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November 26, 2013
VIA ELECTRONIC FILING

FERC Project 2299
California

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington DC 20425

SUBJECT: Don Pedro Hydroelectric Project, FERC Project No. 2299
Filing of Draft License Application

Dear Secretary Bose:

Turlock Irrigation District ("TID") and Modesto Irrigation District ("MID") (collectively, the Districts), co-licensees of the Don Pedro Project, herewith file their Draft License Application ("DLA") in accordance with Federal Energy Regulatory Commission ("Commission") regulations at 18 CFR 5.18. The current license for the Project expires on April 30, 2016.

This DLA filing includes the following:

- **Exhibit A - Project Description** describes the location of the FERC Project Boundary and all Project facilities.

- **Exhibit B - Project Operations and Resource Utilization** describes current operations and the Operations Model base case developed for the relicensing.

- **Exhibit C - Construction History** includes the construction history of the Project.

- **Exhibit D - Statement of Costs and Financing** provides a statement of costs for the Project. Additional detail will be provided with the Final License Application ("FLA").

- **Exhibit E - Environmental Report** is submitted in the format of a draft Applicant Prepared Environmental Assessment. This Exhibit summarizes the existing affected environment and integrates study information from each resource area to provide a comprehensive description of the condition of the resources associated with the Project, and provides environmental analysis of Project effects under current operations.

- **Exhibit F - Project Drawings** contains general arrangement drawings of the existing Project structures and facilities. These drawings will be updated as needed to current FERC drawing guidelines in the FLA. Project drawings are being filed under separate cover as Critical Energy Infrastructure Information.

- **Exhibit G - Project Maps** contains maps of the existing Project Boundary. The maps will be updated to current FERC Exhibit G guidelines in the FLA.

- **Exhibit H - Plans and Ability of Applicant to Operate the Project** contains a description of the need for the electricity provided by the Project, the availability of electrical energy alternatives, and other project-and applicant-related information.

- **Attachment A - Consultation Workshops Record** provides a consolidated record of all the Consultation Workshops notes, comments, and the Districts' responses as filed with the Commission for the six modeling studies conducted during relicensing.

- **Attachment B - Final Study Reports** are being filed concurrently with this DLA for studies that were filed as drafts with the Districts' Initial Study Report on January 19, 2013 and have not required significant revision. If applicable, comments and data requested by relicensing participants related to these studies are documented in the final study reports.

The Districts will be filing the Updated Study Report ("USR") and conducting the USR meeting in January 2014. The USR filing will contain draft reports for studies completed in 2013 and reports of 2012 studies that have been substantially revised to address relicensing participant comments and to incorporate additional analyses completed following the ISR submittal.

If you have any questions about this filing, please contact the undersigned at the addresses or telephone numbers listed below.

Sincerely,

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cc: Relicensing Participants List
Attachment: Don Pedro Project Draft License Application

DON PEDRO PROJECT
FERC NO. 2299

DRAFT LICENSE APPLICATION

TRANSMITTAL LETTER
EXHIBITS A THROUGH H
ATTACHMENT A: CONSULTATION WORKSHOPS RECORD
ATTACHMENT B: FINAL STUDY REPORTS



Prepared by:
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And
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November 2013

DON PEDRO PROJECT
FERC NO. 2299

DRAFT LICENSE APPLICATION

MASTER TABLE OF CONTENTS

Transmittal Letter

Exhibit A **Project Description**

Exhibit B **Project Operations and Resource Utilization**

Appendix B-1 Current License Articles
Appendix B-2 Development of Unimpaired Hydrology
Appendix B-3 1997 to 2012 Historical and Base Case Annual and Monthly Flow Duration Curves
Appendix B-4 Model Description and User's Guide
Appendix B-5 Base Case Project Operations, 1971 to 2012

Exhibit C **Construction History**

Exhibit D **Statement of Costs and Financing**

Exhibit E **Environmental Exhibit**

1.0 Introduction
2.0 Proposed Action and Alternatives
3.0 Environmental Analysis
    3.1 General Description of the Tuolumne River Basin and Don Pedro Project
    3.2 Scope of Cumulative Effects Analysis
    3.3 Geology and Soils
    3.4 Water Resources
    3.5 Fish and Aquatic Resources
    3.6 Botanical Resources
    3.7 Wildlife Resources
    3.8 Threatened and Endangered Species
    3.9 Recreation, Land Use, and Shoreline Management
    3.10 Aesthetic Resources
    3.11 Cultural Resources
    3.12 Socioeconomic Resources
4.0 Cumulative Effects Analysis
5.0 Development Analysis
6.0 Conclusions and Recommendations
7.0 References

Exhibit F **General Design Drawings (*Critical Energy Infrastructure Information [CEII]; Not to be Released to the Public)***

Exhibit G **Project Maps**

Exhibit H **Plans and Ability of Applicant to Operate the Project**

Appendix H-1 Fourth Agreement
Appendix H-2 Single Line Diagram (***Contains Critical Energy Infrastructure Information [CEII]; Not to be Released to the Public***)

Appendix H-3 1972 Army Corps of Engineers Flood Control Manual
Appendix H-4 Don Pedro Recreation Agency Regulations & Ordinances

Attachment A –Consultation Workshops Record

Attachment B – Final Study Reports

RR-04 Visual Quality
TR-01 Special-Status Plants
TR-02 Endangered Species Act & California Endangered Species Act-Listed Plants
TR-03 Wetland Habitats Associated with Don Pedro Reservoir
TR-04 Noxious Weeds
TR-05 Endangered Species Act-Listed Wildlife – Valley Elderberry Longhorn Beetle
TR-06 Special-Status Amphibians and Reptiles
TR-07 Endangered Species Act-Listed Amphibians – California Red-Legged Frog
TR-08 Endangered Species Act-Listed Amphibians – California Tiger Salamander
TR-09 Special-Status Wildlife-Bats
W&AR-01 Water Quality Assessment
W&AR-05 Salmonid Population Information Integration and Synthesis
W&AR-13 Fish Assemblage and Population Between Don Pedro dam and La Grange Dam
W&AR-17 Don Pedro Reservoir Fish Population Survey
W&AR-18 Sturgeon
W&AR-19 Lower Tuolumne River Riparian Information and Synthesis Study
W&AR-20 *Oncorhynchus Mykiss* Scale Collection and Age Determination
Lower Tuolumne River Instream Flow Study

DON PEDRO PROJECT
FERC NO. 2299

DRAFT LICENSE APPLICATION

EXHIBIT A - PROJECT DESCRIPTION



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November 2013

Table of Contents

List of Tables

List of Figures

List of Acronyms

ac ....acres
ACEC.........................Area of Critical Environmental Concern
ACHP.........................Advisory Council for Historic Preservation
ACOE.........................U.S. Army Corps of Engineers
ADA...........................Americans with Disabilities Act (ADA/ABAAG)
AED ....automated external defibrillator
AF ....acre-feet
AGR...........................agricultural supply
AGS............................Annual Grasslands
ALJ.............................Administrative Law Judge
AMF...........................Adaptive Management Forum
APE............................Area of Potential Effect
APEA.........................Applicant-Prepared Environmental Assessment
ARMR........................Archaeological Resource Management Report
AWQC ....Ambient Water Quality Criteria
BA ....Biological Assessment
BDCP ....Bay-Delta Conservation Plan
BLM...........................U.S. Department of the Interior, Bureau of Land Management
BLM-S ....Bureau of Land Management – Sensitive Species
BMI............................Benthic macroinvertebrates
BMP ....Best Management Practices
BO ....Biological Opinion
BOR ....Bureau of Reclamation
BOW ....Blue Oak Woodland
ºC................................celsius
CalCOFI.....................California Cooperative Oceanic Fisheries Investigations
CalEPPC ....California Exotic Pest Plant Council
CalSPA.......................California Sports Fisherman Association
CAS............................California Academy of Sciences
CBDA ....California Bay-Delta Authority
CCC............................Criterion Continuous Concentrations

CCIC..........................Central California Information Center
CCSF..........................City and County of San Francisco
CCVHJV....................California Central Valley Habitat Joint Venture
CD.............................Compact Disc
CDBW........................California Department of Boating and Waterways
CDEC.........................California Data Exchange Center
CESA.........................California Endangered Species Act
CDFA.........................California Department of Food and Agriculture
CDFG.........................California Department of Fish and Game (as of January 2013, CDFW)
CDFW........................California Department of Fish and Wildlife
CDMG........................California Division of Mines and Geology
CDOF.........................California Department of Finance
CDPH.........................California Department of Public Health
CDPR.........................California Department of Parks and Recreation
CDSOD......................California Division of Safety of Dams
CDWR........................California Department of Water Resources
CE.............................California Endangered Species
CEC...........................California Energy Commission
CEII...........................Critical Energy Infrastructure Information
CEQA.........................California Environmental Quality Act
CESA.........................California Endangered Species Act
CFR...........................Code of Federal Regulations
cfs..............................cubic feet per second
CGS...........................California Geological Survey
cm..............................centimeters
CMAP........................California Monitoring and Assessment Program
CMC..........................Criterion Maximum Concentrations
CNDDB......................California Natural Diversity Database
CNPS.........................California Native Plant Society
CORP.........................California Outdoor Recreation Plan
CPR...........................cardiopulmonary resuscitation
CPUC.........................California Public Utilities Commission
CPUE.........................Catch Per Unit Effort

CRAM........................California Rapid Assessment Method
CRC............................Chamise-Redshank Chaparral
CRLF..........................California Red-Legged Frog
CRRF ....California Rivers Restoration Fund
CSAS..........................Central Sierra Audubon Society
CSBP..........................California Stream Bioassessment Procedure
CSU............................California State University
CT ....California Threatened Species
CTR............................California Toxics Rule
CTS ....California Tiger Salamander
CVP............................Central Valley Project
CVRWQCB ....Central Valley Regional Water Quality Control Board
CWA ....Clean Water Act
CWD ....Chowchilla Water District
CWHR........................California Wildlife Habitat Relationship
CZMA ....Coastal Zone Management Act
DDT ....dichlorodiphenyltrichloroethane
Districts......................Turlock Irrigation District and Modesto Irrigation District
DLA ....Draft License Application
DO..............................Dissolved Oxygen
DOI ....Department of Interior
DPRA.........................Don Pedro Recreation Agency
DPS ....Distinct Population Segment
DSE............................Chief Dam Safety Engineer
EA ....Environmental Assessment
EBMUD ....East Bay Municipal Utilities District
EC ....Electrical Conductivity
EFH............................Essential Fish Habitat
EIR ....Environmental Impact Report
EIS..............................Environmental Impact Statement
EL...............................Elevation
ENID..........................El Nido Irrigation District
ENSO ....El Niño Southern Oscillation

EPA............................U.S. Environmental Protection Agency
ESA............................Federal Endangered Species Act
ESRCD.......................East Stanislaus Resource Conservation District
ESU............................Evolutionary Significant Unit
EVC............................Existing Visual Condition
EWUA........................Effective Weighted Useable Area
°F...............................fahrenheit
FERC..........................Federal Energy Regulatory Commission
FFS.............................Foothills Fault System
FL...............................Fork length
FLA............................Final License Application
FMP............................Fishery Management Plan
FMU...........................Fire Management Unit
FOT............................Friends of the Tuolumne
FPA............................Federal Power Act
FPC............................Federal Power Commission
FPPA..........................Federal Plant Protection Act
ft................................feet
ft/mi...........................feet per mile
FWCA........................Fish and Wildlife Coordination Act
FWUA........................Friant Water Users Authority
FYLF..........................Foothill Yellow-Legged Frog
g.................................grams
GIS.............................Geographic Information System
GLO...........................General Land Office
GORP.........................Great Outdoor Recreation Pages
GPS............................Global Positioning System
HCP............................Habitat Conservation Plan
HSC............................Habitat Suitability Criteria
HHWP........................Hetch Hetchy Water and Power
HORB........................Head of Old River Barrier
hp...............................horsepower
HPMP.........................Historic Properties Management Plan

IFIM ....Instream Flow Incremental Methodology
ILP.............................Integrated Licensing Process
in ....inches
ISR ....Initial Study Report
ITA ....Indian Trust Assets
IUCN..........................International Union for the Conservation of Nature
KOPs..........................Key Observation Points
kV..............................kilovolt
KVA ....kilowatt-amps
kW.............................kilowatt
LTAM ....Ladenburg Thalmann Asset Management
LWD ....large woody debris
m ....meters
mm ....millimeter
M&I...........................Municipal and Industrial
MCL ....Maximum Contaminant Level
mg/kg ....milligrams/kilogram
mg/L..........................milligrams per liter
mgd ....million gallons per day
MGR ....Migration of Aquatic Organisms
MHW ....Montane Hardwood
mi ....miles
mi^2.............................square miles
MID...........................Modesto Irrigation District
MOA ....Memorandum of Agreement
MOU ....Memorandum of Understanding
MPN...........................Most Probable Number
MPR ....market price referents
MSCS.........................Multi-Species Conservation Strategy
msl.............................mean sea level
MUN ....municipal and domestic supply
MVA ....Megavolt Ampere
MW ....megawatt

MWh ....megawatt hour
mya............................million years ago
NAE ....National Academy of Engineering
NAHC ....Native American Heritage Commission
NAS............................National Academy of Sciences
NAVD 88 ....North American Vertical Datum of 1988
NAWQA ....National Water Quality Assessment
NCCP ....Natural Community Conservation Plan
NGVD ....National Geodetic Vertical Datum
NEPA ....National Environmental Policy Act
NERC ....North American Electric Reliability Corporation
NGOs ....Non-Governmental Organizations
NHI ....Natural Heritage Institute
NHPA.........................National Historic Preservation Act
NISC ....National Invasive Species Council
NMFS.........................National Marine Fisheries Service
NOAA ....National Oceanic and Atmospheric Administration
NOI ....Notice of Intent
NPS ............................U.S. Department of the Interior, National Park Service
NRCS ....National Resource Conservation Service
NRHP ....National Register of Historic Places
NRI.............................Nationwide Rivers Inventory
NTU ....Nephelometric Turbidity Unit
NWI............................National Wetland Inventory
NWIS ....National Water Information System
NWR ....National Wildlife Refuge
NGVD 29 ....National Geodetic Vertical Datum of 1929
O&M ....operation and maintenance
OEHHA......................Office of Environmental Health Hazard Assessment
OID ....Oakdale Irrigation District
ORV ....Outstanding Remarkable Value
OSHA.........................Occupational Safety and Health Administration
PA ....Programmatic Agreement

PAD............................Pre-Application Document
PDAW........................Project Demand of Applied Water
PDO............................Pacific Decadal Oscillation
PEIR...........................Program Environmental Impact Report
PGA............................Peak Ground Acceleration
PG&E.........................Pacific Gas and Electric
PHABSIM..................Physical Habitat Simulation
PHG............................Public Health Goal
PM&E.........................Protection, Mitigation and Enhancement
PMF............................Probable Maximum Flood
POAOR......................Public Opinions and Attitudes in Outdoor Recreation
ppb..............................parts per billion
ppm ....parts per million
PRISM........................Probabilistic Symbolic Model Checker
PSP.............................Proposed Study Plan
PWA...........................Public Works Administration
QA..............................Quality Assurance
QC..............................Quality Control
RA..............................Recreation Area
RBP............................Rapid Bioassessment Protocol
REC-1 ....water contact recreation
REC-2 ....water non-contact recreation
Reclamation ...............U.S. Department of the Interior, Bureau of Reclamation
RM ....River Mile
RMP...........................Resource Management Plan
RP...............................Relicensing Participant
RPM...........................Rotations per minute
RPS ....Renewable Portfolio Standard
RSP ....Revised Study Plan
RST ....Rotary Screw Trap
RWF...........................Resource-Specific Work Groups
RWG..........................Resource Work Group
RWQCB.....................Regional Water Quality Control Board

SC...............................State candidate for listing under CESA
SCADA......................Supervisory Control and Data Acquistion
SCD............................State candidate for delisting under CESA
SCE ....State candidate for listing as endangered under CESA
SCT ....State candidate for listing as threatened under CESA
SD1 ....Scoping Document 1
SD2 ....Scoping Document 2
SE...............................State Endangered Species under the CESA
SEED..........................U.S. Bureau of Reclamation's Safety Evaluation of Existing Dams
SFP.............................State Fully Protected Species under CESA
SFPUC ....San Francisco Public Utilities Commission
SHPO ....State Historic Preservation Officer
SJRA ....San Joaquin River Agreement
SJRGA ....San Joaquin River Group Authority
SJTA ....San Joaquin River Tributaries Authority
SM..............................Standard Method
SMUD........................Sacramento Municipal Utility District
SPAWN.....................spawning, reproduction and/or early development
SPD ....Study Plan Determination
SRA............................State Recreation Area
SRMA ....Special Recreation Management Area or Sierra Resource Management Area (as per use)
SRMP.........................Sierra Resource Management Plan
SRP ....Special Run Pools
SSC ....State species of special concern
ST...............................California Threatened Species under the CESA
STORET ....Storage and Retrieval
SWAMP.....................Surface Water Ambient Monitoring Program
SWE ....Snow-Water Equivalent
SWP ....State Water Project
SWRCB......................State Water Resources Control Board
TAC............................Technical Advisory Committee
TAF ....thousand acre-feet

TCP ....Traditional Cultural Properties
TCWC........................Tuolumne County Water Company
TDS............................Total Dissolved Solids
TID.............................Turlock Irrigation District
TMDL ....Total Maximum Daily Load
TOC............................Total Organic Carbon
TRT............................Tuolumne River Trust
TRTAC ....Tuolumne River Technical Advisory Committee
UC ....University of California
USBR .........................U.S. Bureau of Reclamation
USDA.........................U.S. Department of Agriculture
USDOC......................U.S. Department of Commerce
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. Department of the Interior, Geological Survey
USR............................Updated Study Report
UTM...........................Universal Transverse Mercator
VAMP ....Vernalis Adaptive Management Plan
VELB ....Valley Elderberry Longhorn Beetle
VES............................visual encounter surveys
VRM ....Visual Resource Management
VRO ....Visual Resource Objective
WBWG ....Western Bat Working Group
WECC........................Western Electricity Coordinating Council
WPA...........................Works Progress Administration
WPT ....Western Pond Turtle
WQCP........................Water Quality Control Plan
WSA...........................Wilderness Study Area
WSIP ....Water System Improvement Program
WSNMB ....Western Sierra Nevada Metamorphic Belt
WUA ....weighted usable area
WWTP ....Wastewater Treatment Plant

WY.............................water year

yd^3..............................cubic yard

yr................................year

µS/cm..........................microSeimens per centimeter

µg/L............................micrograms per liter

µmhos.........................micromhos

EXHIBIT A - PROJECT DESCRIPTION

The following excerpt from the Code of Federal Regulations (CFR) at 18 CFR § 4.51(c) describes the required content of this Exhibit.

Exhibit A is a description of the project. This exhibit need not include information on project works maintained and operated by the U.S. Army Corps of Engineers, the Bureau of Reclamation, or any other department or agency of the United States, except for any project works that are proposed to be altered or modified. If the project includes more than one dam with associated facilities, each dam and the associated component parts must be described together as a discrete development. The description for each development must contain:

(1) The physical composition, dimensions, and general configuration of any dams, spillways, penstocks, powerhouses, tailraces, or other structures, whether existing or proposed, to be included as part of the project;

(2) The normal maximum surface area and normal maximum surface elevation (mean sea level), gross storage capacity, and usable storage capacity of any impoundments to be included as part of the project;

(3) The number, type, and rated capacity of any turbines or generators, whether existing or proposed, to be included as part of the project;

(4) The number, length, voltage, and interconnections of any primary transmission lines, whether existing or proposed, to be included as part of the project (see 16 U.S.C. 796(11));

(5) The specifications of any additional mechanical, electrical, and transmission equipment appurtenant to the project; and

(6) All lands of the United States that are enclosed within the project boundary described under paragraph (h) of this section (Exhibit G), identified and tabulated by legal subdivisions of a public land survey of the affected area or, in the absence of a public land survey, by the best available legal description. The tabulation must show the total acreage of the lands of the United States within the project boundary.

1.0 PROJECT LOCATION

The Don Pedro Project is located on the Tuolumne River in western Tuolumne County, California, along the western slope of the Sierra Nevada. The Project Boundary extends from river mile (RM) 53.2 to approximately RM 80.8 of the Tuolumne River. The Tuolumne River is a tributary to the San Joaquin River, which eventually flows into the Sacramento-San Joaquin River Delta, thence to San Francisco Bay. The Project lies about 40 miles east of the City of Modesto and 26 miles northeast of the City of Turlock. A portion of the Project occupies United States land, administered by the United States Department of Interior (USDOI) Bureau of Land Management (BLM) as part of the Sierra Resource Management Area. All other lands within the Project Boundary are owned jointly by TID and MID.

The Don Pedro powerhouse and its electrical switchyard are located immediately downstream of the dam at RM 54.6. The Don Pedro Reservoir has a normal maximum water surface elevation[1] of 830 feet (ft) above mean sea level. The Project Boundary at the upper end of the reservoir generally follows the 845 ft contour line and extends to RM 80.8. The spillway design flood elevation is 852 ft. The drainage area of the Tuolumne River at Don Pedro Dam is approximately 1,533 square miles (mi^2) (ACOE 1972).

The Don Pedro Project was formerly referred to as the New Don Pedro Project (and the Don Pedro Dam was referred to as the New Don Pedro Dam) because it displaced the original, smaller Don Pedro Dam and powerhouse, which was located approximately 1.5 miles upstream of the current dam. The old Don Pedro Dam remains in place.

Figure 1.0-1 provides general location map of the Project within the larger San Joaquin River watershed and Figure 1.0-2 provides a detailed view of the Project vicinity and facilities.

[1] All elevations provided in the Draft License Application are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

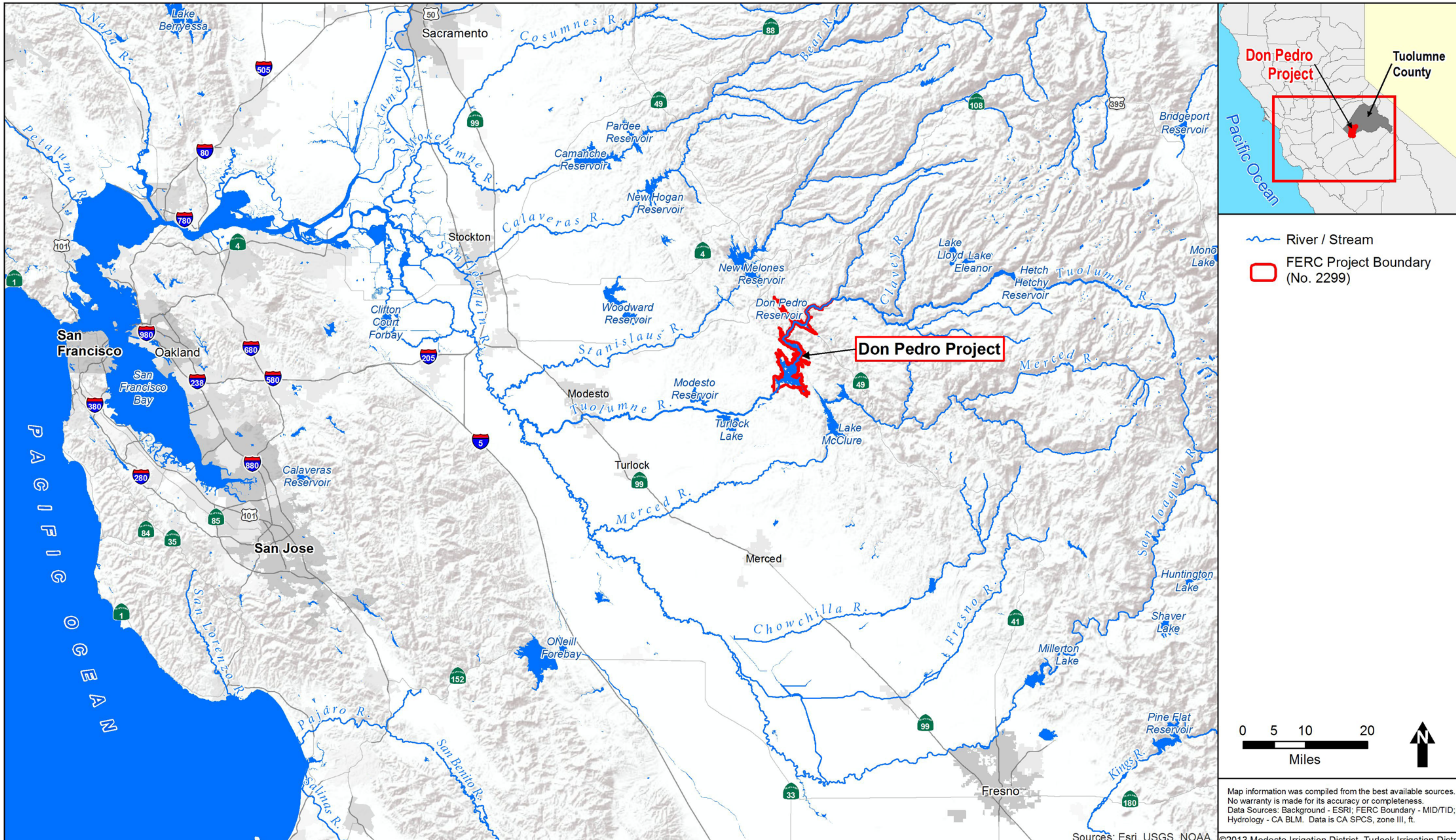

Figure 1.0-1. General map of the San Joaquin River basin and location of Don Pedro Project.

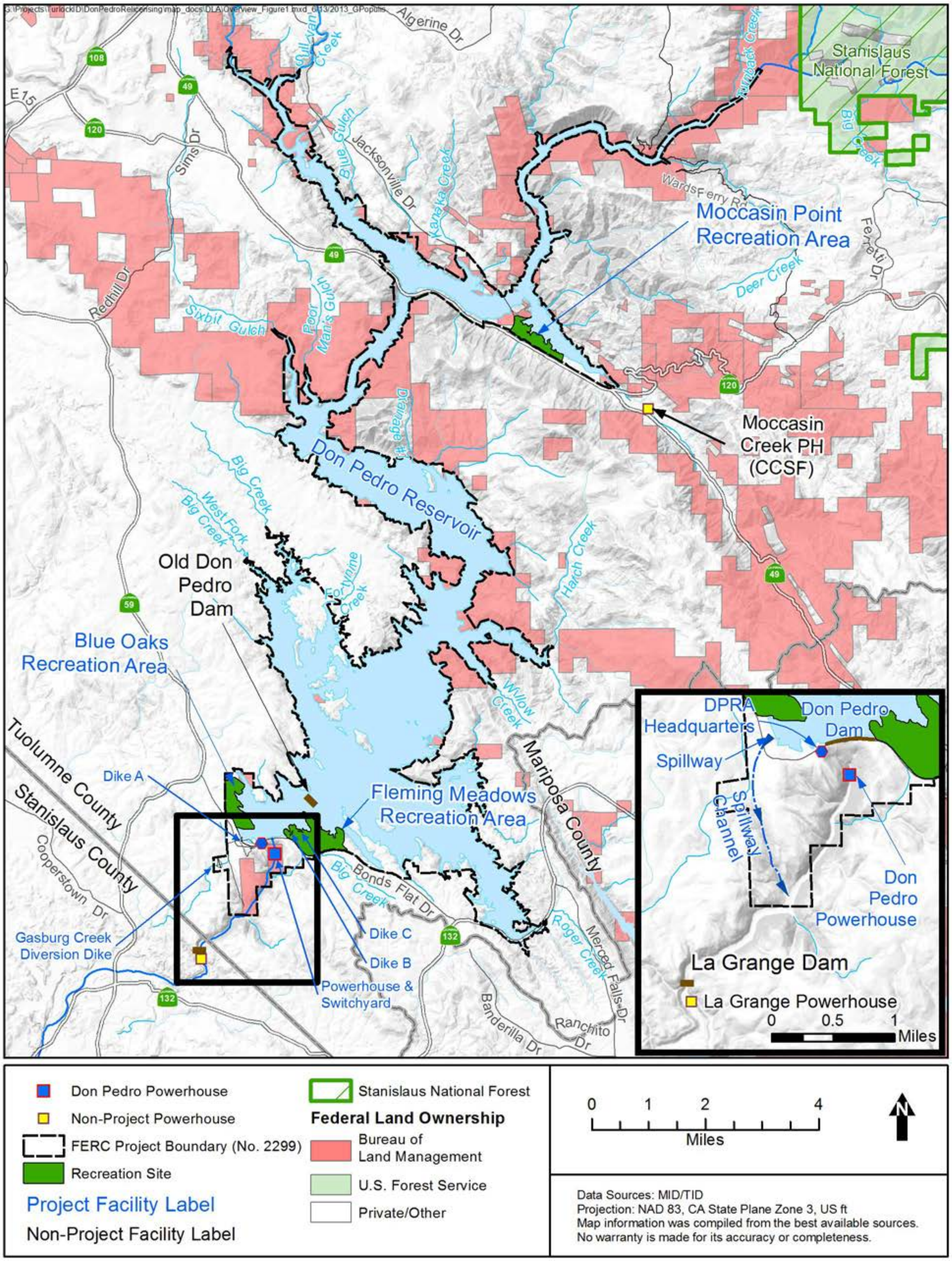

Figure 1.0-2. Don Pedro Project site location map.

2.0 PROJECT FACILITIES

On March 10, 1964, the Federal Power Commission, predecessor to FERC, granted the Districts an initial license to construct and operate the New Don Pedro Project. This initial license has a term that expires on April 30, 2016. The construction of the current Don Pedro Dam began in 1967 and commercial operation commenced in 1971. The current Don Pedro Dam was built approximately 1.5 mi downstream of the original, and much smaller, Don Pedro Dam which had been in operation since 1923.

The primary Project facilities include (1) Don Pedro Dam and Reservoir, (2) controlled and uncontrolled spillways on the right (west) abutment of the main dam, (3) controlled outlet works located in the diversion tunnel in the left (east) abutment of the main dam, (4) the power intake and tunnel, also in the left abutment, (5) the Don Pedro powerhouse, (6) the Project switchyard located at the powerhouse, and (7) four dikes—the Gasburg Creek Dike and Dikes A, B, and C. The Project also includes three developed recreation areas and other small recreation facilities (restrooms and buoys) outside of the developed areas. The Project facilities are described in detail below and summarized in Table 2.0-1.

Table 2.0-1. Description of Don Pedro Project facilities and features.

DON PEDRO DAM AND RESERVOIR	
River Mile of dam axis	54.8
Construction Period	1967–1971
Placed in Service	1971
Don Pedro Dam	--
Hazard Classification	High
Type	Zoned embankment with a core and rockfill shells
Maximum Height	Approximately 580 ft
Crest	--
Elevation	El. 855 ft (without camber)
Width	40 ft
Length	1,900 ft
Base	--
Elevation	El. 275 ft
Width	3,000 ft
Slope	--
Upstream Face (Horizontal to Vertical)	Slope varies until El. 725 ft, then 2.4H:1V
Downstream Face (Horizontal to Vertical)	Slope varies until El. 725 ft, then 2.1H:1V
Don Pedro Dam Gated Spillway	--
Type	3 Radial Gates
Crest	--
Elevation	El. 800 ft
Length	135 ft
Control	Three bays each with a 45ft wide by 30ft high radial gate
Hoist Type	Cable
Maximum Discharge	172,500 cfs at water surface el. 850 ft (total spillway discharge)

Don Pedro Dam Ungated Spillway	
Type	Ogee crest
Crest	--
Elevation	El. 830 ft
Length	995 ft
Control	--
Hoist Type	--
Maximum Discharge	300,000 cfs at water surface el. 850 ft (resulting in total spillway capacity of 472,500 cfs at water surface el. 850 ft)
Don Pedro Outlet Works	--
Number, Size, & Control	One tunnel leading to three individual service gates (4 ft by 5 ft slide gates).
Invert Elevation at the intake	El. 342 ft
Outlet Elevation	El. 310 ft
Maximum Capacity	7,500 cfs at water surface el. of 830 ft
Don Pedro Reservoir (under current license)	--
Project Boundary Upstream Water Surface Elevation	El. 845 ft
Normal Maximum Water Surface Elevation	El. 830 ft
Normal Minimum Operating Pool	El. 600 ft
Drainage Area	1,533 mi^2
Gross Storage at Normal Maximum Water Surface Elevation	2,030,000 AF
Usable Storage at el 830 ft	1,721,000 AF
Surface Area at Normal Maximum Water Surface Elevation	12,960 ac
Length (approximate)	26 mi
Width (maximum)	10 mi
Maximum Depth	550 ft
Shoreline Length	160 mi, including islands
DON PEDRO POWERHOUSE	
Don Pedro Powerhouse	**--**
Location	Immediately downstream of Don Pedro Dam, RM 54.6
Placed in Service (Began Commercial Operation)	September 19, 1971
Plant Operation	Automatic
Normal Type of Operation	Store and release
Structure	--
Type	Outdoor, reinforced concrete
Construction Period	1968–1971
Turbine	--
Number of Units	Four
Type	Vertical Francis
Manufacturer	3 Mitsubishi; 1 Toshiba.
Maximum Output[1]	3@ 85,000 hp; 1@ 54,000 hp
Nameplate Output	3@ 77,700 hp at 450 ft gross head; 1@ 42,000 hp at 425 ft gross head
Maximum Gross Head	3@ 531 ft; 1@ 500 ft
Speed	3@ 277 RPM; 1@ 450 RPM
Nameplate Rated Flow	3@ 1,641 cfs at 450 ft gross head; 1@ 924 cfs at 425 ft gross head
Distributor Centerline Elevation	3@ 299.0 ft; 1@ 330.0 ft

Generator	--
Type	3 phase synchronous generator
Manufacturer	Toshiba
Nameplate Output	3@ 47,900 KVA; 1@ 38,200 KVA
Nameplate Capability	3@ 45,500 kW; 1@ 34,380 kW
Power Factor	3@ 0.95; 1@ 0.90
Voltage	13,800 Volts
Speed	3@ 277 RPM; 1@ 450 RPM
Governor	--
Type	Hydraulic power control unit
Manufacturer	3 Woodward; 1 Toshiba

[1] hp = horsepower

2.1 Don Pedro Dam

The Don Pedro Dam is a 1,900 ft long and 580 ft high zoned earth and rockfill structure. The top of the dam is at elevation 855 ft. The drainage area of the Tuolumne River upstream of the Don Pedro Dam is 1,533 mi^2 (ACOE 1972). The dam has a top width of 40 ft and a bottom width of approximately 3,000 ft. The downstream slope is grass-covered and the upstream slope has riprap protection down to elevation 585 ft. A secured access road is provided along the top of the dam for use by the Districts' personnel.

Figure 2.1-1. Photograph of Don Pedro Dam - downstream slope.

2.2 Don Pedro Reservoir

The Don Pedro Reservoir extends upstream for approximately 24 miles at the normal maximum water surface elevation of 830 ft and 26 miles at the Project Boundary elevation of 845 ft. The surface area of the reservoir at the 830 ft elevation is approximately 12,960 ac and the gross storage capacity is 2,030,000 acre-feet (AF). The Don Pedro Reservoir shoreline, including the numerous islands within the lake (at normal maximum water surface elevation) is approximately 160 mile long. Under the current license, the minimum operating pool elevation is 600 ft. Water storage below this elevation is approximately 309,000 AF. The old Don Pedro Dam, which was displaced by the construction of the new Don Pedro Dam, is located approximately 1.5 miles upstream of new Don Pedro Dam at approximately RM 56.4. The normal maximum water level of the old Don Pedro Dam was approximately at elevation 606 ft and contained 309,000 AF of storage. The old Don Pedro Dam remains in place with its twelve sluice gates open. The permanent spillway crest of the old Don Pedro Dam was at approximate elevation 597 ft and was topped by nine-foot-high gates, which were removed.

2.3 Don Pedro Spillway

The Don Pedro spillway includes a gated and ungated section, located adjacent to one another in a saddle area west of, and separated from, the main dam. The gated spillway section is 135 ft long, with a permanent crest elevation of 800 ft, and includes three radial gates each 45-feet-wide by 30 ft high. The radial gates are operated by motor-driven cables. A travel way is provided over the gated spillway along a top deck at elevation 855 ft. Gate trunnions are located at elevation 810 ft. The ungated spillway is an ogee crest section 995 ft long with a permanent crest elevation of 830 ft and a top of abutment elevation of 855 ft. The total spillway capacity at a reservoir water level of 850 ft is 472,500 cubic feet per second (cfs) (TID/MID 2006). Flow over the ungated ogee crest section of the spillway has occurred only once since Project construction, during the New Year’s 1997 flood. Flows over the spillway are released into Gasburg Creek, which in turn flows into Twin Gulch, and then back into the Tuolumne River approximately 1.5 miles downstream of the main dam. The spillway is founded on bedrock. The spillway channel runs into Twin Gulch which primarily consists of bedrock and large boulders. The spillway gate structure is shown in Figure 2.3-1.

Figure 2.3-1. Don Pedro spillway gate structure.

2.4 Outlet Works

Low level outlet works for the Project are located at the left (east) abutment of the main dam. The outlet works consist of three individual service gate housings, each containing 4-foot-wide by 5-foot-high slide gates. The outlet works are situated in a 3,500 ft long concrete lined tunnel, a portion of which originally served as the water diversion tunnel during Project construction. The original water diversion tunnel had an inlet elevation centerline of 315 ft. At the completion of construction, the original inlet was fitted with a concrete plug and a new 12 ft diameter inlet was constructed with an inlet invert of 342 ft. The diversion tunnel downstream of the new inlet was fitted with the three bonnetted slide gates (Figure 2.4-1). The invert of the three slide gates is at approximate elevation 310 ft. The inlet to the outlet works is provided with a maintenance gate which travels on an inclined gate track. The outlet works tunnel daylights back to the Tuolumne River approximately 400 ft downstream of the powerhouse (Figure 2.4-2). The invert of the outlet works at the river discharge is approximately at elevation 300 ft. At a reservoir water surface elevation of 830 ft, the hydraulic capacity of the three gates constituting the outlet works is 7,500 cfs.

Figure 2.4-1. Don Pedro Dam - gate operators for the low level outlet works slide gates.

Figure 2.4-2. Don Pedro Dam - low level outlet works tunnel discharge.

2.5 Power Intake and Tunnel

Flows are delivered from the reservoir to the powerhouse via a 2,960 ft long power tunnel located in the left (east) abutment of the main dam. The tunnel transitions from an 18 ft 6 inches concrete lined section to a 16 ft steel lined section. Emergency closure can be provided by a 21 ft high by 12 ft wide fixed-wheel gate that is operated from a chamber at the top of the gate shaft located at the left dam abutment (Figure 2.5-1). Flows from the power tunnel are delivered to the four unit powerhouse and a hollow jet bypass control valve in the powerhouse. The inlet to the power tunnel is fitted with trash racks and a hydraulically operated bulkhead gate for tunnel dewatering or emergency closure. The power tunnel invert is at elevation 534 ft, 66 ft below the minimum power pool elevation of 600 ft.

Figure 2.5-1. Don Pedro Dam - power tunnel shaft and gate housing.

2.6 Don Pedro Powerhouse, Turbines, and Generators

Located immediately downstream of the main dam, the reinforced concrete outdoor-type powerhouse contains four turbine generator units and a 72 inches hollow jet valve (Figure 2.6-1). The powerhouse is 171 ft long, 110 ft high and 148 ft wide. It houses four Francis-type turbines direct connected to generator units. Unit performance characteristics are provided in Table 2.6-1 and Table 2.6-2. The current FERC-authorized capacity is 168 megawatt (MW). Combined hydraulic capacity of the four units under the maximum gross operating head of 530 ft is approximately 5,500 cfs. Each of the three original turbines and generators have a rotational speed of 277 revolutions per minute (rpm) and are rated at 77,700 horsepower (hp) and 48 megavolt-amperes (MVA), respectively, at 450 ft of net head. Unit 4 was installed in 1989 after

FERC approved the Districts' amendment to add the fourth unit in February 1987 (38 FERC 61,097). At maximum head, the powerhouse has an output capability of 203 MW at full gate flow supplied to each of the four units.

The powerhouse also contains a 72 in hollow jet valve located in the east end of the powerhouse with a centerline elevation at discharge of 305 ft. The maximum hydraulic capacity of the hollow jet valve is 3,000 cfs. While turbines 1 through 3 discharge directly to the river channel, Unit 4 discharges to the outlet works tunnel approximately 250 ft upstream of the tunnel outlet. Water to Unit 4 is delivered through a bifurcation from the hollow jet valve pipe. With Unit 4 in operation, the hollow jet valve capacity is reduced from 3,000 cfs to 800 cfs.

Access to the powerhouse is via a secured gate located off the Visitor Center parking area. The road provides access directly onto the top deck of the powerhouse at elevation 340 ft. A four ft high parapet wall surrounds the top deck. A two-hook gantry crane sits atop the deck and provides equipment and materials delivery to the powerhouse and maintenance services. The generator floor in the powerhouse is at elevation 323 ft and the turbine floor is at elevation 308 ft.

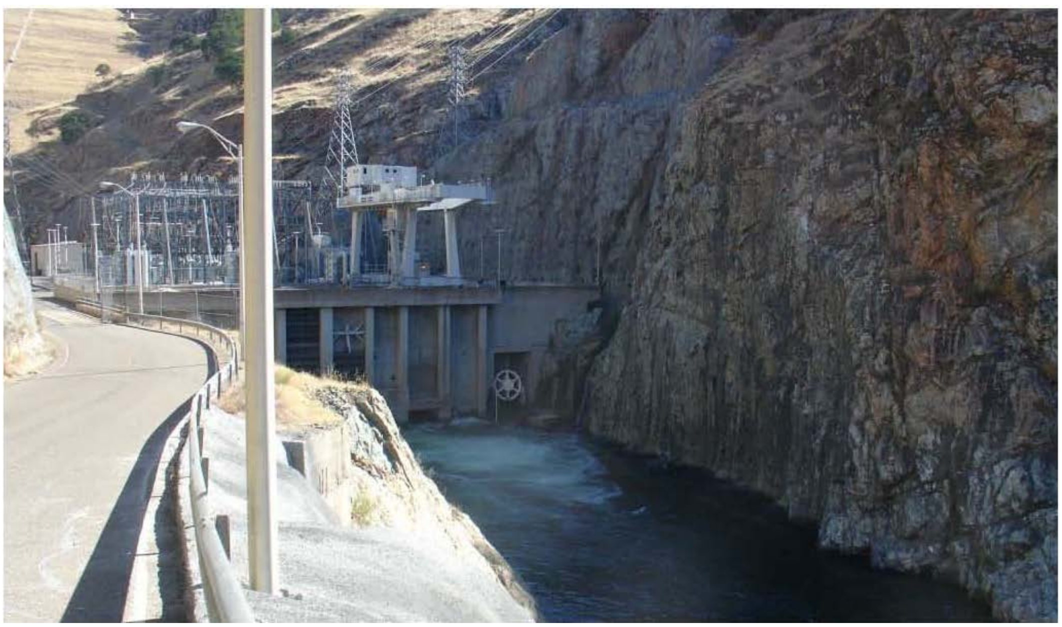

Figure 2.6-1. Don Pedro powerhouse and hollow jet valve viewed from tailwater.

Table 2.6-1. Don Pedro Units 1, 2, and 3 performance characteristics.[1]

Net Head (ft)	Flow (cfs)	Turbine Output (hp)[2]	Generator Output (MW)	Turbine Efficiency
530	545	24,000	17.2	73.5%
530	800	39,000	27.9	81.3%
530	1,000	51,300	36.7	85.6%
530	1,200	65,200	46.7	90.6%
530	1,350	75,000	53.7	92.7%
530	1,510	85,000	60.9	93.9%
450	400	14,500	10.4	71.2%
450	600	24,650	17.6	80.7%

Net Head (ft)	Flow (cfs)	Turbine Output (hp)[2]	Generator Output (MW)	Turbine Efficiency
450	800	34,900	25.0	85.7%
450	1,000	45,550	32.6	89.5%
450	1,200	56,800	40.7	93.0%
450	1,400	67,150	48.1	94.2%
450	1,579	75,000	53.7	93.3%
450[3]	1,641[3]	77,700	55.6	93.0%
375	400	12,350	8.8	72.8%
375	600	20,400	14.6	80.2%
375	800	29,100	20.8	85.8%
375	1,000	38,300	27.4	90.3%
375	1,200	47,300	33.9	92.9%
375	1,400	55,100	39.4	92.8%
375	1,460	56,800	40.7	91.7%

[1] Units can operate at lower flows than indicated in the table
[2] hp = horsepower
[3] Head at nameplate rating.

Table 2.6-2. Don Pedro Unit 4 performance characteristics.[1]

Net Head (ft)	Flow (cfs)	Turbine Output (hp)[2]	Generator Output (MW)	Turbine Efficiency
500	210	6,793	4.4	57.0%
500	485	22,707	16.4	82.5%
500	725	36,618	26.7	89.0%
500	940	50,678	37.0	95.0%
500	1000	53,629	39.2	94.5%
425	185	4,908	3.2	55.0%
425	440	17,404	12.5	82.0%
425	650	27,592	20.1	88.0%
425	850	38,132	27.8	93.0%
425	1010	45,797	33.4	94.0%
425	1155	50,700	37.0	91.0%
275	310	5,080	3.3	52.5%
275	475	10,082	7.0	68.0%
275	625	14,728	10.5	75.5%
275	770	19,587	14.1	81.5%
275	890	22,640	16.4	81.5%

[1] Units can operate at lower flows than indicated in the table
[2] hp = horsepower

2.7 Tailrace

The powerhouse and hollow jet valve discharge directly to the Tuolumne River. Tailwater elevation during turbine operation varies from a low of about 300 ft to a high of about 304 ft under normal operating conditions. The tailwater elevation at the outlet works tunnel is also at approximately 300 ft under low flow conditions.

2.8 Switchyard

The Project switchyard is located atop the powerhouse at elevation 340 ft. The switchyard provides power delivery and electrical protection to the TID and MID transmission systems.

The switchyard includes isolated phase buses, circuit breakers, and four transformers that raise the 13.8 kilovolt (kV) generator voltage to 69 kV transmission voltage. Transformers 1 through 3 are rated at 55 MVA and Unit 4 at 44 MVA. While Units 1, 2, and 4 are directly connected to TID's system and Unit 3 to the MID system, the switchyard has been configured to allow interconnection across the systems when needed. This system, when operating in an interconnected fashion, acts as a pathway for electricity flows across the two systems, providing system benefits to both districts. Recognizing this pathway, the Districts on May 4, 2010 filed a request with FERC to amend the Don Pedro license to remove certain transmission lines from their license. FERC granted the amendment on November 11, 2010 (133 FERC 62,136).

2.9 Gasburg Creek Dike

The spillway structures for Don Pedro Dam discharge into Twin Gulch, a small intermittent drainage which discharges back into the Tuolumne River. To prevent spillway discharges into Twin Gulch from entering the adjacent Gasburg Creek drainage, the Districts constructed the Gasburg Creek Dike. The dike is located in a low saddle that separates Twin Gulch drainage from Gasburg Creek drainage, approximately midway down the Twin Gulch waterway. Gasburg Creek Dike consists of an impervious earth and rock fill dam approximately 75 ft in height, with a slide-gate controlled 18 inches diameter outlet conduit. The top of Gasburg Creek Dike is at elevation 725 ft.

2.10 Dikes A, B, and C

The Project includes three small embankments, Dikes A, B, and C. These embankments are constructed in low saddles on the reservoir rim with top elevations of 855 ft. Dike A is located between the main dam and the spillway. Dikes B and C are located east of the main dam.

2.11 Station Service

Station service power is provided by primary and secondary station service power transformers. The primary unit is a 69kV/12kV step-down transformer that feeds a 12kV line. The 12kV line feeds three secondary 12kV/480kV step-down transformers. The first two secondary transformers service the spillway motor control centers. The third services the powerhouse. There is a 45 kVA diesel generator that serves as an emergency backup for station service power. There is also a portable propane power unit that can power the gate hoists for the radial gates in an emergency.

3.0 EXISTING PROJECT RECREATION FACILITIES

The Project has three developed recreation areas, and primitive and semi-primitive lakeshore camping occurs on much of the rest of its shores (Figure 3.4-1). The Project provides both floating and shoreline restrooms in addition to those at the developed recreation areas. Facilities also include hazard marking, regulatory buoy lines, and other open water-based features including houseboat marinas and a marked water ski slalom course. The recreation facilities included at the Project are operated by the Don Pedro Recreation Agency (DPRA). The DPRA, which is operationally a department within TID, is sponsored and governed by agreement between the Districts and City and County of San Francisco (CCSF). Table 3.4-1 lists the facilities.

3.1 Fleming Meadows Recreation Area

Fleming Meadows Recreation Area is the largest of the Project's developed recreation areas, and lies just east of the main dam at the southwestern portion of the Don Pedro Reservoir referred to as West Bay. The recreation area includes the following facilities and amenities:

- 177 tent campsites,
- 90 full hookup campsites,
- one boat launch facility,
- individual and group picnic areas,
- concessionaire facilities (one houseboat dock, one full-service marina, camp store, snack shack),
- two-acre swimming lagoon and picnic area, and
- restrooms and showers.

3.2 Blue Oaks Recreation Area

The Blue Oaks Recreation Area is located west of the main dam also in the West Bay area. Recreation amenities include:

- 34 partial hookup campsites,
- 161 tent campsites,
- one boat launch facility, and
- concessionaire facilities (including houseboat repair yard).

3.3 Moccasin Point Recreation Area

The Moccasin Point Recreation Area is situated near the upstream end of the reservoir on the southeast trending Moccasin Arm of the reservoir. This recreation area's facilities and amenities include:

- 19 full hookup campsites,
- 77 tent campsites,
- two picnic areas,
- one boat launch ramp, and
- one concessionaire facility and full-service marina.

The Moccasin Point hiking trails provide additional recreation opportunities.

3.4 Boat-in and Dispersed Recreation Areas

In addition to the three developed recreation areas, DPRA operates and maintains one remote, boat-in camping area (Wreck Bay), which consists of six campsites each with a picnic table. DPRA also operates and maintains 15 developed toilet-only facilities, of which 10 are floating toilets and five are dispersed shoreline toilets. The 10 floating toilets are located in the following general locations: Big Creek arm, Gardiner Falls cove, Hatch Creek arm, Middle Bay, Railroad Canyon, Rogers Creek arm, Tuolumne River arm, and Woods Creek arm. Dispersed toilet buildings are located at Graveyard Creek, Lucas Bay, and Mud Flats. The dispersed toilet buildings do not have any roads or parking associated with the facilities.

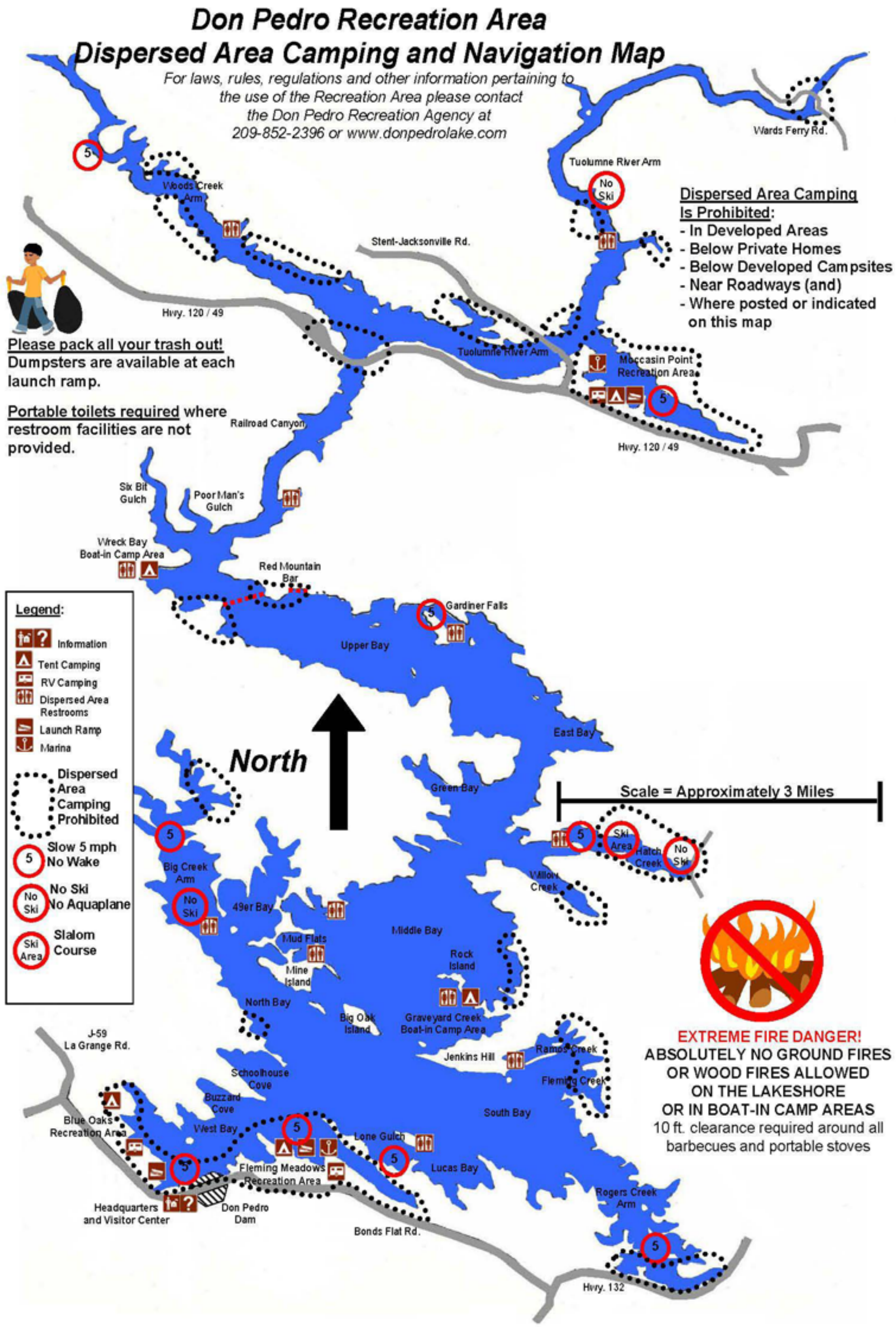

Figure 3.4-1 Don Pedro Project developed recreation facilities.

Table 3.4-1. Summary of recreation facilities and other on-site amenities at Don Pedro Project-developed recreation areas.[1]

Amenities	Moccasin Point Recreation Area	Blue Oaks Recreation Area	Fleming Meadows Recreation Area
Project Recreation Facilities			
Camping Units - Total	96	195	267
With Water and Electric Hookups	18	34	90
Vehicle Parking Spaces with Striped Spaces	256	185	943
ADA Vehicle Parking Spaces	5	3	23
Square Yards of Parking Area without Marked Spaces	513	7,500	52,986
Picnic Areas - Total	2	1	2
Group Picnic Sites	1	1	1
Boat Launch Ramp	1	1	1
Fish Cleaning Stations	1	1	1
Toilet Buildings	8	11	14
Toilet Buildings with Hot Showers	3	5	5
Concession Store	Yes	No	Yes
Swimming Lagoon	No	No	Yes
Marina	Yes	No	Yes
Amphitheatre	No	No	Yes
Houseboat Mooring	Yes	No	Yes
Boat Rentals	Yes	No	Yes
Houseboat Rentals	Yes	No	Yes
Boat Repair Yard	No	Yes	No
Gas and Oil	Yes	No	Yes
Sewage Dump Station	Yes	Yes	Yes

[1] Adapted from RR- 01 Study Report (TID/MID 2013).

4.0 DESCRIPTION OF LANDS WITHIN THE PROJECT BOUNDARY

The existing FERC Project Boundary consists of lands necessary for the safe operations and maintenance of the Project and other purposes, such as recreation, shoreline control, protection of environmental resources. The Tuolumne River watershed covers approximately 1,960 mi^2 upstream of its confluence with the San Joaquin River in the Central Valley of California and approximately 1,533 mi^2 at the Don Pedro Dam. The upper watershed is sparsely populated and is dominated by Yosemite National Park and Stanislaus National Forest lands.

Approximately 14,328 ac, 78 percent of the total 18,370 ac, within the Project Boundary are located on land owned by Modesto and Turlock irrigation districts. The remaining lands, about 4,040 ac, are federal lands located within the Bureau of Land Management (BLM) Sierra Resource Management Area. Much of the 4,040 ac of federal lands are located below the normal maximum water surface elevation (830 ft) of Don Pedro Reservoir. Federal lands within the Project Boundary are designated as withdrawn lands for power purposes (BLM 2008) and are managed by the Districts for Project purposes authorized by FERC.

As noted above, Project recreation facilities are operated by the DPRA. DPRA is responsible for managing the use of all Project lands. The Districts maintain, and DPRA implements, a detailed and extensive land use policy consisting of rules and regulations governing uses of Project lands and waters. The land use rules and regulations prohibit the construction or installation of any land improvements or water access along the Don Pedro shoreline and prohibit motorized off-road vehicle use on Project lands. The end results of the Districts' land use policies are to maintain well over 90 percent of the Don Pedro shoreline in its natural state. This benefits both wildlife and botanical resources.

5.0 LITERATURE CITED

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DON PEDRO PROJECT
FERC NO. 2299

DRAFT LICENSE APPLICATION

EXHIBIT B - PROJECT OPERATIONS AND RESOURCE UTILIZATION



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Table of Contents

Section No.	Description	Page No.

List of Tables

List of Figures

List of Appendices

List of Acronyms

ac ....acres

ACEC.........................Area of Critical Environmental Concern

ACHP.........................Advisory Council for Historic Preservation

ACOE.........................U.S. Army Corps of Engineers

ADA...........................Americans with Disabilities Act (ADA/ABAAG)

AED ....automated external defibrillator

AF ....acre-feet

AGR ....agricultural supply

AGS............................Annual Grasslands

ALJ.............................Administrative Law Judge

AMF ....Adaptive Management Forum

APE ....Area of Potential Effect

APEA ....Applicant-Prepared Environmental Assessment

ARMR........................Archaeological Resource Management Report

AWQC ....Ambient Water Quality Criteria

BA ....Biological Assessment

BDCP ....Bay-Delta Conservation Plan

BLM...........................U.S. Department of the Interior, Bureau of Land Management

BLM-S ....Bureau of Land Management – Sensitive Species

BMI ....Benthic macroinvertebrates

BMP ....Best Management Practices

BO ....Biological Opinion

BOR ....Bureau of Reclamation

BOW ....Blue Oak Woodland

ºC................................celsius

CalCOFI.....................California Cooperative Oceanic Fisheries Investigations

CalEPPC ....California Exotic Pest Plant Council

CalSPA.......................California Sports Fisherman Association

CAS............................California Academy of Sciences

CBDA ....California Bay-Delta Authority

CCC............................Criterion Continuous Concentrations

CCIC ....Central California Information Center

CCSF..........................City and County of San Francisco
CCVHJV....................California Central Valley Habitat Joint Venture
CD..............................Compact Disc
CDBW........................California Department of Boating and Waterways
CDEC.........................California Data Exchange Center
CESA ....California Endangered Species Act
CDFA.........................California Department of Food and Agriculture
CDFG.........................California Department of Fish and Game (as of January 2013, CDFW)
CDFW........................California Department of Fish and Wildlife
CDMG........................California Division of Mines and Geology
CDOF.........................California Department of Finance
CDPH.........................California Department of Public Health
CDPR ....California Department of Parks and Recreation
CDSOD......................California Division of Safety of Dams
CDWR........................California Department of Water Resources
CE ....California Endangered Species
CEC...........................California Energy Commission
CEII...........................Critical Energy Infrastructure Information
CEQA.........................California Environmental Quality Act
CESA ....California Endangered Species Act
CFR...........................Code of Federal Regulations
cfs..............................cubic feet per second
CGS...........................California Geological Survey
cm..............................centimeters
CMAP ....California Monitoring and Assessment Program
CMC..........................Criterion Maximum Concentrations
CNDDB.....................California Natural Diversity Database
CNPS.........................California Native Plant Society
CORP.........................California Outdoor Recreation Plan
CPR...........................cardiopulmonary resuscitation
CPUC.........................California Public Utilities Commission
CPUE ....Catch Per Unit Effort
CRAM........................California Rapid Assessment Method

CRC............................Chamise-Redshank Chaparral
CRLF..........................California Red-Legged Frog
CRRF ....California Rivers Restoration Fund
CSAS..........................Central Sierra Audubon Society
CSBP..........................California Stream Bioassessment Procedure
CSU............................California State University
CT ....California Threatened Species
CTR............................California Toxics Rule
CTS ....California Tiger Salamander
CVP............................Central Valley Project
CVRWQCB ....Central Valley Regional Water Quality Control Board
CWA ....Clean Water Act
CWD ....Chowchilla Water District
CWHR........................California Wildlife Habitat Relationship
CZMA ....Coastal Zone Management Act
DDT ....dichlorodiphenyltrichloroethane
Districts......................Turlock Irrigation District and Modesto Irrigation District
DLA ....Draft License Application
DO..............................Dissolved Oxygen
DOI ....Department of Interior
DPRA.........................Don Pedro Recreation Agency
DPS ....Distinct Population Segment
DSE............................Chief Dam Safety Engineer
EA ....Environmental Assessment
EBMUD ....East Bay Municipal Utilities District
EC ....Electrical Conductivity
EFH............................Essential Fish Habitat
EIR ....Environmental Impact Report
EIS..............................Environmental Impact Statement
EL...............................Elevation
ENID..........................El Nido Irrigation District
ENSO ....El Niño Southern Oscillation
EPA............................U.S. Environmental Protection Agency

ESA............................Federal Endangered Species Act
ESRCD.......................East Stanislaus Resource Conservation District
ESU............................Evolutionary Significant Unit
EVC............................Existing Visual Condition
EWUA........................Effective Weighted Useable Area
°F................................fahrenheit
FERC..........................Federal Energy Regulatory Commission
FFS.............................Foothills Fault System
FL...............................Fork length
FLA............................Final License Application
FMP............................Fishery Management Plan
FMU...........................Fire Management Unit
FOT............................Friends of the Tuolumne
FPA............................Federal Power Act
FPC............................Federal Power Commission
FPPA..........................Federal Plant Protection Act
ft.................................feet
ft/mi...........................feet per mile
FWCA........................Fish and Wildlife Coordination Act
FWUA........................Friant Water Users Authority
FYLF..........................Foothill Yellow-Legged Frog
g..................................grams
GIS.............................Geographic Information System
GLO...........................General Land Office
GORP.........................Great Outdoor Recreation Pages
GPS............................Global Positioning System
HCP............................Habitat Conservation Plan
HSC............................Habitat Suitability Criteria
HHWP........................Hetch Hetchy Water and Power
HORB........................Head of Old River Barrier
hp...............................horsepower
HPMP.........................Historic Properties Management Plan
IFIM...........................Instream Flow Incremental Methodology

ILP............................Integrated Licensing Process
in ....inches
ISR ....Initial Study Report
ITA.............................Indian Trust Assets
IUCN..........................International Union for the Conservation of Nature
KOPs..........................Key Observation Points
kV...............................kilovolt
KVA...........................kilowatt-amps
kW..............................kilowatt
LTAM ....Ladenburg Thalmann Asset Management
LWD ....large woody debris
m ....meters
mm ....millimeter
M&I............................Municipal and Industrial
MCL...........................Maximum Contaminant Level
mg/kg ....milligrams/kilogram
mg/L...........................milligrams per liter
mgd ....million gallons per day
MGR ....Migration of Aquatic Organisms
MHW ....Montane Hardwood
mi ....miles
mi^2..............................square miles
MID............................Modesto Irrigation District
MOA ....Memorandum of Agreement
MOU ....Memorandum of Understanding
MPN...........................Most Probable Number
MPR ....market price referents
MSCS.........................Multi-Species Conservation Strategy
msl..............................mean sea level
MUN ....municipal and domestic supply
MVA ....Megavolt Ampere
MW ....megawatt
MWh ....megawatt hour

mya............................million years ago

NAE ....National Academy of Engineering

NAHC ....Native American Heritage Commission

NAS............................National Academy of Sciences

NAVD 88 ....North American Vertical Datum of 1988

NAWQA ....National Water Quality Assessment

NCCP ....Natural Community Conservation Plan

NGVD ....National Geodetic Vertical Datum

NEPA ....National Environmental Policy Act

NERC.........................North American Electric Reliability Corporation

NGOs ....Non-Governmental Organizations

NHI ....Natural Heritage Institute

NHPA.........................National Historic Preservation Act

NISC ....National Invasive Species Council

NMFS.........................National Marine Fisheries Service

NOAA ....National Oceanic and Atmospheric Administration

NOI ....Notice of Intent

NPS ............................U.S. Department of the Interior, National Park Service

NRCS ....National Resource Conservation Service

NRHP.........................National Register of Historic Places

NRI............................Nationwide Rivers Inventory

NTU ....Nephelometric Turbidity Unit

NWI............................National Wetland Inventory

NWIS ....National Water Information System

NWR ....National Wildlife Refuge

NGVD 29 ....National Geodetic Vertical Datum of 1929

O&M ....operation and maintenance

OEHHA......................Office of Environmental Health Hazard Assessment

OID ....Oakdale Irrigation District

ORV ....Outstanding Remarkable Value

OSHA.........................Occupational Safety and Health Administration

PA ....Programmatic Agreement

PAD............................Pre-Application Document

PDAW........................Project Demand of Applied Water
PDO............................Pacific Decadal Oscillation
PEIR...........................Program Environmental Impact Report
PGA............................Peak Ground Acceleration
PG&E.........................Pacific Gas and Electric
PHABSIM.................Physical Habitat Simulation
PHG............................Public Health Goal
PM&E ....Protection, Mitigation and Enhancement
PMF............................Probable Maximum Flood
POAOR......................Public Opinions and Attitudes in Outdoor Recreation
ppb..............................parts per billion
ppm ....parts per million
PRISM........................Probabilistic Symbolic Model Checker
PSP.............................Proposed Study Plan
PWA...........................Public Works Administration
QA..............................Quality Assurance
QC..............................Quality Control
RA..............................Recreation Area
RBP............................Rapid Bioassessment Protocol
REC-1 ....water contact recreation
REC-2 ....water non-contact recreation
Reclamation ...............U.S. Department of the Interior, Bureau of Reclamation
RM.............................River Mile
RMP...........................Resource Management Plan
RP...............................Relicensing Participant
RPM...........................Rotations per minute
RPS ....Renewable Portfolio Standard
RSP ....Revised Study Plan
RST ....Rotary Screw Trap
RWF...........................Resource-Specific Work Groups
RWG..........................Resource Work Group
RWQCB.....................Regional Water Quality Control Board
SC...............................State candidate for listing under CESA

SCADA.......................Supervisory Control and Data Acquistion
SCD............................State candidate for delisting under CESA
SCE ....State candidate for listing as endangered under CESA
SCT ....State candidate for listing as threatened under CESA
SD1 ....Scoping Document 1
SD2 ....Scoping Document 2
SE...............................State Endangered Species under the CESA
SEED..........................U.S. Bureau of Reclamation’s Safety Evaluation of Existing Dams
SFP.............................State Fully Protected Species under CESA
SFPUC ....San Francisco Public Utilities Commission
SHPO ....State Historic Preservation Officer
SJRA ....San Joaquin River Agreement
SJRGA ....San Joaquin River Group Authority
SJTA ....San Joaquin River Tributaries Authority
SM..............................Standard Method
SMUD........................Sacramento Municipal Utility District
SPAWN.....................spawning, reproduction and/or early development
SPD ....Study Plan Determination
SRA............................State Recreation Area
SRMA ....Special Recreation Management Area or Sierra Resource Management Area (as per use)
SRMP.........................Sierra Resource Management Plan
SRP ....Special Run Pools
SSC ....State species of special concern
ST...............................California Threatened Species under the CESA
STORET ....Storage and Retrieval
SWAMP.....................Surface Water Ambient Monitoring Program
SWE...........................Snow-Water Equivalent
SWP ....State Water Project
SWRCB......................State Water Resources Control Board
TAC............................Technical Advisory Committee
TAF............................thousand acre-feet
TCP ....Traditional Cultural Properties

TCWC........................Tuolumne County Water Company

TDS...........................Total Dissolved Solids

TID............................Turlock Irrigation District

TMDL........................Total Maximum Daily Load

TOC...........................Total Organic Carbon

TRT...........................Tuolumne River Trust

TRTAC......................Tuolumne River Technical Advisory Committee

UC.............................University of California

USBR.........................U.S. Bureau of Reclamation

USDA.........................U.S. Department of Agriculture

USDOC......................U.S. Department of Commerce

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. Department of the Interior, Geological Survey

USR...........................Updated Study Report

UTM..........................Universal Transverse Mercator

VAMP........................Vernalis Adaptive Management Plan

VELB.........................Valley Elderberry Longhorn Beetle

VES...........................visual encounter surveys

VRM..........................Visual Resource Management

VRO...........................Visual Resource Objective

WBWG......................Western Bat Working Group

WECC........................Western Electricity Coordinating Council

WPA..........................Works Progress Administration

WPT...........................Western Pond Turtle

WQCP........................Water Quality Control Plan

WSA..........................Wilderness Study Area

WSIP..........................Water System Improvement Program

WSNMB....................Western Sierra Nevada Metamorphic Belt

WUA..........................weighted usable area

WWTP.......................Wastewater Treatment Plant

WY............................water year

yd^3 ....cubic yard

yr ....year

µS/cm ....microSeimens per centimeter

µg/L............................micrograms per liter

µmhos.........................micromhos

EXHIBIT B - PROJECT OPERATIONS AND RESOURCE UTILIZATION

The following excerpt from the Code of Federal Regulations (CFR) at 18 CFR § 4.51(c) describes the required content of this Exhibit.

Exhibit B is a statement of project operation and resource utilization. If the project includes more than one dam with associated facilities, the information must be provided separately for each such discrete development. The exhibit must contain:

(1) A statement whether operation of the powerplant will be manual or automatic, an estimate of the annual plant factor, and a statement of how the project will be operated during adverse, mean, and high water years;

(2) An estimate of the dependable capacity and average annual energy production in kilowatt-hours (or a mechanical equivalent), supported by the following data:

- *(i) The minimum, mean, and maximum recorded flows in cubic feet per second of the stream or other body of water at the powerplant intake or point of diversion, with a specification of any adjustments made for evaporation, leakage, minimum flow releases (including duration of releases), or other reductions in available flow; monthly flow duration curves indicating the period of record and the gauging stations used in deriving the curves; and a specification of the period of critical streamflow used to determine the dependable capacity;*
- *(ii) An area-capacity curve showing the gross storage capacity and usable storage capacity of the impoundment, with a rule curve showing the proposed operation of the impoundment and how the usable storage capacity is to be utilized;*
- *(iii) The estimated hydraulic capacity of the powerplant (minimum and maximum flow through the powerplant) in cubic feet per second;*
- *(iv) A tailwater rating curve; and*
- *(v) A curve showing powerplant capability versus head and specifying maximum, normal, and minimum heads;*

(3) A statement, with load curves and tabular data, if necessary, of the manner in which the power generated at the project is to be utilized, including the amount of power to be used on-site, if any, the amount of power to be sold, and the identity of any proposed purchasers; and

(4) A statement of the applicant's plans, if any, for future development of the project or of any other existing or proposed water power project on the stream or other body of water, indicating the approximate location and estimated installed capacity of the proposed developments.

1.0 BACKGROUND AND PROJECT PURPOSE

The Don Pedro Project is co-owned by the Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts). Construction of the new Don Pedro Project (Project) was completed in 1971. The Project consists of the 580-foot-high Don Pedro Dam which creates the 2,030,000 acre-foot (AF) Don Pedro Reservoir, covering approximately 13,000 acres (ac) in southwest Tuolumne County. A powerhouse with a Federal Energy Regulatory Commission (FERC) authorized capacity of 168 megawatts (MW) sits at the toe of the dam. The new dam and reservoir inundated the original, smaller Don Pedro dam, located about 1.5 miles upstream. While renewable hydropower generation at the Project is an important benefit to the Districts and the region, it is secondary to the primary purposes of the new Don Pedro Project which are to (1) provide water storage to meet the demand for irrigation and municipal and industrial (M&I) water supply in Stanislaus County and adjacent areas, (2) provide flood control benefits for the Tuolumne and San Joaquin river corridors, and (3) provide water supply benefits to 2.6 million residential, commercial, and industrial water users served by the City and County of San Francisco (CCSF) and its wholesale customers. The water supply and flood control benefits of the Project are essential ingredients to the welfare of the Central Valley region and the greater San Francisco Bay Area.

1.1 TID and MID – Joint Project Owners

Both TID and MID were organized in 1887 under the laws of the State of California to deliver Tuolumne River irrigation water to their respective service areas. The Districts agreed to co-develop and share the waters of the Tuolumne River based on the acreages in their service areas. As a result, TID owns 68.46 percent and MID owns 31.54 percent of the Project. The Districts are authorized under California law to provide both water supply and retail electric service. Over 200,000 ac of highly productive farmland are dependent upon the irrigation water provided by the Districts. The Don Pedro Project (Project) also provide electric service to over 200,000 customers and treated drinking water that serves over 210,000 people.

1.2 Overview of Primary Project Benefits

Combined, the Districts provide water supply and/or retail electric services to customers covering portions of four counties in the Central Valley region of California. The Don Pedro Project is the primary asset of the Districts for providing these services. The reliable water supply provided by the Project is a critical component for the economy of the region served by the Districts.

CCSF owns and operates water supply and hydropower facilities associated with its Hetch Hetchy water supply system in the Tuolumne River watershed upstream of the Don Pedro Project. CCSF contributed financially to the construction of the Don Pedro Project in order to meet its flood control obligations and to obtain water banking privileges in the new Don Pedro Reservoir. This innovative water banking arrangement allows CCSF to pre-release flows from its upstream facilities into the Don Pedro Reservoir where the flows are credited against CCSF's obligation to meet the Districts' entitlements so that at other times, notably droughts, CCSF can divert water that otherwise would have to be released to satisfy the Districts' senior water rights.

Both the transfer of flood management and the creation of the water bank provide CCSF and its wholesale customers in the Bay Area with improved reliability of water supply and greater flexibility in the operation of its water and power operations. As governed by the terms of the Fourth Agreement between the Districts and CCSF, there is a shared responsibility for meeting FERC-imposed flow requirements in the lower Tuolumne River downstream of the Don Pedro Project. Changes in FERC-imposed flow requirements may affect both the Districts' and CCSF's ability to meet the water supply needs of their customers in the Central Valley and the Bay Area, respectively.

The U.S. Army Corps of Engineers (ACOE) also contributed financially to the construction of the new Don Pedro Project. By doing so, the ACOE established 340,000 AF of seasonal flood storage space in the new reservoir. This storage space is maintained seasonally though the Districts' implementation of the ACOE's Flood Control Manual.

1.3 Overview of Project Vicinity

The Tuolumne River watershed covers approximately 1,960 mi^2 upstream of its confluence with the San Joaquin River in the Central Valley of California and approximately 1,533 mi^2 at the Don Pedro Dam. The upper watershed is sparsely populated and is dominated by Yosemite National Park and the lands of the Stanislaus National Forest. The precipitation patterns of the watershed vary considerably, with the uppermost reaches receiving in excess of 60 inches in the form of snow and rain annually and the lowermost less than 12 inches of rain. Along the irrigated lands of the lower Tuolumne River (RM 0 to RM 54) the *total* summertime precipitation is less than *one inch*. During the summers, daily high temperatures can exceed 100°F.

The Don Pedro Reservoir, at a water surface elevation of 830 ft, contains a gross water storage volume of 2,030,000 AF, approximately 1,721,000 AF of which is usable storage under the current FERC license. The long-term mean annual unimpaired flow of the Tuolumne River at Don Pedro Dam is approximately 1.95 million AF. The estimated historical mean annual inflow to the Don Pedro Reservoir (based on the period 1971 to 2012) is 1.7 million AF, with the bulk of the difference being the out-of-basin diversions made by CCSF for its municipal customers in the Bay Area.

The annual runoff of the Tuolumne River is subject to considerable variability. For example, during this same 42-year time period, the annual unimpaired runoff of the Tuolumne River has varied by a factor of 12, from 382,000 AF in 1977 to 4.6 million AF in 1983. The current total demand for Tuolumne River water during normal years is roughly 1.5 million AF, divided among the Districts' needs for irrigation and M&I water (900,000 AF), CCSF's needs for M&I water (250,000 AF), and flows to protect anadromous fish in the lower Tuolumne River (300,000 AF). The storage available in Don Pedro Reservoir provides protection against water shortages in individual and successive dry years such as occurred during the drought periods of 1976–1977, 1987–1992, and 2001–2004.

The Don Pedro Reservoir also plays an important role in flood control on the Tuolumne and San Joaquin rivers. The water storage and flood capacity provided by Don Pedro Reservoir is critical to serving a number of local and regional beneficial uses. Project operations for purposes of hydropower generation are secondary to the primary purposes of the Project, and therefore do not drive decisions related to overall water management at the Project. The Districts refer to this type of water management as a “water-first” operation, as versus water management dominated by hydropower production.

1.4 Overview of Project Operations

In general, the Don Pedro Project operates on an annual cycle consistent with managing for and providing a reliable water supply for consumptive use purposes, providing flood flow management, and ensuring delivery of downstream flows to protect aquatic resources. Current license articles are provided in Appendix B-1. By October 6 of each year, the Don Pedro Reservoir must be lowered to at least elevation 801.9 ft to provide the 340,000 AF of flood control benefits acquired by the ACOE through its financial contribution to Project construction. Beginning on October 1 of each year, minimum flows provided by the Project to the lower Tuolumne River, as measured at the U.S. Department of the Interior, Geological Survey (USGS) gage at La Grange, are adjusted to meet license requirements to benefit upmigrating adult Chinook salmon. This includes in certain years providing a pulse flow, the amount of which varies depending on the water year type.

Minimum flows to the lower Tuolumne River are adjusted on October 16, the rate of flow dependent on water year type, and these flows are maintained through May 31 of the following year to protect egg incubation, emergence, fry and juvenile development, and smolt outmigration of fall Chinook salmon. A spring pulse flow is provided each year to aid smolt outmigration, the amount again depending upon water year type. Irrigation deliveries normally begin in early March, but can begin as early as February to provide water for early growing season soil moisture in dry winters. Irrigation deliveries ramp up considerably by April and normally reach their peak in July and August.

Throughout the winter months, Project operators maintain a constant assessment of snow conditions in the upper Tuolumne River watershed and, during years with heavy snow accumulation, may reduce reservoir levels to balance forecasted inflows, outflows, and reservoir storage. The goal of operations is to fill the reservoir by early June; however, greater snowpack volumes can extend this filling into early July if needed for maintenance of the required ACOE flood control space. ACOE flood control guidelines also provide for maintenance of downstream flows on the lower Tuolumne River to less than 9,000 cfs as measured at the USGS gage at Modesto (RM 16), almost 40 mi below the Don Pedro Project.

Minimum flows to the lower Tuolumne River are adjusted again on June 1 and extend through September 30. Irrigation and M&I deliveries normally continue through October, but may also extend through November depending on moisture conditions. M&I deliveries occur year-round.

Delivery of Project benefits—irrigation water, M&I water, water for the protection of aquatic life, recreation, production of renewable energy, and flood protection—requires careful and skillful management of water. Project operations involve the continuous assessment of known and unknown variables, hydrologic risk assessment, coordination with other water systems, and the balancing of demands and resources. Future hydrologic conditions, even in the near term, are largely unknown. The timing and degree of droughts and floods remain largely unpredictable. Later sections of this Exhibit B provide a detailed description of the water management practices in place for operating the Don Pedro Project. These detailed water management practices have been incorporated into a Tuolumne River Operations Model, also described in detail further below, to depict the current demands, regulatory requirements, and operational policies of both the Districts' and CCSF's Hetch Hetchy water storage and delivery systems, as well as the current fish flow requirements of the lower Tuolumne River. This river-specific Operations Model presents the base case, "no-action" alternative for future Tuolumne River water system operations and provides a means for evaluating the impacts of alternative operating scenarios.

1.5 Project Purposes

The Don Pedro Reservoir provides 2,030,000 AF of total water storage at a normal maximum water surface elevation of 830 ft. The Project is used to satisfy the following primary purposes and needs:

- Provide water storage for the beneficial use of irrigation of over 200,000 ac of prime farmland in California's Central Valley served by the Districts. Combined, the Districts supply, on average, approximately 850,000 AF of irrigation water per year to their customers.
- Provide water storage for the beneficial use of municipal and industrial customers. MID provides treated water to the City of Modesto (population: 210,000), and TID and MID jointly provide treated water to the community of La Grange. The Districts provide up to a maximum of 67,500 AF of water per year for M&I use.
- Consistent with the requirements of the Raker Act and agreements between the Districts and the City and County of San Francisco, the Project provides a water bank of up to 570,000 AF of storage that CCSF may use to help manage the water supply from its Hetch Hetchy water system while meeting the senior water rights of the Districts. CCSF's water bank within Don Pedro Reservoir provides significant benefits for its 2.6 million customers in the Bay Area.
- Provide storage for flood management on the Tuolumne and San Joaquin rivers. In cooperation with the ACOE, the Don Pedro Project provides up to 340,000 AF of storage for the purpose of flood flow management.

These four uses are critical functions of the Project. The water storage capability of the Project under current operations substantially improves the reliability of water supply for over 2.8 million people and numerous commercial, manufacturing, and industrial interests, all of which provide a foundation for the economy of the Central Valley and the San Francisco Bay Area. Other important uses of the Project supported by the water storage and water supply of the Project are protection of aquatic resources, including anadromous and resident fish in the lower Tuolumne River, lake recreation, and renewable, non-CO_2 emitting hydropower generation.

The potential effects of the Project to the environment of the lower Tuolumne River have undergone continuous evaluation, monitoring and study since the Project began commercial operation. The Districts have worked closely with all parties interested in protecting and enhancing the fisheries in the lower Tuolumne River, especially related to the fall-run Chinook salmon population. Between 1972 and 1992, the Districts, in consultation with resource agencies, conducted numerous studies of the lower Tuolumne fisheries resource. In 1992, the Districts provided to FERC and interested parties a compilation of these studies in an eight volume filing consisting of 28 individual environmental reports (TID/MID 1992). These studies led to the development of a FERC-mediated Settlement Agreement with CCSF, resource agencies, environmental groups and other stakeholders in 1995 whereby the Districts agreed, among other things, to increase flows to the lower Tuolumne River for the purpose of enhancing and protecting the fall-run Chinook salmon population.

In accordance with that Settlement Agreement, the Districts continued to monitor the fall-run Chinook population and provided annual reports to all parties. The Tuolumne River Technical Advisory Committee (TAC), consisting of the Districts, CCSF, environmental groups, California Department of Fish and Wildlife (CDFW), and U.S. Fish and Wildlife Service (USFWS), was designated as being responsible for coordinating portions of the Agreement, reviewing annual studies on the fall-run Chinook and *Oncorhynchus mykiss* fisheries, and advising the Districts on adjustments to fishery studies. Numerous aquatic resource monitoring and evaluation studies have been undertaken since 1996 to the present time. In March 2005, the Districts prepared and filed a Ten Year Summary Report covering the environmental studies conducted from 1995 to 2004 (TID/MID 2005). Annual studies and reports have been filed each year since then.

In total, the Districts have performed and completed more than 150 studies of the lower Tuolumne River since 1992 (TID/MID 2010). The Districts continue to work with the Tuolumne River TAC to monitor the fisheries of the lower Tuolumne River. The most recent study results from monitoring conducted in 2012 were filed with FERC in March 2013. In addition to specific studies performed as part of the Project's relicensing, in-river environmental monitoring will continue to be performed and the results filed with FERC through the 2016 term of the current license.

1.6 Proposed Action

FERC is the federal agency authorized to issue licenses for the construction, operation and maintenance of the nation's non-federal hydroelectric facilities. In accordance with the Federal Power Act, FERC is able to issue such licenses for a period not less than 30 years, but no more than 50 years. Upon expiration of an existing license, FERC must decide whether, and under what terms, to issue a new license. Under the FPA, FERC issues licenses which are best adapted to a comprehensive plan for improving or developing a waterway, and, in so doing, must consider a suite of beneficial public uses including among others water supply, flood control, irrigation, and fish and wildlife. As the federal "action agency", FERC complies with the requirements of the National Environmental Policy Act (NEPA). Under NEPA, FERC must clearly define the specific proposed action it is considering and define the purpose and need for the proposed action.

In the case of the Don Pedro Hydroelectric Project, the proposed action under review by FERC is the issuance of a new license to the Districts to authorize the continued generation of hydroelectric power at Don Pedro Dam. As such, and as generally described in FERC's

Scoping Document 2 issued on July 25, 2011, any alternatives to mitigate the Project's effects ("mitigation strategies") must be reasonably related to the purpose and need for the proposed action, which in this case is whether, and under what terms, to authorize the continuation of hydropower generation at Don Pedro.

2.0 CURRENT AND PROPOSED OPERATION OF THE DON PEDRO PROJECT

2.1 Use of Project Waters

The Don Pedro Project is a critical resource for the people and communities served by the Districts and CCSF. It is also an important resource for local and regional flood control, for the protection and enhancement of anadromous and resident fisheries in the lower Tuolumne River, and for providing recreational opportunities at Don Pedro Reservoir.

The primary purpose of the Don Pedro Project is to provide a reliable water supply for irrigation use for over 200,000 ac of high value farmland served by the Districts and for water for over 2.8 million customers in the Central Valley and San Francisco Bay Area. The Project also provides water for municipal and industrial purposes, fisheries protection and enhancement, power generation, recreation, and flood control. MID provides treated water to the City of Modesto with a population of over 210,000 people, and TID and MID provide treated water to the community of La Grange. Don Pedro Reservoir, by providing a water banking privilege for CCSF, benefits over 2.6 million water customers in the Bay Area.

The waters of the Tuolumne River have been the source of competing needs, uses, and claims dating back to the late 1800s. Because the history of these competing interests continues to be relevant to Project operations today, an historical perspective of the water use issues is valuable.

2.2 Historical Perspective of Tuolumne River Water Uses

In 1887, the California legislature authorized a new form of popularly-elected local government, the irrigation district, based on the idea that since irrigation would be a community benefit, its finance and governance should be community-based rather than be controlled by individual landowners or irrigators. In June of that year, TID became the first to organize under the new law, followed in July by MID. Three years later, in August 1890, the two pioneer districts signed an agreement to build a joint diversion dam, La Grange Dam (located about two miles below the present Don Pedro Dam), and to divide such flow as the Districts had rights to in proportion to the total acreage in each district. The agreement also provided an option to share future projects upstream from La Grange dam on the same acreage formula, putting in place a partnership for the development of the river that has lasted for 120 years. La Grange Dam, however, was not the first dam to be built on the Tuolumne River. The first major dam built on the Tuolumne River was Wheaton Dam constructed in 1871 by a small private company, the Tuolumne Water Co., near the present location of La Grange Dam (RM 52.2).

La Grange Dam was built of boulders set in concrete and faced with roughly dressed stones quarried nearby. Its sole purpose was to raise the elevation of the river behind it to the level necessary to divert water into the Districts' irrigation canals, and any water not diverted into the canals simply passed safely over the top of the dam. At 127 feet high and 90 feet thick at the base, it was the highest dam of its kind when it was completed in 1893.

The Districts' position as the only users of the Tuolumne River was challenged in 1901 when San Francisco announced plans to construct dams at Hetch Hetchy valley and on Eleanor Creek to create a new municipal water supply. At first San Francisco's applications for rights-of-way over federal park and forest lands were rejected, but in 1908 Secretary of the Interior James Garfield granted a permit. The Garfield Permit recognized the Districts' senior water rights. The permit also required San Francisco to sell surplus water to the Districts at cost and to sell electricity to the Districts for irrigation and drainage pumping at cost.

Between 1908 and 1912, San Francisco engineers developed plans for diverting water for municipal supply and generating hydroelectric power from the Tuolumne watershed — including an additional dam in Cherry Valley — that would be capable of supplying up to 400 million gallons per day to San Francisco and other cities around the bay. In 1910, Garfield's successors reopened the controversy when they threatened to revoke San Francisco's right to use Hetch Hetchy Valley. In 1913, Secretary of Interior Fisher concluded he could not allow San Francisco to build the Hetch Hetchy Project without clearer authorization from Congress. As a bill authorizing San Francisco's plan worked its way through Congress, the Districts negotiated terms with San Francisco. The Raker Act passed by Congress in 1913 recognized and protected the senior priority water diversions by TID and MID named in the previous Garfield Permit—a total of 2,350 cubic feet per second (cfs) or natural flow, whichever is less, year-round and 4,000 cfs for 60 days each spring.

While the Hetch Hetchy project was being debated, the Districts were moving forward with plans for storage reservoirs because the natural flow and lack of storage at La Grange made it impossible to irrigate any substantial acreage after the snow-melt ended in early summer. Both Districts first built small foothill reservoirs along their main canals—Modesto Reservoir in 1911 and Turlock Lake in 1914—and in 1915, they agreed to cooperate on a larger dam above La Grange.

The construction agreement for the original Don Pedro Project signed in April 1919 allocated costs and benefits according to acreage, fixing TID's share of the Project, and subsequent projects on the river, at 68.46 percent and MID's share at 31.54 percent. When the original Don Pedro Dam was finished in 1923, the 284-foot-high arched dam was the highest in the world and had a maximum storage of 289,000 AF, which expanded the Districts' irrigation season beyond just the spring runoff season.

The original Don Pedro Project also put the Districts in the power business. Because in the 1920s electric lines rarely extended into rural areas, there had long been an interest in having the Districts distribute the power produced at Don Pedro. TID built its own transmission line and began retail distribution in 1923, with a branch to supply MID until it could build its own line from the dam. Growth was rapid, and in 1928, the generation capacity of Don Pedro was doubled to 30 MW. Private utilities found it impossible to compete with the Districts' low rates and expanding network of distribution lines; and in 1931 TID took full control of electric service within its boundaries. MID did not take full control until 1940. The Districts' power development kept them solvent during the Depression while also helping to lower property tax rates to help cash-strapped residents.

To maintain a minimum power pool at Don Pedro and increase irrigation storage, the Districts added gates to the spillway. The nine-foot increase in reservoir elevation flooded federal land above the 1916 reservation of public lands, resulting in the issuance of a Federal Power Commission (FPC) minor part license for the original Don Pedro Project in 1930.

San Francisco and the Districts continued to discuss their respective needs and rights to the Tuolumne River. In 1933 the Districts filed suit as San Francisco neared completion of the Hetch Hetchy Aqueduct, arguing that their rights under state law exceeded the flow San Francisco was required to release to the Districts under the Raker Act. Negotiations soon developed on a cooperative solution. The result was what became known as the First Agreement, a brief document that suspended litigation and committed San Francisco and the Districts to continued cooperation that would "recognize the provisions of the Raker Act as applying to the Districts and to the City without waiving any of their rights."

To satisfy the needs of those depending on the Districts and San Francisco to provide water, the Districts and San Francisco began a cooperative program which included discussions of building additional storage on the Tuolumne River. However, planning was complicated by the efforts of the ACOE to construct a flood control reservoir at Jacksonville, just upstream of old Don Pedro. That prompted the Second Agreement in 1943, which proclaimed that a dam on Cherry Creek in the upper watershed and a larger Don Pedro dam were part of a coordinated plan for developing the river. The next year the Districts and San Francisco took their case to Congress, and succeeded in stopping the federal dam and substituting a federal financial contribution to their projects to provide flood control.

In 1949 the Third Agreement between the Districts and San Francisco spelled out the terms of the comprehensive plan. New Don Pedro would be built with a financial contribution by San Francisco providing it with use of storage in the new reservoir. San Francisco's junior rights on the Tuolumne River would entitle it to relatively little or no water in dry years, which meant that it needed significant year-to-year carry-over storage to turn those junior rights into a reliable water supply.

Rather than building a number of additional small, uneconomical reservoirs in the upper watershed, new Don Pedro allowed San Francisco to acquire storage on more favorable terms. New Don Pedro would be owned and operated exclusively by the Districts, so the Third Agreement introduced the concept of a "water bank"; San Francisco would receive credit for inflow in excess of the Districts' daily Raker Act priorities, and could use those credits to offset the subsequent upstream diversion of water that would otherwise have had to flow to the Districts. In essence, the agreement allows San Francisco to pre-release water from its upstream facilities into a water bank in the Don Pedro Reservoir so at other times it can hold back an equivalent amount of water that otherwise would have had to be released to satisfy the Districts' senior water rights. Once the water enters the Don Pedro Reservoir, it belongs to the Districts and the Districts have unrestricted entitlement to its use.

To pay for its water bank space, and to relieve its reservoirs of any federal flood control obligations, San Francisco agreed to pay for a portion of the construction of a new dam capable of storing a total of 1.2 million AF, including 290,000 AF to replace the original Don Pedro

Project, 340,000 AF of flood control storage requested by ACOE, and 570,000 AF for water bank storage. ACOE flood control space would be kept empty during the rainy season to absorb storm inflows. When not obligated for ACOE flood control space, San Francisco could obtain water bank credits for up to 50 percent of the flood control storage space. All water in the reservoir belongs to the Districts, and San Francisco agreed to not construct or install facilities to divert water from the reservoir. The Districts would provide the land for the Project and pay for the new, and much larger, power plant. They also had the right to create additional storage for themselves by paying the marginal cost of a higher dam.

The Districts opted to increase new Don Pedro to its current maximum capacity of 2,030,000 AF. As part of the licensing process for the new dam, the CDFW asked the FPC, predecessor agency to FERC, to require a set of scheduled minimum flows below La Grange Dam to protect fall-run Chinook salmon that spawned in the Tuolumne River. There was a general recognition that new Don Pedro was a necessary prerequisite for protection of the Tuolumne fall-run Chinook salmon since the existing dam had no downstream release requirement. FPC also recognized that fishery releases, when combined with rising San Francisco diversions, could ultimately undermine the economic feasibility of the Project. To balance those factors, FPC's 1964 decision set normal year releases of 123,210 AF for the first 20 years, and required the Districts to conduct studies that could be used to develop future fishery requirements.

The overall allocation of costs and benefits—the basic New Don Pedro bargain—had been defined by the Third Agreement but implementation still had details to be finalized. San Francisco and the Districts negotiated such further details in the Fourth Agreement, which was executed by the parties in 1966. Key provisions of the Fourth Agreement include the following:

- The Water Bank Account is to be maintained on a daily basis based upon the computed daily natural flow at La Grange Dam. "Daily natural flow" is defined as that flow which would have occurred at La Grange Dam had no facilities been constructed by any party in the Tuolumne River watershed. San Francisco receives a credit of advance releases whenever the inflow to the reservoir from all sources exceeds 2,416 cfs or natural flow, whichever is smaller, year-round, and 4,066 cfs or natural flow, whichever is smaller, for 60 days following and inclusive of April 15. The additional 66 cfs was for an 1871 mining ditch right acquired during the construction of the original Don Pedro Dam. A major portion of the mining ditch right served the Waterford Irrigation District which was later annexed by MID.
- Except with the prior consent of the Districts, San Francisco is never entitled to have a debit balance in the Water Bank Account.
- The parties agree to share in certain costs based on a ratio of 51.7121 percent to San Francisco and 48.2875 percent to the Districts. These costs included (1) continuing costs for deficit operation of recreation facilities required under a FERC license and (2) the costs of (a) fishery studies required by FERC, (b) any resulting proceedings, and (c) any facilities or programs instituted as a consequence of such fishery studies or proceedings.
- Future responsibility for fishery releases in Article 8, which provides

> *The Districts and City recognize that Districts, as licensees under the [FERC] license for the New Don Pedro project, have certain responsibilities regarding the water release conditions*

contained in said license, and that such responsibilities may be changed pursuant to further proceedings before the [FERC]. As to these responsibilities, as they exist under the terms of the proposed license or as they may be changed pursuant to further proceedings before the [FERC], Districts and City agree:

(a) That any burdens or changes in conditions imposed on account of benefits accruing to City shall be borne by City.

(b) That at any time Districts demonstrate that their water entitlements, as they are presently recognized by the parties, are being adversely affected by making water releases that are made to comply with [FERC] license requirements, and that the [FERC] has not relieved them of such burdens, City and Districts agree that there will be a re-allocation of storage credits so as to apportion such burdens on the following basis: 51.7121% to City and 48.2879% to Districts.

In the event City and Districts cannot agree that there has been such an adverse effect and the extent thereof, these issues shall be determined by arbitration as provided in [this Agreement].

(c) That in the event of such adverse effects on Districts' water entitlements, and the consequent necessity for distribution of burden therefor as provided in subparagraph b, Districts shall forthwith seek modifications by the [FERC] of the water release conditions of said license.

Article 37 of the Project license established minimum flow releases for the first 20 years of operation (1971 to 1991) and reserved FPC's authority to revise the minimum flow requirements after 20 years. Article 39 of the license required the Districts, in cooperation with CDFW, to study the Tuolumne River fishery and how it could feasibly be sustained. The Districts subsequently commenced 18 years of fishery studies.

In 1985, the Districts applied to FERC to amend their license to add a fourth generating unit. While the amendment proceeding was underway, the Districts, CDFW, and the USFWS entered into an agreement to amend the approved fish study plan provided for in Article 39 of the license. Among other things, the agreement contemplated extending the existing study and maintaining the existing flows until 1998. In 1987, FERC granted the license amendment and included the revised study plan in the license. FERC added Article 58 to the license, making the Districts' amended fish study plan a condition of the license and requiring the Districts to file a report on the results, with recommendations for changes in the existing flow releases and ramping rates for the Project. In doing so, however, FERC found that it was beyond the scope of the amendment request to extend the ongoing study or minimum flows beyond the initial 20-year period provided for in the existing license. As a result, the requirement to revisit the Project's minimum flows after 20 years, and to provide the results of the ongoing fish study, remained intact.

In 1995, the Districts entered into a settlement agreement with CDFW, USFWS, CCSF, California Sports Fishing Protection Alliance, Friends of the Tuolumne, Tuolumne River Expeditions, and the Tuolumne River Preservation Trust. Pursuant to this agreement, in 1996, FERC amended Articles 37 and 58 of the license to implement new minimum flows and fishery monitoring studies. Before approving the license amendment, FERC completed formal consultation with the USFWS pursuant to Section 7 of the federal Endangered Species Act on two listed fish species, the Delta Smelt and Sacramento Splittail. FERC also prepared an

Environmental Impact Statement (EIS) that examined the effects of various alternative flow regimes. As amended in 1996, Article 37 required a modified minimum flow regime to protect fishery resources in the Tuolumne River. This flow regime remains in effect today. This settlement agreement and its effects on Project operations are discussed below in Section 3.6.

2.3 Water Rights Owned by TID and MID

The Districts have a number of individual water rights on the Tuolumne River including certain appropriative water rights acquired in 1855, riparian water rights, additional pre-1914 appropriative water rights, and post-1914 appropriative water right licenses issued by the State of California (License Numbers 11057 and 11058).

Section 2.2 above provides a description of the Raker Act and the Fourth Agreement between the Districts and CCSF. As the primary holders of water rights on the Tuolumne River, the Fourth Agreement defines the allocation of the waters of the river between CCSF and the Districts. The Districts also have storage water rights in the original and existing Don Pedro Reservoir licensed by the State Water Resources Control Board (SWRCB). The water rights recognized under License Numbers 11057 and 11058 permit the use of water for irrigation, power generation, and recreation. The licenses also allow the storage, withdrawal from storage, diversion, and re-diversion of Tuolumne River water. Specifically, License Numbers 11057 and 11058 permits the Districts to store 1,046,800 AF of water per year to be collected from November 1 to July 31 of the succeeding year, to divert and re-divert a maximum of 1,371,800 AF per year, and withdraw 951,100 AF of water per year.

2.4 Statutes and Agreements Affecting Future Project Operations

The Raker Act was passed by Congress in 1913 to address the allocation of the waters of the Tuolumne River between the Districts and CCSF. The Fourth Agreement currently defines the implementation of the Raker Act. It is anticipated that the terms of the Fourth Agreement will continue through the term of a new FERC license. There are no other agreements that govern Project operations at the present time.

2.5 Detailed Description of Current Project Operations

The operation of the Don Pedro Project is subject to a number of interacting and seasonally overlapping considerations, predominantly consisting of the following elements:

- flood flow management consistent with ACOE guidelines,
- ensuring the reliability and delivery of irrigation and M&I water to the Districts customers, including consideration of annual carry-over storage,
- water bank accounting,
- release of flows for the protection of anadromous fish and aquatic resources in accordance with FERC license terms, and
- hydropower generation.

The factors involved in each of these elements are discussed in the sections below, as are the flow releases and reservoir water levels that result from balancing these considerations. Before discussing each of these areas, an overview of the hydrology of the Tuolumne River is presented.

2.5.1 Hydrology of the Tuolumne River Basin

The climate and hydrology of the 1,960 mi^2 Tuolumne River basin varies considerably over the river's 150-mile length. As an illustration of this variation, annual precipitation in the higher elevations of the watershed, above 10,000 ft, exceed 60-inches per year, occurring mostly as snow, while less than 100 miles away in the lower lying San Joaquin Valley area, the annual precipitation is less than 12 inches. In addition to the geographic variation in precipitation, the seasonal and annual variations are also extreme. In the lower lying reaches of the Tuolumne River, the average precipitation from May through September, inclusive, is less than one inch. Year-to-year variation is also dramatic. In the period of 1971 to 2012, the lowest unimpaired flow of 382,000 AF occurred in WY 1977 and the highest unimpaired flow of 4.6 million AF occurred in WY 1983. This represents a hydrology with a natural annual range that varies by a factor of 12. Another characteristic of the basin's hydrology seems to be the fact that dry and wet years often come in multi-year, back-to-back periods. The third driest year in the water year (WY) 1971 to 2012 period was WY 1976 (670,000 AF), the year before the driest year, and the third wettest year was WY 1982 (3.8 million AF), the year before the wettest year.

Water resource planners design systems to provide adequate water supply through periods of extended droughts. This is especially true where the consequences of drought on human welfare and economic health are significant. This is the case with the Tuolumne River and the Don Pedro Project. The irrigated lands of Stanislaus County served by the Districts are highly productive and prime farmlands, and support high value nut and fruit orchards. However, without a reliable year-to-year supply of irrigation water, crop production is not supportable. Likewise, the 2.6 million Bay Area water users supplied by CCSF's Hetch Hetchy system, which supplies 85 percent of CCSF's water, are significantly impacted when water supplies are reduced. Therefore, having adequate water supplies during drought periods is a "design condition" for the Don Pedro and Hetch Hetchy systems. For the Don Pedro Project, the "design drought" in the WY 1971 to WY 2012 period is the drought of 1987 to 1992. During this six year period, the mean annual unimpaired flow at La Grange was 0.9 million AF, and not any single year in this period had an annual runoff that exceeded 70 percent of the long term average unimpaired flow of 1.95 million AF. Don Pedro Reservoir fell to elevation 690 ft in November 1992. It is important to recognize that this period also preceded the adoption of higher minimum and pulse flows to the lower Tuolumne River to benefit anadromous fish. The two year drought of WY 1976 through 1977 was drier with an average annual unimpaired flow of only 0.53 million AF (27 percent of mean runoff). The reservoir fell to its lowest level ever of 598 ft in October 1977. The period of 2001 through 2004 was another dry period, with unimpaired flow estimated to be only 69 percent of the long-term mean, and no single year in that four year period exceeding 82 percent.

The estimated monthly and annual unimpaired runoff of the Tuolumne River at La Grange (drainage area 1,533 mi^2) is provided in Table 2.5-1. The occurrence of such large variations in seasonal and annual hydrology, as demonstrated in the table, represent the design conditions and highlight the year-over-year planning that the Districts and CCSF must incorporate into their water supply planning.

2.5.2 Flood Flow Management

The ACOE participated financially in the building of the Don Pedro Dam in exchange for the Districts setting aside 340,000 AF of flood control storage space. This space occurs between elevations 801.9 and 830.0 ft and is kept vacant from October 7 through April 27 of the next year. The maximum reservoir level experienced at Don Pedro is 831.4 ft which occurred on January 2, 1997.

Reservoir flood management at Don Pedro allows for winter and spring capture of both rain and snowmelt floods, and is part of the ACOE system for flood control operations along the San Joaquin River which includes the other “rim reservoirs” that surround the eastern rim of California’s Central Valley. Don Pedro Reservoir’s flood control storage requirements increase from zero on September 8 to the maximum reservation of 340,000 AF by October 7. The flood control storage is maintained at 340,000 AF through April 27 after which, unless additional reserved space is indicated by snowmelt parameters, it can decrease uniformly to zero by June 3. Figure 2.5-1 graphically depicts the flood control rule curve for the Project.

In addition to flood control space needs within the reservoir, downstream flow restrictions also affect Project operations from a flood management perspective. The primary downstream flow guideline cited in the 1972 ACOE Flood Control Manual is that flow in the Tuolumne River at Modesto (as measured at the 9th Street Bridge) should not exceed 9,000 cfs. Flows in excess of 9,000 cfs have the potential to cause significant damage to property in this area of the Tuolumne River and Dry Creek, a tributary of the Tuolumne River. Between La Grange Dam and 9th Street in Modesto, the single largest contributor of local flow to the Tuolumne River is Dry Creek. The Dry Creek watershed has its headwaters in the foothills just northeast of Don Pedro Dam. It is a flashy watershed; once the soil is saturated, any rainfall results in a rapid response in runoff. Significant flows, on the order of 6,000 cfs or higher, can occur when there is significant rainfall between Modesto and the upper end of the Dry Creek watershed. Because these flows from Dry Creek come in above the Modesto 9th Street USGS river gage, Dry Creek flows must be taken into account when making releases from Don Pedro that when combined should keep total flow at Modesto below 9,000 cfs.

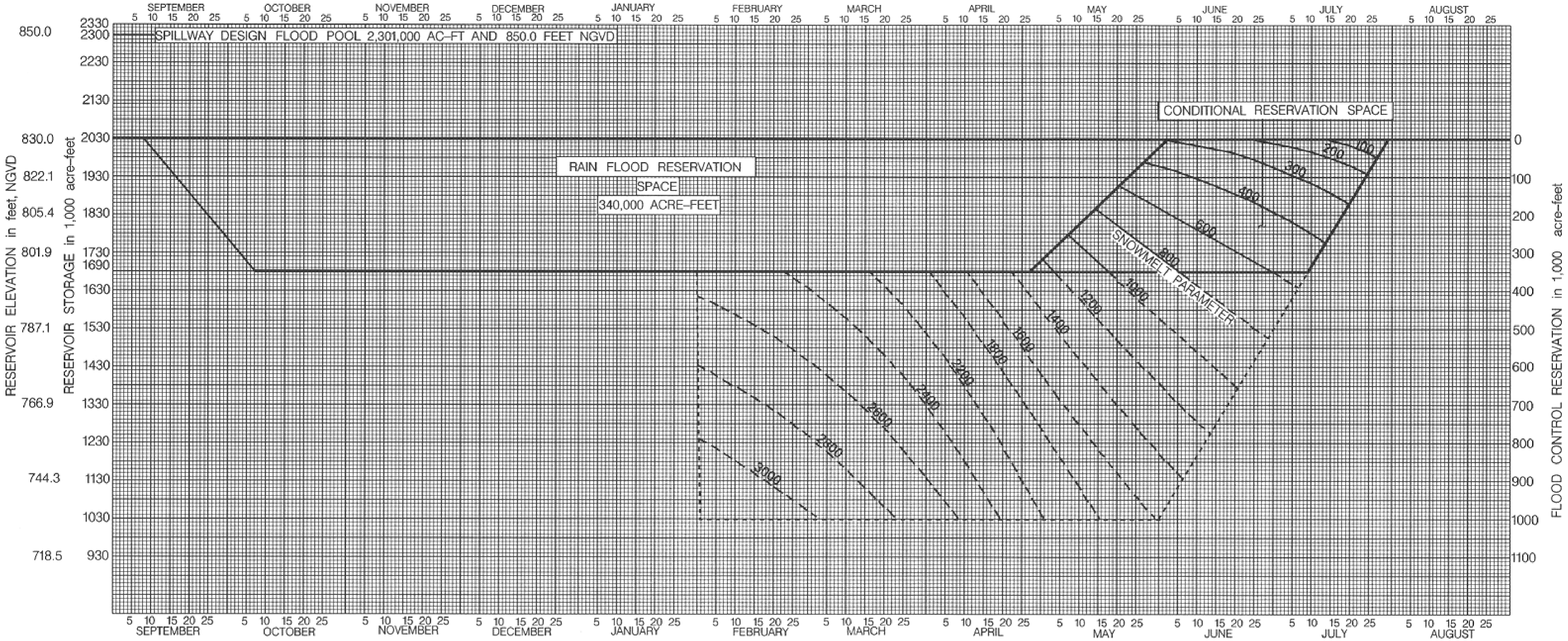
Table 2.5-1. Unimpaired flow at La Grange

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1971	10,403	86,522	123,255	116,137	94,103	146,315	194,252	348,968	418,322	110,651	19,624	9,842	1,678,393
1972	6,172	34,879	76,534	61,383	78,026	181,275	155,725	344,141	219,556	28,316	11,508	11,038	1,208,554
1973	11,439	36,103	86,245	139,554	186,056	173,428	259,410	655,199	400,297	57,344	19,697	5,901	2,030,673
1974	17,289	171,389	136,439	179,855	68,704	228,524	273,855	560,602	441,592	122,520	28,527	9,507	2,238,803
1975	14,699	12,106	35,333	53,844	144,298	224,185	176,272	582,041	596,317	149,543	27,588	14,613	2,030,839
1976	70,107	55,744	31,605	7,900	37,718	70,665	99,528	208,988	39,704	14,409	20,658	14,771	671,798
1977	12,091	8,452	3,231	10,687	16,711	24,991	78,646	105,316	104,440	10,835	3,632	2,800	381,833
1978	1,655	11,798	96,334	189,971	195,781	331,031	354,170	603,288	661,374	309,832	60,386	83,972	2,899,594
1979	10,607	29,477	33,062	153,911	151,774	238,936	260,209	626,232	314,829	66,623	17,076	9,636	1,912,372
1980	29,332	42,198	49,346	528,791	394,144	221,188	304,081	497,410	538,734	346,613	58,809	22,254	3,032,900
1981	11,243	8,339	25,745	48,152	63,400	125,896	243,173	328,482	151,211	21,812	19,147	8,770	1,055,370
1982	29,077	173,741	220,232	227,881	388,417	339,727	660,444	693,111	566,799	322,574	79,977	102,945	3,804,926
1983	152,854	176,418	244,790	261,263	325,705	554,459	291,756	695,534	1,024,537	638,665	205,640	60,567	4,632,189
1984	51,524	313,439	405,707	177,008	152,734	203,760	225,150	563,743	342,461	93,243	19,919	7,576	2,556,263
1985	26,611	86,072	48,301	40,203	69,518	127,565	302,634	341,384	135,004	22,769	15,297	17,853	1,233,211
1986	33,399	49,228	94,056	126,876	637,574	490,248	322,503	539,965	500,911	146,703	30,159	18,815	2,990,437
1987	18,330	7,189	8,644	6,170	43,156	89,931	191,647	205,993	66,200	10,978	5,881	1,736	655,855
1988	10,099	27,213	48,866	70,214	58,513	105,214	158,208	211,691	99,220	23,677	5,289	2,142	820,346
1989	1,847	22,370	26,900	36,981	62,227	286,012	307,438	319,033	208,219	24,567	2,575	13,732	1,311,900
1990	49,807	25,385	20,532	35,561	54,889	133,067	221,040	179,627	101,596	19,804	2,449	1,217	844,974
1991	982	8,779	4,180	5,950	8,851	168,572	179,992	334,911	299,086	66,836	18,852	7,012	1,104,004
1992	15,913	26,032	17,284	25,086	95,292	113,080	231,981	187,793	46,522	56,032	13,076	4,110	832,201
1993	11,096	13,008	45,527	278,924	165,923	319,513	321,485	628,266	505,510	211,719	41,624	13,090	2,555,685
1994	13,216	6,949	17,731	20,248	50,640	103,289	185,954	274,460	115,037	23,356	14,060	7,323	832,264
1995	6,615	62,444	59,634	345,179	147,243	580,033	409,409	658,216	792,024	640,448	149,917	26,786	3,877,947
1996	2,928	1,893	70,462	124,072	350,198	293,830	333,468	577,821	386,230	126,871	25,107	12,406	2,305,286
1997	10,649	111,176	395,920	993,122	164,045	229,020	286,771	527,209	319,150	89,353	31,042	12,881	3,170,339
1998	8,055	17,287	36,321	215,888	367,838	348,714	351,185	469,946	849,275	540,481	70,185	32,748	3,307,924
1999	15,093	51,486	68,248	142,259	257,917	169,912	254,689	567,235	424,883	100,289	25,242	16,656	2,093,910
2000	8,280	17,956	11,370	131,610	278,379	249,790	327,021	529,862	307,687	52,214	21,282	13,384	1,948,836
2001	16,451	15,946	22,001	30,634	63,300	189,870	235,844	416,612	62,364	23,427	11,565	8,052	1,096,067
2002	7,721	38,946	104,487	98,040	79,528	143,210	303,256	385,292	220,546	30,533	11,458	6,580	1,429,597
2003	-588	69,475	70,469	89,021	64,992	130,238	217,015	522,924	373,580	55,918	28,039	11,199	1,632,280
2004	2,626	10,762	82,640	70,234	108,719	257,309	267,607	315,850	145,681	27,310	11,694	3,922	1,304,353
2005	51,651	52,995	72,504	258,454	186,669	315,456	304,589	839,252	584,291	255,278	35,507	16,145	2,972,792
2006	11,313	16,146	253,634	236,755	157,300	292,801	622,598	834,124	644,165	199,162	26,017	9,791	3,303,806

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2007	9,687	16,463	30,830	27,556	94,441	150,141	181,930	246,298	62,309	16,240	10,214	4,089	850,199
2008	7,346	2,877	17,262	76,578	102,747	128,423	192,092	360,565	207,420	35,284	11,766	3,632	1,145,991
2009	4,580	60,476	25,630	107,965	115,404	231,165	261,458	564,833	224,025	59,140	15,673	6,388	1,676,737
2010	56,344	10,585	40,469	90,140	105,834	159,640	247,578	384,423	623,115	140,842	13,441	8,755	1,881,167
2011	103,237	83,675	331,215	174,482	140,926	413,651	430,289	516,744	774,892	450,460	88,097	28,086	3,535,754
2012	36,596	17,767	5,564	48,811	32,290	108,325	289,328	254,087	63,489	17,117	10,898	6,247	890,517
Average	23,057	49,790	85,680	144,365	151,474	223,629	274,183	452,559	356,252	137,138	31,871	16,166	1,946,164

Although flood management operations and flood control space in Don Pedro Reservoir can be generally described in this simplified manner, managing the reserved storage space is accomplished on a real-time basis at the Project. Inflow forecasts are constantly updated. Project operations and management for flood control purposes requires the development of a long-term (up to six months) forecast of the potential inflow into Don Pedro under various potential runoff scenarios. Flood flow management may require the early release of water from Don Pedro (termed “pre-releases”) so as to maintain the reserved storage space and flows at Modesto below the 9,000 cfs level. In short, if there is a large volume of water that is expected to be intercepted by Don Pedro either in the short or longer term that may result in higher releases than 9,000 cfs, then pre-flood releases may be made to reduce the risk of having to release more at a later time. The decision to make pre-releases at the Project involves flow forecasting based on long term weather predictions and risk-based analyses. To perform this task, the Districts review, on a continuous basis, the current status and future forecasts of Tuolumne River runoff. The Districts continuously update their canal flow requirements (long and short term) and communicate with federal and state agencies that operate reservoirs within the San Joaquin River system. The Districts are in contact with the California Department of Water Resources (CDWR) and the federal National Weather Service regarding weather forecasts or forecasted rainfall and/or runoff. The Districts are in frequent contact with the ACOE. The Districts use a number of models and programs for the calculation of estimated inflows to Don Pedro and future release requirements. These models range in time step from annual, monthly, weekly, daily, and finally, hourly or real-time. These models develop statistical operational probability curves for forecasts of potential operations, and finally, operational plans to be followed.

While the guideline of 9,000 cfs at Modesto must be reasonably adhered to, it is recognized that flood flows of substantially greater magnitude can occur on the Tuolumne River and must also be managed at the Project. While the mean annual unimpaired river flow at La Grange is approximately 2,700 cfs, the highest flood flow experienced since the Project has been in commercial operation occurred on January, 1997. The peak inflow to the reservoir was estimated to be 120,935 cfs, and the peak outflow 59,462 cfs. The flood of record on the Tuolumne River occurred in January 1862 and is estimated to have been 130,000 cfs. A flood flow of 61,000 cfs occurred in December 1950, prior to the construction of the new Don Pedro Dam. The design flood for the Project is the Probable Maximum Flood (PMF) event. The PMF has an estimated reservoir inflow of 706,900 cfs and an estimated outflow of 525,600 cfs. During the PMF event, reservoir water levels would rise to a peak elevation of 852 ft, three ft below the top of dam. The Project Boundary along the upper end of the Tuolumne River runs along the 850 ft contour, and is sufficient to accommodate all floods up to just below the PMF event.



NOTES:

1. Don Pedro Lake shall be operated for flood control in accordance with this water control diagram and the accompanying emergency spillway release diagram. Reservoir releases shall be made in accordance with the diagram requiring greater release.

2. Flood control reservation increases uniformly at a rate of 11,700 acre–feet per day from zero requirement on 8 September to the maximum reservation of 340,000 acre–feet by 7 October. The reservation is maintained at 340,000 acre–feet through 27 April after which, unless additional reservation is indicated by the snowmelt parameters, it will decrease uniformly at a rate of 9,200 acre–feet per day to zero requirement by 3 June.

3. Snowmelt parameter value is the forecasted natural runoff in thousand acre–feet of Tuolumne River inflow to Don Pedro Lake between the given date and 31 July. Dash line parameter extentions below rain flood reservation line are used for computation purposes to define gross reservation requirement (before reduction for empty space in upstream reservoirs.)

4. The flood control reservation in Don Pedro Lake determined from snowmelt parameters may be decreased by 80 percent of the available empty space in each of Hetch Hetchy Reservoir and Lake Lloyd. No reduction will be permitted below 50,000 acre–feet or into the rain flood reservation value. No more than 70% of the creditable portion of the requirement may be allowed for empty space in Hetch Hetchy Reservoir nor more than 30% for empty space in Lake Lloyd.

5. When space available for flood control is less than that indicated by the diagram (after allowing credit for empty space in upstream reservoirs), water shall be released as rapidly as possible without causing flows in Tuolumne River below Dry Creek to exceed 9,000 c.f.s. or non–damaging channel capacity.

6. Releases shall not be increased more than 2,000 c.f.s. or decreased more than 1,000 c.f.s. in any 2–hour period except as required by the Emergency Spillway Release Diagram.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

WATER CONTROL DIAGRAM

Prepared Pursuant to Flood Control Regulations for Don Pedro Dam and Lake in accordance with the Code of Federal Regulations Title 33 Part 208.11

APPROVED: ______
Colonel, USA, Division Engineer, South Pacific Division

APPROVED: ______
Chief, Administrative Officer, Modesto Irrigation District

APPROVED: ______
Manager, Turlock Irrigation District

Effective Date: 27 JUL 1978 File No. [illegible]

Figure 2.5-1. **ACOE flood management guide curve for the Don Pedro Project.**

For day-to-day and hour-to-hour operations, the Districts will develop a total release schedule for Don Pedro and the bifurcation of these releases to the TID and MID canals and the river. Flows to the Districts are for the beneficial use of irrigation and M&I requirements either currently or in the future. On occasion, to protect lower Tuolumne River fisheries the Districts voluntarily direct pre-flood flows through their canal systems to their respective lower reservoirs (Turlock Lake and Modesto Reservoir) and finally to the lower canal systems spilling back to the river. This ability is very limited and conditional on the time of year and hydrologic or meteorological conditions.

2.5.3 Agricultural and Municipal Water Supply

The primary function of the Don Pedro Project is to provide water storage benefits for irrigation, municipal, and industrial water supply. Both TID and MID have obligations to supply both water and retail electric service to their respective service areas. The Don Pedro Project also provides water storage (in the form of water bank credits) for CCSF so it can reliably meet the water needs of its 2.6 million customers in the Bay Area.

The Districts irrigation system consists of the Don Pedro Dam and Reservoir for the storage and delivery of Tuolumne River water to the Districts service territory, La Grange Diversion Dam where releases from Don Pedro are diverted from the river into the TID (south side of the river) and MID (north side of the river) canal systems, and a complex system of canals, laterals and control structures. The TID irrigation system consists of approximately 250 miles of canals and laterals. TID also owns and operates an intermediate storage reservoir, Turlock Lake. MID owns and maintains approximately 200 miles of canals, laterals, and pipelines. MID also owns and operates an intermediate reservoir, Modesto Reservoir.

The TID irrigation service area encompasses 307 mi^2 of the Central Valley. TID provides full-service irrigation water to over 150,000 ac of farmland. MID's irrigation service area is 156 mi^2 with over 60,000 ac of irrigated land. The historical reliability of the Districts' water supply has allowed farm owners to make the long-term investments necessary to develop and maintain nut and fruit orchards. The Districts' service territory is also a large dairy area. The approximate crop distributions can change from year to year, but representative percentages are as follows:

- nut orchards: 32 percent,
- corn (including corn silage): 26 percent,
- hay: 23 percent,
- vegetables: 8 percent,
- field and other: 5 percent,
- fruit: 3 percent,
- grape: 2 percent, and
- grain: 1 percent.

The farmland served by the Districts is characterized by rich soils with long growing seasons; however, irrigation water is required due to natural summer precipitation levels being less than one inch. Water delivery from Don Pedro Reservoir to serve the Districts' irrigation systems and irrigation customers occur primarily from March through October. However, irrigation-related water releases may occur from Don Pedro year-round, depending on winter moisture conditions, storage needs in Turlock Lake and/or Modesto Reservoir, and early-or-late season temperatures. MID also provides treated water to the City of Modesto for M&I purposes. Water deliveries to the city for M&I purposes occur year-round, but vary from year to year. MID's potable water treatment facilities are designed to deliver up to a maximum of 67,200 AF per year. The Districts also provide a small amount of domestic water to the community of La Grange.

Average annual water releases from the Project to meet the Districts' needs since 1997, the first full calendar year following the implementation of the 1995 Settlement Agreement, through 2012 have been approximately 900,000 AF. MID, TID, and total canal deliveries for that period are provided in Figures 2.5-2, 2.5-3, 2.5-4, respectively. Total canal deliveries include water to meet crop evapotranspiration needs; M&I needs; canal, lateral, and reservoir evaporation and seepage losses; and operational losses at the ends of laterals and canals.

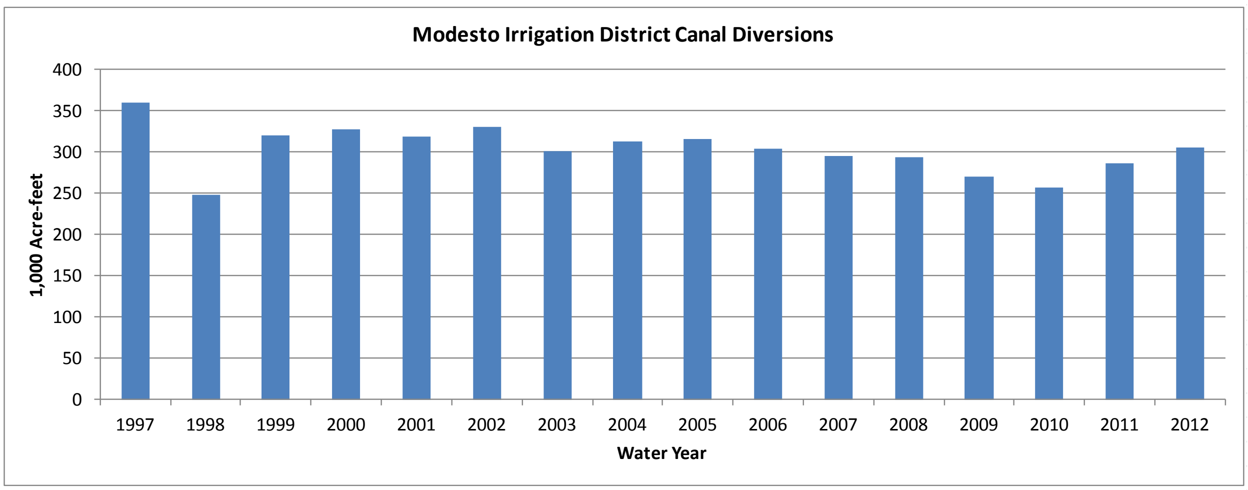


Figure 2.5-2. Total canal deliveries from 1997 to 2012 for Modesto Irrigation District.

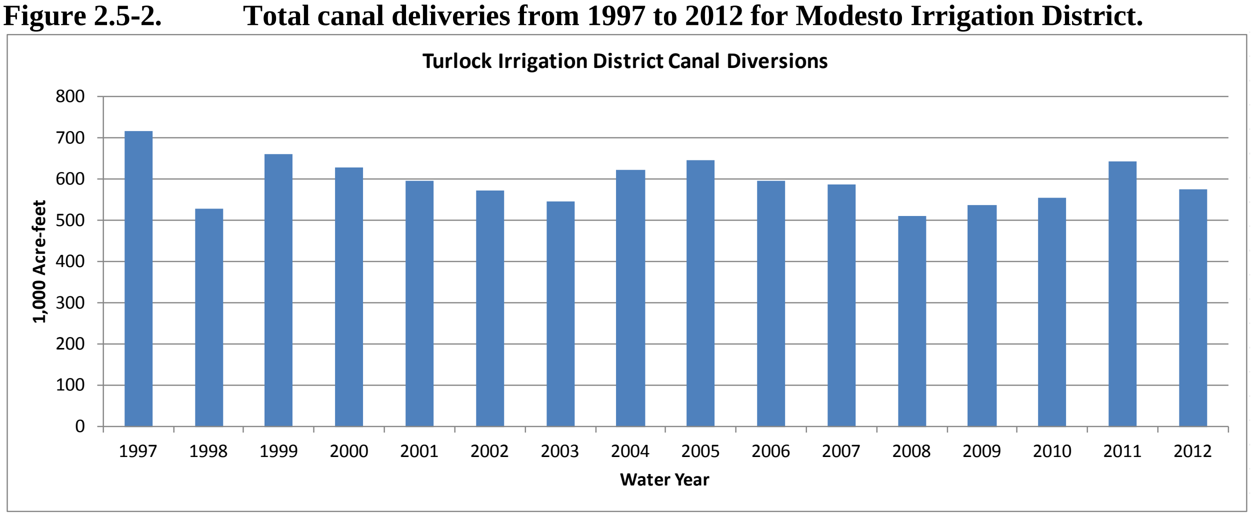


Figure 2.5-3. Total canal deliveries from 1997 to 2012 for Turlock Irrigation District.

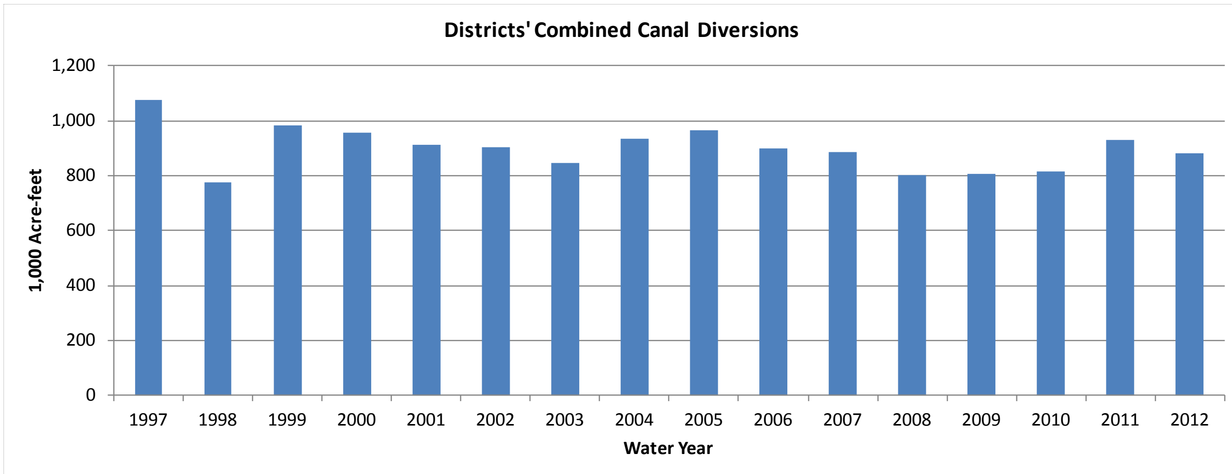


Figure 2.5-4. Districts' combined total canal deliveries from 1997 to 2012.

2.5.4 Water Bank Operations

The CCSF water system on the Tuolumne River includes the three physical reservoirs (Hetch Hetchy Reservoir, Lake Lloyd and Lake Eleanor), diversions to the Bay Area through the San Joaquin Pipeline, and an accounting for the Don Pedro water bank account. As described previously in this application, CCSF participated financially in the construction of the new Don Pedro Dam and Reservoir. For this participation, CCSF acquired water banking privileges amounting to 570,000 AF of available credits that allow CCSF to ensure the reliability of its water supply to its 2.6 million Bay Area customers. By using the water bank, CCSF can pre-release flows from its upstream facilities into the Don Pedro water bank where the flows are credited against CCSF's obligation to meet future District entitlements so that later (in dry periods), CCSF can divert and use Tuolumne River water which it otherwise would have to release to meet the Districts senior water rights. CCSF's water bank credits substantially improve the reliability of its water system by crediting the water bank in wet years so that it can debit the account in dry years. Approximately 85 percent of CCSF's water supply to the Bay Area comes from the Tuolumne River.

The water bank account volume is monitored by both the Districts and CCSF. A running account of the water bank account balance is computed daily, in accordance with the Fourth Agreement and other implementing agreements. In accordance with the Fourth Agreement, CCSF is not allowed to run a negative balance without the consent of the Districts.

2.5.5 Project Releases to Benefit Lower Tuolumne River Fisheries

The Districts have actively participated in the study, monitoring, protection and enhancement of the fall-run Chinook salmon in the lower Tuolumne River. Since the issuance of the original license, operations have been modified to improve conditions for fall-run Chinook salmon. In 1995, the Districts entered into a settlement agreement with CDFW, USFWS, CCSF, and four non-governmental organizations (NGOs) that provided greater releases from the Project to the lower Tuolumne River to improve conditions for fall-run Chinook salmon. FERC issued an order on July 31, 1996 amending the Don Pedro license to incorporate the lower Tuolumne River minimum flow provisions contained in the settlement agreement. The revised summertime minimum flows were to vary from 50 cfs to 250 cfs, a substantial increase over the prior summertime minimum flow of three cfs, and fall through winter minimum flows would vary from 150 cfs to 300 cfs depending on water year type. There are 10 water year types. The water year classifications are re-calculated each year to maintain approximately the same frequency distribution of water year types. The settlement agreement and license order also specified certain pulse flows, the amount of which also varies with water year type. The downstream flow schedule provided for by the Settlement Agreement and subsequent FERC Order is shown in Table 2.5-2. FERC-required minimum instream flows are determined and adjusted as described below.

Under current procedures and protocols, the preliminary determination of the appropriate water year type is completed by April 14 of each year based on a "water first" protocol, which applies an assumption of 90 percent confidence level to the remaining runoff in the current water year. This determination is reviewed by resource agencies and sets the stage for definition of the spring outmigration pulse flow volume and timing. The proposed pulse flow to aid outmigration is provided to resource agencies for comment, then forwarded to FERC for compliance purposes. Final determinations of the actual runoff made in July may result in additional flows dedicated to flows in the lower Tuolumne River. These flows are estimated by the Districts and provided to resource agencies which then decide on the timing and rate of release of these additional flows.

Table 2.5-2. Schedule of flow releases to the lower Tuolumne River by water year type contained in FERC's 1996 order.

Schedule	Units	# of Days	Critical and Below	Median Critical[1]	Interm. CD[1]	Median Dry	Interm. D-BN	Median Below Normal	Interm. BN-AN[2]	Median Above Normal	Interm. AN-W	Median Wet/Max
Occurrence	%	--	6.4%	8.0%	6.1%	10.8%	9.1%	10.3%	15.5%	5.1%	15.4%	13.3%
October 1–15	cfs	15	100	100	150	150	180	200	300	300	300	300
	AF	--	2,975	2,975	4,463	4,463	5,355	5,950	8,926	8,926	8,926	8,926
Attraction Pulse	AF	--	none	none	none	none	1,676	1,736	5,950	5,950	5,950	5,950
October 16–May 31	cfs	228	150	150	150	150	180	175	300	300	300	300
	AF	--	67,835	67,835	67,835	67,835	81,402	79,140	135,669	135,669	135,669	135,669
Outmigration Pulse Flow	AF	--	11,091	20,091	32,619	37,060	35,920	60,027	89,882	89,882	89,882	89,882
June 1–Sept 30	cfs	122	50	50	50	75	75	75	250	250	250	250
	AF	--	12,099	12,099	12,099	18,149	18,149	18,149	60,496	60,496	60,496	60,496
Volume (total)	AF	365	94,000	103,000	117,016	127,507	142,502	165,002	300,923	300,923	300,923	300,923

[1] Critically Dry

[2] Between a Median Critical Water Year and an Intermediate Below Normal-Above Normal Water Year, the precise volume of flow to be released by the Districts each fish flow year is to be determined using accepted methods of interpolation between index values.

Source: FERC 1996.

2.5.6 Hydropower Generation

The Don Pedro powerhouse sits immediately below Don Pedro Dam and contains four turbine-generator units with a total hydraulic capacity of 5,500 cfs and a maximum generation capability of approximately 200 MW at maximum head. Flows to the powerhouse are delivered via the power tunnel which has an inlet centerline elevation of 534.3 ft. Flow releases through the powerhouse from the Don Pedro Reservoir are scheduled based upon requirements for (1) flood flow management, including pre-releases in advance of anticipated high flows during wet years, (2) Districts' irrigation and M&I demands, including flows to maintain water storage in Turlock Lake and Modesto Reservoir, and (3) protection of aquatic resources in the lower Tuolumne River in accordance with the FERC license terms. Once the weekly and daily flow schedules are established based on these demands, then outflows from the Don Pedro powerhouse are scheduled to deliver these flows. During periods of greater electrical demand, outflows may be shaped to generate more electricity during on-peak periods and less during off-peak periods, subject to meeting the requirements of the pre-established flow schedule. In accordance with the Districts' water-first policy, flow releases are scheduled around the three requirements listed above, then delivered via the generation units up to their capacity and availability. Hydropower generation at Don Pedro is a secondary consideration with respect to flow scheduling. Monthly and annual generation at the Don Pedro Project for the period 1997 to 2012 are provided in Table 2.5-3.

CCSF also operates its Hetch Hetchy system under a water-first policy. Flow planning and scheduling is based on water availability for its Bay Area water needs and downstream flow commitments, then secondarily for purposes of hydropower generation.

Table 2.5-3. Monthly and annual generation at the Don Pedro Project for the period 1997 to 2012) in megawatt-hours (MWh).

Year	January	February	March	April	May	June	July	August	September	October	November	December	Calendar Year Total
1997	125,807	112,176	79,403	79,955	91,751	62,960	84,199	64,326	36,628	31,271	9,585	9,543	787,610
1998	56,357	123,068	135,338	125,292	117,338	120,149	120,217	100,448	75,210	40,680	7,151	34,072	1,055,327
1999	44,765	81,324	96,268	41,266	68,889	64,896	76,417	75,500	40,689	31,869	11,881	14,937	648,706
2000	11,795	55,976	110,295	83,714	81,391	71,623	86,957	86,278	48,789	29,422	8,090	12,897	687,232
2001	10,538	30,737	33,242	53,223	72,264	58,898	65,789	54,452	30,734	21,270	4,137	4,900	440,188
2002	5,078	4,258	38,044	61,818	54,412	54,340	66,447	52,811	28,789	18,759	6,073	7,004	397,839
2003	5,394	11,275	25,075	39,599	51,963	65,441	75,800	61,666	32,692	33,134	8,342	6,261	416,648
2004	7,508	12,122	62,984	72,157	58,301	58,788	68,904	54,145	25,451	23,118	4,564	4,401	452,449
2005	12,339	48,759	98,232	137,057	143,776	137,290	122,689	84,792	43,861	22,202	9,831	33,044	893,877
2006	111,668	72,155	125,740	110,498	131,216	124,759	97,386	80,643	46,356	26,151	11,631	8,204	946,413
2007	12,597	15,207	45,087	48,189	54,255	57,215	64,530	53,546	22,956	15,460	7,032	3,779	399,858
2008	3,183	5,562	37,289	43,157	58,311	45,852	54,811	46,689	22,416	11,466	4,646	6,113	339,501
2009	4,911	5,325	21,733	41,083	55,266	56,221	67,625	53,082	28,387	18,050	7,780	5,495	364,964
2010	6,865	7,736	27,539	58,257	119,843	119,846	92,165	70,799	43,904	28,570	19,302	120,918	715,749
2011	114,959	82,977	112,795	109,858	120,545	114,007	105,415	138,488	70,250	29,961	6,913	7,188	1,013,360
2012	32,928	13,185	26,369	27,095	69,323	54,121	66,022	54,510	31,515	17,446	3,900	2,892	399,312
Average	35,418	42,615	67,215	70,764	84,303	79,150	82,211	70,761	39,289	24,927	8,179	17,603	622,440

2.5.7 Total Project Outflows

Once the flow release schedule is established, outflows from the Don Pedro Project are generally released first through the turbine-generator units (up to 5,500 cfs), then the hollow jet valve (either 800 cfs or 3,000 cfs, depending on Unit 4 operation), then through the outlet works (up to 7,500 cfs), and then through the spillways as water levels approach elevation 830 ft. Total Project outflows are recorded for each point of delivery. Flows are also measured at the following downstream locations:

- flows in the lower Tuolumne River are measured at the USGS gage *Tuolumne River at La Grange* located approximately 0.5 mi below the Districts' La Grange diversion dam,
- flows in the TID canal are measured at the entrance to the TID Main Canal, and
- flows to the MID canal are measured at the entrance to the MID Main Canal.

Total Project outflows are the sum of these three measurements. For the WY 1971 to 2012 period, the total Project outflows are shown in Table 2.5-4.

Table 2.5-4. Historical total Don Pedro Project release for the WY 1971 to 2012 (1,000 AF).

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1971	33	9	100	128	93	130	119	120	123	165	153	74	1,247
1972	86	38	50	28	36	150	101	94	129	125	118	64	1,017
1973	68	54	39	37	24	25	86	150	170	187	154	100	1,093
1974	77	43	39	86	64	84	105	161	156	183	176	180	1,354
1975	120	116	138	149	81	104	120	165	169	187	150	140	1,640
1976	134	125	148	121	101	124	144	113	158	162	140	63	1,533
1977	36	35	26	26	14	42	68	16	76	77	69	18	504
1978	7	2	9	5	26	27	120	317	148	186	178	86	1,110
1979	86	109	101	134	151	178	174	133	167	194	163	96	1,686
1980	109	63	65	281	302	377	271	285	264	187	176	197	2,578
1981	137	107	130	122	66	88	138	141	178	183	159	95	1,542
1982	42	34	46	73	163	295	513	520	278	296	207	230	2,697
1983	236	142	327	276	294	410	588	728	455	410	290	323	4,478
1984	288	104	311	367	276	280	174	182	163	180	161	93	2,580
1985	71	76	130	85	62	118	139	132	135	185	142	79	1,354
1986	57	45	62	29	110	387	426	289	246	173	144	100	2,069
1987	117	77	136	49	36	55	133	117	122	127	140	77	1,183
1988	39	43	27	13	9	106	65	40	61	137	61	29	631
1989	8	7	7	6	5	46	132	88	112	155	128	50	745
1990	14	16	24	17	20	70	108	106	104	158	135	45	817
1991	41	13	22	42	20	16	78	127	117	158	141	54	829
1992	48	9	12	16	10	27	129	139	118	143	128	62	840
1993	47	16	16	13	10	40	130	152	149	187	181	139	1,081
1994	87	23	24	41	24	98	135	106	137	159	164	68	1,066
1995	31	15	17	86	251	331	500	572	436	365	207	206	3,018
1996	175	24	24	56	295	348	270	352	187	193	171	106	2,202
1997	98	23	286	828	493	279	195	217	144	205	165	98	3,032
1998	81	29	29	141	364	368	377	291	377	335	219	171	2,783
1999	97	23	86	112	292	259	236	228	153	185	183	108	1,964
2000	81	35	44	35	135	334	195	189	166	199	201	120	1,733
2001	76	25	36	30	79	87	135	180	150	172	148	90	1,208
2002	63	13	16	15	14	100	157	139	141	172	140	83	1,052
2003	56	19	21	16	31	71	106	132	159	186	158	89	1,045
2004	87	24	17	21	33	153	179	148	145	170	143	71	1,189
2005	65	16	14	36	131	308	366	417	358	300	203	114	2,329
2006	63	31	88	301	169	309	489	609	421	226	189	116	3,011

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2007	70	33	22	32	40	112	122	137	148	168	147	67	1,099
2008	47	22	14	12	18	101	117	152	122	148	136	70	960
2009	37	16	20	17	19	61	111	140	142	172	142	82	959
2010	51	23	17	22	23	70	142	271	291	207	168	112	1,398
2011	73	51	292	272	192	358	531	321	424	291	312	170	3,288
2012	77	37	24	79	35	70	70	171	138	170	146	90	1,108
Average	79	42	73	101	110	167	202	216	191	194	163	105	1,644
Min	7	2	7	5	5	16	65	16	61	77	61	18	504
Max	288	142	327	828	493	410	588	728	455	410	312	323	4,478

2.5.8 Don Pedro Reservoir Levels

The Don Pedro Project was constructed for the purposes of providing water storage and flood flow management. The Project is operated to provide water storage sufficient to satisfy annual flow requirements as well as carry-over storage necessary to satisfy water demands for successive dry years. Achieving these primary purposes results in substantial annual and multi-year changes in Don Pedro water levels. The headwater duration curve of the Project, once filling was complete, is provided in Figure 2.5-5.

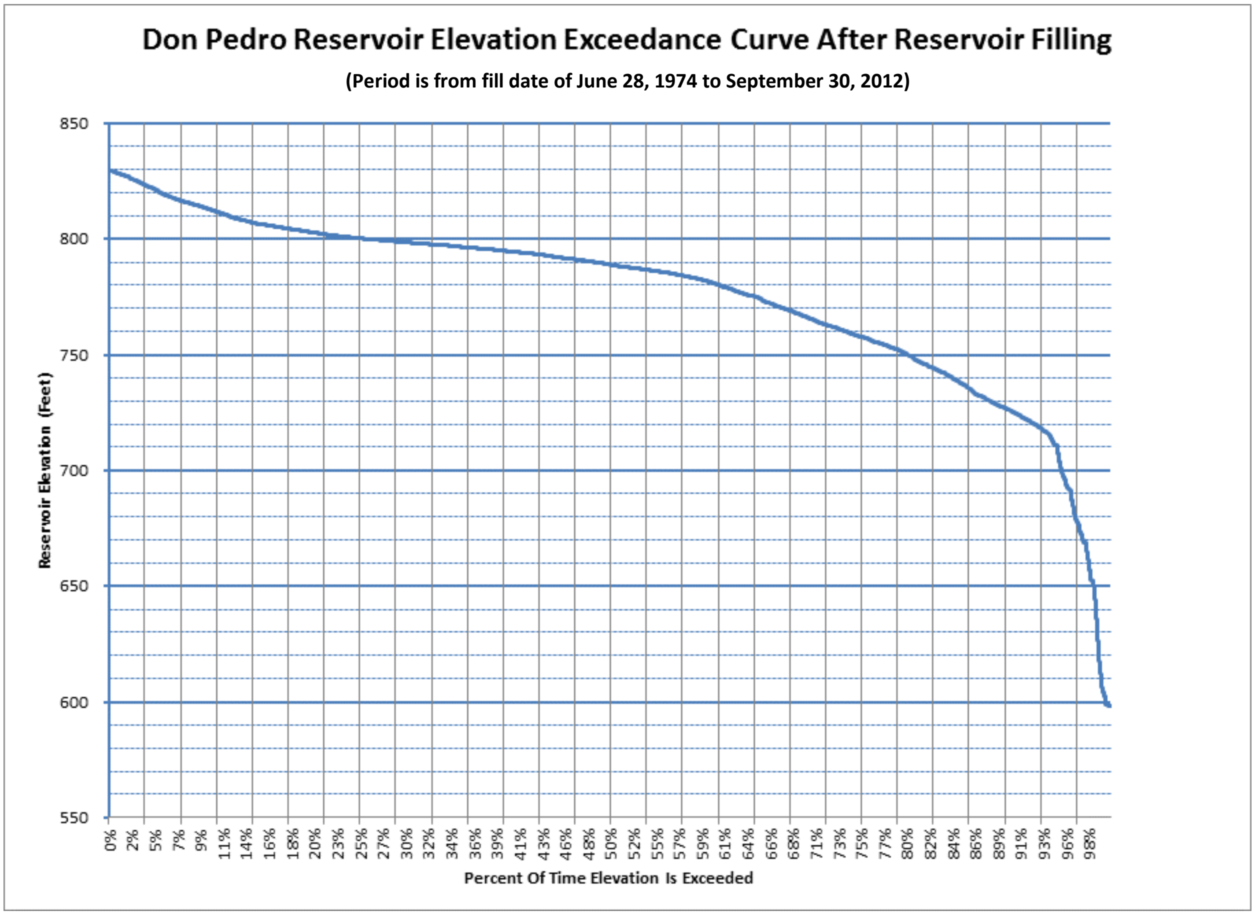


Figure 2.5-5. Don Pedro Reservoir elevation exceedance curve after reservoir filling.

The original gross storage capacity of Don Pedro Reservoir, including storage capacity in old Don Pedro Reservoir, was 2,030,000 AF at elevation 830 ft and 2,300,000 AF at 850 ft mean sea level (NGVD 29)[1]. In 2011, the Districts, as part of their development of a three-dimensional water temperature model of the Don Pedro Reservoir, undertook a reservoir bathymetry study to update the elevation-storage relationship following over 40 years of new Don Pedro Project operations and almost 90 years since the original construction of the old Don Pedro Dam in 1923. The resulting elevation-storage curve is provided in Figure 2.5-6. The bathymetry study found that the reservoir has lost less than one percent of its 2,030,000 AF of storage capacity at

[1] All elevations are NGVD 29.

elevation 830 ft. This is likely due to the character of the watershed above Don Pedro which primarily consists of undisturbed national park and national forest lands and the predominance of shallow soils and durable bedrock.

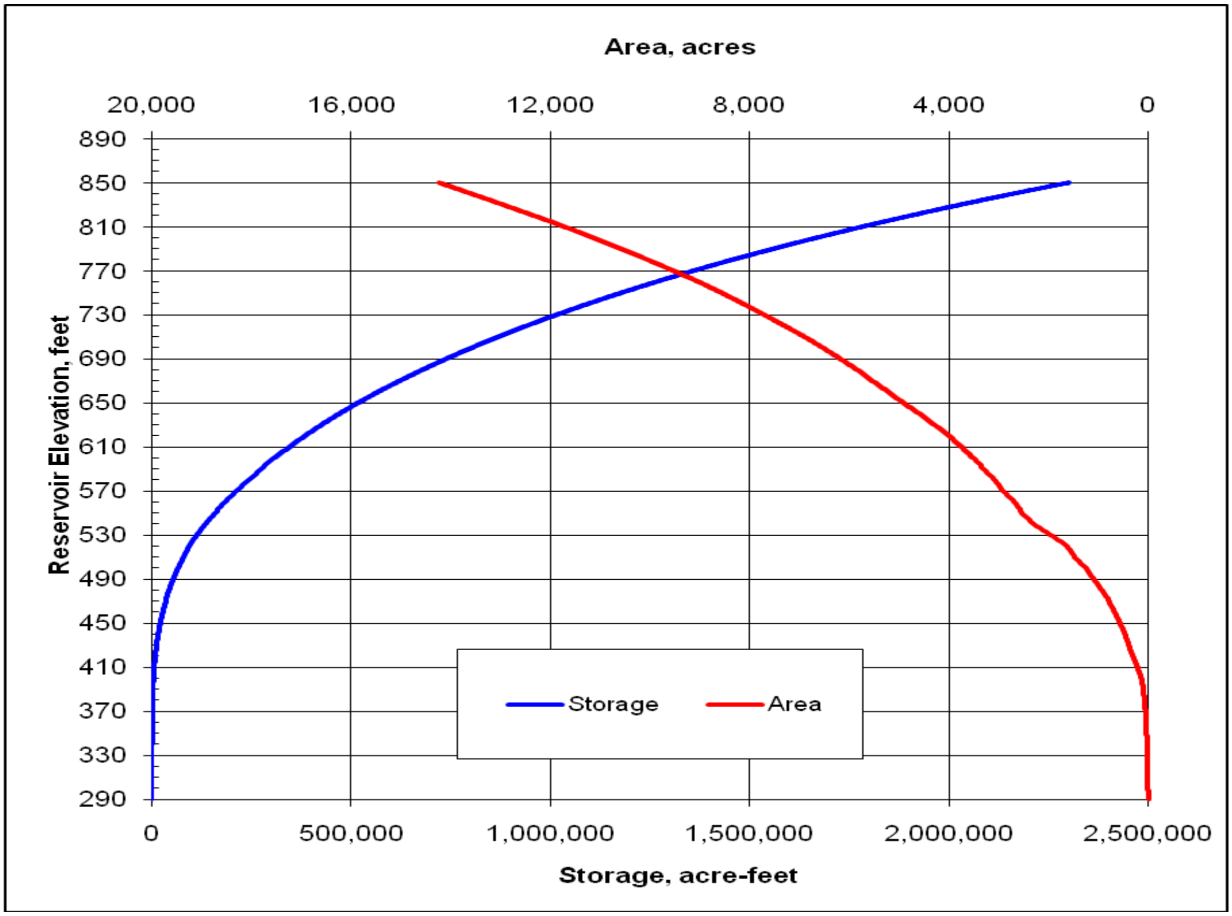


Figure 2.5-6. Don Pedro area-capacity curve.

2.5.9 Reservoir Recreation

Recreational use of the Don Pedro Reservoir is substantial. The recreation facilities included at the Project are operated by the Don Pedro Recreation Agency (DPRA), an agency that is operationally a department within TID and sponsored by the Districts and CCSF. DPRA is responsible for managing the use of all Project lands.

As part of its responsibilities, DPRA manages, operates, and maintains the developed recreation facilities and lake surface facilities. DPRA also manages the campsite reservation system, entry gate administration, and maintenance of all associated facilities (drinking water plant, filtration plant, wastewater treatment plants, and solid waste disposal). DPRA maintains a headquarters building overlooking Don Pedro Dam, just off Bonds Flat Road.

DPRA manages entry points, operation and maintenance of facilities including oversight of concessionaires licensed to provide services on the reservoir. DPRA activities also include some non-recreational management issues such as debris management at the upstream end of the reservoir with collection, corralling, and wintertime disposal of woody debris that collects in the area where the Tuolumne River flows into the reservoir.

Recreation activities at the Don Pedro Reservoir include individual and group activities, organized and spontaneous events for both reserved and at-the-gate participants. Motorized and non-motorized boating, houseboating, camping and RV camping, waterskiing and wakeboarding, jet-skiing, fishing (including scheduled bass tournaments), swimming, and hiking are all recreation opportunities available at Don Pedro.

Typical annual use for the Project exceeds 407,000 visitor days (10 year average, 1999–2008), primarily comprised of use by local area residents from nearby counties (47 percent of use in 2008), and use by Bay Area residents (31.5 percent in 2008).

Dispersed use of the majority of the undeveloped Don Pedro Project shoreline is permitted, including both daytime and overnight use. Use of some shoreline areas is restricted due to conditions such as on-shore hazards or potential for nuisance activity to adjacent property owners. Boat launching is only permitted at the designated launch ramps found in each of the three developed recreation areas.

DPRA maintains shoreline restrooms at five locations in addition to those at the developed recreation areas, and floating restrooms on anchored platforms at six locations throughout the reservoir. Floating restrooms are located in areas with significant recreation but no shoreline or developed services.

2.5.10 Project Operations During Normal, Dry and Wet Years

The Don Pedro Project was developed to provide reliable water storage for the irrigation and M&I water use for the Districts' customers and a water bank to ensure a reliable water supply for CCSF's Bay Area customers. To accomplish the first purpose, sufficient carry-over storage is needed to provide reliable water supplies through drought periods. To accomplish the second purpose, CCSF must maintain a positive balance in the water bank or the Districts must consent to the balance going negative. Subsequent to the implementation of the 1995 settlement agreement, the first full year of which was WY 1997, the Project has witnessed both wet and dry year types. The period WY 2001 through 2004 was relatively dry with total unimpaired flow at La Grange averaging 1.37 million AF per year, or 70 percent of the long-term average. The recent drought of record, 1987 through 1992 inclusive, saw an average annual unimpaired flow of 0.9 million AF over a six year period, or 46 percent of the long term average runoff. The wettest year in the 1997 to 2012 period was WY 2011 with 1998 and 2006 also being wet years. The overall operation of the Project is shown for each year of the 1997 through 2012 period by calendar year in Figures 2.5-7 through 2.5-22.

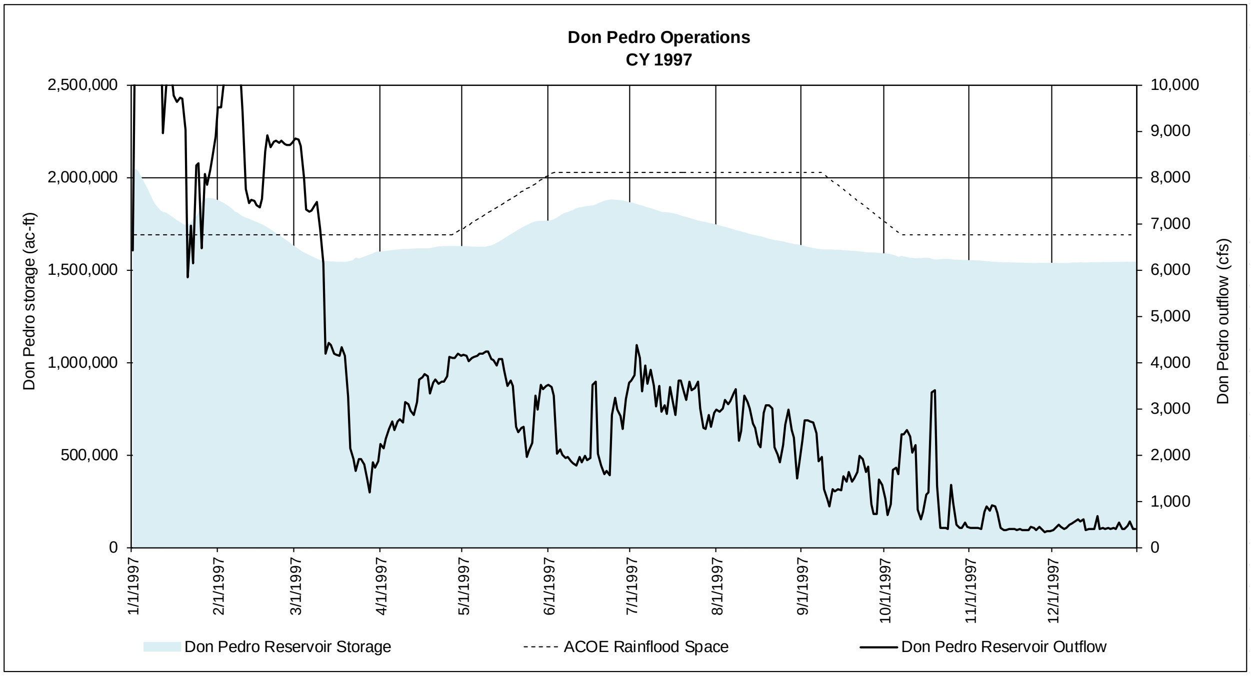


Figure 2.5-7. Don Pedro Project operations – 1997.

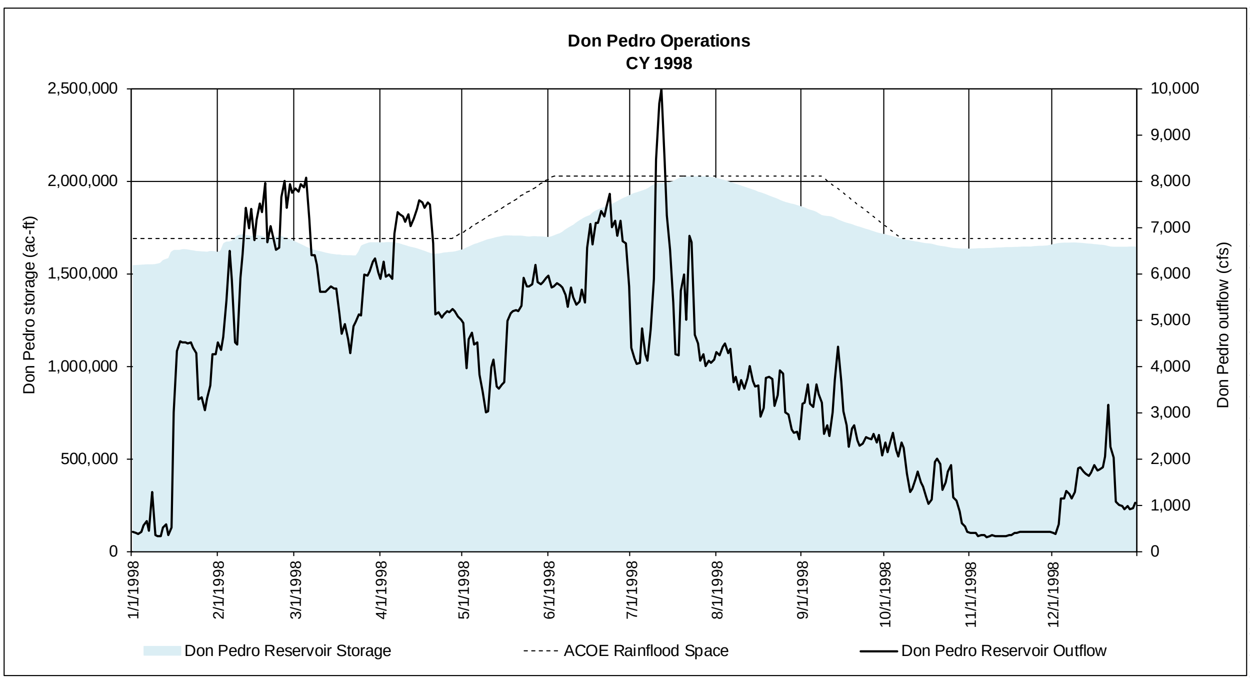


Figure 2.5-8. Don Pedro Project operations – 1998.

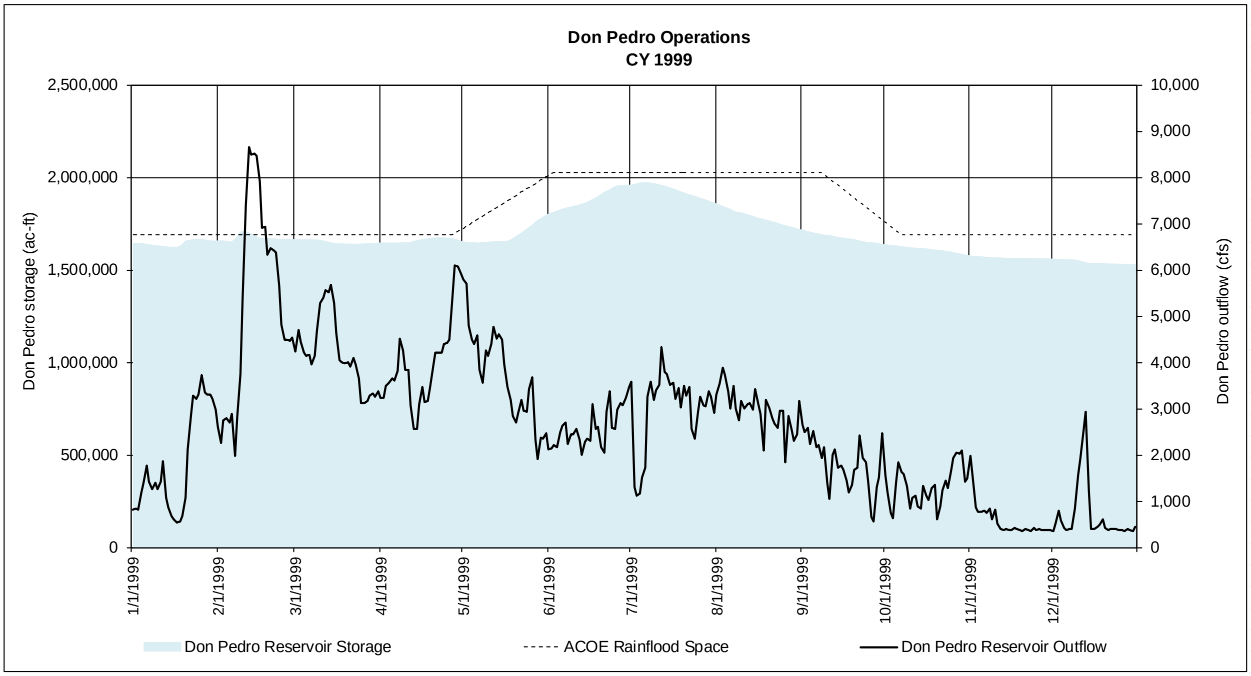


Figure 2.5-9. Don Pedro Project operations – 1999.

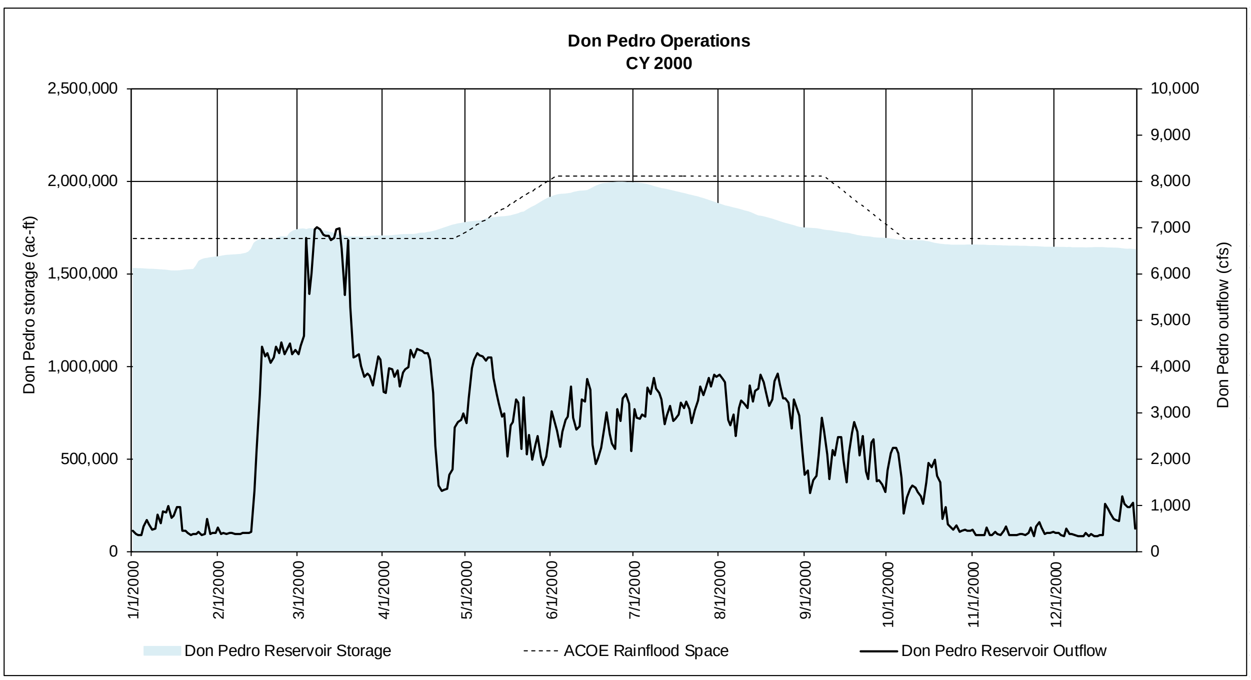


Figure 2.5-10. Don Pedro Project operations – 2000.

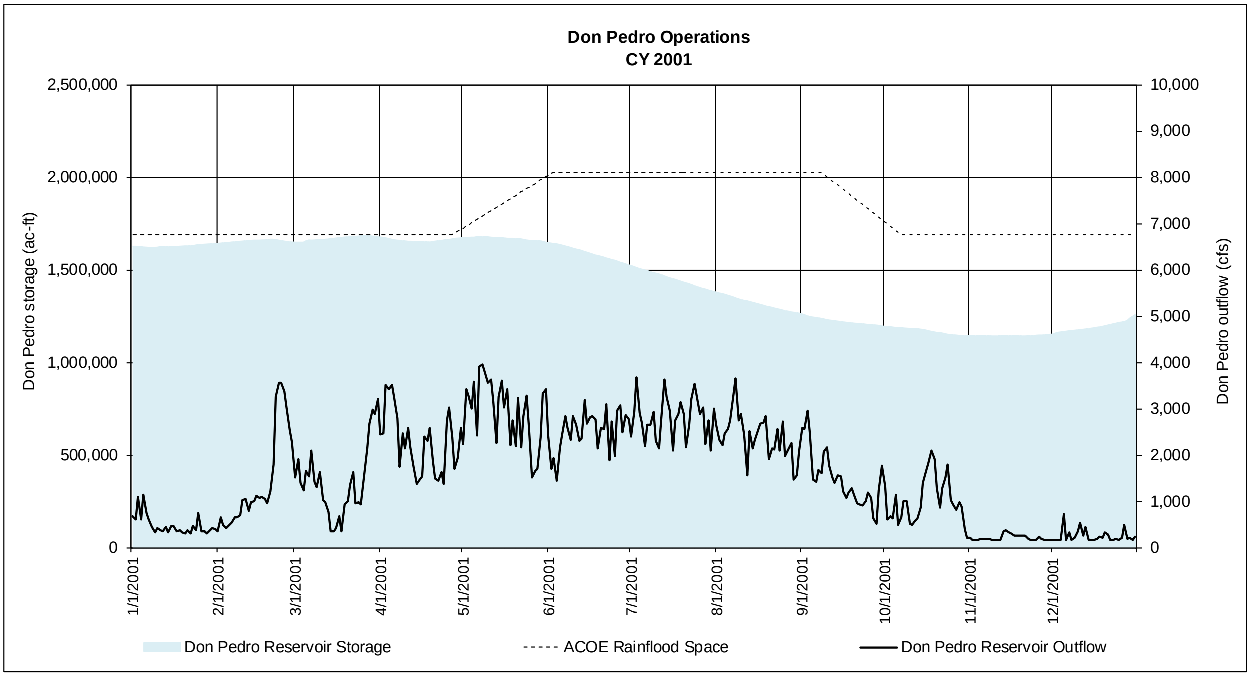


Figure 2.5-11. Don Pedro Project operations – 2001.

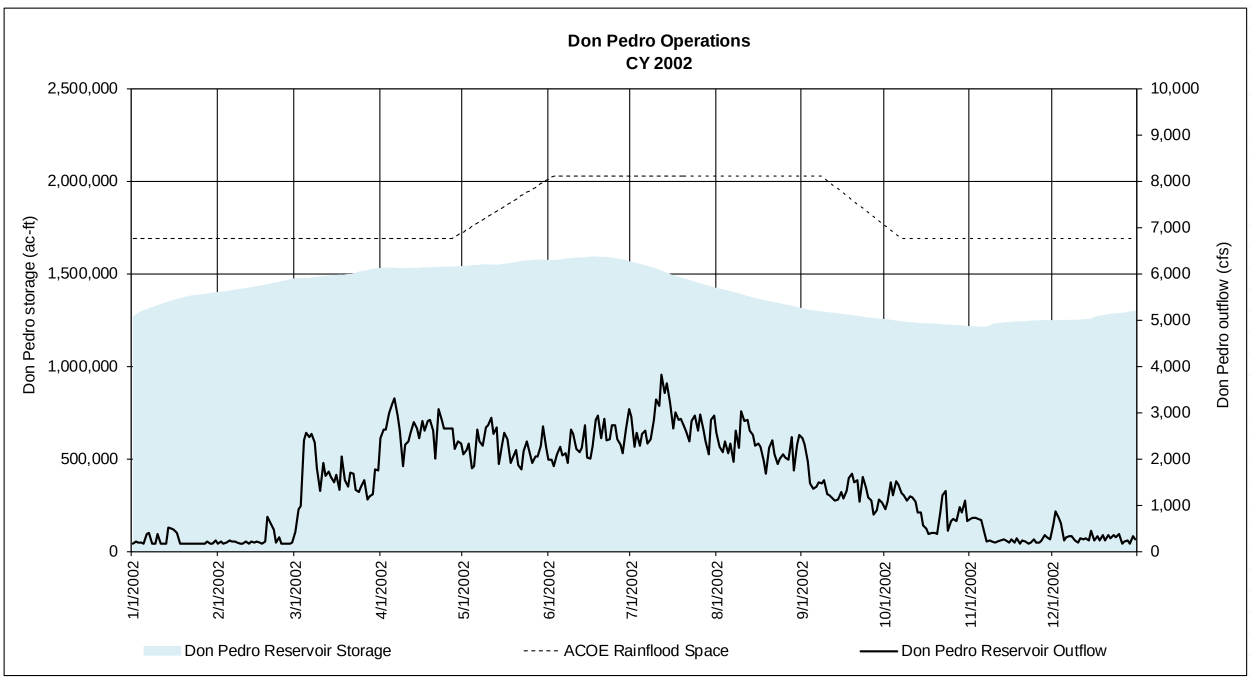


Figure 2.5-12. Don Pedro Project operations – 2002.

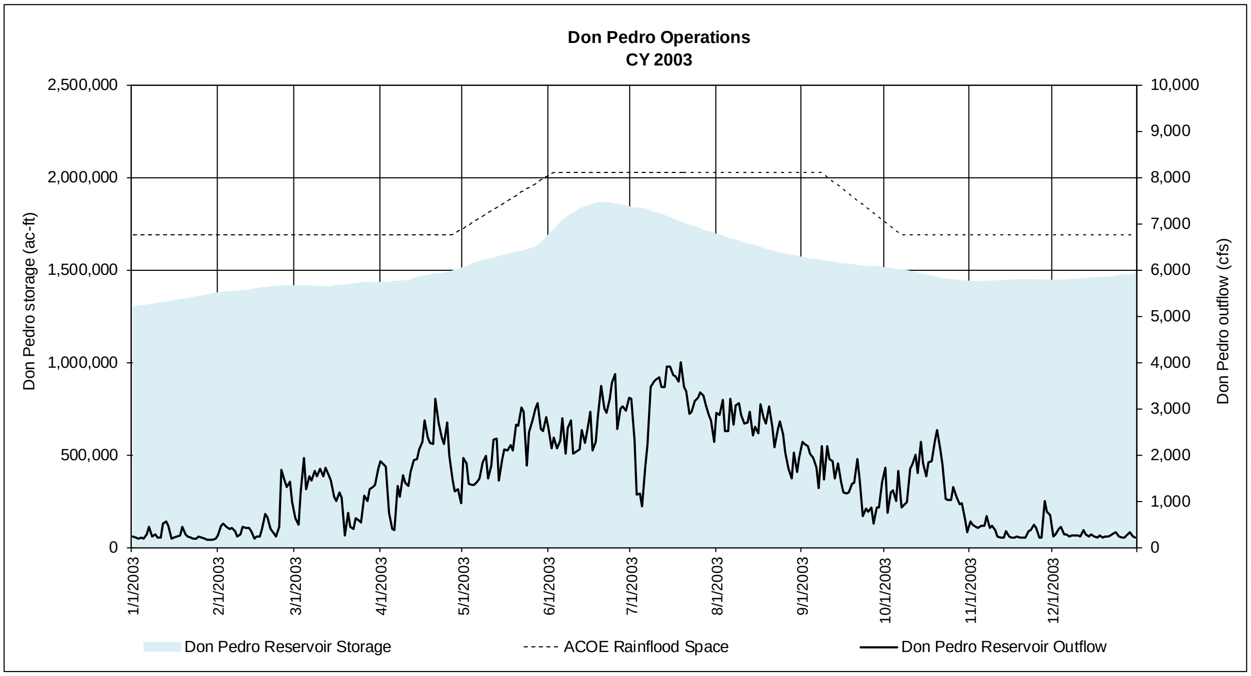


Figure 2.5-13. Don Pedro Project operations – 2003.

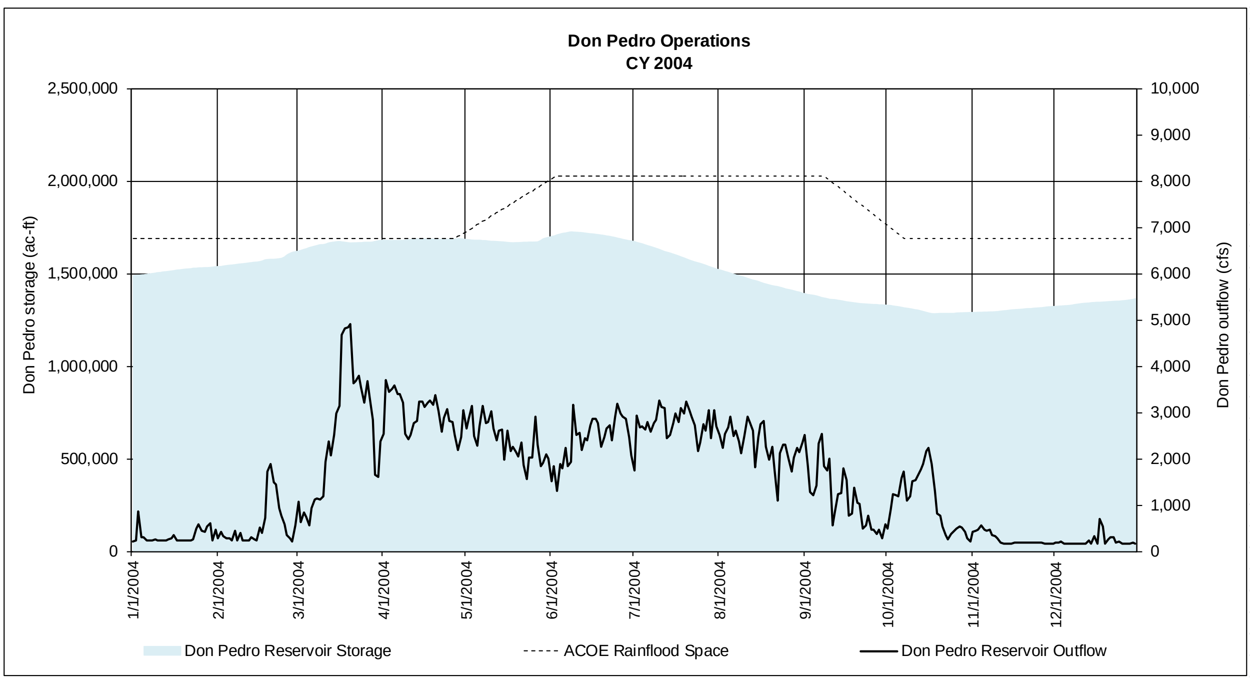


Figure 2.5-14. Don Pedro Project operations – 2004.

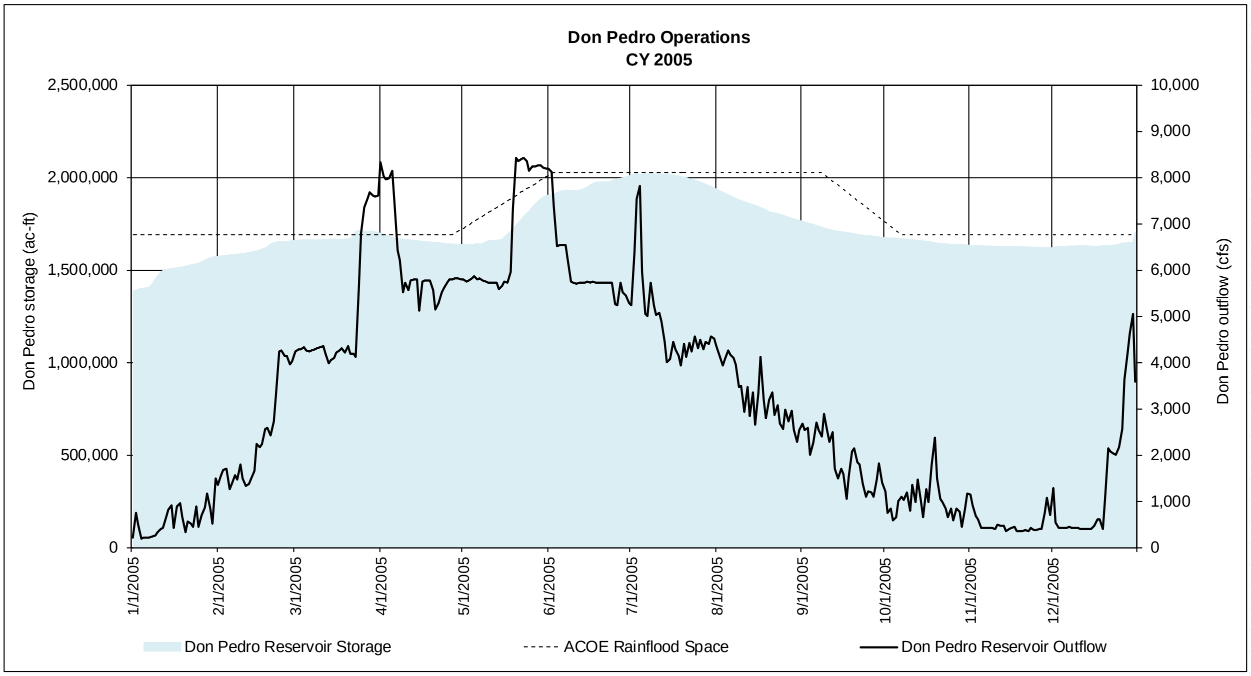


Figure 2.5-15. Don Pedro Project operations – 2005.

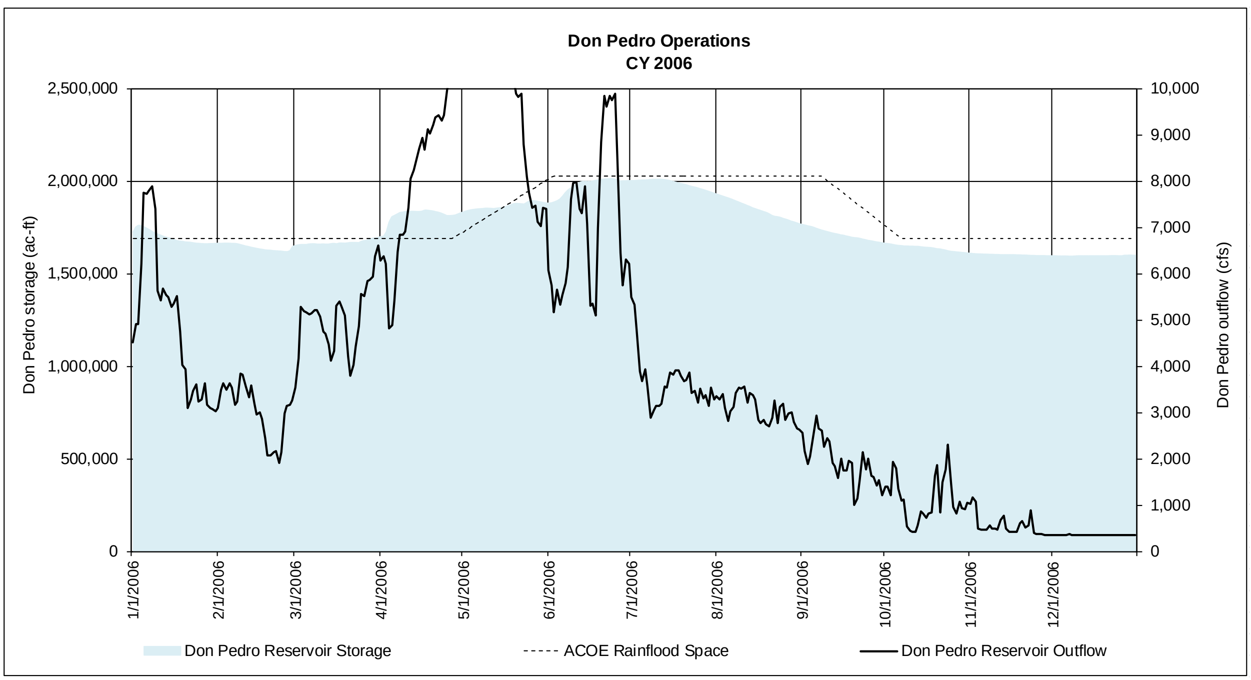


Figure 2.5-16. Don Pedro Project operations – 2006.

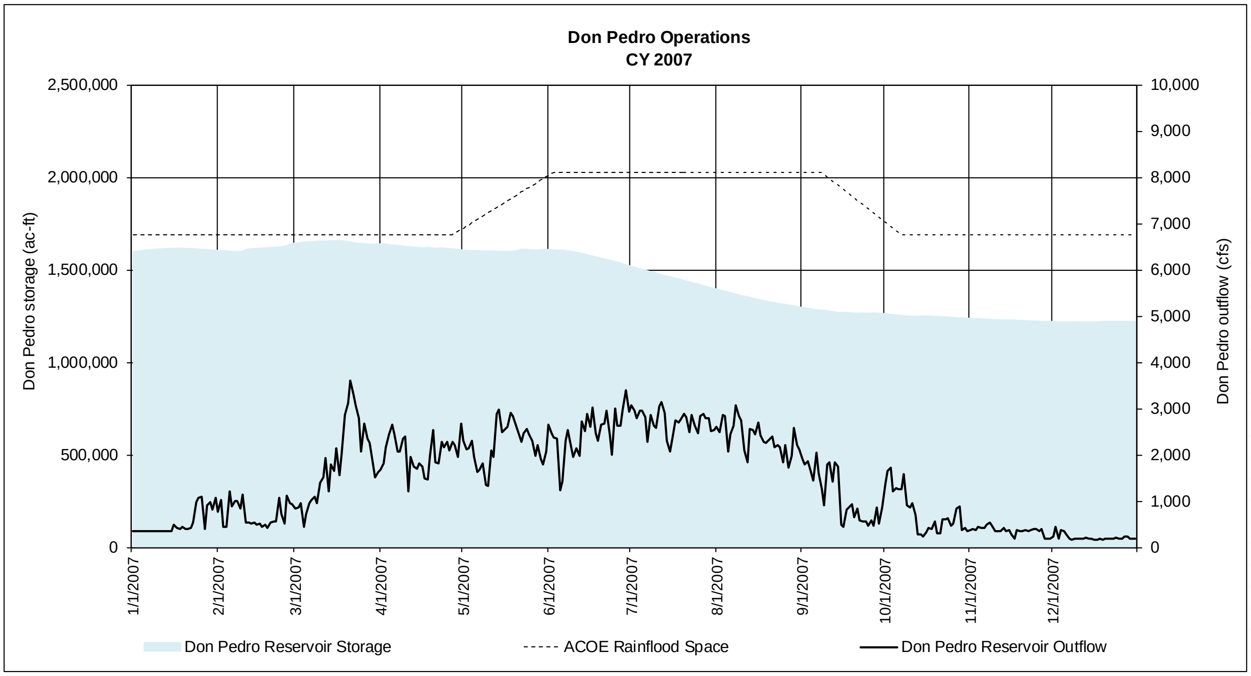


Figure 2.5-17. Don Pedro Project operations – 2007.

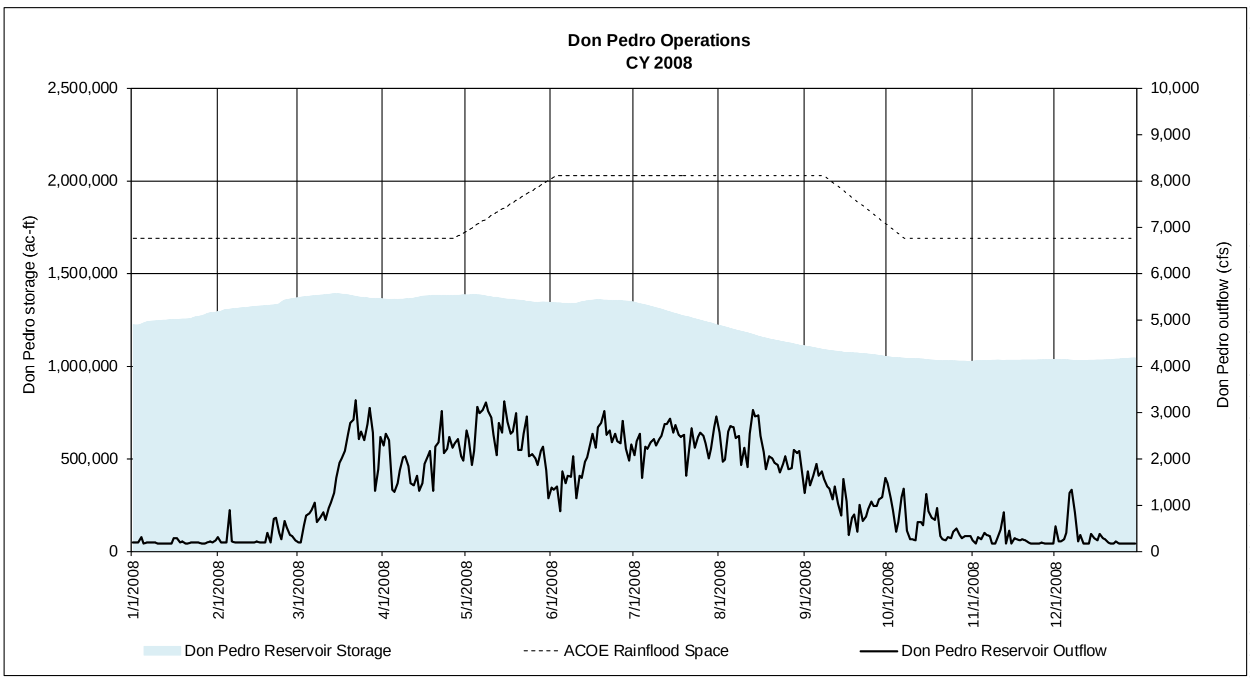


Figure 2.5-18. Don Pedro Project operations – 2008.

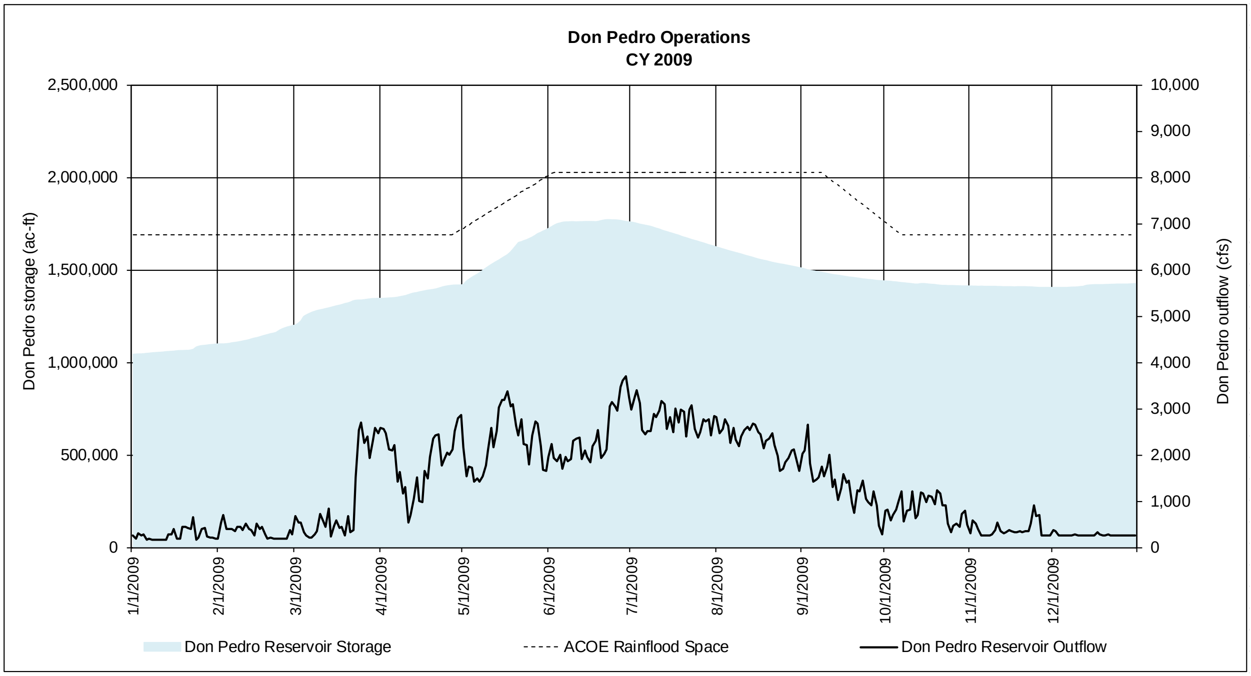


Figure 2.5-19. **Don Pedro Project operations – 2009.**

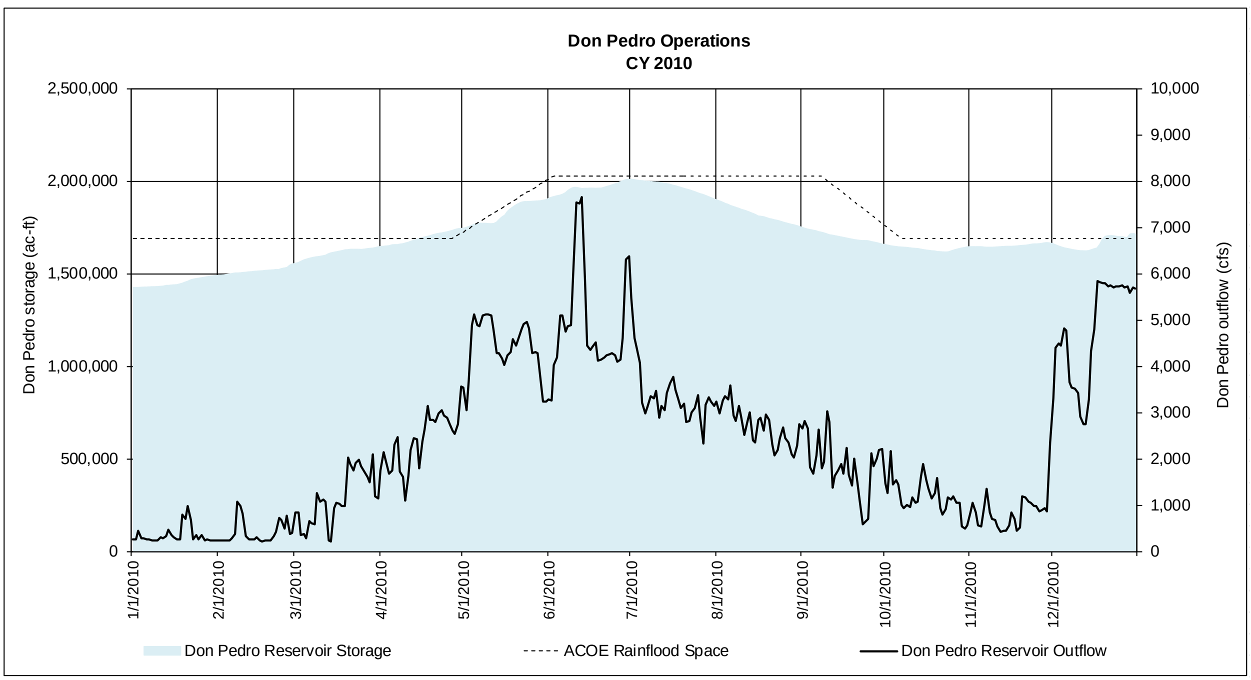


Figure 2.5-20. **Don Pedro Project operations – 2010.**

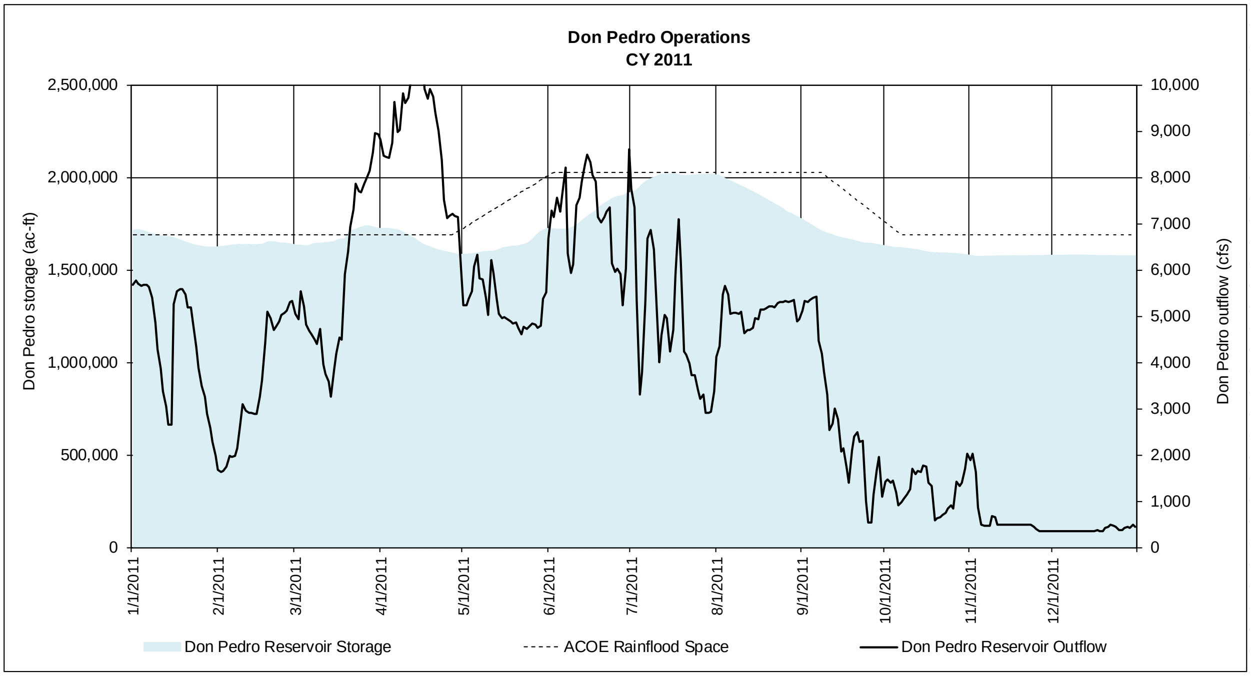


Figure 2.5-21. **Don Pedro Project operations – 2011.**

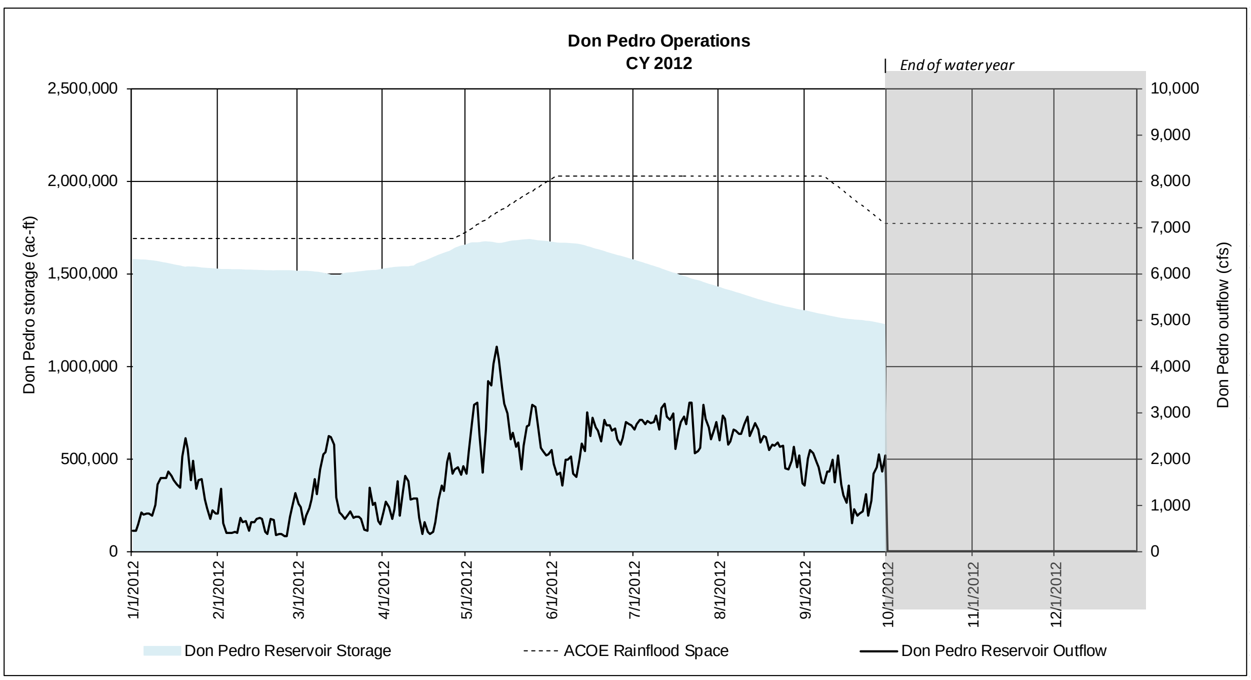


Figure 2.5-22. **Don Pedro Project operations – 2012.**

2.6 Tuolumne River Operations Model

2.6.1 Model overview

As part of the relicensing process for the Project, the Districts developed the Tuolumne River Operations Model. The purpose of the Operations Model is to (1) represent the base case or "no action" alternative in the FERC relicensing process and (2) enable the analysis of the effects of potential changes to current operations to evaluate the effects of potential alternative operating conditions. As part of the development of the Operations Model, a series of six (6) separate Workshops were held with relicensing participants to enhance the collaborative development of the model. There were two Workshops devoted to hydrology and the remaining four focused on interim points in model development (i.e., model description, architecture, and configuration; model validation; base case description, and training in the use of the model).

In order to properly represent the base case conditions and the potential effects due to changes to current operations, all the affected benefits of the Don Pedro Project must be incorporated into the base case. This not only includes all the operations of the Don Pedro Project, but also the affected critical water supply operations of CCSF's Hetch Hetchy system. Therefore, the Tuolumne River Operations Model geographic scope extends from CCSF's O'Shaughnessy Dam and Hetch Hetchy Reservoir on the upper Tuolumne to the river's confluence with the San Joaquin River, inclusive of CCSF's Cherry and Eleanor dams and reservoirs on Cherry Creek, a tributary of the Tuolumne River. The modeled system is shown on Figure 2.6-1.

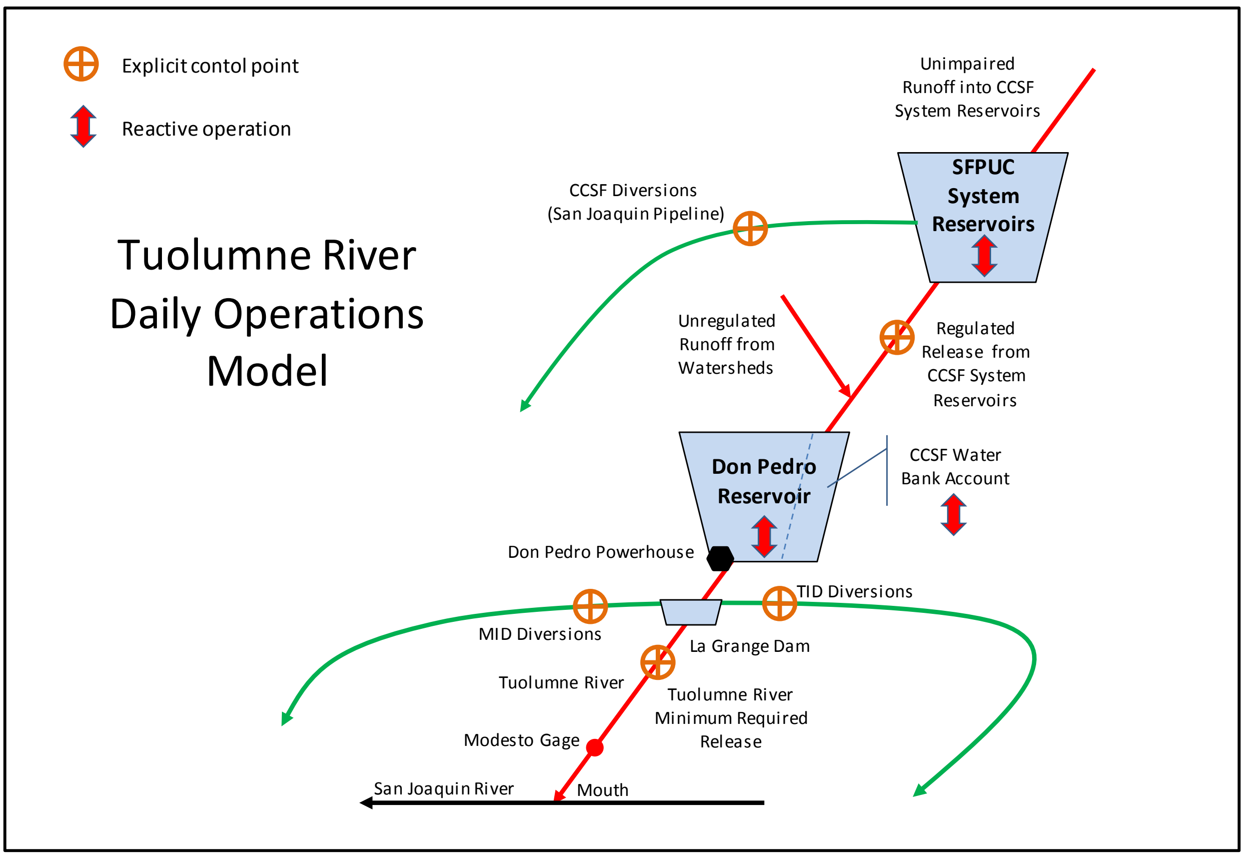


Figure 2.6-1. Tuolumne River daily operations model.

To represent the base case, the Operations Model fully depicts the current demands, regulatory requirements, and operational policies of the Districts' and CCSF's Hetch Hetchy water storage and delivery systems. The model uses an Excel platform for ease of use and complete transparency. The Model comprises two primary subsystems, the Districts' Don Pedro Project and CCSF's Hetch Hetchy Project, which are independently owned and operated by the respective parties. The Don Pedro Project includes the Don Pedro Reservoir and powerhouse. Water that flows into Don Pedro Reservoir is either stored or passed through to the lower Tuolumne River. Also included in the model is the diversion of water at the Districts' La Grange diversion dam to serve irrigation and M&I customers of MID and TID. A model "node" (calculation point) is provided at La Grange diversion dam, where the model simulates flows to the Modesto Canal, the Turlock Canal, and the lower Tuolumne River. A node is also provided to represent the location of the existing USGS stream flow gage entitled *Tuolumne River at Modesto*. Additional nodes may be established above and/or below the Modesto gage node depending on users preferences.

The CCSF System is modeled as three physical reservoirs (Hetch Hetchy Reservoir, Lake Lloyd and Lake Eleanor), the San Joaquin Pipeline that provides water to the Bay Area, and an accounting for the Don Pedro Water Bank Account. All releases from the CCSF System, except those diverted to the San Joaquin Pipeline, enter Don Pedro Reservoir.

The model components operate with systematic algorithms that attempt to mimic operational decisions for reservoir and facility operations. For each subsystem, certain operation constraints can be user-controlled consistent with the FERC-approved study plan. Within each subsystem, each reservoir has the same underlying operation protocol. A daily mass balance is performed: change in reservoir storage = inflow minus outflow (releases) minus reservoir losses. If the calculation results in a reservoir storage that is in excess of preferred/maximum capacity, an additional release is made.

Minimum releases for each modeled reservoir are in accordance with current stream flow requirements and diversion requirements. Each reservoir assumes a common "hold-unless-need-to-release" protocol, except as conditioned by minimum stream release requirements, diversions, preferred/maximum storage, snowmelt management releases, or other specified releases. In essence, each reservoir operates for its own "reservoir conservation" goal and retains storage as much as possible, only drawn down as needed to meet release requirements, diversions, or to achieve reservoir or flow management goals such as flood control.

2.6.2 Model Hydrology

Inflow to Don Pedro Reservoir was developed for the WY 1971–2012 period. It consists of two basic components: (1) a fluctuating unregulated inflow to Don Pedro Reservoir, and (2) the regulated releases from the CCSF System. The inflow will reflect a daily fluctuating pattern mostly associated with the unregulated component of runoff, which amounts to approximately 40 percent of the total runoff in the basin. The unregulated component of inflow to Don Pedro Reservoir remains the same among all operation simulations. The regulated inflow to Don Pedro is based on the operations for the CCSF System. This component of Don Pedro Reservoir inflow may change among operation simulations due to changed flow requirements for the CCSF System demands, or due to user-controlled parameters.

The final model hydrology was based on a collaboration among the Districts and relicensing participants. The selected approach was to develop a flow record for the Tuolumne River using a combination of gauge proration to develop daily flows while conforming to the underlying monthly mass balances developed using existing, reliable reservoir level and outflow data in order to maintain conservation of mass principles over the monthly time steps. Gauged data from both the Tuolumne River and nearby drainages were considered in the gauge proration portion of the analysis. In order to prorate the gauged data to a larger ungauged area, three physical variables were considered – elevation, drainage area, and average annual precipitation (precipitation). Each gauged basin, along with each application basin (Hetch Hetchy, Cherry/Eleanor, and Unregulated), was divided into 100 ft “elevation bands” for its entire drainage area. This was done using USGS National Elevation Dataset, 1/3 arc-second, which equates to about a 30-foot pixel size. Each elevation band for each gauge had attributes added for the drainage area within this band (e.g., the number of mi^2 of the Tuolumne River drainage that exists between elevation 500 and 600 ft) and precipitation (e.g. the average annual precipitation for the drainage area between elevation 500 and 600 ft).

The Oregon Climate Service’s PRISM model was employed to estimate average annual precipitation from 1971–2000 (PRISM 2006) for each of the elevation bands represented by the basins being evaluated (elevation from 100 to 13,000 ft). PRISM uses the observed precipitation gauge and radar data network, in conjunction with an orographic precipitation and atmospheric model, to develop an estimate of average annual precipitation for the contiguous United States at a pixel size resolution of 2,500 ft. Bi-linear interpolation was used to resample the PRISM values to the same pixel size as the elevation model.

Areas at low elevations and high elevations in each of the application basins that were poorly represented or not represented at all by the reference gauges were added into the elevation distributions of the most representative gauges in order to provide some amount of coverage for those elevation ranges. The proration calculation includes two main steps. First, the daily flow for a given gauge is divided across the elevation range that the gauge represents, in equal proportion to the drainage area represented within each 100-foot elevation band. Second, the sum of each of the individual “elevation band flows” for each gauge is scaled up to the area of that elevation band in the application basin. Each of these steps includes a scaling factor for both area and precipitation.

This method for development of the unimpaired hydrology and its results are explained in detail in Appendix B-2 of this Exhibit B and were previously described to relicensing participants in the Districts’ April 9, 2013 submittal to FERC entitled *Districts Response to Relicensing Participants Comments on the Initial Study Report (Attachment 2).* A comparison of the 1997 through 2012 historical flows and the modeled base case flows are provided in Appendix B-3.

2.6.3 Model Simulation of Districts’ Operation of Don Pedro Project

The components of the model depicting the current operation of the Project included all of the reservoir operations related to water management, including irrigation and M&I use, flood flow management, and providing downstream flows in accordance with current FERC requirements. To represent the Districts’ canal demands, a methodology utilizing estimates of recent agricultural land use within the Districts and current MID municipal and industrial water demands was employed. This methodology was chosen because it is consistent with California’s statewide water plan modeling practices. The model also incorporated the most recent data available from the Districts related to water use as contained in TID's and MID's 2012 filings with the State of California entitled *Agricultural Water Management Plans* as required by state regulations. The depiction of the irrigation water system demand is provided in Figure 2.6-2 below.

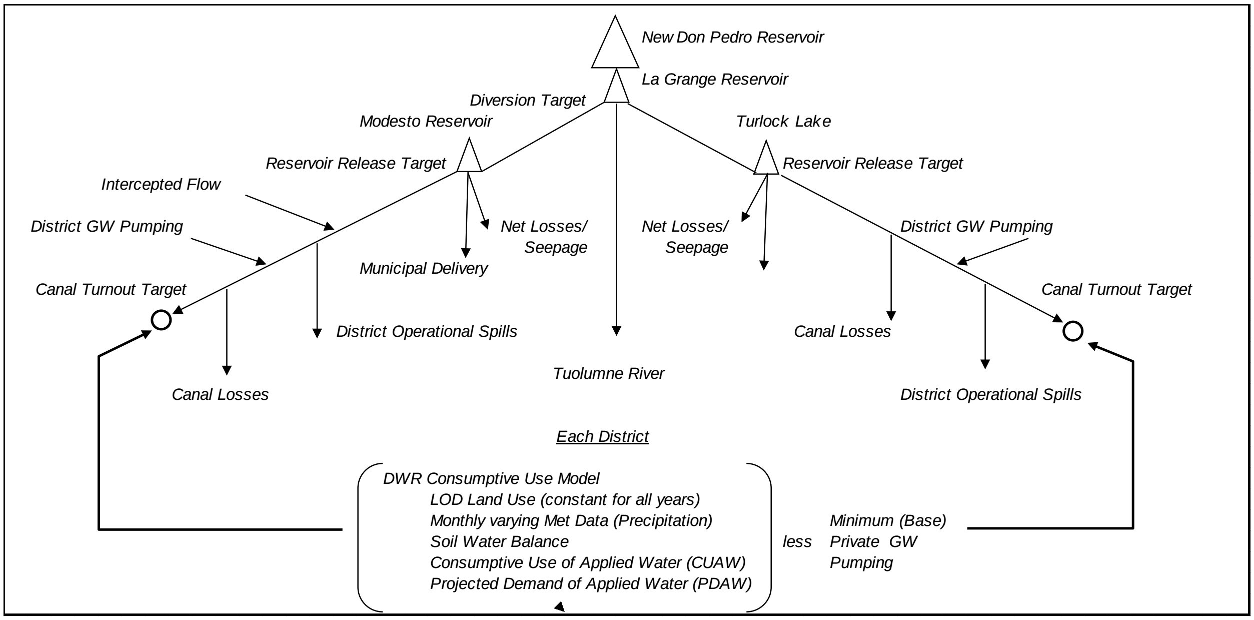


Figure 2.6-2. District canal demand parameters.

Due to changing land use and cropping patterns, groundwater use and irrigation and canal management practices throughout history, the historical record of recorded diversions does not always provide a consistent definition of water diversion needs. Similar to depicting inflow, the Model uses a consistent level of development for establishing irrigation and canal diversion demand, reflective of recent data. The canal diversions are driven by three components: (1) a fluctuating customer component, the Projected Demand of Applied Water (PDAW) that varies year to year and month to month, (2) a relatively constant depiction of District and land owner system losses and efficiencies, and (3) a water supply availability factor based on Don Pedro Reservoir storage and inflow. The PDAW is developed through use of the CDWR consumptive use model, and considers precipitation, ET rates, soil moisture criteria, rooting depth, irrigation indicators, and other factors along with land use to estimate the consumptive use of applied water (CUAW) on a monthly basis. A complete description of the methods employed are provided in this Exhibit B – Appendix B-4: Model Description and User's Guide.

Don Pedro operations also include management of flood flows consistent with the ACOE Flood Control Manual and the guide curve provided in Figure 2.5-1 above. During the relicensing process, the Districts explored the potential to modify the ACOE guideline of maintaining flows at Modesto below 9,000 cfs. The ACOE indicated that it would not agree to any such modification.

The Operations Model also includes the most recent requirements of the Don Pedro Project related to providing flows to the lower Tuolumne River. These flow requirements were discussed in Section 2.5.5 of this exhibit. The Operations Model also incorporates the Don Pedro hydropower generation resulting from flow releases to meet these other requirements.

2.6.4 Model Simulation of City and County of San Francisco System

The Operations Model representation of the CCSF System on the Tuolumne River includes the three physical reservoirs (Hetch Hetchy Reservoir, Lake Lloyd and Lake Eleanor), diversions to the Bay Area through the San Joaquin Pipeline, and an accounting for the Don Pedro Water Bank Account. The CCSF System is illustrated in Figure 2.6-3, with detail provided for the components of explicitly modeled hydrologic parameters.

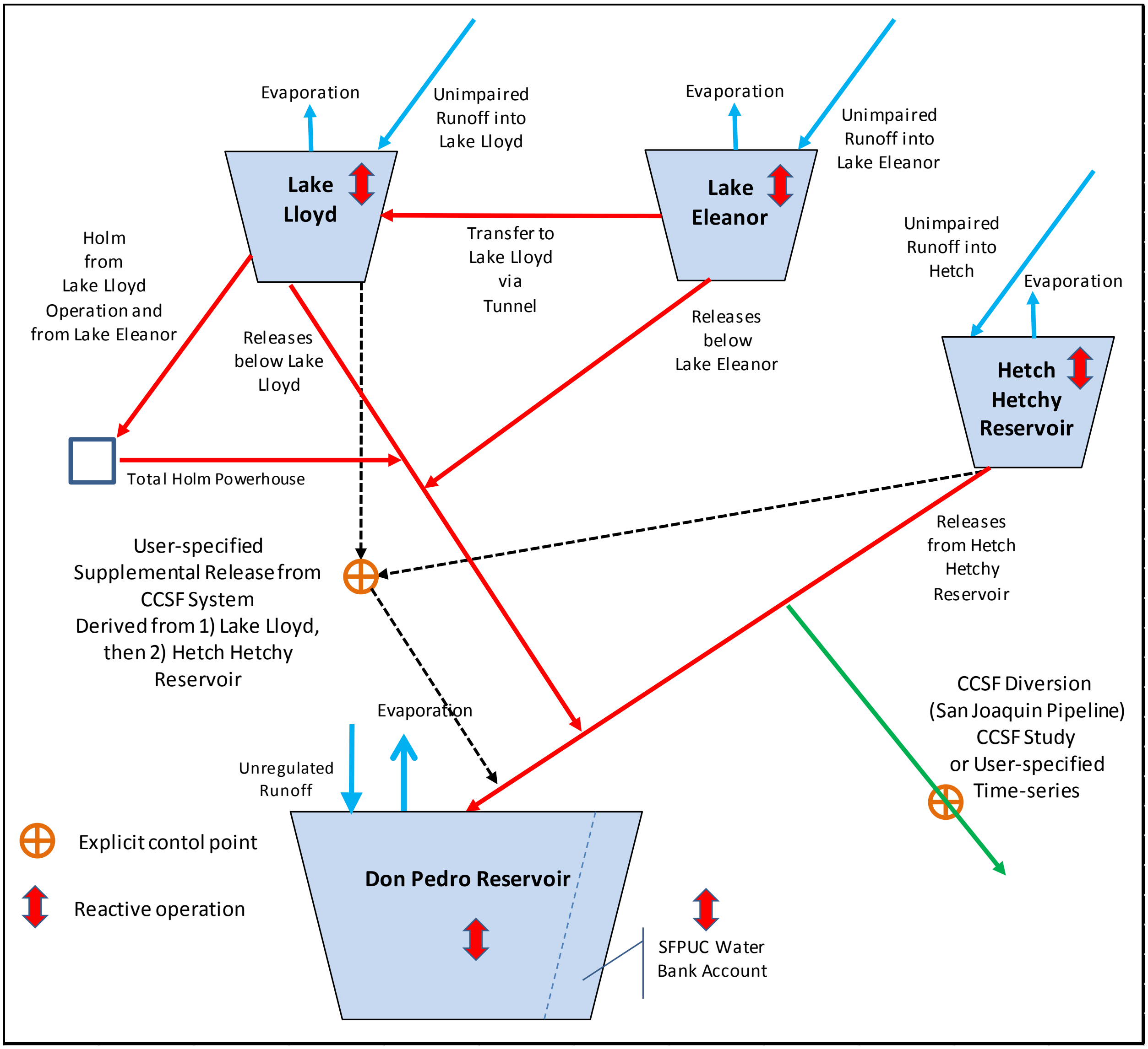


Figure 2.6-3. City and County of San Francisco's Hetch Hetchy system.

Each CCSF System reservoir has the same underlying operation protocol. A daily mass balance is performed: change in reservoir storage = inflow minus outflow (releases) minus reservoir losses. If the calculation results in reservoir storage exceeding preferred/maximum capacity, an additional release of water is made. Each reservoir assumes a common "hold-unless-need-to-release" protocol, except as conditioned by minimum release requirements, diversions, preferred/maximum storage, snowmelt management releases, hydropower, or other flow or management objectives. In essence, each reservoir operates for its own "reservoir conservation" goal of retaining storage unless drawn down by demands or reservoir management objectives. CCSF is required by State law and its Charter to operate its system for "water first".

A full description of model design related to CCSF's system is provided in this Exhibit B – Appendix B-4.

2.6.5 Model Base Case

To represent the base case, the Operations Model fully depicts the current demands, regulatory requirements, and operational policies of the Districts' and CCSF's Hetch Hetchy water storage and delivery systems. The base case model is a simulation used (1) to represent current Tuolumne River operating conditions and (2) for comparison to other alternative operating scenarios. Graphical representation of operations under the base case from 1971 to 2012 are provided in Appendix B-5.

2.7 Proposed Future Project Operations

The Districts are not proposing any changes to Project operations at this time as several studies continue to be performed by the Districts and reviewed by relicensing participants. The Final License Application (FLA) may contain proposals for future Project operations.

3.0 RESOURCE UTILIZATION

3.1 Existing Powerhouse Hydraulic Capacity

As discussed previously, hydropower generation at the Don Pedro Project occurs as a consequence of other demands for water releases. In fact, if hydropower did not exist at the Project, there would be essentially no change in the day-to-day operations of the Project. Clean, renewable hydropower generation is, however, a valuable benefit of the Project. The average annual generation from the Project since 1997 to 2012 period was 535,000,000 kilowatt hour (kWh) of electricity. The current maximum hydraulic capacity of the four turbines is 5,500 cfs and the current FERC-authorized capacity is 168 MW.

3.2 Powerhouse Capability versus Head

The output of the four turbines at Don Pedro varies with the available head at the Project. Table 3.2-1 and Table 3.2-2 show the current units capabilities.

Table 3.2-1. Don Pedro Units 1, 2, and 3 turbine performance characteristics.

Net Head (ft)	Flow (cfs)	Turbine Output (hp)	Generator Output (MW)	Turbine Efficiency
530	545	24,000	17.2	73.5%
530	800	39,000	29.08	81.3%
530	1,000	51,300	38.26	85.6%
530	1,200	65,200	48.62	90.6%
530	1,350	75,000	55.93	92.7%
530	1,510	85,000	63.39	93.9%
450	400	14,500	10.81	71.2%
450	600	24,650	18.38	80.7%
450	800	34,900	26.03	85.7%
450	1,000	45,550	33.97	89.5%
450	1,200	56,800	42.36	93.0%
450	1,400	67,150	50.07	94.2%
450	1,579	75,000	55.93	93.3%
450[1]	1,641	77,700	57.94	93.0%
375	400	12,350	9.21	72.8%
375	600	20,400	15.21	80.2%
375	800	29,100	21.70	85.8%
375	1,000	38,300	28.56	90.3%
375	1,200	47,300	35.27	92.9%
375	1,400	55,100	41.09	92.8%
375	1,460	56,800	42.36	91.7%

[1] Head at nameplate rating.

Table 3.2-2. Don Pedro Unit 4 unit performance characteristics.

Net Head (ft)	Flow (cfs)	Turbine Output (hp)	Generator Output (MW)	Turbine Efficiency
500	210	6,793	4.43	57.0%
500	485	22,707	16.47	82.5%
500	725	36,618	26.74	89.0%
500	940	50,678	37.05	95.0%
500	1000	53,629	39.21	94.5%

Net Head (ft)	Flow (cfs)	Turbine Output (hp)	Generator Output (MW)	Turbine Efficiency
425	185	4,908	3.20	55.0%
425	440	17,404	12.57	82.0%
425	650	27,592	20.10	88.0%
425	850	38,132	27.86	93.0%
425	1010	45,797	33.48	94.0%
425	1155	50,700	37.07	91.0%
275	310	5,080	3.31	52.5%
275	475	10,082	7.00	68.0%
275	625	14,728	10.57	75.5%
275	770	19,587	14.15	81.5%
275	890	22,640	16.42	81.5%

3.3 Tailwater Rating Curve

Tailwater elevation varies as a function of plant flow and is primarily used for determination of the turbine cavitation limit and total available head. Tailwater levels, provided in Figure 3.3-1, were estimated by extrapolating the index test data noted in the April 2005 Hydraulic Conveyance Review. Using a relatively flat extrapolation gives a conservative estimate of maximum power output since the cavitation characteristics will be a more dominant factor than headloss.

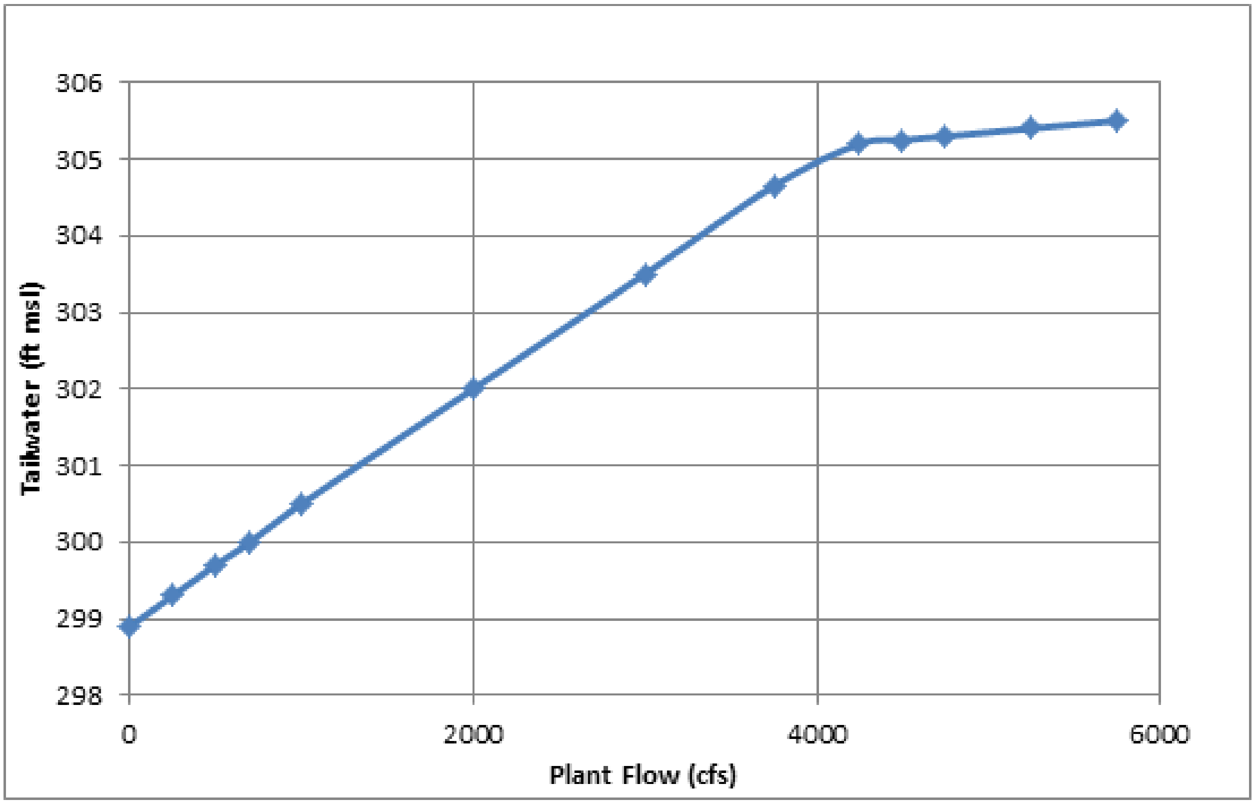


Figure 3.3-1. Don Pedro powerhouse tailwater rating curve.

3.4 Average Annual Energy Production

Historical monthly and annual energy production from 1997 to 2012 are provided in Table 3.4-1.

3.5 Estimate of Dependable Capacity

The dependable capacity at the plant varies with the available head. At 530 ft of head, the dependable capacity is 220 MW, at 450 ft it is 203 MW and at 375 ft it is 187 MW. Linear interpolation can be used to approximate dependable capacity between these heads.

Table 3.4-1. Monthly Project generation for 1997 through 2012 at Don Pedro powerhouse (in MWh).

Year	January	February	March	April	May	June	July	August	September	October	November	December	Calendar Year Total
1997	125,807	112,176	79,403	79,955	91,751	62,960	84,199	64,326	36,628	31,271	9,585	9,543	787,610
1998	56,357	123,068	135,338	125,292	117,338	120,149	120,217	100,448	75,210	40,680	7,151	34,072	1,055,327
1999	44,765	81,324	96,268	41,266	68,889	64,896	76,417	75,500	40,689	31,869	11,881	14,937	648,706
2000	11,795	55,976	110,295	83,714	81,391	71,623	86,957	86,278	48,789	29,422	8,090	12,897	687,232
2001	10,538	30,737	33,242	53,223	72,264	58,898	65,789	54,452	30,734	21,270	4,137	4,900	440,188
2002	5,078	4,258	38,044	61,818	54,412	54,340	66,447	52,811	28,789	18,759	6,073	7,004	397,839
2003	5,394	11,275	25,075	39,599	51,963	65,441	75,800	61,666	32,692	33,134	8,342	6,261	416,648
2004	7,508	12,122	62,984	72,157	58,301	58,788	68,904	54,145	25,451	23,118	4,564	4,401	452,449
2005	12,339	48,759	98,232	137,057	143,776	137,290	122,689	84,792	43,861	22,202	9,831	33,044	893,877
2006	111,668	72,155	125,740	110,498	131,216	124,759	97,386	80,643	46,356	26,151	11,631	8,204	946,413
2007	12,597	15,207	45,087	48,189	54,255	57,215	64,530	53,546	22,956	15,460	7,032	3,779	399,858
2008	3,183	5,562	37,289	43,157	58,311	45,852	54,811	46,689	22,416	11,466	4,646	6,113	339,501
2009	4,911	5,325	21,733	41,083	55,266	56,221	67,625	53,082	28,387	18,050	7,780	5,495	364,964
2010	6,865	7,736	27,539	58,257	119,843	119,846	92,165	70,799	43,904	28,570	19,302	120,918	715,749
2011	114,959	82,977	112,795	109,858	120,545	114,007	105,415	138,488	70,250	29,961	6,913	7,188	1,013,360
2012	32,928	13,185	26,369	27,095	69,323	54,121	66,022	54,510	31,515	17,446	3,900	2,892	399,312
Average	35,418	42,615	67,215	70,764	84,303	79,150	82,211	70,761	39,289	24,927	8,179	17,603	622,440

4.0 POTENTIAL FUTURE DEVELOPMENT

The Districts are presently investigating the potential for increasing the output and efficiency of the exiting Units 1 through 4 at the plant. The results of these studies will be provided in the FLA.

5.0 LITERATURE CITED

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DON PEDRO PROJECT
FERC NO. 2299

DRAFT LICENSE APPLICATION

EXHIBIT B - PROJECT OPERATIONS AND RESOURCE UTILIZATION

APPENDIX B-1
CURRENT LICENSE ARTICLES

This section describes the current FERC license terms most relevant to relicensing and a brief history of license additions, modifications, and compliance. The initial license order was issued by FERC on March 10, 1964 (FERC 1964); however, filings with FERC followed the original license order and, according to the license text, the license would not become active until accepted by the Districts (EES 2006; FPC 1964.) The Districts did not formally accept the license until May 1, 1966. The current license expires on April 30, 2016 (EES 2006).

The license is composed of two basic types of license articles: the Standard Form L-2 articles (Articles 1 through 33), and the Project-specific articles (Articles 34 through 58). Since issuance, several articles of the license have been deleted, modified, or added to the license. Articles 6 and 12 were Standard Form L-2 license articles deleted in the FPC March 10, 1964 issuing order. Article 7 was deleted slightly later on May 10, 1964 in the FPC order denying rehearing and Article 46 was deleted from the license on April 29, 1993. Articles 49 and 50 were added to the license in 1980; Articles 51 through 58 were added to the license in February of 1987 with the order approving the addition of a fourth unit to the Don Pedro powerhouse.

The current license has 54 active articles. Table 1 provides a table of the general subject matter of the active license articles for the Don Pedro Project. Some license articles are considered expired or out of date, often because the article was added to the license at a certain point in time and the activity specified within them has occurred or been completed.

The text of the license terms and conditions deemed most relevant to relicensing are provided below.

Article 10. The Licensee shall, for the conservation and development of fish and wildlife resources, construct, maintain and operate, or arrange for the construction, maintenance and operation of such facilities and comply with such reasonable modifications of the project structures and operation as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any State in which the project or a part thereof is located, after notice and opportunity for hearing and upon findings based on substantial evidence that such facilities and modifications are necessary and desirable, reasonably consistent with the primary purpose of the project and consistent with the provisions of the Act.

Article 11. Whenever the United States shall desire, in connection with the project, to construct fish and wildlife facilities or to improve the existing fish and wildlife facilities at its own expense, the Licensee shall permit the United States or its designated agency to use, free of cost, such of Licensee's lands and interests in lands, reservoirs, waterways and project works as may be reasonably required to complete such facilities or such improvements thereof. In addition, after notice and opportunity for hearing, the Licensee shall modify the project operation as may be prescribed by the Commission reasonably consistent with the primary purpose of the project, in order to permit the maintenance and operation of the fish and wildlife facilities constructed or improved by the United States under the provisions of this article. This article shall not be interpreted to place any obligation on the United States to construct or improve fish and wildlife facilities or to relieve the Licensee of any obligation under license.

Article 13. So far as consistent with proper operation of the project, the licensee shall allow the public free access to a reasonable extent, to project waters and adjacent project lands owned by the Licensee for the purpose of full public utilization of such lands and waters for navigation and recreational purposes, including fishing and hunting, and shall allow to a reasonable extent for such purposes the construction of access roads, wharves, landings, and other facilities on its lands the occupancy of which may in appropriate circumstances be subject to payment of rent to the Licensee in a reasonable amount; Provided that the Licensee may reserve from public access, such portions of the project water adjacent lands, and project facilities as may be necessary for the protection of life, health, and property, and Provided further that the Licensee's consent to the construction of access roads, wharves, landings and other facilities shall not, without its express agreement, place upon the Licensee any obligation to construct or maintain such facilities. These facilities are in addition to the facilities that the Licensee may construct and maintain as required by the Licensee.

Table 1. Subject matter of the active license articles for the Don Pedro Project.

Article #	Topic	Article # (con't.)	Topic
1	General	31	Abandonment of Project
2	FERC approval of changes to exhibits, maps, articles	32	Occupancy of lands of the United Stated after license expiration
3	FERC approval of changes to Project works	33	Applicability of Federal Power Act terms and conditions
4	FERC inspection and supervision	34	Commencement of construction
5	Operations related to storage and use of water	35	Project Boundary Maps and Land Ownership
6	(*deleted March 1964 - cost determination*)	36	Reservoir clearing
7	(*deleted May 1964 - rate of return*)	37	Fish flows (revised in 1996 and in 2009)
8	FERC instruction to install additional capacity	38	Flood control (revised in 1999)
9	Coordination with others if ordered by FERC	39	Fish studies
10	Construction of fish and wildlife protective devices by the Districts	40	FERC orders on operations changes related to water temperature
11	Construction of fish and wildlife protective devices by U.S.	41	Free passage of water through original Don Pedro Dam
12	(*deleted March 1964 - Recreation facilities*)	42	Gravel and sediment management
13	Public access to Project waters and permitting of roads, docks, piers, etc.	43	Flood control agreement.
14	Prevention of erosion and siltation	44	Transmission lines
15	Lease of Project lands	45	Recreation facilities plan
16	Filing of maps to show Project Boundary	46	(*deleted 1993 - Lands*)
17	Approval of facilities by U.S. land management agency	47	Annual charges and installed capacity (revised in 1987, 1989, and 1995)
18	Public safety related to location of transmission and telephone lines, etc.	48	Storage allocation agreement with CCSF
19	Avoidance of inductive interference	49	Cultural resources (*added 1980*)
20	Clearing of transmission line rights-of-way on U.S.-owned lands	50	Granting permission for use of Project lands (*added 1980*)
21	Clearing of reservoir margins	51	Construction erosion and dust control plan (*added 1987*)
22	Fire prevention	52	Woody debris removal plan (*added 1987*)

Article #	Topic	Article # (con't.)	Topic
23	Use of water for fire prevention, sanitary and domestic needs on U.S.-owned lands	53	Wards Ferry Bridge restroom facilities (*added 1987*)
24	Construction liability	54	Addition of fourth generating unit (*added 1987*)
25	Permits for use of U.S.-owned lands for transportation and communication	55	Filing of drawings for fourth generating unit (*added 1987*)
26	Takeover of Project roads	56	The Districts' approval and filing of cofferdam and excavation drawings (*added 1987*)
27	Ownership of Project property	57	Filing of revised Exhibit Drawings (*added 1987*)
28	Gaging and stream gaging	58	Chinook monitoring program (*added 1987, revised in 1996, 1999, and 2009*)
29	Surrender of license due to non-compliance		
30	Headwater benefits		

Article 28. For the purpose of determining the stage and flow of the stream or streams from which water is diverted for the operation of the project works, the amount of water held in and withdrawn from storage, and the effective head on the turbines, the Licensee shall install and thereafter maintain such gages and stream-gaging stations as the Commission may deem necessary and best adapted to the requirements; and shall provide for the required readings of such gages and for the adequate rating of such stations. The Licensee shall also install and maintain standard meters adequate for the determination of the amount of electric energy generated by said project works. The number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, shall at all times be satisfactory to the Commission and may be altered from time to time if necessary to secure adequate determinations, but such alteration shall not be made except with the approval of the Commission or upon the specific direction of the Commission. The installation of gages, the ratings of said stream or streams, and the determination of the flow thereof, shall be under the supervision of, or in cooperation with, the District Engineer of the United States Geological Survey having charge of stream-gaging operations in the region of said project, and the Licensee shall advance to the United States Geological Survey the amount of funds estimated to be necessary for such supervision or cooperation for such periods as may be mutually agreed upon. The Licensee shall keep accurate and sufficient record of the foregoing determinations to the satisfaction of the Commission, and shall make return of such records annually at such time and in such from as the Commission may prescribe.

Article 37. *Amended by 76 FERC 61,117,7/31/96*

The Licensees shall maintain minimum streamflows in the Tuolumne River at La Grange bridge (RM 50.5) for fish purposes in accordance with the table and schedules set forth below or with such schedules as may be agreed to among the Licensees, the CDFG and the USFWS. Any such schedules shall be available for public review at the licensee's offices. These flows may be temporarily modified if required by operating emergencies beyond the control of the Licensees.

Water Year Classification[1]	Cumulative Occurrence	Freq.	60-20-20 Index (1906-1995)
Critical Water Year and below	〈6.4	6.4	1500 TAF
Median Critical Water Yr.	6.4 - 14.4	8.0	1500
Inter. C-D Water Year	14.4 - <20.5	6.1	2000
Median Dry	20.5 - <31.3	10.8	2200
Intermediate D-BN	31.1 - <40.4	9.1	2400
Median Below Normal	40.4 -<50.7	10.3	2700
Intermediate BN-AN	50.7 -<66.2	15.5	3100
Median Above Normal	66.2 - <71.3	5.1	3100
Intermediate AN-W	71.3 - <86.7	15.4	3100
Median Wet/Maximum	86.7 - 100	13.2	3100

[1]The fish flow year is defined as April 15 through April 14 of the following year. The water year is defined as October 1 through September 30.

The water year classification shall be determined using the California State Water Resources Control Board's San Joaquin Basin 60-20-20 Water Supply Index and the California Department of Water Resources' (Water Resources Department) April 1 San Joaquin Valley unimpaired runoff forecast. The 60-20-20 index numbers used each year shall be updated to incorporate subsequent water years pursuant to standard Water Resources Department procedures so as to maintain approximately the same frequency distribution of water-year types. The volume of annual flow shall be periodically readjusted upon agreement among the Licensees, CDFG, and USFWS after April 1 of each year as more current unimpaired flow information becomes available.

Between a Median Critical Water Year and an Intermediate Below Normal-Above Normal Water Year, the precise volume of flow to be released by the Licensees each fish flow year is to be determined using accepted methods of interpolation between index values given above.

Schedule Occurrence	Days	Critical & below 6.4%	Median Critical 8.0%	Interim CD 6.1%	Median Dry 10.8%	Interm D-BN 9.1%	Median Below Normal 10.3%	Interm BN-AN 15.5%	Median Above Normal 5.1%	Interm AN-W 15.4%	Median Wet-Max 13.3%
October 1-15	15	100 cfs 2,975 AF	100 cfs 2,975 AF	150 cfs 4,463 AF	150 cfs 4,463 AF	180 cfs 5,355 AF	200 cfs 5,950 AF	300 cfs 8,926 AF	300 cfs 8,926 AF	300cfs 8,926 AF	300 cfs 8,926 AF
Attraction Pulse	--	none	none	none	none	1,676 AF	1,736 AF	5,950 AF	5,950 AF	5,950 AF	5,950 AF
October 16-May 31	228	150 cfs 67,835 AF	150 cfs 67,835 AF	150 cfs 67,835 AF	150 cfs 67,835 AF	180 cfs 81,402 AF	175 cfs 79,140 AF	300 cfs 135,669 AF	300 cfs 135,669 AF	300 cfs 135,669 AF	300 cfs 135,669 AF
Out-migration Pulse Flow	--	11,091 AF	20,091 AF	32,619 AF	37,060 AF	35,920 AF	60,027 AF	89,882 AF	89,882 AF	89,882 AF	89,882 AF
June 1-Sept. 30	122	50 cfs 12,099 AF	50 cfs 12,099 AF	50 cfs 12,099 AF	75 cfs 18,149 AF	75 cfs 18,149 AF	75 cfs 18,149 AF	250 cfs 60,496 AF	250 cfs 60,496 AF	250 cfs 60,496 AF	250 cfs 60,496 AF
Volume (AF.)	365	94,000	103,000	117,016	127,507	142,502	165,002	300,923	300,923	300,923	300,923

If, as provided for under Article 37 as amended above, the Licensees, the CDFG, and the USFWS agree to a minimum flow release schedule differing from the schedule set forth in Article 37, the Licensees shall notify the Commission of the revised flow schedule within 30 days of the date of the agreement to change the flow schedule. If the project flow releases are temporarily modified as required by operating emergencies beyond the control of the Licensees, as provided under Article 37, the Licensees shall notify the Commission of the flow modifications within 30 days of the date of the temporary flow release change.

FERC further amended this article in 128 FERC 61,035 issued on July 16, 2009 as follows:

(G) Article 37 of the license for the Don Pedro Project, issued March 10, 1964, and amended July 31, 1996 (Ordering Paragraphs (D) and (E), Turlock and Modesto Irrigation District, 76 FERC 61,117) is amended to add the National Marine Fisheries Service as an agency to be consulted on any changes to the minimum flow release schedule for the project.

Article 38. *Amended by 89 FERC 62,247, 12/23/99: (Amended December 23, 1999)*

Flows below La Grange bridge may be altered by the licensees at any time in connection with the operation of the Project for flood control purposes or other emergencies provided that if such flood control operations are required, flows shall be made to meet the requirements of the U.S. Army Corps of Engineer's (Corps) approved Water Control Plan, Water (Flood) Control Diagram, and the Emergency Spillway Release Diagram or an approved deviation from these documents. The licensees shall take reasonable measures to ensure that releases from the project do not cause the flow in the Tuolumne River at the Modesto gage below Dry Creek to exceed 9,000 cubic ft per second unless otherwise agreed to by the Corps. After flood control criteria within the reservoir have been met, the licensees shall reduce the releases from the project as soon as it is reasonably practicable to do so.

Subject to the provisions of paragraph (a) so long as fluctuation do not result in reduction of flows below those in the applicable schedule prescribed in article 37, or such higher minimum daily flows as may be established in the 45-day period of November 5 to December 20 (or such other 45 day period between October 15 through December 31, as may be specified on two weeks prior notice by the California Department of Fish and Game, fluctuations may be made at any time); *Provided*:

(1) Fluctuations shall be controlled as closely as possible during such 45-day period so as not to cause a daily increase of river height in excess of 10 inches; *Provided*, however, for a period of not to exceed two hours per day, the increase may exceed 10 inches but not more than a total of 18 inches.
(2) From the end of such 45-day period until March 31 reduction in river height shall not exceed four inches below the average height established in the 45-day period, excluding heights reached as a consequence of the daily fluctuation in excess of 10 inches provided in paragraph (b)(1) and those resulting under paragraph (a).

(B) In the report required by Article 58, the licensees shall describe any implemented flood control measures or other efforts to change the flood way or flood control operational guidelines for this project during the reporting period.

Article 39. *Order Modifying Opinion No,420 and Denying Applications for Rehearing, issued May 6, 1964. Substitute the following for original Article 39 language:*

The Licensees in cooperation with the California Department of Fish and Game and the Department of the Interior shall make necessary studies aimed at assuring continuation and maintenance of the fishery of the Tuolumne River in the most economical and feasible manner. Such studies shall be completed prior to the end of the 20-year period for which minimum stream flows have been provided in Article 28.

The Licensees shall develop in cooperation with the California Department of Fish and Game and the Department of the Interior a program for making such studies and for financing their cost. The program shall be submitted for Commission approval within one year from the effective date of this license.

Article 40. In the event water temperatures during the critical months of the spawning season are too high for successful salmon spawning, the Licensees and the California Department of Fish and Game shall confer to determine whether project operations may be adjusted to assist in correcting the situation. If no agreement can be reached, the Commission, upon request and after notice and opportunity for hearing, may order such adjustment as it finds to be necessary and desirable, reasonably consistent with the primary purpose of the project.

Article 43. The Licensees shall, prior to commencement of construction of the New Don Pedro project works, enter into an agreement with the Secretary of the Army or his designated representative providing for the operation of the project for flood control in accordance with rules and regulations prescribed by the Secretary of the Army. A conformed copy of the agreement shall be filed with the Commission for its information and records prior to commencement of construction of the project works.

Article 45. The Licensees shall construct, maintain and operate or shall arrange for the construction, maintenance and operation of such recreational facilities including modification thereto, such as access roads, wharves, launching ramps, beaches, picnic and camping areas, sanitary facilities and utilities, as may be prescribed thereafter by the Commission during the term of this license upon its own motion or upon the recommendation of the Secretary of the Interior or interested State agencies, after notice and opportunity for hearing and upon findings based upon substantial evidence that such facilities are necessary and desirable, and reasonably consistent with the primary purposes of the project. The Licensees shall within one year from the date of issuance of the license, file with the Commission for approval of their proposed recreational use plan for the project. The plan shall be prepared after consultation with appropriate Federal, State, and local agencies, and shall include recreational improvements which may be provided by others in addition to the improvements the Licenses plan to provide.

Article 46. *Deleted by Order Deleting Article 46, 4-29-93.*

Article 47. The licensees shall pay to the United States the following annual charges:

(*Revised by errata notice dated 8/28/89 - Installed capacity changed to 222,800 hp.*)

Amended to read: (a) For the purpose of reimbursing the United States for the cost of administration of Part I of the Act, a reasonable annual charge as determined by the Commission in accordance with the provisions of its regulations, in effect from time to time. The authorized installed capacity for that purpose is 222,800 horsepower. (b) For the purpose of recompensing the United States for the use and enjoyment of 4,801.86 ac of its lands, exclusive of transmission line right-of-way, a reasonable annual charge as determined by the Commission in accordance with the provisions of its regulations, in effect from time to time.

Revised September 20, 1995 -72 FERC 62,252 - Order amended Article 47.

Amended to read: (a) For the purpose of reimbursing the United States for the cost of administration of Part 1 of the Act, a reasonable annual charge as determined by the Commission in accordance with the provisions of its regulations, in effect from time to time. From July 1, 1989, the authorized installed capacity for that purpose is 168,015 kW.

Article 49. *Added by Order 11 FERC 62,147, 5-27-80.*

Prior to the commencement of any construction at the project, the Licensees shall consult and cooperate with the California State Historic Preservation Officer (SHPO) to determine the need for and extent of any archaeological or historical resource surveys and any mitigative measures that may be necessary. The Licensees shall, if needed, provide funds in a reasonable amount for such activities. If any previously unrecorded archaeological or historic sites are discovered during the course of construction, construction activity in the vicinity shall be halted, a qualified archaeologist shall be consulted to determine the significance of the sites, and the Licensees shall consult with the SHPO to develop a mitigation plan for the protection of significant archaeological or historical resources.

Article 50. *Added to the License with TID and MID acceptance September 24, 1980.*

Standard License Article allowing licensee to grant permission for certain types of use of project lands.

No later than January 31 of each year, the licensee shall file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed.

Article 51. *Order 38 FERC 61,097 issued 2/2/87.*

Licensees after consultation with ACOE, USFWS, CVRWQCB and CDFG, shall prepare and file with the Commission within one year of this order, a plan to control erosion and dust and to minimize the quantity of sediment or other potential water pollutants resulting from construction and operation of the project, including spoil disposal areas. Plan shall include functional design drawings and map locations of control measures, and implementation schedule monitoring and maintenance programs for project construction and operation and provisions for periodic review and revisions. Documentation of consultation shall be included in the filing. [May begin ground disturbing activities 90 days after filing the plan unless the Director says otherwise.]

Article 52. *Order 38 FERC 61,097 issued 2/2/87.*

Within 1 year, after consultation and coordination with the Sierra Club, the Tuolumne Preservation Trust, Friends of the River, Audubon, CalTrout, Stanislaus League of Voters; Tuolumne River Expeditions and other appropriate authority, establish a plan for removal of logs and debris from the reservoir. Include an implementation schedule, monitoring and notification procedures and evidence of consultation.

Article 54. *Order 38 FERC 61,097 issued 2/2/87.*

The licensees shall commence construction of the fourth generating unit of the project within two years from the issuance date of the license and shall complete its construction within five years from the issuance date of the license.

Article 58. *Order 38 FERC 61,097 issued 2/2/87.*

Revised by Order 76 FERC 61,117, Amending License issued July 31, 1996.

The Licensees after consultation with the CDFG and the USFWS shall implement a program to monitor Chinook salmon populations and habitat in the Tuolumne River. The monitoring program shall conform to the monitoring schedule set forth below and shall include: 1) Spawning escapement estimates; 2) Quality and Condition of Spawning Habitat; 3) Relative fry Density/Female Spawners; 4) Fry Distribution and Survival; 5) Juvenile Distribution and Temperature Relationships; and 6) Smolt Survival.

The monitoring frequencies and methods shall be agreeable among the Licensees and the consulted agencies. Any disagreements regarding the conduct of these studies not resolved among the licensees and consulted entities shall be filed with the Commission for determination.

The above monitoring information is to be documented in annual reports which will be filed with the Commission by April 1 of each year and be available for public review. The results of any fishery studies already completed and not yet filed with the Commission shall be filed by the Licensees by April 1, 2005.

The Licensees shall include in the annual reports filed with the Commission April 1 of each year pursuant to Article 58 a description of the non-flow mitigative measures implemented in the previous year and planned for implementation in the coming year.

The Licensees shall include in the results of fishery studies to be filed with the Commission by April 1, 2005, all results and a discussion of the results of all monitoring studies related to the effects of flow release fluctuations on the salmon resources in the lower Tuolumne River. The filing shall also identify all non-flow mitigative measures implemented to date, and the results of all monitoring studies related to the nonflow mitigative measures.

Based on the information provided in the Licensees' study results to be filed by April 1, 2005, the Commission will determine whether to require further monitoring studies and changes in project structures and operations to protect fishery resources in the Tuolumne River, after notice and opportunity for hearing.

FERC included additional information to be provided in the article 58 Report in the order amending Article 38 issued December 23, 1999 as follows:

In the report required by Article 58, the licensees shall describe any implemented flood control measures or other efforts to change the floodway or flood control operational guidelines for this project during the reporting period.

FERC further amended this article in 128 FERC 61,035 issued on July 16, 2009 as follows:

Article 58 of the license for the Don Pedro Project, issued March 10, 1964, and amended July 31, 1996 (Ordering Paragraphs (F) and (G), Turlock and Modesto Irrigation District, 76 FERC 61, 117) is amended to add the National Marine Fisheries Service as an agency to be consulted on monitoring Chinook salmon populations and habitat in the Tuolumne River.

DON PEDRO PROJECT
FERC NO. 2299

DRAFT LICENSE APPLICATION

EXHIBIT B - PROJECT OPERATIONS AND RESOURCE UTILIZATION

APPENDIX B-2
DEVELOPMENT OF UNIMPAIRED HYDROLOGY

(Note: This report was provided as Attachment 2 to the Districts' April 9, 2013 "Response to Relicensing Participants Comments on the Initial Study Report." The report acted as the March 27, 2013 Workshop Meeting Notes wherein a census was reached on development of Operations Model hydrology.)

Districts "Strawman" for Considering Further Development of Unimpaired Hydrology for the Tuolumne River in Advance of Workshop On March 27, 2013

1.0 Objective

Relicensing participants and the Districts are continuing to consider and discuss Tuolumne River hydrology for use in the Tuolumne River Operations Model (W&AR-02). This draft report is intended to be an initial "strawman" describing one possible approach to discuss further on March 27, 2013. The objective of this particular "strawman" is to develop a daily flow dataset that contains no negative values, results in more gradual changes in day-to-day flows, and conforms to the historical monthly volumes previously recorded by the Districts and CCSF. The period of record under consideration is Water Year 1971 – 2009. It is noted that the period of record may be extended to 2012 for use in the development of the river and reservoir temperature models.

2.0 Background

On September 10, 2012, the California Department of Fish & Wildlife (CDFW), provided comments to the State Water Resources Control Board (SWRCB) related to the unimpaired hydrology for the operations/water balance model being developed for the Don Pedro Project relicensing. In summary, CDFW is concerned "that the Districts' proposed method of estimating unimpaired hydrology is not appropriate for the purpose of the state of California's environmental review process required for a new license."

The Districts subsequently undertook an investigation of CDFW's suggested approach and submitted its report to SWRCB, CDFW and FERC on December 21, 2012. This report was also provided as Attachment A, Appendix A, of the W&AR-2 initial study report issued January 17, 2013. On February 14, 2013, representatives from CDFW, SWRCB, and CCSF met with the Districts to discuss the Districts' report and the comparison of the two approaches. The Districts maintained that there was insufficient Tuolumne River gauge data to support the gauge proration approach for the period of record of the Operations Model. CDFW and SWRCB expressed interest in using all available gauge proration hydrology even if the period of record was not as complete as might be desired. CDFW and SWRCB suggested that alternatives be developed collaboratively in a workshop environment. CDFW and SWRCB agreed that the monthly mass balance from the existing gauge summation hydrology was sound and need not be adjusted. The Districts agreed to continue to discuss and consider alternative approaches, and agreed to provide a "strawman" for to advance and promote dialogue at a meeting to be held on March 27.

3.0 Methods

Hydrologic input to the Operations Model currently includes daily unimpaired hydrology estimates for three locations in the watershed: "La Grange" (at the USGS gage), "Hetch Hetchy Reservoir", and Lake Lloyd Reservoir/Lake Eleanor combined "Cherry/Eleanor". The Operations Model uses these inputs to calculate a fourth dataset of operational significance: the unimpaired flow from the unregulated portion of the watershed above Don Pedro Reservoir ("Unregulated"). Details of these calculations are described in the ISR of W&AR-2, Attachment A.

3.1 Gauge Proration "Strawman"

To promote and advance discussions for the March 27 Workshop, the Districts, as agreed with SWRCB, CCSF and CDFW, have evaluated approaches to developing a hybrid flow record for the Tuolumne River using a combination of gauge proration conforming to the existing monthly mass balances underlying the Operations Model. This "strawman" is described below.

In order to prorate the gauged data to a larger ungauged area (application basin), three physical variables were considered – elevation, drainage area, and average annual precipitation (precipitation). Each gauged basin, along with each application basin (Hetch Hetchy, Cherry/Eleanor, and Unregulated), was divided into 100-foot "elevation bands" for its entire drainage area. This was done using USGS National Elevation Dataset, 1/3 arc-second (USGS, 2009), which equates to about a 30 foot pixel size. Each elevation band for each gauge had attributes added for the drainage area within this band (e.g., the number of square miles of the Tuolumne River drainage that exists between elevation 500 and 600 feet) and precipitation (e.g. the average annual precipitation for the drainage area between elevation 500 and 600 feet).

The Oregon Climate Service's PRISM model results were used to estimate average annual precipitation from 1971 – 2000 (PRISM, 2006) for each of the elevation bands represented by the basins being evaluated (elevation beginning 100 to 13,000 feet). PRISM uses the observed precipitation gauge and radar data network, in conjunction with an orographic precipitation and atmospheric model, to develop an estimate of average annual precipitation for the contiguous United States at a pixel size resolution of 2,500 feet. Bi-linear interpolation was used to resample the PRISM values to the same pixel size as the elevation model.

Areas at low elevations and high elevations in each of the application basins that are poorly represented or not represented at all by the reference gauges were "artificially added" into the elevation distributions of the most representative gauges in order to provide some amount of coverage for those elevation ranges. When artificial areas were added to the gauges, the amount of area added for each gauge was nominally established as one percent of the total application basin area for that elevation bin. For precipitation in artificially augmented elevation bands, a multiplier was applied to the application basin precipitation values equal to the multiplier for the nearest observed elevation band for that gauge.

The proration calculation includes two main steps. First, the daily flow for a given gauge is divided across the elevation range that the gauge represents, in equal proportion to the drainage area represented within each 100-foot elevation band. Second, the sum of each of the individual "elevation band flows" for each gauge is scaled up to the area of that elevation band in the application basin. Each of these steps includes a scaling factor for both area and precipitation. Equation 1 shows the calculation for prorated flow on a single day, with the first step in the left set of parenthesis, and the second step in the right set of parenthesis (mathematical summation form).

$$q_u = \sum_{e=1}^{n} \sum_{g=1}^{n} q_g \left(\frac{a_{ge} p_{ge}}{\sum_e a_{ge} p_{ge}} \right) \left(\frac{a_{ue} p_{ue}}{\sum_g a_{ge} p_{ge}} \right)$$

Equation 3.1.1 Daily unimpaired flow where q is daily average flow, a is area, and p is average annual precipitation. Where g is each gauged basin, u is the application basin, and e is the lower limit of each 100-foot elevation band divided by 100.

It is worth noting here that a few of the reference gauge basins had facilities that resulted in measurable amounts of stream regulation and/or diversion during the period of data use; no effort was made to modify the observed data to account for these hydrologic effects. However, it is not expected that these water regulation facilities would have a meaningful impact on the results of this analysis.

The following three sections of the “strawman” contain specific data to each application basin. Figure 3.1.1 shows where all the gauges used provide elevation coverage in reference to the application basin. The first table in each subbasin description contains a list of gauges used for gauge proration hydrology in that subbasin. The final table in each subbasin description shows gauge data availability from USGS, where white is unavailable, light gray is available but not used, and dark gray means it is being used in the subbasin gauge proration calculation. Some gauged data went unused when better gauged data (closer, more similar in elevation range) were available.

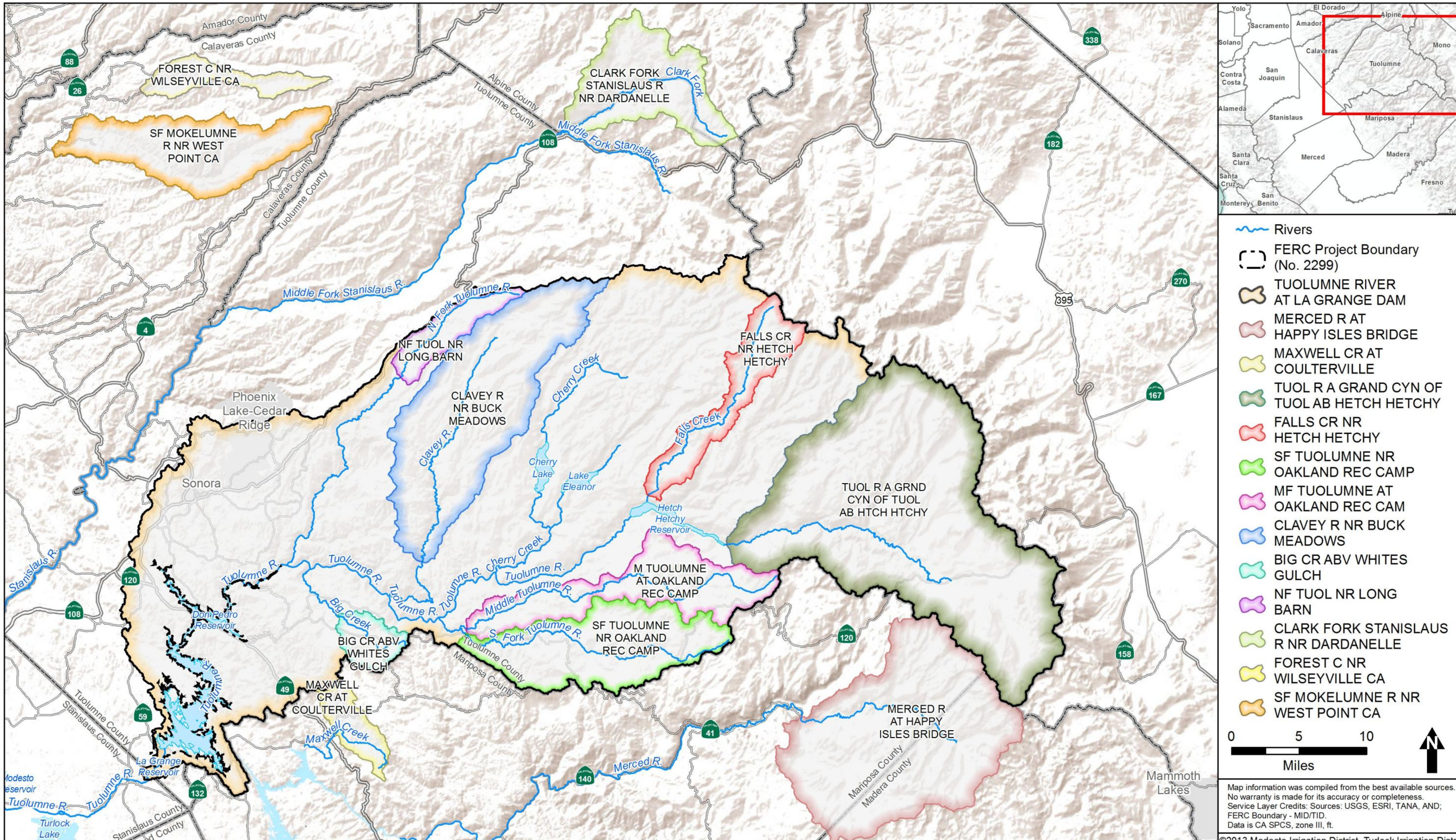

Figure 3.1.1 Map of gauges used in proration method for unimpaired hydrology

3.1.1 Hetchy Hetchy Subbasin

Table 3.1.1 Gauges used for gauge proration of Hetch Hetchy subbasin

11292500	CLARK FORK STANISLAUS R NR DARDANELLE CA
11274790	TUOLUMNE R A GRAND CYN OF TUOLUMNE AB HETCH HETCHY
11264500	MERCED R A HAPPY ISLES BRIDGE NR YOSEMITE CA
11275000	FALLS C NR HETCH HETCHY
11282000	M TUOLUMNE R A OAKLAND RECREATION CAMP CA

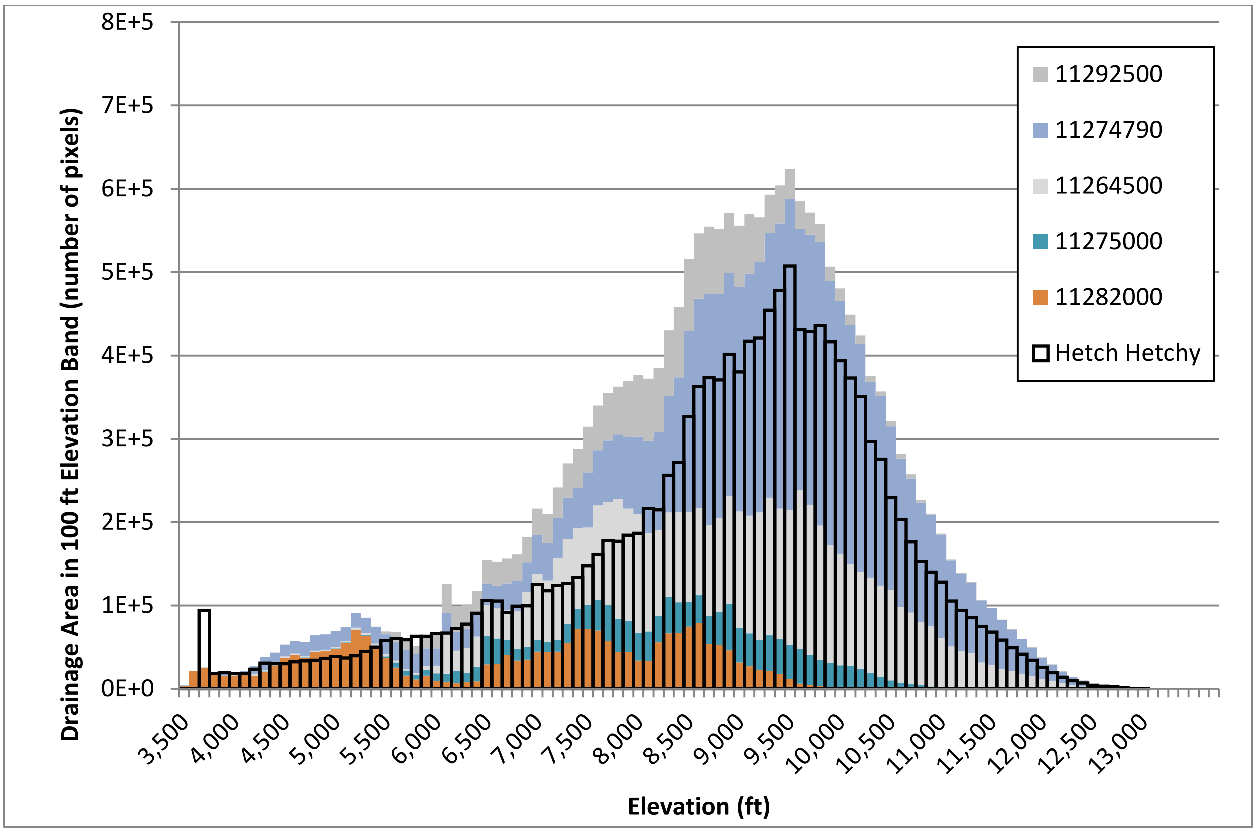

Figure 3.1.2 Elevation histograms for unimpaired gauges, compared to the Hetch Hetchy subbasin

Table 3.1.2 Gauge inventory for gauge proration of Cherry/Eleanor subbasin

WY	11292500	11274790	11264500	11275000	11282000
1971					
1972					
1973					
1974					
1975					
1976					
1977					
1978					

WY	11292500	11274790	11264500	11275000	11282000
1979					
1980					
1981					
1982					
1983					
1984					
1985					
1986					
1987					
1988					
1989					
1990					
1991					
1992					
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1994					
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2003					
2004					
2005					
2006					
2007					
2008					
2009					
2010					
2011					
2012					

3.1.2 Cherry/Eleanor Subbasin

Table 3.1.3 Gauges used for gauge proration of Cherry/Eleanor subbasin

11292500	CLARK FORK STANISLAUS R NR DARDANELLE CA
11274790	TUOLUMNE R A GRAND CYN OF TUOLUMNE AB HETCH HETCHY

11264500	MERCED R A HAPPY ISLES BRIDGE NR YOSEMITE CA
11283500	CLAVEY R NR BUCK MEADOWS CA
11275000	FALLS C NR HETCH HETCHY
11282000	M TUOLUMNE R A OAKLAND RECREATION CAMP CA
11284700	NF TUOLUMNE R NR LONG BARN CA
11281000	SF TUOLUMNE R NR OAKLAND RECREATION CAMP CA

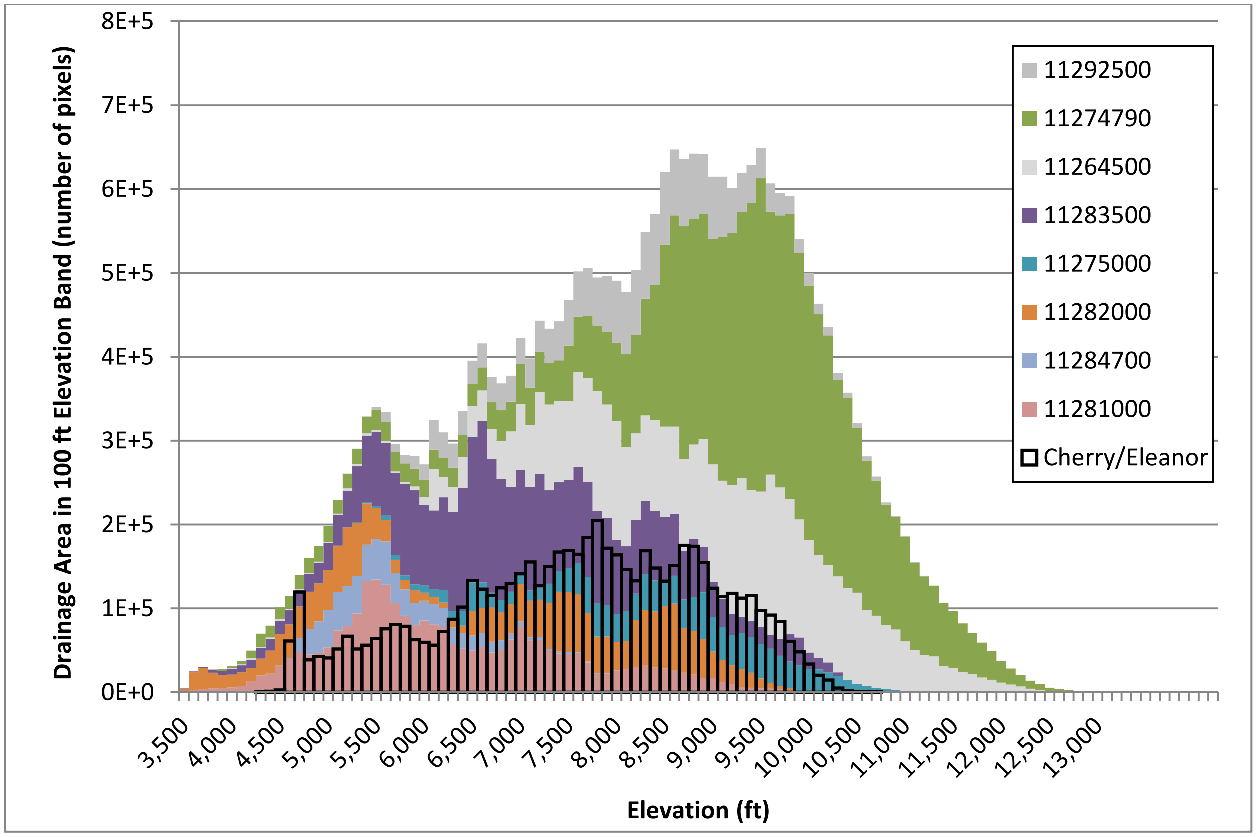

Figure 3.1.3 Elevation histograms for unimpaired gauges, compared to the Cherry/Eleanor subbasin

Table 3.1.4 Gauge inventory for gauge proration of Cherry/Eleanor subbasin

WY	11292500	11274790	11264500	11283500	11275000	11282000	11284700	11281000
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								

WY	11292500	11274790	11264500	11283500	11275000	11282000	11284700	11281000
1981								
1982								
1983								
1984								
1985								
1986								
1987								
1988								
1989								
1990								
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1992								
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2007								
2008								
2009								
2010								
2011								
2012								

3.1.3 Unregulated Subbasin

Table 3.1.5 Gauges used for gauge proration of Unregulated subbasin

11**3185**00	SF MOKELUMNE R NR WEST POINT CA
11**2693**00	MAXWELL C A COULTERVILLE CA
11**3168**00	FOREST C NR WILSEYVILLE CA
11**2844**00	BIG CR ABV WHITES GULCH

11283500	CLAVEY R NR BUCK MEADOWS CA
11264500	MERCED R A HAPPY ISLES BRIDGE NR YOSEMITE CA
11282000	M TUOLUMNE R A OAKLAND RECREATION CAMP CA
11284700	NF TUOLUMNE R NR LONG BARN CA
11281000	SF TUOLUMNE R NR OAKLAND RECREATION CAMP CA

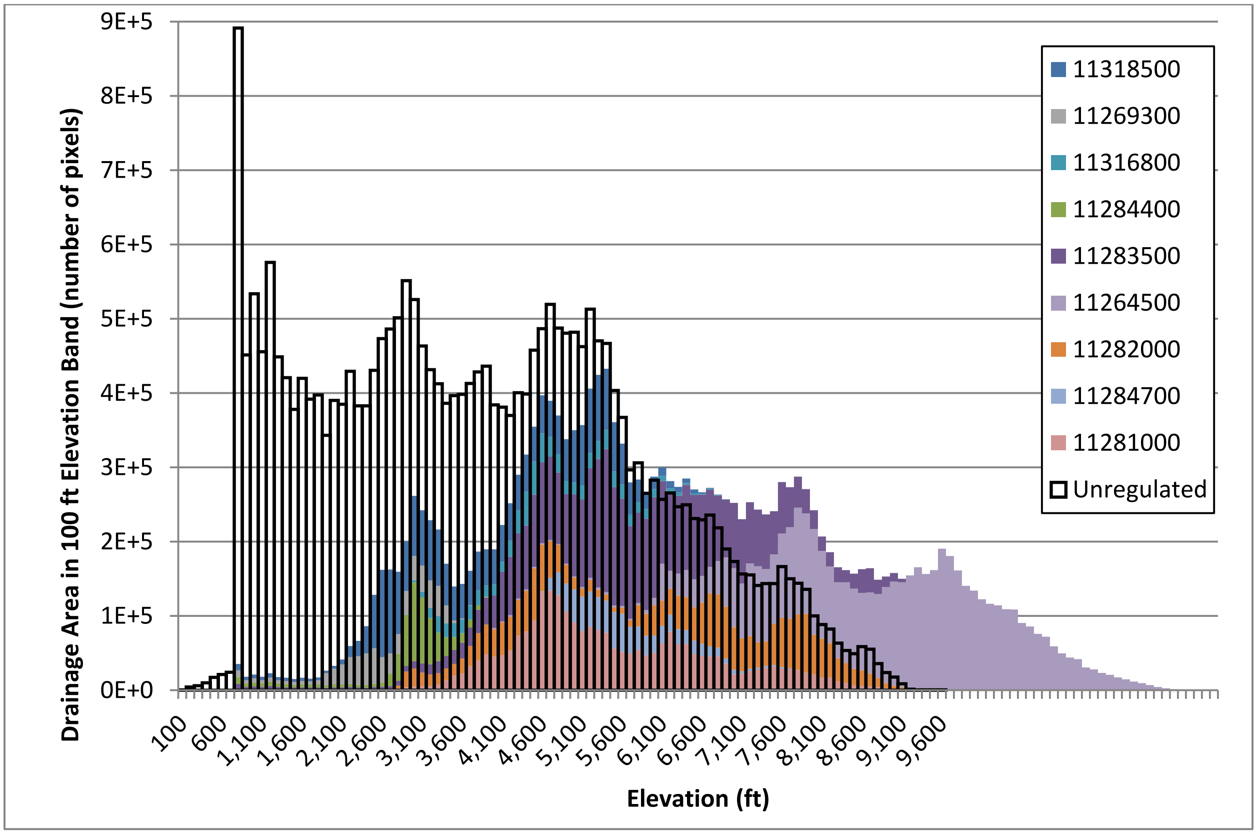

Figure 3.1.4 Elevation histograms for unimpaired gauges, compared to the Unregulated subbasin

Table 3.1.6 Gauge inventory for gauge proration of Unregulated subbasin

WY	3185	2693	3168	2844	2835	2645	2820	2847	2810
1971									
1972									
1973									
1974									
1975									
1976									
1977									
1978									
1979									
1980									
1981									

WY	3185	2693	3168	2844	2835	2645	2820	2847	2810
1982									
1983									
1984									
1985									
1986									
1987									
1988									
1989									
1990									
1991									
1992									
1993									
1994									
1995									
1996									
1997									
1998									
1999									
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2002									
2003									
2004									
2005									
2006									
2007									
2008									
2009									
2010									
2011									
2012									

3.2 Monthly Volume

In order to scale the gauge proration hydrology to the observed historical monthly volumes, some adjustments had to be made to deal with months where the total monthly volume was calculated negative. Negative monthly volumes in the current Tuolumne record are an artifact of gauge summation calculations involving numerous flow and reservoir level gauges, each with small errors. These calculations are described in detail in Attachment A of the ISR of W&AR-2. Negative monthly volumes occur during certain low flow periods (August-January) of Cherry/Eleanor, Hetch Hetchy, and unregulated inflow to Don Pedro. In total, adjustments were needed in 39 of the 504 months of the extended period of record (WY 1971 – WY 2012). This resulted in small changes to the annual volume from contributing subbasins for 22 of the 42 water years.

In order to eliminate negative monthly volumes without disturbing the gauge summation record, each of the upper subbasins (Cherry/Eleanor and Hetch Hetchy) were re-balanced with the Unregulated subbasin so that the monthly unimpaired volume at La Grange remains the same. Rather than transferring just enough volume to 'zero' out the negative month, an attempt was made to use the gauge proration record to find a reasonable value for the month being adjusted.

In the gauge proration hydrology record, typically the gauges being used don't change during a water year due to the way USGS reports data. Monthly volumes were examined as a percentage of the total water year volume for both the gauge summation, and gauge proration data. The monthly percentage of the annual volume was used as a guide to form an 'expected' monthly volume.

When the Unregulated subbasin had a negative month, Cherry/Eleanor and/or Hetch Hetchy volumes for that month were examined for closeness to their 'expected' amount. In many cases, the Cherry/Eleanor subbasin was far wetter than 'expected' and an adjustment down fixed a large portion of the imbalance. In most cases, a blend of both Hetch Hetchy, and Cherry/Eleanor volumes were used to offset a negative volume in the Unregulated subbasin. The exact percentage from each subbasin varies depending on how the adjustment affected each subbasin.

When Cherry/Eleanor or Hetch Hetchy subbasins had a negative month, an 'expected' value was used as a guide for the offset volume. All of the re-balancing volume came from the Unregulated subbasin. In most cases, this volume had to be further adjusted manually in order to keep normal volumes in the Unregulated subbasin. Table 3.2.1 shows these adjustments.

The only "*new water*" adjustment comes in October 2002, where 2000 AF was added to the La Grange gauge. This was the minimum volume that could be used to produce a positive 'expected normal' month in the Unregulated subbasin (and Cherry/Eleanor subbasin). All of the adjustments made to the Unregulated subbasin balance to a net of 2000 acre feet. In other words, for the period of record, CCSF/Districts have the same amount of water flowing into the watersheds. The 2000 AF addition to La Grange goes exclusively to the Unregulated subbasin.

Table 3.2.1 Adjustments to unregulated inflow volume to Don Pedro, in AF. Red indicates water going from the Unregulated subbasin to Cherry/Eleanor, orange to Hetch Hetchy, and green indicates water going from a combination of Cherry/Eleanor and Hetch Hetchy to the Unregulated subbasin.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	-1,633										-3,369	-2,260
1972	-4,146										-3,024	-1,515
1973											-3,271	-4,695
1974												-4,741
1975	-3,518											
1976				8,000								

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1977			-1,041								-1,359	7,287
1978	-1,545											
1981	-6,652											
1987				4,400								-400
1988												-800
1989										6,600	4,500	
1990										3,088	3,600	2,800
1991	1,700		-1,500									
1994				-7,923							-7,500	-981
1995	6,143											
1996	2,400	-200										
2000	-1,527											
2003	**4,400**											
2004	1,945	5,037										
2007												4,200
2012												-500

Monthly scaling factors were used to scale the gauge proration hydrology up or down to the adjusted historical monthly volume. The monthly scaling factor is defined as the adjusted historical monthly volume divided by the gauge proration monthly volume. A scaling factor of less than one means the gauge proration overestimated the historical flow. A scaling factor of greater than one means the gauge proration underestimated the historical flow. When multiplied by the scaling factor, the daily gauge proration flow values will result in adjusted historical monthly volumes. The following three sections show computed scaling factors used for each subbasin, with red to orange indicating a reduction in gauge proration flow, and yellow to green representing an increase in gauge proration flow.

3.2.1 Hetchy Hetchy Subbasin

Table 3.2.2 Hetch Hetchy monthly scaling factors for gauge proration. Bold indicates reduced volume and italics indicates increased volume.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	0.11	1.08	1.15	1.00	0.84	0.87	0.82	0.91	0.95	0.79	0.60	0.57
1972	0.48	0.75	1.04	0.98	0.96	0.82	0.81	0.89	0.84	0.56	0.32	0.27
1973	0.54	0.73	0.90	1.00	1.06	1.01	0.80	0.84	0.88	0.64	0.41	0.02
1974	0.32	0.87	1.02	0.94	0.72	0.88	0.79	0.83	0.87	0.85	0.57	0.07
1975	0.12	0.11	0.96	0.93	1.21	1.23	1.00	0.81	0.86	0.84	0.49	0.36
1976	0.81	0.87	0.74	*0.05*	0.98	0.94	0.83	0.93	0.82	0.71	0.70	0.44
1977	0.81	0.68	0.57	0.52	0.69	0.96	0.89	1.01	1.10	1.12	1.04	*0.97*
1978	0.52	0.96	1.25	1.67	1.67	1.15	0.91	0.79	0.88	1.03	0.73	0.64
1979	0.57	0.73	0.84	1.04	1.19	1.09	0.86	0.89	0.86	0.76	0.45	0.09
1980	0.82	0.92	0.83	1.03	0.98	0.93	0.80	0.80	1.00	1.18	0.84	0.36

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1981	0.16	0.26	0.59	0.64	0.95	1.08	0.84	0.94	0.90	0.53	0.41	0.28
1982	0.91	1.09	1.03	1.09	0.94	0.78	0.74	0.81	0.89	0.87	0.86	0.91
1983	0.90	1.06	1.10	1.00	1.05	1.11	0.80	0.77	0.86	0.88	0.93	0.74
1984	0.95	1.80	1.45	0.96	1.06	1.17	1.22	1.58	1.76	1.24	0.79	0.60
1985	0.97	1.83	1.50	1.15	1.36	1.61	1.42	1.65	1.69	0.89	0.54	0.92
1986	1.55	1.63	2.13	1.90	1.57	1.19	1.27	1.45	1.62	1.56	1.01	0.57
1987	1.31	0.70	0.62	*0.50*	1.83	1.87	1.47	1.57	1.34	0.71	0.30	**0.15**
1988	0.56	1.10	1.77	2.03	1.43	1.40	1.55	1.59	1.40	0.80	0.55	0.57
1989	0.15	0.63	1.35	2.10	2.52	2.00	1.40	1.67	1.69	*1.07*	*0.22*	0.58
1990	1.34	1.41	1.50	2.03	2.14	1.81	1.58	1.61	1.50	*0.76*	*0.39*	*0.12*
1991	*0.20*	0.66	0.53	0.50	1.15	2.66	1.62	1.49	1.53	1.16	0.84	0.50
1992	1.18	1.39	1.35	1.44	2.02	1.70	1.39	1.37	1.00	1.02	0.74	0.61
1993	1.17	0.91	1.55	2.03	1.82	1.39	1.19	1.25	1.33	1.30	0.93	0.47
1994	0.88	0.56	1.28	**0.62**	1.84	2.08	1.64	1.70	1.64	0.62	**2.06**	**0.61**
1995	*0.60*	2.05	1.95	2.36	1.86	1.46	1.23	1.19	1.35	1.43	1.48	1.14
1996	*0.39*	0.95	1.91	1.74	1.78	1.34	1.30	1.47	1.84	1.70	1.05	1.01
1997	1.34	1.40	1.76	1.32	1.00	1.03	1.03	1.20	1.48	1.14	0.87	0.71
1998	1.03	1.17	1.96	2.49	1.72	1.58	1.19	1.23	1.34	1.35	0.87	0.77
1999	1.23	1.82	1.86	2.05	1.79	1.51	1.31	1.55	2.06	1.94	1.13	1.05
2000	1.54	1.61	1.26	2.42	1.98	1.54	1.45	1.49	1.50	1.17	1.11	0.92
2001	1.35	1.39	2.19	1.94	2.12	1.83	1.55	1.42	1.17	1.01	1.14	1.38
2002	2.46	1.71	2.09	1.81	1.67	1.51	1.40	1.57	1.61	1.13	1.22	2.06
2003	*0.84*	1.32	1.91	1.43	1.01	1.08	1.20	1.12	1.03	0.74	0.84	0.43
2004	*1.27*	*1.26*	1.90	0.89	0.95	1.20	1.22	1.40	1.33	0.88	0.96	1.55
2005	1.91	1.22	1.46	1.74	1.49	1.39	1.03	0.95	0.92	0.78	0.52	0.60
2006	0.88	1.09	2.14	1.23	1.24	1.14	1.06	0.99	1.10	0.88	0.56	0.27
2007	0.52	1.22	1.62	1.44	1.79	1.43	1.31	1.43	1.16	0.74	0.83	*0.16*
2008	1.28	1.32	1.90	1.52	1.58	1.36	1.26	1.36	1.32	0.83	0.48	0.77
2009	1.67	1.28	1.27	1.60	1.48	1.46	1.24	1.47	1.48	1.00	0.85	0.83
2010	1.31	1.03	1.52	1.56	1.57	1.52	1.49	1.36	1.31	1.06	0.75	1.06
2011	1.67	1.32	1.92	1.42	1.49	1.88	1.38	1.32	1.41	1.42	1.19	0.95
2012	1.02	0.92	0.58	1.38	1.18	1.30	1.32	1.28	1.07	0.69	0.58	0.61

3.2.2 Cherry/Eleanor Subbasin

Table 3.2.3 Cherry/Eleanor monthly scaling factors for gauge proration. Bold indicates reduced volume and italics indicates increased volume.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	**0.52**	2.91	2.04	1.66	1.42	1.46	1.37	1.47	1.37	1.00	**0.52**	**0.52**
1972	**0.53**	2.46	1.63	1.44	1.47	1.64	1.54	1.52	1.41	0.17	**0.53**	**0.52**
1973	0.67	1.80	2.11	1.48	1.15	1.19	1.43	1.45	1.30	0.44	**0.49**	**0.49**
1974	0.83	2.76	1.62	1.44	1.07	1.36	1.29	1.43	1.28	1.09	0.14	**0.52**
1975	**0.48**	0.23	1.52	1.75	1.37	1.38	1.39	1.46	1.28	1.16	0.42	0.39
1976	2.52	1.61	1.28	*0.09*	1.83	1.89	1.90	1.62	0.81	0.24	2.14	1.63
1977	1.65	0.82	**0.71**	1.57	2.40	2.38	2.16	2.25	1.48	0.14	**0.72**	*1.80*
1978	**0.54**	2.54	3.55	2.05	1.32	1.40	1.25	1.49	1.39	1.30	0.78	2.27

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	0.05	1.27	1.78	2.10	1.62	1.41	1.51	1.44	1.28	0.99	1.15	1.62
1980	2.78	3.02	2.55	1.75	1.09	1.08	1.42	1.34	1.76	2.02	1.06	0.76
1981	**0.62**	0.44	1.61	1.65	2.28	1.85	1.98	1.66	1.36	1.27	3.38	2.36
1982	2.76	3.23	1.83	1.13	1.22	1.33	1.16	1.19	1.21	1.09	0.58	1.75
1983	2.39	1.52	1.03	0.96	0.91	0.84	0.99	1.27	1.27	1.32	1.21	1.07
1984	1.49	4.50	2.33	1.39	1.55	2.26	1.95	2.12	1.80	0.97	0.09	0.17
1985	2.47	5.03	3.28	2.01	2.66	3.12	2.95	2.43	1.91	0.81	0.92	1.16
1986	4.32	4.31	5.71	5.17	2.54	2.11	2.15	2.19	2.14	1.79	0.82	1.50
1987	1.38	0.71	0.98	*0.67*	3.76	3.25	3.89	2.65	1.66	0.36	0.76	0.63
1988	2.70	4.08	5.10	1.04	1.69	3.14	3.44	3.05	2.38	1.52	0.08	**0.51**
1989	1.27	4.80	4.05	4.02	3.73	3.25	2.30	2.36	2.02	*0.52*	*0.09*	3.64
1990	6.66	3.93	2.43	3.50	3.47	3.25	3.14	2.80	2.15	*0.80*	*0.17*	*0.32*
1991	*0.47*	0.67	**0.92**	1.02	2.53	5.29	3.43	3.01	2.68	2.25	0.84	0.24
1992	1.65	4.19	1.95	2.56	3.24	2.95	3.10	2.42	1.43	4.22	1.36	0.11
1993	3.35	3.58	3.09	2.44	1.74	2.08	2.02	2.11	2.20	2.36	1.09	0.40
1994	1.37	0.63	2.69	2.39	3.39	3.75	3.71	3.01	1.98	0.70	0.03	0.05
1995	*1.79*	11.40	4.67	1.83	2.07	1.28	1.80	1.96	2.01	1.64	1.38	0.35
1996	*0.37*	**0.003**	6.32	3.28	3.37	2.11	2.13	2.20	1.76	1.19	0.74	0.33
1997	2.40	3.24	5.53	2.56	1.70	2.05	1.69	1.14	1.06	0.52	0.24	1.27
1998	2.36	3.49	4.36	3.74	1.70	2.51	2.09	1.97	1.93	1.69	0.83	0.82
1999	1.13	5.78	3.78	3.34	2.36	2.49	2.28	2.25	2.27	1.52	0.30	0.04
2000	**0.90**	3.37	1.47	5.53	2.69	2.63	2.63	2.19	1.72	0.86	0.72	1.57
2001	3.18	4.09	5.20	5.25	5.16	4.28	2.84	1.78	0.92	1.02	3.35	3.66
2002	2.25	7.05	5.22	4.21	3.31	3.52	2.43	2.08	1.55	0.35	2.15	2.22
2003	*1.43*	4.70	6.20	4.35	2.99	3.03	2.24	1.42	0.99	0.63	1.18	2.60
2004	*1.63*	*3.32*	7.47	4.33	4.91	2.32	1.87	1.44	0.89	0.48	0.58	0.15
2005	7.77	4.56	5.68	4.44	3.54	2.79	1.99	1.64	1.21	0.85	0.27	0.84
2006	3.79	3.65	7.66	3.42	4.13	3.37	2.51	1.15	0.96	0.71	0.50	0.68
2007	2.07	5.46	7.26	6.35	6.84	3.92	2.59	1.74	1.11	1.68	4.46	*2.06*
2008	5.19	0.74	6.16	5.68	3.91	4.03	3.04	1.79	1.14	0.54	0.70	0.32
2009	2.78	4.80	3.51	5.02	4.01	3.55	2.93	2.61	2.19	1.08	1.02	1.47
2010	4.95	1.72	4.10	3.90	2.81	3.22	2.45	2.22	2.09	1.61	0.80	0.84
2011	4.61	4.01	3.06	2.60	2.86	2.26	2.46	2.51	1.78	1.66	1.71	1.71
2012	2.59	2.11	0.89	5.82	3.82	4.49	3.07	1.70	1.21	0.62	0.45	**0.48**

3.2.3 Unregulated Subbasin

Table 3.2.4 Unregulated subbasin scaling factors for gauge proration. Bold indicates reduced volume and italics indicates increased volume.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	*2.11*	1.73	1.42	1.31	1.01	0.92	0.84	0.85	0.93	1.38	*1.51*	*1.48*
1972	*0.59*	1.24	1.20	1.66	1.19	0.87	0.83	0.88	1.15	2.63	*3.78*	*2.21*
1973	1.18	1.98	1.45	1.27	1.43	1.27	0.84	0.78	1.15	1.89	*1.99*	*1.52*
1974	1.98	1.00	1.23	1.04	0.94	0.92	0.92	0.86	1.14	1.55	2.03	*2.77*
1975	*2.45*	1.39	1.24	1.33	1.60	1.30	1.07	0.70	0.81	0.88	1.73	1.77
1976	1.22	1.45	1.47	**0.81**	1.18	1.13	1.01	0.94	1.35	3.25	3.13	2.87

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1977	1.47	1.62	0.39	1.45	1.14	0.95	0.86	0.96	1.03	0.40	*2.77*	**1.02**
1978	*0.61*	1.52	1.44	1.25	1.22	1.05	0.97	0.93	0.92	1.08	2.62	2.40
1979	1.22	2.85	1.45	1.46	1.50	1.17	0.83	0.79	0.96	1.60	1.52	1.79
1980	1.57	0.96	1.05	0.99	1.03	1.00	0.85	0.92	0.79	0.91	1.96	2.79
1981	*1.48*	0.90	1.56	1.76	0.93	1.40	0.83	0.89	1.40	2.88	8.09	3.69
1982	2.04	1.17	1.10	1.41	0.93	1.37	0.92	0.90	1.25	2.07	1.72	2.08
1983	1.09	1.16	1.01	1.22	1.13	1.05	0.97	0.79	0.75	0.90	0.92	1.12
1984	1.64	1.45	1.21	1.25	1.43	1.23	1.08	0.81	0.90	0.57	0.86	0.52
1985	1.22	1.49	1.15	1.06	1.40	1.62	1.07	0.81	0.73	1.25	3.49	2.36
1986	1.50	1.70	1.33	1.21	1.09	1.25	1.01	0.77	0.53	1.22	1.38	1.97
1987	1.19	0.65	0.77	**0.37**	1.12	1.30	0.73	0.81	1.64	1.87	3.59	*0.66*
1988	1.82	1.42	2.59	2.63	1.86	1.14	0.88	0.85	1.07	3.63	3.11	*0.41*
1989	0.56	2.05	1.65	1.45	1.16	0.94	0.78	0.77	0.94	**0.71**	**0.86**	*0.64*
1990	0.86	0.33	0.54	0.98	1.69	0.98	0.83	0.76	0.90	**0.89**	**0.59**	**0.72**
1991	**0.14**	3.34	*0.86*	1.39	1.18	1.59	0.98	0.94	1.00	3.28	6.76	5.02
1992	3.34	0.77	1.04	1.51	1.32	1.00	0.88	1.08	1.72	1.88	4.97	3.45
1993	2.13	0.40	1.49	1.50	1.31	0.94	0.76	0.76	0.89	1.54	2.77	2.74
1994	1.45	0.81	0.89	*1.48*	1.61	0.91	0.94	0.96	1.77	7.56	*9.85*	*7.59*
1995	**0.40**	1.06	1.77	1.28	0.96	1.10	0.95	0.89	0.92	0.94	0.85	0.70
1996	**0.12**	*0.00*	1.17	1.49	1.30	1.27	1.00	0.96	0.82	0.67	0.94	1.80
1997	0.90	1.44	1.44	1.22	1.04	1.41	1.07	0.74	0.25	0.77	1.77	1.18
1998	0.51	1.01	1.11	1.86	1.47	1.35	1.25	1.07	1.03	0.93	0.72	0.64
1999	0.39	1.00	1.13	1.31	1.17	1.09	1.11	0.97	1.02	1.25	1.65	2.27
2000	*0.86*	0.84	0.81	1.25	1.47	1.51	1.16	0.96	1.04	1.04	1.62	1.34
2001	1.23	0.54	0.85	1.22	1.46	1.33	1.11	0.86	0.85	1.51	2.39	2.60
2002	2.83	1.25	1.49	1.31	1.14	1.20	1.10	0.88	0.78	1.50	2.97	2.05
2003	**0.16**	1.16	1.51	0.94	0.93	1.19	0.92	0.76	0.56	0.66	1.75	1.75
2004	**0.28**	**0.91**	1.02	1.11	1.32	0.86	0.88	0.58	0.27	0.36	2.62	1.54
2005	2.52	0.52	1.14	1.61	1.43	1.25	1.10	1.09	0.99	0.84	1.36	2.22
2006	0.67	0.61	1.08	1.09	0.91	1.20	1.12	1.08	0.46	0.25	0.48	0.97
2007	0.92	0.57	0.68	0.18	1.19	0.79	0.82	0.47	0.42	0.68	0.75	**0.55**
2008	0.92	0.33	1.52	1.86	1.62	1.18	0.85	0.74	0.37	0.52	3.70	2.44
2009	0.24	0.88	0.81	1.74	1.20	0.99	0.83	0.80	0.55	1.00	2.01	1.73
2010	0.99	0.07	1.23	1.39	1.35	1.19	0.79	0.69	0.67	0.42	0.38	1.13
2011	1.01	1.28	1.32	1.25	1.20	1.27	1.03	0.76	0.82	0.69	0.96	1.00
2012	0.64	0.65	0.26	0.84	0.79	1.31	0.94	0.59	0.92	1.65	2.01	*2.14*

3.3 Smoothing Between Scaling Factors

It can be seen in the record of scaling factors that most of the period of record contains gradually changing scaling factors each month. In several cases there are some abrupt changes, which have the potential to artificially shape the gauge proration. This is particularly the case during snowmelt recession, when a large factor in June might drop to a very small factor in July. This would make the hydrograph appear to drop quite rapidly to the baseflow rate, instead of the expected gradual recessional limb of a hydrograph.

In order to alleviate this problem, caused by the boundaries between monthly scaling factors, a smoothing technique was used to gradually shift between scaling factors over the course of two weeks (one week in each month). Any monthly volumetric changes resulting from this smoothing were applied as a multiplier adjustment to the middle two weeks of the month. In most months, where scaling factors do not change significantly, these adjustments do not change the hydrograph in any noticeable way.

The function used to smooth between scaling factors was a cumulative normal distribution with a standard deviation of 1.80. In several cases, in order to maintain the monthly volume, the standard deviation had to be decreased in order to provide a more abrupt transition. An example of typical daily scaling factors can be seen in Figure 3.3.1.

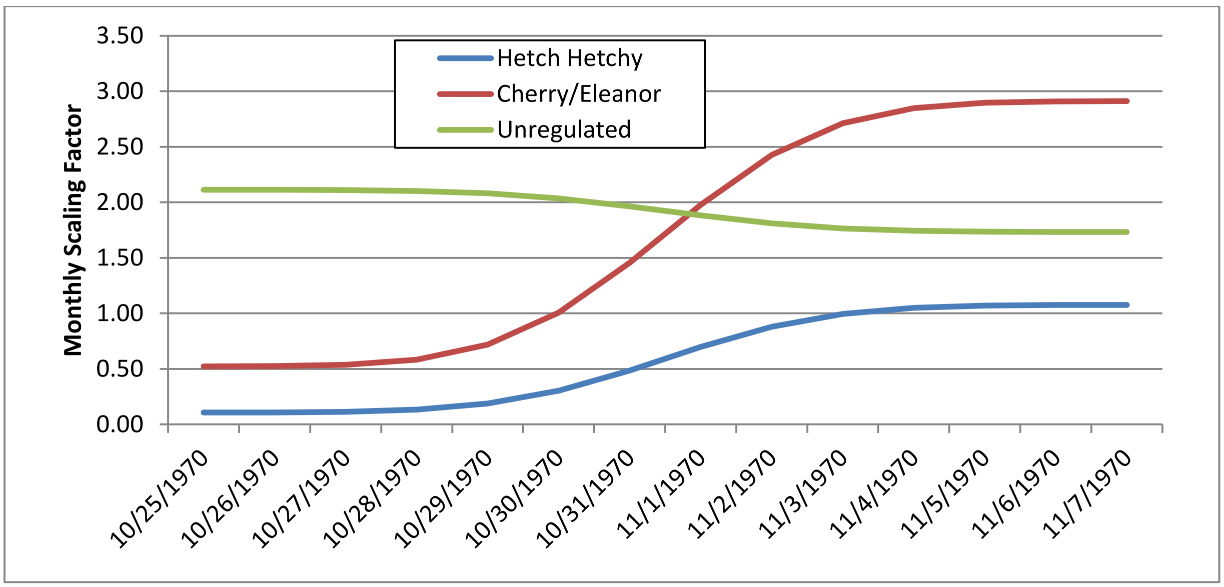

Figure 3.3.1 Typical daily scaling factor smoothing

4.0 Results

The resulting “strawman” can be seen in the attached HEC-DSS database.

5.0 Discussion

In water year 1997, and water years 2003-2008 there are only four unimpaired gauges representing the Unregulated subbasin. Two of those gauges are in the Mokelumne River basin, one in the Merced River basin, and the smallest one is in the Tuolumne River basin. Together, these four gauges provide a poor representation of the Unregulated subbasin, and combined have a drainage area equal to less than 27% of the Unregulated subbasin (Figure 5.1). This period is the poorest representation of any of the application areas for the period of record. Despite the poor match in drainage size, elevation range, and even overall geography, the gauge proration provides a reasonable looking daily hydrograph when scaled to the historical monthly volumes (Figure 5.2).

In the Operations Model, the function of the model is to allow comparisons to be made of different scenarios. Absolute accuracy is not the goal. Relative differences between modeling scenarios is a powerful decision making tool. While statistically <u>accurate</u> daily values may not be achieved using the gauge proration methods described herein, they do create a dataset that:

- Describes general hydrograph shape, variability, and magnitude of peak flows
- Maintains the historical monthly volumes
- Provides a reasonable depiction of daily flow conditions over the period of record

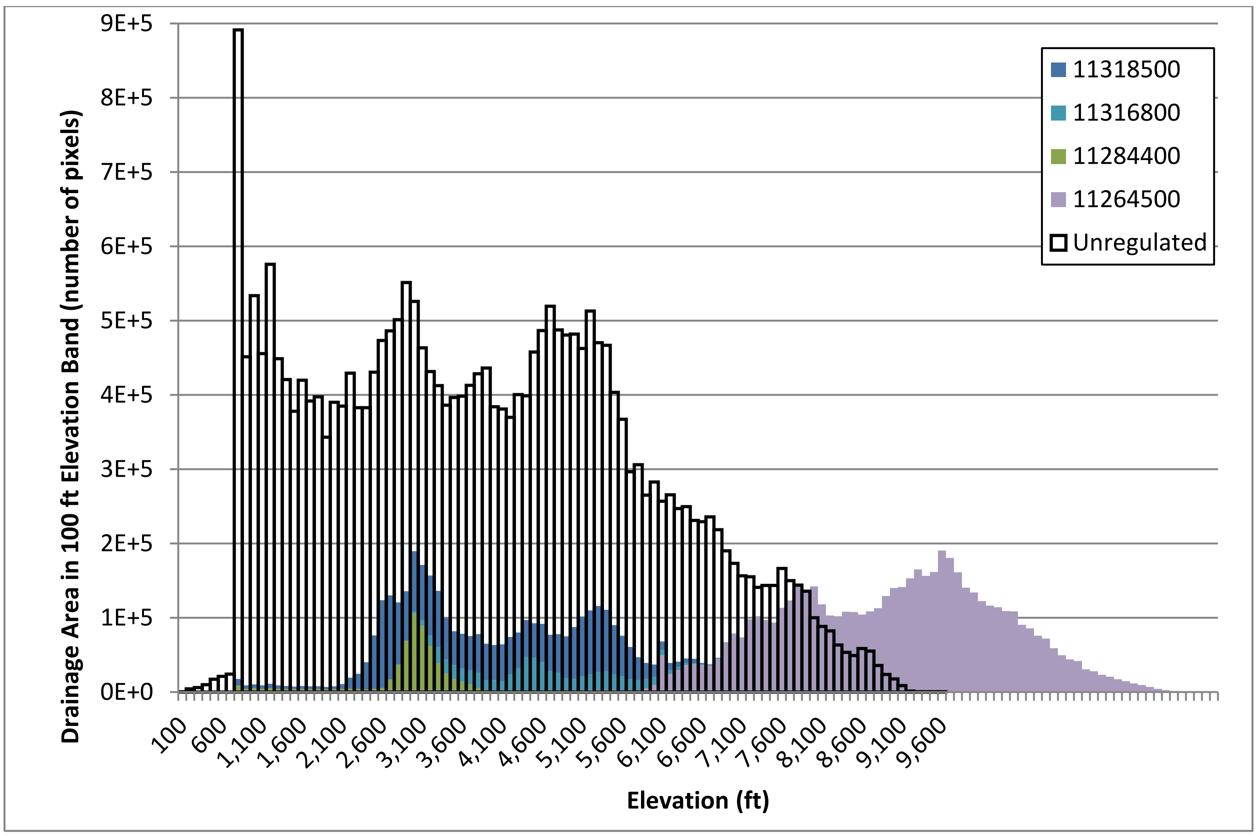

Figure 5.1 Elevation histogram for Unregulated subbasin gauge proration (WY 97, 02-08)

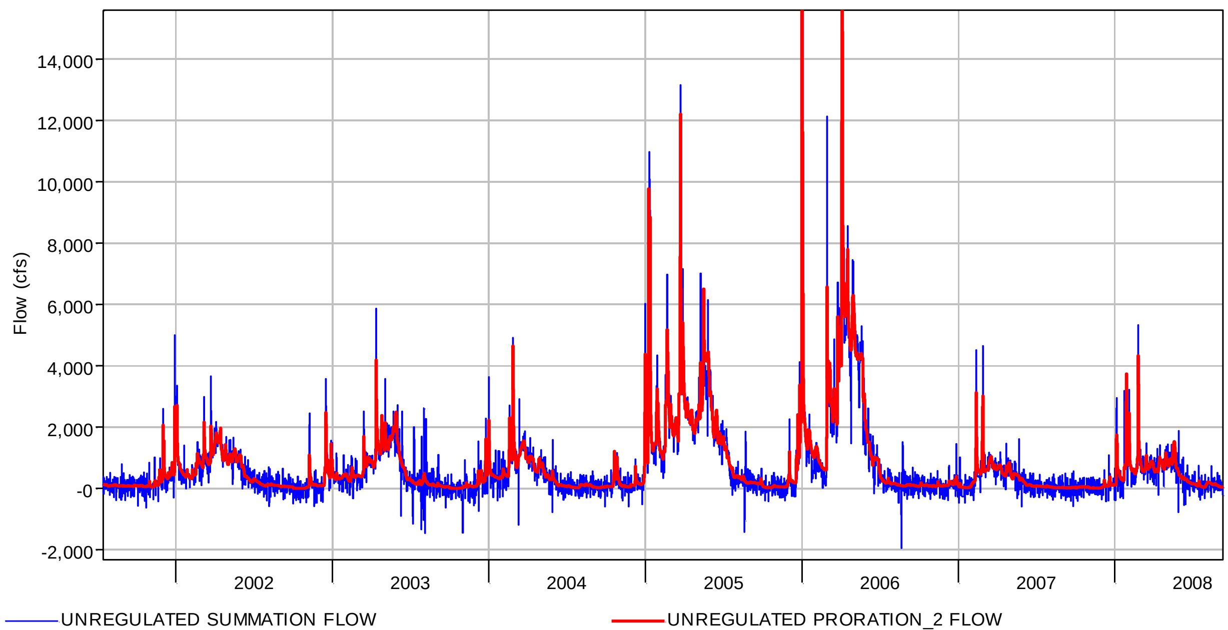

Figure 5.2 Hydrograph comparison gauge summation (W&AR-02) and gauge proration

References

Study Report W&AR-02. Project Operations/Water Balance Model. Attachment A. Tuolumne River Daily Operations Model

PRISM Climate Group, 2006, *United States Average Monthly or Annual Precipitation 1971 – 2000*, <http://prism.oregonstate.edu>, Oregon State University, Created 12 Jun 2006.

United States Geologic Survey (USGS), 2009, *1/3 Arc Second National Elevation Dataset*, <http://seamless.usgs.gov>, USGS Earth Resources Observation & Science (EROS) Center, Sioux Falls, SD, Created 23 March 2009.

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EXHIBIT B - PROJECT OPERATIONS AND RESOURCE UTILIZATION

APPENDIX B-3
1997 TO 2012 HISTORICAL AND BASE CASE
ANNUAL AND MONTHLY FLOW DURATION CURVES

List of Figures

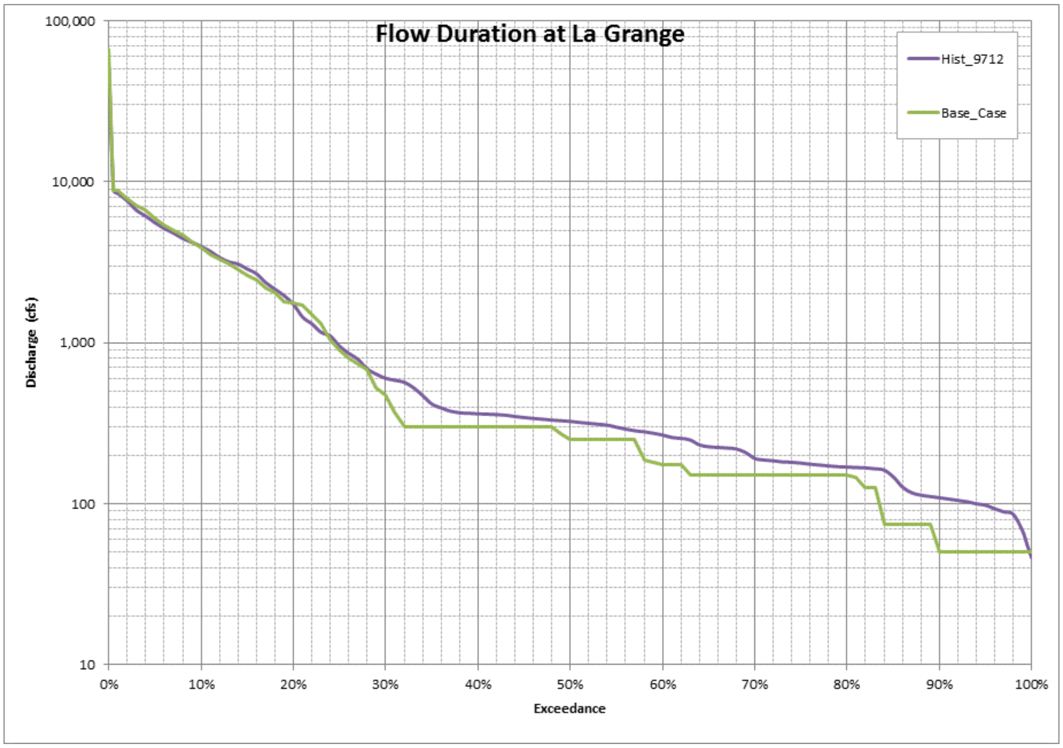

Figure B-1. **Annual flow duration at USGS La Grange gage for historical and base case operations.**

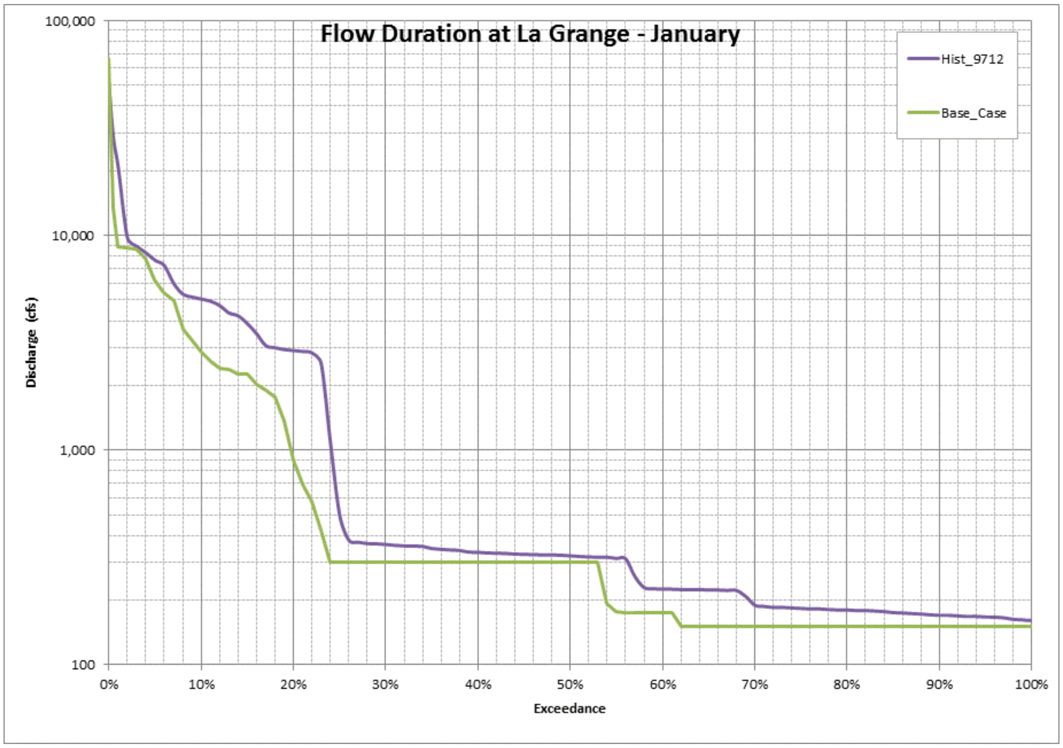

Figure B-2. **Flow duration at USGS La Grange gage for historical and base case operations -- January.**

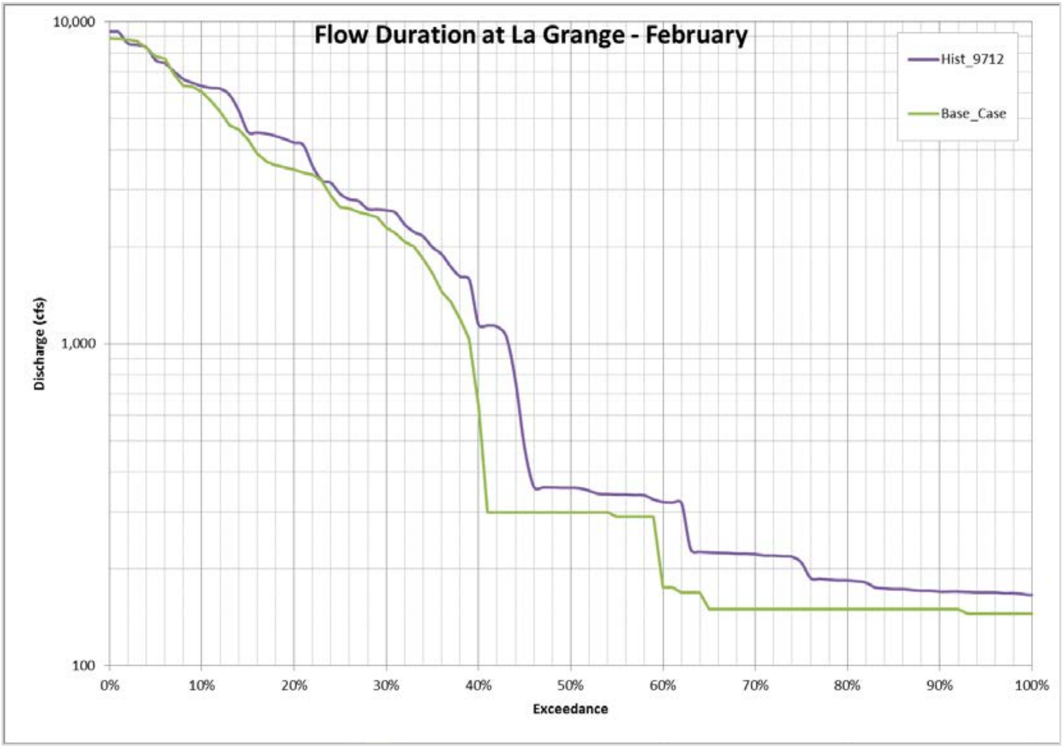

Figure B-3. Flow duration at USGS La Grange gage for historical and base case operations -- February.

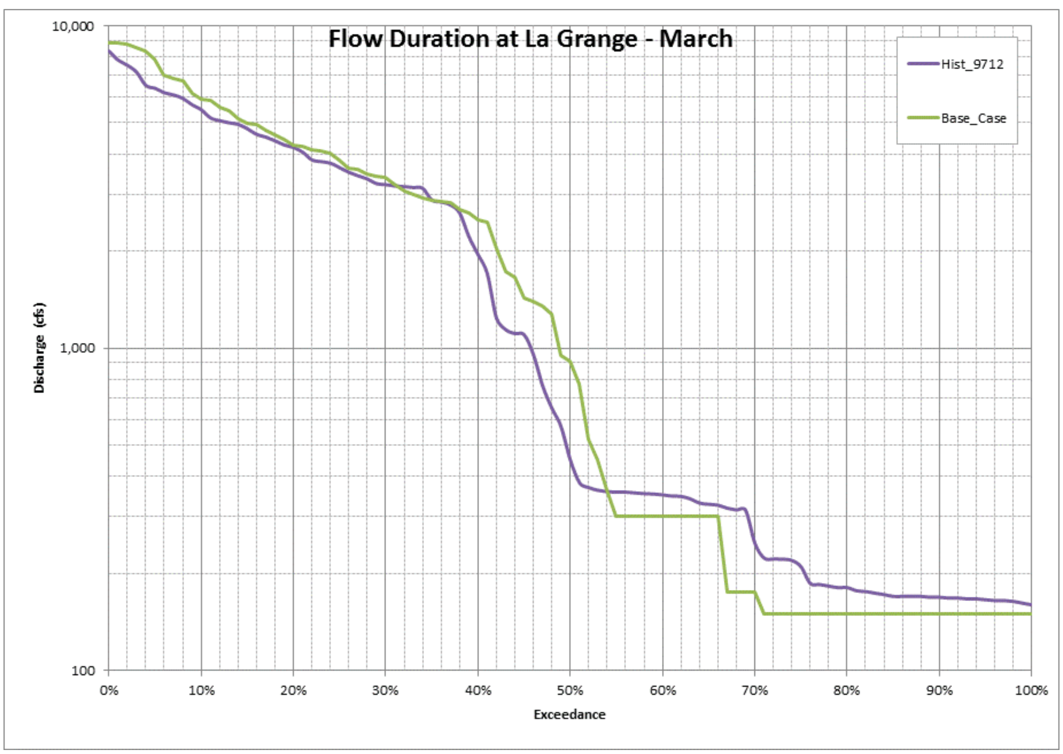

Figure B-4. Flow duration at USGS La Grange gage for historical and base case operations -- March.

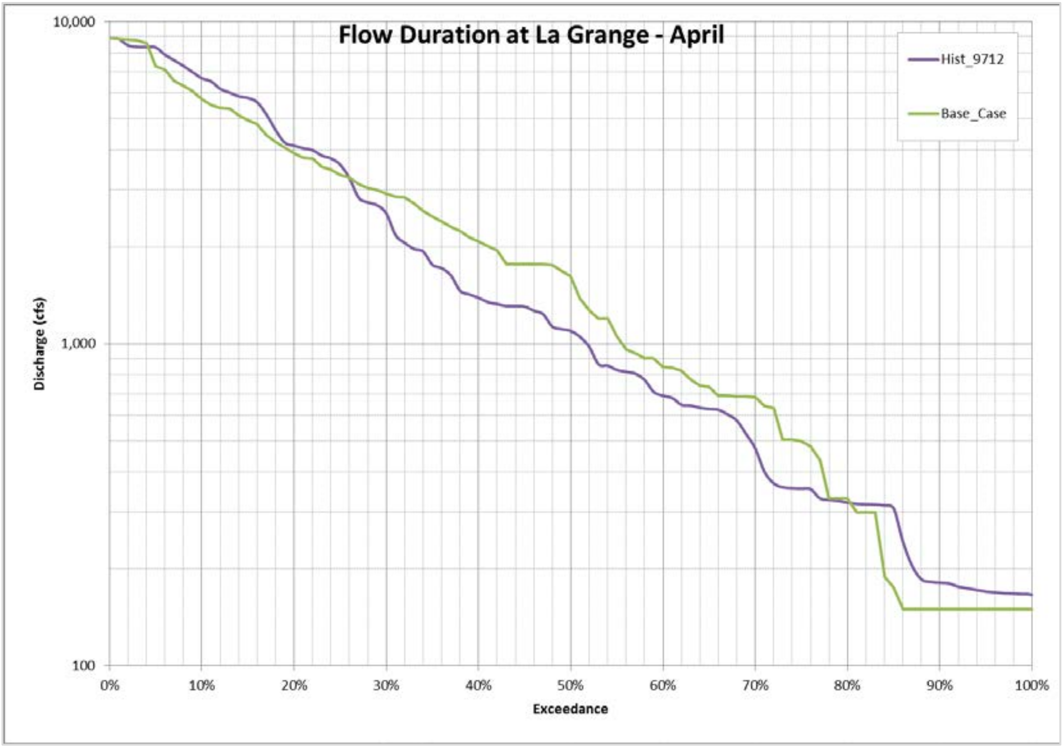

Figure B-5. **Flow duration at USGS La Grange gage for historical and base case operations -- April.**

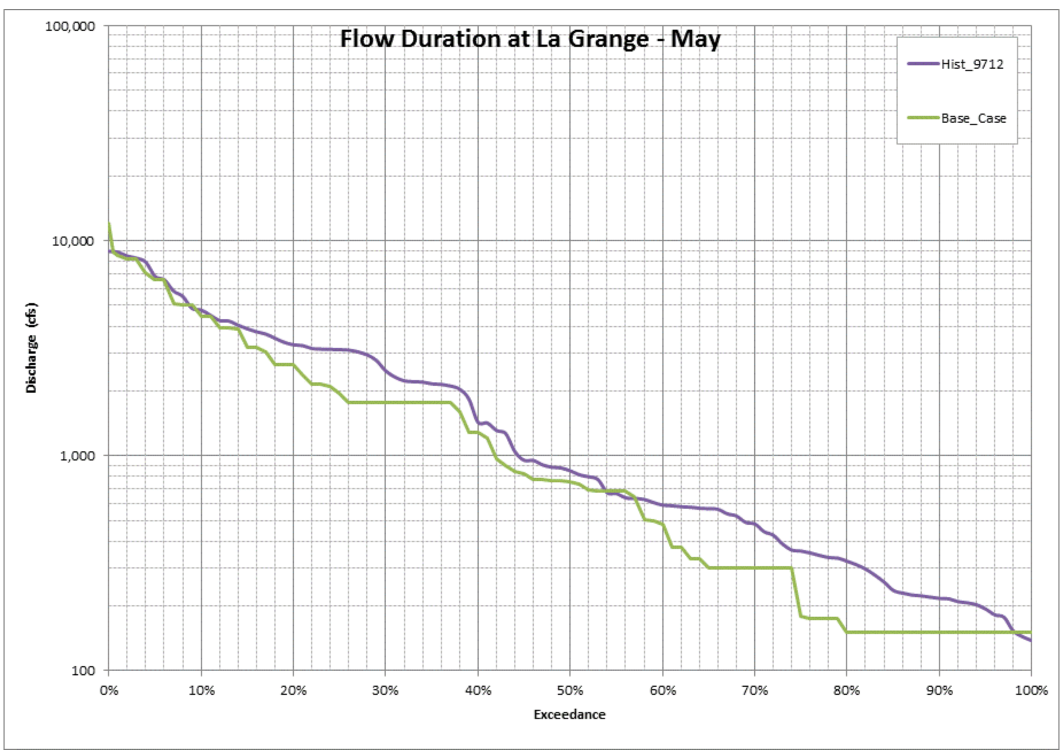

Figure B-6. **Flow duration at USGS La Grange gage for historical and base case operations -- May.**

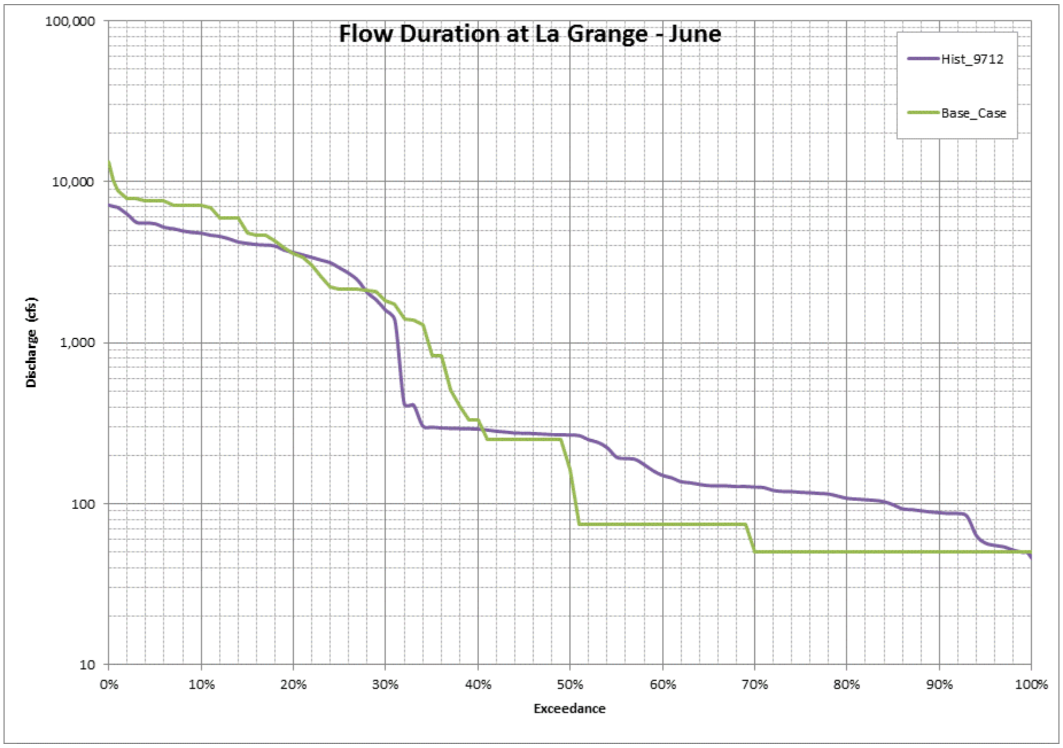

Figure B-7. Flow duration at USGS La Grange gage for historical and base case operations -- June.

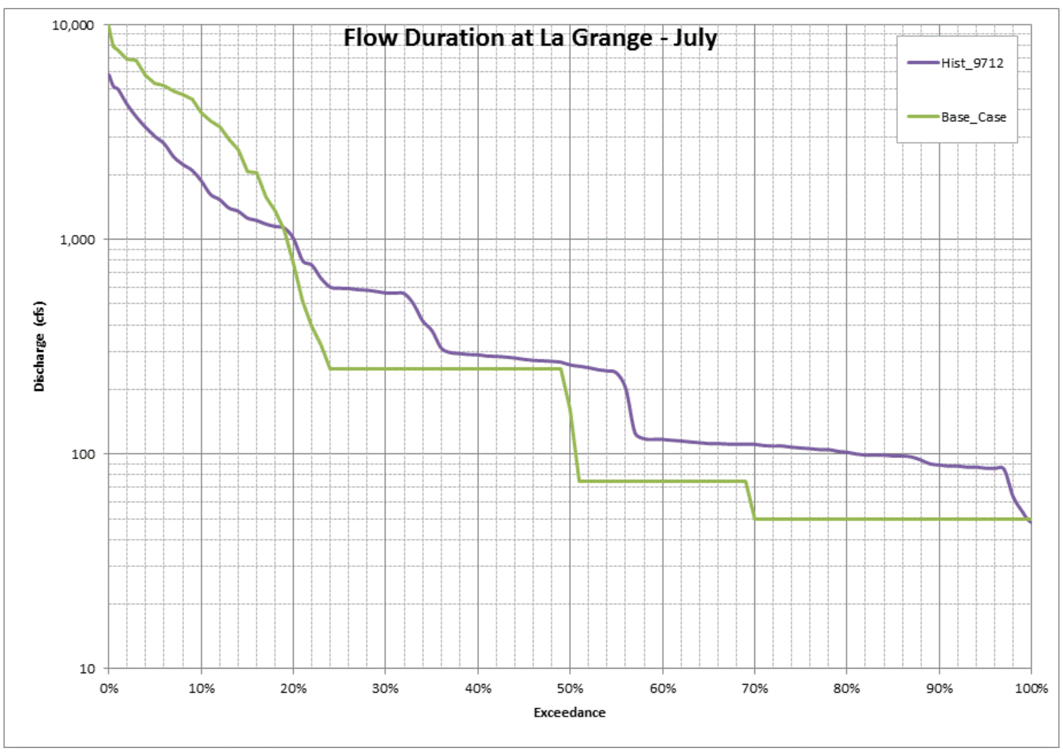

Figure B-8. Flow duration at USGS La Grange gage for historical and base case operations -- July.

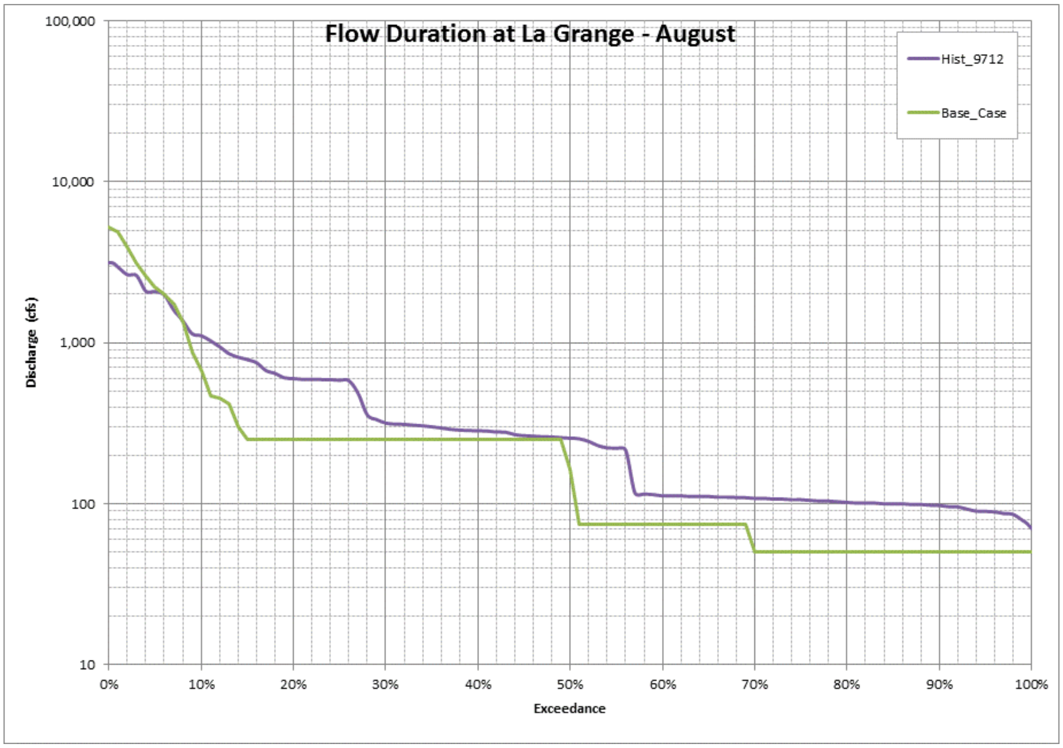

Figure B-9. Flow duration at USGS La Grange gage for historical and base case operations -- August.

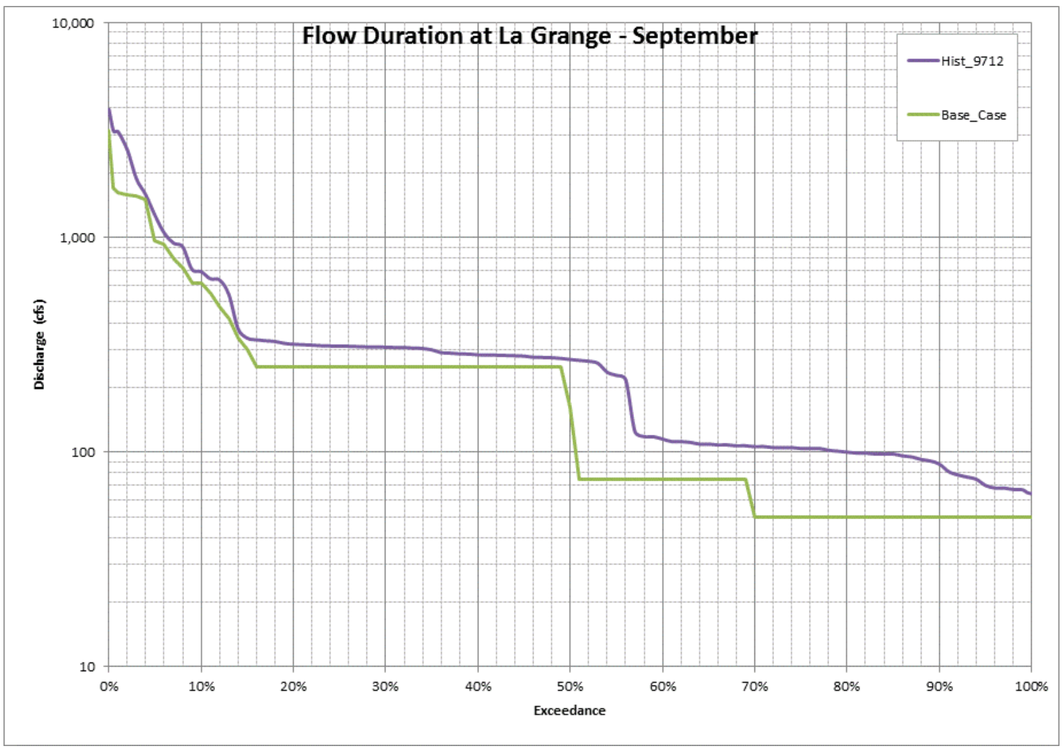

Figure B-10. Flow duration at USGS La Grange gage for historical and base case operations -- September.

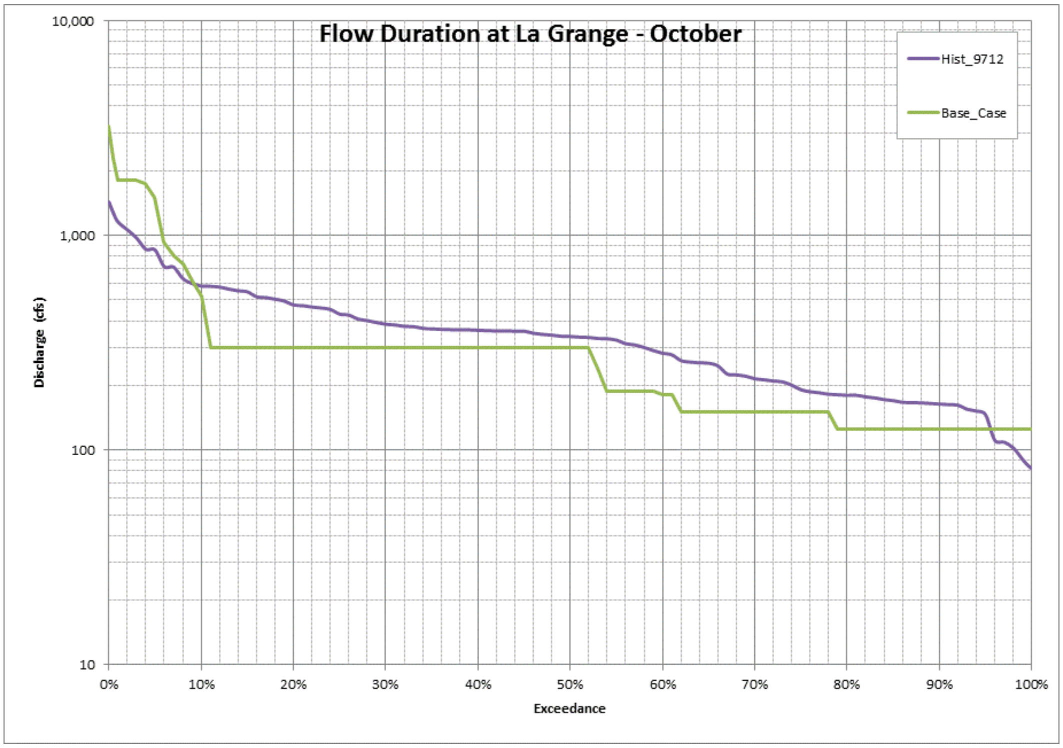

Figure B-11. Flow duration at USGS La Grange gage for historical and base case operations -- October.

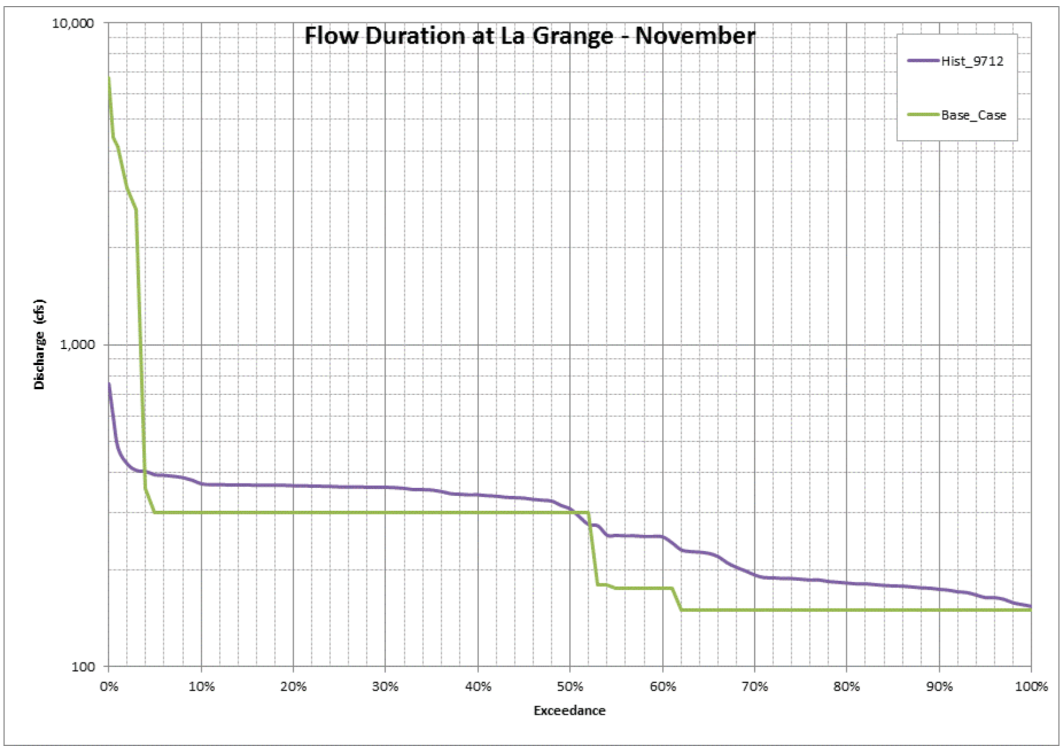

Figure B-12. Flow duration at USGS La Grange gage for historical and base case operations -- November.

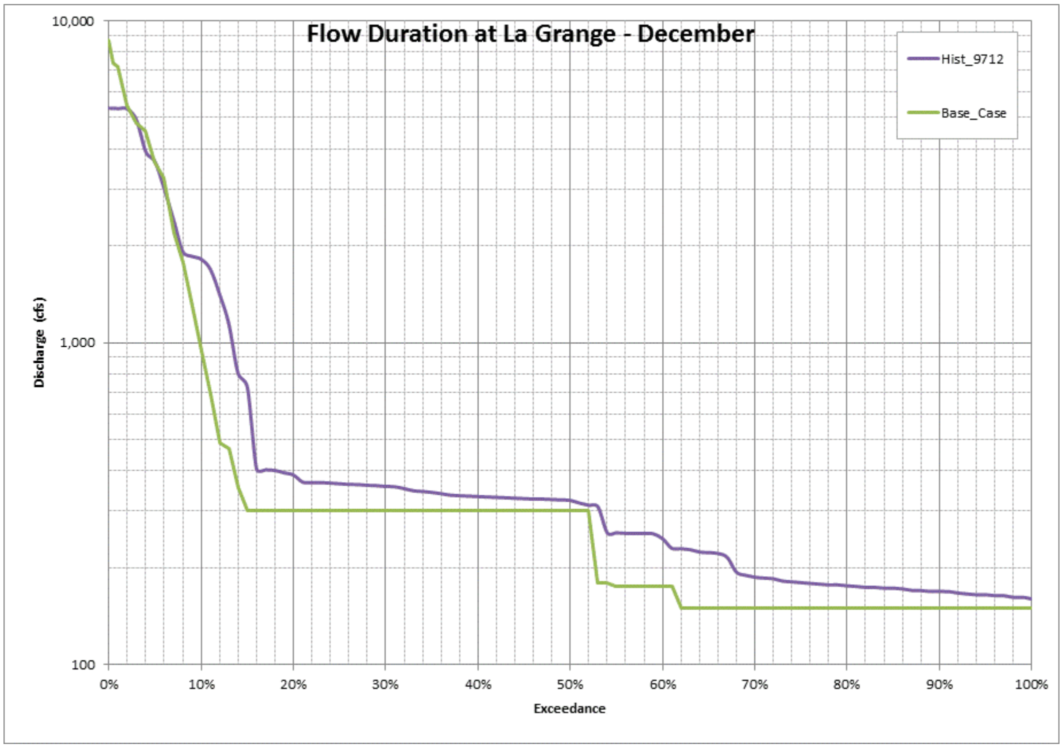

Figure B-13. Flow duration at USGS La Grange gage for historical and base case operations -- December.