshua Tree
JUN	Juniper
KOP	key observation point
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
L	liter
L%	percentile distribution of sound levels
L10	sound level exceeded for 10 percent of the measurement period and represents the peak sound levels present in the environment
L90	sound level exceeded for 90 percent of the measurement period and is commonly used to represent background sound levels
LAC	Lacustrine

Lacustrine	Wetlands and deepwater habitats that: (1) are located in a topographic depression or a dammed river channel; (2) are lacking in trees, shrubs, persistent emergent plants, emergent mosses or lichens with greater than 30 percent areal coverage; and (3) are greater than 20 acres in area
LADWP	Los Angeles Department of Water and Power
lake	Permanent lakes or reservoirs greater than 2 surface hectares (5 surface acres)
landslide	Downslope movement of masses of rock and/or soil materials
lbs/day	pounds per day
LCRA	Lake Casitas Recreation Area
Ldn	day-night average sound level
Leq	equivalent sound level
lentic	Riparian-wetland areas that are not lotic (riverine)
Licensees	California Department of Water Resources and Los Angeles Department of Water and Power
Licensees’ Proposal	Continued operation of the Project; addition of the existing Quail Detention Embankment, an existing stream flow gage (USGS Gage No. 11109525), and existing Primary Project Roads; modification to the existing Project boundary; and removal of the Warne Transmission Line from the license
limnetic	Extends outward from littoral boundary and includes all deep-water habitats within the Lacustrine System
lithic	stone (modified)
littoral	Standing water depths of less than 6.6 feet within the Lacustrine System; these areas typically support aquatic bed or emergent vegetation and would likely be classified as wetlands
LMB	largemouth bass
LOP	limited operating period
LOS-1	San Francisquito Creek east of Castaic Lake (critical habitat unit)
lotic	Riparian areas with flowing freshwater
LPNF	Los Padres National Forest
LWM	large woody material

m	meter
M	magnitude of an earthquake on the Richter scale
m^3	cubic meter
magnitude	A measure of the total amount of strain energy released by an earthquake, as determined by a seismograph
marsh	An ecosystem of more or less continuously waterlogged soil dominated by emersed herbaceous plants, but without a surface accumulation of peat
Max	maximum
MCH	Mixed Chaparral
MCP	Montane Chaparral
mesic	Pertaining to conditions of moderate moisture or water supply; used of organisms occupying moist habitats
Mesozoic Era	The geologic time period between approximately 250 and 66 million years ago marking the time between the Permian-Triassic and Cretaceous-Paleogene extinction events. The Mesozoic is composed of the Triassic, Jurassic and Cretaceous periods.
metamorphic rock	A rock of any origin (i.e., sedimentary, igneous or metamorphic) that has undergone secondary chemical or structural changes produced by increases in heat and/or pressure, or by replacement of elements by hot, chemically active fluids.
mg	milligram
MGD	million gallons per day
mg/L	milligram per liter
MHC	Montane Hardwood-Conifer
MHW	Montane Hardwood
MIB	2-Methylisoborneol
Min	minimum
mineral	A naturally occurring inorganic chemical element or compound or limited mixture of chemical compounds with an orderly internal structure and characteristic composition, crystal form and specific physical and chemical properties that can be used to identify them
ml	milliliter

ML	Minimum Level
mm	millimeter
MMI	Multimetric Index
MOU	Memorandum of Understanding
mph	miles per hour
MPN/100ml	most probable number per 100 milliliters
MRI	Montane Riparian
msl	mean sea level
MTBE	methyl tert-butyl ether
MWD	Metropolitan Water District of Southern California
MWh	megawatt-hours
mya	million years ago
N	Nitrogen
N/A	not applicable
NAHC	Native American Heritage Commission
NAS	Nonindigenous Aquatic Species (USGS location database)
Native Americans	Indigenous people who lived in the area prior to the arrival of Europeans. Encompasses all indigenous communities potentially interested in or affected by the relicensing, regardless of federal recognition.
NAVD 88	North American Vertical Datum of 1988
NAWMP	North American Waterfowl Management Plan
ND	non-detect
NEPA	National Environmental Policy Act
NFS	National Forest System
ng/g	nanogram per gram
ng/L	nanograms per liter
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NISIMS	National Invasive Species Information Management System

NMFS	U.S. Department of Commerce, National Oceanic Atmospheric and Administration, National Marine Fisheries Service
NMWSE	normal maximum water surface elevation
NNIP	non-native invasive plants
No.	Number
NO_2	nitrogen dioxide
NO_3-N	nitrate
NOI	Notice of Intent to File an Application for New License
NPDES	National Pollutant Discharge Elimination System
NPS	U.S. Department of the Interior, National Park Service
NR	not reported
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NTR	National Toxics Rule
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory
O&M	operations and maintenance
O_3	ozone
OBS	observed, but not counted or sampled
O/E	Observed to Expected
OEHHA	Office of Environmental Health Hazard Assessment
OHP	Office of Historic Preservation under the California Department of Parks and Recreation
OHT	Overhead Transmission
OHV	off-highway vehicle
ORV	Outstandingly Remarkable Value
outcrop	A mass of rock exposed at the Earth' surface
oxidation	Removal of electrons from an atom or ion usually by combining with oxygen ions. Minerals (particularly iron-bearing) exposed to air may oxidize as a form of chemical weathering.

P	Phosphorus
PAC	Protected Activity Center
PAD	Pre-Application Document
Paleozoic Era	The geologic time period between about 540 - 250 million years ago. The Paleozoic is compose of the Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian periods.
Palustrine	All nontidal wetlands dominated by trees, shrubs, emergent plants, mosses, or lichens
PAOT	People At One Time
parent materials	The original (preexisting) rock (protolith) from which another form of earth material is derived, such as soil or metamorphic rock.
PAS	Pasture
PCA	Pest Control Advisor
PCBs	polychlorinated biphenyls
pCi/L	picocuries per liter
permanently flooded	Areas in which water covers the land surface throughout the year in all years
Permian Period	A geologic time interval within the Paleozoic Era that includes the time between about 300 to 250 million years ago.
PFC	Properly Functioning Condition
PFMC	Pacific Fishery Management Council
PGS	Perennial Grassland
PJN	Pinyon-Juniper
plant community	All of the plant populations occurring in a shared habitat or environment.
p.m.	(post meridiem) afternoon
PM2.5	Fine particulate matter less than or up to 2.5 micrometers in diameter
PM10	Respirable particulate matter less than or up to 10 micrometers in diameter
PM&E measures	Protection, Mitigation, and Enhancement measures, which are operation and management activities to: (1) protect resources against impacts from continued O&M of the

	Project; (2) mitigate any impacts from continued O&M of the Project (if the resource cannot be fully protected); and (3) enhance resources affected by continued Project O&M
POR	Period of Record
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
Private	Private Land Owner
Privileged	For the purposes of FERC's filing requirements, material deemed confidential by Licensees will be filed with FERC as "Privileged." This information includes material, including, but not limited to, the location of sensitive cultural resources and the location of protected species, such as species listed as threatened or endangered under the Endangered Species Act, as well as business-sensitive information. Each page containing Privileged information will be so marked. Licensees will not provide Privileged material to the public. Upon request, Licensees will provide Privileged material to those agencies and Indian tribes with jurisdiction over
Project	South SWP Hydropower, FERC Project Number 2426
Project area	The area within the FERC Project boundary and the area immediately surrounding the FERC Project boundary
Project region	The area within the FERC Project boundary and the area surrounding the Project on the order of a county or National Forest
Project vicinity	The area within the FERC Project boundary and the area surrounding the Project on the order of a USGS 1:24,000 quadrangle
PSC	prickly sculpin
PSD	proportional size distribution
PSD-P	relative size distribution – preferred
PWC	personal watercraft
PYM	Pyramid Lake gage
QAC	Qualified Applicators Certificate
QA/QC	quality assurance/quality control
Quaternary Period	The current and most recent geologic time period of the Cenozoic Era that encompasses the time interval between

	about 2.6 million years ago through today. Quaternary time includes the Pleistocene and Holocene epochs.
RBT	rainbow trout
Recreation Report	2015 FERC Form 80
regional metamorphism	Metamorphism commonly associated with mountain-building episodes that occur over large areas of the Earth's crust and commonly show no relationship to intrusive igneous bodies. Strongly foliated metamorphic rocks (e.g., slate, schist, gneiss) are common under regional metamorphism.
Relicensing Participants	Federal and State agencies, local governments, Indian tribes, non-governmental organizations, businesses, and unaffiliated members of the public that have participated in the South SWP Hydropower relicensing
riparian	Vegetated zones that form a transition between permanently saturated areas and upland areas and that typically exhibit vegetation and physical characteristics associated with permanent sources of surface or groundwater
Riverine	Habitats contained in natural or artificial channels with periodically or continuously flowing water, or which form a connecting link between two bodies of standing water
RM	river mile
RMP	Recreation Management Plan
RMR	Rocky Mountain Recreation Company
ROS	recreation opportunity spectrum
rpm	revolutions per minute
RSD	Relative Stock Density
RTK	Real-Time Kinematic
RV	recreational vehicle
RWQCB	Regional Water Quality Control Board
SAR	sodium adsorption ratio
saturated	Wetlands in which the substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present
SC	Southern California
SCADA	supervisory control and data acquisition

SCCIC	South Central Coastal Information Center
SCE	Southern California Edison
SCORP	California State Comprehensive Outdoor Recreation Plan
scrub	Vegetation characterized by shrubs; may be classified by habitat type or by characteristic species
SD	State Delisted
SD1	Scoping Document 1
SD2	Scoping Document 2
SE	California State Endangered
SEA	Significant Ecological Area
sedimentary	Sedimentary rocks are formed from erosion of pre-existing rocks (clastic) or pieces of once-living organisms (biologic). They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding.
SFD	DWR Southern Field Division
SFHA	Special Flood Hazard Area
SGB	Sagebrush
SHPO	State Historic Preservation Officer
shrub	A layer of vegetation composed of woody plants less than 3.0 inches in diameter at breast height but greater than 3.2 feet in height, exclusive of woody vines
shrub-dominated	Shrub canopy closure exceeds 10 percent. However, tree crown closure never exceeds more than 10 percent of the site
SIO	Scenic Integrity Objective
SIP	State Implementation Policy
SMC	Sierran Mixed Conifer
SO_2	sulfur dioxide
SOPA	Survey on Public Opinions and Attitudes on Outdoor Recreation in California
SPME	Solid Phase Microextraction
SRA	State Recreation Area
SSC	California Species of Special Concern
ST	California State Threatened

Sta.	Station
State	State of California
s.u.	standard unit
subchronic	exposures over multiple days
submerged plants	rooted vascular plants which do not emerge above the water surface
substrate	The base or substance on which an attached species is growing
Sucker spp.	unknown sucker species
surface water	Water present above the substrate or soil surface
surficial deposit	Any loose, unconsolidated sedimentary deposit, typically less than 2.6 million years old, lying on bedrock
SWAMP	Surface Water Ambient Monitoring Program
SWP	State Water Project
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TCDD	2,3,7,8-Tetrachlorodibenzodioxin
TCP	Traditional Cultural Property
TDS	total dissolved solids
Tertiary Period	The earliest geologic time interval of the Cenozoic Era, beginning about 65 million years ago and ending 2.6 million years ago.
TMDL	Total Maximum Daily Load
topography	The shape of the land surface
TR	Trouble Report
tree	A woody plant greater than 3.0 inches in diameter at breast height, regardless of height (exclusive of woody vines)
tree-dominated	Tree canopy exceeds 10 percent crown closure, or young tree density indicates imminent tree dominance
TSS	total suspended solids
UC	University of California
unconsolidated	Loosely aggregated sediment; lacking cohesion or cement

unconsolidated bottom	All wetland and deepwater habitats with at least 25 percent cover of particles smaller than stones, and a vegetative cover less than 30 percent
unconsolidated shore	Wetlands and deepwater habitats characterized by substrates lacking vegetation except for pioneer plants that become established during brief periods when growing conditions are favorable
understory	The vegetation layer between the overstory or canopy and the ground-story of a forest community, formed by shade tolerant trees of moderate height
UNK	Unknown
upland	Any area that does not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils, and/or hydrologic characteristics associated with wetlands. Such areas occurring within floodplains are more appropriately termed non-wetlands.
URB	Urban
US	upstream
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
USGS	U.S. Geological Survey
USR	Updated Study Report
UWCD	United Water Conservation District
VAOT	Vehicles At One Time
VCWPD	Ventura County Watershed Protection District
vegetation	The total plant life or cover in an area; also used as a general term for plant life; the assemblage of plant species in a given area

vegetation layer	A subunit of a plant community in which all component species exhibit the same growth form (e.g., trees, saplings/shrubs, herbs)
VES	visual encounter survey
VOW	Valley Oak Woodland
VRI	Valley Foothill Riparian
Warne Powerplant	William E. Warne Powerplant
wash	A normally dry stream bed that occasionally fills with water
waters of the United States	Regulated under the Clean Water Act, and include waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce; their tributaries; and adjacent waters, including wetlands, ponds, lakes, impoundments and similar waters
WECC	Western Electricity Coordination Council
weed	Any plant growing where it is not wanted
wetlands	Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and which, under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions
WPLT	Western Pluvial Lakes Tradition
WQO	water quality objectives
WSE	water surface elevation
WSRA	Wild and Scenic Rivers Act
WTM	Wet Meadow
WWII	World War II
WY	water year
YOY	young-of-the-year

1.0 INTRODUCTION

1.1 LICENSEES' APPLICATION FOR A NEW LICENSE

The California Department of Water Resources (DWR) and the Los Angeles Department of Water and Power (LADWP) (Licensees) have prepared this Exhibit E, Environmental Report, as part of their Application for New License Major Project – Existing Dam (Application for New License) from the Federal Energy Regulatory Commission (FERC) for the South SWP Hydropower, FERC Project Number (No.) 2426 (Project). This exhibit has been prepared to conform with Title 18 of the Code of Federal Regulations (CFR), Subchapter B (Regulation under the Federal Power Act [FPA]), Part 5 (Application for License for Major Project – Existing Dam) (Integrated Licensing Process [ILP]). Specifically, this exhibit conforms to the regulations in 18 CFR Section (§) 4.51(f). Further, this Exhibit E was prepared in general conformance with FERC's Preparing Environmental Assessments: Guidelines for Applicants, Contractors and Staff (FERC 2008).

1.2 BRIEF DESCRIPTION OF THE LICENSEES' PROPOSAL

The existing Project is part of a larger water storage and delivery system, the State Water Project (SWP), which is the largest state-owned and operated water supply project of its kind in the United States (U.S.). The SWP provides southern California with many benefits, including affordable water supply, reliable regional clean energy, opportunities to integrate green energy, accessible public recreation opportunities, and environmental benefits.

The existing Project facilities are located in Los Angeles County on the West Branch of the SWP. The existing Project includes two developments, the Warne and Castaic Power Developments. Facilities and features of the Warne Power Development within the existing license include: (1) Quail Lake, Quail Lake Embankment and Quail Lake Outlet; (2) Lower Quail Canal; (3) Peace Valley Pipeline Intake, Peace Valley Pipeline Intake Embankment, and Peace Valley Pipeline; (4) Gorman Bypass Channel; (5) William E. Warne Powerplant (Warne Powerplant) and Switchyard; (6) Warne Transmission Line; (7) Primary Project Roads and Trails; and (8) recreation facilities. Facilities and features of the existing Castaic Power Development include: (1) Pyramid Dam and Lake; (2) Angeles Tunnel and Surge Chamber; (3) Castaic Penstocks; (4) Castaic Powerplant and Switchyard; (5) Elderberry Forebay Dam, Forebay, and Outlet; (6) Storm Bypass Channel and Check Dams; (7) Castaic Transmission Line; (8) Primary Project Roads and Trails; and (9) Pyramid Lake recreation facilities, including the Vista Del Lago Visitor Center. Facilities upstream of the Angeles Tunnel Surge Chamber are operated and managed by DWR. The remainder of the downstream facilities, including the Surge Chamber, are operated and managed by LADWP.

The Licensees propose to add to the Project license the existing Quail Detention Embankment, segments of some existing roads, and an existing streamflow gage. The Quail Detention Embankment lies along the northwest portion of the Lower Quail Canal between Interstate 5 and the Peace Valley Pipeline Intake Embankment, and is owned and operated by DWR. The embankment serves as a flood management structure to attenuate waters from Quail Lake or the Lower Quail Canal, and to protect Interstate 5 if an unplanned release of water occurs from these Project facilities – its sole purpose is related to the Project. The road segments are needed for the Licensees' access to the Project and serve no other purpose. The existing streamflow gage is located in Piru Creek downstream of Pyramid Dam, and monitors compliance with the Licensees' flow requirements.

The Licensees propose to remove from the Project license the Warne Transmission Line. The Warne Transmission Line has never met FERC's definition of a Primary Transmission Line and, therefore, should be removed from the license as a jurisdictional matter.

The Project's existing FERC boundary includes 6,928.0 acres, of which 2,790.02 acres are National Forest System (NFS) lands managed by the U.S. Department of Agriculture, Forest Service (USFS) and 17.26 acres are United States lands administered by the U.S. Department of the Interior (USDOI), Bureau of Land Management (BLM). The Licensees propose modifications to the existing boundary that would have the net effect of reducing the area within the boundary to 4,563.8 acres. Under the Licensees' proposed Project boundary, 1,334.6 acres would be on NFS lands managed by USFS as part of the Angeles National Forest (ANF), 665.9 acres would be on NFS lands managed by USFS as part of the Los Padres National Forest (LPNF), and 6.5 acres would be on United States lands administered by BLM. The modifications remove lands that are not needed for Project purposes and to accurately represent those lands (and associated facilities) required for Project operations and maintenance (O&M).

The existing Project's installed capacity, excluding one pump-starting unit at the Castaic Powerplant, is 1,349,290 kilowatts (kW). The existing Project is operated as a power recovery project using SWP water as it is provided for downstream consumptive use. For that reason, Project operations do not vary based on changes in local hydrological conditions. However, the daily timing of the water through the Warne and Castaic Powerplants is controlled for efficient generation (i.e., to support peaking and ancillary services). In addition, water in Elderberry Forebay is repeatedly pumped back up to Pyramid Lake and released through the Castaic Powerplant until the water is needed to meet downstream water demand. The Project does not use any local surface runoff to generate power: local surface runoff that enters Pyramid Lake is released downstream into Piru Creek in a manner that mimics the natural hydrology in both timing and magnitude; and local surface runoff that enters Elderberry Forebay is released downstream into the non-Project Castaic Lake. Quail Lake is not on a river system drainage and receives very little surface water. The Licensees do not propose any changes to existing operations, with the exception of Protection, Mitigation, and Enhancement (PM&E) measures, which are O&M activities and enhancements to: (1) protect resources against impacts from continued Project O&M; (2) mitigate any impacts from continued Project O&M, if the resource cannot be fully protected; and (3) enhance resources affected by continued Project O&M.

Figure 1.2-1 shows the lands and waters in the Project vicinity. Figure 1.2-2 shows generalized land ownership and the Project facilities; the existing and proposed Project boundaries are shown for reference.

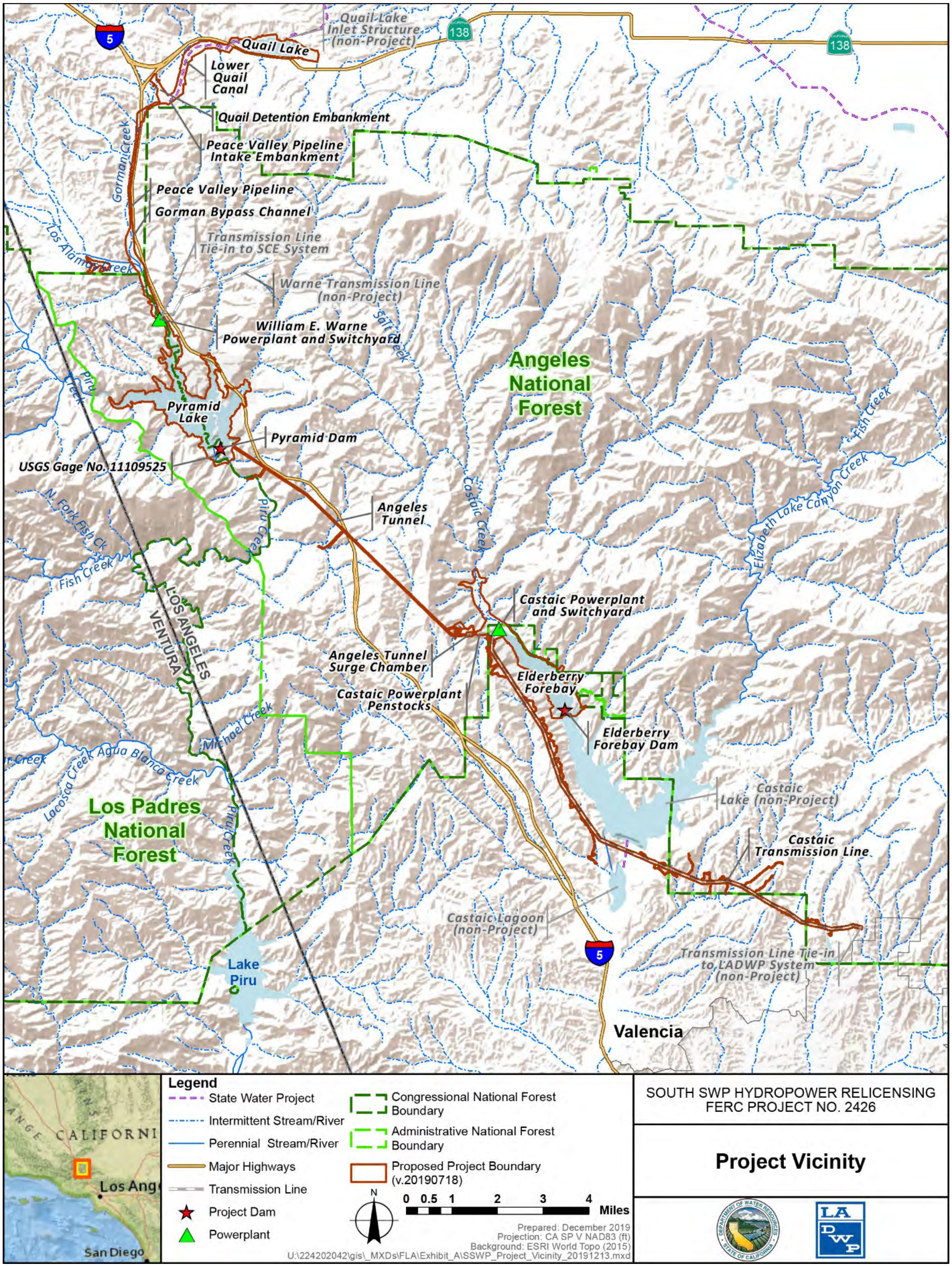

Figure 1.2-1. South SWP Hydropower Vicinity

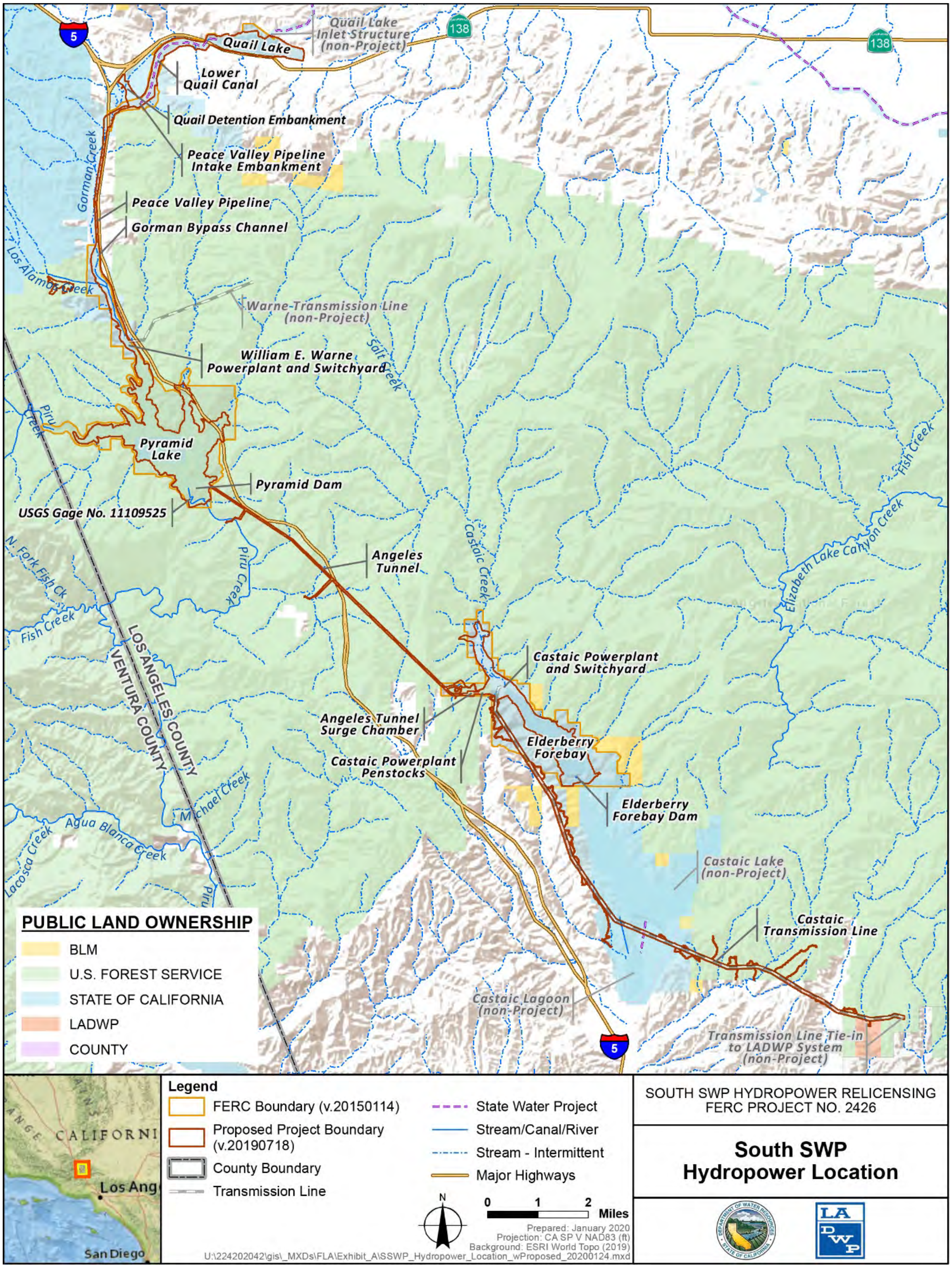

Figure 1.2-2. South SWP Hydropower Project Facilities and Boundary

1.3 PURPOSE OF ACTION AND NEED FOR POWER

1.3.1 Purpose of Action

FERC will decide whether to issue a new license to the Licensees for the Project and what conditions should be placed in the license, if issued. In deciding whether to issue a license for the Project, FERC must determine that the Project will be best adapted to a comprehensive plan for improving or developing the waterway. In addition to the power and developmental purposes for which licenses are issued, FERC must give equal consideration to the purposes of energy conservation; the PM&E measures for fish and wildlife, including related habitat; the provision of recreational opportunities; and the preservation of other aspects of environmental quality. Issuing a new license for the Project would allow the Licensees to continue to generate electricity at the Project for the term of the new license, making electric power from a clean resource available to the California Power Grid. DWR would continue to offset the cost of the SWP with the revenue from Project power generation so DWR can continue to provide affordable consumptive water to southern California. The license will also allow LADWP to continue to use Castaic Powerplant for Power System support and stability.

1.3.2 Need for Power

The Project is located in the California-Mexico Power area of the Western Electricity Coordination Council (WECC). According to the California Energy Commission, electricity consumption statewide is projected to grow at an annual average compounded rate of 1.64 percent from 2017 through 2027 (Kavalec et al. 2018). The Licensees' Proposal would continue to meet part of existing load requirements within the system, which is in need of resources.

Under the Licensees' Proposal, the Project's power capacity and generation would continue providing a portion of the electricity needed to pump water through the SWP at a lower cost than potential replacement power sources. Power from the Project could also help to meet a need for power in the WECC region in both the short and long term. The Project would continue to provide low-cost carbon free power that contributes to a diversified generation mix. Refer to Section 6.0 in Exhibit D of the Licensees' Application for New License for a detailed discussion of Project power.

1.4 APPLICABLE LAWS

As required by 18 CFR § 5.18(b)(3), this section describes the status of the Licensees' compliance with or consultation under applicable laws listed in § 5.18(b)(3).

1.4.1 Section 401 of the Clean Water Act

The Licensees intend to file with the State Water Resources Control Board (SWRCB) a request for Clean Water Act (CWA) Section 401 Water Quality Certification pursuant to FERC's requirements.

1.4.2 Endangered Species Act

Refer to Section 5.4.3 in this Exhibit E for a description of the process the Licensees used to address effects of the Licensees' Proposal on species listed or proposed for listing under the Endangered Species Act (ESA), including anticipated effects, if any; and the Licensees' consultation with USDOI U.S. Fish and Wildlife Service (USFWS); and the U.S. Department of Commerce, National Oceanic Atmospheric and Administration, National Marine Fisheries Service (NMFS) regarding ESA-listed species and their critical habitats. Section 5.4.3 is intended to satisfy the need for a draft Biological Assessment (BA) related to ESA-listed species.

1.4.3 Magnuson-Stevens Fishery Conservation and Management Act

The Project does not affect any freshwater Essential Fish Habitat (EFH) designated by the Pacific Fisheries Management Council (50 CFR § 660.412); therefore, this law is not applicable.

1.4.4 Coastal Zone Management Act

The Project is approximately 36 miles away from the coast, is not located within the boundary of any designated Coastal Zone, and does not affect any land or water use or natural resource of the State's coastal zone. Therefore, the Project is not subject to California coastal zone program review.

1.4.5 National Historic Preservation Act

Refer to Section 5.8 in this Exhibit E for a description of the Licensees' consultation with the Advisory Council on Historic Preservation (ACHP), the State Historic Preservation Officer (SHPO), Indian tribes, USDOI, National Park Service (NPS), and other interested parties, including USFS and BLM, regarding potential effects of the Licensees' Proposal on historic properties, a requirement under the National Historic Preservation Act (NHPA). A draft Historic Properties Management Plan (HPMP) is included in Appendix A of this Exhibit E.

1.4.6 Pacific Northwest Power Planning and Conservation Act

The Project is not located within the Pacific Northwest Electric Power Planning and Conservation Area (i.e., the Columbia River Basin); therefore, this law is not applicable.

1.4.7 Wild and Scenic Rivers Act and Wilderness Acts

Refer to Section 5.6.1.2 for a description of areas within or in the vicinity of the proposed Project boundary that are included in, or have been designated for study for inclusion in, the National Wild and Scenic River System, or that have been designated as wilderness areas, recommended for such designation, or designated as a wilderness study area under the Wilderness Act.

1.5 CONSULTATION DOCUMENTATION

FERC's regulations (18 CFR § 5.1) require that an applicant consult with appropriate federal and state agencies, local governments, Indian tribes, non-governmental organizations (NGO), businesses and unaffiliated members of the public that may be interested in the proceeding before filing an application for a license. This consultation is the first step in complying with NHPA, ESA, and other federal statutes discussed above. Pre-application filing consultation must be completed and documented according to FERC's regulations.

1.5.1 Licensees' Activities Prior to Filing Notice of Intent and Pre-Application Document

Prior to filing its Notice of Intent (NOI) to File an Application for New License and Pre-Application Document (PAD), the Licensees initiated consultation with agencies and others that may be interested in the Project relicensing. This early consultation included requesting from agencies and others existing, relevant, and reasonably available information the party may have regarding the Project, potentially affected resources, potential Project effect issues, and potential studies. Documentation of these requests and responses are provided in the Licensees' PAD.

To facilitate early engagement in the relicensing, the Licensees invited agencies to an informal relicensing meeting and site visit on September 2, 2015. The purposes of the meeting and site visit were to initiate discussions with resource agencies as part of information gathering and issue identification for the PAD, and to provide resource agencies with an overview of Project facilities being relicensed and the proposed relicensing process.

1.5.2 Licensees' Notice of Intent and Pre-Application Document Filings

On August 1, 2016, the Licensees filed with FERC their NOI and PAD. The NOI stated the Licensees' unequivocal intent to file an Application for New License for the Project by January 31, 2020, two years prior to expiration of the existing license. The PAD provided summaries of existing, relevant, and reasonably available information regarding the Project; resources potentially affected by the Project; any known or suspected resource impacts; and outlines for studies that the Licensees proposed to conduct to supplement existing, relevant, and reasonably available information. The document can be found at FERC E-Library Accession #: 20160801-5247.

1.5.3 FERC's Notice of the Licensees' Notice of Intent and Pre-Application Document Filings

On September 30, 2016, FERC issued an NOI to File License Application, Filing of PAD, Commencement of Pre-Filing Process, and Scoping; Request for Comments on the PAD and Scoping Document, and Identification of Issues and Associated Study Request for the South SWP Hydropower. Record of this filing can be found at FERC's E-Library Accession #: 20160930-3020. The notice stated that FERC intended to prepare an Environmental Assessment (EA) for the Licensees' Proposal, but noted there was a possibility that an Environmental Impact Statement would be required. The notice invited agencies with jurisdiction or special expertise with respect to environmental issues that would like cooperating status for the preparation of the National Environmental Policy Act (NEPA) environmental document to so notify FERC. In addition, the notice initiated informal consultation with USFWS and NMFS under Section 7 of the ESA and the joint agency regulations thereunder at 50 CFR, Part 402, and with the SHPO under Section 106 of the NHPA and the implementing regulations at 36 CFR 800.2. Further, the notice designated DWR and LADWP as FERC's non-federal representatives for carrying out informal consultation under Section 7 of the ESA and Section 106 of the NHPA.

1.5.4 FERC's National Environmental Policy Act Scoping

The ILP includes a scoping process that promotes the identification and analysis of all pertinent environmental issues. On September 30, 2016, FERC issued Scoping Document 1 (SD1), which provided Relicensing Participants (i.e., federal and State agencies, local governments, Indian tribes, NGOs, businesses and unaffiliated members of the public that have participated in the South SWP Hydropower relicensing) with FERC's preliminary list of issues and alternatives to be addressed in an EA or EIS for the Project relicensing, and enabled Relicensing Participants to more effectively participate in and contribute to the scoping process. The document can be found at FERC E-Library Accession #: 20160930-3013.

FERC conducted an environmental site review of the Project on October 25, 2016, and held two public NEPA scoping meetings in Valencia, California, on October 26, 2016. The site review and scoping meetings were noticed in a local newspaper and in the Federal Register (FR). The meetings were recorded and the transcript posted by FERC on its Internet E-Library. FERC requested that written comments on SD1 and the Licensees' PAD be provided to FERC no later than November 29, 2016. The morning scoping meeting transcript and the evening scoping meeting transcript can be found at FERC E-Library Accession #: 20161026-4005, and 20161026-4006, respectively.

In addition to the oral comments received during the scoping meetings, FERC received 12 comment letters by the November 29, 2016, deadline, and one comment letter after the deadline. Eleven of the letters provided comments on SD1 and nine of the letters commented on the PAD. Table 1.5-1 lists Relicensing Participants that filed comments on SD1 and the PAD.

Table 1.5-1. List of Comment Letters in Chronological Order Filed with FERC on FERC's Scoping Document 1 and the Licensees' Pre-Application Document

Relicensing Participant	Date of Letter	Document on Which Comments Were Filed		Accession Number
		FERC's Scoping Document 1	Licensees' Pre-Application Document	
U.S. Department of Homeland Security, Federal Emergency Management Agency	10/20/16	X	--	20161107-0111
California Department of Parks and Recreation, Office of Historic Preservation	10/31/16	X	X	20161031-5295
U.S. Department of Agriculture, Forest Service	11/21/16	X	X	20161128-5055
U.S. Department of Interior, Fish and Wildlife Service	11/23/16	--	X	20161129-0080
United Water Conservation District	11/23/16	X	--	20161128-5111
California Department of Fish and Wildlife	11/23/16	X	X	20161125-5015
U.S. Department of Commerce, National Oceanic Atmospheric and Administration, National Marine Fisheries Service	11/25/16	X	X	20161128-5061
State Water Contractors	11/28/16	X	--	20161128-5174
American Whitewater	11/29/16	--	X	20161129-5314
U.S. Environmental Protection Agency	11/29/16	X	--	20161129-5306
California Trout, Inc.	11/29/16	X	X	20161129-5240
State Water Resources Control Board	11/29/16	X	X	20161129-5313
U.S. Department of the Interior, National Parks Service	12/5/16	X	X	20161205-5359
Subtotal		**11**	**9**	
Total Participants Providing Comments		**13**		

Following FERC's review of oral comments during the scoping meetings and written comments on SD1, on January 13, 2017, FERC issued Scoping Document 2 (SD2), which replaced SD1. This document can be found at FERC E-Library Accession #: 20170113-3033.

1.5.5 Interventions

At the time the Licensees file this Application for New License, FERC has not yet solicited interventions in the relicensing proceeding.

1.5.6 Cooperating Agency Status

At the time the Licensees file this Application for New License, no agency has requested cooperating agency status for preparation of the NEPA document.

1.5.7 Relicensing Studies

1.5.7.1 Licensees' Proposed Studies in Pre-Application Document

As part of its PAD, the Licensees conducted a data gap analysis to identify additional information gathering (i.e., studies) necessary to supplement existing, relevant, and reasonably available information. Based on this analysis, the Licensees included in their PAD outlines 13 proposed studies. These were:

1. Aquatic Invasive Species Study
2. Quail Lake Fish Populations Study
3. Pyramid Reach Fish Populations Study
4. Special-Status Aquatic Amphibians and Semi-Aquatic Snakes Study
5. Botanical Resources Study
6. Non-Native Invasive Plants Study
7. Special-Status Terrestrial Wildlife Species – California Wildlife Habitat Relationships Study
8. ESA-Listed Plants Study
9. ESA-Listed Amphibians, California Red-Legged Frog Study
10. ESA-Listed Riparian Bird Species, Southwestern Willow Flycatcher, Least Bell's Vireo and Yellow-billed Cuckoo Riparian Habitat Evaluations Study
11. Recreation Facilities Demand Analysis and Condition Assessment Study

12. Cultural Resources Study

13. Tribal Resources Study

1.5.7.2 Licensees' Proposed Study Plan

After reviewing oral comments during the NEPA scoping meetings and written comments on the PAD, the Licensees found that only USFS, NPS, SWRCB, the California Department of Fish and Wildlife (CDFW), and American Whitewater (AW) requested modifications to the studies proposed by the Licensees in their PAD or new studies. On January 13, 2017, the Licensees issued a Proposed Study Plan, which included detailed plans for 18 studies. The studies included the 13 studies listed in the Licensees' PAD, and the following five new studies:

1. Indicators of Hydrologic Alterations Study

2. Visual Quality Study

3. Water Quality and Temperature Study

4. Fish Entrainment Risk Assessment Study

5. ESA-Listed Terrestrial Wildlife Species – California Wildlife Habitat Relationships Study

For reference, this document can be found at FERC E-Library Accession #: 20170113-5141.

1.5.7.3 Licensees' Revised Study Plan

On April 13, 2017, seven Relicensing Participants and FERC filed comments on the Licensees' Proposed Study Plan (Table 1.5-2).

Table 1.5-2. List of Comment Letters Filed with FERC on the Licensees' Proposed Study Plan

Relicensing Participant	Date of Letter	Accession Number
Federal Energy Regulatory Commission	4/13/17	20170413-3005
U.S. Department of Agriculture, Forest Service	4/13/17	20170413-5175
U.S. Department of Interior, Fish and Wildlife Service	4/13/17	20170413-5323
California Department of Fish and Wildlife	4/13/17	20170413-5234
U.S. Department of Commerce, National Oceanic Atmospheric and Administration, National Marine Fisheries Service	4/13/17	20170413-5274
American Whitewater	4/13/17	20170413-5249
California Trout, Inc.	4/13/17	20170414-5009
State Water Resources Control Board	4/13/17	20170413-5379
Total	**8**	

After reviewing the comments on the Licensees' Proposed Study Plan and holding a February 8, 2017, general study plan meeting and subsequent meetings to try to resolve differences regarding studies, on May 15, 2017, the Licensees issued their Revised Study Plan, in which they modified some of the study plans included in their Proposed Study Plan and added the following four new studies, to bring the total number of Licensees' proposed studies to 22:

1. Whitewater Boating Study
2. Special-Status Raptors Study
3. Pyramid Reach Benthic Macroinvertebrates Study
4. Pyramid Lake Tributaries Fish Passage Barriers Study

The RSP can be found in the FERC E-Library, Accession #: 20170515-5122.

1.5.7.4 FERC's Determination on Revised Study Plan

Comments on the Licensees' Revised Study Plan were filed by seven Relicensing Participants. None of the commenters requested Formal Study Dispute Resolution under 18 CFR 5.14 (Table 1.5-3). FERC's Study Plan Determination can be accessed via the FERC E-Library, under Accession #: 20170614-3030. Refer to Appendix B of this Exhibit E or to the South SWP Hydropower relicensing website (http://south-swp-hydropower-relicensing.com/) for the detailed study approaches, study summaries, and detailed study data.

Table 1.5-3. List of Comment Letters in Chronological Order Filed with FERC on the Licensees' Revised Study Plan

Relicensing Participant	Date of Letter	Accession Number
Metropolitan Water District of Southern California	5/25/17	20170601-0061
U.S. Department of Commerce, National Oceanic Atmospheric and Administration, National Marine Fisheries Service	5/25/17	20170525-5163
State Water Contractors	5/26/17	20170526-5296
U.S. Department of Agriculture, Forest Service	5/30/17	20170530-5198
California Department of Fish and Wildlife	5/30/17	20170530-5253
U.S. Department of the Interior, National Park Service	5/30/17	20170530-5113
State Water Resources Control Board	5/31/17	20170606-0017
Total	**7**	

On June 14, 2017, FERC issued a Study Plan Determination, which approved without modification 10 of the 22 studies proposed by the Licensees in their Revised Study Plan, modified 12 of the studies proposed by the Licensees in their Revised Study Plan, and did not add any new studies. Record of this filing can be found at FERC's E-Library Accession #: 20170614-3030. The Licensees began conducting the FERC-approved studies in July 2017. As studies were completed, the Licensees posted to their Project relicensing website (www.south-swp-hydropower-relicensing.com) study results in the form of "field results and data summary reports." Each report includes: (1) a summary of completed work; (2) key accomplishments and a summary of findings; (3) list of associated data files for field results available on the Licensees' website; and (4) variances from the FERC-approved study. The attachments to the field results and data summary reports include maps, background information, and data. The FERC-approved study plan is also included in the report folder on the Licensees' relicensing website and in Appendix B of this Exhibit E. The Licensees advised Relicensing Participants via e-mail regarding the availability of a report soon after each report was posted.

1.5.7.5 Licensees' Initial Study Report

The Licensees filed with FERC an Initial Study Report (ISR) on May 15, 2018 (see FERC's E-Library Accession #: 20180515-5157). At that time, one study was complete, and the Licensees did not propose any study modifications or new studies. The Licensees held an ISR meeting on May 23, 2018, and filed with FERC an ISR meeting summary on June 7, 2018 (see FERC's E-Library Accession #: 20180607-5024). Four comment letters were filed with FERC on the Licensees' ISR and ISR Meeting Summary (Table 1.5-4).

Table 1.5-4. List of Comment Letters in Chronological Order Filed with FERC on the Licensees' Initial Study Report and Initial Study Report Meeting Summary

Commenter	Date of Comment Letter	Accession Number
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service	6/28/18	20180628-5010
California Department of Fish and Wildlife	7/3/18	20180711-0016
State Water Resources Control Board	7/6/18	20180706-5139
U.S. Department of Agriculture, Forest Service	7/9/18	20180710-0022
Total	**4**	

1.5.7.6 FERC's Determination on Initial Study Report

On September 7, 2018, FERC issued a Determination on Requests for Study Modifications and New Studies – South SWP Hydropower that concluded no modifications to FERC's June 14, 2017, Study Plan Determination were required. This can be found at the FERC E-Library; Accession #: 20180907-3005.

1.5.7.7 Licensees' Updated Study Report

The Licensees filed with FERC an Updated Study Report (USR) on May 15, 2019. Sixteen studies were complete, and the Licensees expected the remaining studies would be complete prior to filing the Draft Application for New License (DLA). The Licensees did not propose any study modifications or new studies. The Licensees held a USR meeting on May 29, 2019, and filed with FERC a USR meeting summary on June 13, 2019.

The Licensees filed three different documents pertaining to the USR meeting summary. They included a privileged meeting summary with privileged attachments and a public meeting summary without attachments. They can be found in the FERC E-Library, at the following Accession Numbers:

- Privileged USR Meeting Summary: 20190613-5040
- Privileged Attachments for USR Meeting Summary: 20190613-5039
- Public USR Meeting Summary: 20190613-5159

Five comment letters were filed with FERC (Table 1.5-5).

Table 1.5-5. List of Comment Letters in Chronological Order Filed with FERC on the Licensees' Updated Study Report and Updated Study Report Meeting Summary

Commenter	Date of Comment Letter	Accession Number
U.S. Department of the Interior, National Park Service	7/11/19	20190711-5129
American Whitewater	7/12/19	20190712-5176
U.S. Department of Agriculture, Forest Service	7/12/19	20190712-5076
California Department of Fish and Wildlife	7/12/19	20190712-5059
California Department of Fish and Wildlife	7/18/19	20190718-0015
Total	**5**	

1.5.7.8 Licensees' Updated Study Report

On August 12, 2019, the Licensees filed their USR Response to Comments on the USR and USR Meeting Summary. For reference, this filing can be found at the FERC E-Library; Accession #: 20190812-5022.

1.5.7.9 FERC's Determination on Updated Study Report

On September 11, 2019, FERC issued a Determination on Requests for Study Modifications and New Studies – South SWP Hydropower that recommended no modifications to FERC's June 14, 2017 Study Plan Determination with one exception. FERC directed the Licensees to modify Study 19, Whitewater Boating, to conduct a Level 3 controlled-flow study in Pyramid reach in fall/winter 2019. FERC's letter can be found at the FERC E-Library; Accession #: 20190911-3000.

1.5.7.10 Study Status

The Licensees have completed the 22 FERC-approved studies, with the exception of the Level 3 controlled-flow study. The fieldwork for the study was conducted on December 19 and 20, 2019. A final report, which will complete the study, is scheduled to be filed with FERC by April 3, 2020. The results of each study, including data, are posted on the Licensees' relicensing website, and the studies are incorporated into this Application for New License.

1.5.8 Collaborative Development of Protection, Mitigation, and Enhancement Measures

From February through August 2019, the Licensees held three meetings, conducted one site visit to the Project, and held two conference calls with Relicensing Participants. The purpose of these meetings, site visit, and conference calls was to collaboratively develop and agree upon certain PM&E measures that the Licensees would include in their DLA and that the Relicensing Participants would support. These meetings and calls were open to all Relicensing Participants.

1.5.9 Summary of Collaborative Meetings

1.5.9.1 PM&E Kick Off Meeting

The Licensees conducted a PM&E Kick Off meeting on February 14, 2019. The meeting was held to provide agencies with updates regarding the study status and to discuss the development of the PM&E measures for preparation of the DLA. Attendees included the Licensees, Consultants, and agency representatives. Meeting materials and documentation can be found in Appendix C of this Exhibit E.

1.5.9.2 PM&E Process Call

The Licensees held a PM&E Process Call with agencies on April 30, 2019 to discuss PM&E development and any necessary or ongoing agency collaboration relative to the DLA. Attendees included the Licensees, Consultants, and agency representatives. Meeting materials and documentation can be found in Appendix C.

1.5.9.3 PM&E Agency Collaboration Meetings

The Licensees held two meetings to discuss PM&E development on June 18 and 19, 2019. The first meeting, held on June 18, was held to discuss the potential development of an Integrated Vegetation Management Plan (IVMP) for the DLA. The second meeting, on June 19, was held to discuss the potential development of Visual Resources and Recreation Management Plans for the DLA. Attendees included the Licensees, Consultants, and agency representatives. Meeting materials and documentation can be found in Appendix C.

1.5.9.4 PM&E Recreation Site Visit

The Licensees conducted a PM&E Recreation Site Visit on July 31, 2019. The meeting was held in order to continue collaboration with Relicensing Participants. The Licensees conducted the site visit with the purpose of viewing and discussing Project-related facilities, signage, and accessibility in relation to PM&Es for the Recreation Management Plan (RMP). Attendees included the Licensees, Consultants, and agency representatives. Meeting materials and documentation can be found in Appendix C of this Exhibit E.

1.5.9.5 PM&E Call-In

The Licensees held a PM&E Call-In with agencies on August 2, 2019 to discuss PM&E development updates and any necessary or ongoing agency collaboration relative to the DLA. Attendees included the Licensees, Consultants, and agency representatives. Meeting materials and documentation can be found in Appendix C.

1.5.9.6 PM&E Collaboration Call

The Licensees held a PM&E collaboration call with agencies on November 1, 2019, in order to review the Relicensing Participants' redline comments on the IVMP and the RMP, and to continue collaborative discussions on development of the plans. Attendees included the Licensees, consultants, and agency representatives. Refer to Appendix C for meeting materials and related documentation.

1.5.10 <u>Licensees' Filing of Draft Application for New License</u>

On August 30, 2019, the Licensees filed with FERC and made available to Relicensing Participants a copy of their DLA for 90-day review. In addition, a copy of the draft was provided to the Director of FERC's San Francisco Regional Office.

1.5.11 <u>Comments on Draft Application for New License and Licensees' Responses</u>

Eight parties filed with FERC comments on the Licensees' DLA: FERC; USFS; NPS; NMFS; SWRCB; CDFW; United Water Conservation District (UWCD); and California Trout (Table 1.5-6). No written comment letters were filed by Indian tribes.

Table 1.5-6. List of Comment Letters in Chronological Order Filed with FERC on the Licensees' DLA

Commenter	Date of Comment Letter	Accession Number
U.S. Department of the Interior, National Park Service	11/20/19	20191121-5037
U.S. Department of Agriculture, Forest Service	11/25/19	20191125-5114[1]
U.S. Department of Agriculture, Forest Service	11/25/19	
California Trout	11/26/19	20191127-5024
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service	11/26/19	20191126-5230
California Department of Fish and Wildlife	11/27/19	20191129-5014
Federal Energy Regulatory Commission	11/27/19	20191127-3042
State Water Resources Control Board	11/27/19	20191127-5171
United Water Conservation District	11/27/19	20191127-5023

Note:
[1]USFS filed two letters under this accession number.

The Licensees carefully reviewed each comment letter and adopted those comments they considered reasonable and appropriate. Other preliminary proposed measures and studies not adopted by the Licensees and the reasons the Licensees did not adopt them are discussed in the appropriate resource sections in Exhibit E.

1.5.12 Licensees' Filing of Final Application for New License

In late January 2020, the Licensees filed with FERC and made available to interested agencies, Indian tribes, and members of the public a copy of the Licensees Final Application for New License (FLA).

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2.0 PROPOSED ACTION AND ALTERNATIVES

This section describes the existing Project (i.e., No-Action Alternative or Environmental Baseline) and the Licensees' proposed changes to the existing Project (i.e., the Licensees' Proposal). This section also discusses other action alternatives that were considered but not analyzed in detail in this document.

2.1 LICENSEES' PROPOSAL

The Licensees' Proposal is a continued operation of the existing Project during the term of the new license with certain changes described below. The existing Project is a power recovery project that operates on the southern end of the West Branch of the SWP in Los Angeles County, California, between the towns of Castaic and Gorman. The SWP provides southern California with affordable water supply to supplement local resources. The existing Project generates clean hydropower, provides significant public recreation opportunities easily accessible to both visitors to the area and residents of the surrounding communities, and provides environmental benefits.

The Licensees propose five changes to the existing Project: (1) addition of the existing Quail Detention Embankment; (2) removal of the Warne Transmission Line from the license; (3) addition of an existing stream flow gage; (4) addition of existing Primary Project Roads; and (5) modifications to the existing Project boundary. The Licensees propose to continue to operate the Project as it has operated historically, with the addition of a number of PM&E measures. These proposed changes are described below.

2.1.1 Licensees' Proposal - Project Facilities

Existing Project facilities are composed of two developments: the Warne Power Development and the Castaic Power Development. Facilities and features of the Warne Power Development include: (1) Quail Lake, Quail Lake Embankment and Quail Lake Outlet; (2) Lower Quail Canal; (3) Peace Valley Pipeline Intake, Peace Valley Pipeline Intake Embankment, and Peace Valley Pipeline; (4) Gorman Bypass Channel; (5) Warne Powerplant and Switchyard; (6) Warne Transmission Line; (7) Primary Project Roads and Trails; and (8) Quail Lake recreation facilities. Features and features of the Castaic Power Development include: (1) Pyramid Dam and Lake; (2) Angeles Tunnel and Surge Chamber; (3) Castaic Penstocks; (4) Castaic Powerplant and Switchyard; (5) Elderberry Forebay Dam, Forebay, and Outlet; (6) Storm Bypass Channel and Check Dams; (7) Castaic Transmission Line; (8) Primary Project Roads and Trails; and (9) Pyramid Lake recreation facilities, including the Vista Del Lago Visitor Center.

The Licensees propose two changes to the existing Warne Power Development generation-related facilities. First, the Licensees propose to remove the Warne Transmission Line from the license.[1] The Warne Transmission Line is part of Southern

[1] For the remainder of Exhibit E, the Warne Transmission Line is described as the 3-mile section of the Pardee-Pastoria-Warne 220kV transmission line from the Warne Substation.

California Edison's (SCE) Pardee-Pastoria-Warne 220 kV transmission line which connects to the Warne Switchyard. It is important to note that, while the Warne Transmission Line is included as part of the Warne Power Development under the existing FERC license, it is a facility owned and operated by SCE. As part of the interconnected electric grid, it is not within FERC's licensing jurisdiction. SCE's transmission line segment has never been a Project work and was included in the original Project license in error – an inaccuracy that has persisted through the term of the current license. The Warne Transmission Line will continue to function as it has historically, despite this administrative change. See Section 5.3 of Exhibit A of this Application for New License for additional information.

Second, the Licensees propose to add the existing Quail Detention Embankment to the Warne Power Development. This embankment lies along the northwest portion of the Lower Quail Canal between Interstate 5 and the Peace Valley Pipeline Intake Embankment. The Quail Detention Embankment serves as a flood management structure to attenuate waters from Quail Lake or the Lower Quail Canal, and to protect Interstate 5 if an unplanned release of water occurs from these facilities. DWR owns and operates all existing Project facilities upstream of the Angeles Tunnel, with the exception of Pyramid Lake recreation facilities, which are owned and operated, through an agreement with DWR, by USFS. LADWP owns and operates all Project facilities downstream of the Angeles Tunnel Surge Chamber. The existing Project facilities are further described in Section 2.2.1 (Existing Project Facilities).

The Project does not include any works maintained and operated by the U.S. Army Corps of Engineers (USACE), BLM, or any other department or agency of the United States, other than the Project recreation facilities that, with two exceptions, are owned by USFS and operated by DWR and its concessionaire. The exceptions are the Quail Lake Fishing Access Path and the Vista Del Lago Visitor Center, which are owned and operated by DWR. The Project does not include the following features located within the proposed Project boundary or its vicinity:

- The portion of the Quail Lake Inlet Structure upstream of and including the stilling basin is part of the SWP and is owned and operated by DWR; the Quail Lake Inlet Structure and associated facilities and features are not part of the Project because they are part of a control structure with the principal purpose of transporting water for SWP operations and are unrelated to the production of power.

- Three short segments of Interstate 5 with California Department of Transportation (Caltrans) maintenance facilities near Liebre Creek that are major public highway segments maintained by the U.S. Department of Transportation through Caltrans as part of the U.S. Interstate Highway System.

- A segment of Hardluck Road that is on State lands, is a multiple use public roadway designated as USFS Road 7N32, and is used to access the USFS Los

Alamos Fire Station and Heliport, a USFS administrative campground, as well as a network of USFS road and trail systems.

- The Goodell Fire Road/Castaic Canyon Road (USFS Road 6N13) on the east side of Elderberry Forebay that is on State and BLM lands, and is not used for Project operations; the USFS road is a public use facility and fire road, and is closed to public vehicular access.

- A segment of Pyramid Lake Road, located on State lands, that is a county road maintained by the Los Angeles County Department of Public Works; the roadway serves as a multiple use public road for DWR, California Department of Parks and Recreation (DPR), USFS, and others, as well as for the general public for accessing DPR, Project, and USFS recreation lands and facilities.

- A portion of Templin Highway west Old Ridge Route that is on NFS and State lands is a county road maintained by the Los Angeles County Department of Public Works as a multiple use public road.

2.1.1.1 Recreation Facilities

The Licensees do not propose to add any new recreation facilities to the Project's licensed facilities, including recreation-related roads and trails.

2.1.1.2 Gages

The Licensees propose to add to the Castaic Power Development licensed facilities one existing streamflow gage for the purpose of documenting compliance with conditions in the new license. The gage is described in Table 2.1-1. The Licensees do not propose to add to the Project any other streamflow gages or reservoir stage gages, since the Licensees do not propose any other measures related to streamflow or reservoir stage gages. See Figure 5.2-1 in Section 5.2 (Water Resources) for Project gages.

Table 2.1-1. Existing Gage Proposed for Addition to the Proposal

USGS Gage No.	Gage Name	Purpose of Gage as Related to the Project
11109525	Piru Creek Below Pyramid lake Near Gorman, CA	Record releases from Pyramid Lake into Pyramid reach

Key:
CA = California
No. = number
USGS = U.S. Geological Survey

2.1.1.3 Roads and Trails

Table 2.1-2 describes 99 road segments that the Licensees propose to add to the Project's licensed facilities as Primary Project Roads; the Licensees do not propose to add any Primary Project Trails to the Project. A Primary Project Road is identified in the license as a Project facility, is used almost exclusively to access the Project, is within the existing Project boundary, and is operated and maintained exclusively by the Licensees as a Project feature. This includes roads associated with Project recreation facilities, but does not include designated parking areas that are considered part of the facility or feature for which the parking area is provided. Primary Project Roads do not include "shared," "joint," or "multiple use" roads that are used and maintained by multiple parties, including the Licensees, because these shared roads are not for the sole purpose of accessing the Project and are, therefore, not the sole responsibility of the Licensees to maintain under the license. Outside of licensing, the Licensees have the necessary permissions, if needed, to use "shared" roads. The Licensees propose to include one Primary Project Trail – the Quail Lake Access Path.

2.1.2 Proposed Project Boundary

The Licensees propose to modify the existing Project boundary, which would result in a reduction of the area within the boundary from 6,928.0 acres to 4,563.8 acres, of which 1,334.6 acres would be NFS lands managed by USFS as part of the ANF; 665.9 acres would be NFS lands managed by the USFS as part of the LPNF; and 6.5 acres would be United States lands managed by BLM. The proposed Project boundary encompasses all pertinent lands and waters associated with all Project facilities and operations, including Project roads listed in Table 2.1-2, and encloses those areas the Licensees found to conform to FERC requirements to "enclose only those lands necessary for operation and maintenance of the project and for other project purposes, such as recreation, shoreline control, or protection of environmental resources." There are lands within the existing Project boundary that do not meet these needs and were never set aside for those purposes in the original license, nor have any been associated with any mitigation or enhancement measure for the Project. The Warne Transmission Line as a facility outside the existing boundary was included in the original Project license in error, and the error has persisted through the term of the current license.

Table 2.1-2. Primary Project Roads Proposed for Addition to the Project

Designation in Exhibit A	Begins	Ends	Land Ownership	Gated or Otherwise Restricted to Public	Length (miles)	Project Use
Castaic Penstock Road	Gate next to Templin Highway	Top of Castaic Penstocks	USFS	yes	0.8	South Portal Access
Angeles Tunnel Surge Tank Road	Templin Highway	Angeles Tunnel Surge Tank	USFS	yes	0.1	Angeles Tunnel Surge Tank Access
Angeles Tunnel South Adit Road	Castaic Penstock Road	Angeles Tunnel South Adit	USFS	yes	0.3	Angeles Tunnel South Adit Access
Elderberry Forebay Dam Access	Gate/FERC Boundary	Bottom of spillway	State of California	yes	0.1	Elderberry Forebay Dam Access
Elderberry Forebay Dam Spillway Access	West end of Elderberry Forebay Dam	Bottom of Spillway	State of California	yes	0.4	Elderberry Forebay Dam Access
Los Angeles Water and Power Road	Gate on Los Angeles Water and Power Road	Elderberry Forebay Dam	State of California	yes	2.9	Dam Patrol Road
LADWP Tower 1-4, 1-5, 2-1 Access	USFS Boundary	LADWP Tower 2-1	State of California	yes	1.5	LADWP Tower 1-4, 1-5, 2-1 Access
Water Tank Access	LADWP Tower 1-2 Access Road	Water Tank	State of California	yes	0.1	LADWP Tower 1-2 Access
Vista Ridge Fire Road	Cutler Canyon Fire Road/Vista Ridge Connector	Ridge Route Road	State of California, BLM, LADWP, Private	yes	4.4	Castaic-Haskell TL Access
LADWP Tower 2-2, 2-3 Access	Vista Ridge Fire Road	LADWP Tower 2-3	State of California	yes	0.3	LADWP Tower 2-2, 2-3 Access
LADWP Tower 3-3 Access	Cutler Canyon Fire Road	LADWP Tower 3-3	State of California	yes	0.1	LADWP Tower 3-3 Access
LADWP Tower 3-4 Access	Cutler Canyon Fire Road	LADWP Tower 3-4	State of California	yes	0.0	LADWP Tower 3-4 Access
LADWP Tower 4-2 Access	Cutler Canyon Fire Road	LADWP Tower 4-2	State of California, LADWP, Private	yes	0.2	LADWP Tower 4-2 Access
LADWP Tower 4-3 Access	Cutler Canyon Fire Road	LADWP Tower 4-3	LADWP, Private	yes	0.1	LADWP Tower 4-3 Access
LADWP Tower 5-1 Access	Cutler Canyon Fire Road	LADWP Tower 5-1	LADWP	yes	0.1	LADWP Tower 5-1 Access
LADWP Tower 5-2, 5-3 Access	Cutler Canyon Fire Road	LADWP Tower 5-3	State of California, LADWP	yes	0.3	LADWP Tower 5-3 Access
LADWP Tower 5-2 Access	LADWP Tower 5-3 Access Road	LADWP Tower 5-2	State of California, LADWP	yes	0.1	LADWP Tower 5-2 Access
LADWP Tower 7-2 Access	Castaic Dam parking area	LADWP Tower 7-2	State of California	yes	0.3	LADWP Tower 7-2 Access

Table 2.1-2. Primary Project Roads Proposed for Addition to the Project (continued)

Designation in Exhibit A	Begins	Ends	Land Ownership	Gated or Otherwise Restricted to Public	Length (miles)	Project Use
LADWP Tower 7-3 Access	Castaic Dam parking area	LADWP Tower 7-3	State of California	yes	0.1	LADWP Tower 7-3 Access
LADWP Tower 7-4, 7-5, 8-1 Access	Lake Hughes Road	LADWP Tower 7-5	State of California	no	0.6	LADWP Tower Access
LADWP Tower 8-1 Access	USFS Boundary	LADWP Tower 8-1	USFS	no	0.5	LADWP Tower 8-1 Access
LADWP Tower 8-2 Access	Lake Hughes Road	LADWP Tower 8-2	USFS	yes	0.6	LADWP Tower 8-2 Access
LADWP Tower 9-1,2 Access (Charlie Canyon Road)	End of Pavement	LADWP Tower 9-1	USFS	yes	0.7	LADWP Tower 9-1,2 Access
LADWP Tower 10-2 Access	unnamed road	LADWP Tower 10-2	LADWP, Private	yes	0.1	LADWP Tower 10-2 Access
LADWP Tower 10-3 Access	unnamed road	LADWP Tower 10-3	LADWP	yes	0.1	LADWP Tower 10-3 Access
LADWP Tower 11-2 Access	LADWP Tower 11-1, 2, 3 Access	LADWP Tower 11-2	USFS	yes	0.2	LADWP Tower 11-2 Access
LADWP Tower 11-4 Access	unnamed road junction with Dry Canyon Road (Forest Service Road 5N29)	LADWP Tower 11-4	USFS, LADWP	yes	0.2	LADWP Tower 11-4 Access
LADWP Tower 9-3 Access	San Francisquito Motorway	LADWP Tower 9-3	USFS	yes	1.2	LADWP Tower 9-3 Access
LADWP Tower 9-4 Access	San Francisquito Motorway	LADWP Tower 9-4	USFS	yes	0.7	LADWP Tower 9-4 Access
Angeles Tunnel Intake Gate Road	Pyramid Dam Crest Road	Angeles Tunnel Intake Gate	USFS	yes	0.2	Angeles Tunnel Intake Gate Access
Pyramid Dam Toe Road	Pyramid Dam Crest Road	Pyramid Dam Toe	USFS	yes	0.4	Pyramid Dam Toe Access
Osito Adit Road (Adit 2 Access)	Highway 99 Segment B	Adit 2	USFS	yes	0.3	Adit 2 Access
Adit 1 Access	Highway 99 Segment B	Adit 1	USFS	yes	0.3	Adit 1 Access
Pyramid Dam Adit Road	Pyramid Dam Crest Road	Pyramid Dam Adit	USFS	yes	0.4	Pyramid Dam Adit Access
Pyramid Dam Adit Road Spur	Pyramid Dam Adit Road	Pyramid Dam Adit	USFS	yes	0.1	Pyramid Dam Adit Road
Pyramid Dam Crest Road	End of Highway 99 Segment C	West end of Pyramid Dam crest	USFS	yes	1.0	Pyramid Dam Crest Access
Quail Detention Embankment Road	Gate on north side of Quail Lake Road	Quail Dam Road	State of California, Los Angeles County	yes	0.7	Quail Detention Embankment Access
Warne Powerplant Access	Pyramid Lake Road (Emigrant Landing Access)	Warne Powerplant	State of California	yes	0.3	Warne Powerplant Access
Emigrant Landing Access	Emigrant Landing Entrance Area	Emigrant Landing Boat Ramp	State of California, USFS	no	0.6	Emigrant Landing Access
Pyramid Lake Road (Emigrant Landing Access)	North parking lot	South parking lot	USFS	yes	0.3	Emigrant Landing Access
Emigrant Landing Parking Loop 1	Emigrant Landing Access	Emigrant Landing Access	USFS	yes	0.2	Emigrant Landing Parking Loop
Emigrant Landing Parking Loop 2	Emigrant Landing Access	Emigrant Landing Access	USFS	yes	0.1	Emigrant Landing Parking Loop

Table 2.1-2. Primary Project Roads Proposed for Addition to the Project (continued)

Designation in Exhibit A	Begins	Ends	Land Ownership	Gated or Otherwise Restricted to Public	Length (miles)	Project Use
Emigrant Landing Parking Loop 3	Pyramid Lake Road (Emigrant Landing Access)	Pyramid Lake Road (Emigrant Landing Access)	USFS	yes	0.2	Emigrant Landing Parking Loop
Emigrant Landing Parking Loop 4	Pyramid Lake Road (Emigrant Landing Access)	Pyramid Lake Road (Emigrant Landing Access)	USFS	yes	0.1	Emigrant Landing Parking Loop
Vista Del Lago Road	Interstate 5 offramp	Vista Del Lago Visitor Center	USFS	yes	0.4	Vista Del Lago Visitor Center Access
Vaqueros Parking Loop	Vaquero Road	Vaquero Road	USFS	yes	0.2	Vaqueros Parking Access
Spanish Point Road	Vista del Lago Visitor Center	Start of dirt road to Spanish Point	USFS	yes	0.2	Spanish Point Road
Vista del Lago Parking Loop	Vista del Lago Road	Vista del Lago Road	USFS	yes	0.3	Vista del Lago Parking Access
Quail Lake Road	Gate on north side of Highway 138	Quail Lake at Upper Canal	State of California	yes	1.5	Quail Lake Access
Lower Quail Canal North Road	Lower Quail Canal Bypass	Gate at Highway 138	State of California	yes	2.1	Lower Quail Canal North Access
Quail Dam Road	FERC boundary west of Lower Quail Canal Bypass	Lower Quail Canal Bypass	State of California	yes	0.3	Quail Dam Access
Lower Quail Canal South Road	Lower Quail Canal Bypass	Gate at Highway 138	State of California	yes	2.2	Lower Quail Canal Access
Lower Quail Canal North Western Toe Road	South extension of Lower Quail Canal North Access	North extension of Lower Quail Canal North Access	State of California	yes	1.0	Lower Quail Canal North Western Toe Access
Lower Quail Canal South Western Toe Road	Lower Quail Canal South Western Toe Road	Quail Detention Embankment Toe	State of California	yes	0.1	Lower Quail Canal South Western Toe Access
Lower Quail Canal South Western Toe Road	Lower Quail Canal Bypass	Lower Quail Canal North Access Road	State of California	yes	0.6	Lower Quail Canal South Western Toe Access
Quail Detention Embankment Toe Road	Gate at east end of Quail Lake Road	East end of Quail Lake Embankment	State of California	yes	0.5	Quail Detention Embankment Toe Access
Bypass Channel Road	Lower Quail Canal Bypass	500 feet east of Interstate 5	State of California	yes	0.5	Bypass Channel Access
Gorman Creek Bypass Channel Access Road Segment A West	200 feet south of Gorman Creek Interstate 5 underpass	Gorman Creek Bypass Channel Access Road Segment B	State of California	yes	2.4	Gorman Bypass Channel Access
Gorman Creek Bypass Channel Access Road Segment A East	200 feet south of Gorman Creek Interstate 5 underpass	Gorman Creek Bypass Channel Access Road Segment B	State of California	yes	2.3	Gorman Bypass Channel Access
Gorman Creek Bypass Channel Access Road Segment B	Gorman Creek Bypass Channel Access Road Segment A	Los Alamos Creek - North Siphon Access	State of California	yes	0.7	Gorman Bypass Channel Access
Quail Lake Road	Gate at Quail Lake Recreation Area	Quail Lake at Upper Canal	State of California	no	2.0	Quail Lake Access
Edison Spring Road	500 feet east of Interstate 5	East side of Interstate 5 underpass	State of California, USFS, Private	yes	0.4	Edison Spring Road

Table 2.1-2. Primary Project Roads Proposed for Addition to the Project (continued)

Designation in Exhibit A	Begins	Ends	Land Ownership	Gated or Otherwise Restricted to Public	Length (miles)	Project Use
Los Alamos Creek - North Siphon Access	Gorman Creek Bypass Channel Access Road	North end of siphon	State of California	yes	0.1	Gorman Bypass Channel Access
Los Alamos Creek - South	Hardluck Road (Los Alamos Road)	South end of siphon	State of California	yes	0.1	Gorman Bypass Channel Access
Los Alamos Campground Group Standard Loop	Hardluck Road (Los Alamos Road)	Hardluck Road (Los Alamos Road)	USFS	yes	0.2	Los Alamos Campground Access
Los Alamos Campground Loop 3	Los Alamos Campground Entrance	Los Alamos Campground Entrance	USFS	yes	0.3	Los Alamos Campground Access
Los Alamos Campground Loop 4	Los Alamos Campground Loop 3	Los Alamos Campground Loop 3	USFS	yes	0.5	Los Alamos Campground Access
Los Alamos Campground Loop 2	Los Alamos Campground Entrance	Los Alamos Campground Entrance	USFS	yes	0.4	Los Alamos Campground Access
Los Alamos Campground Loop 1	Los Alamos Campground Entrance	Los Alamos Campground Entrance	USFS	yes	0.3	Los Alamos Campground Access
Los Alamos Campground Entrance	Hardluck Road (Los Alamos Road)	Camping loop junctions	USFS	yes	0.1	Los Alamos Campground Entrance
Los Alamos Campground Dump Station Access	Hardluck Road (Los Alamos Road)	Hardluck Road (Los Alamos Road)	USFS	yes	0.1	Los Alamos Campground Dump Station Access
Los Alamos Campground Dump Station Access	Hardluck Road (Los Alamos Road)	Hardluck Road (Los Alamos Road)	USFS	yes	0.1	Los Alamos Campground Dump Station Access
Gorman Creek Channel Liner W. Road	Warne Powerplant Access Road	Hardluck Road (Los Alamos Road)	State of California	yes	0.3	Gorman Channel Liner Access
Warne Powerplant Access	Warne Powerplant	End of road along waterway	State of California	yes	0.1	Warne Powerplant Access
Gorman Creek Bypass Channel - West	Hardluck Road (Los Alamos Road)	Gorman Creek Bypass Channel	State of California	yes	0.2	Gorman Bypass Channel Access – West
Gorman Creek E. Road	Pyramid Lake Road	Pyramid Lake Emigrant Landing	State of California, USFS	yes	0.6	Gorman Creek E. Access
Vaquero Road	Vista del Lago Visitor Center	Boat Ramp and Beach	USFS	yes	0.2	Boat Ramp and Beach Access
Spanish Point Road	End of pavement	Spanish Point Day Use Area	USFS	yes	0.2	Spanish Point Road
LADWP Tower 2-4 Access	Cutler Canyon Fire Road	LADWP Tower 2-4	LADWP, Private	yes	0.1	LADWP Tower 2-4 Access
LADWP Tower 6-2 Access	7 Acres Parking Lot Access Road	LADWP Tower 6-2	State of California	no	0.0	LADWP Tower 6-2 Access
LADWP Tower 7-4 Access	LADWP Tower 7-4, 7-5, 8-1 Access Road	LADWP Tower 7-4	State of California	no	0.1	LADWP Tower 7-4 Access
LADWP Tower 8-3,4 Access (Charlie Canyon Road)	USFS Boundary	LADWP Tower 8-3	USFS	yes	0.9	LADWP Tower 8-3, 4 Access
LADWP Tower 11-1, 2, 3 Access	USFS Boundary	LADWP Tower 11-3	USFS	yes	0.5	LADWP Tower 11-1, 2, 3 Access
Los Angeles Water and Power Road Dam Crest	West end of Elderberry Forebay Dam	East end of Elderberry Forebay Dam	State of California	yes	0.4	Elderberry Forebay Dam Access
Los Angeles Water and Power Road	Templin Highway	USFS Boundary	USFS	no	0.2	Castaic Power Entrance Road

Table 2.1-2. Primary Project Roads Proposed for Addition to the Project (continued)

Designation in Exhibit A	Begins	Ends	Land Ownership	Gated or Otherwise Restricted to Public	Length (miles)	Project Use
LADWP Tower 1-2, 3, 4, 5, 2-1 Access	Los Angeles Water and Power Road	USFS Boundary	State of California	yes	0.4	LADWP Tower 1-2, 3, 4, 5, 2-1 Access
LADWP Tower 1-3, 4, 5, 2-1 Access	USFS Boundary	USFS Boundary	USFS	yes	0.1	LADWP Tower 1-3, 4, 5, 2-1 Access
LADWP Tower 1-3, 4, 5, 2-1 Access	USFS Boundary	USFS Boundary	State of California	yes	0.4	LADWP Tower 1-3, 4, 5, 2-1 Access
LADWP Tower 1-4, 5 2-1 Access	USFS Boundary	USFS Boundary	USFS	yes	0.2	LADWP Tower 1-4, 5 2-1 Access
LADWP Tower 8-1 Access	LADWP Tower 7-4, 7-5, 8-1 Access Road	USFS Boundary	State of California, Private	no	0.3	LADWP Tower 8-1 Access
Los Angeles Water and Power Road	USFS Boundary	Security gate at LADWP Powerplant	State of California, USFS	no	1.0	Castaic Power Entrance Road
Cutler Canyon Fire Road	West Ramp Road	Cutler Canyon/Vista Ridge Connector	State of California	yes	1.6	Castaic-Haskell TL Access
Cutler Canyon/Vista Ridge Connector	Cutler Ridge Fire Road	Vista Ridge Fire Road	State of California, LADWP, Private	yes	0.3	Castaic-Haskell TL Access
LADWP Tower 11-1 Access (Private)	FERC Boundary	LADWP Tower 11-1	LADWP	yes	0.1	LADWP Tower 11-1 Access
LADWP Tower 10-2, 10-3 Access	Gate on unnamed road off of San Francisquito Canyon Road	Tower 10-1	LADWP	yes	0.7	LADWP Tower Access
LADWP Tower 5-3 Access	Vista Ridge Fire Road	LADWP Tower 5-3	State of California, LADWP	yes	0.3	LADWP Tower 5-3 Access
LADWP Tower 5-4 Access	Pine Ridge Fire Road	LADWP Tower 5-4	State of California	yes	0.2	LADWP Tower 5-4 Access
Vista Ridge Fire Road	Cutler Canyon/Vista Ridge Connector	Ridge Route Road	State of California	yes	4.4	Castaic-Haskell TL Access
Charlie Canyon Road	USFS Boundary	End of Pavement	USFS	yes	0.1	Charlie Canyon Road
Total	**99 Segments**				**55.4**	**--**

Source: DWR 2019
Key:
BLM = Bureau of Land Management
FERC = Federal Energy Regulatory Commission
LADWP = Los Angeles Department of Water and Power
State of California = Lands owned by California Department of Water Resources, California Department of Parks and Recreation, and California Department of Transportation
Private = Private Land Owner
T.L. = transmission line
USFS = U.S. Department of Agriculture, Forest Service

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2.1.3 Proposed Project Operation

The Licensees propose no changes to existing Project operations, other than the addition of the PM&E measures described below.

2.1.4 Proposed Environmental Measures

The Licensees propose for inclusion in the new license 12 environmental measures to protect or enhance environmental resources within the proposed Project boundary. Each measure is discussed in the pertinent resource area section in Exhibit E. Appendix A of Exhibit E includes a detailed description of each of the Licensees' proposed PM&E measures. The following is a brief summary of each measure:

Geology and Soils

- Measure GS1 – Implement the Erosion and Sediment Control Plan, within one year after license issuance, that includes measures to control sedimentation and erosion when stabilizing slopes affected by the Project.

Water Resources

- Measure WR1 – Maintain a minimum pool and limit water surface elevation fluctuations in Pyramid Lake for the benefit of fisheries and recreation. This measure incorporates minimum pool and water surface elevation restrictions from the DWR and USFS 1969 Memorandum of Understanding (MOU), as amended.

- Measure WR2 – Implement the Hazardous Materials Management Plan, within one year after license issuance, that includes measures to manage hazardous materials, including response and clean-up of hazardous materials spills.

Aquatic Resources

- Measure AR1 – Provide minimum flows from Pyramid Lake into Pyramid reach. This measure is identical to the Pyramid Lake portion of Article 52 in the existing Project license, with three exceptions: First, the multiplier for estimating the ungaged flow into Pyramid Lake has been updated based on current Geographic Information System (GIS) and hydrologic methods. Second, clarification has been included to indicate what the Licensees would do if unsafe conditions occur. Third, the cap on SWP deliveries to UWCD has been removed. This measure including the modifications to Article 52 in the existing license is described in more detail in Appendix A to Exhibit E of this Application for New License.

- Measure AR2 – Stock fish in Pyramid Lake, within one year after license issuance and annually thereafter during the stocking season (October 1 to May

30), to maintain the rainbow trout recreational fishery and conduct periodic angler surveys. This measure is similar to Article 51 in the existing Project license.

Terrestrial Resources

- Measure TR1 – Implement the Integrated Vegetation Management Plan included in Appendix A of Exhibit E, within one year of license issuance, that includes measures for controlling non-native plant species, protecting special-status species, and re-vegetating disturbed areas.

- Measure TR2 - Implement the Sensitive Aquatic and Terrestrial Wildlife Management Plan included in Appendix A of Exhibit E, within one year of license issuance, that includes protections to wetland and riparian habitats, and known occurrences of ESA-listed species (restrictions on some Project O&M activities), procedures for pre-construction surveys prior to non-routine Project activities, and pesticide measures.

Recreation Resources

- Measure RR1 – Implement the Recreation Management Plan included in Appendix A of Exhibit E, within one year of license issuance, that provides guidance for the management and operations of Project recreational facilities, including periodic use monitoring, the modification of Project recreation facilities, and a schedule for implementing modifications. This measure is similar to Article 50 in the existing Project license.

Land Use

- Measure LU1 – Implement the Fire Prevention and Response Plan, within one year after license issuance, that provides measures for preventing, reporting, and investigating Project-related wildfires.

- Measure LU2 – Continue to implement a Project Safety Plan that provides measures for installing and maintaining signs, lights, sirens, and other devices at Project facilities. This measure is similar to Articles 60 and 402 in the existing license.

Visual Resources

- Measure VR1 – Implement the Visual Resources Management Plan, within one year after license issuance, that includes measures to reduce the visual contrast of Project facilities.

Cultural Resources

- Measure CR1 - Implement the Historic Properties Management Plan, within one year after license issuance that provides specific actions and processes to manage historic properties.

See Appendix A for a detailed description of each of the Licensees' proposed PM&E measures.

2.2 NO ACTION ALTERNATIVE (ENVIRONMENTAL BASELINE)

Under the No Action Alternative, the Project would continue to operate into the future as it has historically operated under the terms and conditions of the current license. Therefore, under this alternative, there are no changes to existing Project facilities or operations. Furthermore, the inflow to the Project and downstream water demands would remain the same as they have been historically. Under this alternative, no new PM&E measures would be implemented. A brief description of existing Project facilities follows. Refer to Exhibit A, Project Description, for a more detailed discussion of existing Project facilities.

2.2.1 Existing Project Facilities

2.2.1.1 Warne Power Development

Facilities and features of the Warne Power Development are described below. DWR operates all of the Warne Power Development facilities, with the exception of the Warne Transmission Line. While the Warne Transmission Line is included as part of the Warne Power Development under the existing FERC license, it is a facility owned and operated by SCE. See Section 5.3 of Exhibit A of this Application for New License for additional information.

Quail Lake, Quail Lake Embankment, and Quail Lake Outlet

Quail Lake is the uppermost facility of the Project and is an off-stream impoundment located 5 miles southwest of the bifurcation of the East and West branches of the SWP, and about 23 miles northwest of the City of Santa Clarita. The impoundment consists of a sag pond formed by the San Andreas fault with a built-up embankment (part of State Highway 138) to obtain the required capacity. The Quail Lake Embankment (also known as State Highway 138, Primary Operating Road, and Secondary Operating Road Embankments) provides an operating road for Quail Lake and has a maximum height of about 15 feet above ground surface. At a normal maximum water surface elevation (NMWSE) of 3,325 feet, Quail Lake has a maximum capacity of 7,583 acre-feet (AF) and a surface area of 288 acres.

The facility includes Quail Lake Outlet, which consists of an inlet transition; a 12-foot by 12-foot reinforced concrete double box with four 6-foot by 12-foot remotely controlled slide gates, which are normally in an open position; a service bay; and an outlet transition. Stop log grooves are provided upstream of the slide gate slots and at the downstream end of the service bay. The Quail Lake Outlet structure passes beneath State Highway 138. Quail Lake, with the Lower Quail Canal described below, serves as a forebay to the Warne Powerplant.

Lower Quail Canal

Water released from Quail Lake through the Quail Lake Outlet flows into Lower Quail Canal. The 2-mile-long, concrete-lined canal serves as a conveyance to the Peace Valley Pipeline Intake and acts as a surge pond during startup of the Warne Powerplant until steady state flow is established from Quail Lake. The canal has a bottom width of 24 feet, northern embankment height of approximately 50 feet, and southern embankment height of about 40 feet; a maximum flow capacity of 3,129 cubic feet per second (cfs); and normally operates between an elevation of 3,310 feet and 3,324.5 feet. The Lower Quail Canal volume is 1,150 AF at an elevation of 3,325 feet. An ungated emergency overflow weir is located on the north side of Lower Quail Canal. If an unplanned release occurs, water can be discharged over the ungated weir into a detention basin located to the west and adjacent to the southernmost section of Lower Quail Canal.

Peace Valley Pipeline Intake, Peace Valley Pipeline Intake Embankment, and Peace Valley Pipeline

The Peace Valley Pipeline begins at the earth and rockfill Peace Valley Pipeline Intake Embankment, and extends about 5.5 miles to the Warne Powerplant penstock. The Peace Valley Pipeline Intake is formed by the Peace Valley Pipeline Intake Embankment, which is 50 feet tall, with a crest length of 350 feet and crest elevation of 3,330 feet, located at the downstream end of the Lower Quail Canal.

Lower Quail Canal ends at the Peace Valley Pipeline Intake structure, around which is constructed the Peace Valley Intake Embankment. The intake structure has four 9-foot-wide by 54-foot-high entrances, which transition to two 9-foot by 12-foot conduits at the gate structure. The left conduit, which flows into the Peace Valley Pipeline, contains a 9-foot 9-inch by 13-foot 2-inch bulkhead gate, and a 12-foot by 12-foot emergency slide gate. The unused right conduit contains a bulkhead gate. A 78-inch diameter bypass (Gorman Creek Diversion) has a 78-inch butterfly valve and a 7-foot 3-inch by 9-foot 3.75-inch bulkhead gate located upstream of the valve vault.

The 5.5-mile-long Peace Valley Pipeline is a 12-foot diameter pre-stressed concrete structure entirely underground extending to the Warne Penstock. At the powerplant, the penstock bifurcates into two 8-foot diameter steel branches. The two 8-foot diameter branches have a combined maximum capacity of 1,564 cfs.

Gorman Bypass Channel

In the event of a Peace Valley Pipeline outage or should scheduled SWP water flow exceed the Peace Valley Pipeline's capacity, the water is routed through the 5.9-mile-long Gorman Bypass Channel, which connects the Lower Quail Canal to Pyramid Lake, bypassing the Peace Valley Pipeline and Warne Powerplant. The Gorman Bypass Channel was designed to convey 900 cfs. The 5-inch-thick concrete-lined channel is reinforced with wire mesh fabric. It is a trapezoidal-shaped channel with an 8-foot-wide invert, 5-foot depth, and 1.5 to 1 side slopes. The longitudinal slope of the channel ranges from approximately 1 percent to greater than 5 percent. In addition to the open channel, the Gorman Bypass Channel includes three culverts and one inverted siphon. The culverts and siphons are typically 8-foot diameter reinforced concrete pipe. Due to the slope of the channel, flow velocities are supercritical and typically range from 15 to 25 feet per second (fps). However, velocities can reach up to 32 fps in one section depending on flow volume. Local drainage, if any, drains into the Bypass Channel near Interstate 5.

About 3.2 miles downstream from the Peace Valley Pipeline Intake Embankment, the Gorman Bypass Channel and Peace Valley Pipeline alignments change. The Peace Valley Pipeline continues on the east side of Gorman Creek along Pyramid Lake Road, until it crosses Gorman Creek again to the west and connects to the Warne Powerplant. Between Interstate 5 and Orwin Road, the Gorman Bypass Channel does not receive local drainage. The Gorman Bypass Channel continues from Orwin Road to Pyramid Lake on the west side of Gorman Creek to Pyramid Lake, bypassing local drainage inflow with an encased section crossing Gorman Creek and a siphon crossing Los Alamos Creek (i.e., Cañada de Los Alamos), a tributary to Gorman Creek. The channel is generally flushed by DWR on a quarterly basis when approximately 500 cfs is released from Lower Quail Canal solely for the purpose of flushing sediment and debris that has collected in the channel since its last use.

NFS lands are not located downslope from the Gorman Bypass Channel and, therefore, interception of any upslope precipitation by the channel would not divert water that would otherwise be available to NFS resources.

Warne Powerplant and Switchyard

Warne Powerplant, an aboveground, steel-reinforced, concrete powerhouse, is located at the northern (upstream) end of Pyramid Lake, at the terminus of the Peace Valley Pipeline. The powerplant has two 38,250 kW Fuji Electric Pelton-type turbines, each connected to a Toshiba generator. Each turbine has a rated head of 650 feet, runner speed of 200 revolutions per minute (rpm), rated output of 51,000 horsepower (hp), and a rated discharge of 782 cfs. The total combined flow capacity for the powerplant is 1,564 cfs. The two, three-phase Toshiba electric generators each have a capacity of 39,100 kilovolt-amperes (kVA), at a power factor of 0.95 and a frequency of 60 hertz (Hz), producing a voltage of 13,800 volts. The powerplant has an installed capacity of 74,290 kW, with an average annual generation of 346,000 megawatt hours (MWh) and an average monthly generation of 29,000 MWh during the period of 2000 through 2014. The powerplant has a dependable capacity of 60,400 kW.

The Warne Switchyard is located west and immediately adjacent to the Warne Powerplant and contains two generator step-up transformers (primary voltage of 230 kilovolts [kV] and secondary voltage of 13.6 kV). The single-line diagram showing the transfer of electricity from the Project to the power grid is considered Critical Energy Infrastructure Information (CEII) and is provided separately in Exhibit F of this Application for New License.

Warne Transmission Line

The Warne Transmission Line is a 2.95-mile-long, single-circuit, 220-kV transmission line that connects the Warne Switchyard to SCE's Pardee-Pastoria-Warne 220 kV transmission line. The line is built on steel lattice towers along a 150-foot-wide right-of-way. The line is owned and operated by SCE. SCE's transmission line segment has never been a Project work and was included in the original Project license in error – an inaccuracy that has persisted through the term of the current license. See Section 5.3 of this Exhibit A for additional information.

Primary Project Roads and Trails

For the Warne Power Development, the existing license does not include any Primary Project Roads or Trails.

Recreation Facilities

Recreational amenities at Quail Lake include a shoreline access path, gravel parking area, and three portable restrooms. Only non-waterbody contact recreation is allowed at Quail Lake. No other recreation facilities are associated with the Warne Power Development.

Streamflow and Reservoir Stage Gages

The Warne Power Development does not include any streamflow or reservoir stage gages for the purposes of complying with license requirements: the existing license does not include any streamflow or reservoir stage requirements associated with the Warne Power Development in the license.

2.2.1.2 Castaic Power Development

Facilities and features of the Castaic Power Development are described below.

Pyramid Dam and Lake

Pyramid Dam, at the southern end of Pyramid Lake, is a 1,090-foot-long zoned earth and rockfill dam. The dam is 400 feet high, the dam crest is 35 feet wide, and the dam crest elevation is 2,606 feet. Water can be released from Pyramid Lake into Pyramid reach through two spillways and a low-level outlet. The spillways are located on the right abutment of Pyramid Dam. One is a controlled service spillway, which includes a single 40-foot-wide by 31-foot-tall radial gate, and a concrete-lined chute, which terminates in a flip bucket, used for passing normal flows through the reservoir. The gated chute was designed to discharge small floods and emergency releases up to 17,000 cfs. The second is an emergency spillway, which is an uncontrolled, unlined channel provided with a 365-foot-long overpour weir, with the crest set at an elevation of 2,606 feet. The emergency spillway is designed for discharging very large inflows. The combined spillways have a designed capacity of 165,900 cfs with 5 feet of freeboard.

The low-level outlet works utilize the stream bypass tunnel (diversion tunnel) used during construction of the dam. This stream release facility is a 15-foot diameter, concrete-lined tunnel approximately 1,350 feet long through the right abutment of the dam and is used for downstream releases to Pyramid reach. The maximum safe, designed release from the low-level outlet and service spillway of Pyramid Dam to Pyramid reach is 18,000 cfs. Seepage through the dam is collected at the toe of the dam, where it is gaged before being released into Pyramid reach.

Pyramid Lake serves as regulated storage for the Castaic Powerplant. At an NMWSE of 2,579 feet, Pyramid Lake has a storage capacity of 161,375 AF and a usable storage capacity of 20,844.0 AF. The reservoir has a normal maximum surface area of 1,269.0 acres, a shoreline length of 21 miles, and a maximum depth of approximately 265.4 feet. The Licensees typically maintain Pyramid Lake 1 foot below NMWSE at a surface elevation of 2,578.0 feet, and consider 2,560.0 feet to be the minimum working elevation. Approximately 3 percent of the total inflow to Pyramid Lake is from natural inflow; the majority of the inflow to the reservoir is SWP water. Pyramid Lake receives natural inflow into the west arm of the reservoir from Pyramid reach, and a combination of natural and SWP water inflows into the north arm of the reservoir from Gorman Bypass Channel and Gorman Creek.

Angeles Tunnel and Surge Chamber

The Angeles Tunnel supplies Pyramid Lake water to the Castaic Penstocks that provide water to Castaic Powerplant in the generating mode and return water to the reservoir from Elderberry Forebay when the powerplant is operating in the pumping mode. Angeles Tunnel is 7.2 miles long, has a diameter of 30 feet, has a maximum flow capacity of 18,400 cfs, and includes two adits.

The associated surge chamber is 120 feet in diameter and 383 feet in height, of which 225 feet is underground. The underground portion is concrete and is steel-lined throughout. A steel tank forms the above ground 158-foot portion of the surge chamber. A 108-foot-long juncture structure connects the surge chamber to the Angeles Tunnel through a 28-foot diameter riser.

Castaic Penstocks

The Castaic Penstock assembly for the six units in Castaic Powerplant consists of a double trifurcation immediately downstream of the south portal of Angeles Tunnel, a penstock shutoff valve on each branch of the trifurcations, and six 2,400-foot-long steel penstocks ranging in diameter from 9 feet to 13.5 feet serving the six powerhouse units (Units 1 through 6). Unit 7 in the powerplant is served by a 1,900-foot-long steel penstock ranging in diameter from 7 feet to 9 feet, branching from a Y-connection between the tunnel portal and the main trifurcation.

Castaic Powerplant and Switchyard

The Castaic Powerplant, an aboveground/underground, steel-reinforced, concrete powerhouse, is located on the northern (upstream) end of Elderberry Forebay and is a pumping-generating plant with the ability to pump water back to Pyramid Lake using off-peak energy when it is economical to do so. Elderberry Forebay serves as an afterbay for Castaic Powerplant while in generating mode and as a forebay while in pumping mode. Pyramid Lake serves as the upper reservoir of the powerplant.

Castaic Powerplant has six Voith Siemens Hydro, reversible pump/turbines and motor/generators, Francis-type pump-turbine units, each with a rated head of 1,000 feet, a runner speed of 257 rpm, a rated output of 363,000 hp, and an approximated rated discharge of 3,500 cfs (the Voith Siemens three-phase generator capacity is 250,000 kVA with a power factor of 0.85, a frequency of 60 Hz and voltage of 18,000 volts). The six Francis units have a combined authorized installed generating capacity of 1,275,000 kW, with a plant capacity of 21,000 cfs. The powerplant's average dependable capacity for calendar year 2013 through 2018 was 201.6 MW.

In addition, the Castaic Powerplant includes one Alstom Pelton-type pump starting turbine unit (Unit 7) with a rated head of 950 feet, a runner speed of 225 rpm, rated output of 69,000 hp, and an approximate rated discharge of 752 cfs (the Alstom three-phase generator capacity is 70,000 kVA, with a 0.80 power factor, frequency of 60 Hz, and voltage of 11,000 volts). Castaic Powerplant's Unit 7 is a small generation unit housed in a separate building and used solely to start the six main units when they are used as pumps. In addition, Unit 7 is not used for power generation. Therefore, Unit 7 is excluded from the installed capacity calculation.

LADWP uses Castaic Powerplant to generate and to store electricity when it determines it is the most economical and beneficial to the citizens of Los Angeles. Castaic Powerplant generates electricity when extra power is needed in the Los Angeles area. In addition, water is pumped from Elderberry Forebay to Pyramid Lake to store excess power, normally to support system stability and reliability when there is excess intermittent renewable generation. The powerplant pumps water from Elderberry Forebay back into Pyramid Lake for storage until it is needed for power generation. Pumping capability at normal static head ranges from 2,200 cfs, with one unit operating to about 12,000 cfs with six units pumping. This water can be routed through the turbine generators in a very short time to meet peak and/or unanticipated demands on LADWP's electric system. The pumping function at Castaic Powerplant improves the availability of water for peak power generation, which enhances the power generation benefits to the Los Angeles service territory.

The Castaic Switchyard is a fenced switchyard located adjacent to the powerhouse and uses a double-breaker, double-bus scheme. There are six three-phase step-up-transformers for Units 1 through 6 (primary voltage of 230 kV and secondary voltage of 18 kV). Unit 7 has a three-phase step-up transformer with a primary voltage of 230 kV and secondary voltage of 11 kV. The single-line diagram showing the transfer of electricity from the Project to the transmission grid is considered CEII and is provided separately in Exhibit F of this Application for New License.

Elderberry Forebay Dam, Forebay, and Outlet

Elderberry Forebay Dam, completed in 1974, is a 1,990-foot-long zoned earthfill dam with a height of 200 feet. The crest of the dam is 25 feet wide with an elevation of 1,550 feet.

Elderberry Forebay Dam forms Elderberry Forebay, which is located directly below Castaic Powerplant and serves as an afterbay when Castaic Powerplant is generating power and as a forebay when the plant is pumping water back to Pyramid Lake. The forebay also receives a very small amount of local inflow from Castaic Creek, which enters at the northern end of the reservoir. Of the total inflow to Elderberry Forebay, only 1 percent is from Castaic Creek. The remaining inflow to Elderberry Forebay is SWP water from Pyramid Lake conveyed via the Angeles Tunnel. At an NMWSE of 1,540 feet, Elderberry Forebay has a gross storage capacity of 31,196 AF, a usable storage capacity of 23,096 AF, a surface area of 496 acres, and a shoreline length of 7 miles. With the stop gates (storm gates) in, the Licensees typically maintain Elderberry Forebay 2 feet below NMWSE at a surface elevation of 1,538 feet. With the gates removed, the Licensees maintain the forebay at a working elevation of 1,530 feet, a gross storage capacity of 26,418 AF, a usable capacity of 18,318 AF, and a surface area 459 acres. The Licensees consider the minimum working elevation of Elderberry Forebay to be 1,480 feet. The anti-vortex plates only allow for safe pumping at 1,480 feet.

Besides pump-back water to Pyramid Lake, water from Elderberry Forebay passes downstream into Castaic Lake, a non-Project facility via a spillway and an outlet. The spillway comprises an overflow weir built into a natural topographic saddle located approximately 300 feet east of the left abutment of the Elderberry Forebay Dam and serves as an uncontrolled emergency spillway. The crest elevation of the overflow weir is 1,540 feet, with a capacity of at least 12,000 cfs.

The Elderberry Forebay Outlet works at Elderberry Forebay Dam consist of both high-level and low-level facilities in a tower on the right bank upstream of the dam. The high-level outlet is provided with slide gates on the service spillway shaft. There are two 8-foot-wide by 9-foot-high slide gates at an elevation of 1,498 feet, and six 8-foot-wide by 12-foot-high slide gates at an elevation of 1,477 feet on the spillway shaft. The low-level outlet control works consist of a single set of two 5-foot-wide by 6-foot-high, high-pressure slide gates in tandem within a gate chamber at the base of the tower. The low-level conduit is 7 feet in diameter; has an intake, an uncontrolled box structure with a stop-log emergency bulkhead; and an outlet connection discharging into the 21-foot diameter service spillway conduit just downstream of the tower. The combined capacity of the high- and low-outlet facilities is 17,000 cfs at a forebay NMWSE of 1,540 feet.

The high- and low-outlet facilities connect to a 21-foot diameter conduit that runs under Elderberry Forebay Dam and releases water into the non-Project Castaic Lake (i.e., is not used or useful for Project power generation), which has a capacity of 325,000 AF.

Storm Bypass Channel and Check Dams

The Storm Bypass Channel is on Castaic Creek above Elderberry Forebay and includes a series of three check-dam basins with a total area of approximately 21 acres. The check-dam basins capture sediment runoff during high flow events to reduce the continued accumulation of sediment near the powerplant and promote sustained efficiency of the Castaic Powerplant operation. The check dams have no storage capacity. Sediment and debris are removed from the check-dam basins as needed, and spoils are disposed of onsite on State-owned lands.

Castaic Transmission Line

The existing Project includes the 11.4-mile, 230-kV Castaic Transmission Line that delivers energy from the Castaic Switchyard to the Haskell Junction substation, and transmits energy to the Castaic Powerplant when the reversible turbine generating equipment is in the pump-back operating mode. The line consists of four circuits that are carried on two parallel double-circuit steel towers. The southern towers carry the Castaic – Northridge Line 1 and Castaic – Haskell Line 1 (previously Castaic – Sylmar Line 1) 230-kV circuits. The northern towers carry the Castaic-Haskell Line 2 (previously Castaic – Olive Line 1) 230-kV circuit, and the second position is currently vacant. LADWP filed a non-capacity license amendment with FERC on March 10, 2016, to construct the fourth circuit to the Haskell Junction substation and anticipates the fourth circuit will be in service by October 2020.

Primary Project Roads and Trails

For the Castaic Power Development, the existing license does not include any Primary Project Roads or Trails.

Recreation Facilities

Table 2.2-1 lists Project recreation facilities associated with the Castaic Power Development. All of the facilities are located at Pyramid Lake. Public access to Elderberry Forebay is not permitted due to safety concerns.

Table 2.2-1. Castaic Power Development Recreation Facilities

Recreation Area		Developed Facilities
Emigrant Landing Day Use Area	Emigrant Landing Entrance Area	2 entrance station kiosks; boat inspection station; and approximately 24 parking spaces
	Emigrant Landing Boat Launch	8-lane boat launch ramp; 2 boat docks; 1 unisex restroom with flush toilets; 2 floating restrooms that are deployed on the lake as needed; and parking for approximately 73 vehicles with boat trailers, with 3 other standard parking spaces and 5 additional parking spaces
	Emigrant Landing, Picnic and Fishing Area One	22 picnic sites , with approximately 22 grills, 21 shade ramadas, and 34 standard tables; shoreline fishing platform/walkways; 2 unisex restrooms with flush toilets; 1 drinking fountain; parking for approximately 90 vehicles ; 1 fish cleaning station
	Emigrant Landing Swim and Picnic Area	Swim beach with lifeguard tower; approximately 31 picnic sites with 52 standard tables, 34 grills, 31 shade ramadas, 5 water spigots, and 2 drinking fountains; 2 unisex restrooms with flush toilets; parking for approximately 135 vehicles
	Emigrant Landing, Picnic and Fishing Area Two	Approximately 5 picnic sites with tables, 5 shade ramadas, 14 standard tables, 7 grills; pedestrian overlook structure connected to walkway; 1 unisex restroom with flush toilets; water spigots and 3 drinking fountains; parking for approximately 80 vehicles
Vista Del Lago Visitor Center		18,500-square-foot visitor building with interpretive exhibits, auditorium, potable water and restrooms; parking for 159 vehicles; 1 FERC informational sign, 2 other informational signs; approximately 11 trash receptacles, 2 telescopes, 1 overview lookout structure (1 bench, 1 information sign), and multiple standard parking lot lights
Vaquero Day Use Area		Swim beach with lifeguard tower; 2-lane non-motorized watercraft launch ramp with courtesy dock; approximately 14 picnic sites with 13 standard tables, 14 grills, and shade ramadas; 2 unisex restrooms with flush toilets; approximately 5 water spigots and 1 drinking fountain, 1 fire pit, parking for approximately 146 vehicles; 2 restroom buildings (unisex)
Spanish Point Boat-in Picnic Area		Boat-in or walk-in area with approximately 12 picnic sites, each with shade structure; approximately 9 grills and 1 group barbeque site with 3 grills; 1 restroom with vault toilet; 4 portable restrooms with portable sinks
Serrano Boat-in Picnic Area		6 picnic sites with tables, grills, and shade ramadas; 1 unisex restroom with vault toilets; boat dock
Bear Trap Boat-in Picnic Area		Approximately 2 picnic sites with 3 tables, 2 grills, and 3 shade ramadas; 2 unisex restrooms with vault toilets; boat dock
Yellow Bar Boat-in Picnic Area		Approximately 10 picnic sites with tables and shade ramadas; 2 restrooms with vault toilets; boat dock and paths with shoreline fishing

Table 2.2-1. Castaic Power Development Recreation Facilities (continued)

Recreation Area		Developed Facilities
Los Alamos Campground	Los Alamos Group Campground	Approximately 3 group camping sites with maximum occupancy of 40 people and parking for typically 8 to 10 vehicles per site; each site includes a large shade ramada containing barbeque grills, fire pits, approximately 5 picnic tables, and water spigot; 1 unisex restroom with flush toilets, water spigot and outdoor sink
	Los Alamos Family Campground	Approximately 93 campsites with typically 1 or 2 picnic tables, parking spur, and 1 fire ring per site; 4 signed restrooms with flush toilets; trailer dump station; potable water spigots, 4 of which have sinks; approximately 5 shade ramadas; 2 lane recreational vehicle/trailer dump station
Quail Lake Day Use Area		Day use area with shoreline access paths on both sides of lake; gravel parking area; and 3 portable restrooms

Source: DWR 2019

Streamflow and Reservoir Stage Gages

The existing license does not identify any streamflow of reservoir stage gages associated with the Castaic Power Development for the purpose of complying with streamflow and reservoir elevation requirements associated with the Castaic Power Development in the license.

2.2.2 Existing Project Boundary

The existing Project boundary covers 6,928.0 acres of land. Within the total acreage, 2,807.28 acres are federal lands, with 2,790.02 acres of NFS lands managed by USFS as part of the ANF or LPNF, and 17.26 acres of land administered by BLM.

2.2.3 Existing Project Operation

The existing Project is operated as a power recovery project using SWP water as it is provided for downstream consumptive use. For that reason, existing Project operations do not vary based on changes in local hydrological conditions. However, the daily timing of the water through the Warne and Castaic Powerplants is controlled for efficient generation (i.e., to support peaking and ancillary services). In addition, water in Elderberry Forebay is pumped back up to Pyramid Lake and passed through Castaic Lake until the water is needed to meet downstream water demand. The existing Project's FERC installed capacity is 1,349,290 kW, and the Project's calculated dependable capacity is 262,000 kW. Castaic Powerplant's Unit 7 is a small generation unit housed in a separate building and used solely to start the six main units when they are used as pumps; Unit 7 is not used for power generation. Therefore, Unit 7 is excluded from the installed capacity calculation. See Exhibit B, Project Operations and Resource Utilization, for a detailed description of Project operations.

2.2.4 Existing Environmental Measures

2.2.4.1 Existing License Requirements

The existing FERC license includes 80 articles, two of which affect operations. Article 52, which became effective in 2006, states, in part:

> Stream releases from Pyramid Dam into Pyramid reach shall match natural surface inflow into Pyramid Lake to the extent operationally feasible and consistent with safety requirements, as further described in the following guidelines:
>
> - Natural inflow to Pyramid Lake will be released into Pyramid reach at a rate of up to about 18,000 cfs, which is the maximum safe, designed release from Pyramid Dam. The exact maximum safe release depends on the lake surface water elevation at the time of the release.
> - Storm releases from Pyramid Dam into Pyramid reach may be held back at less than 18,000 cfs if higher releases are deemed a threat to life, safety, property at Pyramid Dam or downstream of the dam.
> - The Licensees may elect to appropriate inflow to Pyramid Lake above the safe release flows under the provisions of its existing water rights.
> - Up to 3,150 AF of SWP water would be delivered to UWCD via Pyramid reach (from Pyramid Dam) between November 1 and the end of February of each water year (WY). During this period, water delivering may be made over a period of a few days, ramping flows up and down to simulate the hydrograph of a typical storm event, or they may be released more gradually over a longer period.
> - Releases from Pyramid Dam could be increased by up to 50 cfs for short periods to exercise the Pyramid Dam radial gate and stream release valves; test emergency power sources; conduct tests mandated by the Commission; or meet other short-term operational or maintenance requirements. No such testing would take place between March 15 and June 15. Testing would also be avoided to the extent possible between June 16 and July 31. Tests may be conducted at any time between August 1 and March 14, provided that flows do not increase by more than 50 cfs above current base flows during the event and that the event does not last longer than 15 minutes. Scheduled tests requiring larger releases or lasting longer than 15 minutes would require prior notification to USFWS. Unscheduled releases due to equipment failure or emergency situations must be reported to USFWS no later than three business days after the event.

- The gaging station on upper Piru Creek (located north of Pyramid Lake) provides 24 hour averages; therefore, instantaneous peak stream releases may be attenuated. Unlike the natural inflow hydrograph, which typically peaks sharply, the stream release hydrograph of Pyramid reach may be attenuated.
- A multiplier is used to account for these portions of Pyramid Lake watershed that are not tributaries of upper Piru Creek and Cañada de Los Alamos upstream of their respective gaging stations. This may result in some deviations for individual storm events due to localized variations in storm water intensity.
- Because of operational constraints, the stream release hydrograph of Pyramid reach would typically gage measured inflow. The valves at Pyramid Dam can be adjusted for release flows of less than 1200 cfs; however, the precise measurement of released flows less than 3 cfs may not be possible due to operational constraints of the dam's gaging instrumentation.

Article 58 requires the Licensees to maintain Pyramid Lake surface elevations at the highest, most practicable level commensurate with other Project purposes during the summer recreation season.

2.2.4.2 Measures in Other Existing Licenses, Permits, Agreements, and Contracts That Affect Project Operations

The Licensees' operations of the Project is affected by a 1969 MOU between DWR and USFS and several long term water contracts between DWR and SWP contractors.

As part of the SWP, the Project utilizes water that is conveyed through the West Branch of the SWP to serve various contractors in southern California who have long-term water supply contracts with DWR. Table 4.1-2 in Exhibit B of this Application for New License lists the SWP contractors that are served by SWP water conveyed through the Project and their associated maximum contractual annual water delivery amounts.

In addition, there is an agreement between DWR and Ventura County Watershed Protection District (VCWPD), under which DWR releases up to 3,150 AF of SWP water from Pyramid Lake for delivery to UWCD on behalf of VCWPD between November 1 and the end of February each year.

The 1969 MOU has provisions regarding water surface elevations. According to Amendment 1 to the MOU, during normal operation conditions, water surface level variations in Pyramid Lake may not exceed 14 feet during each 7-day period beginning midnight each Sunday, and may not exceed 8 feet each day. In addition, the water surface of Pyramid Lake may not be lowered below an elevation of 2,560 feet without taking additional safety precautions and making appropriate notifications.

In addition, the Licensees operate the existing Project consistent with their water rights. Table 4.1-1 in Exhibit B of this Application for New License lists the Licensees' local water rights for Piru Creek and Castaic Creek.

2.2.5 Existing Routine Facility Maintenance

2.2.5.1 Angeles Tunnel

The Angeles Tunnel is always pressurized, except for one to two periods approximately once every 10 years when the tunnel is dewatered for inspection.

2.2.5.2 Powerplant Maintenance

The Licensees conduct mechanical and electrical inspections and maintenance at the Warne and Castaic Powerhouses to verify the structural and/or functional integrity of the facilities, and to identify conditions that might disrupt operations. This activity typically occurs twice a year (prior to summer and during fall) for Castaic Powerplant and annually for Warne Powerplant. During inspection and maintenance, the powerhouse units are offline to support planned outages which are based upon operating hours and system needs. Depending on maintenance work needed on the tunnel and penstock, it can be dewatered by closing the intake gates or valves.

2.2.5.3 Other Facility Maintenance

Routine maintenance activities conducted in the vicinity of Project facilities include vegetation management, pest management, road and trail maintenance, facility painting, recreation facilities maintenance, transmission line maintenance, and debris management. Each of these activities is described below.

Vegetation Management

Vegetation management is implemented by the Licensees at Project facilities. Vegetation management is completed throughout the Project area as necessary to reduce fire hazard, to provide for adequate Project facility access and inspection, to protect Project facilities, and to provide for worker and public health and safety. In general, vegetation management is implemented within approximately 20 to 75 feet of the powerhouse and switchyard; within approximately 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas.

Vegetation management is conducted manually (hand trimming) and chemically (with the use of herbicides). Hand trimming includes cutting grasses and forbs using string trimmers, and removing or trimming overhanging shrubs and tree limbs using a chain saw or other handheld saw or clippers. These management activities are conducted as needed in conjunction with facility inspections.

Hazard trees – generally defined as dead or dying trees or trees with defects that may result in failure and have the potential to cause property damage, personal injury, or death – are removed as needed. Removal is conducted with a chainsaw, handheld saw, or other equipment. Smaller diameter debris from felled hazard trees is either chipped, or lopped and scattered. Downed logs are typically left onsite and are moved only if needed for safety. If moving logs is necessary, it may be completed by hand or machine, depending on the situation. For trees on USFS lands the Licensees coordinate with ANF by first making a phone call seeking permission to drop a hazard tree and follow any requirements the ANF may have.

Pest Management

Herbicides, in combination with surfactants, are used in combination with hand trimming vegetation management activities on an annual basis at Project facilities located on Licensee-owned property. All herbicide applications are supervised by a Qualified Applicator under the direction of a licensed Pest Control Advisor (PCA). The PCA prepares pest control recommendations consistent with the specific herbicide label(s) for each site, prescribing specific application direction and associated precautions that must be strictly followed. All-terrain vehicles, other vehicles (e.g., pick-up trucks), backpack sprayers, or small hand-held sprayers are used to apply herbicides. Herbicide application occurs twice annually, at a minimum. These applications occur seasonally as determined by the PCA for pre-emergents. Follow-up visits to apply post-emergent herbicides and/or additional treatments (as needed) are seasonally dependent. A third cycle would be completed if required.

The Licensees implement rodent control as needed in facility interiors (i.e., within the Warne and Castaic Powerplants), recreation areas, and earthen infrastructure to protect public health and the safe operation of Project infrastructure by applying non-restricted rodenticides in accordance with label instructions. Prior to administering a rodenticide, the feasibility of using non-chemical methods will be evaluated in order to avoid potential effects of carcass consumption by scavenging wildlife.

Road Maintenance

Regular inspection of the Primary Project Roads occurs during the course of day-to-day Project activities. Maintenance generally includes, but is not limited to, the following types of activities: debris removal; filling potholes; grading, sealing, and surfacing; maintenance or replacement of erosion control features (e.g., culverts, drains, ditches, and water bars); repair, replacement, or installation of access control structures, such as posts, cables, rails, gates, and barrier rock; and repair and replacement of signage. Vegetation management may be conducted concurrently with road maintenance.

Trail Maintenance

Regular inspection of trails to access the powerhouse and other ancillary facilities occurs during the course of day-to-day Project activities. Maintenance is conducted as needed. Trail maintenance generally includes, but is not limited to, the following types of activities: debris removal; basic repairs, including minor brushing; maintenance of erosion control features, such as water bars; repair, replacement, or installation of access control structures, such as barrier rock; and repair and replacement of signage. Vegetation management may be conducted concurrently with trail maintenance on an as-needed basis.

Facility Painting

DWR and LADWP paint or coat the exterior of Project facilities, including the powerhouse and ancillary facilities, as needed.

Recreation Facilities Maintenance

Maintenance of recreation facilities is conducted by both DWR and its concessionaire. Maintenance activities include activities to support recreation development and use, and include maintaining parking areas, lawns, restrooms, lights, water, power, shelters, and picnic/campground equipment.

Transmission Line Maintenance

LADWP's Overhead Transmission (OHT) group performs aerial inspections on the Castaic transmission line twice per year at six-month intervals. These inspections include the portions of the transmission line from Castaic Powerplant south to the end of the FERC boundary near Haskell Canyon Switching Station. Aerial inspections are also performed during weather events, such as heavy rain, for erosion control. OHT performs an eight-day insulator hand wash annually to maintain porcelain end insulators.

The transmission line rights-of-way are typically graded as needed before any scheduled maintenance or if there are potential erosion issues. During the grading process, OHT labor crews clear existing McCarthy drains and culverts, install coconut matting and waddles, and clear brush along the roadway. All other maintenance is performed on an as-needed basis.

2.2.5.4 Debris Management

Storm Bypass Channel and Check-Dam Basin Maintenance

The Storm Bypass Channel, which includes a series of three check-dam basins, captures sediment runoff during high flow events. The channel and check dams reduce the continued accumulation of sediment near the powerplant, and maintain the sustained efficiency of the Castaic Powerplant operation.

Sediment removals from the check dam basins are conducted on two- to three-year intervals. Once all necessary permits and environmental clearances are obtained, vegetation is grubbed and biologic controls (i.e., turtle refuge pond) are set up. Excavated sediments have been and are proposed to continue to be placed and compacted on designated spoil pile(s).

Elderberry Forebay Dredging

Mechanical dredging for the removal of soils deposited in Elderberry Forebay, including the tailbay, tailrace, the confluence of the tailbay, and tailrace areas, is conducted at 10-year intervals after obtaining all necessary permits and approvals. The dredging was last completed in 2016, when approximately 500,000 cubic yards (cy) of material were removed from Elderberry Forebay.

The mechanical dredging from these areas requires a complete outage of Elderberry Forebay. All these areas are completely drained to allow mechanical dredging operations. The outage operations are carried out in conjunction with the outage and draining of Castaic Powerplant's penstocks.

An earthen soil dam and ramps are constructed along the tailrace to allow construction equipment to access the areas to excavate and to load and haul dredging materials to the stockpile area. A hauling route to the dewatering zones is determined based on the work stations assigned for the outage project. After dewatering of the soils, they are stored in the stockpile area.

2.3 OTHER ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

2.3.1 Federal Government Takeover of the Project

Pursuant to 16 United States Code (U.S.C.) Section 828b, Section 14 of the FPA pertaining to the taking over by the United States of any project upon or after the expiration of a license shall not be applicable to any project owned by a State or municipality. The Project is a part of the SWP and, therefore, the Project is not subject to federal takeover. Therefore, the federal government takeover alternative was not considered a reasonable alternative to relicensing the Project.

2.3.2 Issuing a Non-Power License

FERC may issue a non-power license if it finds that, in conformity with a comprehensive plan for improving or developing a waterway, a licensed project should no longer be used for power purposes. A non-power license is a temporary license that FERC would terminate whenever it determines that another governmental agency is authorized and willing to assume regulatory authority and supervision over the lands and facilities covered by the non-power license. At this time, no governmental agency has suggested a willingness or ability to assume such responsibilities. No party has sought a non-power license for the Project, and there is no evidence suggesting that such a license would conform to a comprehensive plan for the waterway. Therefore, a non-power license was not considered a reasonable alternative to relicensing the Project.

2.3.3 Retiring the Project

Decommissioning of the Project could be accomplished with or without dam removal. Either alternative would require denying the relicensing application, and surrender or termination of the existing license with appropriate conditions. There would be significant costs involved with decommissioning the Project and/or removing any Project facilities.

The SWP provides southern California with many benefits, including affordable water supply, reliable regional clean energy, opportunities to integrate green energy, accessible public recreation opportunities, and environmental benefits. With decommissioning, the Project would no longer be authorized to generate power.

No party has suggested that Project decommissioning would be appropriate in this case, and there is no basis for recommending it. Therefore, Project decommissioning was not considered a reasonable alternative to relicensing the Project with appropriate environmental enhancement measures.

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3.0 GENERAL DESCRIPTION OF THE RIVER BASINS

This section provides a general description of the river basins in which the Project is located. Climate, topography, major land uses, and economic activities in the Project region are also discussed in this section.

3.1 RIVER BASINS

The Project is located in and around the Sierra Pelona Mountains between the Tehachapi and San Emigdo Mountains, part of the Transverse Ranges in southern California. The Project uses SWP water to generate power.

As shown in Figure 3.1-1, two drainage basins are incidentally intercepted by the Project: (1) the Piru Creek Basin, including its tributary Gorman Creek; and (2) the Castaic Creek Basin. A general description of each of these basins is provided below. Quail Lake, the other Project impoundment, is an engineered water body not located in either creek basin, and does not collect surface water flows or discharge into State surface waters.

3.1.1 Piru Creek Basin

Piru Creek's headwaters collect water from about a dozen named tributaries and are located approximately 40 river miles (RM) upstream of Pyramid Dam, which is located approximately 29 miles upstream of the confluence of Piru Creek and the Santa Clara River. Piru Creek and its tributaries above Pyramid Lake flow relatively unimpaired; there are no diversions or dams located on any of the drainages.

Pyramid Lake is filled with water from the SWP, and also incidentally intercepts water from Piru Creek, Gorman Creek, Cañada de Los Alamos, West Fork of Liebre Gulch, and Liebre Gulch. However, none of the surface water is used for power generation, and instead is released from Pyramid Dam into Pyramid reach.

Releases from Pyramid Dam to Pyramid reach include both release of continuous natural streamflow and periodic release of SWP water for delivery to UCWD. The release into Pyramid reach for natural streamflow below Pyramid Dam averages 25,081 AF per year and the release of SWP water for delivery to UWCD averages 2,018 AF per year, which is released between the months of November through February.

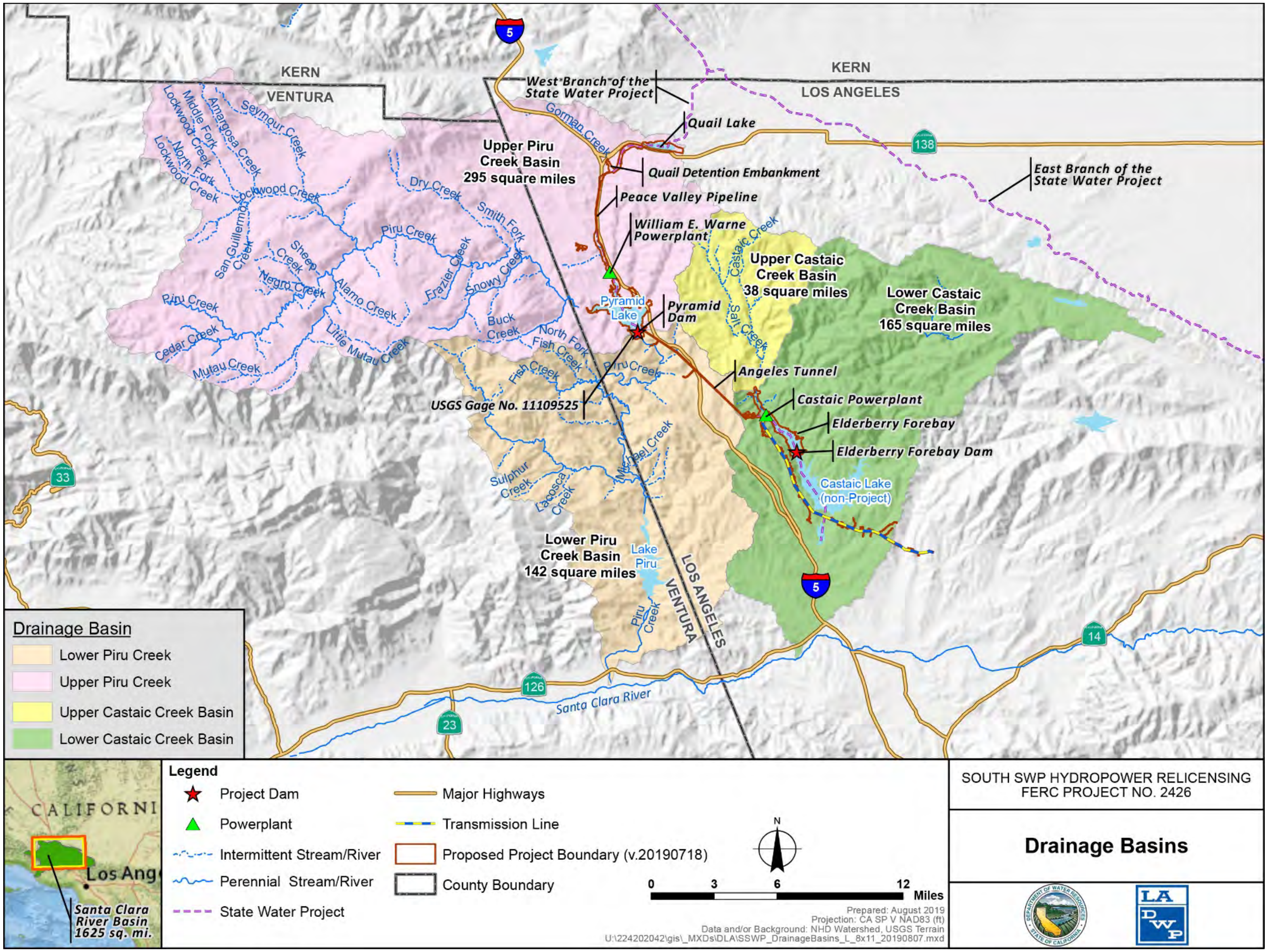
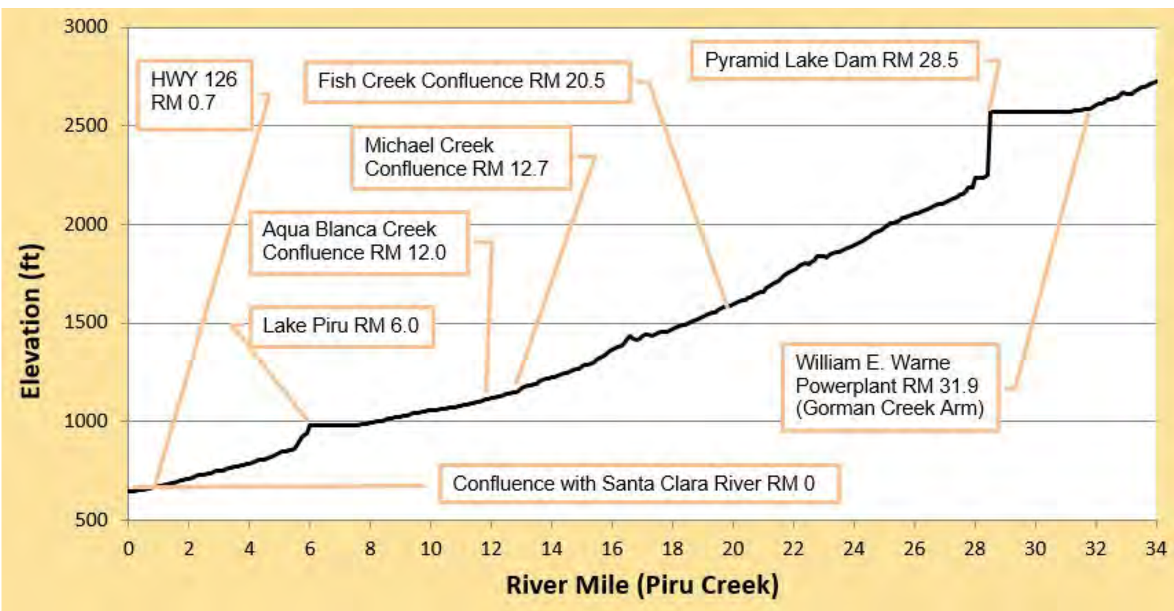


Figure 3.1-1. Drainage Basins in the Vicinity of the Project Facilities

Stream releases from Pyramid Dam are routed into the Pyramid reach of Piru Creek, defined as Piru Creek between Pyramid Dam and Lake Piru. Pyramid reach flows downstream 18.4 miles to the NMWSE of UWCD's Lake Piru. Lake Piru is formed by Santa Felicia Dam, located 5.9 miles upstream of the confluence of Piru Creek and the Santa Clara River. Pyramid reach collects flows from three named tributaries before reaching Lake Piru: (1) Fish Creek, which enters Pyramid reach 8.0 miles downstream of Pyramid Dam; (2) Michael Creek, which enters 15.8 miles below Pyramid Dam; and (3) Agua Blanca Creek, which enters 16.5 miles below Pyramid Dam. Santa Felicia Dam was constructed in 1955 by the UWCD for flood storage and seasonal groundwater recharge.

The sub-basin drainage area upstream of Pyramid Dam (Upper Piru Creek Basin) is 295 square miles of steep mountainous terrain, with elevations that range from 2,600 feet to 8,900 feet. The sub-basin drainage area downstream of Pyramid reach (Lower Piru Creek Basin) is 142 square miles of steep mountainous terrain and rolling foothills, with elevations that range from 650 feet to 6,800 feet.

Figure 3.1-2 shows the gradient in Piru Creek in the vicinity of the Project, with notable features identified.



Key:
ft = feet
HWY = Highway
RM = river mile

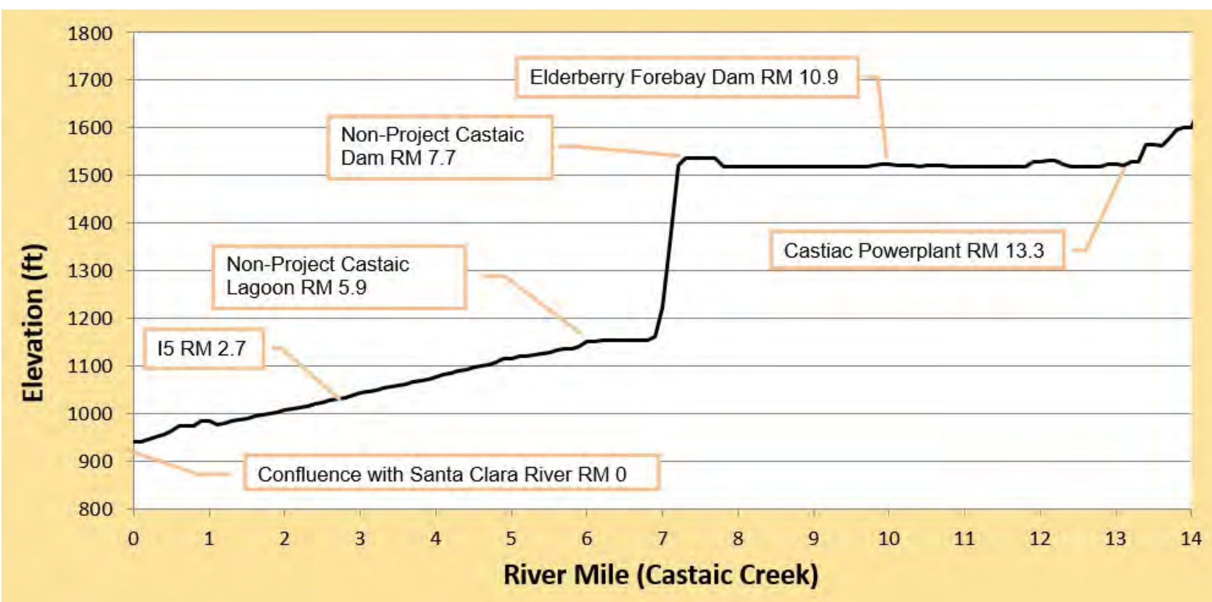
Figure 3.1-2. Piru Creek Profile

3.1.2 Castaic Creek Basin

Castaic Creek headwaters are located approximately 11 RM upstream of Elderberry Forebay, and collect water from Salt Creek before flowing into Elderberry Forebay. Castaic Creek flows along a natural channel until just above Elderberry Forebay, where it enters a series of three check-dam basins that drain into Elderberry Forebay, just downstream of the Castaic Powerplant tailrace.

Castaic Creek flows are passed through Elderberry Forebay Dam, which is 10.9 RM upstream of the confluence of Castaic Creek and the Santa Clara River near Valencia, California. The flows continue through Castaic Lake (non-Project facility) impounded by Castaic Dam, which is located 7.7 miles upstream of the Santa Clara River. Castaic Creek re-emerges after passing south through (non-Project) Castaic Lagoon and into the Santa Clara River. The sub-basin formed by Elderberry Forebay Dam (Upper Castaic Creek Basin) is 38 square miles of steep mountainous terrain with elevations that range from 1,500 to 5,700 feet. The remaining area (Lower Castaic Creek Basin) is 165 square miles of steep mountainous terrain and rolling foothills with elevations that range from 950 feet to 5,400 feet.

Castaic Creek joins the Santa Clara River 40 RM below the Santa Clara River headwaters in the San Gabriel Mountains, which are located east of the confluence. The Piru Creek confluence with the Santa Clara River is 10.4 RM west of the Castaic Creek confluence. From the Piru Creek confluence, the Santa Clara River continues west 32 RM to the Pacific Ocean. The Santa Clara River Basin is 1,626 square miles. Figure 3.1-3 shows the gradient in Castaic Creek in the vicinity of the Project, with notable features identified.



Key:
ft = feet
RM = river mile

Figure 3.1-3. Castaic Creek Profile

3.1.3 Quail Lake

Quail Lake is an engineered water body built by DWR in the former location of a natural sag pond. The source of Quail Lake's water is the SWP. Quail Lake does not collect surface water, except for a small amount of overland flow from the surrounding slopes during and immediately after precipitation events. Also, Quail Lake does not naturally flow to any State surface waters. Quail Lake drains to the Piru Creek watershed through engineered SWP facilities.

3.2 CLIMATE

The climate in the Project area is Mediterranean. It is generally hot in the summer and mild and dry through most of the rest of the year. Air temperatures range from approximately 70 to 100 degrees Fahrenheit (°F) during the summer, and 40°F to 65°F during the winter. Monthly precipitation ranges from 0 to 5 inches, depending on the month, with the wettest months occurring between December and March, and very little rainfall from April through August.

3.3 TOPOGRAPHY

The topography around the three Project reservoirs is generally hilly and mountainous, with lower terrain surrounded by arid chaparral scrub vegetation. Quail Lake is at an elevation of approximately 3,300 feet. Slopes in the vicinity of the lake range from 2 to 20 percent. Pyramid Lake is at an elevation of approximately 3,000 feet, with nearby slopes that range from 2 to 100 percent. Elderberry Forebay is at an elevation of approximately 2,400 feet, with nearby slopes similar to the slopes near Pyramid Lake.

3.4 MAJOR LAND USES AND ECONOMIC ACTIVITIES

3.4.1 Land Uses in the Project Area

The Lower Quail Canal is located on State land that extends to Pyramid Lake. Water from the Lower Quail Canal passes into the Peace Valley Pipeline, which terminates at the Warne Powerplant, located on State land. The areas immediately adjacent to Elderberry Forebay are not accessible to the public for safety purposes. The majority of the areas immediately adjacent to Pyramid Lake are NFS lands managed by the ANF and LPNF. The Angeles Tunnel, which connects Pyramid Lake to Elderberry Forebay, passes mostly under public multiple-use lands managed by the ANF, except where it connects to the Castaic Powerplant, which is on State land.

Prior to the construction of Pyramid Lake and Dam, land uses consisted primarily of grazing, transportation, and open space. The area has always been part of an important north-south transportation corridor. Settlement and commercial development were limited prior to the 1970s. Similarly, Quail Lake was constructed in an area that was mostly used for grazing and transportation associated with nearby State Highway 138.

All three reservoirs are located within Los Angeles County, with land use policies for the region guided by the ANF, LPNF, BLM, and Los Angeles County. The ANF Land Management Plan was adopted in 2006 and is intended to provide guidance for management of the NFS lands for a period of 10 to 15 years (USFS 2006). The LPNF Land Management Plan was adopted in 2005 and describes the strategic direction at the broad program-level for managing the land and its resources over the next 10 to 15 years (USFS 2005). BLM's South Coast Resource Management Plan, adopted in 1994, guides the management of approximately 296,000 acres of land within BLM's jurisdiction (BLM 1994). Land use policies for private lands in the Project area are provided by Los Angeles County's General Plan (Los Angeles County 2015). For a more detailed description of land uses relative to the Project, refer to Exhibit E, Section 5.6, Land Use and Management.

3.4.2 Economic Activities in the Project Area

Los Angeles County includes goods-producing, service-providing, and government industry sectors. Service-providing industries support the majority (75.4 percent) of the labor force within Los Angeles County, while government and goods-producing industries comprise 12.8 and 11.8 percent of the labor force, respectively. For a more detailed description of economic activities and the labor force relative to the Project area, refer to Exhibit E, Section 5.9, Socioeconomics.

4.0 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing NEPA (40 CFR 1508.7), a cumulative effect is “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions.” Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

4.1 RESOURCES THAT COULD BE CUMULATIVELY AFFECTED

FERC’s January 13, 2017, SD2 for the South SWP Hydropower relicensing concluded the following resources could be cumulatively affected by the proposed continued O&M of the Project, in combination with other water projects:

- Water Quality (dissolved oxygen and water temperature)
- Fisheries
- Aquatic Reptiles
- Amphibians
- Recreation

Provided below are the geographic and temporal scopes of the cumulative effects analysis for these resources, and the past, present, and reasonably foreseeable future actions considered in the analysis.

4.2 GEOGRAPHIC SCOPE FOR ANALYSIS OF CUMULATIVELY AFFECTED RESOURCES

FERC’s SD2 defined the physical limits or boundaries of the Proposed Action’s effect on the resources as follows:

- For water quality (dissolved oxygen and water temperature), the geographic scope is Piru Creek Basin from Pyramid Lake to the confluence of Piru Creek with the Santa Clara River, and Castaic Creek from Elderberry Forebay to Castaic Lake. FERC chose this geographic scope because it determined the O&M of the Project, in combination with other water development activities in these drainages, may cumulatively affect dissolved oxygen and water temperature in the geographic reaches identified.
- For fisheries, aquatic reptiles, and amphibians, the geographic scope is Piru Creek Basin from Pyramid Lake to the confluence of Piru Creek with the Santa Clara River, and from Pyramid Lake to Elderberry Forebay within the Castaic

Creek drainage. FERC chose this geographic scope because it determined the O&M of the Project, in combination with other water development activities in these drainages, may cumulatively affect fishery resources, aquatic reptiles, and amphibians in the geographic reaches identified.

- For recreation, the geographic scope comprises the watersheds upstream of Pyramid Lake and Piru Creek. FERC chose this geographic scope because it determined the O&M of the Project, in combination with other recreation uses in these areas, may cumulatively affect recreation use levels throughout the geographic area identified.

The Licensees have included these geographic areas in the cumulative effects analysis for the resources identified by FERC in SD2.

4.3 TEMPORAL SCOPE FOR ANALYSIS OF CUMULATIVELY AFFECTED RESOURCES

The temporal scope of the cumulative effects analysis for the relevant resources includes a discussion of past, present, and future actions, and their effects on each resource that could be cumulatively affected. For any resource identified as potentially having cumulative effects, FERC determined in SD2 that the temporal scope will look 30 to 50 years into the future, based on the potential term of a new license, concentrating on the effect on the resource from reasonably foreseeable future actions.

4.4 PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS CONSIDERED FOR ANALYSIS OF CUMULATIVELY AFFECTED RESOURCES

According to FERC's guidelines for Preparing Environmental Documents (2008), the application should include a brief discussion of past, present, and future actions, and their effects on resources based on the new license term (30 to 50 years). Further, the guidance from FERC notes the need to highlight the effect on the cumulatively affected resources from reasonably foreseeable future actions. The past actions' effects on a resource are outlined in the Affected Environment section.

Each of these actions is discussed below without consideration of the added effects, if any, of the Licensees' Proposal. Incremental effects of the Licensees' Proposal, when taken in combination with these actions, are discussed in the appropriate resource sections of this Exhibit E.

4.4.1 Past and Present Actions

Past and present actions contribute to the current condition of the resources; are intrinsically embedded in the baseline (i.e., existing conditions); and are discussed where appropriate in the specific resource sections of this Exhibit E. One of the more significant past and present actions in the Project area is the construction and operation of the SWP, which is the largest state-owned and operated water storage and delivery system of its kind in the United States. The SWP commenced operations in the 1960s, and today includes 21 dams and more than 700 miles of canals, pipelines, and tunnels that move water from northern California to more than 26 million people in northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and southern California. The SWP irrigates about 750,000 acres of farmland, mainly in California's Central Valley. FERC does not regulate the SWP, except for specific hydropower generating facilities associated with the SWP.

Since the vast majority of water in Quail Lake, Pyramid Lake, and Elderberry Forebay is water from the West Branch of the SWP (i.e., natural inflow is very small as compared to the volume of SWP inflow, as described in Exhibit B), the SWP affects water resources (i.e., both water quantity and water quality) throughout the Project. In addition, biota in SWP water, including fish and aquatic species, freely enter Quail Lake and downstream Project reservoirs. These biota could affect aquatic resources in these reservoirs and some of these biota (e.g., fish) may move upstream from Pyramid Lake and Elderberry Forebay (Quail Lake does not have any inflow tributaries) affecting other species through mechanisms such as predation or competition in tributaries to these reservoirs. Furthermore, water is released from Pyramid Lake into Pyramid reach and from Elderberry Forebay into Castaic Lake (water from Quail Lake is not released into any surface waters). Local surface water also enters Pyramid Lake and Elderberry Forebay, mixes with SWP water in the reservoirs, and is then released downstream. These releases may affect water quality and aquatic resources, including the arroyo toad, in Pyramid reach.

Another important past and present action is the implementation of DWR's water agreements with VCWPD. Under this agreement DWR releases under contract an entitlement of up to 3,150 AF of SWP water from Pyramid Lake for delivery to UWCD on behalf of VCWPD. These releases occur between November 1 and the end of February each year pursuant to license Article 52. In addition, UWCD has plans to take advantage of other SWP water purchase, exchange and transfer opportunities, such as the additional deliveries FERC recently approved in issuing a temporary variance order. These releases supplement the hydrology in the Pyramid reach.

A significant hydroelectric/water project in the geographic region relative to cumulative effects is UWCD's Santa Felicia Project (FERC No. 2153). The project consists of the Santa Felicia Dam which is located on Piru Creek, approximately 18 miles downstream of the Project's Pyramid Dam and 5.9 miles upstream of Piru Creek's confluence with the Santa Clara River. The dam, which is 200 feet high and forms the approximately 87,000 AF Lake Piru, was constructed in 1955 by UWCD for flood storage and seasonal groundwater recharge. UWCD releases water from Lake Piru to downstream municipalities, industry, and agriculture. FERC issued a new license for the Santa Felicia Project on September 12, 2008, with an expiration date of August 31, 2048. The license includes numerous conditions for the protection and enhancement of resources, including water quality, fisheries, aquatic reptiles, amphibians, and recreation in Lake Piru and downstream of Santa Felicia Dam.

One of the more notable conditions in UWCD's license pertains to fish passage. Under License Articles 401 and 402, UWCD is required to study and provide an assessment of passage of steelhead at or around Santa Felicia Dam, or other suitable alternatives to passage. UWCD is in the process of assessing passage feasibility but has no present plans to implement a long-term passage program.

Also relative to cumulative effects, USFS's management of the ANF and LPNF may affect dissolved oxygen, water temperature, fisheries, aquatic reptiles, amphibians, and recreation in the geographic area. These effects occur from USFS's management with regard to vegetation, including riparian habitat; roads and transportation uses; and recreation, including off-highway vehicle (OHV) use. In addition, USFS manages a 7.3-mile-long section of Pyramid reach as a National Wild and Scenic River. FERC does not regulate these USFS activities.

Other cumulative effects on native fish, amphibians, and aquatic reptiles are associated with the introduction and subsequent spread of American bullfrog throughout California. Historically, a commercial bullfrog farm on the Santa Clara River may have facilitated bullfrog range expansion to Piru Creek.

4.4.2 Reasonably Foreseeable Future Actions

The past and present actions described above are likely to continue in the future, though the magnitude of particular actions may change over time. Below is a discussion of reasonably foreseeable future actions with regard to water supply, delivery, and diversion; the Centennial development; and fish passage.

4.4.2.1 Water Supply, Delivery, and Diversion

Presently, the SWP includes only a fraction of the facilities as originally proposed, and has delivered an average of 2.4 million AF of water annually, as compared to the contractual maximum of 4.23 million AF pursuant to the SWP long term water supply contracts. DWR anticipates that few changes will occur with respect to these water deliveries in the future. With regard to SWP water deliveries to UWCD, there may be increased water deliveries in the future as explained above.

4.4.2.2 Recreational Use on National Forest Lands

The recreational uses of the National Forests surrounding the Project are also expected to change and likely increase slightly over the next license term. As the population of the greater Los Angeles and high desert communities grow, there will likely be commensurate increases in numbers of people participating in outdoor recreation uses on National Forests and other public lands.

4.4.2.3 Centennial Development

The Centennial development is a reasonably foreseeable future action that has the potential to contribute to cumulative effects on water quality, fisheries, aquatic reptiles, amphibians, and recreation in the geographic area. The Centennial development is a proposed 12,323-acre, master-planned community on the Tejon Ranch, located in the northwestern portion of the Antelope Valley, and immediately north and east of Quail Lake and the proposed Project boundary. The development plan includes: 19,333 dwelling units; approximately 7,363,818 square feet of business park uses (i.e., office, research and development, and warehousing or light manufacturing uses); approximately 1,034,550 square feet of commercial uses; approximately 1,568,160 square feet of institutional/civic uses (i.e., schools for higher education, medical facilities, and libraries); approximately 130,680 square feet of recreation/entertainment uses (i.e., clubhouse, farmers market, childcare facilities, and health clubs); and approximately 5,624 acres of open space for natural resources protection and greenways. In addition, the development would have schools, utilities, and infrastructure to support the proposed land uses and future residents, including a wastewater reclamation facility, water treatment facility, water bank, materials recovery facility, and Kindergarten through 12th grade schools (Los Angeles County Department of Regional Planning 2017).

The Centennial development also requires off-site components consisting of roadway improvements and connections, and upgrades to existing off-site utility systems. Improvements to utilities within State Highway 138 include the roadway crossing of the Lower Quail Canal within the proposed Project boundary. In addition, along the West Branch of the SWP, upstream of Quail Lake and outside of the proposed Project boundary, a new bridge would be constructed and an existing bridge expanded (Los Angeles County Department of Regional Planning 2017). On December 11, 2018, the Los Angeles County Board of Supervisors approved the Centennial development project, including the proposed general plan amendment, parcel map, conditional use permit for the development, and certification of the final California Environmental Quality Act (CEQA) document.

4.4.2.4 Fish Passage

The Licensees considered, but rejected, fish passage of steelhead at or around Santa Felicia Dam as a reasonably foreseeable future action for the reasons stated in UWCD's January 9, 2020 supplemental filing clarifying several key uncertainties and contingencies regarding potential future fish passage at Santa Felicia Dam. Record of this filing can be found at FERC's E-Library Accession #: 20200110-5022.

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5.0 ENVIRONMENTAL ANALYSIS INTRODUCTION

This section addresses 13 environmental resource areas, and for each describes: (1) the affected environment, or existing Project conditions, which represent the baseline against which to compare the potential effects of the Licensees' Proposal; (2) the potential effects of the Licensees' Proposal on environmental resources, and (as applicable) any PM&E measures to mitigate or eliminate the potential adverse effects of the Licensees' Proposal on those resources; (3) unavoidable adverse effects, if any, that would result from the Licensees' Proposal, including whether the effect is short- or long-term, minor or major, and cumulative or site-specific; and (4) responses to requests for additional PM&E measures and studies as received from the relicensing participants as part of their comments on the DLA.

To develop this section, the Licensees used existing and relevant information included in their PAD or that has become available since the PAD was issued; information derived from the Licensees' FERC-approved studies; and other information otherwise obtained or developed by the Licensees.

Section 5.0 is subdivided into the following resources areas:

- Geology and Soils (Section 5.1)
- Water Resources (Section 5.2)
- Fish and Aquatic Resources (Section 5.3)
- Terrestrial Resources (Section 5.4)
    - Botanical and Wildlife Resources (Section 5.4.1)
    - Wetlands, Riparian, and Littoral Habitats (Section 5.4.2)
    - Federal ESA, Listed and Candidate Species (Section 5.4.3)
- Recreation Resources (Section 5.5)
- Land Use and Management (5.6)
- Aesthetic Resources (Section 5.7)
- Cultural and Tribal Resources (Section 5.8)
- Socioeconomics (Section 5.9)
- Air Quality (Section 5.10)
- Noise (Section 5.11)

A full list of references cited in each of the 13 subsections is included at the end of this exhibit.

5.1 GEOLOGY AND SOILS

This section discusses geology and soils in the Project region. Existing Project conditions are discussed in Section 5.1.1, effects of the Licensees' Proposal are described in Section 5.1.2, and unavoidable adverse effects are addressed in Section 5.1.3. Section 5.1.4 responds to requests for additional PM&E measures.

There is an abundance of existing, relevant, and reasonably available information related to geology and soils at the Project. Because the existing data is sufficient to determine the potential effects of the Licensees' Proposal on geology and soils, and to inform requirements in the new license, the Licensees did not conduct studies related to geology and soils.

5.1.1 Existing Environment

This section provides information regarding existing geology and soil resources. Besides this general introductory information, this section is divided as follows: Section 5.1.1.1 describes the existing regional geologic setting, including geomorphology, tectonic history, seismicity, and faulting; Section 5.1.1.2 summarizes the Project-specific geologic setting; Section 5.1.1.3 describes general soil types known to occur within the Project area; Section 5.1.1.4 describes regional paleontological resources; Section 5.1.1.5 provides information regarding mineral resources in proximity to the Project; and Sections 5.1.1.6 and 5.1.1.7 provide summaries of the geology and soils resources associated with Project facilities, including bedrock, surface deposits and soils, faulting and seismic considerations, and erosion potential and sedimentation.

5.1.1.1 Regional Geologic Setting

Geomorphology

The majority of the Project is located in the Ridge Basin area of the Sierra Pelona Mountains of the Transverse Ranges Geomorphic Province, whereas the northernmost portion of the Project lies in the Antelope Valley of the Mojave Desert Geomorphic Province and crustal block (Figure 5.1-1). The Ridge Basin is a geologic structure within the north-central portion of the Transverse Ranges province (Figure 5.1-1). To the north of the Transverse Ranges is the Mojave Desert Province, including Antelope and Summit Valleys. To the north and west of the Project are the Coast Ranges province and to the south is the Peninsular Ranges province that includes the Los Angeles Basin.

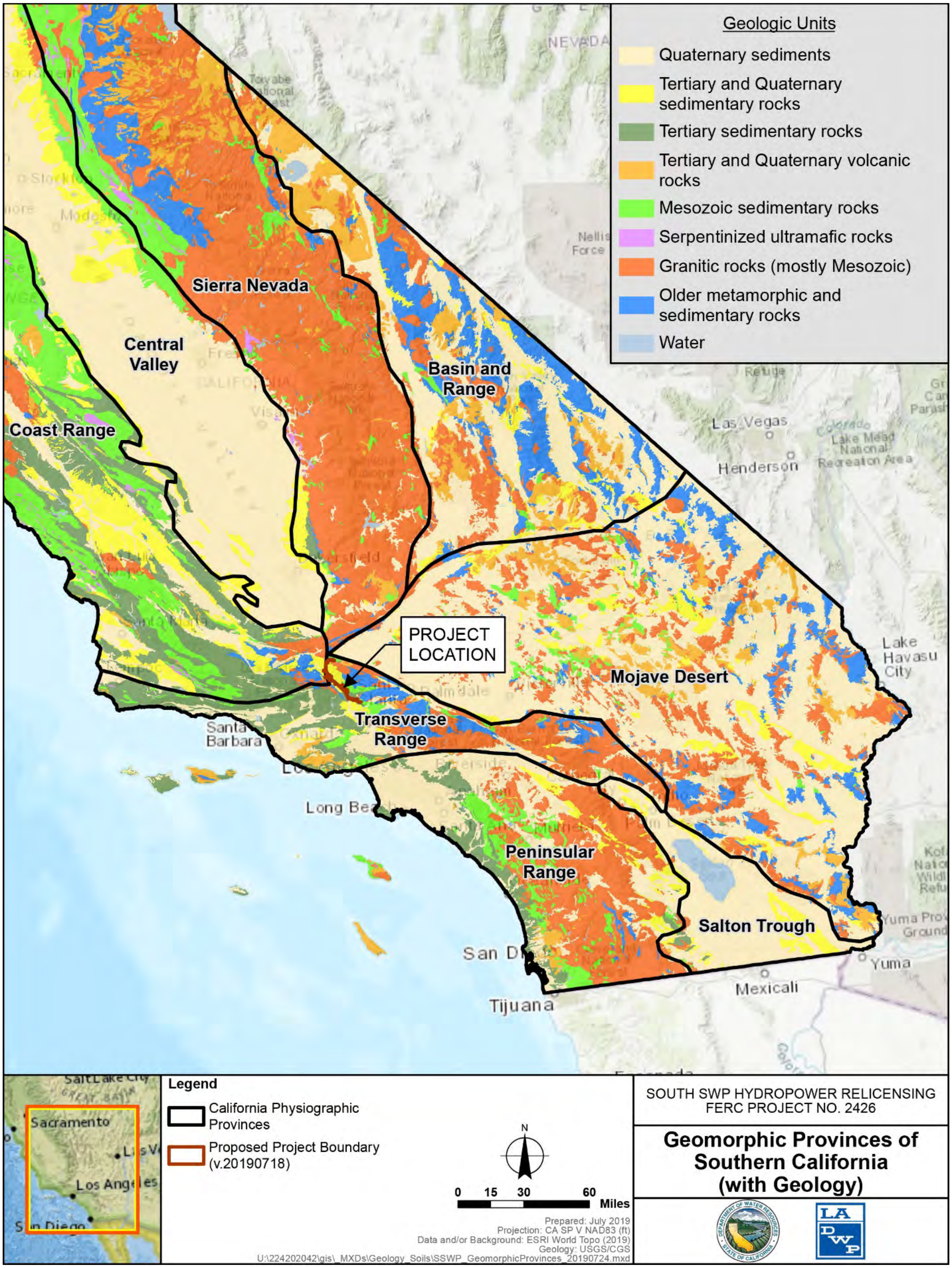

Figure 5.1-1. Geomorphic Provinces of Southern California (with Geology)

The Transverse Ranges are geologically complex regions of southern California characterized by east-west oriented mountain ranges (e.g., the Sierra Pelona, San Gabriel, and San Bernardino Mountains) and valleys, in contrast to the northwest-trending mountains and valleys of the Coast Ranges and Peninsular Ranges Provinces, and much of the rest of the State. Ongoing intense north-south compressional tectonic forces are causing relatively fast uplift of the Transverse Ranges' mountain blocks, and as a result these mountain blocks have developed the characteristically steep terrain (002a as cited in DWR 2009).

The Mojave Desert province is bounded by the Tehachapi Mountains on the northwest, and the Transverse Ranges province on the southwest. These western boundaries are distinct, forming the dominant wedge-shaped Antelope Valley. The boundaries of this valley are caused by the two largest faults in California: the San Andreas fault and the Garlock fault. The Mojave Desert extends eastward into the state of Nevada, occupying approximately 25,000 square miles in total (Figure 5.1-1).

Tectonic History

A myriad of forces – including the accretion of seafloor crust and oceanic sediments along the western margin of the North American continent, their subsequent uplift, intrusion by granitic batholiths, periods of volcanism during subduction, and horizontal translational displacement and concurrent erosion – have resulted in the formation of California's broad geologic features and present-day landscape observed in the Project vicinity (DWR 2009).

Approximately 700 million years ago (mya), the North American continent rifted away from the Rodinia supercontinent, exposing the west coast of the North American continent to the world's oceans. Southern California's current geologic features are a product of long-term tectonic activity associated with episodic subduction, which lasted from about 438 to 144 mya (Paleozoic to the Mesozoic Eras) (Atwater and Ehrenspeck 2000).

During the Mesozoic Era, about 250 to 65 mya, the ancestral southern California coast lay over a subduction zone. Much of the basement rock of California formed during that period. Through late Cretaceous and Eocene time (about 70 to 35 mya), continental and marine sediments were deposited on the continental shelf (Atwater and Ehrenspeck 2000).

As sea levels fell or the continental margin rose, during the late Eocene and Oligocene Epochs, about 35 to 23 mya, the continental margin was exposed, and a lowland of meandering rivers and floodplains developed. By early Miocene Epoch, approximately 16 to 23 mya, the sea again covered the continental margin and marine sediments were deposited. The region's geologic features were then further altered by transform movement between the Pacific and North American Plates, along the San Andreas fault (Figure 5.1-2). Starting about 20 mya, the subduction system between the Pacific and North American Plates was gradually replaced by the transform motion of the San

Andreas fault separating the generally westward-drifting continental North American Plate from the northwest-drifting oceanic Pacific Plate (Atwater and Ehrenspeck 2000).

The Pacific Plate detached slices of the continental rim and transported them northwestward. One slice of a mountain block became trapped in the shear between the North American and Pacific Plates. This slice of mountain block rotated clockwise forming a rift valley on its east. Subsequently, volcanic intrusions followed fractures in the block and sediments filled the deep rift valley. The rotated block, today's Transverse Ranges Geomorphic Province, continues to rotate, causing the ongoing tilting, folding and uplift of the growing mountain range. Thrust faults border the northern and southern mountain block margins (Atwater and Ehrenspeck 2000), further separating its geology from the surrounding geology.

Seismicity

Southern California is a region of high seismic activity. Numerous active, potentially active, and inactive faults are scattered across the region. The criteria for these major groups are based on criteria developed by the California Geological Survey (formerly known as California Division of Mines and Geology) for the Alquist-Priolo Earthquake Fault Zone Program (CGS 2007).

By definition, an active fault is one that has had surface displacement within Holocene Epoch time (approximately 11,500 years through the present). A potentially active fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years), but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

Many active, potentially active, and historically active (last 200 years) faults are located throughout the region and traverse portions of the Project. Significant earthquakes (magnitude [M] 6 or greater on the Richter magnitude scale) have historically occurred along four faults: the San Andreas fault, the Garlock fault, the San Gabriel fault, and the White Wolf fault (Figure 5.1-2). The locations of some of these M6 earthquakes are in close proximity to the Project vicinity, shown in Figure 5.1-2.

The northernmost portion of the Project (Quail Lake and a portion of Lower Quail Canal) lies on the Mojave crustal block (Mojave Desert province, Figure 5.1-1), with main traces of the San Andreas fault passing within 500 feet of the southern bank of Quail Lake and crossing the initial 0.75 miles of Lower Quail Canal. The rest of the Project lies in a crustal slice of rock known as the Ridge Basin (Transverse Range Province, Figure 5.1-2) that is wedged between the San Andreas fault to the north and the San Gabriel fault to the south. The San Gabriel fault merges with the San Andreas fault about 10 miles to the west, near Frazier Park, and about 80 miles to the east-southeast, near Cajon Pass. The two faults form a crustal block that reaches a maximum width of about 20 miles. The crustal block containing the Project is cut by numerous regional and local active, potentially-active, and inactive faults. Other minor faults in the area lie to the east of the Project and several low-angle thrust faults lie to the west.

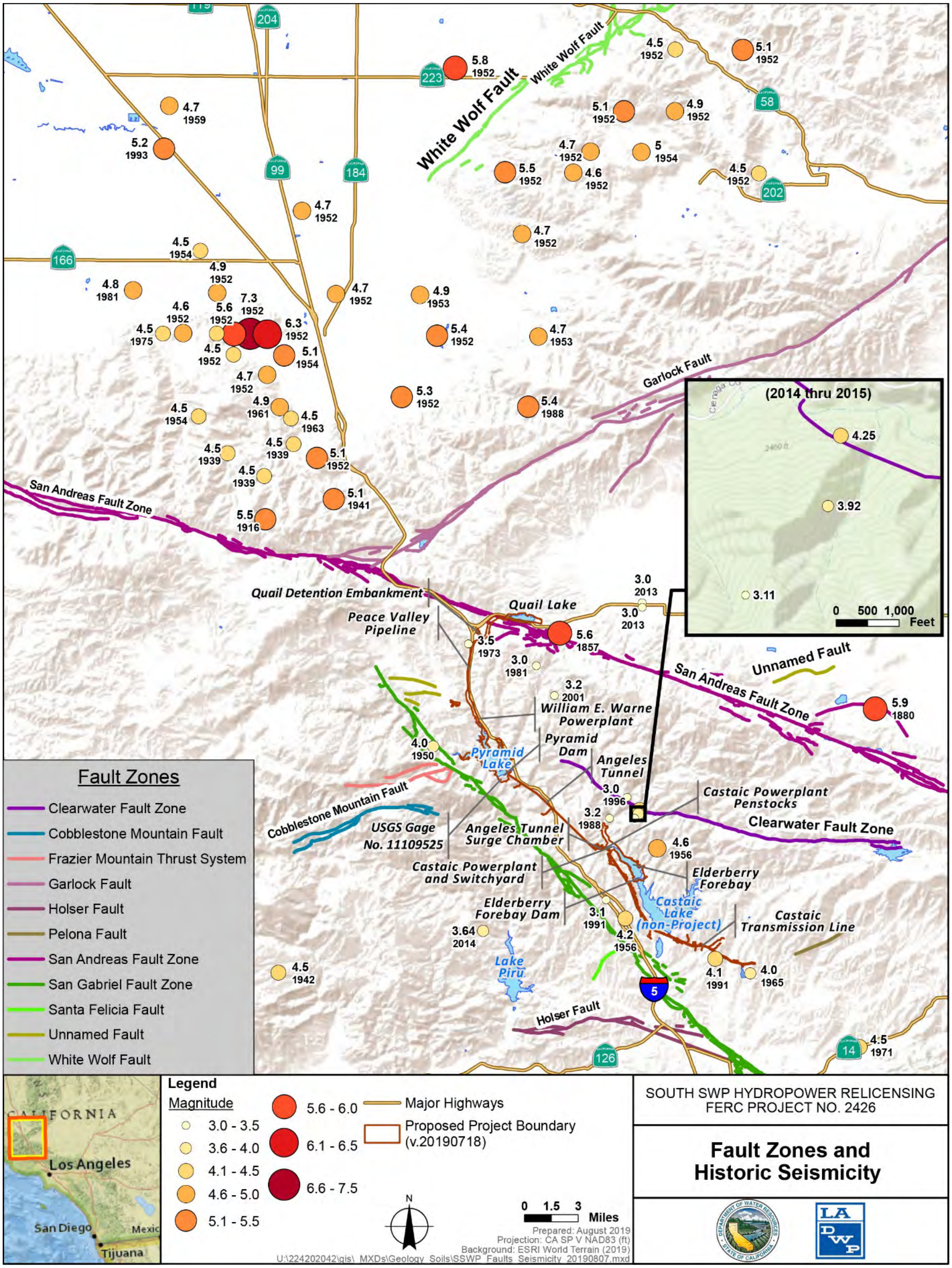

Figure 5.1-2. Fault Zones and Historic Seismicity in the Project Vicinity

Faulting

The most prominent tectonic feature associated with the Project is the San Andreas Fault Zone (Figure 5.1-2). The San Andreas fault is a right-lateral strike-slip feature that trends roughly northwestward, extending about 600 miles from the Imperial Valley in southern California to Point Arena on the northern California coast, where it continues offshore to the west.

The southern segment of the San Andreas fault was responsible for the estimated M 7.9 Fort Tejon earthquake of 1857, the largest historic earthquake to affect southern California. The Fort Tejon earthquake caused a 225-mile-long surface rupture of the San Andreas fault from the likely epicentral area northwest of Parkfield in Monterey County to at least Cajon Pass northwest of San Bernardino, traversing the Project's Quail Lake (SCEDC 2015). An estimated 20 feet of horizontal displacement occurred near the town of Gorman, approximately 4 miles from the Project. The 1857 earthquake, along with the 1906 San Francisco earthquake of northern California, represent the two largest fault ruptures in California history (SCEDC 2015).

The Garlock fault, located northwest of the Project, is an east-northeast striking fault that separates the Tehachapi and Sierra Nevada mountains from the Mojave Desert. Although no significant historic earthquakes have been recorded on the Garlock fault, the last rupture of the fault has been estimated as occurring between the years 1460 and 1900. The Garlock fault is considered an active fault that is capable of producing a significant seismic event (DWR 2009).

The San Gabriel fault is approximately 87 miles in length, extending southeastward from the San Andreas fault about 10 miles west of the Project to the Cajon Pass area, where it merges once again with the San Andreas fault (Figure 5.1-2). This primarily right-lateral strike-slip fault extends through the Project area, passing approximately 0.5 miles southwest of Pyramid Dam and nearly 3 miles from Elderberry Dam. Most of its displacement likely occurred during the middle Miocene to early Pliocene time, approximately 14 mya to 3 mya, and may have functioned as an ancestral branch of the San Andreas fault during some portion of this time (DWR 2012).

More recently, the Kern County or Tehachapi earthquake of 1952 was estimated at M 7.5 and was generated on the White Wolf fault (not shown in Figure 5.1-2), located approximately 30 miles north of the Project. This earthquake caused significant damage locally and was felt as far away as San Diego and San Francisco. This earthquake reportedly caused landslides around the Pyramid Dam area (SCEDC 2015).

The 1971, M 6.6 Sylmar or San Fernando earthquake was centered about 29 miles south of the Project. There were no known reports of slope failure resulting from this earthquake around the Project facilities. The 1994, M 6.7 Northridge earthquake was centered in Reseda, about 22 miles south of the Project. The Licensees did not find evidence of damage to the Project facilities as a result of this event.

Other prominent active faults in and near the Project are the Liebre and Clearwater faults in the northern portion of Ridge Basin, and the Bee Canyon and San Francisquito faults to the east (GSA 2003 as cited in DWR 2014a), which are not shown in Figure 5.1-2.

5.1.1.2 Project Geologic Setting

The Project facilities extend from the southern margin of the Antelope Valley on the western edge of the Mojave crustal block to the southern margin of Ridge Basin, a deep structural trough that contains a thick stratigraphic section of Pliocene Epoch, approximately 5.3 to 2.6 mya, sedimentary rocks (the QPc unit shown in Figure 5.1-3) bounded on the north by the San Andreas fault and on the west and southwest by the San Gabriel fault.

During the late Miocene and early Pliocene epochs, approximately 11.6 to 3.6 mya, this region to the north of Los Angeles and San Bernardino began to rise due to the collision of the Pacific and North American tectonic plates. Eroding soils and rock from the hills were deposited as alluvial sediments in the adjacent, subsiding basin. The combination of rapid erosion and subsidence led to the formation of very thick Pliocene Epoch sedimentary deposits, which are as much as 1,500 feet thick (Figure 5.1-3) (DWR 2014b).

The northern portion of the Project stretches from the Antelope Valley south to the north-trending Peace Valley. Bedrock in this area consists of the Oso and Quail Lake formations (near Quail Lake) and the Hungry Valley Formation (around Lower Quail Canal and the western extent of the Project), of the Ridge Basin Group of formations.

The Oso and Quail Lake Formations were deposited during the late Miocene Epoch, around 5.3 mya. The Oso Formation consists of sandstone, claystone, and conglomerate. The Quail Lake Formation consists of sandstone and silty shale. The Hungry Valley Formation was deposited in Plio-Pleistocene time, approximately 3.6 to 1.8 mya, and consists of coarse-grained arkosic sandstone with interbedded clayey siltstone. The central portion of Peace Valley is underlain by the Peace Valley Formation, which was deposited between the late Miocene and Early Pliocene epochs and consists of claystone and siltstone. The southern portion of Peace Valley and most of Pyramid Lake is underlain by the Peace Valley and Ridge Route formations. The Ridge Route Formation was deposited between the late Miocene and Early Pliocene Epochs, and consists of sandstone, claystone, and interbedded breccia. The floor of Peace Valley is underlain by as much as 100 feet of alluvial deposits consisting primarily of silts, but also includes some clays, fine-grained sands, and gravels.

The geologic structure of the Project area is dominated by the effects of the San Andreas Fault Zone. The Ridge Basin Group, including the Hungry Valley, Peace Valley, and Ridge Route formations, has a regional dip to the northwest, except near the San Andreas fault, where the rocks are tightly folded (Figure 5.1-3) (DWR 2014b; CGS 2012).

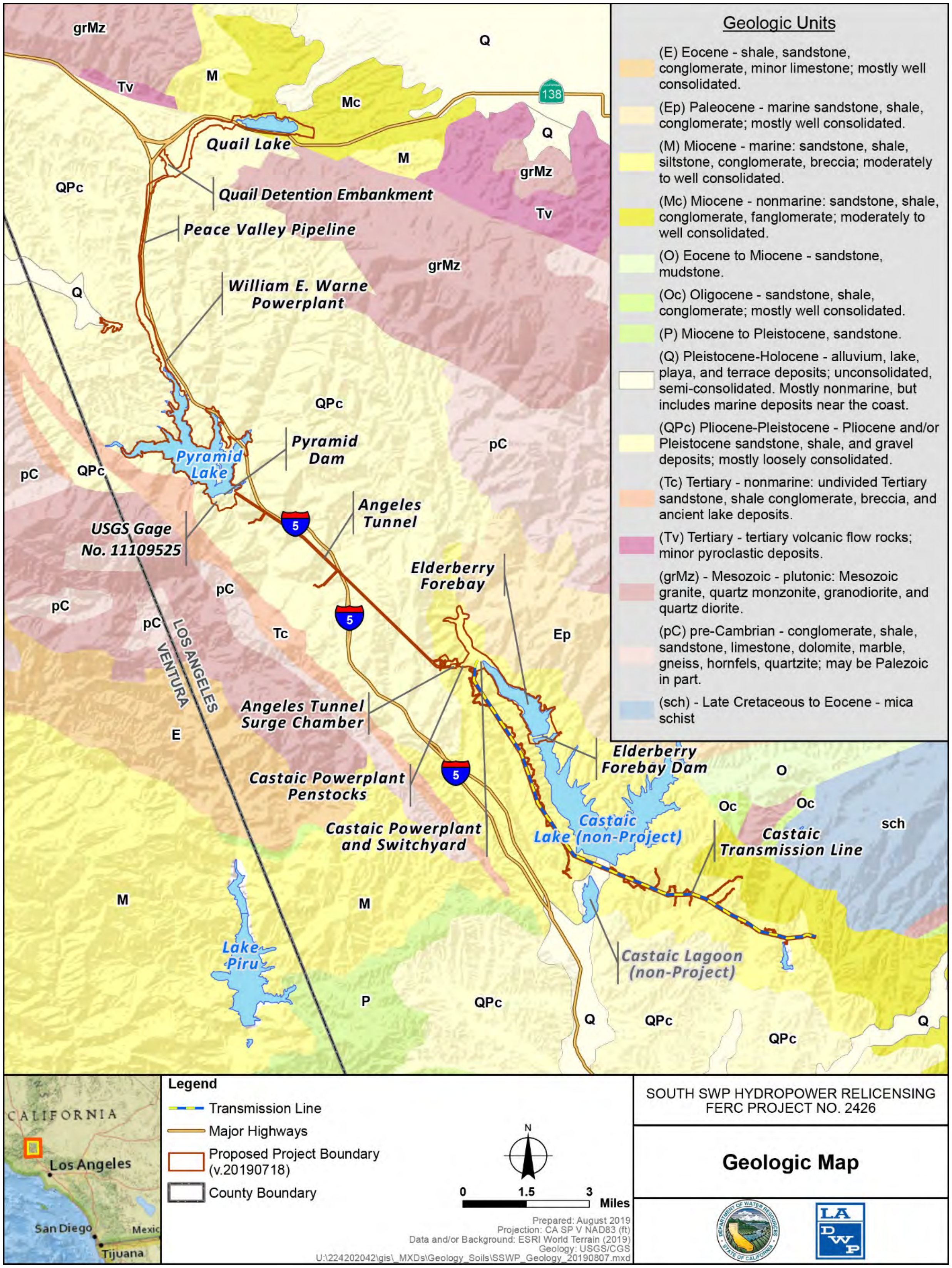

Figure 5.1-3. Geologic Map of the Project Area

The southern portion of the Project lies within the Cretaceous Period (66 to 145 mya) to Paleocene Epoch (56 to 66 mya) San Francisquito Formation, which is overlain by the Miocene Epoch (approximately 23 to 5.3 mya) marine Castaic Formation. These bedrock units consist of clay shale, siltstone, shaley siltstone, sandy siltstone, and sandstone conglomerate that are cut by numerous regional and local east-west trending faults that cross between the San Andreas and San Gabriel faults. These units are all inclined to the west at dips of approximately 10 to 30 degrees, and are covered by relatively thin deposits of soil, slopewash, creep materials, and talus, which form apron-like masses that occupy portions of gullies and drainage channels (Figure 5.1-3) (DWR 2009; Dibblee and Ehrenspeck 1997).

General Bedrock

The oldest sedimentary formation in Ridge Basin is the San Francisquito Formation, which is composed of conglomerate, sandstones, and shales (Crowell and Link 1982). Overlying the San Francisquito is the late Miocene Epoch, approximately 11.6 to 5.3 mya, Castaic Formation that consists primarily of shale with interbedded siltstone, sandstone, and conglomerate (Foster 2003).

Above the Castaic Formation are the Oso and Quail Lake Formations, and the Ridge Basin Group that consists of the Violin Breccia, Ridge Route, Peace Valley, and Hungry Valley formations (Foster 2003; CGS 2012). With the exception of the Oso and Quail Lake formations, these formations have been folded into a series of westerly to northwesterly trending folds. Erosional processes have sculpted these rocks into steep-walled canyons and sharp ridges (Federal Power Commission 1976).

Surface Deposits

Surficial geologic units include Quaternary Period (about 2.6 mya to 11,500 years) alluvial, younger and older river terrace, and landslide deposits. Holocene alluvium, approximately 11,500 years to present, typically consists of loose to slightly consolidated stream deposits of silt, sand, and gravel that may be up to 100 feet thick overlying the Hungry Valley Formation. Younger materials include alluvial fan deposits consisting of slightly consolidated silt, clay, sand, and gravel. Older stream terrace deposits consist of fine sand, silt, and clay, with a few beds of coarse sand and sandy gravel (GEI 2005.). The mountain slopes in the Project vicinity are considered prone to earthquake-induced landslides and the granular alluvial sediments underlying the vicinity may be subject to liquefaction during a significant seismic event.

Some bedrock units are more susceptible to landsliding than others. In the Project area, poorly indurated portions of the Peace Valley Formation are particularly prone to landsliding when bedding dip slopes coincide with natural ground surface slopes (Foster 2003). Sections 5.1.1.6 and 5.1.1.7 provide details regarding surficial deposits adjacent to Project features.

5.1.1.3 Project Soil Types

Soil types in the Project area are variable and reflect the diversity of parent materials and slope conditions that make up the Project. The Project traverses a number of different terrains, from the relatively flat Antelope Valley in which Quail Lake is located, through the Sierra Pelona Mountains in which Elderberry Forebay is located. Figure 5.1-4 shows the soil series within the Project vicinity.

In the Antelope Valley, the Project is underlain almost exclusively by Holocene alluvium, alluvial fan, and saline sand deposits. Soils developed here are well-drained, fine sandy loams that exhibit moderately rapid to moderately slow subsoil permeability (NRCS 2015b).

As the Project enters Peace Valley, it is underlain by thick, recently deposited alluvial silts and sands. Soils that have developed on these deposits are well-drained, sandy, heavy sandy, to gravelly loams. Further south in the Peace Valley, mountainous soils characterized by well-drained sandy loams and silty clay loams are present (NRCS 2015b). A pattern of alluvial valley soils and stony mountainous soils exist, with some variation, through the Pyramid Lake area (NRCS 2015c).

Along the western lobe of Elderberry Forebay, including the Castaic Powerplant, soils consist of well-drained to excessively well-drained loams, clay loams, and sandy loams of less than 20 inches of depth over hard sandstone or shattered sandstone and shale. Soil, slopewash, creep materials, and talus form apron-like masses that occupy the lower portions of gullies, drainage channels, and the base of bluffs along Castaic Creek and Elderberry Forebay (NRCS 2015c).

5.1.1.4 Paleontology

Marine molluscan and echinoid fossils from the upper Miocene have been noted in the Quail Lake Formation (USGS 1967). Beds of the Peace Valley Formation contain lower Miocene fossils of horse, camel, antelope, cat, elephant, and reptiles, including the pond turtle. The Hungry Valley Formation reportedly contains lower Miocene fossils of horse teeth, tapir, rhinoceros, camel, and antelope (Miller and Downs 1974).

The Castaic Formation contains megafauna of about 100 species, most of which are pelecypods and gastropods. Minor elements of the fauna are scaphopods, brachiopods, echinoderms, barnacles, bryozoans, and vertebrates (Stanton 1966).

The San Francisquito Formation ranges in age from the late Maastrichtian (66 mya to 72.1 mya) to late Paleocene, and contains turritellas, ammonites, mytilids, thick-shelled oysters, and bivalve mollusks (Squires and Saul 2006).

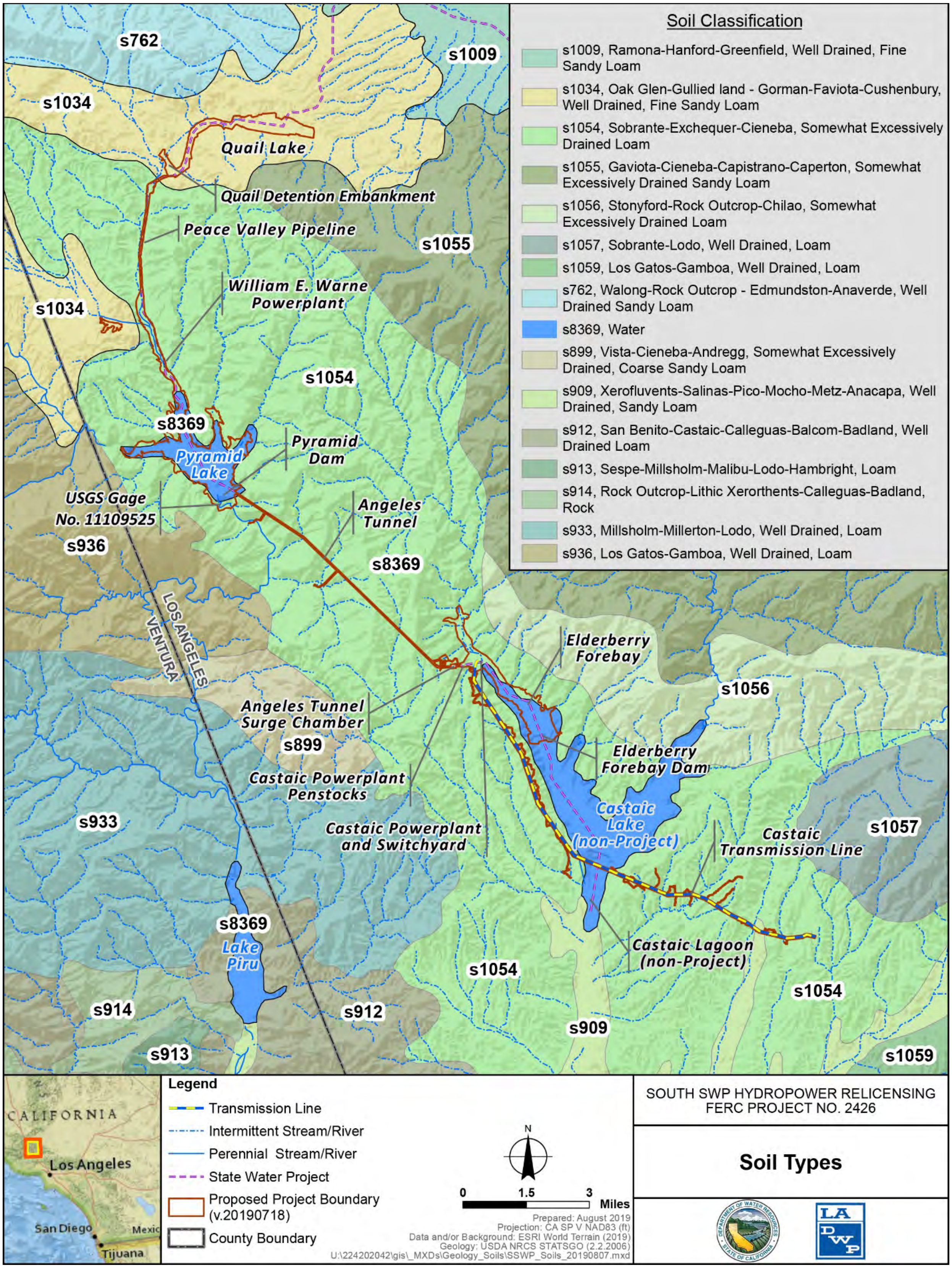

Figure 5.1-4. Soils Map of the Project Vicinity

5.1.1.5 Mineral Resources

There are no significant mineral resources mapped within the drainage basins that surround the Project (Figure 5.1-5). One mineral resource occurrence (gold and silver) was mapped in the Piru Creek drainage basin east of the Project, approximately 2 miles south of the eastern shore of Quail Lake. No production took place at this site and there has been little activity since the discovery, with the exception of routine claim maintenance.

Four mining prospect locations have been mapped within the drainage basins that surround the Project. The first was mapped northwest of Quail Lake in the hills north of Peace Valley in the Upper Piru Creek Drainage basin and included an underground gold mine. The second was mapped southeast of Quail Lake within the Upper Piru Creek Drainage Basin and included a tin prospect. The third and fourth prospect locations were mapped in the Lower Piru Creek Drainage Basin adjacent to Castaic Creek, just north of the Castaic Powerplant, and included gold and silver prospects. These four prospect mining locations went past the occurrence stage and may have included subsequent work, including surface trenching, adits, shafts, drill holes, extensive geophysics, geochemistry, and/or mapping. One past producer location was mapped in the Upper Castaic Creek Drainage Basin, approximately 6 miles upstream of Elderberry Forebay. The primary commodity of this mine was gold recovered from an underground operation (USGS 2018). All claims are currently closed.

5.1.1.6 Warne Power Development

<u>Quail Lake, Quail Outlet, Lower Quail Canal, and Quail Detention Embankment</u>

Detailed descriptions of the subject Project facilities are provided in Exhibit A, Sections 3.1.1 and 3.1.2.

<u>Bedrock, Surface Deposits, and Soils</u>

Quail Lake is underlain almost exclusively by Holocene alluvium, alluvial fan, and saline sand deposits. Present on the northern side of the lake are sandstone outcrops of the Oso Formation. The Lower Quail Canal and the Quail Detention Embankment are underlain by recently deposited thick alluvial silts and sands in the valleys. A small portion of the Lower Quail Canal, near Quail Lake, is underlain by sandstones of the Quail Lake Formation. As Project facilities pass adjacent to bedrock outcrops, they cross over the Miocene Peace Valley Formation of lacustrine shale and siltstone (Foster 2003), and the Pliocene sandstone of the Hungry Valley Formation (Federal Power Commission 1976).

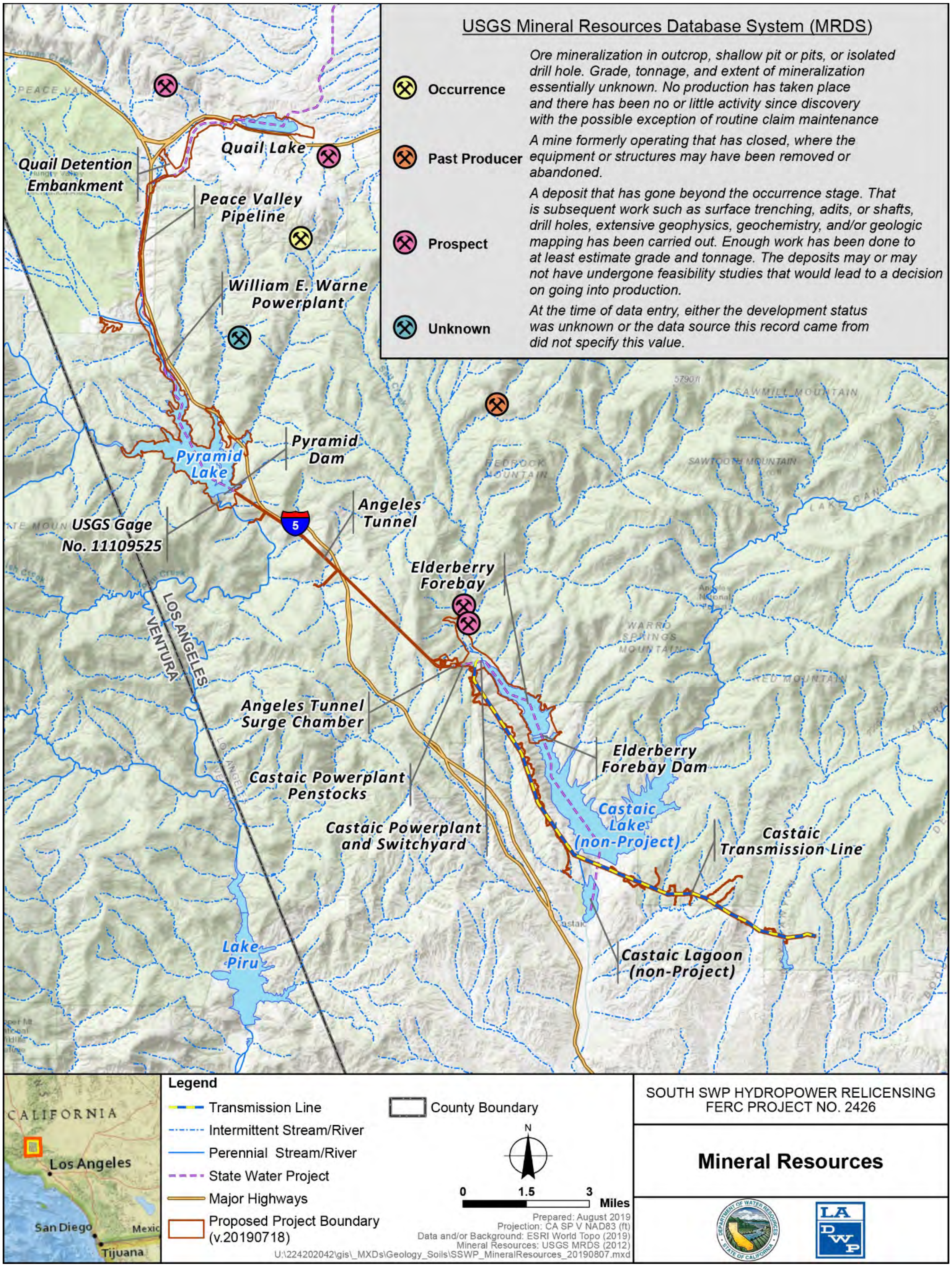

Figure 5.1-5. Mineral Resources in the Project Vicinity

The Lower Quail Canal consists mostly of a sidehill excavation into native materials on the north side and a compacted earth fill embankment on the south side. The canal is lined with 4 inches of unreinforced concrete, which provides an erosion control surface of a compacted clay sub-lining. No joint sealant was applied to the concrete lining when constructed, so that hydrostatic pressures under the slabs could be relieved during drawdown operations (DWR 2004).

Soils developed on the alluvial deposits are a well-drained fine sandy loam, while those on the bedrock units are somewhat excessively drained loams. A U.S. Department of Agriculture (USDA)-National Resources Conservation Service (NRCS) Custom Soil Resource Report of the Quail Lake, Lower Quail Canal, and Quail Detention Embankment areas is presented in Appendix D of this Exhibit E. A map showing the soil series around these areas is shown in Figure 5.1-4.

Faulting and Seismic Considerations

Quail Lake is a former sag pond (i.e., a body of fresh water in a closed or semi-closed depression formed by movement along a strike-slip fault) located within the west-northwest trending rift zone of the San Andreas fault and is the only portion of the Project alignment that is located on an active fault (DWR 2012). Other nearby active faults capable of generating strong ground shaking in the Project area include the Garlock fault, located approximately 7 miles northwest of Quail Lake, and the San Gabriel fault, located approximately 7 miles to the southwest.

Given that active traces of the San Andreas fault pass along the southern margin of Quail Lake and across the upper portion of the Lower Quail Canal, strong ground shaking can be expected to occur over the term of the new license. Fault rupture of Lower Quail Canal near the Quail Lake outlet structure could be expected during a significant event on the San Andreas fault (DWR 1978). Seismic stability evaluations of the Quail Detention Embankment reported that the embankment “is adequately stable for the intended purpose of storing water for only a few tens of hours following a strong earthquake” (DWR 1991). This temporary storage of water behind the Quail Detention Embankment and its slow release through the embankment into the Gorman Creek channel are intended to protect downstream facilities, including Interstate 5.

Some settlement of the Lower Quail Canal embankment has been reported, but is considered a maintenance issue, not a dam safety issue (FERC 2015). Though most of the bedrock formations in the region are prone to landsliding, the relatively low relief around the lake, canal, and detention embankment minimize this risk in this area.

Erosion Potential and Sedimentation

The sedimentation influx at Quail Lake is minimal, as virtually all waters entering the lake are from the SWP. Areas exhibiting surface erosion have been noted during past inspections of the natural bank along the northern shoreline of Quail Lake. Given the low relief of the surrounding topography, landsliding is not considered an issue.

Minor erosional gullies and rills have developed in road cuts and embankment fills around Quail Lake, particularly when developed in or with erodible formational materials. These erosional features are considered minor and typical of minor erosional issues that occur throughout the Project.

Localized minor erosional gullies and rills have developed at various locations in the slopes of the paved service road that extends around Quail Lake. Two distinct erosional gullies are located on the north (lake) side of the service road, along the south side of Quail Lake, adjacent to State Highway 138, approximately 1,250 and 1,425 feet east of the staging area, east of the Lower Quail Outlet Structure.

Another more pronounced gully was observed on the fill embankment swale crossing, located approximately 0.75 miles east of the intersection of the north service road with State Highway 138, adjacent to the Lower Quail Outlet Structure. Erosional rilling was also observed approximately 0.6 miles east of the previously described gullying, or about 0.15 miles west of the Quail Lake Inlet Structure.

Several erosional gullies/rills were observed on the service road fill slopes east of the Quail Inlet Structure. Rilling was noted on the north side of the road embankment, immediately east of the inlet structure, extending eastward over approximately 150 feet.

The service road east of the inlet structure passes through a road cut that exposes the erodible Oso Formation consisting of coarse-grained sandstone and conglomerate. Runoff from the exposed cut slope above the road appears to flow across the service road southeastward, then down the fill slope toward the lake, eroding the slope face.

Two relatively long reaches of gullied/rilled fill slope face were observed between points located approximately 900 and 1,500 feet east of the inlet structure, and between about 1,600 and 2,000 feet east of the inlet structure.

The Licensees are not aware of any continuing problems related to erosion affecting Project roads at or around Quail Lake, the Lower Quail Canal, or the Quail Detention Embankment.

Peace Valley Pipeline Intake Embankment and Peace Valley Pipeline

Detailed descriptions of the subject Project facilities are provided in Exhibit A, Section 3.1.3.

Bedrock, Surface Deposits, and Soils

The Peace Valley Pipeline and Gorman Bypass Channel both extend southward from the Peace Valley Pipeline Intake Embankment to Warne Powerplant, positioned adjacent to Pyramid Lake. As much as 100 feet of Holocene alluvium underlies the pipeline and channel, and some portions of the underlying alluvium are saturated “as it is in a formerly natural drainage channel” (DWR 1977b). Weak, erodible foundation and channel bank materials, and shallow (5 to 10 feet below ground surface) groundwater, led to caving during construction. “Groundwater has always been an issue along the Peace Valley Pipeline” (DWR 2007). Lying below the alluvium are soft sandstones and siltstones of the Hungry Valley formation beneath the upper portion of the combined alignment, with moderately hard shale and sandstone of the Peace Valley Formation underlying the rest of the alignment.

In 1992, an 8-foot diameter sinkhole developed along the Peace Valley Pipeline alignment between approximate stations 184 and 185. Groundwater issues were also associated with planned repairs at approximate Stations 168, 175, and 178. Dewatering was required for the now-completed repairs (DWR 2007).

The underground Peace Valley Pipeline generally parallels the west side of Gorman Creek and Interstate 5, and both the pipeline and bypass channel were built on Holocene alluvium derived primarily from erosion of the Peace Valley Formation. The alluvial sediments are predominantly silty sands, clayey sands, and sandy clays. Sediments are of low density and are saturated at 5 to 10 feet below ground surface. The underlying Peace Valley Formation in this area is composed of alternating beds of sandstone and shale (DWR 2007). The lower portion of the Gorman Bypass Channel to the downstream area near the Warne Powerplant consists of undifferentiated sandstones, siltstones, and shales of the Ridge Basin Group (DWR 1974). Soils developed on the bedrock units are somewhat excessively drained loams, while soils on the alluvial deposits are a well-drained fine sandy loam.

Faulting and Seismic Considerations

No active faults are known to cross or abut this portion of the Project. This area is in a wedge of crustal rock bound by the San Andreas fault to the north and the San Gabriel fault to the southwest. Although the Peace Valley Pipeline and Peace Valley Pipeline Intake Embankment are outside of any active fault zones, strong ground shaking can be expected to occur in this portion of the Project over the term of the new license.

Seismic stability evaluations of the Peace Valley Pipeline Intake Embankment reported that “even in the unlikely event that a fault offset in the foundation led to a breaching failure of the intake embankment after a great event on the San Andreas Fault, the failure would be a moot point. For such an event to happen, a far larger level of offset and shaking would have to be sustained along the Lower Quail Canal. As the canal embankments are more prone to liquefaction and piping failures during such shaking, it is expected that the canal embankment will fail before the intake embankment fails. These canal failures would then release the water stored behind the intake embankment. This water would be safely controlled by the Quail Detention Embankment” (DWR 1991).

Erosion Potential and Sedimentation

Some pavement cracking has been observed in the stub access road to the Peace Valley Pipeline Intake Embankment, but is considered a maintenance issue; however, no erosional or sedimentation issues have been reported with these mostly lined portions of the Project. Minor erosion and sedimentation on paved roads have been observed in the Las Alamos Creek Campground, mainly associated with temporary culvert blockages. A USDA-NRCS Custom Soil Resource Report of the Peace Valley areas is presented in Appendix E of this Exhibit E.

Gorman Bypass Channel

A detailed description of the subject Project facilities is provided in Exhibit A, Section 3.1.4.

Bedrock, Surface Deposits, and Soils

Bedrock, surface deposits and soils are similar to those described for the Peace Valley Pipeline.

Faulting and Seismic Considerations

Faulting and seismic conditions are similar to those described for the Peace Valley Pipeline.

Erosion Potential and Sedimentation

Erosion and sedimentation conditions are similar to those described for the Peace Valley Pipeline, with the exception of the portion of the Gorman Bypass Channel downstream of where Cañada de Los Alamos Creek enters the channel. Given the erosive nature of the bedrock and surface deposits, sedimentation of the Gorman Bypass Channel might be anticipated after significant rainfall events.

Warne Powerplant and Switchyard

Detailed descriptions of the subject Project facilities are provided in Exhibit A, Section 3.1.5.

Bedrock, Surface Deposits, and Soils

The Warne Powerplant and Switchyard location was underlain by alluvium, some of which was saturated, lying atop firm, thinly bedded, gently folded shale of the Ridge Basin Group (DWR 1977b). During construction of the powerhouse, the alluvium and highly weathered bedrock was removed.

Soils developed on the bedrock units are somewhat excessively drained loams, while soils on the alluvial deposits are a well-drained fine sandy loam (NRCS 2015a). Localized block glide landsliding was reportedly evident in roadcuts adjacent to the powerplant site during construction, where dip slopes have been undercut (DWR 1977a).

<u>Faulting and Seismic Considerations</u>

No active faults are known to cross or abut this portion of the Project. This area is in a wedge of crustal rock bound by the San Andreas fault to the north and the San Gabriel fault to the southwest. Although the Warne Powerplant and Switchyard are outside of any active fault zones, strong ground shaking can be expected to occur in this portion of the Project over the term of the new license.

<u>Erosion Potential and Sedimentation</u>

Minor gullies and rills can be expected in slopes and embankment fills, similar to that throughout the Project.

<u>Primary Project Roads, Trails, and Recreation Facilities</u>

Minor erosional gullies and rills have developed and are expected to continue to develop in road cuts, embankment fills, and trails throughout the Warne Power Development portion of the Project area given the generally erosive nature of the bedrock formations and the surface deposits derived from them. The Licensees are not aware of any chronic problems related to erosion affecting Project roads or recreation areas in or around any of the Project facilities. Similarly, given the propensity for slope instabilities within the bedrock units underlying the Project area, landslides may occur, though most commonly under the influence of heavy rainfall and/or seismic events.

5.1.1.7 Castaic Power Development

<u>Pyramid Lake, Dam, and Associated Facilities</u>

A detailed description of the subject Project facilities is provided in Exhibit A, Section 3.2.1.

<u>Bedrock, Surface Deposits, and Soils</u>

Pyramid Dam is considered an extreme consequence dam by DWR's Division of Safety of Dams (DSOD) based on its damage potential (DWR 2012). This rating is based on DSOD's *Guidelines for Use of the Consequence-Hazard Matrix and Selection of Ground Motion Parameters*, dated October 4, 2002 (DSOD 2002). Pyramid Dam, Pyramid Lake, and associated facilities are underlain by rocks of the Ridge Basin Group. Strata in the vicinity are Pliocene nonmarine sandstones, shales, siltstones, argillites, and conglomerate. Most of the bedded shales and siltstones possess zones of weakness parallel to bedding. Bedrock exposed in the lake area is generally less dense and more deeply weathered than rock in proximity to the dam (DWR 2013).

Bedrock around the dam and the downstream portion of the reservoir consists of thinly bedded, relatively hard, sparsely jointed, compact, competent argillites with minor interbedded shales and siltstones. The argillite is composed of sand- to silt-sized quartz and feldspar grains in a microcrystalline calcareous matrix. These strata have been subjected to low-grade regional metamorphism, potentially due to underlying intrusive activity, and are markedly more competent than the normal Ridge Basin Group rocks elsewhere in the block (DWR 2014b).

Unusual hot spots were identified in the downstream slope of the dam. In general, the hot spots were 10 to 30 °F warmer than adjacent rockfill. Investigations found that these hot spots appear to coincide with horizontal fill lifts that contain more significant amounts of fines and, therefore, more moisture and chemical weathering potential. Chemical testing of the fine-grained soils and monitoring found nothing conclusive. It was concluded that the hot spots were the result of oxidation of sulfide minerals in the fill materials containing argillite. There was no indication that this condition contributes to slope instability.

Several piezometers installed in the Pyramid Dam embankment failed before completion of embankment construction and the first fill of the reservoir, likely due to differential settlement between the impervious core and the pervious rockfill. After a series of investigations into causes of piezometer failures, a special Board of Consultants concluded “that there are no open cracks in the Pyramid Dam core” and the dam was considered safe (DWR 1974).

Surficial Quaternary alluvium, landslides, and historic artificial fills overlay the bedrock of the Ridge Basin Group. The Quaternary alluvium consists of unconsolidated gravel and sand with older Quaternary terrace deposits of coarse alluvial fan gravels and sands that unconformably lay on top of the bedrock (DWR 1975). Alluvium within the arms of the reservoir, such as Cañada de Los Alamos and West Fork Liebre Gulch, consist almost entirely of silts and sands (DWR 2013). Slopewash in the area of the reservoir is composed of small argillite fragments in a soil matrix with a thin soil mantle and unconsolidated sand, gravel, and boulders fill stream channels. Where streams and creeks enter Pyramid Lake, deltaic deposits of sand and gravel accumulate (DWR 1975).

Northwest-facing slopes in the area of the dam dip generally at 30 to 35 degrees which, when combined with the low-strength shale beds, results in numerous bedding plane failures of coalescing landslides that blanket dip slopes (DWR 1975). A 1975 landslide study (DWR 1975) concluded that the slopes surrounding Pyramid Lake are prone to continued, small-scale landslides, but are not susceptible to large-scale landslides; however, the slopes could be vulnerable to larger-scale landsliding under seismic conditions, particularly if following periods of “unusually high rainfall” (DWR 2013).

Landslide deposits are highly variable in nature, depending on the source formation, and vary from nearly intact to completely disturbed materials (Foster 2003). In 2013, DWR completed an investigation to define and evaluate areas of potential slope movement associated with Pyramid Lake. The report concluded that the frequency and size of future landslides could increase with reservoir fluctuation, heavy precipitation, and/or seismic loading.

Localized landslide movement of old landslides along the Pyramid Lake shoreline may be induced by undercutting of dip slopes; however, slope movements of such a magnitude to induce waves capable of overtopping Pyramid Dam are not anticipated. The primary landslide movements around the reservoir will likely be relatively slow, progressive slumping and sliding on northwest-facing slopes that are not expected to affect reservoir capacity, Project facilities, or downstream water quality (DWR 2013).

Soils developed on the bedrock units are somewhat excessively drained loams, while soils on the alluvial deposits are a well-drained fine sandy loam. A USDA-NRCS Custom Soil Resource Report of the Pyramid Dam and Lake areas (NRCS 2015b) is presented in Appendix F of this Exhibit E. A map showing the soil series around these areas is shown in Figure 5.1-4.

Faulting and Seismic Considerations

No active faults are known to cross or abut this portion of the Project. This area is in a wedge of crustal rock bound by the San Andreas fault to the north and the San Gabriel fault to the southwest. The San Andreas fault is approximately 10 miles to the north-northeast, while the San Gabriel fault is approximately 1.5 miles to the southwest.

While landsliding east of Interstate 5 does not pose a hazard to Project facilities, landsliding could affect the Licensees’ access to Project facilities (DWR 2013). While failure of Pyramid Dam (with or without seismicity) could result in flooding of downstream areas, the most recent report (2008) from the Safety Review Board noted that the dam was suitable for continued safe and reliable operation. Pyramid Dam is inspected annually by DWR’s Division of Operations and Maintenance Dam Safety Services engineers, DSOD, and FERC. Every five years, DWR retains an Independent Consultant to perform a safety inspection and generate a Part 12D Report consistent with Title 18 of CFR Part 12D. DWR also conducts special inspections and studies each year.

Erosion Potential and Sedimentation

Erosion

Two dark gray shale beds, each approximately 50 feet thick, were observed during initial construction beneath the downstream shell of Pyramid Dam, extending across the emergency spillway west of the dam. Erosion was observed in the emergency spillway associated with these shale beds (DWR 2002). These erodible zones were remediated by placement of anchored and drained reinforced concrete, and no longer present potentially adverse conditions (DWR 2002).

In 2008, an erosion repair was performed on the fill slope immediately south of the Vista Del Lago Visitor Center. This erosional feature was first noted in 2005 and was reportedly the result of run-off of water from the Vista Del Lago Visitor Center rooftop (DWR 2011). Inclinometers were installed in 2005 to assess whether the erosional feature could represent landslide-type movement that might have contributed to cracking observed inside the Visitors Center (DWR 2011). After two years of monitoring the inclinometers, it was concluded that the erosional feature was a shallow mudflow type of movement and not the result of a deep-seated stability problem (DWR 2013).

Minor erosional gullies and rills can be expected in road cuts, embankment fills, and trails around Pyramid Lake given the erosive nature of the bedrock and surface deposits. The Licensees are not aware of any continuing problems related to erosion affecting Project roads at or around Pyramid Dam or Pyramid Lake.

Shoreline Erosion

In general, relatively little shoreline erosion, including erosion from reservoir level fluctuations, wave-induced erosion, and recreational boating, has been observed occurring around Pyramid Lake (DWR 2014a). However, DWR has repaired localized erosion-related shoreline damage.

During the June 4-8, 2001 FERC Environmental Inspection, it was observed that the Emigrant Landing shoreline was eroding to the point of compromising the concrete walkway structure between the boat rental dock and the main boat launch ramp. Subsequently, DWR coordinated with USFS and the California Department of Boating and Waterways to restore and upgrade the site and install riprap along the shoreline for erosion control.

DWR is currently seeking a 401 Water Quality Certification to proceed with seawall erosion repairs to the Spanish Point Boat-in Picnic Area and the boat launch sites at Vaquero Day Use Area as noted in the 2013 FERC Environmental Compliance Inspection (FERC 2013).

While landsliding east of Interstate 5 does not pose a hazard to Project facilities, landsliding could affect the Licensees’ access to Project facilities (DWR 2013). Regionally, the north-northwest regional tilt of the bedrock units and the relatively low strength of shale bedding planes have resulted in numerous bedding plane slips on natural dip slopes in landslide-prone formations (e.g., the Peace Valley Formation). Landslide volumes range from small block glides of several cy to complex landslides of millions of cy. Since the 1950s, major landslides in the area have necessitated construction activities along highways (DWR 2013).

Sedimentation

Where streams and creeks enter Pyramid Lake, deltaic deposits of silt, sand, and gravel accumulate. Original reservoir capacity was determined to be 171,196 AF based on the NAV29 elevation datum. A recent bathymetric survey conducted by DWR found that the current reservoir capacity is 161,375 AF (DWR 2018). These values show that about 9,821 AF of reservoir storage capacity have been lost since the dam was constructed, for an average of about 220 AF per year due to sedimentation. At this rate of sedimentation, it is unlikely that the reservoir would need to undergo sediment removal actions during the new license term and is expected to remain useful for water supply storage purposes.

There are no records of sedimentation removal from Pyramid Lake, with the exception of a 2008 sediment removal project at the Los Angeles County Sheriff's Department boat dock at Emigrant Landing. Quantities of sediment removed were not reported. The Licensees have not dredged or otherwise removed sediment from Pyramid Lake, nor are the Licensees aware of any continuing problems related to a buildup of sediment in the reservoir.

Pyramid Reach

A detailed description of the subject Project facilities is provided in Exhibit A, Section 3.1.6.

Bedrock, Surface Deposits, and Soils

A portion of Pyramid reach within the proposed Project boundary extends approximately 2,000 feet downstream from the plunge pool at the toe of Pyramid Dam. In this section, the reach cuts through geologic units of the Ridge Basin Group. Bedrock consists of thinly bedded, relatively hard, sparsely jointed, compact, competent argillites with minor interbedded shales and siltstones that have been subjected to low-grade regional metamorphism and are markedly more competent than the normal Ridge Basin Group rocks elsewhere in the block. The bottom of the canyon downstream in this section is covered by a thin deposit of alluvium, while the adjacent slopes are covered with thin deposits of slopewash and stream terrace alluvium (DWR 2014a). Soils blanketing the ground consist of somewhat excessively drained loam of the Sobrantes Series (NRCS 2015b).

Conditions in the reach, just upstream of the North Adit of the Angeles Tunnel, were described as "stable and no indication of recent erosion was noted." The channel was described as being "contained naturally between the canyon walls with a mostly bedrock bottom and very little floodplain." It was also noted that the access road bridge was founded on bedrock and "should not be threatened by large flows." (DWR 2010).

The channel is further described as widening just upstream of the North Adit crossing. The channel in this North Adit area "is contained within tunnel-muck deposits from the Angeles Tunnel construction." The left channel bank is protected by 12-inch diameter rocks covered with concrete. Downstream of North Adit Road, the main channel is through box culverts. Higher flows are expected to "overtop a reinforced concrete section of roadway that has integrated cutoff walls on both the upstream and downstream sides." Though the old Highway 99 roadbed is protected, there is the potential for scour adjacent to the roadway. (DWR 2010).

Faulting and Seismic Considerations

Pyramid reach crosses the San Gabriel fault approximately 3 miles downstream of Pyramid Dam and remains west of the fault thereafter. Inactive faults cross the lower reaches of the creek as the creek nears Lake Piru, where bedrock is composed of Tertiary age marine and nonmarine sediments (Sandburg 2005). The San Andreas fault is approximately 8.5 miles to the north-northeast.

Erosion Potential and Sedimentation

Sediment transport analysis conducted on Pyramid reach showed that upstream reaches are dominated by boulders, cobbles, and gravel, while lower reaches contain a greater proportion of fine sands, along with cobble, gravels, and coarse sands (DWR 2004 as cited in Sandburg 2005).

With the exception of Pyramid reach immediately downstream of the dam, a relatively high sediment load is provided to the reach from tributary canyons that transport sediment from the typically erosion-susceptible geologic formations that surround the Project. Field observations made by DWR staff in 2010 (DWR 2010) noted the existing creek channel from downstream of Pyramid Dam to just downstream of the North Adit "appears to be in equilibrium…with regards to sediment deposition and erosion/transport." There was no indication of erosional issues associated with the North Adit spoil pile that borders Pyramid reach (DWR 2010).

Under the existing license, in 2011 the Licensees implemented a Prevention of Erosion Damage to Infrastructure Plan that requires DWR to monitor Pyramid reach at eight locations where the Licensees installed rock slope protection following two large storm events (i.e., flows greater than 10,000 cfs) in 1998 and 2005. The locations included portions of the Old Highway 99 road embankment, the Old Highway 99 bridge, utilities, and other SWP infrastructure in or adjacent to the reach. Monitoring since 2011 has found very minor erosion and no slope or structure stability issues.

Angeles Tunnel Intake, Angeles Tunnel, Adits, and Surge Chamber

Detailed descriptions of the subject Project facilities are provided in Exhibit A, Section 3.2.2.

Bedrock, Surface Deposits, and Soils

The foundation rock for the Angeles Tunnel Intake, the Angeles Tunnel Portal, and most of the tunnel consists of argillite of the Pliocene age portion of the Ridge Basin Group (DWR 1974). The Castaic Formation bedrock of folded and fractured sandstone with conglomerate, shale, and siltstone interbeds is confined to the reach between the South Adit to the downstream end of the tunnel, including the Surge Tank. These strata are regionally tilted to the northwest (DWR 1971). The alignment and profile of the tunnel were chosen to avoid areas where extensive landslides exist and to provide adequate rock cover. Groundwater seepage into the tunnel during construction was reported to be generally minor, stopping after a short period or increasing in response to rainfall (DWR 1974), suggesting that the tunnel is largely above regional groundwater.

Surficial deposits of alluvial silty to gravelly sands, gravels, slopewash, and a thin layer of topsoil are found in canyons overlying the tunnel (DWR 1974). Soils developed on the bedrock units are somewhat excessively drained loams, while soils on the alluvial deposits are a well-drained fine sandy loam (NRCS 2015b). Landslides are common, particularly when dip slopes formed in siltstone and shale of the Ridge Basin Group are undercut (DWR 1971).

Tunnel spoil from the North Adit was placed in an approximately 1,100-foot-wide by 100-foot-high, 2:1 (horizontal:vertical) fill slope below the adit, along the north side of Pyramid reach. There was no indication of erosional issues associated with the North Adit spoil pile that borders Pyramid reach (DWR 2010). Tunnel spoil from the Osito Canyon Adit was placed in an approximately 1,100-foot-wide by 100-foot-high, 2:1 (horizontal:vertical) fill slope below the adit, along the north side of Golden State Highway. A small tributary to Osito Creek (Fisher Canyon Creek) passes along the toe of the spoil pile via a concrete-lined channel. Two spoil piles were placed for the South Adit. One spoil pile, approximately 700 feet wide by 1,300 feet long, is located at the mouth of the adit, while the second spoil pile, approximately 800 feet by 1,200 feet, is located a short distance northeast of the Surge Chamber (DWR 1977b). Using aerial imagery, visual inspection of the Osito Canyon and South Adit spoil piles shows no indication of major erosional issues.

Faulting and Seismic Considerations

No active faults are known to cross or abut this portion of the Project. During construction of the tunnel, no fault traces were reported or mapped crossing its alignment (DWR 1974). Relative to the intake structure and the upstream end of the tunnel, the San Andreas fault is approximately 8 miles to the north-northeast. The San Gabriel fault is roughly parallel with and approximately 2 miles southwest of the Angeles Tunnel.

Erosion Potential and Sedimentation

Steep slopes in the Angeles Tunnel and Intake area are typical of the Ridge Basin area, and can produce slopewash on hillsides or in talus piles at the bottom of the steep slopes (DWR 1974). Typically, the more resistant sandstone forms vertical cliffs where the less resistant shale beds may be more prone to erosion. The steep terrain is subject to ongoing natural erosion that is exacerbated by heavy rains and loss of vegetation due to fire and other natural processes.

Castaic Penstocks, Powerplant, and Switchyard

A detailed description of the subject Project facilities is provided in Exhibit A, Section 3.2.3 and Section 3.2.4.

Bedrock, Surface Deposits, and Soils

The Castaic Penstock alignment traverses a bedrock sequence containing alternating layers of thinly bedded soft to hard siltstone, sandy siltstone, silty shale, and sandstone of the Miocene-age, marine Castaic Formation. These strata uniformly strike roughly north-south, parallel to Castaic Creek, and dip gently westward. Weathering in these strata extends deeper in the more permeable sandstone than in the finer grained sediments. The depth to fresh, unfractured bedrock ranges from 19 to 68 feet, but is generally about 35 feet. Alluvial material overlies bedrock and ranges in depth from 0 to 22 feet (Converse 1967).

For construction of the Castaic Powerplant and Switchyard, alluvial fan materials were excavated down to competent bedrock of the Castaic Formation. The fan materials varied from 5 to 20 feet in thickness, and consisted of mostly boulders, cobbles, and gravels (DWR 1963). The powerplant now bears on the Castaic Formation and the switchyard is now underlain by a thick wedge of engineered fill underlain by the Castaic Formation (Converse 1967).

Soils developed on the bedrock units are somewhat excessively drained loams, while soils on the alluvial deposits are a well-drained fine sandy loam. A USDA-NRCS Custom Soil Resource Report of the Castaic Penstocks and Powerplant areas (NRCS 2015c) is presented in Appendix G of this Exhibit E. A map showing the soil series around these areas is shown in Figure 5.1-4.

Faulting and Seismic Considerations

During pre-construction investigations, it was determined that there are no faults that would affect the alignments of the Castaic Penstocks, Powerplant, or Switchyard (Converse 1967). The San Andreas fault is approximately 10 miles to the north-northeast, while the San Gabriel fault is approximately 2 to 3 miles southwest of the Castaic Penstocks and Powerplant.

Erosion Potential and Sedimentation

Steep slopes in the Castaic Penstocks, Powerplant, or Switchyard area are typical of the Ridge Basin area, and can produce slopewash on hillsides or in talus piles at the bottom of the steep slopes (DWR 1974). During pre-construction field investigations, it was determined that there are no landslides that would affect the alignment of the Castaic Penstocks or the Powerplant (Converse 1967). The Licensees are not aware of any continuing problems related to erosion affecting Project roads at or around the Castaic Penstocks, or the Castaic Powerplant and Switchyard.

Elderberry Forebay Dam, Forebay, and Outlet

Detailed descriptions of the subject Project facilities are provided in Exhibit A, Section 3.2.5.

Bedrock, Surface Deposits, and Soils

Elderberry Dam and Forebay are underlain by the Miocene-age, marine Castaic Formation, which in turn overlies the older Cretaceous Period and Paleocene Epoch, marine San Francisquito Formation. These bedrock units consist of siltstone, shaley siltstone, sandy siltstone, and sandstone conglomerate. The bedrock units are uniformly inclined to the west at dips of approximately 10 to 30 degrees, and are locally affected by minor folds, faults, and shear zones (Crowell 1982).

Fine-grained portions of the Castaic Formation that underlie areas around the Elderberry Forebay are particularly susceptible to landsliding (Foster 2003). Numerous landslides present in the Project area were evaluated during a 1995 study. Due to adverse bedding orientations and dip-slope conditions, landslides were found to more commonly occur on eastern slopes than on the western slopes around the Elderberry facilities. Landslides on the western slopes are influenced by fractures and saturated slopes, and for the most part occur at oblique angles to the bedding planes. None of the landslides are threatening the integrity of the dam (GEI 2005).

The core and abutments of Elderberry Dam are founded on well-bedded, sedimentary bedrock units and the shells are founded on alluvium in the streambed. The right abutment is an area of rugged topography and consisting of layers of resistant sandstone alternating with less resistant shaley siltstone. The bedrock strikes parallel to the stream axis and dips 10 to 25 degrees to the west. The average depth of the sound competent rock ranges between 16 and 41 feet (GEI 2005).

Soil, slopewash, creep materials, and talus form apron-like masses that occupy the lower portions of gullies, drainage channels, and the base of bluffs along Castaic Creek. Terrace deposits appear as elongated remnants of older, alluvial fans at various elevations above the creek. Castaic Creek and local tributaries contain relatively shallow accumulations of alluvium (GEI 2005).

Soils developed on the bedrock units are somewhat excessively drained loams, while soils on the alluvial deposits are a well-drained fine sandy loam. A USDA-NRCS Custom Soil Resource Report of the Elderberry Dam and Forebay areas is presented in Appendix G of this Exhibit E. A map showing the soil series around these areas is shown in Figure 5.1-4.

Faulting and Seismic Considerations

No faults capable of producing earthquakes or displacement that would affect the integrity of Elderberry Dam and Forebay were observed during their initial construction (GEI 2005). The San Andreas fault is approximately 11 miles to the north-northeast of the dam, while the San Gabriel fault is approximately 3 miles southwest of the dam.

Seismic stability analysis for Elderberry Dam concluded that the dam was founded on and constructed such that liquefaction is unlikely. Strong shaking during the maximum credible earthquake is expected to occur during the term of the new license, and the dam embankment may deform, resulting in “minor settlement and cracking of the crest and in surface raveling of the slopes, but [is] not expected to compromise the integrity of the dam. The deformations are not expected to adversely affect the outlet conduit. The analyses indicate that the dam is likely to survive the potential earthquakes with only minor damage, and thus does not pose a significant safety hazard” (WCC 1990).

Erosion Potential and Sedimentation

Elderberry Forebay receives its predominant inflow from the SWP via Pyramid Lake, the Angeles Tunnel, and the Castaic Powerplant. Castaic Creek, along with its main tributary, Salt Creek, contributes minor inflows that increase during and after storm events, and due to snowmelt. The headwaters of Castaic Creek are located 11 RM upstream of Elderberry Forebay. Castaic Creek flows along a natural channel until just above Elderberry Forebay, where it enters the Storm Bypass Channel and Check Dams, a series of three small check-dam basins, which drain into Elderberry Forebay, just downstream of the Castaic Powerplant tailrace. The three check-dam basins are designed to intercept sediment carried by creek water before entering Elderberry Forebay to promote sustained efficiency of the Castaic Powerplant operation.

Periodic removal of sediment from the Elderberry Forebay is conducted on 10-year intervals through mechanical means. Sediment removal is conducted concurrently with outages of the Angeles Tunnel and Castaic Powerplant Penstocks. Areas requiring sediment removal are drained, and earthen dams and ramps are built along the tailrace to provide access for earthwork equipment. In 2016, approximately 500,000 cy of sediment were removed, drained, and stockpiled (DWR 2018).

Periods of heavy rainfall may trigger new landslides or re-activate old landslides. During a period of heavy rainfall in 1992, a portion of a pre-existing landslide west of the Elderberry Forebay failed. The landslide damaged a short section of roadway used for O&M purposes, but did not enter the forebay (Gomez, Sullivan, and Findlay 2000 as cited in GEI 2005).

Significant rainfalls in January and February 2005 caused major landslides around Elderberry Forebay. These landslides partially closed access roads from Interstate 5 to the Castaic Powerplant, and damaged the access road from the Castaic Powerplant to Elderberry Forebay Dam and Spillway, limiting access to only via helicopter. The access roads and spillway have since been restored.

Storm Bypass Channel and Check Dams

Detailed descriptions of the subject Project facilities are provided in Exhibit A, Section 3.2.6.

Bedrock, Surface Deposits, and Soils

The Storm Bypass Channel and Check Dams are periodically cleared of accumulated sediment that deposits in basins upstream of each Check Dam. The sediment disposal facilities overlie a bedrock sequence of alternating layers of thinly bedded, soft to hard siltstone, sandy siltstone, silty shale, and sandstone of the Miocene-age, marine Castaic Formation. These strata uniformly strike roughly north-south parallel to Castaic Creek and dip gently westward. Weathering in these strata extends deeper in the more permeable sandstone than in the finer grained sediments. The depth to fresh, unfractured bedrock ranges from 19 to 68 feet, but is generally about 35 feet. Alluvial material overlies bedrock and ranges in depth from 0 to 22 feet (Converse 1967).

Faulting and Seismic Considerations

During pre-construction investigations for the Castaic Powerplant, it was determined that there are no faults that would affect the alignments of the Castaic Penstocks, Powerplant, or Switchyard (Converse 1967) and, therefore, the Storm Bypass Channel and Check Dams. The San Andreas fault is approximately 9 miles to the north-northeast, while the San Gabriel fault is approximately 2 miles to the southwest.

Erosion Potential and Sedimentation

The Check Dams in Castaic Creek are designed to slow erosive flows and cause sediment to drop out of suspension before entering Elderberry Forebay. Periodic removal of sediment from the Check Dams is conducted on two- to three-year intervals. Before sediment removals begin, environmental clearances are obtained, vegetation is grubbed, and biologic controls (i.e., turtle refuge pond) are set-up. Excavated sediments are placed and compacted on the designated spoil pile. Since 2005-2006, more than 623,000 cy of sediment have been removed from the Check Dam basins and placed on the spoils pile. A summary of sediment quantities removed since 2005-2006 is provided in Table 5.1-1.

Table 5.1-1. Sediment Removal Quantities – Castaic Creek Check-Dam Basins

Year	Basin 1	Basin 2	Basin 3	Total (cy)
2005-2006	56,500	120,325	119,225	296,050
2009-2010	134,450	70,345	40,370	245,165
2011-2012	32,340	8,170	10,450	50,960
2012-2013	3,900	3,420	5,840	13,160
2016-2017	17,590	520	80	18,190
Total	**244,780**	**202,780**	**175,965**	**623,525**

Key:
cy = cubic yards

Castaic Transmission Line

A detailed description of the subject Project facilities is provided in Exhibit A, Section 3.1.7.

<u>Bedrock, Surface Deposits, and Soils</u>

The 230-kV Castaic Transmission Line overlies the Castaic Formation of shale and interbedded siltstone, sandstone, and conglomerate (Foster 2003). Slaking of the more silty and clayey bedrock material is common (Converse 1967). This bedrock unit is uniformly inclined to the west at dips of approximately 10 to 30 degrees, and is locally affected by minor folds, faults, and shear zones (GEI 2005).

The Castaic Transmission Line also crosses small drainages that contain alluvial sediments of predominantly silty sands, clayey sands, and sandy clays. Soils developed on the bedrock units are somewhat excessively drained loams, while soils on the alluvial deposits are a well-drained fine sandy loam.

Faulting and Seismic Considerations

No active faults are known to cross or abut this portion of the Project. This area is in a wedge of crustal rock bound by the San Andreas fault to the north and the San Gabriel fault to the southwest. At its nearest point, the San Gabriel fault is approximately 1.5 miles to the southwest of the Castaic Transmission Line.

The two earthquakes shown in Figure 5.1-2 at the southern end of the transmission line are the closest to occur near this portion of the Project, within 1 mile of its alignment, and occurred in 1965 and 1991. A third earthquake located approximately 1 mile west of the transmission line along Interstate 5 occurred in 1956. The Licensees found no documentation associating these earthquakes with any known fault(s).

Erosion Potential and Sedimentation

The steep terrain in which the Castaic Transmission Line is located is subject to ongoing erosion, which at times is exacerbated by heavy rains and loss of vegetation due to fire and other natural processes. Fine-grained portions of the Castaic Formation that underlies the area along the Castaic Transmission Line are particularly susceptible to landsliding (Foster 2003).

The Castaic Transmission Line right-of-way is typically graded as needed before any scheduled maintenance or if there are potential erosion issues. During the grading process, LADWP’s OHT labor crews clear existing McCarthy drains and culverts, install coconut matting and waddles, and clear brush along the roadway. All other maintenance is performed on an as-needed basis by LADWP’s Power Construction and Maintenance crew.

<u>Primary Project Roads, Trails, and Recreation Areas</u>

Minor erosional gullies and rills have developed and are expected to continue to develop in road cuts, embankment fills, and trails throughout the Castaic portion of the Project area, given the generally erosive nature of the bedrock formations and the surface deposits derived from them. The Licensees are not aware of any chronic problems related to erosion affecting Project roads or recreation areas in or around any of the Project facilities. Similarly, given the propensity for slope instabilities within the bedrock units underlying the Project area, landslides may occur, though most commonly under the influence of heavy rainfall and/or seismic events.

5.1.2 Effects of the Licensees' Proposal

This section discusses the potential environmental effects of the Licensees' Proposal on geology and soils. In general, the primary effects of the Project consist of erosion and sedimentation – primarily the result of erosion-prone and landslide-prone geologic formations and surficial deposits that are found throughout the Project region.

With regard to geology and soils, for the reasons stated below, the Licensees' Proposal includes the following PM&E measure:

- Erosion and Sediment Control Plan

The Licensees do not propose including in the new license the existing Prevention of Erosion Damage to Infrastructure Plan for two reasons. First, erosion due to high flows during storm events in Pyramid reach is not a Project effect. The Licensees' proposed Measure AR1 would require that Project releases mimic the natural hydrograph in timing and magnitude to the extent operationally feasible. Therefore, high storm flow events would occur in the reach regardless of whether the Project was in place, and the Licensees are not responsible to mitigate effects due to these natural events. Second, if a storm event damages a Project facility (e.g., a tunnel adit and associated structures), the Licensees would implement corrective measures to maintain the facility in good working condition.

5.1.2.1 Erosional and Sedimentation Considerations

Many of the geologic formations and most of the surficial deposits throughout the Project possess a potential for erosion. The few ways that the Licensees' Proposal can affect upland erosion and sources of sediment in the area of the Project is through Project roads or recreational activities. Road sediment sources and culverts have the potential to deliver course and fine sediment to channels within the Project area. As discussed above, the Licensees are not aware of any chronic problems related to erosion affecting Project roads or recreation areas in or around any of the Project facilities.

In addition, many of the geologic formations possess the potential for landsliding. Landslides could present site-specific, though relatively minor, effects such as settlement, and temporarily limit the Licensees' access to Project facilities. However, most of these conditions would be present with or without the Project. Given the above, and observations of Project conditions, minor erosion of slope faces cut into native formational deposits and slopes constructed of fill materials derived from the formational and surficial deposits possess the propensity for sedimentation, particularly in Pyramid

Lake and Elderberry Forebay. These potential localized conditions have been recognized and measures have been adopted to mitigate these conditions.

To minimize erosion and sedimentation, the Licensees' proposed Measure GS1 would implement an Erosion and Sediment Control Plan.

Quail Lake

While there is no significant sedimentation in Quail Lake, minor erosion has occurred in slopes cut into erosion-prone formations and embankments constructed with fill materials. The typically minor erosion in the slopes and banks around Quail Lake is similar to that observed throughout the Project region.

Pyramid Lake

From review of available bathymetric data (DWR 2018), a total of nearly 10,000 AF of Pyramid Lake storage has been lost due to sedimentation since original construction. As described in Section 5.1.1.7, in the past 40 years, relatively little shoreline erosion, including erosion from reservoir level fluctuations due to pumped-storage operations, wave-induced erosion, and recreational boating, has been observed occurring around Pyramid Lake (DWR 2014a). Where any significant erosion has occurred, the Licensees have repaired the localized erosion-related shoreline damage, as described in Section 5.1.1.7. The Licensees' Proposal would not change existing Project operations and, therefore, shoreline erosion would continue to be very minor.

Elderberry Forebay

Historical bathymetric data are not available for the Elderberry Forebay; however, a total of approximately 624,000 cy (about 290 AF) of sediment have been removed from the check basins in the storm bypass channel of Castaic Creek since 2005-2006.

Sediment removals from the Check Dam basins are conducted on two- to three-year intervals. Once all necessary permits and environmental clearances are obtained, vegetation is grubbed and biologic controls (i.e., a turtle refuge pond) are set up. Excavated sediments have been and are proposed to continue to be placed and compacted on designated spoil pile(s). The spoil piles have been managed using best practices, including jute netting installation and wattle placement.

Periodic removal of sediment from the Elderberry Forebay (tailbay, tailrace, and confluence area) is conducted at approximately 10-year intervals through mechanical means, after obtaining all necessary permits and approvals. The work is typically done concurrently with planned Angeles Tunnel and Castaic Powerplant outages. Most recently (2016), approximately 500,000 cy of sediment were removed, drained, and stockpiled. LADWP is currently working on the contract and permits to export the sediment from Castaic Powerplant to a qualified landfill.

The Licensees' Proposal will result in a continuation of the same Project effects for the duration of the new license. As such, no substantial change is expected to occur, and the Licensees' Proposal is expected to have minor or less than significant adverse effects.

Pyramid Reach

Pyramid reach channel is in equilibrium (DWR 2010). Farther downstream, a relatively high sediment load is provided to Pyramid reach from tributary canyons.

In general, the Pyramid reach stream bed is relatively stable given its current environment. As such, no substantial change is expected to occur, and the Licensees' Proposal is expected to have minor or less than significant adverse effects on Pyramid reach.

5.1.3 Unavoidable Adverse Effects

Continued O&M activities associated with the Licensees' Proposal will have minor unavoidable Project effects relative to ongoing soils and geologic conditions. Therefore, the Project will not incur any additional unavoidable effects, because the existing Project effects on soils and geology will remain the same in the Licensees' Proposal.

5.1.4 Response to Requests for Additional PM&E Measures and Studies

As described in Section 1.5.11, subsequent to filing the DLA with FERC, the Licensees received written requests from Relicensing Participants to include PM&E measures and conduct studies relative to geology and soils resources. After careful review and consideration, the Licensees did not adopt NMFS' and CDFW's preliminary proposed measures related to geology and soils. Each of these is discussed below including the Licensees' reasons for not adopting the measure. None of the comment letters requested the Licensees conduct studies related to geology and soils. Refer to Table 1.5-6 of Exhibit E for the FERC E-Library Accession numbers to access the letters referenced below.

Augment Sediment and Large Woody Material in Pyramid Reach

NMFS proposes that the loss of substrate between Pyramid Dam and the first tributary should be replenished. NMFS also proposes that a term in the FLA for augmenting spawning gravels and large woody material (LWM) needs to be developed and implemented for the benefit of the isolated SC O. mykiss in Middle Piru Creek. [NMFS' November 26, 2019 letter, pages 4 and 5]

CDFW states that Pyramid Dam blocks substrate vital for native coastal rainbow trout habitat, such as spawning gravels and large woody debris. CDFW requests that the loss of that substrate be replenished. [CDFW Requested Condition #3-5 in its November 27, 2019 letter.]

The Licensees did not adopt NMFS' and CDFW's preliminary proposed measures regarding augmenting sediment and LWM in Pyramid reach for two reasons. First, neither NMFS nor CDFW provide specificity for their preliminary proposed measure if adopted. Neither agency specifies the amount and size of sediment and LWM that would be placed into the reach; when, where, and how the sediment and LWM would be added; or the cost for their preliminary proposed measure if it were implemented. Second, neither NMFS nor CDFW provides evidence to demonstrate a need to augment sediment and LWM in Pyramid reach, other than the sweeping statement that Pyramid Dam blocks sediment from moving downstream, and the implied consequence that this blockage must have an adverse effect on rainbow trout. In fact, as described in Section 5.3.1.3, the Licensees' studies found evidence of spawning in rainbow trout sampled between Pyramid Dam and Frenchmans Flat Campground, indicating that rainbow trout in that reach have adequate access to suitable spawning gravels. Furthermore, the Licensees' studies showed the presence of a variety of aquatic habitat and substrate types throughout Pyramid reach, indicating that sufficient mechanisms for the maintenance of aquatic habitat variety and complexity, a function commonly attributed to LWM, currently exist and continue to persist downstream of Pyramid Dam.

While neither NMFS nor CDFW provides an estimate to implement their preliminary proposed measure, the Licensees developed a very rough cost estimate based on lost storage in Pyramid Lake. With regard to sediment and as described above, based on the original Pyramid Lake capacity and recent bathymetric surveys, the Licensees calculated, as shown in Section 5.1.1.7, that in 2018 approximately 9,821 AF of reservoir storage capacity may have been lost since the dam's construction was completed in 1973 for an average of about 220 AF per year, which equals approximately 354,933 cy of sediment (i.e., 1 AF equals 1,613.33 cy, so 220 AF equals 354,933 cy). For this analysis, the Licensees assumed all the sediment was spawning-size for rainbow trout (i.e., 15 to 11 millimeters [mm] in diameter), which is a very conservative assumption since only a portion of the 220 AF would be in this size range. The 354,933 cy of spawning-size gravel would weigh 603,386 tons (i.e., 1 cy of spawning-size sediment weighs 1.7 tons, so 354,933 cy of sediment weighs 603,386 tons).

The Licensees assumed 12-ton dump trucks would be used to transport the sediment from the sediment source to the downstream base on Pyramid Dam for injection into the reach, and estimated 50,282 truck trips would be required to transport the sediment (i.e., 1 truck trip to transport 12 tons, so 50,282 truck trips to transport 603,386 tons). The Licensees found the nearest commercially available source of sediment that, at this time, could provide clean spawning-size gravel in needed amounts is Western Material Sand & Gravel that is approximately 18 miles via roads from the downstream face of Pyramid Dam. The Licensees assumed one truck trip, including loading time, travel, fueling and unloading, from the gravel source to the dam would take 1.5 hours, so 75,423 hours would be needed to transport all the sediment (i.e., 1 truck trip would take 1.5 hours, so 50,282 truck trips would take 75,423 hours). Assuming the hourly cost of a 12-ton dump truck is $75, the cost to transport the sediment in one year would be $5,656,725 (i.e., $75 for one hour use of a 12-ton dump truck, so $5,656,725 for 75,423 hours). The Licensees estimated the cost to purchase the sediment would be $15,084,650 (i.e., one ton would cost $25, so 603,386 tons would cost $15,084,650). The Licensees estimate the cost to set up sediment injection equipment at the base of the dam and obtain necessary permits and approvals would be approximately $500,000. Therefore, the Licensees estimate that the cost of replenishing 220 AF of sediment into Pyramid reach for one year using trucks for transport is approximately $21,241,375, and would be $637,241,250 over 30 years. This does not include fuel costs and costs related to repairing road wear and tear caused by over 50,000 truck trips (i.e., almost 140 truck trips per day) traversing the roads each year, and related protection and mitigation costs (e.g., traffic control, air quality impacts, and water quality and other impacts in a Wild and Scenic River).

As an alternative to placing the sediment by truck, the Licensees estimated the cost to place the sediment by helicopter, assuming helicopter use could be permitted due to safety concerns (e.g., helicopters with heavy, hanging payloads passing over recreation areas and public roads) and environmental concerns (helicopter use in Wild and Scenic River corridor). The Licensees assumed Chinook helicopters carrying a load of 14 tons of sediment per trip and at an average of 1 hour per trip from the sediment source to the downstream face of the dam, and that the hourly cost of the helicopter of $875. In that scenario, it would take 43,099 helicopter trips to place the sediment, at a cost of $37,711,625. If the cost of purchasing sediment, injecting it, and permitting was the same for helicopter use as for truck use, the cost to replenish 220 AF of sediment into Pyramid reach for one year using helicopters for transport is approximately $53,296,275, and would be $1,598,888,250 over 30 years.

The Licensees did not estimate a cost to replenish LWM since the Licensees' information show that very little LWM is intercepted by Pyramid Dam.

Given that the best available science shows that sediment and LWM is not lacking in Pyramid reach and, therefore, augmenting sediment and LWM would have very little benefit, a cost of between approximately $637 million to $1.6 billion to implement NMFS' and CDFW's preliminary proposed measure is not warranted. In addition, as described above, implementation of the measures would likely have significant adverse effects on the environment.

Modify the Licensees' Proposed Erosion and Sediment Management Plan to Address Facility Management After Storm Events

USFS proposes that the Erosion and Sediment Control Plan in the FLA should include appropriate measures addressing facility maintenance following storm events. USFS indicates that the Licensees state that they "are not aware of any chronic problems related to erosion." USFS recommends that the Erosion and Sediment Control Plan incorporate language to include visual monitoring so chronic problems do not occur and problems that do occur are mitigated in a specified timeframe. [USFS November 25, 2019 letter, page 19.]

The Licensees did not adopt USFS' preliminary proposed measure to modify the Erosion and Sediment Control Plan to include measures and monitoring related to facility maintenance following storm events for four reasons. First, USFS provides no details regarding its proposed monitoring other than visual monitoring (e.g., USFS did not say how the visual monitoring would occur, where, how often, or after what flows – that is, what constitutes a "storm event"), or what specific facility maintenance actions it requests the Licensees to take after a storm. Therefore, the Licensees cannot evaluate USFS' proposal or whether its cost would provide any benefit. Second, USFS states that erosion caused by storm events is a Project effect, even though USFS has not defined what a storm event is. The Licensees concluded such erosion was not a Project effect because, as can be seen in Figure 5.2-2 in Section 5.2.1 of Exhibit E, flows that may be considered a storm event would occur both with and without the Project. Third, USFS provides no evidence that chronic problems related to erosion occur. Fourth, as a matter of good O&M practices, the Licensees routinely inspect all Project facilities and features, especially after storm events that have the potential to damage Project facilities or features. If damage is observed, the Licensees develop corrective actions that are specific to the circumstances at the time and implement them as soon as feasible.

Modify the Licensees' Proposed Erosion and Sediment Management Plan to Include Trigger Points for Mitigating Erosion Before Impacts Become Too Large

USFS proposes that the FLA clearly define trigger points for mitigating erosion before impacts become too large. [USFS' November 25, 2019 letter, page 19]

The Licensees did not adopt USFS' preliminary proposed measure that the Erosion and Sediment Control Plan be modified to include trigger points for mitigating erosion before impacts become too large for two reasons. First, USFS provides no details regarding its proposal (e.g., what would the trigger points be and what measures would be taken when a trigger was observed). Therefore, the Licensees cannot evaluate USFS' preliminary proposed measure or whether its cost would provide any benefit. Second as stated above, the Licensees routinely inspect all Project facilities and features, and if the Licensees observe damage, or an indication that damage will soon occur, the Licensees develop corrective actions and implement them as soon as feasible.

Modify the Licensees' Proposed Erosion and Sediment Control Plan to Address Shared-Use Roads

USFS proposes that erosion control be applied for all Project-related efforts, and that roads that are shared-use be maintained with appropriate erosion control. USFS states that as the Licensees do not include a Transportation Management Plan in its FLA, all erosion control related to road use must be included in the Erosion and Sediment Control Plan. [USFS' November 25, 2019 letter, page 81]

The Licensees have not adopted USFS' preliminary proposed measure to apply the Licensees' proposed Erosion and Sediment Control Plan to "shared-use" roads for two reasons. First, USFS does not describe which specific roads it means when it refers to "shared-use" roads. Second, as described 2.1.1.3, shared (or joint or multiple) use roads are used and maintained by multiple parties, including the Licensees. Because these shared roads are not for the sole purpose of accessing the Project, they are therefore, not the sole responsibility of the Licensees to maintain under the license.

Modify the Licensees' Proposed Erosion and Sediment Control Plan to Include an Annual Erosion and Sediment Monitoring Report

USFS proposes that the FLA state that the Licensees shall provide an annual erosion and sediment monitoring report. USFS recommends that the monitoring report use USFS forms and the forms should be delivered at the annual meeting. [USFS' November 25, 2019 letter, page 82]

The Licensees did not adopt USFS' preliminary proposed measure that the Erosion and Sediment Control Plan be modified to include an annual erosion and sediment monitoring report. USFS has provided no evidence that an annual erosion and sediment control report would provide any additional environmental protection. The Licensees believe it would not, and would be purely an administrative task that places an unnecessary cost and burden on the Licensees. Licensees' estimated cost is approximately $3,000 to $5,000 annually, or $90,000 to $150,000 over 30 years.

5.2 WATER RESOURCES

This discussion of water resources is divided into five sections. Section 5.2.1 describes the existing Project environment and includes two main subsections: water quantity and water quality. The water quantity subsection includes an overview, a description of potentially affected water rights and water contracts, and Project hydrology. The water quality subsection includes information regarding relevant plans and regulations, and existing water quality in the Project area. Section 5.2.2 addresses the effects of the Licensees' Proposal on water resources. Section 5.2.3 discusses cumulative effects and Section 5.2.4 describes unavoidable adverse effects, if any, of the Licensees' Proposal. Section 5.2.5 responds to requests for additional PM&E measures and/or studies.

The Licensees augmented existing, relevant, and reasonably available information relative to water resources by conducting Study 4.1.14, *Indicators of Hydrologic Alteration*, and Study 4.1.16, *Water Quality and Temperature.* Refer to Appendix B of this Exhibit E or to the South SWP Hydropower relicensing website (http://south-swp-hydropower-relicensing.com/) for the detailed study approaches, study summaries, and detailed study data.

5.2.1 Existing Environment

This section provides information regarding existing water quantity and water quality conditions.

5.2.1.1 Water Quantity

This section includes an overview, a description of potentially affected water rights and water contracts, and Project hydrology and contains four main sub-sections: (1) Project area gage information; (2) morphometric data for Quail Lake, Pyramid Lake, and Elderberry Forebay; (3) potentially affected area and Project hydrology; and (4) potentially affected water rights.

Project Area Gage Information

The Licensees operate and maintain 19 of the 21 gages in the Project area, as shown in Figure 5.2-1 and listed in Table 5.2-1. Flow data for these gages are available from two sources, as noted in the table: the U.S. Geological Survey (USGS) National Water Information System (waterdata.usgs.gov) and DWR's California Data Exchange Center (CDEC) (cdec.water.ca.gov). The frequency of data updates is unique to each gage and can change over time as new data is obtained and reviewed. The Period of Record (POR) included in Table 5.2-1 is a general description of data availability. All gages listed in Table 5.2-1 are located in the Project area, but only nine of them are monitored in connection with the Project. Gages monitored as part of the FERC-licensed Project are indicated in Table 5.2-1.

Morphometric Data

This water resources section focuses on morphometric data (the physical characteristics), available for Pyramid Lake on Piru Creek and Elderberry Forebay on Castaic Creek. Key morphometric parameters, such as critical elevations, and their corresponding elevations and storage volumes, are included for each water body. Quail Lake, the other Project impoundment, is also discussed in this section, even though it does not include a direct release to surface waters. Tables 5.2-2, 5.2-3, and 5.2-4 summarize morphometric characteristics of Quail Lake, Pyramid Lake, and Elderberry Forebay, respectively.

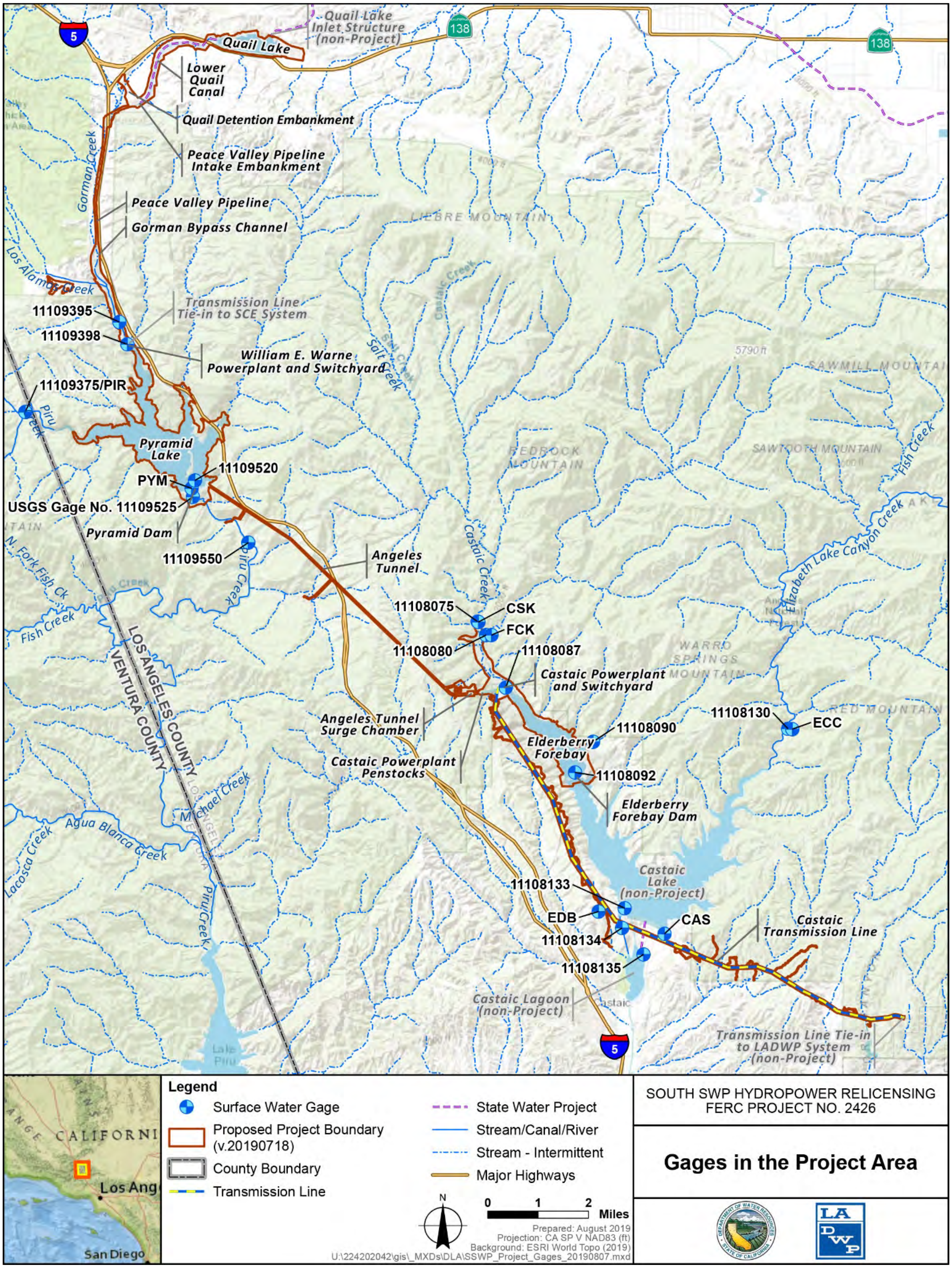

Figure 5.2-1. Gages in the Project Area

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Table 5.2-1. Gages in the Project Area

Gage ID	Gage Name	Gage Owner	FERC Project Gage?	Data Source	Data Reported (units)	Reported Frequency	Period of Published Record	
							Begin Date	End Date
11109395	CAÑADA DE LOS ALAMOS AB PYRAMID LK CA	DWR	Yes	USGS	Discharge (cfs)	Daily	1976-10-1	Present
11109398	WB CA AQUEDUCT A WILLIAM WARNE PP NR GORMAN CA	DWR	Yes	USGS	Discharge (cfs)	Daily	1995-10-1	Present
11109375	PIRU C BL BUCK C NR PYRAMID LK CA	DWR	Yes	USGS	Discharge (cfs)	Daily	1976-10-1	Present
PIR	PIRU CREEK BLW BUCK CR NR PYRAMID LAKE	DWR	No	CDEC	Flow, River Discharge (cfs)	15-minute	2012-10-1	Present
					Flow, River Discharge (cfs)	Hourly	1993-3-30	2012-10-1
					River Stage (feet)	15-minute	2012-10-1	Present
					River Stage (feet)	Hourly	1990-10-30	2012-10-1
11109520	PYRAMID LK NR GORMAN CA	DWR	Yes	USGS	Reservoir storage (AF)	Daily	1988-10-1	Present
11109525	PIRU C BL PYRAMID LK NR GORMAN CA	DWR	Yes	USGS	Discharge (cfs)	Daily	1988-10-1	Present
11109550	PIRU C AB FRENCHMANS FLAT CA	USGS	No	USGS	Discharge (cfs)	Daily	1972-3-22	Present
PYM	PYRAMID	DWR	No	CDEC	Reservoir Elevation (feet)	Hourly	2007-10-24	Present
					Reservoir Storage (AF)	Hourly	2007-10-24	Present
					Reservoir Outflow (cfs)	Hourly	2007-10-24	Present
					Reservoir Storage (AF)	Monthly	1974-10-1	Present
11108075	CASTAIC C AB FISH C NR CASTAIC CA	DWR	No	USGS	Discharge (cfs)	Daily	1976-10-1	1993-9-30
CSK	CASTAIC CANYON CK Z3-2388	DWR	No	CDEC	Flow, River Discharge (cfs)	15-minute	2010-2-23	Present
					River Stage (feet)	15-minute	2010-2-17	Present
11108080	FISH C AB CASTAIC C NR CASTAIC CA	DWR	No	USGS	Discharge (cfs)	Daily	1976-10-1	1993-9-30
FCK	FISH CANYON CK	DWR	No	CDEC	Flow, River Discharge (cfs)	15-minute	2012-3-14	Present
					River Stage (feet)	15-minute	2012-3-14	Present
11108090	ELDERBERRY CYN C AB CASTAIC C NR CASTAIC CA	DWR	No	USGS	Discharge (cfs)	Daily	1977-10-1	1993-9-30
EDB	ELDERBERRY CANYON CK	DWR	No	CDEC	Flow, River Discharge (cfs)	15-minute	2011-4-6	Present
					Flow, River Discharge Precise (cfs)	15-minute	2011-4-6	Present
					River Stage (feet)	15-minute	2011-3-9	Present
11108092	ELDERBERRY FOREBAY NR CASTAIC CA	DWR	Yes	USGS	Storage (AF)	Hourly	1995-10-1	Present
11108087	CASTAIC PP NR CASTAIC CA	DWR	Yes	USGS	Discharge (cfs)	Daily	2009-10-1	Present
11108130	ELIZABETH LK CYN C AB CASTAIC LK NR CASTAIC CA	DWR	No	USGS	Discharge (cfs)	Daily	1976-10-1	1993-9-30
ECC	ELIZABETH CANYON CK	DWR	No	CDEC	Flow, River Discharge (cfs)	15-minute	2003-2-3	Present
					River Stage (feet)	15-minute	2003-2-3	Present

Table 5.2-1. Gages in the Project Area (continued)

Gage ID	Gage Name	Gage Owner	FERC Project Gage?	Data Source	Data Reported (units)	Reported Frequency	Period of Published Record	
CAS	CASTAIC	DWR	No	CDEC	Reservoir Elevation (feet)	Hourly	2007-10-24	Present
					Reservoir Storage (AF)	Hourly	2007-10-24	Present
					Reservoir Outflow (cfs)	Hourly	2007-10-24	Present
					Reservoir Storage (AF)	Monthly	1974-10-1	Present
11108133	CASTAIC LK NR CASTAIC CA	USGS	Yes	USGS	Reservoir Storage (AF)	Daily	1988-10-1	Present
11108134	CASTAIC C BLW MWD DIV BLW CASTAIC LK NR CASTAIC	DWR	Yes	USGS	Discharge (cfs)	Daily	1994-10-1	Present
11108135	CASTAIC C RELEASE BLW CASTAIC LK NR CASTAIC	DWR	No	USGS	Discharge (cfs)	Daily	1976-10-01	1994-9-30

Sources: DWR 2018a; USGS 2018
Note: End Date of Period of Published Record as of January 2019
Key:
AF = acre-feet
CDEC = California Data Exchange Center
cfs = cubic feet per second
DWR = California Department of Water Resources
FERC = Federal Energy Regulatory Commission
USGS = U.S. Geological Survey

Table 5.2-2. Morphometric Characteristics of Quail Lake

Morphometric Characteristics	Quail Lake
NMWSE (feet)	3,325
Surface Area (acres)	288 at NMWSE
Storage Volume (AF)	7,580 at NMWSE
Maximum Depth (feet)	38.3
Mean Depth (feet)	Not available
Flushing Rate (days)[1]	8.5
Shoreline Length (miles)	3 at NMWSE
Primary Substrate Composition[2]	Holocene alluvium, alluvial fan, and saline sand deposits

Sources: DWR 2016a, 2014
Notes:
[1]Average flushing rate calculated using the average daily storage divided by the average daily outflow. The average monthly flushing rate varies seasonally with average monthly flushing rates of 6.7 days in July and 9.9 days in February.
[2]For more information related to the geology and soils in the Project area, see Section 5.1, Geology and Soils.
Key:
AF = acre-feet
NMWSE = normal maximum water surface elevation

Table 5.2-3. Morphometric Characteristics of Pyramid Lake

Morphometric Characteristics	Pyramid Lake
NMWSE (feet)	2,579
Surface Area (acres)	1,300 at NMWSE
Storage Volume (AF)	161,375 at NMWSE 22,221 Useable Storage Capacity
Maximum Depth (feet)	280
Mean Depth (feet)	132
Flushing Rate (days)[1]	58.8
Shoreline Length (miles)	21 at NMWSE
Primary Substrate Composition[2]	Alluvial valley soils and stony mountainous soils

Source: DWR 2016a
Notes:
[1]Average flushing rate calculated using the average daily storage divided by the average daily outflow. The average monthly flushing rate varies seasonally with average monthly flushing rates of 43.6 days in July and 82.6 days in February.
[2]For more information related to the geology and soils in the Project area, see Section 5.1, Geology and Soils.
Key:
AF = acre-feet
NMWSE = normal maximum water surface elevation

Table 5.2-4. Morphometric Characteristics of Elderberry Forebay

Morphometric Characteristics	Elderberry Lake
NMWSE (feet)	1,530
Surface Area (acres)	500 at NMWSE
Volume (AF)	28,231 storage capacity at NMWSE
Maximum Depth (feet)	140
Mean Depth (feet)	N/A
Flushing Rate (days)[1]	7.6
Shoreline Length (miles)	7 at NMWSE
Primary Substrate Composition[2]	Pale brown loams and silty clay loams

Sources: LADWP 2017, DWR 2016a, DWR 2017a
Notes:
[1]Average flushing rate calculated using the average daily storage divided by the average daily outflow. The average monthly flushing rate varies seasonally with average monthly flushing rates of 6.2 days in June and 10.2 days in February.
[2]For more information related to the geology and soils in the Project area, see Section 5.1, Geology and Soils.
Key:
AF = acre-feet
NMWSE = normal maximum water surface elevation
N/A = not applicable

Pyramid Lake and Piru Creek

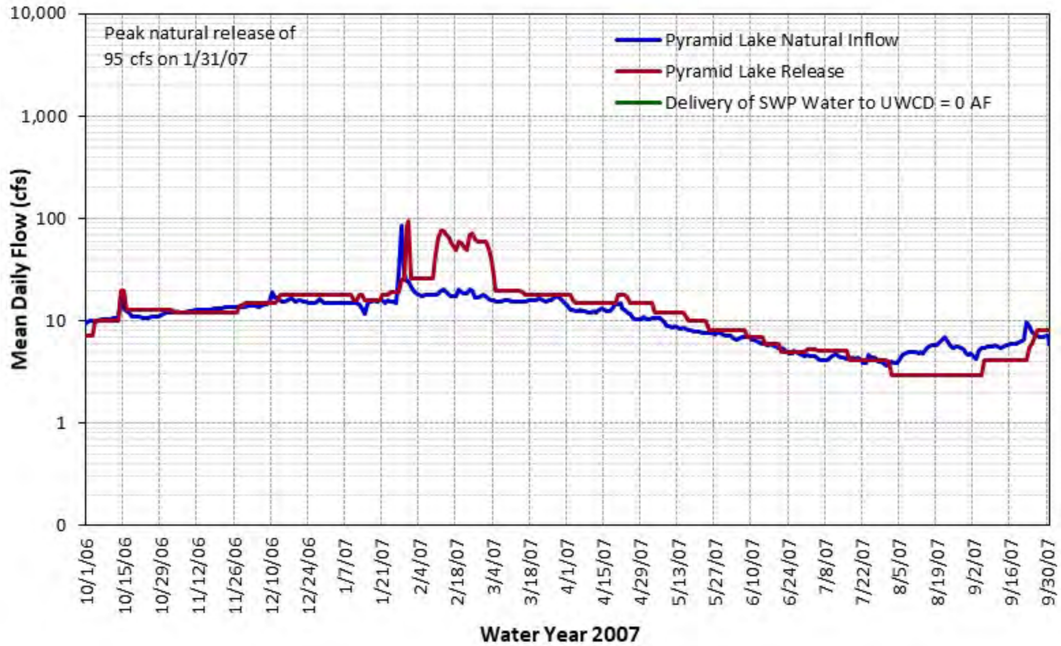
This section describes the natural stream inflow and outflow for Pyramid Lake. Pyramid Lake receives local inflow, including flows from Piru Creek and Cañada de Los Alamos, as measured at Gage 11109375 and Gage 11109395, respectively. Outflows from Pyramid Dam to Pyramid reach, as measured by Gage 11109525, are required to match the natural inflow into Pyramid Lake to the extent operationally feasible, consistent with safety requirements and in accordance with the authorizations provided by USFWS on February 2, 2005 and August 22, 2007, and by FERC on April 12, 2005 and October 28, 2009. Beginning in the mid-1990s following the listing of the arroyo toad (*Anaxyrus californicus*) under the ESA, DWR began actively engaging USFWS, the California Department of Fish and Game (CDFG, now CDFW), the LPNF and ANF, and UCWD to develop an operational plan for stream releases into the Pyramid reach that would benefit the arroyo toad, the California red-legged frog (CRLF) (*Rana draytonii*) and other sensitive species and their habitats, while also supporting the recreational fishery and providing water supply to the UWCD. The 2007 USFWS and 2009 FERC authorizations under Article 52 of the existing license permitted DWR to begin simulating natural flows as well as releases of SWP water to the UWCD between November 1 and the end of February. (DWR 2005, 2017; USFWS 2005, 2007; FERC 2005, 2009).

VCWPD's long-term water supply contract with DWR entitles VCWPD to a maximum annual Table A amount of 20,000 AF, and VCWPD assigned that entitlement to Casitas Municipal Water District. As part of an agreement with the Casitas Municipal Water District, the United Water Conservation District (UWCD) is contracted to receive a maximum of 5,000 acre-feet per year (AF/year) of VCWPD's maximum annual Table A water. UWCD receives up to 3,150 AF/year of SWP water through releases to Pyramid reach. The remaining amount of up to 1,850 AF/year is required, pursuant to a February 1996 water lease agreement, to be delivered to the City of Port Hueneme through the VCWPD turnout at Castaic Lake. Releases for UWCD are made to Pyramid reach through the same low-level outlet in Pyramid Dam used to release the natural flow to Pyramid reach. UWCD's deliveries are typically in November, on a schedule set by UWCD. UWCD releases are included in the USGS data set as part of the Pyramid reach flow, but they are accounted for by DWR as a separate release.

More recently, given the critically overdrafted conditions of groundwater basins and saltwater intrusion within UWCD's jurisdiction, UWCD has pursued and been successful in acquiring supplemental SWP water via transfer agreements. For example, DWR recently requested and obtained from FERC on UWCD's behalf an order permitting a temporary variance from Article 52 to allow a delivery total of 8,997 acre-feet (2,362 AF in SWP Table A water and 6,635 AF obtained via transfer agreements). UWCD filed comments on the Licensees' DLA requesting that the delivery limitations in Article 52 be modified in the new license to allow flexibility for additional deliveries above its Table A 3,150 AF entitlement.

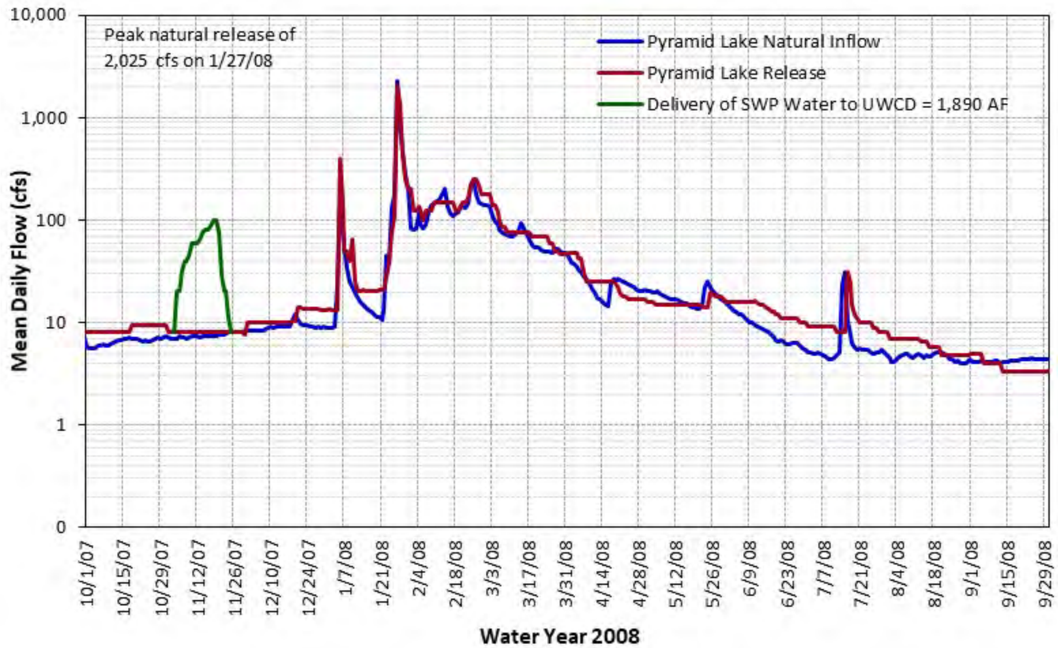
Figure 5.2-2 shows daily natural inflow to Pyramid Lake, Pyramid Lake releases, and Pyramid Lake water supply releases to UWCD for the relicensing POR, WYs 2007 through 2017. The POR was selected for four reasons. First, it includes both an extended drought (WY 2013 through 2016) and several of the wettest years (WY 2011 and WY 2017) on record, so a longer POR would not contribute to a wider range of hydrology. Second, gage data for WY 2006 is not available. Third, since Pyramid Lake hydrology is dominated by SWP operations, which have changed over time, evaluating a longer POR of local hydrology that would primarily include additional moderate years would not provide meaningful insight into current operations of Pyramid Lake, nor inform license conditions for future operations. Lastly, the POR extends from when Article 52 in the existing license was implemented in 2006 (first full year of implementation). Article 52 significantly changed streamflow releases into Pyramid reach (i.e., the 18.1-mile-long section of Piru Creek, which extends from the spillway or low-level outlet from Pyramid Dam to the NMWSE of Lake Piru).

Since the data shown in the figures range from less than 1 cfs to almost 10,000 cfs, flow data in Figure 5.2-2 are plotted in a logarithmic scale to better show both low and high values. This approach tends to exaggerate differences in low flows and minimize differences in high flows. Figure 5.2-2 shows the portion of release allocated to UWCD separately from the other Pyramid Lake releases, because deliveries of SWP water to UWCD are not part of the natural inflow to Pyramid Lake but from SWP water supplies. Pyramid Lake releases are occasionally lower than natural inflows between mid-September and the end of October, and over-released in other periods. This occurs in order to correct over delivery of SWP water and takes place during a time of year when natural flows are very low. The difference between natural inflow and outflow during this period is small and has no measurable effect on the downstream channel. A detailed description of the calculation of natural inflow to Pyramid Lake can be found in Section 3.1.4.1 of Exhibit B. Outflow from Pyramid Lake to Pyramid reach is described in Section 3.1.6.2 of Exhibit B.



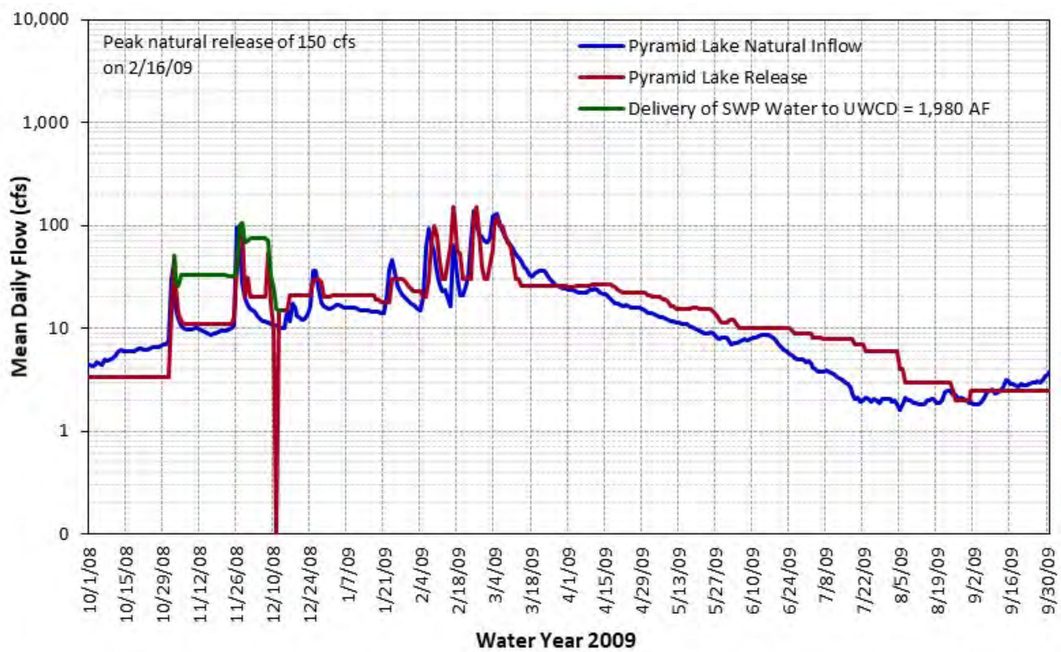
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2a. Pyramid Lake Natural Inflow and Release for Water Year 2007



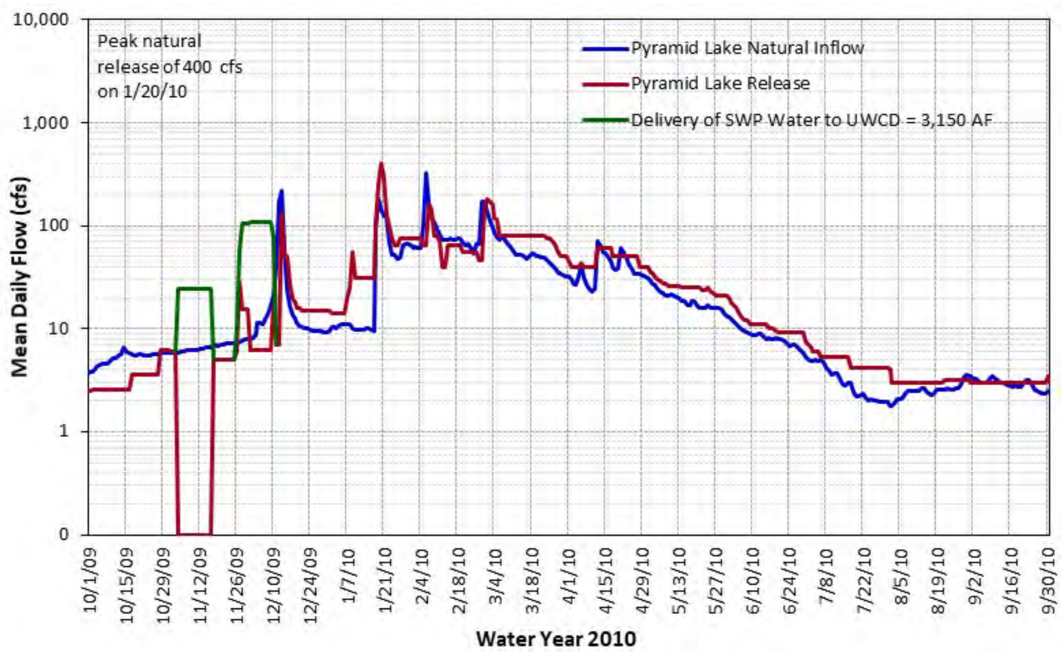
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2b. Pyramid Lake Natural Inflow and Release for Water Year 2008



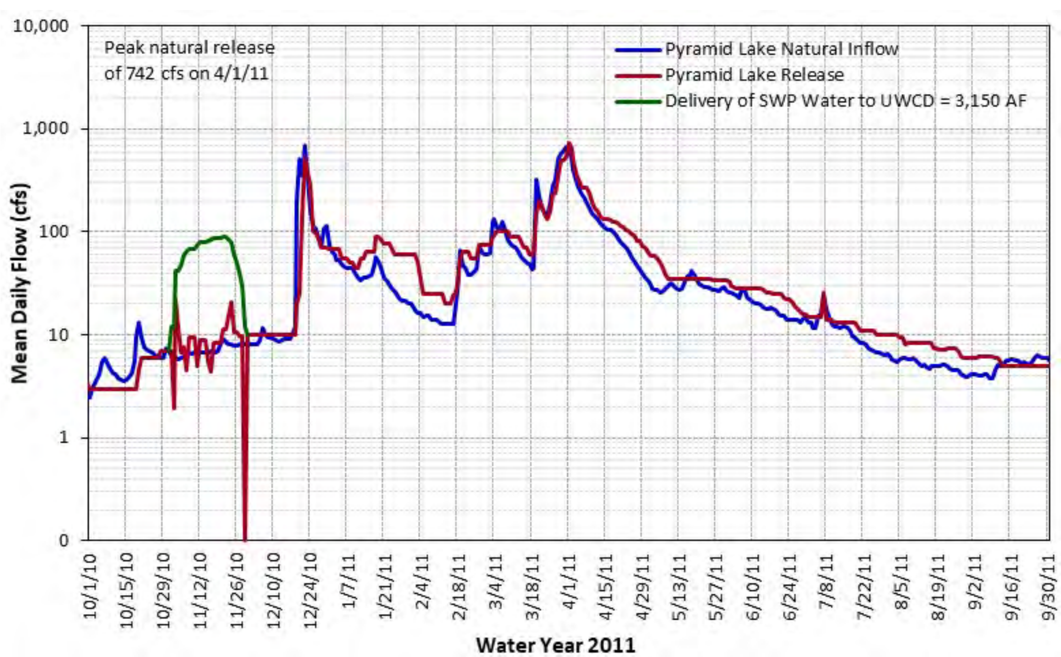
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2c. Pyramid Lake Natural Inflow and Release for Water Year 2009



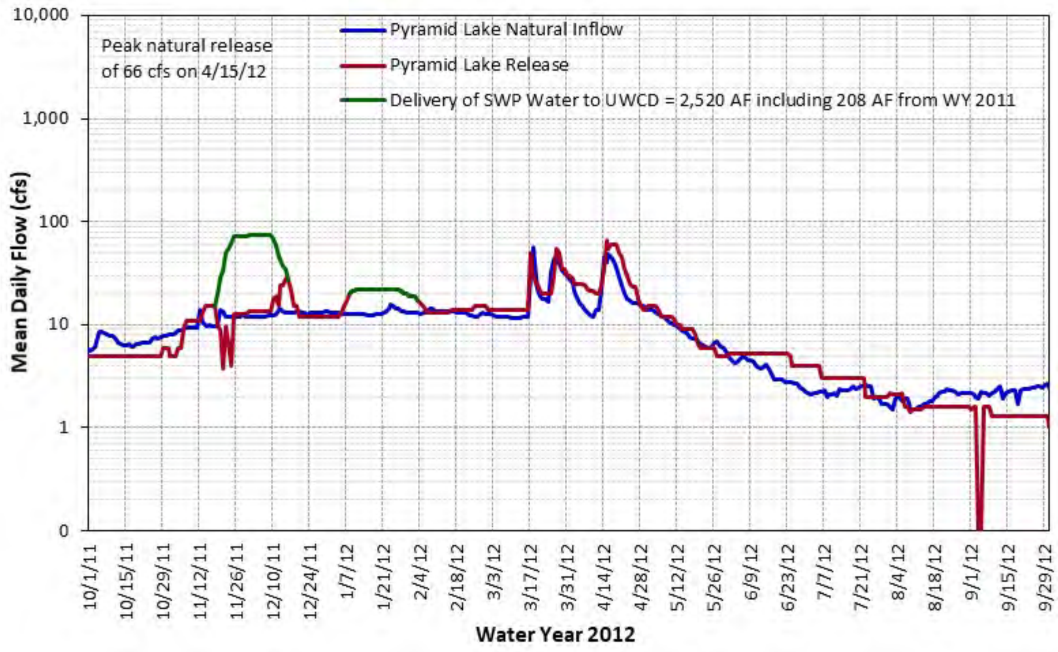
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2d. Pyramid Lake Natural Inflow and Release for Water Year 2010



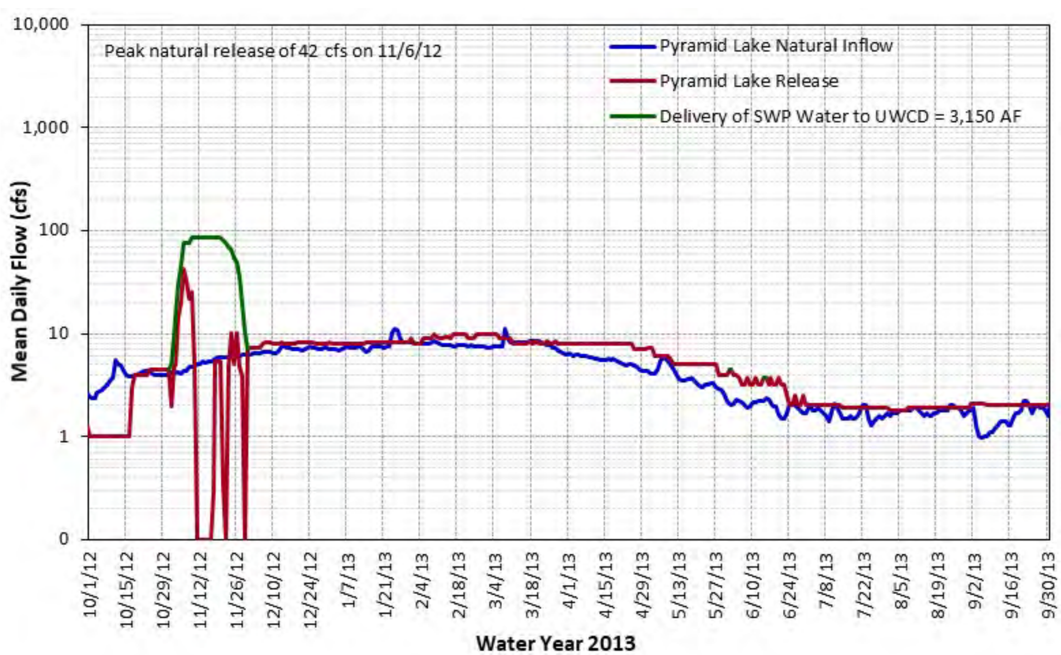
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2e. Pyramid Lake Natural Inflow and Release for Water Year 2011



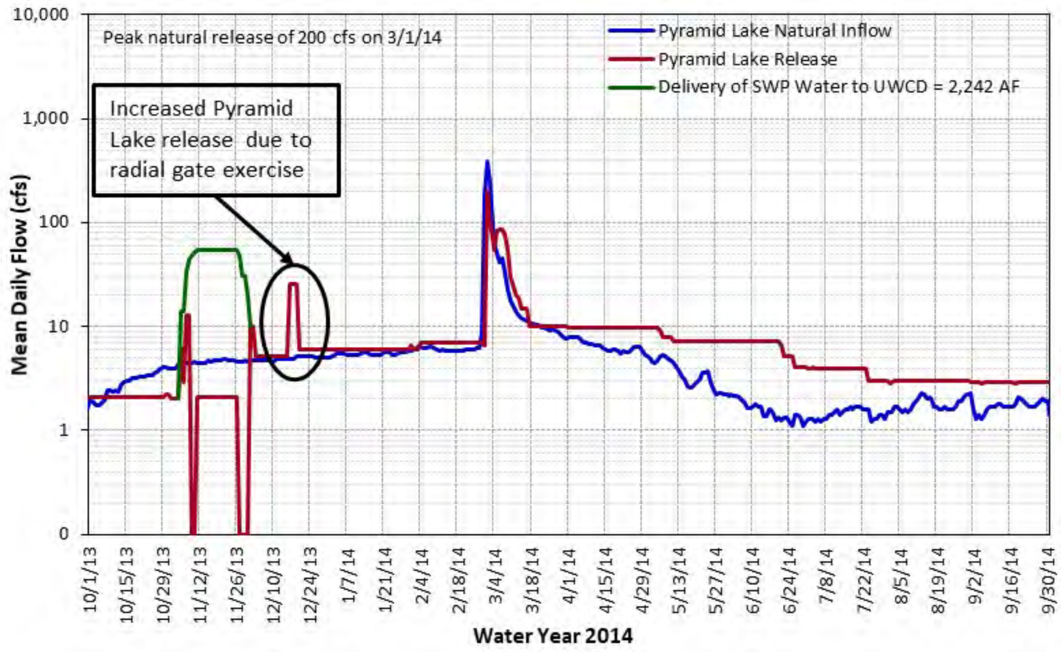
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2f. Pyramid Lake Natural Inflow and Release for Water Year 2012



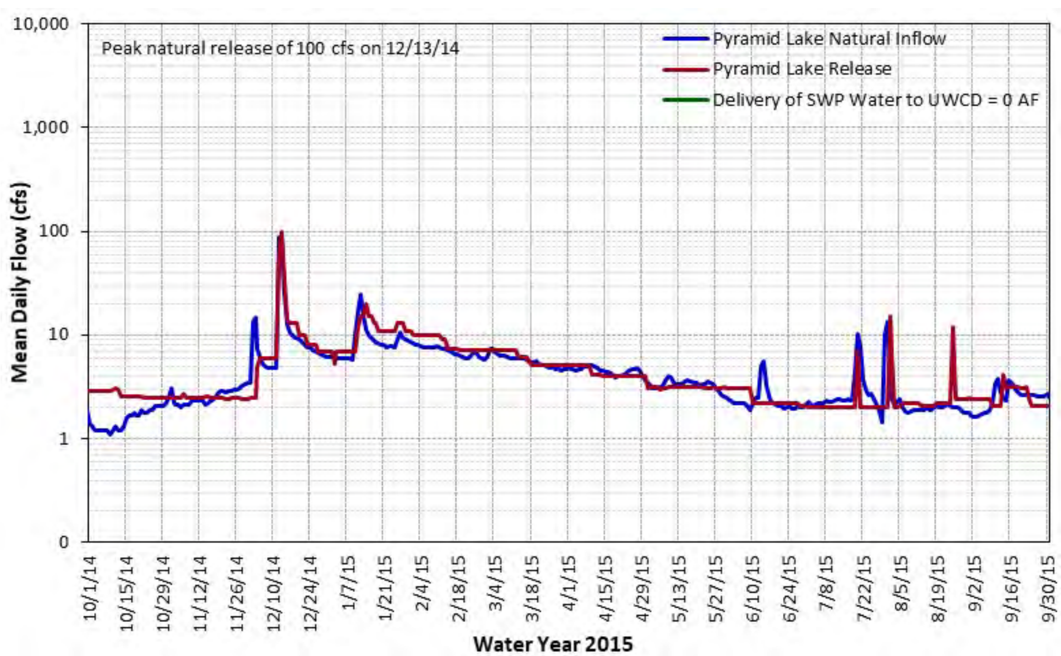
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2g. Pyramid Lake Natural Inflow and Release for Water Year 2013



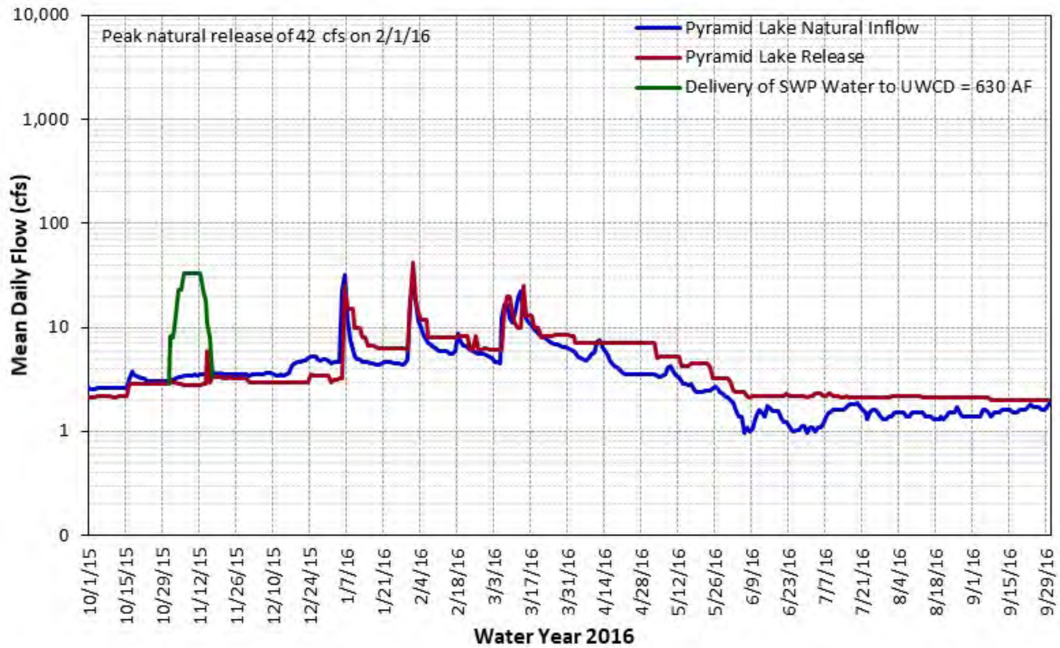
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2h. Pyramid Lake Natural Inflow and Release for Water Year 2014



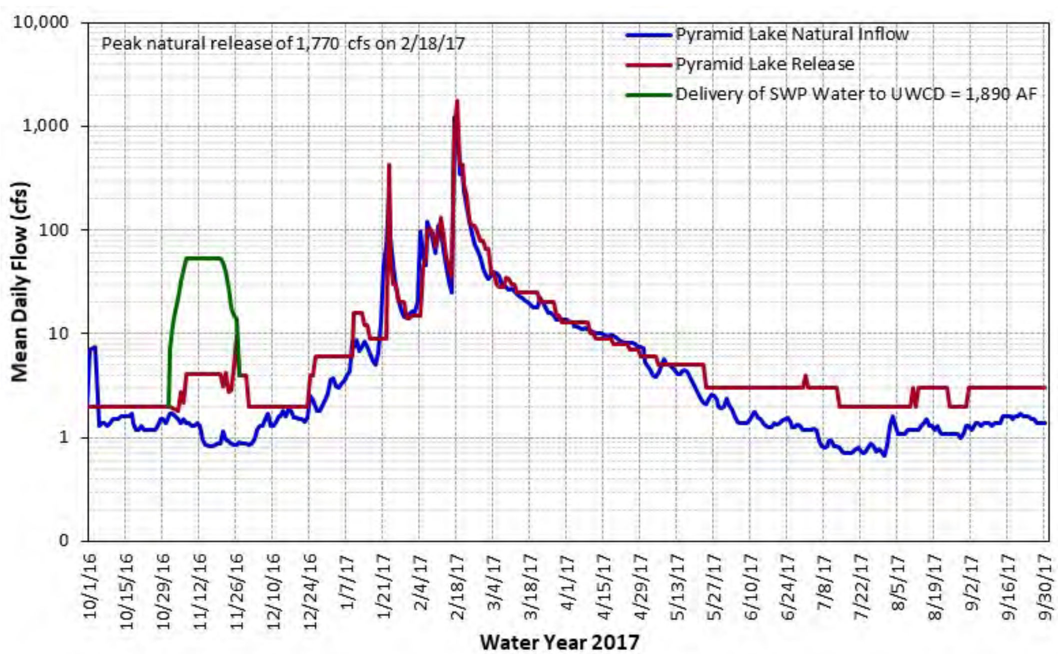
Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2i. Pyramid Lake Natural Inflow and Release for Water Year 2015



Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2j. Pyramid Lake Natural Inflow and Release for Water Year 2016



Key:
AF = acre-feet cfs = cubic feet per second
SWP = State Water Project
UWCD = United Water Conservation District

Figure 5.2-2k. Pyramid Lake Natural Inflow and Release for Water Year 2017

As part of the *Indicators of Hydrologic Alteration* [IHA] Study, DWR conducted several additional evaluations of the hydrologic effects of the Project, in addition to the comparisons of the natural inflow and release from Pyramid Lake shown in Figure 5.2-2.

One of the evaluations in the IHA study was a comparison of hourly flow data for Pyramid Lake natural inflows and Pyramid Lake releases for several discrete events to evaluate how closely releases from Pyramid Lake simulated natural inflows. The evaluation found that DWR typically made daily release changes from Pyramid Lake. Although hourly fluctuations were not well represented in Pyramid reach below Pyramid Dam, DWR's operations generally simulated the natural flow conditions as measured on a daily basis. Note that the hourly flow analysis in the IHA study did not include a representation of the ungaged flow portion of inflows. Article 52, which became effective under a 2009 FERC order, does not specify whether DWR should match releases with inflows on an hourly or daily basis and allows the stream release hydrograph to be attenuated; hourly data from both upper Piru Creek and Cañada de Los Alamos are relatively inconsistent and not as readily available as mean daily data.

Also, as part of the IHA study, DWR used an analytical software package, the Nature Conservancy's IHA Version 7 software developed by Totten Web Design and Smythe Scientific Software, to evaluate the effects of the Project on hydrology. The IHA analysis included five groups of standard statistics, which are described below.

- <u>Magnitude of Monthly Water Conditions</u>. This information is presented as the average monthly flow at each location for all 12 months of the year in side-by-side columns for all years and for each of the five WY types comparing the Pyramid Lake natural inflows to the Pyramid Lake releases.

- <u>Magnitude and Duration of Annual Extreme Water Conditions</u>. This information is presented as the average of each year's 1-, 3-, 7-, 30- and 90-day maximum flow, the average of each year's 1-, 3-, 7-, 30- and 90-day minimum flow, the average number of zero flow days per year, and the base flow index. All of these statistics are provided for all years and for each of the five WY types. The base flow index is calculated by dividing the average annual seven-day minimum flow by the average annual mean flow and, therefore, is a ratio of minimum flow to mean flow.

- <u>Timing of Annual Extreme Water Conditions</u>. This information is presented as the average of all year's Julian date (i.e., number of days counting from January 1) of the one day minimum flow for each year and the one day maximum flow for each year.

- <u>Frequency and Duration of High and Low Flow Pulses</u>. For these statistics, a day is classified as a pulse if the (maximum or minimum) flow during it is greater (i.e., high flow pulses) or less than (i.e., low flow pulses) a threshold value, respectively. The threshold value is set for the Pyramid Lake natural inflows and these same threshold values are used for the Pyramid Lake releases. The threshold values used for each of the locations are provided in Tables 5.2-5 through 5.2-10.

- Rate and Frequency of Change in Water Conditions. For these statistics, the hydrologic period is broken into rising and falling periods, which correspond to periods in which daily changes in flows are positive (i.e., rising) or negative (i.e., falling). The statistic also includes the number of reversals, or changes in sign. Sequential days of constant flow are not considered reversals; they are a part of the preceding rising or falling period.

DWR compiled instantaneous annual peak flow data for Piru Creek using USGS gages 11109375, 11109395, and 11109525. Subsequently, DWR used the USGS PeakFQ version 7.1 software to determine the flood frequency curves, including an estimate of flow for each annual exceedance probability/return period. DWR then associated the 95 percent confidence upper and lower values for each of the three gages for return periods between 1 year and 500 years. The results for each gage are included in the table below. Note that values for gages 11109395 and 11109375 are not necessarily additive, since historical peak flow events upon which the flood frequencies are based may not have occurred at the same time.

Table 5.2-5. Pyramid Lake Natural Inflows and Pyramid Lake Releases – Median Monthly Flows in Pyramid Reach for Water Years 2007 through 2017

Month	Median Monthly Flows[1,3]							
	Pyramid Lake Natural Inflows				Pyramid Lake Releases			
	Median (cfs)	25th Percentile (cfs)	75th Percentile (cfs)	CD[2] (value)	Median (cfs)	25th Percentile (cfs)	75th Percentile (cfs)	CD (value)
January	12.3	8.2	17.7	0.8	18.0	8.2	25.0	0.9
February	18.0	7.8	81.6	4.1	32.5	8.0	64.0	1.7
March	17.6	9.2	57.6	2.8	18.0	8.5	75.0	3.7
April	13.8	6.2	27.0	1.5	15.0	8.0	25.5	1.2
May	9.1	4.0	18.9	1.6	9.0	5.0	15.6	1.2
June	4.2	1.7	9.0	1.7	6.0	3.2	10.5	1.2
July	2.6	1.7	4.8	1.2	4.0	2.1	7.9	1.5
August	2.2	1.9	5.2	1.5	2.9	2.1	3.0	0.3
September	3.0	1.8	4.8	1.0	2.8	2.0	3.3	0.5
October	6.0	3.3	7.4	0.7	2.9	2.4	5.0	0.9
November	7.4	3.9	11.0	1.0	30.7	12.0	54.0	1.4
December	10.1	5.5	14.5	0.9	10.0	6.1	18.0	1.2

Notes:
[1]For any given month, the median value is the average of annual median monthly values for that month.
[2]As defined in the Indicators of Hydrologic Alteration Study, the coefficient of dispersion (CD) is presented as an absolute value and is calculated by the difference between the 25th percentile and the 75th percentile divided by the median value.
[3]All values in the table reflect rounded values from IHA computed output.
Key:
CD = coefficient of dispersion
cfs = cubic feet per second

Table 5.2-6. Pyramid Lake Natural Inflows and Pyramid Lake Releases – Median Magnitude and Duration of Annual Extreme Conditions in Pyramid Reach for Water Years 2007 through 2017

Median Monthly Flows[1,3]								
Consecutive Days	Pyramid Lake Natural Inflows				Pyramid Lake Releases			
	Median (cfs)	25th Percentile (cfs)	75th Percentile (cfs)	CD[2] (value)	Median (cfs)	25th Percentile (cfs)	75th Percentile (cfs)	CD (value)
Minimum Extreme Flow Conditions								
No Flow Days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Day	1.7	1.1	2.8	1.0	2.0	2.0	2.9	0.5
3-Days	1.7	1.1	3.3	1.3	2.0	2.0	2.9	0.5
7-Days	1.8	1.2	4.3	1.8	2.1	2.0	2.9	0.4
30-Days	2.1	1.5	4.7	1.6	2.3	2.0	3.0	0.4
90-Days	2.8	1.7	5.4	1.3	3.2	2.1	4.3	0.7
Maximum Extreme Flow Conditions								
1-Day	156.0	61.9	765.1	4.5	150.0	85.2	742.0	4.4
3-Days	139.3	50.4	700.3	4.7	117.7	73.3	644.3	4.9
7-Days	115.0	37.2	546.6	4.4	89.6	66.6	542.7	5.3
30-Days	51.3	15.0	180.8	3.2	60.9	41.0	193.5	2.5
90-Days	21.8	11.0	78.2	3.1	30.9	18.5	81.7	2.0
Base Flow	0.16	0.08	0.25	1.1	0.10	0.07	0.20	1.3

Notes:
[1]For any given year, the one-day maximum (or minimum) value is the highest (or lowest) single median daily value occurring during that year. For any given year, the multi-day maximum (or minimum) value is the highest (or lowest) average of median daily values over that multi-day period occurring in that year.
[2]As defined in the Indicators of Hydrologic Alteration Study, the coefficient of dispersion (CD) is presented as an absolute value and is calculated by the difference between the 25th percentile and the 75th percentile divided by the median value.
[3]All values in table reflect rounded values from IHA computed output.
Key:
CD = coefficient of dispersion
cfs = cubic feet per second

Table 5.2-7. Pyramid Lake Natural Inflows and Pyramid Lake Releases – Median Timing of Annual Extreme Flow Conditions in Pyramid Reach for Water Years 2007 through 2017

Median Timing of Annual Extreme Flow Conditions[1,3]								
Julian Calendar	Pyramid Lake Natural Inflows				Pyramid Lake Releases			
	Median (cfs)	25th Percentile (cfs)	75th Percentile (cfs)	CD[2] (value)	Median (cfs)	25th Percentile (cfs)	75th Percentile (cfs)	CD (value)
Minimum[4]								
Date	215	213	249	0.1	257	239	275	0.1
Maximum[5]								
Date	37	6	61	0.2	31	348	49	0.2

Notes:
[1]The parameters are the median of the Julian date or the Julian dates when the one-day maximum (or minimum) water condition occurred.
[2]As defined in the Indicators of Hydrologic Alteration Study, the coefficient of dispersion (CD) is presented as an absolute value and is calculated by the difference between the 25th percentile and the 75th percentile divided by 366 days.
[3]All values in table reflect rounded values from IHA computed output.
[4]Computed Julian dates for minimum flows are based on the date of the last occurrence of the minimum flow; since regulated releases have much less variability than the natural inflows, dates for the regulated flows are typically computed in the IHA software as occurring later.
[5]Computed Julian dates for maximum flows are typically associated with storm flows. DWR has limited availability to shape releases during high-flow events, and changes in timing of peak flows are generally associated with this limitation.
Key:
CD = coefficient of dispersion
cfs = cubic feet per second

Table 5.2-8. Pyramid Lake Natural Inflows and Pyramid Lake Releases – Median Frequency and Duration of Annual High and Low Pulses in Pyramid Reach for Water Years 2007 through 2017

Median Frequency and Duration of Annual High and Low Pulses[1,3]								
Consecutive Frequency and Duration	Pyramid Lake Natural Inflows				Pyramid Lake Releases			
	Median (# of days)	25th Percentile (# of days)	75th Percentile (# of days)	CD[2] (value)	Median (# of days)	25th Percentile (# of days)	75th Percentile (# of days)	CD (value)
Low Pulse								
Frequency (#)	1	0	2	2.0	1	1	2	1.0
Duration (days)	78.50	26.00	108.13	1.0	43	22.75	85.25	1.5
High Pulse								
Frequency (#)	4	1	5	1.0	3	2	4	0.7
Duration (days)	12.5	2.875	41	3.1	20.5	15	78.5	3.1

Notes:
[1]Pulses are defined as those periods within a year in which the daily median water condition rose above the 75th percentile (high pulse) or dropped below the 25th percentile of all daily flow values in that year.
[2]As defined in the Indicators of Hydrologic Alteration Study, the coefficient of dispersion (CD) is presented as an absolute value and is calculated by the difference between the 25th percentile and the 75th percentile divided by the median value.
[3]All values in table reflect rounded values from IHA computed output.
Key:
 # = number
CD = coefficient of dispersion

Table 5.2-9. Pyramid Lake Natural Inflows and Pyramid Lake Releases – Median Rate and Frequency of Flow Changes in Pyramid Reach for Water Years 2007 through 2017

Median Rate and Frequency of Annual Flow Changes[1,3]								
Rates and Reversals	Pyramid Lake Natural Inflows				Pyramid Lake Releases			
	Median (cfs/#)	25th Percentile (cfs/#)	75th Percentile (cfs/#)	CD[2] (value)	Median (cfs/#)	25th Percentile (cfs/#)	75th Percentile (cfs/#)	CD (value)
Rise Rate (cfs)	0.16	0.11	0.20	0.6	2.00	0.50	6.00	2.8
Fall Rate (cfs)	-0.23	-0.46	-0.14	-1.4	-1.20	-2.50	-0.70	-1.5
Reversals (#)	102	88	107	0.2	32	28	41	0.4

Notes:
[1]Parameters measured include the median of positive and negative differences between consecutive daily values (rate), and the median number of hydrologic reversals (frequency) based on median daily flows.
[2]As defined in the Indicators of Hydrologic Alteration Study, the coefficient of dispersion (CD) is presented as an absolute value and is calculated by the difference between the 25th percentile and the 75th percentile divided by the median value.
[3]All values in table reflect rounded values from IHA computed output.
Key:
 # = number
CD = coefficient of dispersion
cfs = cubic feet per second

Table 5.2-10. Flood Frequency Probabilities for Key Recurrence Intervals for Stream Gages near Pyramid Lake

Annual Exceedance Probability	Return Period (years)	Gage 11109395[1]			Gage 11109375[2]			Gage 11109525[3]		
		95 Percent Confidence			95 Percent Confidence			95 Percent Confidence		
		Estimate (cfs)	Lower (cfs)	Upper (cfs)	Estimate (cfs)	Lower (cfs)	Upper (cfs)	Estimate (cfs)	Lower (cfs)	Upper (cfs)
0.995	1.005	2	1	4	2	0	8	8	2	20
0.99	1.01	2	1	5	4	1	14	11	3	26
0.95	1.053	6	2	12	19	5	50	28	9	59
0.9	1.111	10	4	20	44	13	102	47	18	93
0.8	1.25	21	10	36	115	43	244	91	40	166
0.6667	1.5	40	21	68	280	123	573	169	85	300
0.5	2.0	82	47	141	705	338	1,476	328	180	593
0.4292	2.33	112	65	196	1,029	502	2,223	434	242	805
0.2	5.0	367	208	752	4,117	1,929	11,000	1,255	686	2,806
0.1	10.0	841	441	2,029	10,150	4,361	33,130	2,594	1,316	6,978
0.04	25.0	2,107	986	6,288	26,180	9,958	108,700	5,726	2,599	19,440
0.02	50.0	3,889	1,667	13,520	47,900	16,680	234,200	9,644	4,024	38,590
0.01	100.0	6,840	2,692	27,490	82,010	26,270	466,200	15,520	5,967	72,490
0.005	200.0	11,590	4,199	53,540	133,600	39,530	873,100	24,120	8,571	130,400
0.002	500.0	22,300	7,262	122,700	239,800	64,380	1,859,000	41,460	13,330	269,200

Key:
cfs = cubic feet per second
Notes:
[1]Annual maximum instantaneous peak flows for USGS gage 11109395 for 1977, 1978, 1988-1997, 1999-2003, 2007-2017 used for flood frequency analysis (28 years)
[2]Annual maximum instantaneous peak flows for USGS gage 11109375 for 1977, 1978, 1989-2003, 2011-2017 used for flood frequency analysis (24 years)
[3]Annual maximum instantaneous peak flows for USGS gage 11109525 for 1996-2007, 2010-2017 used for flood frequency analysis (20 years)

Differences occur between the Pyramid Lake natural inflows and Pyramid Lake releases in the IHA analysis shown in Tables 5.2-5 through 5.2-9. These differences are expected since the analysis compares the natural inflow into the reservoir scenario and the release from the reservoir scenario as required under Article 52 of the license, which includes exceptions to the "outflow equals inflow" paradigm and allows for the stream release hydrograph to be attenuated. Nevertheless, some conclusions can be drawn from the IHA analysis. For instance, Table 5.2-5 shows that, in most months, the release from the dam exceeds natural inflow into the reservoir, and the differences are minor in months when outflow is less than the natural inflow (i.e., from 0.1 cfs to 3.9 cfs median values). Table 5.2-3 shows that the base flow in Pyramid reach under either the release or the natural inflow is very low (i.e., 0.10 cfs and 0.16 cfs, respectively), minimum extreme flow conditions are generally slightly higher under the releases than under the natural inflow condition (i.e., no difference to 0.4 cfs), and maximum extreme flow conditions are generally lower under the releases than under the natural inflow condition, which may be a function of Article 52 implementation at higher flows. Table 5.2-7 shows that the median day for when the lowest minimum flow occurs is 42 days later under releases than under the natural inflow condition (i.e., shifts from August 3 to September 14), but these are months when the median monthly flow is in the 2 to 3 cfs range, so the differences are likely very small. The highest maximum flows occur within six days of each other under both scenarios (i.e., January 31 and February 6). Table 5.2-8 shows that high and low pulses, as defined under the IHA, rarely occur under either scenario (i.e., median number of days between one and four). Table 5.2-9 shows that, when flows increase, under the release scenario they increase at a median rate of 2 cfs per day, which is small but still greater than under the natural inflow scenario median rate of 0.16 cfs per day. In comparison, when flows decrease, under the release scenario, they decrease at a median rate of 1.2 cfs per day, which is small but still greater than under the natural inflow scenario median rate of 0.23 cfs per day.

With regard to the flood frequency analysis in Table 5.2-10, comparison between computed values for the three gages can lead to confusion since the analysis is based on instantaneous annual maximum flows, and annual peak maximum flows may not have been for the same event for all three gages. Furthermore, with the varied periods of record and a maximum of 28 years of data, a direct comparison of the values is not appropriate. However, a relative comparison of the values for the three gages indicates that the confidence ranges overlap appropriately, and the values are of expected general magnitudes.

This section describes the natural stream inflow and outflow for Elderberry Forebay. Elderberry Forebay receives local inflow from Castaic Creek, and its tributaries, including Fish Canyon Creek, Elderberry Canyon Creek, and multiple smaller tributaries. DWR has gaged Castaic Creek since mid-2010, and Fish Canyon Creek since early 2012, and reports 15-minute flows to the CDEC under station identifications "CSK" and "FCK," respectively. While none of the other natural inflows to the Elderberry Forebay are gaged, DWR estimates the total natural inflows and publishes them in Table 26 of DWR's SWP Operations Report (DWR 2017a). A detailed description of the inflow to Elderberry Forebay can be found in Section 3.1.7 of Exhibit B.

Outflow from Elderberry Forebay can be through one of three mechanisms: (1) pumpback to Pyramid Lake by the Castaic Powerplant through the Angeles Tunnel; (2) releases to Castaic Lake through the Elderberry Forebay outlet works; or (3) spill to Castaic Lake over the Elderberry Forebay spillway (in case of an emergency). DWR publishes outflow from Elderberry Forebay in Table 26 of DWR's SWP Operations Report (DWR 2017a). A detailed description of the outflow from Elderberry Forebay can be found in Section 3.1.8 of Exhibit B.

As described in Exhibit B Section 3.1.7, the Licensees do not have water rights to the natural inflows to Elderberry Forebay. The natural inflows to Elderberry Forebay from Castaic Creek and other local drainages, and the natural outflows to Castaic Lake (non-Project facility) are balanced on a daily basis (DWR 2015a). Figures 5.2-3 and 5.2-4 show the monthly range of natural inflow and natural outflow from Elderberry Forebay.

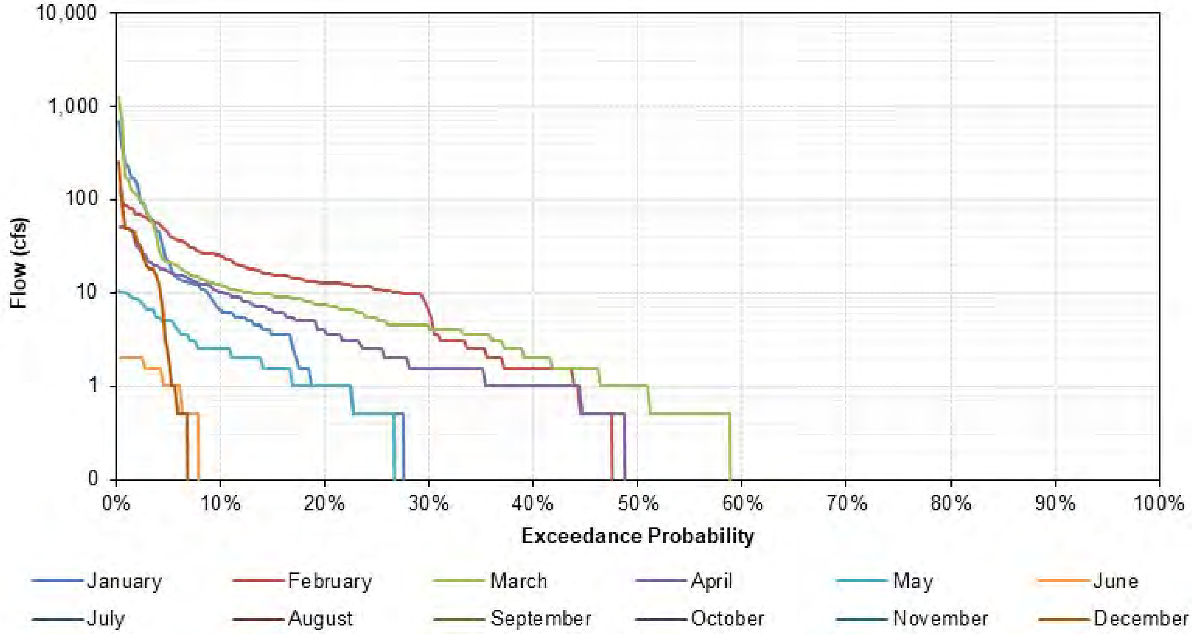
Potentially Affected Water Rights and Water Supply Contracts

Local Water Rights

Table 5.2-11 lists local water rights for Piru Creek and Castaic Creek that could potentially be affected by the Project. This table does not include water rights associated with the operation of the SWP. More information regarding water rights and associated operations is available in Section 4.1.2 of Exhibit B.

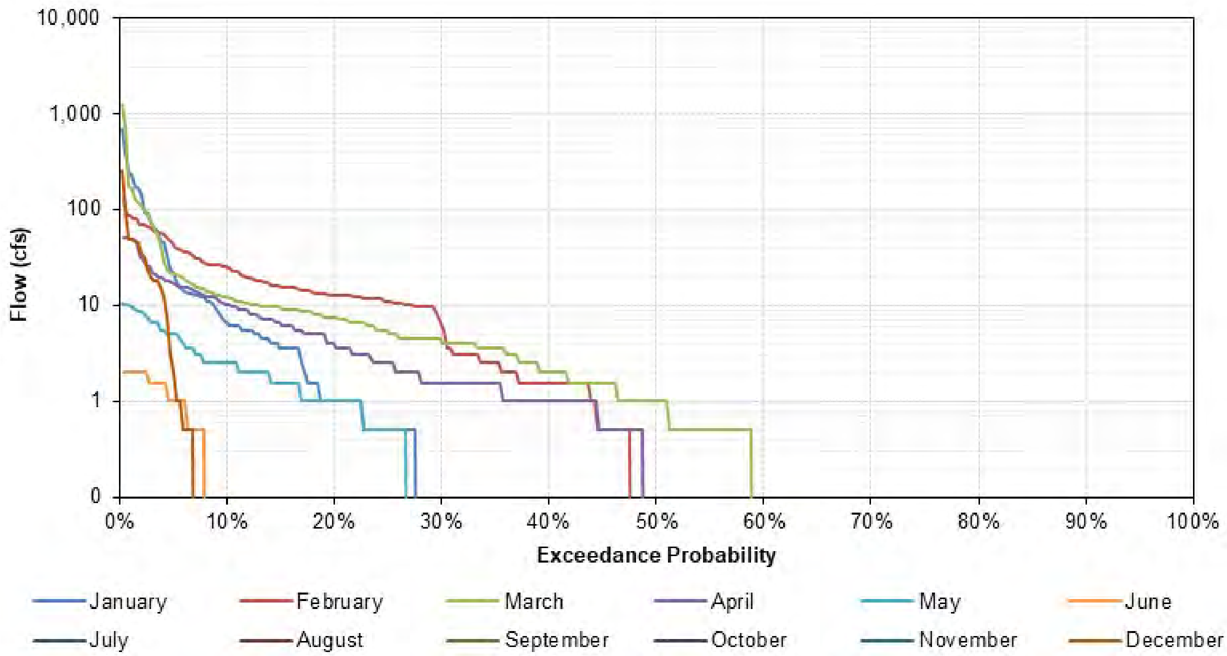
State Water Project Water Supply Contracts

As part of the SWP, the Project utilizes water that is conveyed through the West Branch of the SWP to serve various contractors in southern California who have long-term water supply contracts with DWR. Table 5.2-12 lists SWP contractors that are served by SWP water conveyed through the Project and their associated maximum annual contractual water delivery amounts.



Source: DWR 2017a
Key:
cfs = cubic feet per second

Figure 5.2-3. Monthly Flow Duration Curves for Natural Inflow to Elderberry Forebay for the Relicensing Period of Record



Source: DWR 2017a
Key:
cfs = cubic feet per second

Figure 5.2-4. Monthly Flow Duration Curves for Natural Outflow from Elderberry Forebay for the Relicensing Period of Record

Table 5.2-11. Potentially Affected Water Rights on Piru Creek and Castaic Creek

Local Water Right Users	Priority (date)	SWRCB Designation (application)	SWRCB Designation (permit)	SWRCB Designation (license)[1]	Source (waterbody)	Amount & Place of Diversion or Storage (amount and place)	Season (period)	Place of Beneficial Use	Purpose
California Department of Water Resources	5/3/1979	25988	18709	13897	Piru Creek	55,000 AF per year (maximum diversion 3,128 cfs) storage in Pyramid Lake, and storage in and rediversion to Castaic Lake (non-Project facility)	1/1-12/31	Within the service area of the SWP, as shown on Map 1878-3, Revised December 1964, including Ventura County	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement, and incidental power
	1/4/1983	26058	18710	-	Castaic Creek	85,000 AF per year storage in Castaic Lake (non-Project facility)	1/1-12/31	Within the service area of the SWP, as shown on Map 1878-3, Revised December 1964, including Ventura County	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement, and incidental power
United Water Conservation District	9/18/1947	12092A	11181	10173	Piru Creek	75,000 AF per year in Lake Piru (non-Project facility)	10/1-6/30	Santa Felicia Reservoir (non-Project facility)	Irrigation, domestic, municipal, industrial, recreational, and salinity control uses
						11,800 AF per year (maximum diversion 80 cfs) collected to underground storage via Piru Spreading Ground (non-Project facility)	1/1-12/31	Piru Spreading Ground (non-Project facility)	
	3/25/1982	27264	19373	13445	Piru Creek	80,361.5 AF per year (maximum diversion 111 cfs) at Santa Felicia Dam (Lake Piru, a non-Project facility)	1/1-12/31	Santa Felicia Dam Powerhouse (non-Project facility)	Power use

Source: SWRCB 2016
Note:
[1]License information provided where applicable. If no license information is provided, this indicates that the local water right user has a permit for that water right, not a license.
Key:
AF = acre-feet
cfs = cubic feet per second
SWP = State Water Project
SWRCB = State Water Resources Control Board

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Table 5.2-12. State Water Project Contractors Served by the West Branch of the State Water Project

SWP Contractor	Maximum Annual SWP Water Delivery Amount (AF)[2,3]
Antelope Valley-East Kern Water Agency	144,844[4]
Santa Clarita Valley Water Agency	95,200
Metropolitan Water District of Southern California[1]	1,911,500[1]
Ventura County Watershed Protection District	20,000
Total	**2,026,700**

Source: DWR 2017b
Notes:
[1]Metropolitan Water District of Southern California is served by both the East Branch and West Branch of the SWP. The value in the table represents the total contract amount for the Metropolitan Water District of Southern California (both East and West branches).
[2]As specified in each contractor's long-term water supply contract.
[3]Downstream of Elderberry Forebay Dam
[4]Antelope Valley-East Kern Water Agency is served by both the East Branch and West Branch of the SWP. The value in the table represents the total contract amount for Antelope Valley-East Kern Water Agency (both East and West branches).
Key:
AF = acre-feet
SWP = State Water Project

5.2.1.2 Water Quality

This section provides information regarding existing water quality conditions. Besides this general introductory information, this section includes three main sub-sections: (1) designated beneficial uses and water quality objectives (WQO) from the Los Angeles and Lahontan Regional Water Quality Control Boards' (RWQCB) Basin Plans; (2) existing water quality; and (3) National Pollutant Discharge Elimination System (NPDES) permits.

Designated Beneficial Uses and Water Quality Objectives

The SWRCB was created by the California State Legislature in 1967 when the State Water Quality Control Board and State Water Rights Board were consolidated into a single entity, with the mission of ensuring the highest reasonable quality for waters of California, while allocating those waters to achieve the optimum balance of beneficial uses. The mission of the nine RWQCBs is to develop and enforce WQOs and implementation plans that will best protect the beneficial uses of the State's waters for that region, recognizing local differences in climate, topography, geology, and hydrology. In addition, WQOs sometimes include constituent specific criteria outlined in the National Toxics Rule (NTR) and California Toxics Rule (CTR). Within the Project area, Quail Lake is located within the jurisdiction of the Lahontan RWQCB. Pyramid Lake, Piru Creek, and Elderberry Forebay are within the jurisdiction of the Los Angeles RWQCB.

Beneficial Uses

The Lahontan RWQCB Basin Plan does not list waterbody-specific Beneficial Uses for Quail Lake, but it does define Beneficial Uses for minor surface waters in the Neenach Hydrologic Area (Hydrologic Unit 626.40), which includes Quail Lake (Lahontan RWQCB 1995). Additionally, waters not specifically listed may be designated with the same Beneficial Uses as the streams, lakes, or reservoirs to which they are tributary (the tributary rule). The other waterbodies within the existing Project boundary are part of the Santa Clara River Watershed, the largest river system in southern California that remains in a relatively natural state, that are included under the Los Angeles RWQCB Basin Plan.

Table 5.2-13 presents Lahontan RWQCB Basin Plan (Lahontan RWQCB 2016) and Los Angeles RWQCB Basin Plan (Los Angeles RWQCB 2015) definitions of Beneficial Uses and summarizes the designated beneficial uses of Quail Lake, Pyramid Lake, and Pyramid reach. Beneficial uses designated by the Los Angeles RWQCB are also summarized for Elderberry Forebay – a functioning part of the Castaic Powerplant. Note that beneficial use descriptions are the same in both Basin Plans.

Water Quality Objectives

The Los Angeles RWQCB Basin Plan (Los Angeles RWQCB 2015) and the Lahontan RWQCB Basin Plan (Lahontan RWQCB 2016) present WQOs designed to protect established Beneficial Uses. Table H-1 in Appendix H presents narrative and numeric WQOs that apply to all surface waters in the areas covered by the Lahontan RWQCB Basin Plan and the Los Angeles RWQCB Basin Plan.

Table 5.2-13. Designated Beneficial Uses of Surface Waters Potentially Affected by the Project

Beneficial Use	Description	Surface Waters				
		Quail Lake[1]	Pyramid Lake	Pyramid Reach[2]	Pyramid Reach[3]	Elderberry Forebay[4]
Municipal and Domestic Supply	Uses of water for community, military, or individual water supply systems, including but not limited to, drinking water supply.	X	E	P	P	E
Agricultural Supply	Uses of waters for farming, horticulture, or ranching, including but not limited to, irrigation, stock watering, and support of vegetation for range grazing.	X	E	E	E	E
Industrial Service Supply	Uses of waters for industrial activities that do not depend primarily on water quality, including but not limited to, mining, cooling water supply, geothermal energy production, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.		E	E	E	E
Commercial and Sportfishing	Beneficial uses of waters used for commercial or recreational collection of fish or other organisms, including but not limited to, uses involving organisms intended for human consumption.	X				
Industrial Process Supply	Uses of water for industrial activities that depend primarily on water quality.		E	E	E	E
Ground Water Recharge	Uses of waters for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.	X	E	E	E	E
Hydropower Generation	Uses of water for hydropower generation.		E			E

Table 5.2-13. Designated Beneficial Uses of Surface Waters Potentially Affected by the Project (continued)

Beneficial Use	Description	Surface Waters				
		Quail Lake[1]	Pyramid Lake	Pyramid Reach[2]	Pyramid Reach[3]	Elderberry Forebay[4]
Water Contact Recreation	Uses of waters for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, waterskiing, skin and scuba diving, surfing, whitewater activities, fishing, or use of natural hot springs.	X	E	E	E	E[5]
Noncontact Water Recreation	Uses of waters for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.	X	E	E	E	E[5]
Warm Freshwater Habitat	Uses of water that support warm water ecosystems, including but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.	X	E	E	E	E
Cold Freshwater Habitat	Uses of water that support cold water ecosystems, including but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates.	X	E	E	E	

Table 5.2-13. Designated Beneficial Uses of Surface Waters Potentially Affected by the Project (continued)

Beneficial Use	Description	Surface Waters				
		Quail Lake[1]	Pyramid Lake	Pyramid Reach[2]	Pyramid Reach[3]	Elderberry Forebay[4]
Wildlife Habitat	Uses of waters that support terrestrial ecosystems, including but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.	X	E	E	E	E
Rare, Threatened, or Endangered Species	Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under State or federal law as rare, threatened, or endangered.		E	E[6]	E[6]	E
Freshwater Replenishment	Uses of waters for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).		P	E	E	E
Migration of Aquatic Organisms	Uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.			E		
Spawning, Reproduction, and/or Early Development	Uses of water that support high-quality aquatic habitats suitable for reproduction and early development of fish.			E	E	E

Table 5.2-13. Designated Beneficial Uses of Surface Waters Potentially Affected by the Project (continued)

Beneficial Use	Description	Surface Waters				
		Quail Lake[1]	Pyramid Lake	Pyramid Reach[2]	Pyramid Reach[3]	Elderberry Forebay[4]
Wetland Habitat	Uses of water that support wetland ecosystems, including but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.			E[7]	E[7]	

Sources: Lahontan RWQCB 2016; Los Angeles RWQCB 2015
Notes:
[1]Quail Lake beneficial uses are based on beneficial uses for minor surface waters of the Neenach Hydrologic Area (Hydrologic Unit 626.40). Additional beneficial uses as noted for Pyramid Lake may apply as per the tributary rule.
[2]Piru Creek from gaging station below Santa Felicia Dam to Agua Blanca Creek.
[3]Piru Creek from Agua Blanca Creek to Pyramid Lake
[4]Noted beneficial uses are Regional Water Quality Control Board designations only. Los Angeles Department of Water and Power considers Elderberry Forebay a functioning part of the Castaic Powerplant. The waterbody is not used for recreation, agricultural supply, municipal and domestic supply, groundwater recharge, or industrial service or process supply.
[5]Public access to Elderberry Forebay and its surrounding watershed is prohibited by the Los Angeles Department of Water and Power and the Los Angeles County Department of Public Works.
[6]Condor refuge
[7]Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory action would require a detailed analysis of the area.
Key:
E = Existing Beneficial Use
I = Intermittent Beneficial Use
P = Potential Beneficial Use
X = Designated Beneficial Use

National Toxics Rule and California Toxics Rule

In addition to State standards in the Basin Plans, federal water quality standards for certain toxic pollutants are contained in the NTR (40 CFR § 131.36) and CTR (40 CFR § 131.37). The U.S. Environmental Protection Agency (EPA) adopted the NTR on December 22, 1992, and later amended it on May 4, 1995, and on November 9, 1999. About 40 criteria in the NTR are applied in California. The NTR identified the chemical-specific, numeric criteria for priority toxic pollutants necessary to bring all states into compliance with the requirements of Section 303(c)(2)(B) of the CWA.

On March 2, 2000, the SWRCB adopted the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Implementation Policy, or SIP). The SIP establishes implementation provisions for priority pollutant criteria and objectives and provisions for chronic toxicity control. On May 18, 2000, the EPA adopted the CTR. The CTR identified new toxics criteria for California and incorporated the previously adopted NTR criteria that were applicable in the State. The EPA moved forward with this rule to protect human health and the environment, and to fill a gap in California water quality standards that was created in 1994 when a State court overturned the State's water quality control plans containing water quality criteria for priority toxic pollutants. The rule included: (1) ambient aquatic life criteria for 23 priority toxics; (2) ambient human health criteria for 57 priority toxics; and (3) a compliance schedule provision which authorizes the State to issue schedules of compliance for new or revised NPDES permit limits based on the federal criteria. The State must use this criteria together with the State's existing water quality standards when controlling pollution in inland waters and enclosed bays and estuaries. The numeric water quality criteria contained in the final rule are identical to EPA's recommended CWA Section 304(a) criteria for these pollutants published in December 1998 (see 63 FR 68353).

Waterbody-Specific Objectives

In addition to the general objectives, the Basin Plans establish waterbody-specific objectives for certain areas. All of Piru Creek from above Pyramid Lake to below Santa Felicia Dam above the gaging station has specific numeric WQOs for certain water quality constituents (Table 5.2-14).

Table 5.2-14. Numerical Water Quality Objectives for Piru Creek Above Gaging Station Below Santa Felicia Dam

Waterbody	Water Quality Objectives (mg/L)					
	TDS	Sulfate	Chloride	Boron[1]	Nitrogen[2]	SAR[3]
Piru Creek above gaging station below Santa Felicia Dam	800	400	60	1.0	5	5

Source: Los Angeles RWQCB 2015
Notes:
[1]Where naturally occurring boron results in concentrations higher than the stated objective, a site-specific objective may be determined on a case-by-case basis.
[2]Nitrate-nitrogen plus nitrite-nitrogen (NO3-N + NO2-N).
[3]Sodium adsorption ratio (SAR) predicts the degree to which irrigation water tends to enter into cation-exchange reactions in soil.
Key:
mg/L = milligrams per liter
SAR = sodium adsorption ratio: $Na^{+}/((Ca^{++} + Mg^{++})/2)1/2$
TDS = total dissolved solids

Total Maximum Daily Loads

The SWRCB and RWQCBs are responsible for implementing provisions and pollution-control requirements that the federal CWA specifies for surface waters of the United States within each region. CWA Section 303(d) requires states to identify “impaired” waterbodies (surface waterbodies that do not fully achieve their designated beneficial uses and/or are in noncompliance with WQOs). Following the identification of impaired waterbodies, the SWRCB and RWQCBs establish a priority list that identifies the pollutants that cause the impairments and then develops pollutant-loading limits called Total Maximum Daily Loads (TMDL) for each pollutant. The TMDL analysis seeks to establish quantifiable and measurable numeric targets. These targets must be in compliance with water quality standards (designated Beneficial Uses and waterbody-specific WQOs).

The SWRCB’s Final 2014/2016 California Integrated Report 303(d) list does not classify Elderberry Forebay or Quail Lake as impaired, but it continues to list Pyramid Lake as impaired for mercury in fish tissue. In Pyramid Lake, a total of 24 composite samples were collected from largemouth bass (*Micropterus salmoides*) and brown bullhead (*Ameiurus nebulosus*); 14 of the 24 samples exceeded the Office of Environmental Health Hazard Assessment (OEHHA) fish tissue screening value for human health (SWRCB 2018). The expected mercury TMDL completion date is 2021. The SWRCB is also in the process of developing a “Statewide Mercury Control Program for Reservoirs” for reservoirs listed as mercury impaired and it currently lists 131 reservoirs including Pyramid Lake and Elderberry Forebay. The 2014/2016 Integrated Report (SWRCB 2018) also lists for the first time chlordane, dichlorodiphenyltrichloroethane (DDT), dieldrin, and polychlorinated biphenyls (PCBs) each with TMDL completion targets of 2027. These listings are based on fish tissue data collected in 2007 by the SWRCB Surface Water Ambient Monitoring Program (SWAMP).

The 67 miles of Piru Creek, from the gaging station below Santa Felicia Dam to its headwaters above Pyramid Lake, continues to be listed as impaired for pH, chloride and toxicity in the latest CWA 303(d) list. Eight samples out of 12 taken from below Santa Felicia Dam from July 2001 to April 2004 exceeded the site-specific WQOs for chloride for the Piru Creek tributary to Santa Clara River, Reach 4 (60 milligrams per liter [mg/L] for the protection of Agricultural Supply beneficial uses). Four out of 24 samples exceeded the high end of the Los Angeles RWQCB Basin Plan standard of 8.5 pH units. The expected completion date for the pH and chloride TMDLs for Piru Creek is 2019 (SWRCB 2018). In addition, toxicity was added to the CWA 303(d) list in 2014 based on two of three samples taken in Piru Creek above Pyramid Lake that exhibited “significant toxicity”; one sample was collected on Piru Creek upstream of Mutau Creek adjacent to Forest Road 7N13 (403BA0027) on May 2008 and the other sample was collected upstream of Hardluck Campground (403S01163) on June 2009. The toxicity TMDL completion date for Piru Creek is anticipated in 2027 (SWRCB 2018).

Existing Water Quality

Project water quality monitoring has been conducted by the Licensees since 1968. The water quality program monitors eutrophication, salinity, and other parameters of concern for drinking water, recreation, and fish and wildlife purposes. Additional water quality data are collected by the Metropolitan Water District of Southern California (MWD). The frequency of monitoring, by parameter, is summarized in Tables 5.2-15 and 5.2-16. Additionally, the USGS studies surface-water quality in cooperation with local and state governments, and with other federal agencies. The USGS monitoring program consists of collection, analysis, data archiving, and dissemination of data and information on the quality of surface water resources. The locations of water quality stations for the various monitoring programs are shown in Figure 5.2-5. Results of water quality analyses are summarized below.

The Licensees are also required to monitor water quality under NPDES permits obtained for the application of herbicides to control aquatic weeds and algae; water quality and other physical and visual parameters are sampled and monitored pre-treatment, during the treatment, and post-treatment in Pyramid Lake and Elderberry Forebay. Annual monitoring reports for aquatic pesticide use are filed with the SWRCB consistent with the NPDES permit requirements. The Licensees monitor discharge water quality as required by separate NPDES permits for the operation of the Warne and Castaic powerplants at regular intervals. Quarterly monitoring reports are filed with the Los Angeles SWRCB consistent with the NPDES permit requirements. Additional discussion regarding NPDES permits and monitoring is provided below.

In order to supplement existing information and ongoing monitoring, the Licensees conducted the *Water Quality and Temperature Study*, which included monitoring in Quail Lake, Pyramid Lake, and Pyramid reach downstream of Pyramid Dam.

Table 5.2-15. Frequency of Existing Water Quality Monitoring

Parameter	Monitoring Frequency	
	Pyramid Lake (Station PY001000)	Castaic Lake (Station CA002000)
Project Standard Parameters (Alkalinity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chloride, Chromium, Copper, Fluoride, Iron, Lead, Magnesium, Manganese, Mercury, Nitrate, Selenium, Silver, Sodium, Dissolved Solids, Specific Conductance, Sulfate, Turbidity, and Zinc)	Quarterly	Quarterly
Nutrients	Monthly	Monthly
Total and Dissolved Organic Carbon	--	Monthly
Turbidity	Quarterly	Quarterly
Bromide	Monthly	Monthly
Reservoir Profile (pH, Dissolved Oxygen, Depth, Temperature, Electrical Conductivity)	Weekly (Bi-monthly in winter)	Weekly (Bi-monthly in winter)

Source: DWR 2015a
Key:
-- = not required

Table 5.2-16. Frequency of MWD Water Quality Monitoring – Castaic Lake (Non-Project Facility) at the Jensen Influent

Parameter	Monitoring Frequency
Aluminum, Copper	Monthly
Arsenic	Weekly
Bromide	Weekly
Dissolved Organic Carbon	Weekly
Taste and Odor	Weekly
Total Organic Carbon	Weekly
Ultraviolet	Weekly

Source: Pers. comm., Reynolds 2015

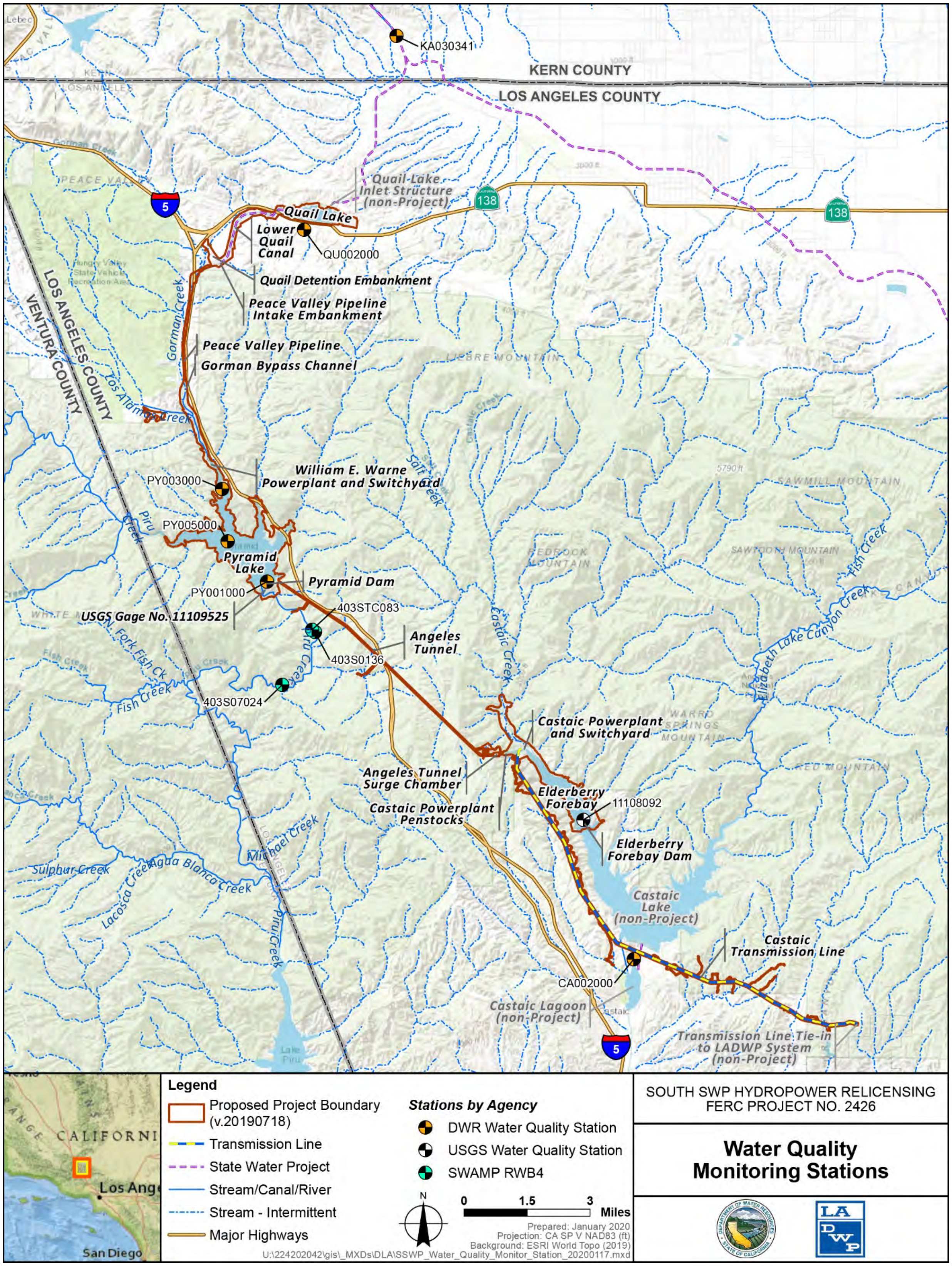


Figure 5.2-5. Existing Water Quality Monitoring Stations Near the Project

Quail Lake Water Quality

DWR collected surface water samples from the Quail Lake outlet (Station QU002000; see Figure 5.2-5) on February 10, 1999. During the same sampling event, DWR tested for 60 different organic compounds, none of which was higher than the laboratories' method reporting limit. While the Lahontan RWQCB Basin Plan (Lahontan RWQCB 1995) does not have site-specific WQOs for Quail Lake, observed water quality in 1999 was consistent with narrative WQOs for surface waters in the Lahontan Region (Table 5.2-17).

Table 5.2-17. Water Quality Data for Quail Lake (Station QU002000), February 1999

Parameter	Units	Laboratory Method Reporting Limit	Result
General Water Quality			
Dissolved Boron	mg/L	0.1	0.2
Dissolved Chloride	mg/L	1	31
Dissolved Nitrate + Nitrite	mg/L as N	0.01	3.9
Total Dissolved Solids	mg/L	1	466
Dissolved Sulfate	mg/L	5	95
pH, sample 1	standard units	0.1	7.8
pH, sample 2	standard units	0.1	7.8
Settleable Solids	mg/L	0.1	ND
Total Suspended Solids, sample 1	mg/L	1	23
Total Suspended Solids, sample 2	mg/L	1	22
Turbidity, sample 1	NTU	1	32
Turbidity, sample 2	NTU	1	33
Total and Dissolved Metals			
Total Aluminum	mg/L	0.01	ND
Total Arsenic	mg/L	0.001	ND
Dissolved Arsenic	mg/L	0.001	0.002
Total Barium	mg/L	0.05	ND
Total Cadmium	mg/L	0.001	ND
Dissolved Cadmium	mg/L	0.001	ND
Total Chromium	mg/L	0.005	ND
Dissolved Chromium	mg/L	0.005	ND
Total Copper	mg/L	0.001	ND
Dissolved Copper	mg/L	0.001	0.002
Total Iron	mg/L	0.005	ND

Table 5.2-17. Water Quality Data for Quail Lake (Station QU002000), February 1999 (continued)

Parameter	Units	Laboratory Method Reporting Limit	Result
Total Lead	mg/L	0.001	ND
Dissolved Lead	mg/L	0.001	ND
Total Manganese	mg/L	0.005	ND
Total Mercury	mg/L	0.0002	ND
Dissolved Mercury	mg/L	0.0002	ND
Total Selenium	mg/L	0.001	ND
Dissolved Selenium	mg/L	0.001	0.001
Total Silver	mg/L	0.001	ND
Dissolved Silver	mg/L	0.001	ND
Total Zinc	mg/L	0.005	ND
Dissolved Zinc	mg/L	0.005	0.011

Source: DWR 1973 through 2018, Station QU002000
Key:
mg/L = milligrams per liter
N = nitrogen
ND = non-detect
NTU = Nephelometric Turbidity Unit

As part of the Licensees' *Water Quality and Temperature Study*, water quality samples were collected at two locations in Quail Lake: (1) near the center of the lake, and (2) near the outlet. Additionally, water quality samples were collected at two depths for each location: (1) near the surface, and (2) approximately 3 feet from the bottom (refer to Table 5.2-18). Similar to the 1999 results, data collected in 2017 was consistent with WQOs for surface waters in the Lahontan RWQCB Basin Plan.

Table 5.2-18. Water Quality Data for Quail Lake, September 2017

Analyte	Sample Location	Quail Lake Near Center; Near Surface	Quail Lake Near Center; Near Bottom	Quail Lake Near Outlet; Near Surface	Quail Lake Near Outlet; Near Bottom	Lahontan Basin Water Quality Objectives
	Sample Depth (feet)	3	~25	3	~25	--
	Units		Result			
***In Situ* Measurements**						
Temperature	°C	20.33	20.12	20.21	20.05	--
Specific Conductance	µS/cm	218	214	214	214	900
pH	standard units	8.1	7.8	7.9	7.8	6.5 - 8.5
Dissolved Oxygen	mg/L	8.17	8.11	7.87	7.81	--
Turbidity	NTU	6.7	8	4.1	16.3	--
Total Concentrations						
Alkalinity (as $CaCO_3$)	mg/L	49	49	49	49	--
Aluminum	mg/L	0.04	0.06	0.04	0.04	1.0[1]
Antimony	mg/L	ND	ND	ND	ND	0.006[1]
Arsenic	mg/L	ND	ND	ND	ND	0.01[1]
Barium	mg/L	0.023	0.023	0.023	0.023	1[1]
Beryllium	mg/L	ND	ND	ND	ND	0.004[1]
Cadmium	mg/L	ND	ND	ND	ND	0.005[1]
Chromium	mg/L	ND	ND	ND	ND	0.05[1]
Copper	mg/L	ND	ND	ND	ND	1
Dissolved Solids	mg/L	124	124	123	123	500
Iron	mg/L	0.1	0.1	0.1	0.1	0.3
Kjeldahl Nitrogen	mg/L	0.3	ND	0.3	0.3	--

Table 5.2-18. Water Quality Data for Quail Lake, September 2017 (continued)

Analyte	Sample Location	Quail Lake Near Center; Near Surface	Quail Lake Near Center; Near Bottom	Quail Lake Near Outlet; Near Surface	Quail Lake Near Outlet; Near Bottom	Lahontan Basin Water Quality Objectives
	Sample Depth (feet)	3	~25	3	~25	--
	Units		Result			
Lead	mg/L	ND	ND	ND	ND	0.015
Manganese	mg/L	0.01	0.02	0.01	0.02	0.05
Nickel	mg/L	ND	ND	ND	ND	0.1[1]
Organic Carbon	mg/L	2.9	2.9	3	2.9	--
Phosphorus	mg/L	0.11	0.14	0.1	0.1	--
Selenium	mg/L	ND	ND	ND	ND	0.05[1]
Silver	mg/L	ND	ND	ND	ND	0.1
Suspended Solids	mg/L	4	5	3	3	--
Zinc	mg/L	ND	ND	ND	ND	5
Mercury, Total	ng/L	0.82	0.92	0.78	0.94	2,000[1]
Methyl Mercury	ng/L	0.054	0.041	0.049	0.046	--
Dissolved Concentrations						
Aluminum	mg/L	ND	0.01	ND	0.01	--
Ammonia (as N)	mg/L	0.04	0.04	0.04	0.04	0.18[2]
Antimony	mg/L	ND	ND	ND	ND	--
Arsenic	mg/L	ND	ND	ND	ND	--
Barium	mg/L	0.021	0.021	0.021	0.021	--
Beryllium	mg/L	ND	ND	ND	ND	--
Cadmium	mg/L	ND	ND	ND	ND	--

Table 5.2-18. Water Quality Data for Quail Lake, September 2017 (continued)

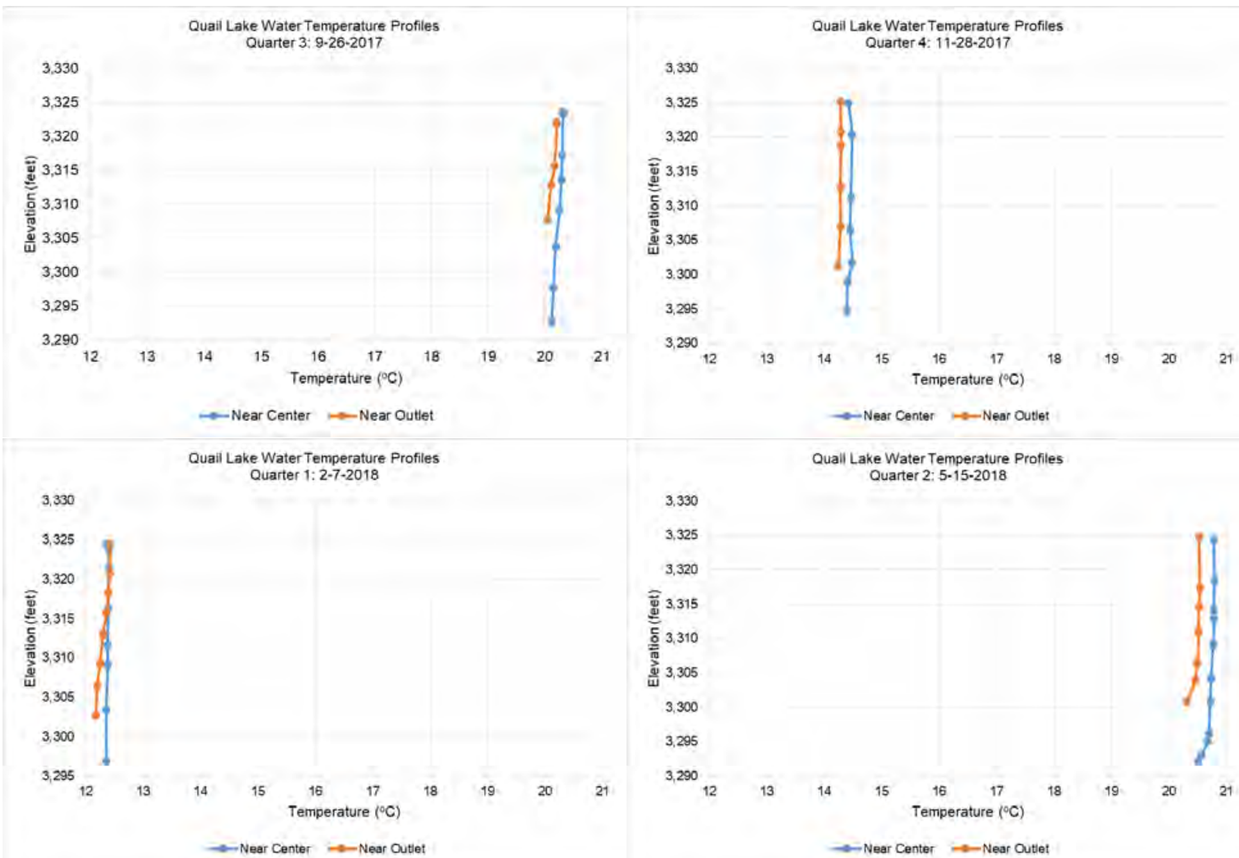
Analyte	Sample Location	Quail Lake Near Center; Near Surface	Quail Lake Near Center; Near Bottom	Quail Lake Near Outlet; Near Surface	Quail Lake Near Outlet; Near Bottom	Lahontan Basin Water Quality Objectives
	Sample Depth (feet)	3	~25	3	~25	--
	Units		Result			
Calcium	mg/L	11	11	11	11	--
Chloride	mg/L	27	27	27	26	250
Chromium	mg/L	ND	ND	ND	ND	--
Copper	mg/L	ND	ND	ND	ND	--
Hardness	mg/L	54	55	54	55	--
Iron	mg/L	ND	ND	ND	ND	--
Lead	mg/L	ND	ND	ND	ND	--
Magnesium	mg/L	7	7	7	7	--
Manganese	mg/L	ND	ND	ND	ND	--
Nickel	mg/L	ND	ND	ND	ND	--
Nitrate + Nitrite	mg/L	0.21	0.2	0.21	0.19	10[1]
Organic Carbon	mg/L	2.8	2.8	2.8	2.8	--
Ortho-phosphate	mg/L	0.1	0.1	0.1	0.09	--
Potassium	mg/L	1.9	1.7	1.8	1.8	--
Selenium	mg/L	ND	ND	ND	ND	--
Silver	mg/L	ND	ND	ND	ND	--
Sodium	mg/L	21	21	21	21	--
Sulfate	mg/L	14	14	14	14	250
Zinc	mg/L	ND	ND	ND	ND	--

Table 5.2-18. Water Quality Data for Quail Lake, September 2017 (continued)

Analyte	Sample Location	Quail Lake Near Center; Near Surface	Quail Lake Near Center; Near Bottom	Quail Lake Near Outlet; Near Surface	Quail Lake Near Outlet; Near Bottom	Lahontan Basin Water Quality Objectives
	Sample Depth (feet)	3	~25	3	~25	--
	Units		Result			
Pesticides						
Diazinon	µg/L	ND	ND	ND	ND	--
Chlorpyrifos	µg/L	ND	ND	ND	ND	--

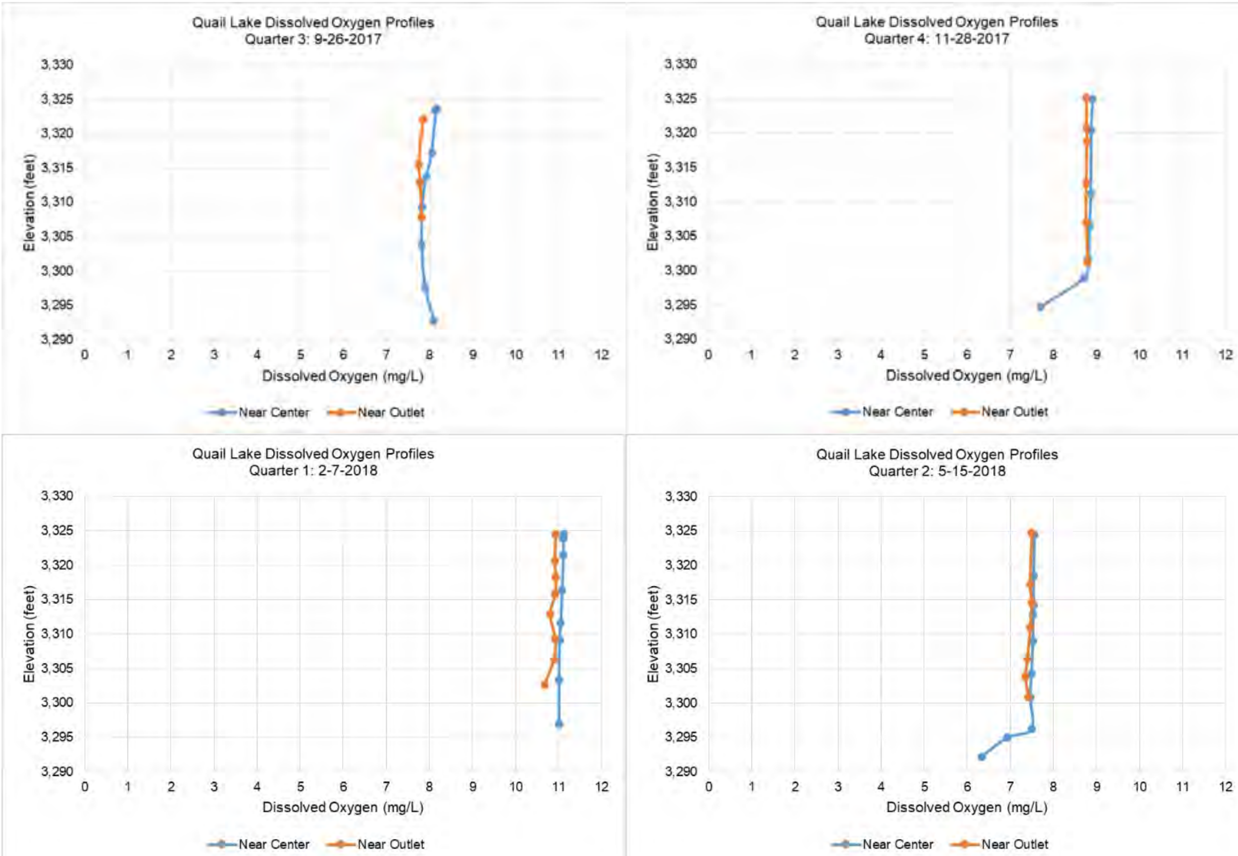
Source: Lahontan RWQCB 2016
[1]*WQOs listed from Lahontan RWQCB 2016 retrieved from the California Code of Regulations for water designated for Domestic or Municipal Supply*
[2]*Ammonia Water Quality Objective based on Table 3-1 to 3-4 of the Lahontan RWQCB.*
Key:
°C = degrees Celsius
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter
N = nitrogen
ND = non-detect
ng/L = nanograms per liter
NTU = Nephelometric Turbidity Unit

The Licensees also collected quarterly reservoir profiles that included depth, water temperature, dissolved oxygen, pH, specific conductivity, and turbidity. Given the way water is moved through Quail Lake as part of the SWP and its shallow depth (less than 30 feet deep at NMWSE), no thermocline or other patterns typical of deeper lakes and reservoirs were present. Water temperature and dissolved oxygen profiles are shown in Figures 5.2-6 and 5.2-7, respectively. Specific conductivity ranged between 214 microsiemens per centimeter (µS/cm) and 547 µS/cm over all depths and sample events. The pH ranged between 7.69 units and 8.52 units over all sample locations, depths and sample events. Quail Lake was at or near its NMWSE at the time of the data collection.



Key:
°C = degrees Celsius

Figure 5.2-6. Quarterly Water Temperature Profiles for Two Locations in Quail Lake, 2017 through 2018



Key:
mg/L = milligrams per liter

Figure 5.2-7. Quarterly Dissolved Oxygen Profiles for Two Locations in Quail Lake, 2017 through 2018

Pyramid Lake Water Quality

The Licensees have collected water quality data on a regular basis in Pyramid Lake since 1972 as part of various programs. Water quality monitoring was required under Article 53 of the existing license to evaluate pre- and post-Project aquatic and water resources conditions in Piru Creek above and below Pyramid Lake and to determine the suitability of Pyramid Lake to support the designated beneficial uses in the Los Angeles RWQCB Basin Plan. The evaluation concluded that in post-Project, Piru Creek remained capable of supporting aquatic life similar to pre-Project conditions, and that the water quality in Pyramid Lake was consistent with the designated beneficial uses. The Article 53 requirement was considered complete upon filing of a 1996 report (DWR 1996). This Application for New License provides discussion primarily on data available since 2010, with some reference to pertinent earlier data where beneficial.

The Los Angeles RWQCB Basin Plan identifies six specific WQOs for the stream segment of Piru Creek upstream of the gaging station below Santa Felicia Dam, which includes Pyramid Lake and Piru Creek above Pyramid Lake: total dissolved solids (TDS), sulfate, chloride, boron, nitrogen, and sodium adsorption ratio. Evaluating the data collected at Station PY001000 (located at Pyramid Lake), only dissolved chloride was not consistent with the Los Angeles RWQCB Basin Plan Objective of 60 mg/L. The average dissolved chloride concentration was 64 mg/L with a maximum recorded concentration of 95 mg/L (Table 5.2-19). The Project does not introduce chloride into Pyramid Lake and, in fact, chloride levels at the Project are influenced by concentrations in the San Francisco-San Joaquin Bay-Delta, where SWP water originates. During certain periods, chloride concentrations were inconsistent with the Los Angeles RWQCB WQO for samples in the Bay-Delta and throughout the SWP, including the stations sampled immediately upstream of Pyramid Lake. For example, between July 2016 and December 2018, 30 of the 60 samples measured at the Warne Powerplant influent monitoring station were inconsistent with the Los Angeles RWQCB WQO for chloride, with a maximum concentration of 130 mg/L. During this same period, discharges from the Warne Powerplant were inconsistent with the WQO for 31 out of 60 samples with a maximum concentration of 130 mg/L (DWR 2019a). Recreational boating could result in oil and grease issues, but the Licensees are unaware of any reports that oil and grease have affected designated beneficial uses or resulted in a nuisance. Out of the 35 samples tested for mercury, a single sample collected on May 14, 2018, was inconsistent with the RWQCB WQO (0.003 mg/L for dissolved mercury) and, in general, mercury concentrations were below the laboratories' method reporting limit.

Table 5.2-19. Water Quality Data for Pyramid Lake – January 2010 through September 2018

Parameter[1]	Units	Laboratory Method Reporting Limit	2010 through 2018 Minimum	2010 through 2018 Maximum	2010 through 2018 Average[2]	Number of Samples	Los Angeles Basin Water Quality Objectives
General Water Quality							
Total Alkalinity	mg/L as $CaCO_3$	1	38	90	71	43	--
Dissolved Bromide	mg/L as $CaCO_3$	0.01	0.04	0.42	0.21	104	--
Dissolved Calcium	mg/L	1	10	33	22	43	--
Dissolved Chloride	mg/L	0.1	20	95	64	35	60
Dissolved Fluoride[2]	mg/L	0.1	ND	0.2	ND	14	2.0[3]
Dissolved Hardness	mg/L as $CaCO_3$	1	45	134	100	34	--
Dissolved Magnesium	mg/L	1	5	16	10	35	--

Table 5.2-19. Water Quality Data for Pyramid Lake – January 2010 through September 2018 (continued)

Parameter[1]	Units	Laboratory Method Reporting Limit	2010 through 2018 Minimum	2010 through 2018 Maximum	2010 through 2018 Average[2]	Number of Samples	Los Angeles Basin Water Quality Objectives
Dissolved Sodium	mg/L	1	16	78	52	35	--
Total Dissolved Solids	mg/L	1	145	372	259	35	800
Suspended Solids[3]	mg/L	0.1	1.1	3.5	2.3	7	--
Turbidity	NTU	1	ND	10	3	32	--
Dissolved Sulfate	mg/L	1	14	77	46	35	400
Dissolved Ammonia	mg/L as N	0.01	ND	0.08	0.03	104	--
Dissolved Nitrate	mg/L	0.1	ND	4.9	2.3	35	45.0[3]
Dissolved Nitrate + Nitrite	mg/L as N	0.01	ND	1.08	0.43	104	5
Total Kjeldahl Nitrogen	mg/L as N	0.1	ND	1.20	0.39	104	--
Dissolved Ortho-phosphate	mg/L as P	0.01	ND	1.08	0.47	104	--
Total Phosphorus	mg/L as P	0.01	ND	0.16	0.05	104	--
Total and Dissolved Metals							
Dissolved Aluminum	mg/L	0.01	ND	0.018	0.014	35	1.0[3]
Dissolved Arsenic	mg/L	0.001	0.001	0.007	0.003	35	0.10[3]
Dissolved Beryllium	mg/L	0.001	ND	ND	ND	35	0.004[3]
Dissolved Boron	mg/L	0.1	0.1	0.3	0.20	35	--
Dissolved Cadmium	mg/L	0.001	ND	ND	ND	35	0.005[3]

Table 5.2-19. Water Quality Data for Pyramid Lake – January 2010 through September 2018 (continued)

Parameter[1]	Units	Laboratory Method Reporting Limit	2010 through 2018 Minimum	2010 through 2018 Maximum	2010 through 2018 Average[2]	Number of Samples	Los Angeles Basin Water Quality Objectives
Dissolved Chromium	mg/L	0.001	ND	ND	ND	35	0.05[3]
Chromium, hexavalent (Cr6+)	mg/L	0.01	ND	ND	ND	16	--
Dissolved Copper	mg/L	0.001	0.001	0.003	0.002	35	--
Dissolved Iron	mg/L	0.005	ND	0.039	0.014	35	--
Dissolved Lead	mg/L	0.001	ND	0.004	0.002	35	--
Dissolved Manganese	mg/L	0.005	ND	ND	ND	35	--
Dissolved Mercury	mg/L	0.0002	ND	0.003	ND	35	0.002[3]
Dissolved Nickel	mg/L	0.001	ND	0.002	0.001	35	--
Dissolved Selenium	mg/L	0.001	ND	0.002	0.001	35	0.05[3]
Dissolved Silver	mg/L	0.001	ND	ND	ND	35	--
Dissolved Zinc	mg/L	0.005	ND	ND	ND	35	--

Source: DWR 2010 through 2018, Station PY001000; Los Angeles RWQCB *2015*
Notes:
[1]*Data from surface samples, 1 meter depth*
[2]*Half of reporting limit used for averaging where applicable.*
[3]*WQOs listed from Los Angeles RWQCB 2015 retrieved from the California Code of Regulations for water designated for Domestic or Municipal Supply.*
Key:
$CaCO_3$ = calcium carbonate
mg/L = milligrams per liter
N = nitrogen
ND = non-detect
NTU = Nephelometric Turbidity Unit
P = phosphorus

The Licensees collected samples for organic chemicals, including carbamate pesticides, chlorinated organic pesticides, chlorinated phenoxy herbicides, sulfur pesticides, glyphosate, phosphorus/nitrogen pesticides, and purgeable (volatile organics) in 1997 and 1998 at Station PY001000 (Figure 5.2-5). Of the 64 compounds tested, results for five parameters were above the laboratory's method reporting limit (DWR 1973 through 2018; Water Data Library, Station PY001000):

- 1,2,4-Trimethylbenzene – Used in United States commerce in the manufacture of trimellitic anhydride, dyes, and pharmaceuticals and as a solvent and paint thinner. The maximum observed concentration was 0.58 micrograms per liter (µg/L).

- Toluene – Occurs naturally as a component of crude oil and is produced in petroleum refining and coke oven operations; toluene is a major aromatic constituent of gasoline. The maximum observed concentration (1.4 µg/L) is below the Criterion Concentration for taste and odor of 42 µg/L (FR, Vol. 54, No. 97, pp. 22138, 22139).

- Methyl tert-butyl ether (MTBE) – Used as a gasoline additive, designed to improve air quality. California has prohibited the use of MTBE in gasoline since January 1, 2004. In 1997, measured MTBE concentrations in Pyramid Lake ranged up to 27 µg/L. The most recent samples in Pyramid Lake (September and October 1998) were below the reporting limit (1 µg/L) for MTBE.

- m-Xylene and o-Xylene – Used in the chemical industry as solvents for products, including paints, inks, dyes, adhesives, pharmaceuticals, and detergents. Used in the petroleum industry as antiknock agents in gasoline. The maximum observed concentration of m-xylene was 1.3 µg/L in 1997. The maximum observed concentration of o-xylene was 0.85 µg/L in 1997.

As part of the Licensees' *Water Quality and Temperature Study*, water quality samples were collected at three locations in Pyramid Lake: (1) near the dam, (2) in the Piru Creek arm, and (3) in the Warne Powerplant arm. Samples were collected at two depths for each location: (1) near the surface, and (2) in the epilimnion (e.g., below the thermocline) (Table 5.2-20). Similar to the historical results, samples collected in 2017 were consistent with narrative WQOs for surface waters in the Los Angeles RWQCB Basin Plan. These samples were also consistent with the water body specific Basin Plan Objectives described in Table 5.2-14.

Table 5.2-20. Water Quality Data for Pyramid Lake, September 2017

Analyte	Sample Location	Near Dam		Piru Creek Arm		Warne Powerplant Arm		Los Angeles Basis Water Quality Objectives
	Sample Depth (feet)	3	200	3	170	3	130	
	Units	Result						
***In Situ* Measurements**								
Temperature	°C	22.98	21.98	23.34	22.68	23.25	22.12	--
Specific Conductance	µS/cm	194	220	196	206	194	203	--
pH	standard units	7.66	7.2	7.39	7.1	7.4	7.32	6.5-8.5
Dissolved Oxygen	mg/L	5.93	3.23	5.4	3.81	6.96	6.81	--
Turbidity	NTU	3.6	7.4	1.8	11.9	1.1	5	--
Total Concentrations								
Alkalinity, Total (as $CaCO_3$)	mg/L	42	48	42	44	42	44	--
Aluminum	mg/L	0.013	0.017	0.013	0.021	0.011	0.016	1.0[1]
Antimony	mg/L	ND	ND	ND	ND	ND	ND	0.006[1]
Arsenic	mg/L	ND	ND	ND	ND	ND	ND	0.01[1]
Barium	mg/L	0.019	0.02	0.02	0.02	0.019	0.019	1.0[1]
Beryllium	mg/L	ND	ND	ND	ND	ND	ND	0.004[1]
Cadmium	mg/L	ND	ND	ND	ND	ND	ND	0.005[1]
Chromium	mg/L	ND	ND	ND	ND	ND	ND	0.05[1]
Copper	mg/L	ND	ND	ND	ND	ND	ND	1
Dissolved Solids	mg/L	115	146	113	116	115	116	800
Iron	mg/L	0.017	0.024	0.013	0.027	0.011	0.021	--

Table 5.2-20. Water Quality Data for Pyramid Lake, September 2017 (continued)

Analyte	Sample Location	Near Dam		Piru Creek Arm		Warne Powerplant Arm		Los Angeles Basis Water Quality Objectives
	Sample Depth (feet)	3	200	3	170	3	130	
	Units	Result						
Kjeldahl Nitrogen	mg/L	0.1	0.2	0.2	0.2	0.3	0.1	--
Lead	mg/L	ND	ND	ND	ND	ND	ND	0.015
Manganese	mg/L	ND	0.028	ND	0.012	ND	ND	--
Nickel	mg/L	ND	ND	ND	ND	ND	ND	0.1[1]
Organic Carbon	mg/L	2.8	3	2.7	2.8	3	2.8	--
Phosphorus	mg/L	0.09	0.14	0.09	0.1	0.09	0.09	--
Selenium	mg/L	ND	ND	ND	ND	ND	ND	0.05[1]
Silver	mg/L	ND	ND	ND	ND	ND	ND	--
Suspended Solids	mg/L	ND	1	4	1	2	ND	--
Zinc	mg/L	ND	ND	ND	ND	ND	0.007	--
Mercury, Total	ng/L	0.56	1	ND	0.78	ND	0.54	2,000[1]
Methyl Mercury	ng/L	0.031	0.068	0.076	0.022	0.038	0.053	--
Dissolved Concentrations								
Aluminum	mg/L	ND	ND	ND	ND	ND	ND	--
Ammonia (as N)	mg/L	ND	ND	ND	ND	ND	ND	--
Antimony	mg/L	ND	ND	ND	ND	ND	ND	--
Arsenic	mg/L	ND	ND	ND	ND	ND	ND	--
Barium	mg/L	0.018	0.018	0.019	0.018	0.018	0.018	--

Table 5.2-20. Water Quality Data for Pyramid Lake, September 2017 (continued)

Analyte	Sample Location	Near Dam		Piru Creek Arm		Warne Powerplant Arm		Los Angeles Basis Water Quality Objectives
	Sample Depth (feet)	3	200	3	170	3	130	
	Units	Result						
Beryllium	mg/L	ND	ND	ND	ND	ND	ND	--
Cadmium	mg/L	ND	ND	ND	ND	ND	ND	--
Calcium	mg/L	11	14	11	12	11	11	--
Chloride	mg/L	23	27	23	24	23	24	60
Chromium	mg/L	ND	ND	ND	ND	ND	ND	--
Copper	mg/L	ND	ND	ND	ND	ND	ND	--
Hardness	mg/L	51	62	51	53	50	51	--
Iron	mg/L	ND	ND	ND	ND	ND	ND	--
Lead	mg/L	ND	ND	ND	ND	ND	ND	--
Magnesium	mg/L	5	6	5	6	5	6	--
Manganese	mg/L	ND	ND	ND	ND	ND	ND	--
Nickel	mg/L	ND	ND	ND	ND	ND	ND	--
Nitrate + Nitrite	mg/L	0.19	0.43	0.51	0.24	0.18	0.18	5
Organic Carbon	mg/L	2.6	3	2.7	2.7	2.7	2.8	--
Ortho-phosphate	mg/L	0.07	0.12	0.07	0.1	0.07	0.07	--
Potassium	mg/L	1.7	2.1	1.8	1.8	1.8	1.7	--
Selenium	mg/L	ND	ND	ND	ND	ND	ND	--
Silver	mg/L	ND	ND	ND	ND	ND	ND	--

Table 5.2-20. Water Quality Data for Pyramid Lake, September 2017 (continued)

Analyte	Sample Location	Near Dam		Piru Creek Arm		Warne Powerplant Arm		Los Angeles Basis Water Quality Objectives
	Sample Depth (feet)	3	200	3	170	3	130	
	Units	Result						
Sodium	mg/L	18	22	18	19	18	19	--
Sulfate	mg/L	15	22	15	16	15	15	400
Zinc	mg/L	ND	ND	ND	ND	ND	ND	--
Methyl Mercury	ng/L	≤ 0.020	0.059	0.034	0.029	≤ 0.020	0.036	--
Pesticides								
Diazinon	µg/L	ND	ND	ND	ND	ND	ND	--
Chlorpyrifos	µg/L	ND	ND	ND	ND	ND	ND	--

Source: Relicensing Study; Los Angeles RWQCB 2015
[1]WQOs listed from Los Angeles RWQCB 2015 retrieved from the California Code of Regulations for water designated for Domestic or Municipal Supply
Key:
°C = degrees Celsius
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter
N = nitrogen
ND = non-detect
ng/L = nanograms per liter
NTU = Nephelometric Turbidity Unit

Field Measurements

Field meters are used to collect monthly data for conductivity, dissolved oxygen, temperature, and pH at the surface (10 feet deep) of Pyramid Lake at stations PY001000, PY003000, and PY00500 (Table 5.2-21 and Figure 5.2-5). During October and November, average dissolved oxygen in surface samples were inconsistent with the Los Angeles RWQCB Basin Plan objective of 6.0 mg/L for water bodies designated with a Cold Freshwater Habitat beneficial use. Peak dissolved oxygen levels in surface waters were observed in February; the lowest levels were observed in October. The average pH of 8.5 is at the high end of the Los Angeles RWQCB Basin Plan recommended pH range for all waters (pH 6.5 to 8.5). Average pH surface readings exceeded 8.5 from June through September. Concentrations of alkaline compounds, such as bicarbonates, carbonates, and hydroxides, influence the acidity and, therefore, the pH of surface waters. Geology and soils, plant activity, and wastewater discharges can influence alkalinity.

In addition to surface samples, field parameters (i.e., temperature, conductivity, dissolved oxygen, and pH) are also measured by the Licensees throughout the water column one to four times per month at three Pyramid Lake stations: (1) near Pyramid Dam (PY001000), (2) at the approximate reservoir mid-point (PY005000), and (3) up the Warne Powerplant arm (PY003000) (Figure 5.2-5). A summary table of water quality readings from the hypolimnion (e.g., near the bottom and below the thermocline) are provided in Table 5.2-22.

Table 5.2-21. Surface Water Quality Data for Pyramid Lake – Field Parameters, January 2015 through March 2019

Month	Sample Size	Monthly Values Near Surface (0 to 10 feet deep)											
		Temperature (°C)			Conductivity (µS/cm)			Dissolved Oxygen (mg/L)			pH (standard units)		
		Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
January	66	11.3	12.0	13.0	248.0	461.8	635.0	7.9	8.5	9.3	7.7	8.1	8.7
February	78	10.0	11.7	14.2	283.0	478.9	630.0	7.7	9.4	12.1	7.6	8.2	8.9
March	99	10.3	13.3	16.6	271.0	486.7	630.0	8.6	9.3	10.1	7.6	8.3	8.9
April	140	13.5	16.5	19.2	246.0	455.3	586.0	7.7	8.7	9.7	7.6	8.4	9.1
May	138	16.8	19.3	21.9	161.0	443.4	622.0	7.5	8.4	9.3	8.1	8.5	9.3
June	144	20.9	22.9	25.9	191.0	437.9	629.0	7.4	9.2	13.4	7.9	8.9	10.0
July	144	23.3	25.0	26.7	150.0	427.9	611.0	7.2	9.2	11.9	8.7	9.2	9.7
August	102	23.8	24.9	25.8	168.0	449.3	614.0	6.8	8.6	11.6	8.6	9.2	9.9
September	141	22.3	23.8	26.0	185.0	456.6	622.0	4.4	6.7	10.5	7.7	8.8	9.5
October	141	19.4	21.3	23.2	196.0	423.9	622.0	3.7	5.3	7.8	7.4	8.1	8.8
November	54	16.4	18.6	20.8	442.0	540.5	619.0	4.6	6.0	6.8	7.8	8.2	8.4
December	45	12.5	14.4	16.0	445.0	533.2	625.0	7.2	7.9	9.0	7.9	8.1	8.5
Average	**107.7**	**16.7**	**18.6**	**20.8**	**248.8**	**466.3**	**620.4**	**6.7**	**8.1**	**10.1**	**7.9**	**8.5**	**9.1**
Minimum	**45**	**10.0**	**11.7**	**13.0**	**161.0**	**423.9**	**586.0**	**3.7**	**5.3**	**6.8**	**7.4**	**8.1**	**8.4**
Maximum	**144**	**23.8**	**25.0**	**26.7**	**445.0**	**540.5**	**635.0**	**8.6**	**9.4**	**13.4**	**8.6**	**9.2**	**10.0**

Source: DWR 2015 through 2019, Stations PY001000, PY003000, PY005000
Note: Data from surface samples
Key:
ºC = degrees Celsius
µS/cm = microsiemens per centimeter
Avg = average
Max = maximum
mg/L = milligrams per liter
Min = minimum

Table 5.2-22. Hypolimnion Water Quality Data for Pyramid Lake – Field Parameters, January 2015 through March 2019

Month	Sample Size	Monthly Values at ~230-Foot Depth											
		Temperature (°C)			Conductivity (µS/cm)			Dissolved Oxygen (mg/L)			pH (standard units)		
		Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
January	15.0	11.2	11.9	12.6	264.0	508.5	626.0	7.8	8.4	8.8	7.5	7.8	8.1
February	21.0	9.7	11.2	12.4	331.0	509.9	627.0	7.4	8.5	9.1	7.4	7.9	8.5
March	27.0	9.8	11.3	12.5	349.0	540.4	631.0	6.8	7.9	9.0	7.4	7.7	8.0
April	33.0	10.5	11.5	12.7	361.0	499.8	635.0	6.2	7.4	8.2	6.9	7.7	8.0
May	26.0	10.8	12.6	15.8	370.0	488.5	621.0	4.8	6.5	7.5	7.6	7.9	8.1
June	34.0	11.9	14.4	17.7	385.0	484.6	579.0	3.1	5.6	6.9	7.5	7.8	8.2
July	31.0	13.3	15.9	19.6	378.0	474.7	587.0	0.0	4.0	6.1	7.1	7.8	8.1
August	26.0	14.3	17.9	21.3	267.0	503.8	608.0	0.0	2.3	4.9	7.1	7.9	8.4
September	33.0	16.4	19.3	22.8	240.0	494.7	613.0	0.0	1.1	3.6	7.3	7.7	8.2
October	33.0	17.1	20.0	22.4	215.0	413.9	634.0	0.0	3.6	6.7	7.0	7.7	8.3
November	9.0	16.4	18.5	20.8	446.0	527.7	617.0	4.6	5.9	6.5	8.0	8.1	8.3
December	10.0	12.3	14.1	15.9	446.0	550.9	626.0	7.2	7.7	8.2	6.9	7.7	8.5
Average	**24.8**	**12.8**	**14.9**	**17.2**	**337.7**	**499.8**	**617.0**	**4.0**	**5.7**	**7.1**	**7.3**	**7.8**	**8.2**
Minimum	**9.0**	**9.7**	**11.2**	**12.4**	**215.0**	**413.9**	**579.0**	**0.0**	**1.1**	**3.6**	**6.9**	**7.7**	**8.0**
Maximum	**34.0**	**17.1**	**19.3**	**22.8**	**446.0**	**550.9**	**634.0**	**7.8**	**8.5**	**9.1**	**8.0**	**8.1**	**8.5**

Source: DWR 2015 through 2019, Station PY001000, PY003000, PY005000
Note: Data from samples below approximately 230 feet deep
Key:
~ = approximately
ºC = degrees Celsius
µS/cm = microsiemens per centimeter
mg/L = milligrams per liter
Min = minimum
Avg = average
Max = maximum

Based on an example full year of data from these depth profiles (2018), monthly dissolved oxygen is depicted in Figure 5.2-8. In January, March, April, November, and December, dissolved oxygen varied by less than 1 mg/L from the top to the bottom of the water column. In August, levels of dissolved oxygen at Station PY003000 varied by 5.7 mg/L. The lake was stratified with a thermocline at approximately 20 meters. In August, average dissolved oxygen above the thermocline (0 to 20 meters) at the deepest station (Station 1) was 7.0 mg/L; average dissolved oxygen below the thermocline (22 meters to bottom) was 5.0 mg/L. The clinograde oxygen profiles in warmer weather reflect an excess of oxygen consumption in the hypolimnion. The Los Angeles RWQCB Basin Plan objective for dissolved oxygen is a mean annual concentration greater than 7 mg/L, with no single determination less than 5.0 mg/L, except when natural conditions cause lesser concentrations. At all three DWR stations the mean annual concentration for 2018 was 6.98 mg/L dissolved oxygen – just slightly below the 7 mg/L standard. Individual dissolved oxygen concentrations below 5.0 were observed in the summer and fall months in 2018 due to natural lake stratification, and is common in deeper lakes and reservoirs such as Pyramid Lake.

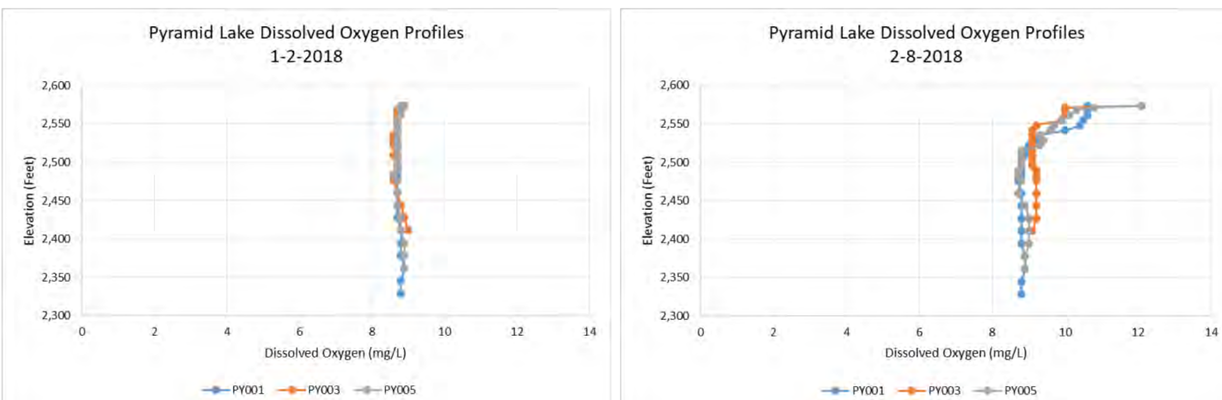


Figure 5.2-8a. Dissolved Oxygen Monthly Depth Profile at Pyramid Lake, January and February 2018

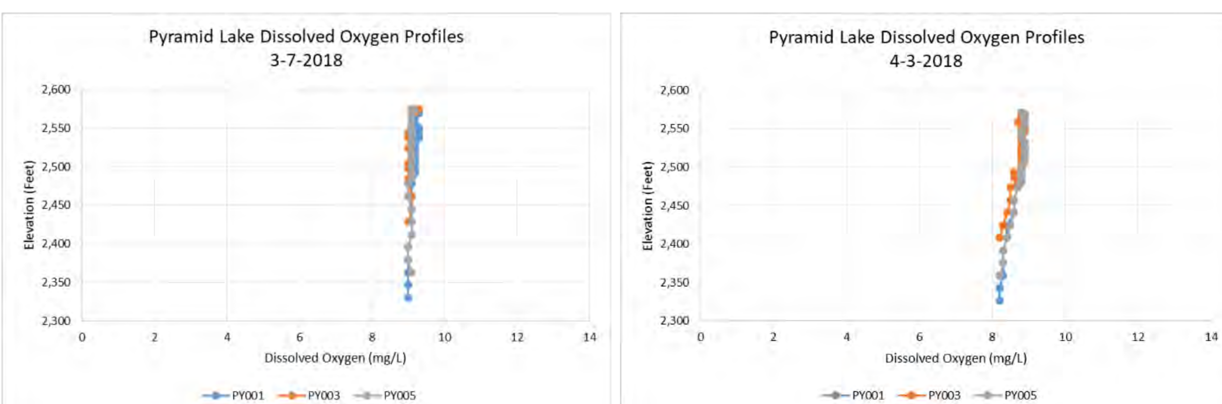


Figure 5.2-8b. Dissolved Oxygen Monthly Depth Profile at Pyramid Lake, March and April 2018

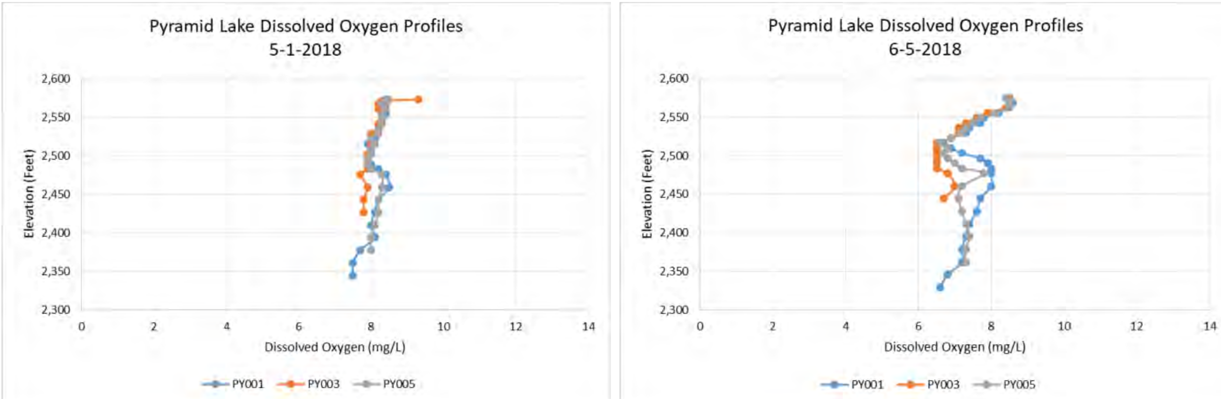


Figure 5.2-8c. Dissolved Oxygen Monthly Depth Profile at Pyramid Lake, May and June 2018

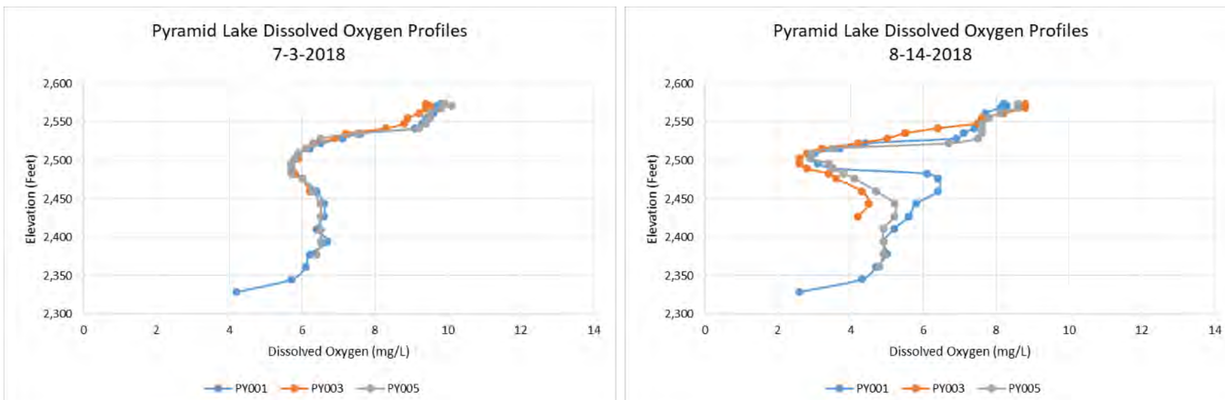


Figure 5.2-8d. Dissolved Oxygen Monthly Depth Profile at Pyramid Lake, July and August 2018

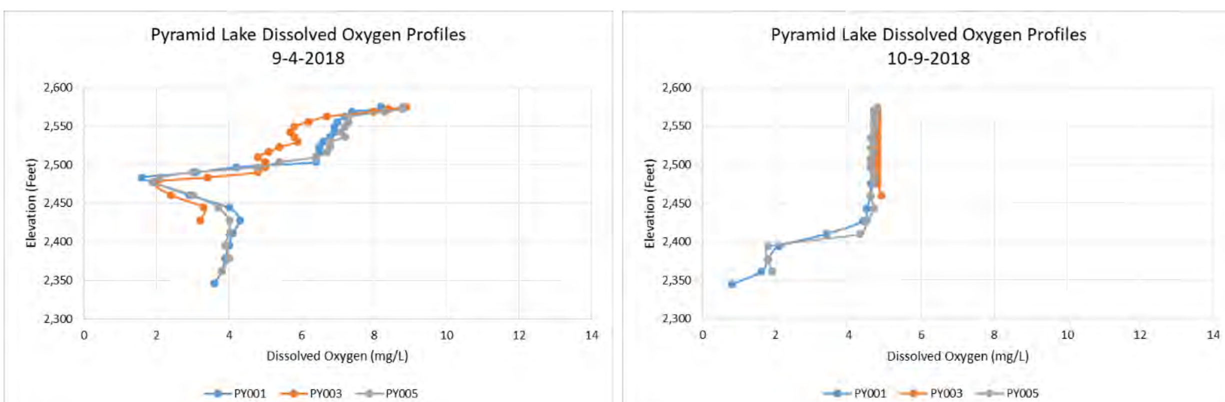


Figure 5.2-8e. Dissolved Oxygen Monthly Depth Profile at Pyramid Lake, September and October 2018

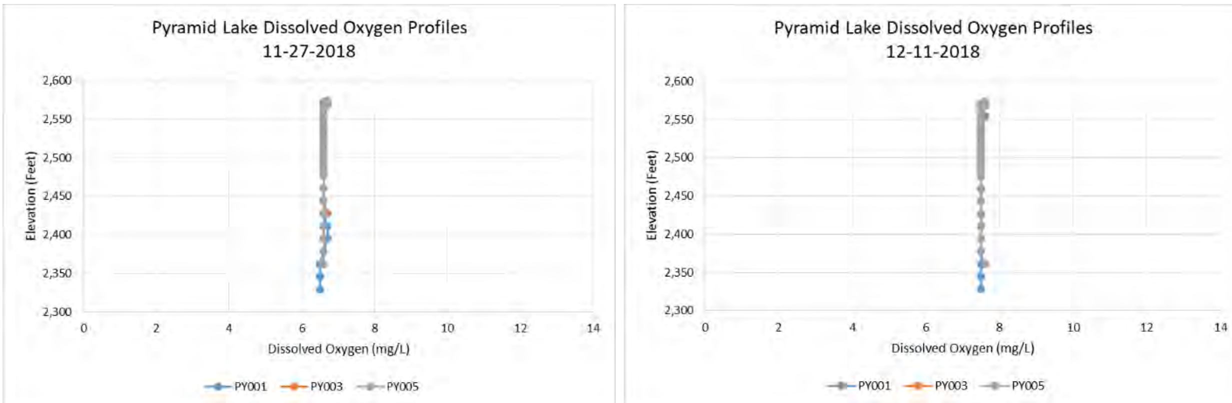


Figure 5.2-8f. Dissolved Oxygen Monthly Depth Profile at Pyramid Lake, November and December 2018

Monthly temperature profiles are depicted in Figure 5.2-9. The minimum water temperature was observed in March at 10.8 degrees Celsius (°C). The maximum water temperature was recorded in August at 24.9°C. Based on these data, a thermocline developed in the lake in April and the lake was mixed again by November. The stratification observed is typical of a warm monomictic lake with one mixing in the winter when the epilimnion cools down. The lake does not freeze.

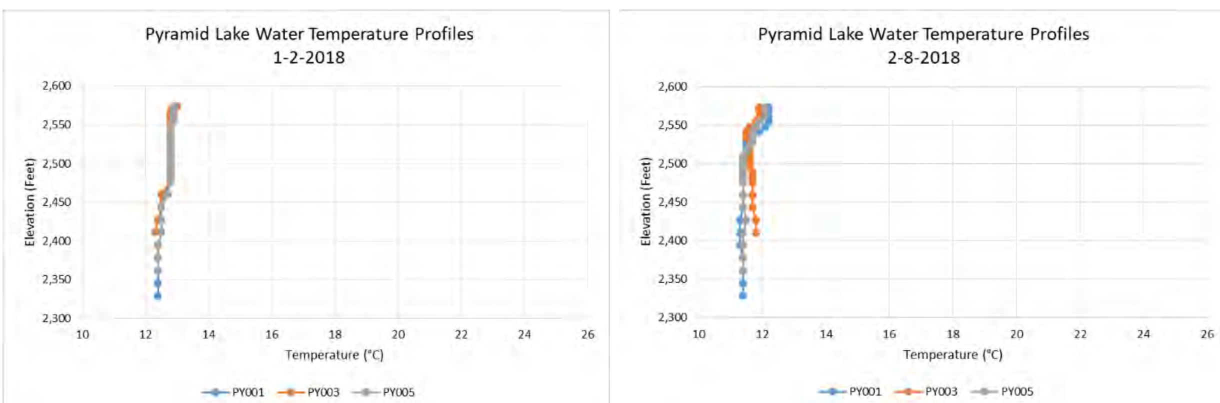


Figure 5.2-9a. Water Temperature Monthly Depth Profile – Pyramid Lake, January and February 2018

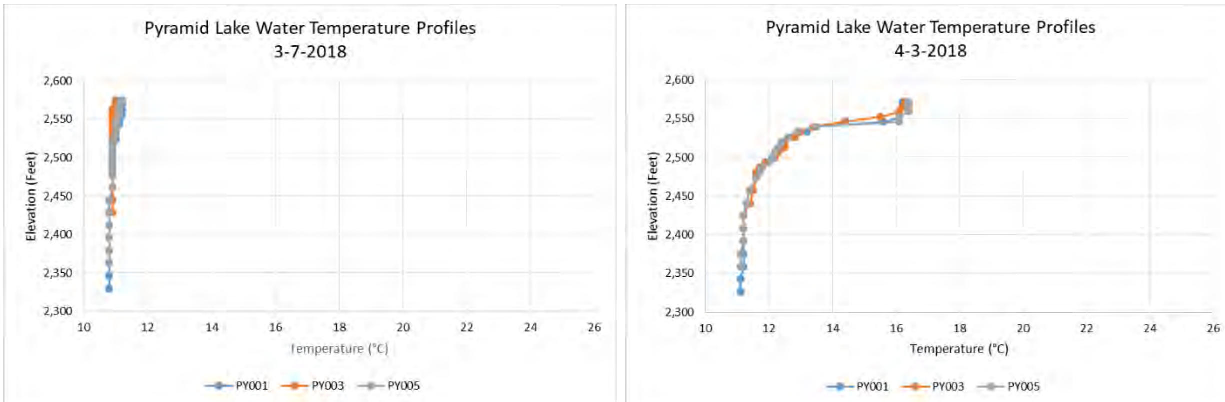


Figure 5.2-9b. Water Temperature Monthly Depth Profile – Pyramid Lake, March and April 2018

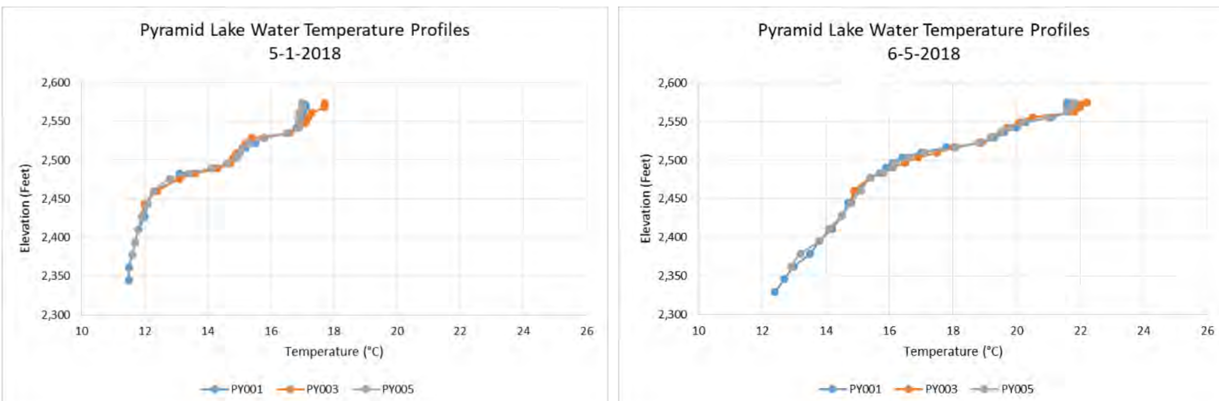


Figure 5.2-9c. Water Temperature Monthly Depth Profile – Pyramid Lake, May and June 2018

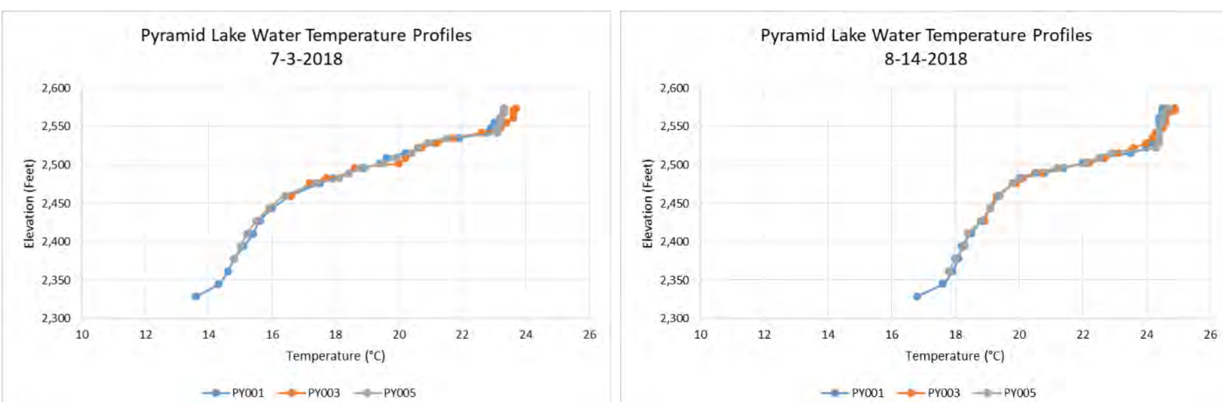


Figure 5.2-9d. Water Temperature Monthly Depth Profile – Pyramid Lake, July and August 2018

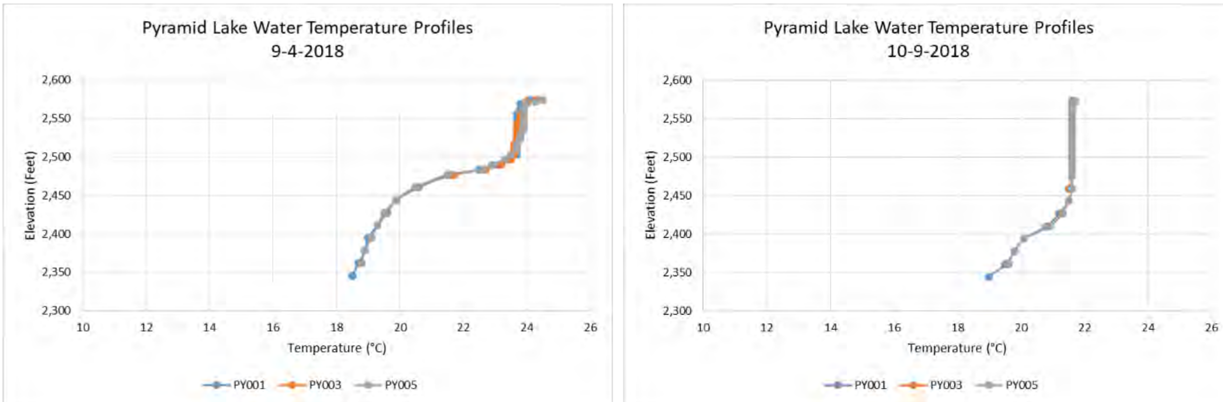


Figure 5.2-9e. Water Temperature Monthly Depth Profile – Pyramid Lake, September and October 2018

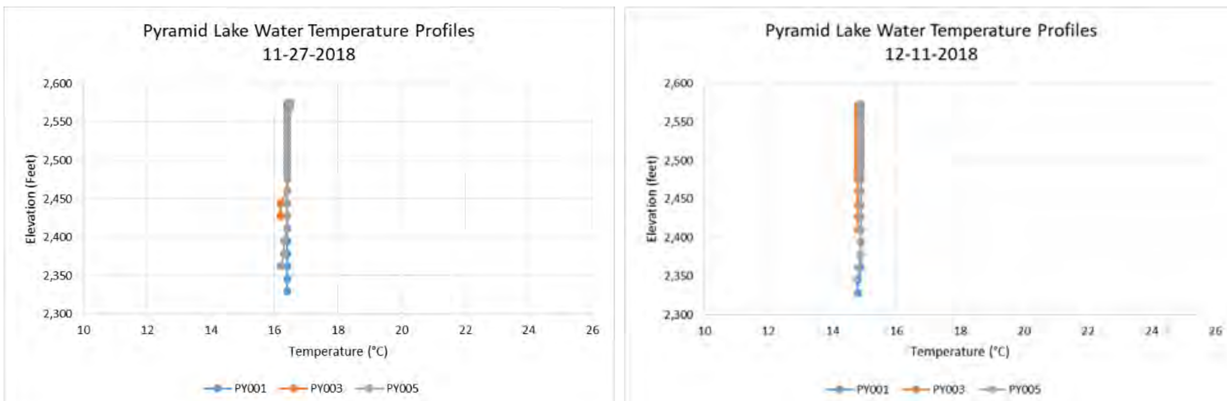
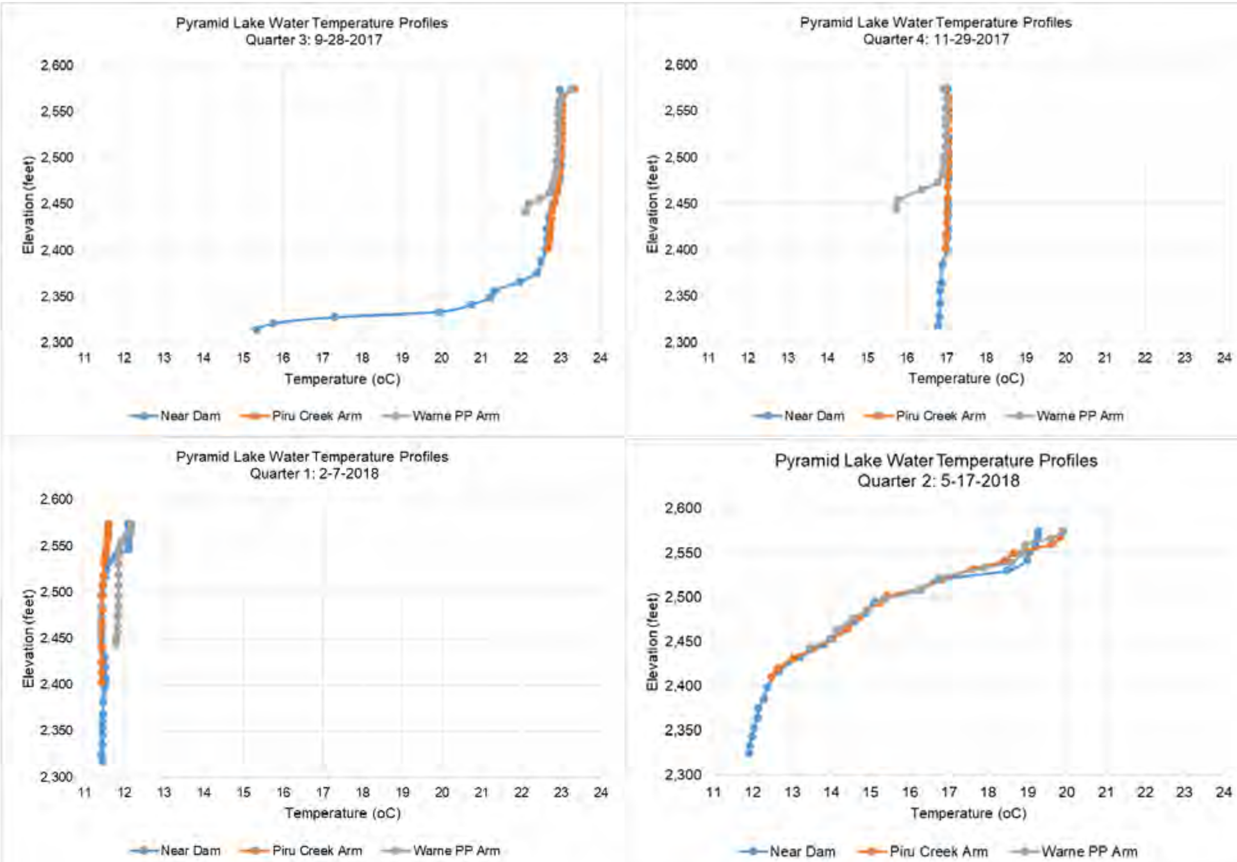


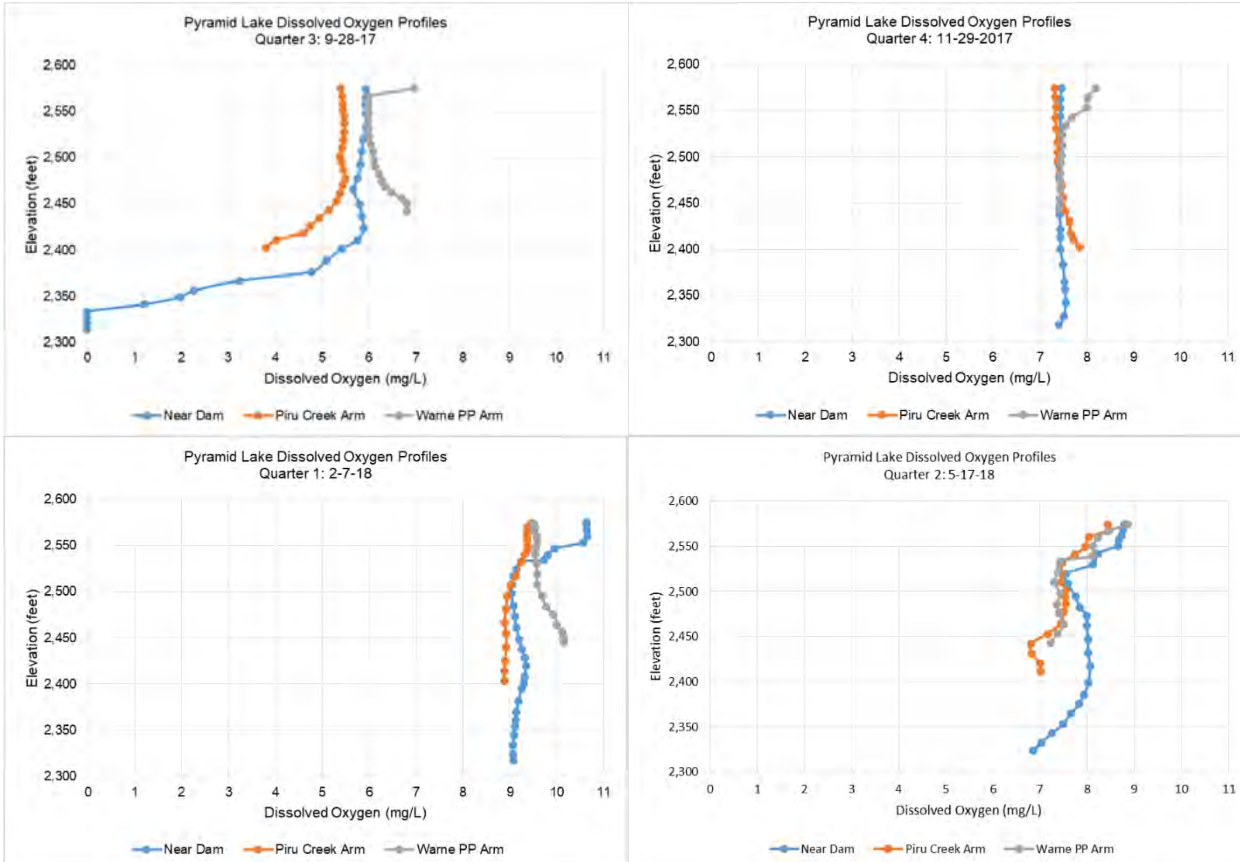
Figure 5.2-9f. Water Temperature Monthly Depth Profile – Pyramid Lake, November and December 2018

As part of the Licensees' *Water Quality and Temperature Study*, quarterly reservoir profiles during 2017 and 2018 were collected at three locations in Pyramid Lake including: (1) near the dam (Near Dam), (2) in the Piru Creek arm (Piru Creek Arm), and (3) in the Warne Powerplant arm (Warne PP Arm). Water temperature, dissolved oxygen, pH, specific conductivity and turbidity were recorded at approximately 10-foot intervals during each profile. Surface water temperatures in Pyramid Lake ranged between 11°C and 23°C, depending on the time of year and sample location. In general, there was no thermocline present during the sampling events, except for a slight one during the third quarter sample (September 2017) (Figure 5.2-10). Surface dissolved oxygen concentrations ranged between 5.4 mg/L and 10.6 mg/L. Dissolved oxygen concentrations tended to stay consistent throughout the water column. The only exception was the third quarter sample (September 2017), when dissolved oxygen concentrations reached near zero at a depth of 260 feet (Figure 5.2-11). A combination of thermal stratification and biological activity can cause characteristic patterns in water chemistry. Values this low are common at deep depths due to the lack of sunlight for plant photosynthesis and other biological processes. The pH values ranged between 6.7 and 8.5 across all depths, locations, and sample events. Specific conductivity ranged between 194 µS/cm and 506 µS/cm across all depths, locations, and sample events. Turbidity ranged from 0.5 Nephelometric Turbidity Unit (NTU) to 30.4 NTU across all depths, locations, and sample events with the highest values recorded near the bottom of the reservoir.



Key:
ºC = degrees Celsius

Figure 5.2-10. Water Temperature Profiles at Three Locations in Pyramid Lake, Quarterly 2017 through 2018



Key:
mg/L = milligrams per liter

Figure 5.2-11. Dissolved Oxygen Profiles at Three Locations in Pyramid Lake, Quarterly 2017 through 2018

<u>*Bacteria*</u>

The Licensees collected water samples to be analyzed for total coliform and *Escherichia coli* (*E. coli*) at two locations in Pyramid Lake: near the dam and in the Piru Creek arm. Water samples were collected five times over a 30-day period, including one sample collected during the 2018 Labor Day Holiday weekend, a peak recreation weekend (Table 5.2-23). Samples were collected from just below the surface and all appropriate procedures were followed as coordinated with the laboratory.

The results were consistent across all sampling dates and locations. Total coliform measured over the maximum possible reporting limit for the analysis (2,419.6 most probable number per 100 milliliters [MPN/100mL]) for 10 of the 12 samples, with the remaining two measuring at 1,300 MPN/100mL and 1,200 MPN/100mL *E. coli*, which was the parameter of interest during sampling, measured under the laboratory's method reporting limit of 1 MPN/100mL for 11 of the 12 samples, and the one measurable result was 1 MPN/100mL from one of two duplicate samples (Table 5.2-23). For perspective, the Los Angeles RWQCB Basin Plan WQO for waters designated as "REC-1" is a geometric mean not to exceed 126 MPN/100mL, and single sample limits that are not to exceed 235 MPN/100mL (Los Angeles RWQCB 2015).

Table 5.2-23. *E. coli* Sampling Results for Two Locations in Pyramid Lake, 2018

Sample Date	Sample Time	# Positive Wells		MPN/100 mL		Presence/Absence (P/A)	
		E. coli Small	*E. coli* Large	Total Coliform[1]	*E. coli*[2]	Total Coliform	*E. coli*
Site 1 - Near Pyramid Lake Dam							
8/21/18	13:20	ND	ND	>2,419.6	<1	P	A
8/28/18[3]	12:51	ND	ND	>2,419.6	<1	P	A
8/28/18[3]	12:51	ND	ND	>2,419.6	<1	P	A
9/1/18	10:07	ND	ND	>2,419.6	<1	P	A
9/4/18	13:31	ND	ND	>2,419.6	<1	P	A
9/11/18	12:52	ND	ND	1,300	<1	P	A
Site 2 - Piru Creek Arm							
8/21/18	12:50	ND	ND	>2,419.6	<1	P	A
8/28/18[3]	11:50	ND	ND	>2,419.6	<1	P	A
8/28/18[3]	11:50	1	ND	>2,419.6	1	P	P
9/1/18	9:42	ND	ND	>2,419.6	<1	P	A
9/4/18	13:40	ND	ND	>2,419.6	<1	P	A
9/11/18	13:37	ND	ND	1,200	<1	P	A

Notes:
[1]2,419.6 MPN/100mL is the maximum recorded value possible for the analysis conducted.
[2]1 MPN/100mL is the method reporting limit for the test. Result of "< 1" are values less than the reporting limit.
[3]Two samples were collected at each location on August 28, 2018 to serve as a duplicate sample for quality assurance protocols.
Key:
> = greater than
< = less than
MPN/100ml = most probable number per 100 milliliters ND = non-detect

In addition, DWR collects *E. coli* data from influent and effluent as part of its NPDES permit at four monitoring locations (INF-001, EFF-001A&B, EFF-002, RSW-001) for the Warne Powerplant. The NPDES permit includes intake water credit for *E. coli* since there are no potential sources of *E. coli* contribution from the Warne Powerplant operations. In 2016, *E. coli* concentrations sampled at the four monitoring locations (20 total samples) ranged between 1 MPN/100mL and 23 MPN/100mL and were consistent with the Los Angeles RWQCB WQO. DWR collected 80 samples in 2017 across the four monitoring locations, and *E. coli* concentrations ranged from 1 MPN/100mL to 1,600 MPN/100mL. While the single sample with an *E. coli* concentration of 1,600 MPN/100mL is above the Los Angeles RWQCB (2015) WQO for a single day (235 MPN/100mL), this sample was collected at the receiving water station (RSW-001) and is not regulated by the Los Angeles RWQCB. Despite the inconsistency with the single sample WQO, the geometric mean concentration for this sampling event was 22

MPN/100mL – well below the Los Angeles RWQCB WQO geometric mean concentration of 126 MPN/100mL. The next highest sample concentration in 2017 was 110 MPN/100mL and below the Los Angeles RWQCB WQO. In 2018, 80 samples were collected, and *E. coli* concentrations ranged between 1 MPN/100mL and 50 MPN/100mL – all below the Los Angeles RWQCB WQO for a single sample and geometric mean.

Mercury and Polychlorinated Biphenyls in Fish from Pyramid Lake

In 2013, OEHHA published Safe Eating Guidelines for Pyramid Lake, which recommended the maximum servings of fish per week by species due to contamination by mercury and PCBs (Table 5.2-24). The statewide survey of fish was conducted by SWAMP (Davis et al. 2010).

Table 5.2-24. Recommended Maximum Number of Fish Servings from Pyramid Lake per Week

Fish Species	Women 18 to 45 Years and Children 1 to 17 Years	Women and Men Over 45 Years
Bullhead (*Ameriurus* sp.)	0	0
Channel Catfish (*Ictalurus punctatus*)	1	2
Largemouth Bass (*Micropterus salmoides*)	0	1
Rainbow Trout (*Oncorhynchus mykiss*)	7	7

Source: OEHHA 2013

The EPA recommended water quality criterion for concentrations of methylmercury in fish tissue of trophic level 4 fish (150-500 millimeters [mm]; fillet wet weight) is 0.20 milligrams per kilograms (mg/kg). In addition, the SWRCB adopted "*Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions*" in 2017 that consists of five mercury fish tissue WQOs including a sport fish WQO which specifies that the average methylmercury concentrations shall not exceed 0.20 mg/kg fish tissue in a calendar year. The OEHHA methylmercury threshold for fish tissue is 0.44 parts per million (ppm). For the purposes of risk assessment, total mercury is analyzed for most fish studies and assumed to be 100 percent methylmercury (Klasing & Brodberg 2008). Fish tissue results for mercury in Pyramid Lake fish ranged from a mean of 28 parts per billion (ppb) in rainbow trout to a mean of 514 ppb in largemouth bass (OEHHA 2013). The National Academy of Science guidelines (National Academy of Science and National Academy of Engineering 1973) establish a maximum total PCB concentration of 500 micrograms per kilograms (wet weight) in tissue samples for the protection of aquatic life from bioaccumulation of toxic substances. OEHHA adopted an advisory tissue level (ATL) of 120 ppb; the ATL is the threshold for considering a recommendation of no consumption. Fish tissue results for PCBs published in the 2013 OEHHA Health Advisory ranged from a mean of 5 ppb in rainbow trout to a mean of 238 ppb in bullhead.

In the water phase, the maximum dissolved mercury value in the last five years in Pyramid Lake was less than the reporting limit of 0.0002 mg/L, below the maximum contaminant level of 0.002 mg/L and the Public Health Goal of 0.0012 mg/L. A TMDL for mercury in Pyramid Lake is planned by 2021, consistent with Section 3.4 of the Listing Policy, which states, "a water segment shall be placed on the section 303(d) list if a health advisory against the consumption of edible resident organisms has been issued by OEHHA or DHS [Department of Health Services]." In addition, water quality monitoring conducted from 2015 to 2019 under the existing NPDES permit for Warne Powerplant collected at discharge points, Warne Powerplant penstock influent, and in Pyramid Lake about 100 feet from the discharge have resulted in non-detect for mercury, PCBs, DDT, and chlordane.

Pyramid Reach

In 2009, the SWRCB considered a petition to reconsider the Water Quality Certification, and ultimately issued a revised Water Quality Certification for DWR’s operation of the natural flow regime in the Pyramid reach (SWRCB 2009). As part of that order, the SWRCB points out that, due to Pyramid Lake stratification in warmer months, water discharged to Pyramid reach is expected to be cooler than the natural inflow to Pyramid Lake during the warmest times of the year (SWRCB 2009). Water temperatures are not expected to exceed those that occurred under natural conditions (SWRCB 2009). Therefore, the Project was found to comply with Los Angeles RWQCB Basin Plan Water Quality Standards for temperature (SWRCB 2009). Similar to temperature, any reduction in dissolved oxygen concentration as a result of the Project will occur because “natural conditions cause lesser concentrations,” and not “as a result” of waste discharges. The SWRCB Order states that the Project was found to comply with Los Angeles RWQCB Basin Plan dissolved oxygen WQOs (SWRCB 2009).

DWR published a water quality assessment of Pyramid reach in July 1996 (DWR 1996), based on data from 1973 through 1990 (Table 5.2-25). As part of the SWAMP, the SWRCB collected water quality data in 2003, 2011, and 2012 (Tables 5.2-26 and 5.2-27). Based on the data, samples were consistent with WQOs for Piru Creek, with the exception of chloride, which was inconsistent with the Los Angeles RWQCB Basin Plan objective of 60 mg/L in 2003 (91.4 mg/L) and 2012 (68.7 mg/L). The Project does not use chloride or introduce it into Pyramid reach.

Table 5.2-25. DWR Water Quality Data for Pyramid Reach, 1973 through 1990

Parameter	Units	Minimum 1973 through 1990	Maximum 1973 through 1990	Median 1973 through 1990
Dissolved Oxygen	mg/L	8.6	10.9	10.1
Temperature	°C	9.5	18.7	13.4
pH	standard units	7.4	8.9	8
Dissolved Solids	mg/L	184	1744	328
Hardness	mg/L	88	1045	150

Source: DWR 1996
Key:
°C = degrees Celsius
mg/L = milligrams per liter

Table 5.2-26. SWAMP Water Quality Data for Pyramid Reach – General Parameters and Nutrients, 2003, 2011, and 2012

Parameter	Units	2003 (Station 403STC083)	2011 (Station 403S01136)	2012 (Station 403S07024)
Temperature	°C	10.51	15.8	23.63
pH	standard units	6.78	7.69	8.58
Dissolved Oxygen	mg/L	--	9.11	12.81
Dissolved Oxygen Saturation	%	103.8	--	149.9
Dissolved Alkalinity	mg/L as CaCO3	--	84	112
Total Alkalinity	mg/L as CaCO3	--	84	130
Nitrate plus Nitrite	mg/L as N	--	0.404	--
Dissolved Nitrite	mg/L as N	ND	0.003	0.0028
Nitrate	mg/L as N	0.777	--	0.213
Total Nitrogen	mg/L	--	0.586	0.339
Ammonia	mg/L as N	ND	ND	0.012
Turbidity	NTU	1.5	2.48	2.91
Boron	mg/L	0.67	--	--
Dissolved Chloride	mg/L	91.4	47	68.7
Total Hardness	mg/L as CaCO3	310	155	186
Dissolved Orthophosphate	mg/L as P	0.0409	--	0.041
Total Phosphorus	mg/L as P	--	0.0493	0.0293
Total Dissolved Solids	mg/L	628	284	372
Chlorophyll a	µg/L	0.69	--	--
Dissolved Sulfate	mg/L	243	84.2	115

Sources: SWAMP 2003, Station 403STC083; 2011, Station CEDEN-250071; 2012, Station 403S07024
Note:
Sampling Dates: February 20, 2003; June 13, 2011; and June 13, 2012
Key:
°C = degrees Celsius
% = percent
-- = not sampled
µg/L = micrograms per liter
$CaCO_3$ = calcium carbonate
mg/L = milligrams per liter
N = nitrogen
ND = non-detect
NTU = Nephelometric Turbidity Unit
P = phosphorus

Table 5.2-27. SWAMP Water Quality Data for Pyramid Reach – Trace Elements, 2011 and 2012

Parameter	Units	2011 (Station 403S01136)	2012 (Station 403S07024)
Dissolved Aluminum	µg/L	3.38	ND
Total Aluminum	µg/L	85.2	11.4
Dissolved Arsenic	µg/L	1.75	2.23
Total Arsenic	µg/L	1.9	2.25
Dissolved Cadmium	µg/L	ND	0.01
Total Cadmium	µg/L	ND	0.01
Dissolved Chromium	µg/L	ND	0.22
Total Chromium	µg/L	0.27	0.23
Dissolved Copper	µg/L	1.23	1.32
Total Copper	µg/L	1.56	1.35
Dissolved Iron	µg/L	4.95	--
Total Iron	µg/L	146	--
Dissolved Lead	µg/L	ND	ND
Total Lead	µg/L	ND	ND
Dissolved Manganese	µg/L	2.49	4.78
Total Manganese	µg/L	29.1	5.89
Dissolved Nickel	µg/L	1.1	1.21
Total Nickel	µg/L	1.34	1.23
Dissolved Selenium	µg/L	0.93	0.93
Total Selenium	µg/L	1.29	0.89
Dissolved Silver	µg/L	ND	ND
Total Silver	µg/L	0.09	ND
Dissolved Zinc	µg/L	ND	ND
Total Zinc	µg/L	0.79	ND

Source: SWAMP 2011, Station 403S01136; 2012, Station 403S07024
Note:
Sampling Dates: June 13, 2011 and June 13, 2012
Key:
µg/L = micrograms per liter
-- = not sampled
ND = non-detect

Additionally, while the median dissolved solids from 1973 through 1990 (DWR 1996) were consistent with the WQO of 800 mg/L, the maximum observed value of 1,744 mg/L was almost double the WQO. A total of three samples over the seven-year monitoring program (164 total samples) were inconsistent with the WQO for dissolved solids. The maximum value measured (1,744 mg/L) occurred when Pyramid Lake was being filled for the first time after construction. The two other samples that were inconsistent with the WQO occurred in 1977 and 1979 (DWR 1996). More recent TDS values (2011 and 2012) were well below the 800 mg/L standard (284 mg/L and 372 mg/L, respectively).

As part of the Licensees' *Water Quality and Temperature Study*, water quality samples were collected once in September 2017 at four locations in the Pyramid reach including: (1) immediately downstream of Pyramid Dam, (2) approximately 1.5 miles downstream of Pyramid Dam, (3) approximately 3.0 miles downstream of Pyramid Dam, and (4) upstream of Lake Piru near Blue Point Campground (Table 5.2-28). All parameters sampled were consistent with applicable Los Angeles RWQCB Basin Plan WQOs at the three most upstream sampling sites. Samples collected at the location near Blue Point Campground, approximately 18 miles downstream of Pyramid Dam, were inconsistent with Los Angeles RWQCB Basin Plan Objectives for TDS (1,056 mg/L, in comparison with the WQO of 800 mg/L), chloride (94 mg/L, in comparison with the WQO of 60 mg/L), and sulfate (430 mg/L, in comparison with the WQO of 400 mg/L). The Project does not release chloride or sulfate into Pyramid reach, and the fact that the lowest results for all three of these analytes occurs closest to Pyramid Dam suggests that they may be introduced through non-Project activities or are present naturally in the Piru Creek watershed below Pyramid Dam.

As part of the *Water Quality and Temperature Study*, the Licensees also installed long-term water temperature loggers at four locations in Pyramid reach: (1) immediately downstream of Pyramid Dam, (2) approximately 1.5 miles downstream of Pyramid Dam, (3) approximately 3.0 miles downstream of Pyramid Dam, and (4) upstream of Lake Piru near Blue Point Campground. The water temperature loggers were installed in late September 2017 and collected data every 15 minutes until their removal in late October 2018. Daily average flows in Pyramid reach during the monitoring period were less than 10 cfs 78 percent of the time and less than 1 cfs 46 percent of the time, as measured at USGS gage 11109600. Flows only exceeded 100 cfs for five days during the monitoring period, with a maximum observed flow of 454 cfs (USGS 2018).

Water temperatures in Pyramid reach varied daily and seasonally at all locations, which was expected given the location and the characteristics of Piru Creek flows. Water temperatures downstream of Pyramid Dam ranged between 10°C and just over 20°C, but showed very little diurnal fluctuation due to the consistent releases from Pyramid Dam (Figure 5.2-12).

Table 5.2-28. Water Quality Data for Pyramid Reach, September 2017

Analyte	Sample Location	Pyramid Reach below Dam	Pyramid Reach at 1.5 miles downstream of Dam	Pyramid Reach at 3.0 miles downstream of Dam	Pyramid Reach near Blue Point Campground	Los Angeles Basin Water Quality Plan Objectives
	Sample Depth (feet)	0.5	0.5	0.5	0.5	--
	Units		**Result**			
***In Situ* Measurements**						
Temperature	°C	19.38	16.39	18.88	17.8	--
Specific Conductance	µS/cm	249	381	660	1490	--
pH	standard units	7.1	7.2	7.9	7.4	6.5-8.5
Dissolved Oxygen	mg/L	8.86	8.19	9.72	7.89	--
Turbidity	NTU	1.9	1.5	3.2	1.2	--
Total Concentrations						
Alkalinity (as $CaCO_3$)	mg/L	49	69	116	246	
Aluminum	mg/L	0.02	0.03	0.07	<0.01	0.2
Antimony	mg/L	ND	ND	ND	ND	0.006
Arsenic	mg/L	0.004	0.003	0.002	0.002	0.01
Barium	mg/L	0.02	0.022	0.029	0.054	1
Beryllium	mg/L	ND	ND	ND	ND	0.004
Cadmium	mg/L	ND	ND	ND	ND	0.005
Chromium	mg/L	ND	ND	ND	ND	0.1
Copper	mg/L	ND	ND	ND	0.001	1
Solids, Total Dissolved	mg/L	152	231	422	1,056	800
Iron	mg/L	ND	0.1	0.2	0.169	--
Kjeldahl Nitrogen	mg/L	0.2	0.1	0.2	<0.1	--

Table 5.2-28. Water Quality Data for Pyramid Reach, September 2017 (continued)

Analyte	Sample Location	Pyramid Reach below Dam	Pyramid Reach at 1.5 miles downstream of Dam	Pyramid Reach at 3.0 miles downstream of Dam	Pyramid Reach near Blue Point Campground	Los Angeles Basin Water Quality Plan Objectives
	Sample Depth (feet)	0.5	0.5	0.5	0.5	--
	Units		Result			
Lead	mg/L	ND	ND	ND	ND	0.015
Manganese	mg/L	0.02	0.01	0.03	0.037	--
Nickel	mg/L	ND	ND	ND	0.005	0.1
Organic Carbon	mg/L	3.3	3.2	2.7	2.1	--
Phosphorus	mg/L	0.14	0.08	0.04	0.02	--
Selenium	mg/L	ND	ND	ND	0.001	0.01
Silver	mg/L	ND	ND	ND	ND	--
Suspended Solids	mg/L	1	3	4	2	--
Zinc	mg/L	0.02	ND	ND	ND	--
Mercury, Total	ng/L	1.3	0.99	1.4	0.89	2,000
Methyl Mercury	ng/L	0.076	0.057	0.079	0.055	--
Dissolved Concentrations						
Aluminum	mg/L	<0.01	<0.01	0.05	<0.01	--
Ammonia as N	mg/L	<0.01	0.02	<0.01	<0.01	--
Antimony	mg/L	ND	ND	ND	ND	--
Arsenic	mg/L	0.003	0.002	0.002	0.001	--
Barium	mg/L	0.019	0.02	0.027	0.05	--
Beryllium	mg/L	ND	ND	ND	ND	--

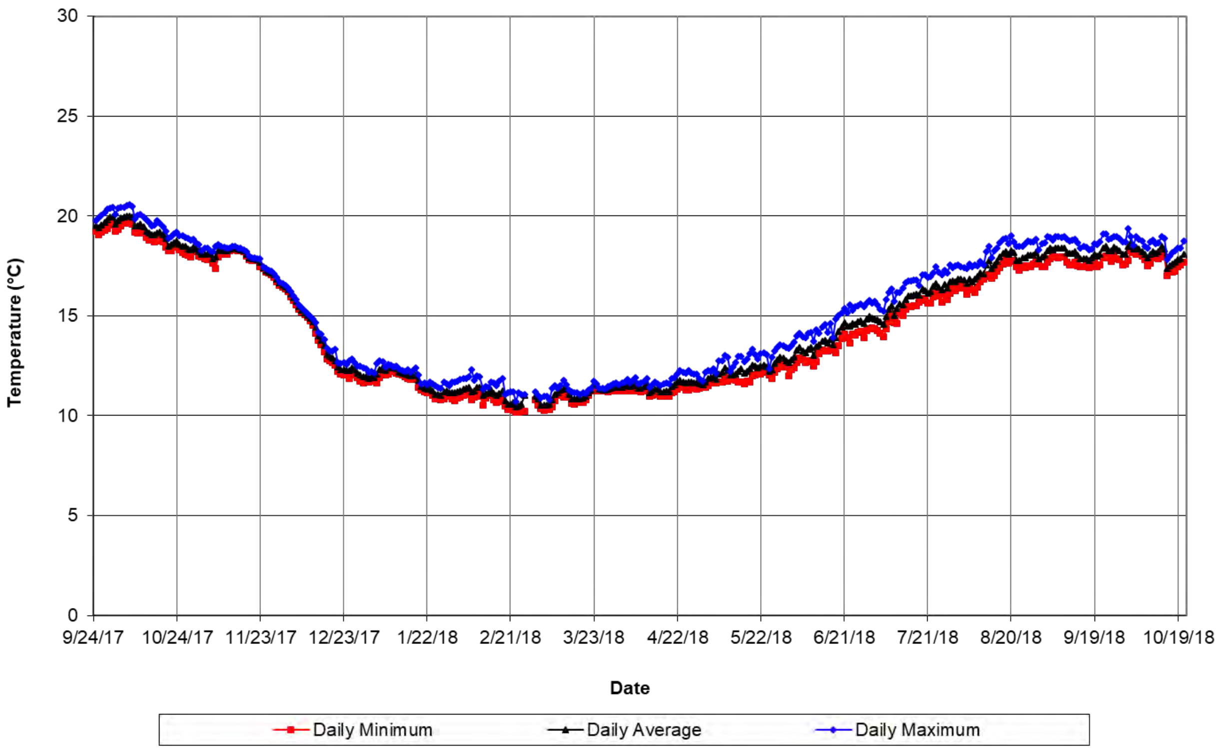
Table 5.2-28. Water Quality Data for Pyramid Reach, September 2017 (continued)

Analyte	Sample Location	Pyramid Reach below Dam	Pyramid Reach at 1.5 miles downstream of Dam	Pyramid Reach at 3.0 miles downstream of Dam	Pyramid Reach near Blue Point Campground	Los Angeles Basin Water Quality Plan Objectives
	Sample Depth (feet)	0.5	0.5	0.5	0.5	--
	Units		Result			
Cadmium	mg/l	ND	ND	ND	ND	--
Calcium	mg/L	15	22	43	141	--
Chloride	mg/L	28	32	48	94	60
Chromium	mg/L	ND	ND	ND	ND	--
Copper	mg/L	ND	ND	ND	ND	--
Hardness, Dissolved as $CaC0_3$	mg/L	65	1	209	579	--
Iron	mg/L	ND	ND	0.1	0.024	--
Lead	mg/L	ND	ND	ND	ND	--
Magnesium	mg/L	7	14	25	55	--
Manganese	mg/L	ND	ND	0.03	ND	--
Nickel	mg/L	ND	ND	ND	0.004	--
Nitrate + Nitrite (as N)	mg/L	0.45	0.34	0.11	0.09	5
Organic Carbon	mg/L	3.1	3.1	2.7	1.9	--
Ortho-phosphate (as P)	mg/L	0.14	0.08	0.04	0.02	--
Potassium	mg/L	2.1	2.4	3.1	4.7	--
Selenium	mg/L	ND	ND	ND	ND	--
Silver	mg/L	ND	ND	ND	ND	--

Table 5.2-28. Water Quality Data for Pyramid Reach, September 2017 (continued)

Analyte	Sample Location	Pyramid Reach below Dam	Pyramid Reach at 1.5 miles downstream of Dam	Pyramid Reach at 3.0 miles downstream of Dam	Pyramid Reach near Blue Point Campground	Los Angeles Basin Water Quality Plan Objectives
	Sample Depth (feet)	0.5	0.5	0.5	0.5	--
	Units		**Result**			
Sodium	mg/L	24	35	69	110	--
Sulfate	mg/L	26	69	141	430	400
Zinc	mg/L	0.01	ND	ND	ND	--
Methyl Mercury	ng/L	0.092	0.076	0.042	0.026	--
Pesticides						
Diazinon	µg/L	ND	ND	ND	ND	--
Chlorpyrifos	µg/L	ND	ND	ND	ND	--

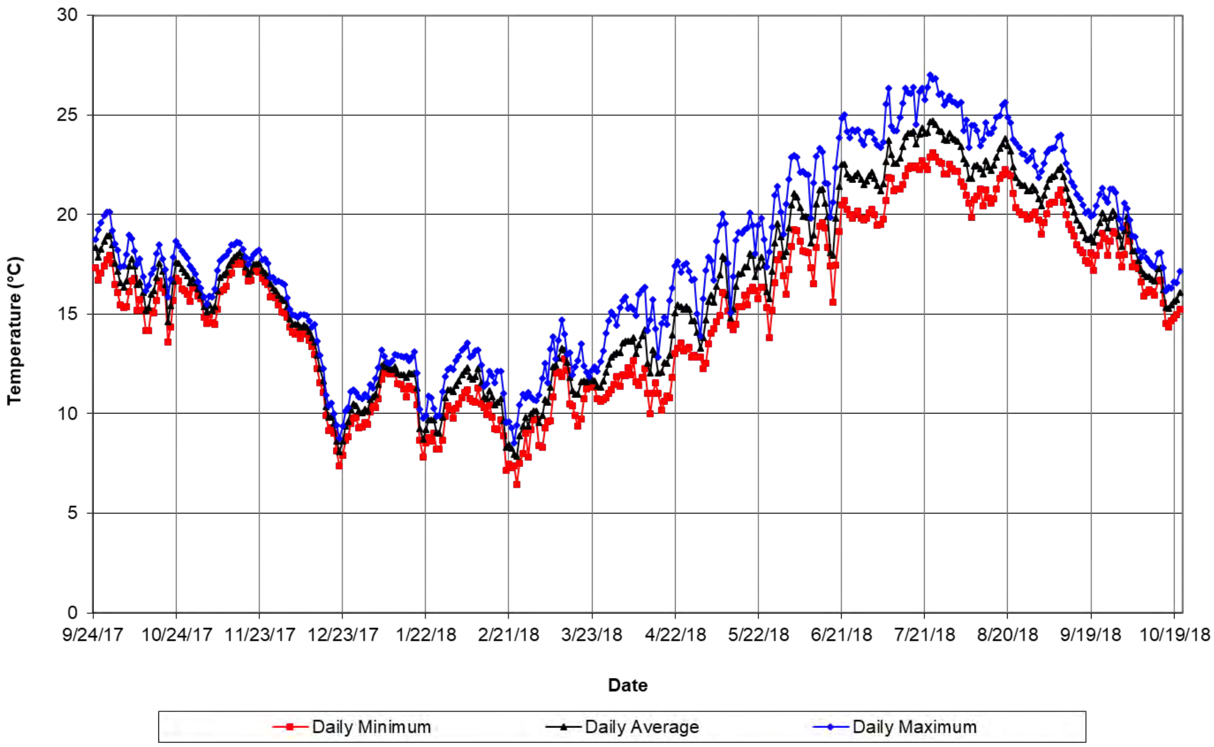
Key:
< = less than; values reported with "<" indicate a result less than the laboratory detection method for that analyte
°C = degrees Celsius
µg/L = micrograms per liter
µS = microsiemens per centimeter
$CaCO_3$ = calcium carbonate
mg/L = milligrams per liter
N = nitrogen
ND = non-detect
ng/L = nanograms per liter
NTU = Nephelometric Turbidity Unit
P = phosphorus



Key:
°C = degrees Celsius

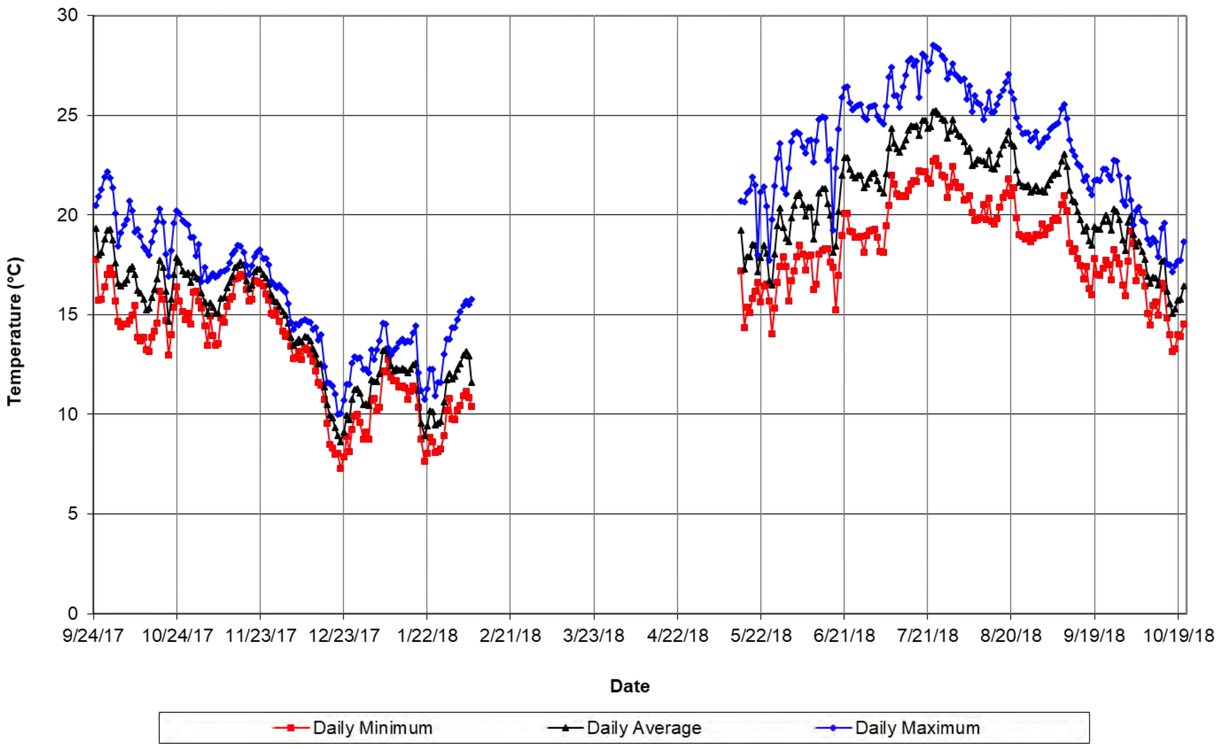
Figure 5.2-12. Daily Minimum, Average, and Maximum Water Temperature at Pyramid Reach, Downstream of Pyramid Dam

Water temperatures further downstream of Pyramid Dam began to show more seasonal and diurnal variation compared to the station near the dam. This indicates that water temperatures were reaching close to ambient conditions, and being effected by local air temperature and other environmental factors. The two monitoring locations at 1.5 miles and 3.0 miles downstream of Pyramid Dam had very similar water temperatures, ranging between 6°C and 28.5°C (Figures 5.2-13 and 5.2-14). The Licensees' employed measures to reduce the risk of data gaps that would be caused if data loggers were lost or destroyed. These measures included using duplicate data loggers, hiding the loggers from public view, and selecting loggers with robust housing. However, when staff visited the site near Frenchmans Flat, in May 2018, one logger and housing was gone, and the second logger was missing with the broken housing found on the bank, likely the result of vandalism. The loss of these two data loggers caused a data gap of 96 days (February 8, 2018 to May 14, 2018) at the location 3.0 miles downstream of Pyramid Dam, near Frenchmans Flat (Figure 5.2-14).



Key:
°C = degrees Celsius

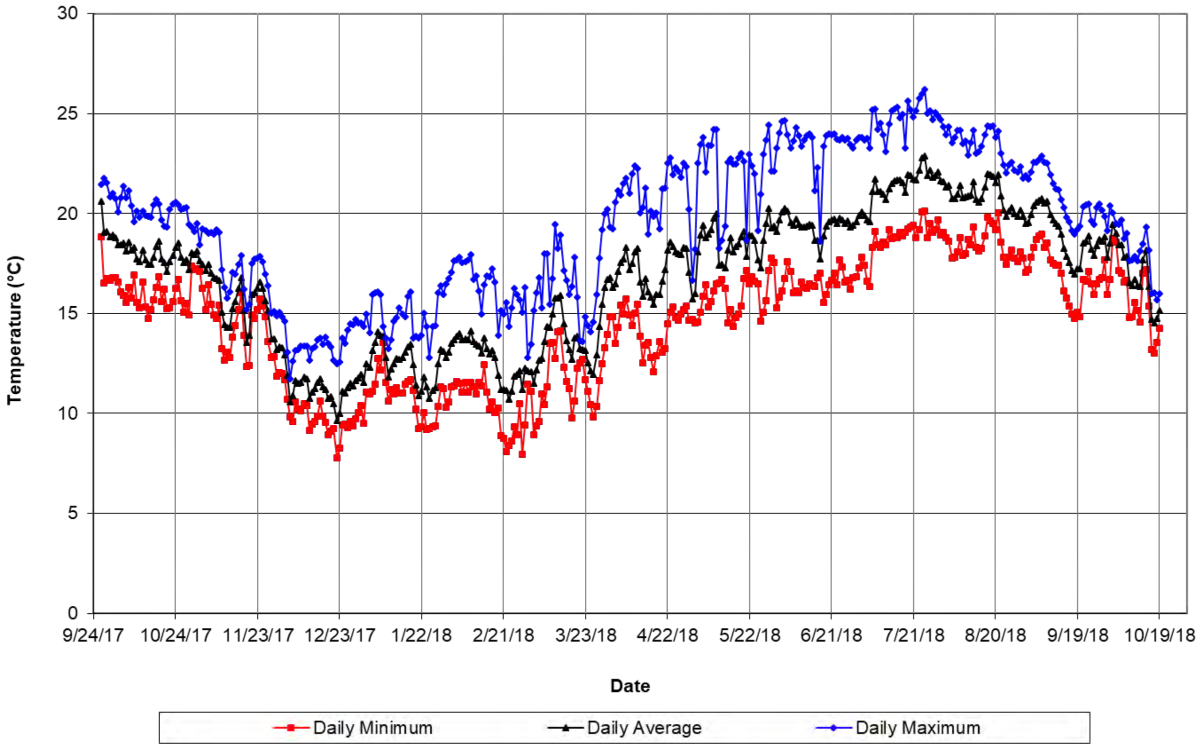
Figure 5.2-13. Daily Minimum, Average, and Maximum Water Temperature at Pyramid Reach, 1.5 Miles Downstream of Pyramid Dam



Note: Data gap due to missing or malfunctioning data loggers.
Key:
°C = degrees Celsius

Figure 5.2-14. Daily Minimum, Average, and Maximum Water Temperatures at Pyramid Reach, 3 Miles Downstream of Pyramid Dam Near Frenchmans Flat

The final water temperature monitoring location was approximately 18 miles downstream of Pyramid Dam, near Blue Point Campground. Water temperatures ranged between 7.7°C and 26.2°C, and had daily variations of as much as 9°C during the monitoring period (Figure 5.2-15). From June through September, monthly average minimum, maximum, and mean daily water temperatures near Blue Point Campground were lower than those measured at the 1.5 mile and 3.0 mile downstream locations. The 1.5 and 3.0 sites had lower monthly average minimum, maximum, and mean daily water temperatures from January through May compared to the Blue Point Campground site. Water temperature near Blue point Campground may be influenced by the two larger tributaries upstream of the monitoring location (Fish Creek [RM 6.5] and Agua Blanca Creek [RM 17]). In addition to the tributary inflow, Pyramid reach flows through a relatively narrow canyon for approximately 9 miles upstream of this monitoring location, which could influence water temperatures due to different shading, substrate, and water depths compared to the monitoring locations upstream. These trends are not applicable when considering the monitoring site nearest the dam because of releases from the low-level outlet.



Key:
°C = degrees Celsius

Figure 5.2-15. Daily Minimum, Average, and Maximum Water Temperature at Pyramid Reach, 18 Miles Downstream of Pyramid Dam, Near Blue Point Campground

<u>Elderberry Forebay</u>

Data from USGS for two dates in 2004 and one date in 2005 are summarized in Table 5.2-29. While the Los Angeles RWQCB Basin Plan (Los Angeles RWQCB 2015) does not have site-specific WQOs for Elderberry Forebay, the observed water quality in 2004 and 2005 did not exceed narrative WQOs for surface waters in the Los Angeles RWQCB Basin Plan.

Table 5.2-29. U.S. Geological Survey Water Quality Data for Elderberry Forebay, 2004 and 2005

Parameter	Units	Laboratory Detection Limit	Minimum	Maximum	Average	Los Angeles Water Quality Objectives
Dissolved Ammonia	mg/L as N	0.04	ND	ND	ND	--
Dissolved Calcium	mg/L	0.01	18.2	48.8	30.2	--
Dissolved Chloride	mg/L	0.2	30	62.6	50.3	60
Dissolved Fluoride	mg/L	0.17	ND	0.39	0.19	2.0[1]
Dissolved Nitrate and Nitrite	mg/L as N	0.06	0.37	0.62	0.52	5
Dissolved Iron	µg/L	6.4	ND	20.9	10.9	--
Dissolved Magnesium	mg/L	0.008	11.20	16.90	13.77	--
Dissolved Manganese	µg/L	0.8	1.01	9.12	5.39	--
Dissolved Nitrate	mg/L as N	not noted	0.37	0.62	0.52	--
Dissolved Nitrite	mg/L	0.008	ND	ND	ND	--
Total Nitrogen	mg/L	0.03	0.56	0.92	0.77	--
Total Organic Nitrogen	mg/L	0.18 – 0.30	ND	ND	ND	--
Dissolved Organic Nitrogen	mg/L	0.23	ND	ND	ND	--
pH	std units	0.1	7.3	8.0	7.7	6.5-8.5
Dissolved Phosphate	mg/L	0.006	0.03	0.07	0.06	--
Total Phosphorus	mg/L	0.004	0.064	0.089	0.080	--
Dissolved Potassium	mg/L	0.16	2.43	3.13	2.80	--
Dissolved Silica	mg/L	0.04	15	16.4	15.63	--
Dissolved Sodium	mg/L	0.1 – 0.2	34.5	46.4	39.8	--
Sodium Adsorption Ratio	none	not noted	1.08	1.9	1.58	5.0[1]
Specific Conductance	µS/cm at 25 ºC	2.6	378	485	433	--
Dissolved Sulfate	mg/L	0.18	27.5	112	60.8	400

Table 5.2-29. U.S. Geological Survey Water Quality Data for Elderberry Forebay, 2004 and 2005 (continued)

Parameter	Units	Laboratory Detection Limit	Minimum	Maximum	Average	Los Angeles Water Quality Objectives
Total Dissolved Solids	mg/L	10	228	334	278	800
Total Hardness	mg/L $CaCO_3$	not noted	91.6	191	131.9	--

Source: USGS 2004 to 2005, LA RWQCB *2015*
[1]*WQOs listed from* LA RWQCB *2015 retrieved from the California Code of Regulations for water designated for Domestic or Municipal Supply*
Note:
Sampling Dates: July 21, 2004; September 23, 2004; and February 27, 2005
Key:
ºC = degrees Celsius
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
$CaCO_3$ = calcium carbonate
mg/L = milligrams per liter
N = nitrogen
ND = non-detect

Dredging occurs at Elderberry Forebay approximately every 10 years and is described in more detail in Exhibit B. While no specific mitigation measures to monitor for water quality are required during dredging, Best Management Practices (BMP) are implemented pursuant to the requirements of the CWA Section 401 and Section 404 permits.

National Pollutant Discharge Elimination System Permits

State Water Project Control of Aquatic Weeds and Algal Blooms

DWR applied for a statewide general NPDES permit to continue application of aquatic herbicides, when necessary, to SWP facilities. A Mitigated Negative Declaration was prepared by DWR to comply with CEQA. DWR was granted a Section 5.3 exception by the SWRCB Water Quality Order 2004-0009-DWQ. In 2014, DWR prepared another Mitigated Negative Declaration and applied for a Section 5.3 exception for the use of copper compounds at four additional water bodies, including Pyramid Lake and Quail Lake. In 2016, DWR completed an Aquatic Pesticides Application Plan (DWR 2016b). The SWRCB granted DWR a Section 5.3 SIP exception and is not required to meet the copper limitation in receiving waters during the exception period as described in the Aquatic Pesticides Application Plan. The treatments at Pyramid Lake are typically for aquatic weeds and algal mats along the shoreline at the recreation day use areas that pose entanglement risk hazards for swimmers and boaters.

DWR has received approval to apply copper compounds (copper sulfate pentahydrate, Komeen®, Nautique®, Captain XTR®, EarthTec®), diquat, endothall, fluridone, imazamox, sodium carbonate peroxyhydrate (PAK®27), and triclopyr on an as-needed basis to control aquatic weeds and algal blooms. The purpose of this control is so algal blooms do not degrade drinking water quality based on elevated geosmin and 2-Methylisoborneol (MIB) that cause tastes and odor problems, production of cyanotoxins, clogging of filters, and reduction in water flows. DWR added glyphosate to the list of aquatic herbicide treatment options for the SWP (DWR 2016b).

As part of DWR's Pesticide Application Plan, annual water quality monitoring and reporting is required. In 2016, diquat-based herbicides were applied three times and copper-based herbicides were applied once to the swim areas and boat-in day use areas in Pyramid Lake following permit guidelines (DWR 2017b). In July 2017, DWR treated these same areas in Pyramid Lake with Tribune® and copper sulfate following permit guidelines (DWR 2018c). Pyramid Lake swim areas and day uses areas were treated five times in 2018, using both diquat-based and copper-based herbicides in compliance with the permit (DWR 2019c). From 2016 to 2018, treatment acreage ranged from 2 to 100 acres, representing 0.2 percent to 7.7 percent of the surface acres of Pyramid Lake.

Blooms of cyanobacteria can result in the degradation of water quality from the production of cyanotoxins and taste and odor compounds. DWR monitors cyanotoxin levels in Pyramid Lake and issues recreational health advisories based on the guidelines provided by SWRCB, and will continue to do so in the future. DWR has not conducted algaecide treatments to control harmful algal blooms (HAB) in Pyramid Lake, to date, but this need may occur in the future, depending upon the severity of the HAB. MWD, in cooperation with DWR, routinely monitors taste and odor compounds (i.e., geosmin and MIB), natural byproducts of cyanobacteria during chlorophyll production that cause unpleasant taste and odors in finished drinking water. DWR's ongoing Taste and Odor Surveys, DWR's ongoing cyanotoxin surveys, as well as the types of cyanobacteria and aquatic invasive species plants present in Pyramid Lake and Elderberry Forebay are discussed in more detail in Exhibit E, Section 5.3, Fish and Aquatic Resources.

<u>Los Angeles Department of Water and Power Control of Aquatic Weeds and Algal Blooms</u>

LADWP received coverage under the General NPDES permit for Residual Aquatic Pesticides on July 22, 2016 to continue application of aquatic herbicides, when necessary, at LADWP facilities, including the Castaic Creek stormwater bypass channel check basins and emergency spillway. LADWP applies aquatic herbicides to remove vegetation that may affect debris basin performance, to eliminate blockages to stormwater flow, and as part of routine maintenance (SWRCB 2016).

<u>Warne Powerplant National Pollutant Discharge Elimination System Permit</u>

DWR discharges non-contact, once-through cooling water and drainage sump water to Pyramid Lake from the Warne Powerplant as permitted by Los Angeles RWQCB Order

No. R4-2016-0224 (NPDES No. CA0059188) issued on June 9, 2016, with an effective date of July 1, 2016 (Los Angeles RWQCB 2016). The design flow of the facility is 1.97 million gallons per day. To demonstrate compliance with permit conditions, water quality monitoring is conducted at the intake water near the penstocks, two effluent locations prior to entry into the powerplant tailrace to Pyramid Lake, and at the Pyramid Lake inlet (receiving water). The permit requires specific monitoring parameters and frequency at each of the sampling locations and submitting quarterly monitoring reports to the Los Angeles RWQCB (Tables 5.2-30 through 5.2-32).

Table 5.2-30. Warne Powerplant Influent Monitoring Requirements at INF-001 (Intake Water)

Parameters	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Turbidity[1]	NTU	Grab	1/Month	[2]
Mercury, Total Recoverable[1]	µg/L	Grab	1/Month	[2]
Chloride[1]	mg/L	Grab	1/Month	[2]
Nitrate plus nitrite (as N) [1]	mg/L	Grab	1/Quarter	[2]
E. coli[1]	MPN/100mL	Grab	5/Quarter[5]	[2]
TCDD Equivalents[3]	µg/L	Grab	2/Year	[2]
Asbestos		Grab	2/Year	EPA method 100.2
Other Priority Pollutants[4]	µg/L	Grab	1/Year	[2]

Source: Los Angeles RWQCB 2016
Notes:
[1]Intake water credits are provided for these constituents. Sampling location and timing of intake water and effluent shall be designed so that the intake water samples directly correspond to the effluent samples. The sampling protocol shall reflect the travel time of water in the Facility and detect any Facility contributions to the discharge.
[2]Pollutants shall be analyzed using the analytical methods described in 40 CFR part 136; for priority pollutants, the methods must meet the lowest MLs specified in Attachment 4 of the SIP, where no methods are specified for a given pollutant, by methods approved by this Regional Water Board or the State Water Board. If more than one analytical test method is listed for a given parameter, the Discharger must select from the listed methods and corresponding Minimum Level.
[3]TCDD equivalents shall be calculated using the following formula, where the MLs and the toxicity equivalency factors (TEFs) are as listed in the Table below. The Discharger shall report all measured values of individual congeners, including data qualifiers. When calculating TCDD equivalents, the Discharger shall set congener concentrations below the MLs to zero. U.S. EPA method 1613 may be used to analyze dioxin and furan congeners.
[4]Priority Pollutants as defined by the CTR are listed in Attachment I of Los Angeles RWQCB 2016
[5]Generally not less than five (5) samples should be taken equally spaced over a 30-day period with the first sample taken in the monitoring month (February, May, August, or November) for the required quarter. The results will provide sufficient data for the calculation of the geometric mean values.
Key:
CFR = Code of Federal Regulations
CTR = California Toxics Rule
EPA = U.S. Environmental Protection Agency
fibers/L = fibers per liter
mg/L = milligrams per liter
ML = minimum level
MPN/100mL = most probable number per 100 milliliters
NTU = Nephelometric Turbidity Units
TCDD = 2,3,7,8-Tetrachlorodibenzodioxin
µg/L = micrograms per liter

Table 5.2-31. Warne Powerplant Effluent Monitoring Requirements at EFF-001 (Non-Contact, Once Through Cooling Water)

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Flow	gpd	Meter	1/Day[1]	--
BOD (5-day @20 Deg. C)[2]	mg/L, lbs/day	Grab	1/Month	[3]
pH	s.u.	Grab	1/Month	[3]
Dissolved Oxygen	mg/L	Grab	1/Month	[3]
Temperature	ºF	Grab	1/Month	[3]
Turbidity[4]	NTU	Grab	1/Month	[3]
Oil and Grease[2]	mg/L, lbs/day	Grab	1/Quarter	[3]
TSS [2]	mg/L, lbs/day	Grab	1/Quarter	[3]
Hardness, Total (as $CaCO_3$)	mg/L	Grab	1/Quarter	[3]
Settleable Solids	ml/L	Grab	1/Quarter	[3]
Chloride[2, 4]	mg/L, lbs/day	Grab	1/Month	[3]
Ammonia Nitrogen, Total (as N)[2]	mg/L, lbs/day	Grab	1/Quarter	[3]
Nitrate plus Nitrite (as N)[2, 4]	mg/L, lbs/day	Grab	1/Quarter	[3]
E. coli [4]	MPN/100 ml	Grab	5/Quarter[5]	[3]
Boron	mg/L	Grab	2/Year	[3]
Iron, Total Recoverable	mg/L	Grab	2/Year	[3]
Sulfate	mg/L	Grab	2/Year	[3]
Total Dissolved Solids	mg/L	Grab	2/Year	[3]
Chronic Toxicity	Pass or Fail, % Effect	Grab	1/Year (Monthly during screening)[6]	[7]
Copper, Total Recoverable[2]	µg/L, lbs/day	Grab	1/Month	[3]
Mercury, Total Recoverable[2, 4]	µg/L, lbs/day	Grab	1/Month	[3]
Bis(2-exthylhexyl) Phthalate[2]	µg/L, lbs/day	Grab	1/Month	[3]
Asbestos	fibers/L	Grab	2/Year	EPA method 100.2
TCDD Equivalents[8]	µg/L	Grab	2/Year	[3]
Remaining Priority Pollutants[9]	µg/L	Grab	2/Year	[3]
Calcium	mg/L	Grab	2/Year	[3]
Sodium	mg/L	Grab	2/Year	[3]
Magnesium	mg/L	Grab	2/Year	[3]

Table 5.2-31. Warne Powerplant Effluent Monitoring Requirements at EFF-001 (Non-Contact, Once Through Cooling Water) (continued)

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Sodium Adsorption Ratio	--	Calculated[10]	2/Year	Calculated[10]
Title 22 Parameters				
Aluminum, Total Recoverable	µg/L	Grab	1/Year	[3]
Barium, Total Recoverable	µg/L	Grab	1/Year	[3]
Chromium, Total	µg/L	Grab	1/Year	[3]
Radioactivity, Gross Alpha	pCi/L	Grab	1/Year	EPA method 900.0
Radioactivity, Gross Beta	pCi/L	Grab	1/Year	EPA method 900.0

Source: DWR 2016c
Notes:
[1]The total daily flow volume shall be recorded daily during each period of discharge. Periods of no flow shall also be reported.
[2]The mass emission (lbs/day) for the discharge shall be calculated and reported using the measured concentration and the actual flow rate at the time of discharge, using the formula:

M = 8.34 x Ce x Q

where: M = mass discharge for a pollutant (lbs/day)

Ce = measured concentration for a pollutant (mg/L) Q = actual discharge flow rate (MGD)

[3]Pollutants shall be analyzed using the analytical methods described in 40 CFR part 136; for priority pollutants, the methods must meet the lowest MLs specified in Attachment 4 of the SIP, where no methods are specified for a given pollutant, by methods approved by this Regional Water Board or the State Water Board. If more than one analytical test method is listed for a given parameter, the Discharger must select from the listed methods and corresponding Minimum Level.
[4]Intake water credits are provided for these constituents. Sampling location and timing of intake water and effluent shall be designed so that the intake water samples directly correspond to the effluent samples. The sampling protocol will reflect the travel time of water in the Facility and detect any Facility contributions to the discharge.
[5]Generally not less than five (5) samples should be taken equally spaced over a 30-day period with the first sample taken in the monitoring month (February, May, August, or November) for the required quarter. The results will provide sufficient data for the calculation of the geometric mean values.
[6]Monthly sampling is required in the first three months. Species sensitivity screening shall be conducted during first three monthly monitoring in the first required monitoring. The species that exhibit the highest "Percent Effect" at the discharge IWC during species sensitivity screening shall be used for the routine annual monitoring.
[7]Refer to section V, Whole Effluent Toxicity Testing Requirements. "Pass" or "Fail" for Median Monthly Effluent Limitation (MMEL). "Pass" or "Fail" and "% Effect" for Maximum Daily Effluent Limitation (MDEL). The MMEL for chronic toxicity shall only apply when there is a discharge more than one day in a calendar month period. During such calendar months, exactly three independent toxicity tests are required when one toxicity test results in "Fail".
[8]TCDD equivalents shall be calculated using the following formula, where the MLs and the toxicity equivalency factors (TEFs) are as listed in the Table below. The Discharger shall report all measured values of individual congeners, including data qualifiers. When calculating TCDD equivalents, the Discharger shall set congener concentrations below the MLs to zero. U.S. EPA method 1613 may be used to analyze dioxin and furan congeners.

Dioxin-TEQ (TCDD equivalents) = C_X x TEF_X)

where: C_X = concentration of dioxin or furan congener x TEF_X= TEF for congener x

[9]Priority Pollutants as defined by the CTR are listed in the Monitoring and Reporting Program No. 6610, General Monitoring Provisions.
[10]Sodium Adsorption Ratio (SAR) = Na+ ÷ √(Ca++ + Mg++) ÷ 2
Key:
% = percent
ºF = degrees Fahrenheit
µg/L = micrograms per liter
-- = not required
BOD = biochemical oxygen demand
$CaCO_3$ = calcium carbonate
EPA = U.S. Environmental Protection Agency

fibers/L = fibers per liter
gpd = gallons per day
L = liter
lbs/day = pounds per day
mg/L = milligrams per liter
MPN/100ml = most probable number per 100 milliliters
N = nitrogen
NTU = Nephelometric Turbidity Unit
pCi/L = picocuries per liter
s.u. = standard unit
TCDD = 2,3,7,8-Tetrachlorodibenzodioxin
TSS = total suspended solids

Table 5.2-32. Warne Powerplant Effluent Monitoring Requirements at EFF-002 (Drainage Sump Water)

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Flow	gpd	Meter	1/Day[1]	--
Flow Duration	hours, days	Meter	--	--
BOD[2]	mg/L, lbs/day	Grab	1/Month	[3]
pH	s.u.	Grab	1/Month	[3]
Dissolved Oxygen	mg/L	Grab	1/Month	[3]
Temperature	ºF	Grab	1/Month	[3]
Turbidity[4]	NTU	Grab	1/Month	[3]
Oil and Grease[2]	mg/L, lbs/day	Grab	1/Quarter	[3]
TSS[2]	mg/L, lbs/day	Grab	1/Quarter	[3]
Hardness, Total (as $CaCO_3$)	mg/L	Grab	1/Quarter	[3]
Settleable Solids	ml/L	Grab	1/Quarter	[3]
Chloride[2, 4]	mg/L, lbs/day	Grab	1/Month	[3]
Chlorine, Total Residual[2]	mg/L, lbs/day	Grab	1/Month	[3]
Ammonia Nitrogen, Total (as N)[2]	mg/L, lbs/day	Grab	1/Quarter	[3]
Nitrate plus Nitrite (as N)[2,4]	mg/L, lbs/day	Grab	1/Quarter	[3]
E. coli [4]	MPN/100 ml	Grab	5/Quarter[5]	[3]
Boron	mg/L	Grab	2/Year	[3]
Iron, Total Recoverable	mg/L	Grab	2/Year	[3]
Sulfate	mg/L	Grab	2/Year	[3]
Total Dissolved Solids	mg/L	Grab	2/Year	[3]
Chronic Toxicity	Pass or Fail, % Effect	Grab	1/Year (Monthly during screening)	[7]
Copper, Total Recoverable[2]	µg/L, lbs/day	Grab	1/Month	[3]
Lead, Total Recoverable	µg/L, lbs/day	Grab	1/Month	[3]
Mercury, Total Recoverable[2, 4]	µg/L, lbs/day	Grab	1/Month	[3]
Zinc, Total Recoverable[2]	µg/L, lbs/day	Grab	1/Month	[3]
Bis(2-exthylhexyl) Phthalate[2]	µg/L, lbs/day	Grab	1/Month	[3]
Bromoform[2]	µg/L, lbs/day	Grab	1/Month	[3]

Table 5.2-32. Warne Powerplant Effluent Monitoring Requirements at EFF-002 (Drainage Sump Water) (continued)

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Chloroform[2]	µg/L, lbs/day	Grab	1/Month	[3]
Chlorodibromomethane[2]	µg/L, lbs/day	Grab	1/Month	[3]
Dichlorobromomethane[2]	µg/L, lbs/day	Grab	1/Month	[3]
Total Trihalomethanes	µg/L	Calculated[8]	1/Month	Calculated[8]
Tetrachloroethylene[2]	µg/L, lbs/day	Grab	1/Month	[3]
Asbestos	fibers/L	Grab	2/Year	EPA method 100.2
TCDD Equivalents[9]	µg/L	Grab	2/Year	[3]
Remaining Priority Pollutants[10]	µg/L	Grab	2/Year	[3]
Calcium	mg/L	Grab	2/Year	[3]
Sodium	mg/L	Grab	2/Year	[3]
Magnesium	mg/L	Grab	2/Year	[3]
Sodium Adsorption Ratio	--	Calculated[11]	2/Year	Calculated[11]
Title 22 Parameters				
Aluminum, Total Recoverable	µg/L	Grab	1/Year	[3]
Barium, Total Recoverable	µg/L	Grab	1/Year	[3]
Chromium, Total	µg/L	Grab	1/Year	[3]
Radioactivity, Gross Alpha	pCi/L	Grab	1/Year	EPA method 900.0
Radioactivity, Gross Beta	pCi/L	Grab	1/Year	EPA method 900.0

Source: DWR 2016c
Notes:
[1]The total daily flow volume shall be recorded daily during each period of discharge. Periods of no flow shall also be reported.
[2]The mass emission (lbs/day) for the discharge shall be calculated and reported using the measured concentration and the actual flow rate at the time of discharge, using the formula:
M = 8.34 x Ce x Q
where: M = mass discharge for a pollutant (lbs/day)
Ce = measured concentration for a pollutant (mg/L) Q = actual discharge flow rate (MGD)
[3]Pollutants shall be analyzed using the analytical methods described in 40 CFR part 136; for priority pollutants, the methods must meet the lowest MLs specified in Attachment 4 of the SIP, where no methods are specified for a given pollutant, by methods approved by this Regional Water Board or the State Water Board. If more than one analytical test method is listed for a given parameter, the Discharger must select from the listed methods and corresponding Minimum Level.
[4]Intake water credits are provided for these constituents. Sampling location and timing of intake water and effluent shall be designed so that the intake water samples directly correspond to the effluent samples. The sampling protocol will reflect the travel time of water in the Facility and detect any Facility contributions to the discharge.
[5]Generally not less than five (5) samples should be taken equally spaced over a 30-day period with the first sample taken in the monitoring month (February, May, August, or November) for the required quarter. The results will provide sufficient data for the calculation of the geometric mean values.

[6]Monthly sampling is required in the first three months. Species sensitivity screening shall be conducted during first three monthly monitorings in the first required monitoring. The species that exhibit the highest "Percent Effect" at the discharge IWC during species sensitivity screening shall be used for the routine annual monitoring.
[7]Refer to section V, Whole Effluent Toxicity Testing Requirements. "Pass" or "Fail" for Median Monthly Effluent Limitation (MMEL). "Pass" or "Fail" and "% Effect" for Maximum Daily Effluent Limitation (MDEL). The MMEL for chronic toxicity shall only apply when there is a discharge more than one day in a calendar month period. During such calendar months, exactly three independent toxicity tests are required when one toxicity test results in "Fail".
[8]The Discharger shall monitor for bromoform, bromodichloromethane, chloroform and dibromochloromethane and report the individual results as well as the sum of concentrations of these constituents. For summing of total trihalomethanes, the Discharger shall set concentrations below the MLs to zero.
[9]TCDD equivalents shall be calculated using the following formula, where the MLs and the toxicity equivalency factors (TEFs) are as listed in the Table below. The Discharger shall report all measured values of individual congeners, including data qualifiers. When calculating TCDD equivalents, the Discharger shall set congener concentrations below the MLs to zero. U.S. EPA method 1613 may be used to analyze dioxin and furan congeners.

Dioxin-TEQ (TCDD equivalents) = $C_X \times TEF_X$*)*

where: C_X *= concentration of dioxin or furan congener x* TEF_X*= TEF for congener x*

[10]Priority Pollutants as defined by the CTR are listed in the Monitoring and Reporting Program No. 6610, General Monitoring Provisions.
[11]Sodium Adsorption Ratio (SAR) = Na+ ÷ √(Ca++ + Mg++) ÷ 2

Key:
% = percent
ºF = degrees Fahrenheit
µg/L = micrograms per liter
-- = not required
BOD = biochemical oxygen demand
$CaCO_3$ *= calcium carbonate*
CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
fibers/L = fibers per liter
gpd = gallons per day
L = liter
lbs/day = pounds per day
mg/L = milligrams per liter
MPN/100ml = most probable number per 100 milliliters
N =nitrogen
NTU = Nephelometric Turbidity Unit
pCi/L = picocuries per liter
s.u. = standard unit
TCDD = 2,3,7,8-Tetrachlorodibenzodioxin
TSS = total suspended solids

While there have been exceedances of the limits for copper, lead, zinc, chlorodibromomethane, dichlorobromomethane, and tetrachloroethylene in 2010, DWR has worked with Los Angeles RWQCB to develop compliance strategies and has taken several steps to comply with the permit. These efforts have included replacing copper sampling lines with high density polyethylene (more commonly known as HDPE) lines, completing a dilution study to demonstrate that dilution credits apply to the discharge, and implementing various administrative controls in the O&M of the plant. Since these efforts were initiated, DWR has achieved a 98 percent reduction in the number and magnitude of the exceedances for copper, lead, zinc, chlorodibromomethane, dichlorobromomethane, and tetrachloroethylene. For example, while DWR exceeded the limits for these six constituents 103 times in the 12-month period from July 2010 to June 2011, the number of exceedances of the limits in 2014 for these same chemicals was reduced to two instances (DWR 2015c). While the exceedances have dropped significantly due to DWR's actions, other exceedances have been documented. For example, there were 10 violations documented between March 2017 and May 2018: one for dissolved oxygen, five for turbidity, two for biochemical oxygen demand, and two for pH. DWR and the Los Angeles RWQCB reviewed these matters and reached a settlement (Los Angeles RWQCB 2019).

Castaic Powerplant

LADWP pumps water from Elderberry Forebay back up to Pyramid Lake and also releases water from Elderberry Forebay to Castaic Lake (non-Project facility). The pumping of water from Elderberry Forebay to Pyramid Lake connects waters of the United States without subjecting the transferred water to intervening industrial, municipal, or commercial use (Los Angeles RWQCB 2013). Discharges from Castaic Powerplant subject to NPDES waste discharge requirements specified in Los Angeles RWQCB Order No. R4-2013-0093 (NPDES No. CA0055824) are summarized in Table 5.2-33.

Table 5.2-33. Discharges Associated with Castaic Powerplant

Outfall/Discharge Point Number	Operations	Maximum Discharge	Description/Treatment
001 (Reporting required, but no effluent limitations)	Pump back water from Elderberry Forebay to Pyramid Lake	1.1 billion gpd	Pump back water from Elderberry Forebay to Pyramid Lake/untreated water
002 (Reporting required, but no effluent limitations)	Recharge from Elderberry Forebay to Castaic Lake.	1.5 billion gpd	Discharge water from Elderberry Forebay to Castaic Lake (non-Project facility)/untreated water
Outfall/Discharge Points that Discharge to Elderberry Forebay			
003	Unit 7 Tailrace	380 MGD	No treatment
004	Oil water separator	179,505 gpd	Oil water separator
005	Dewatering, gallery, seal drain sumps	9,100 gpd	No treatment
	Compressor after cooler	3,000 gpd	No treatment
	Cooling water from air compressors	302,400 gpd	No treatment
	Industrial use water	1,500 gpd	No treatment
006	Backwash water from potable water system	1200 to 1500 gpd	Settling basin
See Note 1, below	Generator and turbine cooling water – Units 1, 2, 3, 4, 5, and 6	12,402,000 gpd	No treatment
See Note 1, below	Air compressor after-cooling water	691,200 gpd	No treatment
Total Discharges to Elderberry Forebay		**393,590,205 gpd (393.59 MGD)**	

Source: Los Angeles RWQCB 2013
Note:
[1]No designated Outfalls/Discharge Serial Number because the waste streams are discharged through underwater discharge points to Elderberry Forebay. These waste streams are not included in the Report of Waste Discharge.
Key:
gpd = gallons per day
MGD = million gallons per day

5.2.2 Effects of the Licensees' Proposal

This section discusses the potential environmental effects of the Licensees' Proposal on water resources. The Licensees' Proposal includes four measures related to water quantity and water quality which are included in Exhibit B. Measure AR1 would continue Article 52 in the existing license that states: "Stream releases from Pyramid Dam into Piru Creek shall match natural surface inflow into Pyramid Lake to the extent operationally feasible and consistent with safety requirements…." (see Exhibit B for additional details). Measure WR1 would continue Article 58 in the existing license that states: "Maintain Pyramid Lake at the highest level possible, commensurate with Project purposes, during summer for recreation.” Measures WR2 and GS1 would implement a Hazardous Materials Management Plan and an Erosion Control Plan, respectively. The three measures describe how the Licensees would address certain Project O&M actions that could have a negative effect on water quality.

Measure AR1 would provide that the Project releases of water into Pyramid reach have no significant effect on surface water; releases would continue to reflect the natural hydrograph of Piru Creek in both timing and magnitude to the extent operationally feasible and consistent with safety requirements under Article 52 of the existing license. SWP water would continue to be released between November 1 and the end of February for UWCD. Further, all SWP releases to UWCD would occur during a time of year when arroyo toads are not expected to be present in the stream channel, and would provide beneficial effects by displacing invasive predators such as bullfrog and crayfish, while also providing scouring to create new breeding and foraging habitat. Licensees propose that, for protection of the arroyo toad, no releases for water supply occur outside the timeframe of November 1 through the end of February unless USFWS provides written concurrence. Finally, allowing additional releases above the current license’s 3,150 AF limit will improve water quality in the groundwater basins within UWCD’s area of influence. Measure WR1 would assure that changes in water surface elevation in Pyramid Lake are minimal, thereby maintaining a release of cool water into Pyramid reach and maintaining the overall storage in Pyramid Lake.

As discussed in Section 5.2.1.2, water quality throughout the Project is generally consistent with WQOs of the Lahontan RWQCB and Los Angeles RWQCB Basin Plans. Based on the Licensees’ water quality sampling, there were four parameters for which samples were inconsistent with the Los Angeles RWQCB Basin Plan WQOs during at least one sampling event: (1) dissolved oxygen, (2) chloride, (3) sulfate, and (4) TDS. Dissolved oxygen concentrations were inconsistent with the Los Angeles RWQCB Basin Plan WQO for samples collected in Pyramid Lake at various depths. Dissolved oxygen concentrations in Pyramid Lake are consistent with what would be expected in a reservoir of Pyramid Lake’s size in inland California. Once the reservoir becomes stratified, the metalimnion (i.e., thermocline) acts as a barrier between the epilimnion and hypolimnion. This barrier limits oxygen exchange between the atmosphere and hypolimnion. Further, hypolimnetic depths are often too dark to support photosynthesis by plants and algae. As bacteria and other organisms consume oxygen, and without a means to replenish concentrations, the hypolimnion can become low in oxygen concentration (Wetzel 1983). The resulting low dissolved oxygen concentration has little effect on aquatic life, since relatively few species utilize the deeper portion of the reservoir. Additional discussion of fish population distribution in reservoirs is provided in Section 5.3.1.3. Dissolved oxygen concentrations near the surface that were inconsistent with the Los Angeles RWQCB Basin Plan WQO were not caused by the operation of the Project, but more likely were a product of water temperature, reservoir stratification or lack thereof, and interactions with the atmosphere. Further, of the 1,292 samples collected near the surface, 184 (14 percent) were inconsistent with the Los Angeles RWQCB Basin Plan WQO (Table 5.2-21) and occurred between September and November, when the reservoir is beginning to mix (i.e., not stratified). Chloride concentrations were inconsistent with the Los Angeles RWQCB Basin Plan WQOs for several samples collected in Pyramid Lake and in Pyramid reach. The Project does not introduce chloride into Pyramid Lake or Pyramid reach. As discussed above, chloride concentrations are elevated throughout the SWP from the San Francisco Bay-Delta all the way to the monitoring station above Warne Powerplant. In addition, during the Licensees' *Water Quality and Temperature Study*, chloride levels in Pyramid reach were highest at the sampling location 18 miles downstream of Pyramid dam (compared to sites located near the dam, and 1.5 miles and 3.0 miles downstream). Sulfate and TDS concentrations were inconsistent with the Los Angeles RWQCB Basin Plan WQOs in Pyramid reach only. Similar to chloride concentrations in Pyramid reach, the Licensees found that sulfate and TDS were inconsistent with Los Angeles RWQCB Basin Plan WQOs at the sampling location about 18 miles downstream of Pyramid Dam near Lake Piru and not at the three upstream sampling locations that were sampled at the same time period. The Project does not introduce sulfate or other materials to increase TDS into Pyramid reach.

The Licensees propose no changes to existing Project operations other than allowing for increased SWP deliveries to UWCD which will improve water quality in the groundwater basins within UWCD's area of influence, propose continuation of Articles 52 and 58 in the existing license, and expect to continue to adhere to the USFS 1969 Agreement, as amended, regarding water surface elevations in Pyramid Lake. According to Amendment 1 to the 1969 MOU between DWR and the USFS, during normal operating conditions, water surface level variations in Pyramid Lake may not exceed 14 feet during each 7-day period beginning midnight each Sunday, and may not exceed 8 feet each day. In addition, the water surface of Pyramid Lake may not be lowered below an elevation of 2,560 feet without taking additional safety precautions and making appropriate notifications. Therefore, the Licensees' Proposal, like the existing Project, is expected to have no adverse effect on water quality. If the Licensees propose any actions that could affect water quality (e.g., new construction, rehabilitation of Project features, sediment dredging, etc.), the Licensees would obtain all necessary permits and approvals, whereby the provisions of those permits and approvals would be protective of water quality.

The Licensees' proposed Measure WR2 would implement a Hazardous Materials Management Plan that would control introduction of hazardous materials into Project waters and mitigation of associated adverse effects. The plan will include information on spill prevention and response and cleanup of hazardous materials, particularly oil-based chemicals that may be used as fuel or lubricants. As such, implementation of Measure WR2 will prevent negative effects to water quality from hazardous materials.

The Licensees' application of aquatic pesticides to control aquatic weeds and algal blooms are implemented consistent with the requirements of the SWRCB-issued NPDES permits for Pyramid Lake and Elderberry Forebay. The total volume treated compared to the lake volume is minimal and would result in significant dilution to non-detectable levels when the treated water disperses away from the shoreline. Even less, if any, treated water could reach the dam outlet. In addition, treatments occur during the summer months when releases to Pyramid reach are minimal due to the minimal amount of natural inflows into Pyramid Lake. Given the infrequent treatments, the high dilution rate, the high bio-uptake rate, the low stream release flows during the summer months, and the depth of the stream release, bio-accumulation is extremely unlikely. The Licensees will continue to comply with State laws and obtain permits for those aquatic pesticide programs.

The Licensees' proposed Measure GS1 contains BMPs related to potential erosion in the Project area due to continued Project O&M. Measure GS1 will control sedimentation and erosion when stabilizing slopes affected by the Project, which will reduce adverse effects on water quality.

5.2.3 Cumulative Effects

The past, present, and future operation of the SWP and transfers of water through the South SWP Hydropower via the West Branch of the SWP have the potential to cumulatively affect water resources, particularly water temperature and dissolved oxygen in Pyramid reach from Pyramid Dam downstream to the confluence of Piru Creek with the Santa Clara River and Castaic Creek from Elderberry Forebay to Castaic Lake.

Cumulative effects in Piru Creek can be considered in two reaches: Pyramid reach and Lake Piru to the confluence with the Santa Clara River. Water temperature in Pyramid reach is discussed in detail above. Water temperature immediately below Pyramid Dam shows little diurnal variation indicating an influence from water released by the dam. At monitoring stations further downstream water temperatures show diurnal and seasonal variation indicating it is more influenced by other factors such as air temperature and sunlight. Water temperatures in Pyramid reach near Lake Piru may also be influenced by the two larger tributaries (Fish Creek [RM 6.5] and Agua Blanca Creek [RM 17]). In addition to the tributary inflow, Pyramid reach flows through a relatively narrow canyon for approximately 9 miles upstream of this monitoring location, which could influence water temperatures due to different shading, substrate, and water depths compared to the monitoring locations upstream. While there are limited data available in Pyramid reach for dissolved oxygen, DWR (1996) reported concentrations between 8.6 mg/L and 10.9 mg/L (Table 5.2-25). Releases from Pyramid Dam influence water temperature and dissolved oxygen, but additional factors contribute to these conditions once water reaches Lake Piru. When water released from Pyramid Dam reaches Lake Piru, it has been influenced by the natural conditions described above and, therefore, impacts to water temperature and dissolved oxygen below Lake Piru cannot be attributed solely to the Project. In the reach from Lake Piru to the confluence of the Santa Clara River, operations (lake level and flow) by UWCD, and other factors, would provide a greater effect on water temperature and dissolved oxygen.

Cumulative effects on water temperature and dissolved oxygen in Castaic Creek from Elderberry Forebay to Castaic Lake are minimal because water is discharged into

Castaic Lake almost directly from Elderberry Forebay. Given the size of the forebay compared to Castaic Lake, effects on overall water quality would be minimal.

5.2.4 Unavoidable Adverse Effects

The Licensees' Proposal is not expected to result in any significant and unavoidable adverse effects on water resources.

5.2.5 Response to Requests for Additional PM&E Measures and Studies

As described in Section 1.5.11, subsequent to filing the DLA with FERC, the Licensees received written requests from Relicensing Participants to include certain PM&E measures relative to water resources. After careful review and consideration, the Licensees did not adopt 22 preliminary proposed measures related to water resources. Each of these is discussed below including the Licensees' reasons for not adopting the measure. None of the comment letters requested the Licensees to conduct studies related to water resources. Refer to Table 1.5-6 of Exhibit E for the FERC E-Library Accession numbers to access the letters referenced below.

Upgrade Gages, Approach for Estimating Ungaged Accretion, and Pyramid Lake Release Management Systems so Pyramid Lake Releases Better Reflect Inflow to Pyramid Lake

As summarized below, USFS proposes the following:

- *More precise gaging, modeling of the ungaged watershed, and better instrumentation would provide more accurate flow information, allowing the Licensees to better match inflow to outflow; it is possible to automate the existing gages and tie that data stream to automated controls that could release flows from Pyramid Dam reducing reaction times.* [USFS' November 25, 2019 letter, page 4]

- *To better mimic natural outflows, the Licensees should upgrade the gages to hourly or better (15-minute), add telemetry, and upgrade release facilities to shorten the time needed to make changes.* [USFS' November 25, 2019 letter, pages 10-11]

- *At the least, there should be a method for accounting for changes in the landscape due to significant events that result in the ungaged watershed area being significantly different from the gaged portions. Following significant events (e.g. wildfire), the assumption that the 11 percent of land would provide the same overland flow should be checked and adjusted until the lands return to a state of similarity.* [USFS' November 25, 2019 letter, page 11]

- *In the FLA, the Licensees should propose upgrades (smaller time increment) to this gage [gaging station on upper Piru Creek located north of Pyramid Lake] to* *improve the inflow/outflow calculations.* [USFS' November 25, 2019 letter, page 11]

- *Regarding Measure AR1, USFS understands that GIS is the standard method for determining this difference. However, the FLA should provide a method for accounting for changes in the landscape due to significant events that result in the ungaged watershed area being significantly different from the gaged portions. Following significant events (e.g. wildfire), the assumption that the 11 percent of land would provide the same overland flow should be checked and adjusted until the lands return to a state of similarity.* [USFS' November 25, 2019 letter, page 12]

- *A straight GIS exercise to determine inflow from an ungaged portion of the watershed should not be the only method for determining inflow from the ungaged watershed. Following a disturbance that affect the vegetative cover, both in the gaged and ungaged areas, an analysis of changes to overland flow should be available to adjust inflow volumes until that vegetative cover and flow regime from the disturbed portion of the landscape returns to a similar condition across the landscape.* [USFS' November 25, 2019 letter, page 16]

- *More precise gaging, modeling of the ungaged watershed, and better instrumentation would provide the information to better match inflow to outflow.* [USFS' November 25, 2019 letter, page 20]

- *Article 52 implementation should be improved by improved modeling of the ungaged area to account for the heterogeneity inherent in the system (slope, aspect, cover, vegetation, etc.), collecting gage data at a smaller time step, and improving the efficiency of upstream data collection and outflow releases to bring the outflow timing and magnitude of flows into line with the actual inflows.* [USFS' November 25, 2019 letter, page 21]

As summarized below, NMFS proposes the following:

- *A flow and temperature gage (15-minute time steps and automated telemetry) is needed just downstream of Pyramid Dam to ensure flow magnitudes, ramping rates, and water temperatures are suitable for Southern California (SC) O. mykiss. Additionally, the gages upstream of Pyramid Lake also need to be upgraded to the same type of automated telemetry gage noted above so the Project can more effectively match inflow to outflow.* [NMFS' November 26, 2019 letter, page 5]

- *Therefore, matching outflow to inflow and the accounting for ungaged areas of Pyramid Lake's watershed needs to be more accurate. In addition, NMFS suggests upgrading and automating the existing gages (or provide new flow/temperature gages) and tie that telemetry data stream to automated controls* *that could release flows from Pyramid Dam so that outflow matches inflow more accurately.* [NMFS' November 26, 2019 letter, page 6.]

As summarized below, CDFW proposes the following:

- *CDFW requests the installation of automated gauges to deliver telemetry-based real-time data. CDFW recommends linking that data stream to automated controls that could release flows from Pyramid Dam so that reaction times could be lessened. The inflow-outflow rate should not exceed 1 hour of lag time. The use of daily, monthly, or yearly averages is not adequate to demonstrate matching the inflow ramping, peak, and duration of the natural storm inflows. The storm hydrograph discharge from Pyramid Dam should match storm hydrograph into Pyramid Lake in real time with no more than a one-hour lag time, and no more than 5 percent deviation of inflow/outflow discharge.* [CDFW Requested Condition #3-2 in its November 27, 2019 letter]

- *CDFW requests that vegetation, aspect, slope, and other modeling factors be used in a new analysis of ungauged flow into Pyramid Lake that allows for future adjustments in the factor if local conditions change over time (e.g., such as a wildfire and subsequent vegetative recovery).* [CDFW Requested Condition #3-7 in its November 27, 2019, letter]

- *CDFW requests the installation of automated, real-time flow and temperature-gauges immediate downstream of Pyramid Dam.* [CDFW Requested Condition #7-1 in its November 27, 2019, letter]

Specifically, USFS', NMFS', or CDFW's preliminary proposed measures include:

- Use modern modeling to take into account vegetative changes, slope, soils, landforms, and aspect to adjust the ungaged factor to account for differences between gaged and ungaged drainage area

- Following significant events (e.g. wildfire), check and adjust the modeling until the disturbed portion of the ungaged drainage returns to a state of similarity with the gaged portion

- Upgrade stream flow gages to hourly or better (15-minute) recording

- Add telemetry to gages and release facilities

- Upgrade release facilities to shorten the time needed to make changes to flow

As described in Exhibit B, Section 3.1.6.2, of this FLA, and consistent with Article 52 of the existing license, DWR takes several steps to determine Pyramid Lake outflow. Staff refer to the CDEC website to determine the flow at the upstream gage on Piru Creek (15-minute increments) and manually read the Cañada de Los Alamos gage. Staff then use the stage reading and rating curve for the gage to determine the flow at each gage, sum the two flow readings, and increase the value by 10.8 percent to account for the ungaged portion of the watershed. After the total inflow is calculated, once a day, staff access the Pyramid stream release and manually adjust one or more of the four valves (an 8-inch pressure reducing valve, a 16-inch fixed cone valve, and two 36-inch fixed cone valves) in the low-level outlet so that the Pyramid Lake outflow tracks the calculated inflow consistent with Article 52. The 8-inch valve is typically always open; and should additional valves need to be used, staff must access the stream release vault, open guard valves, and calibrate measuring devices before the 16-inch and two 36-inch valves can be opened.

One of the primary reasons the larger valves are closed and protected by guard valves when not in use is public safety. During large storm events, two staff are stationed at Pyramid Dam to operate and adjust the spillway radial gate and the valves in the low-level outlet, sometimes up to several times a day, to track inflows.

As acknowledged in Article 52, "instantaneous peak stream releases may be attenuated." Also due to use of a multiplier to account for ungaged tributaries, Article 52 recognizes, "This may result in some deviations for individual storm events due to localized variations in storm water intensity." When approving the modifications to Article 52 in 2009, FERC recognized that inflow and outflow cannot be matched precisely and instantaneously. The intent is to have operational releases reflect the natural hydrograph for protection of downstream resources. Operational data show that, generally, operational staff have done a good job with releases, and the natural hydrograph is clearly reflected in the data.

Stream flow records for the upstream gages and Pyramid Lake outflow are reviewed and certified by USGS annually. In order to comply with USGS accuracy standards, DWR staff visit the upstream gages and use current meters to take stream flow measurements and verify the accuracy of the gage data. Staff visit the gage on Piru Creek twice per month and the gage on Cañada de Los Alamos once a week. SMAR™ differential pressure transmitters on each valve in the low-level outlet continuously measure outflow and transmit the data to a digital recorder. The SMAR differential pressure transmitters have an accuracy rating of 99 percent or greater.

Otherwise, the Licensees did not adopt USFS', NMFS', and CDFW's preliminary proposed measures for two reasons. First, while the agencies provided some specificity, key details are not provided. For instance, the agencies do not describe what "modern model" and release facilities upgrades are proposed, or the cost to implement their preliminary proposed measures. Second, USFS, NMFS, and CDFW provide no rationale for their preliminary proposed measures other than that, in the agencies' opinions: (1) significant differences between outflow and inflow occur; and (2) these differences have ramifications for the habitat under the management of the agencies. With regard to the first argument, the Licensees do not claim, nor is it the purpose, that the Licensees' proposed measure results in outflow exactly matching inflow – only that outflow mimics natural inflow, except when SWP deliveries are being made to UWCD. In general, outflow clearly reflects inflow, as shown in Figure 5.2-2. With regard to habitat, the agencies provide no evidence that habitat is adversely affected by Project operations, let alone that if outflow more closely reflected natural inflow or even if outflow was exactly the same as inflow, the undefined adverse effects would suddenly no longer occur. In fact, in its Final EA for the Amendment to Article 52 of the existing license, FERC concluded that the adjustment of Project operations to provide outflows mimicking inflows would "improve habitat for *O. mykiss* by providing more dynamic geomorphic stream processes and creating deeper pools with cooler water temperatures," and that the resulting "increased scour would improve cottonwood recruitment, which would be a source of large wood debris…" (FERC 2008). Without clarity from USFS, NMFS, and CDFW, the Licensees cannot evaluate whether the agencies preliminary proposed measures are reasonable and what benefit they would provide for the additional cost.

Nevertheless, the Licensees developed rough cost to implement the agencies preliminary proposed measures, to the extent the Licenses understand them.

The Licensees assume the cost of installation of the upstream gages, gage houses, telemetry equipment, and calibration on the two creeks entering Pyramid Lake as proposed by the agencies would be a one-time cost of $80,000 for each gage. Annual O&M on each gage is assumed to be $20,000 per year. The Licensees estimate that the annual cost of reporting data from the two gages either real-time via a website or as an annual report to the agencies would be $10,000 for each gage. Therefore, the cost of installing, maintaining and reporting data from the two proposed upstream gages would be $1,960,000 over 30 years, or an annual levelized cost of $65,333.

To link the Pyramid Dam outlet works to the upstream gages so that adjustments to the downstream releases into Pyramid reach are tied more closely to inflow would require modifications to the outlet works. The modifications would include replacement of the outlet valves, installation of valve controls, temporary alternative passage of downstream flows, installation and updates to the SCADA system, a 20 percent contingency for construction costs, a 30 percent contingency for implementation costs, and any necessary permitting at a one-time cost of $4,293,750. The Licensees estimate that the annual O&M on the new system would be $20,000 annually. Therefore, the cost of modifying the outlet works would be $4,893,750 over 30 years, or an annual levelized cost of $163,125.

The Licensees estimate that the cost to develop a more precise model to account for the ungagged watershed would cost $60,000, or an average annual cost of $2,000.

Therefore, the Licensees estimate the cost to implement the agencies' preliminary proposed measure would be $6,913,750, or an average annual levelized cost of $230,458.

Given that the Licensee current operation of the low level release valves is 98 percent accurate and the safety considerations relative to the adjustment of flows, the cost of

$6,913,750 to implement USFS', NMFS', and CDFW's preliminary proposed measures is not warranted.

Provide Release Schedule for UWCD Water Deliveries

NMFS proposes that a release schedule for the water delivery to UWCD should be developed each year in consultation with NMFS, USFWS, and CDFW, which should show the days and rates for ramping up and down (protective for SC O. mykiss) and the number of days for the peak of the release. [NMFS' November 26, 2019 letter, pages 5 and 6]

CDFW requests a release schedule for the water delivery to UWCD be developed each year. This schedule should show specific days and rates for ramping up and down (to protect all aquatic species) and the number of days for the peak of the release. [CDFW Requested Condition #3-4 in its November 27, 2019 letter]

The Licensees did not adopt the agencies' proposed measure, primarily because it would be impracticable to implement, as there is no way to know in advance when natural storm events will occur, which would change any pre-approved release schedule. Seeking additional approvals to change a release schedule when storms approach is impracticable. Further, the Licensees are concerned that obtaining agency concurrence on a release schedule could unnecessarily delay needed water deliveries to UWCD. Seeking agency concurrence also unnecessarily inserts agencies into administration of an SWP long-term water supply contract. In addition, the agencies provide no explanation of how developing a release schedule for agency approval would provide environmental benefits to any species.

Change UWCD Delivery Wording in New FERC License

UWCD proposes to replace the wording in the existing license with the following proposed alternative language in the new FERC license:

> *State Water Project water will be delivered to United Water Conservation District via Pyramid reach (from Pyramid Dam). Water deliveries made between November 1 and the end of February of each water year., up to 3,150 AF, may be made over a period of a few days, ramping flows up and down to simulate the hydrograph of a typical storm event, or they may be released more gradually over a longer period. Water deliveries made between November 1 and the end of February of each water year, and exceeding 3,150 AF, are required to simulate the hydrology of a typical storm event, and the timing of the release should coincide with a natural storm event when possible. Water deliveries made between March 1 and October 31 may only be made under conditions that would qualify for a no effect determination, or a determination that such deliveries may, but are not likely to, result in adverse effects to protected species or their designated critical habitat.* [UWCD's November 27, 2019 letter, page 1]

The Licensees propose to remove the 3,150 AF constraint between the months of November through February. As stated in FERC's Order Modifying and Approving Temporary Flow Variance dated January 3, 2020, there is benefit to aquatic resources in additional water releases when winter flows are elevated and because arroyo toads and other sensitive species are not present. The Licensees have not adopted UWCD's proposal for deliveries between March 1 to October 31, because arroyo toads may be present.

Conduct Water Quality Monitoring and Include Condition for Mitigation of TMDL Actions

USFS proposes the following:

- *Sampling should be conducted of all inflow sources i.e., State Water Project canal from the Delta, upstream tributaries, to determine the extent of 303(d) listed chemicals as well as rule in or rule out each as a possible source.* [USFS' November 25, 2019 letter], page 20]

- *Monitoring of the SWP water inflow should be included in the monitoring scheme to track the level of chloride introduced to the system.* [USFS' November 25, 2019 letter, page 21]

- *The Licensees need to have a condition that mitigations and actions required by the Los Angeles RWQCB as part of any TMDL actions on Pyramid Lake will be borne by the Licensees at a percentage equal to the percentage of Bay-Delta water brought into the area compared to local runoff.* [USFS' November 25, 2019 letter, page 22]

The Licensees did not adopt USFS' preliminary proposed measure for additional water quality sampling of SWP water and tributary inflow into Pyramid Lake to determine the extent of CWA Section 303(d) listed chemicals for two reasons. First, USFS has not produced any evidence indicating that the Project introduces chemicals of concern to the watershed or that the Licensees' existing water sampling mechanisms are inadequate or insufficient. The Licensees' water quality sampling did not find unusual levels of mercury, chlordane, DDT, and PCBs in Pyramid Lake, and the Project does not use these chemicals. So, there is no reason to believe that the Project contributes to these chemicals in the watershed. Second, if the chemicals are being introduced to the watershed by a non-Project activity, the Licensees have no means or authority to investigate the source of such introduction or to remedy it. Finally, the Licensees vigorously disagree with USFS' unsupported statement that the Licensees must take primary responsibility for TMDLs in the watershed. The Licensees anticipate that responsibility regarding TMDLs will be determined during the collaborative development of appropriate TMDL plans.

Encase Gorman Bypass Channel

USFS proposes that the FLA discuss the costs to encase the Gorman Bypass channel throughout to prevent removal of local precipitation from support of USFS resources. [USFS November 25, 2019 letter, page 6]

The Licensees did not adopt USFS' preliminary proposed measure to encase the Gorman Bypass Channel for two reasons. First, USFS did not provide any details regarding its preliminary proposed measure, including how much of the channel would be encased, what type of material would be used, and what the cost would be to implement the measure. Second, USFS provided no rationale for its proposed measure other than that it would be in "support of Forest Service resources." USFS has not described what resources, or how they are currently adversely affected by some local precipitation being intercepted in the Gorman Bypass Channel, especially since based on the Licensees' GIS mapping, no NFS lands occur downslope from the Gorman Bypass Channel (i.e., precipitation runoff intercepted by the channel would not otherwise flow onto NFS lands until it reaches Pyramid Lake).

While USFS did not provide a cost estimate to implement USFS preliminary proposed measure, the Licensees developed a rough cost estimate based on some broad assumptions. The Licensees estimate that a nominal 8-foot diameter reinforced concrete pipe would be suitable to convey the up to 900 cfs and as high as 32 fps flows experienced in the Gorman Bypass Channel. At a cost of $17,280 per foot, the total material cost of the pipe would be $547,430,400. Assuming a 20 percent contingency for construction costs ($109,486,808) and a 30 percent contingency for implementation costs ($197,074,944), the total estimated cost to encase the Gorman Bypass Channel would be $853,991,424. Given that the Gorman Bypass Channel has no effect on NFS lands or resources on NFS lands, a cost of almost $854 million for a project with no described benefit is not supported by the Licensees.

Implement Water Quality and Flow Adaptive Management Program

NMFS notes that the DLA does not propose any new water flow or water temperature gages, and that there is no proposed measure for adaptive management of Pyramid Dam's releases based on data from the proposed gages. NMFS suggests that the data from these gages are needed to monitor and adaptively manage water quality to benefit isolated SC O. mykiss that exist downstream of Pyramid Dam in Middle Piru Creek. [NMFS' November 26, 2019 letter, page 5]

CDFW requests a measure for the adaptive management of water releases from Pyramid Dam based on data from these requested gages with pre-identified acceptable temperature ranges and flow regimes as a starting point to inform adaptive management measures. Additionally, CDFW suggests that the gages and adaptive management of such data are essential to monitor and maintain water quality for the isolated native coastal rainbow trout that exist downstream of Pyramid Dam keep fish in *good condition pursuant to Fish & Game Code, Section 5937.* [CDFW Requested Condition #7-2 in its November 27, 2019 letter]

The Licensees did not adopt NMFS' and CDFW's preliminary proposed measures regarding: (1) adding additional flow and water temperature gages; or (2) adding adaptive management. The Licensees have not adopted the agencies' proposed measures for two main reasons. First, NMFS and CDFW did not provide specificity regarding the location of the gages, what adaptive management would occur, or the cost to implement their preliminary proposed measures. Second, and most important, NMFS and CDFW state that additional data are needed to adaptively manage water quality, including flow and temperature, to benefit rainbow trout that exist in Pyramid reach. However, neither NMFS nor CDFW suggest what this adaptive management would entail, or even if it is possible. Therefore, using the data from the gages if installed and enhanced would be problematic at best. Without this clarity, the Licensees cannot evaluate NMFS' and CDFW's preliminary proposed measures.

<u>Increase Flow Releases</u>

NMFS notes that there does not appear to be any ramping rates, for the protection of SC O. mykiss, for any flows released from Pyramid Dam. NMFS proposes that ramping rates be discussed, developed, and included in the FLA. [NMFS' November 26, 2019 letter, pages 5 and 6]

CDFW requests that FERC include measures for the release of higher minimum instream flows during winter and spring months with summer, fall, and spring pulse flows to improve conditions for native aquatic species in Piru Creek below Pyramid Dam. [CDFW Requested Condition #3-1 in its November 27, 2019 letter]

The Licensees did not adopt NMFS' and CDFW's preliminary proposed measures regarding releasing from Pyramid Dam higher minimum instream flows during winter and spring months with summer, fall, and spring pulse flows, and ramping rates for four reasons. First, neither NMFS nor CDFW provide a rationale for their preliminary proposed measures other than saying they would improve conditions for rainbow trout and other aquatic species in Pyramid reach. Neither agency describes how its preliminary proposed measure would improve conditions (i.e., state what is wrong with existing conditions or what specific changes NMFS and CDFW would expect to occur if its preliminary proposed measures were implemented). Without this information, the Licensees cannot evaluate NMFS' and CDFW's preliminary proposed measures. Second, neither NMFS nor CDFW provide specificity regarding what ramping rates they propose, and CDFW provides no specificity regarding what the higher flows would be, their timing, and the cost to implement the preliminary proposed measure. Third, the preliminary proposed measures by NMFS and CDFW are inconsistent. In its preliminary proposed measure #3-1, CDFW recommends higher minimum instream flows during winter and spring months with summer, fall, and spring pulse flows, while in CDFW's preliminary proposed measure #3-2, CDFW recommends that releases more closely match inflows into Pyramid Lake with no more than a one-hour lag. NMFS also urges the Licensees to better match outflow to inflow. The agencies' proposed measures appear to be contradictory, with the result that it is not clear what NMFS and CDFW propose for flows. Fourth, the current flow requirements of Article 52, which reflect the natural hydrograph to the extent practicable, were put in place to avoid the illegal take of arroyo toads under the ESA and to benefit aquatic species. The agencies do not explain how their proposed alterations from the natural hydrograph would meet these objectives.

5.3 FISH AND AQUATIC RESOURCES

This section is divided into five subsections. Section 5.3.1 describes existing Project conditions, and includes six main subsections: (1) special-status aquatic species, (2) aquatic invasive species (AIS), which includes a discussion on the use of algaecides and aquatic herbicides, (3) fish, (4) amphibians and semi-aquatic reptiles, (5) aquatic mollusks, and (6) aquatic benthic macroinvertebrates (BMI). Potential environmental effects of the Licensees' Proposal are described in Section 5.3.2, and cumulative effects and unavoidable adverse effects are addressed in Sections 5.3.3 and 5.3.4, respectively. Section 5.3.5 responds to requests for additional PM&E measures and/or studies.

The Licensees augmented existing, relevant, and reasonably available information relative to fish and aquatic resources by conducting the following seven relicensing studies: Study 4.1.1, *Aquatic Invasive Species*; Study 4.1.*2, Quail Lake Fisheries Assessment*; Study 4.1.3, *Pyramid Reach Fish Populations*; Study 4.1.4, *Special-Status Aquatic Amphibians and Semi-Aquatic Snakes*; Study 4.1.17, *Fish Entrainment Risk Assessment*; Study 4.1.21, *Pyramid Reach Benthic Macroinvertebrates*; and Study 4.1.22, *Pyramid Lake Tributaries Fish Passage Barriers*, herein referred to as Study 4.1.1, Study 4.1.2, Study 4.1.3, Study 4.1.4, Study 4.1.17, Study 4.1.21, and Study 4.1.22, respectively. The studies are complete and the results are incorporated into this section. Refer to Appendix B of this Exhibit E or to the South SWP Hydropower relicensing website (http://south-swp-hydropower-relicensing.com/) for the detailed study approaches, study summaries, and detailed study data.

5.3.1 Existing Environment

5.3.1.1 Special-Status Aquatic Species

For the purpose of this Application for New License, a special-status aquatic species is considered an aquatic species occurring as a native (i.e., not introduced) species in its native range and that is: (1) found on NFS lands and listed by the USFS as Sensitive (FSS), except for those species also listed under the ESA; (2) listed by the State as threatened or endangered under the California Endangered Species Act (CESA); (3) listed by CDFW as a species of special concern (SSC), except for those listed under the ESA; (4) listed by BLM as a sensitive species (BLM-S); or (5) considered fully protected (FP) under State law. Aquatic species that are listed as federal threatened

(FT), federal endangered (FE), or proposed or a candidate for listing under the ESA, are addressed in Section 5.4.3.

Arroyo chub (*Gila orcutti*) and Sacramento hitch (*Lavinia exilicauda*) are listed as SSC, but they each occur in the Project vicinity only as introduced species outside of their native ranges. The arroyo chub is native to coastal drainages of the Los Angeles plain, where much of its habitat has been lost or degraded by development. There are records of introduced arroyo chub in the Santa Clara River (CDFW 2018b) and Agua Blanca Creek (a tributary of Piru Creek) (USFS 1979). Sacramento hitch is native to Central California, including the Sacramento-San Joaquin River system in low elevation streams and the Delta. Currently, the species occurs in scattered small populations across much of the native range, with the exception of the southern San Joaquin River and its tributaries where Sacramento hitch are now absent (CDFW 2018a). Outside of its native range, populations of Sacramento hitch have been established in the San Luis Reservoir and other reservoirs. These occurrences are attributed to transport by the SWP (Moyle 2002). According to the literature, hitch have been observed in Pyramid Lake (CDFG 2001; Moyle 2002). DWR (1997a) included hitch in the list of species that might be found in Quail Lake. Despite these references, the Licensees could not find specific information documenting the observations, and did not find hitch to be present in Quail Lake during the Quail Lake relicensing study (Study 4.1.2).

The Licensees' PAD filed with FERC on August 1, 2016 included Santa Ana sucker (*Catostomus santaanae*) as a special-status species, because at that time the species was listed by CDFW as SSC. However, the species was subsequently removed from the SSC list by CDFW (2018a). Although Santa Ana sucker is listed as threatened under the ESA, populations within the Santa Clara River drainage are not covered by the ESA listing, which includes only populations in the Santa Ana, Los Angeles, and San Gabriel river drainages (71 FR 19686); there is no designated critical habitat for Santa Ana sucker within the Santa Clara River drainage. At the time of the listing, the population in the Santa Clara River drainage was believed to be introduced and hybridized with introduced Owens sucker (*C. fumeiventris*) and was only subsequently determined to be native to the Santa Clara River and was of pure stock (Richmond et al. 2018). Information regarding Santa Ana sucker is presented in Section 5.3.1.3 below.

The Licensees developed the list of aquatic special-status species known or with the potential to occur in the Project vicinity by first reviewing the available documentation on CDFW's website, which lists SSC, as well as species listed by other agencies such as USFS Sensitive Species and BLM Sensitive Species lists (CDFW 2018a; USFS 2013; BLM 2014). A query of the CDFW California Natural Diversity Database (CNDDB) (CDFW 2018b) was then performed based on a search of the USGS 7.5-minute quadrangles in which the Project is located (i.e., Lebec, La Liebre Ranch, Black Mountain, Liebre Mountain, Whitaker Peak, Warm Springs Mountain, and Newhall), and the adjacent quadrangles (i.e., Burnt Peak, Cobblestone Mountain, Green Valley, Piru, Val Verde, and Mint Canyon) covering approximately 774 square miles. This is an area much larger than that potentially affected by the Project, but is intended to establish an initial comprehensive list. The Licensees also reviewed species' range maps and other information regarding known distribution, habitat associations, and requirements to determine whether any species should be added or excluded from the list.

Based on this exercise, the Licensees determined that there are four native aquatic special-status species documented in the CNDDB database and a fifth species, not reported by the CNDDB, was added based on limited available information. The Licensees' final list of special-status species that may occur in the Project area or otherwise may potentially be affected by the Licensees' Proposal therefore included:

- Foothill yellow-legged frog (*Rana boylii*)
- Western spadefoot (*Spea hammondii*)
- Two-striped gartersnake (*Thamnophis hammondii*)
- "South coast gartersnake" (i.e., occurrences of California red-sided gartersnake [*Thamnophis sirtalis infernalis*] from coastal Ventura County to San Diego County)
- Southern western (or western) pond turtle (*Actinemys* [=*Emys*] *pallida* [or *marmorata pallida*])

Table 5.3-1 describes the status, habitat associations, and known occurrences in or near the existing Project boundary for each of these five species.

Table 5.3-1. Special-Status Species Potentially Affected by the Project

Common Name *(Scientific Name)*	Status	Habitat Associations	USGS Quadrangles in Project Vicinity with Known Historical or Recent Occurrences
Foothill yellow-legged frog (*Rana boylii*)	SE, BLM-S	Associated with partially shaded perennial streams with backwater habitats and riffles, and coarse substrates. Found historically from Oregon south to at least Los Angeles County, but may be extirpated in southern California.	Black Mountain, Burnt Peak, Cobblestone Mountain, Piru, Whitaker Peak
Western spadefoot (*Spea hammondii*)	SSC, BLM-S	Breeds in seasonal pools, ponds, and intermittent streams within grasslands, oak woodlands, and occasionally chaparral.	Mint Canyon, Newhall, Val Verde, Whitaker Peak
Two-striped gartersnake (*Thamnophis hammondii*)	SSC, FSS, BLM-S	Highly aquatic and mostly associated with rocky streams (sometimes at ponds) with dense riparian vegetation from near sea level to 8,000 foot elevation.	Cobblestone Mountain, Green Valley, Lebec, Mint Canyon, Piru, Val Verde, Whitaker Peak, Warm Springs Mountain
South Coast gartersnake (*Thamnophis sirtalis infernalis*)	SSC	Highly aquatic (presumed) and associated with marsh and adjacent upland habitat near permanent water and dense, riparian vegetation. Found in and adjacent to the coastal plain from Ventura to San Diego counties.	Documented by one record in the Piru quadrangle by Jennings and Hayes (1994)
Southern western (or western) pond turtle (*Actinemys* [*Emys*] *pallida* [or *marmorata pallida]*)	SSC, FSS, BLM-S	Found in permanent ponds, lakes, side channels, backwaters, and pools of streams. May spend long periods aestivating and over-wintering in terrestrial habitats.	Cobblestone Mountain, Lebec, Newhall, Piru, Val Verde, Whitaker Peak, Warm Springs Mountain

Sources: CDFW 2018a; Jennings and Hayes 1994
Key:
BLM-S = BLM sensitive species
CNDDB = California Natural Diversity Database
FSS = Forest Service Sensitive
FT = Federally Threatened
SE = State endangered under CESA
SSC = State species of special concern

Additional information regarding each of these special-status aquatic species is below.

Foothill Yellow-legged Frog[2]

Foothill yellow-legged frog (FYLF) was listed on December 11, 2019 under CESA, with the Southwest/South Coast clade designated as endangered, along with two other clades, two clades designated as threatened, and one clade not listed. Compared to historical distribution, this stream-adapted species has undergone range-wide declines, especially within the area of the Southwest/South clade in southern California, where only two small populations are known to persist near the border of Monterey and San Luis Obispo Counties (CDFW 2017; NatureServe 2019). These declines have been attributed to multiple factors, including pollution, disease, introduced species, climate change, and changes to stream hydrology from dams and water developments (Center for Biological Diversity 2016).

FYLF is usually associated with partially shaded, perennial streams containing backwater habitats and riffles, and coarse substrates, especially cobbles and small boulders (Kupferberg 1996; Stebbins 2003; Jennings and Hayes 1994). Long-term persistence of FYLF populations may require both mainstem and tributary habitats. Streams too small to provide breeding habitat for this species may be critical as seasonal habitats, such as in winter and during the hottest part of the summer (Van Wagner 1996). Evidence suggests that habitat use by young-of-the-year (YOY), subadult and adult frogs differs by age-class and can change seasonally (Randall 1997; Haggarty 2006). Breeding tends to occur in spring or early summer. A site in northwestern California was studied for six years, and the period of breeding activity varied from 3 to 7.5 weeks (Wheeler and Welsh 2008). Eggs are laid in areas of shallow, slow moving waters near the shore and are often associated with depositional features.

FYLF is infrequent in habitats where introduced fish and American bullfrogs (*Lithobates catesbeianus*) are present (Jennings and Hayes 1994). Tadpoles may be particularly vulnerable to predation by introduced fish, such as smallmouth bass (*Micropterus dolomieu*) (Paoletti et al. 2011), and American bullfrogs (Kupferberg 1996, 1997).

FYLF was historically present in the Project vicinity, including presence at multiple documented locations on Pyramid reach. The CNDDB (CDFW 2018b) includes nine records of FYLF on the Black Mountain, Burnt Peak, Cobblestone Mountain, Piru, and Whittaker Peak quadrangles, all associated with Piru Creek. All CNDDB records for FYLF are characterized as “extirpated.” These reported museum collection records and sightings of FYLF occurred mostly between 1940 and 1970 at numerous locations distributed from about 2.5 RM to 18 RM downstream of Pyramid Dam, and at different times of year from March 26 to June 15. The most recent, verifiable record from the region occurred on April 17, 1970, near the mouth of the tributary, Turtle Canyon, 14

[2] Photo credit: Stephen Nyman, PhD

RM downstream of Pyramid Dam. Another reliable, but unverifiable observation of one FYLF occurred on Pyramid reach approximately 0.6 to 1.2 miles south of Frenchmans Flat in July 1977 (Jennings and Hayes 1994). The authors regarded FYLF as apparently extirpated in much of its southern California range and attributed extreme flooding in 1969 as “largely responsible.” The CNDDB (2018b) also notes that FYLF was “not found by independent research crews in southern California in 1981-1993, 1988-1991, or 2011-2014.” Specific locations of these independent research crew surveys are not indicated, but likely included at least some surveys in Piru Creek.

Arroyo toad (*Anaxyrus californicus*) surveys conducted by Sandburg (2005, 2006) and annual surveys for arroyo toad and other sensitive species performed by DWR every year since 2010 (normally between March through June) in a 6.5- to 7-mile section of Pyramid reach between the inlet of Lake Piru to Ruby Canyon and about a 1.5-mile segment of Agua Blanca Creek have not detected FYLF (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a).

Adams et al. (2017) examined and tested museum specimens of FYLF and other amphibians collected in southern California for evidence of the amphibian fungal pathogen *Batrachochytrium dendrobatidis* (Bd) responsible for chytridiomycosis, interviewed biologists and naturalists with long field experience in southern California, and reviewed contemporaneous field notes to assess historical changes in the abundance of FYLF and the probable causative factors. The authors found evidence that Bd spread from the Los Angeles area where it occurred as early as 1915, and steadily increased in the surrounding region beginning in the 1970s, at the same time that field observations indicated that FYLF was disappearing or declining in abundance at sites in southern California, as summarized by Hayes et al. (2016). None of the Adams et al. (2017) interviewees reported sightings of FYLF in southern California later than the July 1977 Piru Creek observation originally presented by Jennings and Hayes (1994) described above, which was confirmed by interview. Hayes et al. 2016 reports that there have been no recorded specimens collected on the LPNF from 1980 to the present. Adams et al. (2017) concluded that FYLF likely underwent rapid extirpation throughout southern California principally from disease, although scouring by extreme floods in January and February 1969 or other factors may have hastened the disappearance of weakened FYLF populations at some locations.

The Licensees’ Studies 4.1.3 and 4.1.4 surveyed for FYLF in Pyramid reach. However, none were detected. Study 4.1.4 included surveys for FYLF using standard accepted protocols for visual encounter surveys (VES) developed for FYLF (Peek et al. 2017; Seltenrich and Pool 2002), with three survey visits to each site designed to detect the different FYLF life stages. Stream reaches with potential habitat for FYLF were identified by a desktop review of aerial imagery and other information, followed by a pre-survey reconnaissance on February 27, 2018 and February 28, 2018. As described in the Revised Study Plan, the purpose of the reconnaissance was to assess potential survey sites for the presence of suitable habitats for the target species, including potential egg deposition habitat for FYLF. Surveys, which are detailed below, were subsequently performed in areas of suitable habitat. Potential habitat in the study area is limited to Piru Creek, upstream and downstream of Pyramid Lake (Figure 5.3-1). Seasonal streams, including ephemeral channels that hold water only after heavy precipitation that are not tributaries of streams with persistent aquatic habitat were not potential FYLF habitat. Los Alamos Creek and Gorman Creek include sections with apparent perennial flows. However, both streams are situated within 50-foot-deep, incised channels, with fine-grained (i.e., sand and silt) substrates, and dense emergent and overhanging riparian vegetation inconsistent with FYLF habitat. Nonetheless, the Licensees surveyed these streams for FYLF at the same time as when the Licensees surveyed them for special-status gartersnakes and no FYLF were observed. Piru Creek within the proposed Project boundary upstream of Pyramid Lake includes approximately 1,700 feet of stream; however, much of this stream is periodically inundated by Pyramid Lake, particularly during late winter and early spring, which may preclude use by FYLF. The reach is characterized by sand substrate and during exposed periods is dominated by runs, with connecting riffles and few pools.

Potential habitat for FYLF was identified within multiple sections of Pyramid reach. Between RM 0.2 to 2.5 (upstream of Frenchmans Flat), the stream is characterized by large, sub-angular substrate, especially cobbles and boulders, with high consolidation and moderate embeddedness (RMs in this section began at Pyramid Dam [RM 0.0] and extended downstream to the NMWSE of Lake Piru, approximately 18 miles downstream. RMs are delineated in tenths of miles and were generated using existing mapping information). Large deep pools are common, as are riffles, runs and glides. Instream hiding cover (margin and emergent vegetation) is limited, with moderate terrestrial cover. American bullfrogs of all life stages, red swamp crayfish (*Procambarus clarkii*), and introduced fish are common throughout this section.

Between RM 3.0 and 8.0 (Frenchmans Flat to upstream of Fish Creek), the reach is contained within a steep-walled canyon, but with varied habitat conditions. Several sections of deep, narrow canyon are interspersed with long sections consisting of pools several hundred feet long. Although suitable FYLF habitat is scattered throughout this reach, the most suitable areas are within the middle to lower portion of this reach, and are associated with areas of moderate instream and terrestrial cover, relatively open vegetation, and moderately embedded, subangular substrate dominated by gravel and cobbles. American bullfrog adults, juveniles and tadpoles, crayfish, and introduced fish are common throughout this reach, with extremely high numbers of bullfrogs present in the areas with pool complexes.

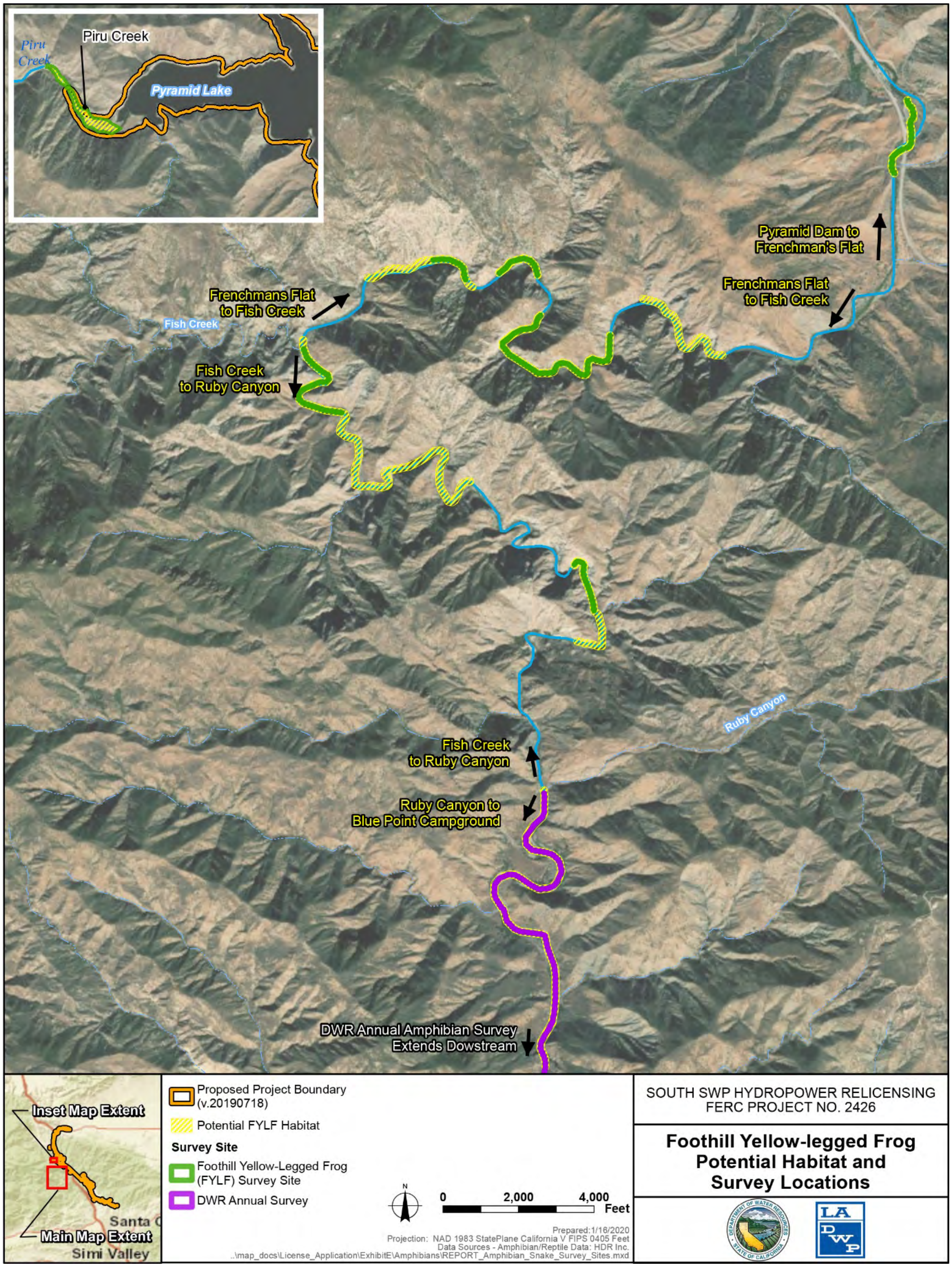


Figure 5.3-1. Potential Habitat for Foothill Yellow-Legged Frog and Survey Locations under Study 4.1.4

The final section surveyed by the Licensees was between RMs 8.0 and 13.1 (Fish Creek to Ruby Canyon) and is generally more open, although shorter sections of confined channel also occur, with habitat not suitable for FYLF. Long pools and frequent riffle/run habitat, along with large cobble bars, occur. These areas with suitable habitat for FYLF are scattered throughout the reach and are characterized by moderate instream cover and moderate to high levels of terrestrial cover, moderate to dense margin vegetation, and low emergent vegetation. Substrate is subangular to rounded, with a mix of cobble, gravel, sand, and boulder substrate. American bullfrogs are common throughout this reach, as are crayfish, largemouth bass (*Micropterus salmoides*), and sunfish (*Lepomis* spp.).

The Licensees did not evaluate the distribution of potential habitat for FYLF downstream of Ruby Canyon or designate survey sites for FYLF in this part of Pyramid reach, because this section has been surveyed annually since 2010 by DWR for arroyo toad and other sensitive species (i.e., southern western pond turtle, two-striped gartersnake, California red-legged frog [*Rana draytonii*], and FYLF), providing substantial opportunity to detect FYLF if present, in an area where FYLF occurred historically, and habitat conditions are described in the annual reports. Stream habitat mapping performed by the Licensees under Study 4.1.3, including detailed field mapping between RM 14.97 and RM 18.42, indicated that the most common mesohabitats were low gradient riffle (22 percent of total), run (17 percent), lateral pool (16 percent), mid channel pool (15 percent), glide (15 percent), split channel (7 percent), and step pool (4 percent).

The Licensees’ survey sites were designated (Figure 5.3-1) and surveyed for FYLF as discussed below. Representative potentially suitable habitat that was surveyed is illustrated in Figure 5.3-2. Because of limited access and safety issues, some of the sites within the reach were surveyed fewer than three times, while other sites were surveyed more often.

- Piru Creek arm above Pyramid Lake: One site approximately 2,600 feet long on April 4, May 16, and July 25, 2018
- Piru Creek (Pyramid reach)
    - RM 0.2 to 2.5 (between Pyramid Dam to upstream of Frenchmans Flat): Two sites representing a total distance of 2,300 feet on April 3, May 15, and May 29, 2018
    - RM 3.0 to 8.0 (Frenchmans Flat to Fish Creek confluence): Four sites representing a total distance of approximately 8,500 feet on April 18, May 30, July 23, September 25, and September 26, 2018, as well as the entire reach incidentally surveyed while traveling to focus sites (typically 10 to 20 percent of available habitat surveyed)

- o RM 8.0 to 13.1 (Fish Creek to Ruby Canyon): Three sites representing a total distance of approximately 3,800 feet on April 16, April 17, September 25, and September 26, 2018, as well as the entire reach incidentally surveyed while traveling to focus sites (typically 10 to 20 percent of available habitat surveyed)

Figure 5.3-2. Representative Potentially Suitable Habitat for Foothill Yellow-Legged Frog in Piru Creek (Left) Downstream of Fish Creek (April 17, 2018) and (Right) Upstream of Frenchmans Flat (May 30, 2018)

No FYLF were detected during Study 4.1.4. Amphibians detected were limited to American bullfrog, arroyo toad, western toad (*Anaxyrus boreas*), Baja California chorus frog (or treefrog; *Pseudacris* [*Hyliola*] *hypochondriaca*; treated in older literature as Pacific chorus frog or treefrog, *P.* [*Hyla*] *regilla*), and California chorus frog (or treefrog; *P.* [*Hyliola* or *Hyla*] *cadaverina*). In addition, environmental deoxyribonucleic acid (eDNA) sampling as part of Study 4.1.3, which included results from 60 locations, distributed at 500 m intervals throughout Pyramid reach, found no detections of FYLF deoxyribonucleic acid (DNA). Based on the visual survey results, eDNA sampling results, and the historical information described above, which concludes that FYLF has been extirpated in southern California, FYLF almost certainly does not occur within the proposed Project boundary or in Pyramid reach. Therefore, the Licensees conclude that FYLF is not likely to be adversely affected by the existing Project.

Western Spadefoot[3]

The western spadefoot is listed as SSC and BLM-S. Loss of habitat as a result of urbanization and agricultural development is considered primarily responsible for substantial range contraction, particularly in the Central Valley and in most southern California areas (NatureServe 2019). On July 1, 2015, USFWS published results of a petition review (also known as a "90-day finding") to consider listing western spadefoot under the ESA, determining that the petition presented "substantial scientific or commercial information indicating that the petitioned actions may be warranted" (80 FR 37568). Therefore, USFWS initiated a more thorough review of available data to determine whether listing is warranted. The results of the 90-day finding have no immediate effect on the regulatory status of the species (i.e., western spadefoot is currently not a candidate species or proposed for listing under the ESA).

The western spadefoot range is located throughout the California Central Valley and adjacent foothills. This species is usually common where it occurs, although the current distribution has been substantially reduced by conversion of native habitats. The species is known to occur from near sea level to about 4,500 feet elevation (Jennings and Hayes 1994; Morey 2005); however, most populations are found below 3,300 feet (Morey 2005). Breeding habitats include various water-filled, often turbid, surface depressions, including vernal pools, vernal playas, rainwater pools, stock ponds, and pools in intermittent streams. Although most breeding sites dry seasonally, permanent ponds are occasionally used. Absence of fish is usually a prerequisite for successful breeding.

This species occurs primarily in grasslands, but populations also occur within open valley-foothill hardwood woodlands or open chaparral, where breeding habitat is present and soils are suitable for burrowing. Populations may adapt well to rangeland practices, but reportedly do not persist long in areas converted to irrigated agriculture.

Western spadefoot is typically an "explosive breeder," often emerging and spawning within 1 or 2 days after relatively warm, winter or spring rains, but may breed over a period of two to three weeks (Morey and Reznick 2004). Under field conditions, eggs develop and hatch in 4 to 6 days and larvae complete metamorphosis in 30 to 79 days (Morey 2005). Under controlled laboratory conditions, larvae have been documented to reach metamorphosis more rapidly (Denver et al. 1998; Morey and Reznick 2004). Morey (1998) reported that most of the pools used by western spadefoot in his study held water after tadpoles had metamorphosed and up to 133 days in total. However, pools that dry too quickly are often used by western spadefoot where tadpoles do not survive (Morey 2005). Similar to other spadefoot species, western spadefoot larvae are capable of feeding on animal tissue and may be cannibalistic, behaviors that accelerate

[3] Photo credit: Chris Brown, USGS [public domain], via Wikimedia Commons

growth. After metamorphosis, juvenile and adult western spadefoot are terrestrial and primarily fossorial, and may spend long periods buried in loose soil or occasionally in existing mammal burrows.

Within the Los Angeles coastal plain, western spadefoot is likely extirpated and much of the suitable habitat within the adjacent foothills has also been lost. There are 16 CNDDB records of western spadefoot in the Project vicinity, including records from San Francisquito Canyon east of the Project and Grasshopper Canyon, approximately 3.37 miles south-southwest of Elderberry Forebay (CDFW 2018b). Breeding occurrences among these records are associated with a cattle stock pond, stormwater detention basins, rainwater pools within road-ruts and other anthropogenic depressions with compacted clay or silty soils; and pools within intermittent streams. Aspen Environmental Group (2007) concluded that there was no suitable habitat for western spadefoot in the Castaic Powerplant area. The Licensees found no information documenting western spadefoot within the proposed Project boundary.

Licensees' Study 4.1.4 included western spadefoot as a target species. Because terrestrial stages of western spadefoot are infrequently and unpredictably present at the surface, the study focused on identifying and searching potential breeding habitats for western spadefoot larvae, including noting evidence of dried pools. Field work associated with this study began with a field reconnaissance survey in Pyramid reach on February 27 and 28, 2018, followed by surveys for target species in Pyramid reach and throughout the proposed Project boundary area in April, May, June, and July 2018. The only sites identified as potential western spadefoot breeding habitat were seasonal pools on the upstream and downstream ends of a culvert under Orwin Road, and a location in a former channel of Piru Creek upstream of Frenchmans Flat along the Pyramid reach on the west side of Golden State Highway (Figure 5.3-3, 5.3-4, and 5.3-5). The latter site was dry when first discovered, but may hold water seasonally for a sufficient period to be breeding habitat for western spadefoot (i.e., at least 30 days). The culvert pools were surveyed on May 18, 2018, when western toad larvae were appeared to be numerous in both pools. The pools were dry when revisited on July 26, 2018. Western spadefoot was not found at this or any other site during the study, was not reported incidentally during other relicensing field work, and no other potential breeding habitats were noted. Therefore, the Licensees conclude western spadefoot is not likely to be adversely affected by the Licensees' Proposal.

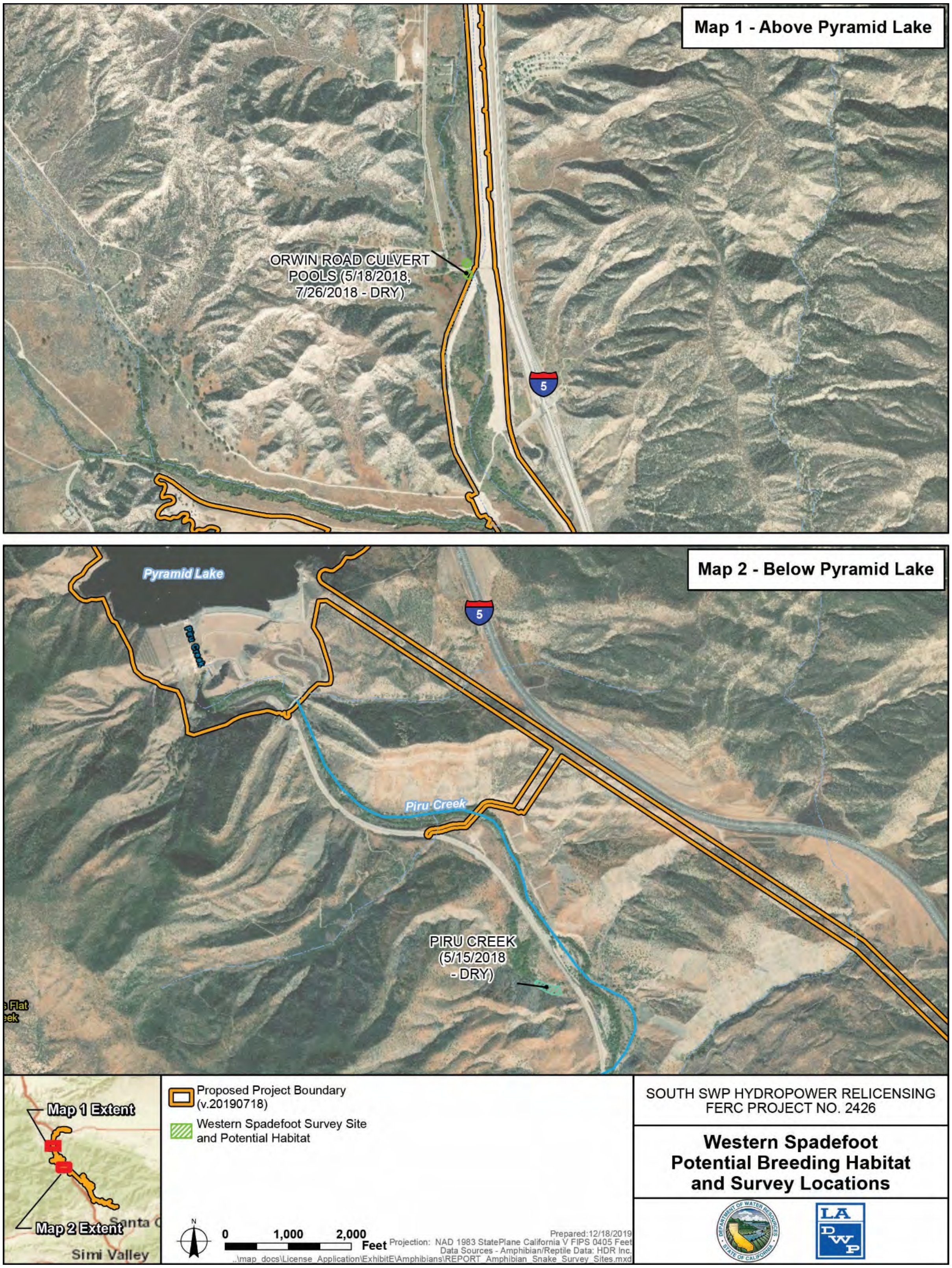


Figure 5.3-3. Potential Aquatic Habitat for Western Spadefoot and Survey Locations under Study 4.1.4

Figure 5.3-4. Orwin Road Culvert Pool Surveyed for Western Spadefoot (Left) on May 18, 2018 and (Right) on July 26, 2018

Figure 5.3-5. Former Channel of Piru Creek Upstream of Frenchmans Flat Examined Under Study 4.1.4 on May 29, 2018 as Potential Aquatic Habitat for Western Spadefoot

Two-striped Gartersnake[4]

The two-striped gartersnake is listed as SSC. Jennings and Hayes (1994) reported evidence that two-striped gartersnake has been extirpated from about 40 percent of known sites, particularly in urbanized areas. In addition to habitat loss from urbanization, Jennings and Hayes suggested that the species has also declined as a result of flood control projects, overgrazing, introduced species, and deliberate killing, and suggested that drought may have accelerated these declines. However, Frost et al. (2007) indicate that the two-striped gartersnake "is probably the most common snake in southern California away from urban areas," warranting the International Union for Conservation of Nature Red List category of "Least Concerned."

The two-striped gartersnake is a highly aquatic species found from Monterey and San Benito counties, California, to northwest Baja California, Mexico in the Coast, Transverse, and Peninsular ranges, and coastal plains. Known occurrences are distributed from sea level to about 8,000 feet elevation, mostly associated with streams (Jennings and Hayes 1994; Stebbins 2003). Preferred habitats for the two-striped gartersnake include rocky, perennial or intermittent streams; large, low gradient streams; and ponds (e.g., oases, stock ponds, and storm-water retention ponds), provided, in each case, that dense riparian vegetation is also present (Jennings and Hayes 1994; Frost et al. 2007). The two-striped gartersnake is primarily aquatic-feeding, with fish, fish eggs, amphibians, and earthworms documented as prey (Stebbins and McGinnis 2012). Although it is rarely found far from water, uplands adjacent to riparian areas may be used in winter (Jennings and Hayes 1994). The two-striped gartersnake is ovoviviparous, and an individual may bear as many as 25 young in a single litter.

There are eight records in the Project vicinity of the two-striped gartersnake in the CNDDB, including repeated observations on Castaic Creek upstream of Elderberry Forebay, Piru Creek downstream of Lake Piru below Santa Felicia Dam, and along the Santa Clara River (CDFW 2018b). Environmental surveys preceding periodic required sediment removal at the Elderberry Forebay sedimentation basins documented two-striped gartersnake on one occasion: an individual observed on September 3, 2009 in the third (lowermost) basin (POWER 2009). Small numbers (i.e., two to four) of the two-striped gartersnake have also been observed each year during DWR's annual sensitive species surveys performed since 2010 along Pyramid reach downstream of Pyramid Lake between Ruby Canyon and Lake Piru (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a).

Surveys for the two-striped gartersnake were performed by the Licensees as part of Study 4.1.4. Although no formal survey protocol has been established for this species,

[4] Photo credit: Connor Long (Own work) [CC BY-SA 4.0 (http://creativecommons.org/licenses/by-sa/4.0)], via Wikimedia Commons

this species is likely to be detected, if present, by multiple VES of potential habitat while walking and scanning suitable basking locations with and without binoculars. The Licensees' study generally consisted of three VES of each site with broadly suitable habitat, except at some locations where the entirety of suitable habitat could be intensively surveyed; these areas were surveyed twice. Survey sites were designated along perennial and intermittent streams, at the mouths of seasonal streams, and in riparian habitat patches associated with Project reservoirs (Figure 5.3-5). In addition, seasonal swales at Los Alamos Campground that were not observed holding water during the study were surveyed.

These locations were surveyed as follows:

- Quail Lake – Riparian habitat patches surveyed entirely on April 2, 2018 and May 31, 2018
- Gorman Bypass Channel, immediately below Quail Lake Spillway, on April 5, May 31, and July 26, 2018
- Gorman Creek on April 5, May 17, and July 26, 2018
- Los Alamos Creek on April 5, May 14, and July 26, 2018
- Los Alamos Campground on April 5, May 14, and July 26, 2018
- Select Pyramid Lake recreation sites and tributaries, including Spanish Point Boat-in Picnic Area, Bear Trap Boat-in Picnic Area, Yellow Bar Boat-in Picnic Area, the Piru Creek arm above Pyramid Lake, Carlos Canyon, Posey Canyon, and the unnamed ephemeral streams at Glory Hole Cove and Priest Cove on April 4, May 16, and July 25, 2018
- Pyramid reach on April 3, 16, 17, and 18; May 15, 29, and 30; July 23, and September 25, and 26, 2018
- Select Elderberry Forebay tributaries and habitat patches on May 18, June 1, and July 27, 2018

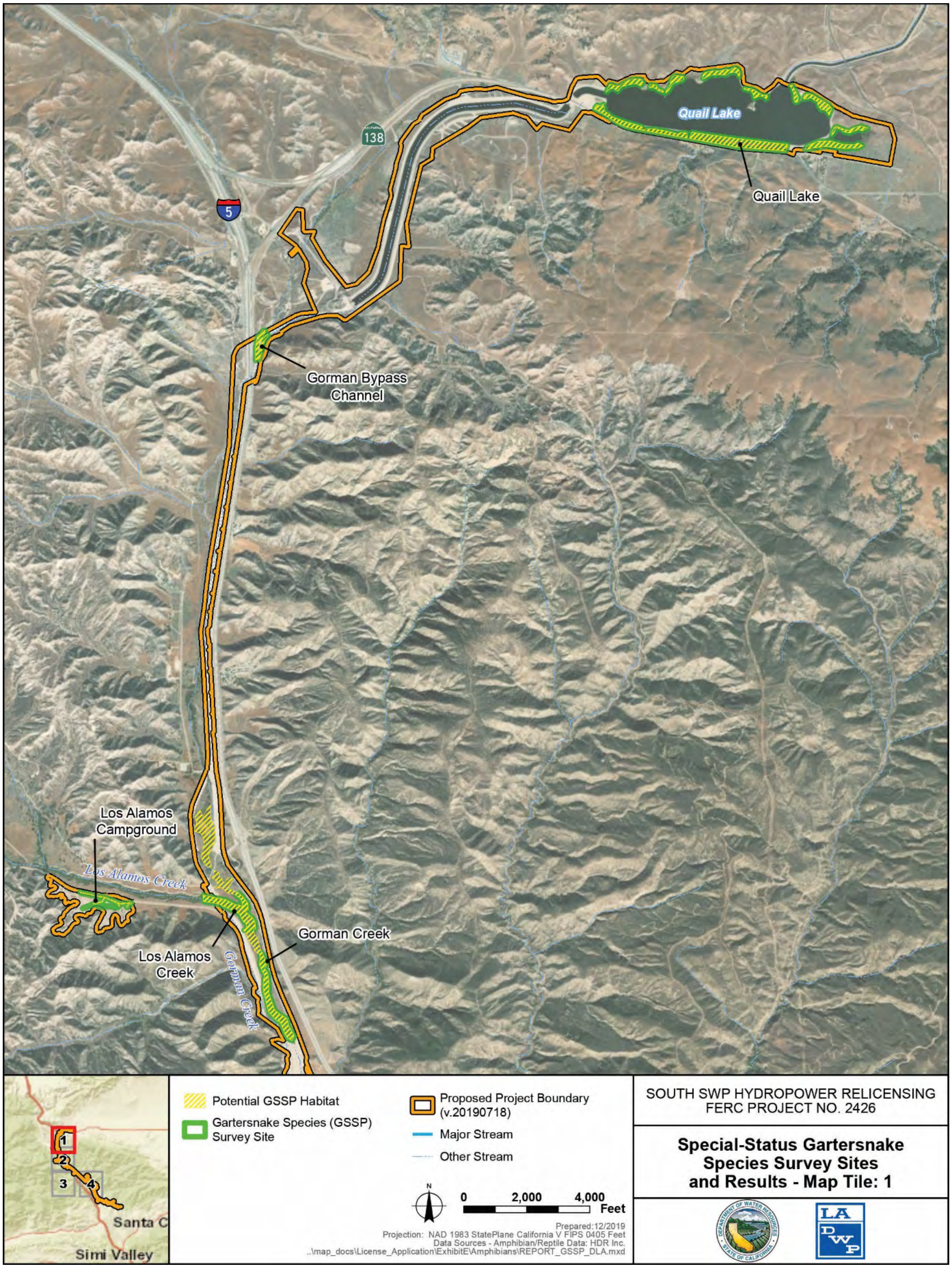


Figure 5.3-5a. Potential Habitat for Gartersnakes and Survey Sites under Study 4.1.4

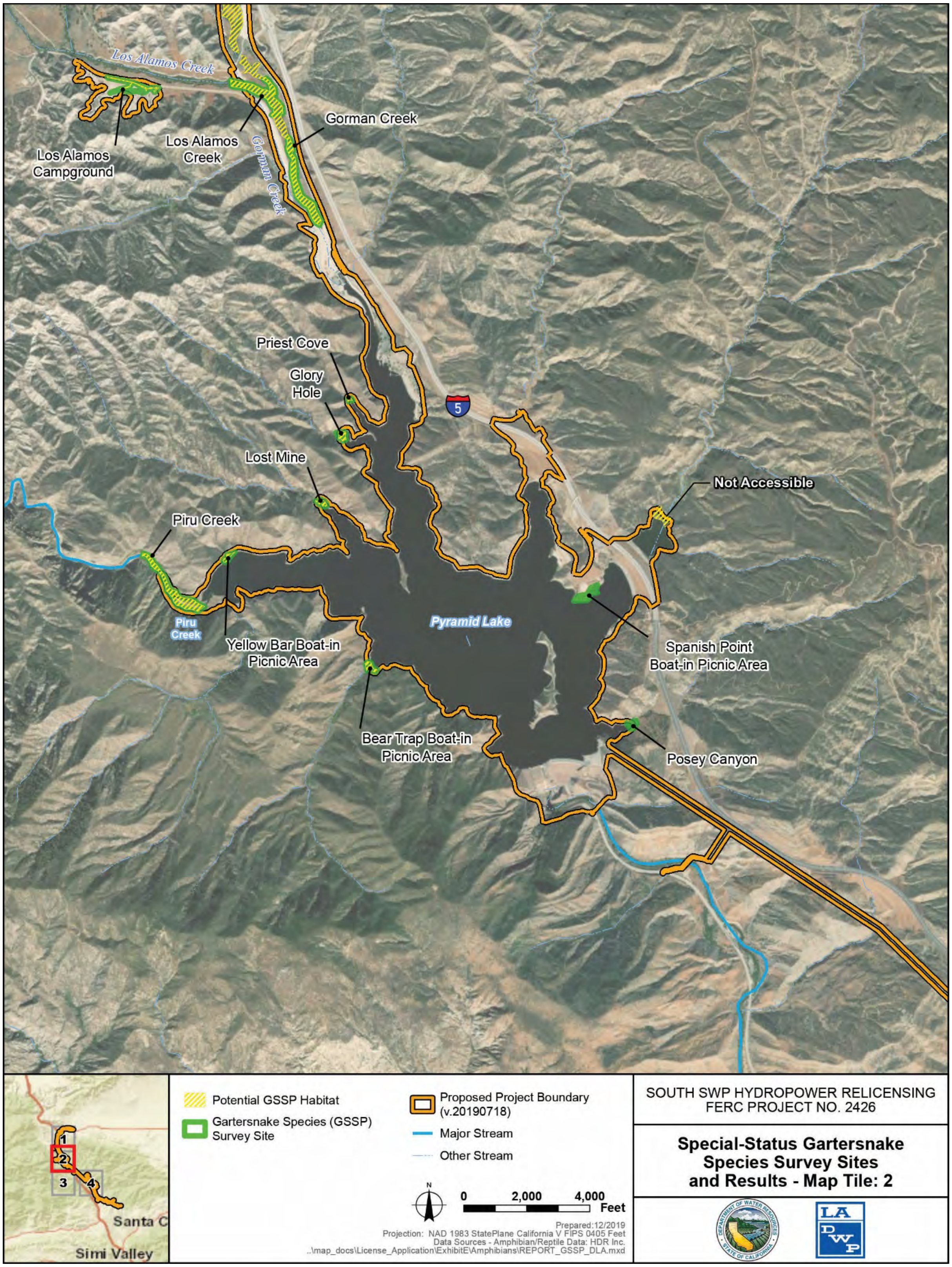


Figure 5.3-5b. Potential Habitat for Gartersnakes and Survey Sites under Study 4.1.4

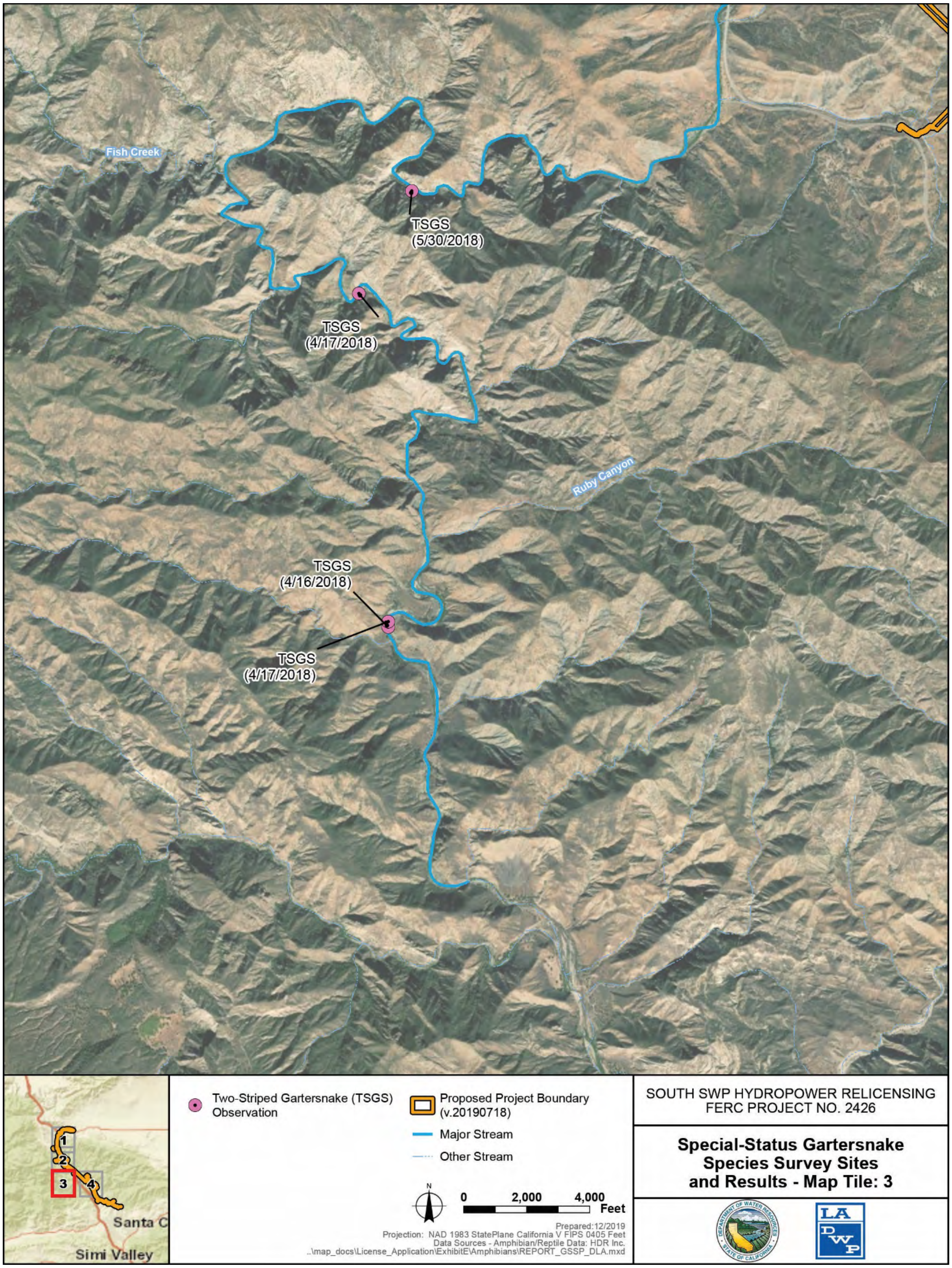


Figure 5.3-5c. Potential Habitat, Survey Sites, and Observations of Gartersnakes under Study 4.1.4

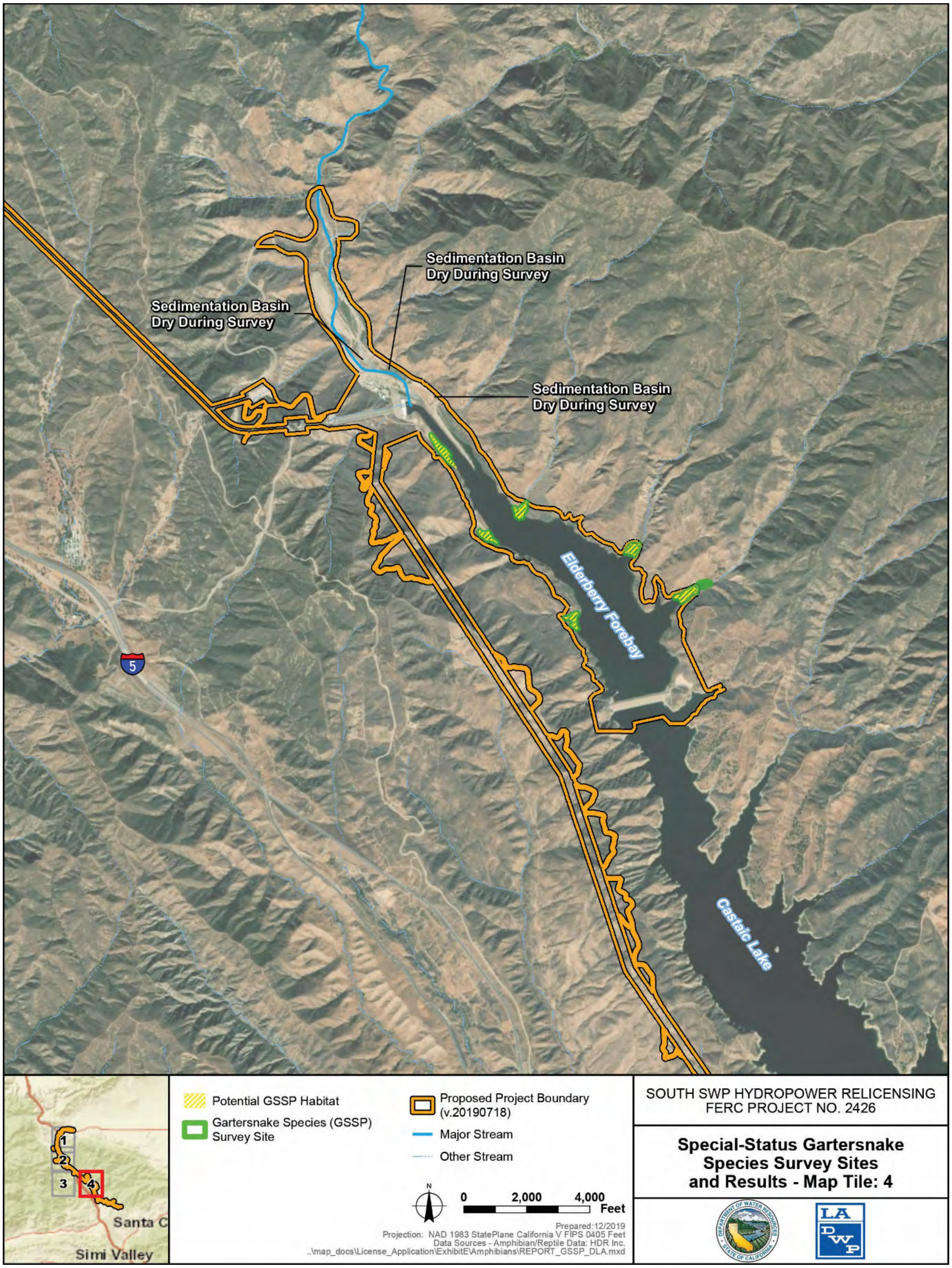


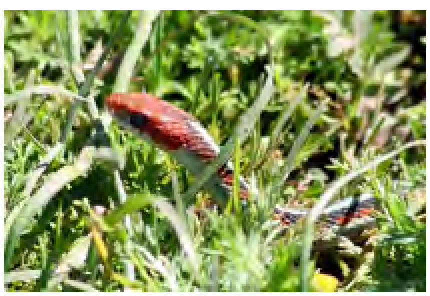
Figure 5.3-5d. Potential Habitat, Survey Sites, and Observations of Gartersnakes under Study 4.1.4

Four observations of the two-striped gartersnake, each representing individual adult gartersnakes, were observed during surveys in Pyramid reach. No other two-striped gartersnakes were observed. These detections occurred on April 16, 2018, near Turtle Canyon (a recently deceased individual was found and appeared to have been partially eaten); April 17, 2018, near Turtle Canyon; April 17, 2018, below Fish Creek; and May 30, 2018, upstream of Fish Creek. Because habitat along Piru Creek is connected, there is potential for snakes to move throughout the reach, although there may be areas that are more or less suitable. Areas with higher suitability are likely to include habitats supporting amphibian larvae and small fish, and dense streamside vegetation, as illustrated by a site upstream of Fish Creek (Figure 5.3-6). Conversely, reach sections that support fewer prey and are more sparsely vegetated are less likely to be used. Based on the number and location of two-striped gartersnakes found during relicensing studies, as well as during annual arroyo toad surveys conducted by DWR in the lower section of the Pyramid reach (i.e., Blue Point to Ruby Canyon), it appears that suitable habitat for this species is concentrated in the more open sections of lower Pyramid reach, with less suitable habitat areas upstream (Figure 5.3-5). In contrast to conditions along Pyramid reach, other areas of potentially suitable habitat, including sites around Pyramid Lake, Elderberry Forebay, Quail Lake, Gorman Creek, and Los Alamos Creek, consist of relatively small and discontinuous riparian habitat patches, including seasonal streams unlikely to support two-striped gartersnake prey species, particularly small fish and amphibians. Operations of the Project since 2005 have included winter flow releases at Pyramid Dam that mimic the timing and magnitude of natural inflow, which likely benefit native species adapted for these conditions, including two-striped gartersnake.

Castaic Creek upstream of Elderberry Forebay was dry during the survey period and therefore was not surveyed, but may support two-striped gartersnake in wetter years. No incidental observations of two-striped gartersnake were recorded during other Licensees’ relicensing study field work. LADWP 2003 concluded that two-striped gartersnakes are likely to occur seasonally in Castaic Creek, moving in response to the presence of aquatic habitat and available prey, and possibly hiding at other times under large rocks, debris, or in burrows, where they could occasionally be affected by periodic required sediment removal at the Elderberry Forebay sedimentation basins. However, sediment removal is performed under a USACE Regional General Permit, which includes BMPs and measures for the avoidance and protection of arroyo toad that are also protective of other sensitive species. These measures include pre-construction surveys and work monitoring by a USFWS-approved biologist, use of exclusionary fences, and a worker training and awareness program. With these measures, the Licensees conclude that the two-striped gartersnake is not likely to be adversely affected by the Licensees’ Proposal.

Figure 5.3-6. Example of Potential Gartersnake Habitat in Piru Creek Upstream of Fish Creek (September 25, 2018)

South Coast Gartersnake[5]



The "South Coast gartersnake" is listed as SSC. The taxon is defined as a form of common gartersnake (*Thamnophis sirtalis*, or referred to as *T. sirtalis* subspecies 1) occurring on the coastal plain from the Santa Clara River Valley in Ventura County to San Diego County (Jennings and Hayes 1994). However, no studies have been published to support a separate taxonomic designation; therefore, the South Coast gartersnake is generally treated as a geographic isolate of the more widely distributed California red-sided gartersnake. Jennings and Hayes (1994) indicate that this species has been extirpated from 75 percent of known sites. This source describes habitats of the South Coast gartersnake as "marsh and upland habitats near permanent water that have good strips of riparian vegetation." These habitats, probably never common, have been substantially lost or degraded by urbanization, flood control projects, agriculture, and introduced species.

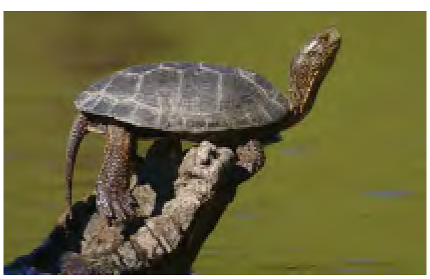
[5] Photo credit: David A. Hoffman (Own work) [CC BY-NC-ND 2.0] via Flickr

The habitat requirements of the South Coast gartersnake are summarized as shallow, permanent, low gradient water and associated dense, multi-storied vegetation (San Bernardino Valley Municipal Water District 2014). Although data are lacking, Jennings and Hayes (1994) suggest that the South Coast gartersnake may be primarily aquatic-feeding, with known prey including amphibian larvae, fish, and insects. Clutches of up to 20 live-born young have been reported (Jennings and Hayes 1994).

There are no records of the South Coast gartersnake in the Project vicinity in the CNDDB (CDFW 2018b). Jennings and Hayes (1994) includes a map showing verified locations where museum specimens of the South Coast gartersnake were collected or where sightings were reported along the Santa Clara River (populations identified as “extant”) and on Piru Creek near the Santa Clara River (populations identified as “extinct”). The upstream limits to their historical distribution in the Project vicinity are unknown; however, apparent preference for low-gradient marshy, streams suggests that the South Coast gartersnake may never have occurred along Piru Creek or Castaic Creek in the Project area. The species is nonetheless included in the subsection as potentially occurring in the Project vicinity because of its uncertain distribution.

Surveys for the South Coast gartersnake were performed by the Licensees as part of Study 4.1.4, with no resulting detections; nor were any incidental observations of this species reported during other relicensing study field work. Taken together with previously known information, the Licensees concluded that the South Coast gartersnake is not likely to be adversely affected by the existing Project.

<u>Southern Western Pond Turtle</u>[6]



The southern western (or southwestern) pond turtle is designated as SSC, FSS, and BLM-S, although not regarded as a taxon separate from “western pond turtle” on any of these lists. Substantial declines have been documented in southern California from the Mexican border to Ventura County (Bury and Germano 2008) associated with habitat loss, introduced species, and historical over-collection for food and the pet trade (Jennings and Hayes 1994; Bury and Germano 2008). Long considered a single species under several scientific names (i.e., *Clemmys marmorata*, *Emys marmorata*, or *Actinemys marmorata*), the previously recognized southern subspecies with the subspecific epithet *pallida* has been recently elevated to a full species on the basis of molecular evidence, with the proposed common name of southern western pond turtle, and also has been reassigned to *Emys* (Spinks et al. 2014); although other sources continue to refer the species to *Actinemys*. Differentiation of the two species in the field is largely based on geographic location, with all populations in the central Coast Range of California south of San Francisco, including the Mojave River area, assumed to be

[6] Photo credit: Yathin S. Krishnappa, [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

southern western pond turtle. However, this does not preclude the possibility of released northern western pond turtles within this range. Much of the published information on western pond turtles, which is summarized below, is derived from studies of northern western pond turtle. Therefore, our understanding of southern western pond turtle is based primarily on the information about the northern western pond turtle and for this reason may be incomplete or not entirely accurate for southern western pond turtle.

Both species of western pond turtle are considered habitat generalists and may occur in a wide variety of aquatic habitats, including pools, side channels, backwaters of streams, ponds, lakes, ditches, and marshes; although natural habitats of the southern western pond turtle were likely mostly associated with streams (Jennings and Hayes 1994). Western pond turtles are the only freshwater turtles native to California.

Although highly aquatic, western pond turtles often overwinter in forested habitats and eggs are laid in shallow nests in sandy or loamy soil in summer at upland sites as much as 1,200 feet from aquatic habitats (Jennings and Hayes 1994). Hatchlings do not typically emerge from the covered nests until the following spring. Reese and Welsh (1997) documented western pond turtle being away from aquatic habitats for as much as seven months a year and suggested that terrestrial habitat use was at least in part a response to seasonal high flows. Basking sites are an important habitat element (Jennings and Hayes 1994) and substrates include rocks, logs, banks, emergent vegetation, root masses, and tree limbs (Reese undated). Terrestrial activities include basking, overwintering, nesting, and moving between ephemeral sources of water (Holland 1991). During the terrestrial period, Reese and Welsh (1997) found that radio-tracked western pond turtles were burrowed in leaf litter.

Breeding activity may occur year-round in California. However, egg-laying tends to peak in June and July in colder climates, when females begin to search for suitable nesting sites upslope from water. Adult western pond turtles have been documented traveling long distances from perennial watercourses for both aestivation (i.e., hibernation in response to high temperatures and arid conditions) and nesting, with long-range movements to aestivation sites averaging about 820 feet, and nesting movements averaging about 295 feet (Rathbun et al. 2002). Introduced species of turtles (e.g., red-eared sliders [*Trachemys scripta elegans*]) likely compete aggressively with western pond turtles for basking sites, and American bullfrogs and predatory fish species may prey on western pond turtle hatchlings. Western pond turtles may also be more easily alarmed by disturbance while basking than red-eared sliders (Lambert et al. 2013).

There are 13 CNDDB records of southern western pond turtle in the Project vicinity, including multiple records from the Santa Clara River, Fish Creek, Pyramid reach, and a record from Lake Piru (CDFW 2018b). Between 0 and upwards to 17 individual southern western pond turtles have been observed during DWR's annual sensitive species surveys performed since 2010 along Pyramid reach between Ruby Canyon and above Lake Piru, as well as a 1-mile section of Agua Blanca Creek (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a).

POWER (2010) reported that in fall 2009, for the first time, southern western pond turtles were found in the second sedimentation basin upstream of Elderberry Forebay and that all 16 of the turtles were moved to Fish Creek, with the approval of CDFW and USFS; turtles were observed again in the same basin by LADWP in April 2010.

Incidental observations of southern western pond turtles documented during the Licensees' relicensing studies occurred at the confluence of the Piru Creek arm with Pyramid Lake (April 4, 2018 and October 5, 2018); and at multiple locations in Pyramid reach, including immediately downstream of Pyramid Dam (May 16, 2017), near Turtle Canyon (April 16, 2018), near Ruby Canyon (April 17, 2018), below Frenchmans Flat (July 23, 2018), and upstream of Fish Creek (September 25, 2018) (Figures 5.3-7a and 5.4.3-7b). No southern western pond turtles were observed during visual surveys for red-eared slider at nine locations at Pyramid Lake, one site downstream of Pyramid Lake, two sites on Quail Lake, and one site on Elderberry Forebay as part of Study 4.1.1, which also yielded only two observations of red-eared slider, both at Pyramid Lake, suggesting that neither species is common at these surveyed sites. In addition, only one red-eared slider was observed during other relicensing studies. Potential effects of the Project on southern western pond turtle are limited. Operations of the Project since 2005 have simulated a natural flow regime likely to benefit native species adapted for these conditions, including southern western pond turtle. Southern western pond turtle may occur rarely within sedimentation basins upstream of Elderberry Forebay, where they could be affected during periodic required sediment removal. However, the potential for effects is limited because LADWP performs relocation surveys for arroyo toad and other sensitive species that are found prior to any sediment removal activities. Although southern western pond turtle is not specifically addressed in the 2016 BO (USFWS 2016) or the USACE's General Permit for maintenance activities at the Castaic Powerplant (USACE 2016), the permit stipulates measures related to arroyo toad including timing restrictions, presence of a USFWS-approved biologist during any activity that may affect arroyo toad, and at least three consecutive days of surveys for arroyo toad "prior to any construction, excavation, clearing of culverts, or other work within the project area which may injure or kill individual arroyo toads." Consistent with earlier practices, the USFWS-approved biologist would direct that any southern western pond turtles found would be moved out of work areas to an area approved by CDFW and USFS. Southern western pond turtle is unlikely to occur at Elderberry Forebay because of frequent water level fluctuations.

Southern western pond turtle is known to occur in Pyramid Lake. Non-native fish species within Pyramid Lake may pose a potential threat to individual southern western pond turtles. However, the presence and continued introduction of non-native species is not a direct effect of the Project; rather, it is an effect of the SWP. Therefore, the Licensees conclude southern western pond turtle is not likely to be adversely affected by the existing Project.

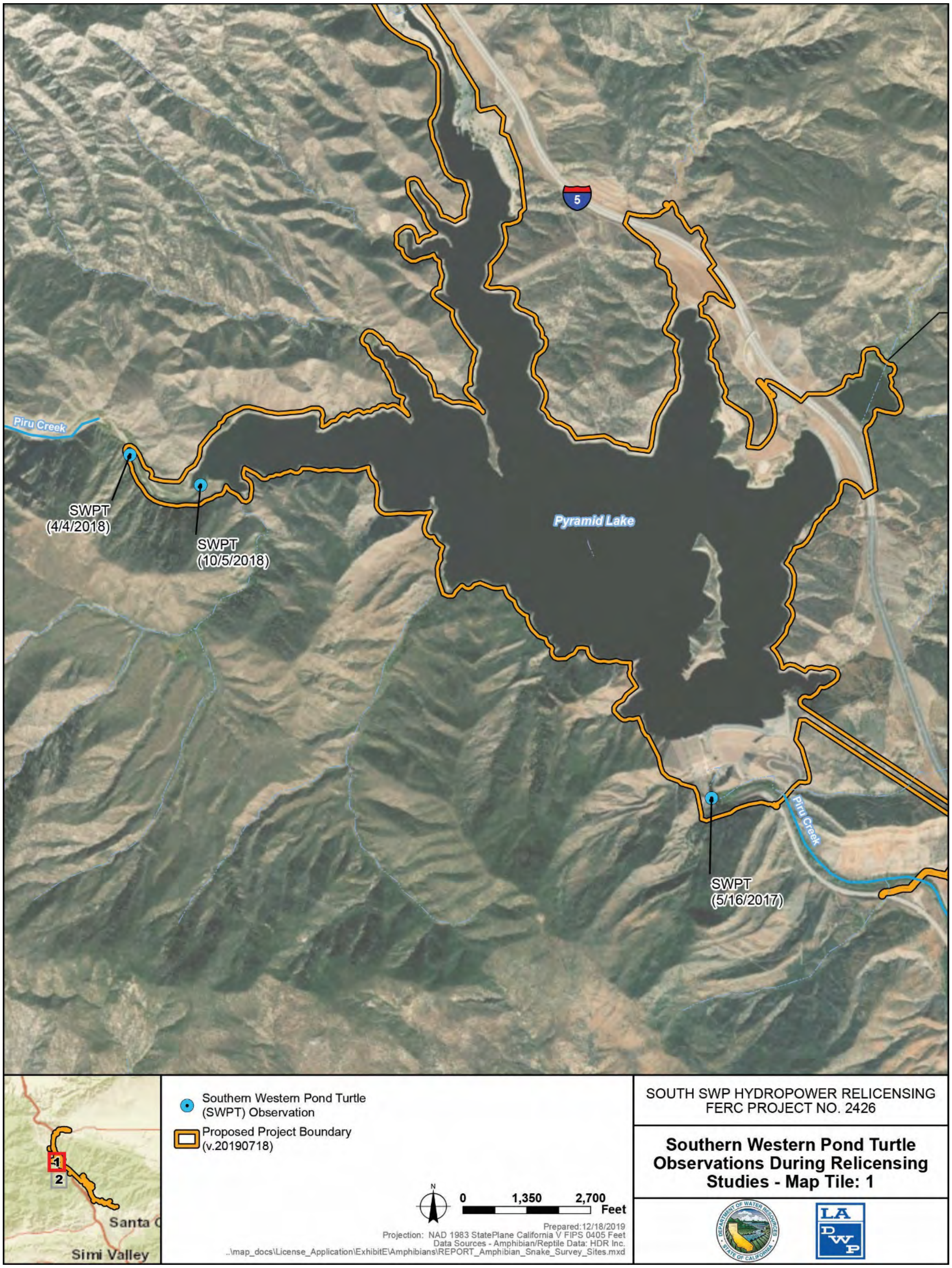


Figure 5.3-7a. Observations of Southern Western Pond Turtle Recorded During Relicensing Studies

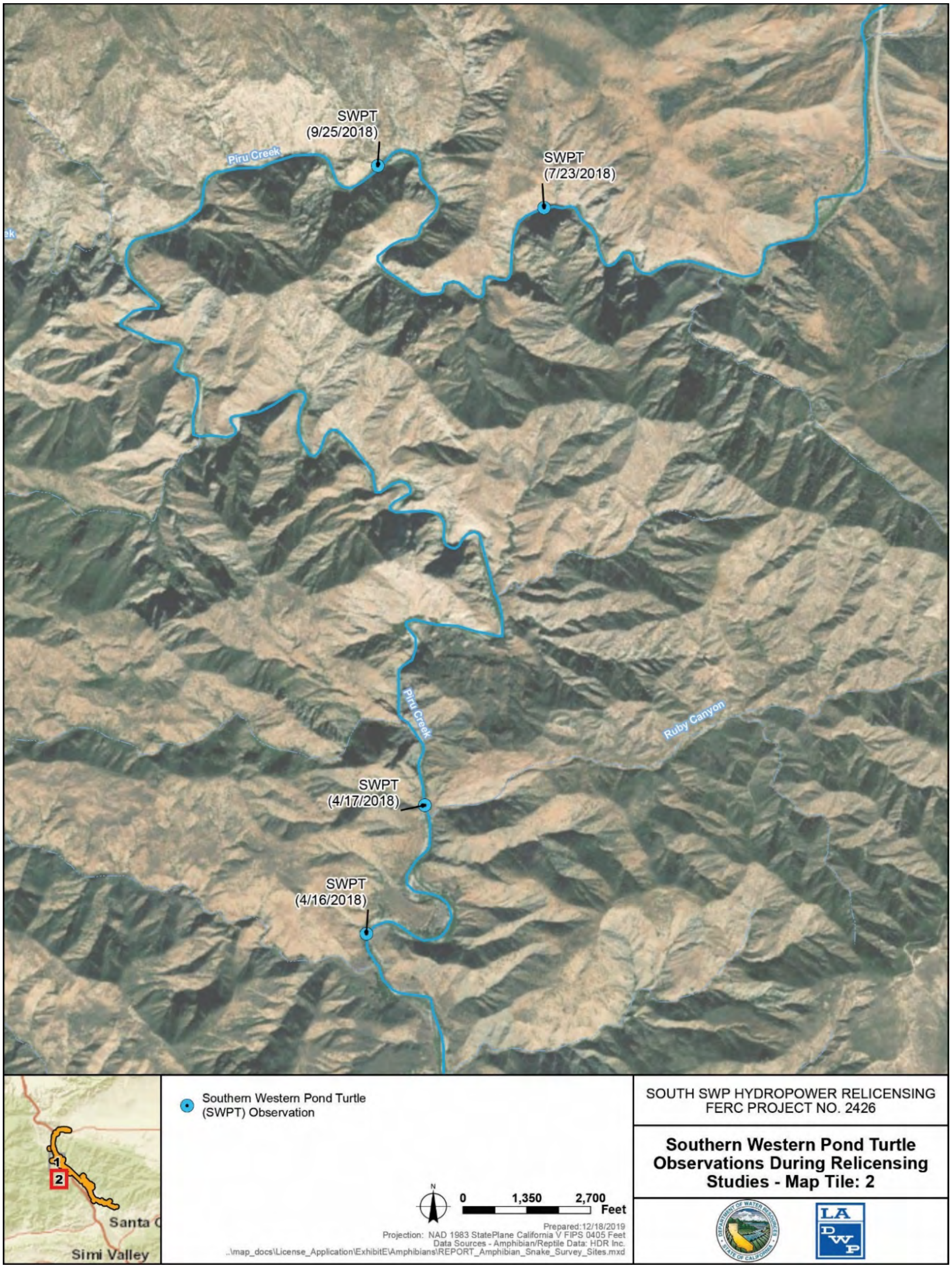


Figure 5.3-7b. Observations of Southern Western Pond Turtle Recorded During Relicensing Studies

5.3.1.2 Aquatic Invasive Species

According to USFWS, "aquatic invasive species (AIS) (sometimes called exotic, invasive, nonindigenous or non-native) are aquatic organisms that invade ecosystems beyond their natural, historic range…[and] may harm native ecosystems or commercial, agricultural, or recreational activities" (USFWS 2017). USFS defines AIS similarly, but also includes "harm to human health" (USFS 2020). However, AIS may also include native species that grow out of control in their natural habitats due to human factors, such as excessive nutrients and warmer waters.

In 2018, the Licensees performed Study 4.1.1 to survey for AIS in Project waters to supplement existing available data including data collected as part of the Licensees' annual monitoring conducted under their respective aquatic pesticides NPDES permits issued by the SWRCB. Table 5.3-2 describes status, habitat requirements, and occurrences of AIS that are known to occur or have the potential to occur in the proposed Project boundary. Zebra mussels are also included in the table because prevention of their spread is critical to the State and is regulated under State law.

The Licensees collected information on AIS through existing documents and a variety of ongoing surveys and relicensing studies, as detailed below.

DWR's Ongoing Creel Surveys at Pyramid Lake

Creel surveys are primarily conducted in order to evaluate and assess recreational fisheries, effectiveness of fish stocking programs, and angler satisfaction. However, creel surveys also can be a source of information on invasive fish species and are described in that context herein. DWR performed creel surveys since 2000 at Pyramid Lake, and will continue to perform creel surveys in the future. There are two survey periods evaluated; fall-spring (October through May) and summer (June through September). DWR compiles the survey data, and submits reports summarizing the creel surveys and trout stocking program to FERC on a biennial basis as a condition of the Amended Exhibit S in the existing license. Beginning in 2006, DWR transitioned these reports from a calendar year to a fiscal year reporting period to coincide with the trout stocking season. No invasive fish species have been documented in any of the creel surveys. Invasive fish species that are known to occur at Pyramid Lake (i.e., shimofuri goby and inland silverside) were not reported by creel surveys, likely because these are small fish and are infrequently caught or reported by anglers. Detailed information on the annual stocking program and creel surveys can be found below, in Section 5.3.1.4.

Table 5.3-2. Aquatic Invasive Species Known to Occur or have the Potential to Occur in the Project Vicinity

Species	Status or Listing: (1) CCR, (2) FGC, (3) Lacey Act, (4) Cal-IPC, (5) CDFA, (6) CDFW AIS Management Plan, (7) UC - California AIS	Habitat Requirements	Known to Occur in the Project Vicinity
Red swamp crayfish (*Procambarus clarkii*)	(7) Listed	Warm freshwater with mud, sandy bottoms, or organic debris, such as lakes, ponds, streams, canals, seasonal swamps, and marshes (Nagy et. al 2018)	Yes, incidental observations throughout Pyramid reach during relicensing studies and in Pyramid reach downstream of Pyramid Dam (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a).
Red-eared slider (*Trachemys scripta elegans*)	(7) Listed	Calm water habitats with abundant aquatic vegetation (Stebbins 2003; California Herps 2018)	Yes, observed in Pyramid Lake at three locations, one each near the Bear Trap Boat-in Picnic Area, near the base of the Piru Creek arm above Pyramid Lake (both during 2018 AIS surveys), and at Glory Hole Cove during special-status aquatic species surveys in 2018.
Shimofuri goby (*Tridentiger bifasciatus*)	(6) Listed	Fresh and brackish water bodies, wide tolerances for salinity and temperature	Yes, observed in Pyramid Lake during CDFW electrofishing surveys in 2013, and in Quail Lake during Licensees' electrofishing surveys in 2018.
Inland silverside (*Menidia beryllina*)	(7) Listed	Fresh and brackish water bodies, wide tolerances for salinity and temperature	Yes, observed in Pyramid Lake during CDFW electrofishing surveys in 2013, and in Quail Lake during Licensees' electrofishing surveys in 2018.
American bullfrog (*Lithobates catesbeianus*)	(6) Listed, (7) Listed	Quiet waters of ponds, lakes, reservoirs, irrigation ditches, streams, and marshes (CDFW 2014)	Yes, occurrences reported in Pyramid reach downstream of Pyramid Dam (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a) and in Pyramid Lake and Pyramid reach during 2018 relicensing studies.

Table 5.3-2. Aquatic Invasive Species Known to Occur or have the Potential to Occur in the Project Vicinity (continued)

Species	Status or Listing: (1) CCR, (2) FGC, (3) Lacey Act, (4) Cal-IPC, (5) CDFA, (6) CDFW AIS Management Plan, (7) UC - California AIS	Habitat Requirements	Known to Occur in the Project Vicinity
Channeled apple snail *(Pomacea canaliculata*)	(1) 14 CCR § 671(c)(9), Restricted Species, (6) Listed, (7) Listed	Warm freshwater habitats: reservoirs, ponds, rivers, ditches, wetlands; agricultural areas, such as rice and taro fields (Daniel 2018)	Yes, observed in Pyramid Lake during 2018 surveys.
Asian clam (*Corbicula fluminea*)	(6) Listed, (7) Listed	Freshwater lakes, reservoirs and streams, and often buried in sandy, bottom sediments (USGS 2018a)	Yes, observed in Elderberry Forebay, Pyramid Lake, and Quail Lake during 2018 surveys.
Quagga mussel (*Dreissena rostriformis bugensis*)	(1) 14 CCR § 671(c)(10), Restricted Species; (2) FGC §§ 2301 and 2302, Regulated, (6) Listed, (7) Listed	Freshwater lakes, reservoirs and streams, colonizing soft and hard substrates (USGS 2018a)	Yes, two separate occurrences; one occurrence involving the identification of 16 dead adults in the Angeles Tunnel and the other occurrence in Elderberry Forebay in 2016. Two adults were observed at the Angeles Tunnel Intake trash rack in 2016. None were observed at Pyramid Lake during 2019 visual surveys of substrate plates, nor during ongoing routine monitoring for larval veligers from 2008-2019. LADWP deployed an artificial substrate in August 2017 at the Elderberry Forebay Outlet Tower. In addition to monthly inspections and monitoring of settlement plates, LADWP conducts monthly shoreline surveys consistent with CDFW data sheet requirements. To date, no mussels have been observed or identified in Elderberry Forebay.

Table 5.3-2. Aquatic Invasive Species Known to Occur or have the Potential to Occur in the Project Vicinity (continued)

Species	Status or Listing: (1) CCR, (2) FGC, (3) Lacey Act, (4) Cal-IPC, (5) CDFA, (6) CDFW AIS Management Plan, (7) UC - California AIS	Habitat Requirements	Known to Occur in the Project Vicinity
Zebra mussel (*Dreissena polymorpha*)	(1) 14 CCR § 671(c)(10), Restricted Species; (2) FGC §§ 2301 and 2302, Regulated; (3) Federal Lacey Act (18 U.S.C. 42) lists zebra mussels as injurious wildlife, (6) Listed, (7) Listed	Freshwater lakes, reservoirs and streams colonizing any stable substrate (USGS 2018a)	No, the closest reported occurrences were in San Justo Reservoir, San Benito County, in 2008, approximately 209 miles northwest of the Project, and in a pump at Ridgemark Golf Course in 2012, approximately 204 miles northwest of the Project (USGS 2018b).
New Zealand mudsnail (*Potamopyrgus antipodarum*)	(1) 14 CCR § 671(c)(10), Restricted Species; (6) Listed	Freshwater streams and lakes; thrives in areas of high nutrients, both fresh and brackish water (Benson et al. 2020)	The closest reported occurrence is located in the vicinity of the Project, in Pyramid reach, approximately 1.5 miles downstream of Pyramid Dam.
Cyanobacteria species	None[1]	Freshwater bodies (USGS 2018a)	Yes, Pyramid Lake is monitored for by-products of cyanobacteria that cause taste and odor issues from algal blooms and potential cyanotoxins produced by dead or dying cyanotoxin-producing cyanobacteria in 2018.
Sago pondweed (*Stuckenia pectinata*)	None[1]	Semi-permanent to permanently flooded areas where the water is less than 8 feet deep (Casey 2010)	Yes, observed in Elderberry Forebay, Pyramid Lake, and Quail Lake during 2018 relicensing studies.

Table 5.3-2. Aquatic Invasive Species Known to Occur or have the Potential to Occur in the Project Vicinity (continued)

Species	Status or Listing: (1) CCR, (2) FGC, (3) Lacey Act, (4) Cal-IPC, (5) CDFA, (6) CDFW AIS Management Plan, (7) UC - California AIS	Habitat Requirements	Known to Occur in the Project Vicinity
Coontail (*Ceratophyllum demersum*)	None[1]	Inland and coastal ponds, lakes, and slow moving streams and rivers (State of Washington 2015)	Yes, observed in Elderberry Forebay, Pyramid Lake, and Quail Lake during 2018 relicensing studies.
Curly-leaf pondweed (*Potamogeton* spp.)	(4) Cal-IPC "moderate," (6) Listed	Grows in fine substrates and quiet, calcium-rich waters. The species prefers lakes, reservoirs, ponds, rivers, streams, and ditches. It can grow in clear to turbid and polluted waters, and in alkaline or brackish waters; and it is tolerant of significant nutrient pollution (Cal-IPC 2018).	Yes, observed in Elderberry Forebay, Pyramid Lake, and Quail Lake during 2018 relicensing studies.
Small pondweed (*Potamogeton pusillus*)	(4) Cal-IPC "moderate"	Found in standing and slow-flowing water throughout California.	Yes, observed in Elderberry Forebay, Pyramid Lake, and Quail Lake during 2018 relicensing studies.

Sources: USGS 2018a, 2018b; Casey 2010; DWR 2014a; State of Washington 2015; Cal-IPC 2018; UWCD 2017
Note:
[1]DWR considers these species invasive and is managing these species through pesticide applications at their facilities per DWR's Aquatic Pesticides Application Plan consistent with the Statewide General NPDES Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications (Water Quality Order No. 2013-0002-DWQ) issued by the SWRCB.
Key:
§ = Section
AIS = aquatic invasive species
Cal-IPC = California Invasive Plant Council
CCR = California Code of Regulations
CDFA = California Department of Food and Agriculture
CDFW = California Department of Fish and Wildlife
FGC = Fish and Game Code
UC = University of California
U.S.C. = United States Code

DWR's Ongoing Quagga and Zebra Mussels Surveys

DWR conducts an Early Detection Monitoring Program throughout the SWP for planktonic veligers (larval life stage of mussels) and adult quagga and zebra mussels. DWR's Early Detection Monitoring Program is described in the Quagga and Zebra Mussel Rapid Response Plan for the SWP (DWR 2010). The specific details of the plan are confidential, privileged, and contain CEII.

Briefly, the Early Detection Monitoring Program involves ongoing monitoring through routine sampling at set intervals and at predetermined sites that are selected based on specified criteria. The Early Detection Monitoring Program allows adaptability in the selection of monitoring sites such that the monitoring sites can be relocated based on current information.

For detecting planktonic veligers, a vertical plankton net tow is run through the water column from the bottom up to the surface, at a target depth of 40 meters (m) and a target distance of 40 m (DWR 2010). The sampling occurs on a monthly basis year-round at the outlet works in Pyramid Lake near the Angeles Tunnel Intake and as needed at the inlet near Emigrant Landing Day Use Area (DWR 2018, 2019). The filtrate is stored in a sample bottle on ice in the field and is sent overnight to the laboratory for analysis. Samples are analyzed either by amplifying the DNA in the filtrate through polymerase chain reaction (PCR) methodology to detect the presence or absence of mussel DNA or viewing the sample under cross-polarized light microscopy to confirm the presence or absence of veligers and to quantify the veliger density (DWR 2010).

DWR uses artificial substrates (i.e., settlement plates) to detect adult mussels. Settlement plate samplers are installed near the outlet works in Quail Lake, and in the Emigrant Landing Boat Launch and near the Pyramid Dam radial gates in Pyramid Lake (DWR 2019a). Additional settlement plates are installed in other locations within each waterbody as necessitated by current conditions. The settlement plate samplers consist of polyvinylchloride plates that are stacked and spaced two inches apart with a plastic-coated cable running through the center of each plate. If present, adult mussels will settle, attach, and grow on the settlement plates. DWR staff who are experienced in identifying adult mussels conduct seasonal visual inspections of the settlement plate samplers. If present, specimens are photographed, collected and stored in a labeled jar containing 70 percent ethanol or in a sealed bag, and submitted to the laboratory for DNA analysis to confirm the species identification (DWR 2010).

If a positive result from a sample occurs as part of the Early Detection Monitoring Program, it is initially considered a preliminary positive result and must undergo further investigation to validate and reclassify as a confirmed positive result. DWR will increase the frequency and coverage of early detection monitoring efforts, as well as implement additional surveying methods and other procedures and management actions, following any positively confirmed results (DWR 2010).

Field equipment is decontaminated following each sampling event. The same equipment is never used or transported to another monitoring site to prevent cross-contamination in the samples and the spread of mussels (DWR 2010, DWR 2018, in draft). In addition to these formal monitoring procedures, all DWR field staff are trained in quagga and zebra mussel identification and are instructed to look for mussels during their regular field work and during routine maintenance activities.

DWR's Ongoing Taste and Odor (Algae) Surveys

Algae can produce compounds that cause unpleasant taste and odors in finished drinking water. Geosmin and MIB are natural byproducts of cyanobacteria during chlorophyll production. Both DWR and MWD routinely monitors taste and odor compounds (i.e., geosmin and MIB) produced by algae through chemical analysis of water samples. When sampling results indicate that concentrations of taste and odor compounds exceed a pre-determined level, DWR and/or MWD determines the source and DWR manages the algal bloom to prevent further production of geosmin and MIB compounds. If an algal source is identified, DWR staff develop a plan for applying aquatic herbicides to control the specific algae associated with elevated taste and odor compound concentrations. Control measures include the application of aquatic herbicides as approved by the Los Angeles RWQCB and the SWRCB, as outlined in the Aquatic Pesticides Application Plan for the SWP (DWR 2016a). To date, the Licensees have not conducted an algicide treatment for taste and odor in Project reservoirs.

DWR's Ongoing Cyanobacteria Surveys

Cyanobacteria are distributed worldwide and are prevalent throughout California in many types of freshwater waterbodies (lakes, rivers, streams, wetlands, estuaries). Certain species of cyanobacteria can produce cyanotoxins that are potentially harmful to human health if present in high concentrations. Although cyanobacteria are not introduced species, their presence can represent a nuisance when present in high abundance and forming HABs.

DWR routinely monitors for cyanotoxins produced by certain cyanobacteria species through microscopic examination and chemical analysis of water samples. Samples are collected at Pyramid Lake on a monthly basis or more frequently if cyanotoxin are detected from spring through fall. When sampling results indicate that concentrations of cyanotoxins are at or reaching a level of concern, DWR water quality staff determine the location of the source (in-lake production versus upstream production) and feasibility of control. Public warning signs and notification is provided at the lake. If the location of the algal source is identified and cyanotoxin levels threaten water supply and recreational safety, DWR staff develop a plan for applying aquatic herbicides to control the HAB. The control plan would be in compliance with the Aquatic Pesticide Application Plan for the SWP, as approved by the RWQCB and the SWRCB.

Use of Algaecides and Aquatic Herbicides

Quail Lake and Pyramid Lake

As described in a revised May 18, 2016 NOI related to its NPDES Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, DWR treats algae and aquatic weeds in SWP aqueducts, reservoirs, and forebays. The DWR Aquatic Pesticides Application Plan associated with the NOI describes treatment areas, control tolerances, herbicide application, and BMPs implemented at Quail Lake and Pyramid Lake (DWR 2016a).

The application area for cyanobacteria blooms is dependent on the source of taste and odor production, as determined by a Solid Phase Microextraction (SPME) analysis that DWR staff perform weekly or the source of cyanotoxin production, as determine by an enzyme linked immunosorbent assay analysis. For each application, a map is generated showing the treatment area, immediate adjacent areas, and water bodies receiving treated water. To date, DWR has not treated a cyanobacteria bloom in either Pyramid Lake or Quail Lake.

Pyramid Lake and Quail Lake are subject to infestations of invasive aquatic weeds, such as coontail (*Ceratophyllum demersum*), Eurasian watermilfoil, and sago pondweed, which if left untreated, can outcompete and shade out native plant species and interfere with recreational activities.

The treatments are typically for aquatic weeds and algal mats located along the shoreline of the day use areas. The total volume treated compared to the lake volume is minimal and would be expected to result in significant dilution such that they would be non-detectable levels or below laboratory method reporting limits. In addition, treatments primarily occur during the summer months when releases to Pyramid reach are minimal. Given the infrequent treatments, the high dilution rate, the high uptake rate by aquatic weeds, the low stream release flows when treatments occur, and the depth of the stream releases, bioaccumulation is unlikely to occur. For aquatic weeds and filamentous green algae, the application area is determined prior to treatment as a result of a vegetation survey

Chelated copper products (Komeen® or Nautique®, copper sulfate pentahydrate crystals, EarthTec®, Captain XTR®) diquat, endothall (Aquathol®K), fluridone (Sonar®), imazamox (Clearcast®), sodium carbonate peroxyhydrate (PAC®27), triclopyr (Renovate®), and glyphosate (AquaMaster®) have all been proven successful in treating algae and aquatic weed infestations. DWR typically uses diquat and copper-base herbicides to control aquatic weeds and green algae in Pyramid Lake. DWR has a licensed PCAs and six to eight certified Qualified Applicators (QAC). These individuals are trained to ensure that applications are at rates consistent with label requirements, in a manner that avoids potential adverse effects, and to ensure that proper storage and disposal practices are followed. The lake is closed for public access during the day of treatment, which in the past has resulted in lake closures of between 1 and up to 5 separate days during the year depending on the number of applications. This averages about 2.5 days during the year. Notification is provided at least 48 hours prior to all downstream water contractors and users, recreation managers, CDFW, the California Department of Pesticide Regulation, and the Los Angeles County Agricultural Commissioner. Signs to notify the public are also posted at the lake and information is provided on DWR's website (www.water.ca.gov).

The effectiveness of the treatment is assessed one week after the application. Water quality monitoring and wildlife monitoring (to ensure wildlife is not present during treatments) is conducted before (within 24 hours collected upstream prior to a treatment event), during a treatment event (immediately downstream after the treatment event), and after a treatment event (within seven days in the application area after the treatment event, or when treatment is deemed complete) consistent with SWRCB Order No. 2013-0002-DWQ and the approved Aquatic Pesticides Application Plan. Physical and chemical parameters are sampled in the water column with grab samples taken at three feet below the water surface using EPA guidelines for water temperature, pH, turbidity, electrical conductivity, active ingredient of the herbicide applied, dissolved oxygen, and hardness (when copper-based herbicides are applied). Visual monitoring parameters (monitoring area, appearance of water, and weather conditions) are also conducted before, during and post treatment. Annual reports containing the treatment locations, the amount of applied aquatic herbicides, and monitoring results are provided to the SWRCB and Los Angeles RWQCB. In addition, water quality is monitored downstream at Pyramid Lake quarterly, and the analytical results are available online through DWR's Monthly Operations Data Library (DWR 2018d).

Appropriate parties are notified by email at least 48 hours prior to a treatment. The notification includes the treatment date and time as well as when releases will resume from the lake. Public notices are posted to inform the public of lake closures. Additionally, a PCA submits a written recommendation for use of the aquatic herbicide to the County Agricultural Commissioner.

The tolerance of AIS should be extremely low and eradication of this class of plants is often a desired outcome, if technically possible. The tolerance for the presence of aquatic weed growth, particularly coontail and Eurasian watermilfoil, in the public access areas is zero.

Castaic Creek Check Dams and Emergency Spillway

As described in a May 28, 2015 NOI related to its NPDES Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, LADWP treats algae and aquatic weeds. The LADWP Aquatic Pesticides Application Plan associated with the NOI described treatment areas, control tolerances, herbicide application and BMPs implemented at Castaic Creek check dams and the Elderberry Forebay Spillway. Invasive species are removed as needed from Castaic Creek and the Elderberry Forebay Spillway. Pretreatment or preconstruction surveys are done prior to any invasive species removal and debris removal to check for sensitive species that may be affected.

Mechanical and hand removal are employed when feasible but typically the amount of vegetation in the debris basin determines the need for treatment with herbicides. Herbicide is applied by LADWP personnel, contractors, or subcontractors who have either a QAC or a license issued by the California Department of Pesticide Regulation. These individuals are trained to ensure that herbicides are applied at rates consistent with label requirements and in a manner that avoids potential adverse effects.

Licensees' Relicensing Aquatic Invasive Species Study

The Licensees' conducted surveys for specific categories of AIS (i.e., vascular plants, mollusks including snails and clams, and red-eared sliders) from August 6 through August 10, 2018; August 13 through 17, 2018; and October 9, 2018 as part of relicensing Study 4.1.1. Per the 2007 National Management and Control Plan for New Zealand Mudsnail, "NZ [New Zealand] mudsnail densities are highest in late summer and early autumn." Accordingly, these New Zealand mudsnail surveys were conducted at the appropriate time. Additionally, per USFS' comment on page 5-159 of its November 25, 2019 comment letter to FERC regarding the Licensees' DLA, "Grazers such as the New Zealand mud snail have 'boom and bust' populations as they track…algal blooms." Since algal blooms were occurring that they were recently treated on Pyramid Lake and were observed at Quail Lake and Elderberry Forebay, it would have been anticipated that New Zealand mudsnails would be in a "boom" population during the time of the surveys. Surveys for aquatic invasive snails and clams were performed at nine locations in Pyramid Lake, one location immediately downstream of Pyramid Dam, two locations in Quail Lake, and one location in Elderberry Forebay (Figures 5.3-8 to 5.3-10). Survey sites were located in areas where AIS in general were more likely to be introduced or have potential habitat for AIS snails and/or clams. In general, areas with silt, sand, or gravel substrate and a relatively low gradient were targeted for the focused surveys for mollusks.

At each focused survey site, surveyors established a 320-foot transect along the shoreline. The Licensees collected general site information, including the geographical extent of the site (using a map grade Global Positioning System [GPS] unit), the date and time of the survey, field crew present, and general characterization of the weather. Representative photographs of each site were taken and can be found in Appendix B of this Exhibit E and on the South SWP Hydropower relicensing website (http://south-swp-hydropower-relicensing.com/).

The presence or absence of Asian clam, European ear snail, New Zealand mudsnail, and channeled apple snail was evaluated using two methods at each focused survey site: visual surveys and a sediment sieve. A visual inspection of the shoreline aquatic vegetation and immediate shallow water was performed first at each survey site to determine the presence of snails, clams, or other mollusks. Depending on gradient, water level, and clarity, staff also visually inspected the area of the shoreline up to 33 feet from the wetted edge.

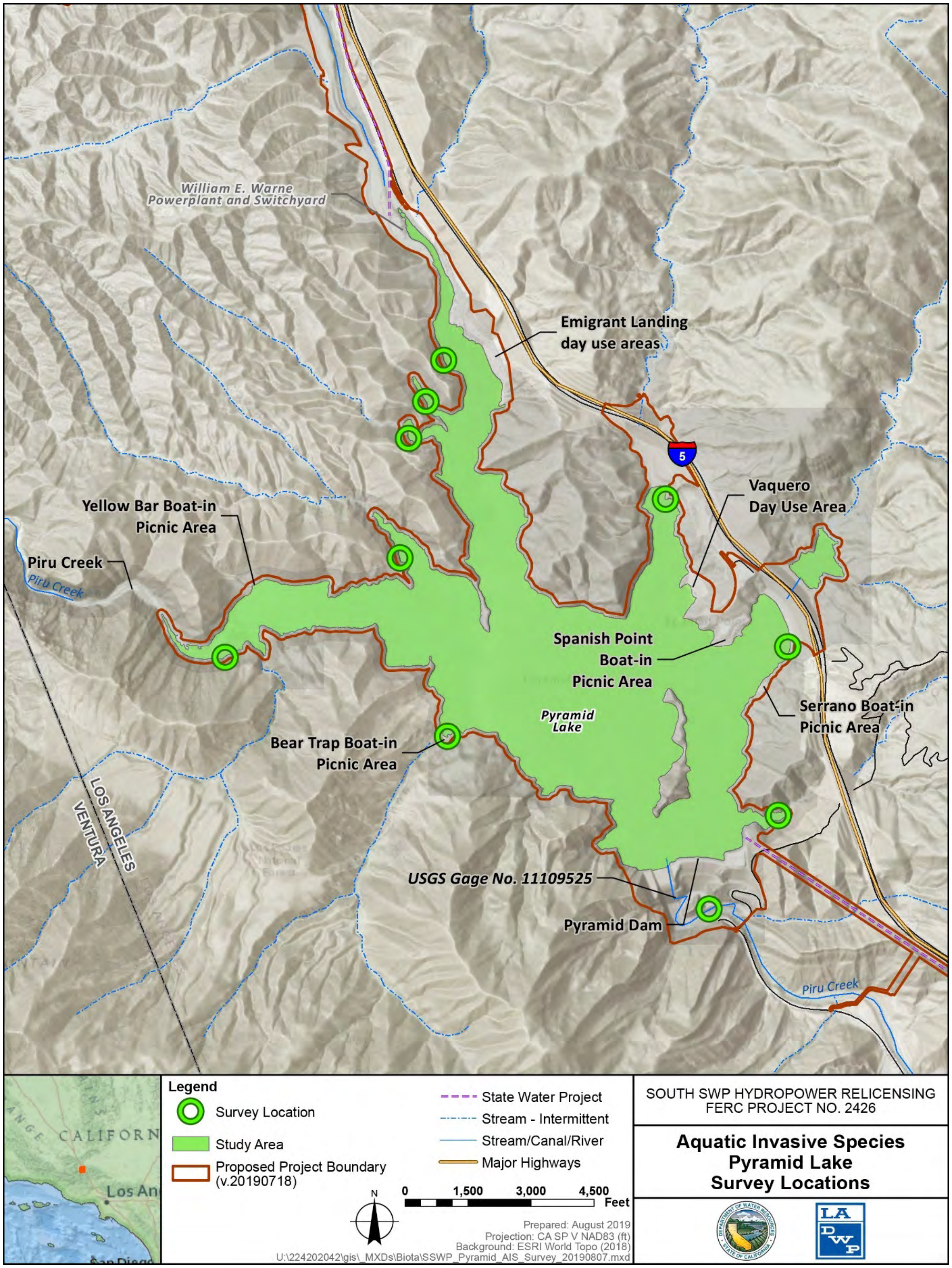


Figure 5.3-8. Map of Focused Survey Locations for Aquatic Invasive Clams and Snails and Red-Eared Sliders at Pyramid Lake under Study 4.1.1

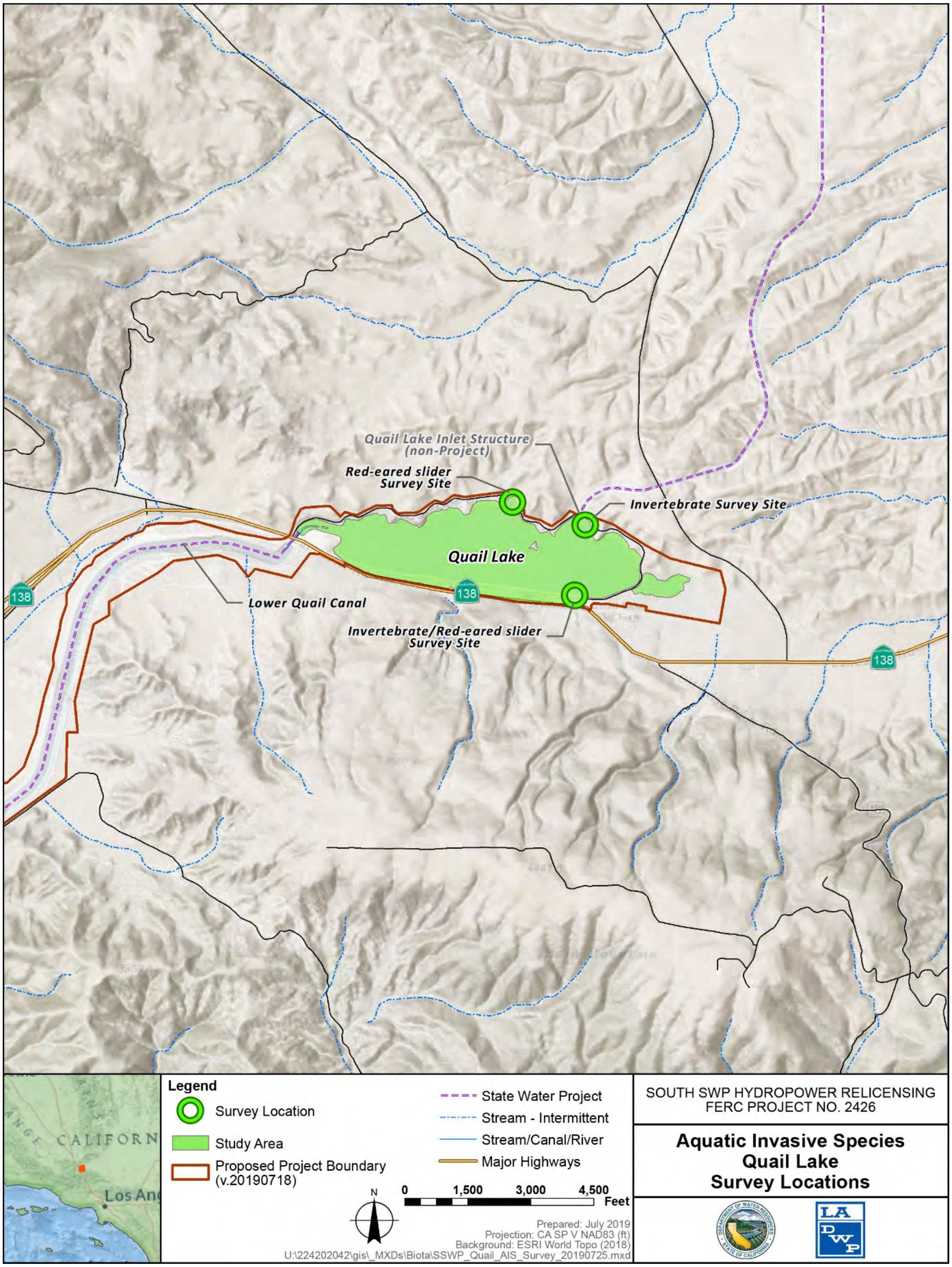


Figure 5.3-9. Map of Focused Survey Locations for Aquatic Invasive Clams and Snails and Red-Eared Sliders at Quail Lake under Study 4.1.1

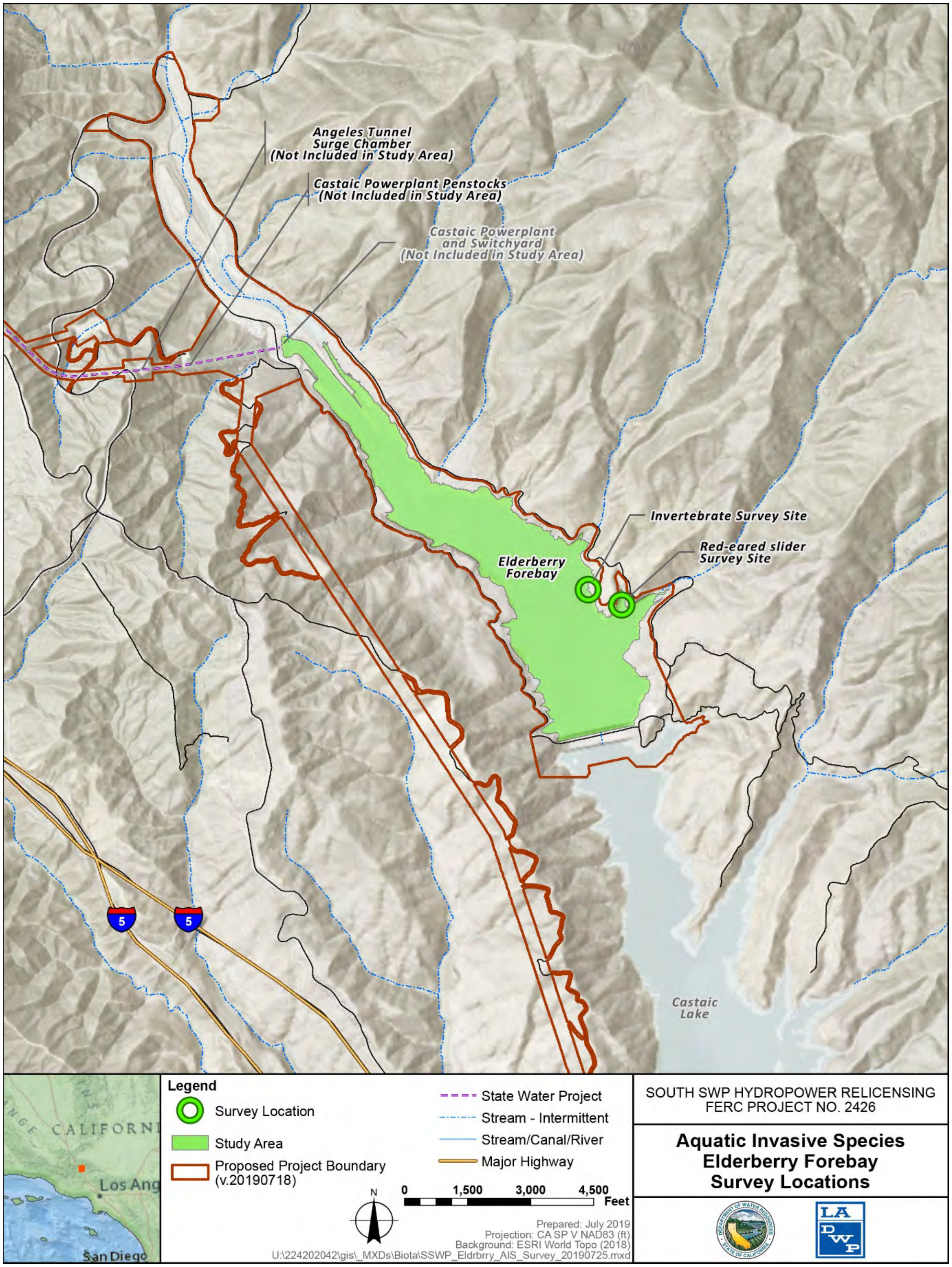


Figure 5.3-10. Map of Focused Survey Locations for Aquatic Invasive Clams and Snails and Red-Eared Sliders at Elderberry Forebay under Study 4.1.1

Additionally, up to 10 unique sediment samples were collected and sieved within each focused site. Five samples were collected along the shoreline (approximately 66 feet apart), and five more were collected approximately 33 feet offshore following the same spacing as the onshore samples (Grohs and Klumb 2010). The samples collected along the shoreline, not underwater, involved shoveling substrate directly into a 5-gallon bucket with a stainless steel wire cloth affixed to the bottom. Each sample consisted of enough sediment to fill the bucket to a predetermined volume (approximately two to three shovelfuls). The substrate sample was rinsed to remove the fine sediment, and staff noted the presence or absence of snails and clams of interest in each subsample. Other mollusks were identified to the extent possible. Samples taken in open water were collected using an Ekman dredge and followed the same process described above.

Red-eared slider VES were also conducted at nine locations at Pyramid Lake, one site downstream of Pyramid Lake, two sites on Quail Lake, and one site on Elderberry Forebay, each at or near the sites where the aquatic mollusk surveys were performed. Suitable turtle habitat was surveyed within the focused location using binoculars and a tripod-mounted spotting scope. Each of these surveys was conducted at dawn and lasted for up to an hour at each of the respective sites.

To document the presence of open water AIS plants, the Licensees surveyed each reservoir, following pre-established survey transects spaced approximately 96 feet apart, from August 6, 2018 through August 10, 2018; August 13, 2018 through August 17, 2018; and October 9, 2018. During these surveys the water surface was also surveyed for aquatic plants. Survey teams consisted of the boat driver and two surveyors, one on each side of the boat, each scanning an approximately 48-foot-wide area. All aquatic plant species documented during the open water surveys were identified to species level, if possible. If necessary for identification, plants were collected and keyed using the Jepson Manual (Baldwin et al. 2012).

The AIS survey results included 69 occurrences of two of the four targeted AIS mollusk species located during surveys: 67 occurrences of Asian clam and 2 occurrences of channeled apple snail. No New Zealand mudsnails or European ear snails were observed. There were also 65 occurrences of AIS plant species: 21 occurrences of coontail, 34 occurrences of sago pondweed, and 10 occurrences of small pondweed. Other documented sightings of AIS (not part of relicensing studies) on the Project include red-eared slider, shimofuri goby, Inland silverside, American bullfrog, and quagga mussels. A description of each of the AIS known to occur within the proposed Project boundary is presented below.

Species Known to Occur in Proposed Project Boundary

Red Swamp Crayfish[7]

The red swamp crayfish is a dark red crustacean with extended claws and head. The first walking leg bears bright red rows of tubercles on its side margin and palm. Adults can grow as large as 4.7 inches and can weigh in excess of 1.75 ounces. Populations in the United States are the likely result of a release from aquaculture or aquarium trade (USGS 2018).

The life cycle of the red swamp crayfish is relatively short, with sexual maturity occurring as early as 2 months of age. Breeding takes place in the fall and females can produce up to 500 eggs. Egg production takes roughly 6 weeks, followed by a 3-week incubation period and an additional 8-week maturation period. The red swamp crayfish demonstrates cyclic dimorphism, alternating between sexually active and inactive periods (USGS 2018).

This species inhabits freshwaters, including rivers, lakes, ponds, streams, canals, seasonally flooded swamps and marshes, and ditches with mud or sand bottoms and plenty of organic debris. Additionally, the red swamp crayfish has been known to colonize rice fields, irrigation channels, and reservoirs. The species is an ecosystem engineer, primarily constructing simple burrows. The species is tolerant of a variety of water quality parameters including salinities less than 12 parts per thousand (ppt), pH from 5.8 to10, dissolved oxygen levels greater than 3 ppm, variable water temperatures, and variable pollution levels (USGS 2018).

It is possible that the species causes an assortment of environmental impacts, including but not limited to alteration of food web, bioaccumulation of toxic substances, community dominance, modification of physical-chemical habitat properties, consumption of native plants and algae, and predation on native species (USGS 2018). Management of this species includes draining small bodies of water, trapping, and the use of biocontrols. However, for larger populations, these methods can be expensive and unlikely to fully eradicate the species (Loureiro et. al. 2015).

Incidental observations of red swamp crayfish have been reported to occur throughout Pyramid reach during relicensing studies and in Pyramid reach downstream of Pyramid Dam (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a).

[7] Photo credit: National Park Service [public domain], via Wikimedia Commons

Red-eared Slider[8]

The red-eared slider is a medium-sized turtle (adults are usually less than 8 inches carapace length) native to the Midwest south to the Gulf of Mexico. Although other subspecies of pond sliders are also considered invasive, the red-eared slider is by far the most widely distributed because of its popularity in the pet trade. Escaped and deliberately released, red-eared sliders have led to numerous, established populations in at least 23 states outside of the species native range, as well as populations in other countries. Within California, the USGS Nonindigenous Aquatic Species (NAS) Database reports red-eared slider occurrences in 13 counties, primarily located in various calm water habitats with abundant aquatic vegetation and urbanized areas in the San Francisco Bay Area and interior southern California. Red-eared sliders are a conservation concern in California because these turtles compete successfully with native western pond turtles (USGS 2018a). Lambert et al. (2013) documented differences in basking site use in an urban area where red-eared sliders occurred with northern western pond turtles, and suggested that the differences were related to greater tolerance for disturbance during basking by red-eared slider.

Sliders mate between March and June, and after eggs have developed the female seeks out suitable terrestrial nesting sites, often significant distances from water. Nesting occurs from April to July in locations that are unshaded, and have well-drained soil. Individuals may nest multiple times in the same year. In California, hatching typically occurs between July and September; however, hatchlings sometimes do not emerge from nest-hole chambers until the following spring (Stebbins and McGinnis 2012).

The red-eared slider is omnivorous, and its diet has been documented to include aquatic plants, crustaceans, insects, snails, fish, amphibian larvae, and various types of carrion (Stebbins 2003; California Herps 2018). During cold periods, red-eared slider is inactive under water or concealed below the surface on land.

In 2014, UCWD captured red-eared sliders in Piru Creek below the Santa Felicia Dam, over 18 miles south of the Project, during an aquatic species eradication effort (UWCD 2014).

Observations of red-eared sliders were recorded at two locations around Pyramid Lake during Licensees' Study 4.1.1, one near the Bear Trap Boat-in Picnic Area and another near the Piru Creek arm. In addition, one adult red-eared slider was observed at Glory Hole Cove at Pyramid Lake on May 16, 2018 during Licensees' Study 4.1.4. On the same day during the study, a sub-adult turtle, briefly observed at the surface and not identified to species, was recorded within the Piru Creek arm of Pyramid Lake.

[8] Photo credit: Trisha M. Shears [Own work] [public domain], via Wikimedia Commons

Shimofuri Goby[9]

The shimofuri goby is native to estuaries around the Sea of Japan. When and how this species was introduced into California waters is unknown; however, it is thought to have occurred at San Francisco Bay through ship ballast water prior to 1985 when they were first collected in Suisun Marsh. Populations of shimofuri goby expanded rapidly in the upper San Francisco estuary, and then expanded to reservoirs in southern California by transmission of larvae through the California Aqueduct (Moyle 2002; Howard and Booth 2016). Shimofuri goby are commonly found in brackish water habitats that have high levels of habitat complexity, and are also able to thrive in freshwater habitats. Shimofuri goby can tolerate broad ranges of temperature (up to 37°C in laboratory studies), and feed extensively on benthic food items such as attached hydroids and small crustaceans. The life cycle of the shimofuri goby rarely exceeds two years, and breeding occurs repeatedly between March and August. Shimofuri goby are aggressive occupants of their habitats, often dominating interactions with other inhabitants to the point of exclusion (Moyle 2002).

There are no effective management strategies to remove shimofuri goby once they are present. This species has been documented during electrofishing surveys in Pyramid Lake conducted by CDFW in 2013 (CDFW 2013b; Howard and Booth 2016; Swift et al. 1993), and in Quail Lake during 2018 electrofishing surveys conducted during Licensees' Study 4.1.2.

Inland Silverside[10]

Inland silversides are native to estuaries and brackish lower segments of coastal streams along the Atlantic Coast and Gulf Coast. Originally introduced in California to Blue Lakes and Clear Lake (Lake County) in 1967, the introduced population thrived in Clear Lake and spread to the Sacramento-San Joaquin River systems through the lake's outlet stream, Cache Creek. Inland silversides were further distributed via the California Aqueduct to reservoirs in southern California (Moyle 2002).

Inland silversides thrive in shallow, near-shore habitats within warm reservoirs and streams which have sand- or gravel-dominated substrates. The diet of the inland silverside is predominantly composed of zooplankton, such as copepods and planktonic instars of aquatic macroinvertebrates. Temperature and salinity tolerances are wide ranging for inland silversides, though optimal ranges are 20°C to 25°C and 0 to 15 mg/L, respectively. Inland silversides are commonly prey items for almost all predatory

[9] Photo credit: Dave Giordano (calfish.ucdavis.edu)
[10] Photo credit: Dan Worth (calfish.ucdavis.edu)

fish species with which they coexist. However, the life cycle of the inland silverside is short, growth rates are relatively fast, and reproduction usually happens within the first or second year, meaning the potential for explosive population growth exists even in the face of predation mortality. Large populations of inland silversides can change fish community structures by outcompeting native fishes for planktonic food resources (Moyle 2002).

There are no effective management strategies to remove inland silversides once they are established. The fish has been documented during electrofishing surveys in Pyramid Lake conducted by CDFW in 2013 (CDFW 2013b) and in Quail Lake during Licensees' 2018 electrofishing surveys under Study 4.1.2.

American Bullfrog[11]

The American bullfrog is the largest frog in North America (up to 8 inches snout to vent length). Native to eastern and central North America, the American bullfrog was first introduced to California in the twentieth century as a food source, and was spread further by fish stocking. The species is currently widespread and well-established in California, with populations found up to 6,000 feet elevation (Zeiner et al. 1988).

American bullfrog is highly aquatic and closely associated with permanent or semi-permanent water bodies, including ponds, lakes, reservoirs, irrigation ditches, streams, and marshes, and are capable of dispersing long distances during wet periods (CDFW 2014). In California, breeding can occur as early as March and as late as July, depending on local conditions, but generally later than native amphibians in the same areas and over a longer period of time (Jones et al. 2005; Cook and Jennings 2007). Breeding sites are often characterized by abundant submerged aquatic or emergent vegetation. Individual clutches are large (10,000 to 20,000 eggs per female). Tadpoles are found primarily in warm, shallow water, and grow to large sizes before metamorphosing, often in their second year (Jones et al. 2005). The presence of predatory fish, particularly black bass (*Micropterus* spp.) and sunfish (*Lepomis* spp.), is a good indicator of bullfrog habitat suitability. Larvae benefit by the presence of fish feeding on predatory aquatic insects that could have preyed upon bullfrog larvae; bullfrog larvae are generally avoided as prey by fish (Kruse and Francis 1977; Werner and McPeek 1994; Adams et al. 2003).

Similar to most native frogs, American bullfrog is an opportunistic, gape-limited predator; however, because this species grows to such a large size, a broad array of species are potential prey, particularly those closely associated with aquatic habitats, including smaller frogs, turtles, fish, and crayfish, as well as aerial insects, birds, and bats (Nafis 2013; CDFW 2014). American bullfrog has also been implicated in the

[11] Photo credit: Jarek Tuszynski [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

spread of the Bd, the agent in the potentially fatal disease of frogs called chytridiomycosis, although several native amphibian species have also been shown to be carriers of the fungal pathogen (Padgett-Flohr 2008; Fellers et al. 2011).

The introduction of the non-native American bullfrog to California beginning early in the twentieth century as a food source has affected a wide variety of native species, including aquatic amphibians and semi-aquatic reptiles (Rosen and Schwalbe 1995; Hallock et al. 2017). Historically, commercial bullfrog farms and unintended releases of tadpoles from fish hatcheries during fish stocking have contributed to the rapid spread of the American bullfrog. Sandburg (2005) noted that a commercial bullfrog farm existed on the Santa Clara River in 1950, before bullfrogs occurred in Piru Creek.

Management methods for American bullfrog are limited to localized populations, as eradicating bullfrogs from large water bodies is currently infeasible. Currently, there are only a few methods for managing bullfrogs, including chemical control, bullfrog-specific traps and hunting. Prevention remains the best means of management (Snow and Witmer 2010).

American bullfrog was documented in 2008 along the Santa Clara River during a bioassessment project prepared for the Santa Clara River Trustee Council (SCRTC 2008). Sandburg (2005) noted that a commercial bullfrog farm existed on the Santa Clara River in 1950 before bullfrogs occurred in Piru Creek. The species is currently well-established in Pyramid reach, where it is regularly observed in abundance during annual sensitive species surveys (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a). However, substantially fewer bullfrogs have been observed in years immediately following high winter flows. For example, Sandburg (2005) noted that American bullfrogs, which had increased in 2002 through 2004, were found in 2005 only in two deep pools where they may have been protected from scouring flows during the preceding winter. Reduced numbers of American bullfrogs were also observed during the annual surveys in 2017 (Environmental Science Associates 2017), yet they had returned to high numbers the following year (Environmental Science Associates 2018). American bullfrogs were again reported to be reduced in numbers during the 2019 annual survey (Environmental Science Associates 2019). During implementation of Licensees' Study 4.1.4, American bullfrogs were observed in abundance in Pyramid reach, including adults, juveniles, and first- and second-year tadpoles. Although found throughout the surveyed areas, the greatest numbers occurred between Pyramid Dam and Frenchmans Flat, and in the area upstream of Fish Creek. Tadpoles were particularly abundant in areas with slow moving water and large in-channel or off-channel pools with algal mats and warmer temperatures. In addition, American bullfrogs were observed in multiple locations within the proposed Project boundary in the Vaquero Day Use Area of Pyramid Lake, at the base of Pyramid Dam, and at the Road 67 crossing.

Channeled Apple Snail

Channeled apple snails (CAS) are large, freshwater snails that grow to over 3 inches long. CAS possesses both a gill and a lung, allowing them to respire both in and out of the water. The species lay egg masses, typically containing 200 to 600 eggs, on solid structures such as rocks, walls, logs, and vegetation above the water surface (CDFW 2018c). CAS are a restricted species under 14 California Code of Regulations (CCR) § 671 and cannot be brought into California without a permit.

These snails occur in reservoirs, ponds, rivers, ditches, wetlands, and agricultural areas. They are native to the Amazon and Plata basins of South America, and, therefore, are well adapted to tropical climates and an assortment of environmental conditions, including a range of salinity, oxygen depredation, and excess nutrients. Individuals stay inundated during the day, hidden within vegetation subsurface, and are active at night, leaving the water to feed (CDFW 2018c).

CAS have been observed in California since at least 1997, and may have originally been introduced as part of the aquarium trade as aquarium snails or as stowaways attached to aquarium plants; as a result, CAS may have accidentally been released into open waters. The best management strategy for CAS is prevention, but intensive hand removal and egg mass suppression efforts may provide some control. However, established populations are unlikely to be eradicated (CDFW 2018c).

Two occurrences were recorded during Licensees' Study 4.1.1. One occurrence was recorded on the small arm of Pyramid Lake just north of the Piru Creek arm and the other occurrence was at the survey site on Quail Lake across from the inlet structure.

Asian Clam[12]

The Asian clam (*Corbicula fluminea*) is a small freshwater mollusk, native to southern Asia, eastern Mediterranean and the Southeast Asian islands to Australia. The species was first located in the United States in 1938 in the Columbia River and is believed to have been brought over by immigrants as food. Bait buckets, aquaculture, and intentional introductions for consumptive purposes are thought to be responsible for its spread (USGS 2018a).

The Asian clam is known to inhabit lakes, reservoirs and streams often covering themselves in sandy, bottom sediments. These bivalves cause serious structural damage, weakening dams and related structures. The species has a low tolerance to cold water, which causes fluctuations in population numbers. Additionally, the Asian

[12] Photo credit: m.wxxi.org

clam exhibits sensitivity to salinity, drying, low pH and siltation (USGS 2018a). Management methods include mechanical removal, barrier placement, and chemical and temperature alteration to water systems. (USGS 2018a).

According to DWR Southern Field Division (SFD) staff, the Asian clam is known to occur in Pyramid Lake, Elderberry Forebay and Quail Lake. The 2007 biological survey completed for the boat dock sediment removal project observed Asian clam in grab samples at Pyramid Lake (DWR 2016b).

Licensees' Study 4.1.1 recorded occurrences of Asian clam at six focused survey sites at Pyramid Lake, both focused survey sites at Quail Lake, and the one focused survey site at Elderberry Forebay (Figure 5.3-1).

Quagga Mussel[13]

The quagga mussel is a small freshwater mollusk native to the Dnieper River drainage of Ukraine and the Ponto-Caspian Sea. The discharge of ballast water from large ocean liners deposited the mollusk in North America. The quagga mussel was first found in the United States in 1989 in the Great Lakes and has since spread west (USGS 2018a). Larval drift and attachment to recreational and commercial boating vessels have enabled their spread throughout other regions of the United States.

The Federal Lacey Act lists quagga mussels as injurious wildlife, whose importation, possession, and shipment within the United States is prohibited. If found, any quagga mussels brought into the United States will be promptly destroyed or exported by USFWS at the cost of the importer.

Under 14 CCR § 671(c)(10), the quagga mussel is listed as a Restricted Species, which means it is "unlawful to import, transport, or possess live [quagga mussels] except under permit issued by the department." Additionally, pursuant to this regulation, all species of Dreissena are termed detrimental, which means they pose a threat to native wildlife, the agricultural interests of the State, or to public health or safety.

In addition, Fish and Game Code (FGC) §§ 2301 and 2302 provide specific regulations on dreissenid mussels, including quagga and zebra mussels. FGC § 2301 states that nobody shall: "possess, import, ship, or transport in the state, or place, plant, or cause to be placed or planted in any water within the state, dreissenid mussels." This law gives the director of CDFW, or his or her designee, the right to conduct inspections of conveyances, order conveyances to be drained, impound or quarantine conveyances, and close or restrict access to conveyances to prevent the importation, shipment, or transport of dreissenid mussels. Additionally, FGC § 2301 requires a public or private

[13] Photo credit: http://www.voicenews.com/news/invasion-of-the-great-lakes-quagga-mussels-least-known-most/article_9a45095a-88af-5ade-a96f-ca4160d4818c.html

agency that operates a water supply facility to prepare and implement a plan to control or eradicate dreissenid mussels if detected in their water system. This law also requires any entity which discovers dreissenid mussels to immediately report the finding to CDFW.

Pursuant to FGC § 2302, any person, or federal, State, or local agency, district, or authority that owns or manages a reservoir where recreational, boating, or fishing activities are permitted, shall: (1) assess the vulnerability of the reservoir for introduction of dreissenid mussels; and (2) develop and implement a program designed to prevent the introduction of dreissenid mussels. At a minimum, the prevention program shall include public education, monitoring, and management of the recreational, boating, and fishing activities that are permitted. DWR completed its vulnerability assessment and implemented a prevention program in 2011.

The quagga mussel inhabits lakes, reservoirs, and rivers. It can colonize a variety of hard substrates and is capable of causing extensive damage to hydropower facilities, pumping plants, and water conveyance systems by clogging small diameter pipes, intakes, and fish screens, and interfering with recreational opportunities (Mackie and Claudi 2010). Ecological impacts associated with the quagga mussel include changes in the phytoplankton community, increase in water clarity causing an increase in macrophyte growth and possibly HABs, alteration of the benthic community, and biofouling of native mussels and clams (Mackie and Claudi 2010).

Quagga mussels cannot tolerate salinity over 10 ppt (Mackie and Claudi 2010). Studies and field surveys have demonstrated that if calcium levels are low (less than 12 mg/L), the adult quagga mussel will not survive and veligers (i.e., larvae) will not develop. Other parameters that inhibit their survival and development include pH, water hardness, and temperature (Mackie and Claudi 2010). A vulnerability analysis concluded that there is suitable habitat for the quagga mussel within the Project vicinity (Claudi and Prescott 2011).

Research is being done on the management of the quagga mussel; however, preclusion is currently the only effective approach (USGS 2018a). Biological control research has concentrated on species that prey on veligers or attached mussels, predominantly birds and fish. Most of these predators do not occur in North America and comparable species have not been observed preying on dreissenids at levels that can limit populations of mussels. In California, native and non-native predators include redear sunfish (*Lepomis microlophus*), smallmouth bass (*Micropterus dolomieu*), diving ducks (*Aythyinae* ssp.), and crayfish (*Cambaridae* spp.) (Hoddle 2014).

Beginning in 2007, DWR began early detection monitoring, and developed and implemented the confidential Quagga and Zebra Mussel Rapid Response Plan on their SWP reservoirs (DWR 2010). The purpose of this plan is to coordinate a rapid, effective, and efficient intra- and interagency response to a reported sighting of mussels in order to delineate, contain, control and, when feasible, eradicate zebra and quagga mussel populations if they are introduced into or become established in SWP waters that include Project waters. The plan outlines immediate actions necessary to respond to non-confirmed sightings and positively confirmed populations of quagga or zebra mussels. The plan describes methods to: determine the distribution of mussels in a SWP facility and/or waterbody; manage pathways (control water flow and other vectors); conduct short- and long-term monitoring; and apply appropriate and immediate control measures on new mussel populations within the SWP (DWR 2010).

Generally, DWR conducts early detection monitoring for veliger and adult quagga and zebra mussels. Larval vertical tow surveys are conducted twice monthly at the water quality station at Pyramid Lake. Attached mussel monitoring (settlement plates) occurs monthly at Pyramid Lake. However, DWR is currently monitoring more frequently (weekly for veligers and at a minimum at least twice during the spawning season) as part of ongoing management of the 2016 quagga mussel detections.

Likewise, the LADWP implemented early detection monitoring and sampling protocols for veliger and adult quagga mussels. Water samples are taken monthly to analyze calcium, pH, temperature, and dissolved oxygen – indicator conditions conducive for quagga reproduction. Additionally, the LADWP performs monthly visual and tactile inspection surveys of the Elderberry shoreline, boat ramp, hard surface landscapes, and artificial substrate settlement plates for the presence of attached mussels. Test and survey results are reported quarterly to the CDFW. As of December 2018, there has not been any detection of larval or adult quagga mussels in Elderberry Forebay.

In addition, DWR has implemented a comprehensive Quagga and Zebra Mussel Boat Inspection Program to ensure all vessels (watercraft including motorized boats, canoes, kayaks, sail boats, rubber rafts, fishing waders, float tubes, etc.) are thoroughly inspected prior to use/launching at Pyramid Lake. The inspection station is located at the entry of Pyramid Lake where vessels are thoroughly inspected by trained staff. Watercraft that fail the inspection are prevented from launching at the lake. Any watercraft that had recently visited an infested reservoir are prevented from accessing Pyramid Lake for seven days. Once a vessel has been deemed clean and dry and has been determined to be clear of any mussels, a tag is placed to connect the vessel to the trailer to indicate that the vessel has been thoroughly inspected. In 2011, DWR contracted with Los Angeles County Department of Parks and Recreation to perform watercraft inspections and provide public outreach and education to aid in preventing the introduction potential of mussels at Pyramid Lake.

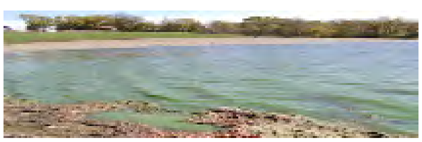
A discovery of quagga mussels was reported to the CDFW in 2013 from UWCD staff at Lake Piru. Lake Piru now institutes a mandatory inspection program, where watercraft must be inspected before entering the lake and watercraft owners must complete a survey form or risk citations. However, the reservoir has not been closed to recreation at this time. UWCD developed a Quagga Mussel Monitoring and Control Plan in consultation with CDFW, FERC, and NMFS that was finalized in 2017 (UWCD 2017).

According to the Quagga Mussel Control Plan Annual Report for 2018, Pyramid Lake and Angeles Tunnel (DWR 2019b), there were two adult mussels observed at the trash rack of Angeles Tunnel intake located over 200 feet deep in Pyramid Lake. However, there is no evidence of quagga mussel reproduction in the Project area through 2018.

Two separate occurrences of quagga mussels initially were reported in 2016: 16 dead adult quagga mussels within the Angeles Tunnel and two dead adult quagga mussels in Elderberry Forebay. During an inspection of the Angeles Tunnel on December 8, 2016, six deceased adult quagga mussels were observed. A follow-up inspection was conducted on December 13, 2016 and ten deceased adult quagga mussels were observed. NAS reported that a single adult quagga mussel was observed on the intake structure to the Angeles Tunnel at a depth of approximately 250 feet near Pyramid Dam in 2016 that was determined to be a potential hitch hiker from a small watercraft or dispersed through another avenue (USGS 2018a). DWR conducted multiple inspections of its facilities and below Pyramid Dam in 2016, 2017, 2018 and 2019, including ROV and dive surveys. In 2017 and 2018, remote operated vehicle video inspection was conducted in the Angeles Tunnel Intake structure. One live adult quagga mussel was observe in 2017, and two live adult quagga mussels were observed on the trash racks; one of the two adult quagga mussels were in the same location as the one quagga mussel detected in 2017. Routine plankton (larval veliger) sampling in Pyramid Lake was conducted 2007 through 2019 and no veligers were detected. Data from surface surveys conducted in 2019 by DWR and CDFW staff and inspection of settlement plates from 2007 to 2019 by DWR staff show no detections of adult quagga mussels in Pyramid Lake. Based on the two years of continuous monitoring since the detections in 2016, there is no evidence of quagga mussel reproduction or establishment of a viable, self-reproducing population in Pyramid Lake.

Quagga mussels were not observed at any locations during Licensees' Study 4.1.1.

<u>Cyanobacteria Species</u>[14]



Cyanobacteria, often erroneously referred to as "blue-green algae," occur in most freshwater ecosystems. Cyanobacteria are photosynthetic, nitrogen fixers. Nitrogen fixers convert atmospheric nitrogen into organic forms of nitrogen (i.e., nitrate or ammonia). Blooms of cyanobacteria occur as a result of excess nutrients, optimal temperature and light, and lack of water turbulence (USGS 2018a).

Water quality issues are associated with cyanobacteria blooms. Cyanobacteria produce compounds including MIB and geosmin that bring about unpleasant taste and odor in drinking water and make fish unpalatable (USGS 2018a).

The most commonly found cyanotoxins in the United States include microcystins, clindrospermopsin, anatoxins and saxitoxins (EPA 2019). OEHHA (2012) conducted a risk assessment of cyanotoxin concentrations that included a toxicity assessment and exposure assessment. According to OEHHA 2012, a corresponding reference dose for each cyanotoxin in which adverse health effects could occur was identified for select

[14] Photo credit: http://ks.water.usgs.gov/cyanobacteria

scenarios (recreational use, fish consumption, and canine subchronic and acute water intake and crust/mat intake) (Table 5.3-3 adapted from OEHHA 2012).

Table 5.3-3. OEHHA 2012 Reference Doses for Selected Scenarios

	Microcystins	Anatoxin-a	Clindrospermopsin	Media (units)
Human recreational uses	0.8	90	4	Water (µg/L)
Human fish consumption	10	5,000	70	Fish (ng/g) wet weight
Subchronic water intake, dog	2	100	10	Water (µg/L)
Subchronic curst and mat intake, dog	0.01	0.3	0.04	Crusts and Mats (mg/kg) dry weight
Acute water intake, dog	100	100	200	Water (µg/L)
Acute crust and mat intake, dog	0.5	0.3	0.5	Crusts and Mats (mg/kg) dry weight

Source: Adapted from OEHHA 2012
Key:
µg/L = microgram per liter
ng/g = nanogram per gram
mg/kg = milligram per kilogram
subchronic = exposures over multiple days
acute = exposures in a single day

Common cyanobacteria species identified in SWP reservoirs in southern California have included *Microcystis* spp., *Aphanizomenon* spp., *Dolichospermum (Anabaena)* spp., and *Gloeotrichia* spp. According to 2014 DWR phytoplankton sampling data, *Dolichospermum (Anabaena) lemmermannii, Aphanizomenon* spp.*, Pseudoanabaena* spp., *Worenchinia* spp., *Microcystis* spp., *and Gleotrichia* spp*.* are invasive cyanobacteria species found at Pyramid Lake. Water sampling at the Vaquero swim beach area on September 26, 2016 identified *Microcystis* spp., *Worenchinia naegeliana*, and *Dolichospermum* spp. Recent sampling detected microcystin levels at 5.0 µg/L at the Vaquero swim beach area on August 2, 2019, but no microcystin detections at the Emigrant Landing swim beach area on August 2, 2019. DWR conducts this continuous routine sampling as part of the water quality monitoring program for the SWP.

DWR has not applied aquatic herbicides to control cyanobacteria blooms in Pyramid Lake, but is permitted to under its NPDES permit. Future treatment for cyanobacteria at all Project reservoirs will be implemented through NPDES permits for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, which requires monitoring. Cyanobacteria were observed at Pyramid Lake during Licensees' Study 4.1.1.

Sago Pondweed[15]

Sago pondweed (*Stuckenia pectinata,* formerly known as *Potamogeton pectinatus*) is a freshwater plant that can grow up to 3 feet tall. Sago pondweed is generally submersed, except for the reproductive stalk that flowers between June and September. The flower stalk can be up to 2 inches long and the fruits are yellow to brown. Sago pondweed is considered a noxious weed in waters used for recreational purposes and irrigation. Dense formations of sago pondweed beds may also limit movement of feeding fish and inhibit fishing success (Casey 2010).

Sago pondweed occurs worldwide and is found submerged in semi-permanent to permanently flooded areas where the water is less than 8 feet deep. The species can be found at elevations from sea level to almost 16,000 feet above sea level. Sago pondweed grows on nearly all substrates and tolerates high salinity, pH fluctuations, and alkaline water (Casey 2010). According to DWR's Aquatic Pesticides Application Plan, Pyramid Lake is subject to infestations of aquatic weeds including sago pondweed (DWR 2014d, 2016b). As previously mentioned, DWR applied herbicides at Pyramid Lake swim areas and boat-in day use areas to control aquatic invasive plants, including sago pondweed, in 2015 through 2019 (DWR 2016c, DWR 2017, DWR 2018c, DWR 2019c).

Sago pondweed was observed on Pyramid Lake and Elderberry Forebay during Licensees' Study 4.1.1.

Coontail[16]

Coontail is a rootless perennial possessing stiff whorls of forked olive-green leaves. The leaves are sometimes coated with lime, giving them a crunchy texture. Coontail tends to form dense colonies either anchored in the mud or floating freely near the surface. The species prefers inland and coastal ponds, lakes, and slow-moving streams and rivers (State of Washington 2015).

The aquarium and pond trade are largely responsible for its initial introduction. Its existence can affect phytoplankton development in multiple ways: by competition for nitrogen, competition for light, and allelopathy (i.e., chemical inhibition of one species by another). A dense bed of coontail can remove up to 0.0035 ounce of nitrogen per 10.8 square feet per day during the preliminary growth stages. Contaminated nets, boat

[15] Photo credit: https://plants.usda.gov/core/profile?symbol=Stpe15
[16] Photo credit: http://www.discoverlife.org/mp/20p?see=I_MWS119649&res=640&guide=Wildflowers&cl=US/IN

trailers and anchors, and drainage machinery have facilitated its spread. The fragmentation of shoots and formation of turions also are important means of distribution to new habitats (GISD 2018).

According to DWR's Aquatic Pesticides Application Plan, Pyramid Lake is subject to infestations of aquatic weeds including coontail and is treated to reduce the infestations at swim areas and boat-in day use areas (DWR 2016c, DWR 2017, DWR 2018c, DWR 2019c). Coontail was recorded in Pyramid Lake during the Licensees' Study 4.1.1.

Small Pondweed[17]

Small pondweed (*Potamogeton pusillus*) is a submerged freshwater grass-like plant found in standing and slow-flowing water throughout California. It has branching stems that can grow up to 3 feet in length with narrow, branching leaves. These plants are usually visible as floating tangled masses near the surface of the water. The inflorescence consists of three to six whorled flowers. Similar in general characteristics to the sago pondweed, small pondweed can be difficult to distinguish without close inspection. The typical blooming period for small pondweed is from May through June (Hellquist et. al 2012).

Small pondweed disperses by breaking off into smaller fragments and floating to other places where it can establish itself. As with other invasive species, these plants crowd out other native plant species. This species prefers eutrophic water conditions, often caused by human activities (Hilty 2017).

Ten occurrences of small pondweed were found during Licensees' Study 4.1.1 at all three reservoirs: in the western cove of Quail Lake; in areas near Chumash Island and other small coves at Pyramid Lake; and in areas near the Elderberry Forebay Dam.

5.3.1.3 Fish

This section describes the fish communities in the following areas: Quail Lake, Gorman Creek, Piru Creek upstream of Pyramid Lake, Pyramid Lake, Pyramid reach, tributaries to Elderberry Forebay, and Elderberry Forebay. Table 5.3-4 lists all fish species known to occur within the waterbodies listed above. The species listed were identified through a comprehensive search of available literature, including stocking records, general fish survey reports, creel surveys, management plans, and regulatory documents, as well information found during the Licensees' studies.

[17] Photo credit: Image Source: http://eol.org/data_objects/31310776

Table 5.3-4. Fish Species Composition and Relevant Information for Species Documented Within the Project Vicinity

Species (Scientific Name)	Historical/ Current	Native/ Introduced[a]	Documented Distribution				
			Quail Lake	Upstream Pyramid Tributaries[b]	Pyramid Lake	Pyramid Reach	Elderberry Forebay[c]/ Tributaries
Arroyo chub (*Gila orcuttii*)	H/C	I	--	--	--	X[7,12,17]	--
Bigscale logperch (*Percina macrolepida*)	C	I	X[13]	--	X[1]	--	--
Black crappie (*Pomoxis nigromaculatus*)	C	I	--	--	X[1,2,3]	--	--
Bluegill (*Lepomis macrochirus*)	C	I	X[13]	--	X[1,2,3]	X[5,6,12]	--
Brown bullhead (*Ameiurus nebulosus*)	C	I	--	--	X[2,3]	--	--
Brown trout (*Salmo trutta*)	C	I	--	--	--	X[5,6]	--
Channel catfish (*Ictalurus punctatus*)	C	I	X[13,14]	X[9]	X[2,3]	--	--
Common carp (*Cyprinus carpio*)	C	I	X[13]	--	X[3]	--	--
Golden shiner (*Notemigonus crysoleucas*)	C	I	--	--	X[3]	--	--
Goldfish (*Carassius auratus*)	C	I	X[13]	--	X[3]	--	--
Green sunfish (*Lepomis cyanellus*)	C	I	--	X[9]	X[1,3]	X[6]	--
Inland silversides (*Menidia beryllina*)	C	I	X[13]	--	X[1,3]	--	--

Table 5.3-4. Fish Species Composition and Relevant Information for Species Documented Within the Project Vicinity (continued)

Species *(Scientific Name)*	Historical/ Current	Native/ Introduced[a]	Documented Distribution				
			Quail Lake	Upstream Pyramid Tributaries[b]	Pyramid Lake	Pyramid Reach	Elderberry Forebay[c]/ Tributaries
Largemouth bass (*Micropterus salmoides*)	C	I	X[13]	X[9]	X[1,2,3], S[12]	X[5,6,12,17], S[5]	--
Mosquito fish (*Gambusia* spp.)	H	I	--	--	--	X[17]	--
Owens sucker (*Catostomus fumeiventris*)	H	I	--	--	--	X[17]	--
Partially armored threespine stickleback (*Gasterosteus aculeatus microcephalus*)	H/C	N	--	--	--	X[6,8,17]	--
Prickly sculpin (*Cottus asper*)	H/C	N	X[13]	--	X[2,3]	X[5,12,17]	--
Rainbow trout (*Oncorhynchus mykiss*)	H/C	N	--	X[9], S[9]	X[1,2,4], S[10,11]	X[5,6,12,17], S[3,5,6]	--
Sacramento blackfish (*Orthodon microlepidotus*)	C	I	X[13,14]	--	X[1]	--	--
Sacramento hitch (*Lavinia exilicauda exilicauda*)	C	I	X[14]	--	X[1]	--	--
Santa Ana sucker (*Catostomas santaanae*)	C	N or I	--	--	--	X[6,12,17]	--
Santa Ana-Owens sucker hybrid (*Catostomus santaanae X fumeiventris*)	H	I	--	--	--	X[17]	--
Shimofuri gobi (*Tridentiger bifasciatus*)	C	I	X[13]	--	X[1,2,3]	X[17]	--
Smallmouth bass (*Micropterus dolomieu*)	C	I	--	--	X[1,2,3]	--	--

Table 5.3-4. Fish Species Composition and Relevant Information for Species Documented Within the Project Vicinity (continued)

Species ***(Scientific Name)***	**Historical/ Current**	**Native/ Introduced**[a]	**Documented Distribution**				
			Quail Lake	**Upstream Pyramid Tributaries**[b]	**Pyramid Lake**	**Pyramid Reach**	**Elderberry Forebay**[c]**/ Tributaries**
Speckled dace (*Rhinichtys osculus*)	H	N	--	--	--	X[6,7]	--
Striped bass (*Morone saxatilis*)	C	I	X[13,14]	X[9]	X[1,2,3]	--	--
Threadfin shad (*Dorosoma petenense*)	C	I	X[13,14]	--	X[1,3]	--	--
Tule perch (*Hysterocarpus traski*)	C	I	X[14]	--	X[1,3]	--	--
Unknown catfish species (*Ictalurus* spp.)	C	I	--	--	X[1]	X[6]	--
Unknown sucker species (*Catostomidae* spp.*)*	C	I	--	--	--	X[12]	--
White catfish (*Ameiurus catus*)	C	I	X[13]	--	X[1,2,3], S[12]	--	--
White crappie (*Pomoxis annularis*)	C	I	--	--	X[1,3]	--	--
Subtotal	H = 4 H/C = 4 C = 24	N = 4 I = 27 N or I = 1	15	5	23	16	0[15,16]
Total	**32**						

Sources:
[1]CDFG 2001; [2]CDFW 2013a; [3]CDFW 2013b; [4]ESA 2015b; [5]FERC 2004; [6]FERC 2008; [7]DWR 2004b; [8]Swift et al. 1993; [9]CDFG 2012; [10]FERC 1982; [11]DWR 2013a; [12]DWR (Study 4.1.3) 2018; [13]DWR (Study 4.1.2) 2018; [14]DWR 1997a; [15]pers. comm., Rubin 2019; [16]pers. comm., Lucero 2019; [17]USFS 2019
Notes:
[a]Species are considered Native if their native range encompasses the Project vicinity.
[b]Upstream Pyramid Lake Tributaries refers to Piru Creek above Pyramid Lake and its tributaries Buck, Snowy, Lockwood, Mutau and Alamo creeks.
[c]The Licensees were unable to locate any data or records regarding fish species composition in Elderberry Forebay.

Key:
H = Historical
C = Current
N = Native
I = Introduced
X = Species documented
S = Species stocked
-- = Species presence not documented

Among these documented species, Santa Ana sucker was previously thought to be introduced and/or hybridized with Owens sucker throughout the Santa Clara River drainage. Richmond et al.'s (2018) genetic study provides evidence that Santa Ana sucker is a native species in the Santa Clara River drainage, at least within the areas sampled by Richmond et al. 2018, which did not include Pyramid reach or other parts of Piru Creek. Based on the limitations of the existing information, the origin of Santa Ana sucker within the Project vicinity is unknown and could be native or introduced. Santa Ana sucker prefers small streams with moderate to fast flowing and cool (71.6°F) water and can be found over gravel, cobble, and boulder substrates and only occasionally in habitats with mud or sand (Moyle 2002). It is capable of very high reproductive rates, enabling it to quickly repopulate streams after a disturbance.

Quail Lake

There was little information available regarding fish populations in Quail Lake prior to the Licensees' Study 4.1.2. A DWR brochure describes six species of fish that can be found in the lake, including striped bass (*Morone saxatilis*), channel catfish (*Ictalurus punctatus*), Sacramento blackfish (*Orthodon microlepidotus*), tule perch (*Hysterocarpus traski*), threadfin shad (*Dorosoma petenense*), and Sacramento hitch (DWR 1997a). Historically, CDFW has sporadically stocked Quail Lake as part of the Statewide trout stocking program; however, CDFW determined that stocking was no longer warranted and ceased stocking Quail Lake in 2012.

Licensees' Study 4.1.2 included boat electrofishing and creel surveys in Quail Lake.

Boat Electrofishing

Boat electrofishing was conducted in Quail Lake on October 9, 2018, using a Smith Root Generator Powered Pulsator 5.0 system. The 3.28-mile-long Quail Lake shoreline was split into six discrete habitat units, each approximately 0.5 miles long (Figure 5.3-11). The six units were characterized as follows:

1. South shore, primarily composed of partially submerged, cement walkway with no apparent vegetation
2. East shore, with limited tule, dam rip-rap and submerged trees
3. North shore, with tule habitat and inlet rip-rap
4. North shore, with predominately tule and shoal habitat
5. Northwest shore, with predominately shallow tule and shoal habitat
6. Southwest shore, including outlet and partially submerged, cement walkway

Figure 5.3-11. Locations of All Habitat Units Electrofished on Quail Lake under Study 4.1.2

Each unit was sampled in a "leap frog" manner to minimize herding of fish. Some sections of units 3 and 6 (approximately 5 percent of the total shoreline) could not be sampled due to insufficient depth and/or presence of anglers. Sampling was conducted in accordance with the CFDW-issued Scientific Collecting Permit. Length (mm), weight (g), and condition were collected for up to 50 individuals of each species captured for the study; additional fish were examined and enumerated, but not measured or weighed.

Species composition was represented by warmwater fishes, including game fish common in California. A total of 13 species were documented, with the most abundant fishes captured being largemouth bass (n=116), white catfish (n=50), and striped bass (n=27). Other species captured included bluegill, bigscale logperch, prickly sculpin, common carp, goldfish, Sacramento blackfish, channel catfish, shimofuri goby, threadfin shad, and inland silverside. Threadfin shad and inland silversides were documented for presence/absence in each unit due to the large numbers of individuals present. Sampling results are presented in Table 5.3-5, and overall catch per unit effort (CPUE, fish per minute of electrofisher operation) and species composition are provided in Figure 5.3-1.

Game fishes were assessed for their proportional size distribution (PSD) and relative size distribution (PSD-P) (Guy et al. 2007) (Table 5.3-5). Quail Lake can be characterized as a "big bass" fishery (Willis et al. 1993), with largemouth bass having a high PSD and PSD-P (80 and 32, respectively) and bluegill having a low PSD and PSD-P values (20 and 0, respectively). Striped bass were also healthy (relative condition range 0.84 to 1.22, Fulton's condition 1.04 to 1.48, average 1.28), and had a similar PSD to largemouth bass (PSD = 80). Although only one very large (718 mm) striped bass was collected, larger individuals tend to occupy deeper water and thus may have been under-represented during sampling due to the decreased effectiveness of boat electrofishing in deeper water.

The fish captured showed a wide range of weight relative to length (Table 5.3-5). Bluegill displayed both the lowest and highest relative condition, a measure of relative expected weight based on length of sampled fish. Fulton's condition, an independent measure of fish condition for fish displaying fusiform body shape, averaged well above 1.0 (considered good). Threadfin shad and inland silversides were documented in large quantities throughout all units, indicating a large prey base for predatory game fish. The diverse assemblage and broad range of fish conditions may indicate a relatively competitive population within the lake.

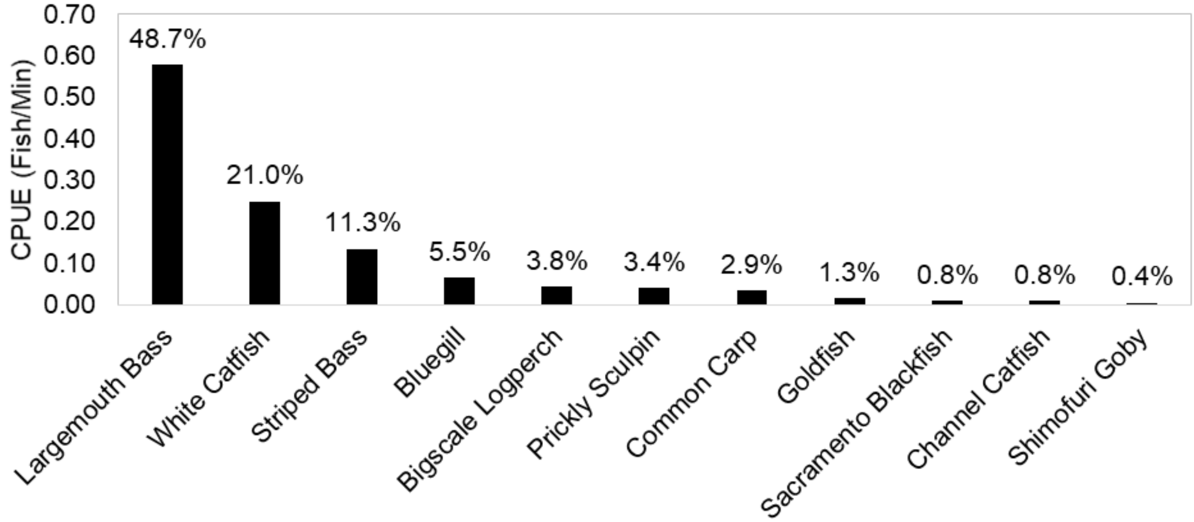
Table 5.3-5. Population Summary of Boat Electrofishing on Quail Lake

Common Name (Scientific Name)	Collected	Length (mm)	Weight (g)	Relative Condition[1]	Fulton Condition[1]	Percent of Total Catch by Number (%)	CPUE	PSD[2]	PSD-P[2]
		Min-Max (Mean)	Min-Max (Mean)	Range	Range (Average)				
Largemouth bass (*Micropterus salmoides*)	116	83-458 (199) [3]	7.5-2,040.0 (294.9) [3]	0.49-1.35[3]	0.77-2.31 (1.54) [3]	48.7	0.58	80[3]	32[3]
White catfish (*Ameiurus catus*)	50	115-503 (270)	13.8-3,150.0 (439.4)	0.64-1.32	0.91-2.48 (1.57)	21.0	0.25	--	--
Striped bass (*Morone saxatilis*)	27	191-718 (283)	80.0-4,000.0 (613.1)	0.84-1.22	1.04-1.48 (1.28)	11.3	0.13	80	0
Bluegill (*Lepomis macrochirus*)	13	34-174 (81)	4.4-152.0 (34.7)	0.45-1.95	--	5.5	0.06	20	0
Bigscale logperch (*Percina macrolepida*)	9	80-91 (87)	2.7-5.4 (4.2)	--	--	3.8	0.04	--	--
Prickly sculpin (*Cottus asper*)	8	39-95 (73)	1.3-14.9 (7.6)	--	--	3.4	0.04	--	--
Common carp (*Cyprinus carpio*)	7	629-676 (656)	5,110.0-5,650.0 (5436.7)	--	--	2.9	0.03	100	100
Goldfish (*Carassius auratus*)	3	354-385 (366)	1,530.0-2,080.0 (1,810.0)	--	--	1.3	0.01	--	--

Table 5.3-5. Population Summary of Boat Electrofishing on Quail Lake (continued)

Common Name (Scientific Name)	Collected	Length (mm)	Weight (g)	Relative Condition[1]	Fulton Condition[1]	Percent of Total Catch by Number (%)	CPUE	PSD[2]	PSD-P[2]
		Min-Max (Mean)	Min-Max (Mean)	Range	Range (Average)				
Sacramento blackfish (*Orthodon microlepidotus*)	2	475-485 (480)	1,620.0-1,700.0 (1,660.0)	--	--	0.8	0.01	--	--
Channel catfish (*Ictalurus punctatus*)	2	350-475 (413)	1,230.0-1,960.0 (1,595.0)	--	--	0.8	0.01	50	0
Shimofuri goby (*Tridentiger bifasciatus*)	1	48	2.8	--	--	0.4	<0.01	--	--
Threadfin shad[4] (*Dorosoma petenense*)	Observed	--	--	--	--	--	--	--	--
Inland silverside[4] (*Menidia beryllina*)	Observed	--	--	--	--	--	--	--	--
Total	**238**	**--**	**--**	**--**	**--**	**100.0**	**1.19[5]**	**--**	**--**

Notes:
[1]Relative and Fulton's condition factors could not be calculated for all fish. Non-game fish, species with insufficient sampled individuals, and species without a fusiform body shape (Fulton) were not calculated.
[2]Proportional and relative stock densities were only calculated for species recognized as game fish by CDFW.
[3]The first 50 individuals captured were used in metric calculations. All individuals captured thereafter were examined and enumerated but not measured or weighed and, therefore, not used in some calculations.
[4]Threadfin shad and inland silversides were noted for presence/absence in each unit due to the large quantities present throughout the sampling event.
[5]Presented CPUE for individual species are rounded to two decimal places, and therefore may not sum to the presented total CPUE.
Key:
CPUE = catch per unit effort, fish per minute of electrofisher operation
g = grams
Max = maximum
Min = minimum
mm = millimeters
PSD = proportional size distribution
PSD-P = relative size distribution – preferred



Key:
% = percent
CPUE = catch per unit effort, fish per minute of electrofisher operation
Min = minute

Figure 5.3-12. Overall Catch Per Unit Effort (Fish Per Minute) with Composition of Species (Percent) Collected During Boat Electrofishing on Quail Lake

CPUE varied by unit for the six habitat units sampled. Unit 2 exhibited the highest density of fish with a CPUE of 1.89 fish per minute, and Unit 1 the least dense with a CPUE of 0.61 fish per minute. CPUE for all units combined was 1.19 fish per minute. Sampling effort (i.e. seconds with electrofisher on) was variable between units depending on accessible habitat and angler presence. Unit 3 had the least amount of shoreline and also multiple anglers in the area (near the inlet). Table 5.3-6 provides CPUE for all species and for all units.

Table 5.3-6. Overall Catch Per Unit Effort (Fish Per Minute) by Habitat Unit During Boat Electrofishing on Quail Lake

Species	Total Catch	Overall CPUE	Unit 1		Unit 2		Unit 3		Unit 4		Unit 5		Unit 6	
			Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
Largemouth bass (*Micropterus salmoides*)	116	0.58	9	0.22	68	1.22	11	0.66	12	0.47	8	0.32	8	0.22
White catfish (*Ameiurus catus*)	50	0.25	6	0.15	5	0.09	3	0.18	25	0.97	10	0.41	1	0.03
Striped bass (*Morone saxatilis*)	27	0.13	8	0.20	6	0.11	1	0.06	2	0.08	1	0.04	9	0.25
Bluegill (*Lepomis macrochirus*)	13	0.06	0	0.00	8	0.14	0	0.00	2	0.08	1	0.04	2	0.05
Bigscale logperch (*Percina macrolepida*)	9	0.04	0	0.00	9	0.16	0	0.00	0	0.00	0	0.00	0	0.00
Prickly xculpin (*Cottus asper*)	8	0.04	1	0.02	5	0.09	0	0.00	1	0.04	0	0.00	1	0.03
Common carp (*Cyprinus carpio*)	7	0.03	0	0.00	4	0.07	0	0.00	0	0.00	0	0.00	3	0.08

Table 5.3-6. Overall Catch Per Unit Effort (Fish Per Minute) by Habitat Unit During Boat Electrofishing on Quail Lake (continued)

Species	Total Catch	Overall CPUE	Unit 1		Unit 2		Unit 3		Unit 4		Unit 5		Unit 6	
			Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
Goldfish (*Carassius auratus*)	3	0.01	0	0.00	0	0.00	0	0.00	1	0.04	2	0.08	0	0.00
Sacramento blackfish (*Orthodon microlepidotus*)	2	0.01	0	0.00	0	0.00	0	0.00	1	0.04	1	0.04	0	0.00
Channel catfish (*Ictalurus punctatus*)	2	0.01	0	0.00	1	0.02	0	0.00	0	0.00	1	0.04	0	0.00
Shimofuri goby (*Tridentiger bifasciatus*)	1	0.00	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Threadfin shad (*Dorosoma petenense*)	OBS	--	OBS	--	OBS	--	OBS	--	OBS	--	OBS	--	OBS	--
Inland silverside (*Menidia beryllina*)	OBS	--	OBS	--	OBS	--	OBS	--	OBS	--	OBS	--	OBS	--
Total Catch	**238**		**25**		**106**		**15**		**44**		**24**		**24**	
CPUE	**1.19**		**0.61**		**1.89**		**0.90**		**1.71**		**0.97**		**0.66**	
Effort (minutes)	**200.35**		**40.80**		**55.97**		**16.68**		**25.73**		**24.65**		**36.52**	

Key:
CPUE = catch per unit effort, fish per minute of electrofisher operation
OBS = observed, but not counted or sampled

Species composition varied among sampled units. Unit 2 produced the most species and Unit 3 the least (8 and 3, respectively). The three most abundant species (largemouth bass, striped bass, and white catfish) were found in all six units. Figure 5.3-13 shows the percent composition of species by unit.

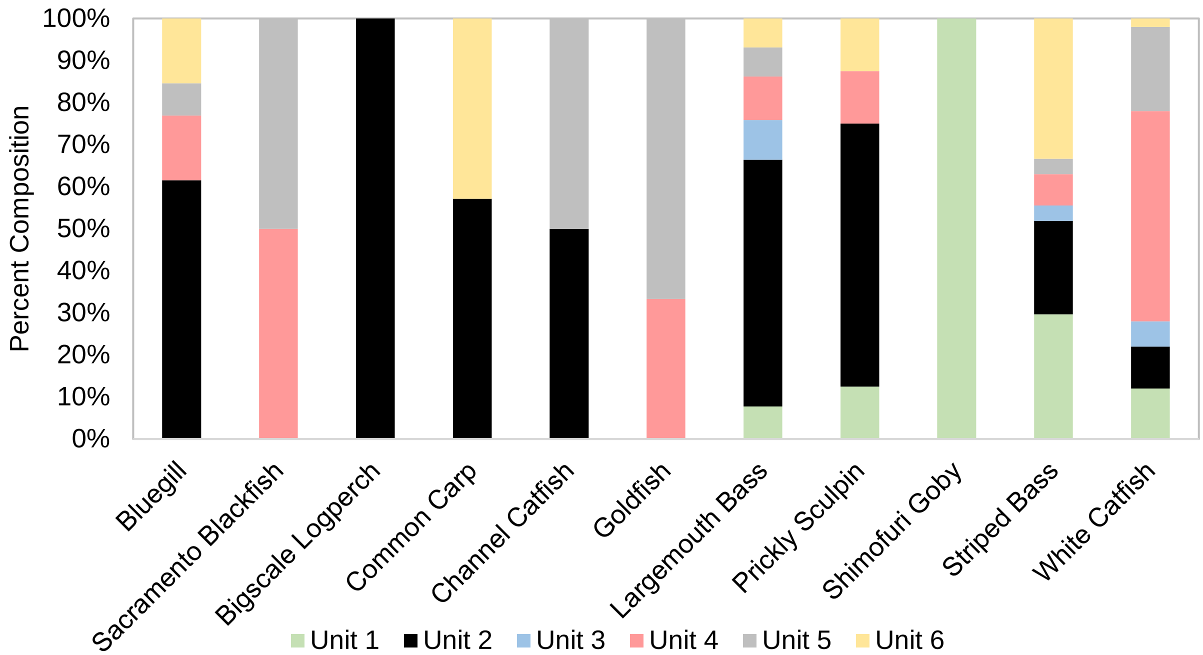


Figure 5.3-13. Percent Composition by Habitat Unit During Boat Electrofishing on Quail Lake

<u>Creel Surveys</u>

Recreational anglers at Quail Lake were surveyed through stratified random sampling that incorporated an active creel design to gather information on fishing pressure and impact to game fish species. A total of 50 surveys were conducted from October 1, 2017 to July 31, 2018, representing 16 high use days (weekends and major holidays) and 34 low use days (weekdays) that were randomly selected. Each survey was also randomly selected as an AM (from 7:00 to 10:00 in the morning) or PM (from 3:00 to 6:00 in the evening) survey, with 30 surveys completed in the morning and 20 in the evening. Surveys were conducted at the parking lot directly west of Quail Lake, as this is the only designated public access.

A total of 85 angler parties were interviewed, representing 175 individual anglers. These anglers had a combined 854.6 angling hours, catching a total of 58 fish. Fish caught were represented by four categories: striped bass, black bass, catfish, and perch. Based on electrofishing data, black bass were likely largemouth bass, and catfish were either white catfish or channel catfish. Some fish recorded were based on angler responses and may not have been accurately identified to species. Overall, CPUE was low, at less than 0.1 fish per hour. Table 5.3-7 presents the overall creel results.

Table 5.3-7. Summary of A.M. and P.M. Creel Survey Results for High Use and Low Use Periods

Event	Number of Surveys	Number of Angler Parties	Number of Anglers	Total Angler Hours	Total Fish Caught	Number Released	CPUE
Weekends, High Use (n=16 surveys)							
Saturday	8	30	65	427.1	26	10	0.06
Sunday	8	17	40	155.5	7	1	0.05
Weekend Subtotal	**16**	**47**	**105**	**582.6**	**33**	**11**	**0.06**
Weekdays, Low Use (n=34 surveys)							
Monday	5	6	9	11.8	7	2	0.59
Tuesday	7	7	17	67.7	2	0	0.03
Wednesday	9	9	17	110.9	7	6	0.06
Thursday	5	8	13	42.4	1	0	0.02
Friday	8	8	14	39.2	8	4	0.20
Weekday Subtotal	**34**	**38**	**70**	**272.0**	**25**	**12**	**0.09**
Overall Total	**50**	**85**	**175**	**854.6**	**58**	**23**	**0.07**

Key:
CPUE = catch per unit effort, fish per hour of angling effort

Thirty-nine of the 58 fish caught by anglers were measured for length and identified to species (Table 5.3-8). The most common fish caught (and kept) was striped bass, representing almost 70 percent of the fish recorded. All striped bass recorded were over 300 mm. Catfish and black bass were caught less frequently, yet were also targeted less often by anglers. One angler reported catching three perch, but did not identify them to species.

Table 5.3-8. Length Frequency of Measured Fish During Creel Surveys

Species	Length (mm)				Total	Percent of Total
	0-150	150-304	304-533	533–787		
Striped bass	0	0	11	16	27	69.2
Catfish sp.[1]	0	1	2	2	5	12.8
Black bass[1]	0	3	1	0	4	10.3
Perch[2]	0	0	3	0	3	7.7
Total	**0**	**4**	**17**	**18**	**39**	**100.0**

Notes:
[1]Based on electrofishing data, black bass were likely largemouth bass, and catfish either white catfish or channel catfish.
[2]Three perch were reported during angler interviews, but the exact species was not identified.
Key:
mm = millimeters

Most angler parties interviewed traveled from nearby counties, primarily Los Angeles County (72 percent). Only a few anglers traveled to Quail Lake from counties outside of the greater Los Angeles area (Figure 5.3-14). Anglers were asked to rate their overall level of satisfaction on a scale of 1 to 5. Eighty-three of the 85 parties interviewed answered this question and the average overall satisfaction was 3.1, meaning more anglers were satisfied with their angling experience than were dissatisfied.

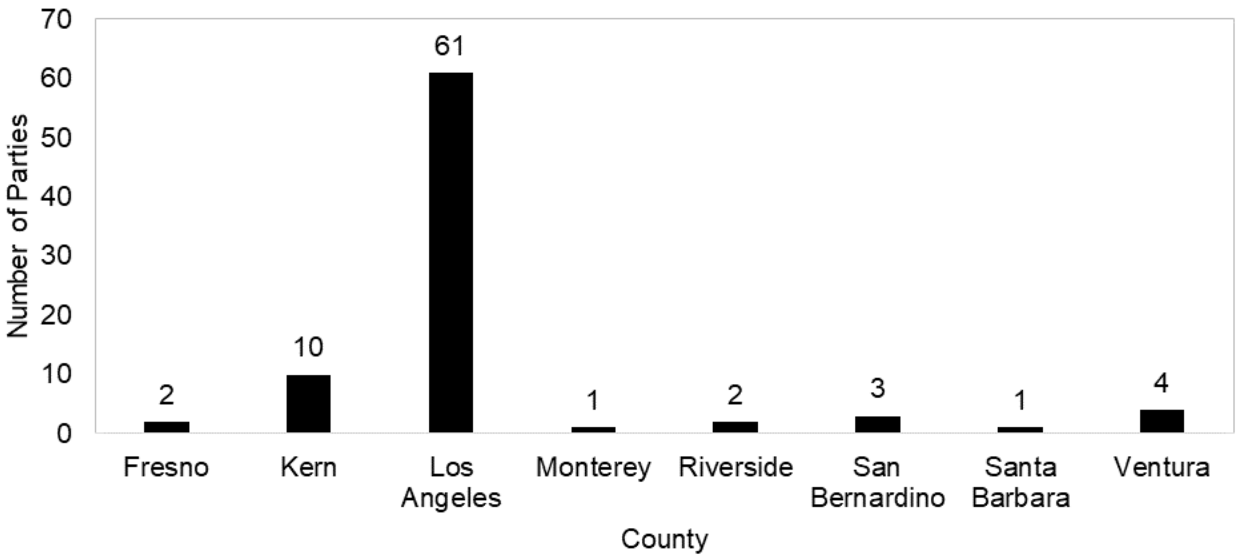


Figure 5.3-14. Angler Parties' County of Residence

In summary, Quail Lake is a small engineered waterbody that fluctuates very little, and the fishery is composed entirely of introduced fish species. The Licensees manage Quail Lake as a recreational warmwater fishery. Water contact is not permitted, so angling occurs only from the shoreline. Even though Quail Lake is not currently stocked, the Licensees found that the game fish population in Quail Lake is healthy, that the impact of recreational angling was relatively low, and that anglers were generally satisfied with the recreational experience.

Gorman Creek

Gorman Creek is not a perennial stream (Caltrans 2015; USFS 1991), and review of aerial imagery reveals long periods during the summer with no apparent flow. This indicates that establishment of self-sustaining populations of fish in Gorman Creek would be challenging. The Licensees requested from CDFW any fish information regarding Gorman Creek. CDFW advised the Licensees that CDFW did not have any information regarding fish species or other aquatic resources in Gorman Creek (pers. comm., Lucero 2019).

Piru Creek Upstream of Pyramid Lake

Piru Creek upstream of Pyramid Lake and its tributaries, are designated as a Heritage and Wild Trout Water, for approximately 69 miles of perennial stream habitat, even though rainbow trout were stocked in those areas until 1979 (CDFG 2012). CDFW developed a five-year plan to guide the management of fish in Piru Creek upstream of Pyramid Lake (CDFG 2012). Heritage and Wild Trout Waters are defined as supporting self-sustaining populations, having aesthetic value, having adequate environmental productivity, and being open to the public for angling. Management of Heritage and Wild Trout Waters may include stocking with native strains of trout, although CDFW does not currently stock fish in Piru Creek upstream of Pyramid Lake. The plan states that CDFW manages the stream as a “fast-action” fishery (catching more than two fish per hour) through the use of adaptive management of regulations. Because this reach is designated as a Heritage and Wild Trout Water, fishing is limited to using artificial lures with barbless hooks. CDFW’s 2019-2020 special fishing regulations under Article 3, Section 7.50(b)(140)(A) specifies a daily bag limit of two trout all year limited to the use of artificial lures with barbless hooks in this area. Trophy size fish (greater than 18 inches) are largely absent; however, large adfluvial trout from Pyramid Lake are occasionally observed spawning in the creek (CDFG 2012).

CDFG (now CDFW) conducted depletion electrofishing and snorkel surveys in Piru Creek and its tributaries above Pyramid Lake periodically between 1996 and 2008 (CDFG 2012). Estimated density of rainbow trout ranged from 0 to 830 fish per mile with an average of 324 fish per mile, and the weight of fish captured ranged from 0 to 3.2 ounces with an average of 1.7 ounces (CDFG 2012). In relation to Pyramid Lake, the Piru Creek tributaries including Buck, Snowy, Lockwood, Mutau, and Alamo creeks are located approximately 1, 4.5, 15, 17.5, and 18 miles upstream, respectively. CDFG surveys on Buck Creek were located within 1.3 miles of the confluence with Piru Creek, on Snowy Creek 1.5 miles from the confluence with Piru Creek, on Alamo Creek approximately 0.5 miles from the confluence of Mutau Creek, and on Mutau Creek within the lower portion below the confluence with Alamo Creek downstream to the confluence with Piru Creek. Surveys on Piru Creek were conducted from Lockwood Creek downstream to the Hardluck crossing (near the USFS Hardluck Campground) at eight distinct locations (CDFG 2008b). Densities ranged from 0 to 2,648 fish per mile with an average of 852 fish per mile. YOY fish (age 0+) were only identified in Alamo and Mutau creeks, where they made up 23 and 48 percent of the observed fish, respectively. Fish less than 5.9 inches were the most common size class in Buck, Piru, and Alamo creeks, and averaged 79 percent of the population in those streams. YOY was the most common size class in Mutau Creek (48 percent).

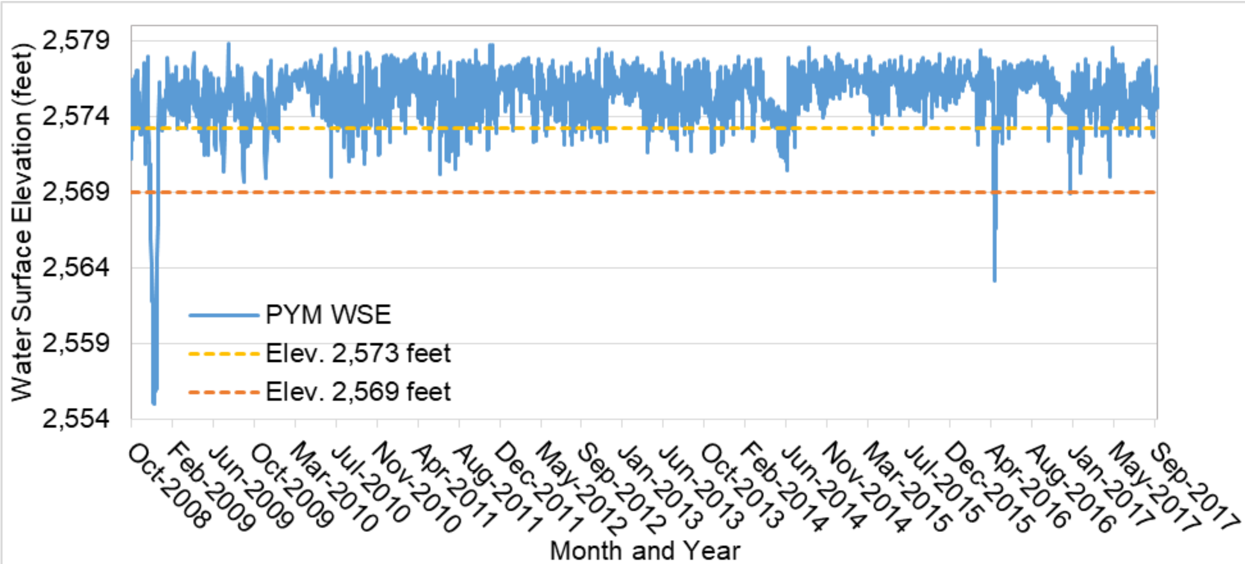
Between 1996 and 2008, CDFG surveys found rainbow trout and four species of non-native fish in Piru Creek upstream of Pyramid Lake: striped bass, channel catfish, largemouth bass, and green sunfish. All of these species are also found in Pyramid Lake. Migration by these non-native species may be blocked during most flows by the USGS gaging station on Piru Creek (downstream of the confluence with Buck Creek) and its associated concrete structure. Largemouth bass have been caught by anglers upstream from the gage. Three additional Arizona-style road crossings (i.e., the road is built into the streambed) may present barriers to migration: Forest Road 8N12 crosses Seymour Creek 1 mile upstream from the confluence with Lockwood Creek, Forest Road 8N24 crosses Piru Creek (approximately 3.5 miles upstream of Pyramid Lake), and Forest Road 8N01 crosses Piru Creek at Gold Hill (approximately 10 miles upstream of Pyramid Lake). CDFW has not evaluated those road crossings for fish passage (CDFG 2012).

In addition to the snorkel surveys in 2008, CDFW conducted additional snorkel surveys in Piru Creek upstream of Pyramid Lake in 2017. The Licensees requested these data from CDFW; however, CDFW advised the Licensees that the 2017 data are considered preliminary and not publicly available until CDFW has completed its full quality assurance/quality control (QA/QC) process (pers. comm., Weaver 2019).

Pyramid Lake Tributaries Fish Passage Barriers Study

Licensees' relicensing Study 4.1.22 evaluated Pyramid Lake operations and annual fluctuations in water surface elevations (WSE) and tributaries to Pyramid Lake for potential fish barriers to fish migrating from the reservoir into the tributaries. The Licensees surveyed from the reservoir water surface elevation at the time of the survey to the NMWSE of the reservoir for Piru, Carlos Canyon, and Gorman creeks in July 2018. Staff utilized Real-Time Kinematic (RTK) GPS survey equipment to measure channel bed and WSE; developed detailed longitudinal profiles; recorded dominant and sub-dominant substrate composition; and took photographs of representative habitat in each tributary. The Licensees used these data to assess the occurrence of barriers to upstream passage of rainbow trout in the surveyed areas. For the purpose of the study, an upstream fish barrier was considered a leaping barrier, a shallow water barrier, or a velocity barrier for any life stage of rainbow trout.

The NMWSE of Pyramid Lake is 2,578 feet. Current operating agreements limit reservoir WSE fluctuations to the upper 19 feet of the reservoir. Actual Pyramid Lake WSEs typically fluctuate within the upper 9 feet of the reservoir between 2,578 feet and 2,569 feet. Further review of WSE data from the Pyramid Lake gage (PYM) (DWR 2018a) during the nine-year period from October 2, 2008 to October 1, 2017, showed that 95 percent of the time, the reservoir's WSE was within 5 feet of the NMWSE (2,573 feet), and on only two occasions was the WSE lower than 2,569 feet: (1) between December 3, 2008 and December 25, 2008; and (2) between April 24, 2016 and April 29, 2016 (Figure 5.3-15). Both instances were due to outages.



Key:
Elev. = elevation
PYM = Pyramid Lake gage (DWR 2018a)
WSE = water surface elevation

Figure 5.3-15. Pyramid Lake Water Surface Elevations (National Geodetic Vertical Datum 29) from October 2, 2008 to October 1, 2017

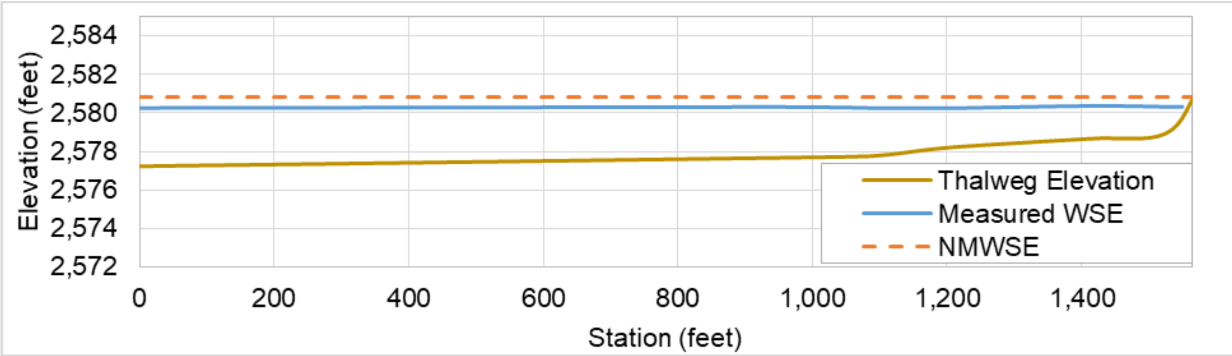
All analyses addressed below are discussed in the North American Vertical Datum of 1988 (NAVD 88) per the FERC-approved Study Plan. The NMWSE of 2,578 feet discussed above, and described in the PAD and study plan, references the National Geodetic Vertical Datum of 1929 and requires a VERTCON shift of 2.825 feet to NAVD 88. The shifted NMWSE is 2,580.8 feet NAVD 88. Reservoir WSE obtained from the PYM gage through the month of July 2018 averaged approximately 2,577 feet NAVD 88, which is 3.8 feet below NMWSE. During the fieldwork, Pyramid Lake was approximately 1.5 feet below NMWSE. Although not required by the FERC-approved Study Plan because the tributaries were low gradient, surveyors mapped the wetted channel below the WSE where reasonable and safe to do so, which was at a depth of 2.5 feet, to gather additional information. Results for each tributary (Piru Creek arm above Pyramid Lake, Gorman Creek, and Carlos Canyon) are provided below. As discussed below, no fish barriers were found on Piru Creek and Carlos Canyon, and one barrier, a man-made concrete feature, was found on Gorman Creek.

Results of Study 4.1.22 on Piru Creek Arm of Pyramid Lake

Surveyors mapped approximately 1,564 feet of the thalweg, from a low of 2,577.2 feet to a high of 2,580.8 feet NAVD 88. Approximately 1,537 feet were mapped in the wet, and 27 feet in the dry. The average gradient of the entire surveyed reach was 0.2 percent, with a high gradient of 4.8 percent at station 1,525 near the NMWSE. Sand was the exclusive substrate throughout all of the survey area. In the wetted portion of the surveyed channel, stream width was approximately 35 feet to 95 feet; whereas in the dry portion of the surveyed channel, stream width was estimated to be 2 feet to 5 feet. Much of the survey area in the wet was bordered by thick riparian vegetation consisting of willow (*Salix* sp.) and alder (*Alnus* sp.), with common reed (*Phragmites australis*) and other hydrophytes along the margins. The dry part of the survey area was bordered by thick patches of willow. No fish were observed in the wetted area surveyed. A map detailing the area surveyed is provided in Figure 5.3-16. A longitudinal profile of Piru Creek, including the measured WSE for the section of the stream surveyed, is presented in Figure 5.3-17. Representative photographs of the area surveyed in the wet and in the dry are provided in Figure 5.3-18. No barriers to fish migration were identified in the surveyed area.

Note:
The majority of the section of stream surveyed (from Station 0 to Station 1,537) was mapped in the wet with a maximum depth of about 2.5 feet.
Key:
NMWSE = normal maximum water surface elevation
RTK = Real-Time Kinematic
WSE = water surface elevation

Figure 5.3-16. Piru Creek Area Surveyed on July 24, 2018, including Thalweg Centerline and Longitudinal Profile Stationing



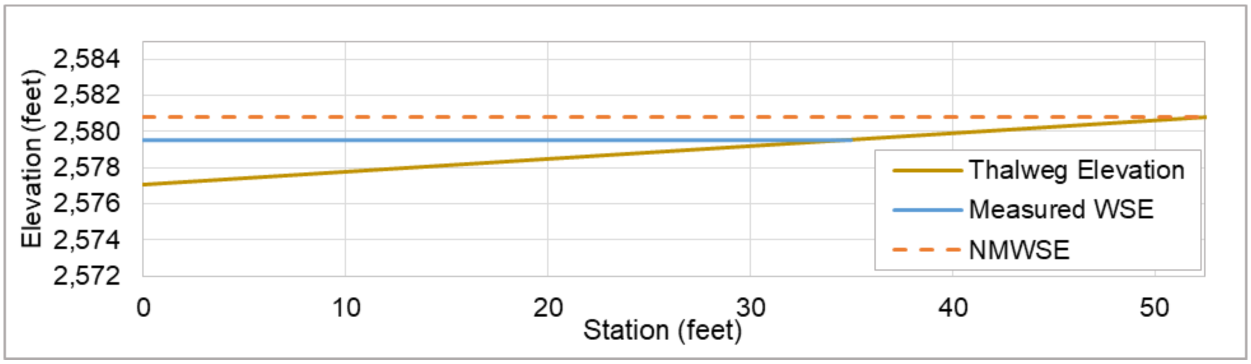
Key:
WSE = water surface elevation
NMWSE = normal maximum water surface elevation

Figure 5.3-17. Piru Creek Longitudinal Profile, including Measured Water Surface Elevation and Normal Maximum Water Surface Elevation for Pyramid Lake

Figure 5.3-18. Representative Photographs Showing Section of Piru Creek Below Pyramid Lake's Normal Maximum Water Surface Elevation Mapped in the Wet (left) and in the Dry (right)

Results of Study 4.1.22 at Carlos Canyon

Surveyors mapped 52.5 feet of the thalweg below the reservoir NMWSE, from a low of 2,577.1 feet NAVD 88. Approximately 34.2 feet were mapped in the wet, and 18.3 feet in the dry. The average gradient was 7.1 percent and remained constant. Sand was the exclusive substrate within the survey area. During the survey, the stream channel was dry from the WSE to the NMWSE. No fish were observed in the wet area surveyed. Figure 5.3-19 shows the Carlos Canyon longitudinal profile, including the measured reservoir WSE. Representative photographs of the area surveyed in the wet and in the dry are provided in Figure 5.3-20. No barriers to fish migration were identified in the surveyed area.



Key:
WSE = water surface elevation
NMWSE = normal maximum water surface elevation

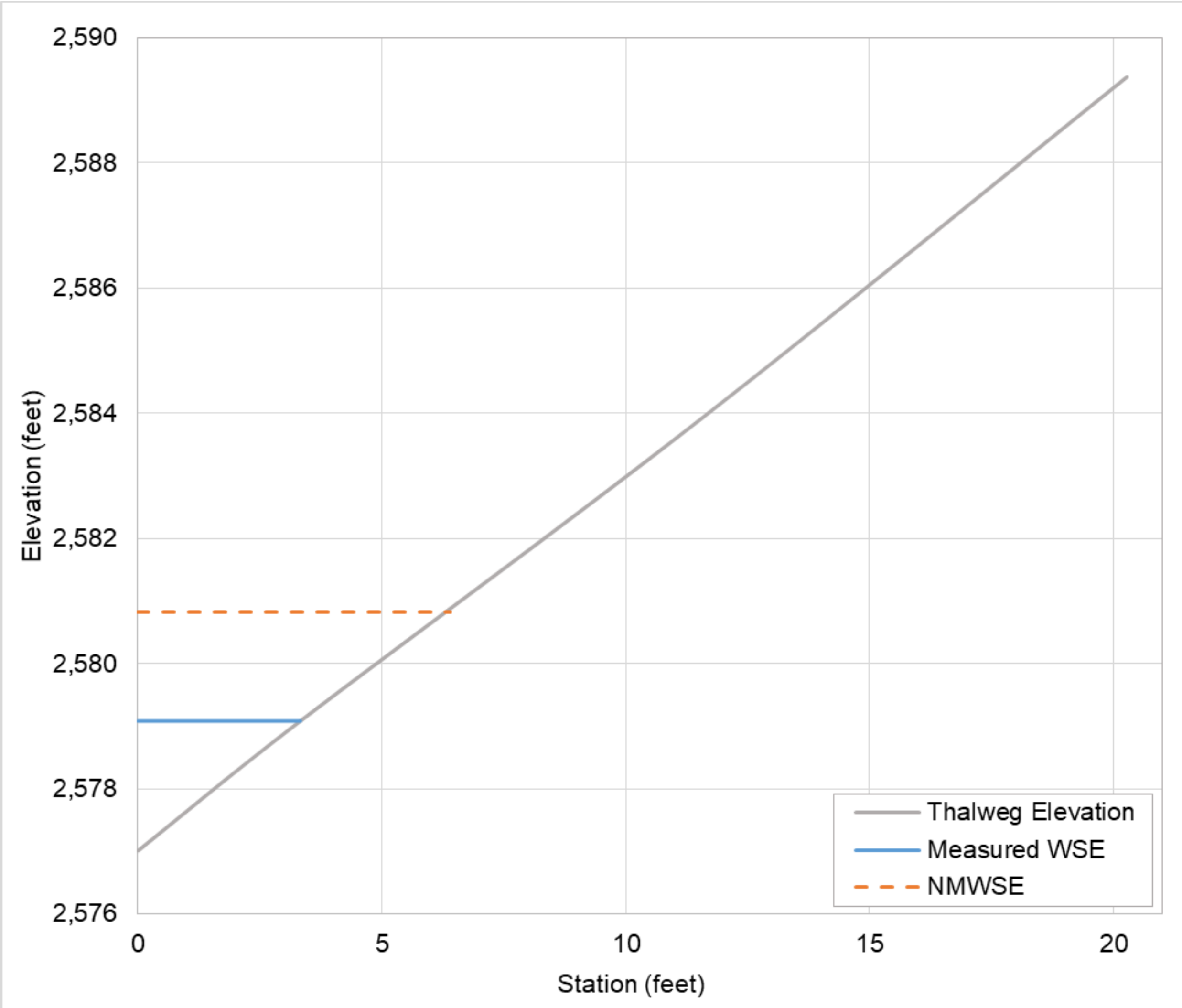
Figure 5.3-19. Carlos Canyon Longitudinal Profile Including Measured Water Surface Elevation and Normal Maximum Water Surface Elevation for Pyramid Lake

Figure 5.3-20. Representative Photographs Showing the Section of Carlos Canyon Below Pyramid Lake's Normal Maximum Water Surface Elevation Mapped in the Wet (left) and in the dry (right)

Results of Study 4.1.22 at Gorman Creek

As mentioned above, a single barrier to upstream fish passage was identified in the area surveyed in Gorman Creek. The barrier is a man-made, 12-foot-high, sloped concrete drop structure located at the mouth of Gorman Creek to Pyramid Lake (Figure 5.3-21). Surveyors mapped in the wet approximately 6 feet of the thalweg from a low of 2,577 feet to a high of 2,580.8 feet NAVD 88 (Figure 5.3-22); none of the stream was mapped in the dry. The average gradient was 60.9 percent and it remained constant. Within 1,600 feet of Pyramid Lake, the stream channel is an engineered concrete structure. Approximately 0.5 cfs of stream flow was present in the tributary at the time of the survey. This flow fanned out over the drop structure and RTK GPS–measured WSE is not discernable graphically from the channel thalweg. No fish were observed.

Figure 5.3-21. Representative Photograph Showing the Section of Gorman Creek Below Pyramid Lake's Normal Maximum Water Surface Elevation Mapped in the Wet



Key:
WSE = water surface elevation
NMWSE = normal maximum water surface elevation

Figure 5.3-22. Gorman Creek Longitudinal Profile, including Measured Water Surface Elevation and Normal Maximum Water Surface Elevation for Pyramid Lake

The Licensees found no information regarding the presence of fish in Gorman Creek and found the ramped concrete spill at its mouth to be a complete barrier to upstream fish migration. However, with no fish species known to be present in Gorman Creek, and none are expected due to its ephemeral nature, the barrier likely has a beneficial effect of restricting access to Gorman Creek by non-native species introduced into Pyramid Lake via the West Branch of the SWP.

Pyramid Lake

The existing license includes the establishment of a self-propagating warm water fishery and a put-and-take rainbow trout fishery in Pyramid Lake (DWR 2002a). Pyramid Lake has historically been stocked by CDFW with rainbow trout, brown trout, channel catfish, largemouth bass, smallmouth bass, and striped bass. The history of fish stocking in Pyramid Lake is discussed in more detail below. Additional species that have not been stocked by CDFW or by the Licensees, but have been documented in Pyramid Lake, include: white catfish, bigscale logperch, Sacramento hitch, Sacramento blackfish, tule perch, and shimofuri goby (CDFG 2001). Other fish species have been cited as present in the reservoir by CDFG (2001) and CDFW (2013a and 2013b); threadfin shad and inland silversides are the primary forage fish found in Pyramid Lake (CDFW 2013b).

The most recent fish surveys in Pyramid Lake conducted by CDFW were in May and October 2013. Boat electrofishing was used to sample the littoral zone along the lake shoreline. Sampling was conducted along 16 transects, each 0.53 miles long, that were randomly selected out of a total of 37 transects. Each transect was sampled for roughly 10 minutes with current applied to the water. Sampling was conducted at night with a four-person crew. Fish were identified to species and measured for length and weight.

The May sampling by CDFW was completed on May 21, 2013. A total of 214 fish from 11 species were collected (Table 5.3-9). Largemouth bass was the most abundant species (27 percent of the catch by abundance) followed by white catfish (19 percent), while only a single brown bullhead and a prickly sculpin were captured. A total of 116.95 generator minutes resulted in a total CPUE of 1.83 fish per minute (CDFW 2013a).

The October 22, 2013 general fish survey by CDFW produced over five times more fish than the May 2013 event, with a total of 1,124 total fish captured. More than half of the catch was largemouth bass, and a single white crappie represented the only species not captured in the previous event. The total fishing effort was also greater with a total of 161.8 generator minutes, resulting in a CPUE of 6.98 fish per minute.

CDFW considers the fish populations at Pyramid Lake to be in good condition (CDFW 2013b). Largemouth bass, smallmouth bass, bluegill, black crappie, white catfish, striped bass, and channel catfish all had relative weights that showed their populations to be in good condition. Relative stock densities (RSD) for largemouth bass were favorably out of balance, with a larger than normal proportion of fish over 12 inches in length. In contrast, RSD for smallmouth bass showed a population weighted toward the stock size (greater than 7.9 inches) and RSD for bluegill showed a balanced population. CDFW is developing this data set to eventually observe population trends (CDFW 2013b).

Table 5.3-9. Abundance and Catch Per Unit Effort (Fish Per Minute of Electrofisher Operation), and Length of Fish Captured by CDFW in Pyramid Lake in May and October of 2013

Species *(Scientific Name)*	Number of Fish	Percent of Total Catch	CPUE (fish per minute)	Length Range (inches)
May 2013				
Largemouth bass (*Micropterus salmoides*)	58	27	0.50	1.2-20.7
White catfish (*Ameiurus catus*)	41	19	0.35	11.8-20.5
Striped bass (*Morone saxatilis*)	29	14	0.25	5.0-14.3
Channel catfish (*Ictalurus punctatus*)	27	13	0.23	13.4-23.6
Bluegill (*Lepomis macrochirus*)	23	11	0.20	2.5-8.1
Smallmouth bass (*Micropterus dolomieu*)	20	10	0.17	4.1-15.2
Shimofuri gobi (*Tridentiger bifasciatus*)	5	2	0.04	2.3-3.1
Rainbow trout (*Oncorhynchus mykiss)*	5	2	0.04	9.2-14.2
Prickly sculpin (*Cottus asper*)	4	2	0.03	1.3-2.8
Brown bullhead (*Ameiurus nebulosus*)	1	0	0.01	13.0
Black crappie (*Pomoxis nigromaculatus*)	1	0	0.01	15.0
Subtotal	**214**	**100**	**1.83**	
October 2013				
Largemouth bass (*Micropterus salmoides*)	591	52	3.67	2.6-19.3
Bluegill (*Lepomis macrochirus*)	134	12	0.83	1.3-9.3
Black crappie (*Pomoxis nigromaculatus*)	98	9	0.61	2.4-13.2
Smallmouth bass (*Micropterus dolomieu*)	91	8	0.56	2.0-14.4
Striped bass (*Morone saxatilis*)	77	7	0.48	4.6-22.1

Table 5.3-9. Abundance and Catch Per Unit Effort (Fish Per Minute of Electrofisher Operation), and Length of Fish Captured by CDFW in Pyramid Lake in May and October of 2013 (continued)

Species *(Scientific Name)*	**Number of Fish**	**Percent of Total Catch**	**CPUE (fish per minute)**	**Length Range (inches)**
White catfish (*Ameiurus catus*)	63	6	0.39	8.9-23.1
Channel catfish (*Ictalurus punctatus*)	60	5	0.37	6.5-26.3
Shimofuri gobi (*Tridentiger bifasciatus*)	7	1	0.04	2.78-3.5
Prickly sculpin (*Cottus asper*)	1	0	0.01	3.7
Brown bullhead (*Ameiurus nebulosus*)	1	0	0.01	13.3
White crappie (*Pomoxis annularis*)	1	0	0.01	3.3
Subtotal	**1,124**	**100**	**6.98**	
Total	**1,338**	**--**	**--**	**--**

Sources: CDFW 2013a, 2013b
Key:
CPUE = catch per unit effort, fish per minute of electrofisher operation

Fish Stocking

Fish stocking at Pyramid Lake was one of two fish mitigation measures included in the existing License when it was issued on March 22, 1978 (with an effective date of February 1, 1972) that required submitting an Exhibit S to FERC for approval. The Exhibit S was revised in 1982, with amendments issued in 1999 and 2000 to reflect changes in fish stocking and reporting requirements. One of the mitigation measures required fish stocking for the purposes of:

- Establishing a self-sustaining warm water fishery in Pyramid Lake
- Supporting a put-and-take trout stocking program at Pyramid Lake and Castaic Lake

According to State laws, management of fish and wildlife resources at SWP facilities (including FERC-licensed facilities) is the responsibility of CDFW (FERC 1999), and fish stocking is a tool used by CDFW in managing fisheries for recreational angling. California Fish and Game Commission (CFGC) policy states that "hatchery trout shall not be stocked in waters where they may compete or hybridize with trout which are threatened, endangered or species of special concern".

The initial fish stocking in 1973 consisted of rainbow trout and channel catfish (DWR 1974). Between 1973 and 1987, CDFW stocked Pyramid Lake primarily with rainbow trout and channel catfish, and infrequently with largemouth bass, striped bass, smallmouth bass, and brown trout (Table 5.3-10). Since 1988, stocking has been restricted to rainbow trout.

Table 5.3-10. Historical Stocking Records for Pyramid Lake

Species	Years Stocked
Rainbow trout	1973-1978, 1986-1993, 1999-2001, 2004-2016
Trout spp.	1979-1985
Brown trout	1977
Channel catfish	1973-1976, 1978-1982, 1984-1987
Striped bass	1974, 1980
Largemouth bass	1974
Smallmouth bass	1979

Sources: DWR 1974, 1975, 1976, 1977, 1978, 1979, 1980b, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1994, 1995, 1996, 1997b, 1998b, 1999, 2001a, 2001b, 2002b, 2004c, 2004d, 2005, 2006b, 2007, 2008, 2012a, 2012b, 2013b, 2013c, 2014b, 2015b, 2015c, 2016e, 2017, 2019a

Since 1982, CDFW has been contracted by DWR to stock rainbow trout in Pyramid Lake at a variety of levels under several management plans. The existing license Exhibit S requires the annual stocking of 20,000 pounds of catchable rainbow trout at both Pyramid Lake and Castaic Lake (DWR 2013a). Stocking status reports with annual creel surveys are required to be reported on a biennial schedule, and have been filed with FERC since 2000.

CDFW has consistently stocked Pyramid Lake with more than the required 20,000 pounds of catchable rainbow trout in all but one year (2004) (Table 5.3-11). CDFW stocks larger-sized fish (about one to two fish per pound) in Pyramid Lake in an attempt to reduce the impact of predation by striped bass on planted fish (DWR 2014b).

Creel Surveys

Creel survey data have been reported for Pyramid Lake in nine out of the 16 years that stocking occurred. Metrics collected varied from year to year. When it was reported, the return to creel (percent of stocked trout captured) ranged from 1.21 to 28 percent, which is well below the goal of 50 percent used by CDFW for put-and-take fisheries (DWR 1998a). The CPUE effort for trout ranged from 0.1 to 0.578 (Table 5.3-11). In most years, CPUE was well below the CDFW goal of 0.5 fish per hour (Table 5.3-11). Anglers, however, were satisfied with their overall angling experience (average of 71.3 percent) and the size of the fish they were catching (average of 57.1 percent). Anglers were less than satisfied with the number of fish caught (average of 42.6 percent) in the years when surveys were conducted.

Table 5.3-11. Annual Fish Stocking and Creel Survey Data for Pyramid Lake from 2000 through May 2016

Year	Stocking		Creel Surveys				
	Number of Fish	Weight (pounds)	Trout CPUE	Return to Creel (percent)	Angler Satisfaction (Percent Satisfied)[6]		
					Overall	Number of Fish Caught	Size of Fish Caught
2000	26,780	24,200					
2000-2001			0.26	NR	82	24	69
2001	24,160	20,500					
2001-2002			0.2	14[1]	85	49	51
2002	24,209	22,800					
2002-2003			NR	NR	NR	NR	NR
2003	29,029	25,800					
2003-2004			0.13	28[1]	84	59	81
2004	14,990	14,000					
2004-2005			0.1	8[1]	84	58	78
2005	27,948	27,700					
2005-2006[2]			NR	NR	NR	NR	NR
2006-2007	32,538	26,900	NR	10[3]	81	73	89
2007-2008	29,024	24,000	NR	NR	NR	NR	NR
2008-2009[4]	26,309	21,519	NR	NR	NR	NR	NR
2009			NR	9	67 (2.68)	33 (2.09)	43 (2.33)
2009-2010	25,915	23,400	NR	NR	NR	NR	NR
2010-2011	31,270[5] (41,550)	24,350[5] (30,300)	NR	NR	NR	NR	NR
2011-2012	25,915[5] (30,647)	23,400[5] (26,650)	NR	NR	NR	NR	NR
2012-2013	22,847	24,002	NR	NR	NR	NR	NR
2013-2014	24,492	24,050	NR	NR	NR	NR	NR

Table 5.3-11. Annual Fish Stocking and Creel Survey Data for Pyramid Lake from 2000 through May 2016 (continued)

Year	Stocking		Creel Surveys				
	Number of Fish	Weight (pounds)	Trout CPUE	Return to Creel (percent)	Angler Satisfaction (Percent Satisfied)[6]		
					Overall	Number of Fish Caught	Size of Fish Caught
2014[4]			0.405	1.21	53 (2.58)	27 (1.89)	27 (1.88)
2014-2015	23,545	24,000	0.578	1.74	34 (2.28)	18 (1.69)	19 (1.72)
2015-2016[7]	21,605	24,000	0.713	9.45	27 (2.11)	16 (1.52)	17 (1.56)
2016-2017	**--**	**--**	**--**	**--**	**--**	**--**	**--**

Sources: DWR 2002a, 2004a, 2006a, 2013, 2014c, 2016c, 2018b; Environmental Science Associates 2010b, 2014b, 2015b
Notes:
[1]Extrapolated value (from DWR 2002a)
[2]Prior to 2006 stocking, allotments were tracked on a calendar year basis. Beginning in 2006-2007, stocking was tracked based on the State fiscal year cycle (July 1 through June 30).
[3]Only six days of creel surveys were performed at Pyramid Lake in 2006-2007
[4]CDFG provided incomplete creel census data in 2006, and no data in 2007 and 2008. DWR entered into a new contract with a private contractor to conduct the creel census surveys beginning in 2009 for Pyramid Lake. Creel data was not yet completely analyzed for the 2012-2014 reporting period prior to the deadline for filing the report with FERC. Only 45 days of creel surveys were performed at Pyramid Lake in 2014 (March through July)
[5]The 2010-2012 stocking report was first filed with FERC on January 30, 2013. The 2010-2012 stocking report was revised to correct errors in the fiscal year timeframe and stocking quantities in Tables 1 and 2. The revised report was filed on June 2, 2014, and it reflects the correct stocking data.
[6]Percent satisfied (average rating); from 2000 to 2009, CDFG reported angler satisfaction as "satisfied or not satisfied." From 2009 to 2015, Environmental Science Associates reported angler satisfaction on a scale of 1 to 4, 1 representing "poor fishing experience" and 4 representing "excellent fishing experience."
[7]This data is based on preliminary mid-year data from October 2015 through February 2016 that is subject to change following completion of the remaining surveys for the 2015-2016 survey period.
Key:
CDFG = California Department of Fish and Game
CPUE = catch per unit effort, fish per minute
DWR = California Department of Water Resources
FERC = Federal Energy Regulatory Commission
NR = Not Reported

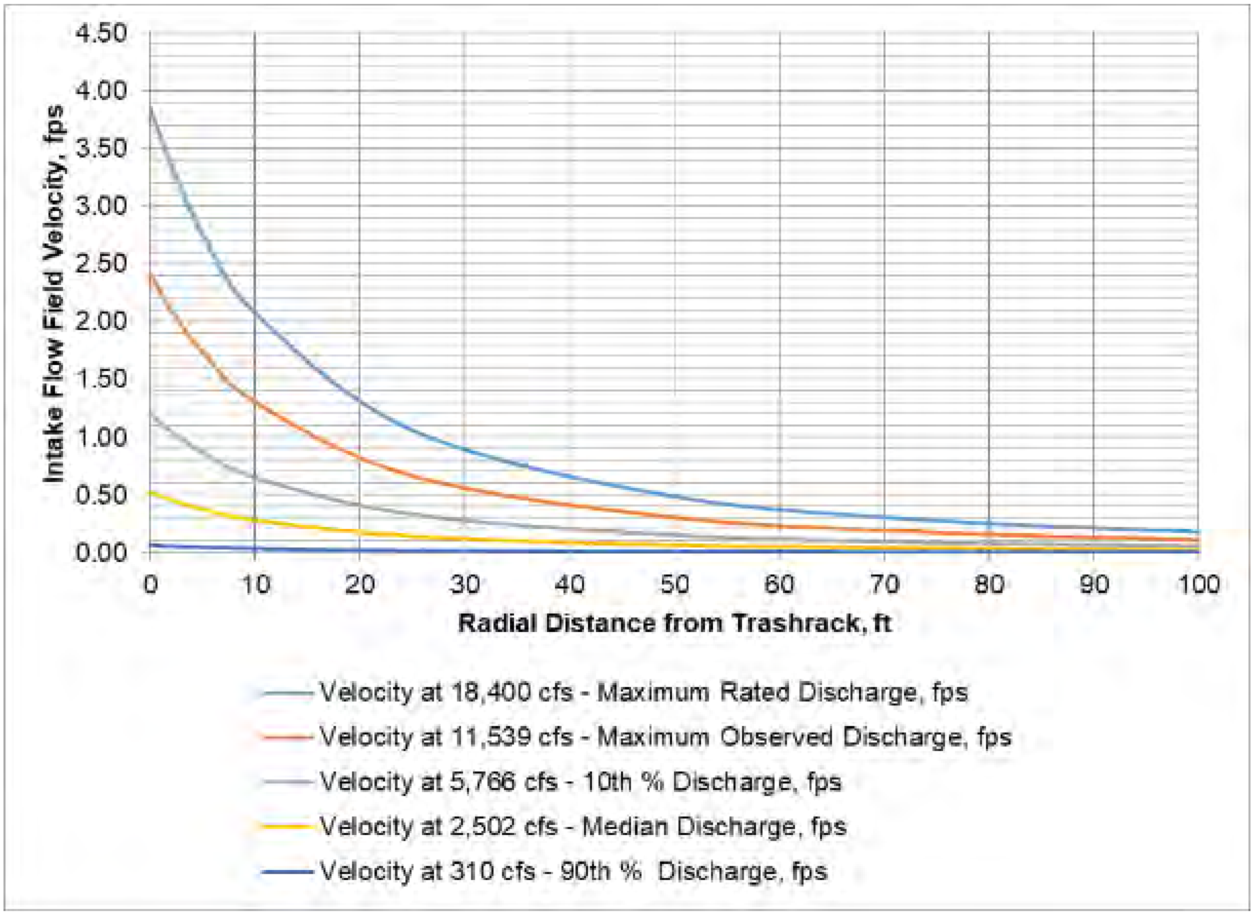
Fish Entrainment

It is a common understanding that the dark, low-productivity environment in deep reservoir waters is infrequently visited by most fish species, and that extreme depths are not likely to be occupied by fish at all. In two California reservoirs of similar depth and size to Pyramid Lake, gill-netting studies found very few fish in deepwater sampling conducted at depths of 80 to 100 feet, as compared to samples collected along shorelines or at shallow depths in open-water areas (Merced Irrigation District 2011; Yuba County Water Agency 2012). In those studies, the few fish that were collected at maximum sampling depths were adult-sized salmonids and centrarchids. Therefore, Licensees' FERC-approved relicensing Study 4.1.17 focused on entrainment of largemouth bass and rainbow trout into Project intakes and included the following components: characterization of the intake structures for Angeles Tunnel and Pyramid Dam Low-Level Outlet, including calculations of intake velocities; determination of the likelihood that rainbow trout and largemouth bass would be near the intakes; and, calculations of swim speeds of rainbow trout and largemouth bass.

The Licensees found a very low likelihood that rainbow trout or largemouth bass would be entrained into the Angeles Tunnel intake or Pyramid Dam Low-Level Outlet intake for three reasons: (1) based on the species' life history, it is unlikely they would be in the deep portions of Pyramid Lake where the two intakes are located; (2) in the unlikely case that individuals of these species were in the deep portions of the lake, it is unlikely they would be in the very small portions of the lake affected by the intakes; and (3) in the unlikely case that individuals of these species were in the deep portions of the lake and in the very small areas affected by these intakes, adult rainbow trout and largemouth bass can avoid being entrained because they each have swim speeds in excess of the intake velocities.

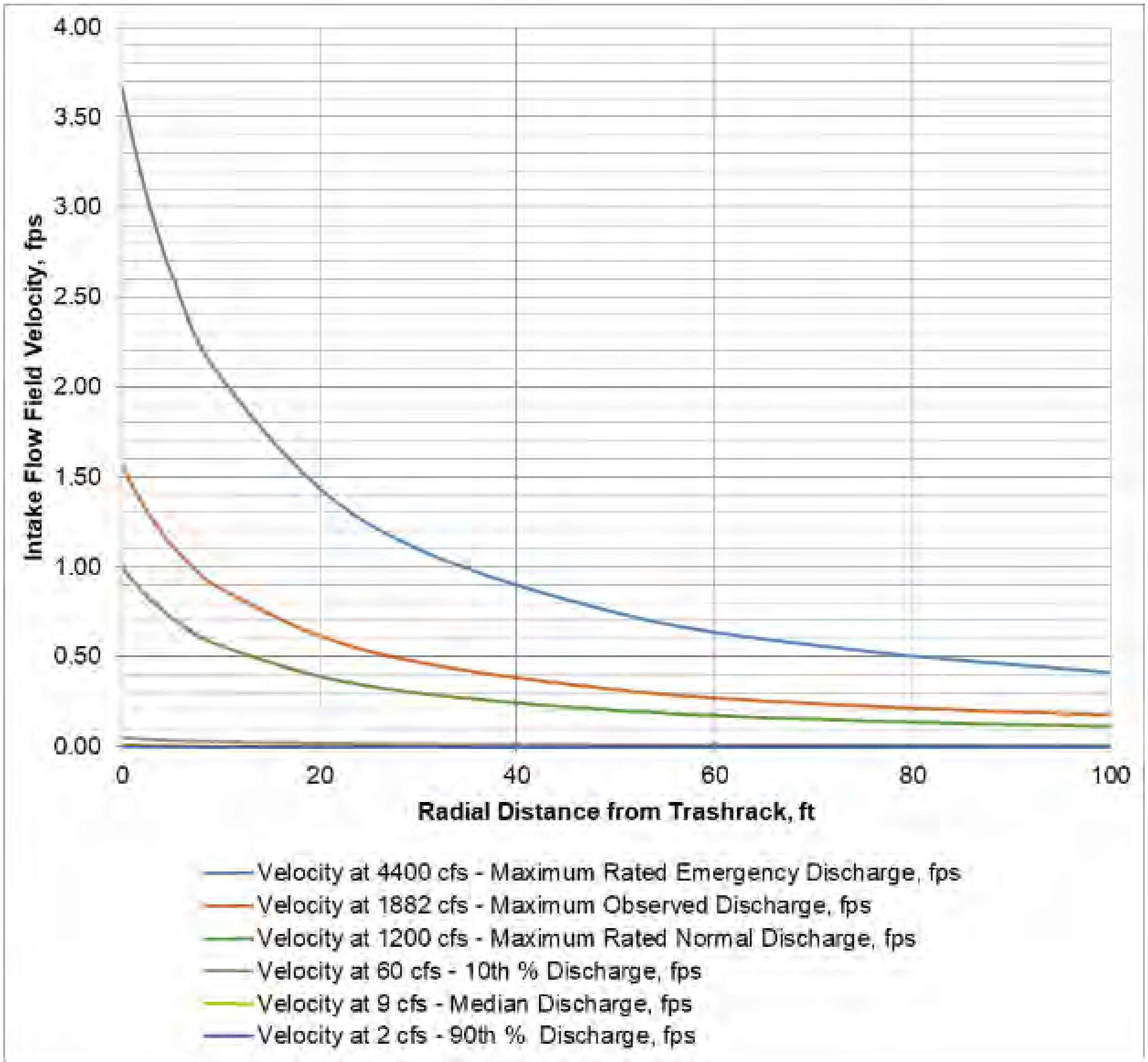
A review of existing literature found that all lifestages of both largemouth bass and rainbow trout, except for the adult lifestage of rainbow trout, prefer littoral habitat near the shallow edges of reservoirs. Rainbow trout adults may be found in the mid-water portions of reservoirs, yet rarely at depths of approximately 250 feet where the intakes are located.

The Licensees used a hemispherical model of surface area to determine the area of influence of the intakes. Figures 5.3-23 and 5.3-24, below, show that each intake's area of influence is relatively limited in the deep portion of the lake (i.e., a velocity of less than 0.5 fps 40 to 80 feet away from the intake), and even at the intake itself, the maximum intake velocity is less than 3.8 fps.



Key:
% = percent
cfs = cubic feet per second
fps = feet per second
ft = feet

Figure 5.3-23. Area of Velocity Influence for the Angeles Tunnel Intake Structure at a Range of Intake Discharges



Key:
% = percent
cfs = cubic feet per second
fps = feet per second
ft = feet

Figure 5.3-24. Area of Velocity Influence for the Pyramid Dam Low-Level Outlet Intake Structure at a Range of Intake Discharges

In the very unlikely event should adult rainbow trout be present in the vicinity of the low-level outlet intake structure, adult rainbow trout with burst swim speed ranging from 6.4 to 13.5 fps (Bell 1986) can easily avoid being entrained. Similarly, in the very unlikely instance should an adult largemouth bass be present in the vicinity of the low-level outlet intake structure, adult largemouth bass with burst swim speed of greater than 4.34 fps (Beamish 1978) can easily avoid being entrained.

In summary, the fish assemblage within Pyramid Lake consists of introduced warmwater game fish, rainbow trout, and non-native species. The Licensees engage in a robust annual rainbow trout stocking program to fortify recreational angling opportunities, and monitor the effectiveness of that program with annual creel surveys. The Licensees evaluated the potential for entrainment of rainbow trout and largemouth bass (i.e. recreational species) into the intake structures for the Pyramid Dam Low-Level Outlet and the Angeles Tunnel, and found that both species are not likely to occur at the depths of the intakes. Additionally, intake approach velocities are less than documented burst swim speeds for both species. The Licensees therefore determined that entrainment of game fishes into the Angeles Tunnel and the Pyramid Dam Low-Level Outlet is unlikely to occur.

Pyramid Reach

Historically, native fish inhabiting Pyramid reach included rainbow trout (NMFS PAD Questionnaire 2015; FERC 2008), prickly sculpin, and speckled dace (DWR 2004b; Swift et al. 1993). Based on the historical but extirpated occurrence in the Piru Creek tributaries above Pyramid Lake (Swift et al. 1993) and a surviving population in the upper Santa Clara River (Richmond et al. 2014), it is possible that the unarmoured threespine stickleback (*Gasterosteus aculeatus williamsoni*) might have once also occurred in Pyramid reach, if suitable habitat existed.

The Santa Ana sucker is documented by a 1975 CNDDB record from near Blue Point Campground upstream of Lake Piru (CDFW 2018a), approximately 18 miles downstream of Pyramid Lake Dam. USFS conducted stream surveys in Pyramid reach between Frenchmans Flat and Blue Point Campground and in Agua Blanca Creek during 1979 (USFS 1979, Attachment 3 in USFS 2019), and noted the presence of Santa Ana sucker and rainbow trout in both streams and largemouth bass, bluegill, and mosquito fish (*Gambusia* spp.) in Pyramid reach. Additionally, UWCD reported that Arroyo chub, Owens sucker, partially armored threespine stickleback (*Gasterosteus aculeatus microcephalus*), Santa Ana/Owens sucker hybrid, and shimofuri gobi have been documented in Pyramid reach near Blue Point Campground, although no timeframe of observations was provided (Attachment 6 in USFS 2019).

Surveys conducted by CDFG in Pyramid reach in 1987 detected only two native species, rainbow trout and prickly sculpin (FERC 2004). In its EA for the Amended Exhibit S and Article 51 to the existing license (FERC 2008), FERC noted that the partially armored threespine stickleback can be found throughout the Piru Creek watershed, including Pyramid reach, although no reference was cited by FERC. Swift et al. (1993) indicated relatively recent (i.e., since 1970) records of partially armored threespine stickleback in Pyramid reach. Other introduced species found during CDFG surveys in 1987 included bluegill, green sunfish, largemouth bass, catfish, and brown trout (FERC 2008).

In June 2008, CDFG conducted snorkel surveys on two major tributaries to Pyramid reach, Fish and Agua Blanca creeks, to determine if the fisheries in the two streams met the minimum criteria for designation as Heritage and Wild Trout Waters. Both creeks flow generally west to east where they meet Piru Creek and are not influenced by Pyramid Lake releases. Fish Creek and the North Fork of Fish Creek join each other approximately 1 mile upstream of the confluence with Piru Creek. Agua Blanca Creek joins Piru Creek approximately 5 miles downstream of the Fish Creek confluence. These tributary streams are flashy with the potential for very high flows in the rainy season, but with typical low flows and the potential to run dry in sections during the summer. Based on the results of the surveys, which are described below, CDFW has not designated Fish Creek as a Heritage and Wild Trout Water.

CDFG surveyed a total of 488.5 feet of Fish Creek in six sections, with an average wetted width of 10.8 feet and average depth of 0.5 feet. A total of 288 rainbow trout were counted (fish density of 3,113 fish per mile) and 285 (99 percent) were less than 5.9 inches in length. No YOY were observed in Fish Creek (CDFG 2008a). CDFG only reported results for rainbow trout and did not include documentation of, or results for, other fish species.

CDFG surveyed a total of 304.3 feet of the North Fork of Fish Creek in five sections, with an average width of 7.4 feet and average depth of 0.88 feet. A total of 103 rainbow trout were observed (fish density of 1,787 fish per mile), with 99 (96 percent) rainbow trout being less than 5.9 inches in length. Similar to Fish Creek, no YOY were observed.

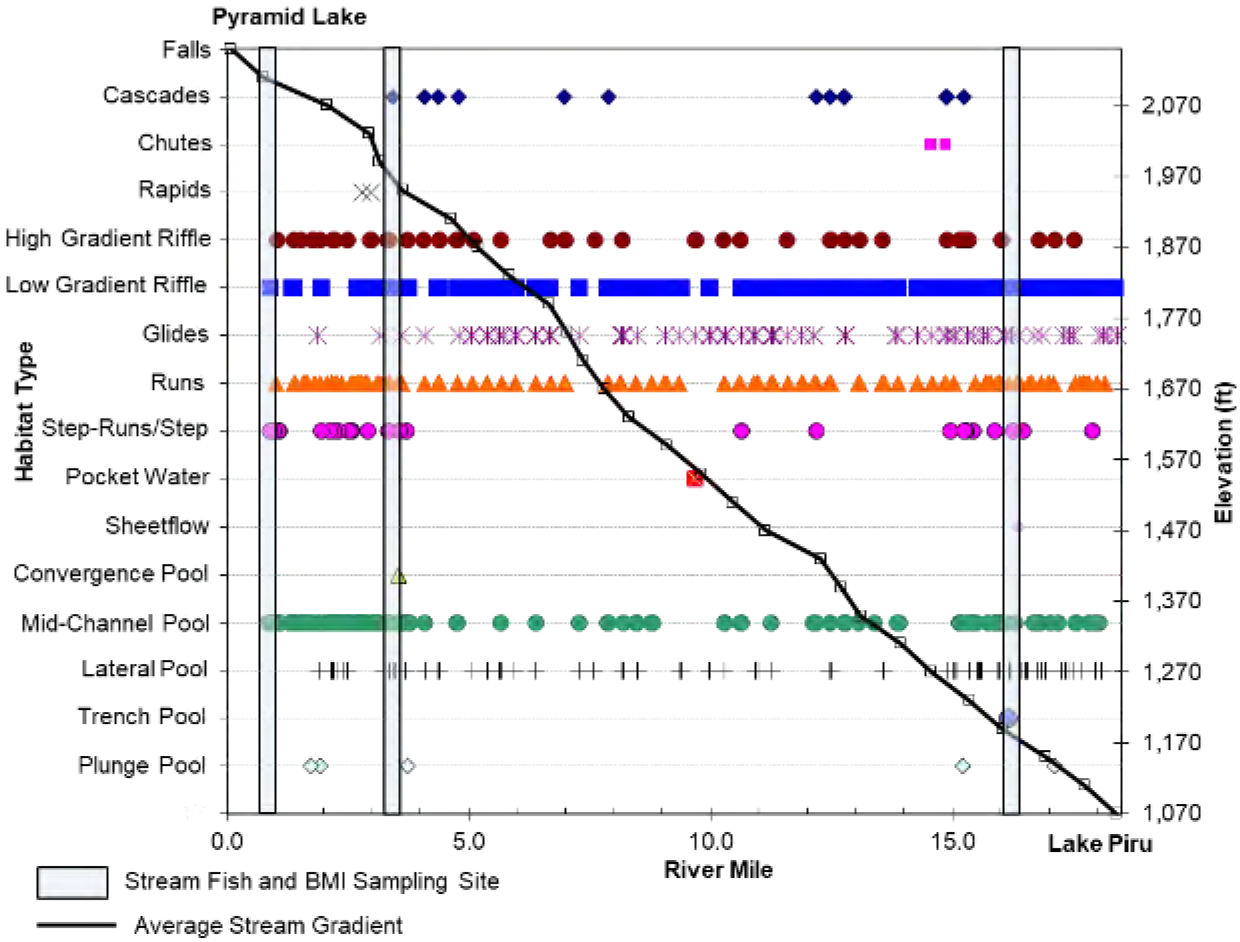
Agua Blanca Creek had the lowest density of the three creeks surveyed. CDFG counted a total of 208 rainbow trout in 834 feet in 13 sections of stream (fish density of 1,316 fish per mile). Average stream width was 11.6 feet and average depth was 0.41 feet. Fish length included a larger range in Agua Blanca Creek, from YOY (less than 2 inches) to large (12 to 17.9 inches), although 86 percent of fish were still in the small (less than 5.9 inches) size class.

CDFG conducted a second round of snorkel surveys in Agua Blanca Creek in 2009 as part of the Heritage and Wild Trout Program’s Phase 2 Candidate Water assessment (CDFG 2009). CDFG’s surveys were focused in the upper watershed and were conducted at 16 sites, including three sites that were surveyed in 2008. A total of 1,102 feet were surveyed in the 16 sections; average stream width was 6.4 feet and average depth was 0.4 feet. A total of 246 rainbow trout were counted, including 21 YOY (less than 2 inches, 8.5 percent of total), 194 small (2 to 5.9 inches, 78.9 percent), and 31 medium (6 to 11.9 inches, 12.6 percent). Fish density was estimated to be 1,179 fish per mile. CDFW has not designated Agua Blanca Creek as a Heritage and Wild Trout Water.

As part of the Santa Felicia Dam Hydroelectric Project (FERC Project No. 2153) license, issued in September 2008, and NMFS' Biological Opinion (BO) (NMFS 2008), UWCD is currently conducting feasibility studies on Pyramid reach to assess *O. mykiss* populations (UWCD 2019). As of January 9, 2019, UWCD has conducted preliminary monitoring activities on the Pyramid reach section of Piru Creek, including a mark-recapture study and collection of tissue samples for genetic testing. Over two mark-recapture events in late 2018, 318 individual *O. mykiss* have been captured, of which 229 individual *O. mykiss* were implanted with passive integrated transponder tags (UWCD 2019). UWCD recently filed a Draft BA for implementing the second phase of its fish passage feasibility studies. In order to supplement existing information in Pyramid reach, the Licensees conducted relicensing Study 4.1.3, which included habitat mapping, eDNA sampling, and backpack electrofishing.

Mesohabitats were classified from the NMWSE of Lake Piru upstream to Pyramid Dam (Figure 5.3-25). A three-tiered habitat mapping classification system developed by Hawkins et al. (1993) was used to assist in the identification of individual habitat units in the field. The Licensees conducted extensive habitat mapping (e.g., mapped each individual unit) of 6.5 miles of Pyramid reach, from RM 0.86 to RM 3.77 and RM 14.97 to RM 18.42 (Figures 5.3-26 and 5.3-27). Extensive habitat mapping was not conducted in the canyon section, which is roughly between Fish and Agua Blanca creeks (RM 4 to RM 15) due to difficult access. However, some additional habitat characteristics were recorded during eDNA sampling in that area. Habitat classified in the upper and lower stretches of Pyramid reach was generally representative of habitat recorded throughout the canyon. Habitat metrics were used to select three stream fish sampling sites with representative habitat distributions.

Figure 5.3-24 provides the distribution of mesohabitat types identified in Pyramid reach during the habitat mapping effort. In general, habitats typical of lower gradient streams; pools, runs, glides, and low gradient riffles were the most common habitat types.



Key:
ft = feet

Figure 5.3-25. Habitat Types Recorded Within Pyramid Reach

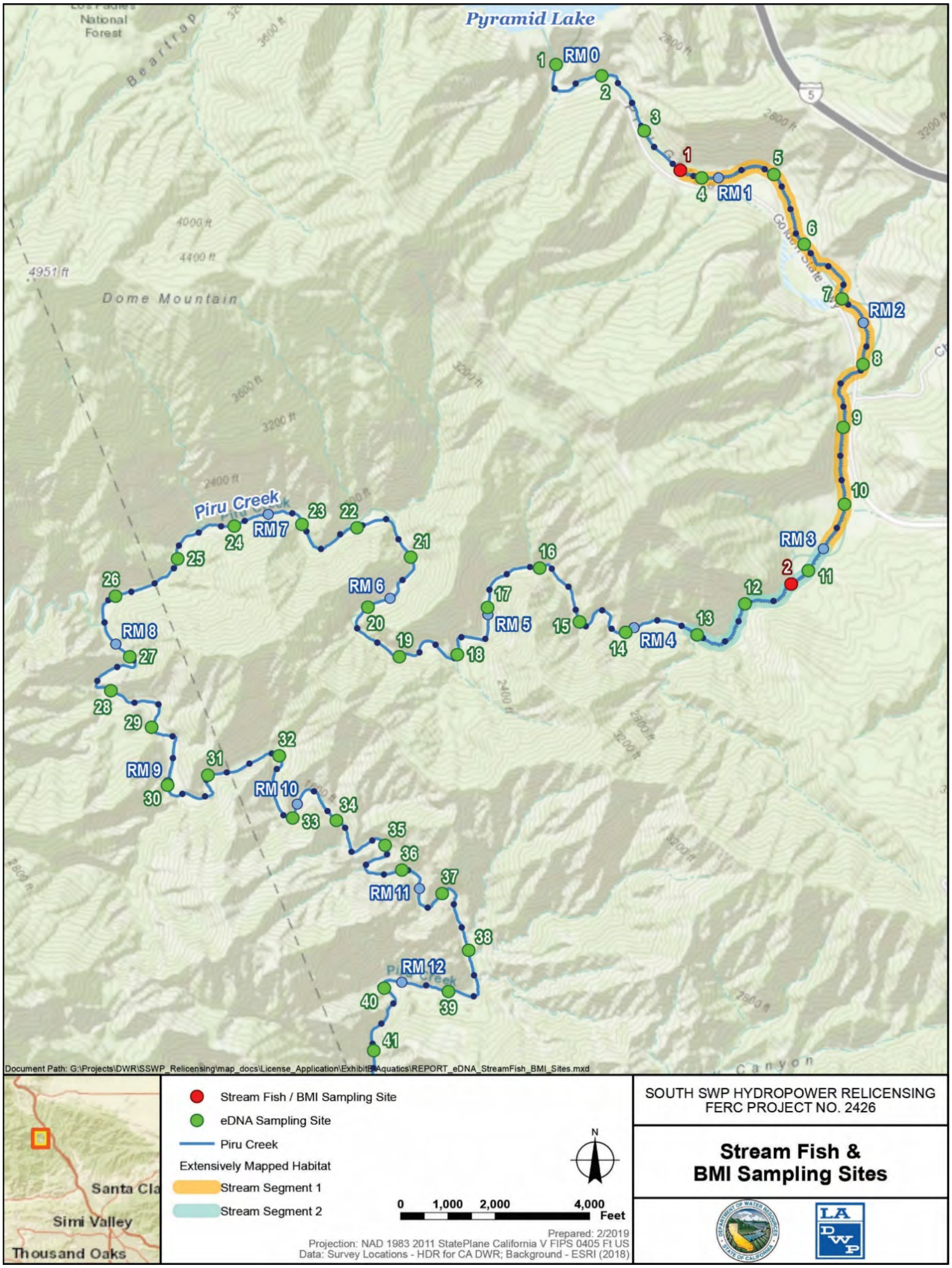


Figure 5.3-26. Habitat Mapping Locations and Sampling Sites for eDNA, Stream Fish, and Benthic Macroinvertebrates Between River Miles 0.0 to 12.5

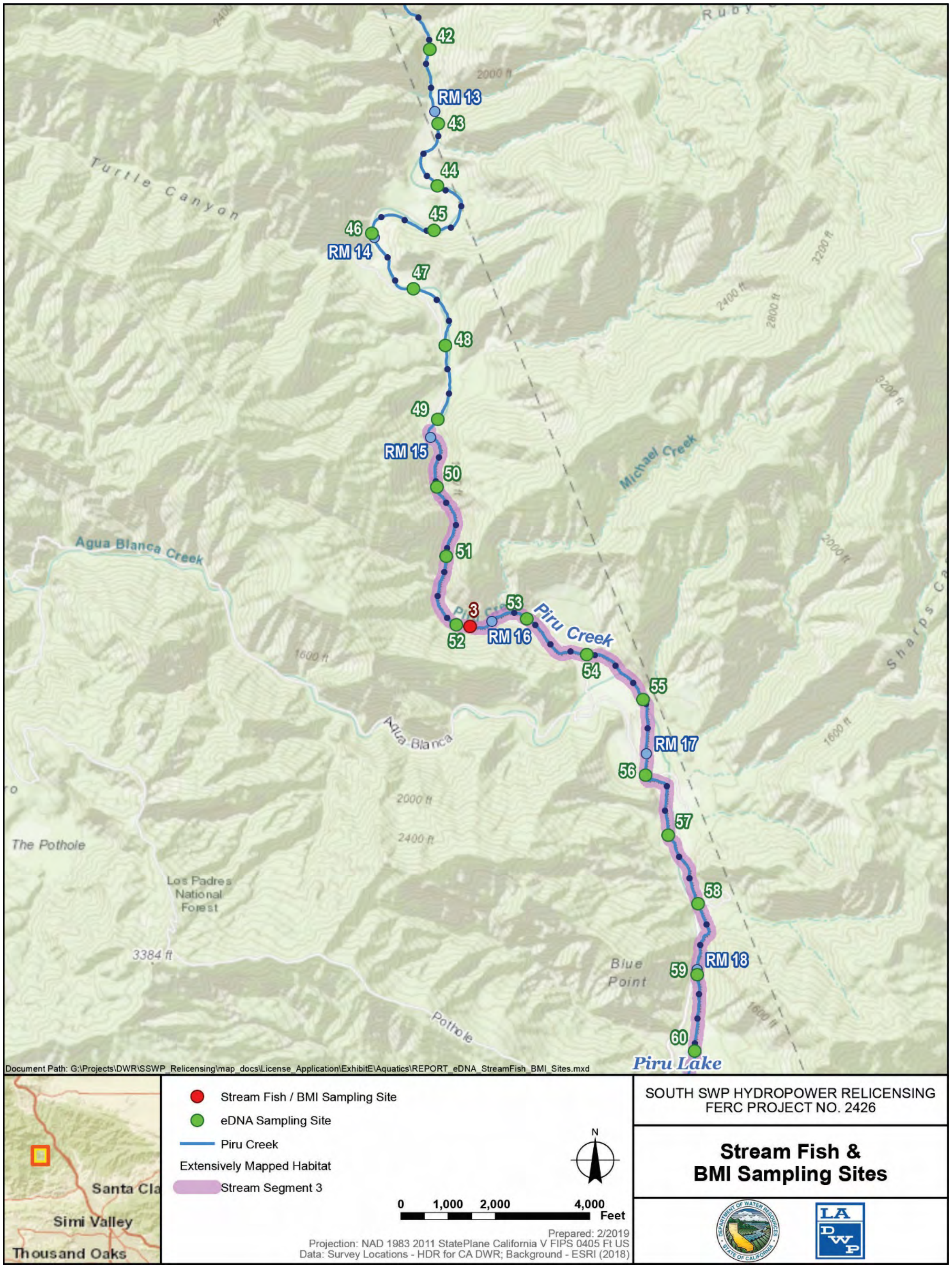


Figure 5.3-27. Habitat Mapping Locations and Sampling Sites for eDNA, Stream Fish, and Benthic Macroinvertebrates Between River Miles 12.6 to 18.3

Extensive habitat mapping of 6.35 miles of Pyramid reach was broken down into three stream segments; two segments were located within the first 4 miles immediately downstream of Pyramid Dam and one segment was located upstream of the NMWSE of Lake Piru. Table 5.3-12 shows that mid-channel pools account for the largest percent of available habitat (31 percent), followed by runs (17 percent), and low-gradient riffles (15 percent). A total of 33,515 feet was mapped in detail.

Environmental DNA

As part of Study 4.1.3, the Licensees conducted eDNA sampling in Pyramid reach at 500 m intervals, for a total of 60 sample sites, in the spring 2018 (Figure 5.3-25 and Figure 5.3-26). In accordance with the FERC-approved study plan, all samples collected were analyzed for the presence of rainbow trout, Santa Ana sucker, and arroyo chub. At each site, two Sterivex™ filters were collected, and approximately one liter of stream water was passed through each filter. Analysis of all collected eDNA was completed by Genidaqs, a qualified genetics laboratory. The eDNA was isolated from each filter following Bergman et al. (2016) and analyzed using quantitative Polymerase Chain Reaction assays. A standard assay for rainbow trout existed and was used for this analysis. Assays for Santa Ana sucker and arroyo chub did not exist, and were developed by Genidaqs for this study using mitochondrial DNA sequences for Cytochrome Oxidase Subunit I (for arroyo chub) and Cytochrome B (for Santa Ana sucker) from the National Center for Biotechnology Information Nucleotide database. As discussed in the Genidaqs 2018 report, the primer-probe sets were validated both in-silico and compared against total genomic DNA for seven co-existing species in the Pyramid reach: rainbow trout, largemouth bass, smallmouth bass, Mississippi silverside, bluegill, Pacific lamprey, and threadfin shad. A positive species-specific double stranded DNA control was synthesized because no DNA was available.

Because the quantitative Polymerase Chain Reaction assays were developed from mitochondrial DNA sequences which are largely maternally inherited, the eDNA analysis did not distinguish between genetically pure eDNA of the species of interest and hybrids if the mother of the hybrid was of the target species. Therefore, based on the eDNA analysis results, the Licensees could not say with certainty whether the fish(es) contributing the mitochondrial DNA in the water sample was a pure Santa Ana sucker (i.e., both the mother and father of the individual fish were Santa Ana suckers) or a hybrid (i.e., the mother was a Santa Ana sucker and the father was another sucker species, or the mother was a hybrid sucker that carried the mitochondrial DNA of Santa Ana sucker and the father was another sucker species or a hybrid itself). Considering the possibility of hybridization, and the inability of the analysis to differentiate pure from hybridized Santa Ana sucker, all suckers are referred to as sucker species (sucker spp.) in this section.

Table 5.3-12. Habitat Units Found Within the Mapped 6.35 Miles of Pyramid Reach

Habitat Unit	Total		Stream Segment 1 (RM 0.86 to 2.99)		Stream Segment 2 (RM 3.0 to 3.77)		Stream Segment 3 (RM 14.97 to 18.42)	
	Total length (feet)	**Proportion (%)**	**Total length (feet)**	**Proportion (%)**	**Total length (feet)**	**Proportion (%)**	**Total length (feet)**	**Proportion (%)**
Mid-Channel Pool	10,351.7	31	6,130.3	54	1,512.1	33	2,709.3	15
Run	5,536.6	17	2,105.8	19	498.6	11	2,932.3	17
Low-Gradient Riffle	5,159.4	15	590.4	5	665.8	15	3,903.2	22
Lateral Pool	3,398.1	10	242.7	2	288.6	6	2,866.7	16
Glide	3,145.5	9	203.4	2	229.6	5	2,712.6	15
Split Channel	2,843.8	8	757.7	7	823.3	18	1,262.8	7
Step Pool	1,567.8	5	669.1	6	246.0	5	652.7	4
High-Gradient Riffle	911.8	3	393.6	3	91.8	2	426.4	2
Cascade	183.7	<1	0	0	131.2	3	52.5	<1
Plunge Pool	154.2	<1	91.8	1	19.7	<1	42.6	<1
Rapids	72.2	<1	72.2	1	0	0	0	0
Not Classified	49.2	<1	49.2	<1	0	0	0	0
Trench Pool	49.2	<1	0	0	0	0	49.2	<1
Convergence Pool	45.9	<1	0	0	45.9	1	0	0
Sheet Flow	39.4	<1	0	0	0	0	39.4	<1
Falls	6.6	<1	6.6	<1	0	0	0	0
Total	**33,515.0**	**100**	**11,312.7**	**100**	**4,552.6**	**100**	**17,649.7**	**100**

Key:
% = percent
< = less than

Rainbow trout were detected at 59 of 60 sampling locations. The eDNA for sucker spp. was detected at 54 of 60 sampling locations (90 percent) and were only absent in an approximately 1.5-mile-long stretch directly below Pyramid Dam. Arroyo chub were detected in 14 of 60 sampling locations (23.3 percent), which were sporadically distributed throughout Pyramid reach (Table 5.3-13).

Table 5.3-13. eDNA Sampling Results for Pyramid Reach

Pyramid Reach RM	Number of Samples Collected	Rainbow Trout	Sucker spp.	Arroyo Chub
Pyramid Dam to Fish Creek confluence (RM 0.0 to 6.5)	22	22	16	4
Fish Creek to Agua Blanca Creek confluence (RM 6.6 to 16.65)	32	31	32	7
Agua Blanca Creek to Lake Piru NMWSE (RM 16.66 to 18.5)	6	6	6	3
Total	**60**	**59**	**54**	**14**

Key:
RM = river mile
NMWSE = normal maximum water surface elevation

Site Selection for Fish Population Sampling and Benthic Macroinvertebrates in Pyramid Reach

Using aerial imagery and habitat mapping data, the Licensees selected three sampling sites based on three criteria: (1) the site is reasonably accessible to field crews; (2) the site represents the overall mesohabitat ratios found in the stream segment of the reach in which the site is located; and (3) the site can be effectively sampled using backpack electrofishing equipment. On May 17, 2018, the Licensees conducted a field site visit with agencies (CDFW, NMFS, SWRCB, and USFS) to discuss the three proposed fish sampling sites. After receiving feedback from the agencies, the Licensees agreed to relocate two of the sampling sites (Fish Sampling Site 1 and Fish Sampling Site 3) upstream from their original location. The Licensees filed a letter with FERC on August 1, 2018,[18] describing these changes and the rationale for the new locations. In the Study Plan Determination dated September 7, 2018, FERC stated the following regarding the updated site selections: “We find this appropriate, consistent with the study plan, and we recommend sampling be conducted at these sites.”

Fish Sampling Site 1 was 155 m long and extended from RM 0.94 to RM 1.04 (Table 5.3-14). Fish Sampling Site 1 included four of 11 mesohabitat types available within the broader stream Segment 1 (Table 5.3-12). The four mesohabitat types represented within Fish Sampling Site 1 were mid-channel pools, which represented 69 percent of Fish Sampling Site 1, runs (14 percent of Fish Sampling Site 1), step pools (13 percent of Fish Sampling Site 1), and high-gradient riffles (4 percent of Fish Sampling Site 1).

[18] FERC Accession Number 20180803-5090

Split channel and low-gradient riffle are the only units with greater than 5 percent representation in stream Segment 1 that are not included in Fish Sampling Site 1. Otherwise, all other excluded habitat units occur at 2 percent frequency or less within stream Segment 1. Fish Sampling Site 1 exhibited excellent canopy and a moderate gradient of 6 percent. The mesohabitat units within Fish Sampling Site 1 represented mesohabitat that occurred in 82 percent of stream Segment 1.

Fish Sampling Site 2 was 223 m long and extended from RM 3.3 to RM 3.4 (Table 5.3-14). Fish Sampling Site 2 included seven of 11 mesohabitat types available within the broader stream Segment 2 (Table 5.3-12). The seven mesohabitat types represented within sampling Fish Sampling Site 2 were mid-channel pools (25 percent of Fish Sampling Site 2), split channels (14 percent of Fish Sampling Site 2), low-gradient riffles (22 percent of Fish Sampling Site 2), runs (18 percent of Fish Sampling Site 2), lateral pools (6 percent of Fish Sampling Site 2), step pools (8 percent of Fish Sampling Site 2), and high-gradient riffles (7 percent of Fish Sampling Site 2). Fish Sampling Site 2 had excellent canopy and a gradient of 2.5 to 5 percent, which was similar to that of other upstream creek sections within the broader stream segment 2. The mesohabitat units within Fish Sampling Site 2 represented mesohabitat that occurred in 90 percent of stream Segment 2.

Fish Sampling Site 3 was 187 m long and extended from RM 16.01 to RM 16.12 (Table 5.3-14). Fish Sampling Site 3 included five of 12 mesohabitat types available within the broader stream Segment 3 (Table 5.3-12). Run and split-channel habitat types were the only two mesohabitats that were moderately available in stream Segment 2 and not represented in Site 3. The five mesohabitat types represented within Fish Sampling Site 3 were low-gradient riffles percent of Fish Sampling Site 3), lateral pools (11 percent of Fish Sampling Site 3), glides (63 percent of Fish Sampling Site 3), mid-channel pools (7 percent of Fish Sampling Site 3), and high-gradient riffles (10 percent of Fish Sampling Site 3). Site 3 had an interspersed canopy that ranged from dense to relatively open and a gradient of 5 percent. The mesohabitats within Fish Sampling Site 3 represented mesohabitat that occurred in 70 percent of stream Segment 3.

Table 5.3-14. Coordinates for Pyramid Reach Fish Sampling Sites 1, 2, and 3

Sampling Site	GPS Coordinates	
	Downstream	Upstream
1	34.634909°N, -118.755024°W	34.635371°N, -118.756890°W
2	34.610384°N, -118.750508°W	34.611379°N, -118.748857°W
3	34.547143°N, -118.771356°W	34.546661°N, -118.773102°W

Key:
N = North
W = West

Electrofishing

As part of Study 4.1.3, multiple-pass depletion electrofishing (Reynolds 1996; Temple et al. 2007) using two Smith Root LR 24 units was conducted at three sites in Pyramid reach in October of 2018 during relatively dry environmental conditions. Conducting electrofishing surveys during low flow conditions in dry years did not negatively affect survey results because low flows tend to confine fishes to smaller areas of habitat and improve electrofishing capture probabilities. The upstream and downstream ends of each site were blocked with fine mesh nets to prevent fish passage. Electrofishing was conducted by qualified biologists in accordance with a CDFW-issued Scientific Collecting Permit.

Captured fish were retained in aerated buckets until each pass was completed. All fish were identified to species (when possible) and counted. Individuals were measured to the nearest mm (fork length when applicable) and weighed by digital scale to the nearest gram. Scale samples were collected on a subsample of largemouth bass for validating length-age indices. Scale samples from rainbow trout were collected by Cramer Fish Sciences biologists under contract to UWCD under a separate CDFW Scientific Collecting Permit.

Tissue samples were collected from suckers captured during electrofishing. In compliance with the study plan and at the request of USFWS, in February 2019, the Licensees mailed tissue samples from each of the collected suckers to Jonathan Richmond, Ph.D., at USGS in San Diego, California. The results of the sequencing analysis are expected in October 2019, and when the results become available, the data will be incorporated into the FLA. Scale samples were collected from rainbow trout equal to or greater than 120 mm in fork length, and from largemouth bass equal to or greater than 150 mm in length. Scales from each sampled individual were mounted on glass microscope slides and examined under a dissecting microscope by an experienced biologist to determine age. For rainbow trout, lengths and ages of individuals for which age was able to be determined were used to construct a model, which was utilized to estimate ages for individuals from which scales were not collected or age determination was not possible through scale analysis. Length-age regression was not possible for largemouth bass because scale analysis yielded a single age class. Instead, ages for unknown-age largemouth bass were estimated by analyzing the largemouth bass length-frequency distribution (Devries and Frie 1996), which showed two distinct age classes (Age 0 and Age 1). These were the only two age classes of largemouth bass encountered during the sampling effort.

A total of four species were observed during backpack electrofishing. Sampling at Fish Sampling Site 1 yielded rainbow trout (n=78), largemouth bass (n=49), and prickly sculpin (n=10). Sampling at Fish Sampling Site 2 yielded rainbow trout (n=47) and sucker spp. (n=81). Sampling at Fish Sampling Site 3 yielded no fish and field crew members did not visually observe any fish within the site during the entirety of the sampling effort. Additionally, backpack electrofishing was conducted for approximately

200 m immediately upstream and downstream of Fish Sampling Site 3, and no fish were captured or observed. Sampling results are presented in Table 5.3-15.

Game fish (rainbow trout and largemouth bass) were assessed based on RSD calculations. RSD was calculated as the percent of fish sampled that were greater than 150 mm (6 inches) in length (Nevada Irrigation District and Pacific Gas and Electric Company 2010). Fulton's condition factor, an independent measure of fish condition for fish displaying fusiform body shape, was calculated cumulatively and by site (Table 5.3-15). All sampled fish visually appeared to be free of parasites and disease.

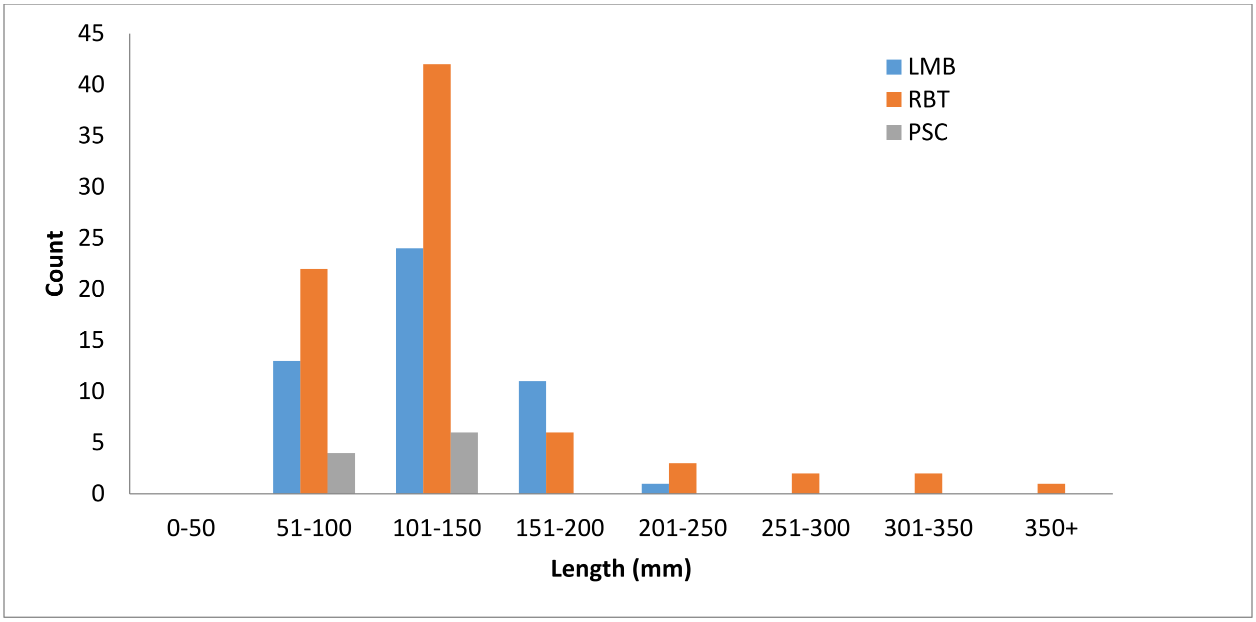
Fish community analysis for Fish Sampling Site 1 and Fish Sampling Site 2 included species composition and relative abundance of each species (Table 5.3-15). In addition, species diversity and species richness were calculated using the Shannon Diversity Index and richness rarefaction, respectively (Table 5.3-15). Species richness, as estimated by rarefaction at a standard sample size of 100 individuals, shows that three species are present within Fish Sampling Site 1, and that two species are present within Fish Sampling Site 2, with a standard error of less than 0.01 for each site estimate. The Shannon Diversity Index calculations illustrate relatively low diversity across both sites, with Fish Sampling Site 1 having slightly greater calculated diversity than Fish Sampling Site 2. Rarefaction calculations were completed using the 'vegan' package (Oksanen et al. 2018) in R Statistical Software (R Core Team 2018).

Fish sampled in Fish Sampling Site 1 were generally larger than those in Fish Sampling Site 2. The majority of rainbow trout and largemouth bass in Fish Sampling Site 1 were in the 101 to 150 mm range, with one individual rainbow trout up to 360 mm (Figure 5.3-28). Fish Sampling Site 1 showed a broader range of size classes than did Fish Sampling Site 2. Most of the sucker spp. in Fish Sampling Site 2 were in the 101 to 105 mm range, with few individuals outside this size class. Rainbow trout in Fish Sampling Site 2 were most abundant in the 51 to 100 mm size class, supplemented by fish in the 101 to 150 mm range. No rainbow trout were observed over 200 mm in Fish Sampling Site 2, and only one sucker spp. was found over 200 mm (Figure 5.3-29).

Table 5.3-15. Population Summary of Pyramid Reach Electrofishing Sites

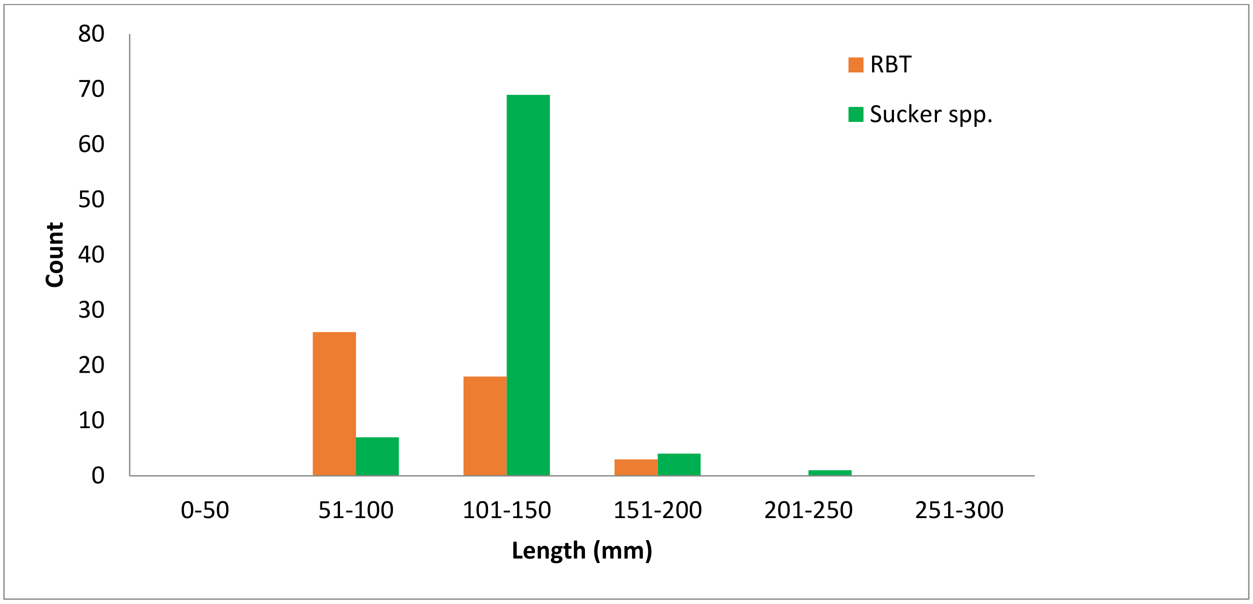
Species		Site 1			Site 2	
		Rainbow Trout	**Largemouth Bass**	**Prickly Sculpin**	**Rainbow Trout**	**Sucker spp.**
Abundance	Number captured by pass (total)	52-16-10 (78)	31-12-6 (49)	5-4-1 (10)	29-7-11-0 (47)	46-25-8-2 (81)
	Estimated abundance	82	52	10	54	86
	95% CI	75-89	46-58	7-13	42-66	76-96
	Fish per 100 m	14.88	9.44	1.81	7.69	12.24
	Fish per mile	785.77	498.29	95.83	405.86	646.38
Length (mm)	Range (Average)	68-360 (131.14)	57-206 (130.27)	70-135 (107.9)	57-173 (97.74)	70-205 (128.28)
Weight (g)	Total	2,330.2	2,214.4	243.1	610.5	2,404.3
	Range (Average)	3.85-281.29 (31.07)	2.8-163.2 (46.13)	4.8-71.5 (24.31)	2.1-50.4 (12.99)	4.5-108.7 (30.74)
	Total estimated weight (g)	2,449.7	2,350	243.1	701.4	2,617.3
	Weight (g) per 100m	422.9	401.89	44.12	86.9	342.25
	Pounds per acre	23.46	22.5	2.33	9.59	35.78
	Kilograms per hectare	26.29	25.22	2.61	10.75	40.1
Condition Factor	Relative – range	0.80-1.31	0.81-1.13	0.80-1.64	0.61-1.19	0.73-1.18
	Fulton's – range (average)	0.90-1.62 (1.21)	1.32-1.91 (1.59)	1.26-2.97 (1.59)	0.70-1.47 (1.21)	0.99-1.60 (1.36)
RSD (% of population >150 mm fork length)		18	24		6	6
Community Diversity	Proportion of Catch per Site	0.57	0.36	0.07	0.37	0.63
	Shannon Index (H')	0.88			0.66	
	Richness[1] (Standard Error)	3.00 (< 0.01)			2.00 (< 0.01)	

Note:
[1]Richness values were calculated using rarefaction and apply to a sampling size of 100 individuals. Values are estimated number of species present.
Key:
< = less than
> = greater than
% = percent
CI = confidence interval
g = grams
H' = Shannon's Diversity Index
m = meters
mm = millimeters
RSD = relative stock density



Key:
count = number of individuals captured
LMB = largemouth bass
mm = millimeters
PSC = prickly sculpin
RBT = rainbow trout

Figure 5.3-28. Length Frequencies of Fish Sampled at Site 1 in Pyramid Reach.



Key:
count = number of individuals captured
mm = millimeters
RBT = rainbow trout
Sucker spp.= unknown sucker species

Figure 5.3-29. Length Frequencies of Fish Sampled at Fish Sampling Site 2 in Pyramid Reach

Overall CPUE (fish per minute of electrofisher operation) was calculated cumulatively, as well as by species, for each site. Sampling effort was calculated by summing the total time the backpack electrofishing units were in use, or “on,” over all passes within the site. Overall effort and CPUE between Sites 1 and 2 were similar (Table 5.3-16).

Table 5.3-16. Catch Per Unit Effort with Species Composition for Fish Sampling Sites 1 and 2 in Pyramid Reach

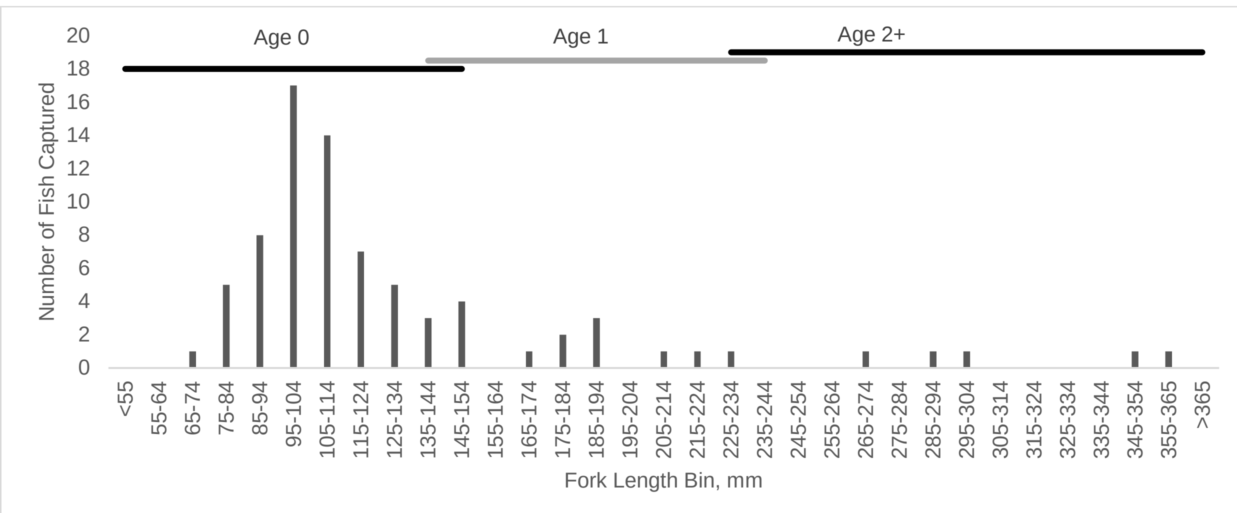
Species	Total Catch	Overall (Number per Minute)	Site 1		Site 2	
			Raw	Number per Minute	Raw	Number per Minute
Rainbow Trout	125	0.22	78	0.29	47	0.18
Largemouth Bass	49	0.08	49	0.18	0	0.00
Sucker spp.	81	0.14	0	0.00	81	0.32
Prickly Sculpin	10	0.02	10	0.03	0	0.00
Total Catch	**265**		**137**		**128**	
Overall Number per Minute	**0.46**		**0.50**		**0.50**	
Effort (seconds)	**34,781**		**16,285**		**15,436**	
Effort (minutes)	**579.68**		**271.42**		**257.27**	

Age analysis results for rainbow trout and largemouth bass are presented in Table 5.3-17 and show multiple age classes for both species. Figure 5.3-30 and Figure 5.3-31 display the length frequencies associated with the different age classes for rainbow trout sampled at Fish Sampling Site 1 and Fish Sampling Site 2. During scale analysis, spawn checks were identified on two rainbow trout scale samples for which age determination was possible (285 and 350 mm fork lengths). Additionally, two other rainbow trout scale samples appeared to display spawn checks but due to scale regeneration these were not confirmed (265 and 301 mm fork lengths). The evidence of spawning observed in the scale samples indicates that rainbow trout downstream of Pyramid Dam have access to suitable spawning gravels. Furthermore, the presence both of multiple age classes and spawning checks indicates that the rainbow trout population is physically healthy and naturally reproductive; although, without a thorough genetic analysis, the extent to which the genetic contribution of previously stocked hatchery rainbow trout has persisted within the current rainbow trout population is unknown. UWCD’s study includes genetic analyses of resident *O. mykiss* in Pyramid reach and are ongoing (UWCD 2019, 2020).

Table 5.3-17. Age Distribution of Game Fish at Fish Sampling Sites 1 and 2 in Pyramid Reach

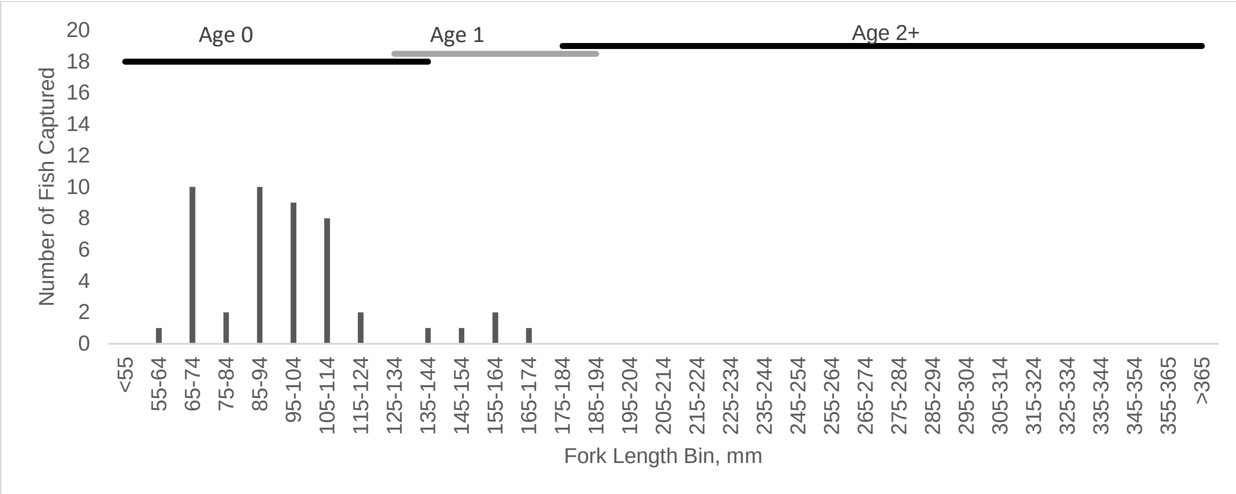
Species	Total		Site 1		Site 2	
	Age	**Count (%)**	**Age**	**Count (%)**	**Age**	**Count (%)**
Rainbow Trout	0	104 (83%)	0	62 (79%)	0	42 (89%)
	1	15 (12%)	1	10 (13%)	1	5 (11%)
	2	6 (5%)	2	6 (8%)	2	0
Largemouth Bass	0	15 (31%)	0	15 (31%)	0	0
	1	34 (69%)	1	34 (69%)	1	0
	2	0	2	0	2	0

Key:
% = percent



Key:
mm = millimeters

Figure 5.3-30. Age–Length Frequency Relationship for Rainbow Trout Sampled at Fish Sampling Site 1



Key:
mm = millimeters

Figure 5.3-31. Age-Length Frequency Relationship for Rainbow Trout Sampled at Fish Sampling Site 2

Article 52 of the existing FERC license includes conditions for the release of natural flows from Pyramid Dam into Pyramid reach including releases of SWP water to the UWCD during November 1 through the end of February. These conditions were primarily developed to protect and enhance arroyo toad populations and habitat in Pyramid reach, although it is assumed that a flow regime that mimics natural runoff in magnitude and timing will also benefit native fishes and other potentially sensitive fish species in Pyramid reach, such as the introduced arroyo chub (CDFW 2018b). The Licensees' study found fish in generally good condition, as indicated by the condition factors reported above.

The potential exists for future introductions of non-native fishes into the Project via the SWP and continued conveyance into Pyramid reach during stream releases and radial valve testing, and could have negative impacts on native aquatic resources in Pyramid reach. However, Licensees' Study 4.1.17 showed that entrainment of game fishes into the Pyramid Dam Low-Level Outlet, and therefore conveyance into Pyramid reach through the mechanism of entrainment, is unlikely. Furthermore, the general understanding that few, if any, fish species generally occupy the dark, low-productivity habitats found in deepwater areas of reservoirs, such as the approximate 250-foot depth of the Pyramid Dam Low Level Outlet intake structure, indicates that non-game fish species found in Pyramid Lake are not likely to be conveyed into Pyramid reach through the mechanism of entrainment.

<u>Fish Stocking</u>

Fish in Pyramid reach have been managed by both CDFW and USFS since the 1930s, including the stocking of catchable size rainbow trout starting in 1931 and steelhead and largemouth bass in 1933 (FERC 2004). CFGC policy states that "hatchery trout shall not be stocked in waters where they may compete or hybridize with trout which are threatened, endangered or species of special concern" (CFGC 2019). Brown trout, catfish, bluegill, and green sunfish (Table 5.3-4) also occur in the Pyramid reach (FERC 2008), but their origins are unknown.

CDFW has primarily stocked rainbow trout since the 1940s in Pyramid reach (FERC 2004). In 1980, the Licensees developed the Piru Creek Fishery Enhancement Plan as part of the original Exhibit S, which directed the stocking of 25,000 catchable size trout between Pyramid Dam and Frenchmans Flat (DWR 1980a). CDFW realized that this level of stocking was not sustainable and exceeded the carrying capacity of the creek. As a result, the Licensees amended Exhibit S of the existing license to allow for lower stocking levels that were developed in consultation with CDFW to be compatible with the carrying capacity of the creek.

FERC Order Modifying and Approving Amendment to Exhibit S (89 FERC Paragraph [¶] 62,066; 2426-144 issued on October 25, 1999) amended the fisheries management portion of the Exhibit S to allow annual stocking of 4,000 pounds of catchable size rainbow trout (CDFW 2013b). The plan also called for a fishery status report every two years that includes the number of fish stocked and the results of any fisheries studies conducted during the period. CDFW determined that the stocking allotment of 4,000 pounds again exceeded the carrying capacity of the creek (DWR 2004b) and planted closer to 3,000 pounds of catchable size trout in the Pyramid reach during fiscal years 2004/2005 through 2007/2008 (CDFW 2013b). The Piru Creek Fishery Enhancement Plan was amended by the October 28, 2009 FERC Order to reflect this practice and directed the surplus 1,000 pounds of fish to be stocked between Pyramid Dam and a remnant concrete creek lining upstream of Frenchmans Flat (FERC 2008). This structure is identified as a weir in the FERC EA (2008).

On August 12, 2008, CDFW suspended fish stocking in many of California's lakes and streams, including Pyramid reach (DWR 2013a), as a result of CEQA litigation. The final Environmental Impact Report (EIR)/EIS for the CDFW fish hatchery-stocking program was released in 2010 (ICF 2010). CDFW selected an alternative that requires a pre-stocking evaluation to be completed prior to commencing fish stocking operations in any watershed that was not excluded and where listed special-status species were present. Additionally, the pre-stocking evaluation requires consultation under Section 7 of the ESA with NMFS and USFWS for potential impacts to federally listed species (DWR 2016d). As a result, the Licensees filed an amendment with FERC to modify the trout stocking requirement in Pyramid reach until CDFW completes its Section 7 ESA consultation (i.e. when a BO is issued), and to file a trout stocking plan with FERC following CDFW's completion of Section 7 ESA consultation (DWR 2011). FERC approved the amendment in 2012[19], requiring the Licensees to file a semi-annual status update of the CDFW Section 7 ESA consultation with NMFS and USFWS until a BO is issued (FERC 2012).

[19] Order Amending October 28, 2009 Order Amending Article 52 and Exhibit S (138 FERC ¶ 62,105; 2426-196) issued on February 10, 2012.

As of the date of this license application filing, CDFW was still consulting with USFWS and NMFS under Section 7 of the ESA in developing a BO on the impacts of stocking hatchery rainbow trout on federally listed species including arroyo toad populations in the Pyramid reach (DWR 2019c).

Elderberry Forebay and Tributaries

Little information exists regarding fish species residing in Salt Creek, Castaic Creek, or Fish Canyon upstream of Elderberry Forebay. Power Associates state that "no fish of any kind have been observed within Castaic Creek channel above the margin of Elderberry Forebay" (LADWP 2003).

Elderberry Forebay has never been stocked with fish, and no fish were documented when the impoundment was drawn down for sediment removal activities in 2016 (pers. comm., Rubin 2019). Elderberry Forebay is not accessible to the public, and access will remain restricted in the future. The Licensees requested any fish information regarding Elderberry Forebay from CDFW, who advised the Licensees that CDFW did not have any information regarding fishes or other aquatic resources in Elderberry Forebay (pers. comm., Lucero 2019).

5.3.1.4 Amphibians and Semi-Aquatic Reptiles

Aquatic herpetofauna resources include amphibians, snakes, and turtles that are closely associated with aquatic environments (Table 5.3-18). FYLF, western spadefoot, two-striped gartersnake, South Coast gartersnake, and southern western pond turtle are special-status species discussed in Section 5.3.1.1. American bullfrog is a non-native invasive species discussed in Section 5.3.1.2. Arroyo toad and CRLF are species listed as endangered and threatened, respectively, under the federal ESA and are discussed in Section 5.4.1.

Western toad, Baja California chorus frog, and California chorus frog are common amphibians documented to occur in the proposed Project boundary and in Pyramid reach. All three species have been observed using sedimentation basins in the storm bypass channel above Elderberry Forebay. Western toad, California chorus frog, and American bullfrog larvae have been observed in the Pyramid reach during annual sensitive species surveys (Environmental Science Associates 2019, 2018, 2017, 2016, 2015a, 2014a, 2013, 2012, 2011, 2010a), and were observed in the Pyramid reach during the Licensees' relicensing studies.

Table 5.3-18. Non-Invasive Aquatic Amphibians and Semi-Aquatic Reptiles, Excluding Special-Status Species, Known to Occur or That May Potentially Occur in the Vicinity of the Project

Species	Habitat Associations
Western toad (*Anaxyrus* [*Bufo*] *boreas*)	Widespread species, breeding in ponds, lakes, and reservoir edges, and slow-moving or still sections of streams across a wide range of elevations and habitats, including woodlands, grasslands, and meadows. May be highly terrestrial outside of the breeding season, with females traveling farther from breeding sites than males, and often inhabiting existing burrows during periods of extreme temperatures. No conservation concerns have been documented for this species in California.
Baja California chorus frog (treefrog) (*Pseudacris hypochondriaca*)	The most common amphibian within its range, and as ecologically adaptable as its more northern-ranging sibling species, Sierra chorus frog (*P. sierra*) and Pacific chorus frog (*P. regilla*), from which it was separated by Recuero et al. (2006). Occurs over a wide range of elevations, and breeds in ponds, lakes and reservoir edges, ditches, slow-moving or still sections of streams, and opportunistically in small rainwater pools. Outside of the breeding season may be heard far from water.
California chorus frog (treefrog) (*Pseudacris cadaverina*)	Locally common species found from San Luis Obispo County south to Baja California, Mexico along coastal and desert slope drainages and in desert oases. Known from near sea level to 7,500 feet elevation. Breeds in pools in rocky, seasonally intermittent and perennial streams, with larvae metamorphosing in June to August. Although not aquatic outside of the breeding season, adults and juveniles usually remain close to stream courses during surface activity season, and may retreat to rock crevices and rodent burrows during the driest periods.

Sources: Lannoo 2005; Jones et al. 2005; Stebbins and McGinnis 2012; California Herps 2018

Continued Project O&M activities that have a potential to affect aquatic breeding amphibians and semi-aquatic reptiles within the proposed Project boundary and in the Pyramid reach include water release schedules, ground-disturbance and vegetation control, including the application of herbicides. Operations of the Project since 2005 have included winter flow releases at Pyramid Dam that follow the timing and magnitude of natural inflow within safe limits of approximately 18,000 cfs, and only provides additional releases to meet UWCD deliveries between November 1 and the end of February, in a fashion that simulates the hydrograph of a typical storm event. Taken together, this flow schedule simulates a natural flow regime likely to benefit native species adapted for these conditions.

5.3.1.5 Aquatic Mollusks

The Licensees referred to the CNDDB to determine if there were any recorded sightings of non-AIS aquatic mollusk species in the Project area (the mollusks discussed in this section do not include AIS from Section 5.3.1.2.). A query of the CNDDB was conducted within USGS 7.5-minute quadrangles located immediately surrounding the existing Project boundary. No occurrences were recorded in the nine quadrangle search (CDFW 2018b). Incidental observations of additional mollusks were made during AIS surveys; however, approximately 219 of these additional mollusks were not identified to species.

Licensees referred to the California Environmental Data Exchange Network (CEDEN) to find data regarding mollusks within and surrounding the existing Project boundary. A county-based query was run emphasizing select map stations with relevance to the Project location. Data from four map stations in the Project area were examined: (1) Random Site 83 – Piru Creek; (2) Piru Creek 01136; (3) Piru Creek 07024; (4) Piru Creek 1.3 miles upstream from Fish Creek; and (5) Castaic Creek. The results of the query included 13 samples identified by family as Corbiculidae, Hydrobiidae, Lymnaeidae, Physidae and Planorbidae. The samples were further broken down into genus and included *Corbicula*, *Helisoma*, *Physa*, and *Potamopyrgus* (SWRCB 2018).

5.3.1.6 Aquatic Benthic Macroinvertebrates

The Licensees consulted CEDEN to find data regarding BMI in the Project vicinity. A county-based query was run on studies completed on Pyramid reach with relevance to the Project vicinity. Data from five map stations on Piru Creek were examined: (1) Piru Creek 16332 (downstream of Blue Point Campground); (2) Piru Creek 1.3 miles upstream of Fish Creek; (3) Piru Creek 07024 (below Frenchmans Flat); (4) Piru Creek above Frenchmans Flat; and (5) Piru Creek 01136 (downstream of Site 5). The orders and families of the aquatic BMI found at the five sampling locations are described in Table 5.3-19 (SWRCB 2018). Aquatic macroinvertebrates represented from the five sites consisted of approximately 17 orders and 47 families. Gastropods (snails and limpets) dominated the samples making up 37 percent of the total invertebrate count from all five sites. Additionally, Platyhelminthes (flatworms) and Nematoda (roundworms) were found and identified to phylum.

Table 5.3-19. Benthic Macroinvertebrate Orders and Families Identified at the Five Researched Locations in the Project Vicinity

Class	Order	Family
Arachnida	Trombidiformes (mites)	Sperchontidae, Hygrobatidae, Torrenticolidae, Lebertiidae
Bivalvia	Veneroida	Corbiculidae, Sphaeriidae
Enopla	Hoplonemertea	Tetrastemmatidae
Gastropoda (snails)	Basommatophora	Physidae, Planorbidae
	Hypsogastropoda	Hydrobiidae
Hidrudinea (leeches)	Rhynchobdellida	Glossiphoniidae
Insecta	Coleoptera (beetles)	Elmidae, Dryopidae, Haliplidae, Psephenidae
	Diptera (flies)	Chironomidae, Empididae, Simuliidae, Ceratopogoidae, Dixidae, Stratiomyidae, Tipulidae
	Ephemeroptera (mayflies)	Leptohyphidae, Baetidae, Ephemerellidae
	Hemiptera (true bugs)	Naucoridae, Corixidae
	Lepidoptera (moths)	Pyralidae
	Megaloptera (dobsonflies, fishflies)	Corydalidae
	Odonata (hellgrammites, alderflies)	Coenagrionidae, Libellulidae, Lestidae, Gomphidae
	Plecoptera (stoneflies)	Nemouridae
	Trichoptera (caddisflies)	Brachycentridae, Glossosomatidae, Lepidostomatidae, Hydropsychidae, Hydroptilidae, Philopotamidae, Heliocopsychidae, Psychomiidae, Polycentropodidae, Sericostomatidae,
Malacostraca	Amphipoda (scuds)	Hyalellidae, Gammaridae, Corophiidae
Ostrocoda	Podocopida	

Source: SWRCB 2018

In order to supplement existing information regarding BMI, the Licensees conducted Study 4.1.21. Surveys were conducted at three sites within Pyramid reach between Pyramid Dam and the NMWSE of Lake Piru. Sites were selected using habitat data to identify representative sites in each reach and in collaboration with the resource agencies. The sites were co-located with Study 4.1.3 Fish Sampling Sites (Figure 5.3-26 and Figure 5.3-27). BMI Sampling Site 1 was downstream of Pyramid Dam, BMI Sampling Site 2 was downstream of Frenchmans Flat, and BMI Sampling Site 3 was upstream of the confluence of Agua Blanca Creek and Piru Creek (Table 5.3-20). Sites were selected in collaboration with Resource Agencies, including a site visit on May 17, 2018. Agencies present on May 17, 2018 included CDFW, NMFS, the SWRCB, and

USFS. After receiving feedback from the agencies, the Licensees agreed to relocate two of the sampling sites (BMI Sampling Site 1 and BMI Sampling Site 3) immediately upstream from their original locations. The Licensees filed a letter with FERC on August 1, 2018,[20] describing these changes and the rationale for the new locations. FERC agreed with the selection of BMI Sampling Sites 1, 2, and 3 in the Study Plan Determination dated September 7, 2018.

Table 5.3-20. Benthic Macroinvertebrate Site Locations

Site	Upstream Coordinates	Downstream Coordinates	Site Description
BMI Sampling Site 1 (DS of Pyramid Dam)	34.635371° N, -118.75689° W	34.63489° N, -118.75497° W	Site begins from RM 0.94 to RM 1.04 and extends 150 m long
BMI Sampling Site 2 (DS of Frenchmans Flat)	34.61117° N, -118.74920° W	34.61032° N, -118.75035° W	Site begins from RM 3.3 to RM 3.4 and extends 150 m long
BMI Sampling Site 3 (US of Agua Blanca Creek)	34.54669° N, -118.77316° W	34.54669° N, -118.77160° W	Site begins from RM 16.01 to RM 16.10 and extends 150 m long

Key:
m = meters
N = north
W = west
DS = downstream
US = upstream
RM = river mile

Sampling followed reach-wide benthos methods for documenting and describing BMI assemblages and physical habitat using the SWRCB's SWAMP protocol (Ode et al. 2016).

Water chemistry and physical habitat were characterized at each site. Data were collected on channel characteristics, substrate composition, riparian vegetation, instream habitat complexity, human influence, channel habitats, bank stability, and canopy cover at each transect.

The three BMI sample sites varied in channel morphology, sediment composition, and habitat conditions. BMI Sampling Site 1, the upstream site, had the highest percentage of pool habitat. BMI Sampling Site 2 varied between pool, riffle, and run habitat. BMI Sampling Site 3, the most downstream site, was primarily comprised of glide and pool habitat. Moving downstream, specific conductivity increased and dissolved oxygen decreased. Substrate composition shifted from larger boulder and cobble substrates to smaller size classes (Table 5.3-21). The shift in substrate composition is likely a reflection of sediment deposition and geomorphic processes.

[20] FERC Accession Number 20180803-5090

Table 5.3-21. Water Quality and Habitat Characteristics for Three Pyramid Reach Benthic Macroinvertebrate Sampling Sites

Category	Metric	Site 1 (Downstream of Pyramid Dam)	Site 2 (Downstream of Frenchmans Flat)	Site 3 (Upstream of Agua Blanca Creek)
Water Quality	Water Temperature (°C)	21.23	24.72	22.15
	Dissolved Oxygen (mg/L)	9.35	7.97	7.44
	Specific Conductivity (µs/cm)	555	867	1056
	pH	7.97	7.94	7.99
	Reach Length (m)	150	150	150
	Flow (cfs)	2.6	1.3	0.3
Site Characteristics	Habitat Composition (% of Site)			
	Cascade/Falls	6	2	0
	Rapid	0	0	0
	Riffle	14	35	0
	Run	22	24	10
	Glide	0	5	48
	Pool	58	36	43
	Dry	0	0	0
	Dominant Thalweg Composition (% of Site)			
	Bedrock, Smooth	1	0	0
	Bedrock, Rough	0	3	0
	Boulder, Large	16	7	0
	Boulder, Small	30	16	1
	Cobble	15	5	2
	Gravel, Course	6	10	22
	Gravel, Fine	3	6	48
	Sand	5	11	13
	Fines	24	39	14
	Wood	1	2	0
	Other	0	2	0

Table 5.3-21. Water Quality and Habitat Characteristics for Three Pyramid Reach Benthic Macroinvertebrate Sampling Sites (continued)

Category	Metric	Site 1 (Downstream of Pyramid Dam)	Site 2 (Downstream of Frenchmans Flat)	Site 3 (Upstream of Agua Blanca Creek)
Transect Characteristics	Averaged Channel Conditions			
	Average Sample Plot Depth (cm)	20.3	14.6	9.9
	Average Wetted Width (m)	6.3	2.8	3.7
	Average Bankful Width (m)	10.3	7.4	9.3
	Average Bankful Height (m)	0.6	0.7	0.4
	Riparian Canopy Cover (%)	79	88	63

Key:
% = percent
°C = Celsius
µm = micrometers
µS = microsiemens
cfs = cubic feet per second
cm = centimeters
m = meter
mg/l = milligrams/liter

Consistent with the FERC-approved study plan and the SWAMP protocol, all BMI sampling sites were 150 m in length with 11 “main” transects spaced equidistantly from each other and arranged perpendicularly to the primary direction of stream flow. BMI samples were collected at the 11 “main” transects by rubbing cobble and boulder substrates and disturbing finer substrate upstream of a D-frame kicknet fitted with a 0.02-inch diameter mesh net. Samples were preserved in 95 percent ethanol, and labeled to form a single composite sample for individual study sites. A replicate sample was collected at BMI Sampling Site 1 for QA/QC procedures per the SWAMP protocol.

Laboratory processing of BMI samples was conducted by EcoAnalysts, a qualified taxonomy laboratory which complies with requirements outlined in the SWAMP protocol. The CDFW Aquatic Bioassessment Laboratory conducted an external quality control review of sample identification completed by EcoAnalysts.

The California Stream Condition Index (CSCI) scores were calculated using the BMI data (Table 5.3-22). CSCI is California’s new assessment tool that translates BMI data into a numerical measurement of stream health. CSCI scores indicate if a stream’s health is altered and to what degree and it reflects ecological structure and the degree of variation of the observed to expected outcome (Rehn et al. 2015). Scores are calculated using two indices: a multi-metric index (MMI) and observed-to-expected

(O/E) index. MMI scores reflect ecological structure and function, and O/E scores measure taxonomic completeness (Rehn et al. 2015).

More specifically, the MMI index combines several BMI metrics into a single measurement of biological condition (Rehn et al. 2015). The O/E index compares the observed versus expected BMI taxa and measures the biological condition of a site. The mean CSCI score of reference sites is 1. CSCI scores greater than 1 indicate more complex ecological functioning and taxonomic richness than predicted. As a stream's CSCI score approaches 0, it represents a stream's increased variance from reference conditions and a degradation of the stream's biological conditions (Rehn et al 2015).

Table 5.3-22. Benthic Macroinvertebrate Metrics from Samples Collected from Licensees' Study in Pyramid Reach

Metric	Site 1 (Downstream of Pyramid Dam)	Site 1 (Downstream of Pyramid Dam) Replicate	Site 2 (Downstream of Frenchmans Flat)	Site 3 (Upstream of Agua Blanca Creek)
MMI Score	0.593	0.573	0.863	0.747
CSCI Score	0.75	0.74	1.07	0.88
CSCI Score Status	Likely Altered	Likely Altered	Likely Intact	Possibly Altered
Clinger Percent Taxa	31.9	34.7	51.5	30.6
Clinger Percent Taxa Predicted	55.1	55.1	55.3	56.5
Coleoptera Percent Taxa	0.0	0.0	11.3	14.2
Coleoptera Percent Taxa Predicted	10.9	10.9	11.1	14.0
Taxonomic Richness	21.05	18.5	33.55	25.75
Taxonomic Richness Predicted	29.2	29.2	29.3	30.1
EPT Percent Taxa	41.8	43.0	36.7	34.2
EPT Percent Taxa Predicted	41.6	41.6	41.4	40.6
Shredder Taxa	0	0	0	1
Shredder Taxa Predicted	1.63	1.63	1.61	1.53
Intolerant Percent	5.4	1.6	2.5	1.7
Intolerant Percent Predicted	14.9	14.9	14.7	13.2

Key:
CSCI = California Stream Condition Index
EPT = Ephemeroptera, Plecoptera, Trichoptera
MMI = Multimetric index

An estimated 29,410 organisms were collected from the three sample sites. A randomly sorted subset of 2,484 BMI were used to derive the eight BMI metrics and calculate the CSCI score.

The BMI Sampling Site 1 CSCI score is the lowest of all sample sites. The CSCI score fell into “likely altered” status with both the original sample and replicate sample (0.75 and 0.74 respectively). BMI Sampling Site 1 was below the predicted value for all CSCI variables except Ephemeroptera, Plecoptera, Trichoptera (EPT) percent taxa. Percent EPT represents the percent of BMI from the orders Ephemeroptera, Plecoptera, or Trichoptera. EPT percent is an important indicator of stream health because of EPT’s sensitivity to disturbance and pollution. The BMI Sampling Site 1 sample of 600 BMI consisted of 53 distinct BMI genera. BMI data did not have population outliers that dominated the sample. Chironomids were the most common family, representing approximately 29 percent of the sample.

BMI Sampling Site 2 had the highest CSCI score at 1.07, indicating a “likely intact” status. BMI Sampling Site 2 placed higher than the predicted value for both Taxonomic Richness and Percent Coleoptera; an order of aquatic beetles. BMI Sampling Site 2 was close to meeting the predicted value for Percent Clinger Taxa and Percent EPT. The BMI sub-sample from Site 2 contained 702 bugs and had 63 different genera of BMI.

The BMI Sampling Site 3 CSCI score of 0.88 indicates a “Possibly Altered” state. BMI Sampling Site 3 scored higher than the predicted value for percent Coleoptera taxa and was close to meeting the predicted value for Percent EPT, Shredder Taxa, and Taxonomic Richness. BMI Sampling Site 3 subsample contained 48 BMI genera and was dominated by a genus of mayflies (Tricorythodes) at 57 percent. Tricorythodes come from the Leptohyphidae family and belong to the Collector-Gatherer feeding group. Leptohyphidae are known to tolerate low oxygen levels, sedimentation, and other types of pollution (Harrington and Born 1999).

The BMI communities were lacking intolerant species (species that are highly susceptible to stream impairment). BMI samples had few to no shredder taxa. The term “shredder” refers to one of the BMI functional feeding groups known for shredding coarse particulate organic matter. Shredders are found in slower moving water in cold streams where leaf material accumulates (Harrington and Born 1999). Having a high number of shredder taxa can be a good indicator for riparian cover. Variability in site CSCI scores and BMI metrics is likely related to differences in habitat complexity and conditions.

As described above, two of the BMI study sites were identified based on their CSCI scores as “likely altered” (BMI Sampling Site 1) or “possibly altered” (BMI Sampling Site 3), but the status of those sites is not induced by Project O&M under the existing license for the following reasons. First, Project water releases into Pyramid reach from Pyramid Dam approximate the timing and magnitude of natural inflow to Pyramid Lake, effectively providing natural streamflow conditions in Pyramid reach. Second, as reported in Section 5.2 of this exhibit E, water quality parameters in Pyramid reach are consistent with Los Angeles Basin Water Quality Plan objectives (except for chloride, which the Project does not add to any waterbody), and water temperature in Pyramid reach is moderated by releases from Pyramid Dam for a short distance before reaching equilibrium with ambient air temperatures. Third, aquatic habitat mapping conducted by the Licensees showed a broad variety of aquatic habitats and substrate components, indicating that quality habitats with appropriate complexity exist in Pyramid reach as would be expected to occur without the Project. Fourth, the Licensees' stream fish study in Pyramid reach (Study 4.1.3) found that native fish species (e.g., rainbow trout) in Pyramid reach from Pyramid Dam to Frenchmans Flat (the area with the lowest CSCI score) were healthy and in good condition, indicating that the "likely altered" BMI population there is sufficient to support healthy native fish populations. Finally, CSCI scores from previous studies in Piru Creek upstream of Pyramid Lake found varied outcomes. In 2003, the site nearest to Pyramid Lake (approximately 3.5 miles upstream) scored 0.77, classifying it as "likely altered." The next closest site upstream of Pyramid Lake (approximately 5.4 miles upstream) scored 1.17 ("likely intact") based on the CSCI assessment (CWMW 2019). All of these factors indicate that Project O&M under the existing Project license are not negatively impacting BMI or stream health in Pyramid reach.

5.3.2 Effects of the Licensees' Proposal

This section discusses the potential environmental effects of the Licensees' Proposal on fish and aquatic resources, as described in Section 2.0 of this Exhibit E. As discussed in Sections 5.3.1.1 through 5.3.1.6 above, existing Project O&M has the potential to affect fish and aquatic resources throughout Project waters, but articles of the existing Project license were amended to address and minimize these effects. The Licensees' Proposal does not propose any changes to Project O&M.

The Licensees' Proposal includes seven PM&E measures that are either directly or indirectly related to fish and aquatic resources:

- Measure WR1 is substantially consistent with Article 58 in the existing Project license and Pyramid Lake water level requirements in the existing USFS/DWR Agreement. The measure would continue to maintain a Pyramid Lake minimum pool and limit fluctuations of water surface elevation in Pyramid Lake for the benefit of fisheries and recreation.

- Measure WR2 would implement the Hazardous Materials Management Plan that includes measures to manage hazardous materials. This would be a new measure (i.e., not included in the existing license).

- Measure AR1 is identical to the Pyramid Lake portion of Article 52 in the existing Project license, with three exceptions: First, the multiplier for estimating the ungaged flow into Pyramid Lake has been updated based on current GIS and hydrologic methods. Second, clarification has been included to indicate what the

Licensees would do if unsafe conditions occur. Third, the cap on SWP deliveries to UWCD has been removed. This measure including the modifications to Article 52 in the existing license is described in more detail in Appendix A to Exhibit E of this Application for New License. Measure AR1 would continue releases of flows from Pyramid Lake into Pyramid reach that mimic the natural hydrograph in Piru Creek in both timing and magnitude for the benefit of arroyo toad and other native aquatic species.

- Measure AR2 is similar to portions of Article 51 and the amended Exhibit S in the existing Project license. Under Measure AR2, the Licensees would continue stocking and periodic angler surveys of rainbow trout in Pyramid Lake to maintain and assess the quality of the recreational fishery.

- Measure GS1 would implement the Erosion and Sediment Control Plan that includes measures to control sedimentation and erosion during Project activities outside Project O&M. This would be a new measure (i.e., not included in the existing license).

- Measure TR1 includes measures for controlling non-native plant species, protecting special-status species during vegetation management activities, providing for the safe application of herbicides, and re-vegetating disturbed areas. This would be a new measure (i.e., not included in the existing license).

- Measure TR2 would implement the Sensitive Aquatic and Terrestrial Wildlife Management Plan that would include protections to wetland and riparian habitats, known occurrences of special-status frogs (restrictions on some Project O&M activities), pre-construction surveys prior to non-routine Project activities, and protection measures when pesticides are used.

See Appendix A for a detailed description of each proposed PM&E measure.

Measures WR1, AR1, and AR2 would continue measures in the existing license and, therefore, would not alter the existing baseline. Measure WR2 would help prevent spills and improve clean-up of any hazardous materials spilled into Project water bodies. Measure AR1 continues the release of flows from Pyramid Lake in a manner mimicking the timing and magnitude of natural flow for the benefit of native aquatic species. Measure AR1 would also allow additional late fall and wintertime water releases to UWCD, which would have benefits for aquatic species. Measure GS1 would have similar benefits to WR2 in preventing pollution in the form of sedimentation and turbidity in Project water bodies. Provisions on herbicide application in Measures TR1 and TR2 will help prevent impacts to aquatic resources. Protections for sensitive habitats (including aquatic) and special-status aquatic amphibians and reptiles are included in TR2, including provisions for protection measures associated with pesticide use, pre-construction surveys prior to non-routine Project activities, and specific measures for Elderberry Forebay work. These measures, combined with the Licensees' current programs, such as ongoing creel surveys to provide information on non-native fish species, regular monitoring for dreissenid mussels, and application of aquatic herbicides to treat algae and invasive weeds, will improve the conditions for aquatic resources.

Through the implementation of the Licensees' proposed PM&E measures, and because the Licensees' Proposal does not include construction of any new facilities or changes in O&M, the Licensees' Proposal would not adversely affect aquatic resources.

The Licensees considered including a measure that would require fish stocking in Pyramid reach, which is included in Article 51 in the existing license. However, with the concurrence of CDFW, this measure has not been implemented for many years due to concerns regarding effects on arroyo toad. Because continuing stocking fish in Pyramid reach has the potential to result in negative impacts to arroyo toad, ESA-listed species, and other native species, the Licensees did not include a measure for fish stocking in Pyramid reach. Since stocking does not occur now, even though stocking in Pyramid reach is included as a condition in the existing license, no change to existing conditions would occur under the Licensees' Proposal.

In addition, the Licensees considered including a measure that would require fish stocking in Castaic Lake. This measure was included in Article 51 in the original license for the Project to mitigate potential effects from flooding of stream habitat and the loss of then-existing fisheries and associated recreational fishing opportunities due to construction of the Project. For the purposes of the Licensees' Proposal, the environmental baseline includes the presence of Pyramid Dam and no new construction is being proposed. The presence of Pyramid Dam does not and will not cause any adverse effects on stream fishing. Therefore, mitigation for flooding of stream habitat in this Application for New License is not warranted. Outside of the new FERC license, however, DWR as a department within the State of California's Natural Resources Agency, will continue fish stocking and associated creel surveys at Castaic Lake at current levels. DWR is pursuing a Castaic Lake fish stocking agreement with CDFW, similar to other agreements that DWR and CDFW have entered into regarding fish stocking in California lakes, to coordinate Castaic Lake fish stocking and creel survey efforts with CDFW. Because DWR will continue fish stocking and associated activities in Castaic Lake, no change to existing baseline conditions will occur under the Licensees' Proposal.

5.3.3 Cumulative Effects

The past, present, and future operation of the SWP and transfers of water through the South SWP Hydropower via the West Branch of the SWP have the potential to cumulatively affect aquatic resources in Pyramid reach from Pyramid Dam downstream to the confluence of Piru Creek with the Santa Clara River through the passage of non-native fish species through the Pyramid Dam Low-Level Outlet during stream releases or during testing of the radial gates. A number of non-native fish species occur and are established in both Quail Lake and Pyramid Lake, introduced there by either intentional actions (e.g., historical stocking of largemouth bass, current stocking of rainbow trout at Pyramid Lake) or unintentionally through the SWP. The potential exists for future introductions of non-native fishes into the Project via the SWP and continued conveyance into Pyramid reach during stream releases and radial valve testing, and could have negative impacts on native aquatic resources in Pyramid reach. However, Licensees' Study 4.1.17 showed that entrainment of fishes into the Pyramid Dam Low-Level Outlet is unlikely. Additionally, populations of native fishes in Pyramid reach (i.e., rainbow trout and prickly sculpin) appear to be healthy and unaffected by interactions with non-native fishes, as indicated by the results of Licensees' Study 4.1.3, as well as CDFW's Heritage and Wild Trout surveys in the tributaries to Pyramid reach. The extent of the conveyance of non-native fishes from Pyramid Lake into Lake Piru is not known. The potential passage of non-native fishes downstream of Santa Felicia Dam into Lower Piru Creek is a result of UWCD's operations at Santa Felicia Dam.

The capture of sediment and large woody material (LWM) in Pyramid Lake has an insignificant effect on aquatic resources in Piru Creek downstream of Santa Felicia Dam. As discussed above, relatively small amounts of sediment and LWM are captured in Pyramid Lake. If some or all of this material were to pass downstream of Pyramid Dam into Pyramid reach, it is likely that the material would be captured and removed from Lake Piru by UWCD for the safe operations of Santa Felicia Dam. Additionally, as shown by the results of Licensees' Study 4.1.3, the evidence of spawning observed in scale samples collected from rainbow trout between Pyramid Dam and Frenchmans Flat Campground indicates that rainbow trout downstream of Pyramid Dam have access to suitable spawning gravels. Furthermore, the Licensees' studies showed the presence of a variety of aquatic habitat and substrate types throughout Pyramid reach, indicating that sufficient mechanisms for the maintenance of aquatic habitat variety and complexity (a function commonly attributed to LWM) currently exists and continues to persist downstream of Pyramid Dam. Recreation, including OHV use, and road use and maintenance on the LPNF, including recreation on Pyramid reach, represent long-term past and present cumulative actions. These activities can disturb wildlife, including special status aquatic amphibians and semi-aquatic reptiles, in areas near recreation facilities, trails, and roads; affect water quality; and can directly affect these species where instream recreation occurs and at road crossings. As described above, FERC does not have the authority to regulate these facilities and activities. Introductions of non-native aquatic species, including deliberate releases of game fish, escape of bait fish, illegal release of pet turtles, and American bullfrog are also cumulative effects which are particularly deleterious to aquatic amphibians, gartersnakes, and some native fish.

The proposed Centennial development also may have cumulative effects on special status aquatic species. The Centennial development is a 12,323-acre, master-planned community on the Tejon Ranch, located in the northwestern portion of the Antelope Valley and immediately north and east of Quail Lake and the proposed Project boundary. The development is expected to accommodate a population of more than 57,000 persons by completion and may increase demand for regional recreation to some extent, including use of the Project recreation facilities during the term of the new license. This increase in demand for recreation is not attributed to the Project or the

Licensees' Proposal, but rather, the cumulative effects of population growth during continued operation of the recreation facilities under the new license.

Overall, the Licensees' Proposal will not significantly add to these described cumulative effects on fish and aquatic species.

5.3.4 Unavoidable Adverse Effects

Operating and maintaining the Project under the Licensees' Proposal would not create any significant or unavoidable adverse effects to fish and aquatic resources.

5.3.5 Response to Requests for Additional PM&E Measures and Studies

As described in Section 1.5.11, subsequent to filing the DLA with FERC, the Licensees received written requests from Relicensing Participants to include PM&E measures relative to water resources. After careful review and consideration, the Licensees did not adopt 11 preliminary proposed measures related to fish and aquatic resources. Each of these is discussed below including the Licensees' reasons for not adopting the measure. None of the comment letters requested the Licensees conduct studies related to fish and aquatic resources. Refer to Table 1.5-6 of Exhibit E for the FERC E-Library Accession numbers to access the letters referenced below.

Stock Fish in Castaic Lake

CDFW proposes that the following language from the 1999 Order be included in the new FERC license: "Since off-site mitigation was originally required as a result of Project-related construction impacts, the Licensees should be required to continue stocking trout in Castaic Lake. The number of trout to be stocked shall be determined in consultation with CDFW." [CDFW Requested Condition #1-1 in its November 27, 2019 letter]

SWRCB staff support CDFW's request to include Castaic Lake fish stocking in the new FERC license for the Project. SWRCB suggests stocking fish in Castaic Lake would benefit the fishery throughout the term of the FERC license, and that stocking Castaic Lake would support the water contact recreation (REC-1) beneficial use designated for Castaic Lake, which includes fishing. [SWRCB's November 27, 2019 letter, page 5]

The Licensees considered proposing a PM&E that would include fish stocking in Castaic Lake. FERC included such a measure in Article 51 in the original license for the Project to mitigate potential effects from flooding of stream habitat and the loss of then-existing fisheries and associated recreational fishing opportunities caused by original construction of the Project. For the purposes of the Licensees' Proposal, the environmental baseline includes the presence of Pyramid Dam and no new dam construction is being proposed. The presence of Pyramid Dam does not and will not cause any adverse effects on stream fishing. Therefore, mitigation for flooding of stream habitat in this Application for New License is not warranted. Outside of the new FERC license, however, DWR as a department within the State of California's Natural Resources Agency, is committed to continue fish stocking at current levels and associated creel surveys at Castaic Lake. DWR is currently working with CDFW to develop an agreement, similar to other agreements that DWR and CDFW have entered into regarding fish stocking in California lakes, to fund and coordinate Castaic Lake fish stocking and creel survey efforts with CDFW. Because DWR will continue fish stocking in Castaic Lake at current levels, no change to existing baseline conditions will occur under the Licensees' Proposal.

Update Quagga Mussel Control Plan

CDFW proposes the following PM&E to reduce Project effects resulting from quagga mussels introductions: "For containment of quagga mussels from releases via the Pyramid Dam Spillway into Middle Piru Creek, the Licensees shall update the Quagga Mussel Control Plan for Pyramid Lake and Angeles Tunnel (Plan) to include spillway and all other releases as part of the shear stress analysis. In addition, the Plan needs to demonstrate control in water releases from Pyramid Lake into the Angeles Tunnel, and demonstrate significant progress towards compliance with Fish & Game Code, Section 2301 and California Code of Regulations, Title 14, section 672.1." [CDFW Requested Condition #1-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's proposed measure regarding updating the quagga mussel control plan for Pyramid Lake and Angeles Tunnel to include a shear stress analysis on spillway releases and other releases, and to demonstrate control of water releases from Pyramid Lake into Angeles Tunnel and significant progress towards compliance with FGC Section 2301 and 14 CCR Section 672.1 relating to Dreissenid mussel control and prevention, for three reasons.

First, CDFW has not substantiated or provided evidence that DWR is not complying with the FGC. DWR continues to work with CDFW on the development of a quagga and zebra mussel prevention plan for the SWP and a separate mussel control plan that have both gone through multiple iterations with CDFW. The current draft mussel control plan includes five potential mussel control measures including the management of recreational boating, aquatic pesticide application, manual/physical removal, low calcium conditions monitoring that prohibit and compromise larval and adult mussel development and survival, and evaluation of turbulence in stream releases through the low-level outlet. The next iteration of the mussel control plan will also include shear stress analysis of spillway releases through Pyramid Dam and DWR will continue to collaborate with CDFW on the shear stress analyses. LADWP is also continuing to work with CDFW on the development of a mussel control plan for Elderberry Forebay.

Second, CDFW has not provided information to indicate that larval quagga mussels are an issue at Pyramid Lake or that Pyramid Dam releases have caused the transport of quagga mussels into Piru Creek. DWR provides an annual report to CDFW on the status of monitoring and management measures that are being undertaken as well as DWR's evaluation of control measures. Since the initial identification of dead quagga mussels in the Angeles Tunnel during the 2016 inspections, monitoring to-date has shown that there is no evidence of quagga mussel reproduction in Pyramid Lake nor were any sub-adults found in the Angeles Tunnel and Pyramid Lake, or in Castaic Lake where monitoring is also occurring. Remote operated vessel monitoring continues for the two live adults found on the Angeles Tunnel Intake trash rakes located over 200 feet deep and they are anticipated to naturally die off based on water quality conditions observed to date that are prohibitive of development and survival. In addition, DWR's ongoing early detection monitoring efforts that began in 2008 has not detected any quagga mussel veligers or any attached adults on settlement plates. The same can be said for Elderberry Forebay where monitoring by LADWP has not detected any adults or larval quagga mussels to date.

Third, CDFW has not provided evidence that the current mussel control plan for Pyramid Lake is deficient in analyzing the shear stress of stream releases to Piru Creek in managing larval quagga mussels. In the most recent version of the draft mussel control plan, DWR describes the analysis taken to assess the resulting shear stress that would be lethal to quagga mussels based on existing equipment of the stream release structure at Pyramid Dam. Based on that analysis, DWR determined that the resulting releases through each of the four release valves of the stream release structure below Pyramid Dam would provide sufficient shear force to cause mortality to larval quagga mussels even in hypothetical veligers of much smaller size. Also, DWR will be including a shear stress analysis of Pyramid Dam spillway releases in the next iteration of the mussel control plan for CDFW's review. Although it would be difficult to calculate the shear stress of and implement reasonable control measures in the Angeles Tunnel because of the continuous large volume of water entering the tunnel, there is no evidence to support that the Angeles Tunnel is transporting live or reproductive quagga mussels as there is no evidence of veliger production or veligers in Pyramid Lake or Elderberry Forebay. DWR will continue to collaborate with CDFW on the development of the shear stress analyses in the mussel control plan.

Install Barriers to Prevent Upstream Passage into Pyramid Dam Tributaries and Eradicate in the Tributaries

USFS proposes the following:

- *Prevent future upstream encroachment of stocked fish and fish transported south through the SWP from the upstream central valley (e.g. Delta species) onto the forest by installing fish passage barrier(s), and*

- *Provide resources for the extirpation of stocked and SWP transported fish species from the forest.* [USFS' November 25, 2019, letter, pages 17 and 18]

The Licensees did not adopt USFS' preliminary proposed measure to install fish passage barriers or provide resources to extirpate fish from NFS lands for two reasons. First, USFS has provided no details regarding its preliminary proposed measure. USFS has not described the location or type of fish barriers it proposes, when the barriers would be in place, what “resources” USFS proposes to extirpate fish from NFS lands or where such extirpation would occur, or anticipated costs to implement USFS’ preliminary proposed measure. Second, USFS provided no rationale for its preliminary proposed measure. USFS implies that fish from Pyramid Lake have entered tributaries on NFS lands, for which USFS provides no evidence, and then concludes that these fish adversely affect resources on NFS lands, for which USFS provides no evidence. In short, USFS provides no evidence that constructing barriers and extirpating an unknown number of fish from unknown areas on NFS lands would provide any environmental benefit. While the USFS has not provided sufficient clarity to allow the Licensees to fully evaluate the need for the preliminary proposed measure, the Licensees provide the following analysis with stated assumptions as an example of the costs that may be associated with the preliminary proposed measure. Aside from Gorman Creek, which is located mostly on State lands, all other significant tributaries to Pyramid Lake are located on NFS lands. Since USFS has not identified the tributaries on which it is requesting barriers to be installed, available information suggests that only Piru Creek and possibly Carlos Canyon have the potential to sustain fish populations. Assuming a 100-foot section of picket weir costs $60,000 to design, construct, and install (pers. comm., Peterson 2019), installing barrier weirs on Piru Creek and Carlos Canyon would cost $120,000. Assuming the weirs would remain installed year-round, personnel would be required for regular weir maintenance and cleaning during the rainy season, which is assumed to extend from January through April in normal years. Assuming one person per day costs $1,000, assuming two people would be required as a minimum due to safety concerns related to working in water, and assuming semi-weekly maintenance and cleaning visits for 16 weeks, weir maintenance would cost $64,000 annually (i.e., $1,000 per person per day times 4 people days per week times 16 weeks). Extrapolated over the term of a 30-year license, and not incorporating repair costs for weir infrastructure, which are difficult to quantify in terms of frequency or severity due to the intermittent but stochastic nature of streams with flashy runoff characteristics, the cost to implement USFS’ proposal to install fish passage barriers would be $2,040,000. Given USFS has provided no evidence that its preliminary proposed measure would provide any environmental benefit, a cost of over $2 million is not warranted. Regarding USFS’ request for providing “resources for the extirpation of stocked and SWP transported fish species from the forest”, USFS has not provided sufficient detail in its request to allow the Licensees to estimate a cost to implement the request.

Conduct Algal Monitoring in Pyramid Lake and Include Adaptive Management

CDFW proposes an algal study be conducted to understand the cause and frequency of HABs [Harmful Algal Blooms] and determine presence/absence of Microcystis in Pyramid Lake. The study design would be developed by DWR and approved by CDFW, and shall assess impacts to fish and other aquatic species from HABs. Algal surveys results shall be filed with FERC. If algal study results show presence of Microcystis and other potentially harmful algae species, DWR shall develop an adaptive management and monitoring plan approved by CDFW. The approved adaptive management and monitoring plan shall implement actions to decrease the frequency of blooms, as well as *improve health of fish and other aquatic species.* [CDFW Requested Condition #5-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure regarding monitoring harmful algae blooms and Microcystis in Pyramid Lake, consulting with CDFW, and developing an adaptive management program for five reasons. First, CDFW has not provided specificity regarding its proposed monitoring (e.g., locations where monitoring would occur, and periods and methods for monitoring). Second, DWR currently follows guidance provided by the EPA and the SWRCB for managing and reporting HABs and implements a comprehensive water quality monitoring program that includes routine monitoring and increased monitoring frequencies when an algal bloom is detected. As part of this comprehensive water quality monitoring program, DWR has documented that Microcystis and other cyanobacteria occurs at times in Pyramid Lake, so the proposed monitoring would provide no additional information, and monitoring for monitoring's sake provides no environmental protection or benefit. Third, it is known that cyanobacteria are naturally occurring in most California reservoirs and that HABs are occurring more frequently nationwide. However, the Project does not introduce any nutrients such as nitrogen or phosphorus or other conditions that would promote HABs. Fourth, CDFW does not describe how potential impacts to fish and other aquatic species would be determined and what "approved adaptive management" would be implemented. Without this, the Licensees cannot evaluate whether any measure, beyond those taken now under DWR's existing monitoring programs, would provide any additional protection or are even reasonable. Further, CDFW did not provide a cost estimate to implement its preliminary proposed measure. Fifth, CDFW does not describe why the current monitoring and ability to apply treatments when needed under DWR's NPDES permit is not adequate protection for the resource. Without this clarity, the Licensees cannot evaluate CDFW's preliminary proposed measure.

Conduct Fish Monitoring and Include Adaptive Management

CDFW proposes that a fish population monitoring plan be developed by DWR and approved by CDFW. The monitoring plan should include periodic fish population and fish habitat assessments along with routine temperature monitoring of fish habitat. Licensees shall consult with CDFW (as stated in the fish population monitoring plan) and shall file with FERC the results of the fish surveys and temperature monitoring data. If fish habitat, populations, and/or fish health conditions decline beyond the criteria approved in the fish population monitoring plan, adaptive management of flow releases shall be required to maintain fish in good condition. [CDFW Requested Condition #4-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure regarding monitoring fish populations and water temperature, consulting with CDFW annually, and developing adaptive management for four reasons. First, CDFW has provided no specificity regarding its proposed monitoring (e.g., locations where monitoring would occur, and periods and methods for monitoring). Second, monitoring for monitoring's sake provides no environmental protection or benefit, and agencies with jurisdiction and trustee responsibility over resources, rather than Licensees, generally have the responsibility to collect information to manage those resources. Third, CDFW's trigger for adaptive management is vague (i.e., fish habitat, populations, and/or fish health conditions decline beyond the criteria approved in the fish population monitoring plan, when it is developed) and does not include hard triggers. Fourth, CDFW does not describe what adaptive management would be implemented, and without this, the Licensees cannot evaluate whether such measure would provide any additional protection or is even reasonable. Additionally, without these clarifications, the Licensees cannot evaluate CDFW's preliminary proposed measure.

Furthermore, it is unclear why this measure is needed. As described in Section 5.3.1.3 of Exhibit E, the available information suggests that the warm-water game fish populations in Pyramid Lake are healthy and appear to be self-sustaining, which in turn indicates that reservoir habitat is adequately available and of sufficient quality. Similarly, the results of Licensees' Study 5.1.3 indicate that native fish populations in Pyramid reach are in good condition (i.e., multiple age classes present, evidence of natural reproduction in rainbow trout), that a variety of aquatic habitat features exist, and that natural habitat maintenance mechanisms currently exist and continue to persist downstream of Pyramid Dam.

<u>Address Invasive Species in Pyramid Reach</u>

USFS proposes that the FLA should suggest a measure to address invasive species (e.g., red-eared slider, bullfrogs, red swamp crayfish, cyprinids, New Zealand mudsnail, etc.) downstream in Piru Creek. [USFS' November 25, 2019 letter, pages 24 and 25]

To address Project impacts on the spread of invasive plants in Piru Creek below the dam, the ANF recommends inclusion of this area into the IVMP. [USFS' November 25, 2019 letter, pages 24, 25, 45, and 46]

The Licensees have not adopted USFS' preliminary proposed measure to "address invasive species downstream in Piru Creek" or to "add invasive plants in Piru Creek into the IVMP" for three reasons. First, USFS has provided no rationale for its preliminary proposed measure, including even whether these species have been documented to occur in Pyramid reach. USFS implies the species do occur and suggests that, because the Project releases water from Pyramid Lake, the Project must be the source of the species in the reach and, therefore, the Licensees should bear the sole responsibility to treat the species in the reach. If that is USFS' argument, it entirely dismisses other reasonable non-Project sources of the species, such as fishing, boating and hiking, that are known to introduce and spread the species in riverine systems. Although the presence of invasive species is by definition an unwanted condition, their presence does not indicate a Project effect. Certainly USFS is aware that the non-Project uses can introduce and spread invasive species since, during the Licensees' whitewater boating study, USFWS specifically requested the Licensees ask boaters to clean their boats to mitigate the spread of invasive species in the reach. Second, USFS has provided no specificity regarding its preliminary proposed measure or related costs.

USFS provides examples of some species for treatment, but does not provide a full target list, describe what treatment would consist of, or describe where and when treatment would occur; nor does USFS provide an estimate to implement its preliminary proposed measure, if it was included in the new license. Without at least some detail, the Licensees cannot estimate the cost. In particular, USFS does not indicate the objective of the preliminary proposed measure (i.e., eradication of established invasive species, population reduction, or some other desired outcome), what methods would be used, or when or where these methods would be employed. Therefore, the Licensees cannot evaluate USFS' proposal. "Downstream in Piru Creek" includes the 18.1-mile-long Pyramid reach, which is contiguous with Lake Piru, and therefore is continuously open to reinvasion, and much of the reach is remote from access roads and includes private property. Because arroyo toad and possibly CRLF occur within the reach, any methods for locating, capturing, and removing invasive species would have to avoid adversely affecting these ESA-listed species and their associated designated critical habitat. This would likely limit the effectiveness of removal methods. Third, USFS has provided no evidence that this measure would lead to an environmental benefit (i.e., that conditions would be substantially different than they would be without the measure). The Licensees' proposed measure AR1 will continue to provide simulated natural flows to Pyramid reach with releases mimicking inflow. Annual surveys performed in Pyramid reach by DWR for the past 10 years indicate that, under current operations, American bullfrog, bass, and red-swamp crayfish are effectively reduced by scouring flows in years with above average winter precipitation. This evidence indicates that these effects on invasive species will continue to occur and will likely be more effective than any eradication program would be.

<u>Monitor and Eradicate American Bullfrog</u>

USFS proposes that the FLA include a measure to deal with the American bullfrog, given that it is a well-known predator. [USFS' November 25, 2019 letter, page 27]

CDFW proposes that the FLA include a measure to monitor and eradicate American bullfrog, given that it negatively impacts native species. [CDFW Requested Condition #14-1 in its November 27, 2019 letter]

The Licensees have not adopted USFS' and CDFW's preliminary proposed measures related to American bullfrog for three reasons. First, neither USFS nor CDFW provide specifics regarding their preliminary proposed measures. The agencies do not describe what treatment or eradication of American bullfrog would entail and when and where it would occur, nor do they estimate the costs related to implementation of their preliminary proposed measures. Further, CDFW does not describe what monitoring would entail, such as where, when, and how it would be conducted. Second, neither USFS nor CDFW provide a rationale for their preliminary proposed measures other than USFS stating bullfrog "is a well-known predator" and CDFW stating bullfrog "negatively impacts native species." Neither agency provides evidence that bullfrogs are having an adverse effect on any species within the proposed Project boundary. Other than in Pyramid reach, the Licensees found American bullfrog in only one location within the proposed Project boundary (i.e., Vaquero Day Use Area of Pyramid Lake), and USFS provided no information that shows this species occurs elsewhere within the Project boundary. Third, neither USFS nor CDFW state why treatment would lead to an environmental benefit (i.e., that conditions within the boundary would be substantially different than they would be without treatment). Further, the Licensees doubt that American bullfrog could be effectively and safely eradicated, given the species' opportunistic habits, continued sources for re-invasion from outside areas, and limitations on methods that could be safely employed in areas where sensitive native species are present. Even without limitations due to sensitive native species, management of bullfrogs is intensive, expensive, and relatively ineffective in areas with uncontrollable source populations. Orchard (2011) performed a study on a small lake of 1.24 shoreline miles, using a modified electro-shocker and a two-person crew in a small boat to capture and kill adult bullfrogs. A thorough circuit of the 1.2 miles took an entire evening when bullfrog numbers were low and two nights when they were higher. After three intensive years of work, the bullfrogs on the lake were reduced, but there were "newly arriving juveniles and adults" from nearby sources. The cost of the work over the three years at the lake was approximately $12,400. Extrapolating these costs to Pyramid Lake is difficult, because the extent of bullfrog occurrence or habitat suitable for bullfrogs is uncertain because they are opportunistic and have shown to occupy a wide range of freshwater habitats. However, if it is assumed that a crew of two, using the same technique, could cover 1.2 miles of Pyramid Lake a night, it would take 17.5 nights to complete a circuit of the 21.5 mile shoreline hunting bullfrogs. If the approximate cost to perform work at Pyramid Lake was also roughly the same as that done for the Orchard (2011) study, it would cost $217,000 for three years of work at Pyramid Lake alone. And since bullfrogs would continue to come to the Project from uncontrollable source populations, CDFW's goal of eradicating the bullfrog would not be met, so the Licensees would presumably need to continue the work into the foreseeable future at great cost over a 30-year license term. Fourth, neither USFS nor CDFW provide evidence that the source of American bullfrogs in the area is a result of the Project. Both historically and currently, there are significant sources of American bullfrog in nearby areas unrelated to the Project. Without these clarifications, the Licensees cannot evaluate CDFW's preliminary proposed measure.

5.4 TERRESTRIAL RESOURCES

5.4.1 Botanical and Wildlife Resources

This discussion of botanical and terrestrial wildlife species and their habitats is divided into four sections. Section 5.4.1.1 describes the existing Project environment within the proposed Project boundary, including the general distribution of habitat types from updated vegetation mapping (excludes the lands overlying the Angeles Tunnel, as no Project O&M or other activities are performed in this area); occurrences of special-status plant species; occurrences of non-native invasive plants (NNIP); potential barriers to wildlife movement; potential distribution of commercially valuable wildlife species; known occurrences of wildlife species; special-status species known or with the potential to occur within the proposed Project boundary; and designated special ecological areas. Potential effects of the Licensees' Proposal on botanical and terrestrial wildlife resources are described in Section 5.4.1.2. Section 5.4.1.3 addresses unavoidable adverse effects to botanical and terrestrial wildlife resources. Section 5.4.1.4 responds to additional PM&E measures and/or studies.

The Licensees augmented existing, relevant, and reasonably available information relative to botanical resources and terrestrial wildlife by conducting the following four studies: (1) Study 4.1.5, *Botanical Resources*; (2) Study 4.1.6, *Non-Native Invasive Plants*; (3) Study 4.1.7, *Special-Status Terrestrial Wildlife Species - California Wildlife Habitat Relationships*; and (4) Study 4.1.20, *Special-Status Raptors,* referenced herein as Study 4.1.5, Study 4.1.6, Study 4.1.7, and Study 4.1.20, respectively, in this section. The studies are complete and the results are incorporated into this section. Refer to Appendix B of this Exhibit E or to the South SWP Hydropower relicensing website (http://south-swp-hydropower-relicensing.com/) for the detailed study approaches, study summaries, and detailed study data.

5.4.1.1 Existing Environment

Habitat Mapping

The study area for Study 4.1.7, which encompasses the area in which habitat was assessed and characterized on the ground, is defined as the area within the proposed Project boundary plus a 1.5-mile buffer. The study area for Study 4.1.7 is illustrated in Figure 5.4.1-1.

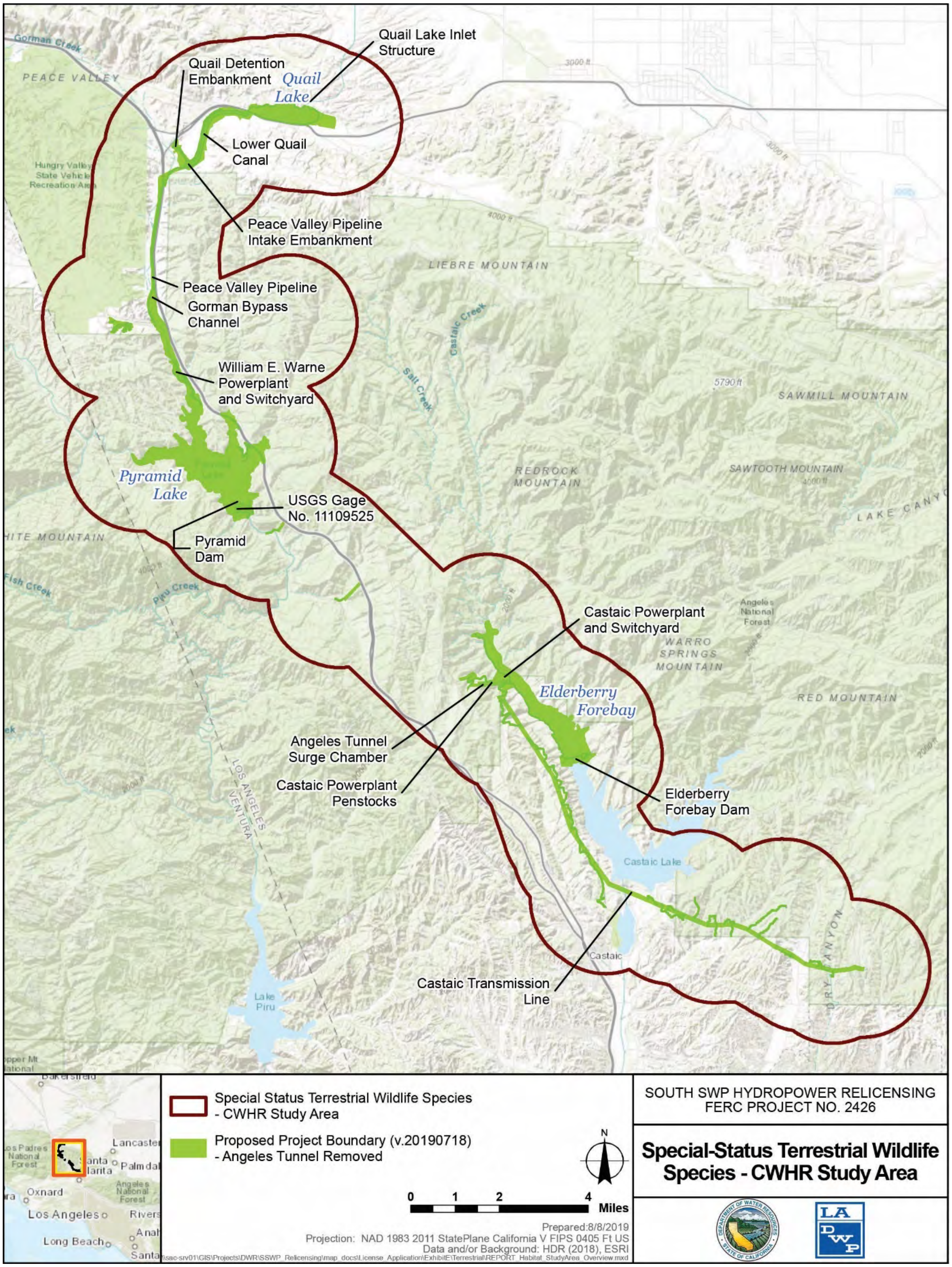


Figure 5.4.1-1. Study 4.1.7, Special-Status Terrestrial Wildlife Species – California Wildlife Habitat Relationships, Study Area

For the purposes of assessing the suitability of habitat for botanical resources and terrestrial wildlife, existing vegetation community mapping within the study area of Study 4.1.7 was used. USFS Classification and Assessment with Landsat of Visible Ecological Groupings (CalVeg) data were available for the majority of the study area, with the exception of the northernmost portion above Quail Lake (USFS 2018). CalVeg data classify and describe existing vegetation according to a hierarchical classification system. The data are created using automated, systematic procedures; remote sensing classification; photo editing; and field-based observations. CalVeg data have a minimum mapping unit of 2.5 acres, with the exception of lakes and conifer plantations, which have no minimum mapping unit. Where areas smaller than 2.5 acres occur in the data, USFS edited and finalized these data. Smaller units (i.e. less than 2.5 acres) also occur in the Project-specific data because the study area of Study 4.1.7 may include only a small part of a mapped vegetation polygon.

The study area of Study 4.1.7 falls largely within the South Coast CalVeg Zone (Zone 7), extending into the South Interior Zone (Zone 8) around Quail Lake, and the Central Valley Zone (Zone 5) just west of Zone 8. USFS mapped vegetation communities in these areas between 2002 and 2010 (USFS 2018). The northernmost portion of the study area has not yet been mapped and, thus, has no CalVeg Classification data associated with it. The area within the proposed Project boundary, minus lands over the Angeles Tunnel, encompasses 4,406.6 acres. The expanded 1.5-mile buffer adds another 80,752.6 acres, for a total study area of approximately 85,159 acres.

CalVeg can be crosswalked with CDFW’s California Wildlife Habitat Relationships (CWHR) classification system (Mayer and Laudenslayer 1988), which is the system that the Licensees used to describe habitat types within the proposed Project boundary. The vegetation sampling portion of Study 4.1.7 was conducted from October 1 through October 19, 2018, to ground truth the accuracy of the initial CWHR habitat maps developed from existing CalVeg data. A total of 66 sampling points were randomly selected, representing 26 CWHR habitat types, as well as areas previously unmapped by CalVeg. The 26 habitat types excluded LAC habitat. LAC is present in the study area of Study 4.1.7 and included in habitat maps and this description, but was not sampled as part of Study 4.1.7. More sampling points were selected in habitats that had a greater potential for special-status wildlife or represented a larger percentage of the study area. When possible, points that were deemed inaccessible through desktop review and ground-truth surveys were relocated in the same habitat.

The number of sampling points selected for each habitat type, along with the actual number of points sampled for each type, is included in Table 5.4.1-1. The actual number of points sampled in each habitat type may differ from the planned number of points sampled at each habitat type, as areas were determined to be incorrectly mapped (Table 5.4.1-1). Additionally, one sample point, in Juniper (JUN) habitat, was not surveyed due to complete inaccessibility, bringing the total number of sampled points down to 65.

At each representative sampling location, a CWHR habitat element checklist was completed to assess habitat components observed at each location and to associate these components with specific habitat types. Three plots were selected at each location to conduct field habitat assessments and characterizations using the CWHR data forms for wooded and non-wooded habitats, as appropriate (CDFW 2016). Within each plot, data were collected on species composition, general density of cover, and size class in order to characterize each habitat type. Additionally, data on canopy closure and trunk diameter was collected in wooded habitats.

In some instances, inaccessibility due to private property, steep slopes, inundation, or other safety concerns eliminated the possibility of collecting plot data at a location. In these instances, an "over-the-fence" approach was implemented, which included the completion of a CWHR habitat element checklist, as well as documenting an estimate of percent cover by species. This modified assessment was conducted at nine of the 65 sample locations. Refer to Appendix I for a summary of the sample locations and the level of assessment performed at each, including the locations at which modified assessments were performed.

The Analysis section of the FERC-approved Study detailed that "…field data will be used in conjunction with CWHR to correct and update the map created in Step 1 and refine the list and habitats of special-status terrestrial wildlife…" Licensees used the collected field data to correct and update maps as follows:

If the mapped habitat type did not match the actual habitat type found at a sampling point, a correction was made to the habitat type at that location and changes in the habitat boundaries were recorded using the field tablets and Collector for ArcGIS application. There were numerous corrections made to previously mapped areas. A total of 33 sampled locations out of 65 total sample locations were determined to be incorrectly mapped. Refer to Appendix J for a map of sample locations surveyed during ground truth surveys. Changes to the CWHR habitat map were digitized in ArcGIS. Within or adjacent (within a 0.25 mile buffer) to the proposed Project boundary, the Licensees ground-truthed 40 sample sites in 19 CWHR habitat types, including all 15 identified in Study 4.1.7. Per the data collected, some 571.5 acres were updated, representing 23.5 percent of the non-water area. Changes to the CWHR habitat map were digitized in ArcGIS in a series of phases: (1) correcting ground-truthed areas; (2) expanding to surrounding areas using information gathered during fieldwork and aerial signatures; and (3) doing a thorough review of remaining areas to fix obvious errors and update habitat types that could be corrected through aerial signatures (these were mainly roads, watered areas, developed areas and barren sites). Figure 5.4.1-2 through Figure 5.4.1-10 illustrate these updated CWHR areas.

Table 5.4.1-1. California Wildlife Habitat Relationship and CalVeg Classification Acreages Within the Proposed Project Boundary and Study Area

California Wildlife Habitat Relationship Type	CalVeg Classification	Planned Number of Sampling Points[1]	Actual Number of Sampling Points[2]	Acreage on BLM Land within Proposed Project Boundary[3]	Acreage on NFS Land within Proposed Project Boundary[3]	Acreage on Other Private/Public Land within Proposed Project Boundary[3]	Total Acreage within Proposed Project Boundary[3]	Percentage of Proposed Project Boundary	Total Acreage in Study Area	Percentage of Study Area
TREE-DOMINATED HABITATS										
Blue Oak - Foothill Pine (BOP)	Gray Pine	2	2	-	-	0.5	0.5	0.01	610.7	0.7
Blue Oak Woodland (BOW)	Blue Oak, Gray Pine, Interior Live Oak	1	1	-	-	-	-	-	381.1	0.4
Coastal Oak Woodland (COW)	Coast Live Oak, Coastal Mixed Hardwood	2	2	-	2.5	0.3	2.8	0.06	264.0	0.3
Desert Riparian (DRI)[4]	Fremont Cottonwood	1	2	-	5.2	46.3	51.5	1.2	65.4	0.08
Joshua Tree (JST)[4]	Joshua Tree	1	1	-	-	0.2	0.2	0.005	5.4	0.01
Juniper (JUN)[5]	California Juniper (shrub)	2	0	-	-	-	-	-	144.5	0.2
Montane Hardwood - Conifer (MHC)	Bigcone Douglas-Fir, Singleleaf Pinyon Pine	1	2	-	-	-	-	-	90.4	0.1
Montane Hardwood (MHW)[6]	Canyon Live Oak, Gray Pine, Interior Mixed Hardwood, Bigcone Douglas-Fir	2	0	-	0.5	-	0.5	0.01	329.3	0.4
Montane Riparian (MRI)[4,7]	Fremont Cottonwood, Willow (Shrub)	2	0	-	-	-	-	-	12.1	0.0
Pinyon - Juniper (PJN)[8]	Singleleaf Pinyon Pine	3	0	-	3.1	0.1	3.2	0.08	572.3	0.7
Sierran Mixed Conifer (SMC)[9]	Bigcone Douglas-Fir, Coulter Pine	1	0	-	-	-	-	-	80.1	0.1
Valley Oak Woodland (VOW)[4]	Gray Pine, Valley Oak, Interior Live Oak	2	2	-	-	-	-	-	307.0	0.4
Valley Foothill Riparian (VRI)[4]	California Sycamore, Riparian Mixed Hardwood, Riparian Mixed Shrub, Willow (Shrub), Willow (Tree), Fremont Cottonwood, Bigcone Douglas-Fir	2	5	0.3	15.7	80.3	96.3	2.2	516.4	0.6
SHRUB-DOMINATED HABITATS										
Chamise - Redshank Chaparral (CRC)	Chamise	5	6	<0.1	75.2	60.2	135.5	3.1	9,391.8	11.0
Coastal Scrub (CSC)	California Sagebrush, Soft Scrub Mixed Chaparral	6	9	2.7	106.9	435.4	545.1	12.4	13,784.0	16.2
Desert Wash (DSW)[4]	Riversidean Alluvial Scrub, Scalebroom	2	1	-	-	2.5	2.5	0.06	215.2	0.25
Mixed Chaparral (MCH)	Birchleaf Mountain Mahogany, Buckwheat, Lower Montane Mixed Chaparral, Manzanita Chaparral, Scrub Oak, Singleleaf Pinyon Pine, Sumac Shrub, Tucker / Muller Scrub Oak, Fremont Cottonwood (VRI, DRI), Bigcone Douglas-Fir, Canyon Live Oak, Singleleaf Pinyon Pine	6	8	-	336.3	51.4	387.7	8.8	37,881.8	44.5

Table 5.4.1-1. California Wildlife Habitat Relationship and CalVeg Classification Acreages Within the Proposed Project Boundary and Study Area (continued)

California Wildlife Habitat Relationship Type	CalVeg Classification	Planned Number of Sampling Points[1]	Actual Number of Sampling Points[2]	Acreage on BLM Land within Proposed Project Boundary[3]	Acreage on NFS Land within Proposed Project Boundary[3]	Acreage on Other Private/Public Land within Proposed Project Boundary[3]	Total Acreage in Proposed Project Boundary[3]	Percentage of Proposed Project Boundary	Total Acreage within Study Area	Percentage of Study Area
Montane Chaparral (MCP)[10]	Great Basin - Mixed Chaparral Transition	1	0	-	-	-	-	-	46.2	0.1
Sagebrush (SGB)[11]	Basin Sagebrush, Great Basin Mixed Scrub, Rabbitbrush	4	8	-	14.2	266.6	280.8	6.4	3,490.6	4.1
HERBACEOUS-DOMINATED HABITATS										
Annual Grassland (AGS)[12]	Annual Grasses and Forbs	3	7	1.9	76.1	119.0	197.0	4.5	8,616.1	10.1
Fresh Emergent Wetland (FEW)[4]	Tule - Cattail	2	3	-	2.8	52.5	55.3	1.3	55.3	0.1
Pasture (PAS)[13]	Pastures and Crop Agriculture	1	0	-	-	-	-	-	-	-
Perennial Grassland (PGS)	Perennial Grasses and Forbs	2	1	-	-	-	-	-	9.7	0.01
Wet Meadows (WTM)[4]	Wet Meadows	3	1	-	8.7	12.2	20.9	0.5	30.2	0.04
DEVELOPED HABITATS										
Urban (URB)	Non-Native/Ornamental Conifer, Non-Native/Ornamental Grass, Non-Native/Ornamental Hardwood, Non-Native/Ornamental Shrub, Urban/Developed (General)	2	3	-	118.3	293.2	411.5	9.3	3,592.9	4.2
NON-VEGETATED HABITATS										
Barren (BAR)	Barren, Urban-related Bare Soil	2	1	1.4	64.2	157.0	222.6	5.1	645.4	0.8
AQUATIC HABITATS										
Lacustrine (LAC)[14]	Water (General), Reservoir	0	0	0.1	942.1	1,050,8	1,993.0	45.2	4,021.3	4.7
OTHER										
Unknown (UNK)[15]	Unmapped	5	0	-	-	-	-	-	-	-
Total[15]		**66**	**65**	**6.5**	**1,771.6**	**2,628.5**	**4,406.6**	**100.00**	**85,159.2**	**100.00**

Source: U.S. Forest Service (USFS) 2018 and field data
Notes:
[1]Represents the number of sample points planned for each habitat type based on acreage in study area and value to wildlife
[2]Represents the number of sample points actually collected for each habitat type. Difference from planned number of points due to incorrect CalVeg mapping and inaccessibility resulting from private property or unsafe conditions. In some cases of limited access, a sampled point had limited data collected (Habitat Element Checklist only, no vegetation plots). This is clarified in the habitat descriptions section below.
[3]All acreages exclude Angeles Tunnel lands.
[4]Considered a Sensitive Natural Community by CDFW (CDFW 2018b).
[5]Reasoning for zero points sampled: (1) one JUN sample point was completely inaccessible and removed from study; (2) other sample point incorrectly mapped by CalVeg. Other areas mapped as JUN were inaccessible and not directly observable, so were assumed to be correctly mapped.
[6]Both MHW sample points were determined to be incorrectly mapped by CalVeg. Other areas mapped as MHW were inaccessible and not directly observable, so were assumed to be correctly mapped. These areas were primarily outside of the proposed Project boundary.
[7]Both MRI sample points were determined to be incorrectly mapped by CalVeg. Other areas mapped as MRI were inaccessible and not directly observable, so were assumed to be correctly mapped. These areas were primarily outside of the proposed Project boundary.
[8]All PJN sample points were determined to be incorrectly mapped by CalVeg. Other areas mapped as PJN were inaccessible and not directly observable, so were assumed to be correctly mapped. These areas were primarily outside of the proposed Project boundary.
[9]Single SMC sample point was determined to be incorrectly mapped by CalVeg. Other areas mapped as SMC were inaccessible and not directly observable, so were assumed to be correctly mapped. These areas were primarily outside of the proposed Project boundary.
[10]Single MCP sample point was determined to be incorrectly mapped by CalVeg. Other areas mapped as MCP were inaccessible and not directly observable, so were assumed to be correctly mapped. These areas were primarily outside of the proposed Project boundary.
[11]Three of the five sample points located in Unknown (UNK) areas previously unmapped by CalVeg were determined to be SGB.
[12]Two of the five sample points located in Unknown (UNK) areas previously unmapped by CalVeg were determined to be AGS.
[13]All areas mapped as PAS were sampled, and determined to be incorrectly mapped. This is the only habitat that was able to be excluded from the study area.
[14]LAC not sampled.
[15]Unknown (UNK) areas were portions of the study area previously unmapped by CalVeg. Categorized as UNK before the field effort, then characterized in the field and found to be a mix of AGS and SGB.
[16]Due to rounding, totals may not align perfectly with the sum of acreages presented by habitat type.

Key:
< = less than
BLM = U.S. Department of the Interior, Bureau of Land Management
CalVeg = USFS Classification and Assessment with Landsat of Visible Ecological Groupings
NFS = National Forest System

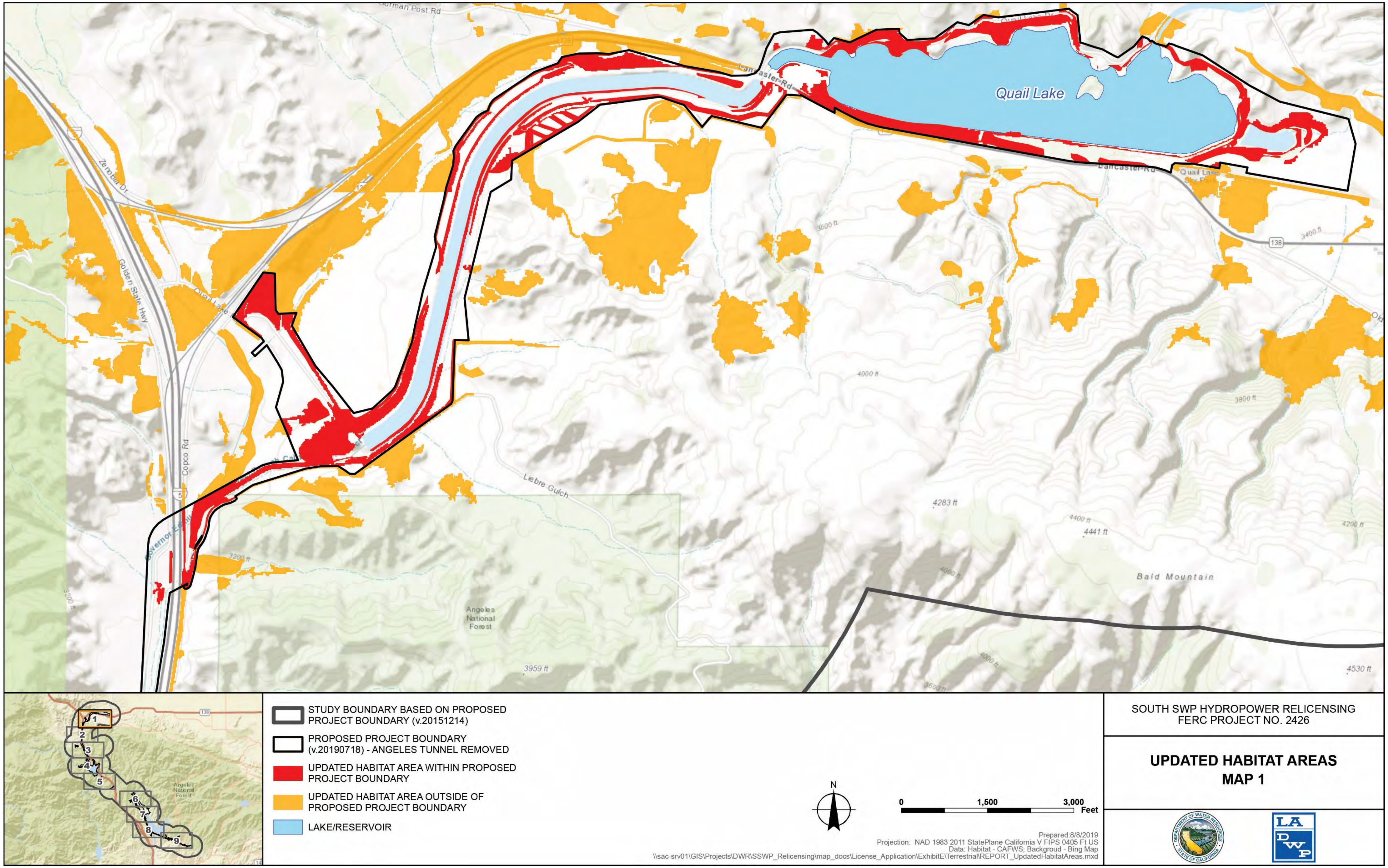
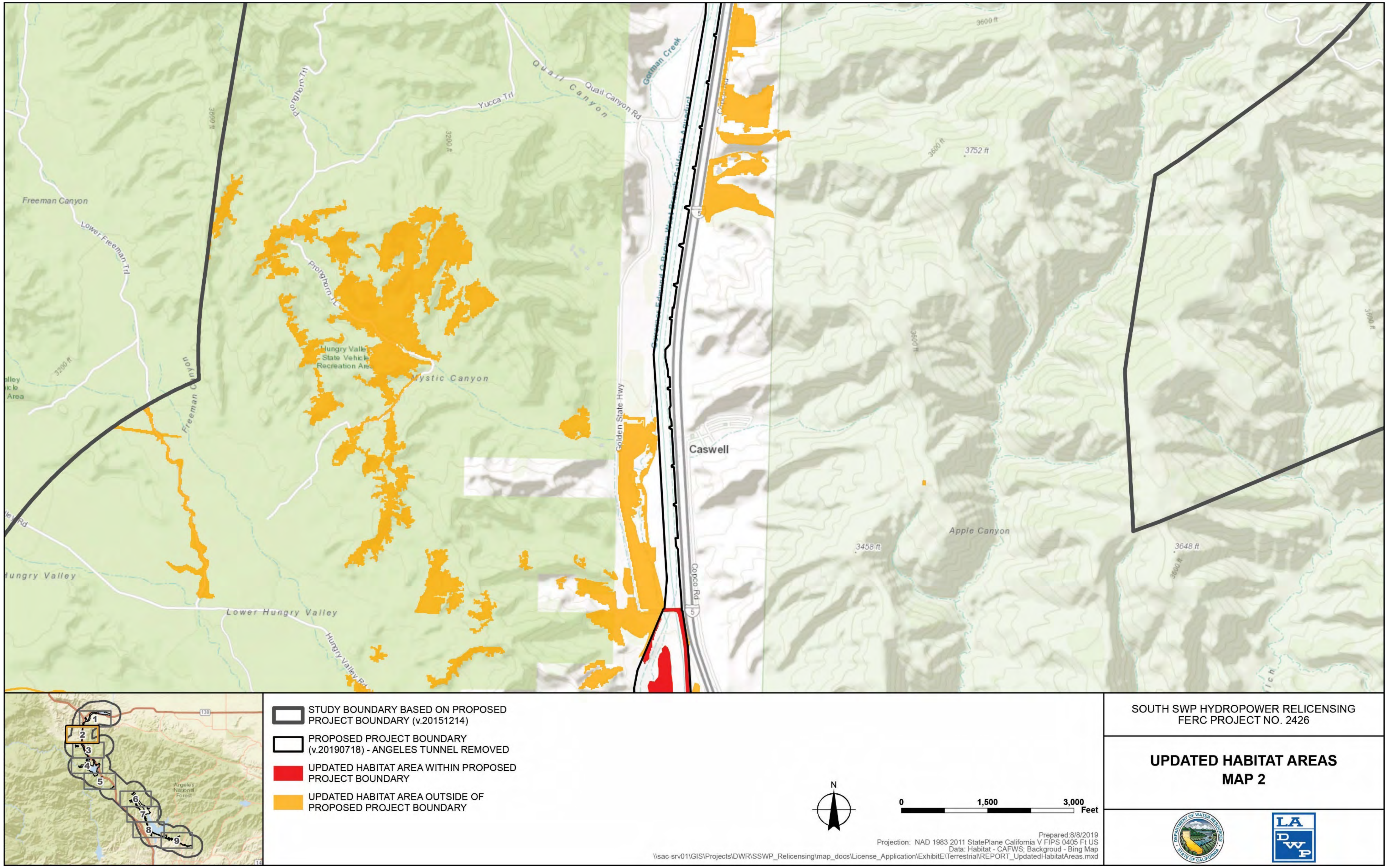


Figure 5.4.1-2. Updated Habitat Areas Within the Proposed Project Boundary



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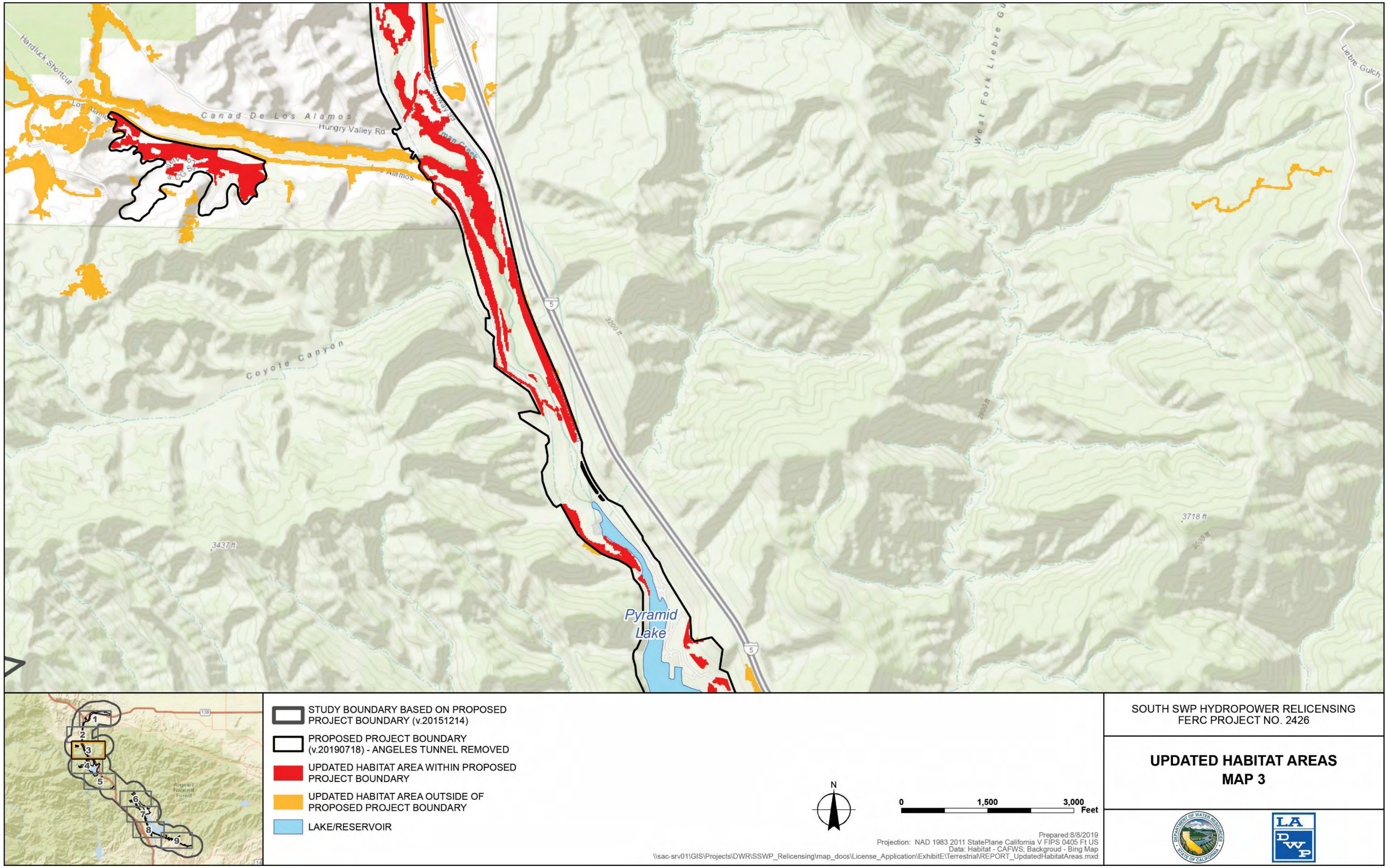

Figure 5.4.1-4. Updated Habitat Areas Within the Proposed Project Boundary

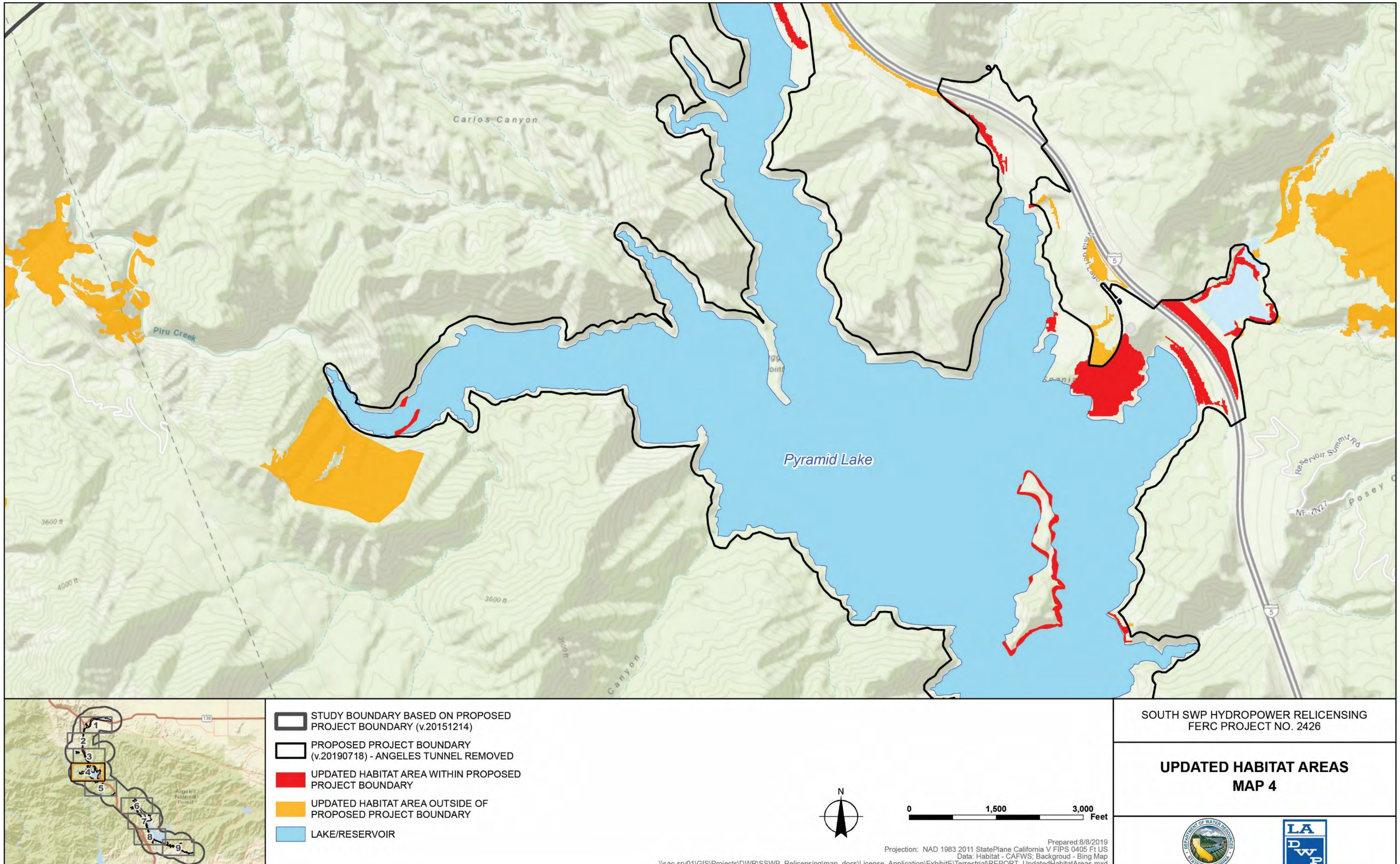

Figure 5.4.1-5. Updated Habitat Areas Within the Proposed Project Boundary

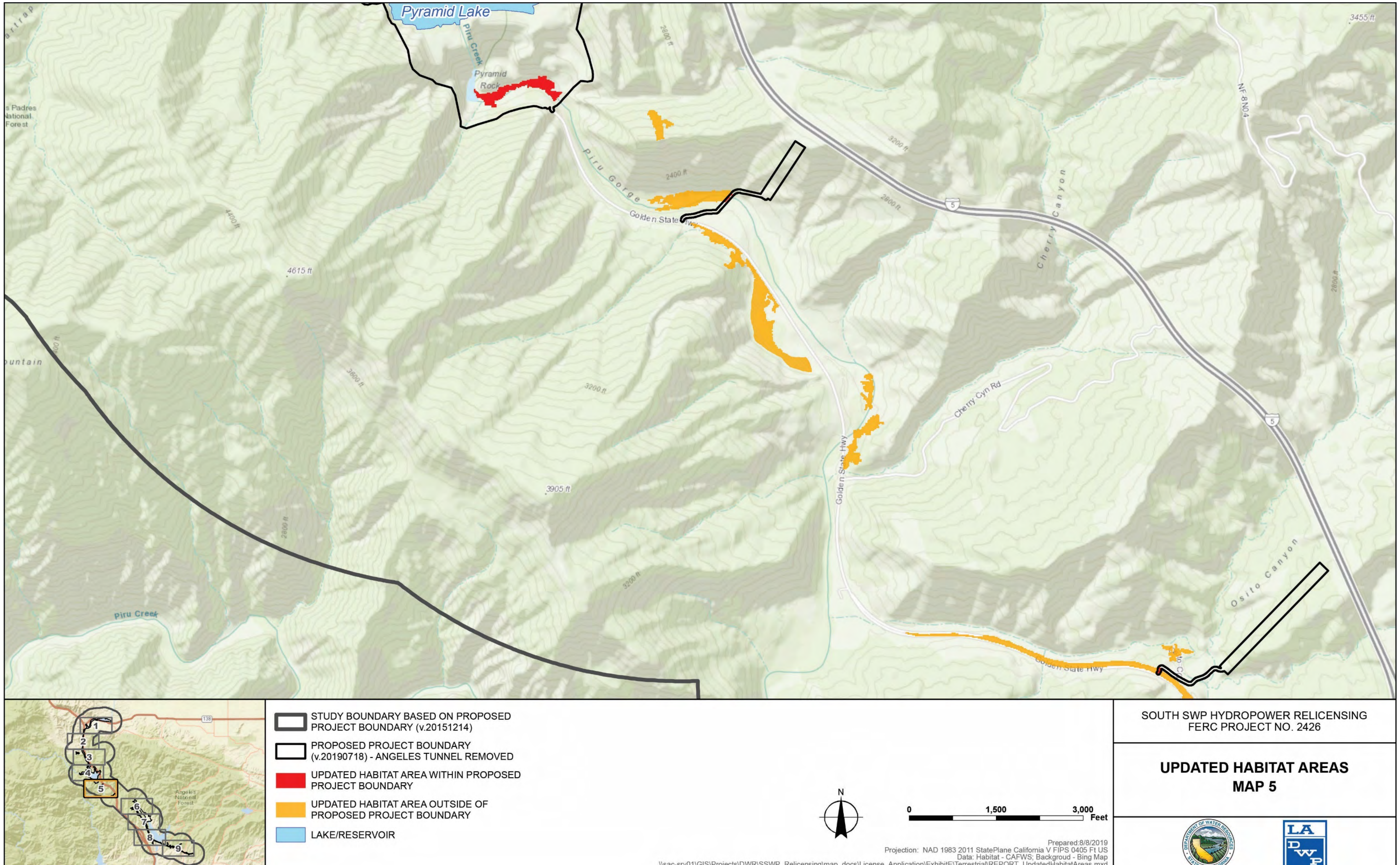

Figure 5.4.1-6. Updated Habitat Areas Within the Proposed Project Boundary

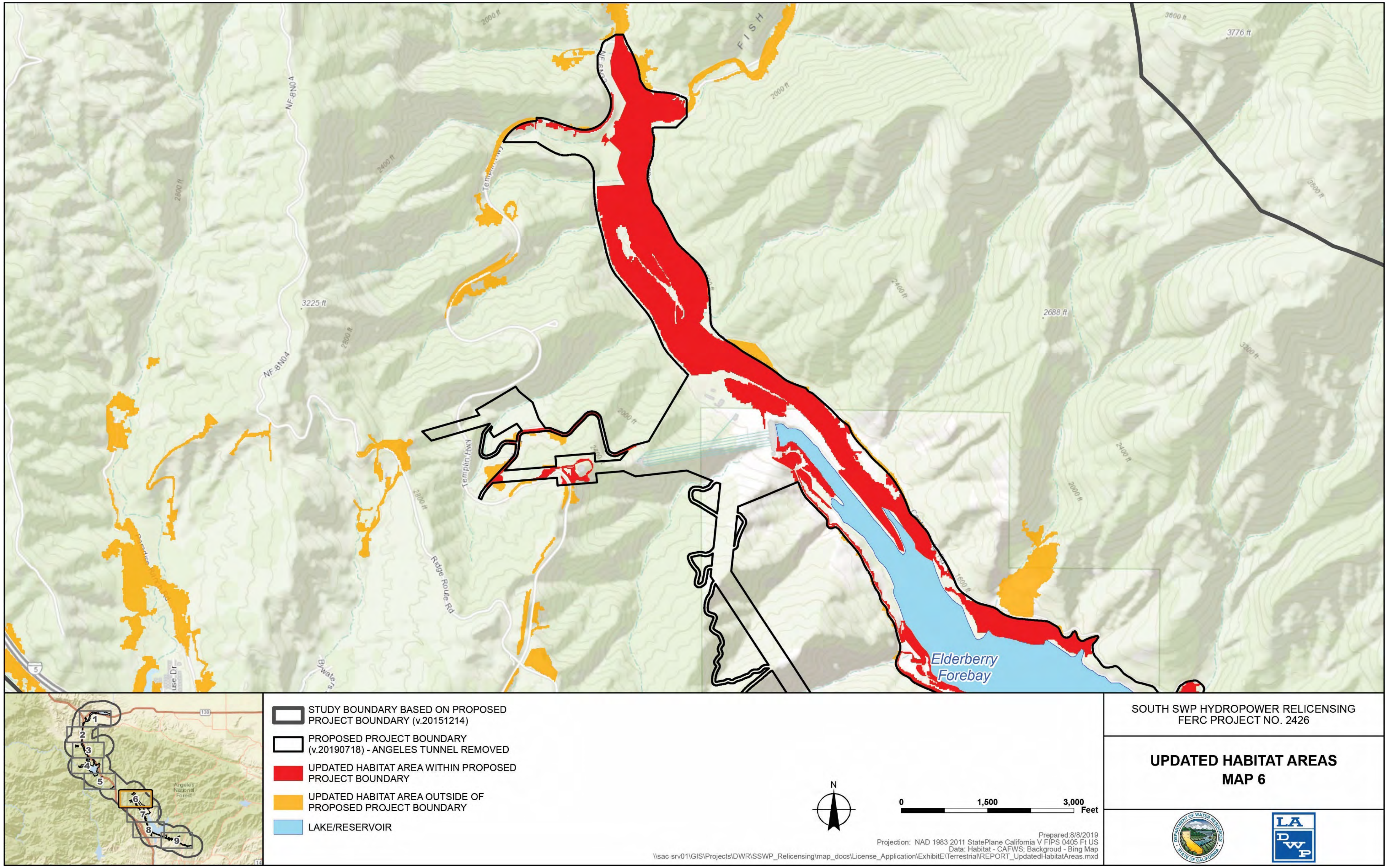

Figure 5.4.1-7. Updated Habitat Areas Within the Proposed Project Boundary

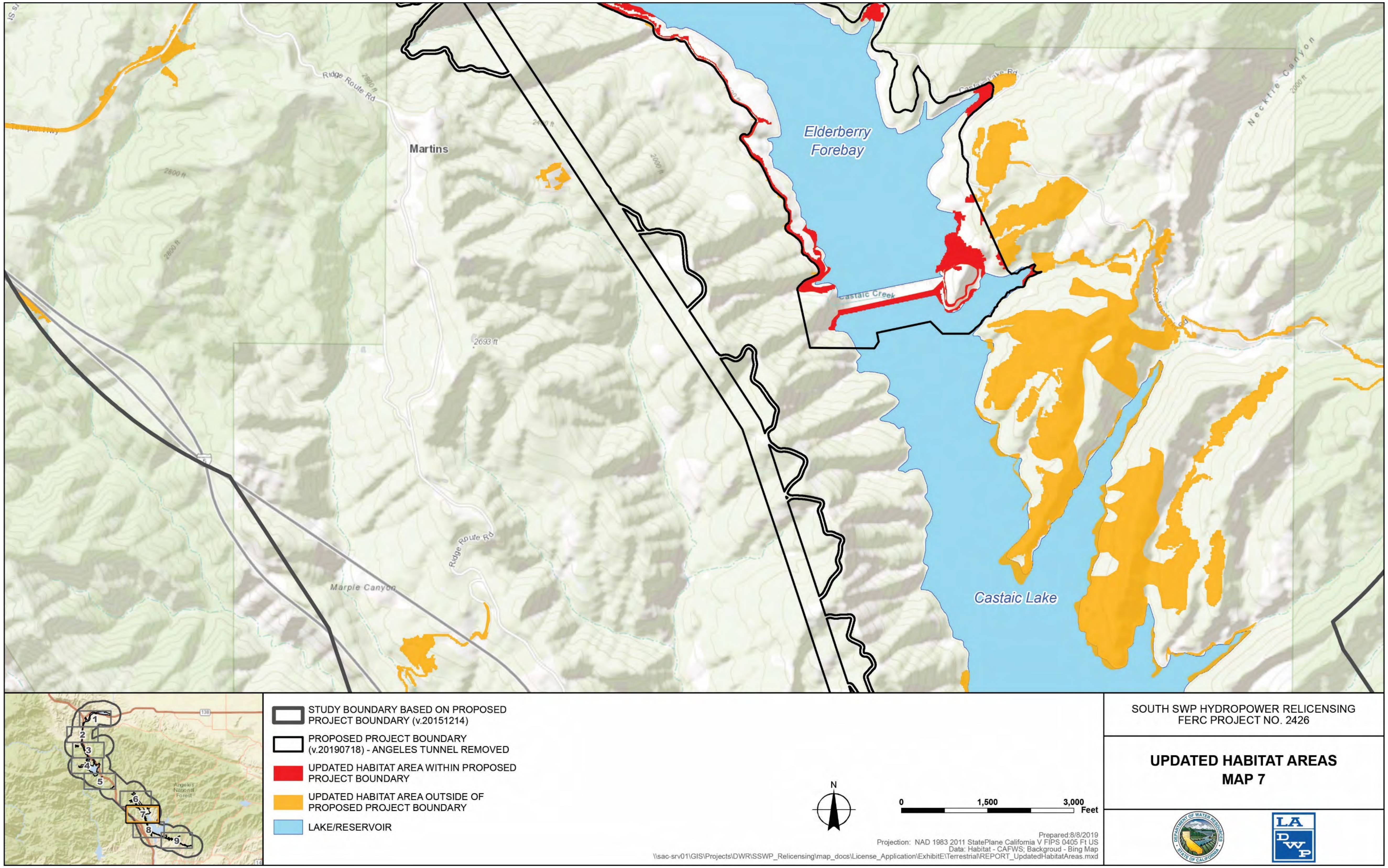

Figure 5.4.1-8. Updated Habitat Areas Within the Proposed Project Boundary

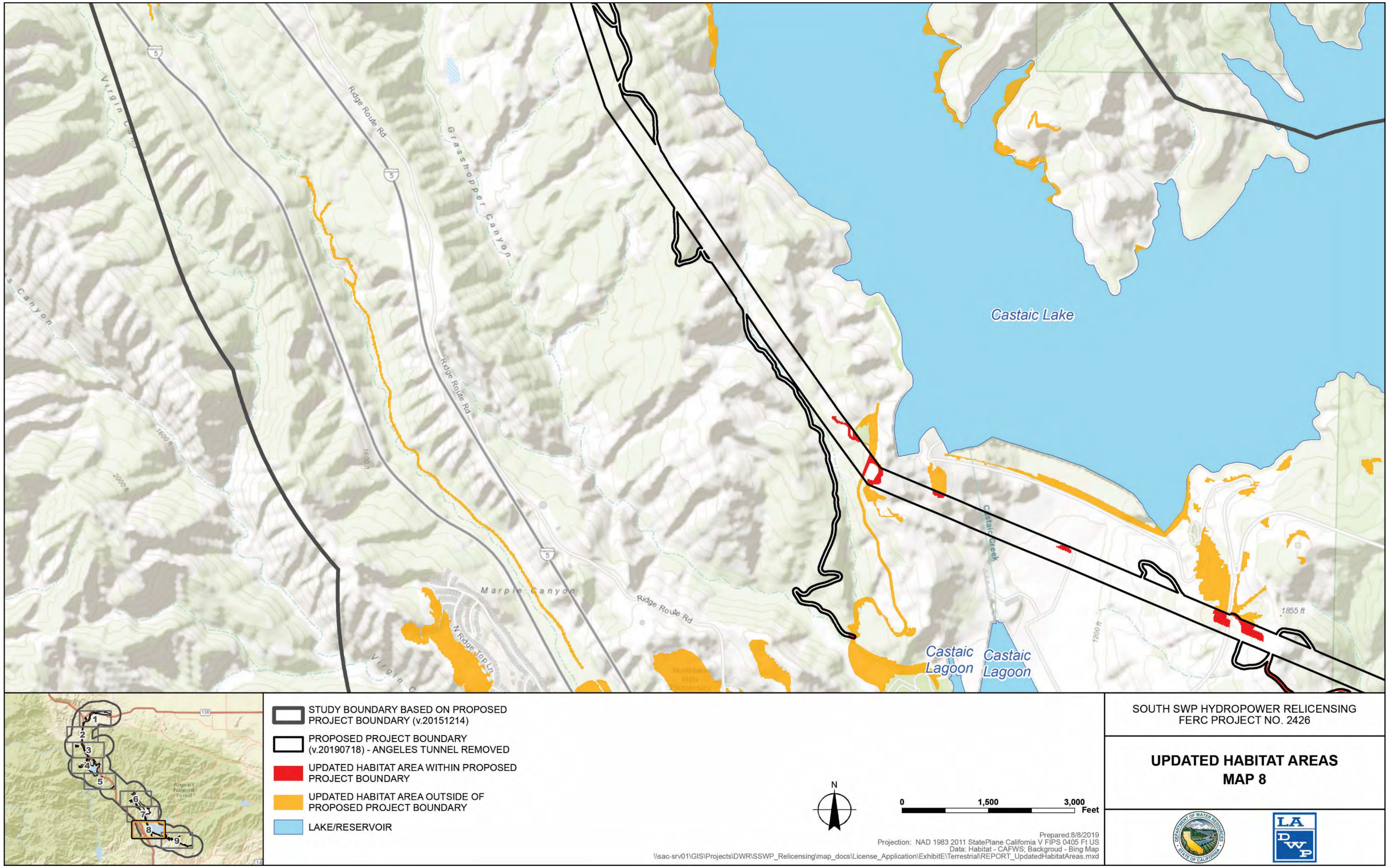

Figure 5.4.1-9. Updated Habitat Areas Within the Proposed Project Boundary

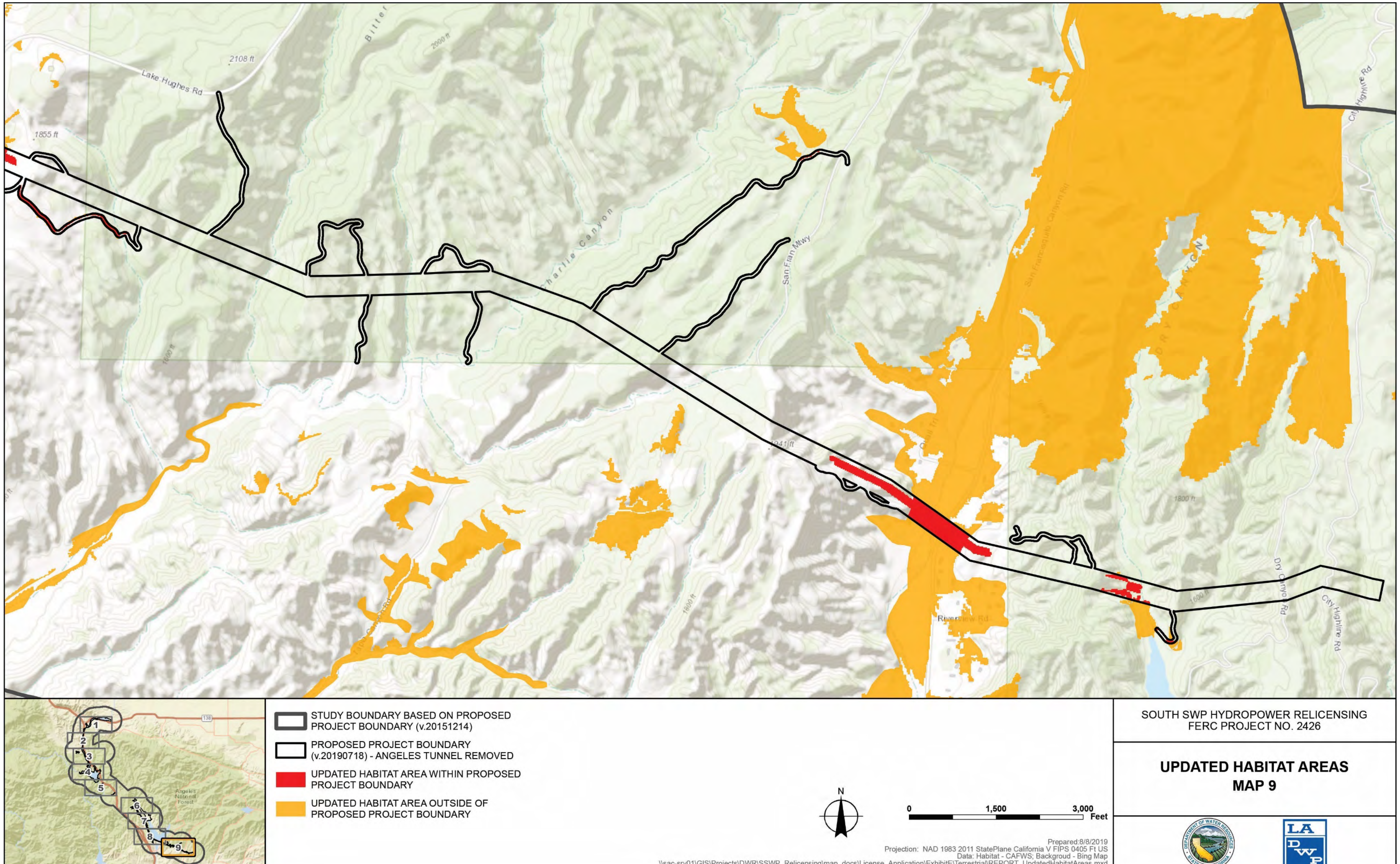

Figure 5.4.1-10. Updated Habitat Areas Within the Proposed Project Boundary

A total of 26 habitat types make up the study area for Study 4.1.7. Mixed Chaparral (MCH) is the overwhelmingly dominant habitat, comprising 44.5 percent of the study area. Within the proposed Project boundary, 18 habitat types were determined to occur; Lacustrine (LAC) comprises almost 45 percent, while Coastal Scrub (CSC) is the most common terrestrial habitat type, making up approximately 12 percent. The 18 habitat types found within the proposed Project boundary include:

- Blue Oak – Foothill Pine (BOP)
- Coastal Oak Woodland (COW)
- Desert Riparian (DRI)
- Joshua Tree (JST)
- Montane Hardwood (MHW)
- Pinyon – Juniper (PJN)
- Valley Foothill Riparian (VRI)
- Chamise – Redshank Chaparral (CRC)
- Coastal Scrub (CSC)
- Desert Wash (DSW)
- Mixed Chaparral (MCH)
- Sagebrush (SGB)
- Annual Grassland (AGS)
- Fresh Emergent Wetland (FEW)
- Wet Meadow (WTM)
- Urban (URB)
- Barren (BAR)
- Lacustrine (LAC)

The acreages of CWHR habitat types within the proposed Project boundary and study area for Study 4.1.7 are summarized in Table 5.4.1-1. Additionally, the location and extent of CWHR habitats within the proposed Project boundary are shown in Figures 5.4.1-11 through 5.4.1-19. Refer to Appendix J for maps showing the acreages and distribution of habitats within the study area for Study 4.1.7. The sample locations surveyed during the study are also included on these maps.

The four primary land CHWR habitat types within the proposed Project boundary were confirmed or expanded during ground-truthing: CSC, MCH, URB and SGB. These habitat types comprise a total of 68 percent (1,670 acres) of the land within the proposed Project boundary. Of the remaining 32 percent, 9 percent was verified as BAR, 8 percent was confirmed as AGS, and 5.5 percent was verified as CRC via ground-truthing and/or aerial signatures. The remaining 9.5 percent of the land within the proposed Project boundary (243.2 acres) was split between 10 additional CWHR types, not all of which were confirmed at all locations (e.g., Montane Riparian was converted to VRI during ground-truthing, representing 39 acres [less than 1 percent]). However, areas not visually verified tended to be in steep or remote areas with no access, making them unlikely to be impacted by Project activities.

Each CWHR habitat type determined to occur within the proposed Project boundary is generally described below, separated by canopy class (tree-dominated, shrub-dominated, herbaceous-dominated) or categorized as developed, non-vegetated, or aquatic habitats. These descriptions include information on associated plant species and vegetation structure, as well as wildlife species typically found in each habitat. The descriptions are derived from the CWHR habitat descriptions originally drafted by Mayer and Laudenslayer (1988), with updated text provided by CDFW (2018a). Specific descriptions also include a summary of what was found in each habitat type during Study 4.1.7 and if the habitat type is considered a Sensitive Natural Community by CDFW (CDFW 2018b).[21] Incidental wildlife observations noted during Study 4.1.7 are included as part of each habitat description.

The habitat types discussed below are limited to those found within the proposed Project boundary. Habitats limited to the larger study area for Study 4.1.7 beyond the proposed Project boundary are not included and will not be discussed further in the text, unless the effects analysis of the Licensees' Proposal determines there will be impacts to that habitat outside of the proposed Project boundary. CWHR habitats occurring only in the study area for Study 4.1.7, but not within the proposed Project boundary, are therefore excluded from the remaining discussion, including Blue Oak Woodland (BOW), Juniper (JUN), Montane – Hardwood Conifer (MHC), Montane Riparian (MRI), Sierran Mixed Conifer (SMC), Valley Oak Woodland (VOW), Montane Chaparral (MCP), and Perennial Grassland (PGS).

Under existing conditions, Project O&M requires minor vegetation clearing, resulting in minor effects on terrestrial habitats within the proposed Project boundary. Additionally, fluctuations in water surface elevations at Elderberry Forebay and Pyramid Lake affect and suppress riparian habitats, and potentially other habitats bordering the waterbody (refer to Section 5.4.2 for more information).

[21] CDFW encourages Natural Communities with Sensitive ranks of S1 to S3 to be addressed in CEQA and its equivalents (CDFW 2018b).

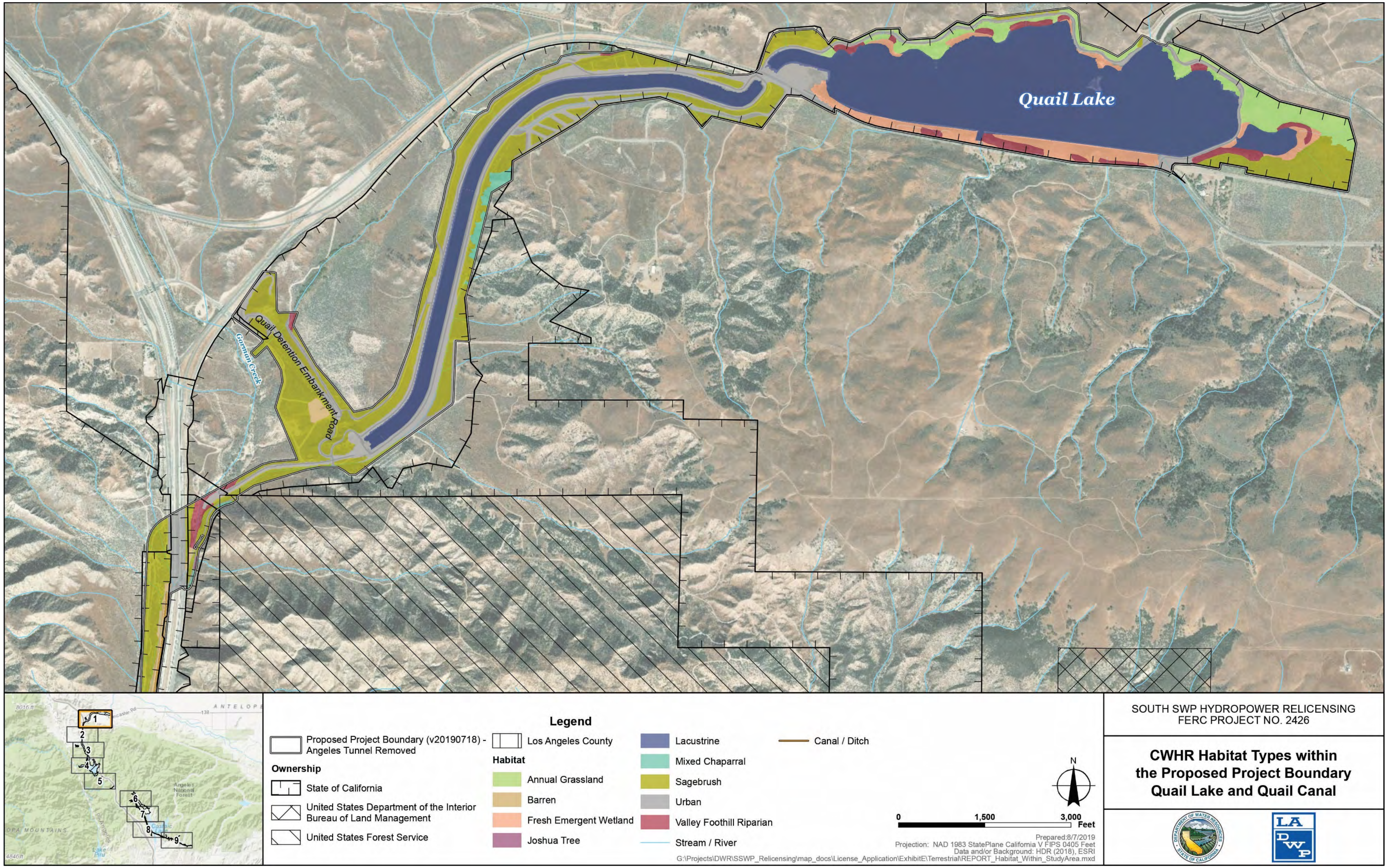

Figure 5.4.1-11. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

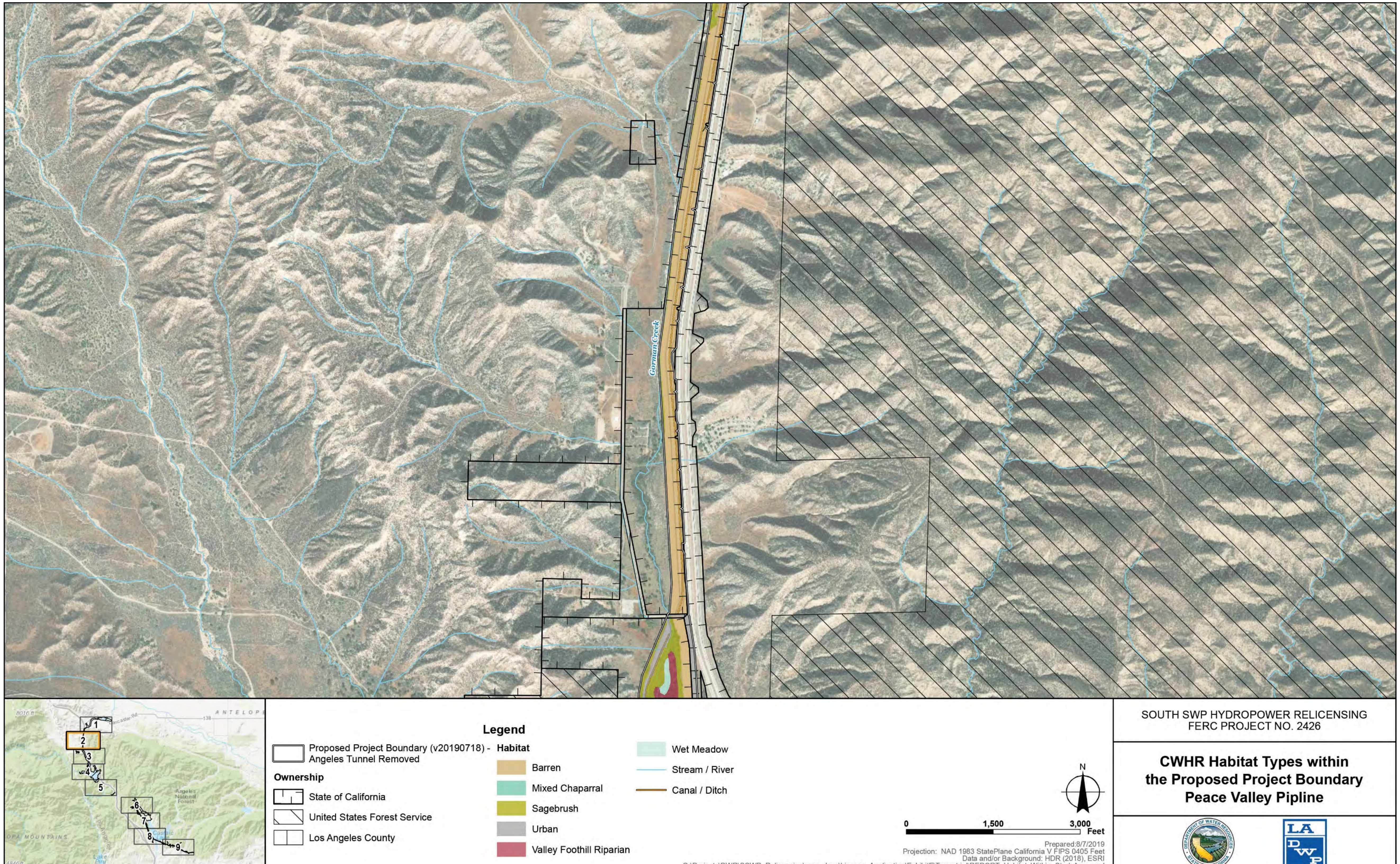

Figure 5.4.1-12. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

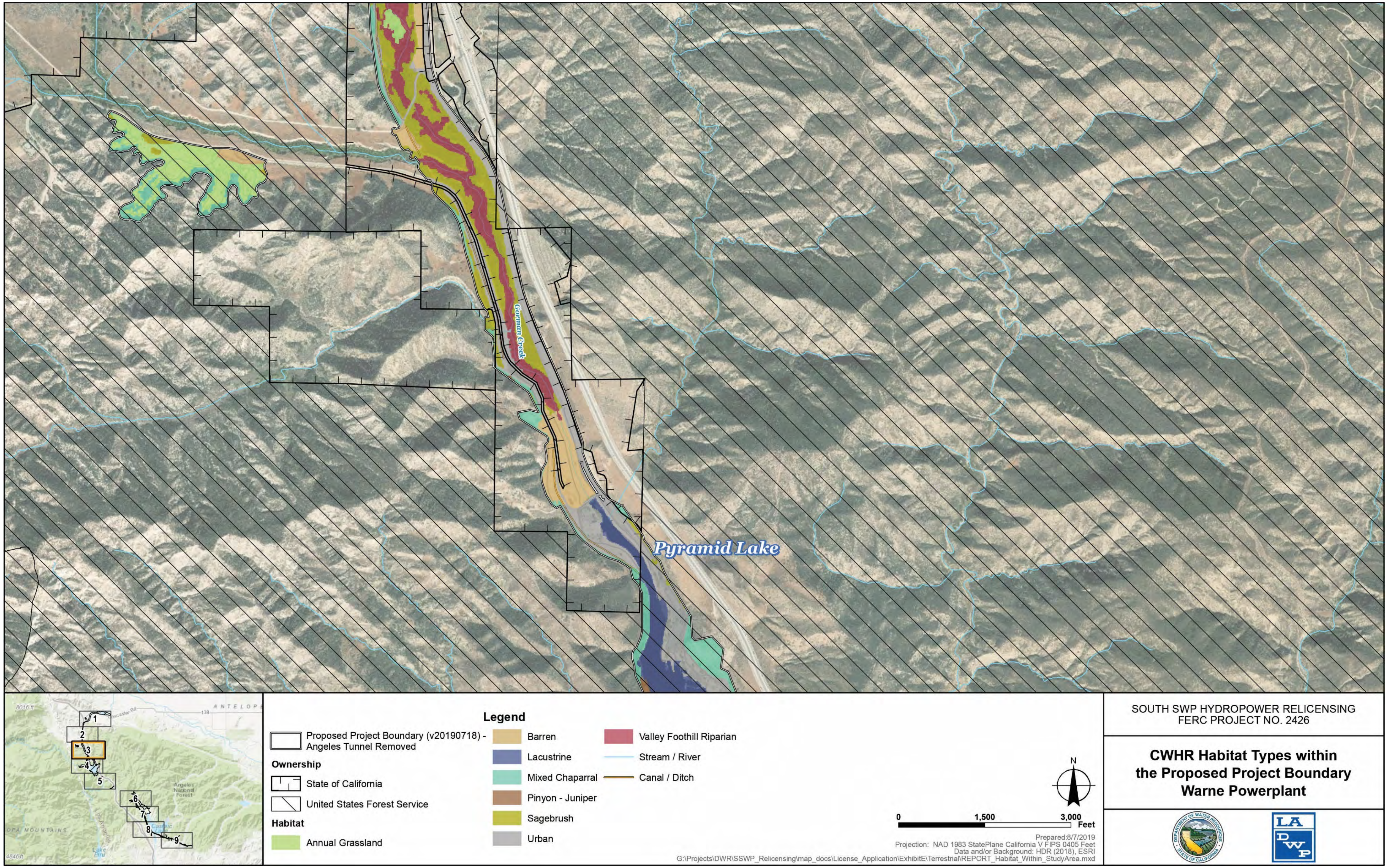

Figure 5.4.1-13. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

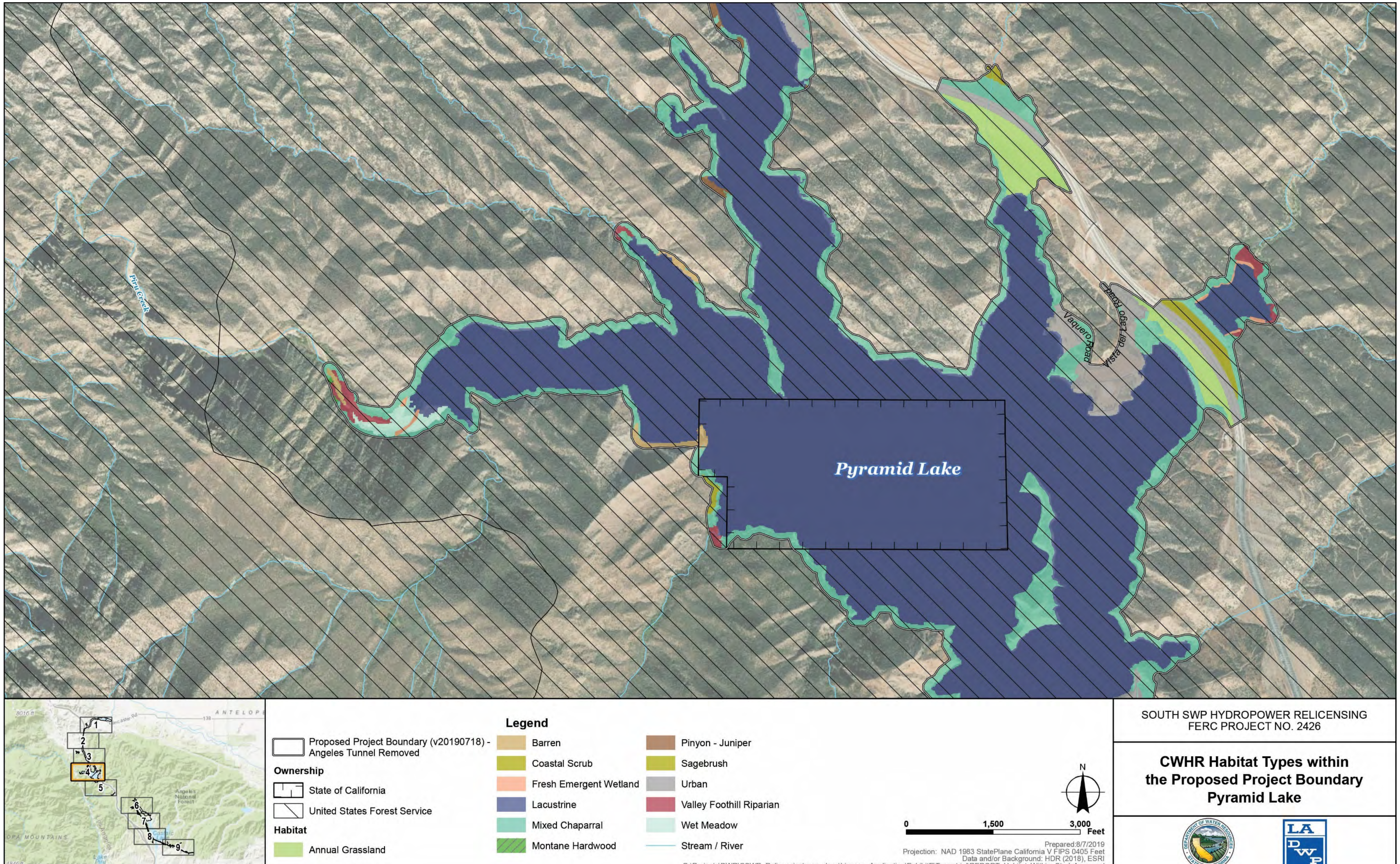

Figure 5.4.1-14. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

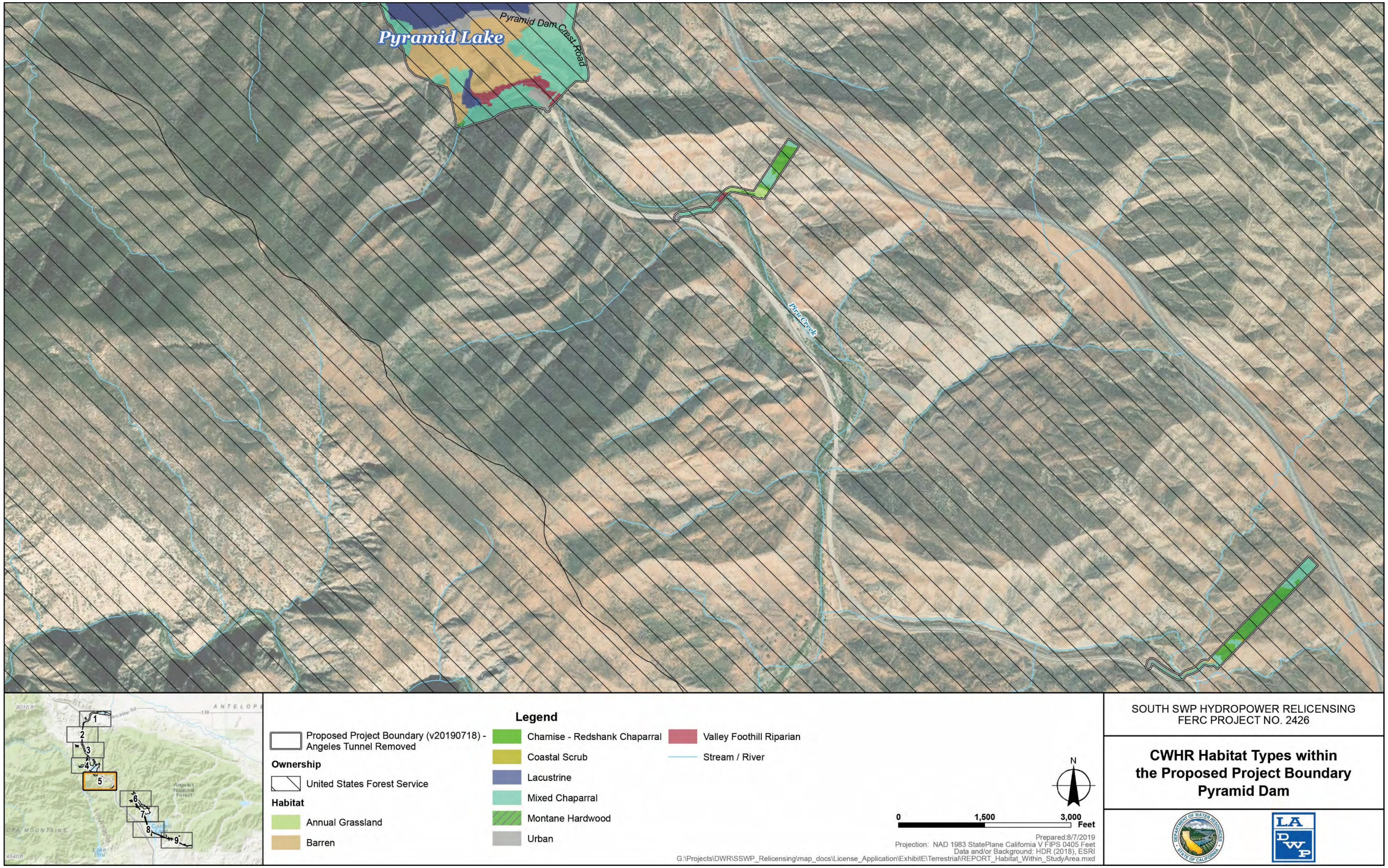

Figure 5.4.1-15. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

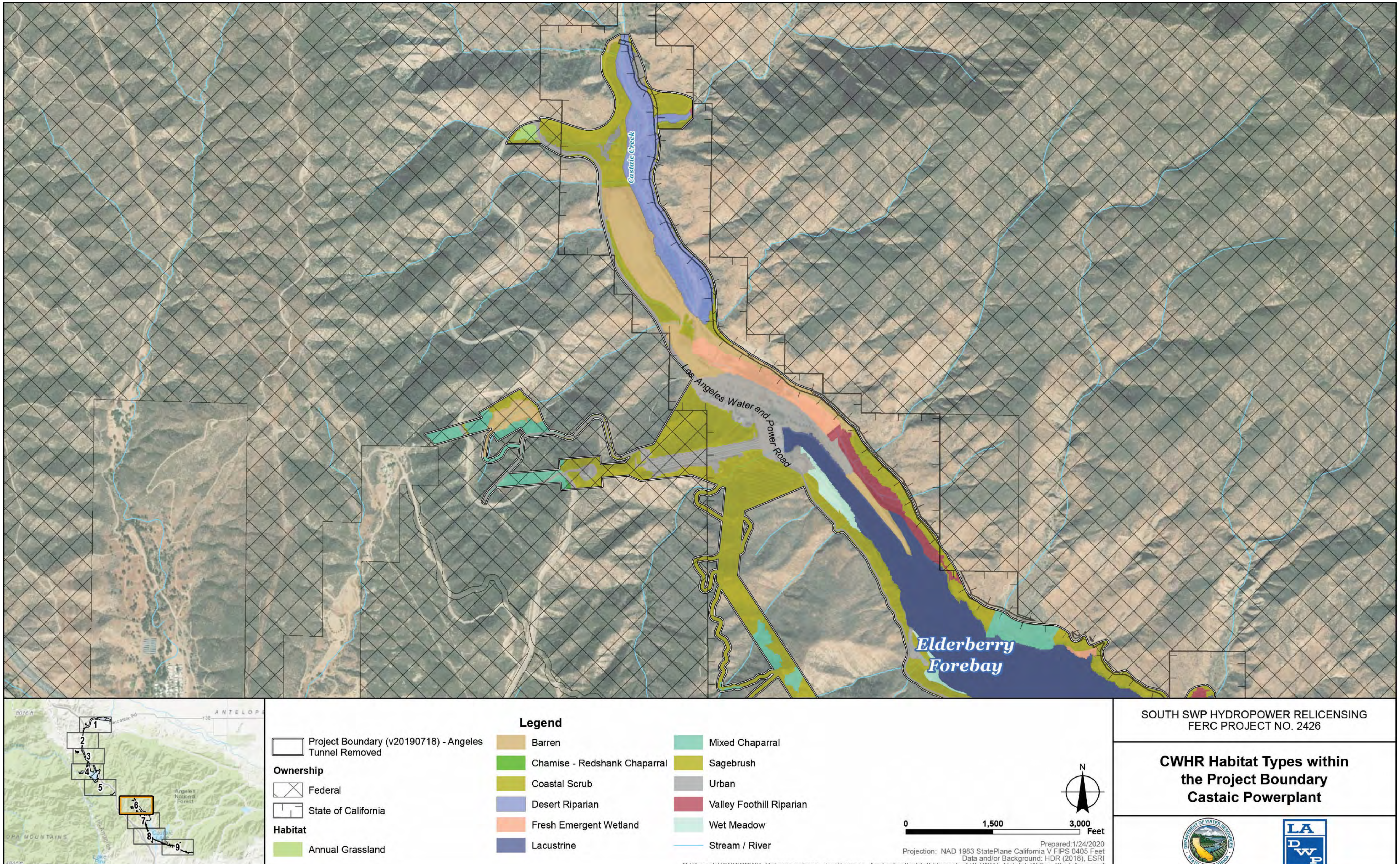

Figure 5.4.1-16. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

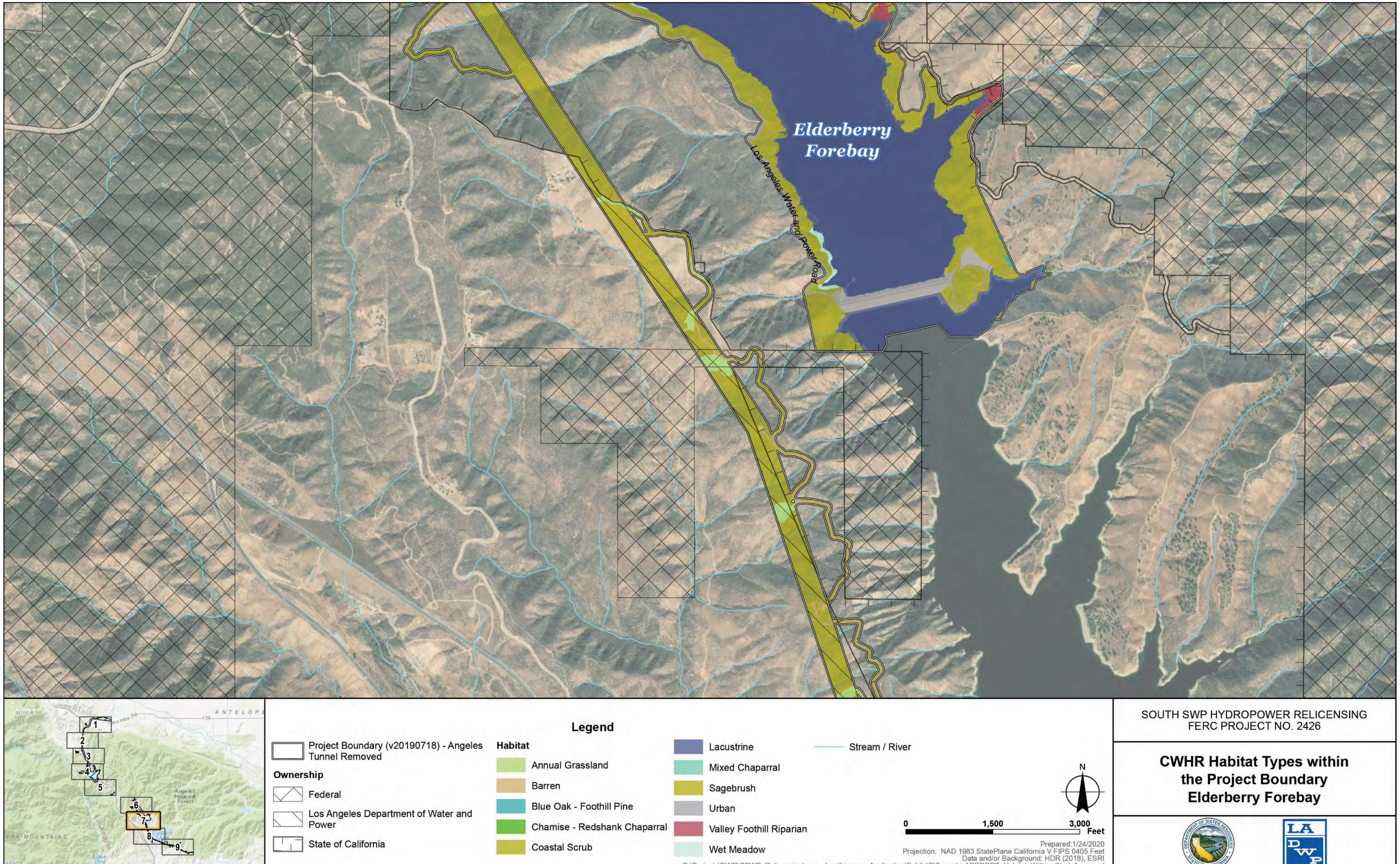

Figure 5.4.1-17. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

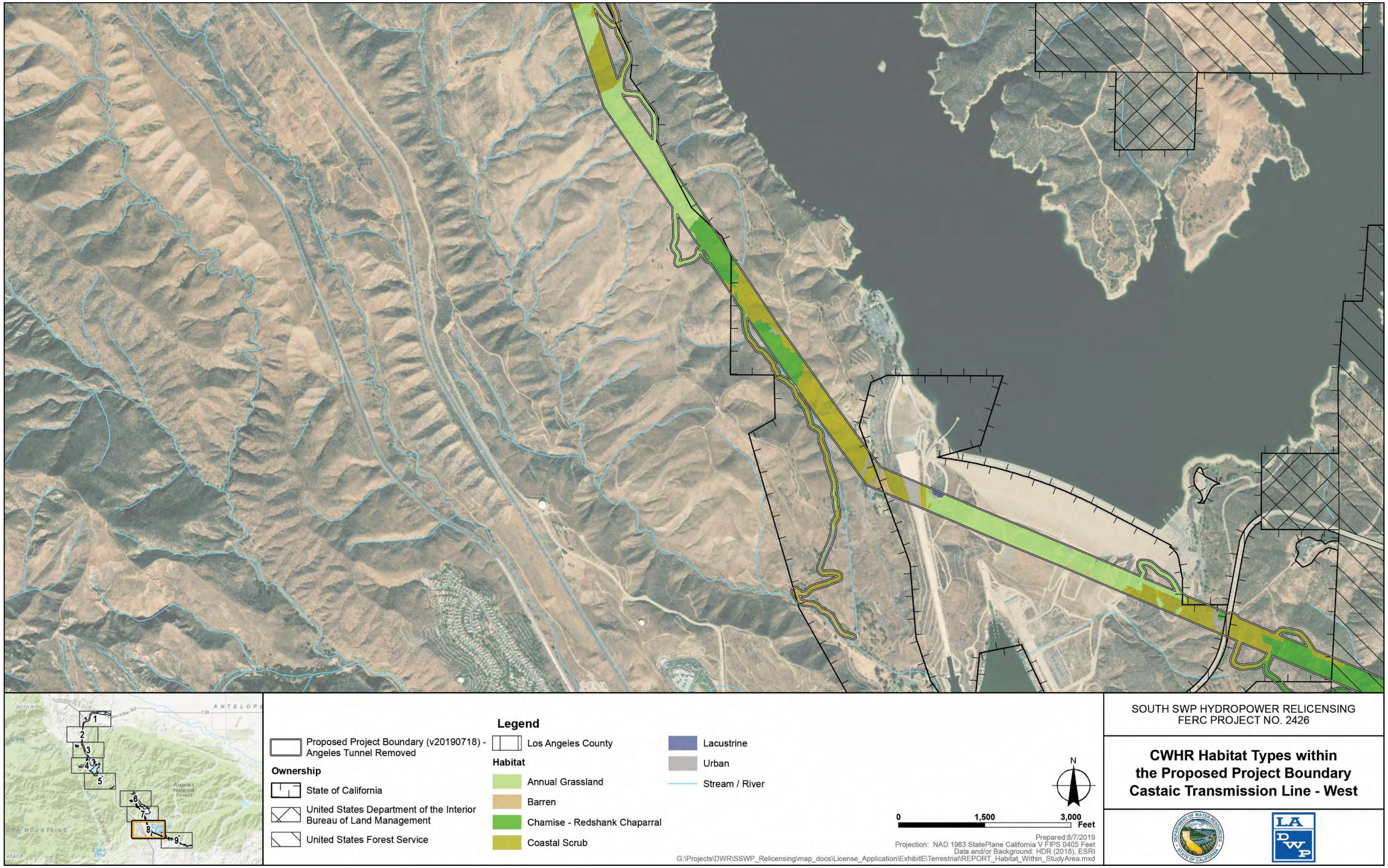

Figure 5.4.1-18. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

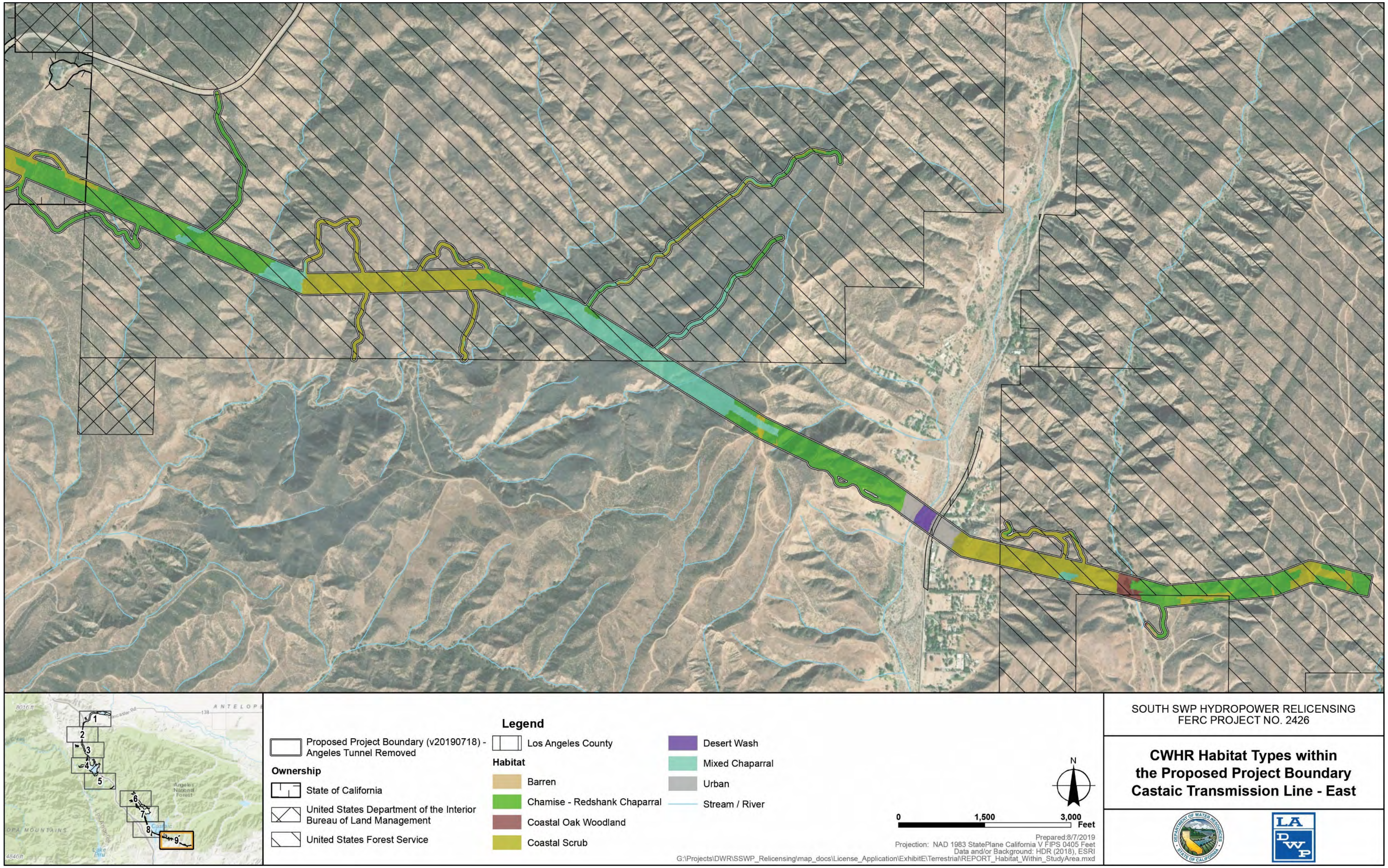

Figure 5.4.1-19. California Wildlife Habitat Relationship Habitat Types Within Proposed Project Boundary

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Tree-Dominated Habitats

Blue Oak – Foothill Pine

Blue Oak – Foothill Pine (BOP) habitat occurs on slopes in a variety of well-drained soils. It is characterized by a diversely structured combination of hardwoods, conifers, and shrubs. Foothill pine (*Pinus sabiniana*) and blue oak (*Quercus douglasii*) typically make up the canopy of this habitat. Associated trees include other oak species, most notably coast live oak (*Q. agrifolia*) and valley oak (*Q. lobata*). Common shrub associates include various species of ceanothus (*Ceanothus* spp.), manzanita (*Arctostaphylos* spp.), California coffee berry (*Frangula californica*), western poison oak (*Toxicodendron diversilobum*), elderberry (*Sambucus* spp.), western redbud (*Cercis occidentalis*), gooseberry (*Ribes* spp.) and yerba-santa (*Eriodictyon* spp.).

BOP is restricted to 0.5 acres in the southern portion of the proposed Project boundary in the hills, west of Elderberry Forebay. Two sampling points were included in this area. All areas mapped as BOP are on private property. Because of this, no plots were sampled and only a visual assessment from the road was conducted. Dominant plant species observed in BOP habitat included foothill pine, coast live oak, and valley oak. Blue oak was not observed to be a dominant component in the areas observed; however, it was present. Foothill pine appeared to constitute approximately 30 percent of the absolute cover, while various oak species made up around 15 percent of the canopy. Other associates included California juniper (*Juniperus californica*), rubber rabbitbrush (*Ericameria nauseosa*), and Kentucky blue grass (*Poa pratensis*).

BOP provides breeding habitat for a wide variety of wildlife, including amphibians, reptiles, birds, and mammals. Oaks provide important habitat for cavity-nesting birds and produce acorns, an important food source for many bird and mammal species. Incidental wildlife sightings for this habitat type included mule deer (*Odocoileus hemionus*), Nuttall's woodpecker (*Picoides nuttallii*), American crow (*Corvus brachyrhynchos*), and red-tailed hawk (*Buteo jamaicensis*).

Coastal Oak Woodland

Coastal Oak Woodland (COW) is a highly variable CWHR habitat type commonly associated with mesic coastal foothills of California. It is found on a variety of parent materials, but generally occurs on moderately to well-drained soils. This habitat type is characterized by a canopy composed of mostly oaks, sometimes mixed with scattered conifers. Like other oak woodland types, this habitat can vary from an open savannah to a dense, almost impenetrable thicket of trees and shrubs. In open woodlands, the understory is almost always grassland. In dense woodland areas, the understory can vary from dense cover of shade-tolerant shrubs and herbs, to sparse cover with large amounts of litter. COW rarely occurs in contiguous belts, but instead creates a mosaic with other chaparral, oak woodland, and grassland habitats.

In the interior of southern California, common associates in the canopy include valley oak, blue oak, and foothill pine. In dense woodland habitats, the understory is dominated by shade-tolerant shrubs, including California blackberry (*Rubus ursinus*), toyon (*Heteromeles arbutifolia*), and snowberry (*Symphoricarpos* spp.). In drier areas with larger canopy openings, the understory is often dominated by annual grasses and various forb species. In many cases, this woodland type intergrades with chaparral or CSC habitats, with shrubs typical of those habitats making up the understory.

Within and around the proposed Project boundary, COW is found along the toeslopes of mountains and in narrow valley floors along washes. This CWHR habitat type is found exclusively in the southern portions of the proposed Project boundary, south of Pyramid Lake. Approximately 2.8 acres of this habitat type occur within the proposed Project boundary. Two sampling points were surveyed in this habitat type. Coast live oak was the dominant species in the sampled areas; however, western sycamore (*Platanus racemosa*) also occurred in the semi-riparian areas along washes. Canopy cover ranged from 60 to 65 percent, with trees ranging from 6 to 42 feet tall, and measuring 0.5 to over 5.5 feet diameter at breast height (dbh). Understory shrubs and grasses/forbs included California buckwheat (*Eriogonum fasciculatum*), coyote brush (*Baccharis pilularis*), rubber rabbitbrush, fragrant sumac (*Rhus aromatica*), smilo grass (*Stipa miliacea)*, wild oats (*Avena* spp.), and various bromes (*Bromus* spp.).

Wildlife use in COW is similar to that of BOP, as described above. This habitat type is especially important to a large variety of birds and mammals. Species such as California quail (*Callipepla californica*), wild turkeys (*Meleagris gallopavo*), squirrels (Order Sciuridae), and deer can be highly dependent on the fall acorn crop. Incidental wildlife observations associated with this habitat type included mule deer, red-tailed hawk, barn owl (*Tyto alba*), California scrub jay (*Aphelocoma californica*), and Nuttall’s woodpecker.

Desert Riparian

Desert Riparian (DRI) habitats are typically associated with desert regions of California and are characterized as dense stands of shrubs or trees adjacent to permanent waterways in canyons or on alluvial deposits in wide valleys. Height and composition of this habitat type are variable, ranging from 3-foot-tall willow (*Salix* spp.) thickets to 80-foot-tall Fremont cottonwoods (*Populus fremontii*). Other common canopy species include non-native tamarisk (*Tamarix* spp.), velvet ash (*Fraxinus velutina*), honey mesquite (*Prosopis glandulosa* var. *torreyana*), and screwbean mesquite (*P. pubescens*). The subcanopy is often composed of smaller versions of canopy species; however, other common species include various species of saltbush (*Atriplex* spp.), mulefat (*Baccharis salicifolia*), and arrow-weed (*Pluchea sericea*).

DRI areas are typically characterized as dense canopies found along permanent water sources. However, within the proposed Project boundary, this habitat type is distinguished by patchy canopy and found growing along seasonal washes, such as along stretches of Castaic Creek, both upstream and downstream of Castaic Lake (a non-Project facility). Approximately 51.5 acres of this habitat type occur within the proposed Project boundary. Two sampling points were surveyed in this habitat type. Sampled areas were a mix of the following: (1) wooded habitats dominated by

Fremont's cottonwood with other tree associates, including special-status Southern California black walnut (*Juglans californica*); and (2) scrub habitats dominated by saltcedar (*Tamarix ramosissima*) and mule fat. Tree canopy cover ranged from 25 to 90 percent, with trees ranging from 6 to 35 feet tall, and measuring up to 3.75 feet dbh. Understory shrubs and grasses/forbs included California sagebrush (*Artemisia californica*), tree-tobacco (*Nicotiana glauca*), wire-lettuce (*Stephanomeria* spp.), smilo grass, wild oats, and various bromes. Many areas intergraded with surrounding scrublands and included rubber rabbitbrush, thick-leaved yerba santa (*Eriodictyon crassifolium* var. *crassifolium*), California buckwheat, and purple sage (*Salvia leucophylla*).

DRI areas provide important habitat for a variety of wildlife species. Dense vegetation and the presence of water results in this habitat providing cover, food, and water to numerous birds, mammals, and other species. DRI is especially important when surrounded by other desert habitats which typically have relatively limited cover, food, and water. Incidental wildlife observed in this habitat type included American crow and mule deer.

All areas mapped as DRI are considered Sensitive Natural Communities by CDFW, using NatureServe's Heritage Methodology. This methodology uses the best scientific information to assess communities based on rarity, threats, and ecological importance (CDFW 2018b).

Joshua Tree

Joshua Tree (JST) habitats are mostly found in desert regions of California and are characterized as open woodlands dominated by Joshua trees (*Yucca brevifolia*). Typically, Joshua trees are the only arborescent species in this CWHR habitat; however, other yucca species, as well as scattered pinyons (*Pinus* spp.) and junipers (*Juniperus* spp.) can co-occur. The understory in JST woodlands is typically characterized by a mix of broad-leaved evergreen and deciduous shrubs and a sparse herbaceous layer. This CWHR habitat type typically occurs in broad valleys with deep soils, on slopes underlain by alluvial or rocky materials, or on desert pediments. Soils are always well-drained; however, other soil characteristics can be highly variable.

The proposed Project boundary represents the far western edge of the JST range. Common shrub associates in this region include common sagebrush (*Artemisia tridentata*), Nevada ephedra (*Ephedra nevadensis*), California buckwheat, Cooper's goldenbush (*Ericameria cooperi*), Anderson thornbush (*Lycium andersonii*), Cooper's box thorn (*Lycium cooperi*), beavertail cactus (*Opuntia* spp.), and horsebrush (*Tetradymia* spp.). Grasses commonly associated with JST habitats include bromes, muhly (*Muhlenbergia* spp.), and needlegrass (*Stipa* spp.).

JST is found in isolated clusters along valley floors exclusively in the northern portion of the proposed Project boundary near Gorman Creek (Figure 5.4.1-11). Less than 0.2 acres of JST habitat overlaps with the proposed Project boundary. Only one sampling point was surveyed in this habitat type. The sampled JST area appeared to have been burned in the recent past and was dominated by mostly dead, burned Joshua trees resprouting at their bases. Tree cover was sparse; however, total cover from shrubs and herbaceous species was dense at over 85 percent. Joshua trees were the only arborescent species present. Shrub associates included thick-leaved yerba santa and California buckwheat. Forbs and grasses observed in the sampled areas included twiggy wreathplant (*Stephanomeria virgata*), needle goldfields (*Lasthenia gracilis*), devil's lettuce (*Amsinckia tessellata* var. *tessellata*), scarlet bugler (*Penstemon centranthifolius*), cheatgrass (*Bromus tectorum*), and foxtail brome (*Bromus madritensis*).

JST woodland provides important habitat for reptiles, mammals, and birds. Joshua trees provide perches and nest sites for various birds. In addition, downed branches and dead material provide cover for lizards and small mammals, while the spiny leaves of the live trees provide protection for both birds and lizards. No incidental wildlife observations were recorded in the sampled area.

All areas mapped as DRI are considered Sensitive Natural Communities by CDFW, using NatureServe's Heritage Methodology (CDFW 2018b).

Montane Hardwood

Montane Hardwood (MHW) forests have a hardwood overstory of varying density, with sparser shrub and herbaceous layers. Trees at middle and higher elevations in the Transverse Range can include Jeffrey pine (*Pinus jeffreyi*), ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), incense cedar (*Calocedrus decurrens*), California white fir (*Abies concolor*), bigcone Douglas-fir (*Pseudotsuga macrocarpa*), California black oak (*Q. kelloggii*), and Coulter pine (*Pinus coulteri*). Lower elevation species include white alder (*Alnus rhombifolia*), coast live oak, bigleaf maple (*Acer macrophyllum*), bay laurel (*Umbellularia californica*), and occasionally valley oak, foothill pine, and blue oak. Understory shrubs can include manzanita, western poison oak, California coffee berry, gooseberry, and ceanothus.

MHW is mapped as isolated patches in the mountainous areas within and around the proposed Project boundary, mostly near Pyramid Lake. Less than 0.5 acres of this habitat type overlaps with the proposed Project boundary. Two sampling points were planned for this habitat type; however, both of these areas were determined to be incorrectly mapped by CalVeg. Other areas mapped as MHW were not surveyed due to inaccessibility.

Acorns are an important component of MHW habitats. Wildlife species that use acorns as a major food source include bears, mountain quail (*Oreortyx pictus*), wild turkey, mule deer, California ground squirrel (*Otospermophilus beecheyi*), and dusky-footed woodrat (*Neotoma fuscipes*). Additionally, many amphibians and reptiles are found on the forest floor in this habitat type and may include ensatina (*Ensatina eschscholtzii*), slender salamander (*Batrachoseps* spp.), western fence lizard (*Sceloporus* *occidentalis*), and sagebrush lizard (*Sceloporus graciosus*). Snakes typically found in this habitat include rubber boa (*Charina bottae*), western rattlesnake (*Crotalus* spp.), and California mountain kingsnake (*Lampropeltis zonata*). No incidental observations of wildlife species were recorded in this habitat type as it was inaccessible and not sampled during the study.

Pinyon-Juniper

Pinyon-Juniper (PJN) woodlands occur on steep, dry slopes on rolling hills, steep mountains, narrow ridges, and canyons. This habitat type is mostly associated with rocky, coarse, highly weathered, and well-drained soils. The canopy is often low and open, and comprises pure pinyon pine stands or stands of pinyon pine mixed with juniper, inland scrub oak (*Q. berberidifolia*), or canyon live oak (*Q. chrysolepis*). Stand structure varies with elevation, gradient, and site quality. Typically, stands are denser at higher elevations or in more mesic locations. In drier areas, or at lower elevations, the canopy opens up and tree size decreases. In more open areas, shrub associates and low herbaceous plants may be present.

Common shrub associates in PJN woodland include California juniper, common sagebrush, snakeweed (*Gutierrezia* spp.), narrowleaf golden bush (*Ericameria linerifolia*), curl-leaf mountain-mahogany (*Cercocarpus ledifolius*), antelope bitterbrush (*Purshia tridentata*), Parry’s rabbitbrush (*Ericameria parryi*), and chamise (*Adenostoma fasciculatum*). Grasses and forbs associated with this habitat include wheatgrass (*Elymus* spp.) and Indian ricegrass (*Stipa hymenoides*).

PJN woodland is mapped across slopes in the northern portion of the proposed Project boundary above Pyramid Lake. Approximately 3.2 acres were left classified as PJN with the proposed Project boundary. Three sampling points were planned for this habitat type; however, those areas were determined to be incorrectly mapped and were dominated by inland scrub oak. Due to inaccessibility, no sampling was conducted in PJN areas. Per aerial review, the remaining area is characterized by a relatively open canopy of California juniper and singleleaf pinyon (*Pinus monophylla*), with an understory dominated by annual grasses, likely various bromes.

In addition to providing cover and breeding habitat for wildlife, juniper berries and pine nuts provide an important food source for a variety of animals. No incidental observations of wildlife species were recorded in this habitat type as it was inaccessible and not sampled during the study.

Valley Foothill Riparian

Valley Foothill Riparian (VRI) habitat occurs in valleys and foothills in areas of low velocity stream flows and gentle topography. This habitat type is generally dense and multilayered, with primarily deciduous trees, including Fremont cottonwood, western sycamore, and valley oak in the canopy. Subcanopy trees include white alder, box elder (*Acer negundo*), and Oregon ash (*Fraxinus latifolia*). Shrub species include rose, California blackberry, blue elderberry (*Sambucus mexicana* ssp. *caerulea*), western poison oak, California button willow (*Cephalanthus occidentalis*), and willows. A variety of herbaceous species occur in the understory, including sedges (*Carex* spp.), rushes (*Juncus* spp.), grasses, spring beauty (*Claytonia* spp.), mugwort (*Artemisia douglasiana*), poison hemlock (*Conium maculatum*), and stinging nettle (*Urtica dioica*). Vines, typically wild grape (*Vitis* spp.), also occur.

Within the proposed Project boundary, 96 acres of VRI habitat occurs along drainages including, but not limited to, Gorman Creek, Los Alamos Creek, Piru Creek, Castaic Creek, and other unnamed ephemeral drainages and valley floors, as well as isolated patches along the edges of Quail Lake, Pyramid Lake, and Elderberry Forebay.

There were five sampling points within the VRI habitat type. Dominant plant species within the sampled areas included Fremont cottonwood, western sycamore, valley oak, and Goodding's black willow (*Salix gooddingii*). Canopy cover was highly variable, with some areas as low as 10 percent, and denser areas at almost 100 percent cover. Trees ranged from 10 to 50 feet tall, and measured 0.5 foot to 3.8 feet dbh. Understory shrubs and grasses/forbs observed included narrowleaf willow (*Salix exigua*), elderberry, mule fat, scalebroom (*Lepidospartum squamatum*), saltcedar, stinging nettle, tarragon (*Artemisia dracunculus*), mugwort, common cryptantha (*Cryptantha intermedia*), Baltic rush (*Juncus balticus*), bedstraw (*Galium aparine*), western poison oak, prickly lettuce (*Lactuca serriola*), black mustard (*Brassica nigra*), giant wildrye (*Elymus condensatus*), smilo grass, cheat grass, soft chess (*Bromus hordeaceus*), and ripgut brome (*Bromus diandrus*). Some areas intergraded with surrounding scrublands and included species such as rubber rabbitbrush, thick-leaved yerba santa, California buckwheat, and common sagebrush.

VRI woodlands provide extremely high habitat value for a variety of wildlife species. These areas function as migratory corridors and often provide water, thermal cover, and diverse feeding and nesting opportunities. Incidental wildlife observations in this habitat type included woodrat nests, mule deer, barn owl, great blue heron (*Ardea herodias*), American coot (*Fulica americana*), American crow, song sparrow (*Melospiza melodia*), and monarch butterfly (*Danaus plexippus*).

All areas mapped as VRI are considered Sensitive Natural Communities by CDFW using NatureServe's Heritage Methodology (CDFW 2018b).

<u>Shrub-Dominated Habitats</u>

Chamise-Redshank Chaparral

Chamise-Redshank Chaparral (CRC) occurs on steep slopes and ridges in areas with thin soils and little accumulated organic matter. This habitat type generally occurs below and intergrades with MCH (described below). Vegetative structure is similar to MCH, but species differ, with stands often being composed almost entirely of chamise or redshank (*Adenostoma sparsifolium*). Sampled areas were determined to be CRC when chamise comprised over 50 percent of the relative shrub cover. If chamise cover was below 50 percent in a given area, this area was mapped as MCH or CSC, depending on the dominant plant species. Other species that can occur in this habitat type include toyon, sugar bush (*Rhus ovata*), western poison oak, California coffee berry, ceanothus, manzanita, interior scrub oak, and laurel sumac (*Malosma laurina*). In southern California, white sage (*Salvia apiana*), black sage (*Salvia mellifera*), and California buckwheat are found in this habitat type at lower elevations and on recently disturbed sites.

CRC occurs on approximately 135.5 acres in large swaths along slopes throughout the proposed Project boundary, with the exception of the northwesternmost portion near Quail Lake. Large portions of the areas mapped as CRC around the Castaic Transmission Line were completely burned from a fire in September 2018. GIS data showing exact locations and extent of the fire is not available. These areas were left as CRC on the revised habitat maps. Six locations within CRC habitat were sampled in the study area. Dominant shrub species within the sampled areas had 50 to 100 percent cover, and included chamise and black sage. Other shrub associates included California buckwheat, big berry manzanita (*Arctostaphylos glauca*), chaparral yucca (*Hesperoyucca whipplei*), California sagebrush, interior scrub oak, purple sage, ceanothus, pine bush (*Ericameria pinifolia*), California juniper, birch-leaf mountain-mahogany (*Cercocarpus betuloides*), and chaparral bush mallow (*Malacothamnus fasciculatus*). Shrubs ranged from 2 to 8 feet tall. Understory species observed included honeysuckle (*Lonicera* sp.), beavertail, chia (*Salvia columbariae*), wild oats, foxtail brome, ripgut brome, and cheat grass.

Wildlife species found in this habitat type are typically the same as those found in other chaparral and scrub habitats. Incidental wildlife observations in CRC areas included mule deer, desert cottontail (*Sylvilagus audubonii*), and jackrabbit (*Lepus californicus*).

Coastal Scrub

Coastal Scrub (CSC) can be found in drier areas than other shrub habitats, and commonly occurs on steep, south-facing slopes on sandy, mudstone, or shale soils. The southern sage scrub form of CSC, found in southern California, is made up of a very dense shrub layer up to 7 feet tall. Southern sage scrub species can include black sage, purple sage, California buckwheat, golden-yarrow (*Eriophyllum confertiflorum*), goldenbush (*Isocoma* spp. or *Ericameria* spp.), sticky monkeyflower (*Diplacus aurantiacus*), California brittlebush (*Encelia californica*), and chaparral yucca.

CSC is the most widely occurring terrestrial habitat within the proposed Project boundary, covering approximately 545 acres, mostly in the southern half of the proposed Project boundary. Dominant shrub species within the 9 sampled areas had from 20 to over 90 percent cover, and included California buckwheat, chamise, black sage, white sage, purple sage, chaparral yucca, thick-leaved yerba santa, and California sagebrush. These shrubs ranged from 1.25 to 8.5 feet tall. Other shrub associates observed in the sampled areas included manzanita, inland scrub oak, ceanothus, sugar bush, California fuchsia (*Epilobium canum*), four-wing saltbush (*Atriplex canescens*), scalebroom, and beavertail cactus. In addition, the following herbs and grasses were observed in the sample areas: doveweed (*Croton setiger*), jimsonweed (*Datura wrightii*), mustard (*Brassica* sp.), redstem filaree (*Erodium cicutarium*), wild oats, Nevada blue grass (*Poa secunda*), and various bromes.

CSC provides similar wildlife habitat value to other shrub-dominated habitats within the proposed Project boundary. Incidental wildlife sightings in CSC areas included California towhee (*Melozone crissalis*), American crow, house finch (*Haemorhous mexicanus*), song sparrow, red-tailed hawk, woodrats, and feral goats (*Capra aegagrus hircus*).

Desert Wash

Desert Wash (DSW) habitats are typically associated with sandy to gravelly intermittent washes or adjacent alluvial deposits. Topographically, this habitat is found in canyons, arroyos, washes, and other features where water is present seasonally. Plant composition is highly variable, but is typically characterized by arborescent, often spiny, shrubs. Common canopy species include tamarisk, honey mesquite, screwbean mesquite, and various other desert shrub species unlikely to occur within the proposed Project boundary. Common subcanopy species include broom baccharis (Baccharis sarithroides), arrow-weed, various species of saltbush (Atriplex spp.), mulefat, Anderson thornbush, desert willow (Chilopsis linearis ssp. arcuata), beavertail cactus, brittlebush (Encelia farinosa), Gutierrezia spp., Ericameria spp., and a variety of forbs and grasses.

DSW habitat is restricted to 2.5 acres in the southern portions of the proposed Project boundary. One sampling point was included in DSW habitat. All areas mapped as DSW are on private property. Because of this, no plots were sampled and only a visual assessment from the road was conducted. Dominant plant species observed in this area included scalebroom and other shrubs typical of arid habitats.

DSW provides important habitat for birds, reptiles, and small mammals. Additionally, the dense shrubbery provides food and cover for a variety of small and medium-sized species. No incidental wildlife was observed in this habitat type.

All areas mapped as DSW are considered Sensitive Natural Communities by CDFW (CDFW 2018b).

Mixed Chaparral

Mixed Chaparral (MCH) generally occurs below 5,000 feet on steep slopes and ridges with relatively thin, well-drained soils. Mature MCH has dense (greater than 80 percent) canopy cover, with shrubs typically between 3 and 13 feet tall. Species generally include inland scrub oak, ceanothus, and manzanita. Chamise, birch-leaf mountain-mahogany, ashy silktassel (*Garrya flavescens*), toyon, yerba santa, California buckeye (*Aesculus californica*), western poison oak, sumac (*Rhus* spp. or *Malosma* spp.), California coffee berry, holly-leafed cherry (*Prunus ilicifolia*), and chaparral pea (*Pickeringia montana*) can also occur. MCH and CRC (see above) intergrade on low to middle elevation slopes at elevations below woodland and forest types. Compared to

CRC, MCH generally occupies more mesic sites at higher elevations or on north-facing slopes.

MCH is the second most widely occurring terrestrial habitat type within the proposed Project boundary, covering approximately 388 acres. There were eight sampling points within the MCH habitat type. Dominant shrub species within the sampled areas had 35 to over 95 percent cover, and included inland scrub oak, Tucker oak (*Q. john-tuckeri*), California buckwheat, chaparral yucca, thick-leaved yerba santa, common sagebrush, manzanita, and chamise. These shrubs ranged from 1.5 to 12 feet tall. Other associated shrubs, herbs, and grasses observed in this habitat type included birch-leaf mountain-mahogany, rubber rabbitbrush, black sage, singleleaf pinyon, California juniper, brittlebush, pine bush, wire-lettuce, white horehound (*Marrubium vulgare*), common cryptantha, redstem filaree, squirreltail grass (*Elymus elymoides*), giant wild rye (*Elymus condensatus*), Nevada blue grass, and various bromes.

MCH provides wildlife habitat value similar to that of other shrub-dominated habitats within the proposed Project boundary. Incidental wildlife observations in MCH included common raven (*Corvus corax*), Nuttall’s woodpecker, blue-gray gnatcatcher (*Polioptila caerulea*), American bushtit (*Psaltriparus minimus*), horned lark (*Eremophila alpestris*), California quail, California scrub jay, song sparrow, woodrat, desert cottontail, jackrabbit, mule deer, and coyote (*Canis latrans*).

Sagebrush

Sagebrush (SGB) occurs on dry slopes and flats, mostly in the eastern part of California. The proposed Project boundary is located along the far western edge of the range of this habitat type. This habitat type can occur as a pure stand of sagebrush, or can alternatively occur as a mix of similarly statured shrub species, including rabbitbrush, horsebrush, gooseberry, western chokecherry, mountain-mahogany, and bitterbrush.

SGB is found along gentle hillslopes and flatlands, covering approximately 281 acres and occurring mostly in the northern portion of the proposed Project boundary. Eight sampling points were located within this habitat type. Most of the SGB habitat within the proposed Project boundary is dominated by rubber rabbitbrush. SGB is present, just not as the dominant species. Shrub cover in this CWHR habitat type ranged from 8 to 95 percent, and shrubs ranged from 1 to 5 feet tall. Other shrub species observed in SGB areas included California juniper, elderberry, and tarragon. Understory species observed included doveweed, longstem buckwheat, common cryptantha, wire-lettuce, sand-aster (*Corethrogyne filaginifolia*), tocalote (*Centaurea melitensis*), Russian thistle (*Salsola tragus*), mustard, redstem filaree, hairy goldenaster (*Heterotheca villosa*), Nevada blue grass, wild oats, and various bromes.

SGB provides important habitat for numerous wildlife species, including mule deer, a variety of rodents and small mammals, as well as reptiles, game birds, song birds, and raptors. Incidental wildlife observations associated with SGB areas included the special-status species loggerhead shrike (*Lanius ludovicianus*), as well as other wildlife species, including horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), house finch, California quail, American crow, and jackrabbit. Black bear (*Ursus americanus*) scat was also observed.

Herbaceous-Dominated Habitats

Annual Grassland

Annual Grassland (AGS) occurs in a variety of locations throughout California, replacing much of what was historically native PGS. These areas now comprise a variety of predominantly non-native annual grasses, including wild oats, soft chess, ripgut brome, red brome (*Bromus madritensis* ssp. *rubens*), barley, and rattail sixweeks grass (*Festuca myuros*). A variety of native and non-native forbs also occur, including longbeak stork's bill (*Erodium botrys*), redstem filaree, doveweed, clover (*Trifolium* spp.), California burclover (*Medicago polymorpha*), and popcornflower (*Plagiobothrys* spp.).

AGS occurs in large swaths over approximately 197 acres within the proposed Project boundary. Dominant plant species within the 7 sampled areas had from 15 to 100 percent cover, and included red brome, soft chess, cheat grass, wild oats, hare barley (*Hordeum murinum ssp. leporinum*), and blue grass. Forbs observed in AGS areas included annual bursage (*Ambrosia acanthicarpa*), doveweed, mustards, Russian thistle, Australian saltbush (*Atriplex semibaccata*), redstem filaree, bird's foot trefoil (*Acmispon americanus*), hairy leaved sunflower (*Helianthus annuus*), telegraph weed (*Heterotheca grandiflora*), common cryptantha, common fiddleneck (*Amsinckia intermedia*), and prickly lettuce. Some areas intergraded with surrounding scrublands and included scattered shrub species, such as rubber rabbitbrush, thick-leaved yerba santa, California buckwheat, scalebroom, and common sagebrush.

Many wildlife species use AGS for foraging; however, some require special habitat features, such as cliffs, caves, ponds, or woody plants for resting and escape cover. Various reptiles, small mammals, and ground nesting birds use AGS areas for breeding. Within the proposed Project boundary, this habitat type also provides important foraging habitat for raptors, as higher quality foraging habitat, such as perennial grassland, is absent. Incidental wildlife observations associated with AGS included California quail, meadowlark, horned lark, desert cottontail, and burrowing rodents.

Fresh Emergent Wetland

Fresh Emergent Wetland (FEW) habitats are found throughout California. This habitat type is typically associated with lake and stream edges. FEW can also be found in basins or depressions that are perennially or periodically flooded or saturated. This habitat type is usually underlain by fine silt or clay sediments. Saturated or periodically flooded soils support plants adapted to wet conditions, including sedges, Baltic rush, nutgrass (*Cyperus* spp.) and, on more alkali sites, saltgrass (*Distichlis spicata*). On wetter sites, cattails (*Typha* spp.), bulrush (*Schoenoplectus* spp.), and arrowhead (*Sagittaria* spp.) are potential dominant species.

FEW occurs along lake edges within the proposed Project boundary, as well as in the check dam basins on Castaic Creek near the Elderberry Forebay. Approximately 55 acres of this CWHR habitat type is mapped within the proposed Project boundary. The dominant plant species observed at the three sampling locations were broadleaf cattail (*Typha latifolia*) and California bulrush (*Schoenoplectus californicus*). In most areas, vegetation cover was very dense, typically over 80 percent. Other species growing in and along the edges of the habitats included tamarisk, narrowleaf willow, milkweed (*Asclepias* sp.), Baltic rush, and scattered Fremont cottonwoods.

FEW provides food, cover, and water for numerous wildlife species, including mammals, amphibians, aquatic reptiles, as well as waterfowl and various other birds. Incidental wildlife observations associated with FEW areas included Pacific chorus frogs (*Pseudacris regilla*), invasive American bullfrog (*Lithobates catesbeianus*), American coot, and red-tailed hawk.

All areas mapped as FEW are considered Sensitive Natural Communities by CDFW (CDFW 2018b).

The acreages and description of wetlands presented in Section 5.4.1 may not match what is presented in Section 5.4.2. Aquatic features are assessed for wetland function in Section 5.4.2, whereas, this section focuses on habitat function. Furthermore, no comprehensive wetland surveys or formal wetland delineations have been performed as part of either study, but instead these studies relied on data from separate, individual sources (CWHR and National Wetlands Inventory [NWI], respectively).

Wet Meadow

Wet Meadow (WTM) occurs in areas where surface water or saturation is present for most of the growing season. This CWHR habitat type is characterized by a simple structure comprising herbaceous species. Trees and shrubs are typically absent; however, they often surround a wet meadow, creating a distinct edge. The herbaceous vegetation often creates a dense canopy of plants ranging from less than 1 inch to over 3 feet tall. Common plant species associated with WTM include sedges, rushes, hairgrass (*Danthonia* spp.), spikerush (*Eleocharis* spp.), muhlys, and various forbs.

WTM occurs in isolated patches of 21 acres within the proposed Project boundary. This habitat type is associated with depressions and the edges of aquatic features. Dominant plant species within the single sampled area had 80 to over 95 percent cover, and included sedges, sprangletop (*Leptochloa fusca*), tall cyperus (*Cyperus eragrostis*), spikerush, smartweed (*Persicaria* sp.), cocklebur (*Xanthium strumarium*), and perennial pepperweed (*Lepidium latifolium*), as well as scattered narrowleaf willow and broadleaf cattail.

WTM provides important wildlife habitat for an array of aquatic and semi-aquatic species. Terrestrial species use this habitat type for water and food. Forbs and palatable grasses provide forage for mule deer. Incidental wildlife observations associated with WTM included the special-status species western pond turtle (*Emys marmorata*), as well as pied-billed grebe (*Podilymbus podiceps*) and song sparrow.

All areas mapped as WTM are considered Sensitive Natural Communities by CDFW.

Developed Habitats

Urban

Vegetated Urban (URB) habitats include a wide variety of native and non-native species that are classified into five types of vegetative structure by CWHR: tree grove, street strip, shade tree/lawn, lawn, and shrub cover. Tree groves occur in landscaped parks, green belts, and cemeteries, and have a continuous canopy that varies in height, tree spacing, crown shape, and understory conditions. Street tree strips vary in spacing, with both continuous and discontinuous canopies. Understories are typically grass or ground cover. Shade trees in lawns, which are typical in residential areas, have a structure similar to that of natural savannas. Lawns are the most structurally simple URB habitat type, with only one uniform layer. Shrub cover is less common than other URB habitat types, and includes hedges.

URB habitat occurs in approximately 412 acres within the proposed Project boundary. URB cover is associated with the powerplants, dams, and other hydropower infrastructure, as well as recreational areas, such as the Pyramid Lake recreation developments (e.g., Vista Del Lago Visitor Center). The CWHR classification system also characterizes highways and roads as URB. Within the three sampled areas, vegetation ranged from 15 to 30 percent cover, and included ornamental pines (*Pinus* spp.), ornamental junipers (*Juniperus* spp.), rosemary (*Rosmarinus officinalis*), and olive (*Olea europea*). Most URB areas were dominated by hardscape and only supported sparse vegetative cover dominated by ornamental species.

Wildlife use of URB areas varies considerably based on the density of development and the distance from the URB edge. Species richness is typically very low in highly developed areas and is often limited to a few bird species, such as rock dove (*Columba livia*), house sparrow (*Passer domesticus*), and European starling (*Sturnus vulgaris*). Species such as California scrub jay, northern mockingbird (*Mimus polyglottos*), house finch, raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and striped skunk (*Mephitis mephitis*) are often found in URB settings with more vegetation cover and diversity. No incidental wildlife observations were recorded in the URB areas.

Non-Vegetated Habitats

Barren

Barren (BAR) habitats are those that are generally devoid of vegetation and include rock outcrops, mudflats, beaches, and areas cleared by human disturbance. Technically, any habitat with less than 2 percent cover by herbaceous species and less than 10 percent cover by trees or shrubs is defined as BAR.

BAR habitat occurs in various small patches across the proposed Project boundary, totaling approximately 223 acres. These include campgrounds, dirt roads, and other cleared areas. Within the single sampled area, vegetation cover was less than 2 percent, and included low statured Australian saltbush, redstem filaree, red brome, and doveweed. Scattered Russian thistle was observed along the edges of BAR areas.

Wildlife habitat value in BAR areas is more dependent upon the substrate and locational attributes rather than the vegetation. For example, rock ledges and other vertical, unvegetated areas can provide important nesting habitat for various birds. On the opposite end of the spectrum, disturbed barren flats provide extremely limited value to wildlife. Incidental wildlife observations associated with BAR areas included song sparrow, house finch, California quail, California scrub jay, and Anna's hummingbird (*Calypte anna*). Most of these species were observed flying over the sampled area or using adjacent habitat areas.

Aquatic Habitats

Lacustrine

LAC habitats are inland depressions or dammed river channels with standing water, and vary from small ponds to large lakes. These habitats can be permanently flooded or intermittent. Lakes typically support suspended organisms called phytoplankton, including diatoms, desmids, and filamentous green algae. Duckweed (*Lemna* spp.) often covers the surface of shallower waters. Submerged plants may include algae and pondweeds (*Potamogeton* spp.), while floating, rooted aquatics, such as smartweeds, are typically found in areas subject to sedimentation.

LAC habitats make up the majority of cover within the proposed Project boundary, totaling approximately 1,993 acres (45.2 percent). This includes Quail Lake, segments of the SWP, Pyramid Lake, and Elderberry Forebay. LAC areas were not sampled as part of the Study 4.1.7 field effort; however, adjacent riparian and wetland areas were sampled and some incidental data was collected. Incidental wildlife observations associated with LAC areas included American coot, mallard (*Anas platyrhynchos*), pied-billed grebe, and western pond turtle, a special-status species. Most species associated with LAC habitats are addressed in Section 5.3; however, waterfowl and other terrestrial species that frequently use LAC habitats are discussed further in this section.

The acreage and description of LAC areas presented here may not match what is presented in Section 5.4.2. Aquatic features are assessed for wetland/hydrological function in Section 5.4.2, whereas, this section focuses on habitat function. Furthermore, no comprehensive wetland surveys or formal wetland delineations have been performed as part of either study, but instead these studies relied on data from separate, individual sources (CWHR and NWI, respectively).

Special-Status Plants

For the purpose of this section (e.g. Section 5.4.1) of the Application for New License, a special-status plant is defined as a vascular plant that meets one or more of the following criteria: (1) listed as an FSS by USFS and occurs on NFS lands; (2) listed by BLM as Sensitive and occurs on federal lands administered by BLM; (3) listed under CESA as an endangered, threatened, or rare plant; (4) State-listed rare or a State candidate for listing species under the Native Plant Protection Act of 1977 (CDFW 2018f); or (5) listed by the California Native Plant Society (CNPS) on its Inventory of Rare and Endangered Plants, including species that are ranked 1A through 4B (CNPS 2018). Section 5.4.3 (Federal ESA, Listed and Candidate Species) of this Application for New License addresses potential effects of the Licensees' Proposal on the special-status plant species listed under the federal ESA.

Prior to conducting field surveys under Study 4.1.5, reference sites for Nevin's barberry (*Berberis nevinii*), short-jointed beavertail cactus (*Opuntia basilaris* var. *brachyclada*), Peirson's morning glory (*Calystegia peirsonii*), Plummer's mariposa lily (*Calochortus plummerae*), slender mariposa lily (*Calochortus clavatus* var. *gracilis*), Palmer's mariposa lily (*Calochortus palmeri* var. *palmeri*), Davidson's bush mallow (*Malacothamnus davidsonii*), Ross' pitcher sage (*Lepechinia rossii*), Santa Susana tarplant (*Deinandra minthornii*), Baja navarretia (*Navarretia peninsularis*), Tehachapi monardella (*Monardella linoides* ssp. *oblonga*), and Peirson's lupine (*Lupinus peirsonii*) were checked and verified to determine local phenology, habitat, and other site factors that could contribute to special-status plant species identification within the Study 4.1.5 study area, which is defined below. Although Nevin's barberry, Davidson's bush mallow, Santa Susana tarplant, and Peirson's lupine were not listed in the Botanical Resources Study Plan, reference sites for these plants were visited because it was later determined that there was potential for these plant species to occur within the proposed Project boundary. Conversely, although it was indicated in the Botanical Resources Study Plan that reference sites for round-leaved filaree, umbrella larkspur, Fort Tejon woolly sunflower, Piute Mountains navarretia, San Bernardino aster, and Greata's aster would be visited, no reference sites were available for these species.

Furthermore, although Nevin's barberry was assessed as part of the Botanical Resources Study Plan, no occurrences of Nevin's barberry were found within the proposed Project boundary. Therefore, this species is not discussed in this section, and instead, further discussion of this species and its federal listing can be found in Section 5.4.3 (Federal ESA, Listed and Candidate Species) of Exhibit E of this Application for New License.

Between March 26 and September 13, 2018, and between April 1 and May 23, 2019, in conformance with Study 4.1.5, the Licensees conducted a comprehensive botanical inventory of the entire study area to identify the locations of special-status plant species. The survey was a comprehensive effort to inventory botanical resources, as defined in Study 4.1.5. The study area consists of the land area within the proposed Project boundary, excluding lands overlying the Angeles Tunnel on which the Licensees do not perform any Project O&M. The study area includes staging areas; construction areas; upstream maintenance areas above reservoirs; fuel modification requirement areas; areas cleared for access to transmission line poles and access routes to these areas; Lower Quail Canal, Quail Lake, and associated maintenance roads/areas and recreational features; and Gorman Bypass Channel and associated maintenance roads/access. Consequently, the study area is synonymous with the area within the proposed Project boundary, excluding lands overlying the Angeles tunnel. The study area for Study 4.1.5 is the same as the study area for Study 4.1.6.

Study 4.1.6 occurred in conjunction with the comprehensive botanical inventory of the study area performed under Study 4.1.5. The study area for Study 4.1.5 is illustrated in Figure 5.4.1-20.

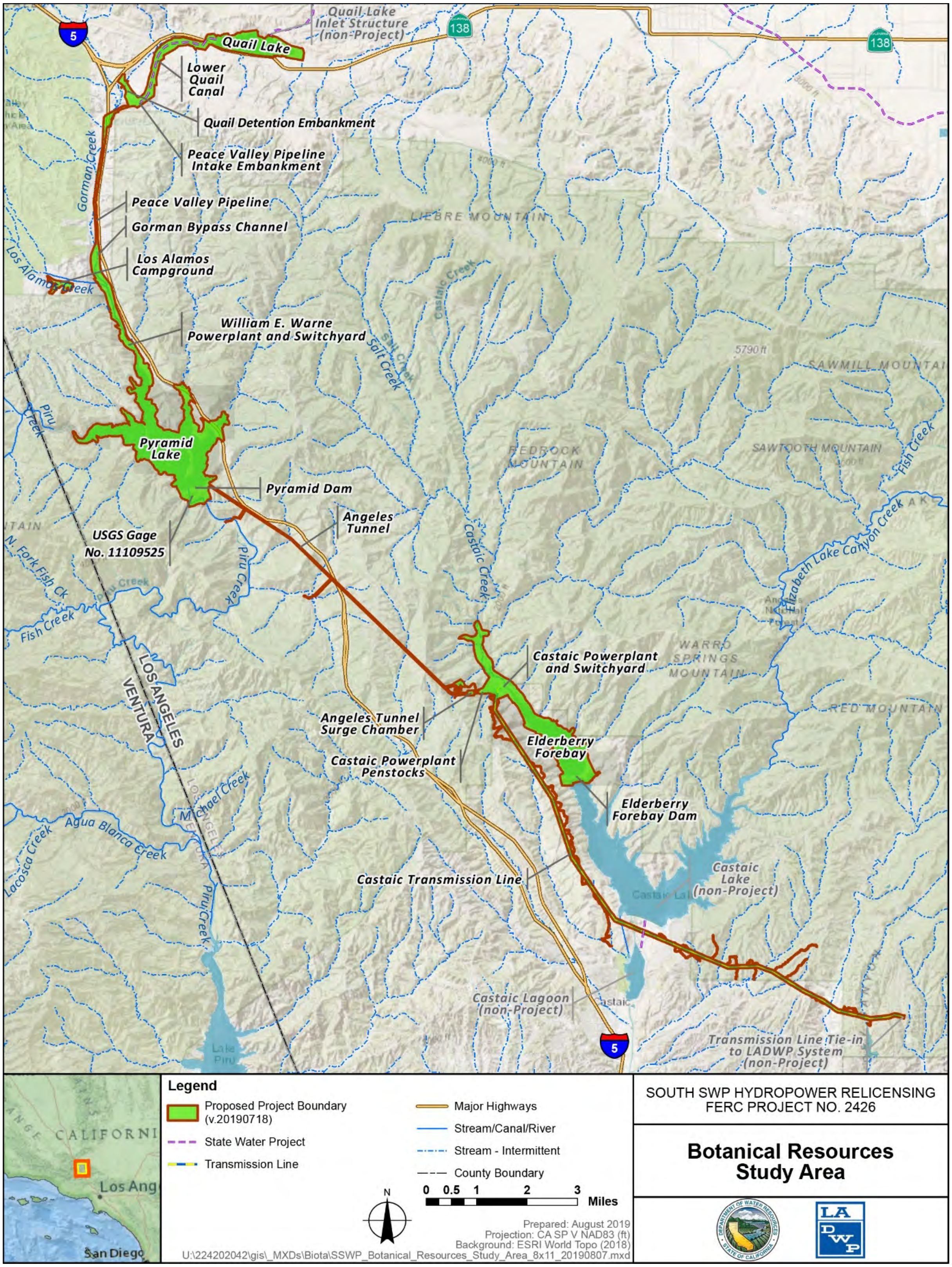

Figure 5.4.1-20. Study Area for Study 4.1.5 – Botanical Resources (Excluding Lands Overlying the Angeles Tunnel) Within Proposed Project Boundary

Between March 26, 2018 and April 19, 2018, the Licensees conducted a comprehensive early season botanical inventory of the study area. Between May 29, 2018 and September 13, 2018, the Licensees conducted a comprehensive late season botanical inventory of the study area. Additionally, between April 1, 2019 and May 23, 2019, the Licensees conducted a follow-up comprehensive early season botanical inventory of the study area. The field methods followed applicable protocol methodology described in the botanical survey section of CDFW's Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (2009). This protocol uses systematic sampling techniques to establish thorough coverage of plant communities that could support special-status plant species. The CDFW protocol states that "the level of effort required per given area and habitat is dependent upon the vegetation and its overall diversity and structural complexity, which determines the distance at which plants can be identified" (CDFW 2009).

The Licensees conducted surveys by walking all locations that could be safely accessed to establish thorough coverage, noting all plant taxa observed. Of the 4,563.8 acres within the proposed Project boundary area, approximately 136 acres were not surveyed due to unsafe conditions. In these unsafe areas visual surveys from a distance were conducted (Figure 5.4.1-21). These inaccessible areas are further described in Table 5.4.1-2. All other areas were surveyed on foot at distances no greater than standard transect widths (15 to 20 meters), which was sufficient to adequately characterize species and vegetation composition. The list of all plant species observed is provided in Appendix K. Because no plants were collected (i.e., as voucher specimens), the Licensees were not required to obtain permits to perform the study.

During the Botanical Resources Study, all incidental wildlife observations were noted. On April 2, 2019, while conducting early season botanical comprehensive surveys on the Castaic Transmission Line, five California condors (*Gymnogyps californianus*) were observed. The California condor is a State and federally listed special-status wildlife species. No other federally listed, State listed, or California Species of Special Concern special-status wildlife incidental observations occurred during the botanical comprehensive surveys. A comprehensive list of incidental wildlife observations is provided in Appendix L.

Documentation of surveys on NFS lands included completion of USFS data forms for any FSS, as specified in the USFS Threatened, Endangered, and Sensitive Plants Survey Field Guide (USFS 2005a), and the Threatened, Endangered and Sensitive Plants Element Occurrence Protocol Field Guide (USFS 2005b).

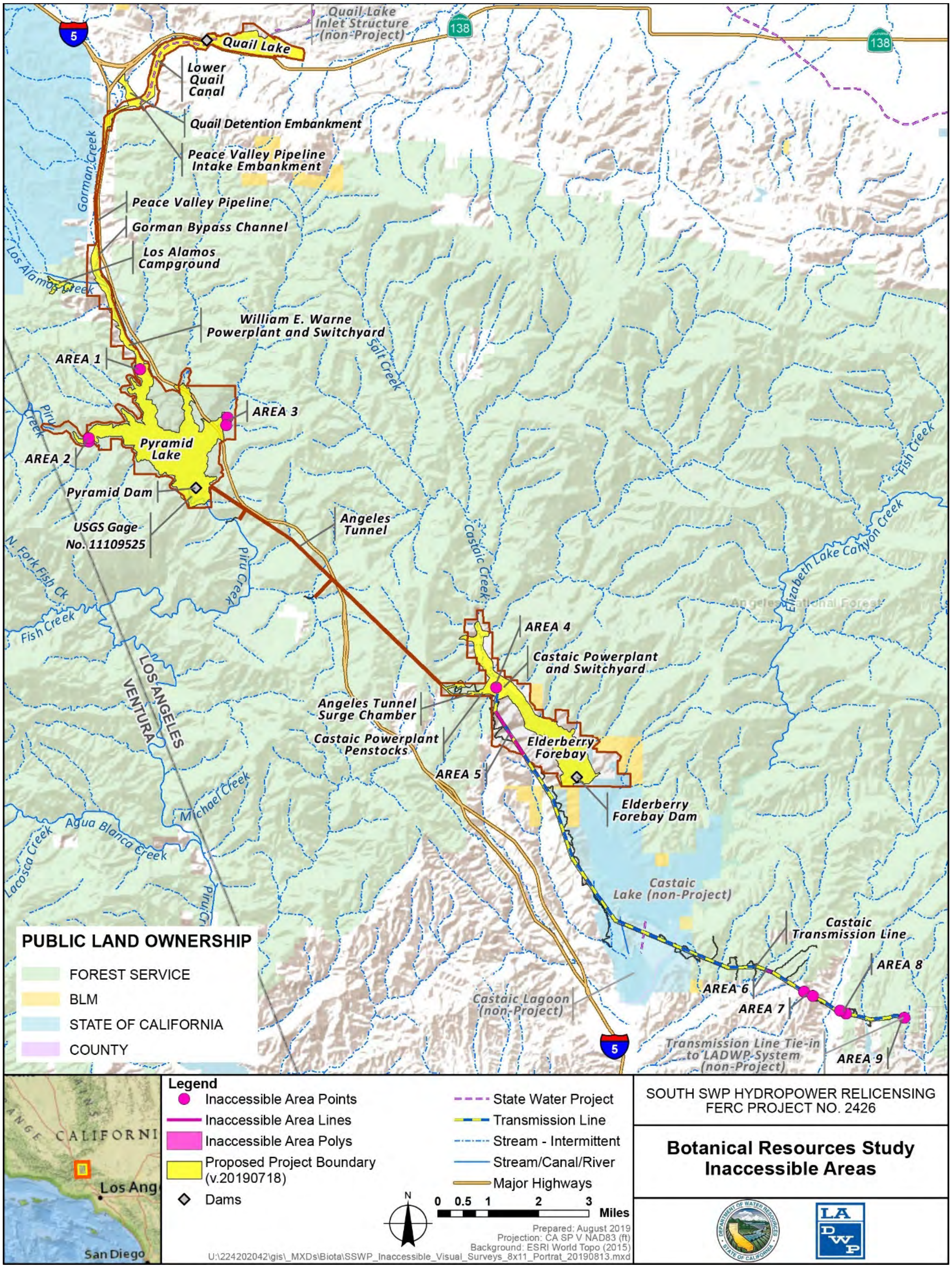

Figure 5.4.1-21. Botanical Resources Study Inaccessible Areas (Excluding Lands Overlying the Angeles Tunnel) Within Proposed Project Boundary

Table 5.4.1-2. Botanical Resources Study Inaccessible Areas Within the Proposed Project Boundary, Excluding Lands Overlying the Angeles Tunnel

Area	Inaccessible Area (approximate acres)	Inaccessible Area Description
1	18	No northward access by boat due to Los Angeles County Sheriff's safety jurisdiction.
2	20	No access westward due to steep slopes and dense vegetation.
3	3	Pockets of inaccessible areas due to steep slopes and dense vegetation.
4	24	No access due to steeply sloped hillside.
5	40	Inaccessible due to steep slopes.
6	17	Inaccessible due to steep slopes.
7	7	Inaccessible due to steep slopes.
8	5	Limited southeastern access due to fencing and steep slopes.
9	2	Inaccessible area westward due to steep slopes.
Total (approximate acres)	**136**	

Surveys were performed within the known flowering periods of special-status plant species with the potential to occur (as identified in the FERC-approved June 14, 2017 Botanical Resources Study Plan), with at least two survey visits performed in all accessible areas of the study area to maximize the likelihood of detection. California Native Species Field Survey Forms were completed for the 180 special-status plant occurrences that were observed, and forms were provided to CDFW to be added to the CNDDB in December 2018 and July 2019. For occurrences that extended beyond the study area boundary, attributes of the entire occurrence, including estimated size, were recorded on hardcopy datasheets, and as attribute data in GIS. However, acreage counts for occurrences that extended beyond the study area boundary were not included in the final acreage count.

There were 180 occurrences of five special-status plant species observed during field surveys, as summarized in Table 5.4.1-3 and depicted on Figures 5.4.1-22 through 5.4.1-33. None of the species are listed under CESA. All have been assigned a CNPS California Rare Plant Rank (CRPR). CRPR is an administrative listing and provides plants listed by CNPS with no specific federal or State legal protection. All incidental observations of special-status plants encountered during the Licensees' comprehensive botanical relicensing studies were mapped and recorded.

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Table 5.4.1-3. Special-Status Plant Species Occurrences Within the Proposed Project Boundary Identified During 2018 and 2019 Field Surveys

Scientific Name	Common Name	Federal Listing Status	State Listing Status[1]	USFS Ranking[1]	BLM Ranking[2]	CNPS Ranking[3]	Number of Occurrences in Study Area[5]	Location of Occurrences	Site Quality	Threats
Calochortus clavatus var. *gracilis*	slender mariposa lily	None	S3	S	S[4]	1B.2	37	Throughout the study area (see maps) occurrences were found on NFS-owned lands	6 excellent, 19 good, 12 fair	Encroachment of non-native invasive plants, road and vehicle use, and human use via recreation
Calystegia peirsonii	Peirson's morning glory	None	S4	None	None	4.2	93	Throughout the study area (see maps) occurrences were found on NFS-owned lands	48 good, 39 fair, 6 poor	Encroachment of non-native invasive plants, road and vehicle use, and human use via recreation
Delphinium parryi ssp. *purpureum*	Mt. Pinos larkspur	None	S4	S	None	4.3	1	Occurrence found in the Castaic Transmission Line area on NFS-owned lands	1 good	Road and vehicle use
Juglans californica	southern California black walnut	None	S4	None	None	4.2	2	One occurrence found in Castaic Creek and one occurrence found in the Castaic Transmission Line area; both occurrences were not found on NFS-owned lands	1 good and 1 fair	Encroachment of non-native invasive plants and road and vehicle use
Opuntia basilaris var. *brachyclada*	short-joint beavertail	None	S3	S	S[4]	1B.2	47	Throughout the study area (see maps) occurrences were found on NFS-owned lands	1 excellent, 10 good, 29 fair, 7 poor	Encroachment of non-native invasive plants, and human use via recreation
Total							**180**	**--**	**--**	**--**

Sources:
[1]CDFW 2018c
[2]BLM 2010
[3]CNPS 2018; DWR 2018a
Notes:
[4]California BLM policy on sensitive plants (California BLM Manual Supplement 6840.06 and Handbook 6840.1) automatically affords sensitive status to plants on List 1B (Plants Rare, Threatened, or Endangered in California and Elsewhere) of the California Native Plant Society's most recent Inventory of Rare and Endangered Plants, unless the State Director decides on a case-by-case basis that a particular List 1B species does not warrant sensitive status (BLM 2010).
[5]The lands overlying the Angeles Tunnel were not a part of the Botanical Resources Study Area and were not assessed for botanical resources.
CDFW State Listing Ranks:
S3 = Vulnerable – Vulnerable in the State due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the State.
S4 = Apparently Secure – Uncommon but not rare in the State; some cause for long-term concern due to declines or other factors.
CNPS Plant Ranks:
1B = Plants rare, threatened, or endangered in California and elsewhere
4 = Watch List: Plants of limited distribution
CNPS Threat Ranks:
0.2 = Moderately threatened in California (20-80 percent occurrences threatened / moderate degree and immediacy of threat)
0.3 = Not very threatened in California (less than 20 percent of occurrences threatened / low degree and immediacy of threat)
USFS and BLM Plant Ranks:
S = Sensitive
Key:
BLM = U.S. Department of the Interior, Bureau of Land Management
CDFW = California Department of Fish and Wildlife
CNPS = California Native Plant Society
NFS = National Forest System
USFS = U.S. Department of Agriculture, Forest Service

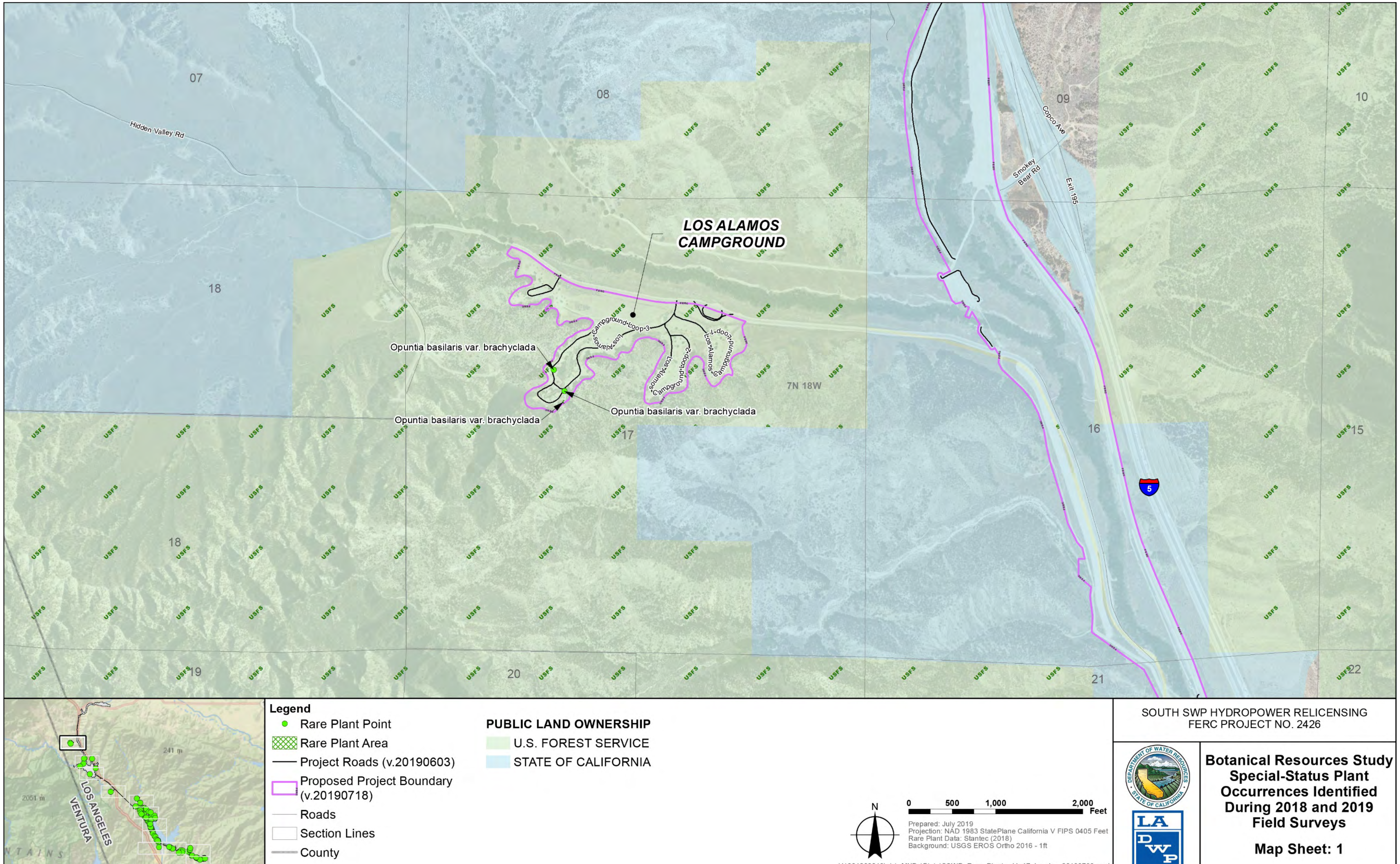

Figure 5.4.1-22. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

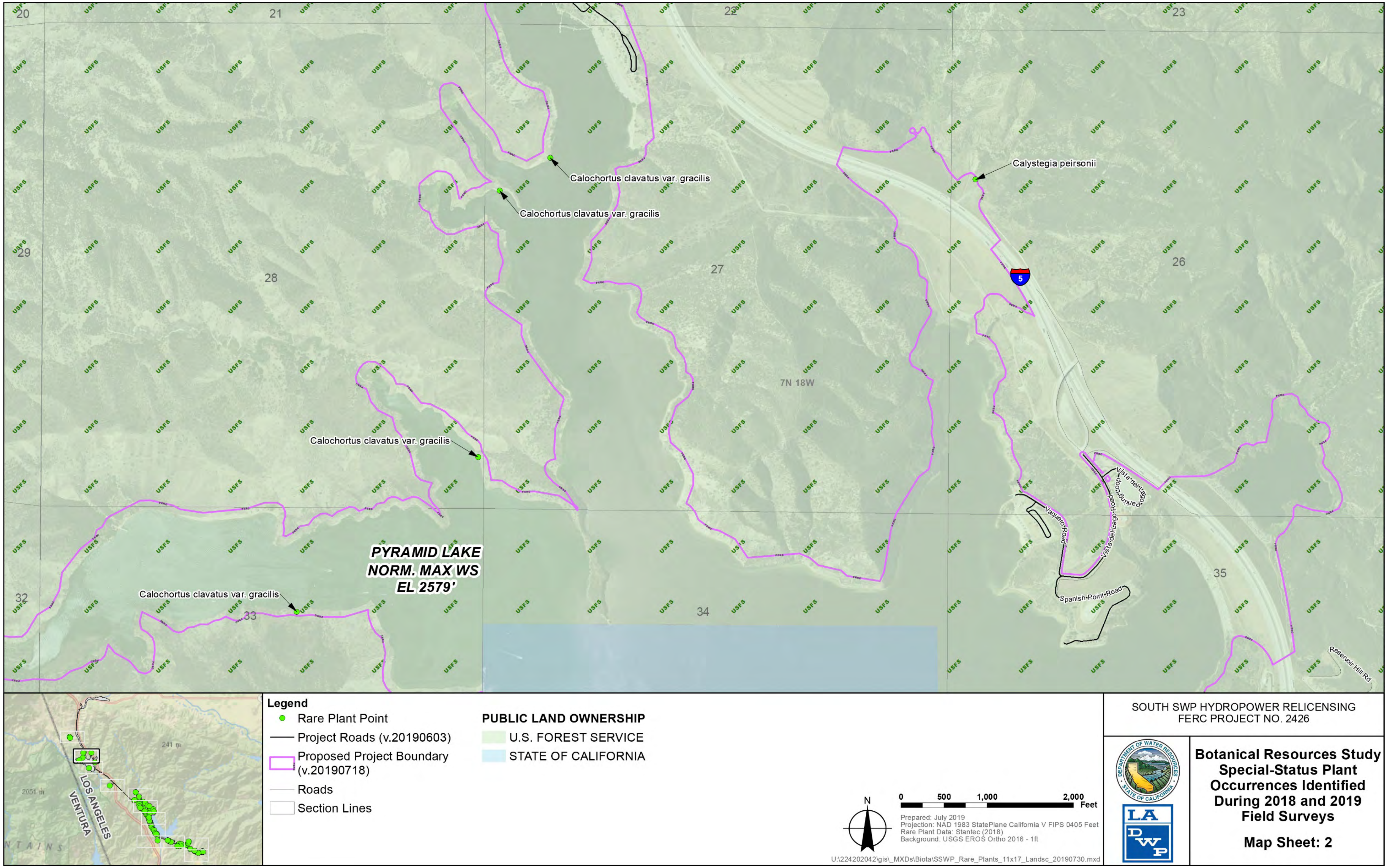

Figure 5.4.1-23. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

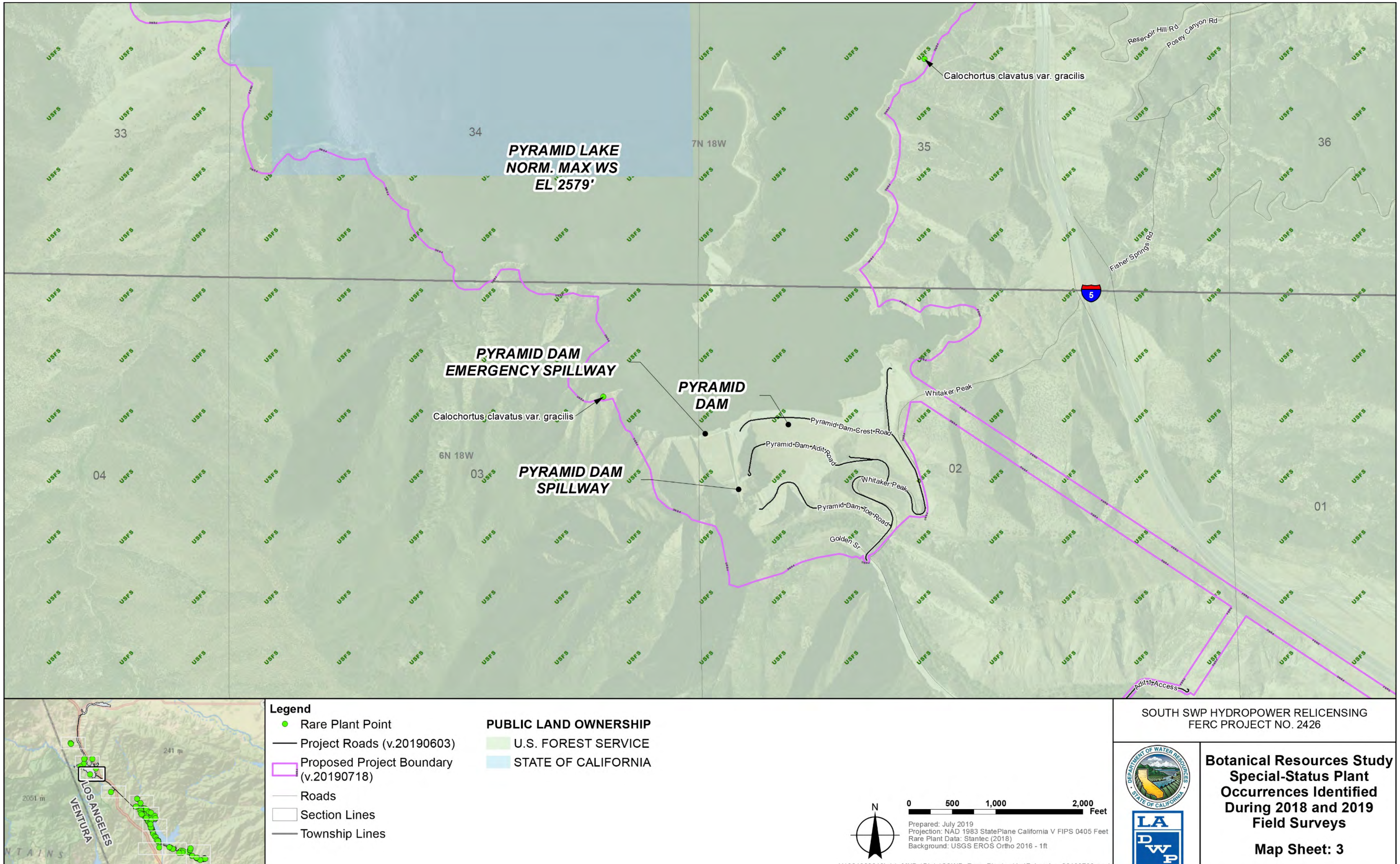

Figure 5.4.1-24. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

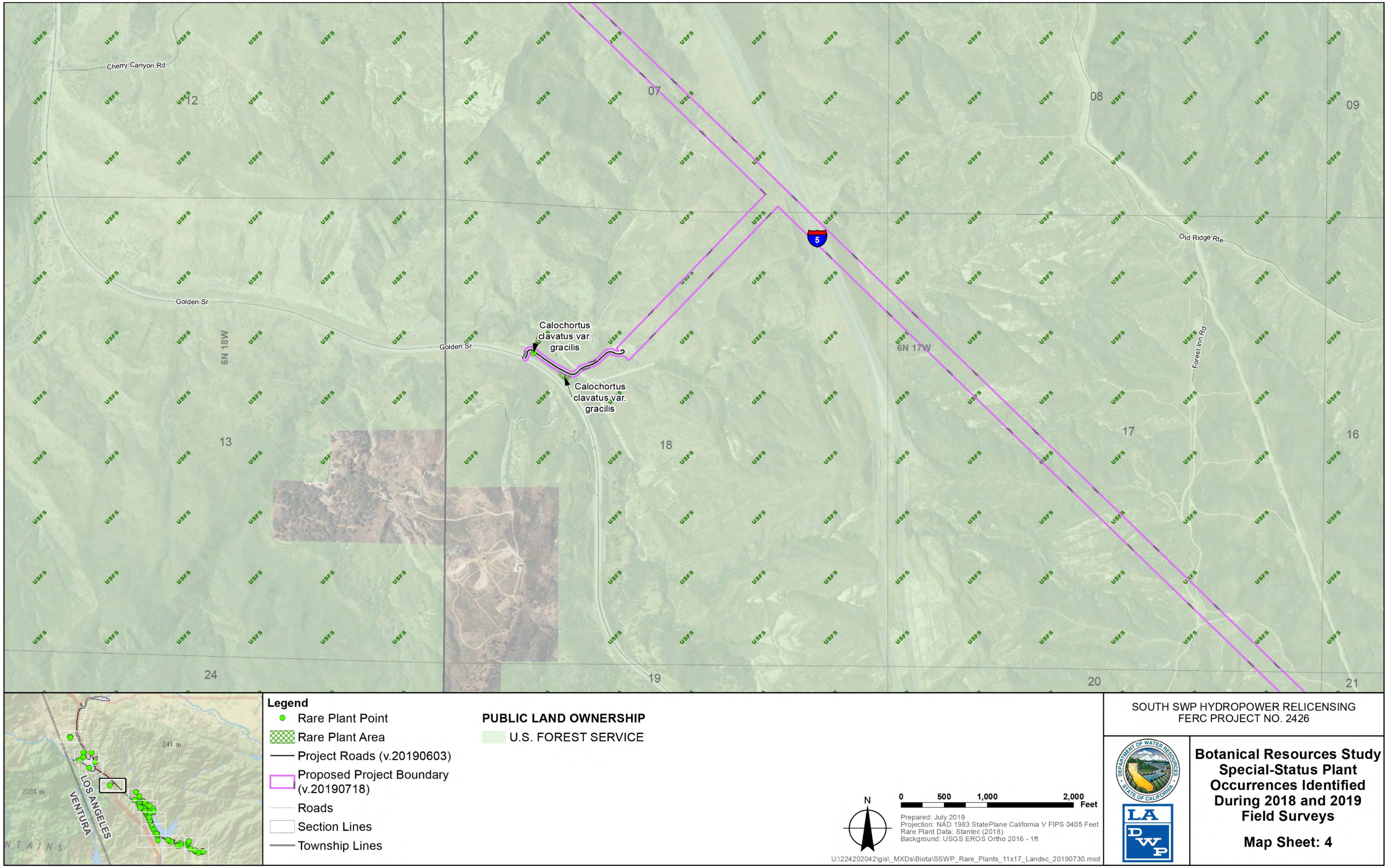

Figure 5.4.1-25. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

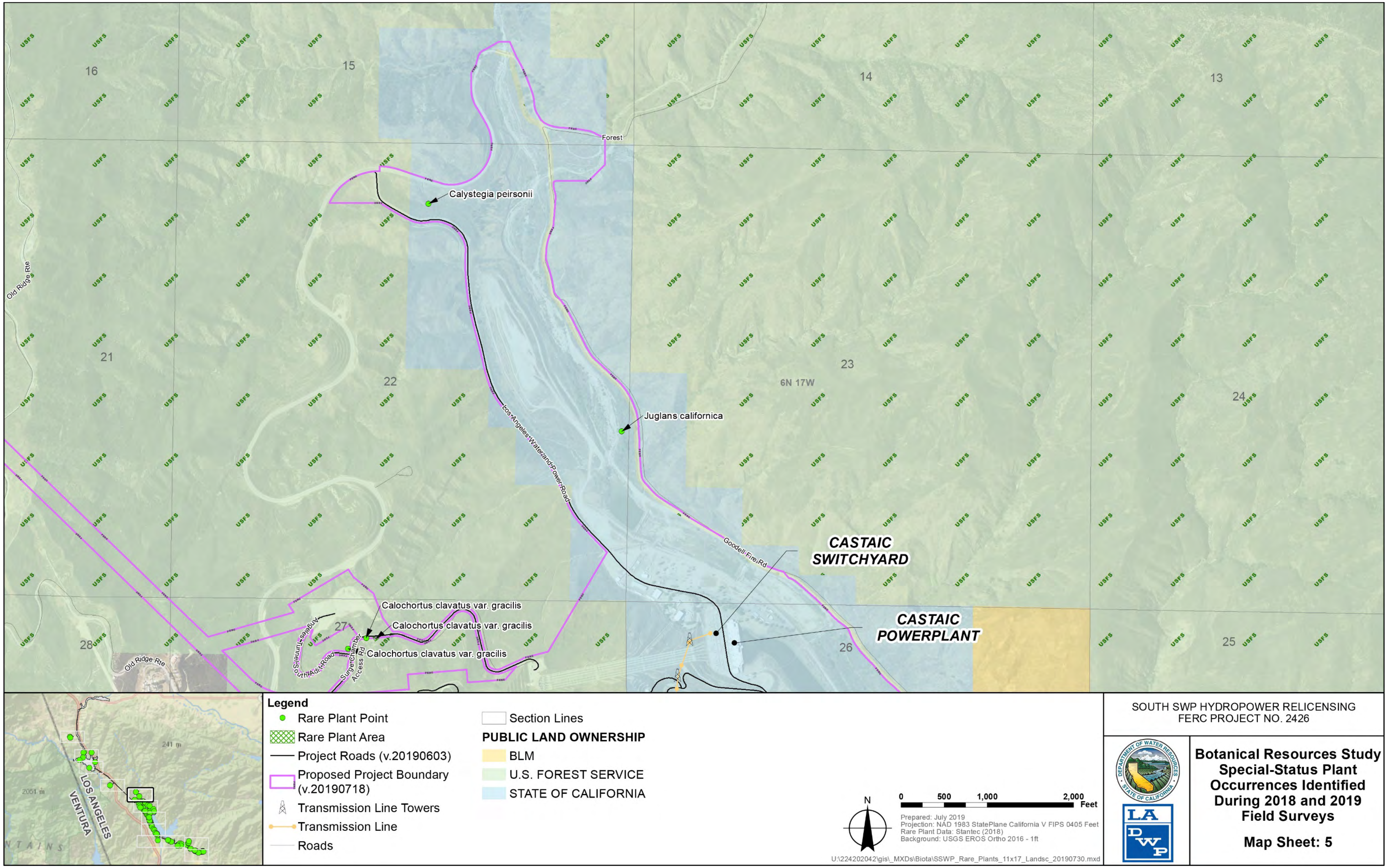

Figure 5.4.1-26. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

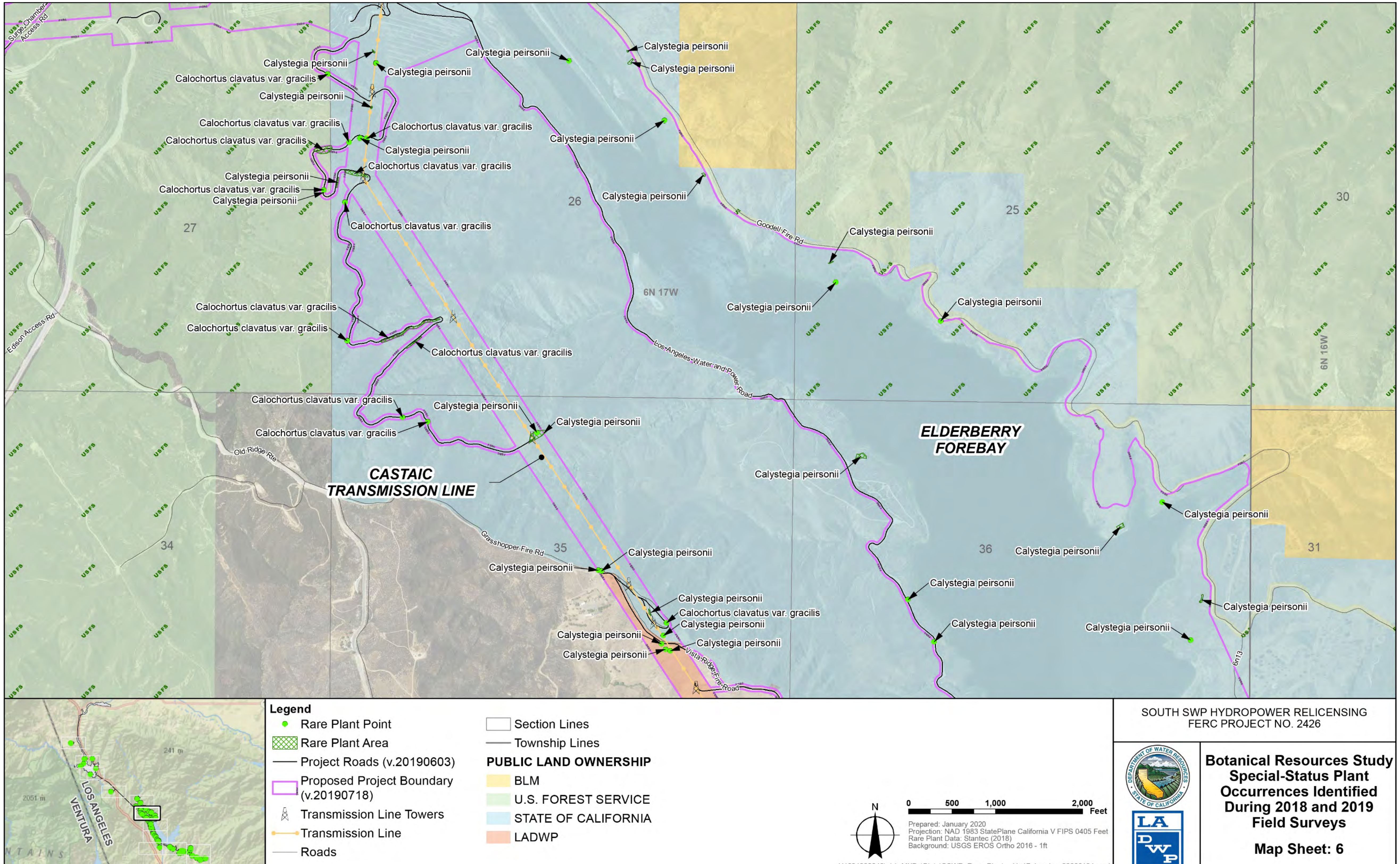

Figure 5.4.1-27. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

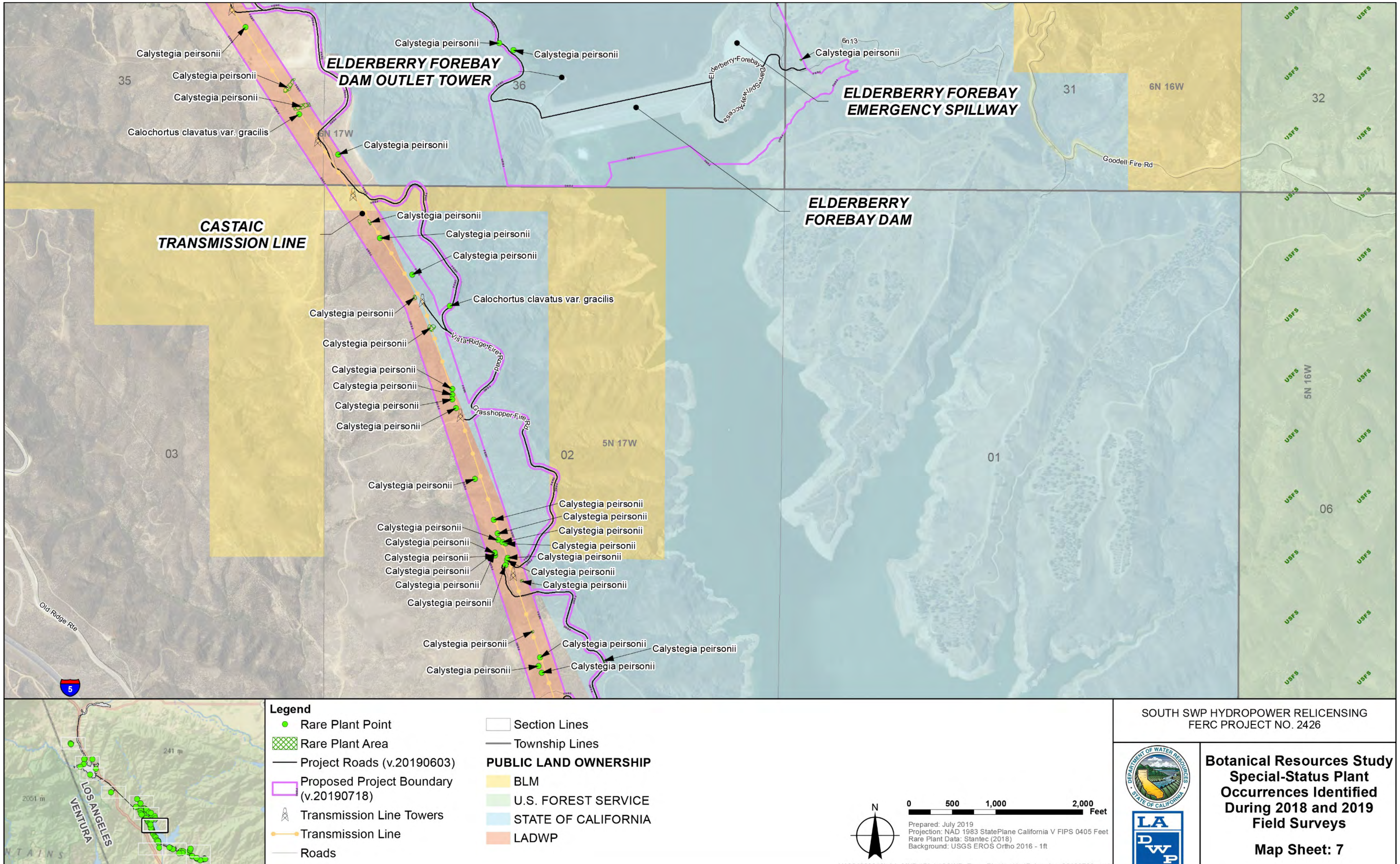

Figure 5.4.1-28. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

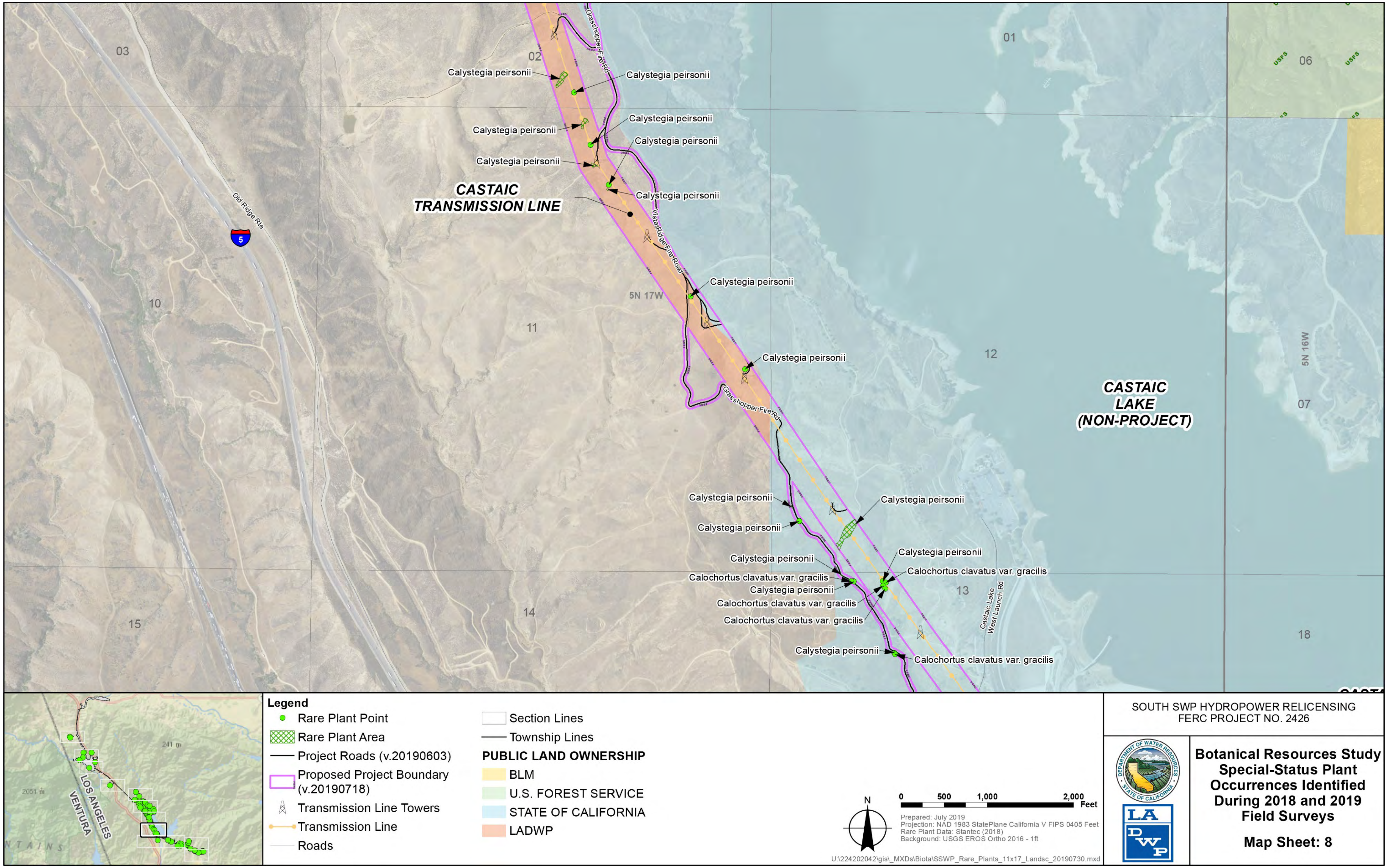

Figure 5.4.1-29. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

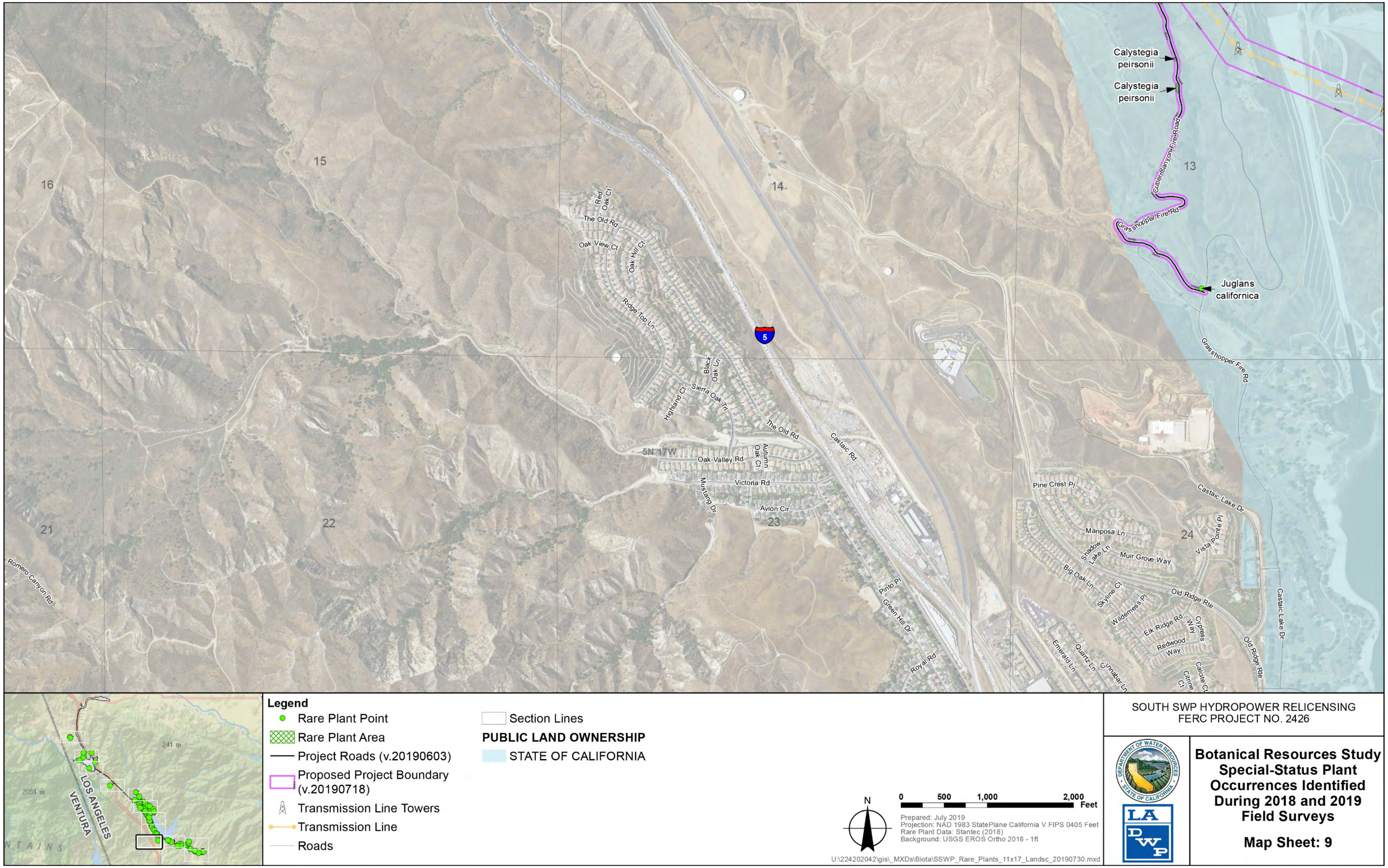

Figure 5.4.1-30. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

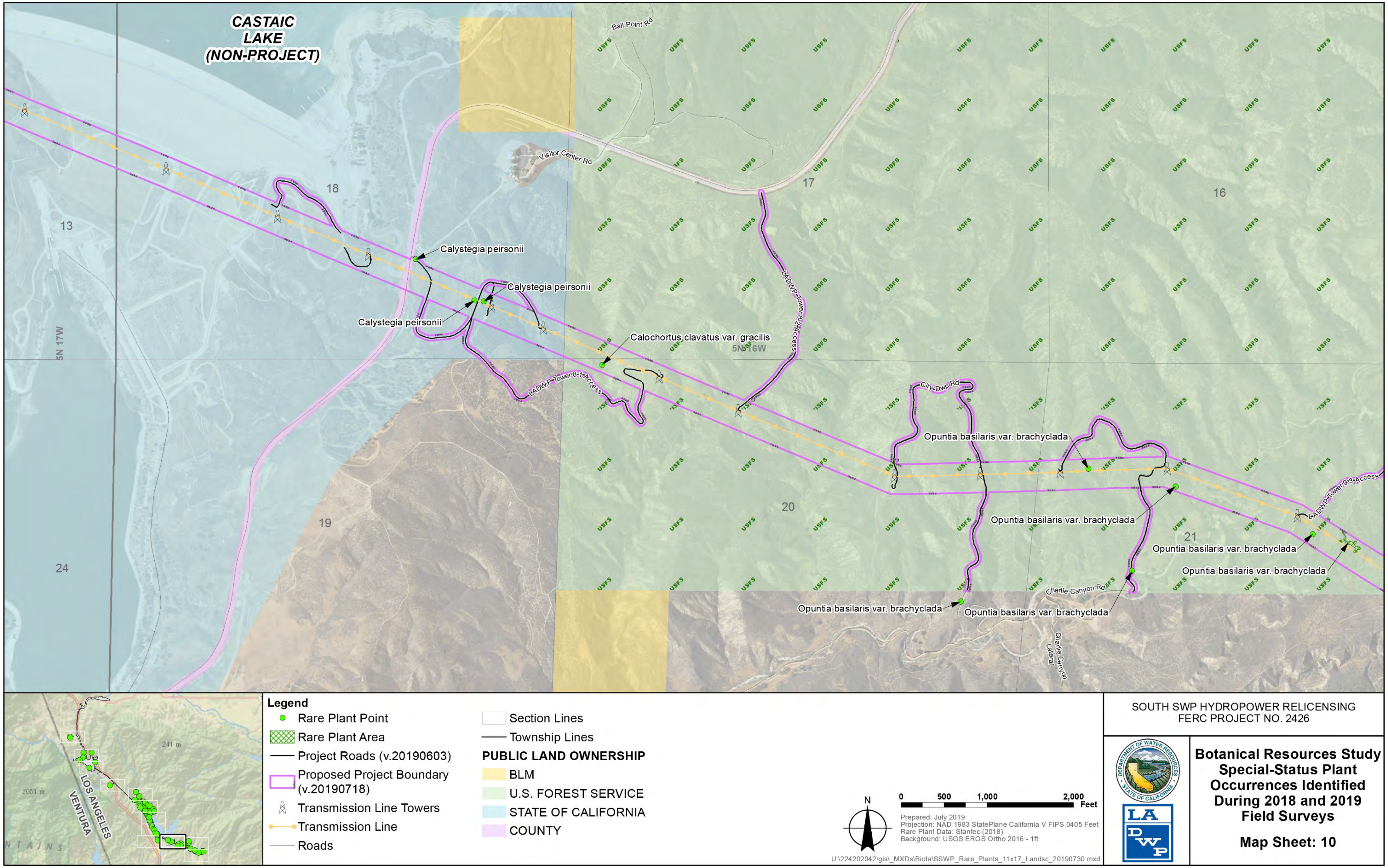

Figure 5.4.1-31. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

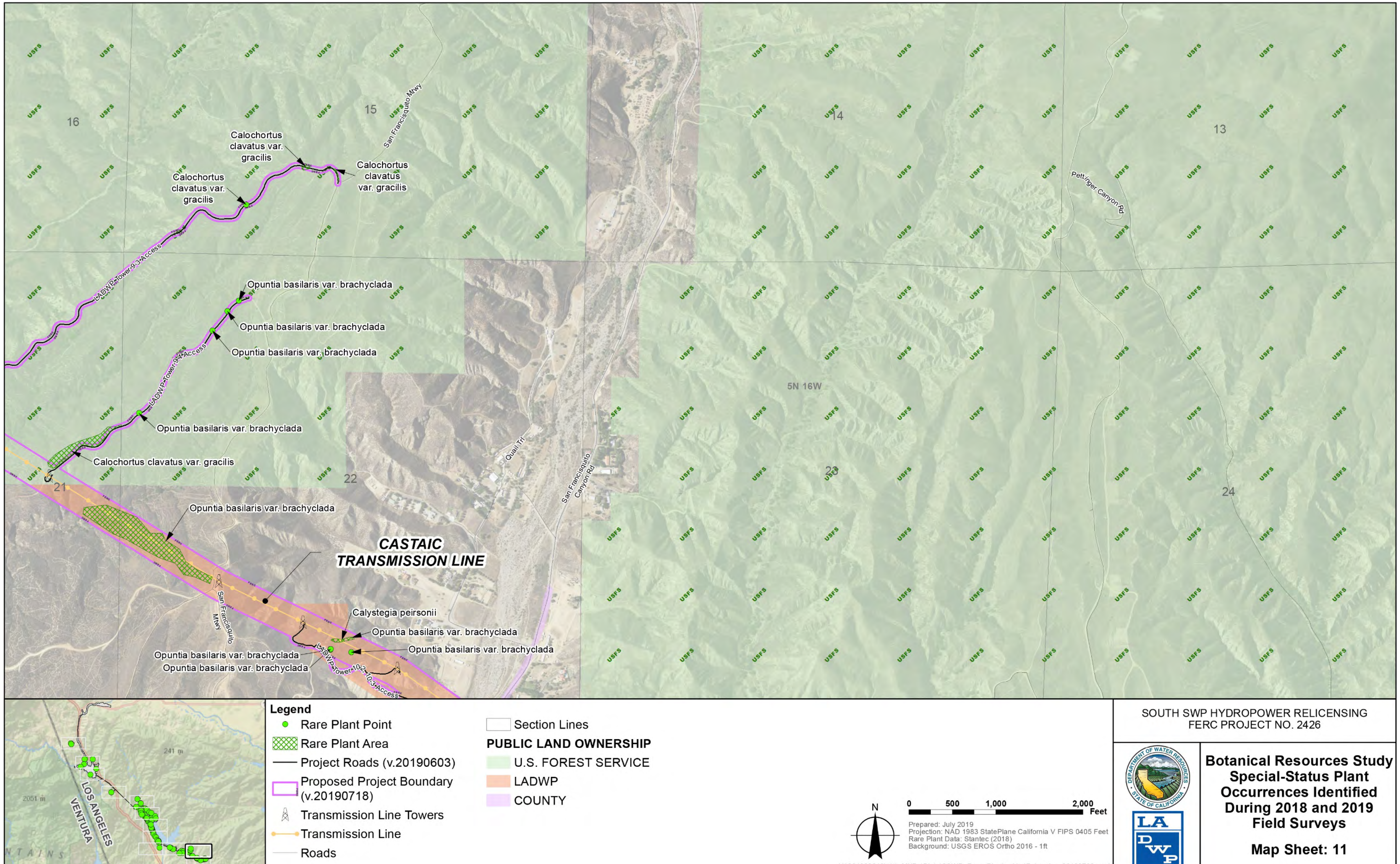

Figure 5.4.1-32. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

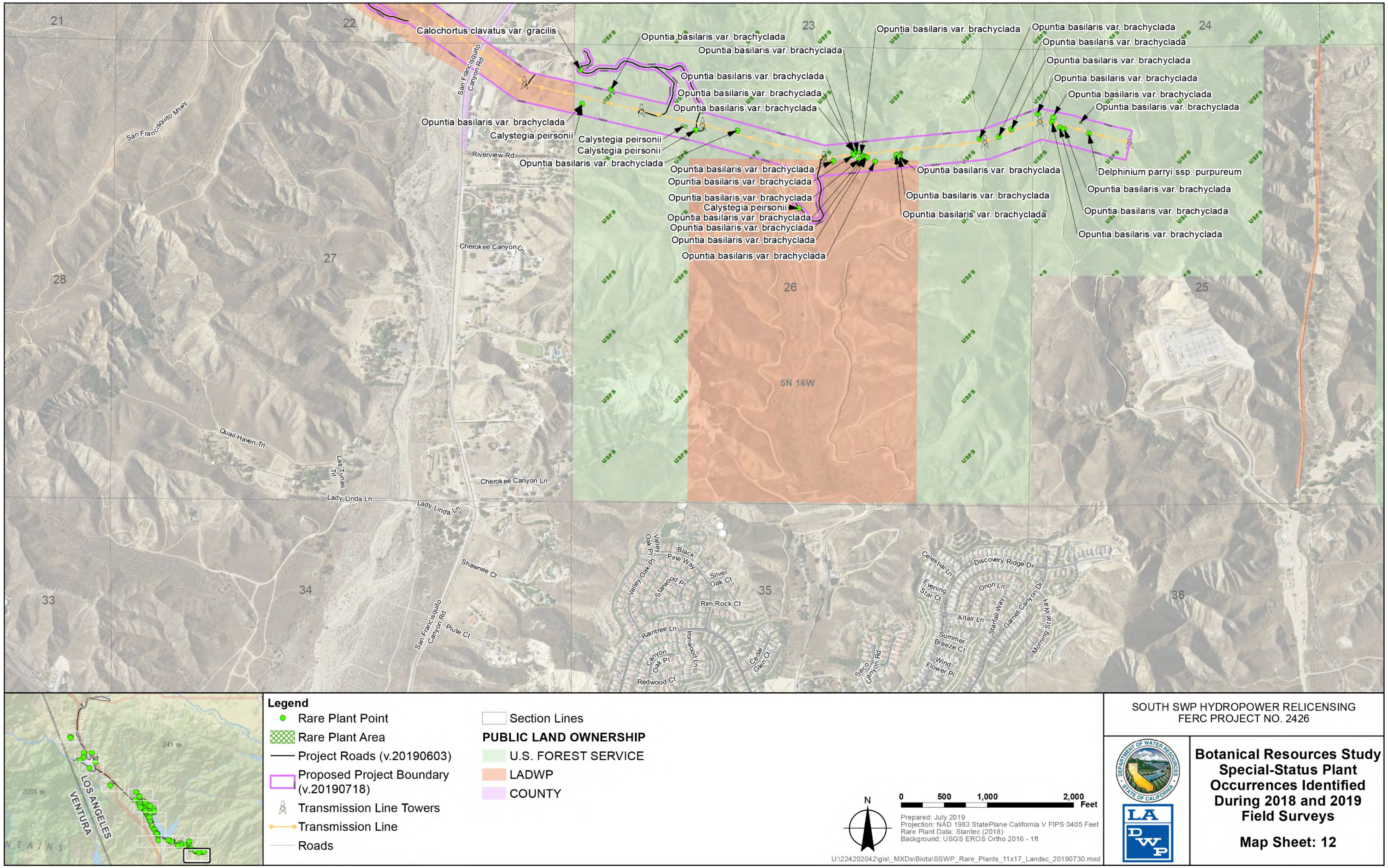

Figure 5.4.1-33. Special-Status Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

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Existing Project Effects

Existing Project effects include ongoing Project O&M, pesticide usage, public use of recreational facilities, and transportation-related effects. Special-status plants have been documented in areas that would be affected by routine maintenance activities, and recreational activities both within and outside of the proposed Project boundary. These existing Project effects on the five special-status plant species found within the proposed Project boundary can be characterized as minor due to the relative ranking and status of each species' overall populations, and given the sporadic and dispersed nature of the Project effects on the species.

Populations of the Peirson's morning glory, slender mariposa lily, California black walnut and short-joint beavertail were healthy and expansive throughout the Project area despite a relatively dry year. Peirson's morning glory, southern California black walnut, and Mount Pinos larkspur are CRPR watch list species (CNPS 2019), and according to the CNPS, range from being moderately threatened in California (Peirson's morning glory and southern California black walnut) to not very threatened in California (Mount Pinos larkspur). Mount Pinos Larkspur is also an FSS species (USFS 2013). These three species (Peirson's morning glory, southern California black walnut, and Mount Pinos larkspur), though of limited distribution throughout California, are experiencing a moderate to low degree of immediacy of threat on their overall viability (CNPS 2019). Project effects may include disturbance or displacement of individuals, and modifications to habitat, including the introduction of NNIP. While these activities are not likely to impact individuals based on known locations, they can pose an impact if these three species expand their range within the Project boundary. However, Project activities are mostly limited to already disturbed and developed areas that are not habitat for these species.

Similarly, slender mariposa lily and short-joint beavertail are both considered rare, threatened, or endangered in California and elsewhere. These two plant species have a CRPR of 1B.2; both are moderately threatened in California, with only a moderate degree of immediacy and threat against their overall viability (CNPS 2019). Project effects on slender mariposa lily are similar to the effects for the aforementioned species. Project effects may include disturbance or displacement of individuals, and modifications to habitat, including the introduction of NNIP. While these activities are not likely to impact individuals based on known locations, they can pose an impact if this species expands its range within the Project boundary. However, Project activities are mostly limited to already disturbed and developed areas that are not habitat for the slender mariposa lily.

The majority of the short-joint beavertail populations found within the proposed Project boundary occur in areas that are void of Project activities and/or low disturbance areas. However, one population observed occurs in the Los Alamos Campground. Therefore, while most short-joint beavertail are only subject to the Project effects mentioned above, the population at Los Alamos Campground may also be subject to effects from recreational activity. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of the campground. While these activities are not likely to impact individuals based on the location of the observed population, they can still pose an impact if destruction or collection occurs. These activities are expected to potentially impact individuals, but are not expected to have an overall impact on the species' viability or habitat.

Non-Native Invasive Plants

For the purpose of this Application for New License, NNIP are defined as A-, B-, or C-listed species by the California Department of Food and Agriculture (CDFA 2018), as species identified as invasive by the California Invasive Plant Council (Cal-IPC) (Cal-IPC 2015), or are included on the LPNF or ANF weed lists, and occur on NFS lands (USFS 2005c; USFS 2015). CDFA ratings provide information on "the statewide importance of the pest, the likelihood that eradication or control effects would be successful, and the present distribution of the pest within the State. The ratings are not laws, but are policy guidelines that indicate the most appropriate action to take against a pest under general circumstances" (CDFA 2018). Cal-IPC compiles an inventory that categorizes plants that threaten California's natural areas. The list is intended to provide guidance for land managers, landscapers, and the general public, but does not circumscribe legal protections. The LPNF and ANF weed lists identify species that may fall under federal legal mandates to control the introduction and spread of invasive species, as described in the Forest Service National Strategic Framework for Invasive Species Management (USFS 2013b) and the 2016 Executive Order, *Safeguarding the Nation from the Impacts of Invasive Species*.

During the pre-field investigation, the Licensees conducted a preliminary assessment of NNIP listed as target species within the Project region. A list of Project-specific target NNIP species was compiled based on the lists available for the ANF and LPNF. In addition, CDFA and Cal-IPC ratings were consulted, and some NNIP species were added to the Project-specific target list. After additional consultation and input from the USFS and CDFW, this target NNIP list was included in the study plan for Study 4.1.6.

Within the proposed Project boundary, 6.5 acres are federal lands administered by BLM. BLM provides GIS information on land ownership and NNIP management to the public from data obtained from the Federal Noxious List, which is maintained by the USDA. This list is used to populate the National Invasive Species Information Management System (NISIMS). NISIMS and the USDA Federal Noxious List were consulted during the development of the Project-specific NNIP target list. However, no federally listed species coincided with the regional, Project-specific listed species and, therefore, were not included in the final NNIP target species list. The Licensees conducted NNIP surveys in 2018 and 2019 in conjunction with special-status plant species surveys described above. Surveys followed applicable CDFW protocol methodology for botanical surveys described earlier in this section. While surveying all accessible areas of the study area and compiling the comprehensive botanical inventory during surveys, field staff consulted the target species list and recorded all NNIP occurrences. Datasheets were completed whenever target NNIP species were encountered, but all plant species (including non-target NNIP) observed were recorded and are reported in the botanical inventory (Appendix K).

For all NNIP species identified on NFS lands, USFS protocols were followed for data collected in accordance with USFS (2014). Special attention was paid to disturbed areas, including road edges, recreation areas, and maintenance areas. For species that are not listed by CDFA (identified with one asterisk in Table 5.4.1-4), data were collected in accordance with USFS protocols (USFS 2014) only for occurrences on NFS lands. For species identified with two asterisks in Table 5.4.1-4 (species that have a CDFW Rating of A, B, or C), occurrence data were collected wherever they were observed. Although they were not used to determine target species criteria, Cal-IPC ratings are also provided in Table 5.4.1-4 because they provide another indicator of land management priority species.

The Licensees performed surveys that encompassed the period within which most NNIP were expected to flower (i.e., April through September), with at least two survey visits performed in all accessible portions of the study area to maximize the likelihood of detection of NNIP (see Figure 5.4.1-21 for portions of the study area that were inaccessible).

A total of 947 occurrences of 27 NNIP species were observed during field surveys within the proposed Project boundary. These occurrences are summarized in Table 5.4.1-4 and depicted on Figures 5.4.1-34 through 5.4.1-49. In addition to the target species, information on other noxious weeds occurrences (non-target NNIP that are not listed in the table above) was recorded on NNIP datasheets, and presence was noted in the botanical inventory. Noxious weeds that were not target NNIP species did not count towards the total number of NNIP species occurrences. This is due in part to the criteria set forth for target species as described above. For occurrences that extended beyond the study area boundary, attributes of the entire occurrence, including estimated size, were recorded. However, acreage counts for occurrences that extended beyond the study area boundary were not included in the final acreage count.

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Table 5.4.1-4. Non-Native Invasive Plant Species Occurrences Within the Proposed Project Boundary, Excluding Lands Overlying the Angeles Tunnel, Documented During 2018 and 2019 Field Surveys

Scientific Name[1]	Common Name	CDFA Rating[2]	Cal-IPC Rating[3]	ANF Invasive Species Non-Native Plant Species List Rating[4]	LPNF Invasive Species Non-Native Plant Species List Rating[4]	ANF Presence[5]	LPNF Presence[5]	Number of Occurrences Within the Proposed Project Boundary[6]
***Acacia* sp.**	Acacia	B	--	--	--	No	No	3
***Ailanthus altissima*	Tree of heaven	C	Moderate	Y	Y	Yes	No	2
***Arundo donax*	Giant reed grass	B	High	Y*	A	Yes	Yes	11
**Atriplex semibaccata*	Saltbush	--	Moderate	--	Y	Yes	No	9
**Brassica tournefortii*	African mustard	--	High	--	--	No	No	1
***Cardaria (Lepidium) draba/pubescens*	Hoary cress/Whitetop	B	Moderate	--	Y	Yes	No	2
***Carduus pycnocephalus*	Italian thistle	C	Moderate	--	Y	Yes	No	17
***Centaurea melitensis*	Tocalote	C	Moderate	--	Y	Yes	Yes	227
***Centaurea solstitialis*	Yellow star thistle	C	High	Y	Y	Yes	Yes	73
***Cirsium arvense*	Canada thistle	B	Moderate	--	--	Yes	Yes	6
***Cirsium vulgare*	Bull thistle	C	Moderate	--	Y	Yes	Yes	55
***Cortaderia jubata/selloana*	Pampas grass	B	High	--	Y	Yes	Yes	9
**Foeniculum vulgare*	Fennel	--	Moderate	--	Y	Yes	No	1
***Halogeton glomeratus*	Halogeton	A	Moderate	--	--	No	No	1
***Lepidium latifolium*	Perennial pepperweed	B	High	--	Y	Yes	No	7
**Marrubium vulgare*	horehound	--	Limited	--	--	Yes	Yes	20
**Nicotiana glauca*	Tree tobacco	--	Moderate	Y	Y	Yes	Yes	9
**Prunus cerasifera*	Cherry plum	--	Limited	--	--	No	No	1
**Ricinus communis*	Castorbean	--	Limited	Y	--	No	No	1
**Robinia pseudoacacia*	Black locust	--	Limited	Y	Y	Yes	No	9
**Rosmarinus officianalis*	Rosemary	--	--	--	--	No	No	2
***Salsola tragus*	Russian thistle	C	Limited	Y	Y	Yes	Yes	206
**Schinus molle*	Peruvian pepper tree	--	Limited	--	--	Yes	No	11
***Spartium junceum*	Spanish broom	C	High	Y	Y	Yes	Yes	102
**Stipa miliacea* var. *miliacea*	Smilo grass	--	Limited	--	--	Yes	Yes	10
***Tamarix ramosissima*	Saltcedar	B	High	--	--	Yes	Yes	147
***Tribulus terrestris*	Puncture vine	C	Limited	--	--	No	No	5
Total:	27 Species							**947**

Sources:
DWR 2018b
Notes:
[1]For species that are not listed by CDFA (identified with one asterisk), data were collected in accordance with USFS protocols (USFS 2014) only for occurrences on USFS lands. For species identified with two asterisks (species that have a CDFA Rating of A, B, or C), occurrence data were collected wherever they were observed.
[2]CDFA Ratings (CDFA 2018):
A = An organism of known economic importance subject to state (or commissioner when acting as a state agent) enforced action involving: eradication, quarantine regulation, containment, rejection, or other holding action.
B = An organism of known economic importance subject to: eradication, containment, control or other holding action at the discretion of the individual county agricultural commissioner. OR An organism of known economic importance subject to state endorsed holding action and eradication only when found in a nursery.
C = An organism subject to no state enforced action outside of nurseries except to retard spread. At the discretion of the county agricultural commissioner. OR An organism subject to no state enforced action except to provide for pest cleanliness in nurseries.
[3]Cal-IPC Ratings (Cal-IPC ratings are provided for reference but were not a criteria in determining which species were target species) (Cal-IPC 2018):
Limited = These species are invasive but their ecological impacts are minor on a Statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.
Moderate = These species have substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
High = These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
[4]ANF and LPNF Designation (USFS 2005c):
Y = Present on forest
Y = Forest is currently treating, in process of treating or has treated in past*
A = adjacent or near Forest, reasonable to expect invasion on Forest lands within next 5 years
? = plants are adjacent or near and highly likely to be present but not documented
 # = plant added to CDFA noxious weed list 8/2003, pest rating not finalized but "C" rating expected
[5]ANF and LPNF occurrences were determined based on congressional boundaries.
[6]These occurrences exclude lands overlying the Angeles Tunnel. In addition, no NNIP occurrences were noted on BLM land.
Key:
ANF = Angeles National Forest
BLM = U.S. Department of the Interior, Bureau of Land Management
Cal-IPC = California Invasive Plant Council
CDFA = California Department of Food and Agriculture
LPNF = Los Padres National Forest
NNIP = non-native invasive plant
USFS = U.S. Department of Agriculture, Forest Service

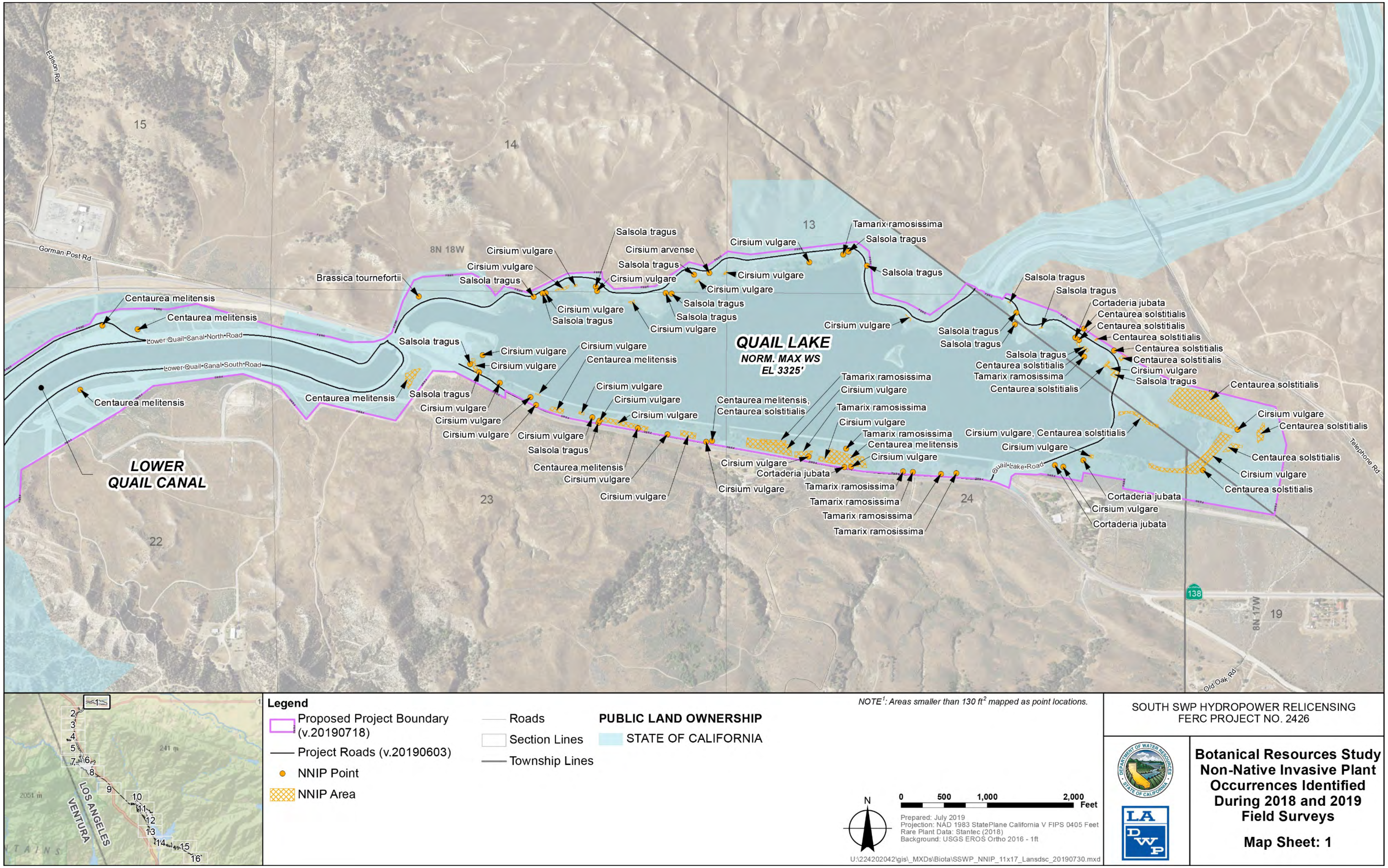

Figure 5.4.1-34. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

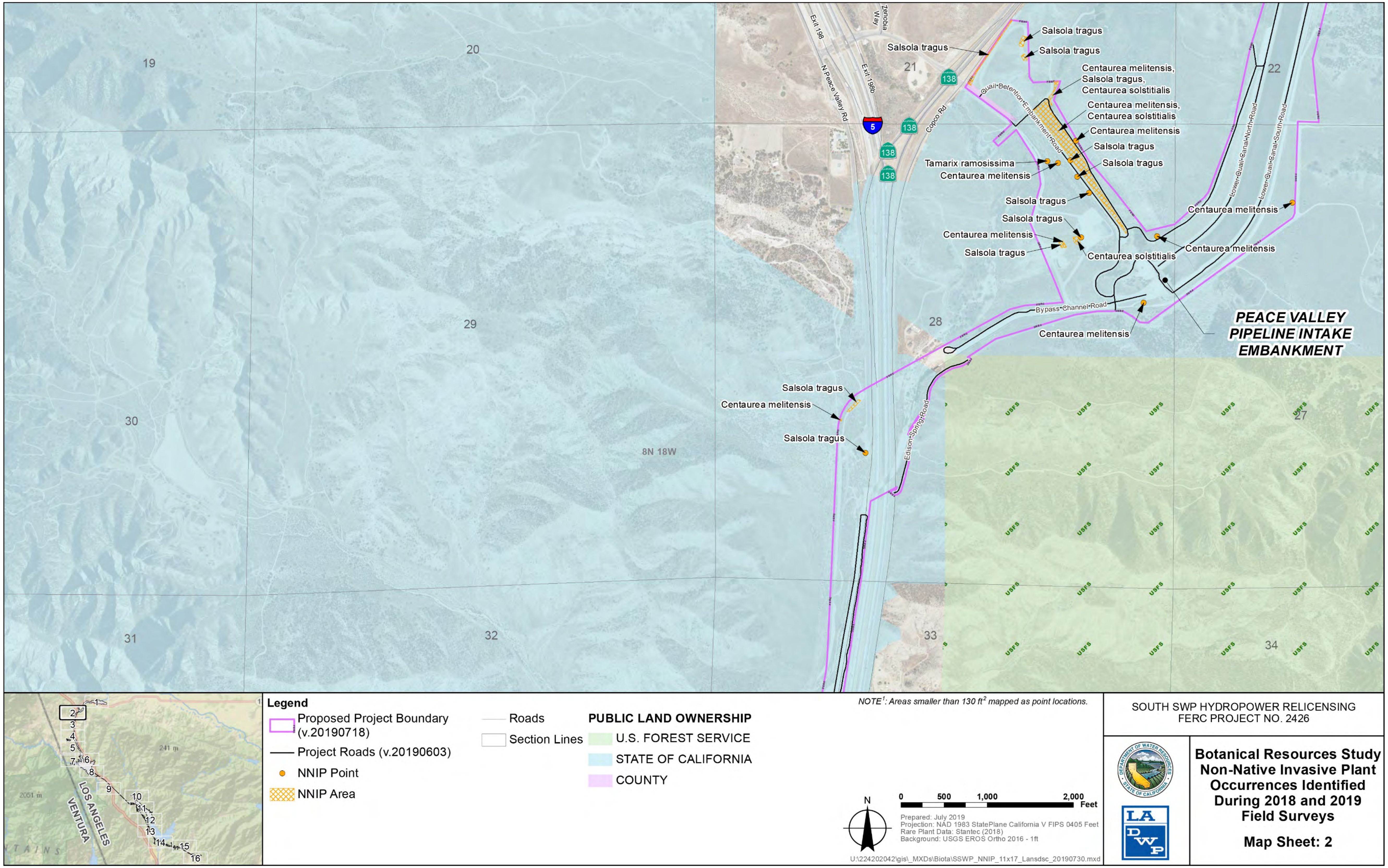

Figure 5.4.1-35. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

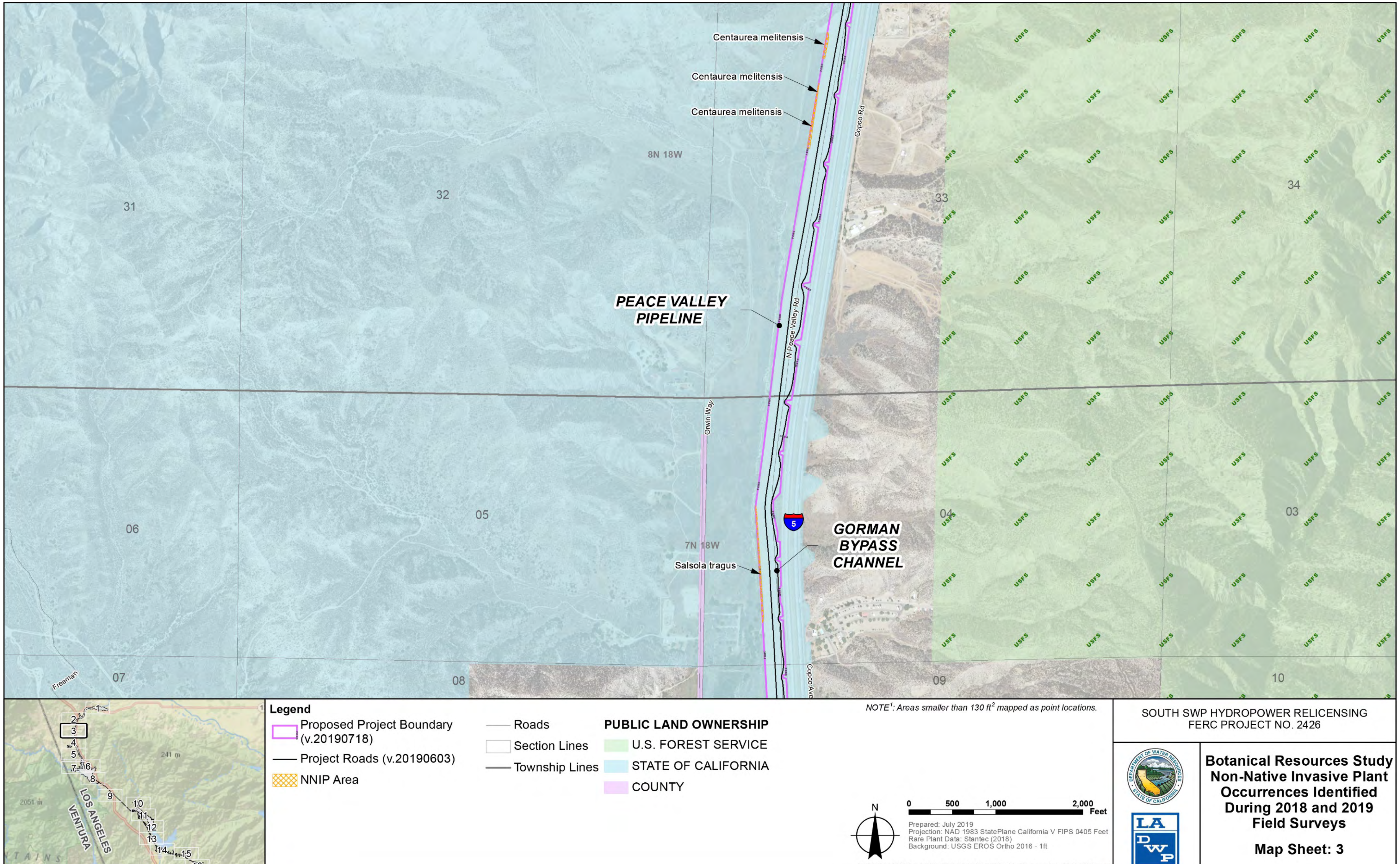

Figure 5.4.1-36. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

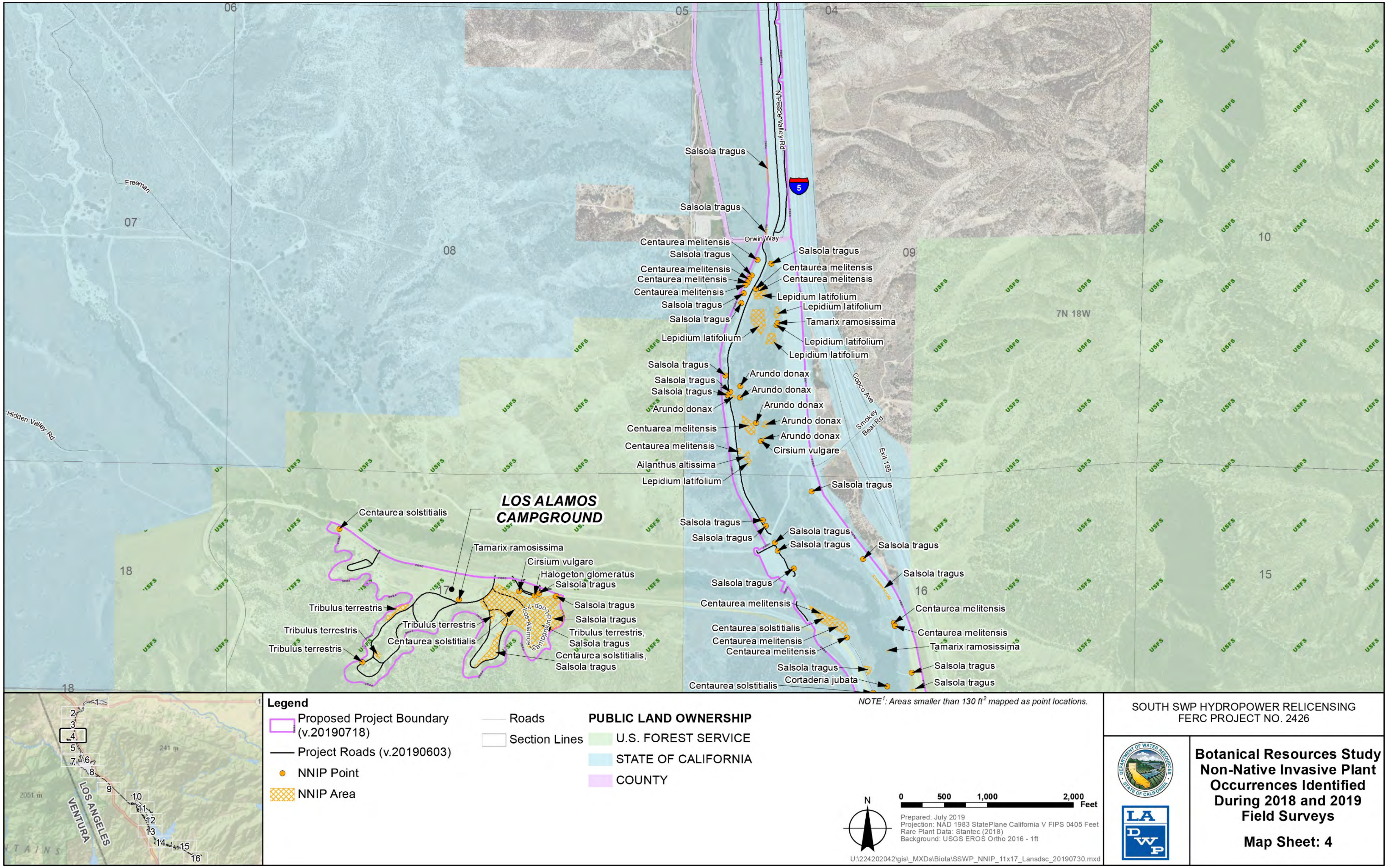

Figure 5.4.1-37. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

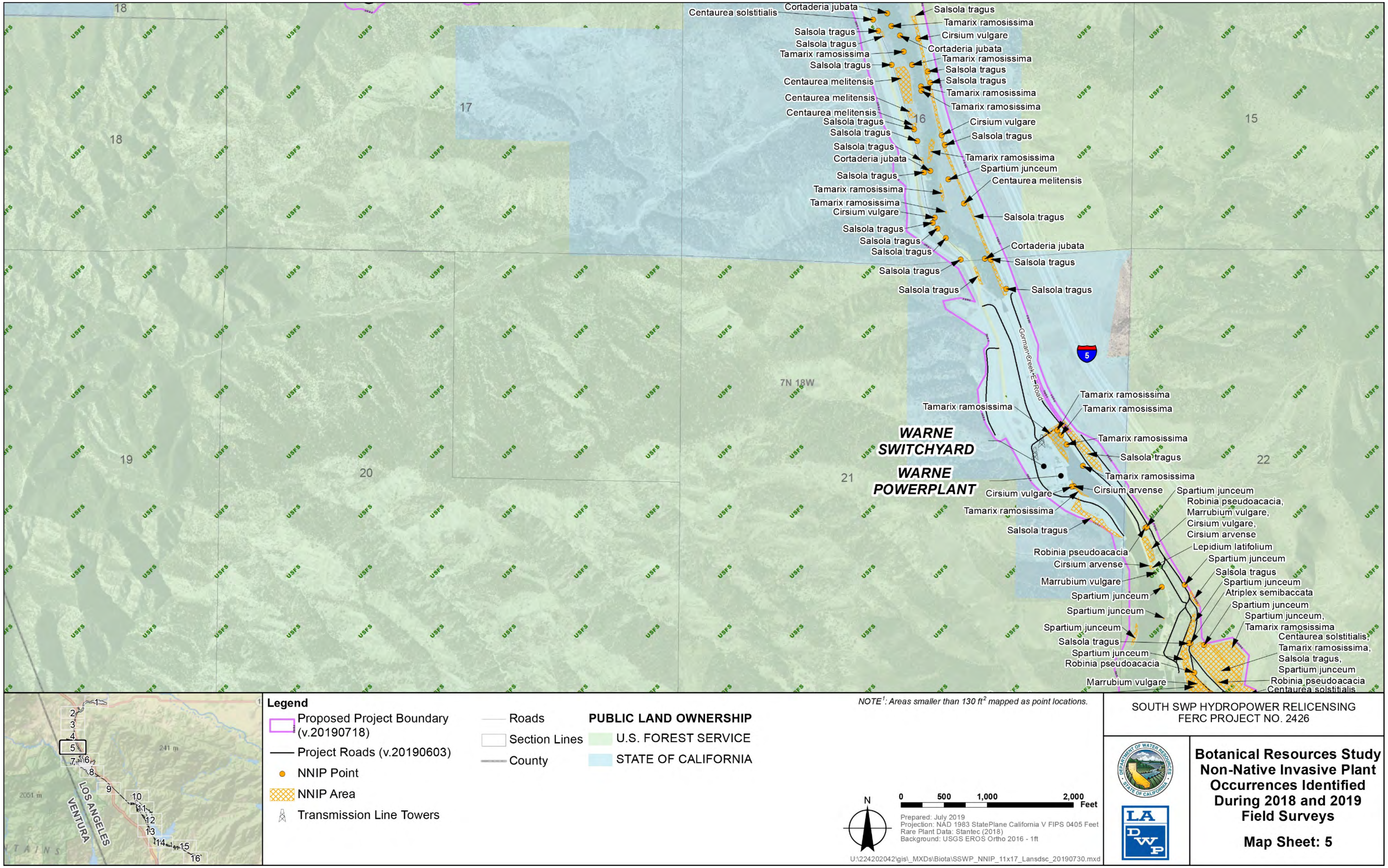

Figure 5.4.1-38. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

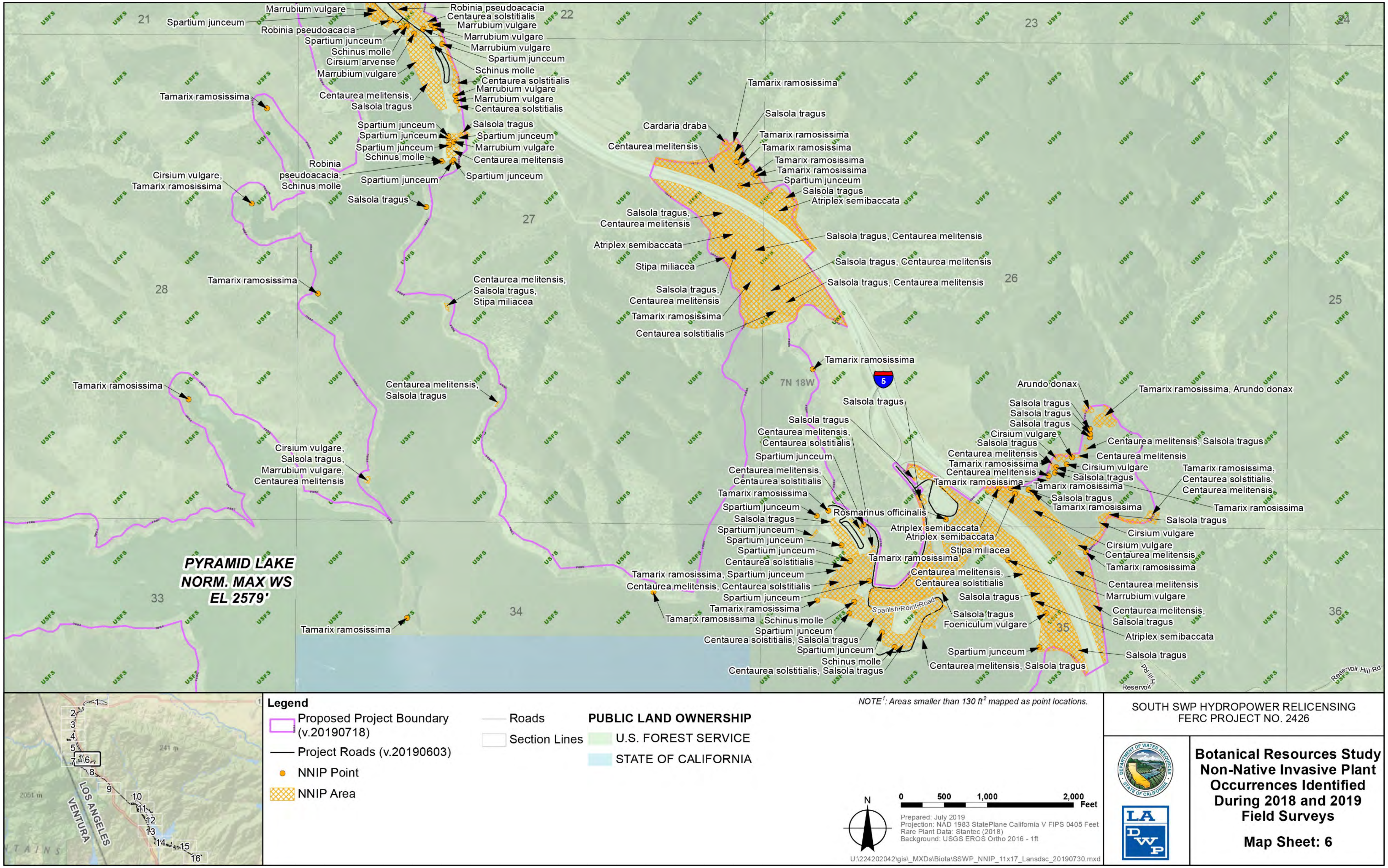

Figure 5.4.1-39. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

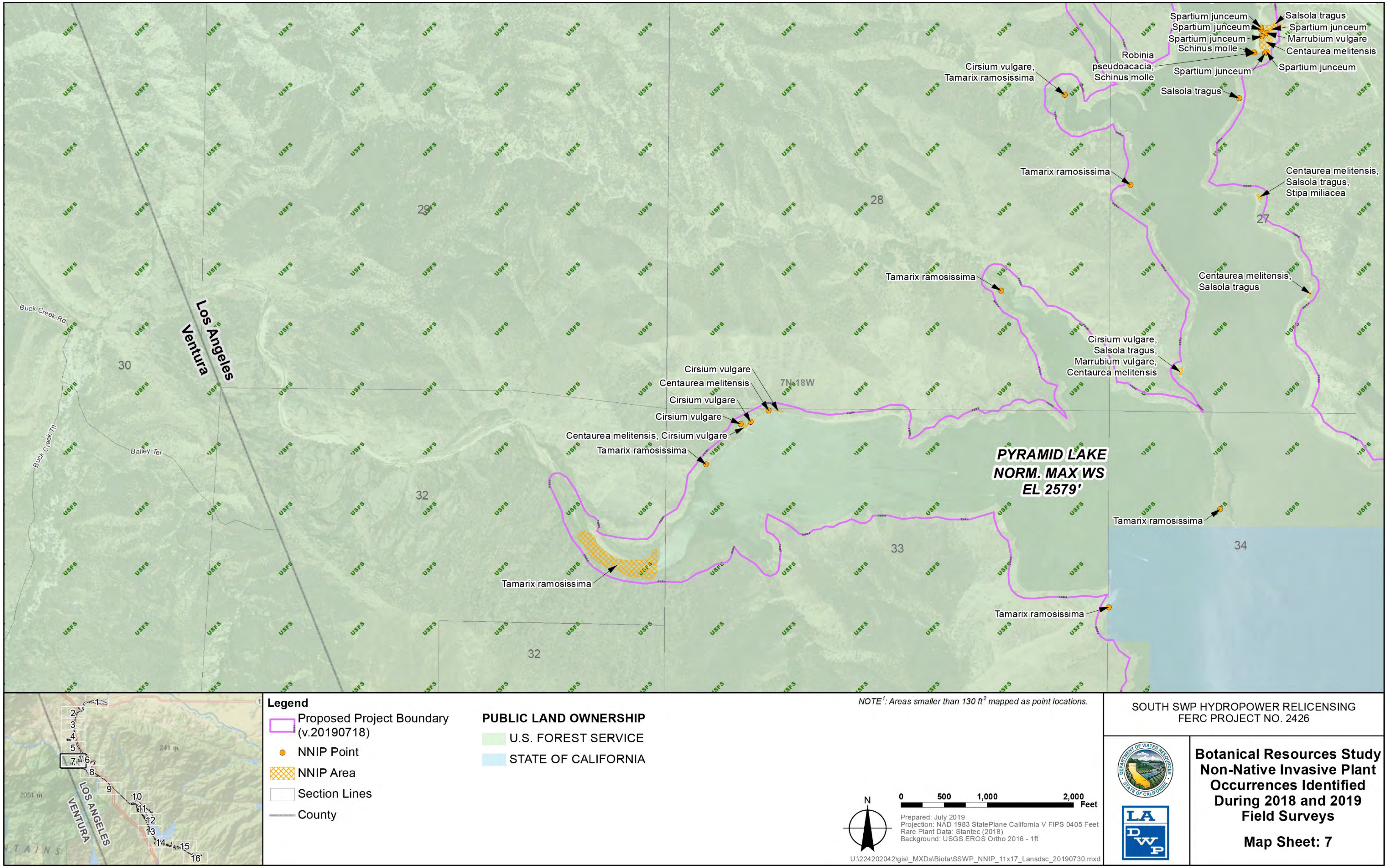

Figure 5.4.1-40. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

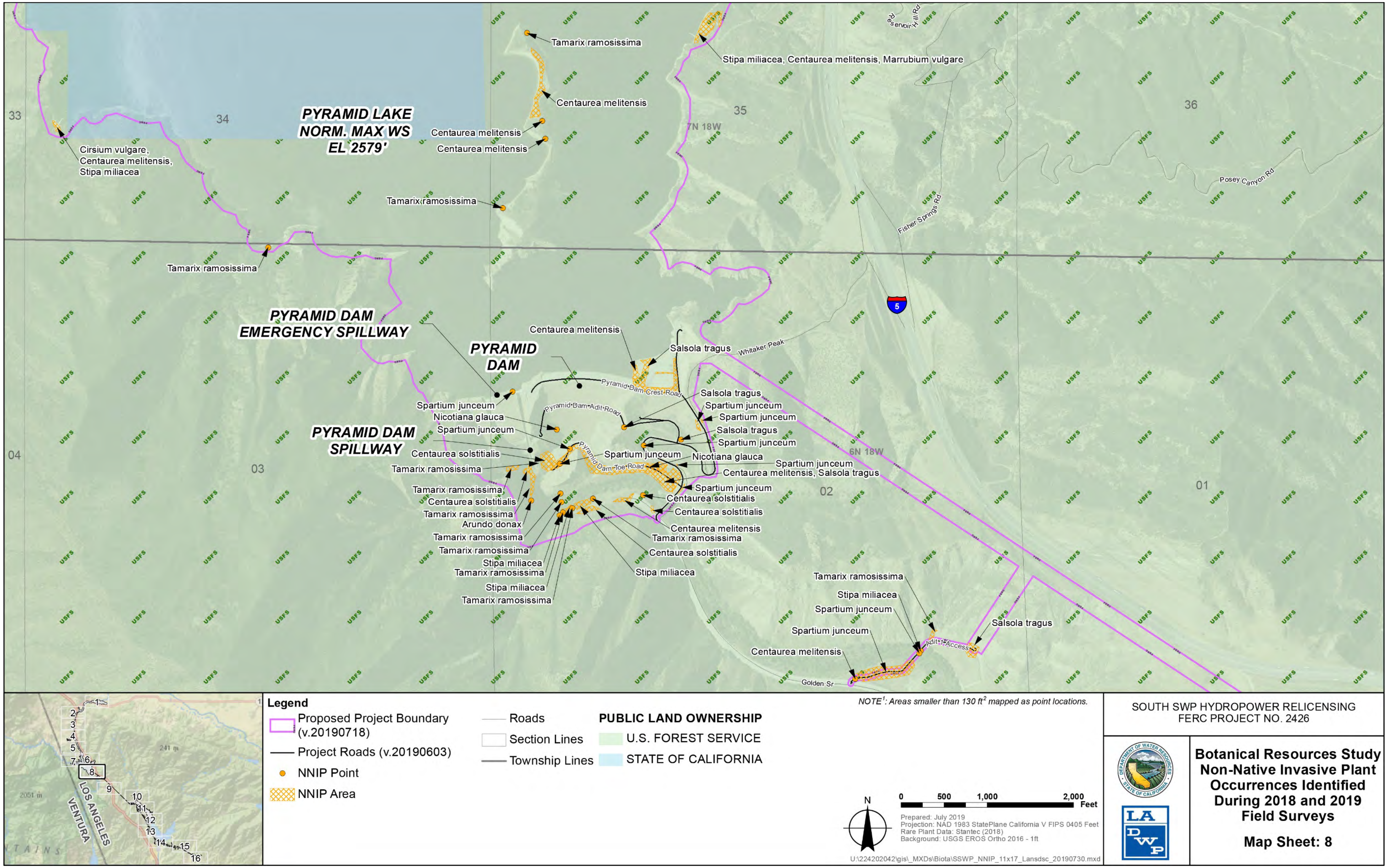

Figure 5.4.1-41. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

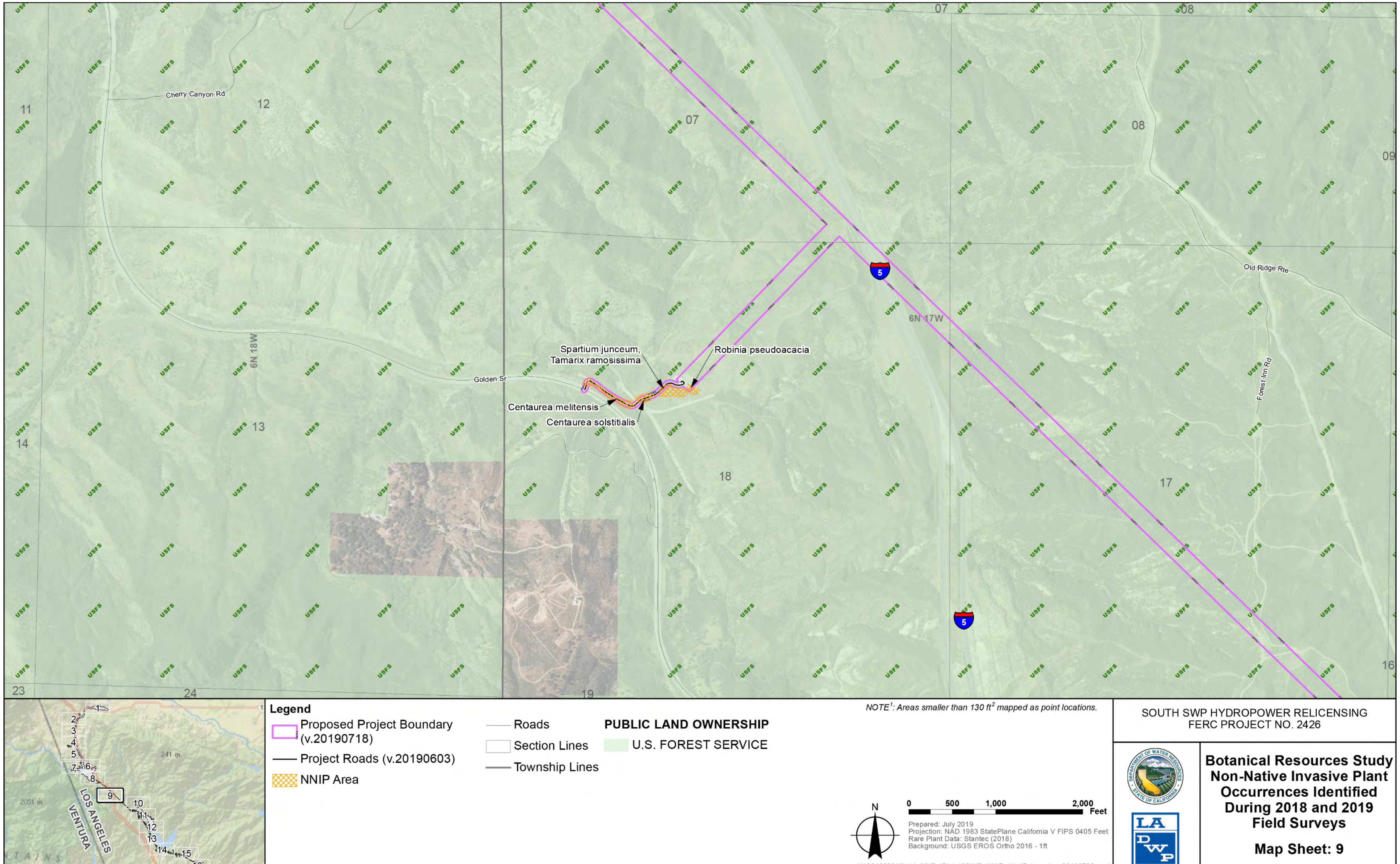

Figure 5.4.1-42. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

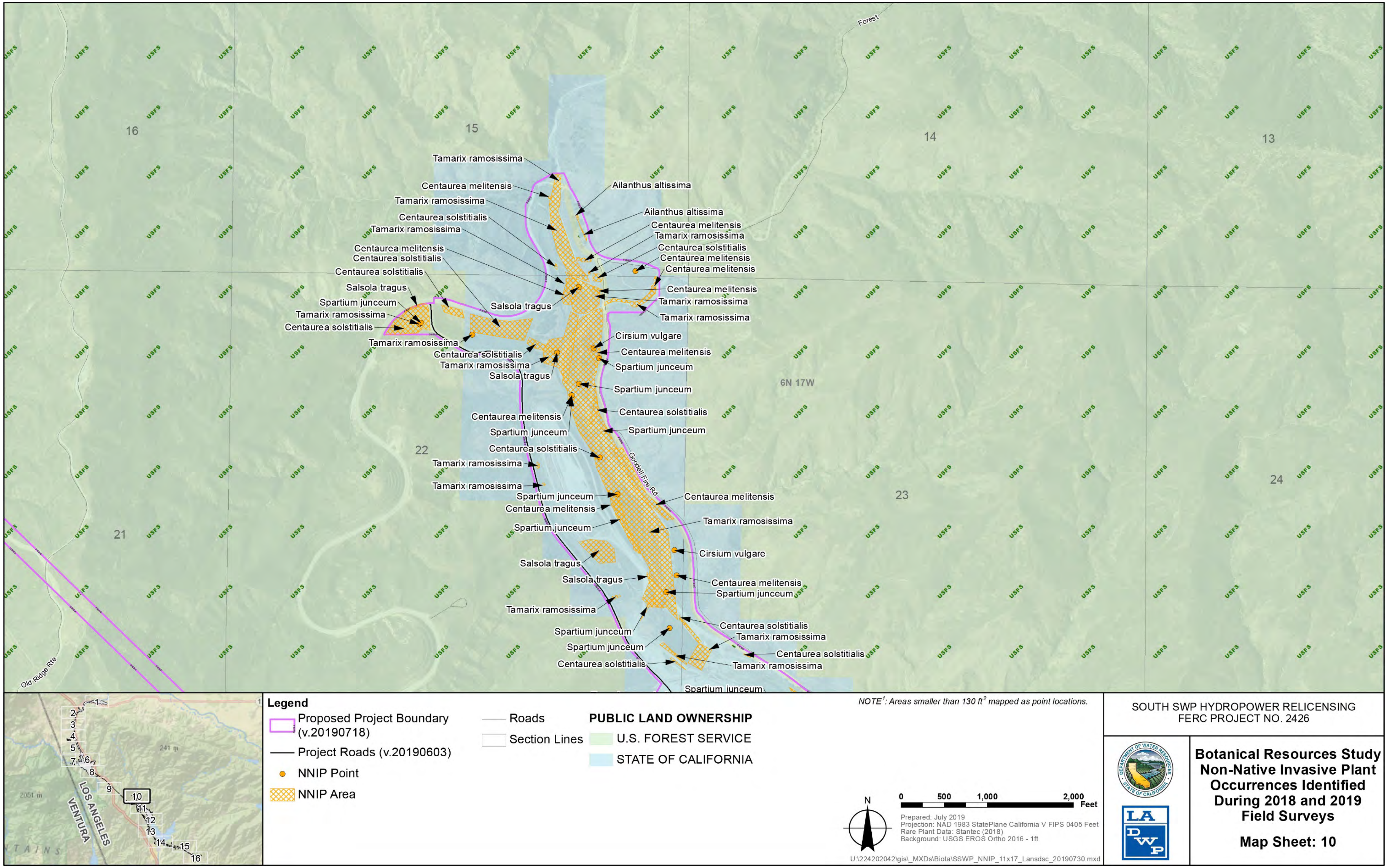

Figure 5.4.1-43. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

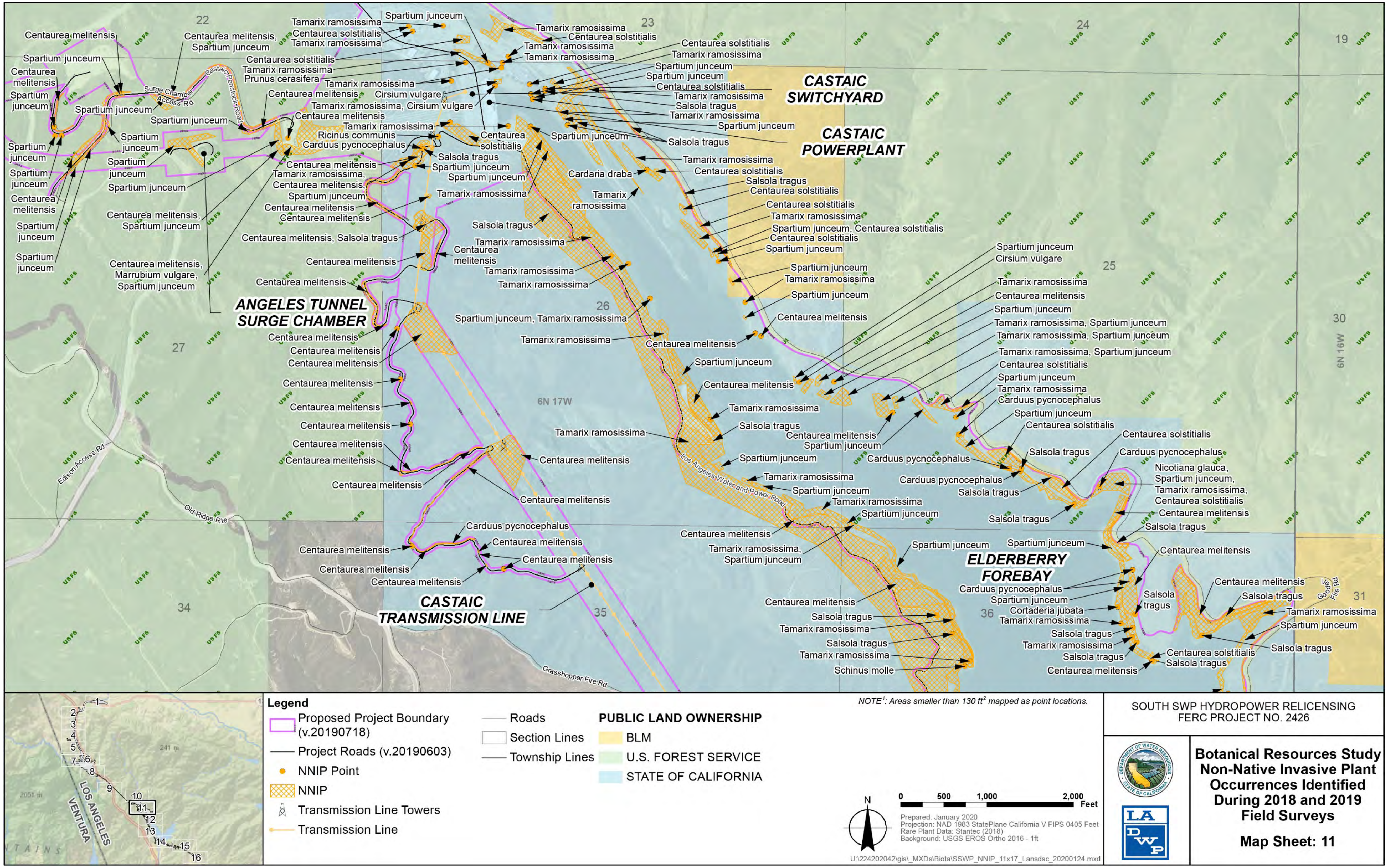

Figure 5.4.1-44. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

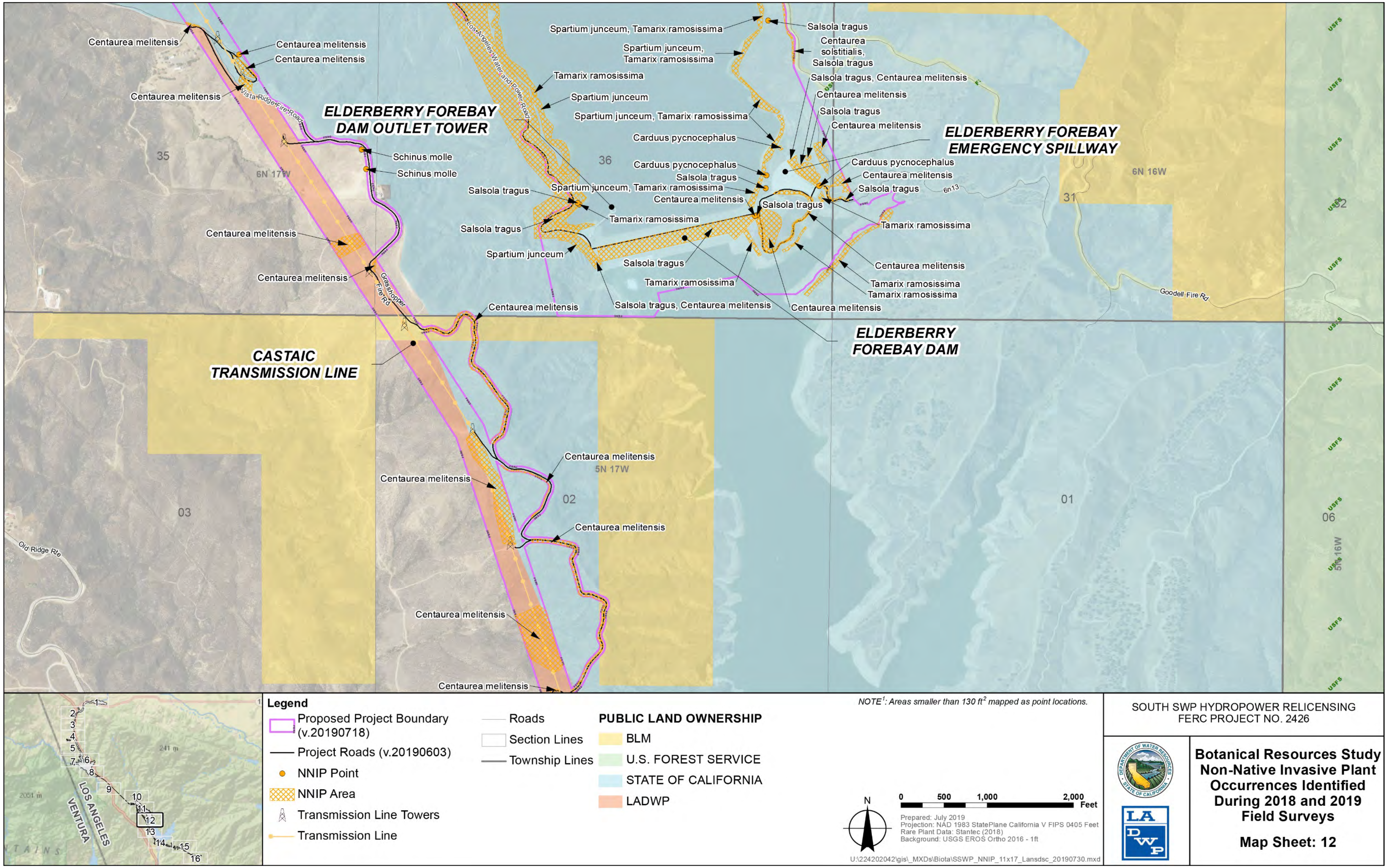

Figure 5.4.1-45. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

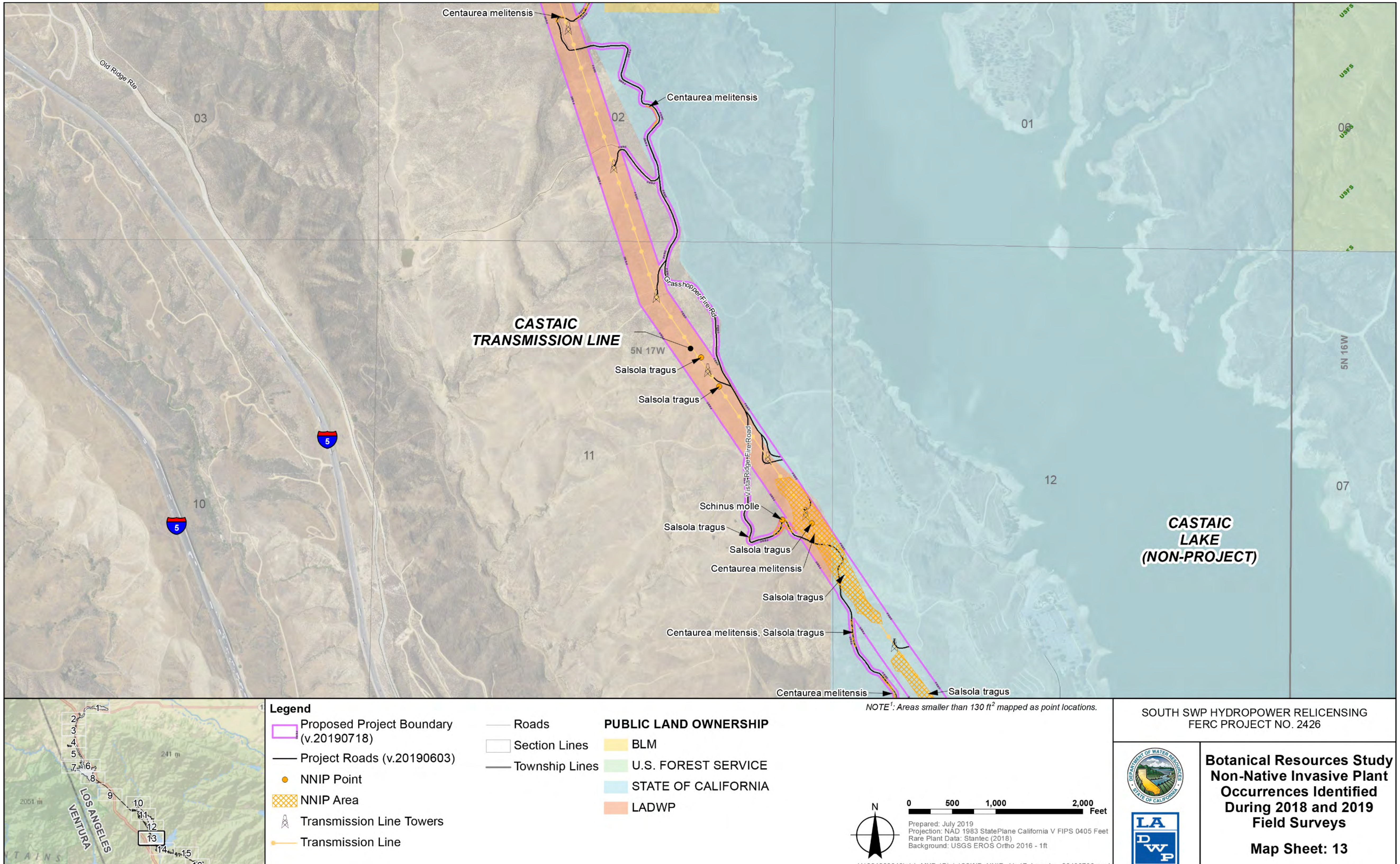

Figure 5.4.1-46. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

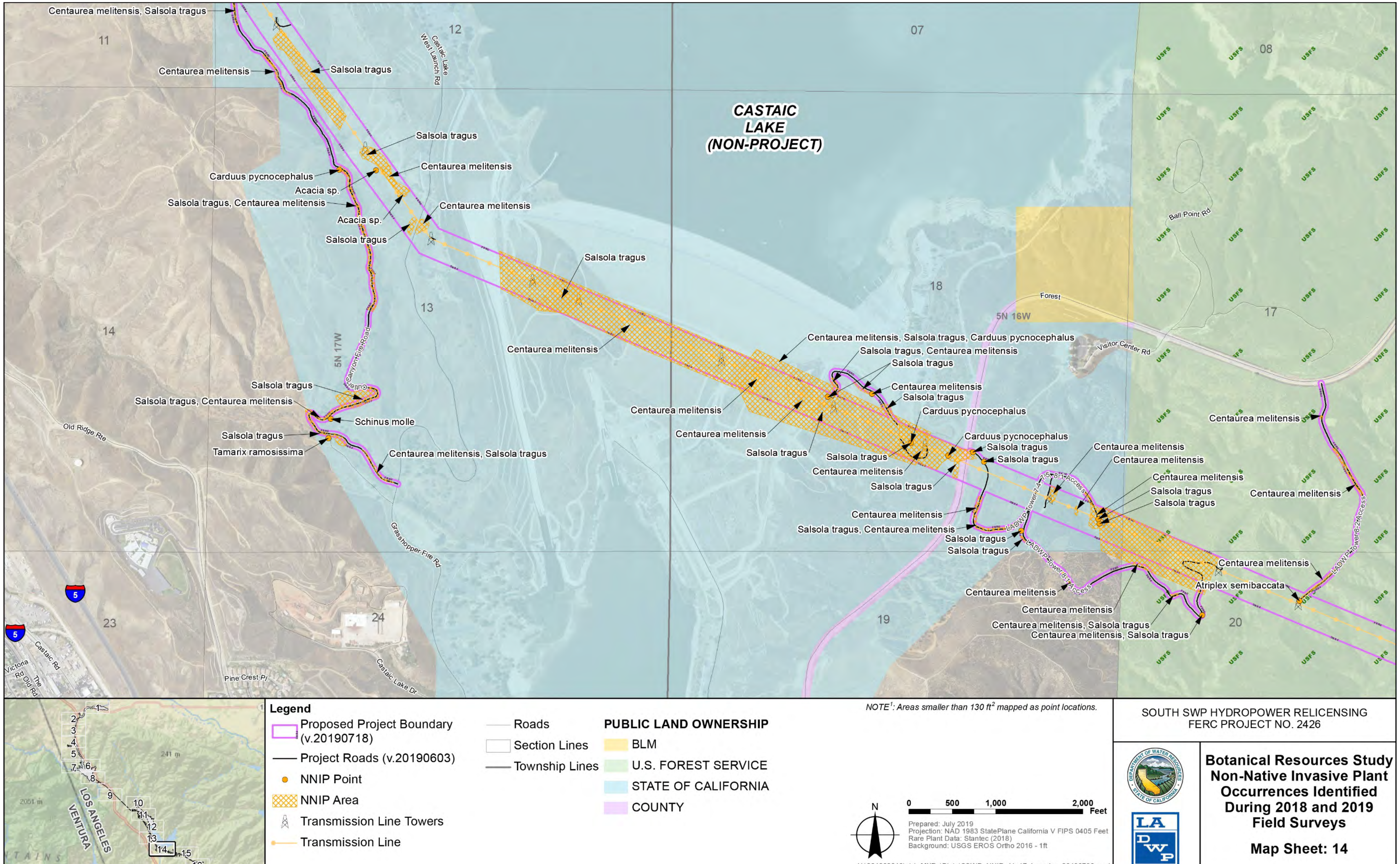

Figure 5.4.1-47. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

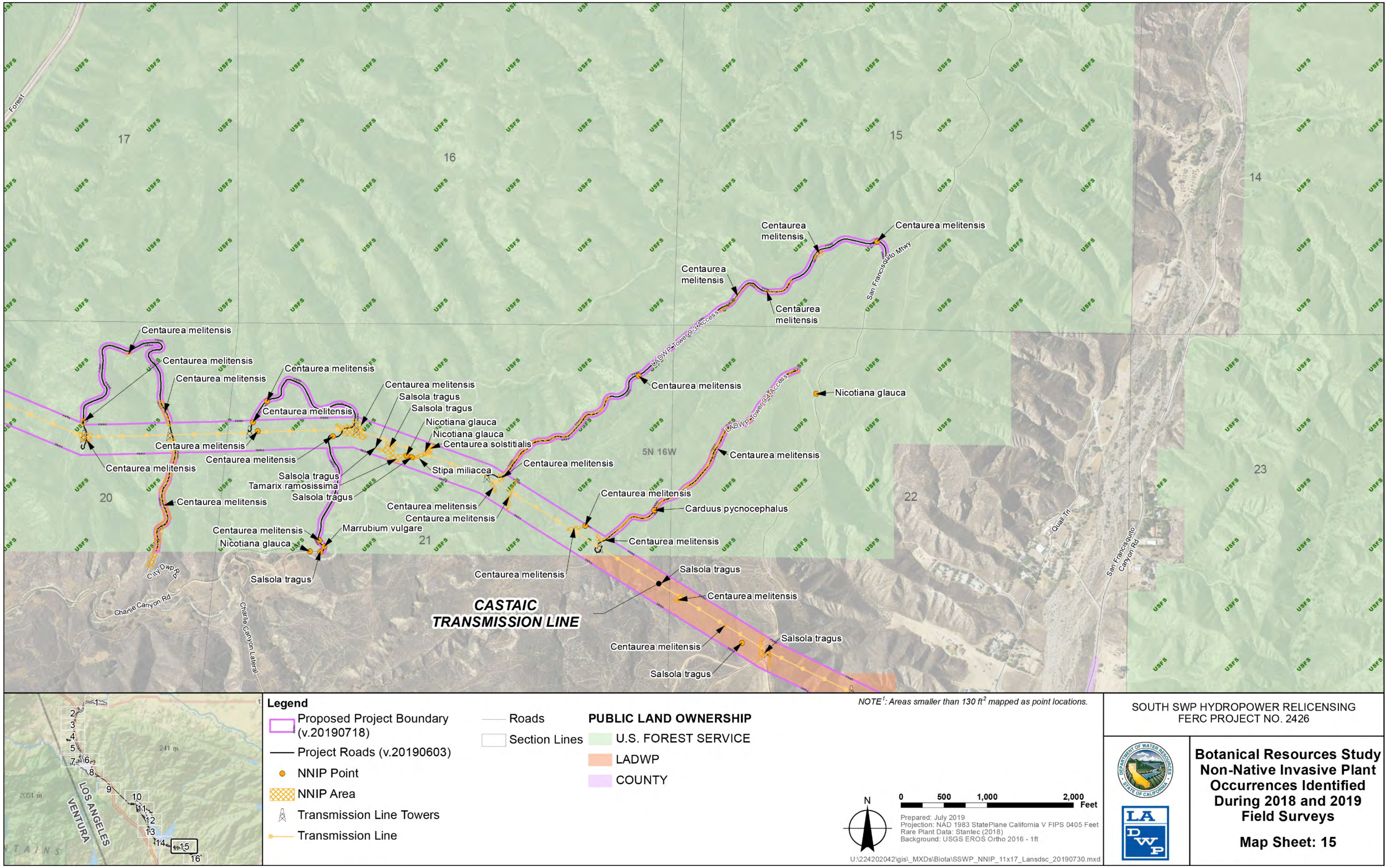

Figure 5.4.1-48. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

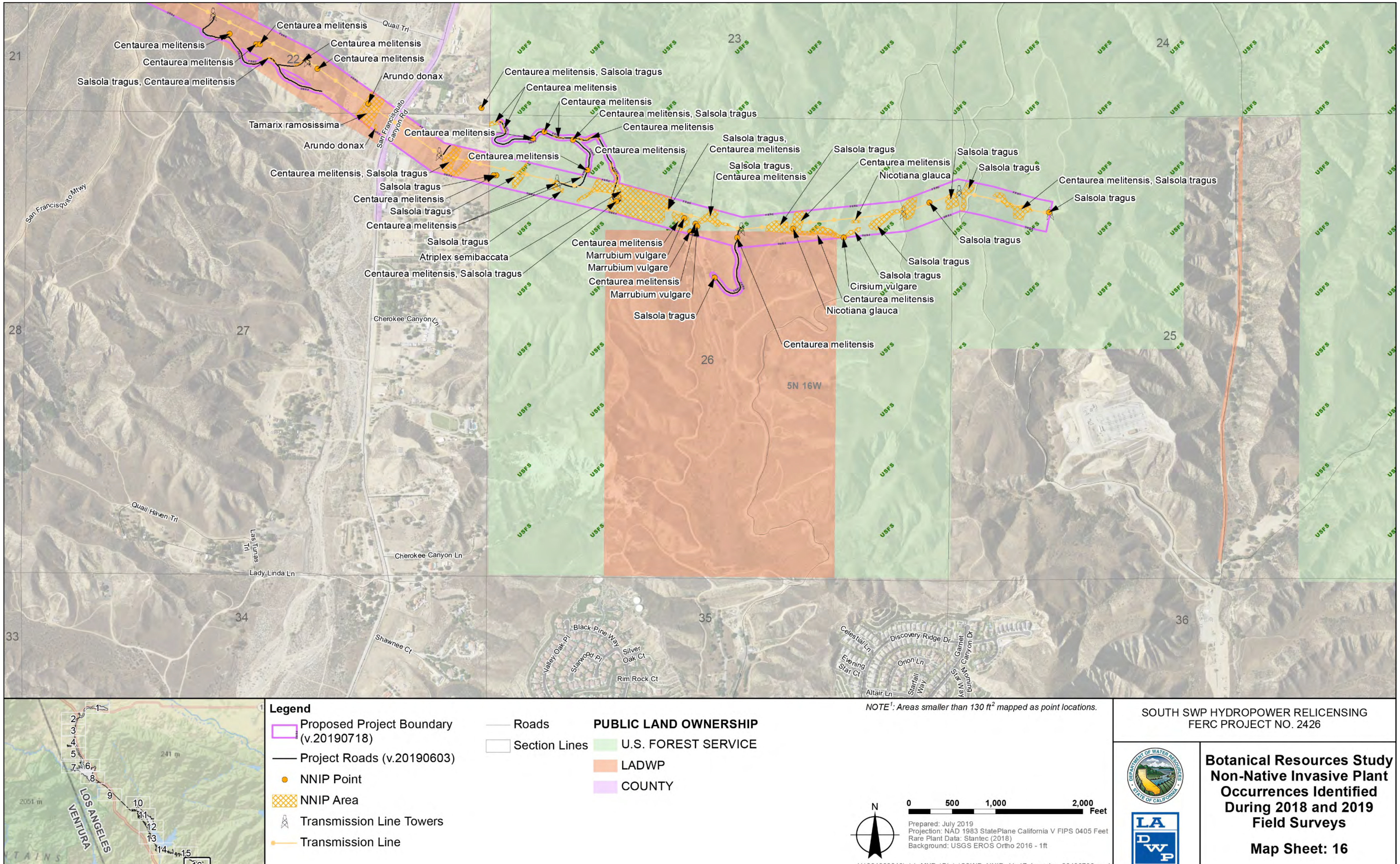

Figure 5.4.1-49. Non-Native Invasive Plant Occurrences Identified During 2018 and 2019 Field Surveys Within the Proposed Project Boundary

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Existing Project Effects

Existing Project effects include ongoing Project O&M, pesticide usage, public use of recreational facilities, and transportation-related effects. NNIP have been documented in the Project area, and Project-related activities, such as road use, vegetation removal, and recreation activities, are all potential vectors for the spread of such species within the proposed Project boundary.

However, although the Project is known to have NNIP within the proposed Project boundary and Project O&M activities are performed that may lead to the dispersal of NNIP throughout the Project area, the Project is not the sole driver for the spread of NNIP in the Project area. The lands abutting the proposed Project boundary, a mix of public and private land, include a variety of vectors for NNIP introduction. For example, non-Project-related NNIP populations are dispersed into the Project via major public roads (Interstate 5) as well as through public and private use of adjacent facilities, such as USFS roads, campgrounds, equestrian trails, and cattle ranches. The existing Project effects on NNIP dispersal within the Project area can be characterized as negligible because it is assumed that NNIP populations will colonize and persist throughout the Project area regardless of ongoing Project O&M.

Project Activities and Wildlife

A large variety of wildlife species, both common and rare, inhabit or have the potential to be present within the Project boundary. Their general potential to be affected by Project activities is summarized in this section, with more specific discussion about wildlife movement, commercially valuable wildlife, and individual species further in the section.

Existing and ongoing O&M activities within the proposed Project boundary include vegetation management, trail and road maintenance, maintenance of recreation facilities and transmission lines, and debris management. In addition, general recreation occurs throughout a large portion of the area within the proposed Project boundary, with a concentration around Pyramid and Quail Lakes. Recreation and routine O&M activities are anticipated to continue as part of the Licensees' Proposal.

Vegetation management is typically restricted to keeping developed and disturbed areas clear of encroaching vegetation (around Project facilities with a 20- to 75-foot buffer and Project roads with up to a 15-foot buffer), and includes manual trimming and herbicide application, along with occasional hazard tree removal. Herbicide application typically occurs twice annually, at a minimum. These applications typically occur between December 1 and March 31, as determined by PCAs for pre-emergent herbicides. Follow-up visits to apply post-emergent herbicides and/or additional treatments (as needed) are seasonally dependent, and typically occur between April 1 and June 30. A third cycle, if required, would typically be completed between July 1 and October 14. Other maintenance is restricted to existing Project infrastructure and does not encroach into undisturbed habitats surrounding existing, trails, roads, or structures.

Debris management and dredging occurs every two to three years at the storm bypass channel, the check-dam basin, and Elderberry Forebay; however, these activities are permitted separately, and measures to avoid and protect biological resources are implemented.

Established recreation areas are concentrated around Pyramid Lake, with other sites limited to the Los Alamos Campground and a single, non-motorized recreation area at Quail Lake. Generally, recreation is localized to these areas, with minimal expansion into surrounding areas due to absence of infrastructure, such as access roads or trails paired with rugged terrain. For example, with the exception of a couple of boat-in picnic areas, all recreation areas associated with Pyramid Lake are along the eastern shore, with the largest and most built-up recreation areas located adjacent to Interstate 5.

The recreation areas on the west shore of Pyramid Lake are only accessible by boat and consist of small beaches between steep valley slopes. The shores of Pyramid Lake are steep and sheer to the edge of the water, making it difficult to traverse or navigate the lake by foot. For these reasons, dispersal of recreation into surrounding NFS lands is restricted and the amount of foot traffic in open space areas providing higher quality habitat is limited.

Recreation at Quail Lake is limited to low-impact activities, such as fishing, picnicking, and walking. Boats are not allowed and the road around the perimeter of the lake is closed to public traffic, so vehicles are restricted to the parking area on the west end of the lake. A single designated recreation area is located near the parking lot.

Recreation in the areas described above has been ongoing for decades, and it can be assumed that wildlife has acclimatized to the existing level of disturbance resulting from recreation, as well as Project O&M and other routine activities. The majority of routine activities occur in or adjacent to disturbed or developed areas, with minimal encroachment into surrounding habitats. Because of this, existing Project effects on the majority of wildlife are considered to be minimal.

Wildlife Movement

Wildlife corridors refer to established migration routes commonly used by resident and migratory species for passage from one geographic location to another. Corridors are present in a variety of habitats and link otherwise fragmented areas in an urban landscape. Maintaining the continuity of established wildlife corridors is important to: (1) meet the needs of species with specific foraging requirements, (2) allow for dispersal of species in response to adverse ecological conditions, and (3) allow for genetic exchange among otherwise geographically separated populations, which helps protect species against the threat of extinction (Penrod et al. 2005). Therefore, resource agencies consider wildlife corridors to be a sensitive resource.

The study area for Study 4.1.7 was previously defined to consist of the proposed Project boundary with an applied 1.5 mile buffer. The entire study area is discussed in this

Wildlife Movement subsection to account for species that may primarily use adjacent habitats, but could move through the Project area.

The study area for Study 4.1.7 overlaps with and is generally bounded on both sides by NFS lands, with the LPNF to the west and the ANF to the east. These areas provide large blocks of open landscape that facilitate relatively uninhibited regional and local wildlife movement within those individual forests. The Sierra Madre-Castaic Linkage, identified by the South Coast Missing Linkages Project, identifies major points of connection for wildlife movement between the LPNF and ANF (South Coast Wildlands 2008). Twelve focal species were designated for this linkage as being important species to consider when assessing wildlife movement through the region (Penrod et al. 2005).

- Mountain lion (*Puma concolor*)
- American badger (*Taxidea taxus*)
- Mule deer (*Odocoileus hemonius*)
- Pacific kangaroo rat (*Dipodomys agilis*)
- California spotted owl (*Strix occidentalis occidentalis*)
- Acorn woodpecker (*Melanerpes formicivorus*)
- Western pond turtle (*Actinemys marmorata*)
- Two-striped garter snake (*Thamnophis hammondii*)
- California mountain kingsnake (*Lampropeltis zonata*)
- Monterey salamander (*Ensatina eschscholtzii eschscholtzii*)
- Bear sphinx moth (*Procerpinus lucidus*)
- Rain beetle (*Pleocoma linsleyi*)

These species represent a diversity of needs for movement, habitat requirements, and home ranges (Penrod et al. 2005). The area south of Quail Lake was identified primarily as a potential movement corridor for American badger. The area north of Pyramid Lake was identified as a potential movement corridor for mountain lion and mule deer. The area south of Pyramid Lake was identified by the South Coast Missing Linkages report as a potential movement corridor for California spotted owl, and the area north of Castaic Lake and the Elderberry Forebay was identified as a potential movement corridor for mountain lion and mule deer (Penrod et al. 2005).

Major non-Project barriers to wildlife movement present in the study area for Study 4.1.7 include Interstate 5, which bisects the entire study area from north to south, State

Highway 138 to the north, and the urban areas of Castaic and Santa Clarita to the south. Gorman Creek, Coyote Canyon, Cherry Canyon, Forest Road 6N43, and Big Oak Flat/Canton Canyon have been identified as areas that need improved wildlife overpass or undercrossing structures where they intersect with Interstate 5 to improve wildlife movement within the Sierra Madre-Castaic Linkage (South Coast Wildlands 2008). All of the aforementioned areas overlap with the study area. Within the study area, smaller, more localized barriers to wildlife movement include roads, dams and diversions, industrial operations, residential development, and recreation (Penrod et al. 2005).

All undeveloped portions of the study area for Study 4.1.7 facilitate some wildlife movement, with certain areas likely functioning as corridors. Specifically, riparian areas within the study area provide potential dispersal corridors for both aquatic and terrestrial species; and man-made waterways, although not ideal, may provide local movement opportunities for species. Finally, the entire study area, especially the lakes and waterways, is likely used as a stop-over point by migratory birds.

The Licensees conducted the wildlife corridor portion of Study 4.1.7 from September 5, 2018 to September 7, 2018. The study involved a field habitat assessment and characterization to document potential barriers to wildlife movement at the Lower Quail Canal and the Castaic Penstocks.

Although there is information on the design of major wildlife movement crossings under or over highways based on species requirements, there is limited information regarding the dimensions of smaller barriers to movement, such as penstocks, canals, and fencing that preclude certain species from going either over or under such structures. For Study 4.1.7, the ANF provided guidelines for the assessment of whether or not structures present within the proposed Project boundary act as barriers to wildlife movement (USFS 2017); see Table 5.4.1-5, below.

Table 5.4.1-5. Dimensions Selected for Assessing Wildlife Crossing Points

Wildlife Species	Distance Between Bottom of Penstock and Ground for Animal Passage (under)	Maximum Penstock Height for Animal Passage (jumping over)	Distance Between Bottom Strain of Wire Fence for Animal Passage (under)	Maximum Height of Fence (Chain Link/Wire) for Animal Passage (jumping over)
Mule deer/bighorn sheep	2.5 feet	6 feet	2 feet between bottom and next strain	4 feet for adults jumping over wire/ young climbing through wire; cannot go over/through chain link.
Black bear	2 feet	3 feet	2 feet	Will climb over chain link or over/through wire.
Mountain lion	1.8 feet	12 feet	1.8 feet	Will climb over chain link or over/through wire.
Badger	0.5 foot	Cannot physically jump over structure	0.5 foot	Cannot jump/climb over chain link – may burrow under, will climb through wire.
Bobcat	1 foot	6 feet	1 foot	Will climb over chain link or over/through wire.
Coyote	1.5 feet	4 feet	2 feet between bottom and next strain	Will climb through wire, cannot climb/jump over chain link.

Source: USFS 2017

The entire length of Lower Quail Canal and the Castaic Penstocks was walked by the Licensees and, based on the guidelines in Table 5.4.1-5, any areas with at least a 2.5-foot clearance were marked by GPS and photographed. A 2.5-foot clearance is the height all of the target mammal species (included in Table 5.4.1-5) are believed to be able to pass under (USFS 2017). The purpose of this study was to determine if Project penstocks and canals are barriers to wildlife movement and to document areas along these linear barriers that could help facilitate wildlife movement.

The Licensees surveyed the 2-mile-long Lower Quail Canal by walking the length of the canal south of Lancaster Road and Quail Lake. Both the east and west sides of the canal were surveyed in their entirety. The canal was generally bounded by a 4.5-foot-tall barbed wire fence, which is intact throughout most of the canal and acts as a barrier to small mammal passage. However, there are a couple of areas along the eastern fence line with at least a 2.5-foot clearance suitable for wildlife passage. The fence would be passable by most large mammals. For example, mule deer, mountain lion, and bobcat would be able to jump over the 4.5-foot-tall fence. Other species would be able to find breaks in the fence or crawl under. Thus, the barbed wire fence does not currently present a significant barrier to movement. However, were the fence to be fixed, smaller animals may no longer have breaks to pass through.

A single east-west drainage culvert that is approximately 4 feet in diameter runs under the canal. This culvert may be adequate for small- to medium-sized mammals to pass under (although small mammals typically prefer vegetated culverts for passage), but large mammals are not expected to use this culvert and would likely circumvent the canal by moving along the fence line. The Licensees noted potential barriers to wildlife movement along the canal, including a chain link fenced area at the southern intake and overhead power lines crossing the canal.

The Lower Quail Canal functions as an obstacle to wildlife movement. The canal itself inhibits terrestrial wildlife movement; however, it does not prohibit avian wildlife from moving through the area. The water in the canal provides drinking water and habitat for waterfowl and other bird species. Although the canal is an obstacle, it potentially acts as a buffer between the open space of the ANF and Interstate 5, and may reduce vehicle hits and mortality caused by wildlife attempting to cross the highway. Furthermore, the southern end of the Lower Quail Canal terminates just northeast of a major bridge undercrossing for Interstate 5 at its intersection with Gorman Creek. The placement of the canal in relation to the undercrossing creates a safe Interstate 5 passageway for species as they attempt to circumvent the canal in a southerly direction. Finally, although the canal is considered a barrier to movement, it is not blocking access to or further fragmenting high quality habitat. The narrow strip of area between Interstate 5 and the canal is disturbed sagebrush community with a high percentage of die off.

The Licensees also surveyed the 2,400-foot-long Castaic Penstocks by walking the outer-most penstock pipes. The inner penstock pipes were not surveyed individually because the slope underneath the pipe is graded and uniform in coverage and does not differ in height above ground surface from the outer-most pipes. The surface underneath the penstocks is sparsely vegetated with grasses. Vegetation encroaching from the outside of the penstocks appeared clipped and cut back and is maintained regularly to prevent it from blocking access to the pipes and supporting structures for maintenance. Although sparse vegetation cover under the penstocks may deter some wildlife from traversing this area, surveyors noted an abundance of rodent scat, as well as California quail (*Callipepla californica*), using the area for shade, cover, or forage. The graded hill slope that the six penstock pipes travel down has approximately 15 concrete V-ditch culverts running perpendicular to the penstocks as well as scattered erosional features which exceeded the 2.5-foot clearance. These drainage ditches under the penstocks provide clearance for movement of wildlife. However, the 7- to 9-foot-tall fencing on either side of the penstocks and around the top pad area would prevent mule deer, bighorn sheep, American badger, and coyote from jumping over, but may allow for other mammals, such as black bear, mountain lion, or bobcat to climb over the fence. No large mammal scat or evidence of movement by large mammals under or around the penstocks was observed during the study.

The survey findings show small mammals and other small wildlife species can move through the area relatively uninhibited by moving under the penstocks, while large mammals are impeded by the penstocks and fence line. Although the penstocks act as a barrier to large mammal movement, they are limited to 2,400 feet (less than 0.5 miles) in length and could be circumvented by these species as they typically have large ranges. The steep and rugged mountain slope on which the penstocks are built does not provide an easy route for movement, regardless of the presence of the Project infrastructure. For these reasons, the penstocks can be considered a barrier; however the impediment to wildlife movement is not significant as it is permeable for small species and circumnavigable for larger ones, and the area would not be conducive to movement naturally due to the extreme steepness of the slopes.

Surveyed areas, potential barriers to wildlife movement, and clearance areas determined to provide potential movement opportunities for mammals are shown on Figure 5.4.1-50 and Figure 5.4.1-51. Representative photos of the surveyed barriers and areas that may facilitate wildlife movement are included as Appendix M (photos associated with photo point locations are shown on Figure 5.4.1-50 and Figure 5.4.1-51).

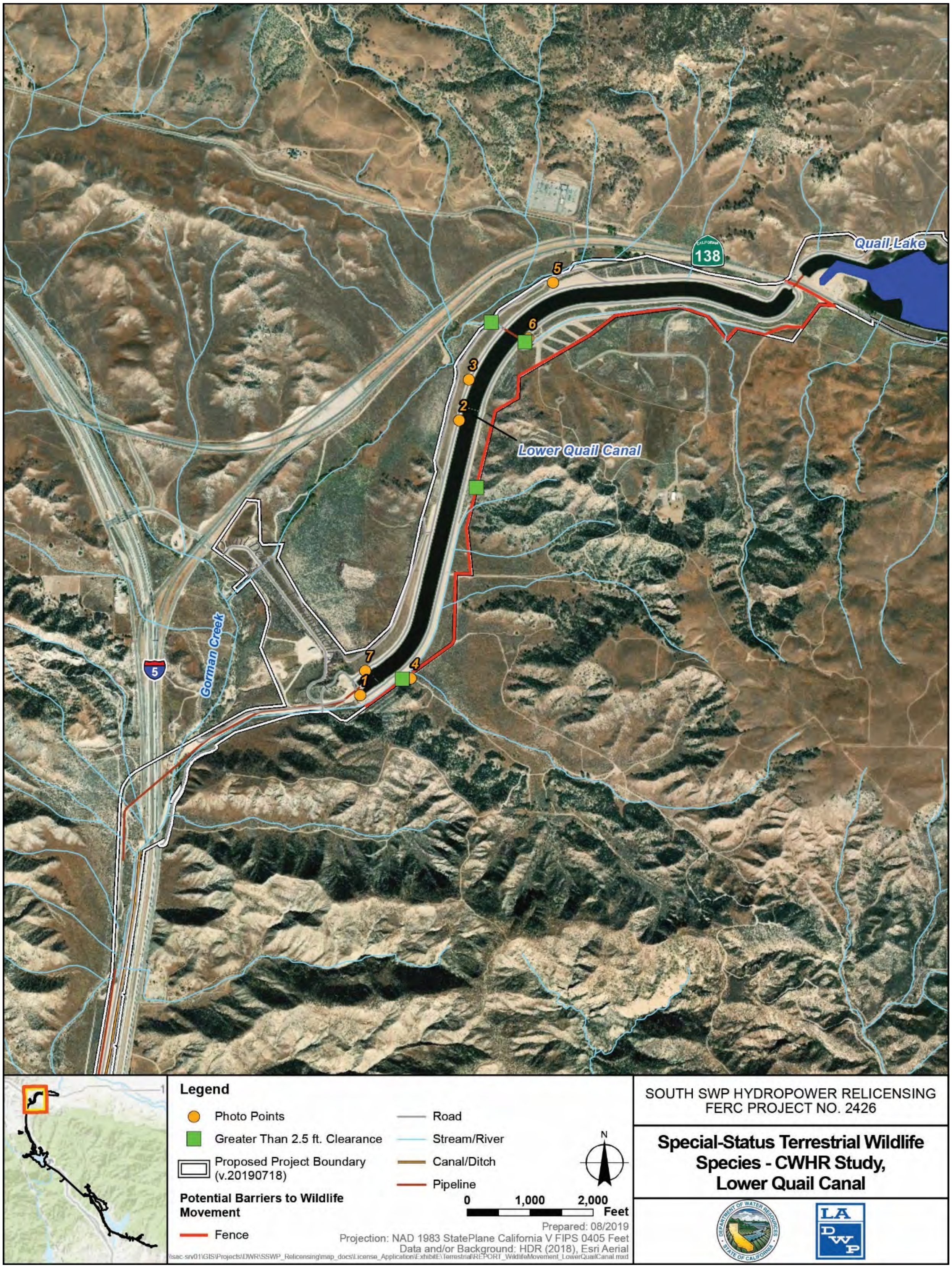

Figure 5.4.1-50. Wildlife Movement Survey Points and Barriers

Figure 5.4.1-51. Wildlife Movement Survey Points and Barriers

In addition to the wildlife movement barriers discussed above, fences and roads associated with the powerplants and other hydropower infrastructure are also potential barriers related to the existing Project (or to the existing wildlife movement). Fences and barriers associated with infrastructure typically obstruct movement in localized areas, as opposed to long, linear barriers, such as penstocks and canals, which can obstruct movement on a more regional scale. Roads associated with the Project are likely not wide enough or well-traveled enough to significantly disrupt wildlife movement. Other major elements of Project infrastructure, such as the Angeles Tunnel and Peace Valley Pipeline, are underground, and therefore do not affect wildlife movement.

Pyramid Lake and Elderberry Forebay may act as barriers to wildlife movement, specifically large and small mammals; however, the reservoirs have existed for more than 45 years and have become naturalized. Quail Lake may act as a barrier to small mammal movement; however, this reservoir is small enough that larger mammals could easily circumvent the area or swim across. Although the reservoirs likely are a hindrance to local terrestrial wildlife's ability to move, both reservoirs are surrounded by mostly unobstructed shoreline contiguous with large areas of open space, allowing species to avoid the reservoirs. Additionally, adjacent features unrelated to the Licensees' Proposal, such as Interstate 5 and other roadways, act as much more significant barriers to wildlife movement. For example, Project features such as the Gorman Bypass Channel and Lower Quail Canal both parallel Interstate 5 and/or State Route 138 for the majority of their length. The potential for these features to hinder wildlife movement is overshadowed by the presence of Interstate 5, as the road functions as a much more significant barrier compared to the channel and canal. The Gorman Bypass Channel is also dry or only shallowly inundated through much of the year, allowing animals to cross.

Interstate 5 is a highly impactful barrier for wildlife and it is possible that it has lowered the threshold for impacts associated with other wildlife movement barriers. As a result, Project features, such as Pyramid Lake, Elderberry Forebay, and Castaic Penstocks, may have greater potential to further fragment area populations and contribute to localized survival rates; however, most features are located parallel to Interstate 5, acting as a buffer between the highway and open space adjacent to the Project, possibly reducing vehicle hits and mortality caused by wildlife attempting to cross the highway. A cumulative increase in habitat fragmentation caused by the pairing of Interstate 5 with existing Project infrastructure is present; however, the Project infrastructure abuts or has a small area of land between it and the Interstate 5 corridor and its anthropogenic disturbance and development, such that there is no additional habitat from which wildlife has been separated. To get to better habitat, all wildlife would need to cross Interstate 5 or State Highway 138. The urban sprawl and continued expansion of Castaic and Santa Clarita to the south contribute much more to the cumulative effect on wildlife movement and habitat fragmentation than existing Project infrastructure.

The aforementioned Project-related infrastructure may function as localized barriers to wildlife that may delay or temporarily hinder movement; however, none of the features appear to represent major impediments or expose wildlife to risk by forcing them into more dangerous alternative routes. After 45 years of existence, these features are part of the landscape, and wildlife movement patterns have most likely adjusted to their presence. The overwhelming majority of lands adjacent to the Project can be characterized as contiguous open space associated with the ANF and LPNF, and capable of facilitating unburdened wildlife movement. There is no evidence that movement between these open space areas would be significantly improved were Project infrastructure not present, as features such as Interstate 5, State Highway 138, and urban development would continue to pose significant barriers.

Commercially Valuable Wildlife Species

A commercially valuable wildlife species is any species listed as a “harvest species” by CDFW. According to CDFW, harvest species are game birds FGC § 3500); game mammals (FGC § 3950), fur-bearing mammals, and non-game animals as designated in the CCR (CDFW 2015). The CWHR identified 59 harvest wildlife species found in Los Angeles County associated with the updated CWHR habitat types mapped within the proposed Project boundary. The list includes 37 species of birds, primarily migratory waterfowl (i.e., 26 species of ducks, geese, and coots) and upland game birds (i.e., 6 gallinaceous species, such as quails and pheasant), and 22 species of mammals, ranging from rabbits and squirrels to mule deer. There are 10 non-native species on the list, including game birds propagated for hunting (e.g., wild turkey) and species that may have established populations from escaped individuals (e.g., spotted dove [*Streptopelia chinensis*] and fallow deer [*Dama dama*]). Designated harvest species may be legally hunted under CDFW license regulations in California. However, hunting is not permitted within the proposed Project boundary. Routine O&M activities are externally limited outside of developed and disturbed areas, and recreation activities are concentrated in designated areas. For these reasons, no Project effects to most harvest species occur, beyond the occasional individual. Additionally, the reservoirs provide habitat for migratory waterfowl.

Mule Deer

Six subspecies of mule deer occur in California. The subspecies occupying the Project area is the California mule deer (*O. hemionus californicus*), the second most abundant subspecies in the State (Higley 2002). CDFW estimated the population of deer in California at 532,621 individuals in 2017 (CDFW 2017). Deer populations have been relatively steady since 2007, following a general decline from a record high in the 1960s, which has been attributed to loss and degradation of habitat (Higley 2002; CDFW 2015). In 1976, CDFG prepared a deer management plan with the goal of restoring deer populations to previous levels. The plan included habitat and population management goals for deer populations by “herd” units. The previous plan did not result in restoration of populations to the goal levels due to the magnitude of landscape changes required to provide suitable habitat and shifts in landscape management priorities since the plans were prepared (CDFW 2015).

In 2015, CDFW prepared the California Deer Conservation and Management Plan to update the 1976 plan, and to focus on conservation and management at a larger scale, outlining a landscape-level approach to deer planning within 10 Deer Conservation Unit's (DCU). The objectives for each DCU are to characterize the current scientific, environmental, sociological, and economic conditions of the DCUs as they relate to deer management; describe population estimates and monitoring measures; and to identify key habitat areas and strategies for restoration/enhancement (CDFW 2015).

The proposed Project boundary falls within the Transverse and Peninsular Ranges DCU. This DCU includes 9,426,348 acres of land, approximately 52 percent of which is publicly owned and 48 percent of which is privately owned. Mule deer in this area are primarily resident, but occasionally move from high to low elevations in winter, especially during years of heavy snow (CDFW 2015). In 2015, CDFW anticipated that plan development for this DCU would occur by November 2015, with implementation planned for March 2016. The Licensees were not able to obtain updates on the current schedule.

No adverse effects to deer herds or their movements are known under existing conditions. Project-related infrastructure may function as localized barriers that may delay or temporarily hinder movement of deer; but local deer do not migrate, and thus, barriers would not impact migration corridors. Refer to the previous section on Wildlife Movement for more information.

Commonly Occurring Wildlife

Information about commonly occurring wildlife has been derived from previous studies and surveys that overlapped with the proposed Project boundary, which included the following:

- 2010 Arroyo Toad (*Anaxyrus californicus*) Clutch Surveys and Sensitive Species Monitoring (Environmental Science Associates 2010)
- Barren Ridge Renewable Transmission Project Final Environmental Impact Statement (FEIS)/EIR (USFS, BLM, and LADWP 2012).
- Biological Assessment and Report of Sensitive Resource Surveys for Castaic Power Plant and Vicinity (Aspen Environmental Group 2007)
- Biological Evaluation/Biological Assessment for Piru Creek Gaging Station Routine Maintenance Project (Environmental Science Associates 2015b)
- Castaic Creek Check Dam Repair Project Arroyo Toad Survey Report (POWER 2013)
- Castaic Power Plant Sediment Removal Project, Arroyo Toad Survey Report (POWER 2009)

- Castaic Power Plant Sediment Removal Project Biological Assessment (POWER 2010)
- Initial Study/Mitigated Negative Declaration, Piru Creek Erosion Repairs and Bridge Seismic Retrofit Project (Aspen Environmental Group 2003)
- Least Bell's Vireo and Southwestern Willow Flycatcher Modeled Habitat Assessment and Protocol-level Surveys in Selected Areas of the ANF (Jones and Stokes 2002)
- Middle Piru Creek Arroyo Toad (*Anaxyrus californicus*) Clutch Surveys and Sensitive Species Monitoring (Environmental Science Associates 2015a)

In addition, incidental observations from the various Licensees' 2018 relicensing studies were recorded and compiled. Commonly occurring wildlife includes any species known to occur or with the potential to occur within the proposed Project boundary that are not ESA-listed or considered special-status. These species are generally widespread within and around the proposed Project boundary, and only experience very minimal effects from ongoing Project O&M and other activities. The commonly occurring wildlife discussed below is not considered an exhaustive list of the species that could occur in the Project area.

<u>Amphibians</u>

Most amphibians are addressed in Section 5.3 as aquatic resources; however, salamanders that are completely terrestrial and without free-living larval stages are treated here as terrestrial resources. Common forest- and chaparral-dwelling terrestrial salamanders include Monterey ensatina (*Ensatina eschscholtzii eschscholtzii*), garden slender salamander (*Batrachoseps major*), black-bellied salamander (*B. nigriventris*), and arboreal salamander (*Aneides lugubris*). These are species that are generally associated with surface cover (e.g., rock shelters, downed wood, bark slabs, or moist leaf litter) and subterranean retreats, including earthworm and termite tunnels and burrows. The Licensees found no records or reports of terrestrial salamanders within the proposed Project boundary.

<u>Reptiles</u>

The Licensees found four documents that present information regarding terrestrial reptiles within the proposed Project boundary, mostly for localized evaluations or opportunistic sightings, including lists of species likely to occur, although not documented. The naming conventions used here are from Nafis 2018.

Species observed in one or more areas include side-blotched lizard (*Uta stansburiana*) (now split into subspecies western side-blotched lizard [*Uta stansburiana elegans*]), western fence lizard (*Sceloporus occidentalis*), yellow-backed spiny lizard (*S. uniformis*) (formerly considered as a subspecies of desert spiny lizard [*S. magister*]), southern alligator lizard (*Elgaria multicarinata*), western whiptail (*Aspidoscelis tigris*), striped racer

(*Masticophis lateralis*) (species now split into subspecies California striped racer [*Coluber lateralis lateralis*]), common kingsnake (*Lampropeltis getulus*) (now California kingsnake [*L. californiae*]), western blind snake (*Leptotyphlops humilis*) (now southwestern threadsnake [*Rena humilis humilis*]), and Pacific rattlesnake (*Crotalus oreganus*) (species now split into subspecies southern Pacific rattlesnake [*Crotalus oreganus helleri*]) (Aspen Environmental Group 2007; POWER 2010, 2013; Environmental Science Associates 2015).

Terrestrial reptiles observed during the 2018 relicensing studies include western fence lizard, northern alligator lizard (*Elgaria coerulea*), western whiptail, red racer (*Coluber flagellum*), desert spiny lizard, western side-blotched lizard, southern Pacific rattlesnake, and Pacific gophersnake (*Pituophis catenifer catenifer*).

While not observed during field surveys, it is likely that other common species also occur (e.g., western yellow-bellied racer [*Coluber constrictor mormon*]), particularly species associated with open forests, scrub and shrub-dominated habitats, and riparian habitats; however, some of these are fossorial or nocturnal species unlikely to be detected without special survey efforts. Desert night lizard (*Xantusia vigilis*) is included as potentially occurring, although this species may require the presence of Joshua trees, and thus may be limited to transitional habitats on the northern edge of the proposed Project boundary.

<u>Birds</u>

Habitats within the proposed Project boundary support a wide variety of migratory and resident bird species. Although information is fragmentary and localized evaluations do not provide a comprehensive account of species, Pyramid Lake, Elderberry Forebay, Castaic Lake, Castaic Lagoon, and Quail Lake provide open water habitats highly attractive to migratory waterfowl and shorebirds. Species associated with emergent wetlands and riparian habitats are also known to frequent the margins of these waterbodies, the lake tributaries, and Piru Creek downstream of Pyramid Dam. Other species are characteristic of chaparral and other upland shrub-dominated habitats, open forests, and transitional habitats on the northern edge of the proposed Project boundary.

In addition to large numbers of migrating American coots, documented waterbirds at the lakes include greater scaup (*Aythya marila*), bufflehead (*Bucephala albeola*), ruddy duck (*Oxyura jamaicensis*), pied-billed grebe, and double-crested cormorant (*Phalacrocorax auritus*). Jones and Stokes (2002) detected 68 species of birds in Pyramid reach and 58 species along Liebre Gulch, a tributary to Pyramid Lake, during protocol-level surveys for ESA-listed riparian bird species.

Numerous incidental bird observations were recorded during the 2018 relicensing studies. Observations included, but were not limited to, red-winged blackbird (*Agelaius phoeniceus*), American coot, mallard, pied-billed grebe, great blue heron, double-crested cormorant, killdeer (*Charadrius vociferus*), California quail, song sparrow, house finch, California scrub jay, California towhee, bushtit, wrentit (*Chaemaea fasciata*), phainopepla (*Phainopepla nitens*), western meadowlark, horned lark, Anna's hummingbird, Nuttall's woodpecker, American crow, common raven, barn owl, red-tailed hawk, and Cooper's hawk (*Accipiter cooperi*).

The Licensees performed surveys for the following raptor species as part of Study 4.1.20 to identify any active raptor nests within 0.25 miles of the proposed Project boundary: ferruginous hawk (*Buteo regalis*), prairie falcon (*Falco mexicanus*), and osprey (*Pandion haliaetus*). These three species were included as part of the survey as they are considered either a USFWS Bird of Conservation Concern (BCC) or a Watch List (WL) species. Neither BCC nor WL species are considered special-status for the purposes of this section. The Study 4.1.20 surveys were conducted from December 2017 through July 2018.

The results of the study included the following:

- Fourteen observations of ospreys soaring, foraging, and flying over both Pyramid and Quail lakes
- A single prairie falcon in the rocky habitat west of Pyramid Lake, perched on a large rock outcrop before flying out of view to the west

None of these birds was observed exhibiting nesting or breeding behavior. Additionally, a single turkey vulture (*Cathartes aura*) nest was observed in the Pyramid Lake area, specifically on Chumash Island, during the February 22, 2018 survey. A single adult turkey vulture was observed perched next to a scrape, with no eggs or hatchlings observed. The nest was not observed to be occupied or in use during subsequent visits and was therefore determined to be inactive.

<u>Mammals</u>

Mammals documented during evaluations for the Castaic Powerplant Sediment Removal Project included deer mouse (*Peromyscus* sp.), California vole (*Microtus californicus*), "Pacific" kangaroo rat (*Dipodomys agilis* or *D. simulans*), dusky-footed woodrat, Botta's pocket gopher (*Thomomys bottae*), California ground squirrel, desert cottontail, raccoon, bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), coyote, and mule deer (Aspen Environmental Group 2007; POWER 2010). A separate evaluation downstream of Pyramid Dam (Aspen Environmental Group 2003) documented big brown bat (*Eptesicus fuscus*) and western pipistrelle (*Pipistrellus hesperus*), and assumed the following other species to be common in riparian areas along Piru Creek: California ground squirrel, brush rabbit (*Sylvilagus bachmanii*), raccoon, striped skunk, coyote, and mule deer. Incidental mammal observations recorded during the 2018 relicensing studies included desert cottontail, dusky-footed woodrat, Botta's pocket gopher, California ground squirrel, gray fox, raccoon, black-tailed jackrabbit, coyote, mule deer, black bear, and feral goats.

Typical ground-disturbing O&M activities could lead to disturbance of common wildlife habitat and removal of vegetation. Recreational activities within and immediately adjacent to suitable habitat could also lead to occasional disturbance of terrestrial wildlife. Impacts from these types of activities are typically limited in scope and duration, infrequent, and dispersed throughout the area. Ongoing O&M and recreation activities may affect terrestrial wildlife individuals; however, the impacts would not be expected to adversely affect the species as a whole.

Special-Status Terrestrial Wildlife Species

For the purposes of this section (i.e., Section 5.4.1) of the Application for New License, a special-status wildlife species meets at least one of the following criteria: (1) listed or proposed for listing under CESA as threatened, endangered, or candidate; (2) classified as FP by the State of California; (3) listed by CDFW as a Species of Special Concern (SSC); (4) listed as FSS and occurring on NFS lands; (5) listed as BLM Sensitive and occurring on BLM lands; or (6) protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Section 5.4.3 of this Application for New License addresses potential effects of the Licensees' Proposal on the terrestrial and aquatic special-status wildlife species listed under the federal ESA. Section 5.3 of this Application for New License addresses potential effects of the Licensees' Proposal on other aquatic special-status species, including FYLF, western spadefoot, two-striped gartersnake, south coast gartersnake, and southwestern pond turtle.

Records for special-status wildlife species were identified from sources located during the Licensees' gathering of existing, relevant, and reasonably available information. These sources included:

- A query of the CNDDB, which provided a list of processed and unprocessed special-status wildlife species occurrences within all USGS 7.5-minute topographic quadrangles in which the proposed Project boundary is located (La Liebre Ranch, Lebec, La Liebre Mountain, Black Mountain, Green Valley, Warm Springs Mountain, Whitaker Peak, Cobblestone Mountain, Mint Canyon, Newhall, and Val Verde), and all adjacent quadrangles (Liebre Twins, Winters Ridge, Pastoria Creek, Grapevine, Nennach School, Frazier Mountain, Lake Hughes, Burnt Peak, Alamo Mountain, Devils Heart Peak, Piru, San Fernando, Oat Mountain, and Simi Valley East) covering almost 1,535 square miles (CDFW 2018c, 2018d).

- A query of the CWHR database (CDFW 2018e), which provided a list of potentially occurring species using the revised habitat mapping data from the study area of Study 4.1.7. Habitat was queried in the study area as a whole in order to capture species and their habitats which may primarily be found outside of the proposed Project boundary, but have the potential to pass through. Because CWHR results are derived from county species lists and do not differentiate sub-species or populations categorized as special-status from more widely occurring species, the list was further refined by reviewing CWHR range maps for each special-status taxon and other sources as needed, including CWHR and other life history accounts and range maps (e.g., Bolster et al. 1998; CDFW 2018f; Shuford and Gardali 2008; IUCN Red List of Threatened Species 2018; Nafis 2018).

- The USFS Sensitive Animal Species Lists for both the ANF and LPNF, because the proposed Project boundary overlaps with both (USFS 2013a). All wildlife species deemed FSS by the USFS were considered in the effects analysis.

The result of the queries identified 104 special-status wildlife species with the potential to occur within and adjacent to the proposed Project boundary. The table provided as Appendix N provides a summary of all 104 species identified in the search results, a description of the habitat requirements for each species, and conclusions regarding the potential for each species to occur within the proposed Project boundary. Species that were determined to not have the potential to occur within the proposed Project boundary (assigned an “N” in the Potential to Occur column in the table provided as Appendix N) are not analyzed further in this document.

Table 5.4.1-6, below, includes the 64 special-status terrestrial wildlife species determined to have the potential to occur within or adjacent to the proposed Project boundary based on the presence of suitable habitat (refer to Appendix N for more information on why the remaining species were ruled out). Of these 64, ten are not addressed in this section but are addressed in either Section 5.3 or 5.4.3. The table includes listing status, expected CWHR habitat associations, and whether the species has been documented or potentially occurs within the proposed Project boundary based on the presence of suitable habitat. The list of special-status species includes 1 terrestrial invertebrate, 1 terrestrial amphibian, 9 reptiles, 27 birds, and 16 mammals.

Of the 54 special-status terrestrial wildlife species addressed in this section (excluding aquatic special-status species) with the potential to occur within the proposed Project boundary, only one reptile and nine birds were observed during relicensing studies. These include coast horned lizard (*Phrynosoma blainvillii*), bald eagle (*Haliaeetus leucocephalus*), golden eagle, northern harrier (*Circus hudsonius*), American peregrine falcon, Swainson’s hawk, burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), tricolored blackbird, and yellow warbler (*Setophaga petechia*). Focused surveys for terrestrial, non-ESA-listed, special-status species during the Licensees’ relicensing studies were limited to Study 4.1.20, which focused on bald eagle, golden eagle, and burrowing owl. The Licensees conducted wintering bald eagle surveys at Pyramid Lake and Quail Lake in December 2017, and January and February 2018. Bald eagle nesting surveys were conducted in March, May, and June 2018. Golden eagle occupancy surveys were conducted at Pyramid Lake in January and February 2018, and nesting/incubation surveys were conducted in March, May, and June 2018. The Licensees also conducted burrowing owl surveys at Quail Lake, Lower Quail Canal, the Gorman Creek, West Fork Liebre Gulch and Liebre Gulch arms of Pyramid Lake near Interstate 5, and Castaic Powerplant.

Results of these surveys are presented in Table 5.4.1-7, below, and are shown on Figure 5.4.1-52 and Figure 5.4.1-53. Figure 5.4.1-52 and Figure 5.4.1-53 illustrate California condor, osprey, and prairie falcon incidental observations. However, these three species are not discussed in this section due to their respective listing status. The California condor is listed as an endangered species and, therefore, is discussed further in Section 5.4.3 (Federal ESA, Listed and Candidate Species) of this exhibit. The osprey and prairie falcon data were a part of the original methodology for Study 4.1.20, due to their listings as a BCC, a watch list for species. These two species are not considered special-status according to the formal definition outlined above. Therefore, aside from this brief discussion, osprey and prairie falcon are not discussed further.

In addition, special-status species incidental observations were recorded during other 2018 relicensing studies. This information is included in Table 5.4.1-6 and shown on Figure 5.4.1-54.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Invertebrates					
Plebulina emigdionis	San Emigdio blue butterfly	FSS	San Emigdio blue butterfly is a nectivore that is known to reside in the host plant fourwing saltbush (*Atriplex canescens*). The species typically prefers riparian areas, as well as dry river courses and intermittent stream sides and surrounds flat lands with adults emerging from April to September (NatureServe 2018).	Not reported by CWHR	No occurrences within proposed Project boundary; however, known occurrence approximately 5.8 miles to the north.
Amphibians					
Ensatina eschscholtzii croceater	yellow-blotched salamander	BLMS, FSS	Palustrine habitats include riparian zones, while terrestrial habitats include hardwood forests. Species is known to prefer shaded slopes with abundant leaf litter, rock, logs, debris to take cover in/under. Individuals known in abundance in areas with large volumes of woody debris (NatureServe 2018).	Not reported by CWHR	No occurrences within proposed Project boundary; however, known occurrence approximately 3.3 miles to the north.
Reptiles					
Anniella pulchra	Northern California legless lizard	SSC, FSS	Occurs in sparsely vegetated areas of beach dunes, chaparral, pine-oak woodland, desert scrub, sandy washes, and stream terraces (Nafis 2018).	Not reported by CWHR	No occurrences within the proposed Project boundary, nearest is 1.2 miles, plus many records for California legless lizards (*Anniella* sp.) in and around the proposed Project boundary, which could represent Southern California legless lizard, northern California legless lizard, or intergrades of the two species.
Anniella stebbinsi	Southern California legless lizard	SSC, FSS	Occurs in sparsely vegetated areas of beach dunes, chaparral, pine-oak woodland, desert scrub, sandy washes, and stream terraces (Nafis 2018).	Not reported by CWHR	No occurrences within proposed Project boundary; however, there is a known occurrence approximately 20 miles to the west. Many records for California legless lizards (*Anniella* sp.) within and around the proposed Project boundary, which could represent southern California legless lizard, northern California legless lizard, or intergrades of the two species.
Arizona elegans occidentalis	California glossy snake	SSC	Mainly a nocturnal species, individuals spend time during the day in burrows and rock outcrops. Requires loose soil for egg laying near vegetation bases and/or mammal burrows. Known to prefer areas with scattered brush and rock outcrops (CDFW 2018f).	Yearlong - AGS, CRC, COW, CSC, JST, MCH, PJN, SGB	There are two known occurrences within the proposed Project boundary.
Aspidoscelis tigris stejnegeri	coastal whiptail	SSC	This subspecies is found in coastal southern California, mostly west of the Peninsular Ranges and south of the Transverse Ranges, and north into Ventura County. Ranges south into Baja California. Found in a variety of ecosystems, primarily hot and dry open areas with sparse foliage - chaparral, woodland, and riparian areas. (Nafis 2018).	Not reported by CWHR	There is one known occurrence within the proposed Project boundary.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary (continued)

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Diadophis punctatus modestus	San Bernardino ringneck snake	FSS	Palustrine habitat includes riparian and temporary pools. Also known to be found near creeks and streams. Terrestrial habitats include croplands, hardwood forests, grasslands, and chaparral. Species known to prefer moist habitats and can found under various cover objects including bark, rock, and logs (NatureServe 2018).	Not reported by CWHR	No occurrences within proposed Project boundary; however, known occurrence approximately 8.3 miles to the north.
Lampropeltis zonata parvirubra	California mountain kingsnake (San Bernardino population)	BLMS, FSS	Found in diverse habitats including coniferous forest, oak-pine woodlands, riparian woodland, chaparral, manzanita, and coastal sage scrub between 804 and 9,022 feet in elevation (Nafis 2018).	Yearlong - AGS, BOP, COW, MCH, MHW, VRI, WTM	No occurrences within the proposed Project boundary; however, known occurrence approximately 45 miles southeast in Angeles National Forest.
Lichanura orcutti	coastal rosy boa	FSS, BLMS	Inhabits arid scrublands, semi-arid shrublands, rocky shrublands, rocky deserts, canyons, and other rocky areas. Appears to be common in riparian areas, but does not require permanent water (Nafis 2018).	Yearlong - BAR, CRC, CSC, DRI, JST, MCH, PJN	The CNDDB does not include records for this species.
Phrynosoma blainvillii	coast horned lizard	SSC, BLMS	Occurs in valley-foothill hardwood, conifer and riparian habitats, as well as in pine-cypress, juniper and annual grassland habitats. Ranges up to 4,000 feet in the Sierra Nevada foothills, and up to 6,000 feet in the mountains of southern California (CDFW 2018f).	Not reported by CWHR	There is one CNDDB occurrence within the proposed Project boundary in addition to two sightings in the vicinity of Pyramid Lake.
Salvadora hexalepis virgultea	coast patch-nosed snake	SSC	Inhabits semi-arid brushy areas and chaparral in canyons, rocky hillsides, and plains at elevations from below sea level to around 7,000 feet (Nafis 2018).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, PJN, SGB, VRI	No occurrences within proposed Project boundary; however, known occurrence approximately 13.5 miles to the west.
Birds					
Accipiter gentilis	northern goshawk	SSC, BLMS, FSS	Mature and old-growth forests, including ponderosa pine, Jeffrey pine, lodgepole pine, mixed conifer, Douglas-fir (*Pseudotsuga menziesii*), mixed redwood-Douglas-fir hardwood, and quaking aspen (*Populus tremuloides*). Occurs in North Coast Ranges through Sierra Nevada, Klamath, Cascade, and Warner Mountains, in Mount Pinos and San Jacinto, San Bernardino, and White Mountains. (Shuford and Gardali 2008).	Winter - BOP, CRC, COW, MCH, SGB, VRI; Yearlong - MHW, PJN	No occurrences within proposed Project boundary; however, known occurrence approximately 66 miles to the north.
Agelaius tricolor	tricolored blackbird	ST, SSC, BLMS	Preferred nesting habitat includes cattails, bulrushes, Himalayan berry, and agricultural silage. Dense vegetation is preferred, but heavily lodged cattails not burned in recent years may preclude settlement. Needs access to open water. Strips of emergent vegetation along canals are avoided as nest sites unless they are about 10 or more meters wide, but in some ponds, especially where associated with Himalayan blackberries and deep water, settlement may be in narrower fetches of cattails. (Shuford and Gardali 2008). Breeds locally in northeastern California. In winter, becomes more widespread along central coast and San Francisco Bay area and is found in portions of the Colorado Desert (CDFW 2018f).	Yearlong - AGS, FEW, URB, VRI, WTM	There are five known occurrences within the proposed Project boundary in addition to several sightings around Quail Lake.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary (continued)

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Ammodramus savannarum	grasshopper sparrow	SSC	Frequents dense, dry or well-drained grassland, especially native grassland with a mix of grasses and forbs for foraging and nesting. Uses scattered shrubs for singing perches (CDFW 2018f).	Summer - AGS, WTM	No occurrences within the proposed Project boundary; however, known occurrence approximately 0.5 miles away.
Aquila chrysaetos	golden eagle	BGEPA, FP, BLMS	Habitat includes rolling foothills and mountain terrain, wide arid plateaus deeply cut by streams and canyons, open mountain slopes, and cliffs and rock outcrops. Uncommon resident and migrant throughout California, except the center of the Central Valley. (CDFW 2018f).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, FEW, JST, MCH, MHW, PJN, SGB, URB, VRI, WMT	This species has been observed perching near Quail Lake and soaring over Pyramid Lake. In addition, two individuals were observed within the proposed Project boundary, one at Pyramid Lake and one at Quail Lake during Study 4.1.20. There are no known CNDDB occurrences within the proposed Project boundary; however, there is a known occurrence approximately 1.2 miles northwest of Quail Lake.
Asio flammeus	short-eared owl	SSC	Found in open, treeless areas with elevated sites for perches, and dense vegetation for roosting and nesting. Associated with perennial grasslands, prairies, dunes, meadows, irrigated lands, and saline and fresh emergent wetlands. Breeds in coastal areas in Del Norte and Humboldt Counties, San Francisco Bay Delta, northeastern Modoc plateau, east Sierras from Lake Tahoe to Inyo County and San Joaquin Valley. Winters in the Central Valley, western Sierra Nevada foothills and along the coastline (CDFW 2018f).	Yearlong - AGS, CSC, FEW, SGB, URB, VRI, WTM; Winter - BOP, CRC, COW, DRI, DSW, JST, MCH, PJN	No occurrences within proposed Project boundary; however, known occurrence approximately 32 miles to the east.
Asio otus	long-eared owl	SSC	Riparian habitat required; also uses live oak thickets and other dense stands of trees. Found in dense conifer stands at high elevations (CDFW 2018f).	Yearlong - AGS, BOP, CRC, COW, DRI, MCH, MHW, SGB, VRI, WTM	No occurrences within proposed Project boundary; however, known occurrence approximately 20 miles to the north.
Athene cunicularia	burrowing owl	SSC, BLMS	Nesting habitat includes open areas with mammal burrows, including rolling hills, grasslands, fallow fields, sparsely vegetated desert scrub, vacant lots and human disturbed lands. Soils must be friable for burrows (Bates 2006).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, PJN, SGB, URB, VRI, WTM	One adult observed on rip-rap near Elderberry Forebay during the Cultural Resources Study. Additionally, there is one CNDDB occurrence within the proposed Project boundary.
Aythya americana	redhead	SSC	Usually nest in freshwater emergent wetlands where dense stands of cattails (*Typha* spp.) and tules (*Schoenoplectus* spp.) are interspersed with areas of deep, open water. Also observed nesting in somewhat alkaline marshes and potholes (Shuford and Gardali 2008).	Yearlong - FEW; Winter - LAC	The CNDDB does not include records for this species.
Buteo swainsoni	Swainson's hawk	ST, BLMS	Nests in stands with few trees in riparian areas, juniper-sage flats, and oak savannah. Forages in adjacent grasslands, agricultural fields and pastures. Breeding resident and migrant in the Central Valley, Klamath Basin, Modoc Plateau, Lassen County, and Mojave Desert. Very limited breeding reported from Lanfair Valley, Owens Valley, Fish Lake Valley, and Antelope Valley (CDFW 2018f).	Summer - AGS, BAR, BOP, CRC, COW, MCH, MHW, PJN, SGB, URB, VRI, WTM	This species has been observed several times soaring or foraging near Quail Canal. There are no documented CNDDB occurrences within proposed Project boundary; however, there are known occurrences approximately 6.6 miles to the south.
Charadrius montanus	mountain plover	SSC, BLMS	Frequents open plains with low, herbaceous, or scattered shrub vegetation below 3,200 feet above msl (CDFW 2018f).	Winter - AGS, BAR, SGB	No occurrences within proposed Project boundary; known occurrence is approximately 16 miles east.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary (continued)

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Circus hudsonius	northern harrier	SSC	Nests on the ground in patches of dense, tall vegetation in undisturbed areas. Breeds and forages in variety of open habitats such as marshes, wet meadows, weedy borders of lakes, rivers and streams, grasslands, pastures, croplands, sagebrush flats and desert sinks (Shuford and Gardali 2008).	Yearlong - AGS, BAR, BOP, COW, CSC, DRI, FEW, LAC, PJN, SGB, URB, VRI, WMT; Winter - CRC, DSW, MCH; Summer - MHW, MHC	One northern harrier individual was observed during Study 4.1.7 and another during Study 4.1.20.The nearest recorded CNDDB occurrence is south of Santa Ana. DWR has recorded sightings of both a male and female northern harrier foraging in the vicinity of Quail Lake and the Peace Valley Pipeline.
Contopus cooperi	olive-sided flycatcher	SSC	Preferred habitat is forest and woodland, with adjacent meadows, lakes or open terrain for foraging. Occurs throughout California exclusive of the deserts, the Central Valley, and other lowland valleys and basins (CDFW 2018f).	Migrant - BOP; Summer - CRC, MCH, MHW	The CNDDB does not include records for this species.
Elanus leucurus	white-tailed kite	FP, BLMS	Occurs in herbaceous and open stages of valley lowland habitats, usually near agricultural land. Forages in undisturbed, open grasslands, meadows, farmlands and emergent wetlands (CDFW 2018f). Typically nest in the upper third of trees that may be 10 to 160 feet tall. These can be open-country trees growing in isolation, or at the edge of or within a forest (Cornell 2018).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, FEW, MCH, URB, VRI, WTM	No occurrences within proposed Project boundary; however, known occurrence approximately 5 miles to the south.
Falco peregrinus anatum	American peregrine falcon	FD, SD, FP	Breeds near wetlands lakes, rivers, or other waters on cliffs, banks, dunes or mounds, mostly in woodland, forest and coastal habitats. Nest is a scrape on a depression or ledge in an open site. May use man-made structures, snags, or trees for nesting (CDFW 2018f).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, FEW, LAC, MCH, MHW, PJN, SGB, URB, VRI, WTM	This species was observed during Study 4.1.20 at Pyramid Lake. No CNDDB occurrences within proposed Project boundary; however, known occurrence approximately 21 miles to the south. This species has been observed perching just outside the proposed Project boundary at the Alamo Powerplant.
Gavia immer	common loon	SSC	Commonly found in estuarine and subtidal marine habitats along entire coast. Also less commonly found on large, deep lakes in valleys and foothills throughout the State. May rarely breed in large mountain lakes (CDFW 2018f).	Winter - LAC	The CNDDB does not include records for this species.
Haliaeetus leucocephalus	bald eagle	BGEPA, FD, SE, FP, BLMS, FSS	Nests in large, old-growth, or dominant live tree with open branchwork, especially ponderosa pine. Requires large bodies of water or rivers with abundant fish, and adjacent snags. Permanent resident, and uncommon winter migrant, now restricted to breeding mostly in Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity Counties. About half of the wintering population is in the Klamath Basin (CDFW 2018f).	Yearlong - AGS, BAR, BOP, COW, DRI, FEW, LAC, MHW, PJN, SGB, VRI, WTM; Winter - CRC, CSC, MCH, PJN	Bald eagles were observed 27 times during Study 4.1.20 within the proposed Project boundary, the majority of which were around Quail Lake and Pyramid Lake. Based on these observations, Study 4.1.20 identified two winter night roosts, one at each lake. No CNDDB occurrences within proposed Project boundary; however, there are known occurrences approximately 13 miles to the north.
Icteria virens	yellow-breasted chat	SSC	Nest in early-successional riparian habitats with a well-developed shrub layer and an open canopy. Restricted to narrow border of streams, creeks, sloughs and rivers. Often nest in dense thicket plants such as blackberry and willow (Shuford and Gardali 2008).	Migrant - CSC; Summer - DRI, VRI; Yearlong - VRI	No occurrences within proposed Project boundary; however, known occurrence approximately 8.5 miles to the south.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary (continued)

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Lanius ludovicianus	loggerhead shrike	SSC	Breed in shrublands or open woodlands with a fair amount of grass cover and areas of bare ground (Shuford and Gardali 2008).	Not reported by CWHR	Individual observed in sagebrush area west of California Canal during Study 4.1.7within proposed Project boundary. In addition, there have been multiple observations of this species calling, perching, and nesting near the Alamo Powerplant, just outside the proposed Project boundary.
Pelecanus erythrorhynchos	American white pelican	SSC	In California, nests only in large lakes in Klamath Basin. Roosts along water edges, beaches, sandbars, or old driftwood (Shuford and Gardali 2008).	Summer - BAR; Yearlong - LAC	CNDDB records are for nesting pelicans, the closest of which is over 500 miles north of the Project area, near Clear Lake Reservoir. This species would only use the study area for roosting.
Pooecetes gramineus affinis	Oregon vesper sparrow	SSC	Obligate grassland species. Open ground with little vegetation or short grass and low annuals, including stubble fields, meadows and road edges (Shuford and Gardali 2008).	Not reported by CWHR	The CNDDB does not include records for this species.
Progne subis	purple martin	SSC	Inhabits open forests, woodlands, and riparian areas in breeding season. Found in a variety of open habitats during migration, including grassland, wet meadow, and fresh emergent wetland, usually near water. In southern California, now only a rare and local breeder on the coast and in interior mountain ranges, with few breeding localities. Absent from higher desert regions except as a rare migrant. In northern California, an uncommon to rare local breeder on the coast and inland to Modoc and Lassen Counties (CDFW 2018f).	Summer - AGS, BOP, COW, FEW, LAC, MHW, URB, VRI, WTM	No occurrences within proposed Project boundary; however, known occurrence approximately 8.8 miles to the north.
Riparia riparia	bank swallow	ST, BLMS	Riparian areas with sandy, vertical bluffs or riverbanks. Also nest in earthen banks and bluffs, as well as sand and gravel pits (Shuford and Gardali 2008).	Summer - AGS, BAR, CSC, DRI, LAC, SGB, URB, VRI; Migrant - FEW, MCH, WTM	No occurrences within proposed Project boundary; however, known occurrence approximately 17.5 miles to the south.
Setophaga petechia	yellow warbler	SSC	Breeding occurs from the coast range in Del Norte County, east to the Modoc plateau, south along the coast range to Santa Barbara and Ventura Counties, and along the western slope of the Sierra Nevada south to Kern County (CDFW 2018f).	Summer - BOP, COW, DRI, URB, VRI; Migrant - CRC, CSC, DSW, JST	This species was observed several times during the ESA-Listed Riparian Bird Study (Study 4.1.10). There are no CNDDB documented occurrences within proposed Project boundary; however, there is a known occurrence approximately 1.7 miles to the north.
Strix occidentalis occidentalis	California spotted owl	SSC, BLMS, FSS	Forests and woodlands with large mature trees and snags containing a high basal area, dense canopy (>70%) cover, multiple canopy layers, and downed woody debris. Breeding range extends west of the Cascade Range through the North Coast Ranges, the Sierra Nevada, and in more localized areas of the Transverse and Peninsular Ranges. May move downslope in winter along the eastern and western slopes of the Sierra Nevada, and in other areas. (Shuford and Gardali 2008).	Yearlong - BOP, COW, MHW, VRI	Records for this species are available in the Spotted Owl Observations Viewer associated with CNDDB. One observation occurs within the proposed Project boundary along Piru Creek just south of Pyramid Lake and is associated with a USFS Protected Activity Center. Several other observations and an activity center are located along Buck Creek west of Pyramid Lake.
Toxostoma lecontei	Le Conte's thrasher	SSC	Occurs primarily in open desert wash, desert scrub, alkali desert scrub and desert succulent shrub habitats (CDFW 2018f).	Yearlong - DSW, JST	No occurrences in study area; however, known occurrence approximately 18 miles from study area.
Vireo vicinior	gray vireo	SSC, BLMS, FSS	Breed in mature, arid chaparral, or open pinyon-juniper woodland mixed with chaparral, desert scrub, or sagebrush (Winter and Hargrove 2004).	Summer - CRC, MCH, PJN	No occurrences within proposed Project boundary; however, known occurrence approximately 52 miles to the north.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary (continued)

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Xanthocephalus	yellow-headed blackbird	SSC	Nest in marshes with tall, emergent vegetation (e.g., tules and cattails) adjacent to deepwater (Shuford and Gardali 2008).	Summer - AGS, WTM; Yearlong - FEW, LAC	No occurrences within proposed Project boundary; however, known occurrence approximately 36 miles to the north.
Mammals					
Bats					
Antrozous pallidus	pallid bat	SSC, BLMS, FSS	Day roosts are in caves, crevices, mines, and occasionally in hollow trees and buildings (CDFW 2018f).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, MHW, PJN, SGB, VRI, WTM; Summer - URB	No known occurrences within the proposed Project boundary; nearest occurrence is approximately 0.6 miles from the boundary.
Corynorhinus townsendii	Townsend's big-eared bat	SSC, BLMS, FSS	Cave-dwelling, also roosts in old mine-workings, occasionally found in buildings. Population concentrations in areas with cavity-forming rock and in old mining districts (Bolster et al. 1998).	Summer - AGS; Yearlong - BAR, BOP, CRC, COW, CSC, DRI, DSW, JST	No occurrences within proposed Project boundary; however, known occurrence approximately 6.2 miles to the north.
Euderma maculatum	spotted bat	SSC, BLMS	The known species range covers British Columbia south through eastern Oregon and Washington to Montana and south through Wyoming, Colorado, and New Mexico to the east, and eastern California and Nevada to the west (Gervais 2016). Individuals are nocturnal and known to utilize crevices and caves for roosting. Additionally, they are known to use conifer and aspen stands for night roosting. Meadows, riparian areas, shrub-steppe, and open stands of forest are typical foraging habitat (Gervais 2016).	Yearlong - AGS, BOP, COW, CSC, DRI, DSW, JST, PJN, SGB, URB, VRI, WTM	No occurrences within proposed Project boundary; however, known occurrence approximately 2.8 miles to the south.
Eumops perotis californicus	western mastiff bat	SSC, BLMS	Open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, annual and perennial grasslands, palm oases, chaparral, desert scrub, and urban areas. Roosts in crevices on vertical cliff faces, high buildings, trees, and tunnels (CDFW 2018f).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, FEW, JST, MCH, MHW, PJN, URB, VRI, WTM	No occurrences within proposed Project boundary; however, known occurrence approximately 5.8 miles to the west.
Lasiurus blossevillii	western red bat	SSC	Roosting habitat includes forests and woodlands, often in edge habitats adjacent to streams, fields, or urban areas (CDFW 2018f).	Yearlong - AGS, BOP, CRC, COW, CSC, PJN, URB, VRI, WTM; Summer - FEW, LAC, MCH, MHW	No occurrences within proposed Project boundary; however, known occurrence approximately 26.7 miles to the south.
Macrotus californicus	California leaf-nosed bat	SSC, BLMS	The species is nocturnal, and individuals are known to forage close to the ground in a hovering fashion. The species feeds on flying insects taken from vegetation or off the ground. Individuals inhabit lowland desert scrub and are known to roost in caves and abandoned mine tunnels during the day, while night roosts include buildings, rock, porches, mines, and caves. Night roosts are typically separate from those used during winter. Long migrations are not typical, but small seasonal roost changes are known to occur (NatureServe 2018).	Yearlong - BAR, VRI; Summer - CSC, MCH	No occurrences within proposed Project boundary; however, known occurrence approximately 14.4 miles to the south.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary (continued)

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Myotis ciliolabrum	small-footed myotis	BLMS	The species is common in arid regions of California. Known ranges include Contra Costa County south, the west side of the Sierra Nevada, various areas of the Great Basin, and areas of Modoc, Kern, and San Bernardino Counties (CDFW 2018f). Individuals are nocturnal and typically inhabit arid upland locations, preferring open stands of forest and brush near water sources. Individuals are known to shelter and roost in small groups of 50 plus in mines, natural crevices, buildings, caves and bridges (CDFW 2018f).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, FEW, MCH, MHW, PJN, SGB, URB, VRI, WTM; Summer - DRI, JST, LAC	No occurrences within proposed Project boundary; however, known occurrence approximately 10 miles to the north.
Myotis evotis	long-eared myotis	BLMS	The species is uncommon throughout its known range, although it is known to be widespread throughout California (CDFW 2018a). Unlike similar species, the long-eared myotis avoids arid regions and is known to occur along the California coast, parts of the Great Basin, as well as the Sierra Nevada and Tehachapi mountain ranges. The long-eared myotis forages fairly close to the ground on insects, with a special attraction to beetles, in open stands of trees, shrubs, and over water sources (CDFW 2018f). The species is known to roost singly or in very small groupings within infrastructure, behind tree bark or snags, and in caves. Feeding habits include foraging in open areas along habitat edges and over water (CDFW 2018f).	Yearlong - BAR, BOP, CRC, COW, CSC, FEW, LAC, MCH, MHW, PJN, VRI, WTM; Migrant - DRI, DSW, JST; Summer - SGB	No occurrences within proposed Project boundary; however, known occurrence approximately 41.7 miles to the southeast.
Myotis thysanodes	fringed myotis	BLMS, FSS	Widespread in California, occurring in all but the Central Valley and Colorado and Mojave deserts. It occurs in a wide variety of habitats; records range in elevation from sea level to 9,350 feet in New Mexico. Optimal habitats are pinyon-juniper, valley foothill hardwood and hardwood-conifer, generally at 4,000 to 7,000 feet (CDFW 2018f).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, MCH, PJN, SGB, URB; Summer - DRI, DSW, JST, LAC, MHW	No occurrences within proposed Project boundary; however, known occurrence approximately 6.2 miles to the north.
Myotis yumanensis	Yuma myotis	BLMS	Yuma myotis is known to be widespread and extremely common in California, occurring from sea level to 11,000 feet in elevation. Preferred habitats include open woodlands and forests with adequate access to water. The species is known to feed heavily over water on small insects using echolocation. Individuals are known to roost in various infrastructures, mines, caves, and other natural crevices. Maternity roosts typically consist of several thousand females and young in similar roost locations with preferred temperatures no greater than 40°C (CDFW 2018f).	Yearlong - AGS, BOP, CRC, COW, CSC, FEW, MCH, MHW, PJN, SGB, URB, VRI, WTM; Summer - DRI, DSW, JST, LAC	No known occurrences within the proposed Project boundary; nearest occurrence is approximately 1.3 miles from the boundary.
Other Mammals					
Bassaricus astutus	ringtail	FP	Species known to inhabit arid oak woodlands, chaparral, deserts, and rocky canyons (LP ForestWatch 2013).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, MHW, PJN, SGB, VRI, WTM	The CNDDB does not include records for this species.

Table 5.4.1-6. Special-Status Species with the Potential to Occur Within the Proposed Project Boundary (continued)

Scientific Name	Common Name	Status	Habitat Association Summary	Temporal and Spatial Distribution[1]	Occurrence Within or Near the Proposed Project Boundary[2, 3]
Lepus californicus bennettii	San Diego black-tailed jackrabbit	SSC	Herbaceous and desert-shrub areas and open, early stages of forest and chaparral habitats (CDFW 2018f).	Yearlong - AGS, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, MHW, PJN, SGB, URB, VRI, WTMI	No known occurrences within the proposed Project boundary; nearest occurrence is approximately 0.2 miles from the proposed Project boundary.
Onychomys torridus ramona	southern grasshopper mouse	SSC	Common in California in arid desert habitats of the Mojave Desert and southern Central Valley, including alkali desert scrub and desert scrub. Lower population densities in succulent shrub, wash, and riparian areas (CDFW 2018f).	Yearlong - AGS, CSC, DRI, DSW, MCH, PJN, SGB, VRI	No occurrences within the proposed Project boundary; however, known occurrence approximately 5.2 miles to the east.
Perognathus alticolus inexpectatus	Tehachapi pocket mouse	SCC, FSS	The known range spans from Tehachapi Pass, west to Mount Pinos, and south to Quail Lake, varying from 3,380 to 6,000 feet in elevation (Bolster et al. 1998). The species is rare and not widespread. The preferred habitat for the species near Mount Pinos includes grassy flats and yellow pine forests. Additionally, it is known to occur in various rangelands and chaparral (Bolster et al. 1998). Individuals feed on various seeds and vegetative plant parts. The species is known to hibernate between the months of October and April. Breeding takes place right after hibernation emergence (Bolster et al. 1998).	Yearlong - BOP, COW, VRI	There is one known occurrence within the proposed Project boundary.
Perognathus inornatus	San Joaquin pocket mouse	BLMS	The San Joaquin pocket mouse prefers dry, grassy, open fields in annual grasslands, desert-scrub, and savannas. On the east side of the San Joaquin Valley, individuals are known to occur in low density up to 1,500 feet in elevation. The species is known to burrow and feeds on various grass seeds, forbs, and other vegetative varieties (NatureServe 2018).	Yearlong - AGS, BAR, COW, MCH	No occurrences within the proposed Project boundary; however, known occurrence approximately 2 miles to the west.
Taxidea taxus	American badger	SSC	Open shrub, forest, and herbaceous habitats with friable soils. Associated with treeless regions, prairies, park lands and cold desert areas. Range includes most of California, except the North Coast (CDFW 2018f).	Yearlong - AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST,MCH, MHW, PJN, SGB, VRI, WTM	No known occurrences within the proposed Project boundary; however, nearest occurrence is approximately 150 feet from the proposed Project boundary.

Notes:
[1]Temporal and Spatial Distribution derived from CWHR, and includes all habitats in study area
[2]Records from CNDDB and other sources
[3]Excluding the Angeles Tunnel
Key:
> = greater than
% = percent
°C = degrees Celsius
AGS = Annual Grassland
BAR = Barren
BGEPA = Bald and Golden Eagle Protection Act
BLMS = Bureau of Land Management Sensitive Species
BOP = Blue Oak-Foothill Pine
CNDDB = California Natural Diversity Database
COW = Coastal Oak Woodland
CRC = Chamise-Redshank Chaparral
CSC = Coastal Scrub
CWHR = California Wildlife Habitat Relationships
DRI = Desert Riparian
DSW = Desert Wash
DWR = California Department of Water Resources
ESA = Endangered Species Act
FD = Federally Delisted
FEW = Fresh Emergent Wetland

FP = Fully Protected
FSS = Forest Service Sensitive
JST = Joshua Tree
LAC = Lacustrine
MCH = Mixed Chaparral
msl = mean sea level
MHW = Montane Hardwood
PJN = Pinyon-Juniper
SD = State Delisted
SE = State Endangered
SGB = Sagebrush
SSC = Species of Special Concern
ST = State Threatened
URB = Urban
USFS = U.S. Department of Agriculture, Forest Service
VRI = Valley Foothill Riparian
WTM = Wet Meadow

Table 5.4.1-7. Summary of the Results from Special-status Raptor Studies

Date of Survey	Location	Survey Type	Bald Eagle (BAEA)	Golden Eagle (GOEA)	Osprey (OSPR)	Burrowing Owl (BUOW)	California Condor (CACO)	Prairie Falcon (PRFA)	Northern Harrier (NOHA)	Peregrine Falcon (PEFA)	Data Forms
12-19-17	Pyramid Lake	BAEA Wintering bird survey	2 (3)	0	4 (2)	0	0	1 (1)	0	0	12.19-01
12-19-17	Quail Lake	BAEA Wintering bird survey, BUOW survey	1 (1)	0	1 (1)	0	0	0	1 (1)	0	12.19-02
12-20-17	Pyramid Lake	BAEA Night Roost Survey	1 (3)	0	0	0	0	0	0	0	12.20-01
12-20-17	Castaic Powerplant	BUOW survey	0	0	0	0	0	0	0	0	12.20-01
1-09-18	Quail Lake	BAEA Night roost survey, BAEA Wintering bird survey, GOEA occupancy survey, BUOW survey	1 (1)	0	0	0	0	0	0	0	1.09-01, 1.09-02
1-09-18	Lower Quail Canal	BUOW survey	0	1 (1)	0	0	0	0	0	0	1.09-01, 1.09-02
1-10-18	Pyramid Lake	BAEA Night roost survey, BAEA Wintering bird survey, GOEA Occupancy Survey	4 (3)	1 (1)	4 (2)	0	0	0	0	0	1.10-01, 1.10-02
2-22-18	Pyramid Lake	BAEA Night roost survey, BAEA Wintering bird survey, GOEA occupancy survey	8 (3)	0	3 (2)	0	1 (2)	0	0	0	2.22-01, 2.22-02
2-22-18	Quail Lake	BAEA Wintering bird survey	2 (1)	0	0	0	0	0	0	0	2.22-03
2-23-18	Quail Lake	BAEA Night roost survey, GOEA occupancy survey	3 (1)	0	0	0	0	0	0	0	2.23-01, 2.23-02
3-15-18	Pyramid Lake	BAEA Nesting territory survey, GOEA incubation survey	4 (2)	0	1 (1)	0	0	0	0	0	3.15-01, 3.15-02
3-16-18	Quail Lake	BAEA Nesting territory survey, GOEA incubation survey	0	0	0	0	0	0	0	0	3.16-01, 3.16-02
5-8-18	Pyramid Lake	BAEA Breeding survey, GOEA Nesting survey	0	0	0	0	0	0	0	0	5.8-01, 5.8-02
5-9-18	Quail Lake	BAEA Breeding survey, GOEA Nesting survey	0	0	0	0	0	0	0	0	5.9-01, 5.9-02
6-12-18	Quail Lake	BAEA Nest Success survey, GOEA Fledgling survey	0	0	0	0	0	0	0	0	6.12-01, 6.12-02
6-13-18	Pyramid Lake	BAEA Nest Success survey, GOEA Fledgling survey	1 (1)	0	1 (1)	0	0	0	0	1 (1)	6.13-01, 6.13-02
Total Number of Observations for Each Species			**27**	**2**	**14**	**0**	**1**	**1**	**1**	**1**	

Note:
[1]Numbers denoted in columns represent the number of observations (individuals observed)

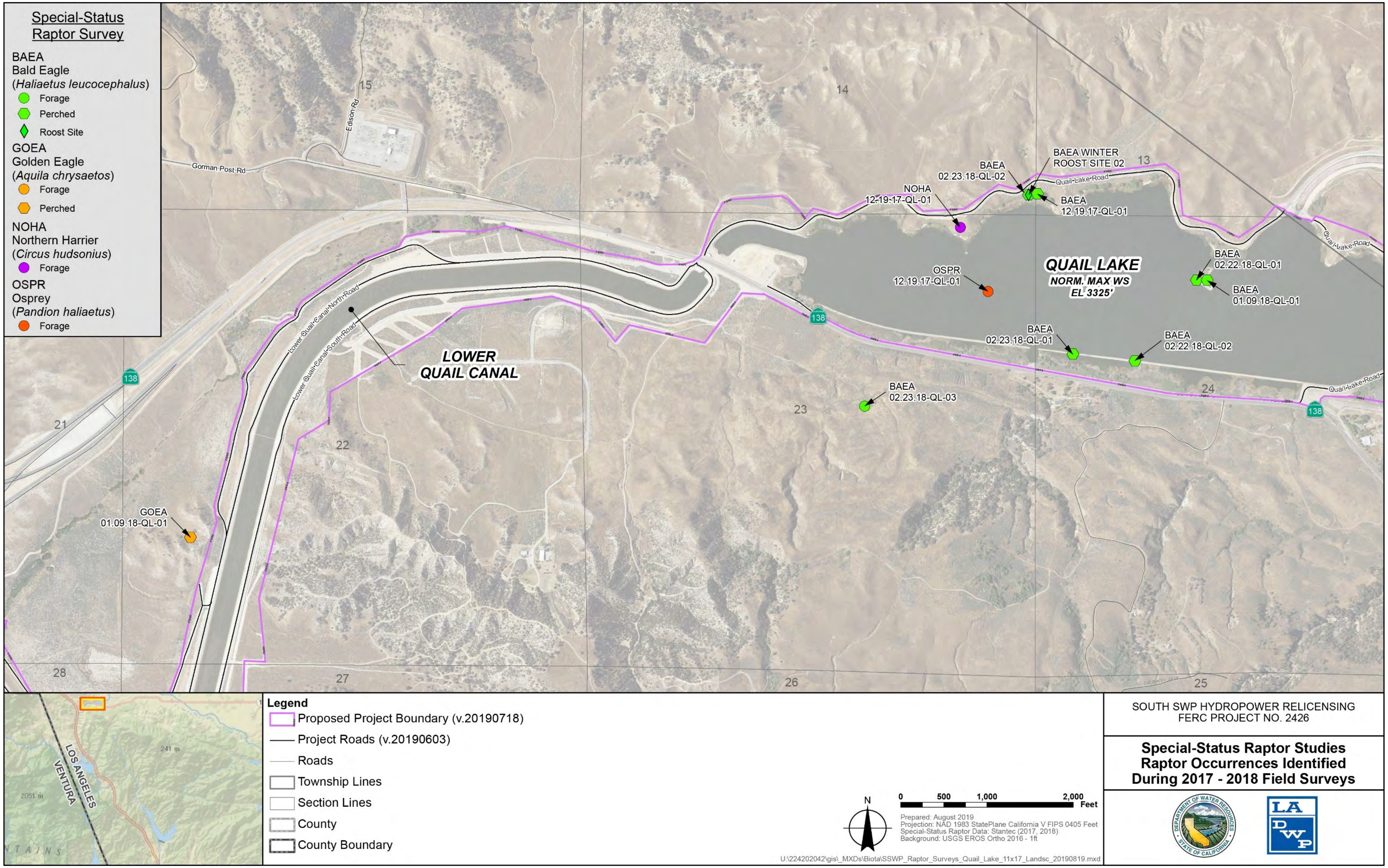

Figure 5.4.1-52. Special-Status Raptor Studies – Raptor Occurrences Identified During 2017-2018 Field Surveys

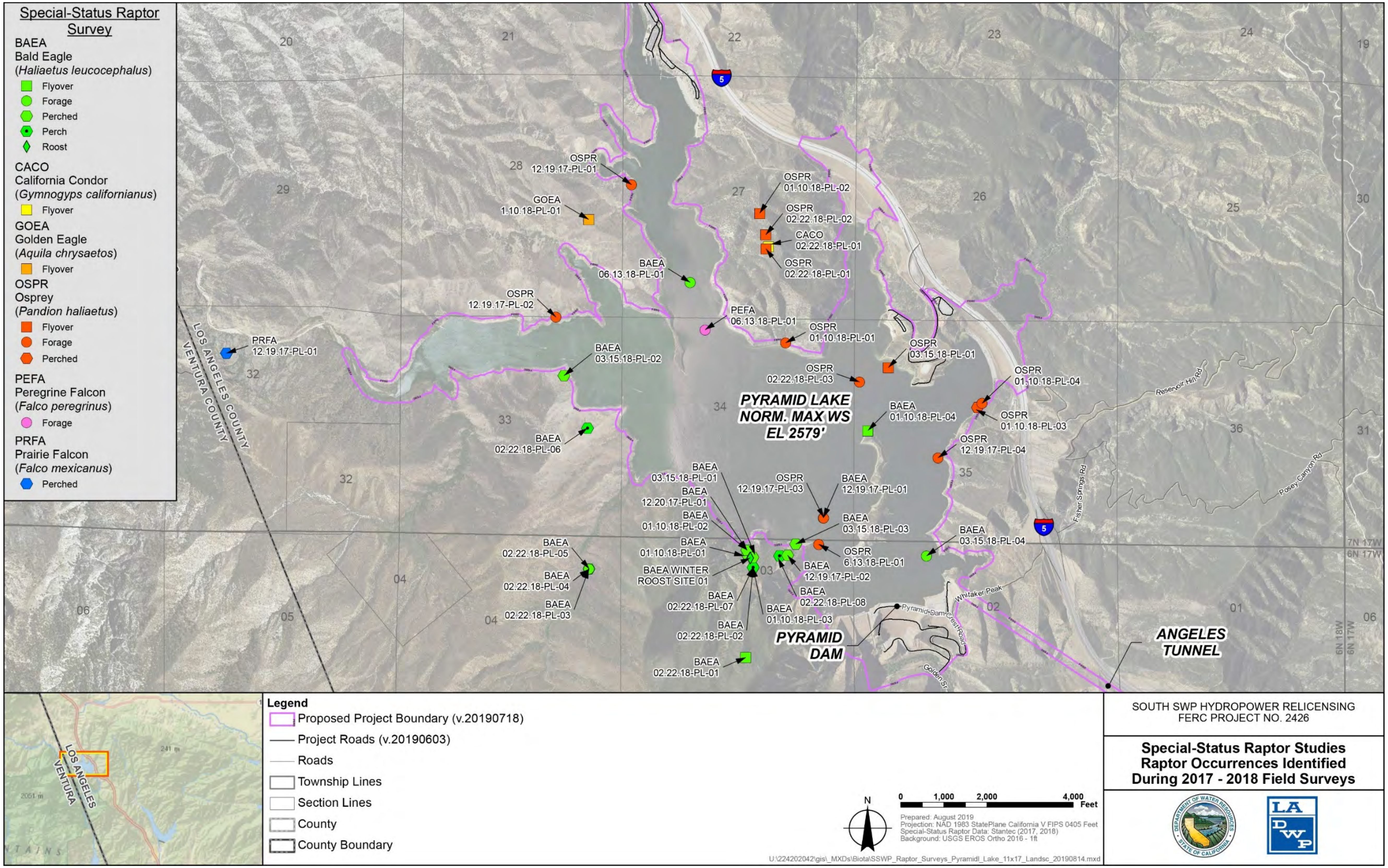

Figure 5.4.1-53. Special-Status Raptor Studies – Raptor Occurrences Identified During 2017-2018 Field Surveys

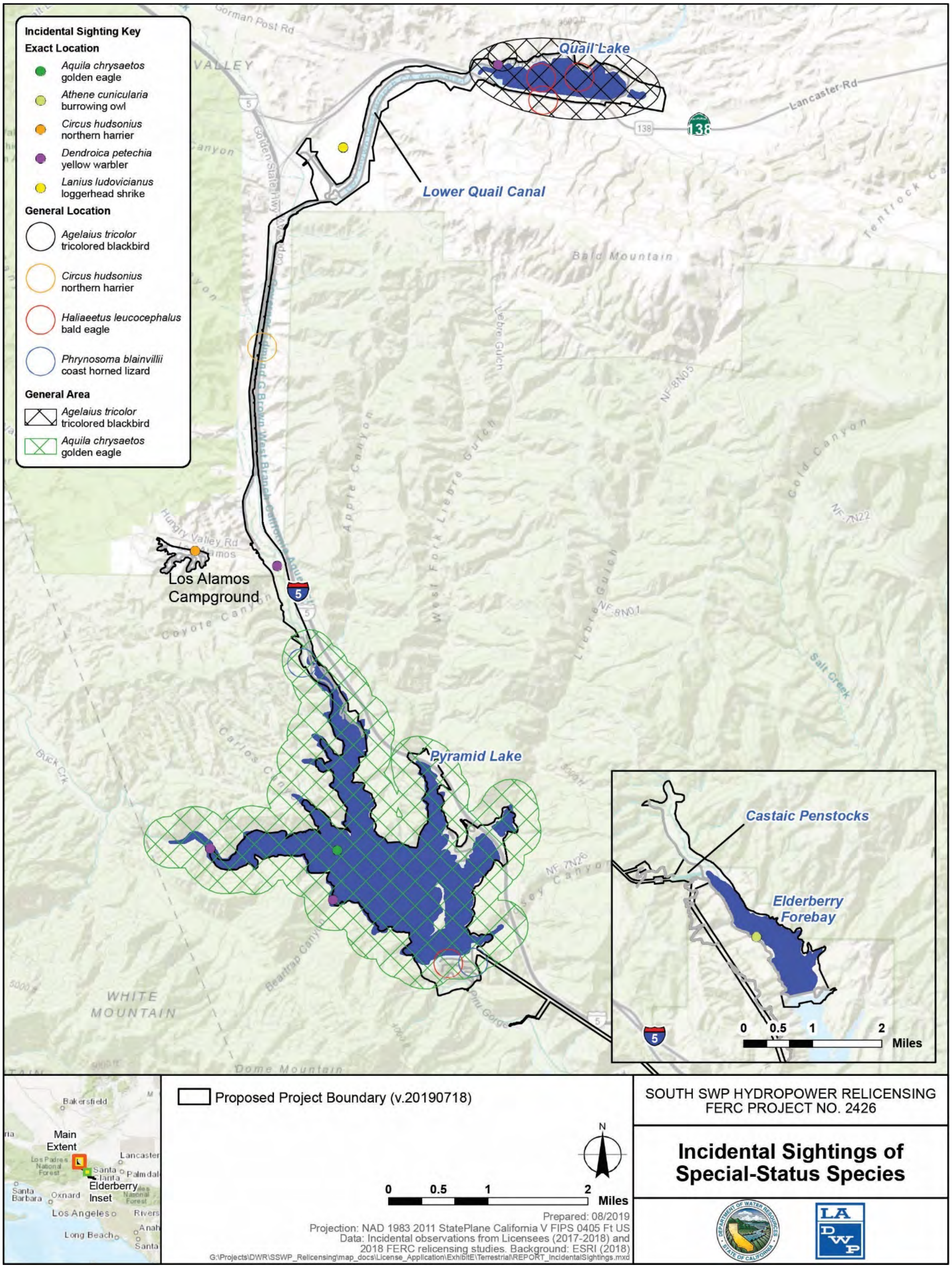

Figure 5.4.1-54. Incidental Observations of Special-Status Species

The following section summarizes the life history of and potential existing effects on the 54 special-status terrestrial wildlife species that are known to occur or have the potential to occur within or immediately adjacent to the proposed Project boundary (all species included in Table 5.4.1-6 above). Included for each species is a summary of: (1) range and preferred habitat; (2) known CNDDB occurrences and observations of the species within and around the proposed Project boundary; and (3) potential effects on species under existing conditions. A high-level summary of potential effects on each species is included in their respective description. Details regarding protective measures, seasonal work restrictions or limited operating periods, and “no activity” buffers are addressed in the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2).

Invertebrates

San Emigdio Blue Butterfly (Plebulina emigdionis)

San Emigdio blue butterfly is designated FSS in the ANF (CDFW 2018g). It is a nectivore that is known to reside in the host plant fourwing saltbush (*Atriplex canescens*). This butterfly typically prefers riparian areas, dry river courses, intermittent streamsides, and surrounds flat lands. Adults emerge from April to September (NatureServe 2018).

There are no known CNDDB occurrences of San Emigdio blue butterfly within the proposed Project boundary. The closest known occurrence (Occurrence #10) is documented near Cuddy Canyon off of Frazier Mountain Park Road at Interstate 5, roughly 5.8 miles north of the proposed Project boundary (CDFW 2018a). This species is not linked with a particular habitat type in the CWHR program (some species are not included in the CWHR program for various reasons [i.e. subspecies, or species recently given special-status designations]); however, it would likely be associated with riparian areas and shrub-dominated habitats near washes within the proposed Project boundary. The current status of the San Emigdio blue butterfly is FSS; thus, effects to this species are only considered on NFS lands. The species’ host plant, fourwing saltbush, has been observed within the proposed Project boundary, primarily near the Peace Valley pipeline. Although San Emigdio blue butterfly is not known to occur within the proposed Project boundary, the presence of suitable habitat and nearby occurrences indicates the potential for this species to occur. Suitable riparian habitat does occur within the portion of the proposed Project boundary located on NFS lands.

Current O&M activities that may affect San Emigdio blue butterfly, should they be present, include activities that could disturb its host plant, such as vegetation management, dispersed recreation use, and road maintenance. However, the host plant is not anticipated to be disturbed by routine Project O&M due to these activities primarily occurring in previously disturbed areas, such as Project facilities and roads. In addition, suitable habitat for this species is not present in designated recreation areas. Therefore, effects on San Emigdio blue butterfly from current O&M activities are not expected to be considered adverse to the species as they are limited to temporary disturbance of occasional individuals from their habitat. Should non-routine Project activities occur on

NFS lands, Project O&M staff would be trained in identification of the butterfly's host shrub (fourwing saltbush), and clearance surveys for the host plant would occur prior to vegetation clearing or other construction activities. Should the host plant be found, it would be flagged and avoided. If effects to the shrub on NFS lands were determined to be unavoidable, consultation with USFS would occur prior to work. Protective measures for this species are included in the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2).

Amphibians

Yellow-blotched Salamander (Ensatina eschscholtzii croceater)

Yellow-blotched salamander is designated BLM Sensitive and FSS (CDFW 2018g). It is limited to the Tehachapi Mountains, extending into the LPNF near Mount Pinos, Frazier Mountain, and Alamo Mountain (LP ForestWatch 2013). Like most salamanders, this species inhabits cool, moist areas and is most often found under debris, near water, and under loose soil. Yellow-blotched salamander is known to occur in a very narrow band of rock outcroppings and old growth forest within its known range (LP ForestWatch 2013).

There are no known CNDDB occurrences of yellow-blotched salamander within the proposed Project boundary. The closest known occurrence (Occurrence #8) is documented roughly 3.3 miles from the proposed Project boundary, 0.25 miles north of Tejon Peak in the Tehachapi Mountains (CDFW 2018d). This species is not linked with a particular habitat type in the CWHR program. Nearby CNDDB occurrences and the presence of suitable habitat in the form of riparian and mesic forested areas, especially those in the higher elevation areas along the northwestern edge of the proposed Project boundary, seem to indicate the potential for this species to occur within the proposed Project boundary. However, the known range of this species barely overlaps with Los Angeles County and does not include the proposed Project boundary (Nafis 2018; LP ForestWatch 2013). Therefore, although areas adjacent to the proposed Project boundary provide suitable habitat for yellow-blotched salamander, it is highly unlikely this species would occur within the proposed Project boundary due to a lack of suitable habitat, such as mesic, mountainous, old-growth forests. Thus, no effects to yellow-blotched salamander are likely to occur under current conditions.

Reptiles

Northern California Legless Lizard (Anniella pulchra)

Northern California legless lizard is designated SSC and FSS (CDFW 2018g). It occurs in sparsely vegetated areas of beach dunes, chaparral, pine-oak woodland, desert scrub, sandy washes, and stream terraces (Nafis 2018). This species is known to forage on insects and associated larvae at the base of shrubs (CDFW 2018f). Northern California legless lizard is known in parts of the San Joaquin Valley and the Tehachapi Mountains, and an isolated population is located in Riverside County (CDFW 2018f; Nafis 2018).

There are no known CNDDB occurrences of northern California legless lizard within the proposed Project boundary. There is a known occurrence (Occurrence #92) of legless lizard (*Anniella* sp.) approximately 1.2 miles from the proposed Project boundary. This occurrence is documented near Gorman Post Road, roughly 2 miles northwest of Quail Lake (CDFW 2018a). There are numerous other records for California legless lizards (*Anniella* sp.) within and around the proposed Project boundary, which could represent southern California legless lizard, northern California legless lizard, or intergrades of the two species. Northern California legless lizard is not linked with a particular habitat type in the CWHR program; however, it may be associated with any habitats underlain by loose soils. Legless lizards are mostly fossorial species (i.e., adapted to digging and life underground) associated with loose, sandy, or loamy soils; therefore, predicting this species' distribution requires more information than is available from general habitat mapping. The presence of suitable habitat and previous occurrences within the proposed Project boundary indicate the potential for this species to occur within or adjacent to the proposed Project boundary.

Northern California legless lizard has the potential to occur in a variety of habitats within and adjacent to the proposed Project boundary, specifically those with loose, sandy, or loamy soils in which they can easily burrow.

Ongoing O&M activities that may affect northern California legless lizard include grading of dirt roads, vegetation management, or other ground-disturbing activities that can lead to disturbances of habitat, including underground burrows should they be present. Project-related recreation activities that could affect the species are largely located at developed recreation sites on Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches and other recreation areas. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and activities that may compact the loose soil required for the species fossorial life phases. Project activities may impact individuals, but are not expected to have an overall impact on the species' viability or its habitat.

Southern California Legless Lizard (Anniella stebbinsi)

Southern California legless lizard is an SSC and FSS (CDFW 2018g). It is found from southwestern California south of the Transverse Ranges south into northwestern Baja California, with separate populations to the north in the Tehachapi and Piute Mountains. Habitat types consist of areas with moist, warm, and loose soils that are sparsely vegetated, including grassland, beach dunes, chaparral, pine-oak woodland, conifer woodland, desert scrub, sandy washes, and terraces of riparian areas containing sycamores, cottonwoods, or oaks. This lizard spends most of its time underground in burrows, foraging in loose soil, leaf litter, and fallen logs during the morning and evening (NatureServe 2018; Nafis 2018).

There are no known CNDDB occurrences of southern California legless lizard within the proposed Project boundary. The closest known occurrence (Occurrence #102) is located approximately 20 miles southwest of the proposed Project boundary near the town of Fillmore (CDFW 2018a). As mentioned in the description for northern California legless lizard, there are numerous other records of California legless lizards within and around the proposed Project boundary, which could be either of the species or intergrades of the two species. Although the nearest definite record of southern California legless lizard is almost 20 miles southwest of the proposed Project boundary, the presence of numerous *Anniella* sp. occurrences indicates the potential for this species to have been previously observed within the proposed Project boundary.

Southern California legless lizard is not linked with a particular habitat type in the CWHR program; however, it may be associated with any habitats underlain by loose soils. Legless lizards are mostly fossorial species associated with loose, sandy, or loamy soils; therefore, predicting this species' distribution requires more information than is available from general habitat mapping. Although not known within the proposed Project boundary, the presence of suitable habitat and nearby occurrences indicates the potential for this species to use habitats within the proposed Project boundary.

Southern California legless lizard has the potential to occur in a variety of habitats within and adjacent to the proposed Project boundary, specifically those with loose, sandy, or loamy soils they can easily burrow in.

Ongoing O&M activities that may affect southern California legless lizard include grading of dirt roads, vegetation management, or other ground-disturbing activities that can lead to disturbances of habitat, including underground burrows should they be present. Project-related recreation activities that could affect the species are largely located around Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches and other recreation areas. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and activities that may compact the loose soil required for the species fossorial life phases. Project activities may impact individuals, but are not expected to have an overall impact on the species' viability or its habitat.

California Glossy Snake (Arizona elegans occidentalis)

California glossy snake is an SSC (CDFW 2018g). It is found throughout southern California up to 6,000 feet above mean sea level (msl). Habitat types include open sandy areas such as deserts, chaparral, sagebrush, valley-foothill hardwood, pine-juniper, and grassland. This animal is primarily nocturnal, spending inactive periods during the day and winter in mammal burrows and on rock outcrops (CDFW 2018f).

A search of the CNDDB revealed two California glossy snake occurrences within the proposed Project boundary. One occurrence is near Gorman (#249), while the other is near Newhall (#247) (CDFW 2018d). Appropriate CWHR habitat types for California glossy snake include AGS, CRC, COW, CSC, JST, MCH, PJN, and SGB, which they use throughout the year (CDFW 2018e). The presence of suitable habitat and previous occurrences within the proposed Project boundary indicate the potential for this species to occur within the proposed Project boundary.

California glossy snake has the potential to occur in various grassland, chaparral, and hardwood and coniferous woodland habitats within and adjacent to the proposed Project boundary.

Ongoing Project O&M activities that potentially affect California glossy snake include road maintenance, vegetation management, or other ground-disturbing activities that can lead to disturbance of habitat, including underground burrows should they be present. Project-related recreation activities that could affect the species are largely located at developed recreation sites on Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout many portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches and other recreation areas. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and activities that may compact the loose soil required for the species fossorial life phases. These Project activities may impact individuals, but are not expected to have an overall impact on the species' viability.

Prior to any non-routine Project activities, pre-construction surveys will be conducted for special-status species, per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2). Project O&M employees will also be taught to identify California glossy snake.

Coastal Whiptail (Aspidoscelis tigris stejnegeri)

Coastal whiptail is designated SSC (CDFW 2018g). It is found in coastal southern California west of the Peninsular Ranges and south of the Transverse Ranges from Ventura County south into Baja California, and occurs from sea level up to 7,000 feet above msl. Habitat types occupied by coastal whiptail include chaparral, woodland, and riparian areas. This wary animal is active during the day and uses heavy brush or holes for cover (Nafis 2018).

A search of the CNDDB revealed a coastal whiptail occurrence within the proposed Project boundary. Occurrence #92 is southeast of Castaic Lake between Tapia and San Francisquito Canyons (CDFW 2018d). This species is not linked with a particular habitat type in the CWHR program; however, it may be associated with any woodland, chaparral, or riparian habitat types. The presence of suitable habitat and previous occurrences indicate the potential for this species to occur within the proposed Project boundary.

Current O&M activities that potentially affect coastal whiptail include road maintenance and vegetation management that may compact the loose sandy soil, burrows, rocks, or logs. The highly mobile nature of this species, in addition to the focused geographic scope and limited frequency of these activities, would minimize the potential for effect. Project-related recreation activities that could affect the species are largely centered at developed recreation sites on Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and other activities. These Project activities may impact individuals, but are not expected to have an overall impact on the species' viability or its habitat.

Prior to any non-routine Project activities that may impact special-status species or their habitat, pre-construction surveys will be performed, per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2).

San Bernardino Ring-necked Snake (Diadophis punctatus modestus)

San Bernardino ring-necked snake is designated FSS (CDFW 2018g). This snake occurs in California, specifically in Kern, Los Angeles, Riverside, and San Bernardino Counties, in high mountains and deserts up to 7,000 feet (NatureServe 2018). Moist habitats are preferred and include wet meadows, rocky hillsides, gardens, farmland, grassland, chaparral, mixed coniferous forests, and woodlands. This snake is secretive and typically only active at night, dusk, or during cloudy days. During the day, it is often found hiding beneath rocks, wood, litter, or other surface debris (Nafis 2018).

There are no known CNDDB occurrences of San Bernardino ring-necked snake within the proposed Project boundary. The closest known occurrence (Occurrence #3) is located just over 8 miles north of the proposed Project boundary in Live Oak Canyon, south of the SWP (CDFW 2018a). This species is not linked with a particular habitat type in the CWHR program; however, it would likely be associated with relatively open, rocky areas in chaparral, open woodland, or grassland habitats. Although not known within the proposed Project boundary, the presence of suitable habitat and nearby occurrences indicates the potential for this species to occur within the proposed Project boundary. Suitable habitat does occur within the portion of the proposed Project boundary located on NFS lands. San Bernardino ring-necked snake has the potential to occur in relatively open, rocky areas in chaparral, open woodland, or grassland habitat types within and adjacent to the proposed Project boundary. San Bernardino ring-necked snake's current status is FSS; thus, effects to this species are only considered on NFS lands.

Current O&M activities that may potentially affect San Bernardino ring-necked snake include ground-disturbing activities, such as road maintenance and vegetation management, that can lead to disturbance of habitat, including rock and other debris used for cover. Project-related recreational activities on NFS lands that could affect the species are centered at Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and activities that may disturb material that the species uses for cover. These Project activities may impact individuals, but are not expected to have an overall impact on the species' viability or its habitat.

California Mountain Kingsnake (Lampropeltis zonata parvirubra)

California mountain kingsnake (San Bernardino population) is designated FSS (CDFW 2018g). This snake occurs in southern California in the San Jacinto, Santa Rosa, San Bernardino, Santa Susana, and San Gabriel Mountains up to 9,000 feet, and in the Verdugo Hills. Habitat types include coniferous forest, oak-pine woodland, riparian woodland, chaparral, and coastal sage scrub. The species spends most of its time underground, inside rock crevices, or under surface objects, typically visible above ground when temperatures are more moderate (Nafis 2018).

There are no known CNDDB occurrences of California mountain kingsnake within the proposed Project boundary. The closest known occurrence (Occurrence #3) is documented roughly 45 miles from the proposed Project boundary, at the mouth of Alder Creek in the ANF (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include AGS, BOP, COW, MCH, MHW, VRI, and WTM yearlong (CDFW 2018a). Although not known within the proposed Project boundary, the presence of suitable habitat within the species range indicates the potential for this species to occur within the proposed Project boundary. Suitable habitat does occur within the portion of the proposed Project boundary located on NFS lands.

California mountain king snake has the potential to occur in relatively open, rocky areas in chaparral, open woodland, or various herbaceous habitat types within and adjacent to the proposed Project boundary. California mountain kingsnake's current status is limited to FSS; thus, effects to this species are only considered on NFS lands. Current O&M activities that may potentially affect California mountain kingsnake include ground-disturbing activities, such as road maintenance and vegetation management, that can lead to disturbance of habitat, including rock and other debris used for cover. Project-related recreational activities that could affect the species are centered at developed recreation areas on Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and other activities that may adversely modify the rocks that the species uses for cover. These activities may impact individuals, but are not expected to have an overall impact on the species' viability or its habitat.

Coastal Rosy Boa (Lichanura orcutti)

Coastal rosy boa (also known as northern three-lined boa) is designated FSS (CDFW 2018g). This species was formerly known as rosy boa in California and is now considered northern three-lined boa based on taxonomic revisions (CDFW 2018g). The species range occurs throughout southern California, south of Los Angeles, from the coast to the Mojave and Colorado Deserts. It is absent in the extreme eastern portion of California and in the vicinity of the Salton Sea. This snake primarily inhabits areas with moderate to dense vegetation and rocky cover such as semi-arid and rocky scrublands, rock deserts, canyons, and other rocky areas and vertical canyon walls. The snake appears to be common in riparian areas, but does not require permanent water. This species is a secretive snake, and little is known about seasonality, but it is most frequently encountered in late spring and early summer (CDFW 2018f).

Occurrences for coastal rosy boa are not included in the CNDDB (CDFW 2018a). However, potential habitat for coastal rosy boa exists throughout the proposed Project boundary, which is within the western portion of the known distribution range of this species (Nafis 2018). Appropriate CWHR habitat types within the proposed Project boundary include BAR, CRC, CSC, DRI, JST, MCH, and PJN. Although the species has not been recorded within the proposed Project boundary, the location of the Project within the species known range and the presence of suitable habitat results in the potential for coastal rosy boa to use rocky habitats within the proposed Project boundary.

Coastal rosy boa has the potential to occur in relatively open, arid areas in chaparral, open woodland, or barren habitat types within and adjacent to the proposed Project boundary. Coastal rosy boa's current status is limited to FSS; thus, effects to this species are only considered on NFS lands.

Current O&M activities that may potentially affect coastal rosy boa include ground disturbing activities, such as road maintenance or vegetation management, that can lead to disturbance of habitat, including rock and other debris used for cover. Project-related recreational activities that could affect the species are centered at developed recreation areas on Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches and other recreation areas. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and other activities that may disturb the rock and other debris that the species uses for cover. These activities may impact individuals, but are not expected to have an overall impact on the species' viability or its habitat.

Coast Horned Lizard (Phrynosoma blainvillii)

Coast horned lizard is designated SSC and BLM Sensitive (CDFW 2018g). This lizard may be found along the Sierra Nevada foothills from Butte County south to Kern County and throughout the central and southern California coast at elevations ranging from 0 to 6,000. Habitat types occupied by this species include valley foothill hardwood, conifer, riparian, and grasslands. Coast horned lizard will often burrow into loose, sandy soil to escape from predators and extreme heat, or will use logs, rocks, mammal burrows, or crevices during periods of inactivity and winter hibernation (CDFW 2018f).

The Licensees have observed coast horned lizard in the vicinity of Pyramid Lake. Specifically, one adult was observed along the road leading to the crest of Pyramid Dam and a juvenile was seen in the equipment staging area at Warne Powerplant, west of Los Alamos Campground Road. There is also one known CNDDB occurrence (Occurrence #158) of coast horned lizard within the proposed Project boundary, located within the Frenchmans Flat Campground. There are an additional six known CNDDB occurrences that are located within 1 mile of the proposed Project boundary; occurrences #543, #545, #546, #570, #711, and #859 are located near Castaic Lake, Pyramid Lake, and Piru Creek. This species is not linked with a particular habitat type in the CWHR program; however, it may be associated with the majority of the habitats within the proposed Project boundary. This species is known to occur within the proposed Project boundary.

Coast horned lizard has the potential to occur in most habitat types within and adjacent to the proposed Project boundary. Current O&M activities that may potentially affect coast horned lizard include ground-disturbing activities (such as grading of dirt roads or vegetation management) that can lead to disturbances of habitat features (loose sandy soil, burrows, rocks or logs) used for escape, cover, or winter hibernation. However, because these O&M efforts are infrequent and dispersed across the area, and this species is wary and highly mobile much of the year, most individuals would likely flee work areas when O&M activities begin. The effects of current O&M activities are limited in scope and duration, and are unlikely to adversely affect the species.

Coast Patch-nosed Snake (Salvadora hexalepis virgultea)

Coast patch-nosed snake is designated SSC (CDFW 2018g). This snake occurs in southern California from San Luis Obispo County south to coastal northern Baja California up to 7,000 feet. Habitat types include semi-arid brush and chaparral, with this species typically found in canyons, on rocky hillsides, and in flat areas. This diurnal animal burrows into loose soil, but is also active above ground, even during extreme heat (Nafis 2018).

There are no known CNDDB occurrences of coast patch-nosed snake within the proposed Project boundary. The closest known occurrence (Occurrence #18) is located approximately 13.5 miles from the proposed Project boundary in Hopper Creek, northwest of Piru Creek (CDFW 2018a). Appropriate CWHR habitat types for coast patch-nosed snake include AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, PJN, SGB, and VRI throughout the year (CDFW 2018e). Although not known within the proposed Project boundary, the presence of suitable habitat and nearby occurrences indicates the potential for this species to occur within the proposed Project boundary.

Coast patch-nosed snake has the potential to occur in a variety of barren, grassland, shrub-dominated, and woodland habitats within and adjacent to the proposed Project boundary.

Current O&M activities that potentially affect coast patch-nosed snake include ground-disturbing activities, such as road maintenance and vegetation management, that can lead to disturbance of habitat, including rock and other debris used for cover. Project-related recreational activities that could affect the species are centered at developed recreation areas on Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches and other recreation areas. This use can cause minor vegetation modification and the introduction or spread of NNIP, noise, and other activities that may disturb the rock and other debris that the species uses for cover. These activities may impact individuals, but are not expected to have an overall impact on the species' viability or its habitat.

Birds

Northern Goshawk (Accipiter gentilis)

Northern goshawk is listed as an SSC, BLM Sensitive, and FSS (CDFW 2018g). In California, the breeding range of northern goshawk is limited to the northern mountain ranges and south through the Sierra Nevada, as well as the San Bernardino Mountains and portions of the LPNF around Mount Abel, Mount Pinos, Frazier Mountain, and the Tecuya Range in northern Ventura County (LP ForestWatch 2013; Shuford and Gardali 2008). This species prefers middle and higher elevation mature, dense coniferous and deciduous forests for breeding. Suitable stands occur in a broad range of conifer and conifer-hardwood types, including ponderosa, Jeffrey, and lodgepole pine (*P. contorta*), mixed conifer, white and California red fir (*Abies concolor, A. magnifica*), Douglas-fir, mixed redwood-Douglas-fir-hardwood, and rarely pinyon juniper (*P. monopylla, Juniperus* spp.), as well as in mature quaking aspen (*Populus tremuloides*) (Shuford and Gardali 2008). Northern goshawk generally select the densest stands available for nesting with a high canopy closure ranging from 60 to 100 percent (Shuford and Gardali 2008). Nests are constructed in large live trees (i.e., mean dbh of 11 inches), usually more than 20 feet above the ground, and are typically found on north-facing slopes. A mosaic of water sources, meadows, and riparian areas are often found within an individual's territory. Foraging habitat includes both dense forests as well as open habitat such as meadow edges and sagebrush flats (NatureServe 2018; Shuford and Gardali 2008).

There are no known CNDDB occurrences of the northern goshawk within the proposed Project boundary. The closest known occurrence (Occurrence #430) is documented near Slick Rock Creek more than 65 miles north of the proposed Project boundary in the Sierra Nevada (CDFW 2018a). The FEIS/EIR for Barren Ridge Renewal Transmission Project (USFS, BLM, and LADWP 2012) stated that northern goshawk was not detected or considered likely within the project boundary for that project, which substantially overlaps the proposed Project boundary. In addition, no northern goshawks were observed during Study 4.1.20 surveys conducted within the proposed Project boundary.

According to the CWHR program, suitable CWHR habitat types within the proposed Project boundary include BOP, CRC, COW, MCH, SGB, and VRI during winter. Additional year-round suitable CWHR habitat types include MHW, MHC, and PJN (CDFW 2018e). Despite the variety of aforementioned habitats, northern goshawk would likely utilize only dense-canopied woodland and forest habitats for nesting. Adjacent areas would be used for foraging.

Northern goshawk may nest in the mountainous, dense-canopied, forested portions adjacent to the proposed Project boundary; however, it is unlikely this species uses the area within the proposed Project boundary for breeding due to an absence of suitable nesting habitat. If this species uses the area within the proposed Project boundary, it is likely limited to foraging and a transient bird moving and/or migrating through the area. Thus, any potential effects resulting from current activities are likely limited to the temporary flushing of individuals by recreation or Project O&M.

Tricolored Blackbird (Agelaius tricolor)

Tricolored blackbird was granted emergency protection by CDFW under CESA on December 3, 2014 (CDFW 2018g). On August 23, 2018, the California Fish and Game Commission adopted and published the findings that listed the species as Threatened under CESA (CFGC 2018). This bird is also designated SSC and BLM Sensitive (CDFW 2018g). This species is common locally throughout the Central Valley of California, and in coastal areas from Sonoma County southward (CDFW 2018f). The species is mostly associated with lowland areas of California and is considered absent from the Transverse Range. However, the area near Quail Lake does overlap with the year-round range for tricolored blackbird, and breeding colonies have been observed (CDFW 2018h). Tricolored blackbirds typically nest near fresh water, preferably in emergent wetlands with tall, dense cattails or tules, but are also known to nest in thickets of willow, blackberry, wild rose (*Rosa* spp.), and tall herbs (CDFW 2018f). A highly gregarious species, tricolored blackbird can be found roosting and foraging in flocks and nesting in large colonies (NatureServe 2018).

This species was observed around Quail Lake during the 2018 relicensing studies. There are also five CNDBB records of tricolored blackbird within the proposed Project boundary. All five occurrences (#399, #944, #945, #946, and #947) are located along the shore of Quail Lake (CDFW 2018a). There are additional records of DWR sightings around Quail Lake as well. Appropriate CWHR habitat types within the proposed Project boundary include AGS, FEW, URB, VRI, and WTM year-round (CDFW 2018e). Previous and current occurrences, combined with the presence of suitable nesting habitat in the form of emergent wetlands and riparian thickets located along lakes and waterways throughout the area within the proposed Project boundary, indicate that this species breeds and forages within the proposed Project boundary.

Tricolored blackbird is known to occur in emergent wetland and riparian areas within and adjacent to the proposed Project boundary, specifically at Quail Lake, but its current nesting status is unknown in southern California. However, should nesting colonies be present, it is unlikely they would be impacted by ongoing routine O&M, as they typically nest in the cattails around the edges of the lake and vegetation management is avoided in wetland and riparian areas.

Recreation at Quail Lake is relatively low compared to Pyramid Lake and is limited to fishing from the shoreline (no boats are allowed in Quail Lake). Furthermore, public vehicle traffic is restricted to the parking lot and the designated recreation area on the west end of the lake, so disturbance around the perimeter of the lake is limited to low-impact foot traffic. However, it is possible that recreators may occasionally walk through nesting habitat. Vegetation management is limited to a 15-foot buffer of the road, which is always kept clear of vegetation and has been for years. There are no upland effects from Project O&M. The reservoir level is also kept relatively constant throughout the year.

Non-routine Project activities have the potential to affect nesting tricolored blackbird, if present, should they occur adjacent to nesting birds during the nesting season. The Licensees will generally avoid areas of breeding/nesting, and plan vegetation removal and other Project activities that could impact nesting birds outside of the general avian breeding season of February 1 through August 31. If Project activities cannot be avoided during this time period, the Licensees will conduct a focused survey for active nests within the area proposed for work, plus a reasonable buffer around the area, prior to the commencement of Project activities. Additional protective measures for tricolored blackbird and their habitat are included in the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2).

Prior to any non-routine Project activities that may impact special-status species or their habitat, pre-construction surveys will be performed per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2).

Grasshopper Sparrow (Ammodramus savannarum)

Grasshopper sparrow is designated SSC (CDFW 2018g). This sparrow is an uncommon and local summer resident in foothills and lowlands west of the Cascade-Sierra Nevada crest, from Mendocino and Trinity Counties south to San Diego County (CDFW 2018f). It prefers grassland habitat, but can also be found in fallow fields, savannas, and shortgrass prairies. Clumped vegetation of intermediate height interspersed in grasslands is required for breeding (NatureServe 2018).

There are no known CNDDB occurrences of grasshopper sparrow within the proposed Project boundary. The closest known occurrence (Occurrence #6) is located approximately 0.5 miles from the proposed Project boundary. The occurrence is located north of Newhall, within Tapia Canyon (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include AGS and WTM during the summer
(CDFW 2018e). Previous occurrences, combined with the presence of suitable nesting

habitat in the form of various grasslands, result in the potential for this species to breed and forage within the proposed Project boundary.

Grasshopper sparrow has the potential to nest in grassland habitats within and adjacent to the proposed Project boundary. Current vegetation management, road maintenance, and recreation activities within and immediately adjacent to suitable grassland nesting habitat may affect grasshopper sparrow. Effects on nesting birds could include mortality of young through forced fledging or nest abandonment by adult birds. Grasslands within the proposed Project boundary also provide foraging value for grasshopper sparrow; however, any effects on foraging birds would be limited to flushing, as there would be limited to no habitat modification associated with Project O&M, since vegetation management is limited to areas already modified to Project use. A measure in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will protect sensitive species and nesting birds while conducting Project O&M during the nesting season without performing nesting bird surveys, thereby substantially reducing any possible effects on nesting birds.

Golden Eagle (Aquila chrysaetos)

Golden eagle is protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and is designated FP and BLM Sensitive (CDFW 2018g). This species ranges up to 11,500 feet and can be found throughout California, except in the middle of the Central Valley. Golden eagles are typically associated with rolling foothills, mountainous areas, sage-juniper flats, and desert habitats (CDFW 2018f). Cliffs, large trees, and man-made structures (e.g., electric transmission towers) with a commanding view are used for nesting (NatureServe 2018). Breeding occurs between late January and August, with most eggs laid between early February and mid-May (CDFW 2018f).

The Licensees performed golden eagle surveys as part of Study 4.1.20 to identify active nests within 0.25 miles of the proposed Project boundary. Surveys were conducted in accordance with protocols outlined in the *Interim Golden Eagle Inventory and Monitoring; and Other Recommendations* (USFWS 2010) and *Protocol for Golden Eagle Occupancy, Reproduction, and Prey Population Assessment* (Driscoll 2010). Four surveys, spaced at least 30 days apart, were conducted between February and July 2018, the typical nesting period for this species (Driscoll 2010). The surveys were performed by biologists utilizing spotting scopes and binoculars from a boat on Pyramid Lake and on foot from the Quail Lake Dam. Both locations provided unobstructed viewing conditions sufficient to observe a golden eagle in flight, perching, or nesting from a distance. In addition, suitable nesting habitat was scanned for signs of whitewash (i.e., excrement staining) or other indications of a nest or roost. In particular, the rocky crags along the western edge of Pyramid Lake was targeted as it contained the best suitable nesting habitat for golden eagle.

The results of the study included two observations of the species during surveys in January 2018. One adult golden eagle was observed perching near Lower Quail Canal. After perching for a period of time, the bird was observed flying to the north before disappearing from sight. The eagle was followed and tracked by visual observation for as long as possible to determine nesting or breeding status. The bird was not observed displaying breeding or nesting behavior. A second individual was observed flying over Pyramid Lake. The study documented no other golden eagles or any evidence of nesting.

There are no known CNDDB occurrences of golden eagle within the proposed Project boundary. The closest known occurrence (Occurrence #87) is located approximately 1.2 miles from the proposed Project boundary. The occurrence is located 0.2 miles north of Gorman Post Road, northwest of Quail Lake (CDFW 2018a). In addition, an incidental observation of a pair of golden eagles soaring over Pyramid Lake was documented during field efforts for Study 4.1.7. Appropriate CWHR habitat types for golden eagles within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, FEW, JST, MCH, MHW, PJN, SGB, URB, VRI, and WTM year-round (CDFW 2018e). Previous observations, combined with the presence of suitable nesting habitat and structures, result in the potential for this species to breed and forage in various habitats within the proposed Project boundary.

Golden eagle has the potential to nest in various habitats with appropriate nesting structures (large trees, snags, transmission towers, cliffs) within and adjacent to the proposed Project boundary. Current road management, vegetation management, and recreation activities within and immediately adjacent to suitable nesting habitat may affect golden eagle via mortality of young through forced fledging or nest abandonment by adult eagles. Ground disturbance and O&M activities outside of the nesting season are limited to temporary disturbances of occasional individuals, as are year-round recreation effects. Various habitats within the proposed Project boundary also provide foraging value for golden eagle; however, only temporary impacts from limited recreation activities would be expected.

Prior to any non-routine Project activities that may impact special-status species or their habitat, pre-construction surveys will be performed per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2). These measures, all included in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), will substantially lower the potential for any Project effects on golden eagle.

Short-eared Owl (Asio flammeus)

Short-eared owl is designated SSC (CDFW 2018g). It inhabits open areas, including annual grasslands, prairies, dunes, meadows, irrigated lands, and saline and fresh emergent wetlands. Nests are depressions on dry ground that are lined with grasses, forbs, sticks, and feathers, and concealed by surrounding grasses and shrubs. This species is known to breed in the coastal areas of Del Norte and Humboldt Counties, the San Francisco Bay Delta, northeastern Modoc Plateau, east side of the Sierra Nevada between Lake Tahoe and Inyo Counties, and in the San Joaquin Valley (CDFW 2018f). There have been previous records of breeding in the Antelope Valley, east of the proposed Project boundary (Shuford and Gardali 2008). The short-eared owl migrates from breeding areas in September or October to wintering areas in the Central Valley, western Sierra Nevada foothills, and along the California coast (CDFW 2018f).

There are no known CNDDB occurrences of short-eared owl within the proposed Project boundary. The closest known occurrence (Occurrence #1) is located approximately 32 miles from the proposed Project boundary, northeast of Lancaster (CDFW 2018a). In addition, no short-eared owls were observed during Study 4.1.20 surveys conducted within the proposed Project boundary. According to CDFW range maps, the proposed Project boundary does not appear to overlap with the breeding range for short-eared owl (CDFW 2018f). Appropriate CWHR habitat types within the proposed Project boundary include AGS, CSC, FEW, SGB, URB, VRI, and WTM year-round, and BOP, CRC, COW, DRI, DSW, JST, MCH, and PJN in the winter (CDFW 2018e). Despite the absence of nearby CNDDB occurrences, short-eared owl may use various habitats within the proposed Project boundary for foraging or wintering.

Short-eared owl has the potential to occur within a wide variety of suitable habitats within and adjacent to the proposed Project boundary; however, it is likely this species only uses this area for wintering as it does not overlap with this species' breeding range. Current Project O&M and recreation activities may temporarily flush animals from wintering areas should they be present. These effects are temporary and minimal, and do not result in adverse effects to the species. Various habitats within the proposed Project boundary may also provide foraging value for short-eared owl; however, any Project effects on foraging habitats are limited and temporary in nature, caused primarily by recreation outside developed areas.

Long-eared Owl (Asio otus)

Long-eared owl is designated SSC (CDFW 2018g). In California, this species can be found throughout the State year-round, excluding the Central Valley and desert regions, where it is only found in the winter. For roosting and nesting, long-eared owls require dense riparian or live oak thickets, or other stands of densely canopied trees. At higher elevations, this species can also be found in dense stands of conifers. The long-eared owl hunts in open areas for voles and other rodents (CDFW 2018f).

There are no known CNDDB occurrences of long-eared owl within the proposed Project boundary. The closest known occurrence (Occurrence #48) is located approximately 20 miles north of the proposed Project boundary along the south side of Tejon Creek (CDFW 2018a). In addition, no long-eared owls were observed during the Study 4.1.20 surveys conducted within the proposed Project boundary. Appropriate CWHR habitat types within the proposed Project boundary include AGS, BOP, CRC, COW, DRI, MCH, MHW, SGB, VRI, and WTM year-round (CDFW 2018e). Despite an absence of nearby CNDDB occurrences, the proposed Project boundary does overlap with the accepted breeding range for this species (CDFW 2018f). Thus, long-eared owl may use various habitats within the proposed Project boundary throughout the year, specifically dense woodland and riparian areas for breeding and all other habitats for foraging.

Long-eared owl has the potential to nest in dense woodland and riparian habitats within and adjacent to the proposed Project boundary. The limited Project O&M and recreation activities outside developed areas within and immediately adjacent to suitable woodland nesting habitat may affect long-eared owl. Effects on nesting owls could include mortality of young through forced fledging or nest abandonment by adult owls. The effect of Project activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Various habitats within the proposed Project boundary also provide foraging value for long-eared owl; however, any effects on foraging habitats would be temporary in nature and limited to recreation outside of developed areas.

A measure in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will protect sensitive species and nesting birds while conducting Project O&M during the nesting season without performing nesting bird surveys, thereby substantially reducing any possible effects on nesting birds.

Burrowing Owl (Athene cunicularia)

Burrowing owl is designated SSC and BLM Sensitive (CDFW 2018g). It is a small, ground-dwelling owl. Its habitat is associated with open grassland, open lots near human habitation, and along roadsides. Within California, the breeding range of burrowing owl includes the Modoc Plateau, Central Valley, San Joaquin Valley, Imperial Valley, Mojave and Colorado Deserts, the southwest corner of San Diego County, and a few coastal counties between Los Angeles and San Francisco. Burrowing owls nest in abandoned burrows dug by small mammals, such as ground squirrels (*Spermophilus* spp.), and larger mammals, such as foxes (*Vulpes* spp.) and American badgers. If burrows are unavailable, burrowing owls may dig their own in soft soil, or utilize pipes, culverts, or nest boxes (CDFW 2018f).

Burrowing owls were targeted as part of Study 4.1.20. Per CWHR maps reviewed prior to the study, the following areas were determined to contain potential habitat and were therefore surveyed for burrowing owl: Quail Lake, Lower Quail Canal, the arms of Pyramid Lake near Interstate 5, and the area surrounding Castaic Powerplant, where accessible. Licensees conducted surveys by following the *Burrowing Owl Survey Protocol and Mitigation Guidelines* (California Burrowing Owl Consortium 1993). The Licensees did not observe suitably sized burrows for burrowing owl in the areas surveyed; therefore, follow-up surveys were determined not to be required, as provided in the FERC-approved study plan. However, during the *Cultural Resources Study* effort, an incidental sighting of a burrowing owl near Elderberry Forebay occurred. This area was not identified in the initial surveys area as having the potential for burrowing owls. It was observed near some rip rap, which provided suitable burrowing habitat for this species. No other suitable burrows were observed in other Project areas.

There is a single CNDDB occurrence of burrowing owl located within the proposed Project boundary. Occurrence #1795 is located west of Castaic Lake (a non-Project facility) and east of Grasshopper Canyon (CDFW 2018a). There are multiple observations of this species outside the proposed Project boundary within the vicinity of the Alamo Powerplant (a non-Project facility). According to the CWHR program, appropriate CWHR habitat types for this species within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, PJN, SGB, URB, VRI, and WTM year-round (CDFW 2018e). Previous observations, combined with the presence of suitable nesting habitat, indicate this species likely uses open habitats with friable soils within the proposed Project boundary year-round, for both wintering and nesting.

Burrowing owl has the potential to nest and overwinter in various open habitats with friable soils within and adjacent to the proposed Project boundary. Current Project O&M and recreation activities within and immediately adjacent to suitable nesting habitat may affect burrowing owls. Effects on nesting owls may include mortality of young through burrow abandonment by adult owls. Ground disturbance and O&M activities outside of the nesting season are limited to temporary disturbances of occasional individuals wintering or foraging within the proposed Project boundary. Year-round recreation effects are also limited to the flushing of occasional individuals from burrows or perches. Various habitats within the proposed Project boundary also provide foraging value for burrowing owl; however, any effects on foraging habitats are temporary in nature and are due to recreation activities.

Prior to any non-routine Project activities that may impact special-status species or their habitat, pre-construction surveys will be performed per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2). These measures, all included in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), will substantially lower the potential for any Project effects on burrowing owl.

Redhead (Aythya americana)

Redhead is designated SSC (CDFW 2018g). It is uncommon to locally common during the winter and a common breeder during the summer in lacustrine waters from Modoc County to Mono County in eastern California. During winter, it can also be found in the Central Valley, central California foothills and coastal lowlands, and along the coast from Monterey County to Ventura County during the winter. Breeding also occurs locally in the Central Valley, coastal southern California, and eastern Kern County (CDFW 2018f). Its habitat includes large marshes, lakes, lagoons, rivers, and bays. Nesting sites can be found in dense bulrush or cattail stands that are interspersed with areas of deep, open water (Shuford and Gardali 2018). Necessary foraging habitat includes large freshwater marshes with persistent emergent vegetation (NatureServe 2018). Redheads dive for food, primarily eating leaves, stems, seeds, and tubers of aquatic plants and smaller amounts of aquatic insects (CDFW 2018f).

The CNDDB includes very limited occurrence information for this species. The nearest recorded CNDDB occurrence is north of Sacramento (CDFW 2018a); however, the CDFW recognizes the northern portion of Los Angeles County as current breeding habitat for redhead (Shuford and Gardali 2008). Appropriate CWHR habitat types for redhead within the proposed Project boundary include FEW year-round and LAC habitats in the winter (CDFW 2018e). Although not known within the proposed Project boundary, the presence of suitable habitat and the presence of breeding habitat in Los Angeles County indicates the potential for this species to use the waterbodies and adjacent wetlands within the proposed Project boundary for breeding and foraging.

Redhead has the potential to nest in emergent wetlands within and adjacent to the proposed Project boundary. Current Project O&M and recreation activities within and immediately adjacent to suitable freshwater wetland nesting habitat may affect redhead, if present. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds, if present. Ground-disturbing and O&M activities outside of the nesting season are limited to temporary disturbances of occasional individuals, as are year-round recreation effects. LAC habitats within the proposed Project boundary provide foraging value for redhead; however, no effects to the foraging value of open water areas occur.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) contains measures for protecting sensitive species and nesting birds while conducting Project O&M during the nesting season, and special provisions for activities around riparian/wetland habitats that will significantly lower the potential for Project effects on this species.

Swainson's Hawk (Buteo swainsoni)

Swainson's hawk is listed as State Threatened (ST) and BLM Sensitive (CDFW 2018g). This species is an infrequent breeding resident and migrant in the Central Valley, Klamath Basin, Modoc Plateau, Lassen County, and Mojave Desert. Swainson's hawks breed in stands with sparse trees in juniper-sage flats, riparian areas, and oak woodlands. They are known to forage in neighboring grasslands, alfalfa fields, or livestock pastures (CDFW 2018f).

There are no known CNDDB occurrences of Swainson's hawk within the proposed Project boundary. The closest known occurrence (Occurrence #2534) is documented 2 miles west of Newhall, roughly 6.6 miles south of the proposed Project boundary (CDFW 2018a). Although there are no records of this species nesting within the proposed Project boundary, Swainson's hawk has commonly been observed soaring and foraging around Quail Canal. No Swainson's hawks were observed during Study 4.1.20 surveys conducted within the proposed Project boundary. Suitable CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, MCH, MHW, PJN, SGB, URB, VRI, and WTM during the summer (CDFW 2018c). The existence of nearby occurrences and the presence of suitable habitat within the proposed Project boundary indicate the potential for Swainson's hawk to use various trees for nesting, especially those in riparian or oak woodland habitats.

Swainson's hawk is known to forage and has the potential to nest in a variety of wooded habitats within and adjacent to the proposed Project boundary, mostly limited to valleys and other lowland areas. Existing Project O&M and recreation activities within and immediately adjacent to suitable nesting habitat may affect Swainson's hawk. Effects on nesting hawks may include mortality of young through forced fledging or nest abandonment by adults. Ground-disturbing and O&M activities outside of the nesting season are limited to temporary disturbances of occasional individuals, as are year-round recreation effects. Grasslands within the proposed Project boundary also provide low level foraging habitat for Swainson's hawk (typically prefers croplands, which are absent); however, any effects on foraging habitats are temporary in nature.

Mountain Plover (Charadrius montanus)

Mountain plover is designated SSC and BLM Sensitive (CDFW 2018g). This species is a fairly common winter resident in California, from Sutter and Yuba Counties south to Los Angeles and western San Bernardino Counties, and extending down to Baja California. It is typically found below 3,200 feet. Habitat types include open grasslands, plowed agricultural fields with little vegetation, heavily grazed rangelands, alkali flats, and open sagebrush areas. Mountain plover does not nest in California and only overwinters in the State (NatureServe 2018; CDFW 2018f).

There are no known CNDDB occurrences of mountain plover within the proposed Project boundary. The closest known occurrence (Occurrence #55) is located approximately 16 miles away in the vicinity of Antelope Valley California Poppy Reserve, within Antelope Valley (CDFW 2018a). Despite the lack of nearby occurrences, the CDFW recognizes the northern portion of Los Angeles County as current wintering habitat for mountain plover (Shuford and Gardali 2008). Appropriate CWHR habitat types include AGS, BAR, and SGB during the winter (CDFW 2018c). Previous occurrences, combined with the presence of suitable wintering habitat in the form of various grasslands, result in the potential for this species to winter within the proposed Project boundary.

While mountain plover has the potential to occur within grassland, barren, and open scrubland habitats within the proposed Project boundary, it is likely this species only uses this area for wintering as it does not overlap with this species' breeding range. Current Project O&M and recreation activities may temporarily flush animals from wintering areas should they be present. Various habitats within the proposed Project boundary may also provide foraging value for mountain plover; however, any effects on foraging habitats are temporary in nature and primarily caused by visitor recreational activities.

Northern Harrier (Circus hudsonius)

Northern harrier is designated SSC (CDFW 2018g). In California, this species ranges up to 5,700 feet in elevation and can be found throughout most of the State, with the exception of the far northern central portion of California and the higher elevations of the Sierra Nevada. Suitable habitat for this species includes meadows, grasslands, open rangelands, desert sinks, and fresh and saltwater emergent wetlands (CDFW 2018f).

Northern harrier may also be found in wheat fields, ungrazed or lightly grazed pastures, and some croplands (Nature Serve 2018). Nesting habitat includes shrubby vegetation along the edges of marshes, emergent wetlands, or along rivers and lakes. This species has been known to nest in grasslands, grain fields, or on sagebrush flats several miles from water. Nests are constructed of a large mound of sticks in wet areas or of a smaller cup of grasses in drier areas (CDFW 2018f).

During Study 4.1.20 surveys, one adult northern harrier was observed foraging near Quail Lake, flying closely over the marsh vegetation along the northern shore. The bird was followed and tracked by visual observation for as long as possible to determine nesting or breeding status. The bird was not observed displaying breeding or nesting behavior. The study documented no other northern harriers or any evidence of nesting. There was also one incidental observation of this species soaring near Los Alamos Campground during relicensing Study 4.1.7. Additionally, DWR has previously recorded sightings of both a male and a female northern harrier foraging in the vicinity of Quail Lake.

The CNDDB includes limited occurrence information for this species. The nearest recorded CNDDB occurrence is south of Santa Ana (CDFW 2018a); however, the CDFW recognizes the northern portion of Los Angeles County as current breeding habitat for northern harrier (Shuford and Gardali 2008). Suitable habitat for northern harrier exists throughout the proposed Project boundary. Appropriate CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, COW, CSC, DRI, FEW, LAC, PJN, SGB, URB, VRI, and WTM year-round; CRC, DSW, and MCH in the winter; and MHW in the summer (CDFW 2018e). Despite a lack of records of northern harrier nesting in the area, this species may potentially use wetland, riparian, and SGB areas within the proposed Project boundary for nesting, as well as the entirety of the area for foraging.

Current Project O&M and recreation activities within and immediately adjacent to suitable nesting habitat may affect northern harrier. Effects on nesting harriers may include mortality of young through forced fledging or nest abandonment by adults. Project activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Various habitats within the proposed Project boundary also provide foraging value for northern harriers; however, any effects on foraging habitats are temporary in nature, and primarily caused by visitor recreational activities.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will have a provision for protecting sensitive species and nesting birds while conducting Project O&M during the nesting bird season and pre-construction surveys prior to non-routine Project actions, which will reduce any potential impacts to the species.

Olive-sided Flycatcher (Contopus cooperi)

Olive-sided flycatcher is designated SSC (CDFW 2018g). This species is a common to uncommon summer resident in a wide variety of forest and woodland habitats throughout California, and is typically found below 9,000 feet above msl. It is not found in the deserts, the Central Valley, or other lowland valleys or basins. Preferred breeding habitat for this species includes a variety of conifer-dominated woodlands and forests. This species is most commonly found in montane coniferous forests where tall trees overlook canyons, meadows, lakes, or other open terrain (CDFW 2018f).

Records for this species are not included in the CNDDB (CDFW 2018a). However, potential habitat for olive-sided flycatcher exists throughout the proposed Project boundary, and the proposed Project boundary is within the species' breeding range (CDFW 2018f). Appropriate CWHR habitat types within the proposed Project boundary include CRC, MCH, and MHW in the summer, and BOP during migration (CDFW 2018e). Although this species has not been recorded within the proposed Project boundary, the summer range for this species overlaps with northern Los Angeles County (CDFW 2018f). This, paired with the presence of suitable habitat, results in the potential for olive-sided flycatcher to use forest habitats within the proposed Project boundary for nesting and various other habitat for foraging.

Olive-sided flycatcher has the potential to nest in forested habitats within and adjacent to the proposed Project boundary. Project O&M and recreation activities within and immediately adjacent to suitable woodland and forest nesting habitat may affect olive-sided flycatcher. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Project activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Habitats within the proposed Project boundary also provide foraging value for olive-sided flycatcher; however, any effects on foraging habitats are temporary in nature, restricted mainly to visitor recreational activities.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will have a provision for protecting sensitive species and nesting birds while conducting Project O&M during the nesting bird season and pre-construction surveys, prior to non-routine Project actions, which will reduce any potential impacts to the olive-sided flycatcher.

White-tailed Kite (Elanus leucurus)

White-tailed kite is designated FP and BLM Sensitive (CDFW 2018b). It is a common to uncommon, year-round resident in the Sierra Nevada foothills and adjacent valley lowlands within California. This species has increased in numbers and extended its range in recent decades (CDFW 2018f). White-tailed kites forage in undisturbed, open grasslands, meadows, farmlands, and emergent wetlands. Trees with dense canopies provide cover and suitable nesting habitat. Nests are usually placed near the top of dense oaks, willows, or other tree stands near foraging areas. Breeding occurs from February to October, with the peak from May to August (CDFW 2018f).

There are no known CNDDB occurrences of white-tailed kite within the proposed Project boundary. The closest known occurrence (Occurrence #86) is approximately 5 miles west of the proposed Project boundary along the Santa Clara River (CDFW

2018a). No white-tailed kites were observed during Study 4.1.20 surveys conducted within the proposed Project boundary. Appropriate CWHR habitat types for white-tailed kite within the proposed Project boundary include AGS, BAR, BOP, COW, CSC, FEW, LAC, PJN, SGB, URB, VRI, and WTM year-round; CRC and MCH during the winter; and MHW during the summer (CDFW 2018e). Although white-tailed kite has not been recorded within the proposed Project boundary, the presence of suitable habitat and nearby occurrences indicate the potential for this species to use a variety of habitats within the proposed Project boundary.

White-tailed kite has the potential to nest in a variety of habitats within and adjacent to the proposed Project boundary. Project O&M recreation activities within and immediately adjacent to suitable nesting habitat may affect white-tailed kite. Effects on nesting kites may include mortality of young through forced fledging or nest abandonment by adults. Project O&M activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Various habitats within the proposed Project boundary also provide foraging value for white-tailed kite; however, any effects on foraging habitats are temporary in nature.

A measure in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will protect sensitive species and nesting birds while conducting Project O&M during the nesting season without performing nesting bird surveys, thereby substantially reducing any possible effects on nesting birds.

Prior to any non-routine Project activities that may impact special-status species or their habitat, pre-construction surveys will be performed per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2). These measures, all included in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), will substantially lower the potential for any Project effects on white-tailed kite.

American Peregrine Falcon (Falco peregrinus anatum)

American peregrine falcon is designated FP (CDFW 2018g). This species may be found throughout the United States, utilizing cliffs and man-made structures, such as buildings and bridges, for nesting (NatureServe 2018). Known active nesting sites are located along the California coast, in the Sierra Nevada, and in other mountains of northern California. In winter, American peregrine falcons can be found inland. Breeding occurs mostly in woodland, forest, and coastal habitats; however, riparian and wetland areas are important year-round, especially outside of the breeding season (CDFW 2018f).

Peregrine falcons were targeted as part of Study 4.1.20. Results of the study included one observation of an adult American peregrine falcon harassing a bald eagle over Pyramid Lake. After being observed soaring for a period of time, the falcon flew northwest before disappearing from sight. The falcon was followed and tracked by visual observation for as long as possible to determine nesting or breeding status. The falcon was not observed displaying breeding or nesting behavior. The study documented no other American peregrine falcons or any evidence of nesting.

There are no known CNDDB occurrences of American peregrine falcon within the proposed Project boundary. The closest known occurrence (Occurrence #14) is within the Pasadena USGS quadrangle (CDFW 2018a). DWR has previously observed one American peregrine falcon perching near the Alamo Powerplant, just outside the proposed Project boundary. Appropriate CWHR habitat types for American peregrine falcon within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, DRI, FEW, LAC, MCH, MHW, PJN, SGB, URB, VRI, and WTM (CDFW 2018e). According to CDFW, the proposed Project boundary does not overlap with the breeding range of American peregrine falcon (CDFW 2018f). Therefore, only wintering falcons would be expected within the proposed Project boundary.

While the American peregrine falcon has the potential to occur within a wide variety of suitable habitats within the proposed Project boundary, it is likely this species only uses this area for wintering as it does not overlap with this species' current breeding range. Current Project O&M activities and recreation activities may temporarily flush individuals from wintering areas should they be present. These effects are temporary and minimal. Various habitats within the proposed Project boundary may also provide foraging value for American peregrine falcon; however, any effects on foraging habitats are temporary in nature, and are limited to small areas around the reservoirs and developed Project facilities.

Common Loon (Gavia immer)

Common loon is designated SSC (CDFW 2018g). It breeds on remote, freshwater lakes with both shallow and deep, clear water in the northern United States and Canada (NatureServe 2018). From May to September, common loon can be seen in estuarine and subtidal marine habitats along the California coast, but is also found on large, deep lakes in the valleys and foothills throughout the State (CDFW 2018f). Northeastern California is considered to be within the historic breeding range of this species. Nests are nearly always built at the water's edge in a quiet, protected, hidden area and are made of aquatic and terrestrial vegetation. Both the male and female build the nest together over the course of one week in May or early June. In winter and during migration, they can be found on lakes, rivers, estuaries, and coastlines. Some individuals will overwinter in inland lakes and rivers (CDFW 2018f).

Records for this species are not included in the CNDDB; however, portions of the proposed Project boundary overlap with the wintering range for this species (CDFW 2018a, 2018f). Appropriate CWHR habitat types for common loon within the proposed Project boundary are limited to LAC habitats during the winter (CDFW 2018e). The proposed Project boundary contains multiple bodies of water that provide suitable wintering habitat for the common loon.

While common loon has the potential to occur in LAC habitats within the proposed Project boundary, it is likely this species only uses this area for wintering as it does not overlap with this species' breeding range. Current recreation activities, especially water-based recreational activities involving boats on Pyramid Lake (the only Project water body where recreational boating is allowed), may temporarily flush animals from wintering areas should they be present. These effects are temporary and minimal.

Bald Eagle (Haliaeetus leucocephalus)

Bald eagle is State Endangered, FP, BLM Sensitive, and FSS (CDFW 2018g; USFS 2013a). Bald eagle is also protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Bald eagle breeds and winters throughout California, excluding desert areas and typically requires large, old-growth trees or snags in remote, mixed stands (CDFW 2018f). It typically nests within 1 mile of water bodies, preferring large lakes or rivers with abundant fish populations (CDFW 2018f). Between mid-October and December, migratory birds from areas north and northeast of California arrive in the State. Wintering populations remain through March or early April. Breeding generally occurs from February through July, but can be initiated as early as January via courtship, pair bonding, and territory establishment. The breeding season normally ends around August 31, as the fledglings are no longer attached to their nest area (CDFW 2018f).

The Licensees performed bald eagle surveys as part of Study 4.1.20 to identify any active roosts or active nests within 0.25 miles of the proposed Project boundary. Surveys were conducted in accordance with protocols outlined in the *Bald Eagle Breeding Survey Instructions* (CDFW 1999) and *Protocol for Evaluating Bald Eagle Habitat and Populations in California* (Jackman and Jenkins 2004). Bald eagle surveys were conducted during all raptor survey periods. The surveys were performed by biologists utilizing spotting scopes and binoculars from a boat on Pyramid Lake and on foot from the Quail Lake Dam. Both locations provided unobstructed viewing conditions sufficient to observe a bald eagle in flight, roosting, or nesting from a distance. In addition, suitable habitat was scanned for, signs of whitewash (i.e., excrement staining), or other indications of a nest or roost. In particular, the southwestern edge of Pyramid Lake was targeted as it contained the highest quality of suitable nesting habitat, including large trees adjacent to the water.

The results of the study included 27 observations of bald eagles soaring, foraging, and perching over both Pyramid Lake and Quail Lake, primarily during the December, February, and March survey periods. All bald eagle individuals were followed and tracked by visual observation for as long as possible to determine nesting or roosting status. No bald eagles were observed exhibiting nesting or breeding behavior during the study; however, surveys did identify two night roosting habitats for wintering bald eagles, which are described below.

Two night roosting habitats for wintering bald eagles were documented during the December 2017 and January, February, and March 2018 visits at both Pyramid Lake and Quail Lake. Refer to Figure 5.4.1-52, Figure 5.4.1-53, and Table 5.4.1-7 for Study 4.1.20 field results. At Pyramid Lake, two adult bald eagles and one juvenile bald eagle were observed consistently roosting and foraging out of a stand of bigcone Douglas-fir trees on a north-facing slope adjacent to the lake. At Quail Lake, one bald eagle was observed consistently roosting in a large cottonwood tree on the north side of the lake adjacent to the water's edge. This eagle was identified as the same individual in all four of the winter observations, due to an inflammation in one eye (i.e., pox) that made it recognizable.

There are no known CNDDB occurrences of bald eagle within the proposed Project boundary. However, there are three CNDDB records that are located approximately 13 miles north and east of the proposed Project boundary (CDFW 2018a). One occurrence (Occurrence #258) is located in Tejon Ranch, a second (Occurrence #257) at the A.D. Edmonston Pumping Plant, and the third (Occurrence #348) along the north shore of Elizabeth Lake (CDFW 2018a).

Appropriate CWHR habitat types for bald eagle within the proposed Project boundary include AGS, BAR, BOP, COW, DRI, FEW, LAC, MHW, PJN, SGB, VRI, and WTM year-round, and CRC, CSC, MCH, and PJN in the winter (CDFW 2018e). Bald eagles have been recorded along the shores of two lakes within the proposed Project boundary; however, no nesting behavior or nest structure was observed or has been known to occur. Bald eagle has the potential to nest in various habitats with appropriate nesting structures (large trees, snags, transmission towers, cliffs) within and adjacent to the proposed Project boundary.

Project O&M and recreation activities within and immediately adjacent to suitable nesting habitat may affect bald eagles, should they nest in the future within the proposed Project boundary. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Project activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Various habitats within the proposed Project boundary also provide foraging value for bald eagle; however, any effects on foraging habitats are temporary in nature. These effects are temporary and minimal.

Prior to any non-routine Project activities that may impact special-status species or their habitat, pre-construction surveys will be performed per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2). These measures, all included in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), will substantially lower the potential for any Project effects on bald eagle.

Yellow-breasted Chat (Icteria virens)

Yellow-breasted chat is designated SSC (CDFW 2018g). It is an uncommon summer resident and migrant to coastal California and the foothills of the Sierra Nevada. This species uses thickets of willows and other brushy vegetation in riparian areas near watercourses for cover and nesting, and may be found up to 4,800 feet above msl. During migration, yellow-breasted chat may occupy riparian habitats in the lower elevations of mountains (CDFW 2018f). This species is usually associated with early-successional riparian areas with dense thickets of saplings. Nests are built in these dense sapling stands, or in blackberry thickets or other thick vegetation. More mature trees are typically used for perches (Ricketts and Kus 2000).

There are no known CNDDB occurrences of yellow-breasted chat within the proposed Project boundary. The closest known occurrence (Occurrence #43) is located approximately 8.5 miles from the proposed Project boundary along the Santa Clara River, east of Piru Creek (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include DRI and VRI year-round and during the summer, and CSC during migration (CDFW 2018e). Although this species has not been recorded within the proposed Project boundary, the presence of nearby occurrences and suitable riparian nesting habitat indicates the potential for this species to nest and forage within the proposed Project boundary.

Yellow-breasted chat has the potential to nest in riparian habitats within and adjacent to the proposed Project boundary. There are limited Project O&M and recreation activities near identified riparian habitat, but if any occurred, they could affect nesting birds. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Effects outside of the nesting season are limited to temporary disturbances of occasional individuals. Habitats within the proposed Project boundary also provide foraging value for yellow-breasted chat; however, any effects on foraging habitats are temporary in nature.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) contains provisions to protect riparian habitat, protect sensitive species and nesting birds while conducting Project O&M during the nesting season, and implement pre-construction surveys for non-routine Project activities. All of these provisions will significantly lower the potential for any Project impacts on the yellow-breasted chat.

Loggerhead Shrike (Lanius ludovicianus)

Loggerhead shrike is designated SSC (CDFW 2018g). It is a common resident and winter visitor in lowlands and foothills throughout California. This species prefers habitats that include open-canopied valley foothill hardwood, valley foothill hardwood-conifer, valley-foothill and desert riparian, pinyon-juniper, and Joshua tree habitats (CDFW 2018f). Loggerhead shrikes often perch on poles, wires, or fenceposts (Shuford and Gardali 2008).

One loggerhead shrike was observed in sagebrush habitat near Lower Quail Canal during Study 4.1.7. In addition, this species has been observed multiple times perching and nesting just outside the proposed Project boundary near the Alamo Powerplant (a non-Project facility). The nearest CNDDB occurrence (Occurrence #95) is located approximately 400 feet from the proposed Project boundary within Grasshopper Canyon, west of Castaic Dam. There are four additional occurrences located within 1 mile of the proposed Project boundary. Occurrences #67, #69, #92, #95, and #115 are located within Tapia Canyon, Grasshopper Canyon, and northwest of Zenobia Road (CDFW 2018a). This species is not linked with a particular habitat type in the CWHR program; however, it would likely use most of the tree-dominated habitats for breeding, including riparian and JST areas. Most of the proposed Project boundary would be considered potential foraging habitat for loggerhead shrike.

Loggerhead shrike has the potential to nest in a variety of tree-dominated habitats within and adjacent to the proposed Project boundary. Current Project O&M and recreation activities within and immediately adjacent to suitable nesting habitat may affect loggerhead shrike, should they be present. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Project activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Habitats in the Project area also provide foraging value for loggerhead shrike; however, any effects on foraging habitats are temporary in nature.

American White Pelican (Pelecanus erythrorhynchos)

American white pelican is designated SSC (CDFW 2018g). Its habitat includes rivers, lakes, reservoirs, estuaries, bays, and open marshes (NatureServe 2018). Nesting sites require flat or gently sloped topography, without shrubs or other obstructions that would impede taking flight, are free of human disturbances, and usually have loose earth suitable for constructing nest-mounds (CDFW 2018f). In California, American white pelican’s nesting range is currently limited to large lakes in the Klamath Basin of northern California. Outside of nesting season (April to August), migrant flocks are often seen throughout California (CDFW 2018f; NatureServe 2018).

There are no known CNDDB occurrences of American white pelican within the proposed Project boundary. The closest documented nesting occurrence (Occurrence #1) is over 500 miles from the Project area near Clear Lake Reservoir (CDFW 2018a). The proposed Project boundary does not overlap with the nesting range for this species; however, American white pelicans may roost within the proposed Project boundary. Suitable habitat for the pelican within the Project boundary includes LAC yearlong and BAR during summer months (CDFW 2018e).

While American white pelican has the potential to occur within open water and adjacent habitats within the proposed Project boundary, it is likely this species only uses this area for wintering as it does not overlap with this species’ breeding range. Current Project activities may temporarily flush animals from wintering areas should they be present. These effects are temporary and minimal. LAC habitats within the proposed Project boundary may also provide foraging value for American white pelican; however, no effects to the foraging value of this habitat occur.

Oregon Vesper Sparrow (Pooecetes gramineus affinis)

Oregon vesper sparrow is designated SSC (CDFW 2018g). It is an obligate grassland species. Preferred habitats include open ground with little vegetation or short grass and low annuals, including stubble fields, meadows, and road edges (Shuford and Gardali 2008). The known breeding range for this species in California includes the northern and eastern portions of the State, but it winters in central and southern California (Shuford and Gardali 2008).

Records for this species are not included in the CNDDB (CDFW 2018a). However, the proposed Project boundary overlaps slightly with the known wintering range of this species, and potential wintering habitat for Oregon vesper sparrow exists throughout the proposed Project boundary in various grasslands (CDFW 2018f). This species is not linked with a particular habitat type in the CWHR program; however, it would likely use various grassland habitats for wintering and foraging. The presence of suitable habitat indicates this species may use grassland habitats within the proposed Project boundary during the winter.

While Oregon vesper sparrow has the potential to occur within grassland habitats within the proposed Project boundary, it is likely this species only uses this area for wintering as it does not overlap with this species' breeding range. Current Project O&M and recreation activities may temporarily flush animals from wintering areas, should they be present. These effects are temporary and minimal. Grassland habitats within the proposed Project boundary may also provide foraging value for Oregon vesper sparrow; however, any effects on foraging habitats are temporary in nature.

Purple Martin (Progne subis)

Purple martin is designated SSC (CDFW 2018g). This species is a long distance migrant, arriving in California from South America in late March and departing by late September. Purple martin is an uncommon to rare local summer resident of various wooded, low-elevation habitats comprising various hardwood and mixed hardwood conifer woodlands, and riparian habitats. Purple martin also occurs in coniferous habitats, including closed-cone pine-cypress, ponderosa pine, Douglas-fir, and redwood (*Sequoia sempervirens*). These habitats vary structurally and may be old growth, multi-layered or open, and may also have snags. Purple martin most often nests in old woodpecker cavities found in tall, old, isolated trees or snags in open forests or woodlands. However, this species may also utilize man-made structures, such as bridges and culverts, for nesting (CDFW 2018f).

There are no known CNDDB occurrences of purple martin within the proposed Project boundary. The closest known occurrence (Occurrence #60) is approximately 8.8 miles north of the proposed Project boundary, between Liveoak and Bear Trap canyons (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include AGS, BOP, COW, FEW, LAC, MHW, URB, VRI, and WTM during the summer (CDFW 2018e). Although this species has not been recorded within the proposed Project boundary, the presence of nearby occurrences and suitable breeding habitat in the form of various wooded areas indicates the potential for this species to use habitats within the proposed Project boundary for nesting and foraging.

Purple martin has the potential to nest in a variety of wooded habitats within and adjacent to the proposed Project boundary. Current Project O&M and recreation activities within and immediately adjacent to suitable woodland and forest nesting habitat may affect purple martin, should they be present. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Effects from Project activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Habitats within the proposed Project boundary also provide foraging value for purple martin; however, any effects on foraging habitats are temporary in nature.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) contains provisions to protect riparian habitat, protect sensitive species and nesting birds while conducting Project O&M during the nesting season, and implement pre-construction surveys for non-routine Project activities. All of these provisions will significantly lower the potential for any Project impacts on the purple martin.

Bank Swallow (Riparia riparia)

Bank swallow is listed as ST and is BLM Sensitive (CDFW 2018g). Bank swallow is a neotropical migrant found in lowland areas of California from spring through fall, with some staying in southern California through the winter months. In summer, this species is restricted to riparian, lacustrine, riverine, and coastal areas. This species requires vertical banks, bluffs, or cliffs with fine-textured or sandy soils. Bank swallows dig holes for nesting and cover into these vertical, friable banks. This species is a colonial nester, often occurring in groups of 100 to 200 nesting pairs. Bank swallows forage over riparian areas, but may also use adjacent grassland, cropland and scrub (CDFW 2018f).

There are no known CNDDB occurrences of bank swallow within the proposed Project boundary. The exact location of the closest known occurrence (Occurrence #2534) is mapped to Arroyo Simi within the City of Simi Valley (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, DRI, MCH, MHW, PJN, SGB, URB, VRI, and WTM during the summer (CDFW 2018e). Although this species has not been recorded within the proposed Project boundary, the presence of nearby occurrences and suitable breeding habitat in the form of riparian areas or steep banks along waterways indicates the potential for this species to use these habitats within the proposed Project boundary for nesting and foraging.

Bank swallow has the potential to nest in steep-banked riparian habitats within and adjacent to the proposed Project boundary. However, as no Project O&M and limited recreation activities occur in any habitat even slightly resembling steep-banked riparian areas, there are no anticipated Project effects on nesting bank swallow. Activities outside of the nesting season are limited to temporary disturbances of occasional individuals. Habitats within the proposed Project boundary also provide foraging value for bank swallow; however, any effects on foraging habitats are temporary in nature.

Yellow Warbler (Setophaga petechia)

Yellow warbler is designated SSC (CDFW 2018g). It is a migrant, found in California between April and October. Yellow warblers construct nests from 2 to 16 feet above ground in riparian deciduous habitats that comprise cottonwoods, willows, alders, and other small trees and shrubs found in low, open-canopy woodlands. Territories occupied by yellow warblers usually contain tall trees for singing and foraging, and heavy brush in the understory for nesting (CDFW 2018f).

Several yellow warbler individuals were observed during the *ESA-Listed Riparian Bird Study* (Study 4.1.10), specifically near Gorman Creek, Quail Lake, Bear Trap, and Piru Creek. The nearest known CNDDB occurrence (Occurrence #94) is located approximately 1.7 miles from the proposed Project boundary within Gorman Creek, between Gorman Post Road and Interstate 5, west of Quail Lake (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include BOP, COW, DRI, URB, and VRI during the summer, and CRC, CSC, DSW, JST, and MCH during migration (CDFW 2018c). Based on previous observations, yellow warbler is known to use riparian habitats within the proposed Project boundary, likely both for nesting and foraging.

Yellow warbler is known to be present and have the potential to nest in riparian habitats within and adjacent to the proposed Project boundary. Current Project O&M and recreation activities within and immediately adjacent to suitable riparian nesting habitat may affect yellow warbler. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Project activities outside of the nesting season are limited to temporary disturbances of occasional individuals, as are year-round recreation effects. Habitats within the proposed Project boundary also provide foraging value for yellow warbler; however, any effects on foraging habitats are temporary in nature.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) contains provisions to protect riparian habitat, protect sensitive species and nesting birds while conducting Project O&M during the nesting season, and implement pre-construction surveys for non-routine Project activities. All of these provisions will significantly lower any potential Project impacts on the yellow warbler.

California Spotted Owl (Strix occidentalis occidentalis)

The California spotted owl is designated SSC, BLM Sensitive, and FSS (CDFW 2018g; USFS 2013a). In 2014, the Wild Nature Institute and John Muir Project of Earth Island Institute petitioned USFWS to have California spotted owls protected. The species was under review for ESA listing; but, the USFWS determined listing was not warranted (USFWS 2017; 84 FR 60371). Typical habitat for this owl includes dense, diverse, multi-layered evergreen forests with open areas under the canopy. In southern California, this species is nearly always associated with oak and oak-conifer habitats (Garret and Dunn 1981 as cited in CDFW 2018f). Nests are constructed on broken tree tops, cliff ledges, in natural tree cavities, and can also include abandoned hawk nests. Foraging habitat includes areas of larger trees with at least 40 percent canopy closure, as well as areas characterized by multiple vegetation layers (NatureServe 2018).

Records for this species are available in the Spotted Owl Observations Viewer associated with CNDDB (CDFW 2018d). One observation occurs within the proposed Project boundary along Piru Creek, just south of Pyramid Lake, and is associated with a USFS Protected Activity Center (PAC) (see Special Ecological Areas section for more information). Several other observations and another PAC are located along Buck Creek west of Pyramid Lake (CDFW 2018d). The CWHR database has not designated specific habitat types for this subspecies. However, CWHR habitat types that would be expected to provide suitable habitat for spotted owl within the proposed Project boundary include BOP, COW, MHW, and VRI year-round (CDFW 2018e). The presence of known PACs within and adjacent to the proposed Project boundary, paired with the presence of suitable habitat, indicates the potential for this species to use forest and woodland habitats within the proposed Project boundary.

California spotted owl has the potential to nest in a variety of dense, tree-dominated habitats within and adjacent to the proposed Project boundary. Current Project O&M and recreation activities within and immediately adjacent to suitable forest nesting habitat may affect California spotted owl. Effects on nesting owls may include mortality of young through forced fledging or nest abandonment by adult owls. Project O&M activities outside of the nesting season may temporarily disturb occasional individuals. Various habitats within the proposed Project boundary also provide foraging value for California spotted owl; however, any effects on foraging habitats are temporary in nature.

Prior to any non-routine Project activities that may impact special-status species or their habitat, pre-construction surveys will be performed per the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2). These measures, all included in the proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), will substantially lower the potential for any Project effects on California spotted owl.

Le Conte's Thrasher (Toxostoma lecontei)

Le Conte's thrasher is designated SSC (CDFW 2018g). The species is an uncommon resident in southern California deserts from southern Mono County south to the border with Mexico, also occurring in the western and southern San Joaquin Valley. Habitat types include sparsely vegetated desert wash, desert scrub, and Joshua tree woodland habitats. Le Conte's thrasher typically nests in dense, spiny shrubs or densely branched cacti in DSWs from 2 to 8 feet above ground. It eats fruits and invertebrates, lizards, and snakes (NatureServe 2018; CDFW 2018a).

There are no known CNDDB occurrences of Le Conte's thrasher within the proposed Project boundary. The closest documented occurrence (Occurrence #57) is more than 20 miles from the proposed Project boundary, approximately 5 miles west of Willow Springs, near the intersection of Meers Road and 104th Street (CDFW 2018a). Suitable habitat for Le Conte's thrasher within the proposed Project boundary includes DSW and JST year-round (CDFW 2018a). Although this species has not been recorded within the proposed Project boundary, the presence of suitable breeding habitat indicates the potential for this species to use habitats within the proposed Project boundary for nesting and foraging.

Le Conte's thrasher has the potential to nest in arid habitat, such as washes and JST areas, within and adjacent to the proposed Project boundary. Current Project O&M and recreation activities within and immediately adjacent to suitable riparian nesting habitat may affect Le Conte's thrasher, should they be present. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Project activities outside of the nesting season may temporarily disturb occasional individuals. Habitats within the proposed Project boundary also provide foraging value for Le Conte's thrasher; however, any effects on foraging habitats are temporary in nature.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) contains provisions to protect riparian habitat, protect sensitive species and nesting birds while conducting Project O&M during the nesting season, and implement pre-construction surveys for non-routine Project activities. All of these provisions will significantly lower any potential Project impacts on the Le Conte's thrasher.

Gray Vireo (Vireo vicinior)

Gray vireo is designated SSC, BLM Sensitive, and FSS (CDFW 2018g, USFS 2013a). It is a local migrant that prefers warm, arid environments (USGS 2018). This species can be found in pinyon-juniper woodlands, oak scrub, and chaparral in mountains and on high plains. Individuals typically feed on different life stages of a variety of arthropods (USGS 2018).

A search of CNDDB records revealed no mapped occurrences of gray vireo within the proposed Project boundary; however, the CNDDB shows unprocessed occurrences of this species in the Liebre Mountain and Mint Canyon quadrangles. The next closest documented occurrence (Occurrence #35) is located an estimated 51 miles away from the proposed Project boundary, roughly 6 miles northwest of Castle Butte (CDFW 2018a). Suitable CWHR habitat types for this species include CRC, MCH, and PJN during the summer (CDFW 2018e). Despite no nearby mapped occurrences, the accepted range of this species overlaps with the proposed Project boundary (CDFW 2018f). Thus, the gray vireo has the potential to occur within and use woodland and chaparral habitats within the proposed Project boundary for nesting and foraging.

Gray vireo has the potential to nest in woodland and chaparral habitats within and adjacent to the proposed Project boundary. Project O&M and recreation activities within and immediately adjacent to suitable nesting habitat may affect gray vireo, should they be present. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Effects of Project activities outside of the nesting season may temporarily disturb occasional individuals. Habitats within the proposed Project boundary also provide foraging value for gray vireo; however, any effects on foraging habitats are temporary in nature.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) contains provisions to protect riparian habitat, protect sensitive species and nesting birds while conducting Project O&M during the nesting season, and implement pre-construction surveys for non-routine Project activities. All of these provisions will significantly lower any potential Project impacts on the species.

Yellow-headed Blackbird (Xanthocephalus xanthocephalus)

The yellow-headed blackbird is designated SSC (CDFW 2018g). This species breeds in freshwater marshes with cattail, tule, or bulrush east of the Cascade Range and Sierra Nevada (CDFW 2018f). Nests, which are basketlike structures comprising wet grasses, reeds, and cattails woven around stems, are placed within a male's territory and always overhang the water (Twedt and Crawford 1995). During migration and winter, open, cultivated lands, pastures, and fields are used. The yellow-headed blackbird feeds on insects, seeds, and grains in fields, on muddy ground near water, or at the water's surface during the breeding season (NatureServe 2018), and forages on grains and weed seeds outside of the breeding season (Twedt and Crawford 1995).

There are no known CNDDB occurrences of yellow-headed blackbird within the proposed Project boundary. The closest known occurrence (Occurrence #3) is located approximately 35 miles northwest of the proposed Project boundary at Buena Vista Lake (CDFW 2018a). The breeding range appears to end just short of the proposed Project boundary, at the western edge of Antelope Valley (CWHR 2018f). Suitable CWHR habitat types within the proposed Project boundary include FEW and LAC year-round, and AGS and WTM during the summer (CDFW 2018e). Although the proposed Project boundary does not directly overlap with the breeding range for this species, Quail Lake, which provides suitable habitat, is very close to the range. Thus, there is a slight potential for yellow-headed blackbird to use wetlands within the proposed Project boundary for nesting.

Yellow-headed blackbird has the potential to nest in wetland habitats within and adjacent to the proposed Project boundary. Project O&M and recreation activities within and immediately adjacent to suitable wetland nesting habitat may affect yellow-headed blackbird, should they be present. Effects on nesting birds may include mortality of young through forced fledging or nest abandonment by adult birds. Outside of the nesting season, Project effects would be limited to temporary disturbances of occasional individuals. Grassland habitats within the proposed Project boundary also provide foraging value for yellow-headed blackbird; however, any effects on foraging habitats are temporary in nature.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) contains provisions to protect wetland habitats, protect sensitive species and nesting birds while conducting Project O&M during the nesting season, and implement pre-construction surveys for non-routine Project activities. All of these provisions will significantly lower any potential Project impacts on the yellow-headed blackbird.

Bats

Pallid Bat (Antrozous pallidus)

Pallid bat is designated SSC and FSS (CDFW 2018g; USFS 2013a). It occurs throughout California. Preferred habitats include low elevation (below 6,000 feet) rocky arid deserts and canyonlands, shrub-steppe grasslands, karst formations, and coniferous forests above 7,000 feet. Common roost locations include crevices in rocky outcrops and cliffs, caves, mines, trees, and various human structures, such as bridges, barns, porches and attics. Roosts may be occupied by one or up to hundreds of pallid bats. Pallid bats typically breed from October to February, with one or two pups born between late April and July and weaned in August (WBWG 2018).

There are no known CNDDB occurrences of pallid bat within the proposed Project boundary. The closest known occurrence (Occurrence #186) is located approximately 0.6 miles from the proposed Project boundary within the town of Castaic; however, the exact location is unknown (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, MHW, PJN, and SGB year-round (CDFW 2018e). Due to the presence of previous occurrences and suitable habitat, there is the potential for this species to use any appropriate cover within the proposed Project boundary for roosting and breeding. In addition, most habitats could be used for foraging.

Pallid bat has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Existing O&M and recreation activities may affect pallid bat individuals. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, trees, and various man-made structures associated with Project facilities and recreation areas. While roosts in rocky areas are unlikely to be affected by Project-related activities as none are known around developed facilities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats. Therefore, impacting maternal roosts through vegetation removal or management would be very unlikely.

Additionally, there are no current plans to do major upgrades to Project facilities, and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for pallid bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to pallid bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

Townsend's Big-eared Bat (Corynorhinus townsendii)

Townsend's big-eared bat is designated SSC, BLM Sensitive, and FSS (CDFW 2018g; USFS 2013a). This species can occur throughout California, with the exception of the highest elevations of the Sierra Nevada crest (CDFW 2018f). Preferred habitats include coniferous forests, mixed mesophytic forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitat types. This species forages along edge habitats associated with streams and wooded habitats (WBWG 2018). Caves and abandoned mines are primary roosting habitat, but roosts in buildings, bridges, rock crevices, and hollow trees have been reported. Maternity colonies vary in size and can have a few individuals up to several hundred individuals. Mating occurs between October and February, and a single pup is born between May and June (WBWG 2018).

There are no known CNDDB occurrences of Townsend's big-eared bat within the proposed Project boundary. The closest known occurrence (Occurrence #31) is located approximately 6.2 miles from the proposed Project boundary, west of Castaic Lake (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include BAR, BOP, CRC, COW, CSC, DRI, DSW, and JST year-round, and AGS in the summer (CDFW 2018c). Although Townsend's big-eared bat has not been recorded within the proposed Project boundary, the presence of suitable habitat, paired with the existence of nearby occurrences, results in the potential for this species to use any part of the area within the proposed Project boundary with appropriate cover for roosting and breeding. In addition, most habitats could be used for foraging.

Townsend's big-eared bat has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Existing O&M and recreation activities may affect Townsend's big-eared bat individuals. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, trees, and various man-made structures associated with Project facilities and recreation areas. While roosts in rocky areas are unlikely to be affected by Project-related activities as none are known around developed facilities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats. Therefore, impacting maternal roosts through vegetation removal or management would be very unlikely.

Additionally, there are no current plans to do major upgrades to Project facilities, and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for Townsend's big eared bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to Townsend's big eared bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

Spotted Bat (Euderma maculatum)

Spotted bat is designated SSC and BLM Sensitive (CDFW 2018g). In California, this species ranges across the eastern and southern portions of the State (CDFW 2018f). Individuals are nocturnal and are known to use crevices and caves for roosting. Additionally, they are known to use conifer and aspen stands for night roosting. Meadows, riparian areas, shrub-steppe, and open stands of forest are typical foraging habitat (Gervais 2016). Spotted bats typically breed in late summer with females giving birth to a single pup in early summer. This bat species appears to be solitary, but occasionally can be found roosting or hibernating in small groups (WBWG 2018).

There are no known CNDDB occurrences of spotted bat within the proposed Project boundary. The closest known occurrence (Occurrence #19) is documented near the mouth of Castaic Creek in Ventura County, approximately 2.8 miles from the proposed Project boundary (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include AGS, BOP, COW, CSC, DRI, DSW, JST, PJN, SGB, URB, VRI, and WTM, which are used year-round (CDFW 2018e). The presence of suitable habitat, paired with the existence of nearby occurrences, results in the potential for this species to use any part of the area within the proposed Project boundary with rocky crevices or caves for roosting and breeding. In addition, most habitats could be used for foraging.

Spotted bat has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Spotted bat may occur within the proposed Project boundary; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to spotted bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

Western Mastiff Bat (Eumops perotic californicus)

Western mastiff bat is designated SSC and BLM Sensitive (CDFW 2018g). This species is primarily found in the Sierra Nevada, the Coast Range south of San Francisco, and throughout southern California (CDFW 2018f). It occupies a variety of habitats, including desert scrub, chaparral, oak woodland, ponderosa pine forests, and high elevation meadows in mixed conifer forests. In California, western mastiff bats were thought to only occur below 1,200 feet, but recent surveys have found roosts as high as 4,600 feet. Roosts are generally high above the ground and allow an unobstructed drop at the roost opening of 10 feet or more. Suitable roosts include exfoliating rock slabs and crevices in large boulders and buildings. Maternity colonies typically have fewer than 100 individuals. Western mastiff bats mate between late winter and early spring, and a single pup is born in early to mid-summer. Foraging occurs 100 to 200 feet above ground, typically along dry DSWs, floodplains, chaparral, oak woodland, open ponderosa pine forest, grassland, and agricultural areas (WBWG 2018).

There are no known CNDDB occurrences of western mastiff bat within the proposed Project boundary. The closest known occurrence (Occurrence #12) is located approximately 5.8 miles from the proposed Project boundary along Piru Creek, north of Lake Piru (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, FEW, JST, MCH, MHW, PJN, URB, VRI, and WTM year-round (CDFW 2018e). The presence of suitable habitat, paired with the existence of nearby occurrences, results in the potential for this species to use any part of the area within the proposed Project boundary with rocky crevices, caves, or buildings for roosting and breeding. In addition, most habitats could be used for foraging.

Western mastiff bat has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Existing O&M and recreation activities may affect western mastiff bat. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, and various man-made structures associated with Project facilities and recreation areas. While roosts in rocky areas are unlikely to be affected by Project-related activities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a small buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats. Therefore, the likelihood of impacting a maternal roost through vegetation removal or management would be very unlikely. Additionally, there are no current plans to do major upgrades to Project facilities and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for Western mastiff bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to Western mastiff bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

***Western Red Bat (Lasiurus blossevillii*)**

Western red bat is designated SSC (CDFW 2018g). In California, this species can be found along most of the coast and west of the Sierra Nevada crest (CDFW 2018f). Western red bats are often solitary and roost primarily among foliage of trees or shrubs adjacent to streams, open fields, and occasionally, in urban areas. This species migrates in groups and forages in close proximity with one another. Males and females appear to occupy different summer ranges and differ in the timing of their migration. Winter behavior is poorly understood, but it is believed that red bats occasionally wake from hibernation on warm days to feed. Mating occurs in late summer or early fall, and females postpone pregnancy until spring. Gestation is about 80 to 90 days, and up to 5 pups may be born (WBWG 2018). Based on documentation of eastern red bat hibernating in leaf litter during the winter, western red bat may also do the same (Texas Parks and Wildlife 2019). There are no known CNDDB occurrences of western red bat within the proposed Project boundary. The closest known occurrence (Occurrence #12) is located approximately 27 miles south of the proposed Project boundary, within Stunt Ranch near Cold Creek (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include AGS, BOP, CRC, COW, CSC, and PJN year-round (CDFW 2018e). The presence of suitable habitat, paired with the existence of nearby occurrences, indicates the potential for this species to use vegetation within the proposed Project boundary for roosting and breeding. In addition, most habitats could be used for foraging.

Western red bat has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Existing O&M and recreation activities may affect western red bat individuals. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include leaf litter and hollow logs in winter and vegetation throughout the year. Roosts in vegetation, hollow logs, and leaf litter have the potential to be affected by vegetation management, should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats.

Additionally, controlled burn activities, identified as the primary cause of harm to bats roosting in leaf litter (Texas Parks and Wildlife 2019), is not performed at the Project. Therefore, impacting roosts through vegetation removal or management would be very unlikely. Year-round recreation effects are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for Western red bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to Western red bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

California Leaf-nosed Bat (Macrotus californicus)

California leaf-nosed bat is designated SSC and BLM Sensitive (CDFW 2018g). In California, this species is found along most of the coast and west of the Sierra Nevada crest (CDFW 2018f). Individuals inhabit lowland desert scrub, are known to roost in caves and abandoned mine tunnels during the day, and in buildings, rock outcrops, porches, mines, and caves at night. Night roosts are typically separate from those used during the winter (NatureServe 2018).

There are no known CNDDB occurrences of California leaf-nosed bat within the proposed Project boundary. The closest known occurrence (Occurrence #45) is documented near Iverson Ranch in the town of Chatsworth, almost 14.4 miles south of the proposed Project boundary (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include BAR and VRI year-round, and CSC and MCH during the summer (CDFW 2018e). Although California leaf-nosed bat has not been recorded within the proposed Project boundary, the presence of suitable habitat paired with the existence of occurrences in the region results in the potential for this species to use habitats within the proposed Project boundary for roosting and breeding. In addition, most habitats could be used for foraging.

California leaf-nosed bat has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Existing O&M and recreation activities may affect California leaf-nosed bat. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, trees, and various man-made structures associated with Project facilities and recreation areas. While roosts in rocky areas are unlikely to be affected by Project-related activities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats. Therefore, the likelihood of impacting a maternal roost through vegetation removal or management would be very unlikely.

Additionally, there are no current plans to do major upgrades to Project facilities, and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for California leaf-nosed bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to California leaf-nosed bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

Small-footed Myotis (Myotis ciliolabrum)

Small-footed myotis is designated BLM Sensitive (CDFW 2018g). This bat is common in arid regions of California, known from Contra Costa County south, the west side of the Sierra Nevada, various areas of the Great Basin, and areas of Modoc, Kern, Los Angeles, and San Bernardino Counties (CDFW 2018f). Individuals are nocturnal and typically inhabit arid upland locations, preferring open stands of forest and brush near water sources. This species is known to shelter and roost in small groups of around 50 individuals in mines, natural crevices, buildings, caves, and bridges (CDFW 2018f).

There are no known CNDDB occurrences of small-footed myotis within the proposed Project boundary. The closest known occurrence (Occurrence #83) is documented roughly 0.4 miles from the Frazier Mountain Lookout, approximately 10 miles from the proposed Project boundary (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, FEW, MCH, MHW, PJN, SGB, URB, VRI, and WTM year-round. Summer habitats include DRI, JST and LAC (CDFW 2018e). Although small-footed myotis has not been recorded, there is the potential for this species to use any part of the area within the proposed Project boundary with appropriate cover for roosting and breeding. In addition, most habitats could be used for foraging. Appropriate habitats overlap with BLM lands within the proposed Project boundary.

Small-footed myotis has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Small-footed myotis' current status is limited to BLM Sensitive; thus, effects to this species are only considered on BLM lands. Existing O&M and recreation activities may affect small-footed myotis. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, and various man-made structures associated with Project facilities and recreation areas. While roosts in rocky areas are unlikely to be affected by Project-related activities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already disturbed and not preferred habitat for bats. Therefore, impacting maternal roosts through vegetation removal or management would be very unlikely.

Additionally, there are no current plans to do major upgrades to Project facilities, and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for small footed myotis bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to small-footed myotis bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

Long-eared Myotis (Myotis evotis)

Long-eared myotis is designated BLM Sensitive (CDFW 2018g). It is uncommon throughout its known range, although it has a widespread distribution throughout California (CDFW 2018f). Unlike similar species, the long-eared myotis avoids arid regions and is known to occur along the California coast, parts of the Great Basin, as well as the Sierra Nevada and Tehachapi mountain ranges. The long-eared myotis forages on insects fairly close to the ground, in open stands of trees, shrubs, and over water sources (CDFW 2018f). This species is known to roost singly or in very small groupings within infrastructure, behind tree bark or snags, and in caves. Feeding habits include foraging in open areas along habitat edges and over water (CDFW 2018f).

There are no known CNDDB occurrences of long-eared myotis within the proposed Project boundary. The closest known occurrence (Occurrence #37) is documented over 41 miles southeast of the proposed Project boundary, roughly 0.3 miles north of California State Route 2 and just east of Blue Bridge in the ANF (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include BAR, BOP, CRC, COW, CSC, FEW, LAC, MCH, MHW, PJN, VRI, and WTM year-round, with SGB providing suitable summer habitat. Additionally, this species is considered a migrant of DRI, DSW, and JST habitat (CDFW 2018e). Although long-eared myotis has not been recorded, there is the potential for this species to use any part of the area within the proposed Project boundary with appropriate cover for roosting and breeding. In addition, most habitats could be used for foraging. Appropriate habitats overlap with BLM lands within the proposed Project boundary.

Long-eared myotis has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Long-eared myotis' current status is limited to BLM Sensitive; thus, effects to this species are only considered on BLM lands. Existing O&M and recreation activities may affect long-eared myotis. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, and various trees and snags. While roosts in rocky areas are unlikely to be affected by Project-related activities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats. Therefore, impacting maternal roosts through vegetation removal or management would be very unlikely.

Additionally, there are no current plans to do major upgrades to Project facilities, and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for long-eared myotis bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to long-eared myotis bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

Fringed Myotis (Myotis thysanodes)

Fringed myotis is designated BLM Sensitive and FSS (CDFW 2018g). It has a widespread distribution throughout California, occurring in almost all regions of the State, except in the Central Valley at elevations ranging from sea level to roughly 9,500 feet (CDFW 2018f). This species has low urine-concentrating abilities, so it requires a water source. Fringed myotis feeds on insects from foliage and over open habitats, including water (CDFW 2018f). This species can be found roosting in infrastructure, caves, and mine sites, with adults and subadults forming separate groups in the roosts. Maternity roosts occupy similar roost sites, with colonies found in numbers of up to 200 individuals (CDFW 2018f).

There are no known CNDDB occurrences of fringed myotis within the proposed Project boundary. The closest known occurrence (Occurrence #83) is documented on the west side of Interstate 5 near the intersection of Lebec Road and Ridge Drive, approximately 6.2 miles from the proposed Project boundary (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, MCH, PJN, SGB, and URB year-round. Summer habitats include DRI, DSW, JST, LAC, and MHW (CDFW 2018e). Although fringed myotis has not been recorded within the proposed Project boundary, there is the potential for this species to use any part of the area within the proposed Project boundary with appropriate cover for roosting and breeding. In addition, most habitats could be used for foraging. Appropriate habitats overlap with both NFS and BLM lands within the proposed Project boundary.

Fringed myotis has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Fringed myotis' current status is limited to FSS and BLM Sensitive; thus, effects to this species are only considered on NFS and BLM lands. Existing O&M and recreation activities may affect fringed myotis. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, and various man-made structures associated with Project facilities and recreation areas. While roosts in rocky areas are unlikely to be affected by Project-related activities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats. Therefore, impacting maternal roosts through vegetation removal or management would be very unlikely.

Additionally, there are no current plans to do major upgrades to Project facilities, and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for long-eared myotis bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to fringed myotis bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

Yuma myotis (Myotis yumanensis)

Yuma myotis is designated BLM Sensitive (CDFW 2018g). It is known to be widespread and extremely common in California, occurring from sea level to 11,000 feet. Preferred habitats include open woodlands and forests with adequate access to water. The species is known to feed heavily over water on small insects using echolocation. Individuals are known to roost in various infrastructures, mines, caves, and other natural crevices. Maternity roosts typically consist of several thousand females and young in similar roost locations with preferred temperatures no greater than 40°C (CDFW 2018f).

There are no known CNDDB occurrences of Yuma myotis within the proposed Project boundary. Occurrence #260 is documented east of Interstate 5 near a suspension bridge along Ridge Road, roughly 1.8 miles southeast of Reservoir Hill and approximately 1.3 miles from the proposed Project boundary (CDFW 2018a). Suitable CWHR habitat types within the proposed Project boundary include AGS, BOP, CRC, COW, CSC, FEW, MCH, MHW, PJN, SGB, URB, VRI, and WTM year-round (CDFW 2018a). Suitable summer habitat includes DRI, DSW, JST and LAC (CDFW 2018e). Although Yuma myotis has not been recorded within the proposed Project boundary, there is the potential for this species to use any part of the area within the proposed Project boundary with appropriate cover for roosting and breeding. In addition, most habitats could be used for foraging. Appropriate habitats overlap with BLM lands within the proposed Project boundary.

Yuma myotis has the potential to roost in a variety of habitats with suitable cover within and adjacent to the proposed Project boundary. Existing O&M and recreation activities may affect Yuma myotis. This species is sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites, including maternity roosts. Potential roost sites include rocky outcrops and crevices, and various man-made structures associated with Project facilities and recreation areas. While roosts in rocky areas are unlikely to be affected by Project-related activities, roosts in vegetation or man-made structures have the potential to be affected should they be present. However, vegetation management is limited to existing Project facilities, roads, and recreation areas with a buffer of 20 to 75 feet around facilities and within up to 15 feet on either side of roads and trails adjacent to Project facilities; and within and adjacent to recreation areas depending on site conditions and landowner agreements. Since this vegetation management has been ongoing through the life of the Project, the vegetation in this area is already expected to be disturbed and not preferred habitat for bats. Therefore, the likelihood of impacting a maternal roost through vegetation removal or management would be very unlikely.

Additionally, there are no current plans to do major upgrades to Project facilities, and ongoing maintenance is generally minor and would not be anticipated to impact maternal roosts that were already contained in a man-made structure where human activity is common. Vegetation removal and other O&M activities may lead to temporary disturbances of occasional individuals in temporary solitary roosts, but would be limited in the same way as impacts to maternal roosts. Year-round recreation effects outside of man-made structures are also limited to the flushing of occasional individuals within a small buffer of recreational facilities. There is limited opportunity for recreation outside of facilities and reservoirs due to the steep nature of the slopes around Pyramid Lake and the lack of motorized access to much of Quail Lake. Habitats within the proposed Project boundary also provide foraging value for Yuma myotis bats; however, any effects on foraging habitats are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities and recreation areas. These areas have been developed for multiple years and bats are likely naturalized to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. Combined with the already low likelihood of impacts to Yuma myotis bats, Project O&M and ongoing recreation would be expected only to affect the occasional individual.

<u>Other Mammals</u>

Ringtail (Bassariscus astutus)

Ringtail is designated FP (CDFW 2018b). Ringtail is a widely-distributed, common to uncommon, permanent resident of California. This species is nocturnal and can be found in low- to mid-elevation (up to 5,000 feet) riparian, forest, and shrub habitats in close proximity to water (less than 0.6 miles). Important elements of ringtail habitat include rocky areas with cliffs or crevices, hollow trees, logs and snags – all of which are used for daytime shelter. Ringtails den in rock crevices, hollow trees, logs and snags, burrows dug by other animals, and remote buildings (NatureServe 2018).

Ringtail occurrences are not included in the CNDDB, and no observations of this species within the proposed Project boundary have been recorded; however, the proposed Project boundary overlaps with the known range of this species (CDFW 2018f). Appropriate CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, MHW, PJN, SGB, VRI, and WTM year-round (CDFW 2018e). There is the potential for ringtail to use a variety of habitats within the proposed Project boundary year-round.

Ringtail has the potential to occur throughout a variety of different habitats within and adjacent to the proposed Project boundary. Existing Project activities that may affect ringtail include road maintenance, vegetation management, recreation activities, and other disturbances within suitable habitat. However, the majority of all activities are located around developed areas, where ringtail (except for ones adapted to human presence) would not be present. Additionally, ringtail is active nocturnally and there are no night-time Project activities. Only the removal of hazard trees might be anticipated to impact a ringtail beyond occasional flushing.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will have a provision for surveying hazard trees prior to removal to avoid harming denning or sleeping ringtails. Pre-construction surveys prior to non-routine Project activities will also look for ringtails. This combination of measures would be expected to limit effects on ringtail to the occasional disturbance, which would not be considered take under the FP definition.

San Diego Black-tailed Jackrabbit (Lepus californicus bennettii)

San Diego black-tailed jackrabbit is an SSC (CDFW 2018g). It occurs in cismontane and transmontane areas in southern California, including Los Angeles, Riverside, San Bernardino, and San Diego Counties, to northern Baja California (NatureServe 2018). Habitat types include open plains, fields, deserts with scattered patches of shrubs, open chaparral, scrub, and grasslands (CDFW 2018f).

There are no known CNDDB occurrences of San Diego black-tailed jackrabbit within the proposed Project boundary. The nearest known occurrence (Occurrence #68) is located approximately 0.2 miles from the proposed Project boundary, 2.6 miles southeast of Castaic Lake, and west of San Francisquito Canyon (CDFW 2018a). The CWHR database has not designated specific habitat types to be suitable for this subspecies. However, potential CWHR habitat types for black-tailed jackrabbit include AGS, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, MHW, PJN, SGB, URB, VRI, and WTM year-round (CDFW 2018e). This species is known to occur in the Project vicinity and has the potential to use various woodland, chaparral, scrub, and grassland habitats within the proposed Project boundary for breeding and foraging year-round.

San Diego black-tailed jackrabbit has the potential to occur in a variety of habitats within and adjacent to the proposed Project boundary. Project O&M activities that result in habitat disturbance, and recreational activities within and immediately adjacent to suitable habitat, may affect San Diego black-tailed jackrabbit, by way of flushing. Impacts from these types of activities are typically limited in scope and duration, infrequent, and focused on already disturbed or developed areas.

Southern Grasshopper Mouse (Onychomys torridus ramona)

Southern grasshopper mouse is designated SSC (CDFW 2018g). This mouse is found in the Mojave Desert and arid habitats in the southern Central Valley of California, with low to moderate shrub cover, as well as in Los Angeles and San Diego Counties. Habitat types include alkali desert scrub, desert scrub, succulent desert scrub, DSW, DRI, CSC, MCH, SGB scrub, and bitterbrush scrub. This species is less common in valley foothill and MRI habitats. This nocturnal animal is active year-round and eats invertebrates (NatureServe 2018; CDFW 2018f).

There are no known CNDDB occurrences of southern grasshopper mouse within the proposed Project boundary. The closest known occurrence (Occurrence #24) is located approximately 6.7 miles southeast of the proposed Project boundary within Mint Canyon in the ANF (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include AGS, CSC, DRI, DSW, MCH, PJN, SGB, and VRI year-round (CDFW 2018e). Although southern grasshopper mouse has not been observed within the proposed Project boundary, the presence of suitable habitat and nearby occurrences results in the potential for this species to use scrub and riparian habitats within the proposed Project boundary.

Southern grasshopper mouse has the potential to occur in a variety of habitats within and adjacent to the proposed Project boundary. Current Project O&M activities that lead to disturbance of habitat, and recreational activities within and immediately adjacent to suitable habitat, may affect southern grasshopper mouse. Impacts from these types of activities are typically limited in scope and duration, infrequent, and concentrated at already disturbed developed sites. Ongoing O&M and recreation activities may affect occasional individuals; however, the impacts likely do not adversely affect the species as a whole.

Tehachapi Pocket Mouse (Perognathus alticolus inexpectatus)

Tehachapi pocket mouse is designated SSC and FSS (CDFW 2018b). The known range spans from Tehachapi Pass, west to Mount Pinos, and south to Quail Lake, varying from 3,380 to 6,000 feet in elevation (Bolster et al. 1998). The species is rare and not widespread. The preferred habitat for the species near Mount Pinos includes grassy flats and yellow pine forests. Additionally, it is known to occur in various rangelands and chaparral (Bolster et al. 1998). Individuals feed on various seeds and vegetative plant parts. The species is known to hibernate between the months of October and April. Breeding takes place right after hibernation emergence (Bolster et al. 1998).

A search of CNDDB records shows one occurrence of the Tehachapi pocket mouse within the proposed Project boundary (Occurrence #11), and several others just outside. Occurrence #11 is documented just west of Quail Lake (CDFW 2018a). Suitable CWHR habitat types include BOP, COW, and VRI yearlong (CDFW 2018a). The presence of suitable habitat and a recorded occurrence within the proposed Project boundary results in the potential for this species to be present.

Tehachapi pocket mouse has the potential to occur in a variety of habitats within and adjacent to the proposed Project boundary. Current Project O&M activities that lead to disturbance of habitat, and recreational activities within and immediately adjacent to suitable habitat, may affect Tehachapi pocket mouse. These effects may include disturbance or displacement of individuals, and modifications to habitat necessary for shelter or foraging, including the introduction of NNIP. While these activities are not likely to impact individuals, they can pose a significant impact if they occur during the reproductive season or result in damage or destruction of essential shelter. However, Project activities are mostly limited to already disturbed and developed areas. Ongoing O&M and recreation activities may affect occasional individuals; however, the impacts likely do not adversely affect the species’ vitality or habitat.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will contain non-routine Project activity pre-surveys to look for Tehachapi pocket mouse. These measures would be expected to limit effects on Tehachapi pocket mouse to the occasional disturbance.

San Joaquin Pocket Mouse (Perognathus inornatus inornatus)

San Joaquin pocket mouse is designated BLM Sensitive (CDFW 2018b). The species is known to prefer open, dry grasslands and scrub areas with fine-textured soils in the Salinas and Central Valleys (CDFW 2018a). Individuals are nocturnal and typically feed on seeds, green vegetation, and insects (CDFW 2018a).

The closest documented occurrence (CNDDB Occurrence #63) of the San Joaquin pocket mouse is roughly 4 miles from the proposed Project boundary, 4 miles west of Interstate 5, and 3.2 miles northwest of Hardluck Campground in the Hungry Valley State Vehicular Recreation Area (Hungry Valley SVRA) (CDFW 2018a). Suitable habitat for San Joaquin pocket mouse within the project boundary includes AGS, BAR, COW, and MCH yearlong (CDFW 2018a). Although San Joaquin pocket mouse has not been observed within the proposed Project boundary, the presence of suitable habitat and nearby occurrences results in the potential for this species to be present.

San Joaquin pocket mouse has the potential to occur in open grassland and shrubland habitats within and adjacent to the proposed Project boundary. Current Project O&M activities that may lead to disturbance of habitat, and recreational activities within and immediately adjacent to suitable habitat, may affect San Joaquin pocket mouse. Impacts from these types of activities are typically limited in scope and duration, infrequent, and concentrated at developed and disturbed locations. Ongoing Project O&M and recreation activities may affect occasional individuals; however, the impacts likely do not adversely affect the species as a whole or its habitat.

American Badger (Taxidea taxus)

American badger is designated SSC (CDFW 2018g). This species is an uncommon, but permanent resident throughout most of California, except in the North Coast area (CDFW 2018f). It is found most abundantly in drier open stages of most shrub, forest, and herbaceous habitats with friable soils. This species' diet consists mostly of rodents, including rats (*Rattus* spp.), mice, chipmunks, pocket gophers (Geomyidae family), and ground squirrels. The American badger will also eat reptiles, insects, earthworms, eggs, birds, and carrion when ground squirrel populations are low (NatureServe 2018).

There are no known CNDDB occurrences of American badger within the proposed Project boundary. However, there are two occurrences approximately 150 feet (Occurrence #7) and 400 feet (Occurrence #416) from the proposed Project boundary. Occurrence #7 is located where the West Branch of the SWP enters Quail Lake. Occurrence #416 is located in Peace Valley along Gorman Creek (CDFW 2018a). Appropriate CWHR habitat types within the proposed Project boundary include AGS, BAR, BOP, CRC, COW, CSC, DRI, DSW, JST, MCH, MHW, PJN, SGB, VRI, and WTM (CDFW 2018e). The existence of known occurrences in the Project vicinity, paired with the presence of suitable habitat, results in the potential for this species to use various habitats within the proposed Project boundary.

American badger has the potential to occur in a variety of habitats within and adjacent to the proposed Project boundary.

Current Project O&M activities that lead to disturbance of habitat, and recreational activities within and immediately adjacent to suitable habitat, may affect American badger by resulting in the displacement of individuals and modifications to habitat necessary for shelter or foraging. Project-related recreational activities that could affect the species are centered on developed recreation areas on Pyramid and Quail Lakes; however, lower frequency recreational use can occur throughout many portions of the Project boundary. These activities include pedestrian and vehicle traffic on trails and roadways, as well as the general use of beaches and other recreation areas. While these activities are not likely to impact individuals, they can still pose an impact if they occur during the reproductive season or result in damage or destruction of a den. These activities are expected to potentially impact individuals, but are not expected to have an overall impact on the species' viability or habitat. Badgers could also be harmed or killed if they eat dead or dying rodents that were killed by rodenticide at Project facilities. The use of rodenticide is limited in scope and placement, but could affect individuals. These provisions will significantly reduce impacts to American badger.

Designated Special Ecological Areas

The proposed Project boundary abuts a designated special ecological area: a USFS Critical Biological Land Use Zone for arroyo toad on Piru Creek, just west of Pyramid Lake (Figure 5.4.1-55). Other Critical Biological Land Use Zones for arroyo toad that abut the proposed Project boundary include Fish Creek and Castaic Creek, north of Elderberry Forebay. Critical Biological Land Use Zones are areas managed by USFS for the protection of rare species. Human activities and land modifications are restricted, but are not excluded, to prevent any adverse effects to the protected species within the land use zone (USFS 2005d).

The proposed Project boundary includes a second type of designated special ecological area: a proposed USFS PAC for California spotted owl (Figure 5.4.1-55). In 2014, the Wild Nature Institute and John Muir Project of Earth Island Institute petitioned USFWS to have California spotted owls protected. Listing is currently under review, and USFWS is expected to issue a decision in 2019 (CBD 2018).

The proposed PAC for California spotted owl is located on NFS lands approximately 0.5 miles south of Pyramid Lake, along a 0.4-mile stretch of Pyramid reach (USFS 2005e). PACs are special management areas around nest or roost sites to protect critical habitat (Berigan et. al. 2012). One of the protection measures used in PACs is Limited Operating Periods, which restrict activities that might disturb birds during the breeding season within a specific distance of a PAC. For spotted owl PACs, this distance often includes a 0.25-mile area during the breeding season of March 1 through August 15. No other designated special ecological areas occur within or adjacent to the proposed Project boundary.

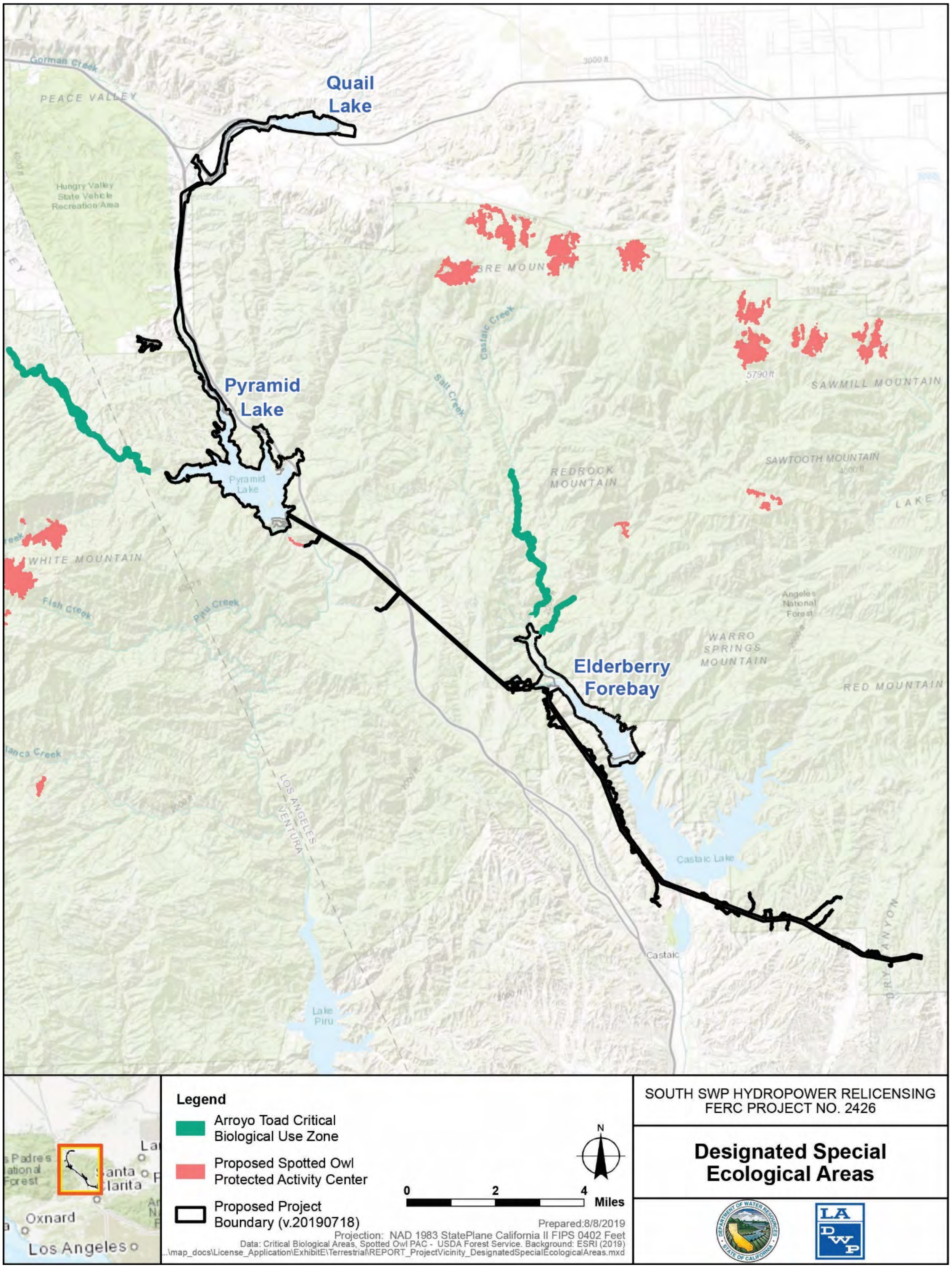

Figure 5.4.1-55. Designated Special Ecological Areas

While not a designated special ecological area, some migratory birds use the Project's reservoirs as a resting place on their flights between breeding grounds and wintering grounds (Golightly et al. 2005). Additional areas considered sensitive, such as CDFW's high priority natural community elements or vegetation types, may also exist within the proposed Project boundary, but are not designated by resource agencies as special ecological areas.

5.4.1.2 Effects of the Licensees' Proposal

This section discusses the potential environmental effects of the Licensees' Proposal on botanical and terrestrial resources, as described in Section 2.0 of this Exhibit E. The Licensees' Proposal includes Measure TR1 that would implement the IVMP. The plan includes measures for controlling non-native plant species, protecting special-status species during vegetation management activities, providing for the safe application of herbicides, and for re-vegetating disturbed areas. The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) would include provisions protecting wildlife and sensitive habitat, nesting bird limited operating periods (LOP) and buffers, pre-construction surveys for specific activities, surveys for specific nesting bird species, provides for work in wetlands and riparian habitats, and reporting for certain activities and surveys. These would be new measures (i.e., not included in the existing license).

Special-Status Plants

The Licensees do not propose any changes to the Project that would add new Project effects to special-status plants; activities associated with the Licensees' Proposal are expected to be ongoing and similar to existing conditions. As such, effects to special-status species would be substantially similar to those under the existing Project. In addition, Measure TR1 would provide for continued protection of special-status plants, in particular the short-joint beavertail found at the Los Alamos Campground.

Non-Native Invasive Plants

The Licensees do not propose any changes to the Project that would add new Project effects on NNIP dispersal; activities associated with the Licensees' Proposal are expected to be ongoing and similar to existing conditions. As such, effects to NNIP dispersal would be substantially similar to those under the existing Project. In addition, Measure TR1 would provide for the control of NNIP and known NNIP populations.

Special-status Terrestrial Wildlife

The Licensees do not propose any changes to the Project that would affect special-status wildlife. Activities associated with the Licensees' Proposal are expected to be ongoing and similar to existing conditions; these activities have the potential to affect special-status terrestrial species. The Licensees' Proposal includes continued O&M of dams, powerhouses, and access routes; vegetation management, which includes control of NNIP and trimming, or removal of vegetation around Project facilities for safe operation; and ongoing public use of Project recreational facilities at Pyramid Lake, Quail Lake, and Los Alamos Campground, including but not limited to, hiking, fishing, camping, boating, swimming, and picnicking.

As previously mentioned, vegetation management and hazard tree removal are the only regular Project O&M activities that have the potential to modify wildlife habitat. Other activities that may occur less frequently include, but are not limited to, road repairs, canal liner repairs, and staging of dredged soil. Vegetation management is generally restricted to areas within 20 to 75 feet of Project facilities and up to 15 feet of roads, and within and adjacent to recreation areas depending on site conditions and landowner agreements. The removal or trimming of vegetation can affect nesting birds if the work has to be performed during the nesting bird season (from January 1 to August 31). FGC Subsections 3503, 3503.5, and 3800 prohibit the possession, incidental take, or needless destruction of birds, their nests, and eggs.

The proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) requires pre-construction surveys for sensitive habitat and sensitive species in and within a reasonable buffer of the proposed work area. Any non-routine Project activity will trigger pre-construction surveys, as will some activities at Elderberry Forebay.

FERC also identified the use of pesticides in its SD2 as a preliminary issue related to wildlife that would be addressed in an environmental assessment of the relicensing. Currently, no rodenticide is being used in terrestrial habitats outside of Project facilities. To maintain the structural integrity of Project structures and facilities, the Licensees use rodenticides (i.e., squirrel bait) as needed to reduce damage caused by burrowing rodents at Castaic Powerplant (including Elderberry Forebay shoreline and dam, South Portal, and penstock), Pyramid Dam, Lower Quail Canal, and Peace Valley Pipeline Intake Embankment. For more information on pesticide use in aquatic habitats, refer to Section 5.3.

Additionally, given that the Licensees' Proposal would not result in the construction of additional infrastructure, Project effects to wildlife movement through the area within the proposed Project boundary would not be affected by the Licensees' Proposal.

In SD2, FERC's proposed measure for protecting and enhancing wildlife resources is the continued implementation of Article 51 of the current license. However, Article 51, under the current license, covers multiple elements that DWR has already completed – (i.e., Exhibit S for the fish and wildlife enhancement for the initial construction of the SWP). The wildlife habitat measures included purchasing land and transferring it to USFS, and transferring lands to CDFW along the right-of-way and planting trees and shrubs. The only current measures remaining in Exhibit S of Article 51 are the fish stocking measures, which is why this FERC recommendation is no longer relevant to terrestrial wildlife.

5.4.1.3 Unavoidable Adverse Effects

Special-Status Plants

Five special-status plant species are known to occur within the proposed Project boundary. These species have the potential to be disturbed by recreational activities, both inside and outside of the scope of Project operations. They also have potential to be affected by Project O&M. The definition of an effect on special-status plants includes actions taken on an individual plant, wherein it is willfully or negligently cut, destroyed, mutilated, or removed, as stated in California Penal Code Section 384a (CDFW 2018i). However, because these species (with the exception of one population of short-joint beavertail) are generally dispersed throughout the Project area in open space habitat, these unavoidable effects are, overall, expected to be minor, local, and short-term. Potential impacts to the short-joint beavertail at Los Alamos Campground are expected to be minimal based on the inclusion of Measure TR1, which would provide continued protection for the species.

Non-Native Invasive Plants

NNIP are known to occur within the proposed Project boundary, and Project maintenance activities have the potential to introduce new or spread existing infestations. NNIP persists within the proposed Project boundary, and some dispersal is still likely to occur as an unavoidable adverse effect of the Project due to major vectors of NNIP including Interstate 5. Dispersal from Project activities, however, is expected to be minor, local, and controlled based on Measure TR1 in the IVMP.

Special-Status Terrestrial Wildlife

As discussed throughout this section, the combination of all Project activities is not anticipated to have an adverse effect on any specific population of wildlife species. Project O&M is relegated to existing Project facilities and a small buffer around them, as are associated noise, lighting, traffic, vibration, and other movement. Recreation is similarly confined to the developed recreation areas, the reservoir surface, and a small buffer around the reservoirs due to the steepness of Pyramid Lake and the lack of motorized access, including by boat, to Quail Lake. Vehicular traffic on Project access roads does not go off-road and is limited to Project O&M staff and recreationists, where they are allowed. Therefore, pedestrian and vehicular traffic impacts are also confined to narrow areas of the Project, the majority of which are developed. Many wildlife species avoid areas of human activities and, given the age of the Project, would be anticipated to avoid Project recreation areas and roads. Those species that do utilize these areas have some naturalization to interaction with Project activities. Therefore, Project activities would only impact individuals of any given wildlife species and are not expected to adversely affect any species as a whole.

Noise and movement generated by O&M and recreation could temporarily and unavoidably disrupt local wildlife for short durations, and animals may be flushed or displaced from areas requiring vegetation management during the limited time it is conducted. Certain species, such as snakes and lizards, may be more prone to mortality if individuals are crushed by pedestrian and vehicular traffic. However, these unavoidable impacts would not be expected to affect the population or species as a whole. Additionally, since vegetation management activities are confined to existing Project facilities and areas where vegetation management has been going on for years, impacts to existing habitat or wildlife are not anticipated. In total, due to the infrequent and concentrated nature of Project activities, unavoidable effects are minor, and unlikely to be concentrated on a particular species.

5.4.1.4 Response to Requests for Additional PM&E Measures and Studies

As described in Section 1.5.11, subsequent to filing the DLA with FERC, the Licensees received written requests from Relicensing Participants to include PM&E measures and conduct extensive studies relative to terrestrial resources. After careful review and consideration, the Licensees did not adopt 12 preliminary proposed measures related to terrestrial resources. Each of these is discussed below, including the Licensees' reasoning for not adopting the measure. Refer to Table 1.5-6 of Exhibit E for the FERC E-Library Accession numbers to access the letters referenced below.

Modify the Licensees' Proposed Integrated Vegetation Management Plan

Include Piru Creek Below the Dam in the IVMP

USFS requests to include areas of Piru Creek below the dam in the IVMP for potential NNIP management. [USFS' November 25, 2019 letter, page 51]

As discussed in Section 5.3.5, the Licensees have not adopted USFS' request to include treatment of NNIP in Piru Creek in the IVMP because USFS has provided no reasonable direct nexus between the Project and NNIP in the creek. Piru Creek below the dam is not in the proposed Project boundary and contains other potential vectors for invasive plant dispersal that are currently being managed by USFS (i.e., hiking, fishing, recreation, road use/management) and have no bearing on the Project or the Licensees' Proposal. In addition, USFS has provided no specifics regarding its request (e.g., what treatment would entail, and when and where it would occur) or related costs.

Tamarisk Noted in Pyramid Reach and Elderberry Forebay

USFS proposes that tamarisk removal and riparian restoration could be completed in Pyramid reach and Elderberry Forebay to promote native riparian habitat. In particular, USFS postulates that this could benefit the recovery of the southwestern willow flycatcher. [USFS' November 25, 2019 letter, page 80]

The Licensees have not adopted USFS' request due to misinformation on tamarisk habitat as well as southwestern willow flycatcher habitat. Tamarisk is known to occur in many types of waterways, including "free-running streams," rivers, and other moving waterways, and is not restricted to managed waterways (USFS 2010). In addition, tamarisk potentially serves as nesting habitat for the southwestern willow flycatcher and has not been determined in studies to be detrimental to the species, or sub-par habitat, as is commonly thought (Sogge et al. 2006). In fact, recent loss of nesting habitat for the flycatcher in the southwest is due to a beetle that preys on tamarisk. Removal of tamarisk has the potential to result in take of an endangered species and therefore is not viable.

Include CNPR List 3 and 4 Plants in IVMP

CDFW requests that the IVMP include CRPR Ranks 3 and 4 plants, all of which qualify as locally (regionally) significant, in the active protection and management of plants with CRPR Ranks 1 and 2. [CDFW's Requested Condition #8-1 in its November 27, 2019 letter]

These species are not protected by FESA or CESA and, therefore, have not been included.

Allow Wildlife Unimpeded Movement at All Project Facilities

CDFW requests that the FLA include a PM&E that prohibits changing/altering the areas with 2.5-foot clearance suitable for wildlife passage. Additionally, the PM&E would require that repairs of existing breaks or holes in a fence would not occur in areas identified as providing potential wildlife movement access. Further, any existing breaks in fencing, holes, or other features would remain to allow wildlife movement. Additionally, CDFW requests the Licensees incorporate measures to mitigate Project impacts to local and regional wildlife movement that improve the ability of all sizes of terrestrial and aquatic wildlife to move through/beyond Project and Project-related features. [CDFW's Requested Condition #17-1 in its November 27, 2019 letter]

In addition, CDFW requests that all fencing surrounding Project features be made wildlife friendly for animals of all sizes. CDFW recommends a camera study be completed as part of the measure to identify barriers to wildlife movement areas to determine the species being impacted and designing features to allow unimpeded crossing for these animals. [CDFW's Requested Condition #17-2 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure related to wildlife movement at all Project facilities for four reasons. First, the majority of the fences are in place to prevent human interaction with Project facilities, both for security and safety reasons. The fences cannot be made "wildlife-friendly" nor left unrepaired without also allowing humans to access these facilities, increasing these risks to public safety and Project operations. Second, there is no specificity about the methodology for the "camera study," including the duration, locations for the cameras, what type of equipment would be used, or how much the study would cost. Third, the way to make fencing "wildlife friendly" is also not fleshed out sufficiently to allow the Licensees to analyze effort, potential effectiveness, or cost. Finally, CDFW does not further define any of the other "mitigation measures" for wildlife movement so that the Licensees could evaluate them for their feasibility, potential to protect resources or cost.

Restore Tricolored Blackbird at Quail Lake and Monitor Nesting Annually

CDFW proposes that the FLA require restoration of tricolored blackbird nesting habitat at Quail Lake and that the adjacent grasslands be restored to improve prey availability. CDFW proposes that the Licensees be required to maintain adequate nesting vegetation for tricolored blackbirds at Quail Lake. Additionally, maintenance and vegetation clearing/pruning should not occur during the bird nesting season (February-September). CDFW suggests that the Licensees should monitor tricolored blackbird nesting annually, and document specific measures to be undertaken by the Licensees to ensure successful nesting at this location. [CDFW's Requested Conditions #19-1 and #19-2 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure regarding tricolored blackbird for six reasons. First, there is no definition for "adequate nesting vegetation" at Quail Lake, so there is no target for the restoration proposed for Quail Lake for the Licensees to analyze or adopt. The referenced document (Feenstra 2017) gives a general recommendation for habitat improvement everywhere in California without specifics. Second, there is no evidence presented by CDFW that riparian habitat at Quail Lake is either inadequate or in need of restoration. Project vegetation management is restricted to existing facilities and roads, along with a buffer, and vegetation in those areas is maintained in the same fashion to safely operate the Project. Third, no methods, duration, or potential costs for restoration were included in the preliminary proposed measure for the Licensees to evaluate. Fourth, other than a thin strip in the corner of Quail Lake, adjacent grasslands, as understood from the vague description in CDFW's comment, would be outside of the FERC Project boundary. No Project activities, including recreation, are conducted in the area mapped as grassland either within or outside of the FERC Project boundary. Fifth, no actions taken by the Licensees can "ensure successful nesting" of tricolored blackbird. Many non-Project factors could affect nest success, all outside of the Licensees' control and the purview of the FERC license. This is especially true if nesting is not taking place at Quail Lake currently, as the word "resumes" in the CDFW comment implies. This would be holding the Licensees to an impossible standard. Sixth, the Licensees' proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2) will have provisions for restricted time periods for work in nesting season and pre-construction surveys for any non-routine Project activities. These measures will provide sufficient protection for tricolored blackbirds.

Conduct Surveys for Burrowing Owls as Part of the New License

CDFW requests the FLA to present a full analysis of the Project impacts to burrowing owls. CDFW recommends the FLA utilize the three-tiered approach and mitigation methods detailed in CDFWs Staff Report on Burrowing Owl Mitigation (2012) that was designed to analyze the potential for impacts to the species and condition appropriate avoidance and mitigation measures. The three components to evaluating species impacts are: (1) habitat assessment; (2) surveys; and, (3) impact assessments. CDFW proposes that the Lead Agency use the results of the focused survey conducted to *assure a robust analysis is made to identify potential impacts to the species, and should propose specific avoidance and minimization mitigation measures.* [CDFW's Requested Condition #21-2 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure regarding surveys for burrowing owls for two reasons. First, the Staff Report on Burrowing Owl Mitigation (2012) specifies the following as having "the potential to take burrowing owls, their nests or eggs, or destroy or degrade burrowing owl habitat: grading, discing, cultivation, earthmoving, burrow blockage, heavy equipment compacting and crushing burrow tunnels, levee maintenance, flooding, burning and mowing (if burrows are impacted), and operating wind turbine collisions." Currently, the Project does not perform any of these activities outside of routine Project O&M, nor are there any proposed changes to the Project that would add these activities in the future. The report also states that "the following activities may have impacts to burrowing owl populations: eradication of host burrowers; changes in vegetation management (i.e. grazing); use of pesticides and rodenticides; destruction, conversion or degradation of nesting, foraging, over-wintering or other habitats; destruction of natural burrows and burrow surrogates; and disturbance which may result in harassment of owls at occupied burrows" (CDFW 2012). Of these activities, only use of pesticides and disturbance that could harass owls are relevant to the Project. Protection during these potential impact activities will be provided by the Licensees' proposed Integrated Vegetation Management Plan (Measure TR1) and Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), which include provisions for pesticide use and LOPs, combined with nest buffers. Additionally, pre-construction surveys for any non-routine Project work, which may include any of the activities listed above, are also included in the Licensees' proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2). Second, the Project activities that can affect the burrowing owl are limited to certain areas and can be sufficiently analyzed to determine protective measures, such as those in the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2).

Bat Surveys

CDFW recommends that bat surveys be conducted by a qualified bat specialist to determine baseline conditions within the Project and within a 500-foot buffer, and recommends that the Licensees analyze the potential significant effects of the proposed Project on the species. CDFW recommends the FLA require the use of acoustic recognition technology as well as visual surveys to maximize detection of bat species, prior to any Project operation and maintenance activities, to minimize impacts to sensitive bat species. To avoid the direct loss of bats that could result from removal of trees, rock crevices, structures, that may provide roosting habitat (winter hibernacula, summer, and maternity), CDFW recommends the following steps be implemented:

a) *Identify the species of bats present on the site;*

b) *Determine how and when these species utilize the site and what specific habitat requirements are necessary (thermal gradients throughout the year, size of crevices, tree types, location of hibernacula/roost [e.g., height, aspect]);*

c) *Avoid the areas being utilized by bats for hibernacula/roosting; if avoidance is not feasible, a bat specialist should design alternative habitat that is specific to the species of bat being displaced and develop a relocation plan in coordination with CDFW;*

d) *The bat specialist should document all demolition monitoring activities and prepare a summary report to CDFW upon completion of tree/rock disturbance and/or building demolition activities;*

e) *If confirmed occupied or formerly occupied bat roosting/hibernacula and foraging habitat is destroyed, habitat of comparable size, function and quality should be created or preserved and maintained at a nearby suitable undisturbed area. The bat habitat mitigation shall be determined by the bat specialist in consultation with CDFW;*

f) *A monitoring plan should be prepared and submitted to CDFW. The monitoring plan should describe proposed mitigation habitat, and include performance standards for the use of replacement roosts/hibernacula by the displaced species, as well as provisions to prevent harassment, predation, and disease of relocated bats; and,*

g) *Annual reports detailing the success of roost replacement and bat relocation should be prepared and submitted to CDFW for five years following relocation or until performance standards are met, whichever period is longer.* [CDFW's Requested Conditions #24-2 and 24-3 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure for two reasons. First, the Project does not currently conduct, nor does it propose, any O&M activities that warrant a complete baseline survey of the Project, plus a 500-foot buffer. No Project activities would impact bat habitat outside of facilities, aside from hazard tree removal. The IVMP (Measure TR1) includes surveys prior to non-emergency hazard tree removal for the protection of roosting bats. In addition, the Licensees' Sensitive Aquatic and Terrestrial Wildlife Management Plan (TR2) requires pre-construction surveys for sensitive-species, including bats, prior to the performance of any non-routine Project activities that could impact wildlife habitat. Work will be completed in such a fashion as to avoid impacts to bats, and if it cannot, then the appropriate agencies will be consulted on other measures, such as roost replacement. Second, portions of CDFW's preliminary proposed measure (e.g., how and when these bat species utilize the site and what specific habitat requirements are necessary (thermal gradients throughout the year, size of crevices, tree types, location of hibernacula/roost [e.g., height, aspect])) would not provide information necessary to determine adaptive management of bats, but would merely be collecting data for data's sake. Therefore, the Licensees did not adopt this preliminary proposed measure.

Prohibit Project Activities in Habitat that Support Ringtail

CDFW suggests that due to the lack of studies and the lack of information necessary to inform specific Project conditions for the ringtail, CDFW requests that all Project O&M activities be prohibited within areas potentially supporting ringtail habitat. [CDFW's Requested Condition #25-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure for three reasons. First, CDFW provided no evidence that the proposed Project would have any impacts on ringtail that meet the definition of take under the FP status. There are no reports of injuries or death to ringtails, nor ringtails being caught in any Project facilities. Hunting or pursuit of ringtail or any other wildlife is prohibited on the Project. Second, ringtail are a widely distributed, common to uncommon, permanent resident of California that utilize 15 of the 26 total habitat types present on the Project. A single animal can have a home range of 109 to 1,280 acres, and travel throughout it during its lifetime. Since ringtail moves in and out of areas and utilizes the majority of habitat types at the Project, CDFW's proposal would essentially mean the shutdown and removal of the Project. Third, provisions that will further reduce any potential impacts to ringtails are included in the Licensees' Integrated Vegetation Management Plan (Measure TR1) and Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), including surveys prior to the removal of hazard trees, pre-construction surveys prior to all non-routine Project activities, and restrictions on O&M during sensitive seasonal periods.

Bald Eagle Assessment

CDFW requests that the FLA include requirements that the Licensees conduct an assessment following the Protocol for Evaluating Bald Eagle Habitat and Populations in California (Jackman, 2004). [CDFW's Requested Condition #25-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure for three reasons. First, Licensees conducted a bald eagle study during relicensing and located two night roosts and no nests. Historically, the Project has been utilized by bald eagles during the winter, but is not known for nesting activity. Second, the Licensees' proposed Sensitive Aquatic and Terrestrial Wildlife Management Plan (Measure TR2) provides adequate protection for bald eagles through LOPs and/or surveys prior to Project O&M during the nesting bird season, and pre-construction surveys for all non-routine Project activities. Finally, CDFW gives no parameters on the assessment, including locations and frequency, for Licensees to analyze potential additional protective measures for bald eagles, level of effort or costs.

Conduct Tehachapi Pocket Mouse Surveys and Remove Invasive Vegetation

CDFW requests focused surveys be conducted for Tehachapi pocket mouse in suitable habitat, prior to any ground or vegetation disturbing activities. CDFW also recommends removing invasive vegetation and restoring degraded Tehachapi pocked mouse native habitat within the Project. [CDFW's Requested Condition #26-1 in its November 27, 2019 letter]

The Licensees did not accept this proposal for the following three reasons. First, all current and proposed Project vegetation management and ground-disturbing activities are at developed Project facilities and recreation areas, or a small buffer around them. The habitat types identified for Tehachapi pocket mouse were not mapped in these areas, nor are there any proposals for new vegetation management and ground-disturbing activities at the Project that would encroach on their habitat. CDFW had requested focused surveys for all special-status species with the potential to occur at the Project, but FERC accepted the Licensees' proposal for wildlife studies at the Project. Second, per the provisions of the Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), where non-routine Project activities are proposed in areas of Tehachapi pocket mouse habitat, they (and other sensitive species) would be surveyed for prior to work proceeding. Third, CDFW does not define any of the terms in "invasive vegetation and restoring degraded…native habitat." It is unclear what would constitute the restoration, what makes habitat for the species degraded and what kinds of vegetation are included under the term 'invasive.' Without this clarity, the Licensees cannot evaluate CDFW's preliminary proposed measure, including cost, feasibility, and likelihood to provide protection to the species. Therefore, the Licensees did not adopt this measure.

Restrict Use of Second-Generation Anticoagulant Rodenticides

CDFW requests the FLA include conditions to prohibit the use of second-generation anticoagulant rodenticide in the Project area [CDFW's Requested Condition #9-1 in its November 27, 2019 letter]

The Licensees did not adopt this recommendation for several reasons. First, rodent activity at Project facilities threatens public safety by compromising the structural integrity of facilities and heightening the potential for the spreading of disease (including plague) if rodent populations are left unchecked. It is critically important that the Licensees have the ability to use a variety of measures to effectively control rodent populations. Second, CDFW did not provide evidence that the use of second generation anticoagulants at Project facilities has had any adverse impact to wildlife, including California condor, within the Project boundary. Additionally, the Project operational record includes no evidence of adverse impacts to wildlife due to rodenticide use. Lastly, the use of second generation anticoagulants is an industry standard that is both effective and efficient. The Licensees are committed to using second generation anticoagulants sparingly, on an as-needed basis, and in concurrence with California Department of Pesticides Regulation statutes and regulations. In addition, the

Licensees are bound by all federal, State, and local laws pertaining to the use of rodenticides as a part of O&M activities. These products are legally registered for use within the state of California and are used as directed on product labels.

Restrict Use of Rodenticides

CDFW requests the FLA include conditions to prohibit the use of rodenticides. The FLA should encourage natural predation by raptors and owls. CDFW suggests this can be accomplished by installing raptor perches, nesting platforms, and owl nesting boxes, as modelled by both the Santa Barbara County Flood Control District Raptor Program and the Ventura County Public Works Agency Raptor Pilot Study for Levee Protection (2017). CDFW indicates that the County of Ventura study found that constructing the above recommended perches and nesting boxes controlled rodent burrows/damage more effectively then rodenticide use. [CDFW's Requested Condition #27-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure for three reasons. First, rodent populations must be kept under control as they pose a threat to public health and Project facilities. While there are several ways to control rodent populations, rodenticides are the most efficient and effective. DWR is dedicated to using rodenticides sparingly on an as needed basis for the preservation of public health and the structural integrity of Project facilities. Rodenticides are professionally applied by a licensed California Department of Pesticide Regulation-certified pesticide applicator. Application of pesticides is done according to the agency's regulations, pesticide label instructions, and applicable use restrictions outlined in the corresponding County Agricultural Commission permit obtained by DWR. Second, although predation by raptors and owls may be a good way to hold down the rodent population, the LOPs and buffers around nesting birds requested by CDFW (and USFS) for potential Project impacts to raptors and all nesting birds preclude erecting nesting platforms and boxes as a useful tool in this situation. Since rodent control is concentrated at Project facilities, the perches and nesting boxes would need to be situated close to them in order to facilitate hunting of rodents in those areas. However, nesting birds will be protected by LOPs and nest buffers, meaning that the Licensees might need to restrict activities at their own facilities and/or the nests would be in danger of disturbance. The levees where the perches and nesting features were erected for the Pilot Study were not heavily trafficked (County of Ventura 2017). Finally, CDFW did not present any details on how many perches/nesting boxes should be erected, nor how they should be maintained; therefore, the Licensees cannot fully analyze the cost and effort piece of their proposal. For these reasons, the Licensees did not adopt CDFW's preliminary proposed measures.

Protect and Monitor Quail Lake Habitat

CDFW proposes that the FLA contain specific, measurable criteria to protect the quantity and quality of habitat at Quail Lake. CDFW proposes that annual vegetation mapping of all habitat at Quail Lake, to the association level, should be required. CDFW further states that the quantity and quality of these vegetation alliances should be *compared annually, and if there is a decline in quality of any alliance, or quantity of any alliance greater than 5 percent over a 10 year period or 3 percent between any two years, the Licensees should provide a plan to CDFW detailing specific measures, such as habitat creation/enhancement to correct this decline/loss of habitat.* [CDFW's Requested Condition #28-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure for three reasons. First, Project activities at Quail Lake are minimal, consisting of vegetation management around existing facilities – the road and parking lot – and dispersed, non-motorized recreation around the lake (no boats are allowed). Vegetation management at the parking lot and road have been occurring for many years, and the existing vegetation in these areas already reflects that work. In addition, the water level at Quail Lake fluctuates only slightly throughout the year. There would be no significant changes to the majority of habitat at Quail Lake that would impact vegetation or deleteriously effect wildlife that may be present. Since CDFW provided no evidence that there are current problems with vegetation at Quail Lake, there is no reason for the Licensees to believe Project activities will cause them in the future. Second, a wide variety of non-Project factors could affect vegetation well beyond Project activities, including, but not limited to, rainfall, temperature, climate change, and disease. CDFW's proposal would make the Licensees responsible for impacts to vegetation that have no Project nexus and that the Licensees have no control over. Third, there are no details or protocols to follow provided in CDFW's recommendation for vegetation health determination, so the Licensees cannot evaluate this request or its costs, or determine if it would provide additional protection to the resources.

Species-specific Surveys at Quail Lake

CDFW requests that protocol surveys be conducted, for any CESA-listed species potentially present at Quail Lake…during the appropriate season, prior to any ground or vegetation disturbing activities [CDFW's Requested Condition #10-1 in its November 27, 2019 letter].

In addition, CDFW proposes that no Project activities occur within or around Quail Lake until CDFW-approved species-specific surveys have been completed that document the presence, range, and extent of these species due to the lack of species specific surveys for southern western pond turtle, tri-colored blackbird, two striped garter snake, burrowing owl, monarch butterfly, and breeding birds. CDFW suggests that any impacts to vegetation, bare ground, or the lake is likely to affect these special status species. CDFW further states that the studies conducted did not contain sufficient data on presence, abundance, location, and range to allow the Licensees to avoid these resources or provide avoidance PM&Es. [CDFW's Requested Condition #28-1 in its November 27, 2019 letter]

The Licensees did not adopt CDFW's preliminary proposed measure for four reasons. First, CDFW requested protocol surveys for all of these same species on the entire Project during study plan development. In FERC's study determination dated June 14, 2017, FERC stated, “While protocol-level surveys can document presence of species at specific sites, it is difficult for surveys to confirm absence. When protocol surveys do indicate a lack of presence, the results typically expire after a certain time period. Documenting presence or lack of presence at a snapshot in time during the application development process is not likely to provide useful information that would warrant the effort to do so.” FERC further stated, “Identification of the availability of suitable habitat for special-status species…would be sufficient to analyze potential effects and develop appropriate protective measures.” Second, CDFW has not provided enough detail on what would constitute a “CDFW-approved” protocol-level survey. Without this level of detail, the Licensees cannot evaluate this proposal for cost, level of effort, feasibility, or potential protection to species. Third, the level of Project activity at Quail Lake is minimal, and CDFW has provided no evidence that any of these listed species are currently negatively impacted by the Project. Fourth, adequate protection measures for all of the species listed in CDFW’s comment are included in the Licensees’ proposed Sensitive Aquatic and Terrestrial Wildlife Plan (Measure TR2), including LOPs that address the nesting bird season, and pre-construction surveys prior to any non-routine Project activities. For these reasons, CDFW’s preliminary proposed measure is not adopted.

5.4.2 Wetlands, Riparian, and Littoral Habitats

Wetlands, riparian, and littoral habitats are addressed in four sections. Section 5.4.2.1 describes existing conditions related to wetlands, riparian, and littoral habitats. Section 5.4.2.2 describes effects of the Licensees’ Proposal, including the Licensees’ PM&E measures, on wetlands, riparian, and littoral habitats. Section 5.4.2.3 addresses any unavoidable adverse effects to wetlands, riparian, and littoral habitats. Section 5.4.2.4 discusses responses to requests for additional PM&E measures or studies.

The Licensees augmented existing, relevant, and reasonably available information relative to wetlands, riparian, and littoral habitats by conducting Study 4.1.5, *Botanical Resources*. The study is complete, and the study results are incorporated into this section. Refer to Appendix B of this Exhibit E or to the South SWP Hydropower relicensing website (http://south-swp-hydropower-relicensing.com/) for the detailed study approaches, study summaries, and detailed study data.

5.4.2.1 Existing Environment

This section includes three main sub-sections: the first section describes the pre-field investigation, including wetlands identified by USFWS in its NWI maps; the second section discusses a literature review of wetlands identified within the proposed Project boundary by previously conducted surveys; and the third section describes the results of field surveys conducted in 2017 and 2018. Each of the sections addresses habitats associated with Project reservoirs within the proposed Project boundary and along Pyramid reach. Pyramid reach is outside the Licensees’ Botanical Resources Study area; however, this area was considered as requested by agencies. For information on special-status aquatic species, AIS, and fish resources, refer to Section 5.3.

Wetlands are defined by federal policy as “areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and which, under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (EPA 2018). Wetland areas include marshes, shallow swamps, lakeshores, wet meadows, and riparian areas, and often occur along or adjacent to perennial or intermittent water bodies.

Riparian areas are vegetated zones that form a transition between permanently saturated areas and upland areas, and that typically exhibit vegetation and physical characteristics associated with permanent sources of surface or groundwater (USACE 1987). Littoral areas, per Cowardin et al. (1979), are those with standing water of depths less than 6.6 feet. These areas typically support aquatic bed or emergent vegetation and would likely be classified as wetlands.

When on NFS lands, wetlands, drainages, and riparian areas are subject to land management measures as dictated by USFS and are outlined in USFS’s Land Management Plan (USFS 2005).

Pre-Field Investigation

Prior to field surveys during the pre-field investigation, the Licensees accessed USFWS’ NWI data (USFWS 2017) to identify wetlands within the proposed Project boundary for surveying. NWI mapping provides preliminary data on potential location and type of wetlands. These data are based on aerial imagery, which is not typically ground-truthed, and likely do not capture some areas where wetlands may occur, such as in and adjacent to riparian areas. NWI maps provide no information about vegetation, condition of the wetland, whether an area meets the USACE’s definition of a wetland, or whether it would be considered jurisdictional (USACE 1987).

In addition, a literature review was conducted of various studies that described wetland habitat within the proposed Project boundary and along Pyramid reach. These studies are presented in the “Literature Review” section in greater detail.

National Wetlands Inventory Mapped Wetlands

NWI areas are described using the Cowardin classification (Cowardin et al. 1979), a hierarchical system that defines wetlands and deepwater habitats according to System, Subsystem, Class, Subclass, and Modifiers. Mapped features are not always described using all categories, but they are typically classified by System and Class, at a minimum. Table 5.4.2-1 summarizes Cowardin classification system descriptions for Cowardin classifier wetland systems. This classification system is different from that in Section 5.4.1, which utilizes CDFW’s CWHR classification system (Mayer and Laudenslayer 1988). Cowardin is more specific to classifying water bodies, while the CWHR classification system is used to analyze habitats for wildlife use.

Three Cowardin classifications were mapped by NWI within the proposed Project boundary: Palustrine, Lacustrine, and Riverine. Palustrine wetlands include all non-tidal wetlands dominated by trees, shrubs, emergent plants, mosses, or lichens. Lacustrine areas include wetlands and deepwater habitats that: (1) are located in a topographic depression or a dammed river channel; (2) are lacking in trees, shrubs, persistent emergent plants, emergent mosses, or lichens with greater than 30 percent areal coverage; and (3) are greater than 20 acres in area. Riverine areas include habitats contained in natural or artificial channels with periodically or continuously flowing water, or which form a connecting link between two bodies of standing water. Lacustrine and riverine habitats are generally not considered wetland areas, but they are included here for completeness in evaluating NWI data.

NWI wetland and other water types and specific features mapped within the proposed Project boundary and Pyramid reach are described below and are depicted in Figures 5.4.2-1 through 5.4.2-9.

Table 5.4.2-1. Cowardin Classification System Descriptions for Cowardin Classifier Wetland Systems

Cowardin Classifier[1]	Abbreviation	Description
System		
Palustrine	P	Non-tidal wetlands dominated by trees, shrubs, emergent plants, mosses, or lichens
Lacustrine	L	Wetlands and deepwater habitats that (1) are located in a topographic depression or a dammed river channel; (2) are lacking in trees, shrubs, persistent emergent plants, emergent mosses, or lichens with greater than 30 percent areal coverage; and (3) are greater than 20 acres in area
Riverine	R	Habitats contained in natural or artificial channels with periodically or continuously flowing water, or which form a connecting link between two bodies of standing water
Subsystem – Riverine		
Lower Perennial	2	Characterized by a low gradient and slow water velocity, with some water flows throughout the year. The substrate consists mainly of sand and mud, and the floodplain is well developed.
Upper Perennial	3	Characterized by a high gradient and fast water velocity. Some water flows throughout the year. This substrate consists of rock, cobbles, or gravel with occasional patches of sand. There is very little floodplain development.
Intermittent	4	Describes channels that contain flowing water only part of the year, but may contain isolated pools when the flow stops
Subsystem – Lacustrine		
Limnetic	1	Extends outward from Littoral boundary and includes all deep-water habitats within the Lacustrine System
Littoral	2	Extends from shoreward boundary to 2 meters (6.6 feet) below annual low water or to the maximum extent of nonpersistent emergents, if these grow at depths greater than 2 meters
Class		

Table 5.4.2-1. Cowardin Classification System Descriptions for Cowardin Classifier Wetland Systems (continued)

Cowardin Classifier[1]	Abbreviation	Description
Unconsolidated Bottom	UB	Wetlands and deepwater habitats with at least 25 percent cover of particles smaller than stones (less than 6 to 7 centimeters) and a vegetative cover less than 30 percent
Unconsolidated Shore	US	Wetlands and deepwater habitats characterized by substrates lacking vegetation, except for pioneer plants that become established during brief periods when growing conditions are favorable
Forested	FO	Wetlands characterized by woody vegetation with height 6 meters or taller
Emergent	EM	Wetlands characterized by erect, rooted, herbaceous hydrophytes (plants adapted to growing in wet conditions), excluding mosses and lichens. This vegetation is present for the majority of the growing season in most years, and most emergent wetlands are dominated by perennial plants.
Scrub-shrub	SS	Includes areas dominated by woody vegetation less than 6 meters (about 20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.
Subclass		
Persistent	1	Dominated by species that normally remain standing at least until the beginning of the next growing season
Modifiers		
Temporarily Flooded	A	Areas in which surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the growing season. Plants that grow both in uplands and wetlands may be characteristic of this water regime.
Seasonally Flooded	C	Areas in which surface water is present for extended periods especially early in the growing season but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.
Semipermanently Flooded	F	Areas in which surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.
Intermittently Exposed	G	Areas in which surface water is present throughout the year, except in years of extreme drought
Permanently Flooded	H	Areas in which water covers the land surface throughout the year in all years
Artificially Flooded	K	Areas in which the amount and duration of flooding is controlled by means of pumps or siphons in combination with dikes or dams. The vegetation growing in these areas cannot be considered a reliable indicator of water regime. Wetlands within or resulting from leakage of man-made impoundments, or irrigated pasture lands supplied by diversion ditches or artesian wells, are not included.

Table 5.4.2-1. Cowardin Classification System Descriptions for Cowardin Classifier Wetland Systems (continued)

Cowardin Classifier[1]	Abbreviation	Description
Special Modifiers		
Excavated	x	Areas that occur in a basin or channel that have been dug, gouged, blasted, or suctioned through artificial means
Diked/ Impounded	h	Areas that have been created or modified by a man-made barrier or dam which obstructs the inflow or outflow of water

Source: Cowardin et al. 1979
Note:
[1]Non-exhaustive list of Cowardin classifications

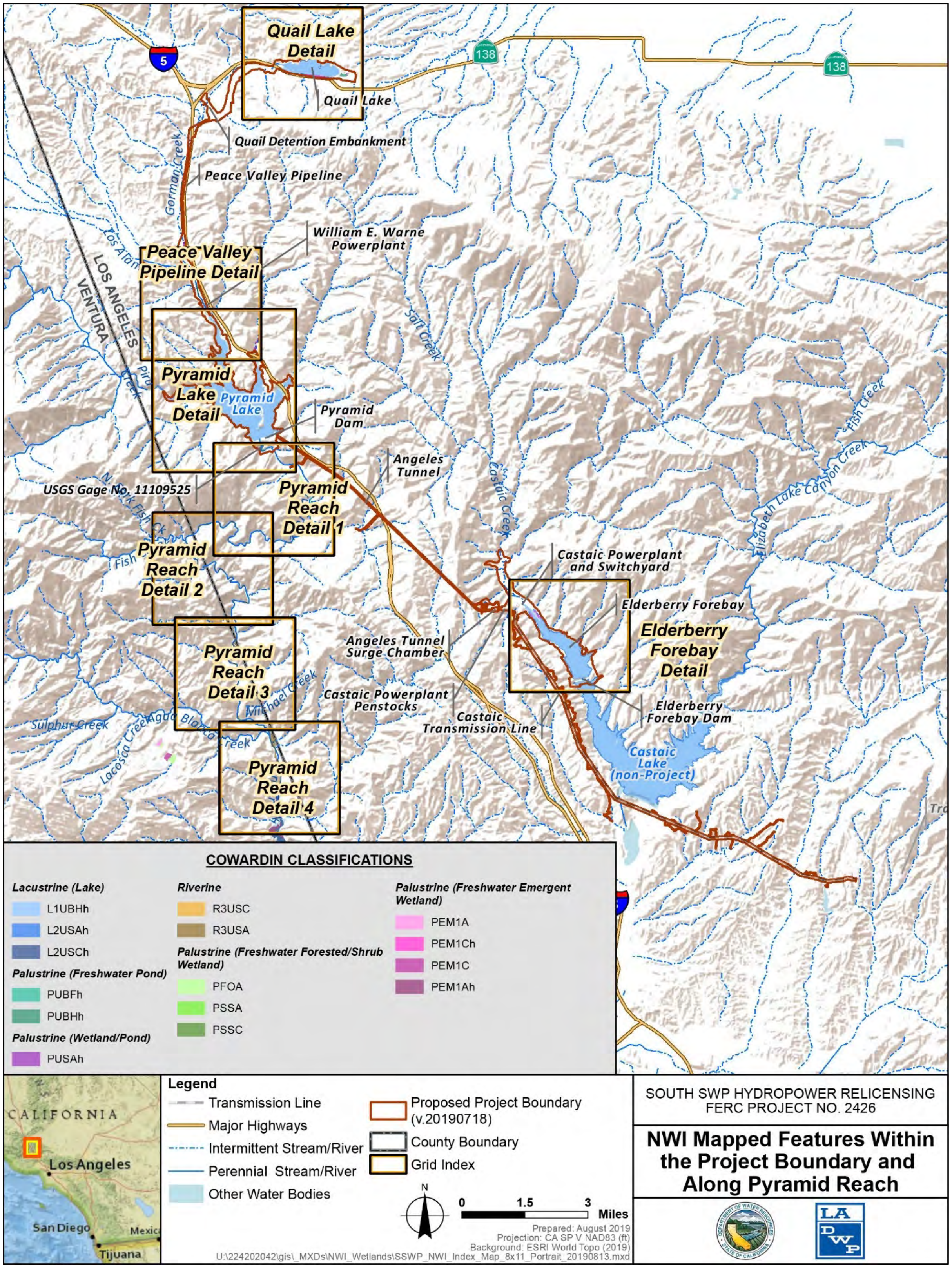

Figure 5.4.2-1. National Wetland Inventory Within the Proposed Project Boundary and Along Pyramid Reach – Key Map

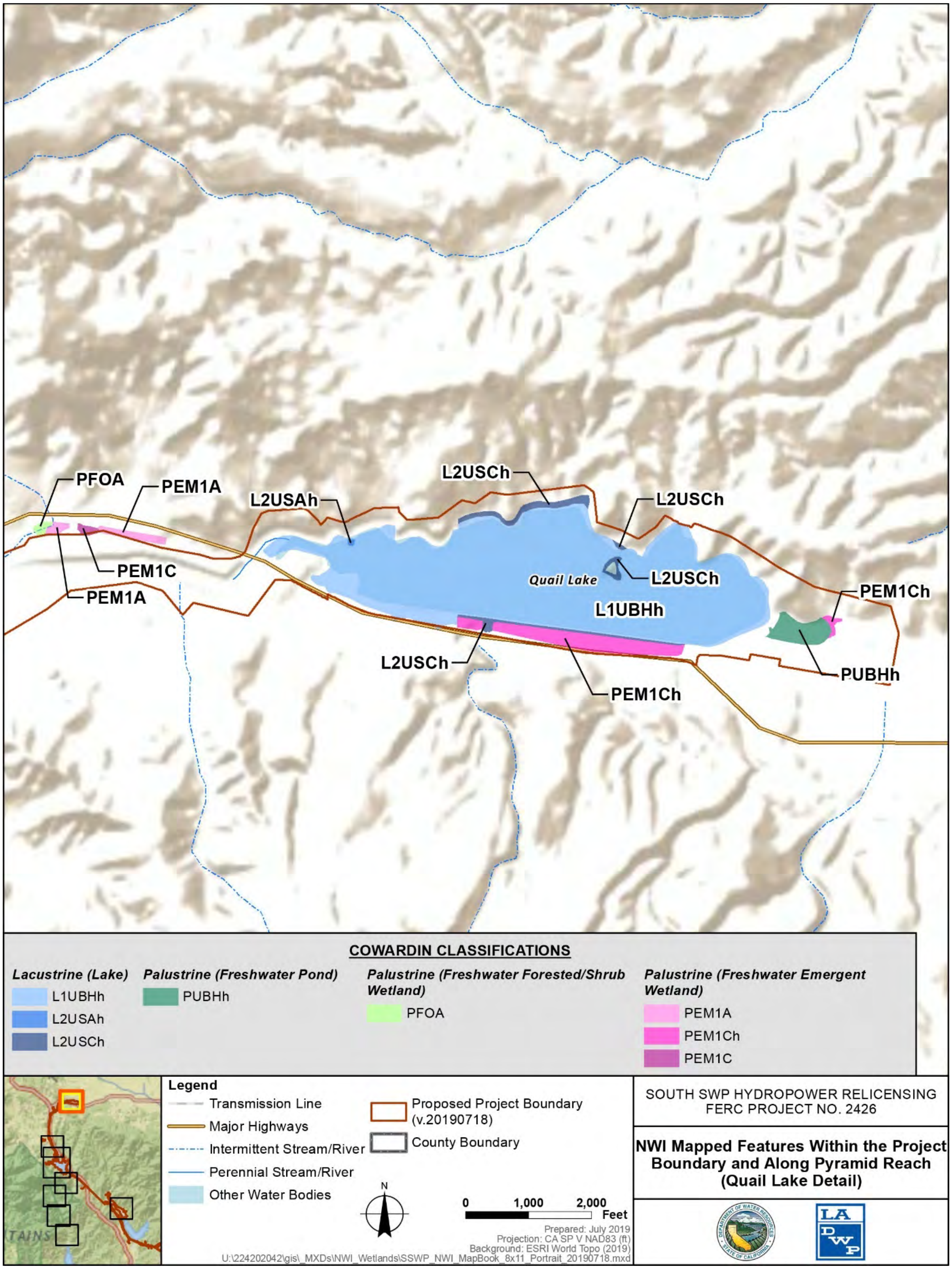

Figure 5.4.2-2. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Quail Lake Detail

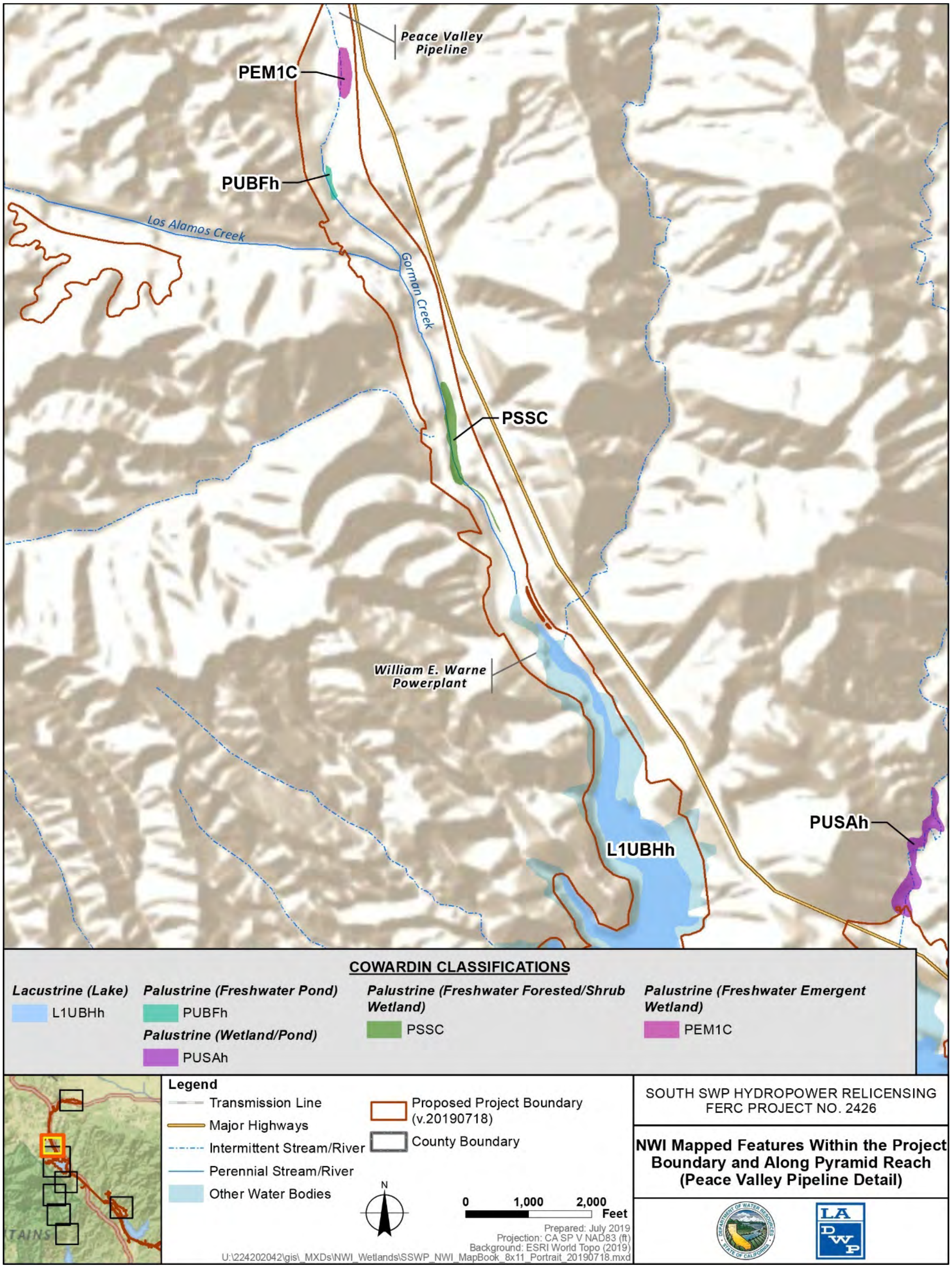

Figure 5.4.2-3. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Peace Valley Pipeline Detail

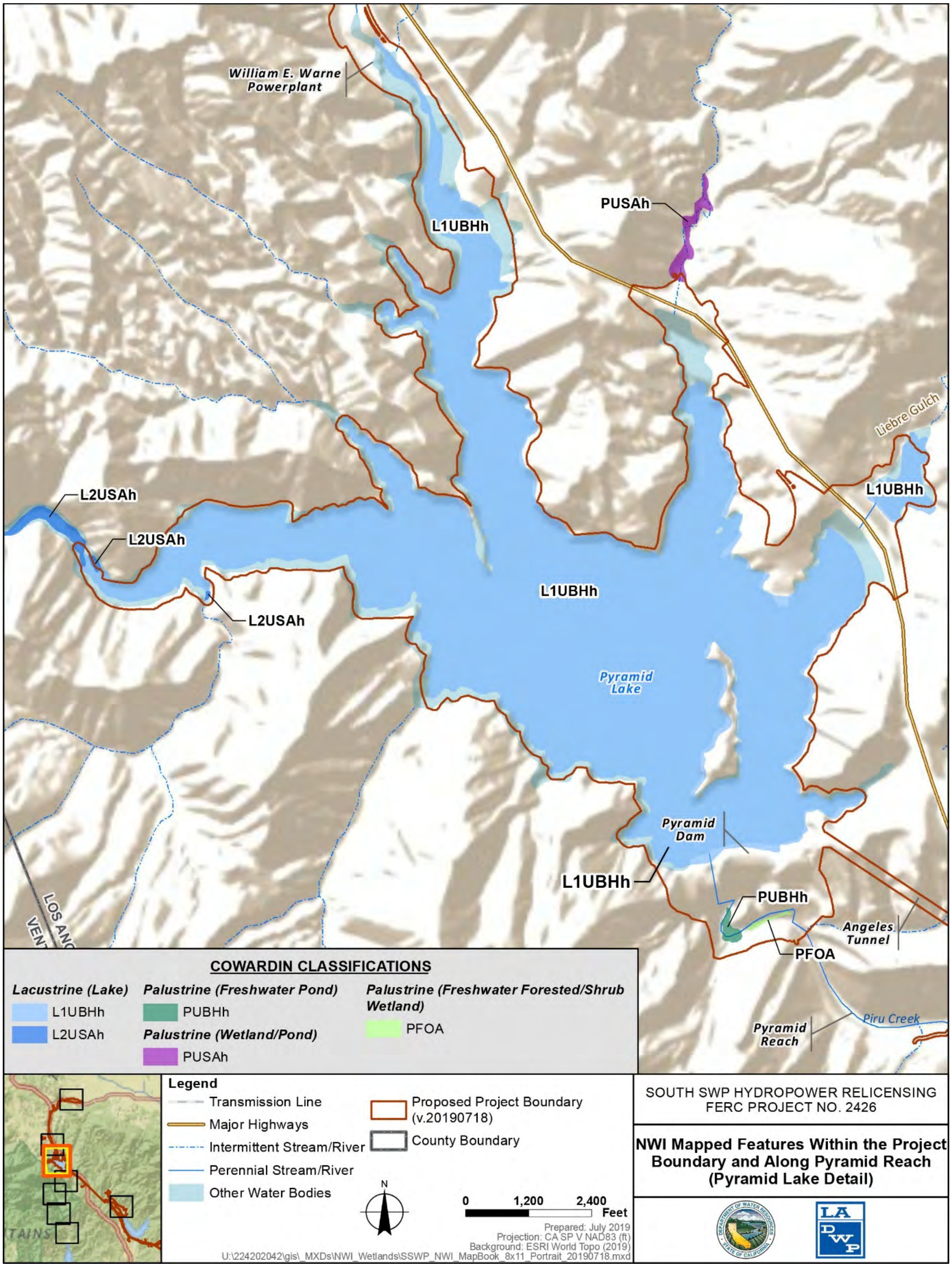

Figure 5.4.2-4. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Pyramid Lake Detail

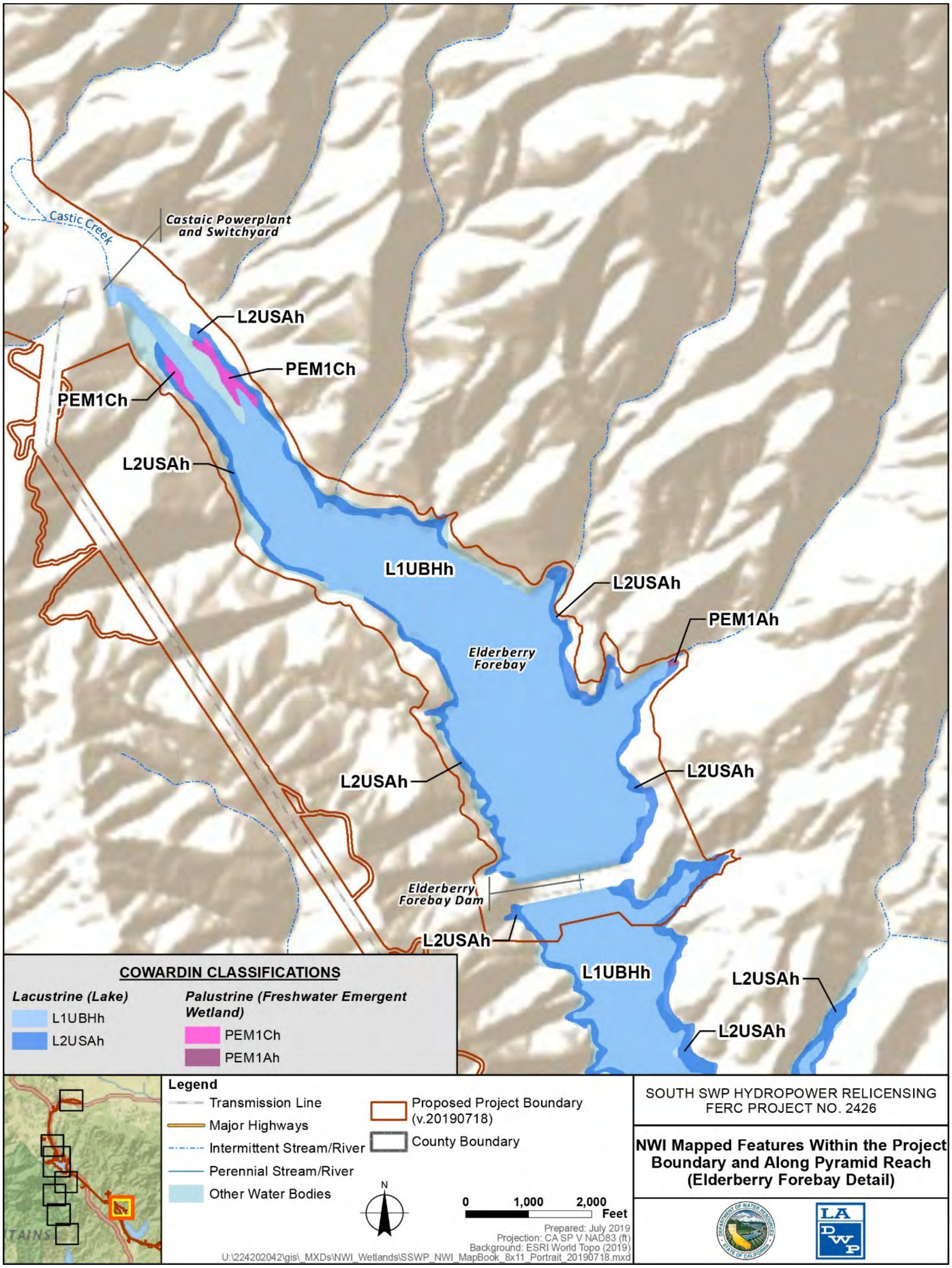

Figure 5.4.2-5. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Elderberry Forebay Detail

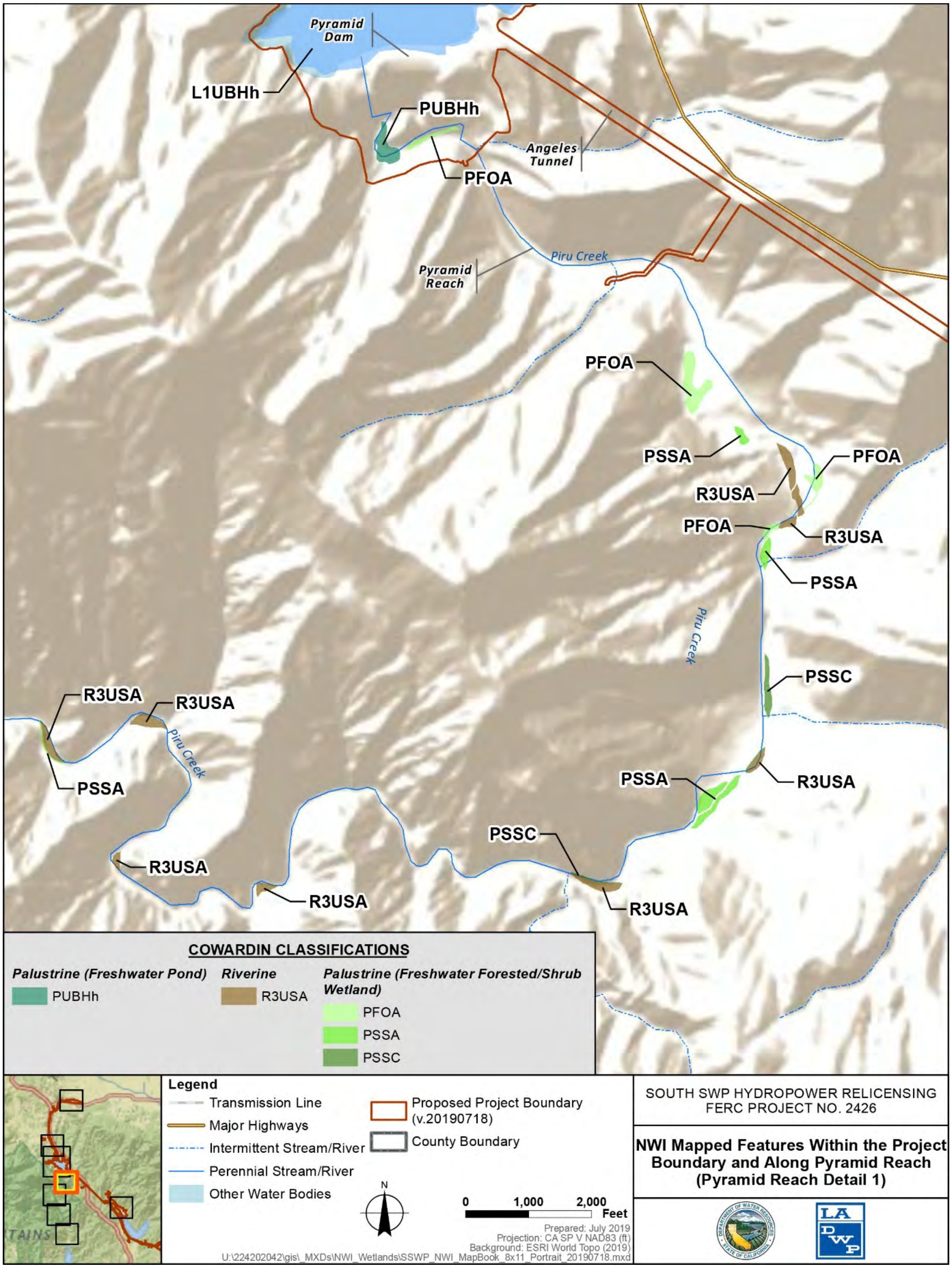

Figure 5.4.2-6. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Pyramid Reach Detail 1

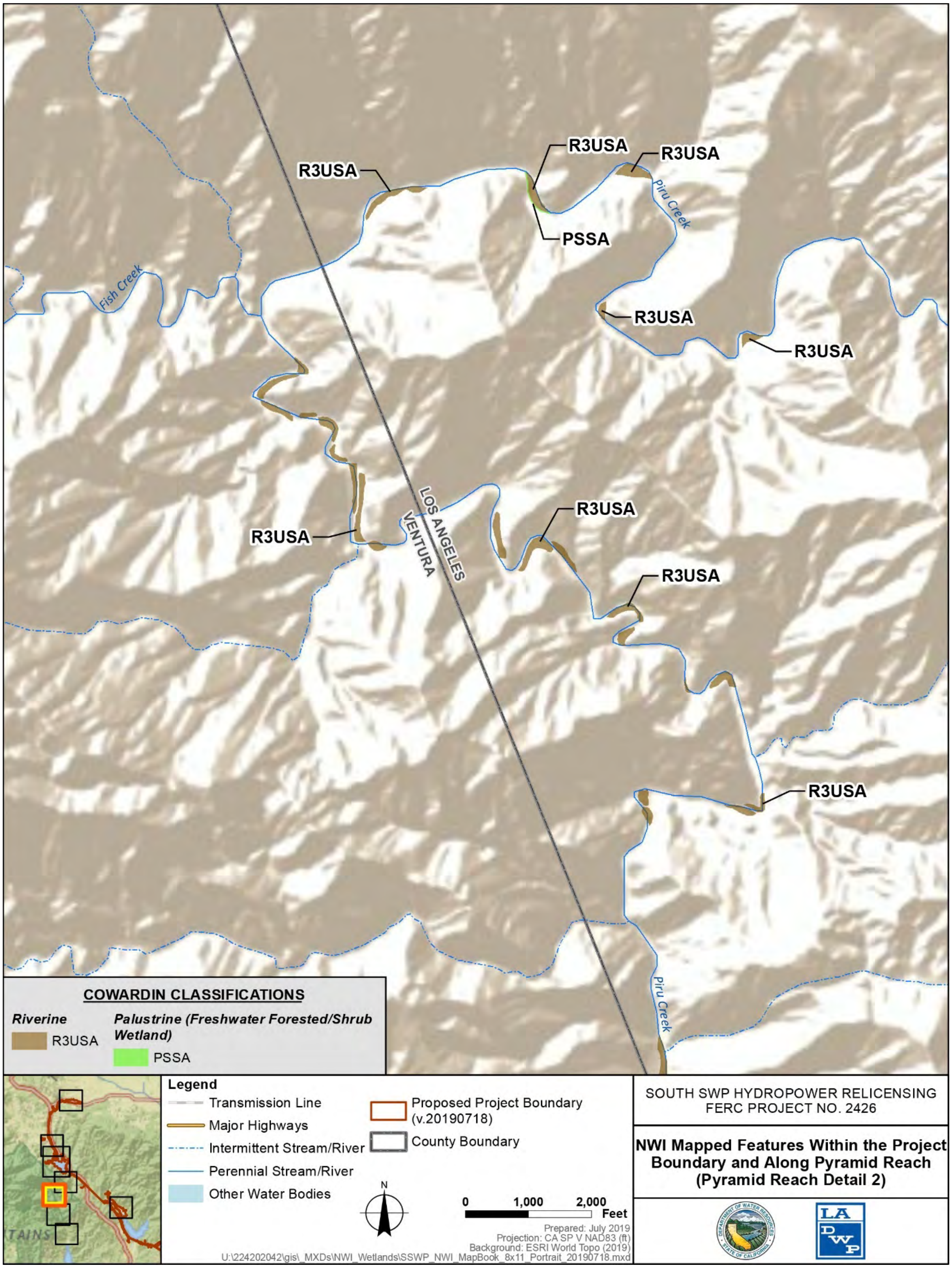

Figure 5.4.2-7. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Pyramid Reach Detail 2

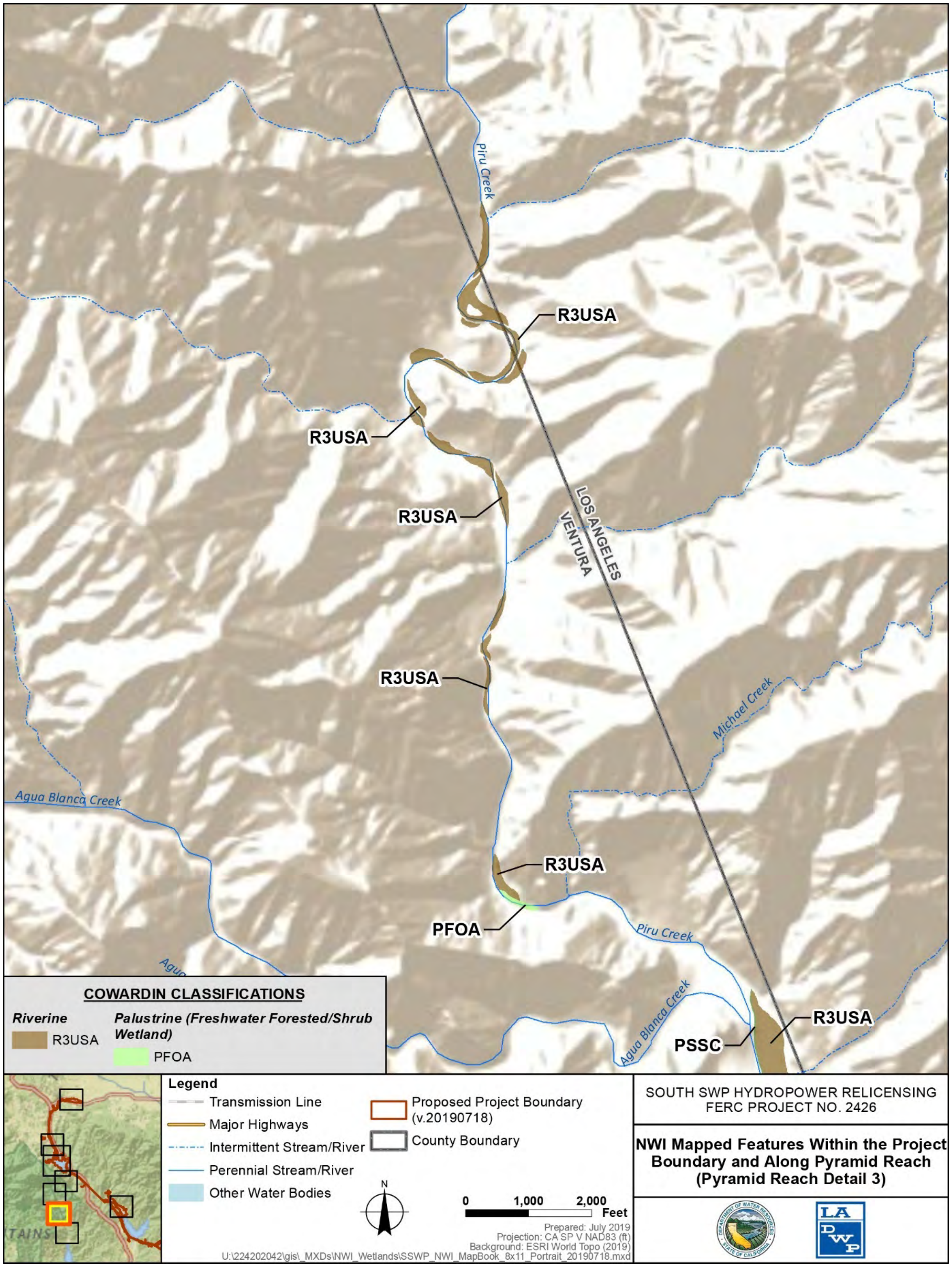

Figure 5.4.2-8. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Pyramid Reach Detail 3

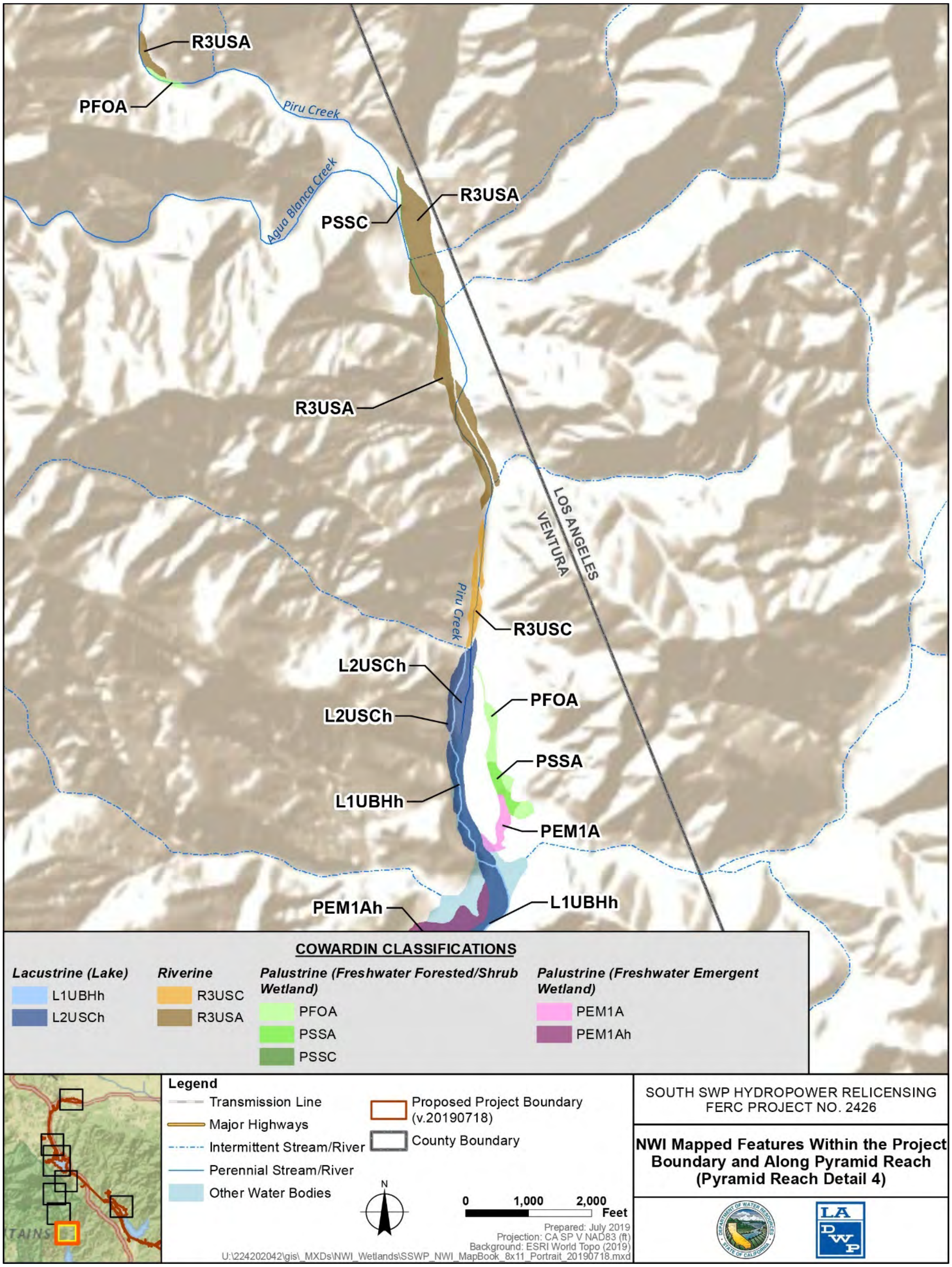

Figure 5.4.2-9. National Wetland Inventory Mapped Features Within the Proposed Project Boundary and Along Pyramid Reach – Pyramid Reach Detail 4

Lentic Features

<u>Palustrine</u>

Palustrine areas were mapped within the proposed Project boundary and are described below.

Palustrine areas mapped along Quail Lake and Lower Quail Canal are as follows:

- Palustrine--Emergent--Persistent--Seasonally Flooded--Diked/Impounded (PEM1Ch) areas were mapped by NWI on the margins of Quail Lake.
- Palustrine--Unconsolidated Bottom--Permanently Flooded--Diked/Impounded (PUBHh) was mapped east of Quail Lake (east of the unimproved road on the east end of Quail Lake). These areas are all considered impounded.
- Palustrine--Emergent--Persistent--Temporarily Flooded (PEM1A), Palustrine--Emergent--Persistent--Seasonally Flooded (PEM1C), and Palustrine--Forested--Temporarily Flooded (PFOA) areas were mapped on the north side of the Lower Quail Canal.

Palustrine areas were mapped along the Peace Valley Pipeline, including at the Gorman Bypass Channel. These palustrine areas include:

- Palustrine--Emergent--Persistent--Seasonally Flooded (PEM1C)
- Palustrine--Unconsolidated Bottom--Semipermanently Flooded--Diked/Impounded (PUBFh)
- Palustrine--Scrub-Shrub--Seasonally Flooded (PSSC)

Palustrine areas were mapped by NWI in several locations along the margin of Pyramid Lake and in the area immediately below Pyramid Lake, specifically:

- One Palustrine--Unconsolidated Shore--Temporarily Flooded--Diked/Impounded (PUSAh) area on the east side of Interstate 5 along West Fork Liebre Gulch
- One Palustrine--Unconsolidated Bottom--Permanently Flooded--Diked/Impounded (PUBHh) area immediately below Pyramid Lake

Palustrine areas were mapped in several locations on the margins of Elderberry Forebay within the proposed Project boundary, specifically:

- Palustrine--Emergent--Persistent--Temporarily Flooded--Diked/Impounded (PEM1Ah)

- Palustrine--Emergent--Persistent--Seasonally Flooded--Diked/Impounded (PEM1Ch)

Palustrine areas were also mapped along Pyramid reach. These are:

- Palustrine--Forested--Temporarily Flooded (PFOA)
- Palustrine--Scrub-Shrub--Temporarily Flooded (PSSA)
- Palustrine--Scrub-Shrub--Seasonally Flooded (PSSC)
- Palustrine--Unconsolidated Bottom--Semipermanently Flooded (PUBF). PUBF is mapped as open water because it is not considered a wetland. .

<u>*Lacustrine*</u>

In the Cowardin et al. (1979) classification, the Lacustrine System has two Subsystems: littoral (shallow water) and limnetic (deep water). Littoral areas per Cowardin et al. (1979), are those with standing water of depths less than 6.6 feet. These areas typically support aquatic bed or emergent vegetation and would likely meet wetland criteria. Unvegetated littoral areas (Unconsolidated Bottom, per Cowardin et al. [1979]) also occur; these areas are not considered wetlands based on USACE wetland criteria (USACE 1987).

Limnetic and littoral lacustrine habitat was mapped within the proposed Project boundary. Quail Lake, Pyramid Lake, and Elderberry Forebay were mapped as Lacustrine--Limnetic--Unconsolidated Bottom--Permanently Flooded--Diked/Impounded (L1UBHh) areas, as were areas at the confluence of the Gorman Bypass Channel and at Liebre Gulch east of Interstate 5. Littoral habitats occur throughout the proposed Project boundary on the margins of Quail Lake, Pyramid Lake, and Elderberry Forebay, but they have not been fully delineated or previously described. Other mapped lacustrine areas within the proposed Project boundary were Lacustrine--Littoral--Unconsolidated Shore--Temporarily Flooded--Diked/Impounded (L2USAh) areas at the impounded area on the margins of Quail Lake, two areas at the confluence of the Piru Creek arm to Pyramid Lake, and several areas on the margins of Elderberry Forebay that are almost completely dominated by tamarisk (*Tamarix ramisissima*) (POWER 2013). Lacustrine--Littoral--Unconsolidated Shore--Seasonally Flooded--Diked/Impounded (L2USCh) areas occur on the north side and in a small area on the south side of Quail Lake.

Lotic (Riverine) Features

Downstream of Quail Lake, open water areas of the Lower Quail Canal were mapped as Riverine--Lower Perennial--Unconsolidated Bottom--Artificially Flooded (R2UBK), and one Riverine--Intermittent--Temporarily Flooded (R4A) area was mapped downstream along the Peace Valley Pipeline. Pyramid reach was mapped by NWI primarily as a Riverine--Upper Perennial--Unconsolidated Shore--Temporarily Flooded

(R3USA) area for most of its length, as well as Riverine--Upper Perennial--Unconsolidated Shore--Seasonally Flooded (R3USC) at its interface with Lake Piru. These areas of open water are shown as open water on the map as they are not considered wetlands.

Literature Review

The following sections describe information obtained from the Licensees' literature review with regard to riparian habitat conditions within the proposed Project boundary and Pyramid reach. The available literature pertaining to the Licensees' Proposal primarily focused on riparian areas and habitats as components of the surveys.

In particular, the following arroyo toad reports pertinent to the local area were examined:

- Frank Hovore & Associates in 1999 and 2005 (Castaic Creek and Elderberry Forebay, respectively)
- POWER Engineers in 2013 (Elderberry Forebay)
- Environmental Science Associates from 2010 through 2018 (Pyramid Reach from Ruby Canyon to Blue Point Campground)
- Sandburg in 2006 (Pyramid Reach)

Other literature reviewed included DWR's EIR (DWR 2005) and FERC's EA (FERC 2008) for the simulation of natural flows. In addition, surveys (Environmental Science Associates 2014a) were conducted along the perimeters of Quail Lake and Pyramid Lake to evaluate the potential effects of the Licensees' application of copper-based herbicides to control aquatic weeds and algal blooms.

Quail Lake

Environmental Science Associates (2014b) reported that riparian forest/scrub was observed sporadically along the perimeter of Quail Lake, particularly in the southeastern corner near the access road. These areas were dominated by arroyo willow (*Salix lasiolepsis*), with an understory of other willow species (*Salix* spp.) and mule fat (*Baccharis salicifolia*). Fremont cottonwood (*Populus fremontii*) were scattered sparsely along the perimeter of the lake. The small patch of riparian forest/scrub in the southeast corner of the lake would be described as Southern Willow Scrub based on the Holland (1986) classification (Environmental Science Associates 2014b).

Pyramid Lake

Environmental Science Associates (2014b) reported that riparian forest occurs sporadically along the perimeter of Pyramid Lake at the confluence with natural drainages. Dominant trees observed included Fremont cottonwood along drainages upstream of the shoreline, and arroyo willow along drainages at or below the lake shoreline. Understory species included other willow species and mule fat. These areas transitioned into broadleaf cattail (*Typha latifolia*) marsh at the edge of Pyramid Lake. The riparian areas would be classified by CDFW under the Holland (1986) system as Southern Cottonwood Willow Riparian Forest where cottonwood is the dominant species, and as Southern Willow Scrub where willow is dominant (Environmental Science Associates 2014b).

Pyramid Reach

Both Sandburg and Environmental Science Associates reported on vegetation along Pyramid reach between Ruby Canyon and Blue Point Campground, and along Agua Blanca Creek upstream of Lake Piru during arroyo toad surveys in 2005, as well as 2010 through 2018. Surveyors noted that riparian plant communities in this area are dynamic, primarily due to the intensity of winter stream flows. After consecutive years of severe drought throughout southern California, the winter of 2016/2017 brought above-average rainfall to the region. The extensive precipitation scoured the bed and banks of Pyramid reach, removing existing riparian vegetation. In contrast, the 2017/2018 winter precipitation was much less significant, and flows remained low throughout the 2018 season. As a result, an early reduction in water level and the regeneration of riparian vegetation was observed throughout Pyramid reach in 2018 (Environmental Science Associates 2018).

Riparian vegetation identified in DWR's Simulation of Natural Flows in Middle Piru Creek EIR (DWR 2005) and FERC's EA (FERC 2008) includes a variety of riparian plant communities primarily dominated by dense stands of willows (*Salix* spp.) and cottonwoods. Other common riparian trees and shrubs documented include white alder (*Alnus rhombifolia*), elderberry (*Sambucus mexicana*), and western sycamore (*Platanus racemosa*). In addition, Cattails (*Typha* sp.), sedges (*Carex* spp.), and rushes (*Juncus* spp.) were identified in the lower banks of middle Piru Creek and have colonized many in-stream sandbars and benches.

In 2014, Environmental Science Associates observed widespread vegetation encroachment on the riparian channel, with mule fat, willow, Fremont cottonwood, white alder (*Alnus rhombifolia*), and broadleaf cattail being dominant on stream banks. The non-native tamarisk was reported to be expanding in this area, but was primarily confined to isolated locations on gravel bars. Southern Willow Scrub was reported to be the dominant plant community in the riparian floodplain, with dominant species being willows (*Salix* sp.) and mule fat, and occasionally poison oak (*Toxicodendron diversilobum*) and Spanish broom (*Sparteum junceum*) (Environmental Science Associates 2010, 2011, 2012, 2013, 2014a, 2015, 2016, 2017, 2018).

Mule fat scrub was found on lower and upper flood terraces in drier areas. Narrow creek gorges that experience frequent flooding supported alluvial scrub, consisting of scale broom (*Lepidospartum squamatum*), mule fat, California buckwheat, California sagebrush (*Artemisia californica*), California brickelbrush (*Brickella californica*), scattered riparian trees, hairy yerba santa (*Eriodyction crassifolium*), shortpod mustard (*Hirschfeldia incana*), black mustard (*Brassica nigra*), and non-native grasses.

Southern Sycamore Alder Riparian Woodland (as identified under the Holland 1986 system) was observed upstream and downstream from Blue Point Campground (approximately 0.5 miles north of Lake Piru). At Frenchmans Flat (approximately 1.5 miles downstream of Pyramid Lake) and upstream from Blue Point Campground, Southern Cottonwood Riparian Forest (as identified under the Holland 1986 system) was observed, with large Fremont cottonwoods in the overstory, and less frequently coast live oak (*Quercus agrifolia*), white alder, and California sycamore (*Platanus racemosa*). Understory species included arroyo willow and bush senecio (*Senecio flaccidus* var. *douglasii*) (Environmental Science Associates 2014a).

Castaic Creek Upstream of Elderberry Forebay

Frank Hovore & Associates described riparian habitat during 1999 and 2005 arroyo toad surveys along Castaic Creek in the check dam basins upstream of Elderberry Forebay (Frank Hovore & Associates 2005). Weather in 1999 was relatively dry and cold, which resulted in low to intermittent stream flows in the Piru-Castaic drainage basins. However, record high rainfall occurred in the winter of 2004/2005 that resulted in heavy erosional flows from surrounding uplands into Castaic Creek, particularly from canyons that had been recently disturbed by fire or human activity. Large mud and debris flows altered channel morphology by downcutting the channel bottom in the upper portions of the basins, and depositing silt and gravel fans in the middle and lower portions. During this period, mature riparian vegetation was scoured from the banks in many areas.

POWER Engineers reported on vegetation in the three check dam basins during 2013 arroyo toad surveys. In Basin 1 (furthest upstream), the upper third contained a dense cover of sandbar willow (*Salix exigua*) and tamarisk. The middle section of Basin 1 was dominated by sandbar willow, and the southern end was dominated by sparse sandbar willow and broadleaf cattail. The margins of Basin 1 were dominated by tamarisk and tree tobacco (*Nicotiana glauca*), with some additional sandbar willow. The northern half of Basin 2 supported very dense broadleaf cattail cover, and the lower half contained a relatively even mixture of mule fat and cottonwood saplings, with the lower 25 to 30 feet being primarily tamarisk. With the exception of some broadleaf cattail clusters, the lower half of Basin 2 is generally sparsely vegetated. The margins of Basin 2 supported emergent vegetation, with the southeast end containing a row of mature cottonwoods above the basin along the access road. Vegetation in the northern half of Basin 3 (the furthest downstream basin) was primarily made up of broadleaf cattails and willows. The southern two-thirds of Basin 3 was almost completely dominated by tamarisk (POWER 2013).

Field Survey Results

As part of the *Botanical Resources Study*, the Licensees performed field surveys between May 1, 2017 and May 23, 2017, to map and assess wetland and riparian habitats using BLM's Properly Functioning Condition (PFC) assessment. During field surveys, a qualified team of field staff assessed the condition of wetland and riparian habitat using the PFC qualitative methods for wetland (i.e., lentic) (Prichard et al. 2003) and riparian (i.e., lotic) areas adjacent to flowing water (Dickard et al. 2015). Surveyors identified areas to be evaluated prior to field surveys during the review of existing information. Field staff traversed all features on foot or by boat, depending on accessibility, including the entire length of riparian vegetation within the study area whenever safely accessible, and collected data at representative areas. Surveyors determined the locations where PFC data were collected (sample points) while in the field based on site observations. Surveyors collected data at a minimum of one sample location at each discrete wetland or riparian area. For wetland or riparian areas that span a sufficiently large area, such that physical and biological features vary significantly (as determined in the field based on best professional judgment by the Licensees' field staff), up to three sample points were evaluated. Field staff completed the Reach Information Form and PFC Assessment Form (either lentic or lotic). The Reach Information Form records key information that must be included with the assessment. Surveyors recorded locations with a GPS unit, took photographs at each sample point, and photographed features at other locations to document conditions within each wetland and riparian area. Maps of the field results are shown in Figures 5.4.2-10 through 5.4.2-16.

Previously recorded wetlands from the NWI wetlands mapping and literature review components generally corresponded with the information obtained in the field survey. However, using information from the field survey gave greater detail on wetland boundaries and plant species composition. In addition, the field survey identified new wetlands not observed in previous studies nor mapped by the NWI (i.e., GC-2-Lo-A, Py-3).

<u>Lotic Features</u>

The Licensees identified nine lotic areas in Gorman Creek, Pyramid reach, Pyramid Lake, and Castaic Creek. These are summarized in Table 5.4.2-2 and are shown in Figures 5.4.2-10 through 5.4.2-16. All areas found to have no wetland/riparian vegetation were excluded from the field summary maps.

Seven of the nine lotic areas were determined to exhibit "Proper functioning condition," and two areas, one at the inlet of Gorman Creek and Pyramid Lake (PL-10-Lo-A) and one at Castaic Creek (CC-4-Lo-B), were determined to be "Functional – at risk." These two areas were determined to be "Functional – at risk" based on their simplified geomorphological structure (e.g., channelization) and limited ability to dissipate energy. None of these characteristics are due to existing Project operations or were created from conditions attributable to Project operations. In addition, Castaic Creek is upstream of the proposed Project boundary above Elderberry Forebay and is not subject to Project-induced water level fluctuations or influences, and therefore is not considered to have a nexus with the Licensees' Proposal.

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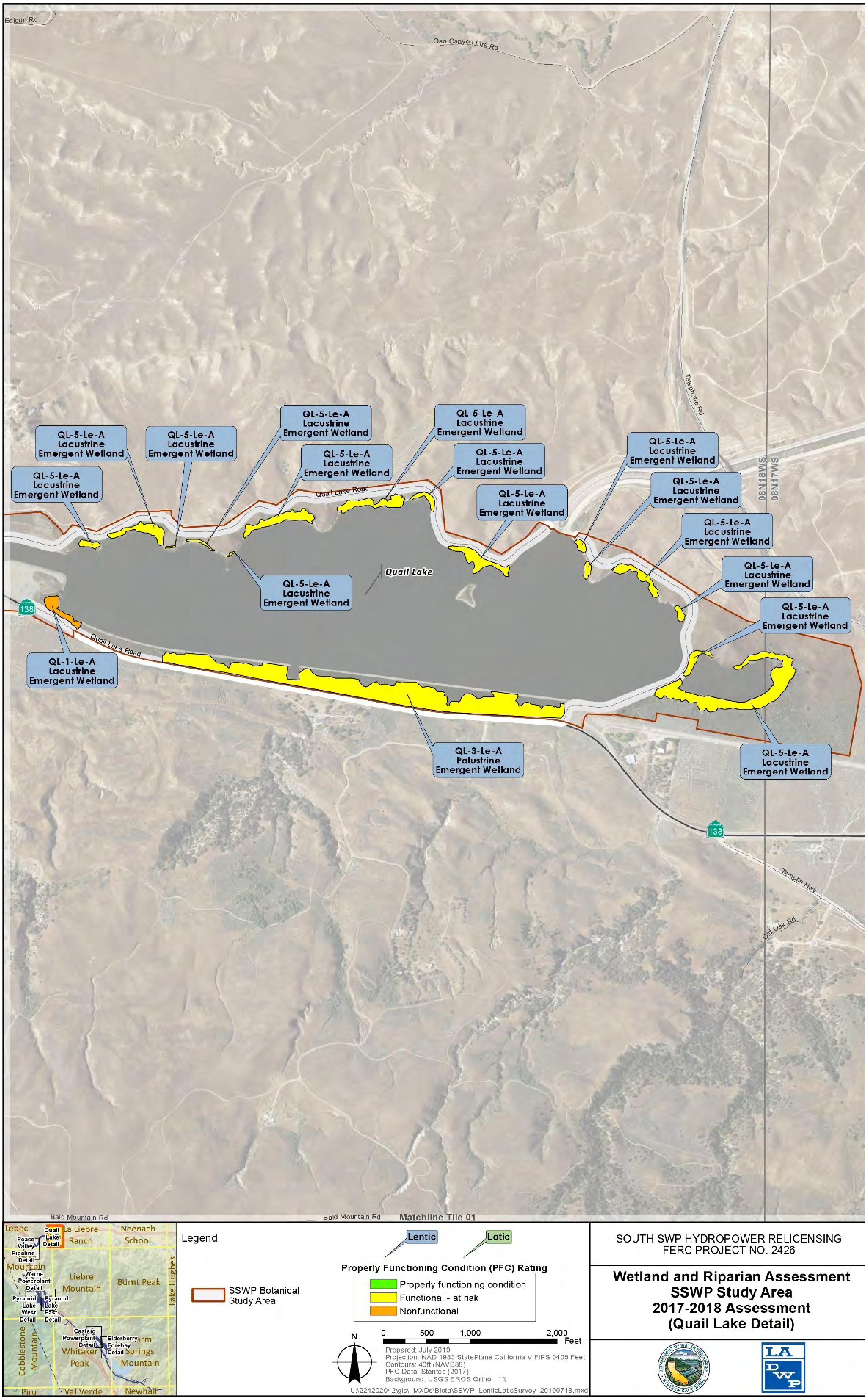

Figure 5.4.2-10. 2017-2018 Wetland and Riparian Assessment – Quail Lake Detail

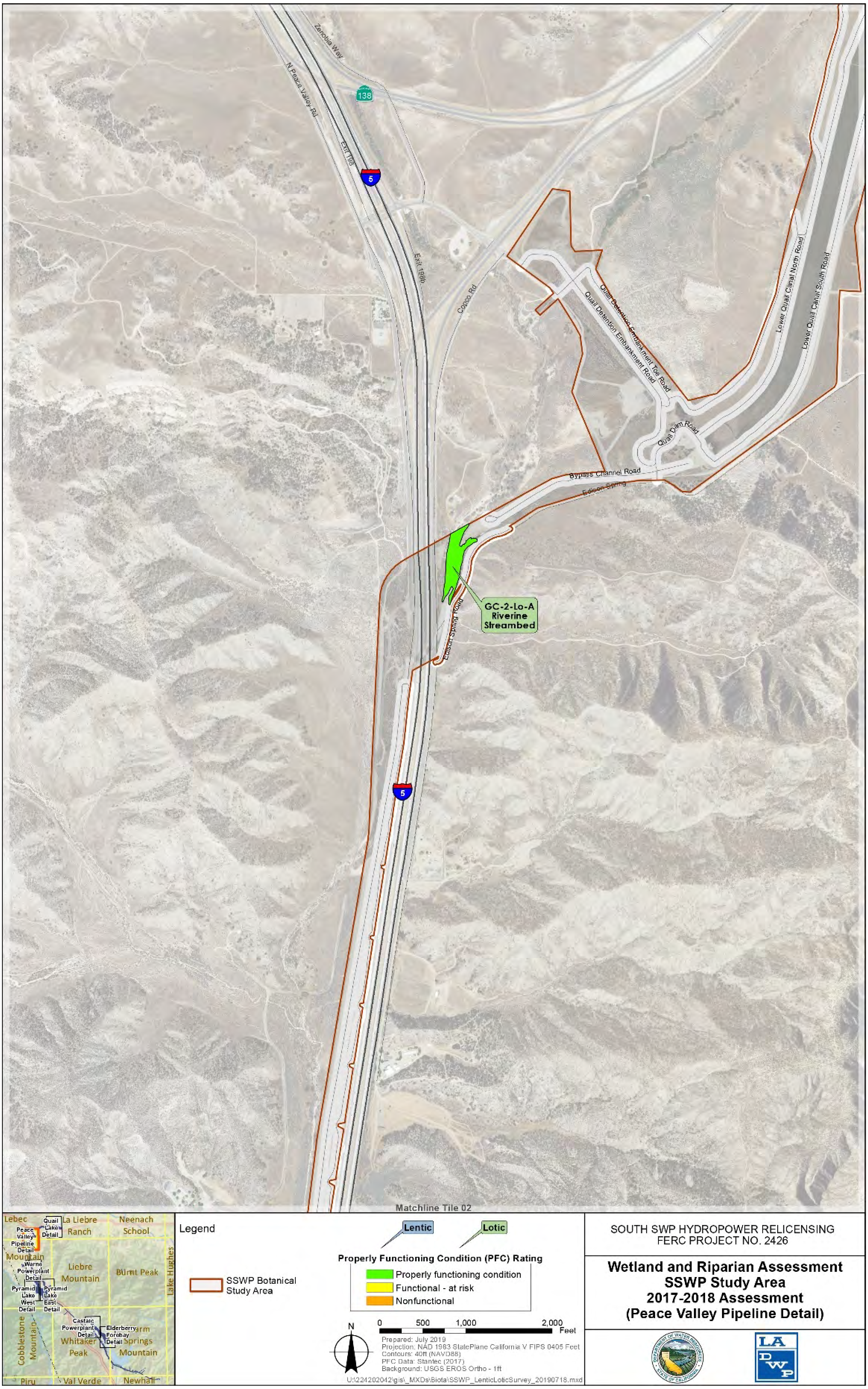

Figure 5.4.2-11. 2017-2018 Wetland and Riparian Assessment – Peace Valley Pipeline Detail

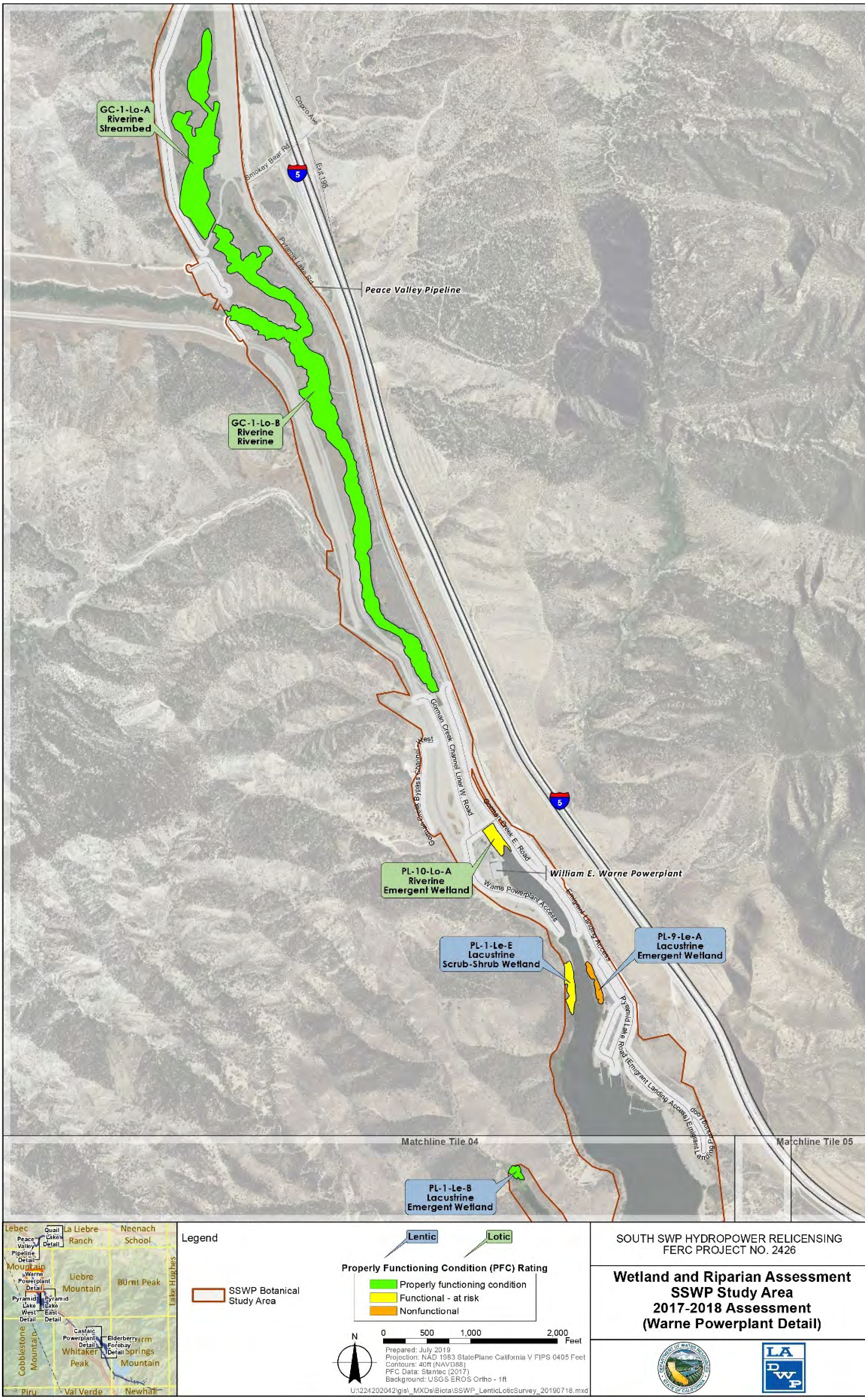

Figure 5.4.2-12. 2017-2018 Wetland and Riparian Assessment – Warne Powerplant Detail

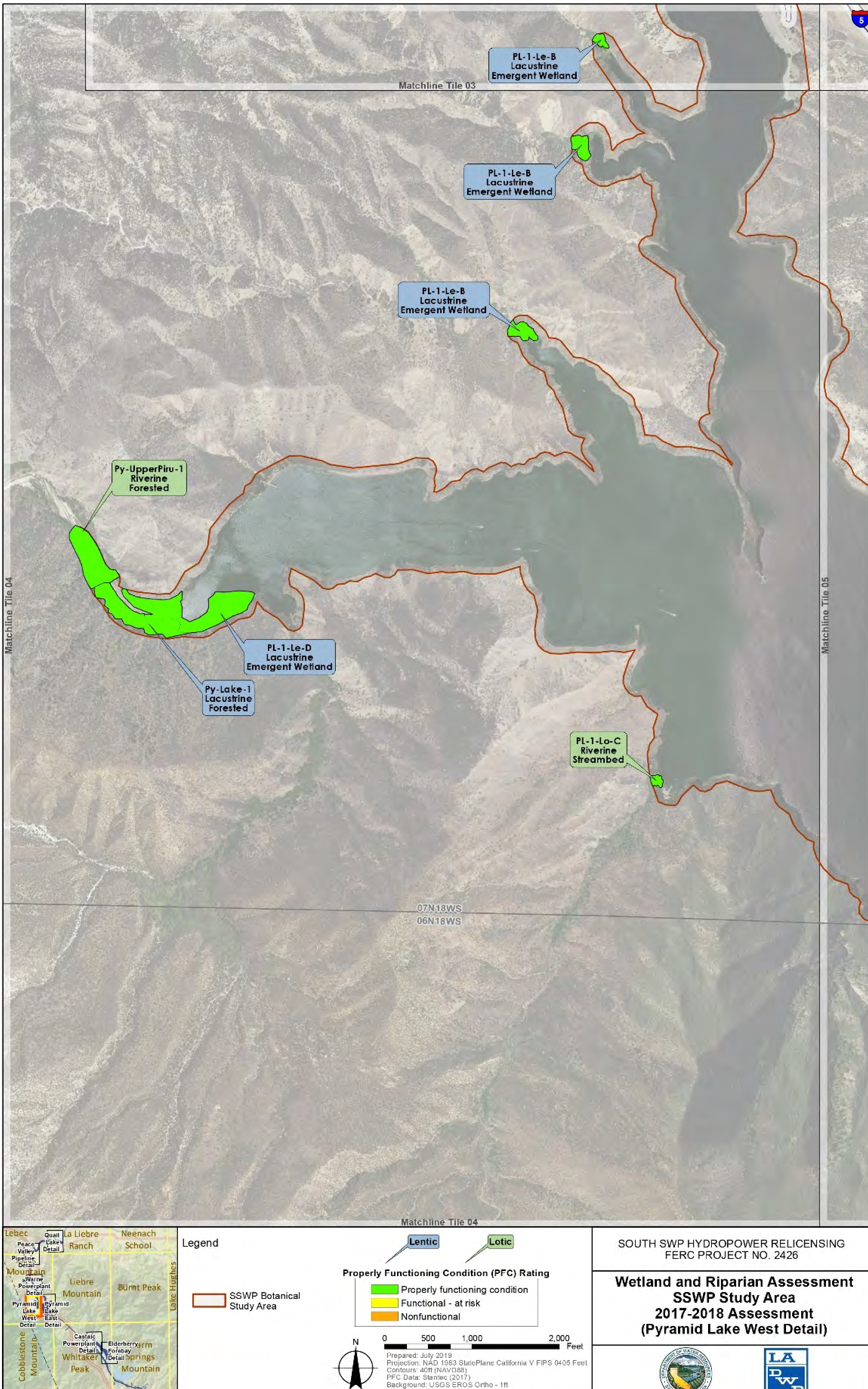

Figure 5.4.2-13. 2017-2018 Wetland and Riparian Assessment – Pyramid Lake West Detail

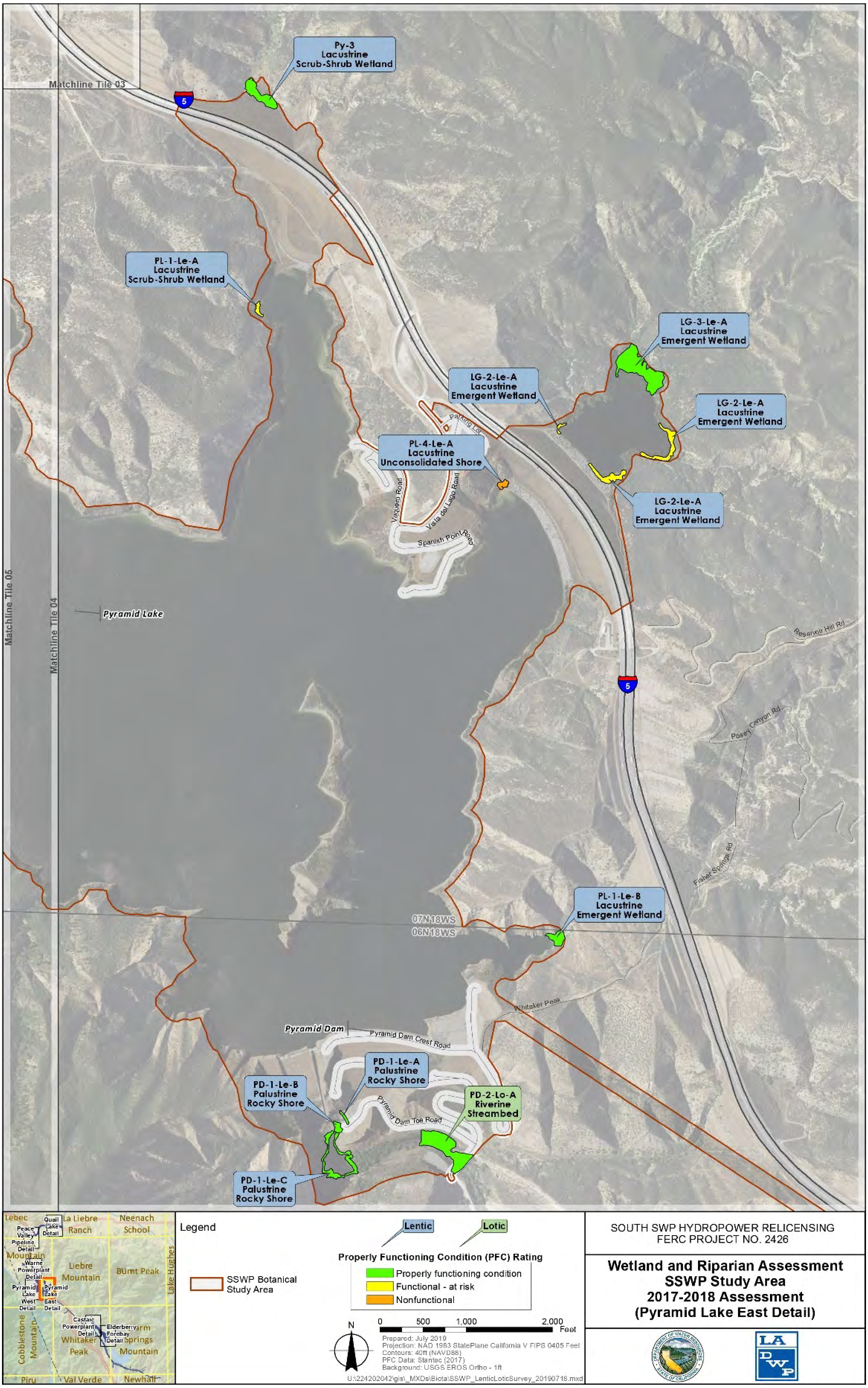

Figure 5.4.2-14. 2017-2018 Wetland and Riparian Assessment – Pyramid Lake East Detail

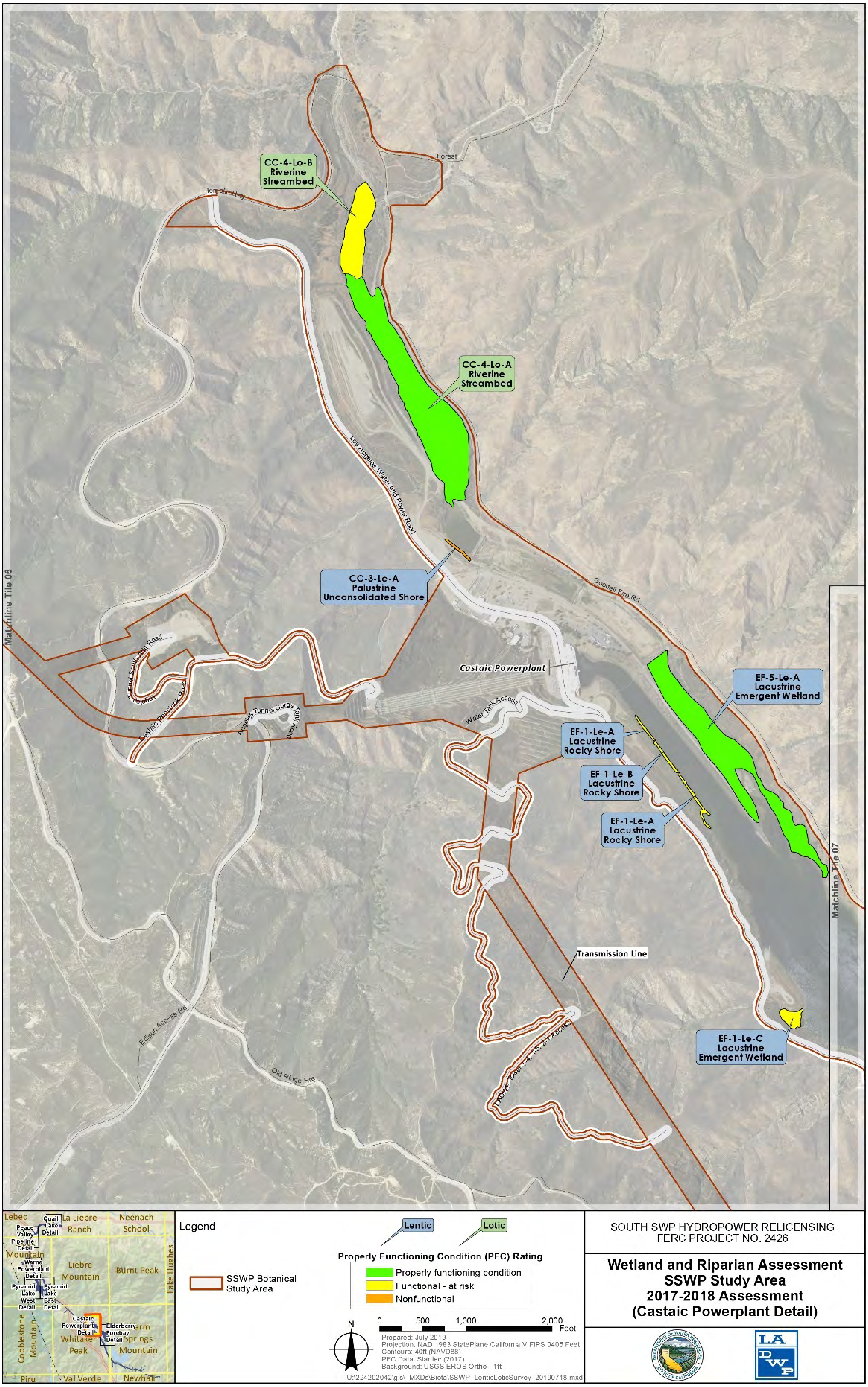

Figure 5.4.2-15. 2017-2018 Wetland and Riparian Assessment – Castaic Powerplant Detail

Figure 5.4.2-16. 2017-2018 Wetland and Riparian Assessment – Elderberry Forebay Detail

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Table 5.4.2-2. Lotic Features Observed During 2017 and 2018 Field Surveys

Feature ID	Location	Functional Assessment	Wetland System (Cowardin)	Wetland Class (Cowardin)	Water Regime (Cowardin)	Basis for Conclusion	Land Ownership	Area (acres)
CC-4-Lo-A	Castaic Creek	Proper functioning condition	Riverine	Streambed	Permanently flooded	Hydrologic, vegetative, and geomorphic conditions appear stable	State lands	22.37
CC-4-Lo-B	Castaic Creek	Functional at risk	Riverine	Streambed	Intermittently flooded	No significant scouring, erosion, or sediment deposition in system; at risk of excessive sedimentation	State lands	5.81
GC-1-Lo-A	Gorman Creek	Proper functioning condition	Riverine	Streambed	Semi-permanently flooded	Hydrologic, vegetative, and geomorphic conditions appear stable	State lands	12.54
GC-1-Lo-B	Gorman Creek	Proper functioning condition	Riverine	Riverine	Semi-permanently flooded	Hydrologic, vegetative, and geomorphic conditions appear stable	State lands	26.96
GC-2-Lo-A	Gorman Creek	Proper functioning condition	Riverine	Streambed	Permanently flooded	Hydrologic, vegetative, and geomorphic conditions appear stable	State lands	2.85
PD-2-Lo-A	Pyramid Reach	Proper functioning condition	Riverine	Streambed	Permanently flooded	Hydrologic, vegetative, and geomorphic conditions appear stable	NFS	2.40
PL-1-Lo-C	Pyramid Lake	Proper functioning condition	Riverine	Streambed	Permanently flooded	Hydrologic, vegetative, and geomorphic conditions appear stable	NFS	0.33

Table 5.4.2-2. Lotic Features Observed During 2017 and 2018 Field Surveys (continued)

Feature ID	Location	Functional Assessment	Wetland System (Cowardin)	Wetland Class (Cowardin)	Water Regime (Cowardin)	Basis for Conclusion	Land Ownership	Area (acres)
PL-10-Lo-A	Pyramid Lake	Functional at risk	Riverine	Rock Bottom	Permanently flooded	Geomorphology is a result of channelization; area likely to be maintained; this may eliminate structure such as natural debris buildup	NFS	1.01
Py-UpperPiru-1	Pyramid Lake	Proper functioning condition	Riverine	Forested	Flowing	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	4.16

Lentic Features

Twenty-two lentic areas were identified and assessed in the 2017 and 2018 surveys. The areas identified included several disjunct areas that were similar and close in proximity, but not connected (e.g., areas of cattail marsh that were similar in structure and composition, but separated by a different type of vegetation or shoreline structure). Disjunct features in proximity were combined into a single feature for purposes of analysis and reporting. These twenty-two features are summarized in Table 5.4.2-3 and are displayed in Figures 5.4.2-10 through 5.4.2-16. Ten features were found to have “Proper functioning condition,” eight “Functional – at risk,” and four “Nonfunctional.” Areas were determined to be “Functional – at risk” or “Nonfunctional” for a variety of reasons, including limited vegetative structure and riprapped shorelines. Of the features that were categorized as either “Functional – at risk” or “Nonfunctional,” it was determined that in all but three features the characteristics were not due to existing Project operations and were not created from conditions attributable to Project operations. However, the “Functional – at risk” characteristics of three features at Elderberry Forebay – EF-1-Le-A, EF-1-Le-B, and EF-1-Le-C – were most likely due to ongoing effects of the Project, as determined by the survey data, with the details described below.

Project Effects of Features Identified in Field Survey Results

Lotic Features at Gorman Creek (GC-1-Lo-A, GC-1-Lo-B, and GC-2-Lo-A) are subject to minor impacts from ongoing effects due to infrequent operations of the Gorman Bypass Channel, the canals, and Project roads. Minor amounts of local precipitation, in the form of overland flow or flooding, are directed away from natural drainages by Project canals and Project roads. Due to the quality of wetlands at GC-1-Lo-A, GC-1-Lo-B, and GC-2-Lo-A, which exhibited “Proper Functioning Condition,” these effects were determined to be minor and not significant.

In addition, ongoing effects at Gorman Creek are having minor impacts on PL-10-Lo-A, a lotic feature adjacent to the Gorman Creek inlet at Pyramid Lake. Although PL-10-Lo-A was determined to be “Functional – at risk,” this determination was based on the channelization of the wetland and its limited ability to dissipate energy. The characteristics that qualify PL-10-Lo-A as “Functional – at risk” were determined to not be a function of existing Project operations.

Lentic Features EF-1-Le-A, EF-1-Le-B, and EF-1-Le-C have fluctuating water levels due to existing Project operations. Observations of riparian vegetation during field surveys indicated vegetation in these areas is suppressed due to fluctuating water surface elevations. Although lake levels also fluctuate at Pyramid Lake and Quail Lake, the lentic features in those areas were all shown to have “Proper Functioning Condition.” This observation implies that these features are not as greatly impacted from surface water level fluctuations and do not show the lack of vigor in riparian vegetation compared to those at Elderberry Forebay.

Table 5.4.2-3. Lentic Features Observed During 2017 and 2018 Field Surveys

Feature ID	Location	Functional Assessment	Wetland System (Cowardin)	Wetland Class (Cowardin)	Water Regime (Cowardin)	Basis for Conclusion	Land Ownership	Area (acres)
CC-3-Le-A	Castaic Creek	Nonfunctional	Palustrine	Unconsolidated Shore	Ponded	Flow patterns altered by disturbance, structure does not accommodate safe passage of flows, lack of structure, diversity in riparian-wetland vegetation, lack of shoreline structure, excessive erosion	State lands	0.17
EF-1-Le-A	Elderberry Forebay	Functional - at risk	Lacustrine	Rocky Shore	Ponded	Fluctuation of water levels, flow patterns altered by disturbance, lack of vigor in riparian-wetland vegetation	State lands	0.45
EF-1-Le-B	Elderberry Forebay	Functional - at risk	Lacustrine	Rocky Shore	Ponded	Fluctuation of water levels, flow patterns altered by disturbance, lack of vigor in riparian-wetland vegetation	State lands	1.07
EF-1-Le-C	Elderberry Forebay	Functional - at risk	Lacustrine	Emergent Wetland	Ponded	Fluctuation of water levels, flow patterns altered by disturbance, lack of vigor in riparian-wetland vegetation	State lands	5.16
EF-4-Le-A	Elderberry Forebay	Proper functioning condition	Lacustrine	Emergent Wetland	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	State lands	6.27

Table 5.4.2-3. Lentic Features Observed During 2017 and 2018 Field Surveys (continued)

Feature ID	Location	Functional Assessment	Wetland System (Cowardin)	Wetland Class (Cowardin)	Water Regime (Cowardin)	Basis for Conclusion	Land Ownership	Area (acres)
EF-5-Le-A	Elderberry Forebay	Proper functioning condition	Lacustrine	Emergent Wetland	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	State lands	16.23
LG-2-Le-A	Liebre Gulch	Functional - at risk	Lacustrine	Emergent Wetland	Ponded	Lack of structure and diversity of riparian-wetland vegetation	NFS	1.28
LG-3-Le-A	Liebre Gulch	Proper functioning condition	Lacustrine	Emergent Wetland	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	2.79
PD-1-Le-A	Pyramid Reach	Proper functioning condition	Palustrine	Rocky Shore	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	0.07
PD-1-Le-B	Pyramid Reach	Proper functioning condition	Palustrine	Rocky Shore	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	0.18
PD-1-Le-C	Pyramid Reach	Proper functioning condition	Palustrine	Rocky Shore	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	0.85
PL-1-Le-A	Pyramid Lake	Functional - at risk	Lacustrine	Scrub-Shrub Wetland	Ponded	Lack of diversity in riparian-wetland vegetation, and lack of energy dissipation in system	NFS	0.12

Table 5.4.2-3. Lentic Features Observed During 2017 and 2018 Field Surveys (continued)

Feature ID	Location	Functional Assessment	Wetland System (Cowardin)	Wetland Class (Cowardin)	Water Regime (Cowardin)	Basis for Conclusion	Land Ownership	Area (acres)
PL-1-Le-B	Pyramid Lake	Proper functioning condition	Lacustrine	Emergent Wetland	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	2.89
PL-1-Le-D	Pyramid Lake	Proper functioning condition	Lacustrine	Emergent Wetland	Ponded	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	7.29
PL-1-Le-E	Pyramid Lake	Functional - at risk	Lacustrine	Scrub-Shrub Wetland	Other	Lack of structure in riparian-wetland vegetation	NFS	1.09
PL-4-Le-A	Pyramid Lake	Nonfunctional	Lacustrine	Unconsolidated Shore	Other	Excessive erosion, natural flow patterns altered by disturbance, inadequate riparian-wetland vegetation to prevent erosion, inadequate soil saturation, inadequate underlying geologic structure, inadequate shoreline structure	NFS	0.17
PL-9-Le-A	Pyramid Lake	Nonfunctional	Lacustrine	Emergent Wetland	Ponded	Continual disturbance by human activities, lack of structure and diversity of riparian vegetation, artificial banks	NFS	0.60
Py-Lake-1	Pyramid Lake	Proper functioning condition	Lacustrine	Forested	Flowing	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	4.39

Table 5.4.2-3. Lentic Features Observed During 2017 and 2018 Field Surveys (continued)

Feature ID	Location	Functional Assessment	Wetland System (Cowardin)	Wetland Class (Cowardin)	Water Regime (Cowardin)	Basis for Conclusion	Land Ownership	Area (acres)
Py-3	Pyramid Lake	Proper functioning condition	Lacustrine	Scrub-shrub	Ephemeral	Hydrologic, vegetative, and erosion/deposition conditions appear to be functioning properly	NFS	0.99
QL-1-Le-A	Quail Lake	Nonfunctional	Lacustrine	Emergent Wetland	Ephemeral	Natural flow patterns altered by disturbance patterns, lack of diversity and vigor in riparian-wetland vegetation, inadequate underlying geologic structure	State lands	0.91
QL-3-Le-A	Quail Lake	Functional - at risk	Palustrine	Emergent Wetland	Ponded	Area is disturbed by recreational use	State lands	17.59
QL-5-Le-A	Quail Lake	Functional - at risk	Lacustrine	Emergent Wetland	Ponded	Inadequate underlying geologic structure	State lands	14.80