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FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

WATER CONTROL MANUAL

APPENDIX VIII TO
MASTER WATER CONTROL MANUAL
SACRAMENTO RIVER BASIN, CALIFORNIA

US Army Corps
of Engineers ®
Sacramento District

DECEMBER 1987
REVISED SEPTEMBER 2017

Public Review Copy

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FOLSOM DAM AND LAKE

American River
California

APPENDIX VIII
To
MASTER WATER CONTROL MANUAL

Sacramento River Basin
California

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

December 1987

Revised September 2017

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NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in looseleaf form in a hard copy binder and only those section, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so those inserts can be added to make the manual current. Changes to individual pages must indicate the date of revision, which is also the division's approval date. Pages or sections that are changed after the revision is approved and distributed will indicate the new change month/year.

VERTICAL DATUM

All elevations in this manual, except where otherwise noted, are based on the North American Vertical Datum of 1988 (NAVD88) which became the official vertical datum for the United States in 1993. A single reference was chosen to serve as the point of origin for measuring standard mean sea level (MSL) in North America. This base monument is located at Pointe-au-Pere (Father Point), Rimouski, Quebec, Canada. The NAVD88 elevation of all other bench marks or base monuments in North America are determined relative to this established reference point. In accordance with ER 1100-2-8160 *Policies for Referencing Project Elevation Grades to Nationwide Vertical Datums* dated 1 March 2009, controlling elevations and local datums are to be properly and accurately referenced to nationwide spatial reference systems established and maintained by the U.S. Department of Commerce [NOAA'S National Geodetic Survey] and used by other federal, state, and local agencies responsible for flood forecasting, inundation modeling, flood insurance rate maps, navigation charting, and topographic mapping. Elevations originally based on the National Geodetic Vertical Datum of 1929 (NGVD29) or on superseded datums (i.e., msl) were converted to NAVD88, or, where noted, a conversion factor was identified.

WATER CONTROL PERSONNEL

In the event that unusual conditions arise during non-duty hours, communication can be achieved by contacting the personnel listed in the front of this manual and in Exhibit A, Standing Instructions to Project Operators for Folsom Dam and Lake.

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PERSONNEL CONCERNED WITH THE PROJECT OPERATION

Personnel list is not available in this version of the manual

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FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

U.S. Army Corps of Engineers
Sacramento District
Revised September 2017

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Abbreviations and Acronyms

ac	acres
ac-ft	acre-feet (the volume of an acre, one foot deep)
ACE	Annual Chance Exceedence
API	Antecedent Precipitation Index
ARCF	American River Common Features
ARD	American River Division
C	Celsius
CCAO	Central California Area Office
CDEC	California Data Exchange Center
CDF	California Department of Forestry
CDFW	California Department of Fish and Wildlife
CDPR	California Department of Parks and Recreation
CESPD	U.S. Army Corps of Engineers, South Pacific Division
CESPK	U.S. Army Corps of Engineers, Sacramento District
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNRFC	California-Nevada River Forecast Center
COO	Continuity of Operations
Corps	U.S. Army Corps of Engineers
cu-yd	cubic yards
CVCC	Central Valley Control Center
CVOO	Central Valley Operation Office
CVP	Central Valley Project
CWMS	Corps Water Management System
DCP	Data Collection Platform
DETS	Directorate of Engineering and Technical Services
DWR	California Department of Water Resources
EA	Environmental Assessment
EAP	Emergency Action Plan
EIP	Environmental Inventory Paper
EIS	Environmental Impact Statement
elev	elevation
EM	Engineer Manual, U.S. Army Corps of Engineers
ENSO	El Niño/Southern Oscillation
EOC	Emergency Operations Center
ER	Engineer Regulation, U.S. Army Corps of Engineers
ERB	Environmental Review Board
ESA	Endangered Species Act
ESRD	Emergency Spillway Release Diagram
ETL	Engineering Technical Letter, U.S. Army Corps of Engineers
EWDAA	Energy and Water Development Appropriations Act
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulation Commission
FOC	State-Federal Flood Operations Center
ft	feet
FWS	U.S Fish and Wildlife Service
GPUD	Georgetown Divide Public Utility District
GOES	Geostationary Operational Environmental Satellite

HADA	Hydrometeorologic Automatic Data Acquisition System
HMR	Hydrometeorological Report
hp	horsepower
in	inches
JFP	Joint Federal Project
JOC	Joint Operations Center
kv	kilovolts
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt hours
LOS	Line-of-sight (radio)
mgd	million gallons per day
mi	mile
mi^2	square mile
MIAD	Mormon Island Auxiliary Dam
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MW	megawatt
NAP	Normal Annual Precipitation
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NEMD	Natomas East Main Drainage Canal
NEPA	National Environmental Policy Act
NEXRAD	The Next Generation Weather Radar System
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic Atmospheric Administration
NTU	Nephelometric Turbidity Unit
NWIS	National Water Information System
NWS	National Weather Service (an organization of NOAA)
OES	California Office of Emergency Services
OMP	Operations Management Plan
PACR	Post Authorization Change Report
PAO	Public Affairs Officer
PCWA	Placer County Water Agency
pf	power factor
PG&E	Pacific Gas and Electric Company
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMS	Probable Maximum Storm
PPM	parts per million
PRV	Pressure Regulator Valve
Pub. L.	Public Law
QPF	Quantitative Precipitation Forecast
QTF	Quantitative Temperature Forecast
RDF	Reservoir Design Flood
RFC	Joint Federal-California State River Forecast Center
RM	river mile
RPM	revolutions per minute
SAFCA	Sacramento Area Flood Control Agency
SCADA	Supervisory Control and Data Acquisition
SDAT	California State Drought Action Team
SDF	Spillway Design Flood
SFD	second foot day
SMUD	Sacramento Municipal Utility District
SOP	Standard Operation Procedure
SPF	Standard Project Flood
SPK	U.S. Army Corps of Engineers, Sacramento District

sq mi	square mile
SRI	Sacramento River Index
SWP	State Water Project
SWRCB	California State Water Resources Control Board
TDS	Total Dissolved Solids
UPS	Uninterrupted Power Supply
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USFS	United States Forest Service
USGS	United States Geological Survey
VOIP	Voice over Internet Protocol
VTC	Video Teleconference Connection
WAN	Wide Area Network
WCD	Water Control Diagram
WCM	Water Control Manual
WCDS	Water Control Data System
WCP	Water Control Plan
WRDA	Water Resources Development Act

FOLSOM DAM AND LAKE
AMERICAN RIVER
Sacramento County, California

PERTINENT DATA
(IP Units)
Elevation notation key: NAVD88 (NGVD29)
All areas and capacities based on Reclamation's 2005 tables

GENERAL

Location	
Latitude	38º 42' 28" North
Longitude	121º 09' 24"West
County	Sacramento
State	California
Drainage area	
American River at Folsom Dam	1,861 sq miles
South Fork American River at Lotus	673 sq miles
North Fork American River near Auburn	614 sq miles
Middle Fork American River at N Fork Dam	342 sq miles
American River at Fair Oaks	1,888 sq miles
American River at mouth	2,100 sq miles
Flows at Folsom Dam	
Mean annual unregulated runoff (1905-86)	2,788,000 ac-ft
Maximum mean daily inflow (23 Dec 1955)	189,000 cfs
Maximum 2-hour inflow (18 Feb 1986)	553,000 cfs
Reservoir design flood peak inflow	340,000 cfs
Reservoir design flood peak outflow	115,000 cfs
Standard project flood peak inflow (2016)	542,750 cfs
Standard project flood peak outflow (2016)	474,695 cfs
Spillway design flood peak inflow (1946)	615,000 cfs
Spillway design flood peak outflow (1946)	585,000 cfs
Probable maximum flood peak inflow (2001)	906,000 cfs
Probable maximum flood peak outflow	833,100 cfs
Historical pool elevations	
Maximum June 1963	469.57 ft (467.23 ft)
Minimum November 1977	349.9 ft (347.56 ft)

LAKE

Elevation	
Min power pool (top of inactive pool)	329.34 ft (327.0 ft)
Maximum flood control pool (bottom)	429.34 ft (427.0 ft)
Gross pool (top of joint use pool)	468.34 ft (466.0 ft)
Spillway design flood pool	478.54 ft (476.2 ft)
Top of induced surcharge pool	477.74 ft (475.4 ft)
Guide taking line	468.34 ft (466.0 ft)
+300 ft landward	
Area	
Minimum power pool	2,030 ac
Flood control pool	9,040 ac
Gross pool	11,450 ac
Spillway design flood pool	11,960 ac
Top of induced surcharge pool	
Guide taking line	12,000 ac
Acquisition line	15,754 ac
Storage capacity	
Minimum power pool	83,000 ac-ft
Flood control pool	578,000 ac-ft
Gross pool	967,000 ac-ft
Spillway flood pool	1,094,200 ac-ft

MAIN DAM

Type	
Location	30 RM

MAIN SPILLWAY

OUTLETS

AUXILIARY SPILLWAY

FOLSOM DAM AND LAKE
AMERICAN RIVER
Sacramento County, California

PERTINENT DATA
(IP Units)
Elevation notation key: NAVD88 (NGVD29)

POWER PENSTOCK (STEEL LINED)

Generator capacity,	215,100 kW
Maximum discharge capacity	7,650 cfs

WING DAMS

Side slopes	
Upstream (above elevation 452.34 (450 ft))	1 on 2.25
(between elevation 452.34 ft (450) and 429.34 ft (427))	1 on 3.25
(below elevation 429.34 ft (427 ft))	1 on 3.75
Downstream	1 on 2
Total excavation	240,000 cu-yds
Total volume of embankment	7,810,000 cu-yds

DIKES

Type	
Freeboard above spillway flood pool	3.0 ft
Crest length	
Maximum height	
Side slopes	
Upstream (crest to elevation 468.34 ft (466 ft))	1 on 2.25
(below elevation 468.34 ft (466 ft)	1 on 3.25
Downstream	1 on 2.25
Total excavation	140,000 cu-yds
Total volume of embankment	1,200,000 cu-yds

MORMON ISLAND DAM (ROLLED EARTH)

Freeboard above spillway flood pool	3.0 ft
Side slopes	
Upstream (crest to elevation 468.34 ft (466 ft))	1 on 2
(between elev 468.34 ft (466 ft) and 429.34 ft (427 ft))	1 on 3
(below elev 429.34 ft (427 ft))	1 on 4.5
Downstream (crest to elevation 468.34 ft (466 ft))	1 on 2
(between elev 468.34 ft (466 ft) and 429.34 ft (427 ft))	1 on 2.5
(below elev 429.34 ft (427 ft))	1 on 3.5
Undredged valley and abutment section	
Upstream and downstream slope	1 on 2
Total excavation	1,062,000 cu-yds
Total volume of embankment	3,820,000 cu-yds

NIMBUS DAM AND LAKE NATOMA
AMERICAN RIVER
Sacramento County, California

LAKE

Maximum water level	
Elevation	125.0 ft
Surface area	540 ac
Capacity	8,760 ac-ft
Active (elev 120.84 ft (118.5 ft) - 127.34 ft (125.0 ft))	2,800 ac-ft

SPILLWAY (overflow weir)

Capacity	300,000 cfs
Design discharge capacity at elev 119.94 ft (117.6 ft)	150,000 cfs
at elev 128.84 ft (126.5 ft)	300,000 cfs

DAM

Location	23 RM

NIMBUS POWER PLANT

Capacity of units	6,763 kW each
Normal operating head	41.5 ft
Maximum discharge capacity	5,500 cfs
Runoff	1-inch runoff = 99,284 ac-ft at dam

I - INTRODUCTION

1-01. Authorization. Section 7 of the Flood Control Act of 22 December 1944 (58 Stat 890) authorizes the development of the rules and regulations contained in this manual. The relevant portion of the Act reads as follows:

> "Hereafter it shall be the duty of the Secretary of War to prescribe regulations for use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations..."

The Sacramento District of the Corps of Engineers (Corps), the U.S. Bureau of Reclamation (Reclamation), and non-federal sponsors jointly authored the manual's specific regulations in order to achieve the goals set during the project's planning and design phases.

The Water Control Diagram and Emergency Spillway Release Diagram, which comprise the Water Control Plan, have been authorized by the Division Engineer and his Reclamation counterpart, the Regional Director, per the policies and procedures contained in Title 33 of the Code of Federal Regulations, Section 208.11 (33 CFR 208.11).

The content of the Folsom Dam and Lake Water Control Manual, American River, California (Appendix VIII to the Sacramento River Basin Master Water Control Manual) was prepared in accordance with the instructions contained in the following Corps regulations and guidance:

ER 1110-2-240	*Engineering and Design – Water Control Management* Provides guidance on water control management policy and procedures.	30 May 2016
EM 1110-2-3600	*Management of Water Control Systems* Provides guidance on water control management fundamentals and objectives to be taken into account when formulating Water Control Plans.	30 November 1987
ER 1110-2-8156	*Preparation of Water Control Manuals* Standardizes the format and content of Water Control Manuals.	31 August 1995

1-02. Purpose and Scope. This manual provides descriptive information about the project's authorization and purposes; history; watershed characteristics and hydrometeorology; data collection and communication networks; hydrologic forecasting; benefits and effects of the Water Control Plan; and water resource management functions (including responsibilities and coordination for water control decision-making). The exhibits include: (1) special instructions to

the dam tender or reservoir manager regarding data collection requirements, reporting procedures, and procedures to be followed in the event of a communication outage under emergency conditions, (2) a copy of 33 CFR 208.11 and subsequent letters of understanding, and (3) other water control agreements.

1-03. Related Manuals and Reports. This Water Control Manual is Appendix VIII of the *Master Manual of Reservoir Regulation*, Sacramento River Basin, California, which describes the overall plan for flood control for the Sacramento River Basin. Other projects included as appendices to the Master Manual are as follows:

Title		Date
Master Manual of Reservoir Regulation, Sacramento River Basin, Calif.		March 1959
Appendix I	- Shasta Dam and Lake	Rev. January 1977
Appendix II	- (Reserved for Cottonwood Creek)	TBD
Appendix III	- Black Butte Dam and Lake	Rev. May 1987
Appendix IV	- Oroville Dam and Lake	Rev. August 1970
Appendix V	- New Bullards Bar Reservoir	June 1972
Appendix VI	- (Reserved for Marysville Dam and Lake)	TBD
Appendix VII	- Indian Valley Dam and Reservoir	October 1977
Appendix VIII	- Folsom Dam and Lake	Rev. September 2017

The original Water Control Manual for Folsom Dam and Lake was published in October 1956, then revised in March 1959 and December 1987. This manual supersedes all previous Folsom Dam and Lake Water Control Manuals. Project development is documented in the following historical definite project reports, design memoranda, and design documentation reports:

	Title		Date
1.	*Definite Project Report*:		
	Part I	Hydrology	28 June 1946
	Part II	Reservoir and Flowage	1 July 1948
	Part IV	Dam and Appurtenances with Appendix A thru D	20 February 1950
	Part VI	Malaria Control	15 January 1946
	Part VII	Recreation Facilities with Appendix A	20 April 1949
	Part VIII	Fish and Wildlife Facilities with Appendix A and B	10 November 1952
	Part IX	Reservoir Clearing	15 August 1951
2.	Folsom Reservoir, American River, California: *Planning Report*		January 1955
3.	*Design Memorandum No. 1, American River Levees*, American River Project, California, General Design		25 June 1956
4.	*Design Memorandum No. 2, American River Levees*, American River Project, California; Pumping Plants for Interior Drainage		7 September 1956
5.	*Auxiliary Spillway General Design Documentation Report*		October 2008
6.	*Folsom Engineering Report*		September 2017
7.	*Folsom Dam and Lake, Operation and Maintenance Manual*		XXX 2017

Other related manuals and reports relevant to history of the project and/or leading to the current regulation plan can be found in Tables 1-1 and 1-2 in the Table Section following Chapter 9.

1-04. Project Owner. Folsom Dam and Lake is a federally-owned project entrusted to the U.S. Bureau of Reclamation (Reclamation).

1-05. Operating Agency. Reclamation's Central California Area Office (CCAO), headquartered at Folsom Dam, is responsible for operating and maintaining Folsom Dam and appurtenances. The CCAO oversees the facilities of the Central Valley Project, which includes Folsom Dam and Nimbus Dam. The power generation facilities located at Folsom Dam and Nimbus Dam can be operated remotely by the Control Center, which is staffed 24 hours a day The recreational features at Folsom and Natoma Lakes are operated by the State of California Department of Parks and Recreation (CDPR). The Nimbus Fish Hatchery is operated by the State of California Department of Fish and Wildlife (CDFW).

1-06. Regulating Agencies. Folsom Dam and Lake is regulated to obtain the greatest practicable benefits from flood control and other authorized purposes.

a. Reclamation regulates Folsom Dam and Lake for flood control and, as an integrated part of the CVP, for agriculture, municipal and industrial use. The Regional Director, Mid-Pacific Region, Sacramento, California, holds responsibility for the overall water control regulation. The Central Valley Operations office (CVO), which supervises the CVP, handles the regulation plans for Folsom Dam and Lake.

b. The principles behind the flood control regulation for Folsom Dam and Lake were mutually agreed upon by Reclamation and the U.S. Army Corps of Engineers (Corps). However, the Corps holds responsibility for both prescribing and approving the flood control regulations (33 CFR 208.11). The Corps is also responsible for monitoring the project for compliance with the approved Water Control Plan. Any deviation from the flood control instructions must be authorized by the Corps.

c. There are no other agencies with the authority to plan or make decisions on the water control regulation of Folsom Dam. However, other entities can influence Reclamation's flood risk management decisions based on legislated requirements, agreements, or interest focused on other authorized purposes. These entities include, but are not limited to, the following:

- The California Department of Water Resources (Hydrology and Flood Operations Branch, River Forecasting Section) and the California Nevada River Forecasting Center (CNRFC), which is a field office of the National Weather Service in Sacramento, California, are responsible for producing the hydrologic forecasts used to regulate Folsom Dam.

- California State Water Resources Control Board (SWRCB) safeguards water quality and enforces water rights by issuing permits, orders, and decisions regulating streamflow requirements on the lower American River (LAR). (see Plate 4-7 depicting the LAR)

- Water districts, irrigation districts, or others needing water supply or water for municipal and industrial uses enter into agreements with Reclamation. These agencies may or may not be a part of the CVP.

- The National Marine Fisheries Service (NMFS), the California Department of Fish and Wildlife (CDFW), and the U.S. Fish and Wildlife Service (FWS) enter into agreement with Reclamation or provide information to help Reclamation manage temperature and flows for fishery purposes in the LAR.

II – DESCRIPTION OF PROJECT

2-01. Location. The Folsom Dam and Lake project is about 20 miles northeast of the city of Sacramento, and 2 miles north of the city of Folsom. It is located on the American River about 26 miles upstream from its confluence with the Sacramento River and about seven miles upstream of Nimbus Dam (an afterbay structure for Folsom Dam) and Lake Natoma. The dam is located in Sacramento County, but its lake spans three counties: Sacramento, Placer and El Dorado.

The geographic coordinates of Folsom Dam are:

Latitude: 38° 42’ 28” North
Longitude: 121° 09’ 24” West

A network of county roads, which connect with U.S. Highway 50 near the city of Folsom, provides access to the various features of the project. Plate 2-1, the General Map, shows the location of Folsom Dam and Lake in relation to the American River Basin. Plate 2-2 is the Folsom Dam and Lake Area Map.

2-02. Purpose. The Folsom Dam and Lake project is a multipurpose project operated as an integral part of Reclamation’s Central Valley Project (CVP). It provides flood protection for the Sacramento metropolitan area, water supplies (for domestic, municipal and industrial use as well as irrigation and hydropower), and extensive water-related recreational opportunities. Releases from Folsom Dam are also used to control water quality for project diversions to the Sacramento-San Joaquin Delta and to maintain anadromous fish runs in the American River below the dam. Folsom Dam’s maximum flood control reservation is 600,000 acre-feet.

a. The following legislation authorized the initial project construction:

   (1) Rivers and Harbors Act of 1935

   (2) Rivers and Harbors Act of 1937

   (3) Pub. L. 534 Flood Control Act of 1944

   (4) Pub. L. 356 American River Basin Development Act of 1949

b. Legislation authorizing changes or additions to the project includes:

   (1) Pub. L. 104-303 Water Resources Development Act of 1996

   (2) Pub. L. 106-53 Water Resources Development Act of 1999

   (3) Pub. L. 107-66 Energy and Water Development Appropriations Act of 2002

(4) Pub. L. 108-137 Energy and Water Development Act of 2004

(5) Pub. L. 109-103 Energy and Water Development Act of 2006

(6) Pub. L. 110-114 Water Resources Development Act of 2007

c. The following general Congressional acts apply to Folsom Dam and Lake and expand on its project purposes:

(1) Pub. L. 78-534 Flood Control Act of 1944 (recreation, surplus water)

(2) Pub. L. 85-624 Fish and Wildlife Coordination Act of 1958

(3) Pub. L. 85-500 Water Supply Act of 1958

(4) Pub. L. 89-665 National Historic Preservation Act of 1966 (historic and archaeological data preservation)

(5) Pub. L. 91-190 National Environmental Policy Act of 1969 (environmental protection)

(6) Pub. L. 92-500 Federal Water Pollution Control Act Amendments of 1972 (water quality)

(7) Pub. L. 93-205 Endangered Species Act of 1973 (endangered or threatened fish/wildlife)

(8) Pub. L. 102-240 Clean Air Act of 1990

2-03. Physical Components. These features are described in detail in the following subsections and can be seen on Plate 2-2, the Folsom Dam and Lake Area Map. Additional information can be found on the pertinent data sheets in the front matter of this manual. Note that unless otherwise stated, all elevations indicated here and elsewhere in this manual are based on the North American Vertical Datum of 1988 (NAVD88).

a. Main Dam. The Folsom Dam consists of a straight section across the river channel with a crest length of feet, a maximum height of from the lowest point of the foundation to the crown of the roadway, and a maximum hydraulic height of

. The crest length of the right wing dam is the length of the left wing dam The maximum height of the wing dams is Plans, profiles and sections of the dam and appurtenances are shown in the as-built drawings on Plates 2-3 through 2-8.

b. Mormon Island Auxiliary Dam (MIAD). The Mormon Island Auxiliary Dam (Figure 2-1), which crosses Blue Ravine about 2.5 miles east of the main dam, has a crest elevation of . During the early 1990s, the MIAD foundation was determined to be at high risk of liquefaction during an earthquake. Remediation efforts in 2013 included the excavation and removal of a wide column of liquefiable alluvium materials within the downstream toe area, and replacement with concrete and compacted soil. Two million cubic yards of decomposed granite rock excavated for the auxiliary spillway was used to construct the overlay berm at the MIAD.

Figure 2-1 is not available in this version of the manual

Figure 2-1. Mormon Island Auxiliary Dam

c. Dikes. There are dikes, totaling approximately 11,700 lineal feet, composed of on the upstream and downstream slopes. See Plate 2-2, the Folsom Dam and Lake Area Map, for locations of dikes. Crest widths are between

d. Outlet Works. rectangular gated river outlets reside below the service spillway section of the main dam (see Figure 2-2 and Plate 2-4).

There are also three power penstocks to the Folsom Powerplant through the main dam on the right of the spillway (as the viewer faces downstream from the dam) with an intake centerline elevation of and a pumphouse furnish water to San Juan Suburban Water District, the cities of Roseville and Folsom, and Folsom Prison. The conduit replaces the Natoma and North Fork ditches, which were inundated by the reservoir. Outlet works rating curves are shown in Exhibit A on Plate A-3. Figure 2-2 shows the location of the outlet works.

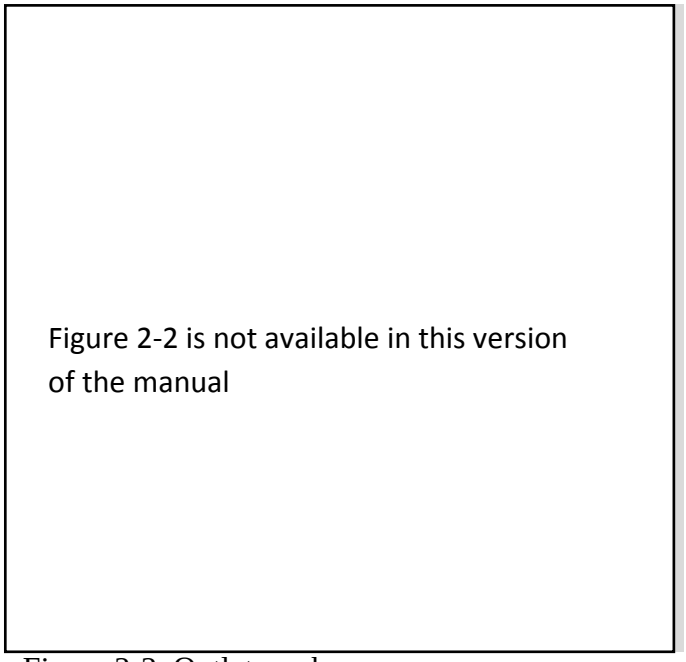


Figure 2-2. Outlet works

e. Main Spillway. The main spillway (see Figure 2-2 and Plate 2-4) is located in the center of the dam. The flow over this section of the spillway is discharged into a stilling basin This portion of the spillway has a flip-bucket energy dissipater, intended for use only during extreme flood events. The main spillway discharge rating curve is shown on Plate A-4 in Exhibit A.

f. Auxiliary Spillway. The auxiliary spillway, constructed southwest of the existing main concrete dam on the left abutment, includes the following main features: an approximately

Together, the stepped spillway and stilling basin will act as an energy dissipation structure as water discharges into the American River below the main concrete Folsom Dam. See Figure 2-3 for a photo of the completed auxiliary spillway.

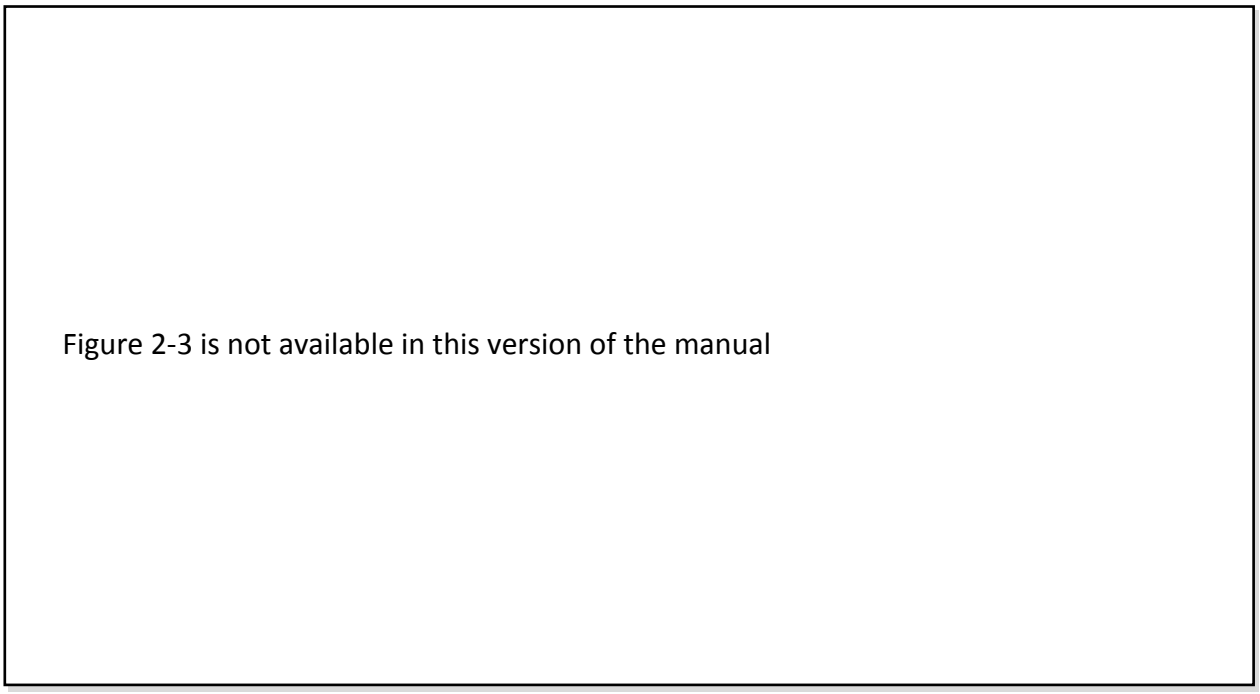


Figure 2-3. Auxiliary spillway

The rectangular stilling basin walls and are designed to contain the design flow of 160,000 cfs from a combined release of 135,000 cfs from the auxiliary spillway and 25,000 cfs from the main dam river outlets, with minimal splash over the walls. The walls will be overtopped during higher release events. Plans, profiles and sections of the auxiliary spillway features are shown on Plates 2-7 and 2-8. The auxiliary spillway discharge rating curves are shown in Exhibit A on Plate A-5.

g. Powerplant. . Its turbines are each rated at just over 71,700 kilowatts when operating at rated speed and a head of 300 feet. The units were uprated in 1972. They now have a

combined capacity of 215,100 kilowatts. The discharge through each turbine at rated speed and head is 2,550 second-feet.

Folsom is a peaking powerplant which is dedicated to first meeting the requirements of the project facilities. The remaining energy is marketed to various preferential customers in northern California. This plant also provides power for the pumping plant, which supplies the local domestic water supply. Nimbus powerplant units each generate an additional 6,700 kilowatts that are transmitted via the Folsom switchyard.

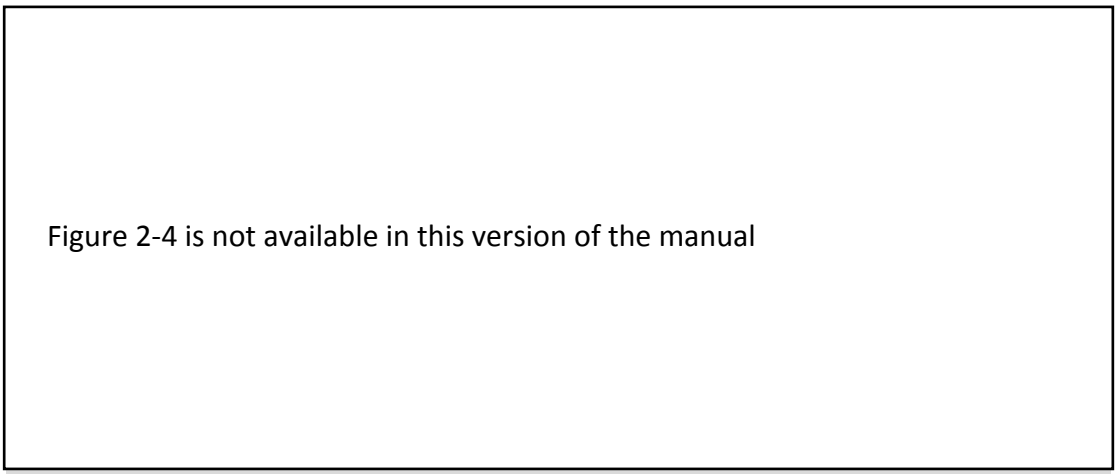


Figure 2-4. Penstock Trashracks and Temperature Shutters

. The shutters can be raised or lowered with the gantry crane.

2-04. Related Control Facilities. The American River is one of the two major tributaries to the Sacramento River. The Folsom Dam and Lake project is a component of the Folsom Unit under the American River Division of the Central Valley Project and is also an important feature in the comprehensive plan of development to control flooding in the Sacramento Valley. Plate 4-7 identifies integrated components located downstream which includes a reregulation and diversion facility, local protection projects such as the levees, and the Sacramento Weir and Bypass facility.

a. Nimbus Dam. Nimbus Dam and Lake Natoma (Figure 2-5) is a reregulation and diversion facility located about 7 miles downstream from Folsom Dam.

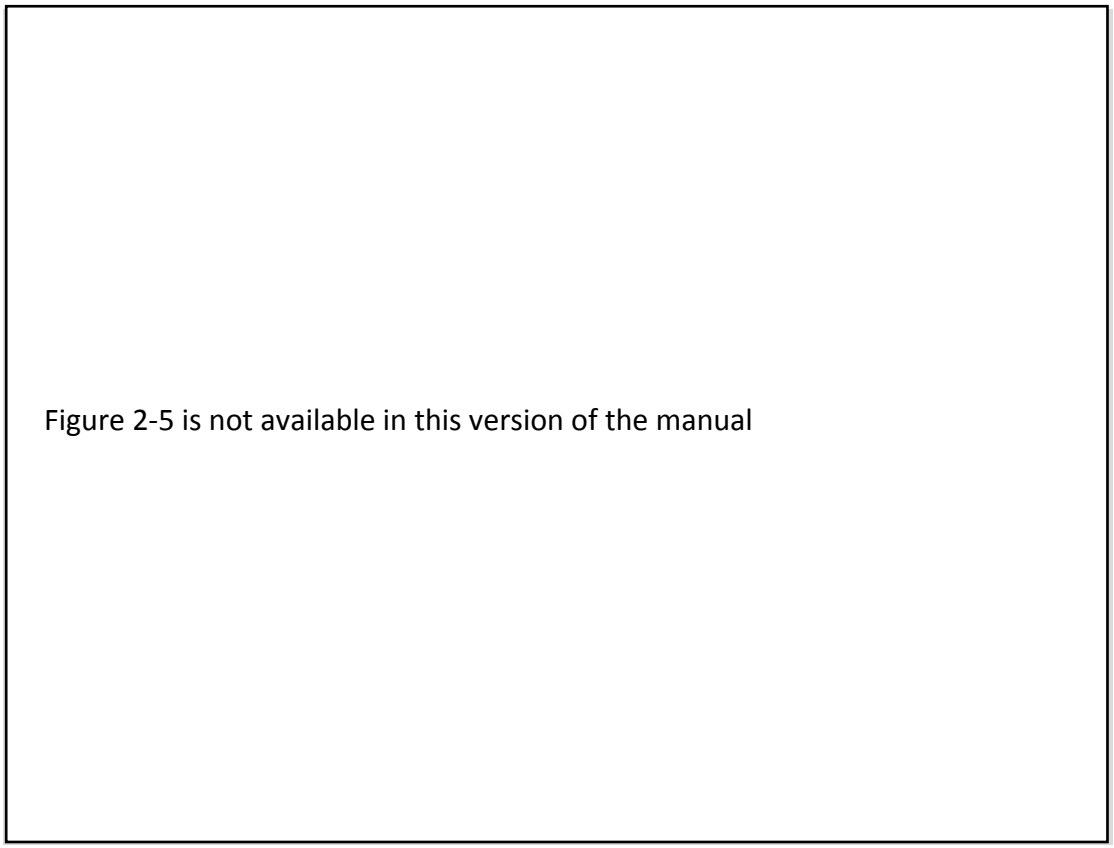


Figure 2-5. Nimbus Dam

Lake Natoma serves as an afterbay to reregulate the discharges made through the Folsom Power plant to the Lower American River. Constructed and operated by Reclamation, Nimbus Dam is a base load hydroelectric dam that also functions as a forebay for the Nimbus generators. Lake Natoma has a storage capacity of 8,760 acre-feet at elevation 127.34 feet NAVD88 (125 feet NGVD29). Due to the small storage capacity the water surface may fluctuate between four and seven feet daily.

Additional facilities at Nimbus Dam include the Nimbus Fish Hatchery (see Figure 2-6), which is owned by Reclamation and operated by the California Department of Fish and Wildlife (CDFW). The hatchery is located 1,000 feet below Nimbus Dam on the south bank of the American River

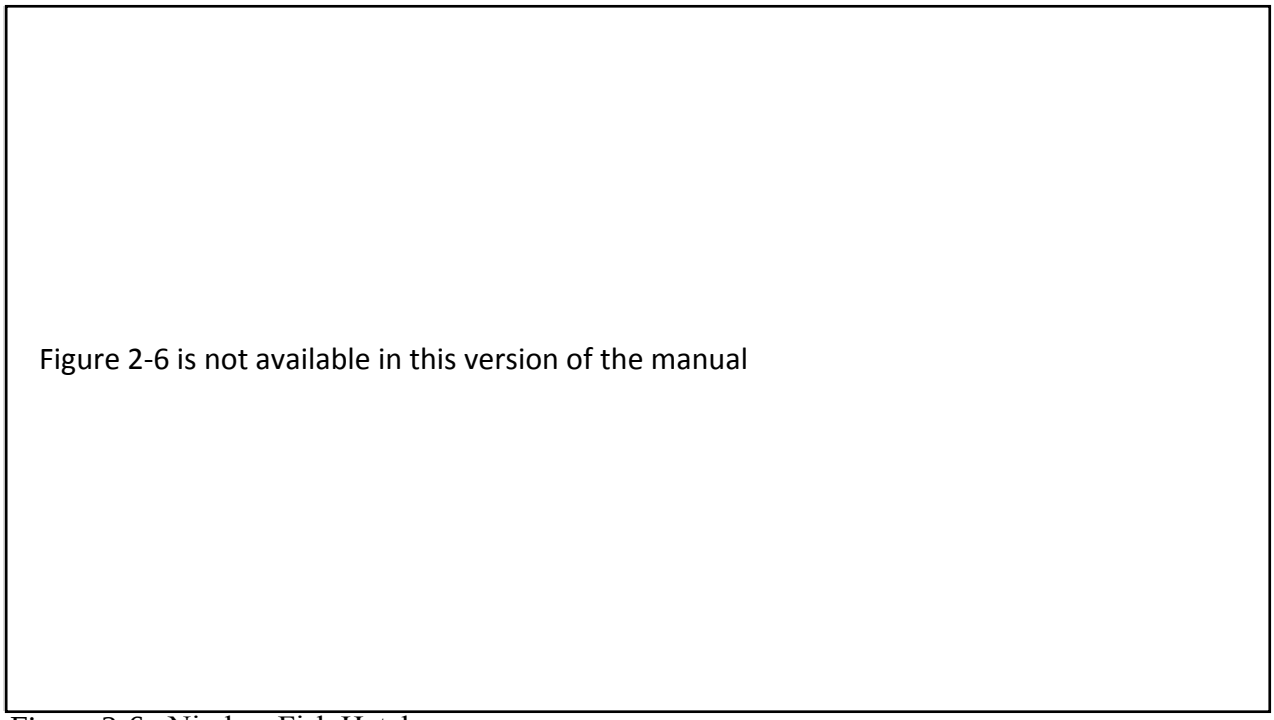


Figure 2-6. Nimbus Fish Hatchery

A weir structure (see Figure 2-7) and fish ladder are part of the hatchery infrastructure. The diversion weir structure guides the fish in the direction of the ladder to enter the hatchery.

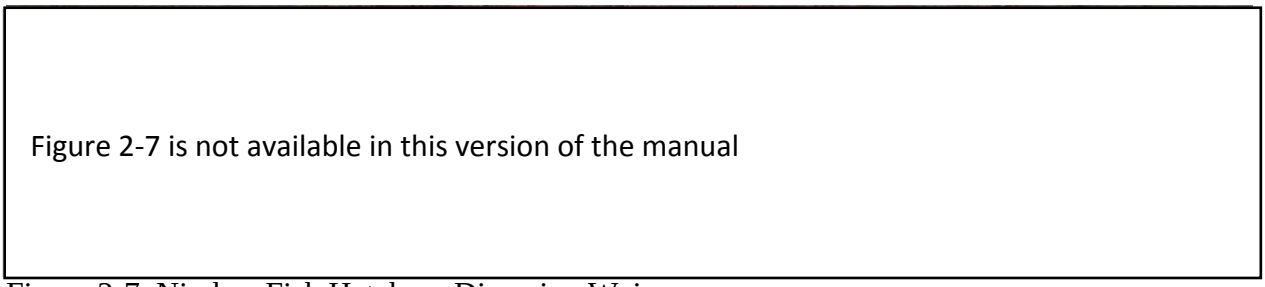


Figure 2-7. Nimbus Fish Hatchery Diversion Weir

Nimbus Dam acts as a diversion dam to direct water into the partially constructed Folsom South Canal. The diversion facility's minimum operating elevation requirement at Lake Natoma is about 120.84 feet NAVD88 (118.5 feet NGVD29).

b. Folsom South Canal. Nimbus Dam acts as a diversion to direct water through the Folsom South Canal facility. Authorized in 1965, construction of the Folsom South Canal began in 1968. Only two of the five planned reaches were successfully completed before the project was terminated. The Folsom South Canal extends 26.7 miles southward and stops below State Highway 104. A siphon carries the canal beneath the Cosumnes River. The Folsom South Canal is concrete-lined and has a capacity of 3,500 cfs. The canal supplies water for municipal, industrial, and irrigation use in Sacramento and San Joaquin counties. There are no plans as of

the writing of this manual to complete construction, which has been delayed indefinitely pending reauthorization. Figure 2-8 shows the location of the Folsom South Canal.

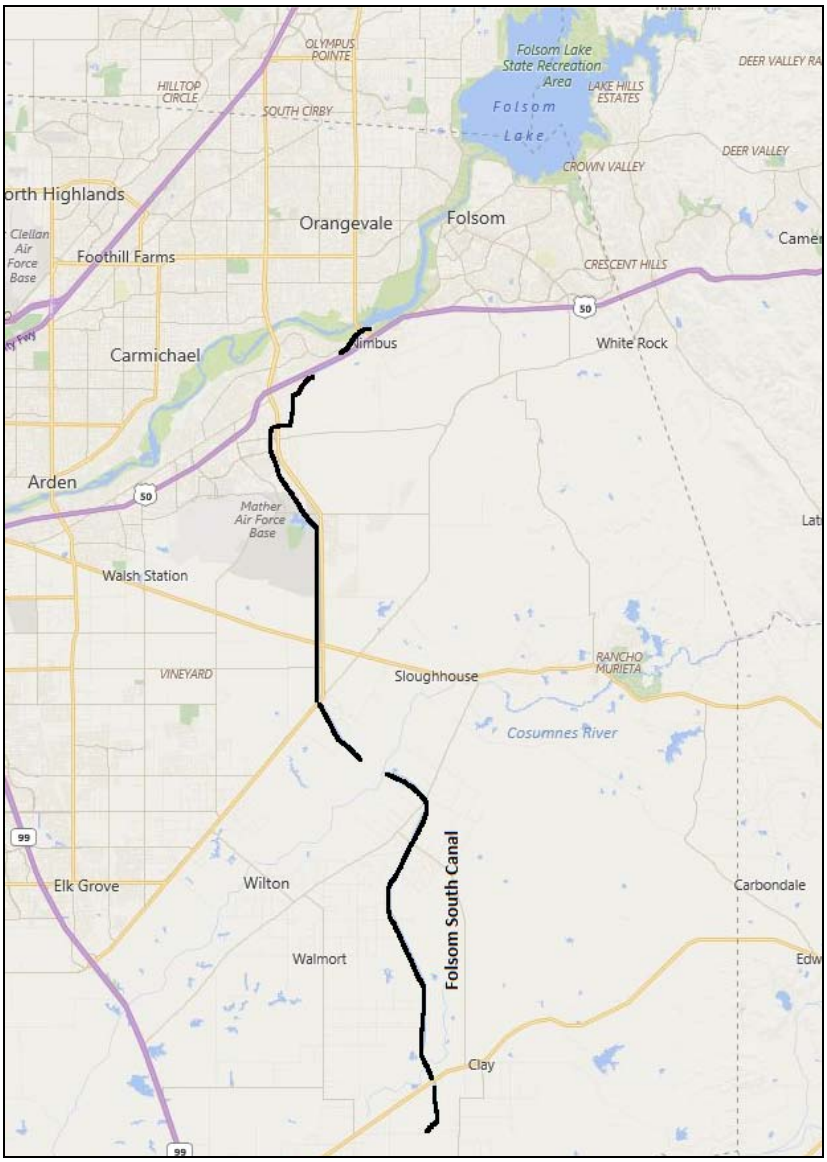


Figure 2-8. Folsom South Canal

c. Local Protection Projects. Extensive levee improvements were authorized and constructed to enable the downstream levees to handle design releases from Folsom Dam ranging from 115,000 cfs (normal objective release) to 160,000 cfs (emergency objective release), particularly in the vicinity of the city of Sacramento at the junction of the American and Sacramento rivers. The American River Levee Project, Common Features Project, and portions of the Sacramento River Flood Control Project have designs meant to support the operation of Folsom Dam. Levee projects for the protection of urban areas along the lower American River are designed to operate in conjunction with Folsom Dam to provide the requisite flood protection.

(1) *American River Levee Project*. The project was built in 1958 and was initially operated and maintained by the Reclamation Board of the State of California. The project consists of a levee on the north bank of the American River originating just south of the town of Carmichael and extending 7 miles downstream to the upper end of the Sacramento River Flood Control Project (near the intersection of Howe Avenue and Arden Way).

This project also includes two pumping station facilities with gravity drains to facilitate interior storm drainage. These pumping plants direct flow through the levee and into the river when the American River flow ranges from 500 cfs to 115,000 cfs.

(2) *Sacramento River Flood Control Project*. Features of the Sacramento River Flood Control Project associated with the American River basin consist of levees along the lower American River, NEMDC, Arcade and Dry creeks, Pleasant Grove Canal, Natomas Cross Canal, Sacramento River, and Yolo Bypass. Prior to construction in 1958, levee improvements were required under the authority of the Sacramento River Flood Control Project to raise the safe non-damaging downstream capacity to 115,000 cfs while providing a 5-foot freeboard (152,000 cfs with 3 feet of freeboard) along the lower American River.

The lower American River levees consist of 10.8 miles of levee improvements along the south bank of the river and about 5.8 miles of improvements along the north bank. The south bank levee originates at the Mayhew Drain at Mayhew Road and extends downstream to the mouth of the American River. The north bank levee originates near Cal Expo (near the intersection of Howe Avenue and Arden Way) and extends downstream to the mouth of the American River. The American River is adjacent to the Natomas Basin and NEMDC between river miles 0.0 and 2.3.

(3) *Common Features Project.* This is a local protection project designed to operate in conjunction with Folsom Dam and provide the ability to convey the increased emergency objective release while also providing the requisite flood protection along the lower American River.

d. Sacramento Weir and Bypass. Completed in 1916, the Sacramento Weir is located on the Sacramento River 2 miles upstream from the confluence of the Sacramento River and the mouth of the American River. See Figure 2-9.

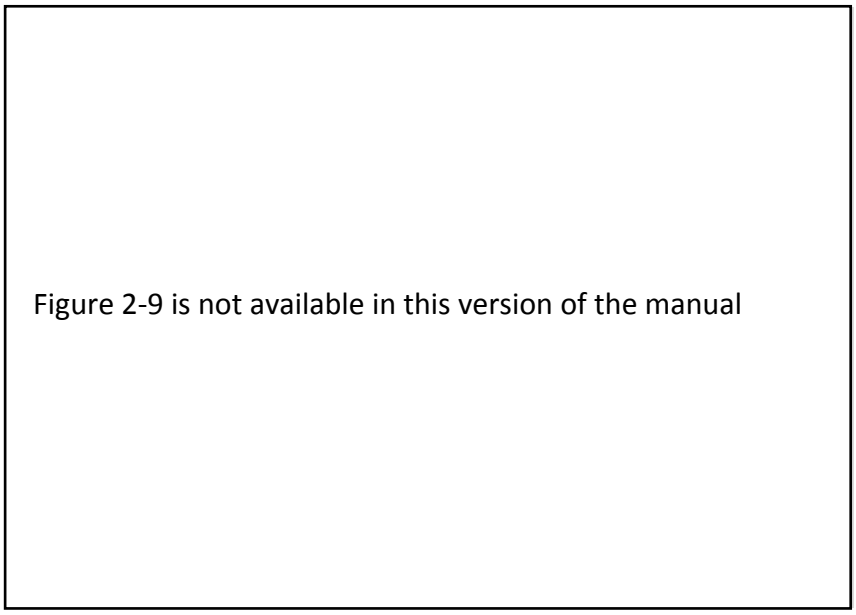


Figure 2-9: The Sacramento Weir

The 1,920-foot-long Sacramento Weir protects the cities of Sacramento, West Sacramento, and the surrounding area by discharging water to the Yolo Bypass via the mile-long Sacramento Bypass. The California Department of Water Resources manually opens and closes the 48 gates at the Sacramento Weir based on regulating criteria established by the Corps. The weir has a design capacity of 112,000 cfs.

The Folsom Dam and Lake project is related to the Sacramento River Flood Control Project in that flows from the reservoir will affect stages in the Sacramento River. When flows are high on both the Sacramento River and the American River, a backwater effect occurs at the confluence, which sends combined floodwaters upstream on the Sacramento River. Because of this effect, when the stage in the Sacramento River at the "I" Street Bridge, downstream of the American River confluence exceeds 29.87 feet NAVD88 (27.5 feet NGVD29), the gates are opened at the Sacramento Weir. The weir discharges into the Yolo Bypass by way of the Sacramento Bypass. The number of gates that must be opened is based on two criteria: (1) preventing the stage at the "I" Street gage from exceeding 31.37 feet NAVD88 (29 feet NGVD29), or (2) to hold the stage at the downstream end of the weir to 29.87 feet NAVD88 (27.5 feet NGVD29). (Note: The NAVD88 conversion factor can vary between 2 to 3 feet depending upon previous surveys and subsidence at a given location. The conversion factor for the gage located at "I" Street is 2.37 per DWR's Gage Datum Update document of 3 October 2016.)

2-05. Real Estate Acquisition. Project lands comprise a total of 17,300 acres acquired in fee; State lands comprise approximately 2,200 acres. Project boundaries are shown on Plate 2-9, the Real Estate and Recreation Facilities Map.

2-06. Public Facilities. The areas both upstream and downstream of Folsom and Nimbus dams provide many opportunities for recreation. The federal land surrounding Folsom Lake and Lake Natoma, known as the Folsom Lake State Recreation Area, is managed by the California

Department of Parks and Recreation (CDPR) under an agreement with Reclamation to develop, operate, and maintain the land.

The purpose of the Folsom Lake State Recreation Area, according to the CDPR, is to make the great recreational opportunities afforded by Folsom Lake and Lake Natoma available to the public, including boating, water skiing, swimming, fishing, hiking, camping, picnicking, horseback riding, and nature study. All recreational facilities in the Folsom Lake and Lake Natoma area are shown on Plate 2-9. A list of specific site amenities for eight of the major recreational facilities is shown in Table 2-1.

TABLE 2-1
Folsom Lake State Recreation Area

Area Facility	Camp Sites	Picnic Sites	Launch Lanes	Restroom Facilities	Parking	
					Car	Car-Trailer
Granite Bay	None	100	54	8	Yes	Yes
Beal's Point	69	53	None	5	Yes	Yes
Folsom Point	None	50	4	2	Yes	Yes
Brown's Ravine	None	50	7	2	Yes	Yes
Peninsula Area	104	6	2	7	Yes	Yes
Negro Bar	3	17	2	4	Yes	Yes
Nimbus Flat	None	37	2	2	Yes	Yes
Rattlesnake Bar	None	None	2	1	Yes	Yes

Source: California Department of Parks and Recreation, Gold Fields District, April 2015

Below Lake Natoma, the American River Parkway borders the American River and extends to the confluence with the Sacramento River. Sacramento County and the California Department of Fish and Wildlife (CDFW) manage the American River Parkway. Sacramento County designed and developed the parkway to preserve its natural beauty and open space. The parkway includes a 12-square-mile area of recreational and open space greenbelt along 30 miles of the American River within the floodplain between Folsom Dam and the Sacramento River. The easterly 7 miles of the parkway within Sacramento County are included in the Folsom Lake State Park. The lower American River portion, which Sacramento County has primary responsibility for, includes approximately 5,400 acres.

Since the parkway is within cycling distance for many local residents, and within easy driving distance for residents throughout Sacramento County, it has become an increasingly important focal point for recreational activities. Facilities for boating, fishing, swimming, hiking, cycling, horseback riding, nature study, picnicking, camping, golf, archery, and many other recreational pastimes are available for an increasing number of people.

III – HISTORY OF PROJECT

3-01. Authorization

a. Flood Control Act of 1944, Pub. L. 78-534 (approved 22 December 1944). Congress authorized the Folsom Dam and Lake Project on the American River for flood control and future power generation. The pertinent portions of the authorization follow:

> "Section 10. That the following works of improvement for the benefit of navigation and the control of destructive flood waters and other purposes are hereby adopted and authorized….to be prosecuted under the direction of the Secretary of War and supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein…."
>
> "…The Folsom Reservoir on the American River, California, is hereby authorized substantially in accordance with the plans contained in House Document Numbered 649, Seventy-eighth Congress, Second Session, with such modification thereof as in the discretion of the Secretary of War and the Chief of Engineers may be advisable…"

The plan set forth in House Document 649 included construction of a dam at the Folsom site to create a reservoir with a gross storage capacity of 355,000 acre-feet and the installation of outlet facilities for future power generation.

The Corps, Reclamation, and the State sought to optimize the project plans. After further study, alternative plans of development were created and examined by the agencies to best optimize for reservoir size and the most economical flood control reservation, the best plan of multiple-purpose operation and the optimum power installation.

b. American River Basin Development Act, Pub. L. 81-356, Chapter 690, 63 Stat. 852 (approved 14 October 1949). Subsequent modifications were agreed upon and these features were authorized by the Act which reads, in part, as follows:

> "Sec. 2. The American River Development shall consist of: Folsom Dam and Reservoir having a storage capacity of approximately one million-acre-feet, to be constructed by the Corps of Engineers…and the following features for the development and use of water, to be constructed, operated, and maintained by the Secretary of Interior through the Commissioner of Reclamation: A hydroelectric powerplant with a generating capacity of approximately one hundred and twenty thousand kilowatts, and necessary hydroelectric afterbay powerplants and necessary electric transmission lines…"
>
> "Folsom Dam and Reservoir upon completion of construction by the Corps of Engineers, to the extent where water from said reservoir is ready to be turned either into the powerplant or conduits, shall be transferred to the Bureau of Reclamation for operation and maintenance under the supervision of the Secretary of Interior…After the transfer as

provided herein, the dam shall be operated for flood control in accordance with criteria established by the Secretary of the Army as provided for in Section 7 of the Flood Control Act of 1944…"

The 1949 Act provided for construction by the Corps but at a larger size than that considered in the Act of 1944. The 1949 Act also provided for construction of a powerplant at the dam by Reclamation and stipulated that upon completion the project would be included as part of the Central Valley Project (CVP) operated by Reclamation. The CVP is the largest federal reclamation project in the country and was originally authorized by the Rivers and Harbors Act of 1935. The CVP was reauthorized by the Rivers and Harbors Act of 26 August 1937 (50 Stat 850) for the purposes of "improving navigation, regulating the flow of the San Joaquin River and the Sacramento River, controlling floods, and providing for storage and for the delivery of the stored waters."

c. Auburn-Folsom South Authorization Act, Pub. L. 89-161, 79 Stat. 615. In September 1965, the construction of Auburn Dam was authorized based on a feasibility report submitted by Reclamation to Congress in 1960. Construction work began in 1972. By 1975, the contractors had completed the 265-foot-high cofferdam and diversion tunnel. Construction was halted in 1976 when the USGS identified a fault close to the Auburn Dam site following earthquake activity near Oroville Dam north of Auburn. The need for more studies, lack of funding, and litigation kept Auburn Dam construction in limbo. The completed cofferdam and diversion tunnel collapsed during the flood of 1986 and could have caused destructive flooding in Sacramento if Folsom Dam and Lake were not prepared for the incoming volume.

d. Flood Control Act of 1962, Pub. L. 87-875, § 209, 76 Stat. 1180, 1196-98. The basic authority for the Corps to study flood control-related issues in the American and Sacramento rivers is Section 209 of the 1962 Act. The February 1986 flood event prompted several studies which evaluated the ability of the existing flood control system to provide the city of Sacramento with sufficient flood protection. The studies showed that the Sacramento area's flood protection was substantially below 1/100 ACE. Both the American River Watershed Investigation Feasibility Report dated December 1991 and the Supplemental Report dated March 1996 identified several measures to increase flood protection to Sacramento. Individual measures were combined to create alternative plans which might effectively raise the flood protection to a minimum of 1/100 ACE or greater. The detention dam measure that would have replaced the authorized Auburn Dam was never authorized as a result of these studies. The levee improvement measure was included within all the viable alternatives presented in the report, which highlighted the major deficiencies of the American and Sacramento river levees.

e. Water Resources Development Act of 1996, Pub. L. 104-303, § 101(a)(1). Downstream conveyance features common to all the aforementioned alternatives were authorized by Congress for improvement or construction (hence the American River Common Features (ARCF) project). The following identifies the specified modifications:

(1) Approximately 24 miles of slurry wall in the levees along the lower American River.

(2) Approximately 12 miles of levee modifications along the east bank of the Sacramento River downstream from the Natomas Cross Canal (NCC).

(3) Installation of 3 telemeter stream flow gages upstream from the Folsom Lake.

Additional improvements were authorized under the Water Resources Development Act of 1999, Pub. L. 106-53, § 366, 113 Stat. 269, 319-320 (1999) (WRDA 99). The Common Features Project was designed to raise and strengthen the levees:

(1) Raising the left bank of the non-federal levee upstream of the Mayhew Drain for a distance of 4,500 feet by an average of 2.5 feet.

(2) Raising the right bank of the American River levee from 1,500 feet upstream to 4,000 feet downstream of the Howe Avenue Bridge by an average of 1 foot.

(3) Modifying the south levee of the Natomas Cross Canal for a distance of 5 miles to ensure that the south levee is consistent with the level of protection provided by the authorized levee along the east bank of the Sacramento River.

(4) Modifying the north levee of the Natomas Cross Canal for a distance of 5 miles to ensure that the height of the levee is equivalent to the height of the south levee as authorized by paragraph (3).

(5) Installing gates to the existing Mayhew Drain culvert and pumps to prevent backup of floodwater on the Folsom Boulevard side of the gates.

(6) Installing a slurry wall in the north levee of the American River from the east levee of the Natomas East Main Drain upstream for a distance of approximately 1.2 miles.

(7) Installing a slurry wall in the north levee of the American River from 300 feet west of Jacob Lane north for a distance of approximately 1 mile to the end of the existing levee.

The work specified under the WRDA 96/99 was completed in January 2016.

Work on the existing Folsom Dam outlets was also authorized for construction by WRDA 99. Corps efforts to construct the authorized modifications to the existing Folsom Dam lower outlet gates were terminated in the procurement phase when it became evident that the technical, construction, and cost risks associated with the modification project were significantly greater than previously understood.

The Energy and Water Development Appropriations Act of 2006, Pub. L. 109-103, § 128, 119 Stat. 2247, 2259-60 (2005) (EWDAA 2006) then directed further joint study by the Secretary of the Army (through the Corps) and the Secretary of the Interior (through Reclamation) to maximize flood damage reduction improvements and address dam safety needs. These successor studies formulated an auxiliary spillway alternative that addressed both hydraulic risk reduction (passing the Probable Maximum Flood (PMF)) to Folsom Dam and reduced downstream flood risk. Study results were refined and formalized in the *Post Authorization Change Report* (PACR) for the American River Watershed Project dated March 2007. This report included recommendations for the Joint Federal Project (JFP) auxiliary spillway and a 3.5-foot raise of the dam and reservoir dikes.

The Water Resources Development Act of 2007 (WRDA 07) authorized the changes to the Folsom Dam Modifications project in accordance with the PACR, resulting in approval of design and construction of the Folsom Dam JFP Auxiliary Spillway. WRDA also authorized changes to the Folsom Dam Raise project which was previously authorized by Congress (EWDAA 2004). The addition of the auxiliary spillway reduced the need for a 7-foot raise to a 3.5-foot raise.

The lower American River levees were constructed under the Sacramento River Flood Control Project, which was authorized by Congress in 1917. The lower American River was designed to transport flows up to 180,000 cfs to the Sacramento River. Extension of the American River levees to a location terminating a few miles upstream was accomplished under the American River Levee Project authorized by the Flood Control Act of 3 September 1954, Pub. L. 83-780, § 203. This component was necessary in order to handle a release of 115,000 cfs from Folsom Dam. The Folsom Dam Definite Project Report dated 1946 found that the controlling channel capacity downstream from Folsom is 115,000 cfs and that releases from the dam should be limited to 115,000 cfs during all floods up to the very large flood adopted as the Reservoir Design Flood. The objective flow of 115,000 cfs was established after evaluating the effects of the combined American and Sacramento River flows. The analyses showed that the peak American River outflows have always preceded the arrival of peak Sacramento River flows by 1 to 3 days. Further analyses also concluded that a sustained flow of 115,000 cfs could pass through all downstream channel reaches on the Sacramento River without exceeding the existing or recommended channel capacities at any point. The levees were constructed to pass 115,000 cfs with 5 feet of freeboard or 152,000 cfs with 3 feet of freeboard (whichever is higher). This was done to equalize protection provided by the north and south levees of the American River.

Subsequent improvements were made through WRDA 96, Pub. L. 104-303, § 101(a)(1), 110 Stat. 3658, 3662-3663, which authorized levee modification along both banks of the American River and along the east bank of the Sacramento River downstream from the Natomas Cross Canal. The goal was to enable the lower American River to convey a peak release of 160,000 cfs (emergency objective release) during a 1/200 ACE for an indeterminate period. WRDA 99, Pub. L. 106-53, § 366, 113 Stat 269, 319-320 modified WRDA 96 to include additional improvements.

3-02. Planning and Design. The existing flood control system for the lower American River is composed of Folsom Dam and downstream levees. The planning and design of Folsom Dam was accomplished by the Sacramento District of the Corps and reviewed by higher level authorities, including the office of the Chief of Engineers in Washington, D.C.

As directed under EWDAA 2006, the Corps and Reclamation collaborated to address both the Corps' flood damage reduction effort and Reclamation's dam safety issues. The March 2007 PACR, adopted by Congress in Section 3023 of the Water Resources Development Act of 2007, reevaluated the two existing authorizations (for the Folsom Modification Project and the Folsom Dam Raise Project) and revised the authorized projects to include the auxiliary spillway under the JFP authorization. The crest of the auxiliary spillway resides 50 feet lower than the main spillway. This allows larger releases to be made sooner during a flood, increasing the effectiveness of the flood storage space behind the dam.

Under WRDA 99, Congress authorized improvements to Folsom Dam to control a 200-year flood event with a peak release of 160,000 cfs. Because the state of the downstream levees is a key component in achieving this goal, the Corps recommended congressional authorization for additional improvements throughout Sacramento's flood infrastructure system. These recommendations included further levee improvements and widening the Sacramento Weir and Bypass to increase the resiliency and flexibility of the system via the ARCF General Reevaluation Report (GRR) dated March 2015.

3-03. Construction. Under contracts supervised by the Corps, road construction and excavation for Folsom Dam began in November 1948. Construction of auxiliary earth dikes was initiated in May 1950 and completed in April 1951; construction of Mormon Island Auxiliary Dam was initiated in 1951 and completed in July 1952; and canal relocations, initiated in 1951, were completed in November 1953. The Folsom Dam was completed and transferred to Reclamation for operation and maintenance on 15 May 1956.

Contractors, supervised by Reclamation, initiated construction of the Folsom Powerplant on 28 April 1952. Although this work was not completed until 14 March 1956, the first generator began production of electric power on 20 May 1955. The plant began operating at full capacity, with all generators functioning, on 6 December 1955. Rewinding of its three generators in 1974 increased the generating capacity from 162,000 kilowatts to a rating of 198,720 kilowatts. Rewinding of its three generators in 2014 increased the generating capacity to the current rating of 215,100 kilowatts. Power produced is absorbed into the Central Valley Project system through the Folsom-Elverta 230-kv transmission line.

Construction of the auxiliary spillway was divided into five phases. Phase 1 and Phase 2, excavation for the spillway, was initiated by Reclamation in August 2008 and completed in 2011. Phase 3 and Phase 4 included construction of the control structure, completed in August 2015, and construction of the approach channel and the chute and stilling basin, which were initiated in May 2013 and completed in December 2016. Phase 5 consisted of site restoration activities and was scheduled to be completed in October 2017.

3-04. Related Projects. Extensive levee improvements were authorized and constructed to enable the levees to handle design releases from Folsom Dam ranging from 115,000 cfs to 160,000 cfs, particularly in the vicinity of the city of Sacramento at the junction of the American and Sacramento rivers.

The American River Levee Project, which included two pumping station facilities to facilitate interior storm drainage, was constructed in 1958 and was initially operated and maintained by the Reclamation Board of the State of California.

Features of the Sacramento River Flood Control Project associated with the American River basin consist of levees along the lower American River, Natomas East Main Drainage Canal (NEMDC), Arcade and Dry Creeks, Pleasant Grove Canal, NCC, Sacramento River, and Yolo Bypass. Prior to construction work completed in 1958, levee improvements were required under

the authority of the Sacramento River Flood Control Project to raise the safe non-damaging downstream capacity along the lower American River to 115,000 cfs while providing 5 feet of freeboard (152,000 cfs with 3 feet of freeboard). See Sections 4-09 Channel and Floodway Characteristics and 4-11 Downstream Structures.

The American River Common Features Project Downstream levees will be upgraded or modified via the Common Features Project towards the goal of being able to convey 160,000 cfs (emergency objective release) for an indeterminate period. Section 101(a)(1) of WRDA 96 authorized levee modification along both banks of the American River and along the east bank of the Sacramento River downstream from the Natomas Cross Canal.

Many reservoirs exist upstream from Folsom, all of which are used for water supply and/or hydroelectric power generation (see Section 4-10). The reservoirs with significant storage capacity were constructed starting in the early 1960s. All of these reservoirs have some effect in the partial regulation or reduction of a small percent of the runoff. When full, the upstream reservoirs do not make a significant reduction to the peak inflow to Folsom Lake.

Folsom Dam and Lake, being part of the Central Valley Project (CVP), is operated as one component in a system of water control projects. The main objective of the CVP is to store the surplus flood water of the Sacramento River Basin and provide for its use as irrigation water in the San Joaquin Valley. The CVP also provides river regulation for salinity control; fresh water for municipal and industrial purposes; generation and distribution of power; flood control; and navigation. Additional components of the CVP include Shasta Dam and Powerplant, Keswick Dam and Powerplant, Friant Dam, Delta Cross Channel, Contra Costa Canal, Delta-Mendota Canal, Tracy Pumping Plant, Friant-Kern Canal, Madera Canal, Folsom Dam and Powerplant, Nimbus Dam and Powerplant, and Sly Park Dam and Camp Creek Diversion Dam. Other project components include the San Luis Dam and Pump/Generating Plant, the San Luis Canal, O'Neill Forebay and Pump/Generating Plant, New Melones Dam and Powerplant, the San Felipe Division of the CVP, Sugarpine Dam, the Sacramento Valley canals, and several features in the Trinity River division. Additional components are under investigation to meet the valley's future needs.

3-05. Modification to Regulations. The Folsom Dam Water Control Diagram has been modified multiple times since the start of the project. Each major drought or flood event served to highlight the limitations associated with a given Water Control Diagram.

a. Effective 24 May 1956. An interim water control diagram was in effect at the start of Folsom Dam operation, most notably during the December 1955 flood event. Paragraph 3.a. listed under the Use of Diagram stipulates "That prior to completion of construction of the American River levee authorized in the Flood Control Act approved 3 September 1954, outflows at the tail water of Nimbus Dam do not exceed (1) 40,000 cfs or rate of inflow, whichever is greater, or (2) 70,000 cfs at any time."

b. Effective March 1959. Following the completion of the levee construction, the Water Control Diagram was modified to enable outflows up to 115,000 cfs below Nimbus Dam to the

American River. No other modifications were made. The seasonal variation in flood space was based on observing the storm potential at various months of the year. The rain flood parameter lines were a means of measuring the basin's ground wetness potential. The method for estimating ground wetness relied on an accumulation of the preceding 60-day basin mean precipitation. The parameter was then used to determine the amount of flood control space required on any given day.

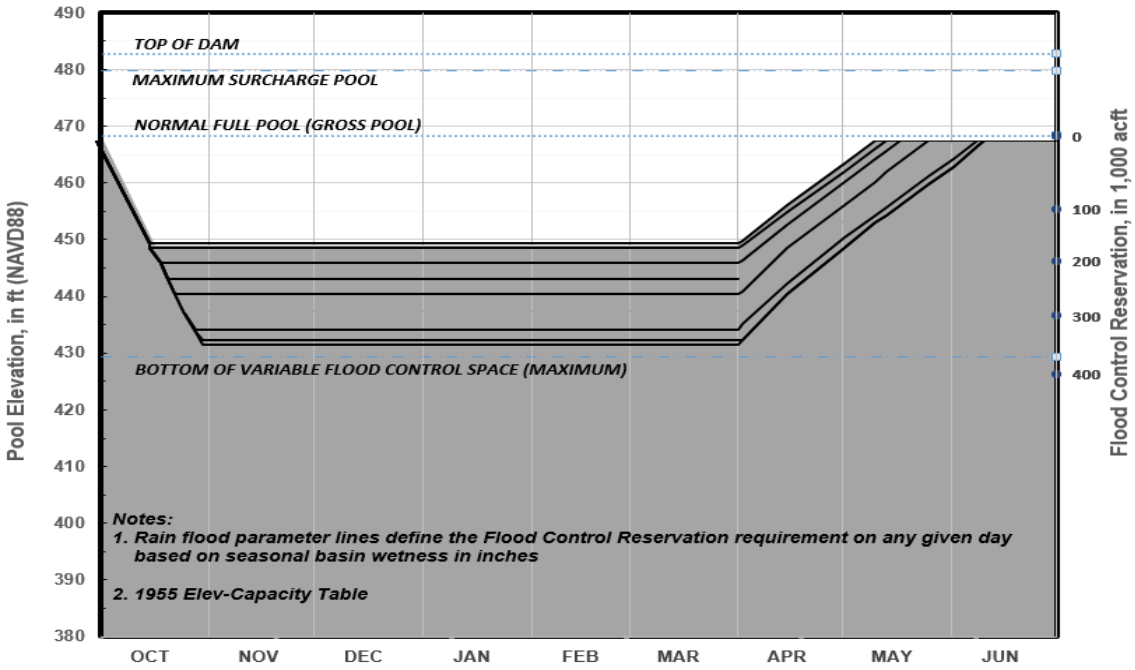


Figure 3-1. Water Control Diagram water year 1956

The variable flood control space could range from a minimum 200,000 acre-feet of flood control space during periods of dry ground up to a maximum 400,000 acre-feet of flood control space during periods of saturated ground. Together, the seasonality of the flood control space and of the ground wetness potential represented by the rain flood parameter lines aimed to balance the competing need to maintain sufficient flood control space and to conserve water supply.

c. Effective 8 July 1977. The Flood Control Diagram and Emergency Spillway Release Diagram were both revised. These modifications were made as a result of a joint investigation by the Sacramento District and Reclamation initiated in the early 1970s. The changes were meant to reflect the operating experience gained since 1956. The 1977 diagram (Figure 3-2) incorporated the latest method of estimating ground wetness and delayed activating the variable flood control space segment of the operation by requiring the maximum flood reservation of 400,000 acre-feet between mid-November and 1 January.

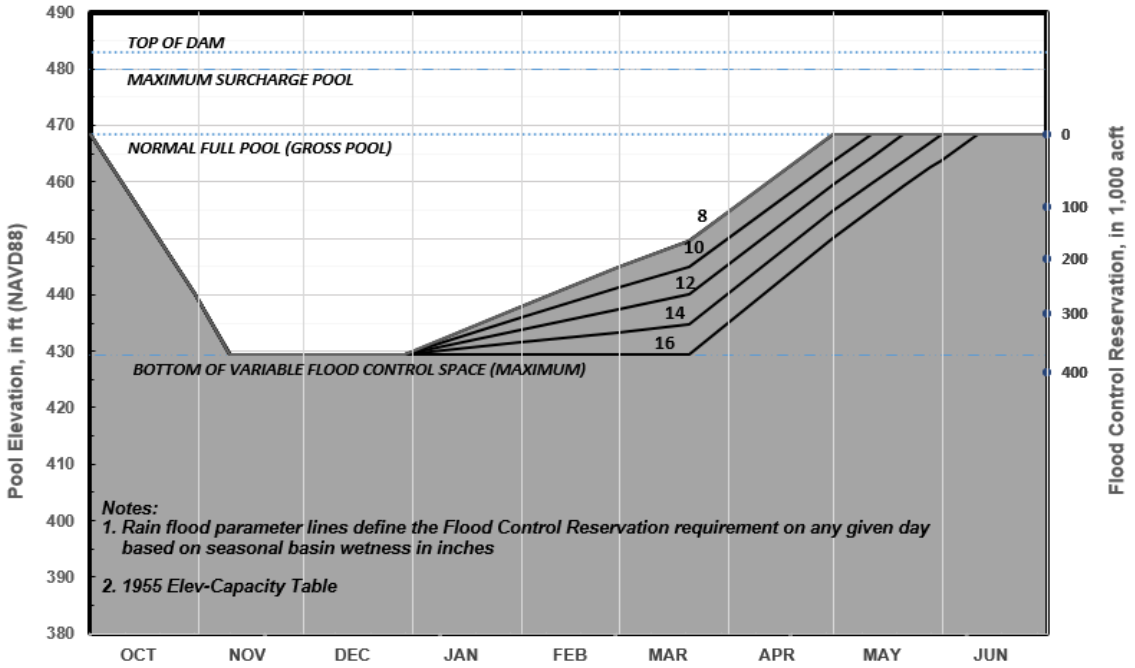


Figure 3-2. Water Control Diagram water years 1977-1986

The revised ESRD maximized use of the surcharge storage space to allow timed evacuation of urban areas prior to the overtopping of project levees.

d. Effective 7 November 1986. The February 1986 flood event of that year was determined to be the largest of record. This modification (Figure 3-3) coincided with the update of the Folsom Dam Water Control Manual to address the short-term goal of providing increased flood protection. The 1986 flood event emphasized a need to maintain the maximum flood control space later into the season.

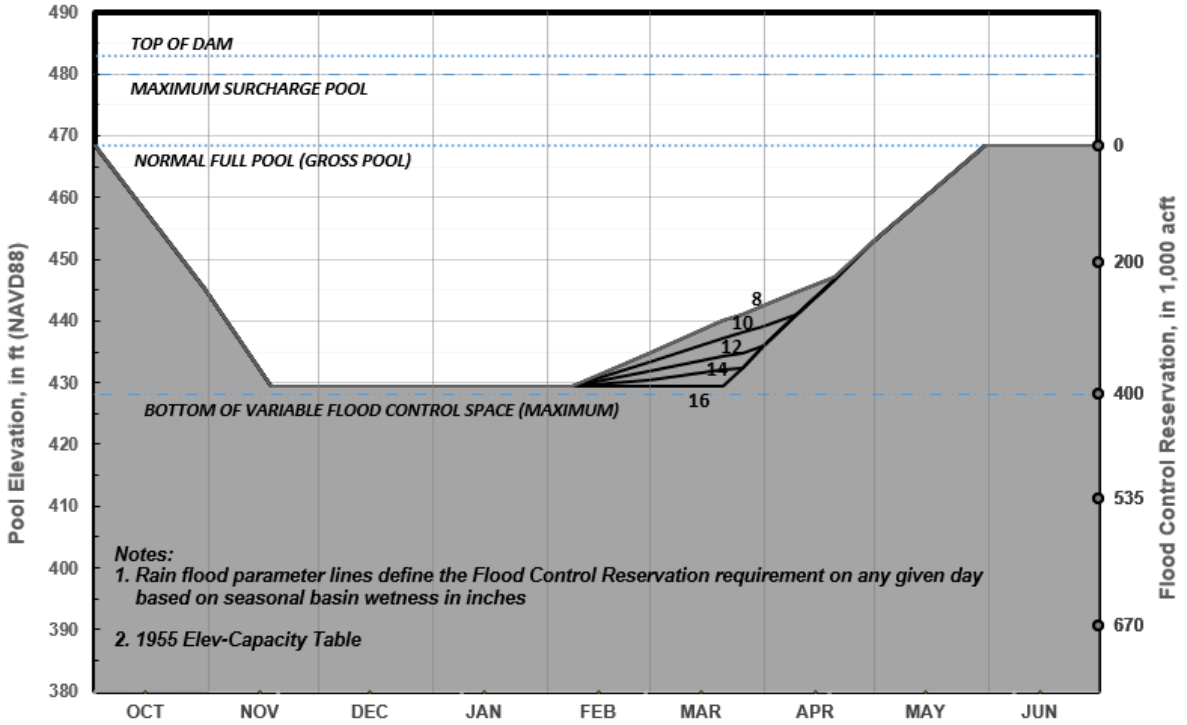


Figure 3-3. Water Control Diagram water years 1987-2017

A maximum flood reservation of 400,000 acre-feet was required between 18 November and 8 February. However, during the spring refill period through 21 April, the amount of required flood control space was governed by a basin wetness parameter.

e. Effective October 1995. Long-term studies initiated after the February 1986 flood event examined alternative flood risk management plans. This investigation led to Reclamation and the Sacramento Area Flood Control Agency (SAFCA) entering into an agreement to reoperate Folsom Dam and Lake such that Reclamation would augment the flood control space with up to 270,000 cfs of conservation space for 400,000 to 670,000 acre-feet of variable flood control space. The amount of upstream storage credit available determines the flood space requirement at Folsom Lake. The maximum amount of creditable space in the upstream reservoirs needed to match storage space in Folsom Lake is 200,000 acre-feet to 270,000 acre-feet because of the limited release capacity of the Folsom outlets. The three upstream reservoirs which are used to determine the amount of creditable space are French Meadows, Hell Hole, and Union Valley.

The four-year contract (which terminated on 31 October 1999) between SAFCA and Reclamation addressed compensating the affected water service and hydroelectric power contractors for the costs of implementing the reoperation plan. Given that the 1986 Water Control Diagram operation only requires a fixed 400,000 acre-feet of flood control space, the reoperation with 670,000 acre-feet was considered more robust in terms of the ability to provide additional flood protection. As described via the 1995 contract agreement, the Water Control Diagram (Figure 3-4) will make it possible to store a 1/100 Annual Chance Exceedence (ACE)

flood, as heretofore designated by the Federal Emergency Management Agency (FEMA), in Folsom Reservoir with releases from Folsom Dam to the American River that do not exceed 115,000 cfs.

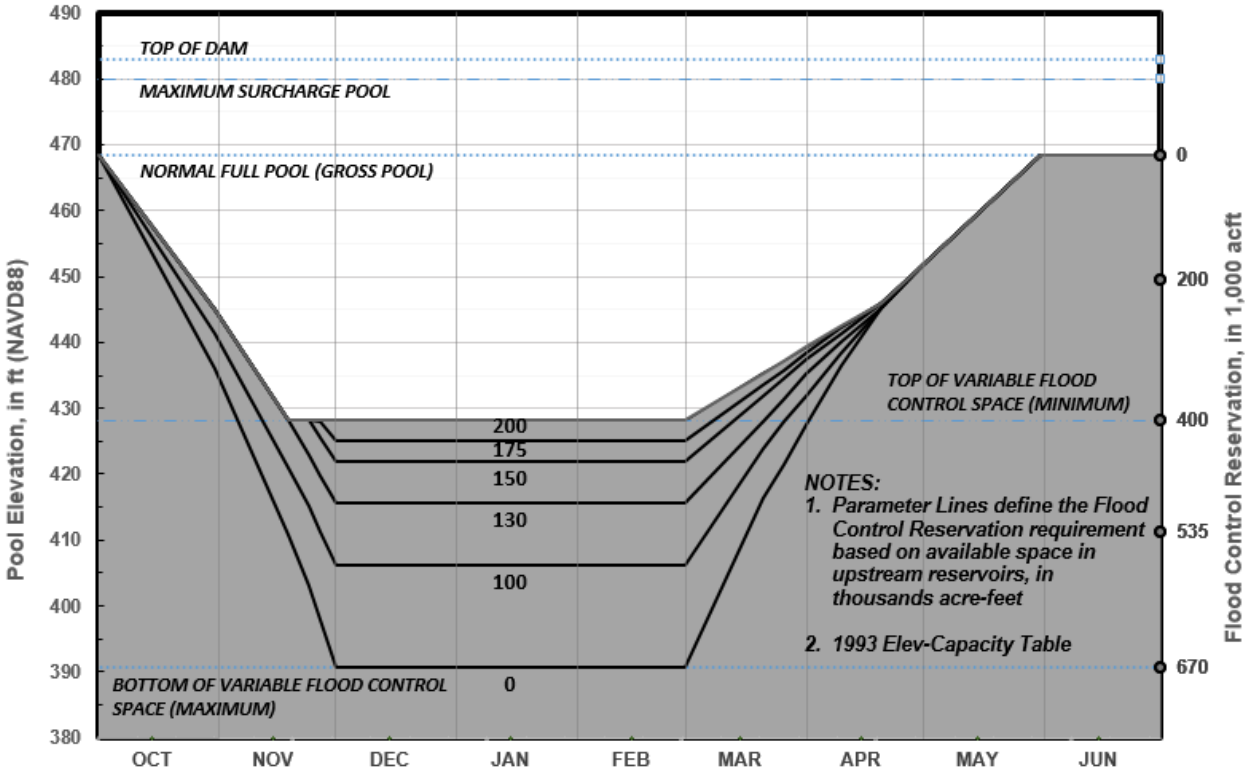


Figure 3-4. Water Control Diagram water years 1995-2017

In the Water Resources Development Act of 1996, Pub. L. 104-303 (WRDA 96), Congress directed the secretary of the Interior as follows:

> "Until such time as a comprehensive flood damage reduction plan for the American River Watershed has been implemented, the Secretary of the Interior shall continue to operate the Folsom Dam and Reservoir to the variable 400,000-670,000 acre-feet of flood control space and shall extend the agreement between the Bureau of Reclamation and the Sacramento Area Flood Control Agency with respect to the watershed."

f. Effective October 2004. The agreement between Reclamation and SAFCA was renewed in 2004 and is scheduled to terminate in 2018 or earlier upon the Corps' next issuance of a newly prescribed operation plan signed by both the Corps and Reclamation. In 2004, the Corps determined that the American River levee system (right and left bank) and the Sacramento River levee system, from the confluence of the American River down past the Little Pocket area, could be certified to withstand 145,000 cfs, the FEMA base flood event (1/100 ACE). This was attributed to the accomplishments of the American River Common Features up to that timeframe in conjunction with the 2004 Interim Operation Plan, which is a slight variation of the 1995 reoperation plan. This interim plan was meant to accomplish the following: (1) limit the outflow

from Folsom Dam to a maximum of 145,000 cfs while the lake level is below elevation 472.34 NAVD88 (470.0 NGVD29), and (2) utilize 100 percent gate opening for the outlet gates in conjunction with use of the service spillway, if required.

Upon completion of improvements to Folsom Dam (i.e., the auxiliary spillway), Congress directed the reduction of the variable flood control space requirement from 400,000-670,000 acre-feet to 400,000-600,000 acre-feet under WRDA 99. The new operation plan, contained herein, will terminate the United States- and SAFCA-prescribed operation contract and all prior provisions, articles, and obligations automatically in their entirety.

3-06. Principal Regulation Problems

a. Downstream Channel Limitations

The limitations of the downstream levees were evident during the February 1986 flood when considerable erosion and a number of boils developed due to several days of flows that equaled or exceeded the levee design capacity of 115,000 cfs. In addition, at the time of the Folsom Dam construction, the dam was believed to provide greater than a 1/100 Annual Chance Exceedence (ACE). However, primarily because of additional years of records, flows at or above the levee design capacity are now estimated to occur much more frequently, thereby endangering the developed and populated areas downstream. The Corps has improved the American River levees since 1986. Although the levees are currently designed to contain flows up to 160,000 cfs, whenever flows exceed 80,000 cfs, lateral erosion may occur and place the levees in jeopardy. It is likely that repair of the erosion areas will be necessary following a major flood event. The Corps is authorized to armor the American River levees so they will safely pass flows up to 160,000 cfs. Completion of the armoring is estimated to take place by 2025.

b. Operational and Physical Limitations

(1) Main Dam Spillway Operation Restrictions

(a) River Outlets Gate Opening Limitation. Reclamation's current limitation on the operation of the main dam river outlets during concurrent operation of the main dam service spillway gates should be maintained. This will limit the potential cavitation on the face of the dam at the exit portals for the main dam river outlets.

(b) Main Dam Service Spillway Overtopping Prevention. In the closed position, the top of the main dam service gates is at elevation 470.34 feet NAVD88 (468.00 feet NGVD29). The service gates must commence opening when the distance between the water surface and the top of the gates is within 2 feet. As the pool elevation continues to rise, the service spillway gates should be operated to maintain at least a 2-foot minimum distance between the water surface and top of the service spillway gates.

(c) Main Dam Emergency Spillway Overtopping Prevention. In the closed position, the top of the main dam emergency gates is at elevation 473.34 feet NAVD88 (471.00 feet NGVD29). The emergency gates must commence opening when the distance between the water surface and the top of the gates is within 1 foot. As the pool elevation continues to rise, the service spillway gates should be operated to maintain at least a 2-foot minimum distance between the water surface and top of the emergency spillway gates.

(d) Operations to Provide Tailwater Cushion for Emergency Spillway Releases. Model testing conducted at the Technical Services Center in Denver indicated that the tailwater may not be sufficient under the conditions when the emergency spillway would be utilized. Insufficient tailwater could lead to damage to the concrete slab, causing further instability in the area. Optimally, the total project release (flow from the main dam service spillway and auxiliary spillway) would be maximized to the fullest extent possible prior to making releases from the emergency gates. Given the operation plan is tailored to minimize the discharge downstream, the discharge requirement will not be sufficient during the initial operation of the emergency gates. **Initial use of the emergency spillway gates will likely be driven solely by the need to prevent overtopping of the emergency gates regardless of any tailwater requirement**.

(e) Main Dam Spillway Gate Opening Limitation.

(2) Auxiliary Spillway Operation Restrictions

(a) Flow Split Requirement between the Main Dam and Auxiliary Spillway. Optimally, an equal split between the main dam and auxiliary spillway provides the greatest stability to the right bank. Even small releases from the main dam, in combination with auxiliary spillway discharge, improves the hydraulic performance at the confluence. For total project discharges greater than or equal to 115,000 cfs, at least 25,000 cfs or greater should be released from the main dam.

(b) Unbalanced Gate Operation Restrictions and Minimum Gate Opening Requirements

(c) Auxiliary Spillway Gate Opening Limitation. The maximum gate opening should be limited to 95 percent open (31.4 feet) except under extreme conditions. At 100 percent open, the flow may become unsteady, with oscillating water surface and some splash and impact to gate trunnions. This also may result in negative pressures along the roof curve downstream of the bulkhead gate slot.

c. Miscellaneous Considerations

(1) Upstream Regulation. There is in excess of 800,000 acre-feet of storage capacity in reservoirs upstream of Folsom Lake in the American River Basin (see Section 4-10 Upstream Structures). None of the storage is dedicated to flood control and none of it is under the control of either Reclamation or the Corps. While this storage has at times proved beneficial in attenuating inflow to Folsom Lake, it is not operated as a system, nor is it operated specifically for the purpose of controlling floods on the lower American River. Real-time operations data for the five main reservoirs above Folsom (Union Valley, Ice House, Loon Lake, Hell Hole, and French Meadows) are readily available, but the rest of the upstream reservoirs' real-time data may be difficult to obtain or may not exist at all. This adds to the difficulty of predicting inflow to Folsom Lake during rain floods.

(2) Operating Impacts to Recreation. Usage of the marina at Browns Ravine is severely impacted when the lake stage is at or below 429.34 feet NAVD88 (427.0 feet NGVD29). Operable lake level ranges for the marina are between 362.34 and 467.34 feet NAVD88 (360.0 feet and 465 feet NGVD29). As water drains from the lake, more hazards, like boulders and islands, emerge. The lake does not close to boating, however. When the elevation drops to below 414.34 feet NAVD88 (412 feet NGVD29), the California Parks Department restricts the speed limit to 5 miles an hour. Hobie Cove ramp is a low water ramp that goes into operation when the lake elevation drops to elevation 437.34 feet NAVD 88 (435 feet NGVD29).

Reclamation coordinates with the Folsom Lake Marina (Browns Ravine) to notify boaters when lake levels reach 414.34 feet NAVD88 (412 feet NGVD29) and access to boat slips is limited.

IV – WATERSHED CHARACTERISTICS

4-01. General Characteristics. Folsom Dam and Lake is located on the American River at the foothill line about 20 miles northeast of Sacramento. The watershed area comprises 1,861 square miles of mostly rugged mountains along the westward face of the Sierra Nevada. The area has a well-developed drainage system consisting of three principal streams – North Fork, Middle Fork, and South Fork – which flow generally westward. There is considerable variation in vegetative cover over the watershed, ranging from light to medium density at low elevations, heavy over most of the intermediate area, decreasing to moderate and light over the high areas, and practically non-existent in severely glaciated areas around the high peaks. The watershed area is suitable for grazing, lumbering, mining, and, to a limited extent, the planting of fruit orchards. The area above 3,000 feet is sparsely populated, with most of the population residing along two all-year transcontinental highways, U.S. 50 and Interstate 80. Placerville is the largest town in the drainage area. Table 4-1 shows the land coverage distribution in the American River Basin above Folsom Dam.

TABLE 4-1
LAND COVERAGE DISTRIBUTION

DESCRIPTION	RANGE OF ELEVATION (Feet)	PERCENT OF BASIN AREA
Non-Natural Woody (Orchards/Ornamentals)	1,000 to 2,000	Less than 0.1
Wetlands	468.34 to 7,000	0.2
Urban/Developed	468.34 to 9,000	2.7
Forested Upland	468.34 to 10,000	67.1
Open Water	468.34 to 10,000	1.8
Barren	468.34 to 11,000	1.0
Herbaceous Upland	468.34 to 11,000	4.8
Shrubland	468.34 to 11,000	22.3

Source: Derived from the National Land Coverage Dataset (NLCD 2011)

4-02. Topography. The American River drainage basin above Folsom Dam is very rugged, with precipitous rocky slopes, V-shaped canyons, and very little flat valley or plateau area. Elevations range from about 10,400 feet at the headwaters to about 300 feet at the dam, with an average basin slope of approximately 80 feet per mile. The upper third of the basin has been intensely

glaciated and is alpine in character with bare peaks and ridges, considerable areas of granite pavement, and only scattered areas of timber. The middle third is intensely dissected by profound canyons which have reduced the interstream areas to narrow ribbons of relatively flat land. The lower third consists of low rolling mountains and foothills. The area is drained by the three forks of the American River, which rise near the crest of the range and flow directly down the slope of the range in a fan-shaped pattern to unite into one main channel within the reservoir area. See Plate 4-1 for a topographic map of the American River Basin, Plate 4-2 for stream profiles of the American River, and Plate 4-3 for an area-elevation curve of the basin. Table 4-2 shows the elevation distribution of the basin area above Folsom Dam.

TABLE 4-2
ELEVATION DISTRIBUTION

ELEVATION (feet)	PERCENT OF BASIN AREA ABOVE ELEVATION
468.34	100.0
500	98.9
1,000	95.4
2,000	82.1
3,000	68.8
4,000	57.1
5,000	42.8
6,000	27.0
7,000	12.8
8,000	4.0
9,000	0.4
10,000	0.0

Source: National Elevation Dataset Digital Elevation Models (10m), developed by USGS. Data downloaded in 2014.

4-03. Geology and Soils. The geologic features of the drainage area above Folsom Dam are characteristic of the Sierra Nevada foothill region. The formations consist of a wide variety of metamorphic rocks into which various types of granitic rocks have intruded. Massive granite outcroppings are visible in the upper third of the basin. In the middle third, soil cover is shallow but canyon walls and ridges are covered by a heavy coniferous forest. The lower third consists of low rolling foothills with a moderate depth of soil.

Folsom Dam is situated at the break in slope between the Great Valley and Sierra Foothills. The area is characterized by weathered granites, mine tailings, and stream clastics. Soil cover in the area ranges from moderate to heavy.

4-04. Sediment. Reclamation surveyed Folsom Lake in the fall of 2005 as part of an interagency agreement with the Corps. Table 4-3 identifies previous survey dates and the results of those investigations relative to gross pool elevation 468.34 feet NAVD88 (466.0 feet NGVD29).

Underwater and above-water surveying was conducted to produce a high-accuracy dataset (all digital topographic images for these studies were tied to vertical datum NAVD88). Add 2.34 feet to convert the project vertical elevations from NGVD29 to NAVD88). Extensive topographic imagery surveys were developed for Folsom Dam, the wing and auxiliary dams, and the eight dikes that form Folsom Lake. The 2005 survey estimated that only 1,020 square miles of the total drainage area into Folsom Lake contributes to the sediment inflow.

Sedimentation rates in the American River Basin and adjacent basins are relatively low due to limited development, the general shallowness of soils, and a low rate of upstream erosion. Estimates of the annual sediment yield range from 0.10 to 0.30 acre-feet per square mile. The sediment load of Folsom Lake does not appear to have been impacted by the failure of the partially completed Hell Hole Dam in 1964 or the failure of the Auburn Coffer Dam in 1986.

TABLE 4-3

FOLSOM LAKE SEDIMENTATION

DATE	SURFACE AREA (acres)	CAPACITY (acre-feet)	SEDIMENT (below elev. 468.34 ft NAVD88)	
			LOSS (acre-feet)	DEPOSITS (acre-feet)
March 1946	N/A	1,010,294	N/A	N/A
February 1955	11,440	1,010,230	N/A	N/A
April 1991	11,183	976,955	33,275	N/A
September 2005	11,140	966,823	43,407	N/A

Sources: Reclamation surveys and CESPK Water Management Section

Original estimates placed sediment loss at about 0.38 acre-feet per year per square mile of drainage area, which is equivalent to about 700 acre-feet per year. The 2005 survey also estimates roughly 700 acre-feet per year. This is consistent with the rate of sediment production estimated for the basis of design. As of 2005, about 43,407 acre-feet of volume loss has been measured at gross pool.

4-05. Climate

a. General. The climate of the American River Basin is closely associated with the topography of the area – there is a marked difference in temperature and precipitation within short distances. Climate is characterized by cool, wet winters and hot, dry summers. The major portion of the seasonal rainfall occurs in 2 or 3 of the winter months. The seasons are so distinctly different that the period from May to October may be termed the dry season and November to April the wet season.

b. Effect of Climate Change on the Watershed. Simulations with global climatic models are mostly consistent in predicting that future climate change will cause a general increase in air temperatures in California, including during the critical months when most precipitation falls. It has been projected that air temperatures will increase by over three degrees Fahrenheit by the middle of the current century. November through March is the period when the most significant and damaging storms hit this region. The American River above Folsom dam ranges in elevation from 300 feet at the dam to mountain peaks as high as 8,500 feet above sea level. Significant portions of the upper watershed are covered in snowpack during the winter months. As temperatures warm during the century, it is expected that the snowpack line (demarcation between bare ground and snowpack-covered ground) will recede to higher elevations, and a greater percentage of the total drainage area will incur rainfall, as opposed to snowfall, during storm events. This trend is expected to cause significant increases in runoff volume from the higher elevations of the watershed for large storms, which could increase the peak regulated outflows from Folsom Dam. Another impact of warmer air temperatures is that the spring snowpack will melt earlier, thus increasing reservoir inflows at a time when spring storms still threaten the region and empty space is still required to attenuate flood inflows. In other words, flood control operations at reservoirs will become more difficult in the spring months. The trend towards earlier spring snowmelt has already been observed in the Sierra Mountains over the last century.

This warming trend is also expected to increase the severity and length of droughts in northern California. In drought years, this will reduce the water supply available in the reservoir, which will negatively impact urban water supplies, recreation, and the ability of the reservoir to make environmental releases that are beneficial to the downstream ecosystem.

With less certainty than the above, some global climate models indicate that future conditions may increase the amount of moisture in the storms, since warmer air holds more moisture than cold air. When air gets too cold, condensation occurs, which causes precipitation. The largest storms that typically impact the west coast of California are termed “pineapple express” or more recently “atmospheric rivers” by meteorologists. This type of event occurs when a long plume of saturated air moves northeastward from the low-latitudes of the Pacific Ocean and mixes with cold dense air moving southward from the arctic. The mixing of cold and warm air causes a storm front. As these very moist storms move eastward over the Sierra Mountain range, the air is pushed to higher elevations where more cooling occurs, thus increasing condensation and precipitation. Historically, the largest and most damaging floods in the Central Valley of California are caused by atmospheric rivers. The impact of having larger amounts of precipitation in atmospheric rivers is to increase the runoff peaks and volumes into the reservoir, thus causing higher regulated releases from the reservoir.

c. Temperature. Temperatures in the valley are high in the summer and moderate in the winter. Temperatures in the mountains decrease generally with elevation – the summers are moderate at higher elevations while the winters are severe. Observed temperature extremes are 119° and 15°F at Folsom, 114° and 8°F at Placerville, 110° and 8°F at Colfax, 93° and 5°F at Blue Canyon, 88° and -28°F at Soda Springs, and 91° and -26°F at Twin Lakes. Except for extremely high elevations, these temperatures are representative of the whole watershed. Table 4-4 shows the monthly distribution of mean temperatures at representative stations.

TABLE 4-4
MEAN MONTHLY AND ANNUAL TEMPERATURES (°F)

Month	Sacramento Elev. 25 ft[1]	Colfax Elev. 2418 ft[1]	Blue Canyon Elev. 5280 ft[1]	Twin Lakes Elev. 7829 ft[1]
January	45.6	44.4	37.6	27.1
February	50.4	46.7	38.2	28.0
March	53.9	49.1	39.3	29.6
April	58.6	54.0	44.0	34.4
May	65.4	61.2	52.2	41.5
June	71.3	69.6	60.7	49.5
July	75.5	76.7	68.6	56.9
August	74.6	75.2	67.7	56.3
September	71.7	70.5	63.0	51.7
October	63.9	61.3	54.1	43.7
November	53.2	50.5	44.1	34.3
December	46.0	44.7	39.0	28.6
Average Annual	60.8	58.6	50.7	40.1
Period of Record	1941-2010	1948-2010	1948-2010	1948-2000

[1] Vertical Datum: NGVD29
Source: Western Regional Climate Center, http://www.wrcc.dri.edu/htmlfiles/ca/ca.avg.html [Nov 2015]

d. Precipitation. Precipitation varies throughout the drainage area, ranging from 18 to 20 inches on the valley floor to about 70 inches in the higher mountains, and averages about 53 inches over the watershed above Folsom Dam. Precipitation usually falls as rain up to the 5,000 foot elevation and as snow at higher elevations, but some storms produce rain up to the highest elevations of the basin and, at rare intervals, snowfall occurs as low as the valley floor. For the normal monthly distribution at selected stations, see Table 4-5.

TABLE 4-5
MEAN MONTHLY AND ANNUAL PRECIPITATION

Month	Sacramento Elev. 25 ft[1]		Colfax Elev. 2418 ft[1]		Blue Canyon Elev. 5280 ft[1]		Twin Lakes Elev. 7829 ft[1]	
	inches	%	inches	%	inches	%	inches	%
January	3.60	20.89	8.33	17.83	12.71	18.57	8.99	18.13
February	3.10	17.99	7.51	16.07	10.48	15.31	7.29	14.70
March	2.35	13.64	6.80	14.55	9.06	13.23	6.71	13.53
April	1.17	6.79	3.63	7.77	5.36	7.83	3.94	7.95
May	0.50	2.90	1.78	3.81	3.26	4.76	2.46	4.96
June	0.16	0.93	0.56	1.20	0.86	1.26	1.12	2.26
July	0.03	0.17	0.10	0.21	0.22	0.32	0.65	1.31
August	0.06	0.35	0.19	0.41	0.39	0.57	0.74	1.49
September	0.26	1.51	0.70	1.50	0.96	1.40	1.22	2.46
October	0.92	5.34	2.63	5.63	3.73	5.45	2.58	5.20
November	2.06	11.96	6.19	13.25	9.06	13.23	6.05	12.20
December	3.02	17.53	8.31	17.78	12.37	18.07	7.84	15.81
Average Annual	17.23	100%	46.73	100%	68.46	100%	49.59	100%
Maximum Annual	33.44 (1983)		86.91 (1983)		130.98 (1996)		85.21 (1983)	
Minimum Annual	6.25 (1976)		15.38 (1976)		23.48 (1976)		23.51 (1976)	
Period of Record	1941-2010		1948-2010		1948-2010		1948-2000	

[1] Vertical Datum: NGVD29
Source: Western Regional Climate Center, http://www.wrcc.dri.edu/htmlfiles/ca/ca.ppt.html [Nov 2015]

About 90 percent of the runoff-producing precipitation occurs from November through April. The areal distribution of normal annual precipitation is shown on Plate 4-5.

e. Snowfall. Winter snowfall above 5,000 feet elevation normally accumulates until the first of April when increasing temperatures mark the beginning of the snowmelt season. Snow falling at lower elevations usually melts within a relatively short time. See Table 4-6 for basin snowpack data at six representative snow courses, and Plate 4-5 for the location of the snow courses.

TABLE 4-6
SNOW SURVEY DATA
(Snow Water Equivalent - Inches)

STATION	SITE #	AVERAGE[1]				MAXIMUM	MINIMUM
		1-Jan	1-Mar	1-Apr	1-May	1 April (Year)[2]	1 April (Year)[2]
Upper Carson Pass (Elev. 8500 ft) 1930 - 2015	106	21.6	29.7	33.8	26.9	68.6 (1969)	0.0 (2015)
Echo Summit (Elev. 7450 ft) 1942 - 2015	108	18.7	25.2	29.7	22.9	79.6 (1952)	0.0 (2015)
Tamarack Flat (Elev. 6550 ft) 1946 - 2015	289	17.9	24.1	27.4	18.4	64.0 (2011)	0.0 (2015)
Onion Creek (Elev. 6100 ft) 1951 - 2015	120	14.9	19.4	18.4	11.3	66.6 (1952)	0.0 (2015)
Talbot Camp (Elev. 5750 ft) 1968 - 2015	122	13.9	19.2	18.7	9.1	50.0 (1983)	0.0 (1988/2015)
Ice House (Elev. 5300 ft) 1932 - 2015	127	6.5	9.0	5.5	2.1	33.8 (1938)	0.0 (multiple years)

[1]Years 1966-2015 [2] Period of Record Source: DWR Snow Surveys, 2015

f. Evaporation. The average historical monthly gross evaporation at Folsom Lake is listed in Table 4-7. All data were obtained from a class "A" pan.

TABLE 4-7
HISTORICAL MONTHLY EVAPORATION

	EVAPORATION (in)	
MONTH	AVERAGE	STANDARD DEVIATION
January	0.99	0.46
February	1.58	0.49
March	3.06	0.82
April	4.90	1.17
May	1.58	0.49
June	9.01	1.75
July	10.28	1.32
August	9.19	1.16
September	7.04	1.30
October	4.50	0.95
November	1.82	0.54
December	1.01	0.43
TOTAL	54.97	---

Source: Reclamation HAR Database, 1966-2014

g. Wind. Peak wind velocities in California are generally associated with winter-type storm fronts. The strongest sustained winds generally occur in the summer. Table 4-8 is a compilation of the mean and peak monthly wind velocities for Sacramento Executive Airport and Sacramento International Airport. Reclamation does not have a continuous-recording ground level anemometer at Folsom Dam.

TABLE 4-8
MEAN AND PEAK MONTHLY WIND VELOCITIES

	Sacramento Executive Airport July 1996 to December 2008		Sacramento International Airport May 1998 to December 2008	
MONTH	MEAN (mph)	PEAK GUST (mph)	MEAN (mph)	PEAK GUST (mph)
January	5.0	56	6.8	66
February	5.7	53	7.8	61
March	6.4	44	7.9	52
April	7.0	43	8.5	45
May	7.3	46	8.7	47
June	7.6	46	9.0	48
July	7.2	87	8.6	35
August	6.6	35	8.2	56
September	5.7	48	7.4	43
October	5.2	46	6.9	46
November	4.4	49	6.2	56
December	5.3	53	7.5	56
Annual	6.1	87	7.8	66

Source: Western Regional Climate Center http://www.wrcc.dri.edu/summary/lcdus08.html [Nov 2015]

The prevailing wind direction in the lower American River Basin is from the south and southeast during April through September, and from the north during October through March.

4-06. Storms and Floods. Floods in the American River Basin are typical of those occurring on the other Sierra Nevada streams. Maximum inflows are the result of winter rain floods and spring snowmelt. However, only intense rainfall over the foothills and mountains during the winter season causes serious flooding, because the highest rate of snowmelt runoff is well below that corresponding to the damaging stage of the river.

a. Snowmelt. Snowmelt flows do not present a serious threat. The snowmelt season generally spans April through July and is characterized by low peak flows, long durations of flow, and large volumes of runoff. The amount of snowmelt varies according to the depth and

areal extent of the snowpack, and temperature. Unimpaired flows and volumes at Fair Oaks for the ten largest snowmelt flows of record are shown in Table 4-9. The highest mean daily flows presented in the table could potentially include the effects of rain. The highest snowmelt volumes usually occur during years with an unusually deep snowpack. High flows are sustained during May and June when rising daily temperatures cause the snowpack to melt.

TABLE 4-9
TEN LARGEST HISTORICAL SNOWMELT FLOWS
UNIMPAIRED FLOWS
AMERICAN RIVER AT FAIR OAKS

WATER YEAR	MAXIMUM MEAN DAILY FLOW (cfs)	120-DAY VOLUME (ac-ft)
1938	27,200	2,310,000
1906	26,600	2,982,000
1983	26,400	2,921,000
2006	25,280	2,920,480
1967	24,550	1,696,000
1911	23,800	2,580,000
1922	23,200	2,220,000
1958	22,830	2,936,000
1942	22,800	1,873,000
1969	21,950	2,359,000

Source: CESPK Water Management Section

b. Rain Flood Potential. Historically, only intense rainfall has caused serious flooding. Extremely warm winter rain storms could induce critical flooding conditions, and a series of prolonged, extremely warm winter storms in combination with high freezing levels would enable rain to fall over the entire basin. If the accumulated snow cover is shallow enough, snowmelt can occur. When the upper elevations are bare or the ground is frozen, the runoff generated would be much more than during a typical storm, due to the larger contributing area. Normally, above the 5,000-foot level, precipitation falls as snow.

During a warm winter storm, a deeper snowpack tends to inhibit snowmelt by absorbing the falling rain. Generally, by the end of winter, most of the area above 5,000 feet is covered by a compact snowpack which often averages more than 10 feet in depth over large areas and occasionally reaches 30 feet. Travel times from the upper basin to Folsom Lake are approximately 18 hours and may decrease to around 8-10 hours for large floods. Flood peaks from the three adjoining forks may arrive almost simultaneously at Folsom Lake.

Typical storms affecting this area are cyclonic wave disturbances along the polar front that usually originate in the vicinity of the Aleutian Islands. The normal trajectory of the waves along this front is to the south and east from the Pacific Ocean to the west coast. In the summertime, this frontal zone is located far to the north and the accompanying precipitation seldom reaches as far south as California. From October to April, the frontal zone moves southward and the cyclonic wave disturbances move over California. Occasionally in the winter, a large jetstream forms across the mid-Pacific Ocean, sending a continuous flow of cool moist ocean air inland past the low barrier formed by the Coastal Range, through the large gap provided by the San Francisco Bay, directly into the seaward face of the Sierra Nevada where the American River Basin lies. When the jetstream orientation is nearly perpendicular to mountainous terrain, the winter precipitation may be orographically enhanced.

The annual precipitation is concentrated almost entirely during the winter storm season from November through March. Unimpaired flows and volumes for the American River at Fair Oaks for the ten largest rain floods of record are listed in Table 4-10.

TABLE 4-10
TEN LARGEST HISTORICAL RAIN FLOODS
UNIMPAIRED FLOWS
AMERICAN RIVER AT FAIR OAKS

WY	DATE	PEAK FLOW (cfs)	MAXIMUM MEAN DAILY FLOW (cfs)	MAXIMUM MEAN 3-DAY FLOW (cfs)	7-DAY VOLUME (ac-ft)
1997	Jan 1997	300,000	252,430	164,300*	1,289,100
1965	Dec 1964	260,000*	183,240	140,300*	991,000*
1986	Feb 1986	259,000*	204,000	166,000*	1,366,000
1963	Feb 1963	240,000*	153,000	93,900*	682,000
1956	Dec 1955	219,000*	189,100	127,400*	986,000
2006	Dec 2005	190,100	136,300	496,300*	709,280
1951	Nov 1950	180,000	132,000	107,500*	858,000
1980	Jan 1980	175,000*	125,000	97,800*	886,000
1928	Mar 1928	163,000	119,000	98,200*	815,000
1907	Mar 1907	156,000	105,000	87,800*	915,000

*Estimated Value
Source: CESPK Water Management Section

Rain floods have a high peak discharge and on occasion may last 2 to 5 days. These floods may occur in rapid succession with succeeding peaks occurring before flows from the preceding floods have completely subsided. When antecedent rainfall has resulted in saturated ground conditions, the groundwater levels rise as infiltration capacities decline and the natural and

artificial storage within the basin is progressively filled. The volume of runoff is much greater and flooding more severe when the ground is saturated or when the ground is frozen.

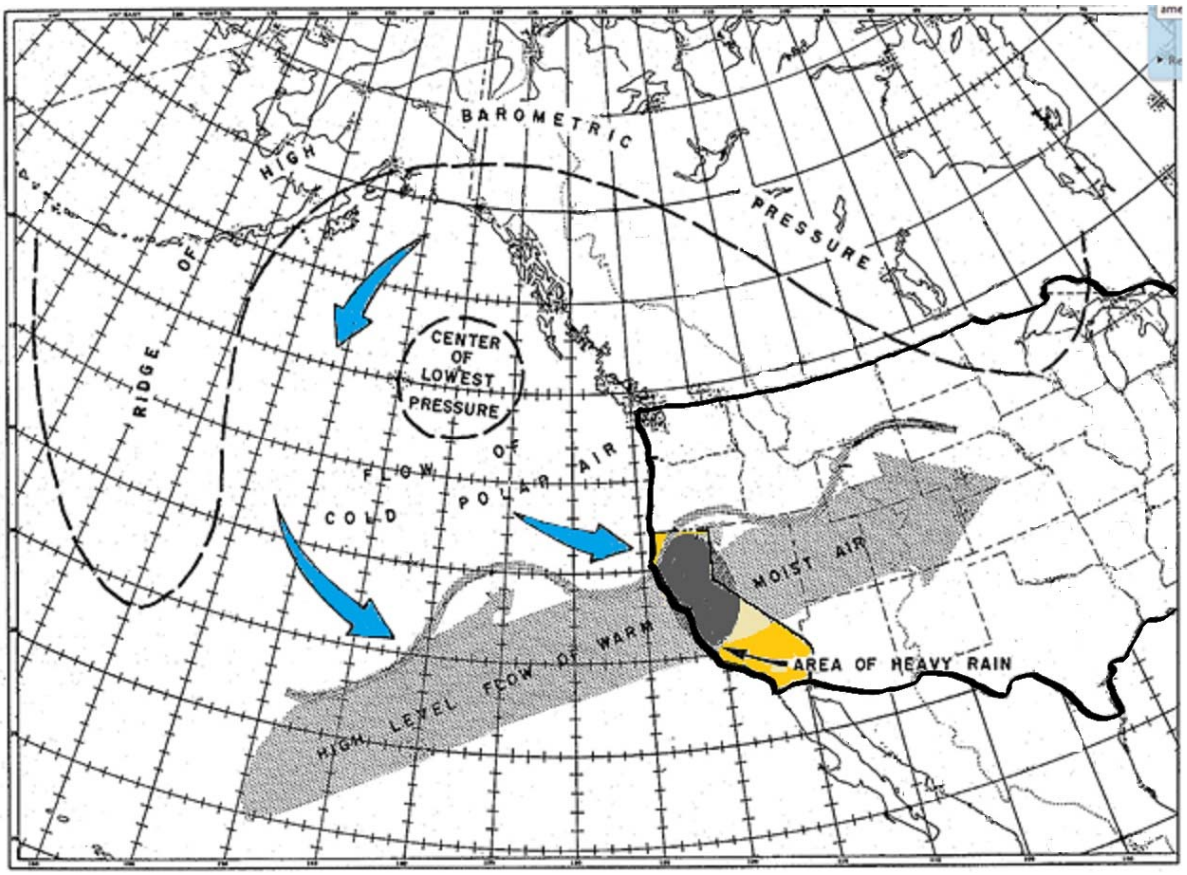
From late spring through early fall, the storms are typically weaker and so widely separated in time that basin storages have an opportunity to drain away, with resulting lower runoff factors. Thunderstorms lasting up to three hours can occur over small areas at higher elevations. The resulting runoff is characterized by high peaks of short duration with low volumes. For small tributaries, peak flows from thunderstorms can approach those which occur during major winter rain floods, but flows on the mainstem are barely affected.

A discussion of some of the most notable floods in the basin follows in chronological order. (See Plate 8-4 for the historical and hypothetical routings.)

(1) Floods of December 1861-January 1862. This flood event occurred during ENSO-neutral conditions in the equatorial Pacific. (Note: ENSO-neutral, or El Niño/Southern Oscillation, refers to the period when neither El Niño nor La Niña is present – per NWS online FAQs about El Niño and La Niña.) California was hit by a combination of continuous rain, large accumulations of snow, and fluxes of unseasonably high temperatures over the entire length of the state. It snowed heavily during the latter part of November and the first few days of December. When the temperature rose unusually high, it began to rain. Many areas received 200 to 400 percent of their average rainfall. In northern California, there were four distinct rainy periods: The first occurred on 9 December 1861, the second on 23-28 December, the third on 9-12 January, and the fourth on 15-17 January. Sacramento recorded 23.68 inches during the two-month period of December-January (the annual average is 17.23 inches). Heavy rainstorms in the lower elevations led to areas in the lower Sacramento River Basin becoming a “sea of water.” This was one of the largest floods in California history. The estimated peak flow on the American River is between 265,000 and 318,000 cfs for this event. Overflows from the American River caused property damage and loss of life.

(2) Flood of December 1955. This event is notable for the prolonged duration of rain. The Pacific jetstream propelled very moist, warm tropical air from the Hawaiian Islands to central and northern California. The general features that characterized the weather pattern in mid-December included a very strong high pressure system over Alaska with the surface ridge extending southeast along the east slopes of the Canadian divide, a deep low pressure area over the southern portion of the Gulf of Alaska. During the first half of December, periods of moderate to heavy rain preceded the record-breaking precipitation that fell during mid-December. The intense precipitation during the period 15-28 December led to measurement of 35.82 inches at Blue Canyon in the Sierra Nevada. At the time, this amounted to 55 percent of the normal seasonal total for that area. The rains drenched the mountains and melted much of the snow that had accumulated in the Sierra Nevada, which produced excess runoff due to saturated soil.

Figure 4-1 illustrates the general weather pattern for the December 1955 flood event.



Source: California Floods of Dec 1955, State of California, Department of Public Works, Division of Water Resources, Jan 1956

Figure 4-1. December 1955 general weather pattern

Newly constructed, Folsom had 790,000 acre-feet of space available at the beginning of the flood event and utilized 670,000 acre-feet during the December 1955 flood. The inflow to Folsom Dam peaked at 219,000 cfs on 23 December. Folsom Dam limited the maximum flows of the American River at Fair Oaks to 70,000 cfs. Interim regulations in effect at the time had been developed with the idea that flows in excess of 70,000 cfs would induce flooding. A release of 115,000 cfs, as designed, was not considered feasible. Such a release would have caused serious damage along the right bank of the river without the extension of the American River right bank levees from north Sacramento to Carmichael, as authorized by Public Law 780, 83rd Congress, 2d Session (House Document 367).

(3) Floods of January-February 1963. A prolonged dry period preceded the storm period from 28 January-2 February. Prior to the storm's arrival, the weather pattern could be described as a blocking high over Alaska with low pressure in the middle latitudes. This pattern eroded away allowing two warm, slow-moving fronts to approach the northern California coast near Eureka. The first warm, moist storm originated from north of the Hawaiian Islands and became centered over the Yuba, American, and Truckee river basins. The second storm hit the Kaweah, Tule, and Kern river basins. The higher elevations received the heaviest concentration of rainfall between 29 January and 1 February. The temperatures preceding the storm were well below normal. The ground was largely bare of snow and had low infiltration rates because it was

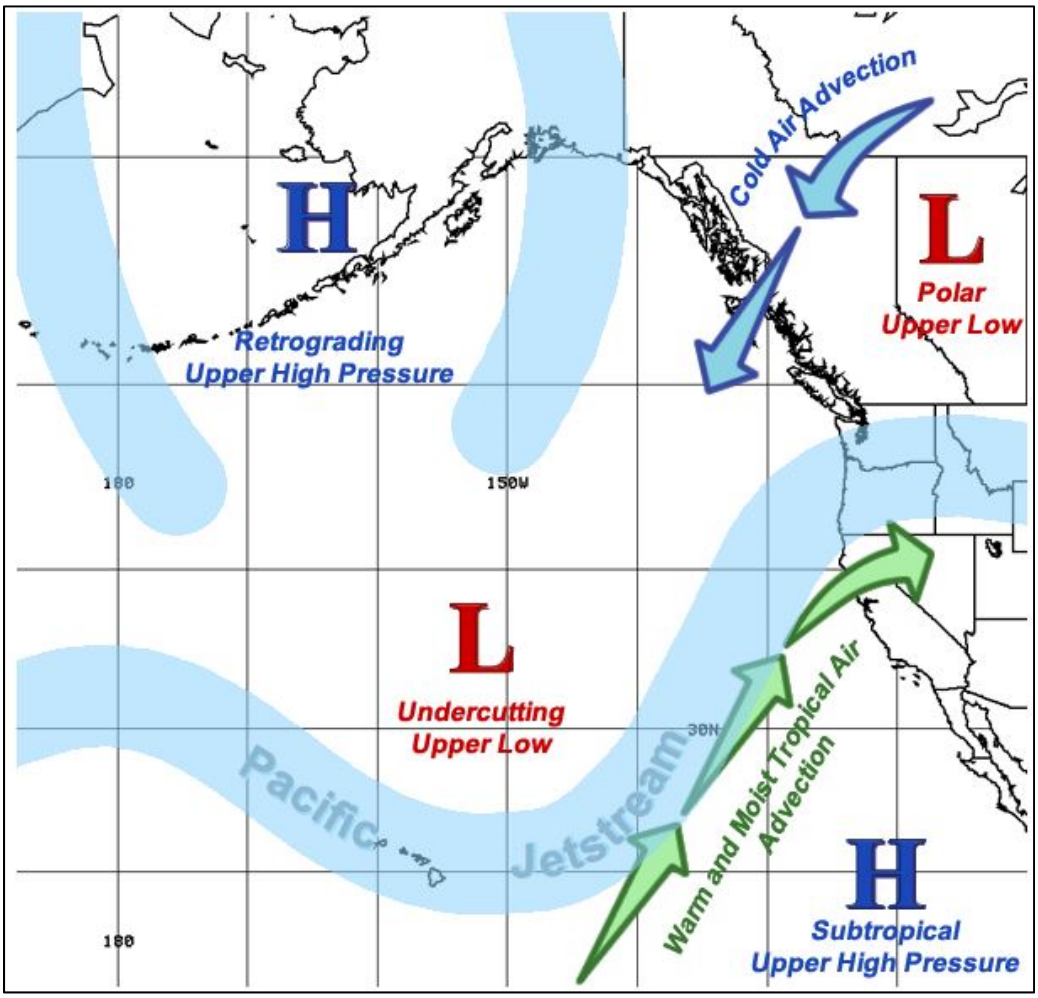
deeply frozen. The total storm precipitation is estimated to have ranged from 13 to 15 inches in the Sierra Nevada. The principal difference between this and the other historic storm events was that the volume of runoff was not particularly notable due to the relatively short duration of the storm event. Regulation provided by the newly constructed upstream reservoirs in the Silver Creek Basin reduced flood peaks on the South Fork American River. Folsom Dam reduced the peak inflow, estimated to be around 240,000 cfs, to a release of 110,000 cfs of which 101,000 cfs was measured downstream below Nimbus Afterbay Dam.

(4) Flood of December 1964. This event resulted from meteorological conditions similar to the December 1955 floods. On the weekend of 19-20 December 1964, a combination of factors – a warm mass of moist Pacific air, a flow of cold air from an Alaskan high, a low pressure trough off the coast, and a strong westerly flow – provided almost optimum conditions for heavy precipitation. A storm track 500 miles wide extended from Hawaii to Oregon and northern California. Warm, moist air collided with the arctic air resulting in turbulent storms that produced substantial rainfall accompanied by strong gusty winds in northern California. Much of the snow from the previous storms melted. As the storm moved inland, precipitation was centered primarily in the basins of the Feather, Yuba and American rivers. The heaviest rains occurred on 22 and 23 December; however, the nine-day totals (19-27 December) were also quite high. Rainfall in the American River Basin created high stages on most tributaries above Folsom Lake. Hell Hole Dam, a small sloping-core, rock-fill structure under construction on the Middle Fork, failed under the stress of record rainfall, sending 30,000 acre-feet of water and 700,000 cubic yards of rock travelling down the Rubicon River canyon. The inflow to Folsom Lake surged four hours later and peaked around 280,000 cfs. After removing the effects of the Hell Hole dam failure, the peak inflow to Folsom Lake is estimated to be 260,000 cfs. Storage in Folsom Lake increased 322,000 acre-feet to a maximum of 899,000 acre-feet on 23 December and controlled releases were increased to a peak rate of 115,000 cfs and maintained for approximately fifty hours.

(5) Flood of February 1986. ENSO-neutral conditions were present during the winter season. The weather pattern began to resemble the December 1964 flood. In early February, a strong high pressure ridge blocked out major storms. When the storm doors opened, a series of storms, increasing in strength, slammed northern California over a period of 10-12 days. The first storm period occurred 11-13 February. In the American River Basin, the heavy rains began on 12 February. The next storm period occurred 14-16 February. The final storm occurred 17-20 February. On the afternoon of 18 February, the Auburn cofferdam collapsed. The cofferdam was designed to store 120,000 acre-feet of water and fail with a 30-year frequency event. The collapse was therefore anticipated and storage space in Folsom Lake was made available to absorb the water released by the cofferdam. After the cofferdam breached, Folsom Lake experienced a peak inflow of 607,430 cfs (which includes inflow from the failed cofferdam). After removing the effects of the Auburn cofferdam collapse, the peak inflow to Folsom Lake is estimated to be 259,000 cfs. The releases from Folsom Dam at this time were increased to 125,000 cfs. On 19 February, storage in Folsom Lake reached a historic high with a water surface elevation of 469.9 feet NAVD88 (467.56 feet NGVD29) and 1,028,000 acre-feet. This was 1.56 feet into surcharge storage but 7.84 feet below the maximum spillway design surcharge elevation of 477.74 feet NAVD88 (475.4 feet NGVD29). Releases were increased to a maximum of 130,000 cfs (releases at or above 115,000 cfs were maintained for approximately 64 hours

during the storm). Between 12 and 21 February, Blue Canyon on the Sierra west slope measured 34.25 inches of rain. On 19 February, Folsom Lake reached a maximum storage level of 1,028,000 acre-feet, which corresponds to use of 318,000 acre-feet of flood control storage space. During this same time interval, an additional 216,000 acre-feet was stored in the small non-dedicated flood control reservoirs located upstream of Folsom Lake.

Figure 4-2 shows the general weather pattern in mid-February of 1986.



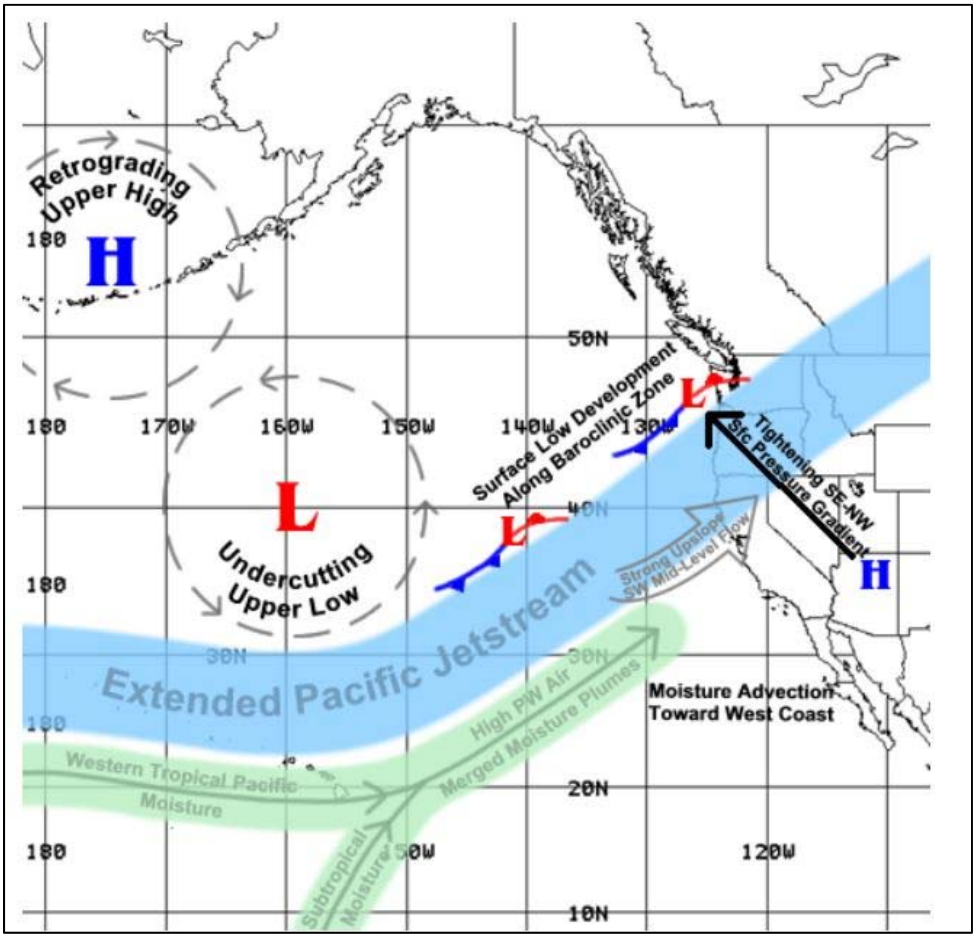
Source: NOAA, California-Nevada River Forecast Center, Storm Summary, 1985-1986 Winter Season, 11 February 1986 to 20 February 1986. Location/Event: Northern and Central California and Western Nevada Significant Precipitation Event. Authors: Jamie Meier, Mike Ekern, Kyle Lerman, and Dan Kozlowski, [no date], Viewed April 2016 at http://www.cnrfc.noaa.gov/storm_summaries/feb1986storms.php.

Figure 4-2. General weather pattern, mid-February 1986

(6) Flood of January 1997. ENSO-neutral conditions were present during the winter season. The trio of subtropical storms that hit northern California between 29 December 1996 and 2 January 1997 brought varying amounts of rain. Cities in lower elevations, such as downtown Sacramento, only received 3.7 inches of rain. However, areas of higher elevations, such as Blue Canyon, received over 30 inches of rainfall. This led to an orographic ratio of 8 to 1

in comparison to the 3 or 4 to 1 ratio of a typical storm between these two locations. The Sacramento and San Joaquin river basins reached record flows due to the large amounts of precipitation in the Sierra Nevada. The three subtropical storms also contributed to the snowmelt runoff by melting the snow recently brought by a cold storm from the Gulf of Alaska prior to Christmas. It is estimated that about 15 percent of the runoff totals were due to the effect of the snowmelt. The peak inflow to Folsom Lake was 252,538 cfs on 2 January at 1400 hours, with a peak outflow of 116,148 cfs occurring on 2 January at 0800 hours. The storage peaked at 868,066 acre-feet which corresponds to a peak elevation of 457.99 ft (455.65 ft NGVD29).

Figure 4-3 shows the general weather pattern from 26 December 1996 to 03 January 1997.



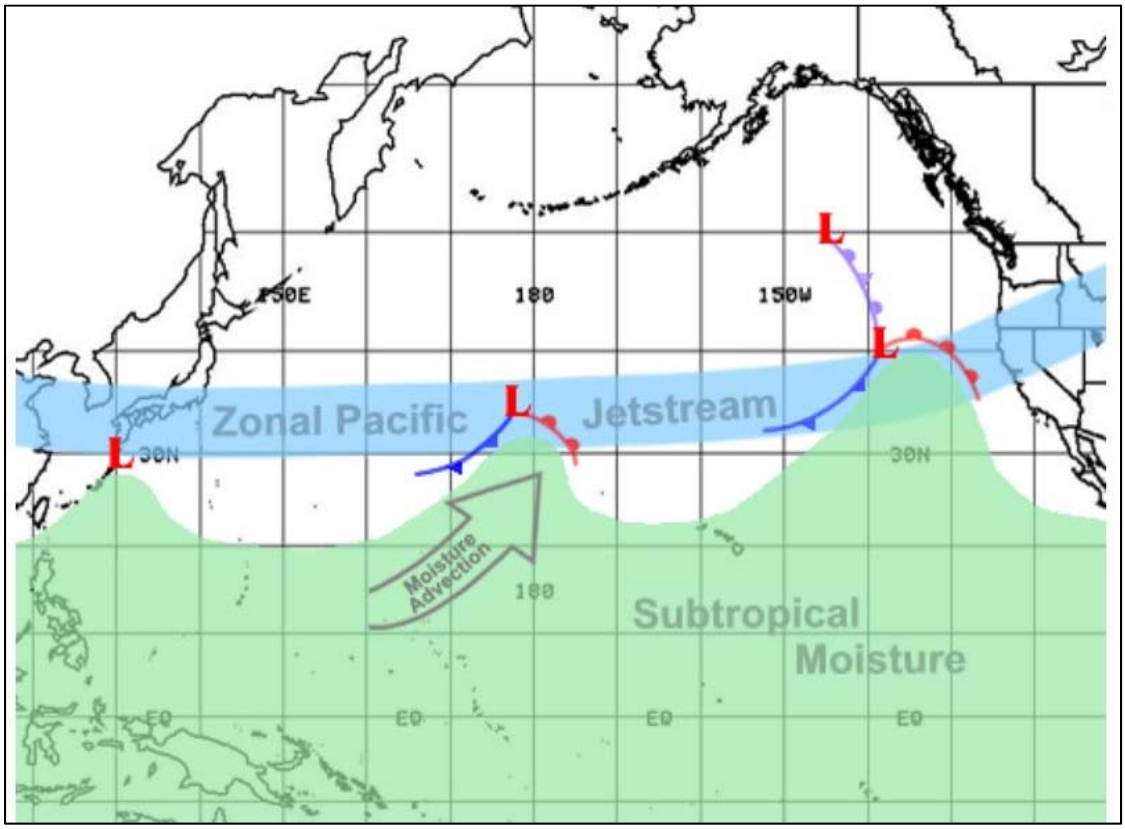
Source: NOAA, California-Nevada River Forecast Center, Storm Summary, 1996-1997 Winter Season, 26 December 1996 to 03 January 1997. Location/Event: Southwest Oregon, Northern California, and Western Nevada Significant Precipitation Event. Authors: Dan Kozlowski and Mike Ekern, [no date], Viewed April 2016 at http://www.cnrfc.noaa.gov/storm_summaries/jan1997storms.php.

Figure 4-3. General weather pattern, 26 December 1996 to 03 January 1997

(7) Flood of January 2006. There were no major incidents in the American River Basin due to the previous dry antecedent conditions and the spacing of storms between early December 2005 and the much more prolonged wet and stormy period spanning 17 December 2005 through the 02 January 2006. The inland Feather and American river basins received the brunt of the

precipitation during the 30-31 December 2005 storm due to the cold front stalling over the area. There was a lot of localized flooding in Sacramento. Orographic effects enhanced the precipitation totals greatly. In the 48-hour period from 30 December 2005 to 1 January 2006, Blue Canyon (elevation 5,280 feet NAVD88 (5,277.66 feet NGVD29)), received 11.42 inches of rainfall. The total precipitation from 24 December through 3 January 2006 for Blue Canyon was 19.95 inches. Folsom Lake peaked at 659,910 acre-feet (elevation 437.42 feet NAVD88 (435.08 feet NGVD29)). The peak regulated inflow was 178,500 cfs on 31 December 2005 at 12 p.m., while the outflow peaked at roughly 37,600 cfs on 31 December 2005, according to measurements at the American River at Fair Oaks gage downstream.

Figure 4-4 shows the general weather pattern for 24 December 2005 through 03 January 2006.



Source: NOAA, California-Nevada River Forecast Center, Storm Summary, 2005-2006 Winter Season, 24 December 2005 to 03 January 2006. Location/Event: Southwest Oregon, Northern California and Western Nevada Significant Precipitation Event. Authors: Dan Kozlowski and Mike Ekern, [no date], Viewed April 2016.at http://www.cnrfc.noaa.gov/storm_summaries/dec2005storms.php.

Figure 4-4. General weather pattern, 24 December 2005 to 03 January 2006

4-07. Runoff Characteristics. Flood-producing runoff occurs during the months of October through April and is most extreme from November through March. The rain flood season is followed during the months of April through July by a period of moderately high runoff from snowmelt. Such runoff generally does not result in flood-producing flows, but is ordinarily adequate to fill reservoir space maintained empty during the winter months for flood control. Greatest water demands occur from June through September. In years of normal or above normal

snowmelt, flood control operation does not interfere with the filling of the reservoir for subsequent water deliveries.

Unimpaired flows at Fair Oaks and historical monthly regulated inflows to Folsom Lake are presented on Tables 4-11 and 4-12, respectively, in the Table Section following Chapter 9.

4-08. Water Quality. Chemical, biological, and physical attributes of water are formed and influenced by complex and interdependent environmental conditions that may be naturally occurring or man-made. Major influences on water character and quality include instream conditions (e.g., hydrodynamics, flora) and local and upstream conditions (e.g., geology, topography, precipitation, climate, ground water supply, storm water runoff, flora, fauna, land-use and recreational water use). Most influences on water quality in the lower American River are out of Reclamation's control.

Reclamation has been monitoring lower American River water quality since 1966, as a matter of due diligence. Quarterly water quality monitoring conducted by Reclamation from 1996 to 2008 indicates that, overall, the water in the lower American River is of good quality and typically satisfies all evaluated water quality standards (see Reclamation 2009 report: Baseline Water Quality Data for the Central Valley Project, 1996-2008). Monitoring was conducted at a number of American River locations between Folsom Dam and Nimbus Dam and a broad suite of common inorganic and organic chemical constituents, biological components, and common physical water quality indicators were evaluated. From 2011 forward, Reclamation has been monitoring American River water quality on a semi-annual basis at Folsom-Auburn Road and at Aquatic Park, Lake Natoma. Summary data from 2011-2015 are shown in Table 4-13 in the Table Section following Chapter 9.

Water quality objectives to be considered are as follows:

Currently, Reclamation's water quality monitoring obligations are limited to meeting temperature requirements. Temperature management is required for the success of federally listed endangered species on the lower American River as well as the Nimbus and American River Fish Hatcheries operated by the California Department of Fish and Wildlife. The National Marine Fisheries Services (NMFS) 2009 Biological Opinion and amended 2011 Reasonable and Prudent Alternatives contain objectives for managing the Central Valley steelhead on the lower American River. Objectives include management of water temperatures during the summer through fall period. Annually, Reclamation prepares and submits a temperature management plan that balance resources for steelhead and Fall Run Chinook salmon integrated into the CVP system-wide operation.

Temperature management on the American River is accomplished by the operation of temperature shutters that access water from various elevations in the reservoir via the penstocks. Adjustments to the temperature shutters allow for continuous hydropower generation. Frequently, due to the physical limitations of the temperature shutters, releases are also made from the lower river outlets (bypassing hydropower generation) to access the coldest water in the reservoir.

NMFS' management objective sets a daily average water temperature target of 65°F or lower at Watt Avenue Bridge from 15 May through 31 October. November temperatures are managed with remaining resources (typically targeting 60°F or lower) until Folsom Lake becomes isothermal. Often poorer hydrologic years require annual temperature management plans with warmer daily average temperature water targets than the NMFS objective.

The American River mercury Total Maximum Daily Load (TMDL) has been replaced with a Statewide Mercury Control Program in which Reclamation participates. There is no additional Reclamation regulatory water quality monitoring requirement as a result of the Statewide Mercury Control Program.

The Central Valley Regional Water Quality Board's Basin Plan of April 2016 for the American River from Folsom Dam to the Sacramento River has set objectives for arsenic (0.01 mg/l), total dissolved solids (not to exceed 125 mg/l – 90 percentile), and turbidity (less than or equal to 10 Nephelometric Turbidity Units (NTUs), except for periods of storm runoff).

4-09. Channel and Floodway Characteristics. Plate 4-7 delineates the federal levee system along the lower American River and provides information on design capacities. These levees were constructed to protect the Sacramento urban area via the American River Flood Control Project.

Most of the American River Project levees are designed to pass 115,000 cfs and have sustained substantial damages when flows are above that level. In the lower reaches of the system (Sacramento River upstream about 4.75 river miles on the right bank), the levees are considered to be able to pass 180,000 cfs through the channel. As this portion of the levee system was designed and built as a unit of the Sacramento River Flood Control Project prior to construction of Folsom Dam, freeboard allowances were set at 3 feet for 180,000 cfs as an unregulated flow. These flows would have been of short duration and unconfined on the right bank upstream of North Sacramento.

Damages can occur at flows less than channel capacity (115,000 cfs). Table 4-14 summarizes these damages.

TABLE 4-14
POTENTIAL AREAS OF DAMAGE ALONG THE FLOODWAY

Flow in cfs	Floodway Consideration
5,000	Nimbus Dam Fish Hatchery diversion weir superstructure (Pickets, racks, and walkway incur damage above 5,000 cfs, 10,000 cfs, and 15,000 cfs, respectively).
10,000	Low-lying park areas are inundated
15,000	Areas of Campus Commons Golf Course and segments of the American River Parkway bike trail are inundated
20,000	Areas of Discovery Park are inundated
30,000	Arcade Water District must turn off their river intake
45,000	The Sacramento County bike bridge is inundated and damaged
50,000	Carmichael Water District access road is damaged
65,000	Significant stretches of the American River Parkway bike trail are damaged
80,000-115,000	Banks are eroded in many places along the lower American River channel

The American River levees are used to confine flows to a dedicated portion of the river's natural floodway; therefore, they result in higher water levels and increased velocities of flows through the levee reaches. Higher water surface levels greatly increase the chance of quick and unexpected failure with potentially catastrophic results to protected areas. Increased velocities of flow results in constant attack on the integrity of the levees through erosion and weakening of the levee by increased seepage.

Flows exceeding 80,000 cfs can result in erosion of the river banks. It is likely that repair of the eroded areas will be necessary following a major flood event. The American River levees require proper maintenance and patrol to sustain flows up to the design release of 115,000 cfs and for short duration flows over 115,000 cfs (130,000 cfs was released in 1986). The Corps is authorized to armor the American River levees so they will safely pass flows up to 160,000 cfs. It is estimated that the armoring will take place by 2025. Maintenance of the Sacramento River Flood Control Project, American River Unit, is performed by the American River Flood Control District. The American River Project levees are maintained by the DWR.

Water surface profiles on the lower American River for selected flows are presented on Plate 4-8. Flood wave travel times for the reach of the American River from Nimbus Dam to the mouth are as follows:

Nimbus Dam to mouth	8 hours
Nimbus Dam to Howe Avenue	6 hours

Nimbus Dam to Watt Avenue	5 hours
Nimbus Dam to Town of Fair Oaks	2 hours

4-10. Upstream Structures. Numerous reservoirs have been built in the upper American River Basin above Folsom Dam by the Pacific Gas and Electric Company (PG&E), the Sacramento Municipal Utility District (SMUD), the Georgetown Divide Public Utility District (GPUD), the Placer County Water Agency (PCWA), the Corps, and others. These agencies own and operate dams, reservoirs, canals and powerplants. Principal water uses are irrigation, municipal and industrial supplies, power generation, and recreation (see Table 4-15 in the Table Section following Chapter 9).

4-11. Downstream Structures. Lake Natoma, behind Nimbus Dam, is an afterbay for the Folsom Powerplant. Nimbus Dam and powerplant are operated to reregulate Folsom Dam releases to the lower American River. This dam also serves as a diversion structure for the Folsom South Canal.

The Folsom South Canal was planned to be constructed in five reaches for a total length of 68.8 miles. Only the first two reaches have been built, a total length of 26.7 miles, and there are no current plans to construct the remaining three reaches, about 42 miles, due to delayed pending reauthorization. The first two reaches were completed in 1973 to a point just south of State Highway 104. The canal originates at Nimbus Dam, on the American River in Sacramento County, and extends southward. It supplies water for municipal, industrial, and irrigation use in Sacramento and San Joaquin counties. As originally planned, it would have terminated about 20 miles southeast of the city of Stockton. This concrete-lined canal has a capacity of 3,500 cfs for the first two reaches. The canal has a bottom width of 34 feet, and a maximum water depth of 17.8 feet.

A system of levees associated with the American River Basin consists of levee improvements along the lower American River (see Section 4-09); the Natomas East Main Drainage (NEMD) Canal and upstream along both banks of Arcade Creek and the south bank of Dry Creek; the Sacramento River; and the Yolo Bypass. Levees along the east and west banks of the Sacramento River between the Sacramento Weir and the American River are designed to have 3 feet of freeboard at a flow of 107,000 cfs. Downstream of Sacramento to about Courtland, the design freeboard of the system is also 3 feet but at a flow of 110,000 cfs.

The Sacramento River flood Control Project was designed to provide a comprehensive plan for managing floods on the Sacramento River and its tributaries. The Yolo Bypass is a complex series of levee and channel improvements from the terminus of the Sutter Bypass to near Rio Vista on the Sacramento River. The Yolo Bypass receives flows from west side tributaries, the Sacramento River, and sometimes from the American River. When the combined flow of the Sacramento and Feather rivers and Sutter Bypass exceeds about 70,000 cfs, most of the excess spills over the Fremont Weir into the Yolo Bypass. Additionally, when flows in the Sacramento River at the “I” Street Bridge reach 94,000 cfs, gates at the Sacramento Weir are opened, allowing excess flow into the Yolo Bypass. During extremely high flow conditions, flows from the American River will travel upstream on the Sacramento River and enter the Yolo Bypass via the Sacramento Weir. The design capacity of the Yolo Bypass at a freeboard of 6 feet from

Fremont Weir to Sacramento Weir is 343,000 cfs, from Sacramento Weir to Putah Creek 480,000 cfs, and from Putah Creek to Sacramento River 500,000 cfs.

4-12. Economic Data

a. Population. The upper reaches of the American River Basin are sparsely populated and developed, with Placerville (population approximately 10,000) being the largest town above Folsom Dam. By contrast, the floodplain of the lower American River, which includes the city of Sacramento, is highly developed in residential, commercial, industrial and public properties. Agricultural development is relatively minor.

The American River Basin includes much of El Dorado and Placer counties and the northern portion of Sacramento County. Table 4-16 shows the population history and projections for these counties.

TABLE 4-16
POPULATION

LOCALITY	POPULATION BY YEAR				
	1990	2000	2010	2020	2030
Sacramento County	1,041,219	1,223,499	1,421,236	1,554,022	1,730,276
El Dorado County	125,995	156,299	181,567	190,850	201,509
Placer county	172,796	248,399	350,230	396,203	447,625
California	29,760,021	33,871,653	37,341,978	40,619,346	44,085,600

Sources: California Department of Finance

b. Agriculture. A good portion of water from Folsom Lake is used for agricultural purposes downstream from the dam. Crops grown in Sacramento County include field crops (e.g., rice, corn, alfalfa), fruit and nuts (grapes, walnuts, pears, cherries, almonds, apricots), and vegetables (e.g., tomatoes, asparagus, squash, sugar beets, and others). Additionally, livestock and poultry, milk (market), and aquaculture contribute significantly to the county's total agricultural production. Tables 4-17 and 4-18 display the value of agricultural production in Sacramento County.

TABLE 4-17
GROSS VALUE OF COMMODITY GROUP PRODUCTION
IN SACRAMENTO COUNTY (2015)

COMMODITY GROUP	GROSS VALUE OF AGRICULTURAL PRODUCTION ($1,000)
Field Crops	74,612
Seed Crops	4,812
Vegetable Crops	26,164
Fruit and Nut Crops	189,117
Nursery Stock	23,778
Apiary Products	234
Livestock & Poultry	101,315
Livestock Products	49,916
TOTAL	469,948

Source: Summary of County Agricultural Commissioner's Reports, 2015
http://www.agcomm.saccounty.net/Documents/CropandLivestockReports/2015Report.pdf
[September 2016]

TABLE 4-18
GROSS VALUE OF FIVE MAJOR FARM COMMODITIES
IN SACRAMENTO COUNTY (2015)

CROP	GROSS VALUE ($1,000)	PERCENT OF TOTAL
Grapes, Wine	128,134	27
Milk - Market	49,077	11
Pears, Bartlett	39,893	9
Poultry	39,415	8
Aquaculture	32,917	7

Source: Summary of County Agricultural Commissioner's Reports, 2015
http://www.agcomm.saccounty.net/Documents/CropandLivestockReports/2015Report.pdf
[September 2016]

c. Industry. Table 4-19 displays the number of employees and the Gross Regional Product (GRP) by industry type. (GRP represents the size of a region's economy and is a measure of the market value of all final goods and services produced within a metropolitan area in a given period of time.) The values in Table 4-19 are annual values for the Sacramento-Arden-Arcade-Roseville metropolitan statistical area, which includes Sacramento, Yolo, Placer, and El Dorado counties. By far the largest industry is government (federal, state, and local), which employs upwards of 240,000 people and has a GRP of approximately $20 billion. Not far behind is the finance/insurance/real estate/rental and leasing industry, which employs more than 118,000 people and has a GRP of more than $14 billion.

TABLE 4-19
EMPLOYMENT AND GROSS REGIONAL PRODUCT BY INDUSTRY
IN SACRAMENTO COUNTY (2015)

INDUSTRY CATEGORY	TOTAL NUMBER OF EMPLOYEES	GRP ($ Millions)
Manufacturing	39,136	4,460
Wholesale Trade	30,383	3,467
Retail Trade	123,095	6,519
Accommodations, Food Service, Arts, Entertainment, and Recreation	96,209	3,135
Agricultural, Forestry, Fishing, and Hunting	11,783	671
Construction	82,970	5,999
Government	241,383	19,940
Finance, Insurance, Real Estate, Rental and Leasing	118,760	14,551

Source: American River Common Feature General Reevaluation Report, Regional Economic Development Analysis, October 2015.

d. Flood Damages

Estimates of damageable property in the 0.2 percent Annual Chance Exceedance (ACE) floodplain are shown in Table 4-20 for the three major areas (American River North Basin, American River South Basin excluding the downtown area, and the Natomas Basin) and the

Downtown Sacramento area in the lower American River floodplain. The total value of damageable property was estimated at about $69 billion (structures and contents). Public property (e.g., government buildings) was estimated at about $10.6 billion. See Table 4-20.

Estimated damages prevented by Folsom Dam during the floods of 1955, 1963, 1964, 1986, 1997, and 2006 are shown in Table 4-21. Damages prevented are due to the combined effects of the American River levee system and Folsom Dam operation.

TABLE 4-20
TOTAL VALUE OF DAMAGEABLE PROPERTY
IN THE 0.2% ANNUAL CHANCE EXCEEDENCE (ACE) FLOODPLAIN
OCTOBER 2015 PRICE LEVEL

	PROPERTY VALUES ($ millions)		
FLOOD PLAIN AREAS	PRIVATE	PUBLIC *	TOTAL
Natomas Basin	8,012	772	8,784
American River North Basin	8,004	835	8,839
American River South Basin (excluding Downtown Sacramento)	39,722	7,019	46,741
Downtown Sacramento	5,493	2,018	7,511
TOTAL	61,231	10,644	71,875

*Excludes, roads, bridges, and utilities
Source: American River Common Features General Reevaluation Report, October 2015

TABLE 4-21
DAMAGES PREVENTED BY FOLSOM DAM

WATER YEAR	VALUE OF DAMAGES PREVENTED AT TIME OF FLOOD ($1,000)
December 1955	20,000
Jan-Feb 1963	45,000
December 1964	45,000
February 1986 [1]	530,000
January 1997	773,560
Dec-Jan 2006	90,910

Source: CESPK Water Management Section, Reports on Flood Damages Prevented

[1] Previously, economic reports estimated $4,700,000 as the value of damages prevented for the 1986 event. The revised amount reflects an unregulated inflow of 255,000 cfs (Auburn Dam cofferdam failure removed). The failure produced a sharp peak in inflow but did not have substantial volume.

V – DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations

Long-term hydrologic and meteorologic data are recorded and published for many sites throughout the American River Basin and adjacent basins. Over several decades, a strategic network of hydrologic and meteorologic monitoring stations has been installed in the American River Basin upstream of Folsom Lake as part of a multi-agency cooperative program. This network provides watershed data that influences the water runoff estimations from various agencies.

The American River watershed monitoring stations include fourteen Geostationary Operational Environmental Satellite (GOES) reporting stations. Real-time data feeds are monitored and recorded for the American River watershed from multiple federal, state, and local agencies. See Plates 4-1 and 4-5.

a. Facilities

b. Reporting. Data from the American River Basin is collected and reported via the Internet by various agencies including DWR, NWS, Reclamation, USGS and the Corps. Reclamation's Central Valley Operations Office (CVOO) generates daily project data reports and distributes them over the Internet.

c. Maintenance. Reclamation provides routine maintenance to monitoring stations at Folsom Dam and financially supports programs which provide funding to DWR for hydrologic and meteorologic network maintenance.

Total outflow from Folsom Dam is computed as the sum of flows through the powerhouse, pumping plant, the river outlets, and over the spillway. Flows through the river outlets and spillway gates are calculated from the rating of these structures for various openings and heads. Outflow from Nimbus Dam is computed in a manner similar to that for Folsom Dam.

5-02. Water Quality Stations

Reclamation has a program of water quality sampling on the lower American River as described in Section 4-08. Water quality samples are collected for testing semiannually from Folsom-Auburn Road and Aquatic Park (Lake Natoma).

a. Facilities. Water temperature is measured by the USGS

b. Reporting. Temperature and turbidity data are recorded semi-annually USGS data are presented in their Annual Water Data Report for California. Other Folsom Lake water quality data are available on Reclamation's online database.

c. Maintenance. Required gage maintenance is performed by the operators of the water quality stations.

5-03. Sediment Stations. Sedimentation ranges are shown on Plate 4-4; however, the movement of sediment in the Folsom Lake system is not presently monitored either by sampling sediment in the river or by periodic surveying of sedimentation and degradation ranges upstream and downstream of the project.

5-04. Recording Hydrologic Data. . Storages for the numerous reservoirs above Folsom Dam (see Section 4-10) and continuous streamflow measurements at several locations throughout the American River watershed are recorded and published by the USGS. The NWS and DWR also record various hydrologic and hydrometeorologic data from the American River Basin.

5-05. Communication Network

The Joint Operations Center (JOC) was formed in 1995 to co-locate government agencies with water operations, flood management, and weather forecasting responsibilities, and to facilitate face-to-face interactions amongst those agencies. The JOC houses the DWR Division of Flood Management (Hydrology and Flood Operations Branch, Flood Management Branch); the DWR Division of Operations and Maintenance (State Water Project (SWP) Operations Control Office and Power and Risk Office); Reclamation's Central Valley Project Operations Office; and NOAA (NWS, CNRFC). This location also hosts the State-Federal Flood Operations Center (FOC), a focal point for gathering, analysis, and dissemination of flood and water-related information. Regular weather and hydrology briefings are held in the FOC during the winter and spring seasons. In order to take part virtually in these weather briefings, the Corps has established a direct video teleconference (VTC) connection.

The FOC also provides access to the media for timely dissemination of information to the public and to the California Data Exchange Center (CDEC). The CDEC data exchange program with state, federal, and other public agencies provides automated transfer and receipt of real-time or event data critical to coordinated operations.

Several modes of communication are used between Reclamation's project offices and the Central Valley Operations Office (CVOO). These include voice and data communications used by Central Valley Control Center (CVCC) Hydro System Controllers located at CVOO, and by the Plant Operators located at the project facilities. Voice communications include commercial

telephone, government-owned VOIP, cellular phones, government-owned VHF radio, and satellite phones.

. If necessary, CVCC can have Plant Operators directly operate project equipment. Communications between CVOO system managers and the CESPK Water Management Section is by commercial telephone or via e-mail. Daily operations reports are distributed over the Internet, by phone, or e-mail.

5-06. Communication with Project. Project operating instructions (Operations Change Orders) are transmitted by e-mail from Reclamation's CVO Operators to the CVOO Hydro System Controllers. Operators and Hydro System Controllers are both co-located at CVOO, and face-to-face communication or commercial (interoffice) telephone may be used to confirm instructions. Plant Operators at Folsom Dam receive copies of all change order instructions. Backup communications are mentioned in Section 5-05.

Notification calls to entities requiring warnings of significant changes in project releases or other conditions are made by the Project Office during normal working hours, when possible. During flood or other emergencies, notification calls may be made by Hydro System Controllers from the CVCC or the Folsom Dam Plant Operators. Both are staffed around the clock. Continuity of Operations (COO) Plans are maintained for both locations.

a. Regulating Office with Project Office. Project operating instructions (Operations Change Orders) are transmitted by e-mail from CVO Operators to the Folsom Dam Plant Operators. Backup communications are mentioned in Section 5-05.

b. Between Project Office and Others. Project operating instructions (Operations Change Orders) are transmitted by e-mail from CVO Operators to other agencies. Scheduled releases are also posted on the Internet (Corps and DWR). Contingency plans are employed as described above.

5-07. Project Reporting Instructions. As required by the notification protocol in the Central California Area Office (CCAO) Folsom and Nimbus Emergency Action Plan (EAP), during flood operations, project personnel are to report any unusual or unpredicted events or data that may affect operations. Important phone numbers and key operating personnel are shown in the Personnel Concerned with the Project Operation list in the front of this Water Control Manual.

Data required by the CESPK Water Management Section are shown in Section 9-06.

5-08. Flood Warnings and Emergencies. The National Oceanic and Atmospheric Administration (NOAA), through its NWS, maintains year-round surveillance of weather conditions. NOAA storm forecasts for the American River Basin are issued by the NWS in Sacramento. These are distributed to agencies responsible for flood protection and, by way of local news media, to the public.

Personnel from the NWS office in Sacramento and the DWR are assigned to the CNRFC in Sacramento, which monitors weather conditions and river stages on a year-round basis. When floods are imminent, the FOC is activated. It operates on a 24-hour basis in conjunction with the CNRFC. In addition, the center advises all interested parties of flood situations as they develop. The FOC furnishes flood information and flood warnings for the American River to the local news media, law enforcement agencies, and other agencies for dissemination to the public.

Both Sacramento and Placer counties have plans for emergency evacuation of the floodplain areas along the American River and its tributaries. DWR, through the FOC, coordinates flood-fight activities throughout the state and is authorized to receive requests for assistance from local public agencies during floods. The Corps responds to requests for flood fighting and rescue work from the California Office of Emergency Services (Cal OES) when the emergency is beyond the capabilities of state and local governmental agencies.

Reclamation's EAP is designed to provide information during all kinds of emergencies to the following personnel and offices:

- Area Office Emergency Officer
- Area Manager
- Local emergency response services, as required
- NWS
- Reclamation Safety and Security Office
- CVCC
- Chief of Facility Engineering
- Regional Dam Safety Office
- Cal OES
- City of Folsom
- City of Rancho Cordova
- City of Roseville
- City of Sacramento
- Sacramento Area Flood Control Agency (SAFCA)
- Sacramento County Office of Emergency Services (OES)
- Placer County OES
- El Dorado County OES
- Yolo County OES
- American River Flood Control District
- Reclamation District 1000
- Folsom Prison

During normal working hours, the Folsom operations and maintenance personnel will be requested to assist in any emergency.

However, for the rest of the day, the Control Operator on duty is to request assistance from CVCC in contacting the appropriate personnel or agencies as directed in the EAP.

Pursuant to the provisions of Section 8589.5, Government Code of California, emergency procedures must be established for the evacuation and control of areas of potential flooding in the event certain dams should suddenly fail. Under the law, the responsible agencies (Reclamation and the Corps) have prepared maps showing areas that would be inundated if Folsom Dam should fail, and submitted these maps to the OES. On the basis of the maps, OES, in cooperation with the DWR, designated the evacuation area. Local jurisdictions have adopted emergency procedures that include, among other things, specific routes to be used for evacuation, traffic control measures, movement of people without personal transportation, shelter of evacuees, perimeter and interior security, and reoccupation of evacuation areas.

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VI – HYDROLOGIC FORECASTS

6-01. General. The purpose of the forecasting system for the basin above the reservoir is to predict approximate rates of inflow to the reservoir for given periods and estimate the expected total volume, in order that outflow rates may be controlled, insofar as possible, without causing damages downstream. The present flood warning system consists of gages on the mainstem and major tributaries of the American River. Flows in the American River are the result of snowmelt and rainfall runoff, which are measured at stations in the basin.

a. Role of the U.S. Army Corps of Engineers. CESPK is responsible for monitoring the operation of Folsom Dam and Lake to ensure it complies with the authorized Water Control Plan. The Corps monitors reservoir storage, outflow, calculated inflow, air temperature, and precipitation. The Corps also monitors weather and runoff forecasts.

b. Role of Other Agencies. To assure that the flood control operation of Folsom Dam will be as effective and reasonable as possible, it is essential that the Bureau of Reclamation (Reclamation), the operating agency, be kept advised at all times of weather conditions, inflow to the reservoir, flow in upstream tributaries, flows in the American River below Folsom Dam, and possible flood hazards. The NWS prepares Quantitative Precipitation Forecasts (QPF), Quantitative Temperature Forecasts (QTF), and streamflow forecasts, and makes this information available to federal, state and local agencies and to the public through a joint effort between the CNRFC and DWR.

The CNRFC also provides 365-day probabilistic unregulated streamflow forecasts. These forecasts incorporate current watershed conditions (soil and snow), near-term weather forecasts, and climatology in the form of precipitation and temperature. Both short (regulated) and long range (unregulated) streamflow volume forecasts are issued daily by the CNRFC, and more frequently during flood events. A variety of both short- and long-range products can be found on the CNRFC website: http://www.cnrfc.noaa.gov/. The California Cooperative Snow Surveys, managed by DWR, also provides long-range unregulated volume forecasts (April-July runoff) starting in February and updated weekly.

6-02. Flood Condition Forecasts

a. Requirements. Folsom Dam is operated for optimum control of flood flows through the Sacramento area. Flood management can be improved by leveraging the information and insight available in the operational reservoir inflow forecasts produced by the CNRFC and DWR. These inflow forecasts, in turn, leverage and integrate the skill of NOAA's weather forecasting enterprise. Efficiently filling the reservoir during the snowmelt season for water supply is also a goal for Reclamation. Long-range inflow volume forecasts assist in achieving this goal. Knowledge of snowpack and watershed conditions and future weather variability is essential in understanding runoff timing and quantity during the snowmelt season.

b. Methods

(1) Rain Floods. Precipitation and temperature forecasts for the American River Basin are issued by the NWS in Sacramento. Six-hour QPF and QTF forecasts for the next six days are issued twice a day (7:30 a.m. and 1:00 p.m.), and more frequently as needed during flood events. These forecasts, in combination with observations of precipitation, temperature, and streamflow obtained from real-time gages in the basin and adjacent basins, are used for rain flood forecasting. Hydrologic forecasters from the CNRFC and the DWR utilize established and proven process-simulation models to prepare the inflow forecasts (inflow hydrographs).

(2) Snowmelt (Long-Range Water Resource Forecasting). Yearly, seasonal, and monthly runoff volume forecasts are issued daily by the CNRFC. These forecasts are influenced by near-term weather forecasts, current watershed conditions, and historical climatology. Watershed conditions (soil and snow) are continuously updated using information from a variety of sources, including real-time gage networks, remote sensing data, and snow course data obtained by the California Cooperative Snow Surveys program. Both the CNFRC and the California Cooperative Snow Surveys prepare and publish seasonal runoff volume estimates on a routine basis.

The methods described in this section are current as of the writing of this Water Control Manual. As technology advances, new procedures and products issued by the CNRFC/DWR will continue to evolve. Close coordination with these two agencies is vital in keeping up with the latest forecast products to assist in reservoir management.

6-03. Conservation Purpose Forecasts – Operation Outlooks

a. Requirements. Conservation operation of Folsom Dam is affected by decrees and agreements in connection with water rights on the American River. Conservation purpose forecasting requires estimation of available seasonal water supply in Folsom Lake and other CVP reservoirs. This information is combined with forecasts of water requirements for holders of water rights, long-term contracts, temporary contracts, in-stream flow requirements and Delta operations to determine the conservation purpose operation of Folsom Dam and Lake.

b. Methods. Reclamation develops Operation Outlooks by estimating available seasonal water supply, system-wide demands, and requirements in Folsom Lake, other CVP reservoirs, and features of the State Water Project (SWP). The Operation Outlooks are generated using a range of probabilistic seasonal and water year runoff forecasts produced by the CNRFC and California Cooperative Snow Surveys (described in Section 6-02b). The Outlooks address short-term operational expectations and long-term performance on a twelve-month rolling projection. The Operation Outlooks estimate reservoir and release performance for the 90 percent to the 50 percent runoff exceedence. The most conservative hydrologic condition, the 90 percent runoff exceedence probability, captures persistent dry conditions and describes dry-year performance expectations.

VII – WATER CONTROL PLAN

7-01. General Objectives. Folsom Lake is a multipurpose reservoir whose objectives are to provide a high degree of flood protection to areas below Folsom Dam and supply water needs for domestic, industrial and agricultural uses. Recreation, hydroelectric power generation and downstream fishery enhancement are also provided by the project.

7-02. Constraints. Except during emergency spillway operations, releases from Nimbus Dam, insofar as possible, will be restricted to flows which will not exceed the channel capacity of 115,000 cfs. Damages that occur at flows less than 115,000 cfs are shown in Table 4-14.

Flood preparation is also integrated in the management approach. Response times may be impacted by time required to issue advance warnings or notification to the public possibly affected by scheduled release changes, due to coordination amongst flood officials and concerned agencies, and other decision making and possibly operational issues. Delays in making release decisions or changes could lead to encroachment of the reservoir at the start of an event.

Flood control releases from Folsom Dam and Nimbus Dam should be limited insofar as practicable to:

a. Maximum rate of increase:
   (1) 10,000 cfs during any 2-hour period for releases below 30,000 cfs.
   (2) 30,000 cfs during any 2-hour period for releases between 30,000 to 160,000 cfs.
   (3) 50,000 cfs each half hour for releases between 160,000 to 360,000 cfs.

b. Maximum rate of decrease: 10,000 cfs during any 2-hour period for all releases.

Bank sloughing and caving is more likely to occur when channel flows decrease rapidly; therefore, rates of changes in releases from Folsom Dam shall not be decreased more than 10,000 cfs during any 2-hour period.

7-03. Overall Plan for Water Control. A detailed description of the Water Control Plan for flood control is provided in Section 7-05. Folsom Dam and Lake are a key component of the wide-ranging CVP. The CVP is the largest federal reclamation project in the country. The Rivers and Harbors Act of 1937 Act provided that the dams and reservoirs of the CVP “shall be used, first, for river regulation, improvement of navigation and flood control; second, for irrigation and domestic uses; and, third, for power.” More specifically, Folsom Dam and Lake is operated to meet the following objectives:

a. To protect the city of Sacramento and other areas within the lower American River floodplain against reasonable probable rain floods.

b. To control flows in the American River downstream from Folsom Dam to existing channel capacities, insofar as practicable, and to reduce flooding along the lower Sacramento River and in the Sacramento-San Joaquin Delta in conjunction with other CVP projects.

c. To provide the maximum amount of water conservation storage that can be achieved without impairment of the flood control functions of the reservoir.

d. To provide the maximum amount of power that can be generated without affecting the required flood control operations and the conservation functions of the reservoir.

e. To provide releases to enhance an anadromous fishery on the lower American River.

f. To provide acceptable water quality in the American River for users, and to meet water quality standards in the Sacramento-San Joaquin Delta.

7-04. Standing Instructions to Project Operators. During normal flood periods, the reservoir will be regulated in accordance with normal regulations for flood control operation in Section 7-05a and Exhibit A of this manual. Exhibit A is designed to be separated from this manual when needed and used as an emergency flood control regulation guide in conjunction with Reclamation's Emergency Action Plan (EAP) for Central California Area Office Facilities. To facilitate independent use of Exhibit A, plates required for the emergency flood control operation of Folsom Dam and Lake are included therein. Instructions for storage and discharge of floodwaters in the flood control space will be issued by the U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, California. If assistance is needed to determine the flood control reservation and releases, Reclamation will contact the CESPK District Engineer or designee, Chief, Water Management Section. In the event that communications with Reclamation are disrupted, the reservoir will be regulated in accordance with the emergency regulations for flood control operation in Section 7-05b and Exhibit A.

7-05. Flood Control

a. Normal Flood Control Regulation. Flood control regulation begins when storage in Folsom Lake and Dam exceeds the flood control reservation required according to the Water Control Diagram, Plate A-9, Exhibit A. The Water Control Diagram, Emergency Spillway Release Diagram, and this manual are the authorized project documents regarding operation for flood control. The Water Control Diagram is the result of analyses of flood frequency, seasonal flood potential, and downstream channel capacities, and is consistent with project objectives.

The reach of the American River from Folsom Dam to its confluence with the Sacramento River is of primary concern for urban protection, including the city of Sacramento. The existing channel capacity throughout this reach is 115,000 cfs. A discharge rating curve for the American River at Fair Oaks is shown on Plate A-7.

Releases from Folsom Dam affect the stage of the Sacramento River at the Sacramento Weir. However, flows in the Sacramento River are not normally considered when making flood control releases at Folsom.

b. Emergency Regulation. If communications with the project are disrupted, the following procedures will be followed for project operation:

(1) Continue releases in accordance with the last instructions from Reclamation's CVOO in Sacramento and make every attempt to re-establish communication.

(2) If communication cannot be re-established, make releases in accordance with the Water Control Diagram (Exhibit A, Plate A-9), and if necessary, the emergency release schedule on the Emergency Spillway Release Diagram (Exhibit A, Plate A-10).

When the ESRD indicates that emergency releases should be initiated, it is essential that these releases be made immediately and that subsequent changes in releases be made as soon as indicated.

7-06. Recreation. The primary purposes of Folsom Lake are flood control and water conservation, including fishery mitigation in the lower American River. Even though numerous recreation areas exist around the lake, there is no guaranteed minimum recreation pool. Recreation pursuits are therefore dependent upon existing water levels. Normal conservation operation requires the pool to be drawn down over the summer recreation season. However, the pool has generally remained stable enough during the summer for boating, swimming, and fishing.

7-07. Water Quality. No specific operation of Folsom Dam and Lake is presently required to enhance water quality. However, the multi-level outlet capability of Folsom Dam is used to provide adequate water temperature for the downstream fishery.

A water quality monitoring program exists on the lower American River to assure compliance with applicable water quality standards. Reclamation has a program of water quality sampling on the lower American River as described in Section 4-08.

Although water quality may not be an authorized project purpose, compliance with Public Law 92-500 requires that all federal facilities be managed, operated, and maintained to protect and enhance the quality of water and land resources through conformance with applicable federal, state, interstate, and local substantive standards.

7-08. Fish and Wildlife. The CDFW is responsible for developing and maintaining a lake fishery in Folsom Lake by stocking rainbow trout and landlocked Chinook salmon.

The Nimbus Fish Hatchery and Ladder was built to mitigate the loss, due to the construction of Folsom and Nimbus Dams, of historical spawning grounds of several anadromous fish species including Chinook salmon and steelhead trout. In addition, minimum flow requirements below Nimbus Dam and a multi-level outlet capability at Folsom Dam help provide adequate flow and water temperature for downstream fishery resources. In late summer/early fall, Reclamation and CDFW install a fish diversion structure (fish weir and pickets) to encourage fish to enter the Nimbus Fish Hatchery. If Folsom Dam releases are expected to exceed 5,000 cfs, the pickets on the fish diversion structure must be raised. If releases are expected to increase and exceed 8,000 cfs, the pickets must be removed. If releases are expected to continue to increase and exceed

15,000 cfs, the racks must also be removed. The fish diversion structure is removed annually by mid-December.

Folsom Lake must maintain a minimum downstream flow requirement for fish preservation and enhancement as established by the 1957 Memorandum of Operating Agreement with the CDFW, which was later included in the State Water Resources Control Board Decision 893 (D-893). Decision 893 provides for a minimum American River flow at the mouth from 250 cfs to 500 cfs, except during critically dry years. D-893 flows, however, do not provide comprehensive habitat protection. Endangered species on the American River are protected by the NMFS Biological Opinion Reasonable and Prudent Alternative Actions. These actions draw on lower American River Flow Management minimum release requirements to improve conditions of aquatic resources.

Wildlife species inhabiting the Folsom Lake area are characteristic of most areas in the foothills of the Central Valley. Bird species include migratory waterfowl, such as wood ducks and Canada Geese, and predatory species such as hawks. Mammals inhabiting the area include deer, skunk, raccoon, beaver, mink, muskrat, river otter, and coyote.

7-09. Water Supply

Reclamation operates Folsom Dam and Lake as an integrated part of the CVP to divert, store, and convey project water consistent with applicable law and contractual obligations. The CVP provides water for agriculture, municipal and industrial use, and for wildlife needs such as refuges. The CVP's major storage facilities include Shasta, Trinity, Folsom, New Melones, Friant (Millerton), and San Luis. These facilities are also coordinated with the SWP where upstream reservoir releases, via natural water courses and canal systems, provide water for consumptive use and to the Sacramento-San Joaquin Delta. A portion of Delta water can be re-diverted through pumping plants to store water in the joint reservoir, San Luis, or delivered down the Delta Mendota Canal and California Aqueduct. The projects are permitted by the California State Water Resources Control Board (SWRCB) to store water during wet periods, divert water that is surplus to the Delta, and re-divert project water that has been stored in upstream reservoirs. The CVP operates pursuant to water right permits and licenses issued by the SWRCB to appropriate water by diverting to storage or by directly diverting to use and re-diverting releases from storage later in the year. As conditions of the water right permit and licenses, the SWRCB requires meeting specific water quality, quantity, and operational criteria within the Delta. Water supply reserved at Folsom Lake provides fish and wildlife protection and protection of the Delta from intrusion of saline ocean water.

The CVP contracts with water districts, irrigation districts, and others for delivery of CVP water. Approximately 250 contracts provide for varying amounts of water. Some contracts are with entities which claim water rights senior to the CVP, while other contracts are for water service.

The American River Division (ARD) diverts water directly from Folsom Dam to serve municipal and industrial water users in Sacramento County and also diverts water from Lake Natoma via the Folsom South Canal. Annual volumes vary depending on the type of water year (dry, normal, wet) and are approximately 250 TAF per year historically (years 2000-2006). In

addition, units of the ARD provide a high degree of flood control along the American River, protecting several communities including the city of Sacramento. The ARD consists of the Folsom, Sly Park, and Auburn-Folsom South Units. ARD contractors include the City of Roseville, East Bay Municipal District, El Dorado Irrigation District, Placer County Water Agency, Sacramento County Water Agency, Sacramento Municipal Utilities District, and San Juan Water District.

7-10. Hydroelectric Power. Folsom Powerplant is located at the foot of Folsom Dam on the north side of the river. Its generating units have a total capacity of 215,100 kilowatts (kW) and are tied into the CVP power system through the 20-mile-long Folsom-Elverta 230-kilovolt (kV) transmission line.

Nimbus Powerplant is located on the right abutment of Nimbus Dam on the north side of the river. The total capacity of its generators is 15,526 kW. Power is transmitted to Folsom for retransmission at 230 kV to the CVP at Elverta.

7-11. Navigation. Navigable waters include all "waters of the United States" which are in turn defined by regulation to include all waters which might be susceptible to use in interstate commerce and all other waters, such as lakes and wetlands, which could affect interstate commerce, including those from which fish could be taken and sold in interstate commerce. Navigation is not a project purpose of Folsom Dam and Lake or the American River.

7-12. Drought Contingency Plans. During droughts, flood control is not expected to be a principal factor in the operation of Folsom Dam. Conservation storage in Folsom Lake is managed by Reclamation in accordance with its water service contracts and other requirements for release of water. Folsom Lake serves as the sole source of CVP water for several Reclamation water contractors. During drought conditions, water contractors can be expected to conserve water to the best of their ability. In extreme cases, when water elevations drop below municipal diversion inlets, alternative diversion access will be secured. For many other CVP purposes, such as water quality requirements, Folsom Lake water is comingled with releases from other Central Valley Project reservoirs prior to reaching the Sacramento-San Joaquin Delta.

The Governor of California can declare a state-wide drought emergency, and the Governor’s State Drought Action Team (SDAT) has been formed to address drought planning. This team, established 1 February 1991 by the Governor’s Executive Order No. W-3-91, consists of key state and federal personnel who are responsible for overseeing and coordinating state and federal responses to droughts. The Division Engineer of the South Pacific Division (CESPD) is an SDAT member. Any drought declaration, drought forecasts, or drought planning which may impact project operation will be the responsibility of this entity.

7-13. Emergency Action Plans

a. Reclamation EAP.

b. Corps All Hazards Plan. CESPK has an All Hazards Plan which describes levels of activation during emergencies. The levels of activation are consistent with the Corps' Engineering Regulation ER 500-1-1 and with national emergency preparedness programs. CESPK's Water Management Section adopted those levels of activation. They are defined specifically for flood activation below. The project's status and condition at each level of activation is further defined on Plate A-8, Operational Data Requirements. Prior to the flood season, personnel assigned to the emergency flood organization will review ER 500-1-1 and Exhibits A, B, C, and D in this manual to ready themselves to accomplish their duties.

(1) Phase IV – Normal Operations. This phase is in effect during normal day-to-day operations. Water Managers will monitor and operate projects from office or home, seven days a week when encroachment exists. The Chief of Water Management will determine the need for obtaining hydrologic and meteorologic data during non-duty hours. The hydrometeorlogical conditions would be as follows: small rivers and streams are below monitoring stage, few tributary rivers or streams within a major basin are at or above monitoring stage, no mainstem rivers are at or close to monitoring stage, most reservoirs are below 20 percent encroachment, and forecast conditions are not showing anything approaching. The various levels of river guidance stages are shown on the CNRFC website.

(2) Phase III – Emergency Watch. The Chiefs of Emergency Operations and Water Management will place the District in Emergency Watch upon indication of impending floods, including flash floods, localized short duration floods, minor floods, and the early stages of major floods when property damage is not extensive and danger to life is not serious. An alert or warning will be issued to all District personnel, including field offices and local interests in the area affected. The District may assign liaison personnel to the Federal or State Flood Center during non-duty hours. The hydrometeorlogical conditions would be as follows: small rivers and streams are at monitoring stage, possibly approaching flood stage; few tributary rivers or streams within a major basin are above monitoring stage and approaching flood stage; mainstem rivers are above monitoring stage; and most reservoirs are at about 50 percent encroachment.

(3) Phase II – Partial Activation. Whenever a flood situation becomes so severe that forecast gage heights indicate river stages will reach or exceed flood stage and reservoirs are above 60 percent encroachment, Water Management will be working a 24/7 schedule with two 13-hour shifts. The Chief of Emergency Operations will activate the Corps Emergency Operations Center (EOC). The EOC will be staffed 10 hours a day, seven days a week with personnel necessary to maintain a close and continuous check on weather and hydrological conditions and to issue situation reports to all District elements concerned.

(4) Phase I – Full Activation. Mobilization will be ordered by the CESPK District Engineer whenever major flooding appears imminent, and when the District may be called upon to furnish major emergency assistance. Notification will be given to all parties as rapidly as possible, and flood emergency activities will be given priority over all other District activities for

the duration of the mobilization period. In addition, the District's flood emergency organization will be fully activated to a 24/7 schedule.

7-14. Other. There are no other project purposes.

7-15. Deviation from Normal Regulation. Because every possible circumstance cannot be accounted for in the Water Control Plan, deviations from approved Water Control Plans may occur. There are three types of deviations: Emergency, Unplanned, and Planned. The types of deviations are further defined in the CESPD deviation policy included in Exhibit D.

7-16. Rate of Release Change. Changes in reservoir releases should be gradual in order to permit orderly evacuation of people and personal property in advance of rising water downstream, and to minimize bank caving after extended periods of bankfull flows. The downstream levees are estimated to begin overtopping at around 210,000 cfs. During extremely large floods when emergency spillway release criteria are invoked, the limitations on the rate of increase for discharges above 160,000 cfs should provide a period of time for the levees to slowly fail and allow those people who ignored earlier warnings to evacuate. Flood control releases from Folsom Dam and Nimbus Dam should be limited insofar as practicable to:

a. Maximum rate of increase:
    (1) 10,000 cfs during any 2-hour period for releases below 30,000 cfs.
    (2) 30,000 cfs during any 2-hour period for releases between 30,000 to 160,000 cfs.
    (3) 50,000 cfs each half hour for releases between 160,000 to 360,000 cfs.

b. Maximum rate of decrease: 10,000 cfs during any 2-hour period for all releases.

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VIII – EFFECT OF WATER CONTROL PLAN

8-01. General. Folsom Dam and Lake regulates flood flows in the lower American River by controlling releases, insofar as possible, to obtain the maximum practical reduction in flood damages. The flood control storage in Folsom Lake is adequate to control the floods of record to existing channel capacities below the dam. The reservoir provides a minimum flood control reservation of 400,000 acre-feet and a maximum flood control reservation of 600,000 acre-feet between mid-November and early March of each year, and variable smaller reservations of flood control space at the beginning (October) and end (May) of the rain flood season. During the seasons when this space is not reserved for flood control, it is allocated for other project purposes. Storage is provided for conservation, flood control, hydroelectric power generation, recreation and downstream fisheries.

8-02. Flood Control. The principal objective of the flood control plan is the reduction of flood damages along the lower American River, including the city of Sacramento.

a. Spillway Design Flood (SDF). The office report, Definite Project Report, Folsom Dam and Reservoir, American River, California, Part I-Hydrology, dated June 1946, documents the development of the Spillway Design Flood which determined the requisite spillway capacity and surcharge storage space necessary to control floods in excess of the normal flood control space. This flood was derived using the analysis of the maximum possible precipitation published in Hydrometeorological Report No. 3 (HMR No.3) by the former U.S. Weather Bureau – currently known as the NWS. The current terminology for the “maximum possible precipitation” is Probable Maximum Precipitation or PMP. The PMP is defined as the greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular geographical location and certain time of year. The PMP amount was used to produce a Probable Maximum Flood (PMF), which was adopted as the Spillway Design Flood. The PMF would result from a combination of the most severe meteorological and hydrologic conditions considered reasonably possible in the basin above the dam. See Table 8-1 for pertinent hydrologic parameters associated with the Spillway Design Flood and Plate 8-1 for the routing of the SDF.

b. Probable Maximum Flood (PMF). The PMF was revisited several times throughout the years. Refer to the CESPK Hydrology Office Report, Folsom Dam Spillway Adequacy Studies, American River Basin, California, dated September 1980 (revised November 1991) for details regarding the development of the various PMFs. The most recent PMF study is presented in the CESPK Hydrology Office Report, Folsom Dam and Lake Revised PMF Study, American River Basin, California, dated October 2001. See Table 8-1 for pertinent hydrologic parameters associated with the various PMFs along with a tabulation of their routing results. See Plate 8-1 for the routing of the PMF.

TABLE 8-1
SPILLWAY DESIGN AND REVISED PMF SUMMARY

	Year Flood Computed and Method				
	HMR 3 1946 SDF [1,2,3]	HMR 36 1980 PMF [1,2,3]	HMR 36 1991 PMF [1,2,3]	HMR 58 1996 PMF [1,2,3,4]	HMR 59 2001 PMF [2,3,4]
Peak Inflow (1000 cfs)	615	848	839	681	906
72-hour Inflow Volume (1000 ac-ft)	1,638	2,495	2,509	800	2,810
72-hour PMP (in)	31.20	32.83	32.83	29.62	29.62
Snowmelt (in)	5.00	2.10	2.10	3.60	2.91
Remaining in snow (in)	1.70	1.64	1.64	N/A	N/A
Initial Loss	See pg 20 of SDF	None	None	None	N/A
Uniform Loss	---	0.10 in/hr	0.10 in/hr	0.10 in/hr	0.04 in/hr
Total Loss (in)	8.40	7.12	7.12	3.22	3.22
Excess (in)	16.10	26.17	26.17	27.45	27.45
Water Control Plan	Original	1977	1986	1993	2017
Maximum Storage (1000 ac-ft)	1,130	1,201	1,201	1,138	1,170
Surcharge Elevation (ft)	476.2	482.1	482.1	480.0	482.6
Maximum Spillway Discharge (cfs)	585	848	1,048	635	N/A
Freeboard (ft)	4.0 – 5.0	-1.6	-1.6	0.5	-2.1
Duration of Overtopping (hours)	0	9	11	0	9

1. Folsom Lake Initial Starting Storage: 977,000 acre-feet (Normal Full Pool). Assume critical downstream conditions in the vicinity of the city of Sacramento might prevent drawdown of Folsom Lake during the 4-day interval between the preliminary and Spillway Design Flood.
2. River outlets are assumed closed and inoperative (potential obstruction from drift).
3. Results are shown without upstream dam failure.
4. Information from the CESPK Hydrology Office Report, Folsom Dam and Lake Revised PMF Study, American River Basin, California, dated October 2001.

c. Standard Project Flood (SPF). A Standard Project Flood is one that can be expected from the most severe combination of meteorologic and hydrologic conditions characteristic of the geographic region, excluding extremely rare combinations. New methods in risk-based analysis have generally replaced the Standard Project Flood criteria as outlined in Corps guidance EM 1110-2-1411, Standard Project Storm Determination, dated 1952 (revised March 1965); however, the SPF is still relevant and is used when comparing project performance

against nearby existing projects that were designed to a SPF. SPF development is best suited to watersheds in the United States east of the Mississippi (105° west longitude) with drainage basins less than approximately 1,000 square miles. Generalizations become more difficult as the size of the basin increases.

By convention, it is possible to approximate or estimate the SPF, which is generally equal to 40 to 60 percent of the PMF for the same basin, based on the SPF/PMF ratios used for similar basins in the Sierra Nevada. Past analyses often show the SPF ranging within the 1/200 to 1/500 AEP. Under unregulated conditions, the 1986 SPF plots at about a 1/250 AEP for a 3-day flow duration. This flood is about 15 percent larger in peak and 34 percent larger in volume than the SPF developed in 1961. Routing of the revised SPF through Folsom Dam and Lake is shown on Plate 8-2. See Table 8-2 for a summary of the pertinent hydrologic parameters associated with the various SPFs along with a tabulation of their routing results.

TABLE 8-2
STANDARD PROJECT FLOOD SUMMARY

	Year Flood Computed and Method			
	HMR 36 1961 SPF [1,2,3]	HMR 36 1986 SPF [1,2,3]	HMR 58/59 2001 SPF [1,2,3,4]	HMR 58/59 2017 SPF [1,2,3,4]
Peak Inflow (1000 cfs)	460	530	441	525
Peak Outflow (1000 cfs)	360	530	N/A	N/A
72-hr Inflow Volume (1000 ac-ft)	1150	N/A	1397	1683
72-hr PMP (in) [96-hr for 1961]	17.92	N/A	N/A	N/A
Recurrence Interval[5]	350	350	N/A	355
Maximum Storage (1000 ac-ft) [6]	1103.5	1121.5	N/A	567
Surcharge Elevation (ft) [6]	N/A	475.5	N/A	479.34

1. Folsom Lake Initial Starting Storage: Bottom of the maximum flood control reservation during the winter season.
2. River outlets are assumed closed and inoperative (potential obstruction from drift).
3. Results are shown without upstream dam failure.
4. Information from the CESPK Hydrology Office Report, Folsom Dam and Lake Revised PMF Study, American River Basin, California, dated October 2001. The antecedent event for the PMF is 50% of the 2001 PMF.
5. Recurrence Interval. 6. 1993 Elevation-Capacity Table

d. Reservoir Design Flood (RDF). The provision of a maximum of 400,000 acre-feet of flood control space in Folsom Lake was based on the control of the Reservoir Design Flood with a maximum release of 115,000 cfs. The Reservoir Design Flood was computed as the flood which would result from the occurrence, directly over the drainage basin, of the largest rainstorm

of record within the region (December 1937 storm), at a time when ground and snow cover conditions are moderately conducive to high runoff. This flood, with a basin mean precipitation of 14.86 inches, has a peak flow of 340,000 cfs and a 6-day volume of 978,000 acre-feet, or 9.6 inches depth over the drainage basin. Routing of the Reservoir Design Flood is shown on Plate 8-3.

e. Other Floods. The February 1986 flood is the flood of record in the American River Basin based on the 7-day volume. This flood was one of the four floods since the design and construction of the project that have exceeded the volume of the Reservoir Design Flood (RDF). The floods of December 1955, December 1964, and January 1997 also exceeded the RDF. The 1986 flood, with a basin mean precipitation of 23.19 inches, had a maximum 7-day inflow volume of 1,366,000 acre-feet. A description of the 1964, 1986, and 1997 floods is included in Section 4-06. Routings of the 1955, 1964, 1986, and other floods are shown on Plate 8-4.

8-03. Recreation. The Folsom Lake State Recreation Area has been described as the most popular unit in the California State Parks system. The area served by the State Recreation Area is primarily northern California with about 90 percent of the day-users and 50 percent of the campers traveling no farther than 100 miles. The major population centers served include Placer, Yolo, El Dorado, San Joaquin, and Sacramento counties. The annual paid day use, free day use, camping use, and boat launches for the years 2005 through 2015 are shown on Table 8-3. Water-dependent activities (e.g., boating, swimming, water skiing, fishing, rafting) are estimated to account for 85 percent of all use within the unit.

TABLE 8-3
RECREATIONAL USAGE
FOLSOM LAKE STATE RECREATION AREA
2005 – 2015

YEAR	PAID DAY USE	FREE DAY USE	CAMPING	**TOTAL**	BOAT LAUNCHES
2005	964,834	6,577	26,783	**998,194**	101,047
2006	1,080,845	106,473	27,182	**1,214,500**	100,608
2007	952,674	84,014	25,764	**1,062,452**	69,577
2008	719,401	68,370	25,117	**813,888**	39,916
2009	1,218,759	84,148	37,455	**1,340,362**	68,401
2010	1,182,493	88,417	32,126	**1,303,036**	70,437

TABLE 8-3
RECREATIONAL USAGE
FOLSOM LAKE STATE RECREATION AREA
2005 – 2015

YEAR	PAID DAY USE	FREE DAY USE	CAMPING	**TOTAL**	BOAT LAUNCHES
2011	1,181,318	143,294	28,882	**1,353,494**	58,014
2012	1,258,261	89,099	30,553	**1,377,913**	55,456
2013	1,193,568	87,694	31,929	**1,313,191**	46,709
2014	1,085,851	82,423	28,138	**1,196,412**	40,628
2015	1,027,955	76,364	38,732	**1,143,051**	34,209
TOTALS	11,865,959	916,873	333,661	**13,116,493**	686,002
AVERAGES	1,078,724	83,352	30,332	**1,192,408**	62,364

Source: California Department of Parks and Recreation, Gold Fields District

The American River Parkway in the lower American River also experiences heavy recreational usage, with an estimated 5 million visitors using the parkway each year. In 1981, the 23-mile reach from Nimbus Dam to the confluence with the Sacramento River was designated by Congress as part of the National Wild and Scenic Rivers System. This system was created to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations.

8.04. Water Quality. Since 1956, when Folsom dam began regulating American River flows, the quality of the water has been more uniform, without the previous seasonal changes that resulted from large variations in streamflows. Data collected from the American River at Fair Oaks since 1951 by the DWR indicate that American River water quality has generally improved since completion of Folsom Dam. Water quality in the basin is maintained in accordance with applicable State Water Resources Control Board permits. See Section 4-08 for further discussion on water quality.

8-05. Fish and Wildlife. The impoundment of the American River at Folsom Dam has created a fishery which includes various species of bass, sunfish, bullhead, catfish and trout. In addition, the reservoir provides resting grounds for migratory waterfowl. The shallow water areas attract a variety of birds and animals, which in turn attract predatory species. However, some animals are displaced or have their habitat altered when the reservoir level rises during floods.

Several decisions implementing instream flow requirements to protect fisheries and recreation on the lower American River have been issued since SWRCB D-893, dated 1958. (For example, NFMS 2009 Biological Opinion and the lower American River Flow Management Standard

(FMS) developed by the Water Forum while working in cooperation with Reclamation, CDFW, NMFS, and FWS.) The FMS is intended to balance two co-equal objectives: providing long-term reliable and safe water supply, and protecting fishery, wildlife, recreational, and aesthetic values of the American River. At the present time, minimum flow in the lower American River has been maintained principally between 800 cfs and 1,750 cfs, which is consistent with the NMFS Biological Opinion Reasonable and Prudent Alternative Actions that set minimum release requirements (and in excess of the minimum flow required by Decision 893). Other factors, including CVP system-wide operations, frequently require river releases to be greater.

The Nimbus and American River hatcheries aid in mitigating and supplying part of the increasing commercial and sport fishing demands for Chinook salmon, steelhead, rainbow, and Lahonton cutthroat trout.

8-06. Water Supply. The historical monthly inflow to Folsom Lake for 60 years of record is 2,697.2 thousand acre-feet (see Table 4-12 in the Tables Section following Chapter 9). The inflow records at Folsom Lake reflect the historical diversion and storage of water upstream of Folsom Dam. The average annual discharge of the American River at Nimbus Dam (1955-2014) is 2.6 million acre-feet. Average monthly release data for the same location is given in Table 8-4.

TABLE 8-4
AVERAGE MONTHLY RELEASE AT NIMBUS DAM

Month	Volume (1000 ac-ft)	Percent of Annual
October	115	4.4
November	133	5.1
December	228	8.8
January	301	11.6
February	286	11.0
March	289	11.1
April	250	9.6
May	262	10.1
June	229	8.8
July	218	8.4
August	162	6.2
September	127	4.9
TOTAL	2600	100.0

Period of Record: 1955 – 2014 Source: Reclamation

8-07. Hydroelectric Power. The principle purpose of the Folsom and Nimbus powerplants is to use the releases mandated for downstream appropriators, flood control, fish, and other uses to

generate power while still meeting requirements of prior water rights. In addition, all water diverted by the powerplants is to be returned to the river immediately downstream of the powerplants. The current capabilities to operate for flood control are not changed by power generation.

8-08. Navigation. Navigation is not a project purpose of Folsom Dam and Lake or the American River.

8-09. Frequencies

a. Unregulated Flow Frequencies. Unregulated flows and statistical parameters for the American River at Fair Oaks for snowmelt and rain floods are tabulated on Tables 8-5 and 8-6 (in the Tables Section following Chapter 9), respectively. Flow frequency curves for peak, 1-, 3-, 7-, 15-, 30-, 60-, 90-, and 120-day flows for snowmelt floods are shown on Plate 8-5. Flow frequency curves for peak, 1-, 3-, 5-, 7-, 10-, 15-, and 30-day flows for rain floods shown on Plate 8-7. The statistics were computed using the HEC Regional Frequency Program.

b. Regulated Flow Frequencies. Peak flow frequency curves for the American River at Fair Oaks for project conditions for rain floods are shown on Plate 8-6. The curves reflect operation of Folsom Dam for the period 1955-2015, which includes both dry and wet periods and is representative of a longer period of record. In order to extend the flow frequency curves to include very rare events, such as the one percent and rarer floods, hypothetical floods were routed through Folsom Dam and Lake.

Peak flow frequency curves for snowmelt were not developed, because the large channel capacity below Folsom Dam and the characteristic low peak flows and long durations of snowmelt floods do not pose a significant threat to the lower American River.

c. Stage-Frequency Curve. A stage-frequency curve is shown on Plate 8-8, and stage-duration curves are shown on Plate 8-9. The seasonal variation of reservoir storage frequency is shown on Plate 8-10. The level of storage is the highest in the spring at the beginning of the recreation season (May-September) as a result of storing runoff for water supply and flood control. Subsequent releases made through the summer for water supply and downstream rights draw the reservoir down for the beginning of the winter flood season.

d. Operation Record. The official operating record of Folsom Lake is published in Water Supply papers of the USGS. Operation of Folsom Dam began in February 1955 and is shown on Plate 4-6.

8-10. Other Studies. [Need to add information about American River Common Features (ARCF) General Reevaluation Report (GRR).]

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IX – WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization. Folsom Dam and Lake is operated by the Bureau of Reclamation, United States Department of the Interior, and is under the jurisdiction of their Regional Director, Mid-Pacific Region, Sacramento, California. Details concerning the responsibility for flood control operation are discussed in Exhibit A. Flood control regulations prescribed by the Secretary of the Army under the authority of Section 7 of the Flood Control Act of 1944 and in accordance with rules and regulations contained in the Code of Federal Regulations, Title 33, Part 208.11 (see Exhibit C in this manual) are reflected in the Water Control Diagram and Field Working Agreement in Exhibits A and B, respectively. In general, the following personnel and agencies have operational responsibilities:

a. The U.S. Army Corps of Engineers. The CESPK District Engineer is responsible for:

(1) Monitoring the operation of the project to ensure compliance with the Water Control Plan and flood control regulations.

(2) Advising operating agencies and the Chief of Engineers of any departure from the flood control regulations.

(3) Reviewing and reporting to the Division Engineer any emergency or planned deviation from prescribed flood control criteria.

(4) Preparing short period, daily, and monthly operation and other special reports relative to operation of the reservoir required by the Office, Chief of Engineers.

(5) Preparing revisions to the flood control criteria found herein.

(6) Providing training in water management and instrumentation to the Project Operator.

b. Bureau of Reclamation. The Bureau of Reclamation (Reclamation) is responsible for:

(1) Accomplishing the physical operation of the reservoir and associated facilities in accordance with the official regulations.

(2) Advising the CESPK District Engineer of any deviation from the flood control operation.

(3) Reporting to the CESPK District Engineer any unusual condition in the reservoir or along downstream channels that might interfere with planned flood control operation of the reservoir.

(4) Taking reasonable steps to inform the public of significant changes in flood control releases.

(5) Making available for access by the CESPK Water Management Section, data as outlined in paragraph 9-06 and Plate A-8, and other data that may be required from time to time.

(6) Keeping informed of the rules and regulations contained in the Water Control Manual and bringing to the attention of the CESPK District Engineer any features of the manual that may require clarification or revision.

(7) Keeping the CESPK District Engineer advised of any inaccuracies contained in the Water Control Manual or that may develop as a consequence of changing conditions.

(8) Immediately after the end of each month, making available for access by the CESPK Water Management Section data specified in paragraph 9-06.

c. Other Federal Agencies

(1) National Weather Service. Reclamation cooperates with the National Weather Service (NWS) in the operation of a network of hydrometeorological stations throughout the American River Basin. The NWS office in Sacramento maintains year-round surveillance of weather conditions. The NWS also prepares and distributes weather and streamflow forecasts to agencies responsible for flood protection and to the public by way of the local news media, Internet, and e-mail.

The NWS office furnishes meteorological data and weather forecasts on a continuous 24-hour basis. Quantitative Precipitation Forecasts (QPF), Quantitative Temperature Forecasts (QTF), and streamflow forecasts are issued twice a day, and more frequently during flood events.

The CNRFC provides 365-day probabilistic unregulated streamflow forecasts. These forecasts incorporate current watershed conditions (soil and snow), near-term weather forecasts, and climatology in the form of precipitation and temperature. Both short- (regulated) and long-range (unregulated) streamflow volume forecasts are issued daily by the CNRFC, and more frequently during flood events. A variety of both short and long range products can be found on the CNRFC website: http://www.cnrfc.noaa.gov.

(2) U.S. Geological Survey. The U.S. Geological Survey (USGS) operates stream gaging stations on a cooperative basis with local, state, and federal agencies. The USGS regularly measures, services, and publishes the records from stream gaging stations and can provides preliminary flow data, if required. Reservoir stage and contents data are furnished to the USGS by Reclamation and the Corps for publication.

(3) National Marine Fisheries Service. The National Marine Fisheries Service (NMFS) provides actions for protection of endangered fishery species. Flows and temperatures of the lower American River are managed to protect the Central Valley steelhead as specified within the NMFS Biological Opinion (2009 and 2011 amendments).

d. State and County Agencies. The State Water Resources Control Board is responsible for administration of water rights. The California Department of Fish and Wildlife (CDFW) has the responsibility of protecting downstream fisheries resources and operating the Nimbus Fish Hatchery. Operating under the authority of the Central Valley Flood Protection Board (a State entity), the American River Flood Control District and Reclamation District 1000 are responsible for maintaining and patrolling the American River Flood Control Project Levees (see Plate 4-7). In addition, the Department of Parks and Recreation (CDPR) has a management agreement with Reclamation to develop, operate and maintain the federal land around Folsom Lake and Lake Natoma that is within the Folsom Lake State Recreation Area.

The Sacramento Area Flood Control Agency (SAFCA) was formed in 1989 to address the Sacramento area's vulnerability to catastrophic flooding. This vulnerability was exposed during the record flood of 1986 when Folsom Dam exceeded its normal flood control storage capacity and several area levees nearly collapsed under the strain of the storm. In response, the City of Sacramento, the County of Sacramento, the County of Sutter, the American River Flood Control District, and Reclamation District No. 1000 created SAFCA through a Joint Exercise of Powers Agreement to provide the Sacramento region with increased flood protection along the American and Sacramento rivers.

9-02. Interagency Coordination. To ensure that the flood control operation of Folsom Dam will be as effective as possible, it is essential that the operating agencies be continually advised of possible flood hazards, weather conditions, inflow to the reservoir, and flows at key locations in the American River. This requires close liaison between the Corps, Reclamation, Western Area Power Administration, NWS, USGS, DWR, CDFW, CDPR, SAFCA, and other downstream interests on a daily or hourly basis, as required.

a. Operating Agency Bulletins. Reclamation notifies local agencies and property owners of scheduled changes in reservoir releases and coordinates the publication of these changes, and other information of public interest regarding floods, through the local news media.

b. Power Marketing Agency. The Western Area Power Administration is the marketing agency for power generated at Reclamation facilities in the American River Basin.

c. Other Federal, State, or Local Agencies

(1) Federal-State River Forecast Center. Personnel from the CNRFC of the NWS office in Sacramento and the DWR are assigned to the Joint Federal-State River Forecast Center, which monitors weather conditions and river stages on a year-round basis. If floods on major rivers are imminent, the Federal-State Flood Operations Center is activated.

(2) Federal-State Flood Operations Center. This center operates on a 24-hour basis and, among other flood emergency activities, advises all interested parties of flood situations as they develop. The Center furnishes flood warnings and forecasts of river stages to local news media, law enforcement agencies, and other responsible agencies for their use and for dissemination to the public.

9-03. Interagency Agreements

A Field Working Agreement between the Department of the Interior, Bureau of Reclamation, and Department of the Army, Corps of Engineers, for Flood Control Operation of Central Valley Project Dams and Reservoirs in California was finalized on 14 August 1978 by representatives of Reclamation and the Corps. The agreement was initiated to ensure that there exists a clear understanding of the flood control regulations and information exchange required for the project operation. A copy of the agreement is contained in this Water Control Manual as Exhibit B.

The United States and the State of California entered into an agreement on 24 November 1986, recognizing the need for coordinated operation of the Central Valley Project (CVP) and the State Water Project (SWP), both of which provide for the development, conservation, control and utilization of water resources in California. The United States and the State agreed to observe reservoir operational criteria prescribed by the Corps to minimize flood hazards, meet all requirements and objectives of their respective projects, coordinate operation so as not to adversely affect the right of the other parties, and to conserve water. In addition, both the CVP and the SWP are operated in conformity with the Sacramento-San Joaquin Delta standards established by the State Water Resources Control Board in Decision D-1641 (December 1999).

The California State Water Resources Control Board Decision D-893 (dated March 1958) states that minimum flows in the lower American River (250 cfs from 1 January to 14 September, and 500 cfs from 15 September to 31 December) apply to the river from Nimbus Dam to the Sacramento River. Recognizing D-893 flows do not provide comprehensive habitat protection, minimum flows on the lower American River are guided by the NMFS Biological Opinion (2009 and 2011 amended). Releases from Nimbus Dam are expected to exceed the D-893 minimum flows in all but the driest of conditions. Decision D-1641 (December 1999) concerns flows to be maintained in the Delta for salinity control and for fish and wildlife. Releases from Nimbus Dam are affected by this decision since the American River contributes to flows through the Delta.

9-04. Commissions, River Authorities, Compacts, and Committees. Management of the resources of the American River, including water supply and quality, hydroelectric power marketing, and storage utilization in general, has evolved through numerous court issued decrees and decisions. Related information is presented throughout this manual and is contained in the Agreement between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley Project and the State Water Project (24 November 1986).

9-05. Non-Federal Hydropower. Hydropower facilities are owned and operated by Reclamation.

9-06. Reports

a. The reservoir operator or operating agency shall provide to the CESPK Water Management Section and to the DWR, each workday between midnight and 2:00 a.m. and at other times upon request, data as described in Exhibit A, Plate A-8, Operational Data Requirements. Data shall be distributed daily via automatic electronic transmittal.

b. Immediately after the end of each month, the operating agency will provide to the CESPK Water Management Section daily inflow, outflow, elevation, storage, precipitation, and daily requirements of flood control space at Folsom Dam.

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- DRAFT -

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

U.S. Army Corps of Engineers
Sacramento District
Revised September 2017

TABLES

TABLE OF CONTENTS

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TABLE 1-1
RELATED MANUALS AND REPORTS
(U.S. Bureau of Reclamation)

	Title	Date
1.	Standing Operating Procedures for Folsom Dam and Lake	October 2002
2.	Standing Operating Procedures for Nimbus Dam and Lake	October 2002
3.	Technical Memorandum No FOL-8130-CAS-TM-04-2…… Folsom Dam, Central Valley Project, California Hydrologic Corrective Action Study (CAS) Evaluation of Long-Term Alternatives	October 2004
4.	Folsom Lake 2005 Sedimentation Survey	September 2005
5.	Technical Memorandum No FOL-8130-EI-TM-05-3 Folsom Dam, Central Valley Project, California Recommended Freeboard – Hydrologic Dam Safety Feasibility Design	October 2005
6.	Folsom Lake 2005 Sedimentation Survey	September 2005

TABLE 1-2
RELATED MANUALS AND REPORTS
(U.S. Army Corps of Engineers)

	Title	Date
1.	Office Report, Standard Project Rain Flood Criteria, Auburn and Folsom Reservoirs, California	July 1961
2.	Office Report, Folsom Dam and Lake, Spillway Adequacy Studies	September 1980
3.	Folsom Dam and Lake Revised PMF Study	October 1983
4.	Agreement between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley Project and the State Water Project, Public Law 99-546 (100 Stat 3050)	27 October 1986
5.	Report on the February 1986 Floods, Northern California and Northwestern Nevada	January 1987
6.	American River Watershed Investigation Feasibility Report, California	December 1991
7.	Flood Management Plan, American River and Folsom Dam	March 1995
8.	American River Watershed Project, Supplemental Information Report	March 1996
9.	Sacramento and San Joaquin River Basins, Post-Flood Assessment for 1983, 1986, 1995, and 1997 Events	March 1999
10.	Folsom Dam and Lake Revised PMF Study	October 2001
11.	American River Watershed, California, Long Term Study	February 2002
12.	American River Watershed, California, Folsom Dam Modifications Project, Final Limited Reevaluation Report and Environmental Assessment/Initial Study	November 2003
13.	Post Authorization Change Report (PACR) and Appendices	March 2007
14.	American River Watershed, Common Features Project, Natomas Basin, Sacramento and Sutter Counties, California Post-Authorization Change Report	July 2010

TABLE 4-11

HISTORICAL UNIMPAIRED[1]
MONTHLY INFLOWS
TO FOLSOM LAKE
(1,000 ACRE-FEET)

WATER YEAR[2]	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1901	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1902	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1903	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1904	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1905	0	55	82	201	235	378	409	376	179	43	17	8	1983
1906	9	12	16	446	330	870	720	927	955	390	63	25	4761
1907	18	34	244	255	825	1520	931	750	661	339	92	48	5716
1908	43	49	110	160	113	203	267	283	155	53	12	7	1454
1909	24	26	37	1494	863	397	476	585	455	142	37	17	4553
1910	31	273	577	524	291	646	624	489	135	32	13	12	3647
1911	21	32	98	853	589	798	898	892	1055	197	28	18	5478
1912	22	26	25	70	46	118	171	421	284	51	13	20	1264
1913	15	87	37	97	71	107	359	444	151	38	17	9	1433
1914	10	29	132	1052	390	499	561	717	392	130	28	11	3950
1915	20	22	42	95	512	286	507	954	478	109	24	13	3062
1916	13	22	81	476	584	807	700	607	399	121	21	13	3846
1917	38	39	124	98	407	275	549	633	531	103	23	12	2832
1918	11	11	32	17	124	313	441	307	115	20	4	25	1421
1919	58	48	48	42	361	314	562	594	96	17	9	8	2155
1920	10	9	42	39	37	238	361	439	162	34	11	9	1391
1921	35	152	272	473	316	534	432	527	372	76	20	15	3224
1922	25	47	136	118	371	338	488	1018	671	98	22	16	3346
1923	31	63	399	268	175	218	566	613	278	97	22	22	2753
1924	40	28	29	38	115	54	119	92	12	2	1	1	531
1925	14	57	99	94	604	319	606	603	258	66	20	17	2758
1926	27	32	55	49	259	194	475	197	48	15	10	12	1373
1927	22	174	138	223	770	441	727	602	412	76	23	20	3628
1928	28	117	103	104	135	992	536	381	80	25	14	13	2529
1929	22	34	43	44	102	150	214	341	158	30	10	8	1156
1930	6	5	155	137	144	320	343	274	144	25	11	14	1579
1931	16	34	20	53	70	132	155	118	39	8	4	6	655
1932	15	31	171	176	332	295	388	639	402	92	19	13	2572
1933	23	31	43	48	55	143	238	352	329	39	15	9	1325
1934	25	39	117	165	175	253	184	98	39	12	12	9	1127
1935	13	70	72	174	145	209	804	647	345	62	17	13	2572

TABLE 4-11

HISTORICAL UNIMPAIRED[1]
MONTHLY INFLOWS
TO FOLSOM LAKE
(1,000 ACRE-FEET)

WATER YEAR[2]	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1936	29	42	46	413	777	428	624	573	344	84	28	25	3415
1937	30	34	42	55	349	409	507	667	217	54	19	18	2401
1938	34	70	442	144	552	809	718	1003	586	129	35	29	4552
1939	42	57	61	67	86	236	310	159	47	10	7	6	1086
1940	28	31	42	479	613	847	622	494	192	45	24	24	3442
1941	26	56	264	359	485	461	452	703	276	81	28	21	3213
1942	29	64	336	596	573	305	625	714	545	148	33	23	3991
1943	22	163	293	706	392	946	599	439	258	78	22	15	3931
1944	26	37	48	77	161	250	227	461	185	39	13	13	1537
1945	28	130	142	111	566	259	408	550	272	65	17	16	2564
1946	41	153	541	306	151	343	509	534	193	46	18	22	2858
1947	34	99	103	65	174	295	284	242	86	17	11	9	1419
1948	50	53	41	178	84	158	522	625	439	80	19	14	2262
1949	28	50	73	67	101	364	507	518	155	23	11	10	1906
1950	15	35	39	317	349	347	586	588	319	73	17	20	2705
1951	57	979	1067	594	434	433	425	457	149	38	18	16	4668
1952	42	113	334	556	559	502	818	1119	660	238	57	31	5031
1953	28	33	120	470	157	232	467	489	500	158	28	24	2706
1954	34	63	87	140	220	451	547	358	104	27	15	21	2068
1955	27	46	132	164	107	168	239	467	202	23	12	19	1606
1956	31	46	1250	963	338	319	410	747	411	110	29	23	4677
1957	51	56	71	76	298	447	301	557	277	42	13	12	2201
1958	43	58	118	182	618	562	860	1041	520	120	32	26	4180
1959	30	47	38	164	220	199	274	191	64	3	0	12	1242
1960	20	25	29	74	360	435	359	275	104	6	0	0	1687
1961	16	53	75	44	130	157	236	264	99	0	0	0	1074
1962	8	25	68	66	428	253	546	403	221	41	13	8	2080
1963	322	69	199	247	743	238	661	764	275	51	8	20	3597
1964	47	213	97	175	120	133	292	390	180	22	9	1	1679
1965	8	82	1506	794	296	240	620	523	313	92	39	11	4524
1966	18	93	101	143	121	236	416	260	35	0	0	2	1425
1967	20	92	301	430	283	548	452	886	747	241	33	20	4053
1968	26	52	87	150	443	291	279	235	81	5	14	4	1667
1969	30	116	153	1102	514	370	682	934	464	112	20	27	4524
1970	47	65	365	1334	350	339	219	356	194	39	14	14	3336

TABLE 4-11

HISTORICAL UNIMPAIRED[1]
MONTHLY INFLOWS
TO FOLSOM LAKE
(1,000 ACRE-FEET)

WATER YEAR[2]	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1971	28	196	371	302	222	399	424	549	418	106	25	17	3057
1972	37	74	158	137	198	456	334	368	161	20	8	15	1966
1973	43	114	249	606	410	370	417	625	199	30	13	29	3105
1974	45	430	437	756	236	733	626	621	336	148	33	28	4429
1975	38	49	70	107	261	440	326	733	500	102	30	20	2676
1976	87	94	78	62	73	124	124	134	5	0	5	12	798
1977	24	9	1	19	24	36	64	86	42	0	0	0	305
1978	1	14	178	561	305	565	543	581	366	83	5	27	3229
1979	12	28	49	201	230	364	375	634	160	30	3	8	2094
1980	49	83	98	1217	730	415	403	482	287	122	14	24	3924
1981	23	33	64	97	142	258	285	212	33	0	0	0	1147
1982	34	536	839	523	908	708	1132	815	377	127	24	59	6082
1983	152	288	579	486	710	1182	626	979	949	377	92	71	6491
1984	63	717	969	400	301	385	324	469	226	40	10	17	3921
1985	47	192	124	83	148	212	423	269	67	0	0	23	1588
1986	14	76	157	350	1827	1053	442	411	229	43	20	31	4653
1987	31	18	22	46	149	219	226	138	16	1	1	1	869
1988	7	20	106	165	97	130	146	109	36	1	1	3	820
1989	6	82	78	86	123	847	552	316	149	18	8	22	2285
1990	44	54	44	106	108	243	256	158	117	12	9	12	1162
1991	8	15	11	13	23	330	279	325	158	26	7	5	1201
1992	34	29	42	47	228	212	237	76	14	11	5	2	936
1993	18	19	125	527	378	664	518	644	392	78	14	12	3388
1994	25	29	67	51	104	179	180	161	29	2	0	2	829
1995	4	62	157	941	304	1265	684	991	710	298	52	23	5490
1996	16	8	181	361	830	581	545	797	245	49	10	17	3640
1997	23	152	921	1933	352	285	343	310	140	14	6	10	4489
1998	19	51	91	536	730	598	571	714	787	271	49	45	4464
1999	36	83	171	402	720	455	421	631	370	78	28	34	3429
2000	32	44	48	316	689	435	423	448	140	28	19	32	2654
2001	37	40	55	60	114	232	260	258	35	14	6	13	1124
2002	11	57	179	241	225	363	436	367	161	23	18	20	2101
2003	14	73	199	257	173	274	428	633	278	46	22	23	2421
2004	18	37	168	151	281	394	321	249	71	17	14	15	1736
2005	40	59	142	286	233	514	468	959	443	110	28	24	3307

TABLE 4-11

HISTORICAL UNIMPAIRED[1]
MONTHLY INFLOWS
TO FOLSOM LAKE
(1,000 ACRE-FEET)

WATER YEAR[2]	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
2006	25	47	808	709	460	667	1219	934	352	89	32	26	5368
2007	30	58	117	108	265	294	255	229	56	15	8	10	1445
2008	24	17	58	130	151	198	255	317	86	18	11	13	1278
2009	2	45	40	100	234	446	325	589	106	22	-4	-1	1904
2010	17	6	46	135	153	251	399	503	514	72	7	7	2110
2011	98	92	650	263	227	865	744	682	748	324	57	29	4777
2012	54	22	29	99	65	429	565	310	92	26	9	6	1706
2013	17	100	582	141	106	213	250	161	71	18	9	8	1676
2014	3	7	12	19	229	249	231	145	33	10	4	11	953
2015	4	26	223	67	236	85	80	85	27	-4	-2	3	830
MEAN	31.1	84.4	198.9	307.2	328.0	405.3	449.5	496.5	272.4	70.3	18.0	16.3	2677.8

1. Data from 1905 to 2008 is from the USACE Period of Record Data. 2008-2015 is from CDEC Full Natural Flow.

TABLE 4-12

HISTORICAL REGULATED [1]
MONTHLY INFLOWS
TO FOLSOM LAKE
(1,000 ACRE-FEET)

WATER YEAR[2]	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1955	N/A	N/A	N/A	N/A	N/A	164.1	244.3	483.3	218.4	41.4	26.4	27.0	N/A
1956	53.4	61.8	70.6	977.1	340.5	334.6	419.9	770.8	420.3	114.5	29.2	28.3	3621.0
1957	45.4	60.9	113.6	77.5	300.4	455.2	317.5	566.7	293.2	57.4	22.0	21.4	2331.1
1958	34.3	46.2	37.2	172.5	597.9	579.3	862.5	1042.3	532.3	129.8	40.6	29.2	4104.2
1959	26.6	23.6	28.5	160.4	214.1	196.8	277.3	199.2	73.9	19.4	11.5	21.6	1252.9
1960	23.4	54.2	70.8	73.1	361.3	441.7	356.7	276.3	118.6	26.8	14.9	13.1	1830.9
1961	19.3	33.1	73.9	45.3	128.5	157.6	237.0	267.4	120.1	34.5	24.8	17.1	1158.7
1962	324.7	70.8	182.6	69.7	423.3	251.3	542.3	398.4	237.8	58.1	36.7	27.8	2623.3
1963	104.4	244.3	146.0	244.1	682.8	216.9	613.7	660.4	278.9	64.4	23.5	24.3	3303.7
1964	29.3	99.2	1328.4	218.0	131.0	124.9	255.9	325.6	180.1	75.9	65.0	43.3	2876.6
1965	80.7	107.1	152.3	787.5	324.0	241.3	559.2	480.7	271.5	138.2	89.7	73.1	3305.4
1966	52.6	92.9	293.8	169.8	133.7	198.8	267.4	174.6	79.4	52.9	54.1	45.9	1616.1
1967	93.0	125.0	152.1	435.3	293.5	517.7	478.0	712.5	582.4	282.7	146.4	99.8	3918.2
1968	94.7	137.3	185.1	175.8	349.7	231.5	198.2	172.7	111.8	72.9	86.1	76.0	1891.6
1969	108.4	141.3	326.3	993.2	591.2	457.3	608.9	653.9	386.0	170.7	146.9	124.3	4708.5
1970	101.9	209.9	427.7	1128.2	391.8	335.5	205.0	233.6	191.4	103.9	123.9	90.7	3543.5
1971	104.9	96.3	191.2	333.0	240.7	334.2	301.9	354.3	313.6	169.7	143.7	111.1	2694.6
1972	103.4	139.9	252.6	201.5	226.0	302.8	241.8	227.5	140.4	99.4	136.4	99.8	2171.6
1973	90.8	350.2	448.0	595.4	453.0	407.9	306.5	374.9	172.8	92.5	93.7	101.0	3486.6
1974	112.4	120.0	115.8	683.6	284.7	699.3	592.1	494.8	329.0	177.3	132.2	126.6	3867.6
1975	125.2	93.5	115.9	158.4	270.2	422.5	340.8	505.7	348.3	138.5	119.7	133.4	2772.1
1976	58.0	26.0	27.3	100.0	134.4	153.9	83.4	89.1	42.4	63.4	65.7	75.5	919.1
1977	20.7	19.0	129.5	29.1	21.4	32.7	34.9	43.2	25.4	11.4	24.1	24.2	415.6
1978	50.1	87.6	82.9	499.6	304.5	496.6	472.9	459.4	256.8	120.3	103.3	81.2	3015.1
1979	88.8	100.1	144.9	229.1	265.3	335.1	298.3	428.6	154.3	118.0	114.4	113.3	2390.1
1980	83.6	102.4	144.5	986.9	711.6	474.9	403.2	406.7	237.0	179.8	109.1	129.2	3968.9
1981	62.5	384.0	727.2	130.6	137.5	234.6	188.7	130.5	64.4	66.8	61.2	67.2	2255.2
1982	165.5	318.5	602.1	598.3	850.9	715.7	1086.8	769.4	400.2	215.1	163.6	140.2	6026.3
1983	119.8	629.1	934.2	491.1	743.4	1196.5	681.0	822.1	774.0	405.7	187.4	154.2	7138.6
1984	82.9	190.8	168.7	463.7	359.0	399.8	332.7	337.6	208.5	118.7	129.8	126.5	2918.6
1985	54.1	85.7	174.9	108.6	174.8	203.3	275.5	170.7	94.1	104.8	105.7	116.5	1668.6
1986	62.0	65.6	59.9	290.9	1621.3	966.2	396.2	365.7	249.5	121.9	121.3	126.1	4446.7
1987	32.0	24.1	105.5	68.9	149.0	180.8	138.1	100.7	71.5	75.8	76.3	54.4	1076.9
1988	30.6	68.3	89.7	164.1	112.6	105.1	101.3	77.3	61.7	60.3	58.9	59.5	989.4
1989	65.1	84.7	94.6	103.6	124.5	647.6	377.4	230.9	152.1	117.9	118.3	106.1	2222.8
1990	77.7	69.2	47.7	113.5	113.3	194.3	144.6	109.6	109.2	106.8	118.0	87.2	1291.0

TABLE 4-12

HISTORICAL REGULATED [1]
MONTHLY INFLOWS
TO FOLSOM LAKE
(1,000 ACRE-FEET)

WATER YEAR[2]	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1991	66.6	67.1	66.6	38.6	41.0	273.0	201.2	211.7	142.9	98.2	91.8	83.8	1382.6
1992	37.5	39.8	138.3	74.9	202.2	164.8	145.9	78.9	56.6	57.8	59.8	45.2	1101.7
1993	79.4	77.2	111.1	478.3	366.4	568.0	452.3	441.4	337.3	161.5	136.2	102.4	3311.6
1994	43.7	76.6	158.8	74.9	110.8	135.3	110.5	102.5	75.5	62.0	60.0	42.2	1052.6
1995	107.1	77.5	166.1	840.6	339.3	1135.8	645.0	865.3	662.5	347.0	166.9	132.8	5485.8
1996	82.9	144.9	939.6	322.3	698.8	566.9	482.6	762.9	267.9	129.8	109.9	107.8	4616.4
1997	94.5	88.9	133.8	1935.8	437.5	330.7	249.8	237.1	168.4	112.6	123.4	124.1	4036.6
1998	55.1	110.0	197.7	466.1	729.9	544.4	545.2	575.6	630.7	309.5	178.7	140.1	4482.9
1999	77.8	93.4	94.8	367.2	707.6	490.9	400.9	441.5	276.9	132.8	139.2	111.2	3334.2
2000	55.1	115.8	128.9	266.4	629.4	425.1	292.2	316.5	178.9	106.6	131.5	111.3	2757.8
2001	16.0	42.2	168.1	90.2	118.1	178.1	172.3	160.4	62.1	58.2	58.4	47.0	1171.1
2002	58.9	95.7	203.1	239.9	212.3	303.5	272.1	245.8	131.9	76.6	79.7	77.2	1996.9
2003	51.9	75.4	170.0	242.4	179.2	226.5	348.1	493.8	245.8	119.2	95.7	93.3	2341.1
2004	77.3	76.2	171.4	189.2	275.5	311.6	197.0	159.7	90.1	85.7	94.7	93.5	1821.9
2005	72.0	92.5	693.1	286.7	238.5	454.4	409.3	695.4	430.7	157.4	115.9	85.9	3732.0
2006	52.3	86.1	131.7	664.9	476.4	692.4	1170.9	819.7	352.4	163.3	138.1	87.2	4835.3
2007	53.9	36.1	65.7	113.0	227.9	230.8	169.9	163.9	74.7	86.7	81.1	66.4	1370.1
2008	45.6	51.7	78.6	125.1	159.5	156.1	169.7	180.5	81.6	76.2	82.4	70.1	1277.2
2009	76.9	59.2	100.3	90.2	228.4	402.5	254.7	419.2	120.1	77.9	93.0	100.4	2022.9
2010	92.0	123.6	679.3	159.4	183.6	223.9	362.4	399.5	390.4	125.4	90.3	84.9	2914.8
2011	77.2	55.4	66.3	338.7	280.8	866.0	664.9	556.9	631.4	329.6	138.9	129.4	4135.6
2012	60.2	80.3	487.8	108.7	69.7	346.1	415.9	249.3	98.5	84.1	90.9	78.1	2169.6
2013	29.4	28.3	33.0	173.6	113.3	154.6	164.2	132.9	89.2	71.9	80.3	53.6	1124.3
2014	36.1	39.2	201.1	24.8	171.4	169.3	161.1	98.4	60.6	66.8	80.4	57.3	1166.3
2015	23.1	28.1	138.8	76.6	167.9	64.6	50.0	51.9	50.9	43.6	54.5	41.6	791.6
MEAN	71.7	107.1	229.5	331.1	332.1	374.2	356.6	373.4	229.7	117.2	93.4	81.4	2697.2

1. Data from 1905 to 2008 is from the Corps Period of Record Data. 2008-2015 is from CDEC Full Natural Flow.

2. The water year includes months from two calendar years. For instance, 1955 water year includes Oct, Nov, and Dec from 1954 calendar year.

TABLE 4-13
WATER QUALITY SUMMARY
LOWER AMERICAN RIVER, 2011-2015

		Folsom-Auburn Road			Lake Natoma (Aquatic Park)		
		Mean	Min.	Max.	Mean	Min.	Max.
Physical Measurements							
Temperature	°C	11.7	8.9	15.5	13.6	9.7	17.1
Specific Conductance	µS/cm	60.	37.	78.	65.	39.	108.
pH	units	7.8	7.2	8.4	7.5	6.8	8.2
Turbidity	NTU	4.9	1.7	12.1	2.7	1.3	8.0
Dissolved Oxygen	mg/l	8.6	1.3	11.1	11.8	9.9	13.4
Conventional Analytes							
Alkalinity	mg/l	22.	14.	26.	25.	14.	36.
Calcium	mg/l	5.8	4.0	7.0	6.4	4.0	8.7
Magnesium	mg/l	2.1	1.0	3.0	2.4	1.0	3.8
Hardness	units	23.	14.	30.	26.	14.	37.
Ammonia (as N)	mg/l	<<0.05	<0.02	0.07	<0.05	<0.02	0.06
Nitrate + Nitrite (as N)	mg/l	<0.1	<0.01	0.2	<0.1	<0.01	<0.1
Total Phosphorus (as P)	mg/l	<0.03	<0.01	<0.10	<0.03	<0.01	<0.10
Potassium	mg/l	<0.80	0.64	<1.00	0.85	0.68	<1.00
Sodium	mg/l	2.3	2.	2.7	2.8	2.	3.9
Chloride	mg/l	1.96	1.2	2.6	<2.36	<1.0	4.2
Fluoride	mg/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sulfate	mg/l	<2.1	<1.0	3.4	<2.3	<1.0	4.1
Chemical Oxygen Demand	mg/l	<5.32	<5.	7.	<6.1	<5.	9.4
Total Dissolved Solids	mg/l	44.	27.	54.	43.	31.	63.
Total Organic Carbon	mg/l	1.7	1.4	2.1	1.9	1.4	3.2

TABLE 4-13
WATER QUALITY SUMMARY
LOWER AMERICAN RIVER, 2011-2015

		Folsom-Auburn Road			Lake Natoma (Aquatic Park)		
		Mean	Min.	Max.	Mean	Min.	Max.
Metals							
Aluminum	µg/l	70.	12.	260.	49.	8.7	200.
Antimony	µg/l	<0.33	<0.2	<0.5	<0.33	<0.2	<0.5
Arsenic	µg/l	<0.52	<0.50	0.69	<0.53	<0.5	0.71
Barium	µg/l	12.9	9.5	16.4	13.3	10.	19.3
Beryllium	µg/l	<0.33	<0.2	<0.5	<0.33	<0.2	<0.5
Boron	µg/l	<18.3	<10	<25.0	<18.3	<10	<25.0
Cadmium	µg/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chromium	µg/l	<0.62	<0.5	1.4	<0.57	<0.5	1.1
Copper	µg/l	0.76	0.59	1.19	0.69	0.54	1.12
Cyanide	µg/l	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Iron	µg/l	141.	55.	350.	101.	49.	360.
Lead	µg/l	<0.07	<0.05	0.16	<0.06	<0.05	0.10
Manganese	µg/l	64.	6.1	373.	21.6	8.8	51.7
Mercury	ng/l	<2.17	<2.0	3.5	<2.1	<2.0	2.8
Molybdenum	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/l	<0.98	<0.5	1.60	<0.95	<0.5	1.70
Selenium	µg/l	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Silver	µg/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Thallium	µg/l	<0.06	<0.05	<0.10	<0.06	0.05	<0.10
Uranium	µg/l	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Zinc	µg/l	2.0	<2.0	2.2	<2.2	<2.0	2.8
Other							
Gross Alpha	pCi/L	<3.1	<2.4	4.5	2.9	0.49	6.2
Perchlorate	µg/l	-	-	-	<0.5	<0.5	<0.5
Total Trihalomethane Potential	µg/l	-	-	-	111.	54.	206.

Source: Reclamation (Central Valley Office), 2011-2015

TABLE 4-15
EXISTING RESERVOIRS AND POWERPLANTS ABOVE FOLSOM DAM

NAME	STREAM	USGS ID	OWNER	STORAGE CAPACITY (AC-FT)	DRAINAGE AREA (SQ-MI)
Brush Creek	Brush Creek	4426.9	SMUD	1,350	8.02
Buck Island	Little Rubicon R	4284	SMUD	1,070	6.0
Camino Diversion	Silver Creek	4418.9	SMUD	543	160
Caples Lake	Tr Silver Fork	4369.5	PG&E	22,338	13.5
Chili Bar	SF American R	4445	PG&E	3,700	598
Echo Lake	SF American R	103366.08	PG&E	1,890	4.84
French Meadows	MF American R	4274	PCWA	136,405	47.0
Gerle Diversion	Gerle Creek	4296	SMUD	826	28.7
Hell Hole	Rubicon R	4287	PCWA	207,342	114.0
Ice House	SF Silver Creek	4411	SMUD	46,000	28.4
Interbay Dam	MF American R	4277.7	PCWA	130	89.1
Junction Diversion	Silver Creek	4417.6	SMUD	2,610	146.0
Lake Aloha	Pyramid Creek	4349	EID	5,000	3.36
Lake Clementine	NF American R	4270	USACE	12,800	342.0
Loon Lake	Gerle Creek	4293.5	SMUD	67,670	7.96
Rubicon	Rubicon R	4279.6	SMUD	1,450	26.8
Silver Lake	Silver F of SF Am	4359	EID	8,590	15.1
Slab Creek	SF American R	4434.5	SMUD	13,080	493.0
Stumpy Meadows Lake	Pilot Creek	4330.4	GPUD	20,000	21.1
Sugar Pine	Shirttail Creek	n/a	USBR	6,921	n/a
Union Valley	Silver Creek	4410.01	SMUD	266,389	83.7
Camino Powerplant	SF American R	4418.95	SMUD	n/a	n/a
Chili Bar Powerplant	SF American R	4445	PG&E	n/a	n/a
French Meadows Powerplant	MF American R	4272	PCWA	n/a	n/a
Jaybird Powerplant	Silver Creek	4417.6	SMUD	n/a	n/a
Jones Fork Powerplant	Sf Silver Creek	4409	SMUD	n/a	n/a
Loon Lake Powerplant	Gerle Creek	4293.4	SMUD	n/a	n/a
Middle Fork Powerplant	MF American R	4286	PCWA	n/a	n/a
Oxbow Powerplant	MF American R	4332.12	PCWA	n/a	n/a
Ralston Powerplant	MF American R	4277.65	PCWA	n/a	n/a
Robbs Peak Powerplant	Div fr Rubicon R	4293	SMUD	n/a	n/a
Rock Creek Powerplant	SF American R	4442.8	RC LTD PNSP	n/a	n/a

TABLE 4-15
EXISTING RESERVOIRS AND POWERPLANTS ABOVE FOLSOM DAM

NAME	STREAM	USGS ID	OWNER	STORAGE CAPACITY (AC-FT)	DRAINAGE AREA (SQ-MI)
Union Valley Powerplant	Silver Creek	4410.02	SMUD	n/a	n/a
White Rock Powerplant	SF American R	4434.6	SMUD	n/a	n/a

Source: 2013 USGS Water Data Reports - http://wdr.water.usgs.gov/wy2013/search.jsp
2011 USGS Water Data Reports - http://wdr.water.usgs.gov/wy2011/search.jsp
2008 USGS Water Data Reports - http://wdr.water.usgs.gov/wy2008/search.jsp
2007 Annual Data Reports: South Form and Middle Fork American and Rubicon River Basins Schematics - http://ca.water.usgs.gov/data/waterdata/schematics2007.html
Database of California Power Plants - http://www.energy.ca.gov/almanac/power_plant_data/

TABLE 8-5

ANNUAL MAXIMUM SNOWMELT FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	1-DAY		3-DAY		7-DAY		15-DAY		30-DAY		60-DAY		90-DAY		120-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
1905	17 MAY	9080	16 MAY	8627	15 MAY	7917	14 MAY	6855	01 MAY	6221	01 MAY	4645	01 MAY	3341	01 MAY	2578
1906	28 MAY	26600	27 MAY	23000	05 MAY	19343	10 JUN	18046	26 MAY	17890	27 APR	15852	01 APR	14482	01 APR	12530
1907	15 APR	21000	13 APR	20066	13 APR	18214	11 APR	17373	01 APR	15643	01 APR	13911	01 APR	13007	01 APR	11211
1908	14 APR	7030	12 APR	6610	11 APR	5961	11 APR	5566	11 APR	5121	11 APR	4626	15 MAR	4222	11 MAR	3684
1909	04 MAY	13000	09 MAY	12400	04 MAY	11971	28 APR	11423	18 APR	10690	16 APR	9644	02 APR	8433	02 APR	6917
1910	21 APR	12400	20 APR	12100	21 APR	11928	15 APR	11388	02 APR	10503	29 MAR	9367	29 MAR	7241	29 MAR	5573
1911	06 JUN	23800	11 JUN	24400	10 JUN	23443	05 JUN	22906	22 MAY	20270	23 APR	17201	15 APR	13975	15 APR	10839
1912	02 JUN	11300	02 JUN	10433	30 MAY	9424	25 MAY	8206	09 MAY	7835	24 APR	6102	28 MAR	4903	10 MAR	4106
1913	27 APR	10900	26 APR	9360	23 APR	8041	06 MAY	8158	26 APR	7538	03 APR	6677	22 MAR	5432	03 MAR	4445
1914	20 APR	16000	14 APR	14233	14 APR	13628	04 MAY	12613	03 MAY	11858	05 APR	10740	06 MAR	9796	01 MAR	9039
1915	18 MAY	20600	18 MAY	18433	18 MAY	14971	18 MAY	14387	18 MAY	12425	18 MAY	8027	18 MAY	5595	18 MAY	4264
1916	06 MAY	17000	04 MAY	15900	02 MAY	13957	24 APR	13280	08 APR	12490	28 MAR	11079	28 MAR	9788	28 MAR	7965
1917	14 MAY	15500	13 MAY	14367	09 MAY	13628	04 MAY	12167	06 MAY	10588	01 MAY	9721	01 MAY	7086	01 MAY	5413
1918	23 APR	9600	22 APR	9000	01 MAY	8400	22 APR	8300	16 APR	7080	16 APR	5130	16 APR	3687	16 APR	2801
1919	01 MAY	16200	01 MAY	15667	29 APR	14543	23 APR	12669	18 APR	11265	30 MAR	9736	23 MAR	7535	23 MAR	5767
1920	19 MAY	11400	18 MAY	10800	16 MAY	9997	08 MAY	8309	27 APR	7411	16 APR	6447	16 APR	4753	16 APR	3619
1921	14 MAY	13800	13 MAY	12633	11 MAY	10763	13 MAY	9282	29 APR	8934	18 APR	8300	21 MAR	7924	21 MAR	6566
1922	18 MAY	23200	18 MAY	22167	15 MAY	20814	14 MAY	18260	07 MAY	17297	23 APR	14884	04 APR	11965	04 APR	9327
1923	10 MAY	14900	08 MAY	13833	06 MAY	12357	05 MAY	11877	28 APR	10141	10 APR	9032	10 APR	7342	10 APR	5761
1924	09 APR	2930	09 APR	2780	08 APR	2760	08 APR	2393	08 APR	2246	25 MAR	1798	01 MAR	1471	01 MAR	1161
1925	05 MAY	15500	04 MAY	15033	02 MAY	13486	25 APR	11752	26 APR	10220	20 APR	8405	20 APR	6375	20 APR	4899
1926	14 APR	8960	13 APR	8273	12 APR	7674	12 APR	6603	12 APR	5903	12 APR	4005	12 APR	2830	12 APR	2173
1927	28 APR	17600	25 APR	16433	24 APR	14914	23 APR	12927	21 APR	12107	20 APR	9883	10 APR	8125	10 APR	6333
1928	01 MAY	11800	30 APR	10733	27 APR	9310	28 APR	9037	16 APR	7744	16 APR	5412	16 APR	3853	16 APR	2964
1929	04 MAY	7200	03 MAY	6833	03 MAY	6657	03 MAY	6613	26 APR	6082	29 MAR	4701	23 MAR	4098	17 MAR	3425
1930	14 APR	7580	22 APR	7580	19 APR	6954	13 APR	6351	27 MAR	6003	25 MAR	5286	12 MAR	4759	12 MAR	3977
1931	29 APR	3880	28 APR	3760	27 APR	3543	22 APR	3149	08 APR	2842	20 MAR	2550	20 MAR	2000	20 MAR	1599
1932	12 MAY	14800	11 MAY	14200	11 MAY	13814	08 MAY	12471	01 MAY	10554	16 APR	8762	28 MAR	7984	24 MAR	6718
1933	30 MAY	12700	29 MAY	12067	27 MAY	10803	26 MAY	9153	19 MAY	7876	22 APR	6073	28 MAR	5205	04 MAR	4447
1934	24 APR	3700	07 APR	3340	08 APR	3289	07 APR	3121	07 APR	2905	07 APR	2063	07 APR	1575	07 APR	1227
1935	23 MAY	12700	22 MAY	12633	22 MAY	12143	09 MAY	10796	07 MAY	10674	01 MAY	8306	01 MAY	5900	01 MAY	4495

TABLE 8-5

ANNUAL MAXIMUM SNOWMELT FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	1-DAY		3-DAY		7-DAY		15-DAY		30-DAY		60-DAY		90-DAY		120-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
1936	18 APR	14400	16 APR	14267	16 APR	13643	12 APR	12733	15 APR	11313	10 APR	9846	08 APR	8162	08 APR	6388
1937	15 MAY	15900	13 MAY	15367	12 MAY	13771	03 MAY	12961	19 APR	11173	01 APR	9759	01 APR	7771	01 APR	6062
1938	15 MAY	27200	14 MAY	26400	12 MAY	23114	13 MAY	19420	10 MAY	17790	12 APR	15256	08 APR	12422	08 APR	9706
1939	03 APR	7380	03 APR	7187	03 APR	7014	01 APR	6180	21 MAR	5754	14 MAR	4617	13 MAR	3742	13 MAR	2924
1940	12 MAY	11300	11 MAY	10933	10 MAY	10044	06 APR	9547	06 APR	8849	06 APR	8200	06 APR	6363	06 APR	4932
1941	13 MAY	18000	12 MAY	16767	08 MAY	14785	04 MAY	13626	29 APR	11696	09 APR	9260	09 APR	7383	09 APR	5772
1942	26 MAY	22800	24 MAY	16400	21 MAY	16914	15 MAY	13784	16 MAY	12532	13 APR	11266	09 APR	9980	09 APR	7669
1943	02 MAY	13200	02 MAY	11367	30 APR	10441	30 APR	8754	30 APR	7297	30 APR	5953	30 APR	4435	30 APR	3422
1944	08 MAY	10900	07 MAY	10533	05 MAY	9863	02 MAY	8980	01 MAY	7573	12 APR	5917	11 MAR	5087	09 MAR	4356
1945	04 MAY	13900	03 MAY	13433	02 MAY	13271	28 APR	12500	19 APR	11098	17 APR	8318	01 APR	6867	01 APR	5434
1946	26 APR	13300	25 APR	12633	24 APR	12057	24 APR	11880	16 APR	10822	07 APR	8636	05 APR	6690	05 APR	5182
1947	03 MAY	7900	03 MAY	7583	02 MAY	6913	26 APR	5527	10 APR	10561	16 MAR	4847	16 MAR	4081	16 MAR	3216
1948	27 MAY	14800	25 MAY	13867	13 MAY	11830	13 MAY	11199	06 MAY	10483	11 MAY	7770	11 MAY	5415	11 MAY	4130
1949	15 MAY	14500	23 APR	13633	22 APR	12443	15 APR	11344	17 APR	10046	06 APR	8629	11 MAR	7343	10 MAR	5941
1950	22 APR	14600	21 APR	13867	20 APR	12714	15 MAY	11560	09 MAY	7571	05 APR	9931	26 MAR	8544	26 MAR	6871
1951	11 MAY	10800	10 MAY	9740	10 APR	9215	06 APR	8296	29 APR	7571	30 MAR	7359	12 MAR	6734	12 MAR	5503
1952	28 MAY	21700	27 MAY	20400	23 MAY	19860	18 MAY	19360	08 MAY	18376	13 APR	16845	27 MAR	14699	21 MAR	12446
1953	07 JUN	13200	18 JUN	11967	15 JUN	10340	07 JUN	9610	29 MAY	8492	27 APR	9067	27 APR	7202	27 APR	5539
1954	18 APR	10800	17 APR	10453	17 APR	10123	15 APR	9753	10 APR	8658	11 APR	6417	11 APR	4702	11 APR	3611
1955	09 MAY	10528	21 MAY	10120	07 MAY	9850	09 MAY	8584	05 MAY	7786	16 APR	6400	20 MAR	5320	01 MAR	4512
1956	23 MAY	17396	22 MAY	16161	20 MAY	14779	17 MAY	12964	09 MAY	11370	09 MAY	8368	09 MAY	6019	09 MAY	4626
1957	02 JUN	9995	26 MAY	9615	27 MAY	9343	24 MAY	8781	24 MAY	6423	24 MAY	3812	24 MAY	2635	24 MAY	2014
1958	23 MAY	22827	22 MAY	21374	18 MAY	20727	10 MAY	18459	03 MAY	17154	11 APR	14382	11 APR	11717	11 MAR	12336
1959	06 APR	6260	05 APR	6105	02 APR	5540	31 MAR	5025	02 APR	4631	18 MAR	4036	01 MAR	3675	01 MAR	3056
1960	07 APR	9551	06 APR	9038	05 APR	8539	27 MAR	7978	20 MAR	7106	18 MAR	6040	17 MAR	5153	17 MAR	3984
1961	04 APR	6914	03 APR	6455	02 APR	5417	10 MAY	4926	28 APR	4425	30 MAR	4155	30 MAR	3414	30 MAR	2543
1962	15 APR	13018	14 APR	12273	13 APR	11540	06 APR	10265	11 APR	9814	27 MAR	7908	23 MAR	6731	12 MAR	5530
1963	20 MAY	16430	19 MAY	15249	18 MAY	14510	16 MAY	13051	01 MAY	12493	20 APR	9595	20 APR	6987	20 APR	5305
1964	13 MAY	9205	13 MAY	8967	13 MAY	8886	11 MAY	7987	28 APR	6583	12 APR	5720	22 MAR	4960	01 MAR	4164
1965	30 APR	16190	29 APR	15629	25 APR	14514	23 APR	12192	23 APR	10476	23 APR	8390	23 APR	6381	23 APR	4989
1966	02 APR	8658	01 APR	8414	02 APR	8169	30 MAR	7963	30 MAR	7110	14 MAR	6094	01 MAR	5073	01 MAR	3984
1967	23 MAY	24551	22 MAY	24011	20 MAY	22572	16 MAY	19698	16 MAY	15751	13 MAY	13225	13 MAY	9375	13 MAY	7124
1968	01 APR	6669	01 APR	6349	30 MAR	5745	01 APR	5479	21 MAR	4872	25 MAY	4437	21 MAR	3744	21 MAR	2884
1969	12 MAY	21952	11 MAY	20532	09 MAY	19147	07 MAY	17318	07 MAY	15543	12 APR	13456	25 MAR	11964	11 MAR	9911
1970	19 MAY	8690	18 MAY	7943	16 MAY	7316	16 MAY	6710	04 MAY	5961	08 APR	4868	14 MAR	4784	14 MAR	4086

TABLE 8-5

ANNUAL MAXIMUM SNOWMELT FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	1-DAY		3-DAY		7-DAY		15-DAY		30-DAY		60-DAY		90-DAY		120-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
1971	12 MAY	11931	15 MAY	11615	11 MAY	11454	12 MAY	10058	30 APR	9002	30 APR	8073	01 APR	7748	01 APR	6282
1972	16 MAY	7761	04 MAY	7618	01 MAY	7040	03 MAY	6752	26 APR	6039	26 APR	4791	26 APR	3356	26 APR	2550
1973	14 MAY	14817	14 MAY	14544	14 MAY	14314	11 MAY	12265	26 APR	10690	07 APR	8899	26 MAR	7159	26 MAR	5553
1974	10 MAY	14229	08 MAY	13916	07 MAY	12962	02 MAY	11729	03 MAY	10160	07 APR	9364	07 APR	7707	07 APR	6343
1975	19 MAY	16929	18 MAY	16254	14 MAY	15749	14 MAY	14191	11 MAY	13863	28 APR	10438	28 APR	7670	28 APR	5872
1976	04 MAY	3786	02 MAY	3506	04 MAY	3225	01 MAY	3085	19 APR	2817	19 MAR	2278	07 MAR	1949	07 MAR	1482
1977	10 JUN	2358	27 MAY	2090	22 MAY	1841	14 MAY	1679	06 MAY	1507	07 APR	1343	14 MAR	1152	01 MAR	961
1978	15 MAY	12782	14 MAY	12399	10 MAY	11549	03 MAY	10456	02 MAY	9435	01 MAY	7912	01 MAY	5763	01 MAY	4359
1979	06 MAY	13306	17 MAY	13029	16 MAY	12626	14 MAY	11472	01 MAY	10455	01 MAY	6652	01 MAY	4606	01 MAY	3465
1980	05 MAY	11552	05 MAY	11193	02 MAY	10764	26 APR	10059	14 APR	8813	05 APR	7457	05 APR	6561	16 MAR	5881
1981	25 APR	8432	24 APR	7795	23 APR	6559	19 APR	6173	06 APR	5153	29 MAR	4230	29 MAR	3153	29 MAR	2306
1982	04 MAY	17268	03 MAY	16987	02 MAY	16392	24 APR	15657	19 APR	14255	19 APR	11743	19 APR	9197	19 APR	7088
1983	30 MAY	26398	28 MAY	26061	25 MAY	24714	21 MAY	21704	20 MAY	19857	28 APR	16399	01 APR	14189	01 APR	12273
1984	14 MAY	10722	13 MAY	10307	10 MAY	9352	11 MAY	8354	09 MAY	7672	08 MAY	5245	08 MAY	3638	08 MAY	2774
1985	15 APR	10783	15 APR	10369	11 APR	9493	04 APR	9027	04 APR	7258	01 APR	5784	01 APR	4256	01 APR	3190
1986	01 APR	11845	31 MAR	11716	28 MAR	11051	20 MAR	10617	20 MAR	9012	20 MAR	7701	20 MAR	7125	20 MAR	5718
1987	13 APR	5464	13 APR	4893	26 APR	4540	17 APR	4048	08 APR	3920	04 APR	2941	04 APR	2031	04 APR	1530
1988	18 MAY	2669	01 MAR	2902	01 MAR	2529	12 APR	2377	04 APR	2178	03 APR	1903	02 APR	1460	02 APR	1099
1989	09 APR	12133	07 APR	11926	07 APR	11436	07 APR	10379	07 APR	8154	07 APR	6404	07 APR	4954	07 APR	3766
1990	16 APR	5032	25 MAR	4758	22 MAR	4592	04 APR	4362	20 MAR	4292	17 MAR	3604	17 MAR	3060	17 MAR	2446
1991	07 APR	8722	06 APR	7340	05 APR	6216	22 MAY	5468	07 MAY	5211	06 APR	4902	01 APR	4167	01 APR	3248
1992	02 APR	4794	02 APR	4582	31 MAR	4437	28 MAR	3844	27 MAR	3557	14 MAR	3147	14 MAR	2264	14 MAR	1768
1993	12 MAY	13797	02 MAY	12219	20 MAY	11303	12 MAY	10925	29 APR	10732	15 APR	9044	13 APR	7407	13 APR	5700
1994	11 MAY	5009	02 MAY	2431	02 MAY	2402	02 MAY	3416	28 APR	2727	28 APR	1712	28 APR	1153	28 APR	866
1995	08 APR	20205	07 APR	16470	30 MAY	15903	22 MAY	14930	09 MAY	13308	01 MAY	11972	04 APR	11371	02 APR	9754
1996	03 MAY	11083	01 MAY	10424	27 APR	9904	12 MAY	9324	25 APR	9264	01 APR	8488	04 MAR	8478	01 MAR	7461
1997	28 APR	7485	20 APR	8000	19 APR	7748	17 APR	6636	18 APR	6291	20 MAR	5505	03 MAR	4954	01 MAR	4279
1998	09 JUN	19662	13 JUN	17028	09 JUN	16471	07 JUN	15362	29 MAY	13236	23 APR	12373	02 APR	11100	15 MAR	10202
1999	25 MAY	15652	25 MAY	15167	23 MAY	14500	18 MAY	12125	05 MAY	10534	15 APR	9161	27 MAR	7946	09 MAR	7163
2000	25 MAY	9756	24 MAY	8632	22 MAY	7718	03 APR	7356	28 APR	6915	28 MAR	6772	13 MAR	6262	13 MAR	5062
2001	27 APR	8362	26 APR	7802	26 APR	7050	20 APR	6317	19 APR	5621	20 MAR	4809	13 MAR	3853	13 MAR	2993
2002	15 APR	11200	03 APR	10193	03 APR	9231	02 APR	9119	22 MAR	7496	23 MAR	6776	19 MAR	5967	19 MAR	4707
2003	25 MAY	13366	23 MAY	13043	23 MAY	12098	15 MAY	11347	12 MAY	10042	12 MAY	6224	12 MAY	4298	12 MAY	3316
2004	22 MAR	9854	22 MAR	9470	19 MAR	8656	12 MAR	7796	15 MAR	6930	09 MAR	6143	09 MAR	5159	09 MAR	4071
2005	22 MAY	18645	22 MAY	18280	22 MAY	17609	22 MAY	14309	22 MAY	10613	22 MAY	6944	22 MAY	4803	22 MAY	3704

TABLE 8-5

ANNUAL MAXIMUM SNOWMELT FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	1-DAY		3-DAY		7-DAY		15-DAY		30-DAY		60-DAY		90-DAY		120-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
2006	30 APR	25277	29 APR	24937	27 APR	22761	25 APR	19575	22 APR	18107	27 MAR	16358	01 MAR	14101	01 MAR	12121
2007	17 MAR	7389	17 MAR	7172	14 MAR	6778	13 MAR	5835	12 MAR	5115	13 MAR	4757	08 MAR	4181	08 MAR	3317
2008	16 MAY	8304	16 MAY	8070	13 MAY	6855	06 MAY	6451	23 APR	5640	24 MAR	4854	01 MAR	4254	01 MAR	3592
2009	22 APR	10095	22 APR	9642	19 APR	8268	08 MAY	7260	21 APR	6967	26 MAR	6102	25 MAR	4976	25 MAR	3891
2010	07 JUN	17400	05 JUN	16856	04 JUN	15325	01 JUN	12109	17 MAY	10169	19 APR	9415	30 MAR	8123	27 MAR	6619
COMPUTED STATISTICS																
YEARS		106		106		106		106		106		106		106		106
LOG MEAN		4.066		4.038		4.034		3.967		3.92		3.84		3.744		3.647
STANDARD DEV		0.209		0.214		0.224		0.207		0.205		0.214		0.238		0.248
SKEW COEFF		-0.71		-0.83		-0.95		-0.70		-0.61		-0.60		-0.68		-0.57
ADOPTED STATISTICS																
EQUIVALENT YRS		106		106		106		106		106		106		106		106
LOG MEAN		4.066		4.038		4.034		3.967		3.92		3.84		3.744		3.647
STANDARD DEV		0.209		0.214		0.224		0.207		0.205		0.214		0.238		0.248
SKEW COEFF		-0.71		-0.70		-0.69		-0.65		-0.61		-0.60		-0.58		-0.57

TABLE 8-6

ANNUAL MAXIMUM RAIN FLOOD FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
1905	19 MAR	24200	19 MAR	21200	19 MAR	13690	19 MAR	10309	17 MAR	8547	04 MAR	6433
1906	19 JAN	59700	19 JAN	44500	17 JAN	36700	14 JAN	23854	22 MAR	18560	7 MAR	15386
1907	19 MAR	156000	19 MAR	105000	19 MAR	87833	17 MAR	65914	17 MAR	41847	1 MAR	25081
1908	27 DEC	10300	27 DEC	8460	22 JAN	6183	21 JAN	4974	21 JAN	3666	27 DEC	2956
1909	14 JAN	119000	14 JAN	98000	14 JAN	87167	14 JAN	59114	12 JAN	41520	14 JAN	28949
1910	2 DEC	81300	2 DEC	47000	1 DEC	23713	30 DEC	18157	21 NOV	13649	21 NOV	10991
1911	31 JAN	94950	31 JAN	69100	30 JAN	57300	29 JAN	36100	24 JAN	25493	11 JAN	19139
1912	2 JUN	5814	7 MAR	4490	6 MAR	3263	6 MAR	2653	6 MAR	2320	20 FEB	1633
1913	10 MAY	10771	7 NOV	8210	6 NOV	6597	6 NOV	4023	15 JAN	2468	15 JAN	1868
1914	1 JAN	74100	1 JAN	57700	24 JAN	41933	22 JAN	33571	14 JAN	22391	31 DEC	18323
1915	12 MAY	39900	2 FEB	23100	1 FEB	17800	1 FEB	11066	31 JAN	9937	1 FEB	8975
1916	20 MAR	40700	20 MAR	33200	20 MAR	25633	18 MAR	19029	11 MAR	15593	27 FEB	13694
1917	25 FEB	42300	25 FEB	37600	24 FEB	27033	21 FEB	22200	19 FEB	13758	20 FEB	8948
1918	10 APR	14928	12 MAR	11300	26 MAR	8467	26 MAR	7761	12 MAR	5867	11 MAR	6007
1919	11 FEB	67500	11 FEB	45000	10 FEB	26067	10 FEB	14890	9 FEB	9031	9 FEB	7429
1920	16 APR	15100	16 APR	18800	15 APR	12833	15 APR	9486	10 APR	7345	22 MAR	5724
1921	18 JAN	39200	18 JAN	32800	18 JAN	22400	18 JAN	14086	18 JAN	10867	5 MAR	8877
1922	18 MAY	31600	18 MAY	22200	18 FEB	17533	18 FEB	11699	18 FEB	8890	9 FEB	7224
1923	13 DEC	39000	13 DEC	29800	12 DEC	23433	11 DEC	15964	6 DEC	9565	7 DEC	7382
1924	8 FEB	14000	8 FEB	10600	7 FEB	7357	7 FEB	4490	7 FEB	2913	6 FEB	1996
1925	6 FEB	99500	6 FEB	68200	5 FEB	40233	5 FEB	24323	5 FEB	15867	5 FEB	10887
1926	6 APR	27400	6 APR	22700	6 APR	18467	5 APR	14346	29 MAR	8447	14 MAR	5949
1927	21 FEB	67700	21 FEB	48200	21 FEB	38667	18 FEB	29257	15 FEB	20482	15 FEB	14049
1928	25 MAR	163000	25 MAR	119000	25 MAR	98167	24 MAR	58686	23 MAR	33980	23 MAR	21349
1929	4 FEB	19667	4 FEB	14800	4 FEB	7893	3 FEB	4469	2 FEB	2679	2 FEB	1778
1930	5 MAR	24400	5 MAR	18800	4 MAR	13703	4 MAR	9033	4 MAR	6162	18 FEB	4581
1931	19 MAR	9900	19 MAR	7920	19 MAR	5390	18 MAR	4240	12 MAR	3124	2 MAR	2179
1932	7 FEB	21100	7 FEB	18900	7 FEB	16333	6 FEB	12381	31 JAN	8229	31 JAN	5740
1933	30 MAY	6437	17 MAR	4960	17 MAR	3743	13 MAR	3160	17 MAR	2889	2 MAR	2371
1934	2 JAN	22600	2 JAN	13300	1 JAN	10367	30 DEC	7203	29 DEC	4472	29 DEC	2994
1935	8 APR	52900	8 APR	49300	8 APR	29133	4 APR	19486	8 APR	16453	3 APR	13836

TABLE 8-6

ANNUAL MAXIMUM RAIN FLOOD FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
1936	22 FEB	58300	22 FEB	46400	22 FEB	34367	21 FEB	23486	12 FEB	21653	12 FEB	14822
1937	14 FEB	33000	14 FEB	22500	5 FEB	17733	4 FEB	10226	12 MAR	8945	12 MAR	7919
1938	11 DEC	114000	11 DEC	81100	10 DEC	47467	10 DEC	24997	13 MAR	16967	13 MAR	13361
1939	9 MAR	10900	9 MAR	8500	9 MAR	5647	9 MAR	3889	1 MAR	2543	14 FEB	2000
1940	30 MAR	89200	30 MAR	69600	30 MAR	53533	27 MAR	38629	26 MAR	24367	26 MAR	16880
1941	11 FEB	38800	11 FEB	26900	11 FEB	21267	10 FEB	15209	10 FEB	11861	10 FEB	10921
1942	27 JAN	83200	27 JAN	54600	26 JAN	40267	25 JAN	28029	25 JAN	23436	24 JAN	15510
1943	22 JAN	152000	22 JAN	73800	21 JAN	52967	9 MAR	33457	6 MAR	22925	6 MAR	16024
1944	4 MAR	20100	4 MAR	12400	4 MAR	9227	29 FEB	7851	29 FEB	5756	29 FEB	4382
1945	2 FEB	94400	2 FEB	70900	2 FEB	40733	1 FEB	23661	1 FEB	14983	1 FEB	9738
1946	22 DEC	42200	22 DEC	32400	28 DEC	25533	22 DEC	22086	22 DEC	18041	21 DEC	11576
1947	13 FEB	27900	13 FEB	20100	12 FEB	12410	12 FEB	7654	10 MAR	5867	10 MAR	5297
1948	18 APR	21000	8 JAN	14400	8 JAN	9143	3 JAN	7180	3 JAN	4763	3 JAN	2988
1949	3 MAR	37500	3 MAR	25500	3 MAR	15647	2 MAR	9109	3 MAR	7415	2 MAR	6035
1950	6 FEB	34400	6 FEB	22800	22 JAN	20067	18 JAN	13923	17 JAN	9811	17 JAN	8948
1951	21 NOV	180000	21 NOV	132000	19 NOV	107500	18 NOV	61757	18 NOV	31688	18 NOV	30557
1952	2 FEB	37200	2 FEB	30500	2 FEB	20800	12 JAN	16593	12 JAN	12749	12 JAN	12008
1953	28 APR	48400	10 JAN	17900	19 JAN	15233	9 JAN	12463	9 JAN	11609	7 JAN	8004
1954	10 MAR	42600	10 MAR	36500	9 MAR	26100	9 MAR	16126	9 MAR	10651	9 MAR	8919
1955	9 MAY	10800	2 JAN	8710	1 JAN	6777	4 DEC	4443	3 DEC	3277	31 DEC	2694
1956	23 DEC	219000	23 DEC	189073	22 DEC	127450	21 DEC	70984	19 DEC	40608	19 DEC	28223
1957	25 FEB	42000	25 FEB	31117	24 FEB	21043	23 FEB	14303	24 FEB	13393	22 FEB	9654
1958	3 APR	54000	3 APR	42302	1 APR	33635	30 MAR	25279	21 MAR	19005	21 MAR	15438
1959	17 FEB	20000	17 FEB	15394	17 FEB	12262	16 FEB	8854	16 FEB	5875	16 FEB	4586
1960	8 FEB	75000	8 FEB	63014	8 FEB	34802	8 FEB	18198	2 FEB	10095	8 FEB	7154
1961	4 APR	8000	11 FEB	5954	10 FEB	5760	10 FEB	4064	1 FEB	2970	31 JAN	2297
1962	10 FEB	40000	10 FEB	35216	14 FEB	20717	10 FEB	19671	9 FEB	12694	9 FEB	8754
1963	1 FEB	240000	1 FEB	152614	31 JAN	93881	31 JAN	49107	31 JAN	26738	30 JAN	15499
1964	15 NOV	24000	15 NOV	17002	20 JAN	9561	19 JAN	6447	19 JAN	4554	18 JAN	3403
1965	23 DEC	260000	23 DEC	183242	22 DEC	140371	21 DEC	87834	21 DEC	50629	20 DEC	33147
1966	2 APR	6500	19 NOV	6231	29 DEC	5433	28 DEC	3829	28 DEC	3626	25 DEC	2701
1967	17 MAR	46000	17 MAR	36197	16 MAR	29825	16 MAR	20067	16 MAR	13856	16 MAR	10941
1968	21 FEB	30000	21 FEB	24697	20 FEB	22341	20 FEB	17942	18 FEB	12405	17 FEB	8708
1969	21 JAN	120000	21 JAN	83526	20 JAN	71862	20 JAN	49450	19 JAN	32444	19 JAN	21017
1970	22 JAN	122000	22 JAN	88316	21 JAN	68756	17 JAN	49561	14 JAN	38627	10 JAN	23500

TABLE 8-6

ANNUAL MAXIMUM RAIN FLOOD FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
1971	26 MAR	48000	26 MAR	34047	26 MAR	25337	26 MAR	16884	25 MAR	12270	24 MAR	9915
1972	4 MAR	12000	4 MAR	10046	4 MAR	9585	4 MAR	8824	4 MAR	8471	25 FEB	7823
1973	12 JAN	69000	12 JAN	49291	12 JAN	31181	12 JAN	25659	9 JAN	16754	12 JAN	11074
1974	17 JAN	55000	17 JAN	40631	17 JAN	35520	15 JAN	28113	13 JAN	18103	27 DEC	14662
1975	25 MAR	46000	25 MAR	30037	25 MAR	20826	22 MAR	13482	21 MAR	9622	7 MAR	7604
1976	27 OCT	15000	27 OCT	10389	26 OCT	5970	26 OCT	3656	27 OCT	2449	26 OCT	2151
1977	22 FEB	2500	22 FEB	1717	22 FEB	1548	19 FEB	952	18 FEB	754	20 FEB	662
1978	17 JAN	40000	17 JAN	31170	15 JAN	25754	14 JAN	18782	5 JAN	13963	28 DEC	10212
1979	12 JAN	33000	12 JAN	18301	11 JAN	15618	11 JAN	9677	15 FEB	6875	16 FEB	6475
1980	14 JAN	175000	14 JAN	124915	13 JAN	97778	12 JAN	63759	10 JAN	35359	31 DEC	20411
1981	26 MAR	20000	26 MAR	15531	25 MAR	11169	22 MAR	7779	14 MAR	5704	27 FEB	3979
1982	16 FEB	152000	16 FEB	113126	15 FEB	78853	15 FEB	45266	14 FEB	27422	14 FEB	19741
1983	13 MAR	93000	13 MAR	68791	13 MAR	48643	12 MAR	31052	1 MAR	24340	26 FEB	19820
1984	26 DEC	88000	26 DEC	65182	25 DEC	54042	25 DEC	36951	24 DEC	23893	10 DEC	17196
1985	8 FEB	17000	8 FEB	13473	8 FEB	8445	8 FEB	5307	8 FEB	3554	8 FEB	3065
1986	18 FEB	255000	18 FEB	170960	17 FEB	165653	15 FEB	101105	14 FEB	56303	14 FEB	39115
1987	14 FEB	15455	14 FEB	11690	13 FEB	10141	12 FEB	6240	5 MAR	4803	5 MAR	3805
1988	17 JAN	7083	17 JAN	5447	16 JAN	4456	11 JAN	3861	4 JAN	3628	4 JAN	2814
1989	25 MAR	45935	25 MAR	33949	9 MAR	26229	8 MAR	21044	7 MAR	15139	8 MAR	14900
1990	31 MAY	8497	4 MAR	6509	3 MAR	6015	2 MAR	4640	26 FEB	3958	15 FEB	3082
1991	5 MAR	36849	5 MAR	27362	4 MAR	19336	2 MAR	10317	2 MAR	6570	2 MAR	5476
1992	20 FEB	17587	20 FEB	13266	20 FEB	11813	19 FEB	8191	15 FEB	6335	12 FEB	5078
1993	22 JAN	46342	22 JAN	34244	21 JAN	28018	20 JAN	17988	15 MAR	15583	14 MAR	12707
1994	20 APR	6226	20 APR	4801	19 APR	4572	16 APR	4208	15 APR	3438	29 MAR	3115
1995	11 MAR	93771	11 MAR	68260	10 MAR	55301	10 MAR	38877	9 MAR	30706	3 MAR	21213
1996	16 MAY	73960	05 FEB	54111	4 FEB	37252	4 FEB	23414	4 FEB	15845	4 FEB	14427
1997	2 JAN	300000	2 JAN	252431	1 JAN	165893	30 DEC	92847	27 DEC	50296	30 DEC	34346
1998	3 FEB	56016	3 FEB	41226	24 MAR	31015	3 FEB	22359	2 FEB	16896	12 JAN	14164
1999	9 FEB	69852	9 FEB	51168	8 FEB	35652	7 FEB	23792	7 FEB	18440	7 FEB	14498
2000	14 FEB	67061	14 FEB	49166	13 FEB	34648	12 FEB	23588	14 FEB	16477	11 FEB	13260
2001	27 APR	6244	05 MAR	4815	23 FEB	3943	19 FEB	3389	20 FEB	3120	11 FEB	2763
2002	7 MAR	21015	7 MAR	15792	7 MAR	11789	6 MAR	8744	1 MAR	6454	17 FEB	6166
2003	13 APR	21282	13 APR	15988	13 APR	12207	4 MAY	9873	25 APR	9320	12 APR	8528
2004	26 FEB	20972	26 FEB	15760	25 FEB	11624	25 FEB	8380	17 FEB	7703	7 FEB	5215
2005	19 MAY	50226	19 MAY	37050	19 MAY	32841	15 MAY	24441	7 MAY	17706	22 APR	13047

TABLE 8-6

ANNUAL MAXIMUM RAIN FLOOD FLOWS
AMERICAN RIVER AT FAIR OAKS
UNREGULATED CONDITION
(Flows in cfs)

WATER YEAR[1]	PEAK		1-DAY		3-DAY		7-DAY		15-DAY		30-DAY	
	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW	DATE	FLOW
2006	31 DEC	190111	31 DEC	136327	31 DEC	83388	28 DEC	51085	22 DEC	33312	22 DEC	20733
2007	11 FEB	33522	11 FEB	24942	10 FEB	16373	10 FEB	9647	9 FEB	6121	6 FEB	5043
2008	16 MAY	10710	5 JAN	8164	4 JAN	5340	4 JAN	3747	3 JAN	2585	5 JAN	2327
2009	3 MAR	40419	3 MAR	29954	2 MAR	23125	2 MAR	14864	23 FEB	12598	23 FEB	8832
2010	27 FEB	12502	27 FEB	9499	27 FEB	7470	27 FEB	6214	24 FEB	5051	25 FEB	4455
2011	19 DEC	62669	19 DEC	46012	18 DEC	36984	18 DEC	23540	15 DEC	17192	7 DEC	12554
COMPUTED STATISTICS												
YEARS		107		107		107		107		107		107
LOG MEAN		4.582		4.452		4.323		4.162		4.108		3.903
STANDARD DEV		0.430		0.421		0.414		0.395		0.371		0.354
SKEW COEFF		-0.15		-0.09		-0.02		-0.05		-0.08		-0.20
ADOPTED STATISTICS												
EQUIVALENT YRS		107		107		107		107		107		107
LOG MEAN		4.596		4.461		4.331		4.17		4.027		3.911
STANDARD DEV		0.416		0.402		0.397		0.376		0.352		0.336
SKEW COEFF		-0.005		0.023		0.05		0.045		-0.077		-0.198

- DRAFT -

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

U.S. Army Corps of Engineers
Sacramento District
Revised September 2017

PLATES

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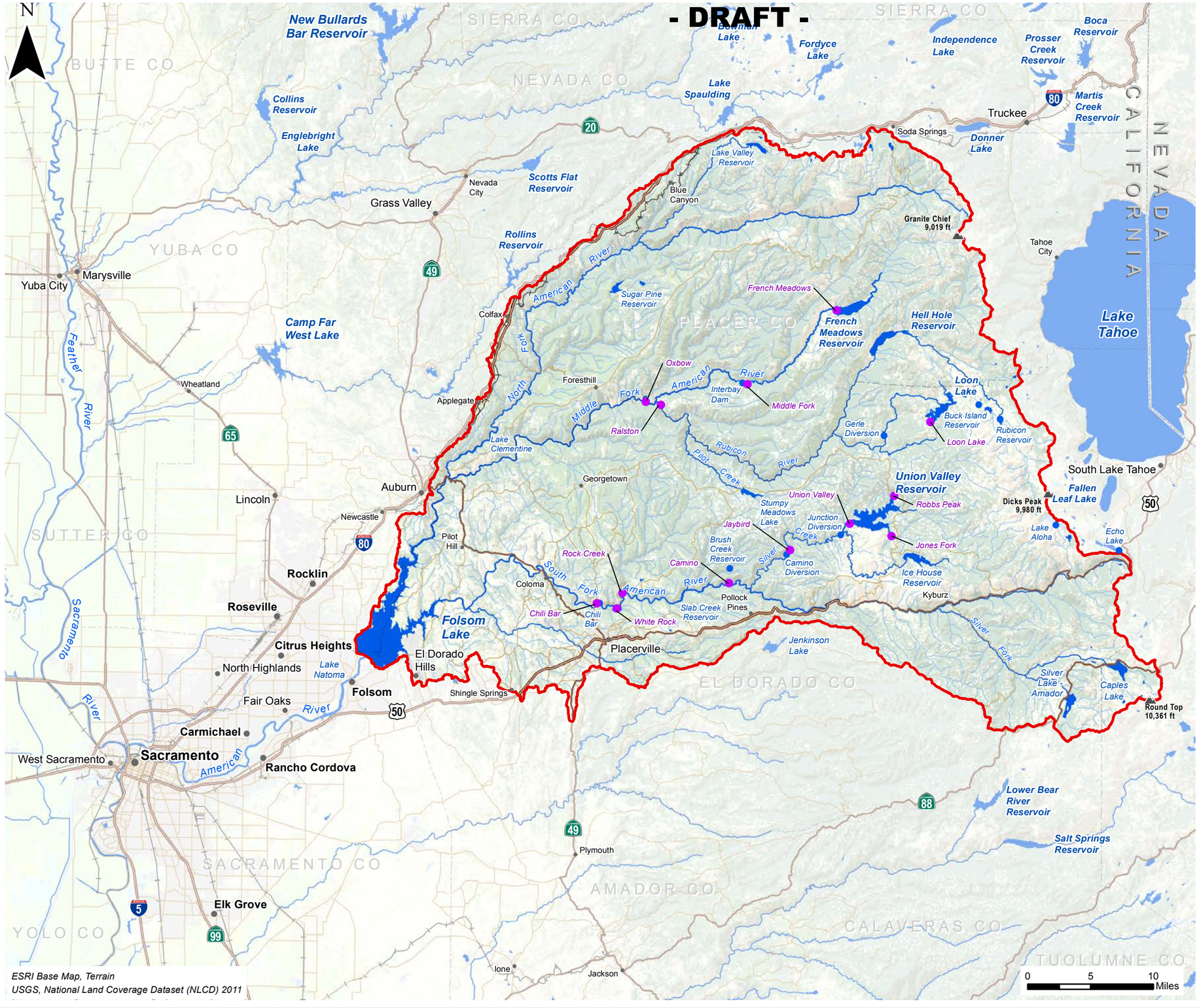

ESRI Base Map, Terrain
USGS, National Land Coverage Dataset (NLCD) 2011

MAP LEGEND

- Project Watershed
- Lake or Reservoir
- Multi-Lane Highway
- Highway
- Primary Road
- Railroad
- County Boundary
- City or Town
- Hydro Powerplant
- Mountain Peak

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

GENERAL MAP

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by J.S.M

Revised September 2017

PLATE 2-1

PLATE 2-2 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

PLATE 2-3 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

PLATE 2-4 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

PLATE 2-5 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

PLATE 2-6 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

PLATE 2-7 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

PLATE 2-8 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

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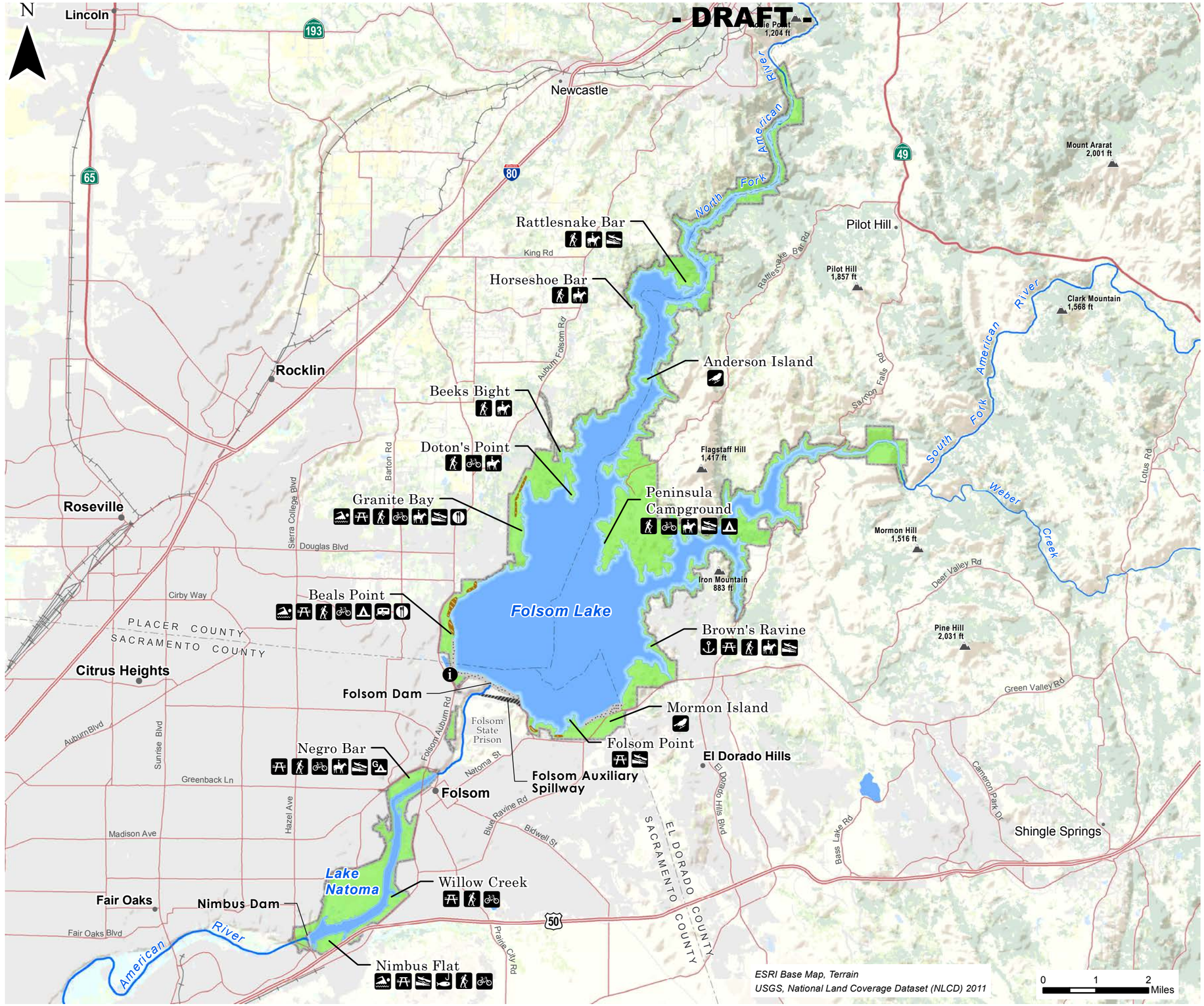
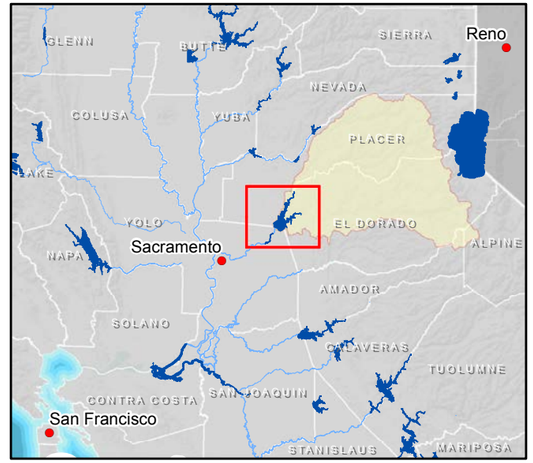




MAP LEGEND

- Recreation Boundary
- Lake or Reservoir
- River or Stream
- City or Town
- Mountain Peak
- Multi-Lane Highway
- Highway
- Primary Road
- Railroad
- County Boundary

Recreation Types

- Information Center
- Swimming
- Picnic Area
- Refreshments
- Hiking
- Bike Trails
- Horse Trails
- Boat Ramp
- Marina
- Fishing
- Campground
- Group Camping
- Trailer/RV Camping
- Natural Preserve

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

REAL ESTATE AND RECREATION

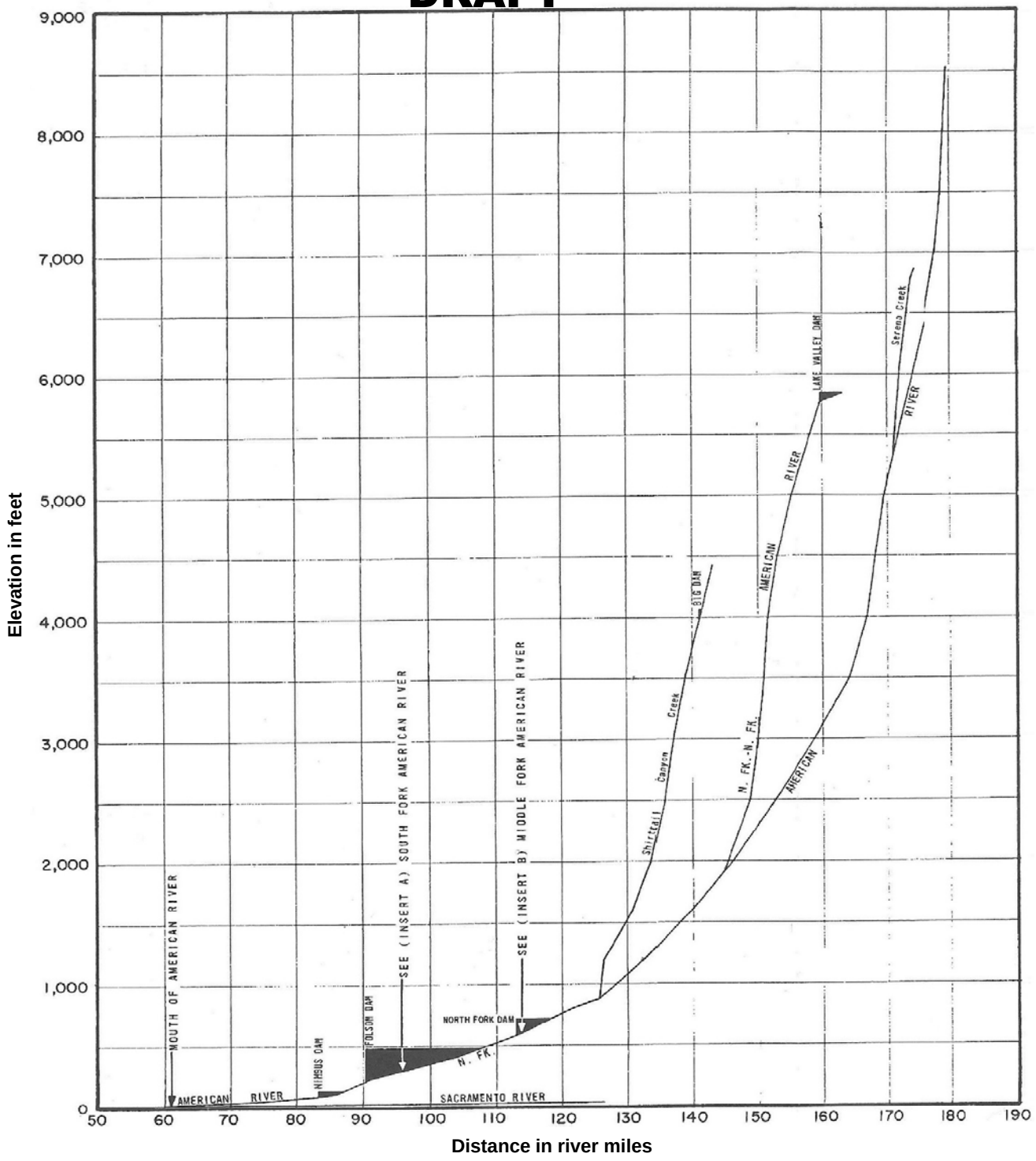
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by J.S.M

Revised September 2017

PLATE 2-9

PLATE 4-1 IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

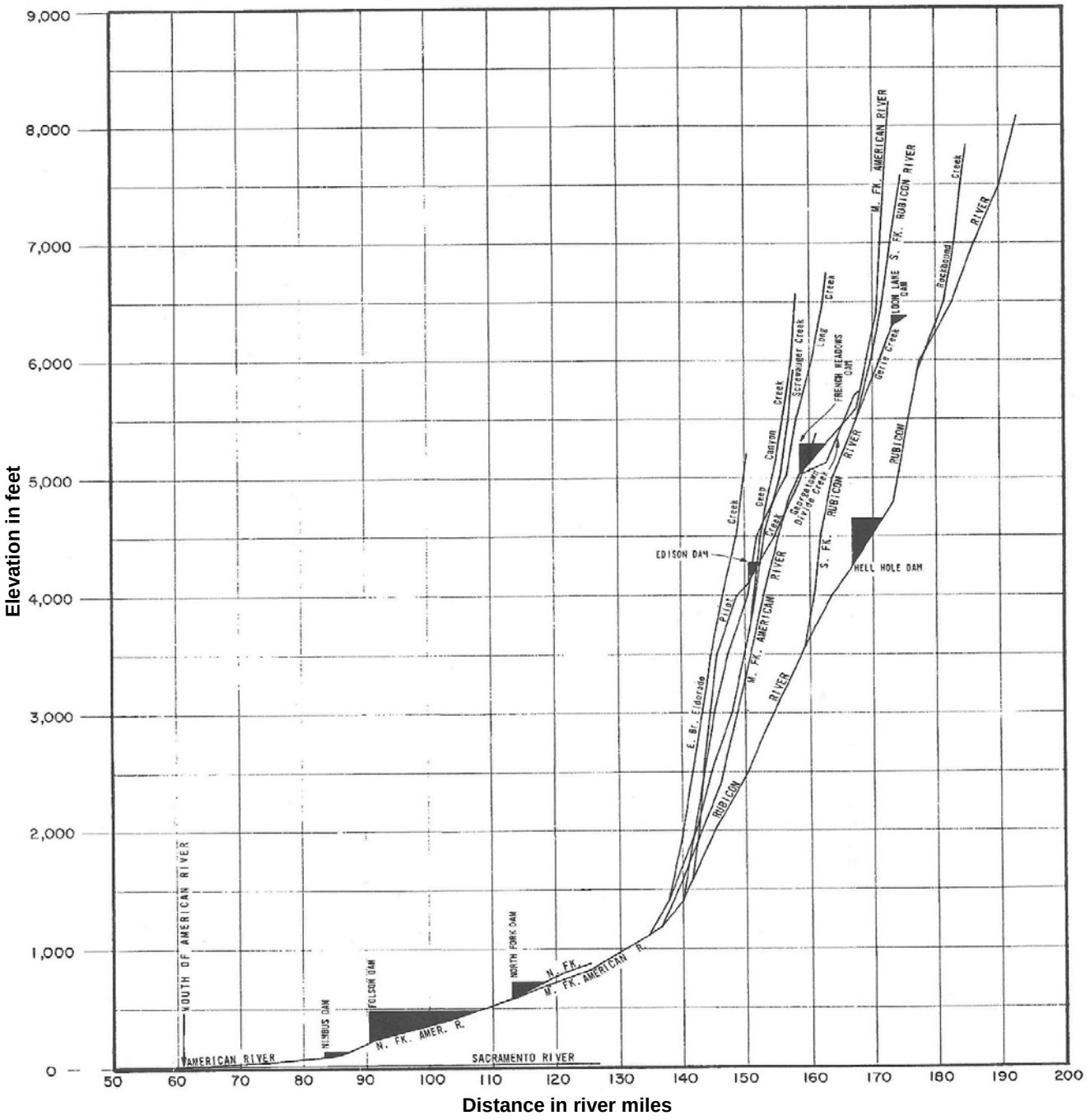


Note: Elevations are in vertical datum NGVD29.
To convert to NAVD88, add 2.34 feet.

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

STREAM PROFILES: NORTH FORK AMERICAN RIVER

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

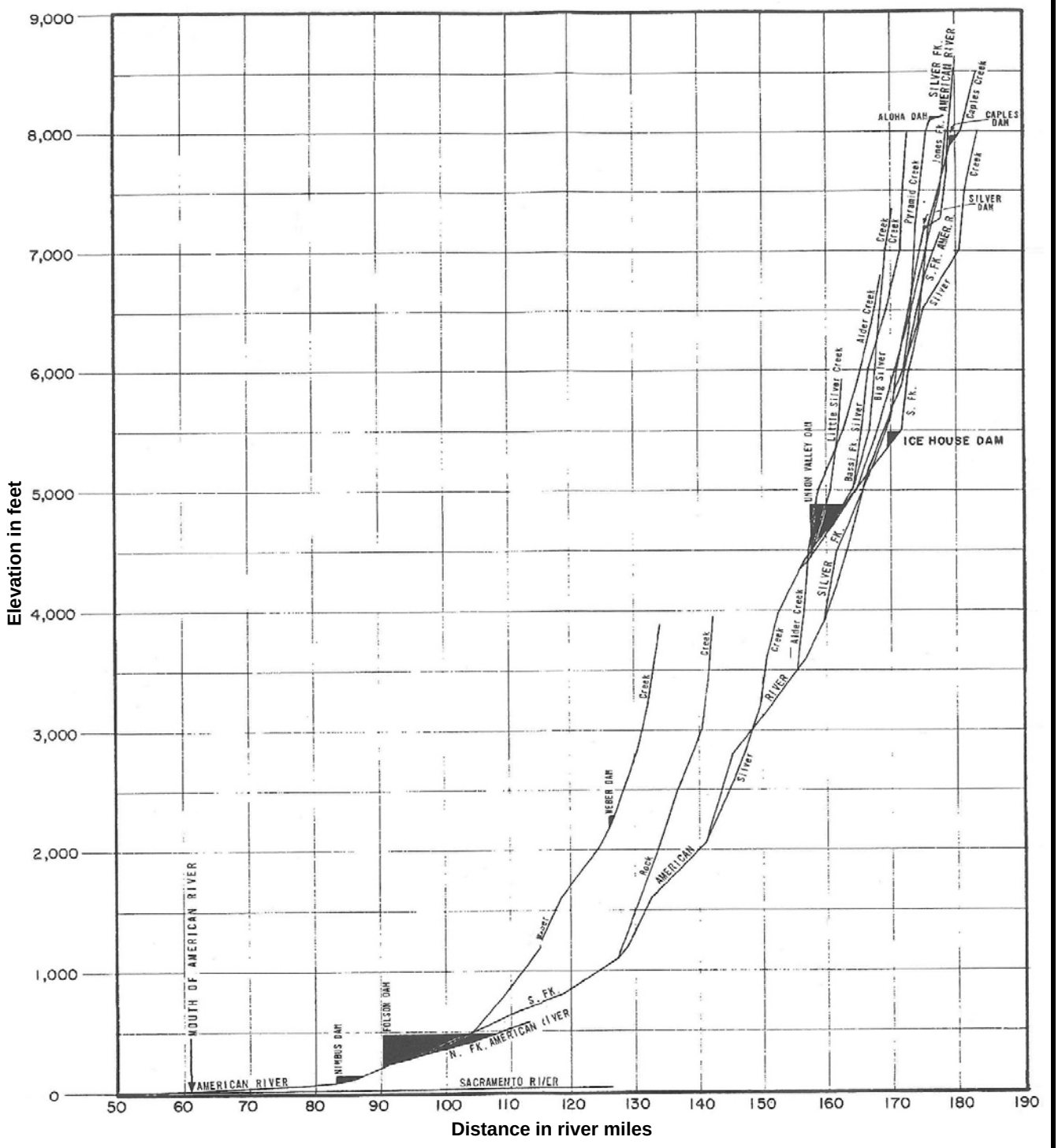


Note: Elevations are in vertical datum NGVD29.
To convert to NAVD88, add 2.34 feet.

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

STREAM PROFILES: MIDDLE FORK AMERICAN RIVER

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

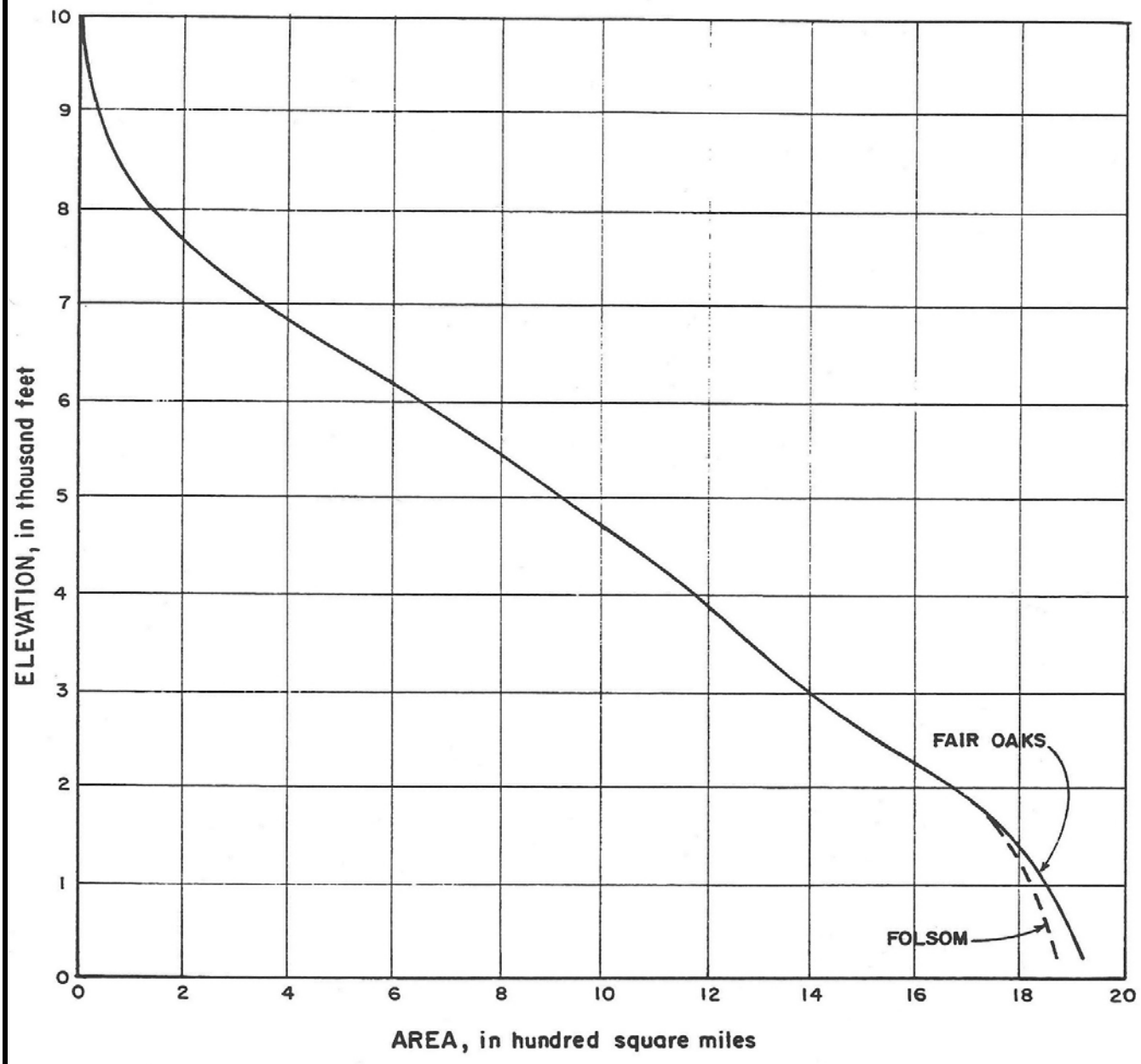


Note: Elevations are in vertical datum NGVD29.
To convert to NAVD88, add 2.34 feet.

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

STREAM PROFILES: SOUTH FORK AMERICAN RIVER

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

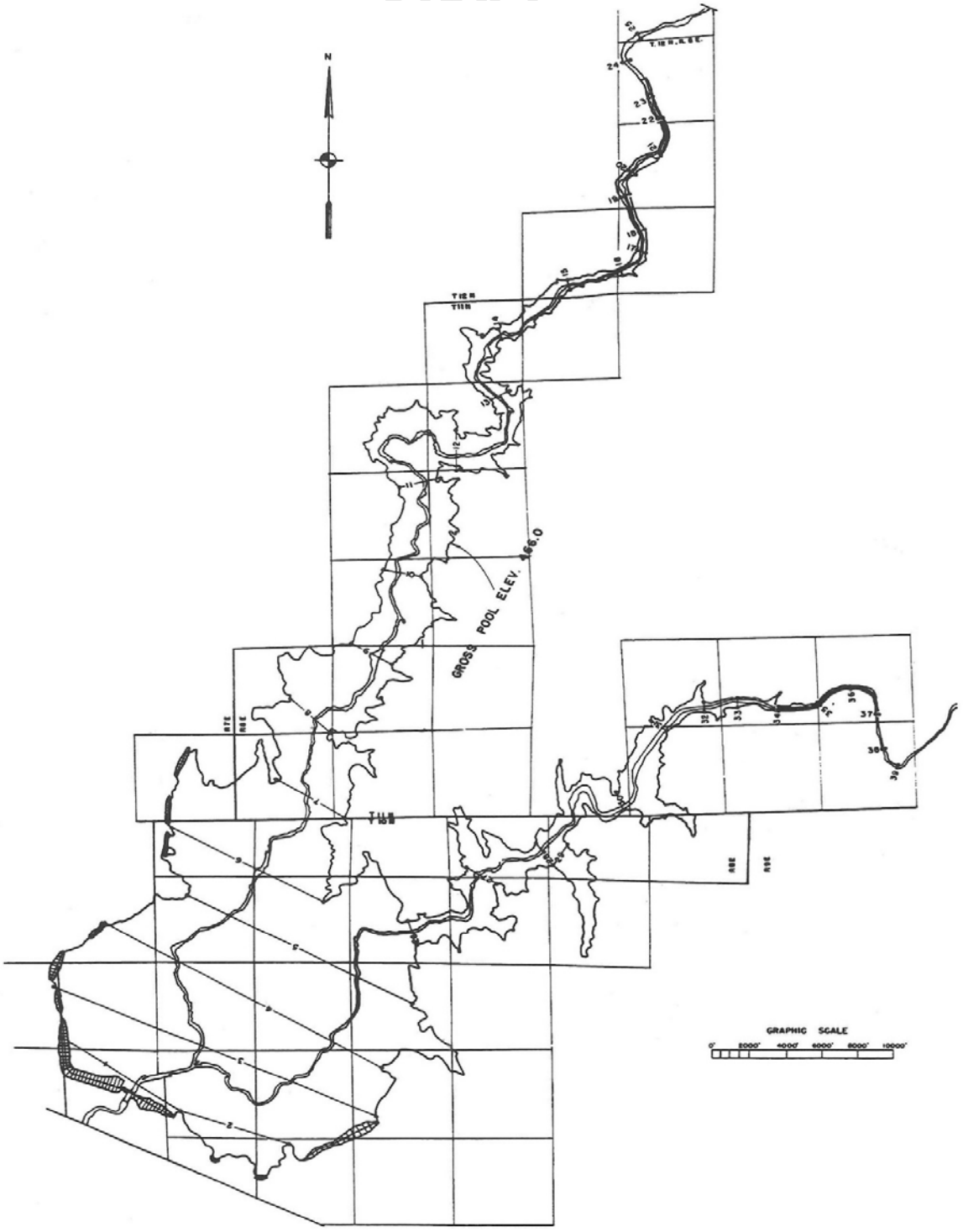


Note: Elevations are in vertical datum NGVD29.
To convert to NAVD88, add 2.34 feet.

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

AREA-ELEVATION CURVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



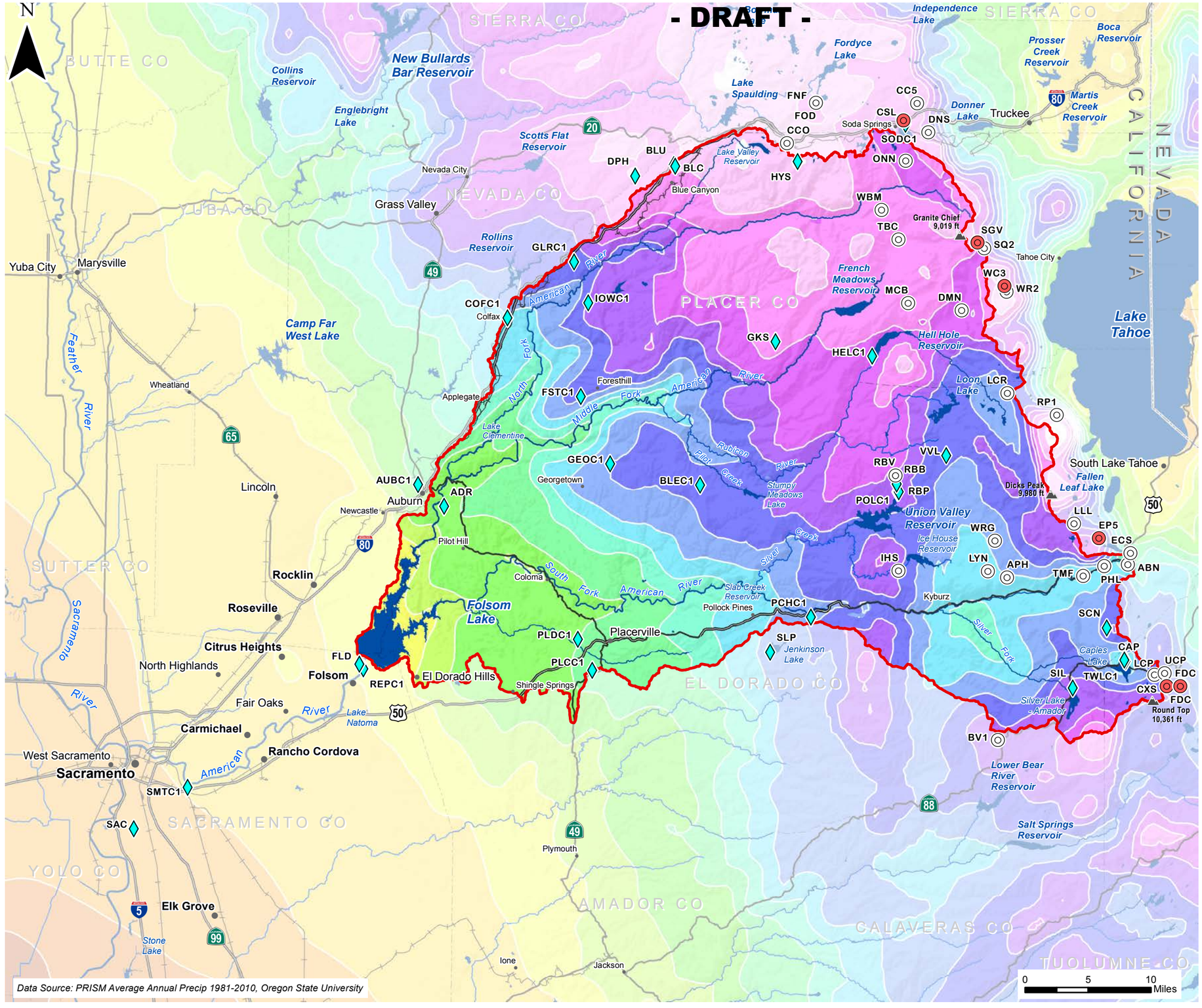
Note: Elevations are in vertical datum NGVD29.
To convert to NAVD88, add 2.34 feet.

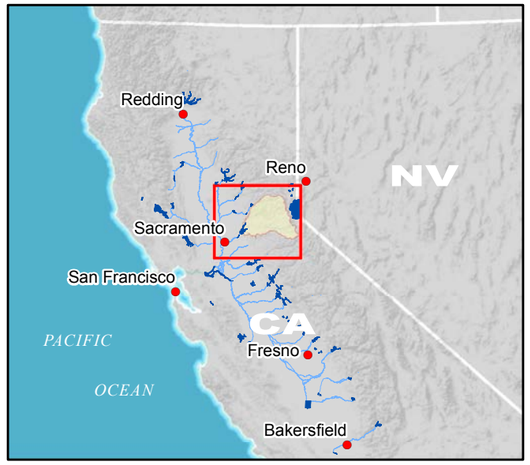
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

SEDIMENTATION RANGES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -





MAP LEGEND

- Project Watershed
- Lake or Reservoir
- River or Stream
- City or Town
- Mountain Peak
- Multi-Lane Highway
- Highway
- Railroad
- County Boundary

Average Annual Precipitation in Inches:

less than 14	28 - 32	52 - 56
14 - 16	32 - 36	56 - 60
16 - 18	36 - 40	60 - 64
18 - 20	40 - 44	64 - 70
20 - 24	44 - 48	70 - 80
24 - 28	48 - 52	greater than 80

Climate Sensor Types:

- Climate Station
- SNOTEL Site
- Snow Course

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

NORMAL ANNUAL PRECIPITATION CLIMATOLOGICAL STATIONS AND SNOW COURSES

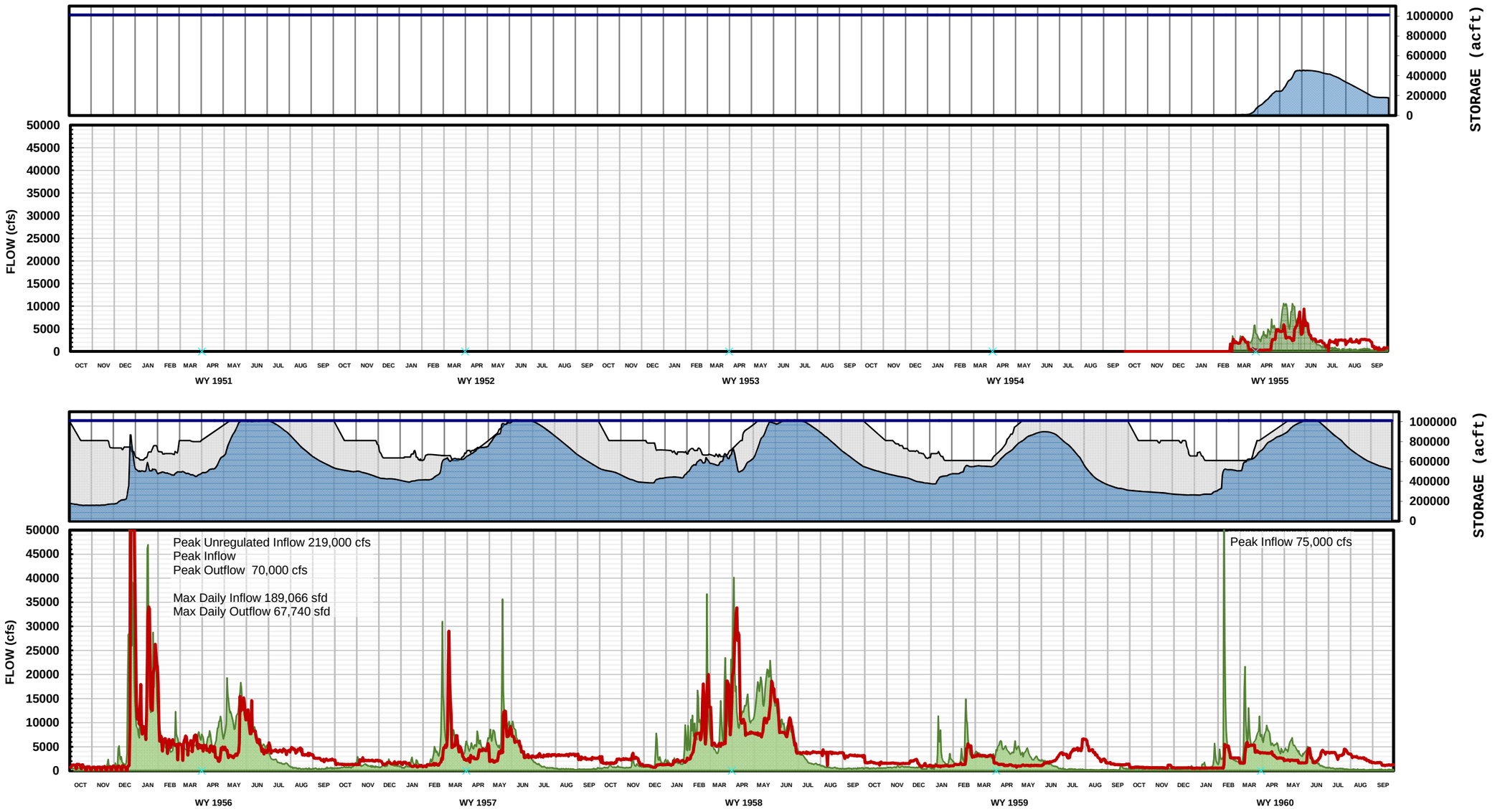
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by J.S.M

Revised September 2017 SHEET 1 OF 2 PLATE 4-5

PLATE 4-5, SHEET 2, IS NOT AVAILABLE IN THIS VERSION OF THE MANUAL

- DRAFT -



NOTE:
Prior to 17 January 1992, historical storage values shown are per the Elevation-Capacity Table dated 1955. Datum is mean sea level.
Thereafter, historical storage values shown are per the Elevation-Capacity Table dated 1992. Datum is mean sea level.

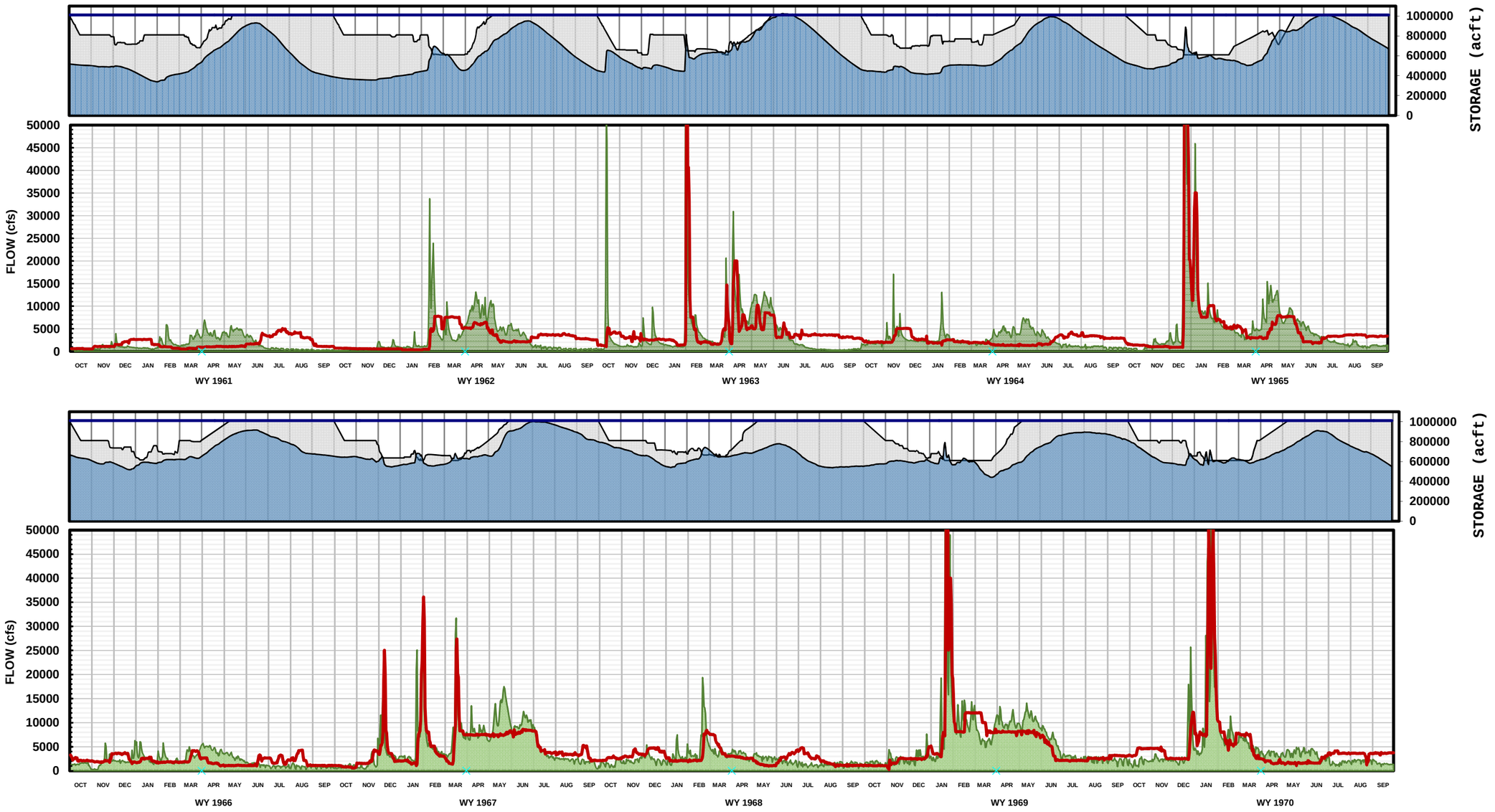
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



NOTE:
Prior to 17 January 1992, historical storage values shown are per the Elevation-Capacity Table dated 1955. Datum is mean sea level.
Thereafter, historical storage values shown are per the Elevation-Capacity Table dated 1992. Datum is mean sea level.

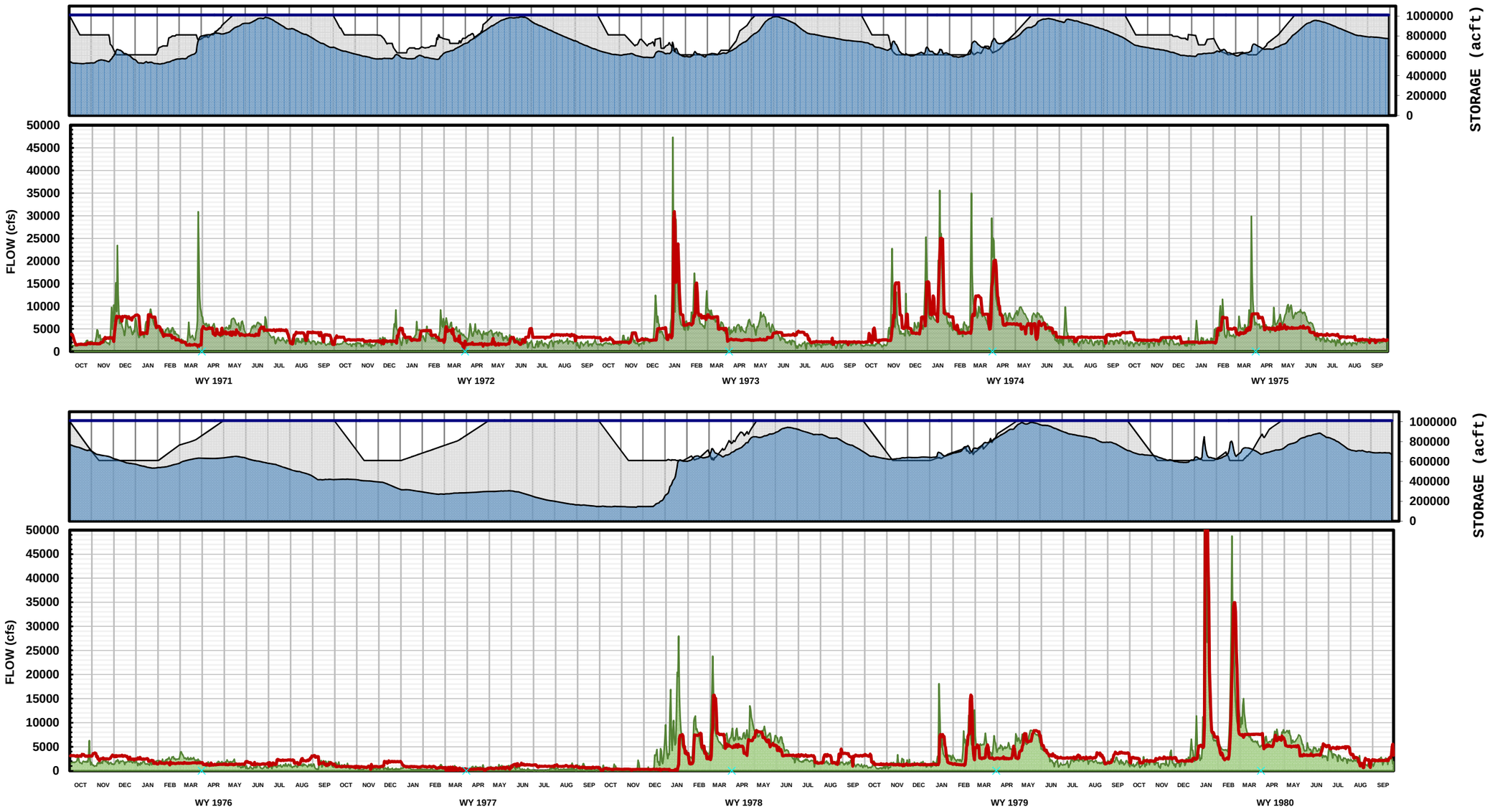
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



Inflow
Outflow
Top of Conservation Storage
Storage
Gross Pool

NOTE:
Prior to 17 January 1992, historical storage values shown are per the Elevation-Capacity Table dated 1955. Datum is mean sea level.
Thereafter, historical storage values shown are per the Elevation-Capacity Table dated 1992. Datum is mean sea level.

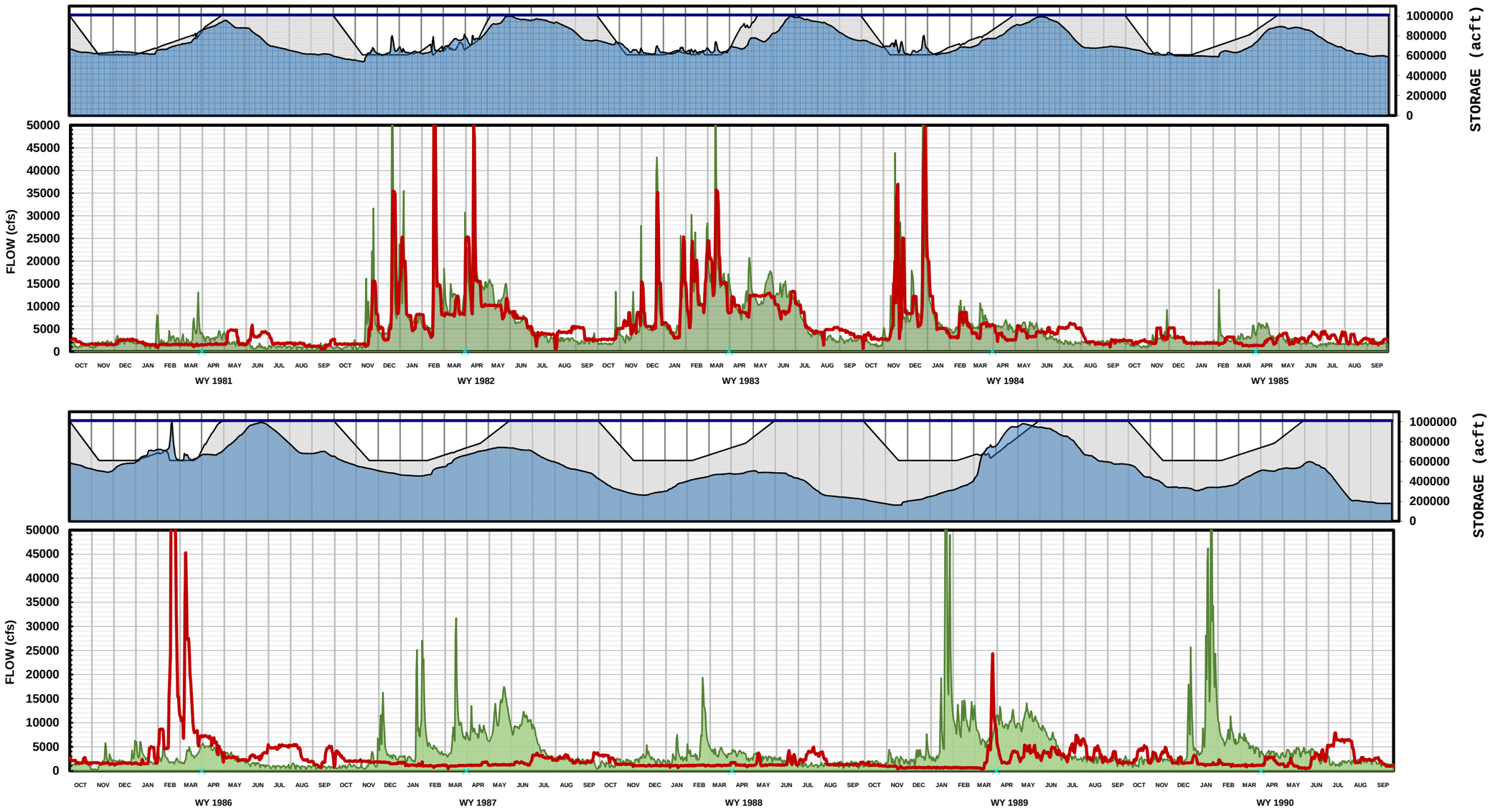
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



Inflow
Outflow
Top of Conservation Storage
Storage
Gross Pool

NOTE:
Prior to 17 January 1992, historical storage values shown are per the Elevation-Capacity Table dated 1955. Datum is mean sea level.
Thereafter, historical storage values shown are per the Elevation-Capacity Table dated 1992. Datum is mean sea level.

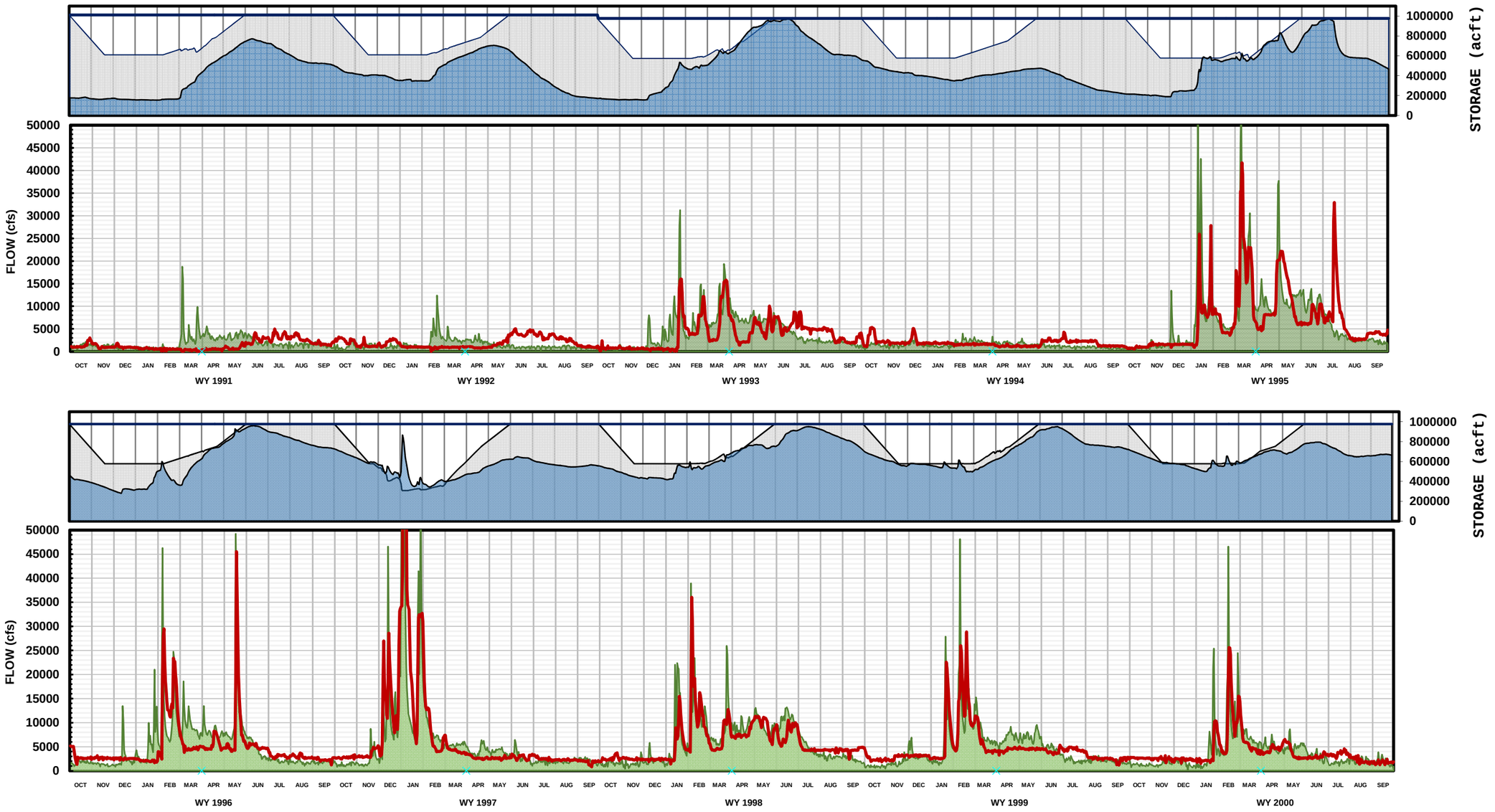
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



NOTE:
Prior to 17 January 1992, historical storage values shown are per the Elevation-Capacity Table dated 1955. Datum is mean sea level.
Thereafter, historical storage values shown are per the Elevation-Capacity Table dated 1992. Datum is mean sea level.

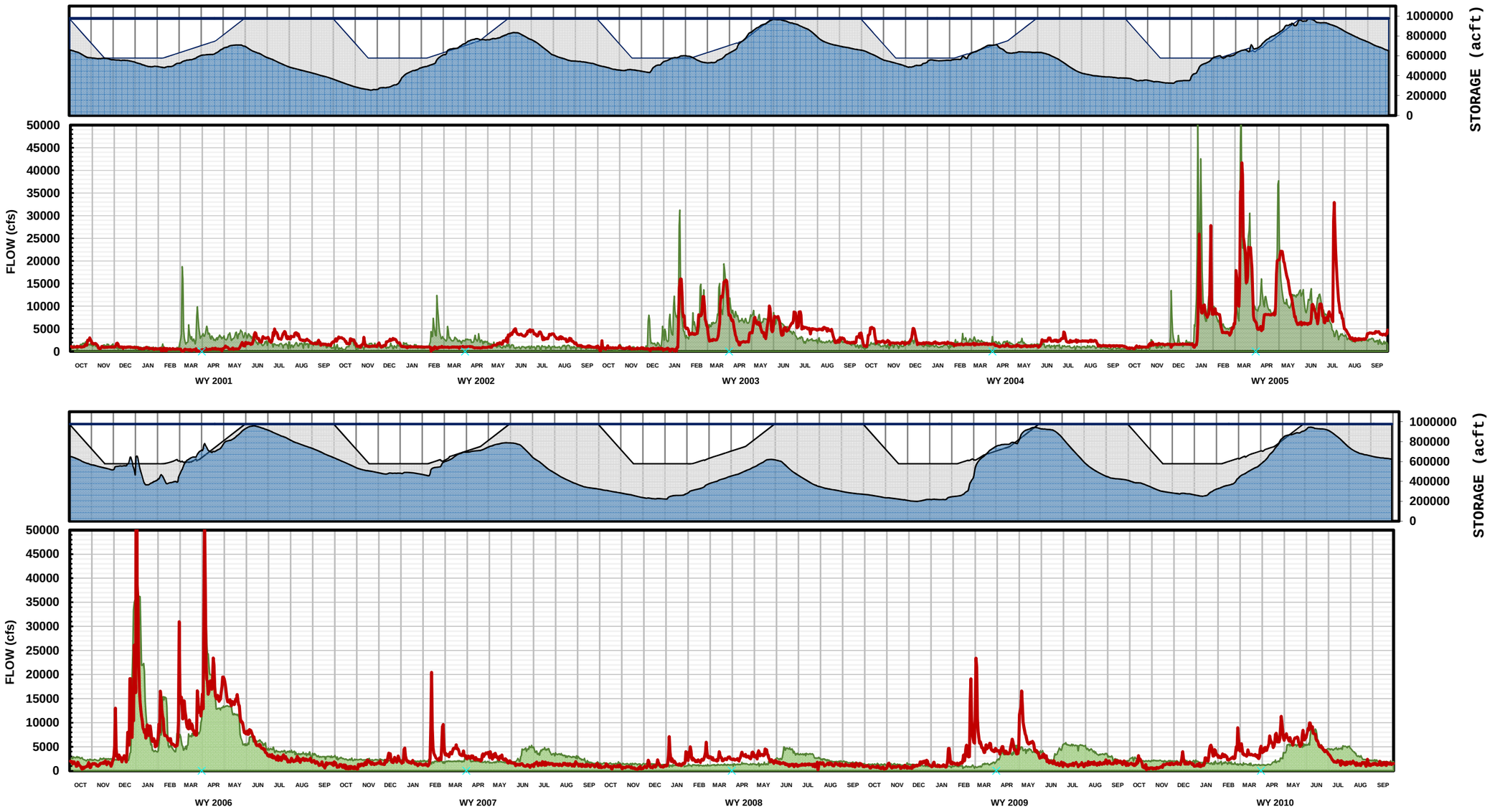
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



NOTE:
Prior to 17 January 1992, historical storage values shown are per the Elevation-Capacity Table dated 1955. Datum is mean sea level.
Thereafter, historical storage values shown are per the Elevation-Capacity Table dated 1992. Datum is mean sea level.

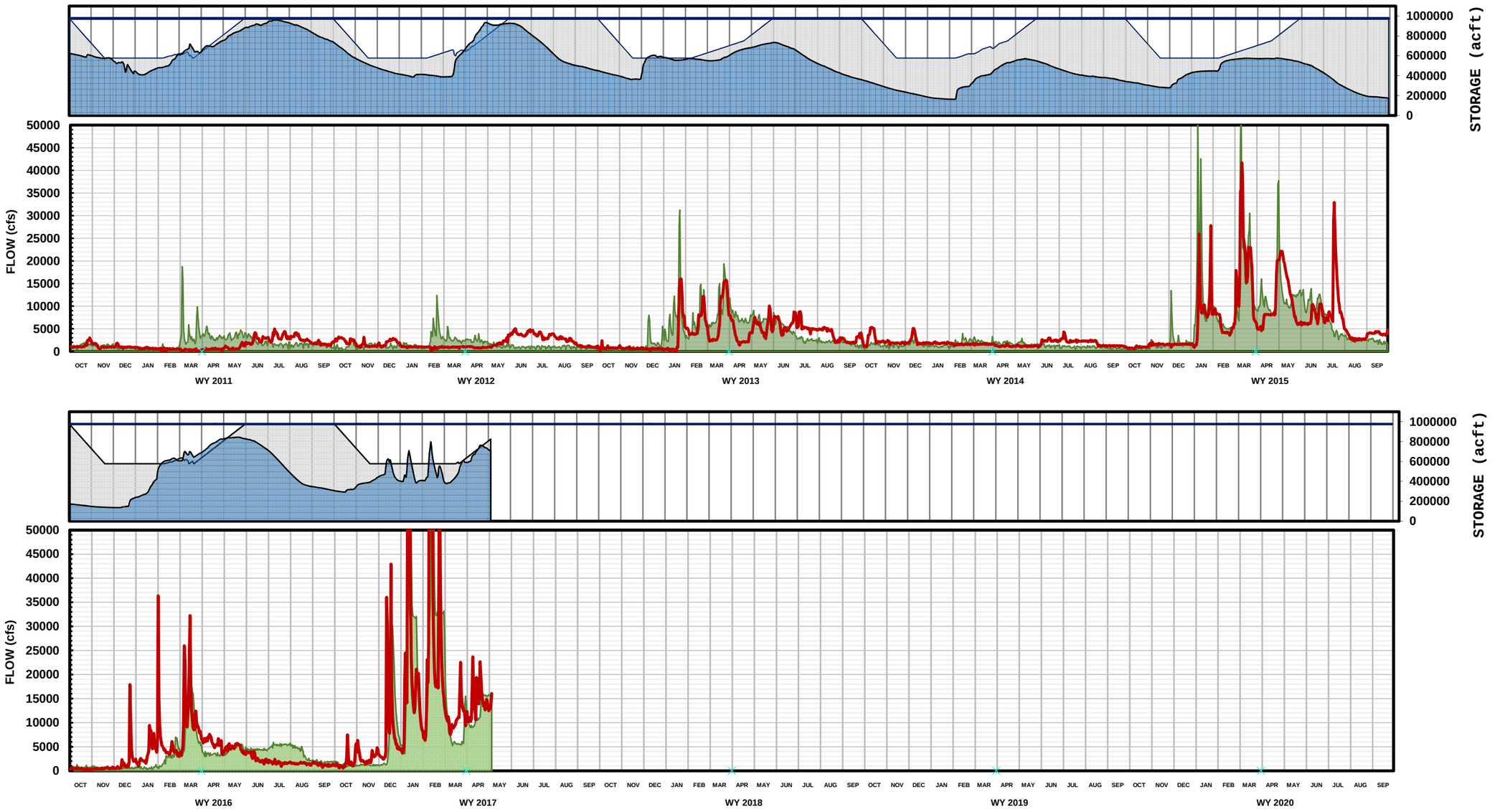
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



NOTE:
Prior to 17 January 1992, historical storage values shown are per the Elevation-Capacity Table dated 1955. Datum is mean sea level.
Thereafter, historical storage values shown are per the Elevation-Capacity Table dated 1992. Datum is mean sea level.

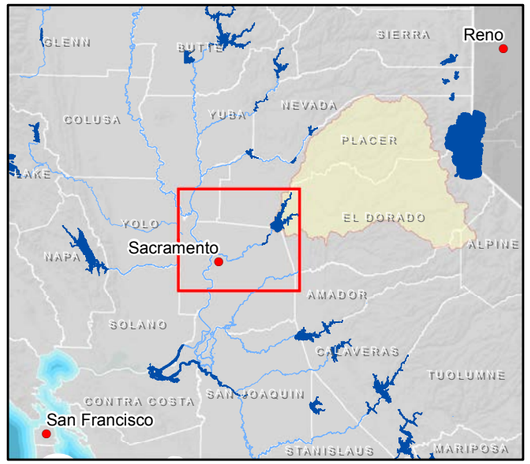
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL OPERATION

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



MAP LEGEND

15,000 cfs	Design Flood Flow Capacities
8	River Mile
P	Pump Station
	American River Flood Control Project Levee
	Other Federal Levee
	Water Body
	American River Parkway
	State Recreation Area
	Levee Agency Boundary

Design Flood Flow Capacities obtained from Flood SAFE California report: *State Plan of Flood Control Descriptive Document, November 2010.*

*American River reach Carmichael Bluffs to the State Exposition:
115,000 cfs with 5 feet freeboard
152,000 cfs with 3 feet freeboard

Background Imagery: *ESRI Basemap, Topographic*

0 2 4 Miles

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

DOWNSTREAM LEVEES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

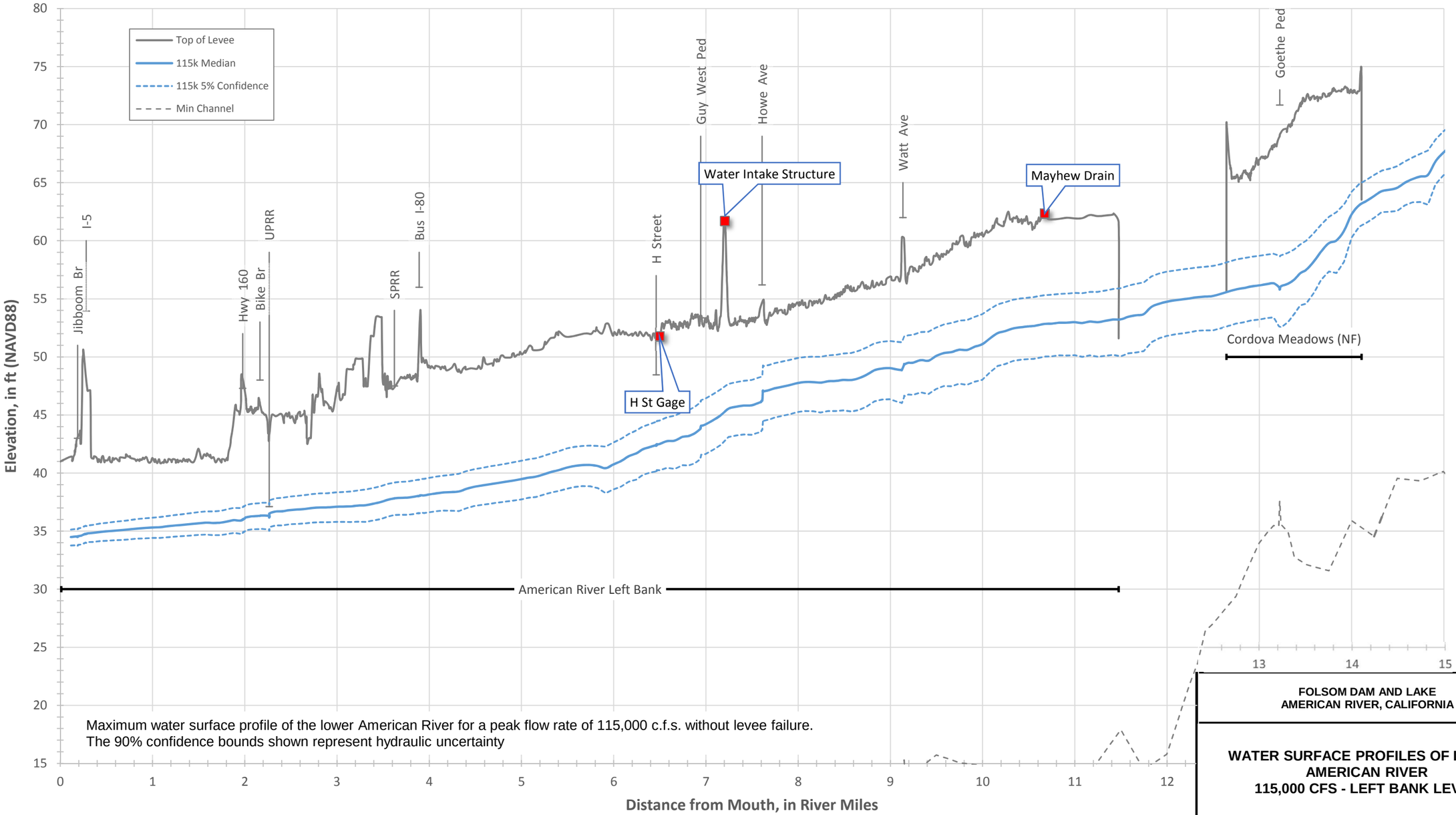
Prepared by J.S.M

Revised September 2017

PLATE 4-7

- DRAFT -

American River Left Bank - Nimbus Dam to Mouth



Maximum water surface profile of the lower American River for a peak flow rate of 115,000 c.f.s. without levee failure.
The 90% confidence bounds shown represent hydraulic uncertainty

Prepared by: D. Pate, P.E .April 2017 / MVB

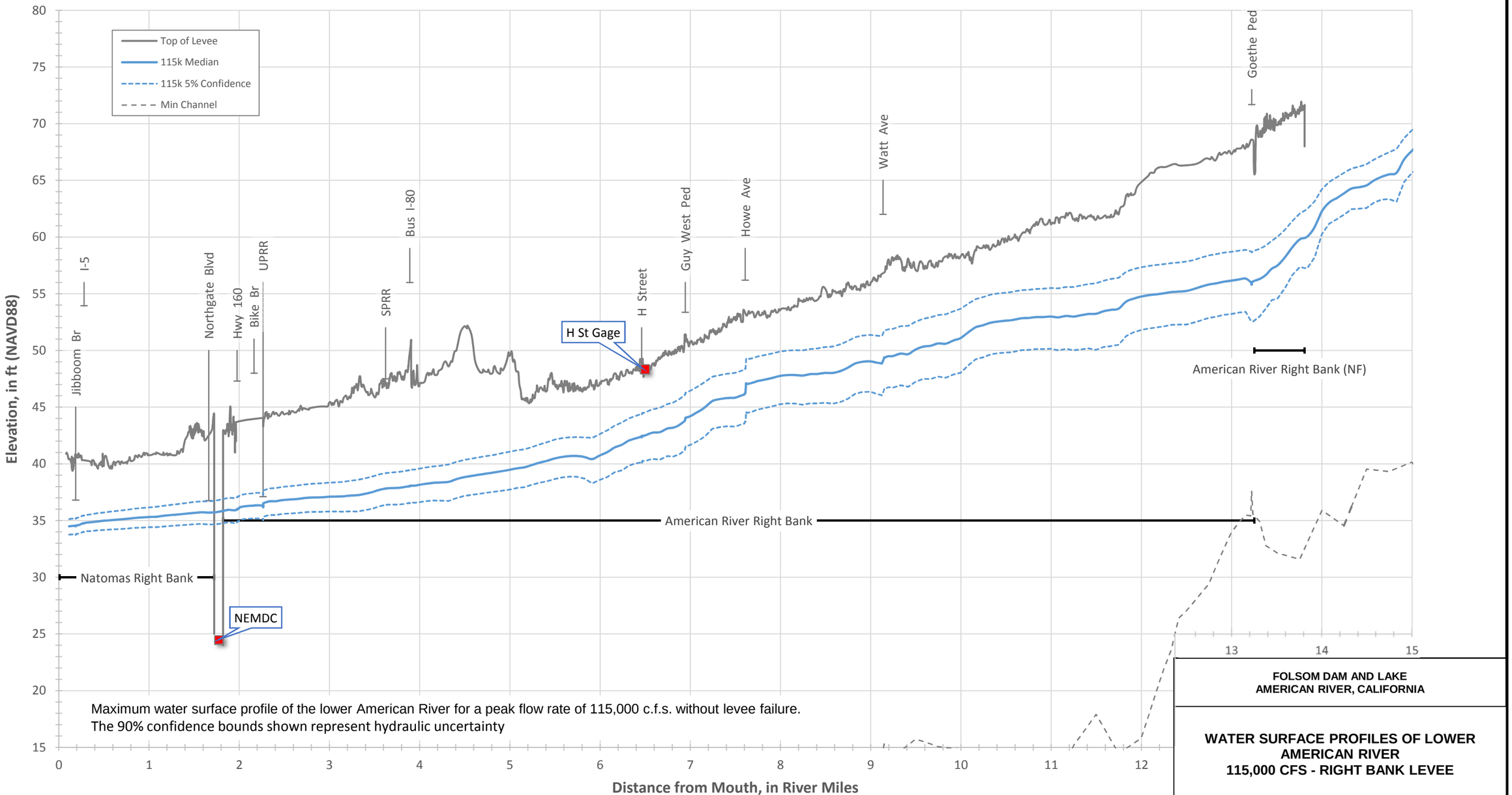
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

WATER SURFACE PROFILES OF LOWER AMERICAN RIVER
115,000 CFS - LEFT BANK LEVEE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -

American River Right Bank - Nimbus Dam to Mouth



Maximum water surface profile of the lower American River for a peak flow rate of 115,000 c.f.s. without levee failure.
The 90% confidence bounds shown represent hydraulic uncertainty

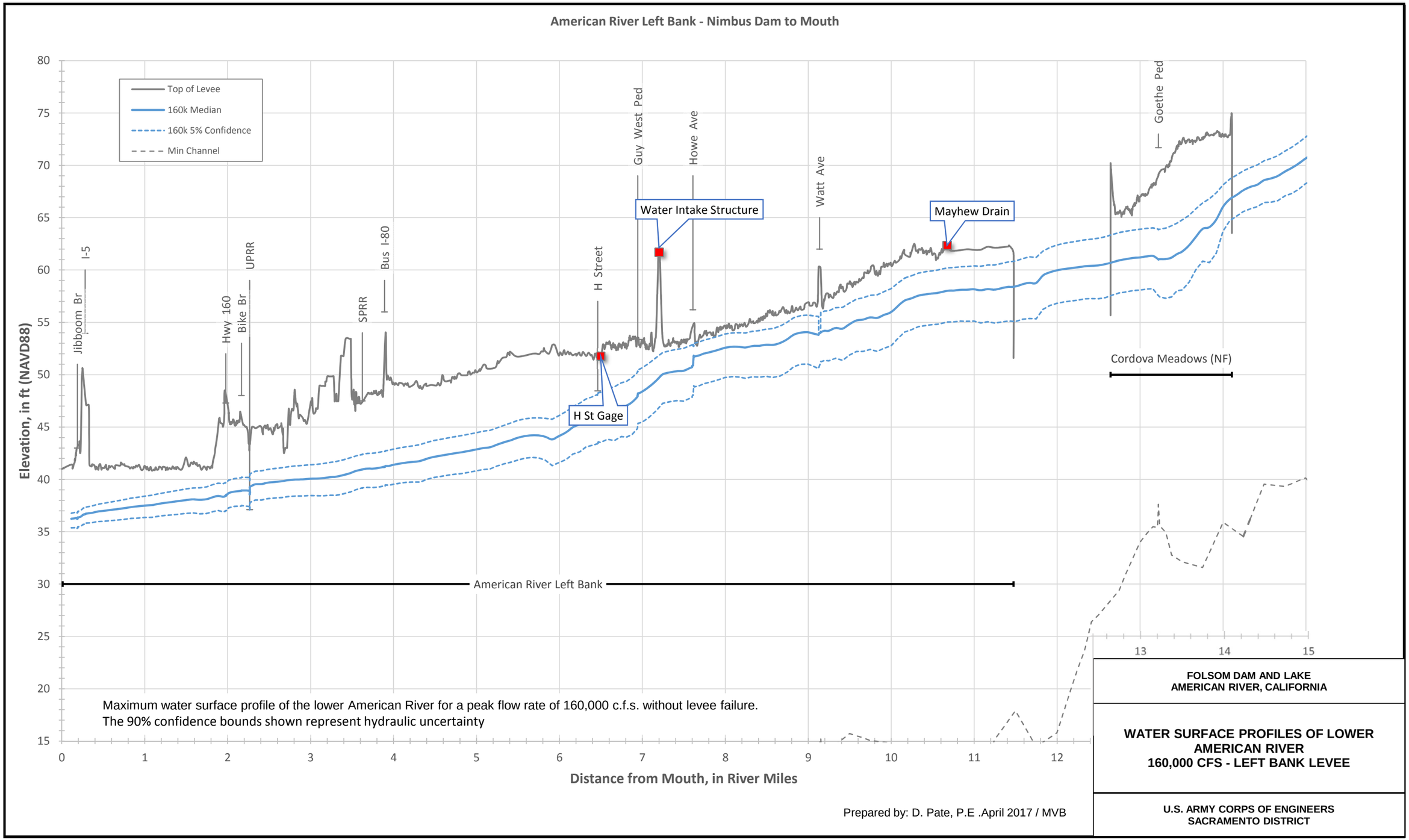
Prepared by: D. Pate, P.E. April 2017 / MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

WATER SURFACE PROFILES OF LOWER AMERICAN RIVER
115,000 CFS - RIGHT BANK LEVEE

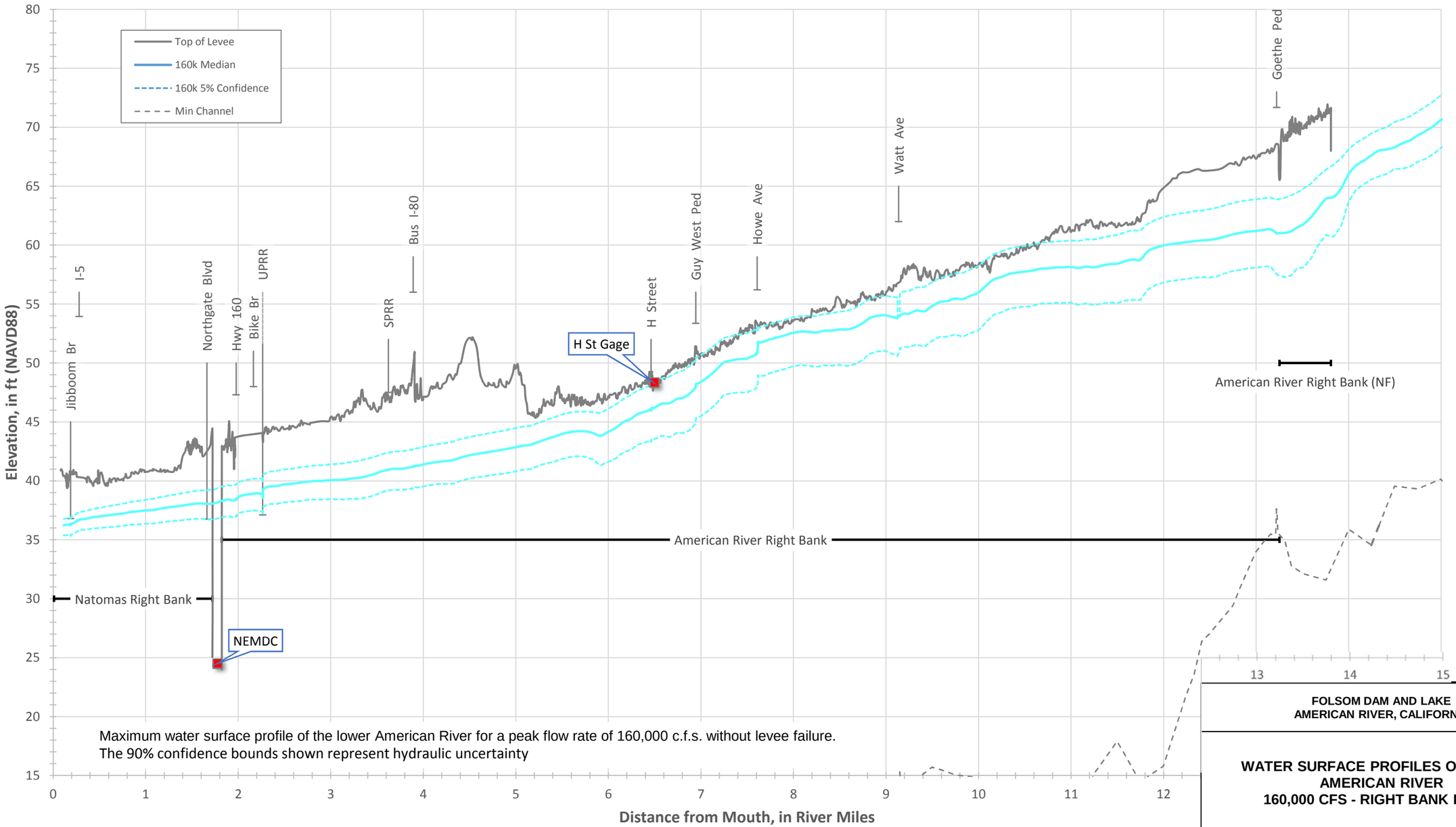
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -


American River Left Bank - Nimbus Dam to Mouth
Top of Levee
160k Median
160k 5% Confidence
Min Channel
Jibboom Br
I-5
Hwy 160
Bike Br
UPRR
SPRR
Bus I-80
H Street
Guy West Ped
Howe Ave
Water Intake Structure
Watt Ave
Mayhew Drain
Goethe Ped
Cordova Meadows (NF)
H St Gage
American River Left Bank
Elevation, in ft (NAVD88)
Distance from Mouth, in River Miles
Maximum water surface profile of the lower American River for a peak flow rate of 160,000 c.f.s. without levee failure.
The 90% confidence bounds shown represent hydraulic uncertainty
Prepared by: D. Pate, P.E .April 2017 / MVB
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA
WATER SURFACE PROFILES OF LOWER AMERICAN RIVER
160,000 CFS - LEFT BANK LEVEE
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -

American River Right Bank - Nimbus Dam to Mouth



Maximum water surface profile of the lower American River for a peak flow rate of 160,000 c.f.s. without levee failure.
The 90% confidence bounds shown represent hydraulic uncertainty

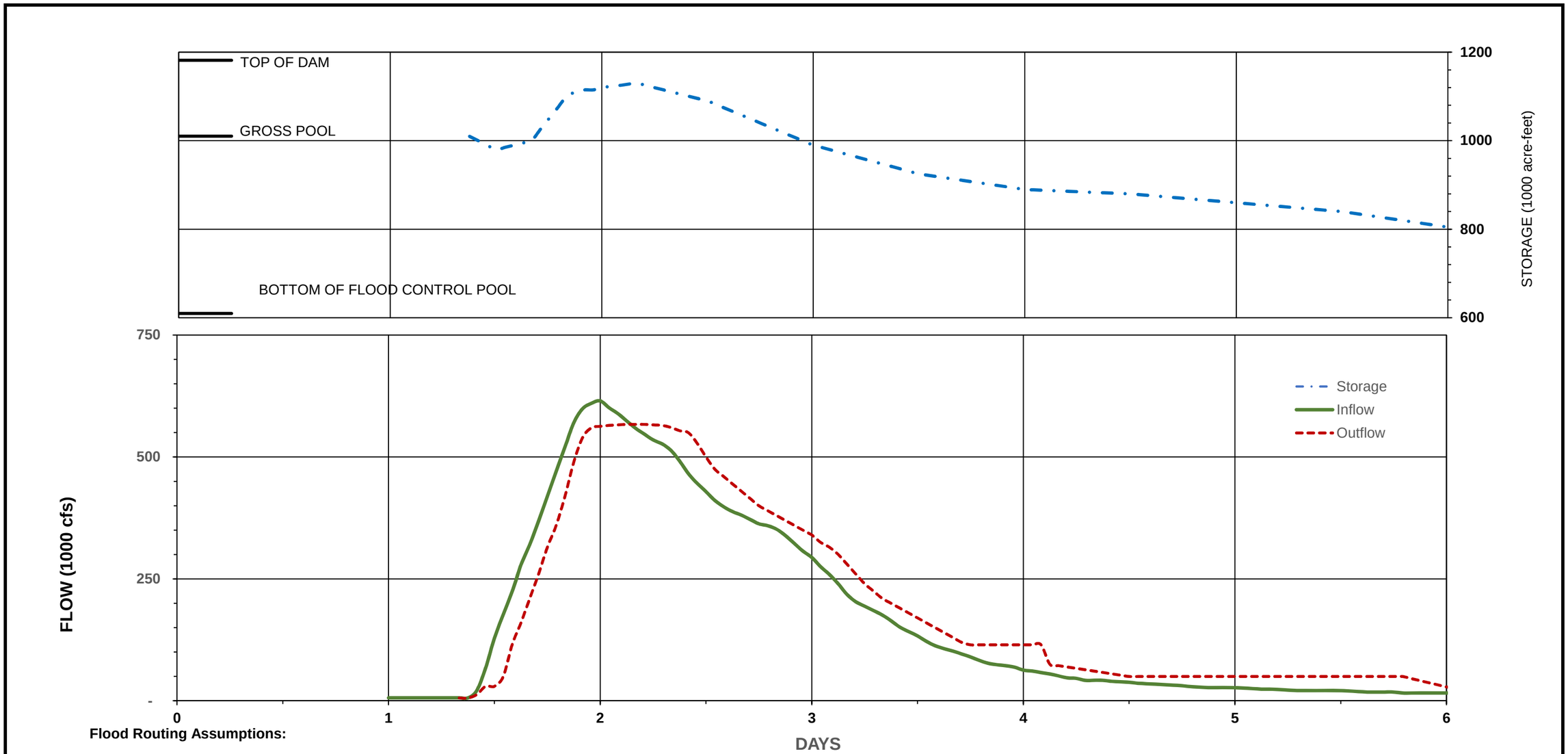
Prepared by: D. Pate, P.E .April 2017 / MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

WATER SURFACE PROFILES OF LOWER AMERICAN RIVER
160,000 CFS - RIGHT BANK LEVEE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



Flood Routing Assumptions:

1. GROSS POOL: 1,010,000 acre-feet.
2. BOTTOM OF FLOOD CONTROL RESERVATION: 610,000 acre-feet.
3. TOP OF DAM ELEVATION: 482.84 feet NAVD88 (480.5 NGVD29).
4. This flood was routed in accordance with criteria shown on the 1956 Folsom Dam Water Control Manual Emergency Spillway Release Diagram (ESRD),Chart C2.
5. The routing utilized all eight spillway gates.
6. Per Nov 1955 Elevation-Capacity Table.

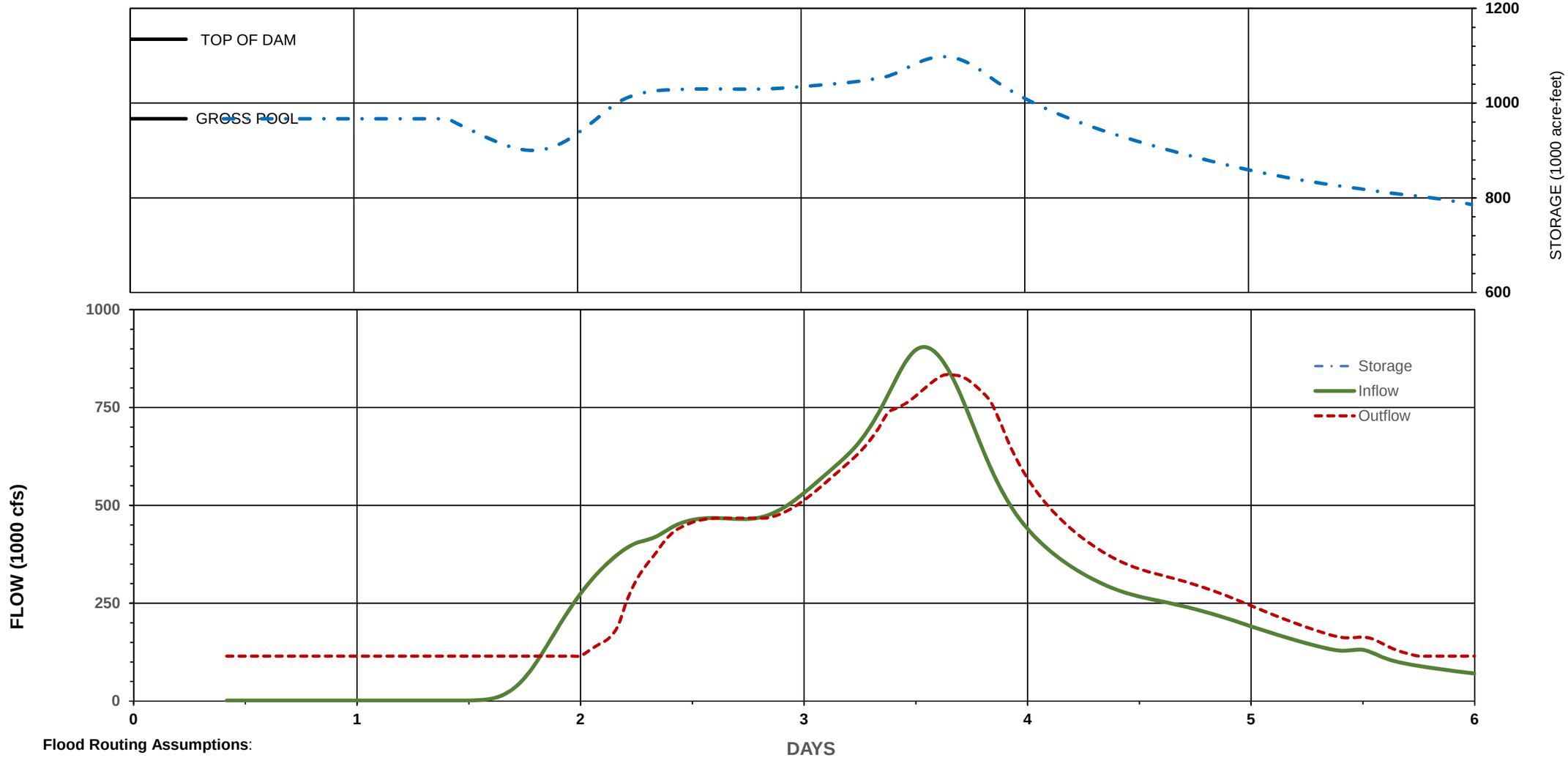
Prepared by AIB/MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

SPILLWAY DESIGN FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



Flood Routing Assumptions:

1. GROSS POOL: 967,000 acre-feet.
2. BOTTOM OF FLOOD CONTROL RESERVATION: 367,000 acre-feet.
3. TOP OF DAM ELEVATION: 482.84 feet NAVD88 (480.5 NGVD29)
4. This flood was routed in accordance with criteria shown on the 1987 Folsom Dam Water Control Manual Emergency Spillway Release Diagram (ESRD), Plate A-9
5. The routing utilized all eight main dam spillway gates plus the auxiliary spillway.
6. Per 2005 Elevation-Capacity Table.

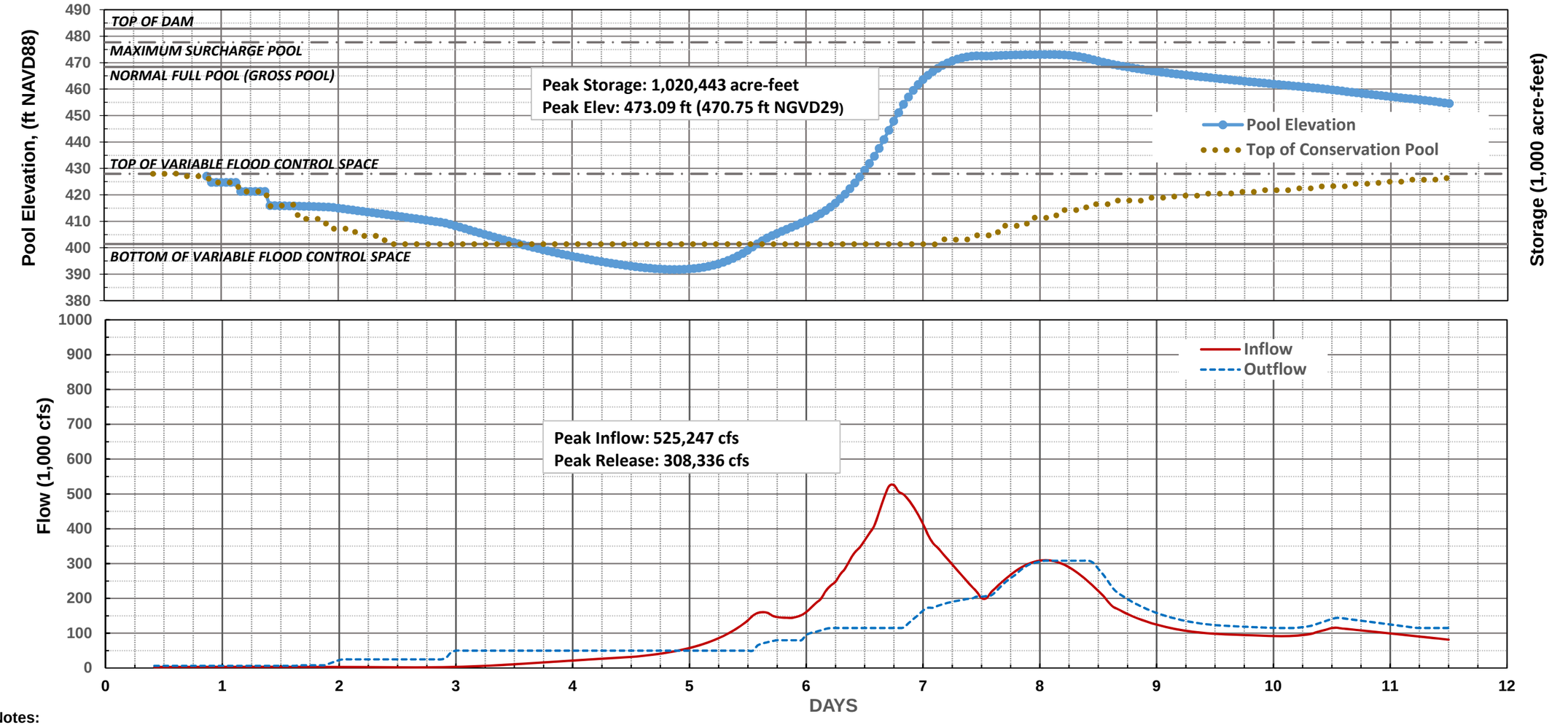
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

PROBABLE MAXIMUM FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



Notes:

1. Gross Pool: 468.34 ft NAVD88 (466.0 ft NGVD29) 966,820 acre-feet.
2. Top of Dam: 482.84 ft NAVD88 (480.5 ft NGVD29).
3. Top of Conservation Pool: 428.00 ft NAVD88 (425.66 ft NGVD29) 566,930 ac-ft.
4. The 2017 Standard Project Flood is patterned after the 1964 Flood Event.
5. The 2017 Standard Project Flood's 3-day inflow volume is equivalent to the 3-day volume associated with *"60% of the Probable Maximum Flood (October 2001)".*
6. This flood was routed in accordance with criteria shown on Plates A-9 and A-10.
7. Storage values are per the Elevation-Capacity Table dated September 2005.

Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

STANDARD PROJECT FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

PLACEHOLDER

This plate is not yet available

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

RESERVOIR DESIGN FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by AIB/MVB

- DRAFT -

PLACEHOLDER

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FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL AND HYPOTHETICAL ROUTING OF DEC 1955 RAIN FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by MVB

PLACEHOLDER

This sheet is not yet available

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

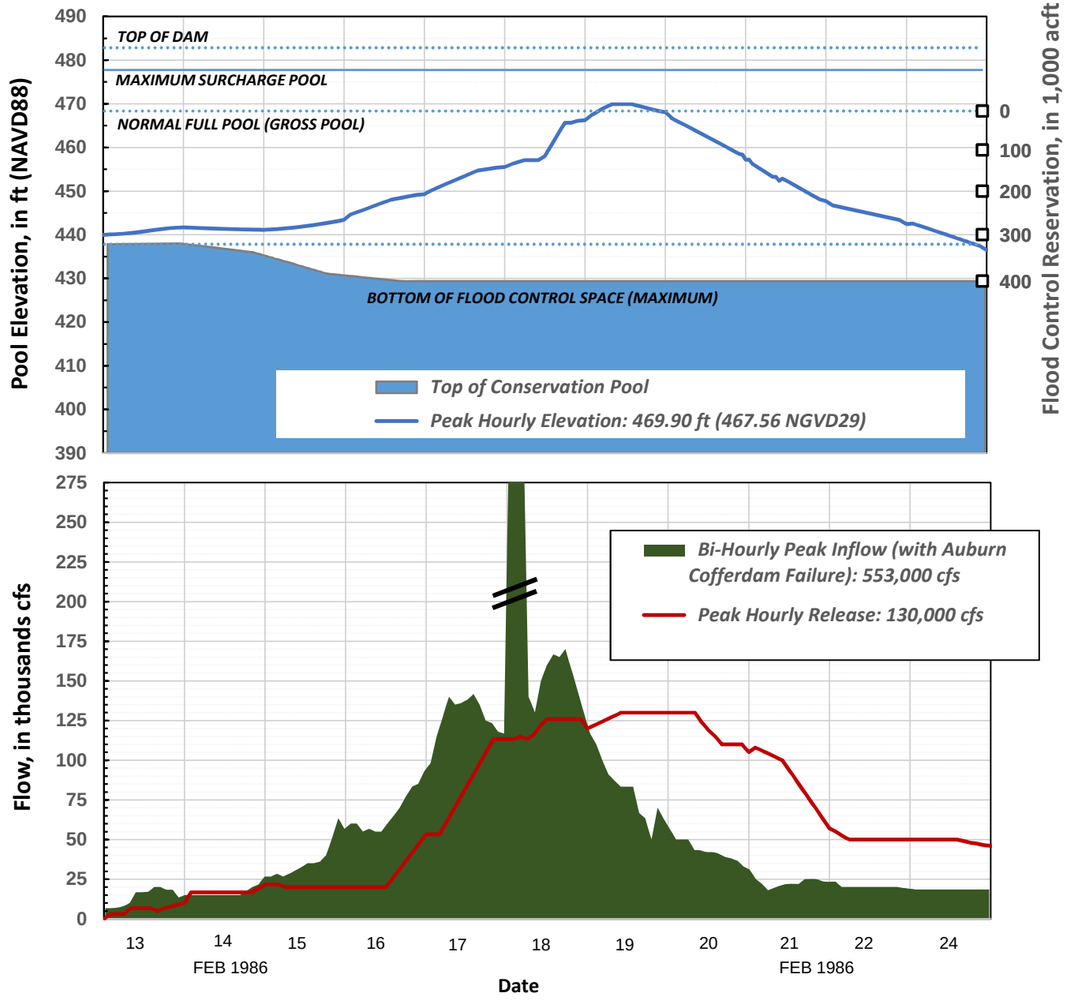
HISTORICAL AND HYPOTHETICAL ROUTING OF DEC 1964 RAIN FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

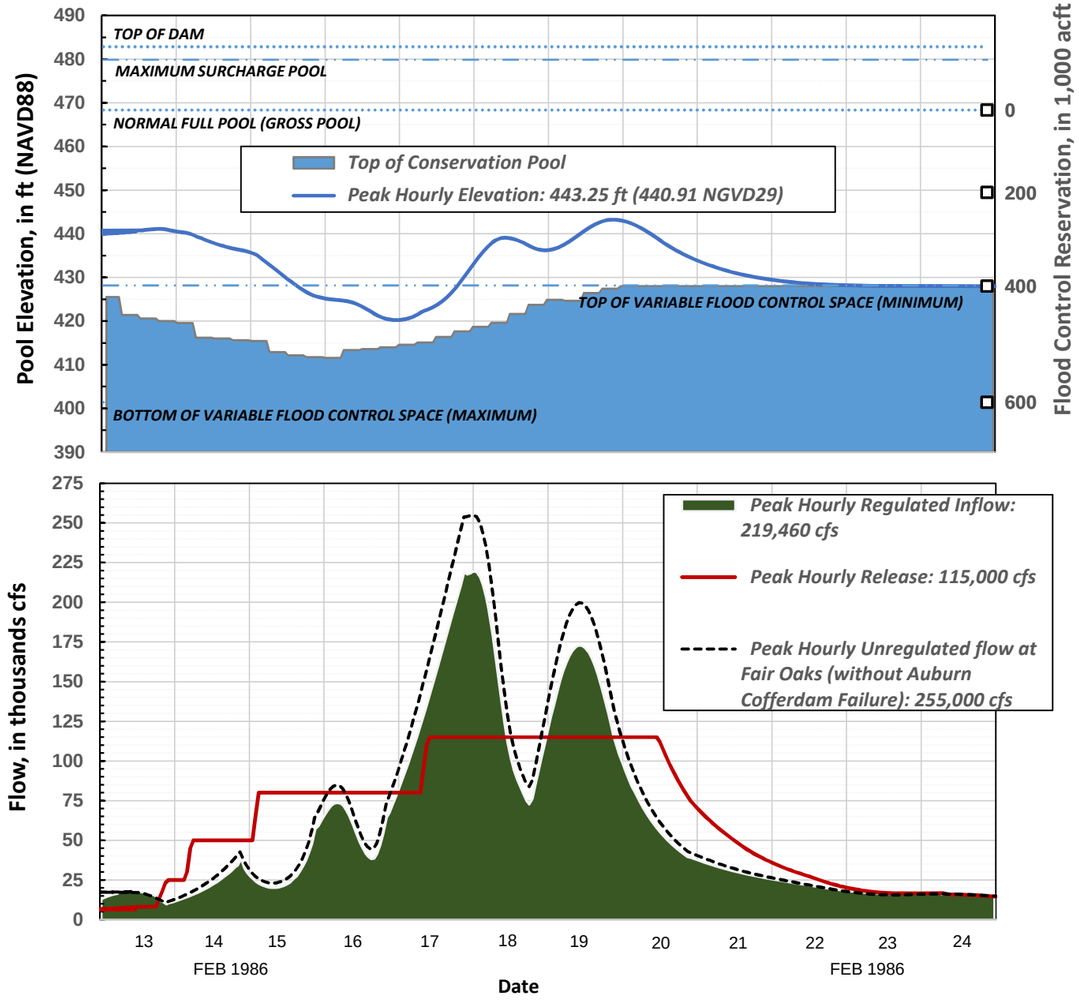
Prepared by MVB

- DRAFT -

Historical Event



Hypothetical Event



NOTE: The hypothetical flood was routed in accordance with criteria shown on Plates A-9 & A-10

	Historical	Hypothetical
. Elevation-Capacity Table:	1956	2005
Gross Pool 468.34 ft (466.0 ft, NGVD29):	1,010,290 ac-ft	966,930 ac-ft
Top of Dam 482.84 ft (480.5 ft, NGVD29):	1,181,640 ac-ft	1,134,670 ac-ft
Bottom of Flood Control Space (Maximum 400,000 ac-ft):	428.16 ft (425.82 ft NGVD29) 576,955 ac-ft	---
Top of Variable Flood Control Space (Minimum 400,000 ac-ft):	---	428.00 ft (425.65 ft NGVD29) 566,930 ac-ft
Bottom of Variable Flood Control Space (Maximum 600,000 ac-ft):	---	401.42 ft (399.08 ft NGVD29) 366,930 ac-ft

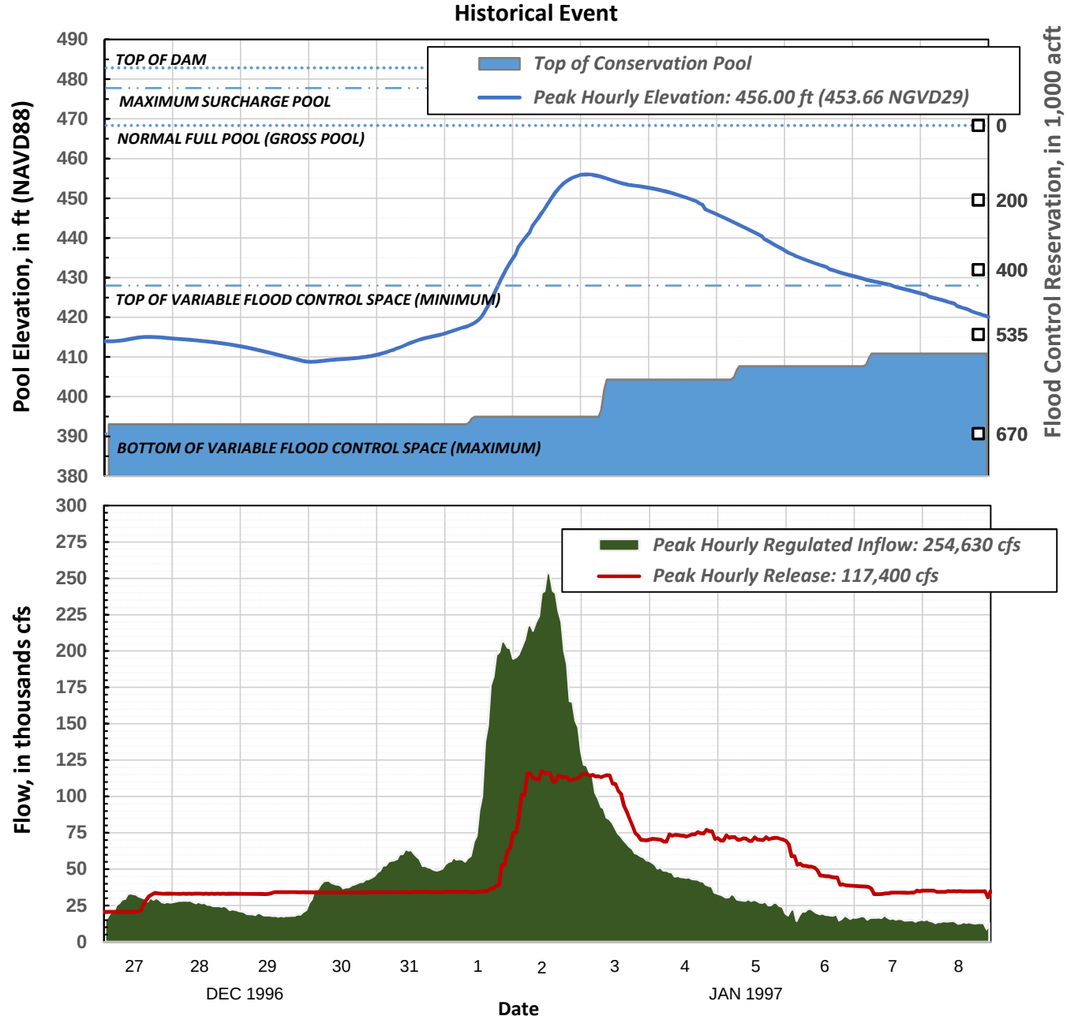
Prepared by MVB

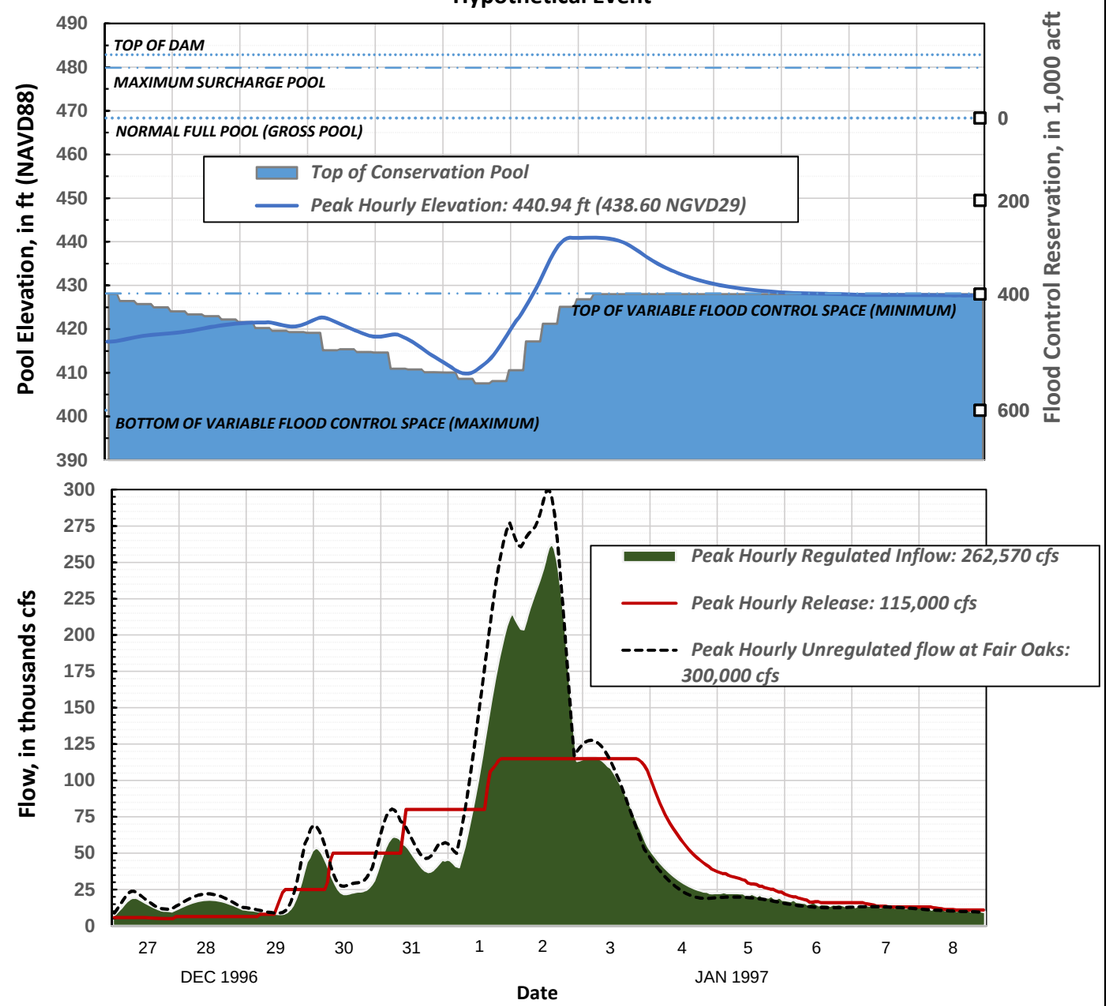
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL AND HYPOTHETICAL ROUTING OF FEB 1986 RAIN FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -





NOTE: The hypothetical flood was routed in accordance with criteria shown on Plates A-9 & A-10

	Historical	Hypothetical
. Elevation-Capacity Table:	1992	2005
Gross Pool 468.34 ft (466.0 ft, NGVD29):	976,955 ac-ft	966,930 ac-ft
Top of Dam 482.84 ft (480.5 ft, NGVD29):	1,145,310 ac-ft	1,134,670 ac-ft
Top of Variable Flood Control Space (Minimum 400,000 ac-ft):	428.16 ft (425.82 ft NGVD29) 576,955 ac-ft	428.00 ft (425.65 ft NGVD29) 566,930 ac-ft
Bottom of Variable Flood Control Space (Maximum 670,000 ac-ft):	393.03 ft (390.69 ft NGVD29) 306,955 ac-ft	---
Bottom of Variable Flood Control Space (Maximum 600,000 ac-ft):	---	401.42 ft (399.08 ft NGVD29) 366,930 ac-ft

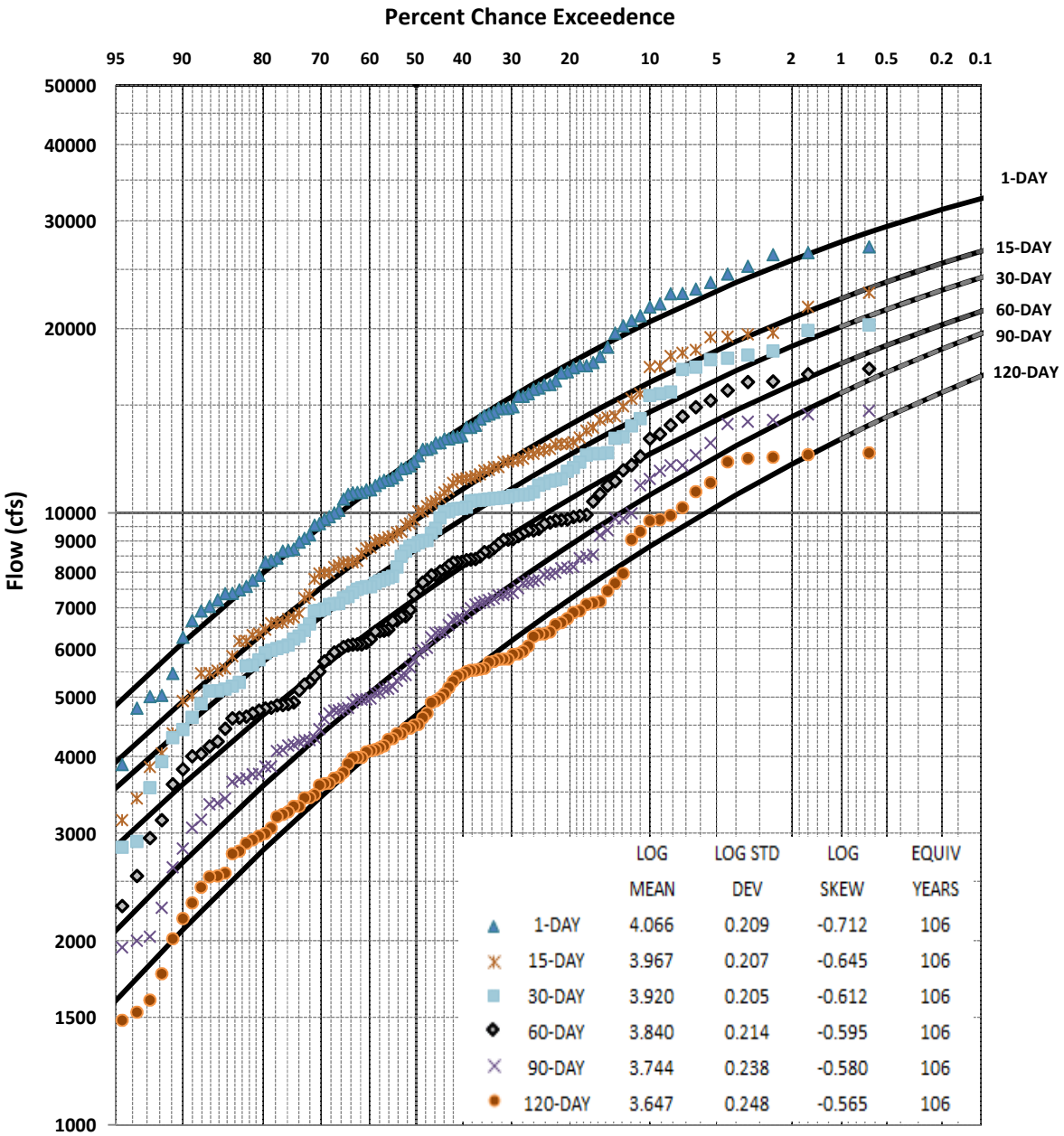
Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

HISTORICAL AND HYPOTHETICAL ROUTING OF JAN 1997 RAIN FLOOD

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



NOTES:

1. Median plotting positions
2. Computed probability
3. Drainage area: 1,888 sq. mi.
4. Period of record: WY 1905-2010

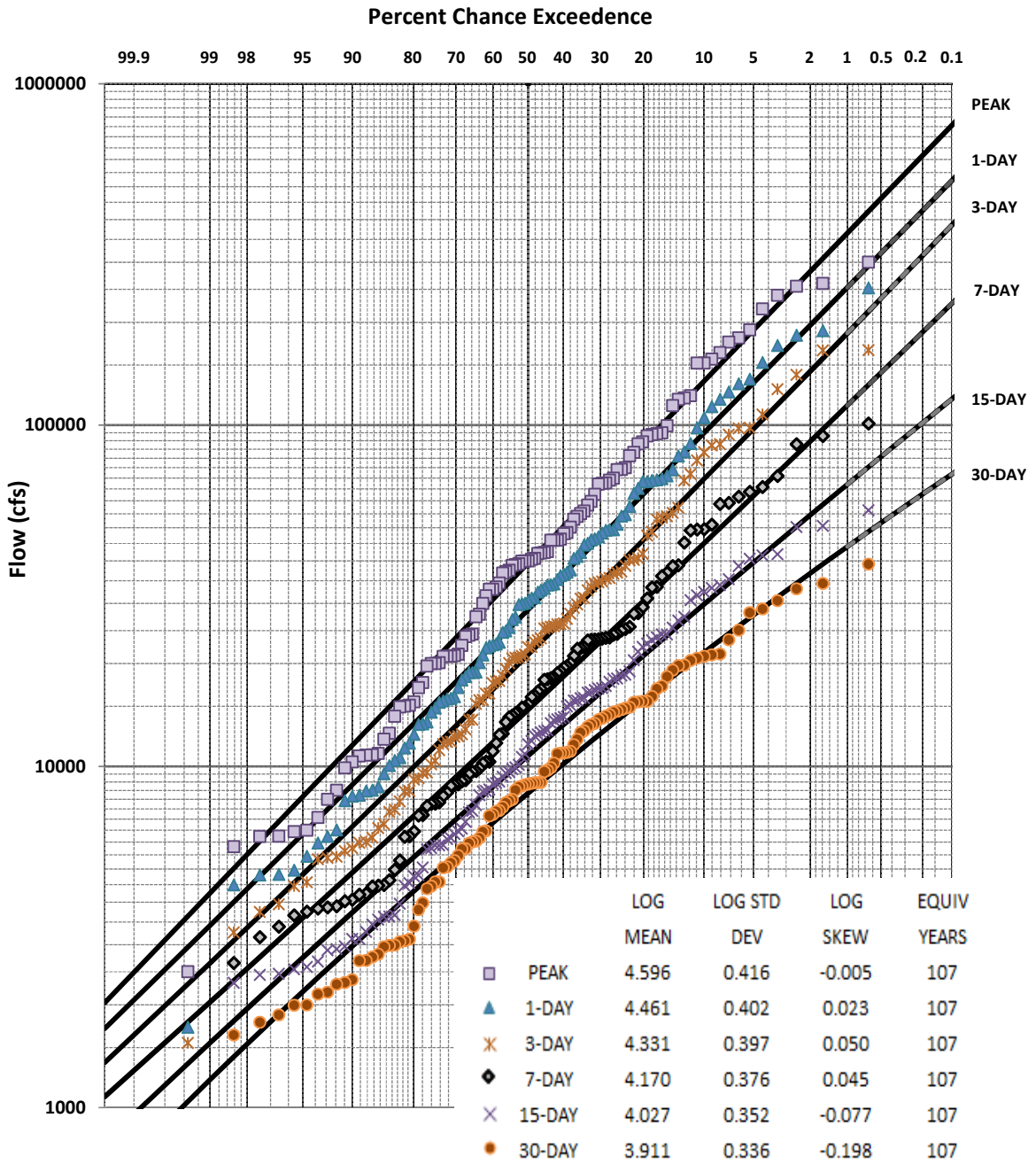
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

SNOWMELT FREQUENCY CURVES UNREGULATED CONDITION AMERICAN RIVER AT FAIR OAKS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017 PLATE 8-5

- DRAFT -



NOTES:

1. Median plotting positions
2. Computed probability
3. Drainage area: 1,888 sq. mi.
4. Period of record (Oct-Mar): WY 1905-2011

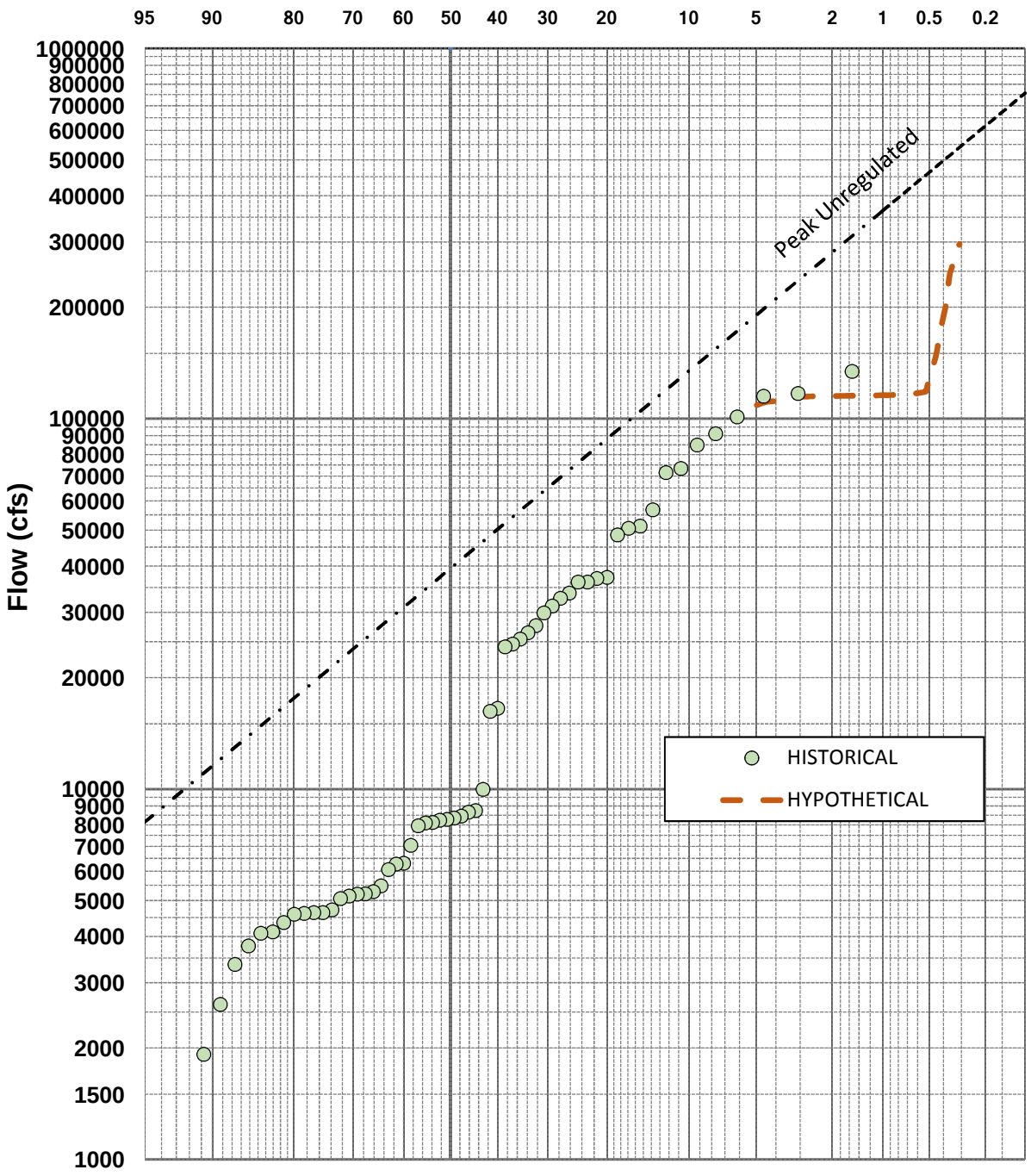
FOLSOM DAM AND LAKE
AMERICAN RIVER BASIN, CALIFORNIA

RAIN FLOOD FREQUENCY CURVES UNREGULATED CONDITION AMERICAN RIVER AT FAIR OAKS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017 PLATE 8-6

- DRAFT -



NOTES:

1. Median plotting positions
2. Computed probability
3. Drainage area: 1,888 sq. mi.
4. Period of record (Oct-Mar):
   WY 1955 - 2014

Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

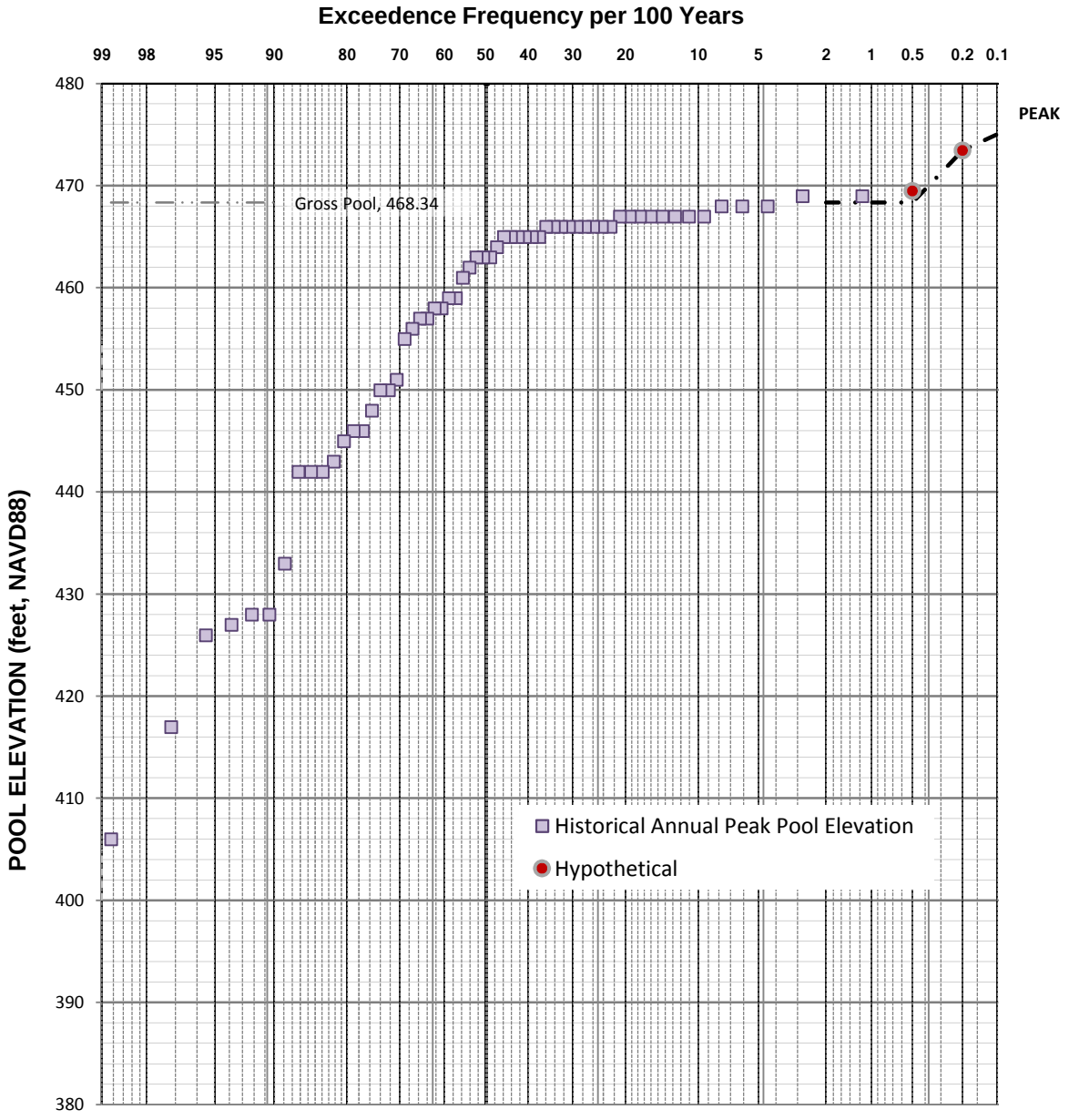
PEAK FLOW FREQUENCY CURVE

REGULATED CONDITION
AMERICAN RIVER AT FAIR OAKS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017

- DRAFT -



Period of Record is WY 1956 - 2016

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

POOL ELEVATION-FREQUENCY CURVE

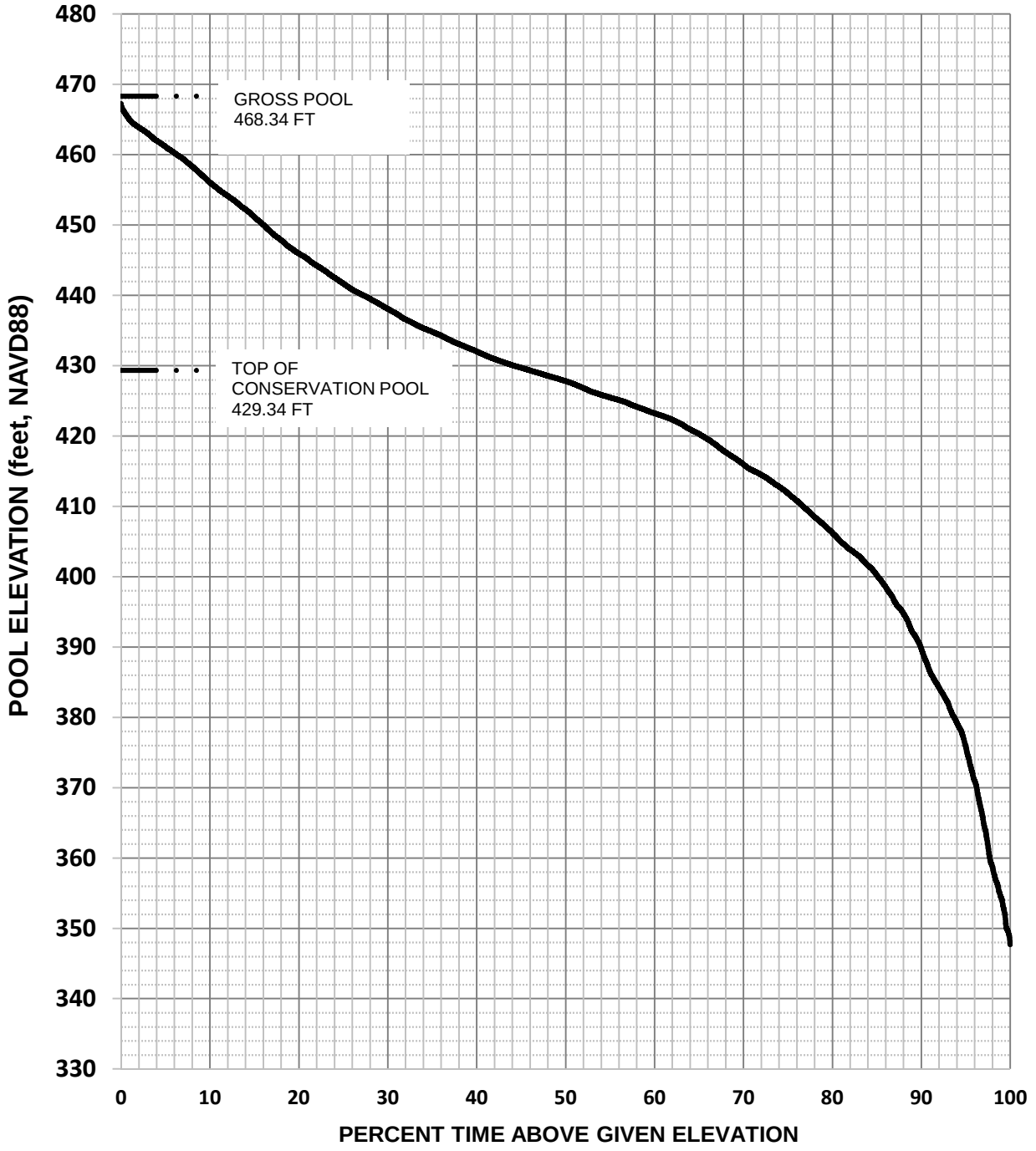
Prepared by AIB/MVB

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017

PLATE 8-8

- DRAFT -



Period of Record: 1956 to 2016

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

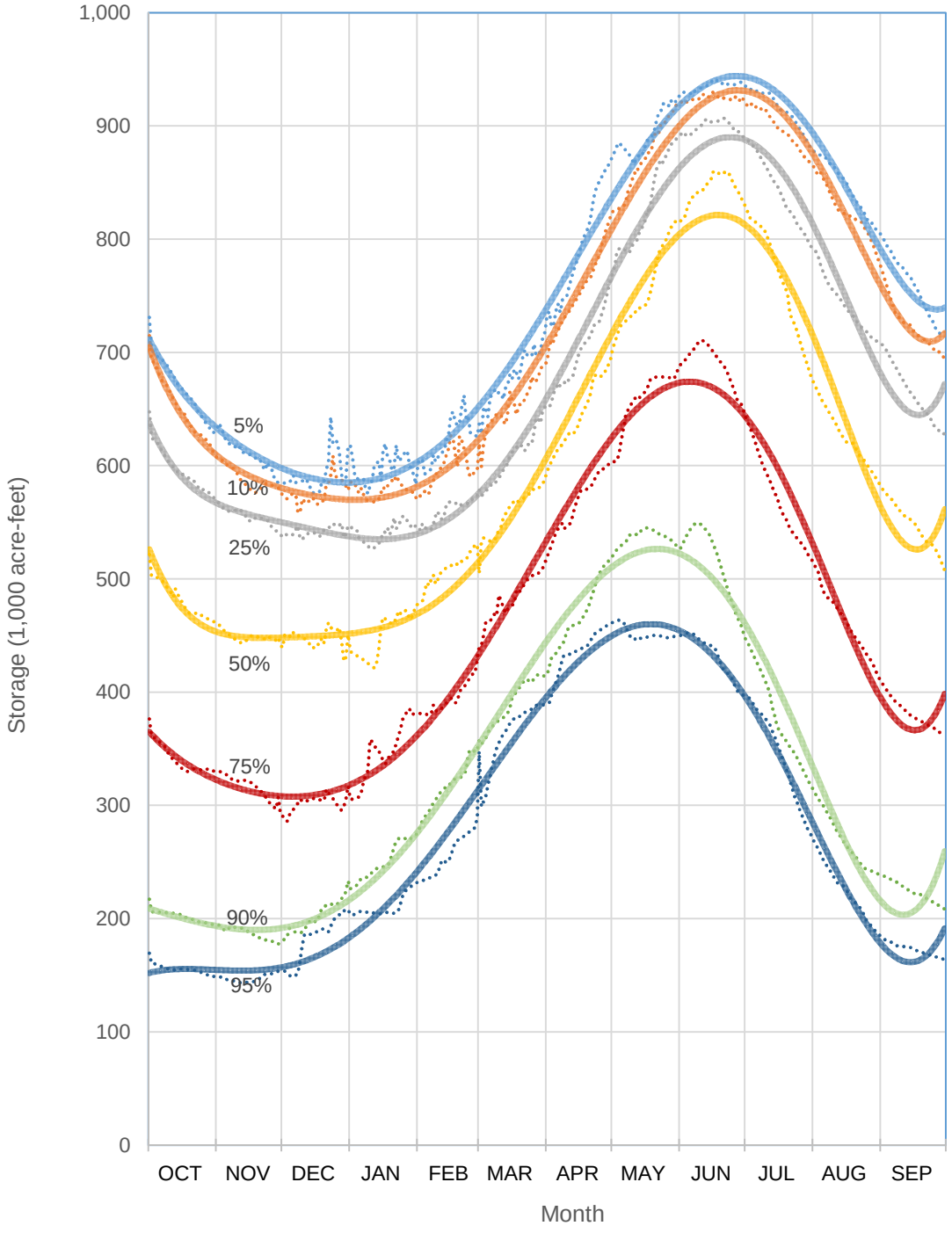
POOL ELEVATION-DURATION CURVE

Prepared by AIB/MVB

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017 PLATE 8-9

- DRAFT -



NOTE: The indicated value is percentage of years that the pool elevation is exceeded on a given date based on daily pool elevation records converted to storage (using the 2005 Area-Capacity table issued by Reclamation) for the water years 1956 - 2016.

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

SEASONAL VARIATION OF STORAGE FREQUENCY

Prepared by MVB

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017

PLATE 8-10

- DRAFT -

WATER CONTROL MANUAL
FOLSOM DAM AND LAKE

American River
California

EXHIBIT A

STANDING INSTRUCTIONS TO PROJECT OPERATORS FOR FOLSOM DAM AND LAKE

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

December 1987
Revised September 2017

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EXHIBIT A

STANDING INSTRUCTIONS TO THE PROJECT OPERATORS
FOR
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

Table of Contents

LIST OF TABLES

LIST OF PLATES

Personnel list is not available in this version of the manual

Personnel list is not available in this version of the manual

Personnel list is not available in this version of the manual

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EXHIBIT A

STANDING INSTRUCTIONS TO PROJECT OPERATORS
FOR WATER CONTROL
FOR
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA
WATER CONTROL MANUAL

A-01. Background and Responsibilities

a. General Information

(1) **Policies**. This exhibit to the Folsom Dam and Lake, American River, California, Water Control Manual is in compliance with instructions contained in Corps guidance listed as follows:

- ER 1110-2-240 (Engineering and Design, *Water Control Management*, 30 May 2016), Paragraph 4-3, Policies Governing USACE Regulation of Non-USACE Projects

- EM 1110-2-3600 (Engineering and Design, *Management of Water Control Systems*, 30 November 1987), Paragraph 9-2, Standing Instructions to Project Operators for Water Control which reads as follows:

> "Standing Instructions to Project Operators for Water Control are essential to ensure efficient and safe operation of the Project at all times. The instructions apply to Project Operators, power plant superintendents, resource managers, and other operators in similar positions. Any physical operating constraints should be within design limitations and clearly outlined to ensure that water control features are operated in a safe manner during all phases of the project's life, including the construction phase."

- ER 1100-2-8160 (Engineering and Design, *Policies for Referencing Project elevation Grades to Nationwide Vertical Datums*, 1 March 2009)

A copy of Exhibit A must be kept on hand at all times. It is designed to be used independently as the water control regulation guide, or as published, in conjunction with the Water Control Manual. To facilitate independent use of this exhibit for flood control operation of Folsom Dam and Lake, pertinent diagrams and tables can be found in Plate A-01 through A-10. Any deviation from the approved Water Control Plan will require approval of the CESPK District Engineer or designee. For information on personnel telephone numbers and addresses, refer to the Personnel Concerned with the Project Operation list in the front of this exhibit.

This exhibit outlines the duties and responsibilities of the Corps and the Project Operator in regulating the flood control storage space and in reporting hydrologic data. This exhibit also

emphasizes the procedures that must be followed during extreme flood emergencies when communication between the Central Valley Operation Office, Reclamation, and the Water Management Section, Sacramento District, U.S. Army Corps of Engineers, may have been disrupted, and during events requiring deviation from the Water Control Plan.

Add 2.34 feet to convert the project vertical elevations from the National Geodetic Vertical Datum of 1929 (NGVD29) to the North American Vertical Datum of 1988 (NAVD88). All elevations in this exhibit are NAVD88 unless otherwise specified.

(2) **Project Purpose**. Folsom Dam and Lake will be operated for flood control in accordance with rules and regulations prescribed by the Code of Federal Regulations Title 33, Part 208.11, and the Field Working Agreement for Folsom Dam and Lake, copies of which are contained in this manual as Exhibits C and B, respectively. The Water Control Diagram and Emergency Spillway Release Diagram, working in conjunction with these regulations, together define the requirements for flood control operation of Folsom Dam and Lake. The flood control objectives for Folsom Dam and Lake are:

(a) To control flows in the American River, insofar as possible, to not exceed 115,000 cfs below the dam.

(b) To avoid causing damage, insofar as practicable, that would not have occurred under conditions without the project.

(c) To provide the maximum practical amount of storage space for conservation, power, and other purposes without impairment of the flood control functions.

(d) To release water stored within the flood control space as rapidly as possible without causing flows in the American River below Folsom Dam to exceed the limits defined by the Water Control Diagram and in Paragraph A-03a below.

(3) **Chain of Command.** The water management function for Folsom Dam and Lake is performed by the U.S Bureau of Reclamation (Reclamation), Mid-Pacific Region, Central Valley Operations Office (CVOO).

(4) **Project Location and Description.** The Folsom Dam and Lake project is about 20 miles northeast of the city of Sacramento, and 2 miles north of the city of Folsom. It is located on the American River about 26 miles upstream from its confluence with the Sacramento River and about seven miles upstream of Nimbus Dam (an afterbay structure for Folsom Dam) and Lake Natoma. Folsom dam is located in Sacramento County, but Folsom Lake spans three counties: Sacramento, Placer and El Dorado. A network of county roads, which connect with U.S. Highway 50 near the city of Folsom, provides access to the various features of the project. Plate 2-1 General Map shows the location of Folsom Dam and Lake in relation to the American River Basin.

These features are described in detail in Chapter 2 and can be seen on Plate 2-2, the Folsom Dam and Lake Area Map. Additional information can be found on the pertinent data sheet. The following provides more details regarding the water control features.

- The total discharge capacity at the maximum surcharge pool elevation 477.5 ft NAVD88 (479.5 ft NGVD29), assuming 2 ft of freeboard remains between the maximum water surface and top of gate, is roughly 587,000 cfs.

- penstocks have a center-line elevation of 309.34 feet and total maximum discharge of 7,650 cfs.

- . The auxiliary spillway design flow is 160,000 cfs from a combined release of 135,000 cfs from the auxiliary spillway and 25,000 cfs from the main dam river outlets. The discharge capacity at the maximum surcharge pool elevation 477.5 feet NAVD88 (479.5 feet NGVD29) is 314,000 cfs.

(5) **Physical Constraints.** The following constraints have been identified and should be considered during operation:

(a) Main Dam Spillway Operational Constraints

(i) River Outlets Gate Opening Limitation. Reclamation's current limitation on the operation of the main dam river outlets during concurrent operation of the main dam service spillway gates should be maintained. This will limit the potential cavitation on the face of the dam at the exit portals for the main dam river outlets.

(ii) Main Dam Service Spillway Overtopping Prevention. In the closed position, the top of the main dam service gates is at elevation 470.34 feet NAVD88 (468.00 feet NGVD29). The service gates must commence opening when the distance between

the water surface and the top of the gates is within 2 feet. As the pool elevation continues to rise, the service spillway gates should be operated to maintain at least a 2-foot minimum distance between the water surface and top of the service spillway gates.

(iii) Main Dam Emergency Spillway Overtopping Prevention. In the closed position, the top of the main dam emergency gates is at elevation 473.34 feet NAVD88 (471.00 feet NGVD29). The emergency gates must commence opening when the distance between the water surface and the top of the gates is within 1 foot. As the pool elevation continues to rise, the service spillway gates should be operated to maintain at least a 2-foot minimum distance between the water surface and top of the emergency spillway gates.

(iv) Operations to Provide Tailwater Cushion for Emergency Spillway Releases. Model testing conducted at the Technical Services Center in Denver indicated that the tailwater may not be sufficient under the conditions when the emergency spillway would be utilized. Insufficient tailwater could lead to damage to the concrete slab, causing further instability in the area. Optimally, the total project release (flow from the main dam service spillway and auxiliary spillway) would be maximized to the fullest extent possible prior to making releases from the emergency gates. Given the operation plan is tailored to minimize the discharge downstream, the discharge requirement will not be sufficient during the initial operation of the emergency gates. **Initial use of the emergency spillway gates will likely be driven solely by the need to prevent overtopping of the emergency gates regardless of any tailwater requirement**.

(v) Main Dam Spillway Gate Opening Limitation.

(b) Auxiliary Spillway Operational Constraints

(i) Flow Split Requirement between the Main Dam and Auxiliary Spillway. Optimally, an equal split between the main dam and auxiliary spillway provides the greatest stability to the right bank. Even small releases from the main dam, in combination with auxiliary spillway discharge, improves the hydraulic performance at the confluence. For total project discharges greater than or equal to 115,000 cfs, at least 25,000 cfs or greater should be released from the main dam.

(ii) Unbalanced Gate Operation Restrictions and Minimum Gate Opening Requirements.

(iii) Auxiliary Spillway Gate Opening Limitation. The maximum gate opening should be limited to 95 percent open (31.4 feet) except under extreme conditions. At 100 percent open, the flow may become unsteady, with oscillating water surface and some splash and impact to gate trunnions. This also may result in negative pressures along the roof curve downstream of the bulkhead gate slot.

(6) **Operation and Maintenance.** The physical operation and maintenance of Folsom Dam and Lake is made by Reclamation, Mid-Pacific Region, Central California Area Office (CCAO) headquartered at Folsom Dam. Remote operation of the powerplant at Folsom Dam and five of the Nimbus Dam gates can be accomplished via the Central Valley Control Center (CVCC) which is staffed 24-hours.

b. Role of the U.S. Bureau of Reclamation (Project Operator). The Regional Director, Mid-Pacific Region, Reclamation, is responsible for the following, which apply to both normal conditions (not dependent on day-to-day instruction) and emergency conditions (flood or drought):

(1) Accomplishing the physical operation of the reservoir and associated facilities in accordance with the official regulations.

(2) Advising the CESPK District Engineer of any deviation from prescribed requirements.

(3) Reporting to the CESPK District Engineer any unusual condition in the reservoir or along downstream channels that might interfere with the planned flood control operation of the reservoir.

(4) Keeping downstream interests advised of all changes of flood control releases which might affect them.

(5) Reporting to the CESPK Water Management Section and to the DWR, data as outlined in Section A-02a(1) below and other data that may be required from time to time.

(6) Keeping informed of the rules and regulations contained in the Water Control Manual and bringing to the attention of the CESPK District Engineer any feature of the manual that may require clarification or revision.

(7) Keeping the CESPK District Engineer advised of any inaccuracies contained in the manual or that may develop as a consequence of changing conditions.

(8) Immediately after the end of each month, transmitting to the CESPK Water Management Section data specified in section A-02a(2) below.

c. Role of the U.S. Army Corps of Engineers. The Sacramento District, U.S. Army Corps

of Engineers, is responsible for the following, which apply to both normal and emergency conditions:

(1) Monitoring the operation of the project to ensure compliance with the Water Control Plan and flood control regulations.

(2) Advising operating agencies and the Chief of Engineers of any departure from the flood control regulations.

(3) Reviewing, preparing, and reporting to the CESPD Division Engineer any emergency or deviation (unplanned or planned) from prescribed flood control criteria.

(4) Preparing short-period, daily, and monthly operation and other special reports relative to operation of the reservoir required by the Office, Chief of Engineers.

(5) Preparing revisions to the flood control criteria found herein.

(6) Providing training in water management to the Project Operator.

A-02. Data Collection and Reporting

a. Normal Conditions

(1) The reservoir operator or operating agency shall provide to the CESPK Water Management Section and to the DWR each workday between midnight and 2:00 a.m. and at other times upon request, data as described on Plate A-8, Operational Data Requirements. Data obtained on non-work days will be furnished on the following work day.

(2) Immediately after the end of each month, the operating agency shall provide to the CESPK Water Management Section a summary of the following operation data:

(a) Daily inflow, outflow, elevation and storage at Folsom Lake.

(b) Daily requirement of flood control space at Folsom Lake.

(c) Precipitation at Folsom Dam.

b. Emergency Conditions. For flood events or other emergency conditions, the information in paragraph A-02a above will also apply. Reclamation will immediately notify the appropriate agencies, as well as the Corps.

c. Regional Hydrometeorological Conditions. The Project Operator and Water Management Section will be informed of regional hydrometeorological conditions which could impact the structure. The Water Control Manager obtains information on hydrometeorological conditions from the following agencies:

(1) The National Weather Service (NWS) office in Sacramento maintains year-

round surveillance of weather conditions. The NWS also prepares and distributes weather and streamflow forecasts to agencies responsible for flood protection and to the public by way of the local news media, Internet, and e-mail. The NWS office furnishes meteorological data and weather forecasts on a continuous 24-hour basis. Quantitative Precipitation Forecasts (QPF), Quantitative Temperature Forecasts (QTF), and streamflow forecasts are issued twice a day and more frequently during flood events.

(2) Personnel from the California-Nevada River Forecast Center (CNRFC) of the NWS office in Sacramento and the DWR are assigned to the Joint Federal-State River Forecast Center, which monitors weather conditions and river stages on a year-round basis. If floods on major rivers are imminent, the Federal-State Flood Operations Center (FOC) is activated.

(3) The FOC is activated when floods on major streams become imminent. This center operates on a 24-hour basis and, among other flood emergency activities, advises all interested parties of flood situations as they develop. The center furnishes flood warnings and forecasts of river stages to local news media, law enforcement agencies, and other responsible agencies for their use and for dissemination to the public.

A-03. Water Control Action and Reporting

a. Normal Conditions. Whenever encroachment into the currently required flood control storage reservation occurs, this water should be released in accordance with the criteria contained on the Water Control Diagram, Plate A-9 and the Emergency Spillway Release Diagram, Plate A-10. Operation of the project will be in accordance with the procedures defined in the following paragraphs.

(1) During the flood season from 01 October thru 31 May, the flood control operation each day consists of determining the required storage space reservation and scheduling releases in order to provide the required space reservation, whenever possible. Storage space in Folsom Lake shall be reserved on the basis of the Water Control Diagram, Plate A-9, which indicates seasonal storage space requirements. The flood control space increases from zero on 01 October to a variable flood space which ranges from 400,000-600,000 acre-feet on 18 November.

Between 18 November and 01 March, the flood control space is regulated using inflow forecast products issued by the California-Nevada River Forecast Center (CNRFC). CNRFC provides “impaired” or “regulated” inflow forecast products, reflecting current upstream storage and basin wetness conditions. Ensembles contain 60+ members or forecasted “impaired” inflow hydrographs. The number of inflow hydrographs included in an ensemble increases by 1 each year. The “impaired” inflow ensemble product is issued once daily or as frequently as every 6 hours once the 120-hour volume exceeds 300,000 acre-feet. This product has a 1-hour time step. The “impaired” 1-, 2-, 3-, or 5-day forecasted inflow volumes (acre-feet) are used to determine the flood control space requirement and to schedule releases.

Beginning on 1 March, the flood space requirement gradually decreases along with the rain flood potential until zero flood control space is required on 1 June.

(2) Releases above 115,000 cfs are governed by the ESRD, and are a function of current pool elevation and current inflow. Except during emergency spillway operations, releases from Nimbus Dam, insofar as possible, will be restricted to flows which will not exceed the channel capacity of 115,000 cfs. Table A-1 identifies locations where damages may occur for flows less than 115,000 cfs.

TABLE A-1
POTENTIAL AREAS OF DAMAGE ALONG THE FLOODWAY

Flow in cfs	Floodway Considerations
10,000	Low-lying park areas
15,000	Areas of Campus Commons Golf Course and segments of the American River Parkway bike trail
20,000	Areas of Discovery Park
30,000	Arcade Water District must turn off their river intake
45,000	The Sacramento County bike bridge
50,000	Carmichael Water District access road
65,000	Significant stretches of the American River Parkway bike trail
115,000	Below Nimbus Fish Hatchery with bank erosion occurring in many places along the lower American River channel

(3) Whenever the lake level rises above elevation 450.7 feet NAVD88 (448.36 feet NGVD29), refer to the Emergency Spillway Release Diagram, Plate A-10, for the necessity of larger releases. When the diagram indicates emergency releases be made immediately, it is essential that these releases be made immediately. The Emergency Spillway Release Diagram, Plate A-10, indicates the minimum permissible releases that can be made without endangering the structure and without releasing quantities in excess of natural runoff, and without requiring excessively rapid changes in outflow. In order to assure the safety of the structure and minimize surcharge, the operating agency may, on the basis of forecasts, make releases somewhat greater than those required by the diagram.

EM 1110-2-3600 provides guidance on the development of Emergency Spillway Release Diagrams. Additional adjustments were made to the family of inflow curves to obtain the diagram shown in Plate A-10. With this diagram, inflow curves for releases up to 160,000 cfs were adjusted to allow the use of surcharge space when routing a 1/200 ACE event. This portion of the diagram therefore is designed to provide downstream flood protection. Inflow curves for releases greater than 160,000 cfs were adjusted to take advantage of the high ramping rate

capacity provided by the auxiliary spillway. These curves are more aggressive than the EM 1110-2-3600 method and successfully pass the PMF with required freeboard. This portion of the diagram therefore is designed to ensure dam safety.

The diagram is thus designed to defer emergency releases until it is virtually certain that those or larger releases will be necessary. Accordingly, when such releases are indicated by the diagram, it is essential that they be made immediately in order that it will not subsequently be necessary to make still larger releases. For this reason, the dam operators should be thoroughly familiar with the Emergency Spillway Release Diagram and should be empowered by standing instructions to initiate use of the diagram if required when communication with Central Valley Project (CVP) operations in Sacramento is disrupted.

(4) In addition, the restricted rate of change of release will minimize bank sloughing and caving. As an operating guide, the rate of change of release from Folsom Dam should be limited insofar as practicable to:

(a) Maximum rate of increase:

i. 5,000 cfs each hour for releases up to 30,000 cfs.
ii. 15,000 cfs each hour for releases from 30,000 to 160,000 cfs.
iii. 50,000 cfs each hour for releases from 160,000 to 360,000 cfs.

(b) Maximum rate of decrease: 5,000 cfs each hour for all releases.

b. Emergency Conditions. During floods and other emergencies, the official regulations are subject to temporary modifications by the CESPK District Engineer or designee. The Corps will revisit the flood control criteria, as necessary, to reflect changed conditions that come to bear upon flood control operation of the Lake. Permanent revisions of the flood control criteria are subject to prior approval of the Chief of Engineers or designee.

c. Inquiries. All significant inquiries received by the Project Operator from citizens, constituents, or interest groups regarding water control procedures or actions must be communicated directly to the Corps' project Water Manager. The Water Manager will provide a courtesy copy of the response and the inquiries to the CESPK District Engineer or designee, Chief, Water Management Section.

d. Water Control Problems. When water control problems occur, such as an operational malfunction, erosion, or an incident that could impact project integrity or water control capability, the Corps' project Water Manager must be contacted immediately by the most rapid means available. The Water Manager will then forward a description of the problem with the executed or recommended resolution to the CESPK District Engineer or designee, Chief, Water Management Section.

e. Communication Outage. If communication is broken between the operating personnel and the Regional Office during a flood emergency, the following procedure is recommended:

(1) Continue releases in accordance with the last instructions received from the Regional Office and make every attempt to re-establish communication.

(2) If communications cannot be re-established and larger releases are required by the Water Control Diagram (Plate A-9), releases should be increased in accordance with the diagram.

(3) Whenever the reservoir level of Folsom Lake approaches pool elevation (450.7 feet NAVD88 (448.36 feet NGVD29)) and the reservoir level is rising because of flood inflow, the necessity for emergency spillway releases from Folsom Dam should be determined. Plate A-10, Emergency Spillway Release Diagram, indicates the minimum release considered permissible to avoid endangering the structure.

A.04. Deviation from Normal Regulation. Deviations from approved Water Control Plans occur because every possible circumstance cannot be accounted for in a Water Control Plan. Because of the often competing goals and complex interactions of interested groups or agencies, even seemingly inconsequential deviations from an approved plan can lead to unforeseen environmental and legal complications. The CESPD regulation, CESPD R 10-1-04 dated 18 December 2014, serves to assist the Sacramento District of the Corps (CESPK) in preparing their deviation requests. It outlines a minimum set of considerations that need to be addressed when making a recommendation to deviate from an approved Water Control Plan.

Deviations from approved Water Control Plans are intended, therefore, to address unforeseen and unique circumstances. They are not intended as a means for identifying or initiating new opportunities to re-operate or reallocate storage in response to new and changing public needs.

a. Definitions

(1) Emergency Deviations. An emergency deviation from an approved Water Control Plan is one that is required due to an emergency situation. An emergency situation is defined herein as a situation in which there is a potential for injury, loss of life, threat to the project, or other serious hazards; but furthermore, an emergency situation also demands immediate action, such that time constraints render notification to the CESPK Water Management Section and subsequently to South Pacific Division (CESPD) impractical. Depending upon the need for immediate action, an emergency situation could include: drowning and other accidents, assistance to local authorities responding to an emergency (e.g., police and fire departments), failure of operations facilities, chemical spills, treatment plant failures, and other temporary pollution or water quality problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions.

(2) Unplanned Deviations. The need for unplanned deviations can arise due to unforeseen conditions that do not allow sufficient time for a full analysis prior to the deviation. These types of unplanned deviations could arise due to construction, maintenance, inspection or flood control needs. Such deviations generally last from a few hours to a few days. Each request for an unplanned deviation should be analyzed on its own merits, with an evaluation of factors such as impacts to potential failure mode and consequences, upstream watershed conditions, potential flood threat, condition of the lake, possible alternative measures, and potential adverse effects on the overall regulation of the project for the authorized purposes. Requests for and approval of unplanned deviations may be transmitted by telephone or electronic media. Follow-

up written documentation explaining the deviation and its cause shall be furnished as soon as practicable to the CESPD Senior Regional Hydrology and Hydraulics (H&H)/Water Control Engineer with notification to CESPK and CESPD Dam Safety Officers. Unplanned deviation should follow the guidance and process of a planned deviation. It is recognized that unplanned deviation may require expedited review/approval due to the circumstances. Hence, early notification to CESPD is of utmost importance.

(3) Planned Deviations. Planned deviations cover all other deviations to any approved Water Control Plan and/or Lake Regulation Schedule. Planned deviations are categorized into two types: Planned Minor and Planned Major.

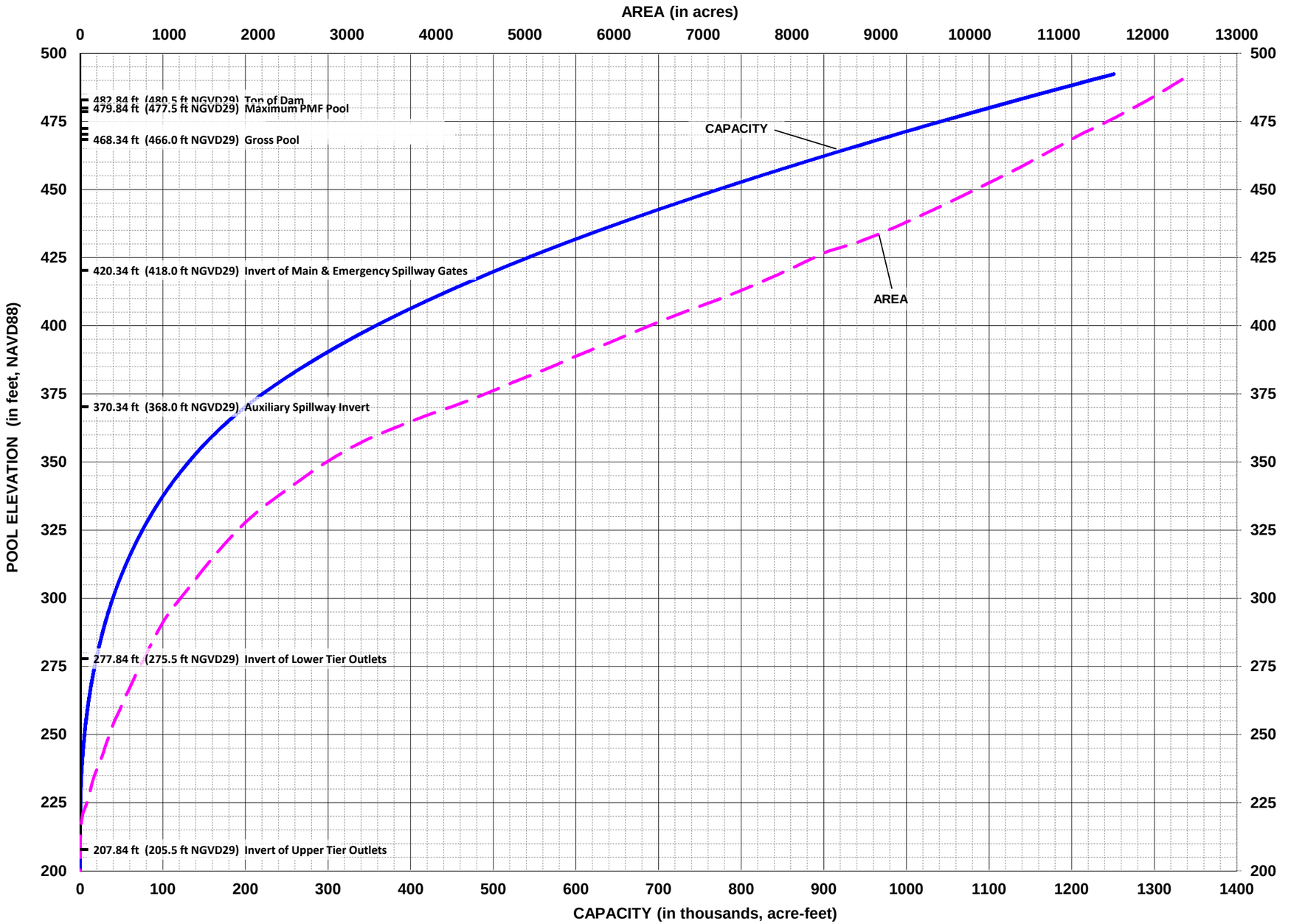
(a) *Planned Minor.* A planned minor deviation is limited by: (i) flood control pool elevation will not vary more than 2 feet from what would have been the water surface elevation under the approved Water Control Plan or (ii) the storage difference from the approved Water Control Manual will not exceed 5 percent of the total storage. Minor deviation should not last more than 10 days. Longer minor deviation must be coordinated with the CESPD Senior Regional H&HWater Control Engineer.

(b) *Planned Major.* All other planned deviations are considered major deviations.

b. Office of Record. CESPK's Water Management Section will be responsible for maintaining all relevant records documenting the deviation.

c. General Information for Preparing All Deviations. All information regarding preparation and approval of a deviation can be found in Exhibit D.

- DRAFT -



Prepared by VNT / MVB

Notes:

1. The storage capacity information (ac-ft) on this plate will be adjusted as information concerning sediment deposition in the lake becomes available.

   Between sediment surveys, it will be assumed that the sediment deposition in the project space will be 5,300 acre-feet over a 100-year period, or 53 acre-feet per year, beginning in 1975 (2,173 acre-feet through 2016).

2. Area and capacity based on Reclamation Technical Service Center (TSC), Denver CO September 2005 Folsom lake survey.

3. Datum is NAVD88

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

AREA AND CAPACITY CURVES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017

PLATE A-1

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE AREA TABLE IS IN ACRES — THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET		0	.1	.2	.3	.4	.5	.6	.7	.8	.9
NAVD88*	NGVD29										
192.34	190	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
193.34	191	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
194.34	192	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
195.34	193	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
196.34	194	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
197.34	195	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
198.34	196	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
199.34	197	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
200.34	198	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
201.34	199	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
202.34	200	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
203.34	201	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
204.34	202	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
205.34	203	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
206.34	204	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
207.34	205	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
208.34	206	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
209.34	207	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
210.34	208	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
211.34	209	1.	2.	2.	2.	2.	2.	2.	2.	2.	2.
212.34	210	2.	2.	3.	3.	3.	3.	4.	4.	4.	5.
213.34	211	5.	5.	6.	6.	6.	7.	7.	7.	7.	8.
214.34	212	8.	8.	9.	9.	9.	10.	10.	10.	10.	11.
215.34	213	11.	11.	11.	11.	12.	12.	12.	12.	12.	12.
216.34	214	12.	12.	13.	13.	13.	13.	13.	13.	13.	13.
217.34	215	13.	14.	14.	14.	14.	14.	14.	14.	14.	15.
218.34	216	15.	15.	16.	17.	17.	18.	18.	19.	20.	20.
219.34	217	21.	21.	22.	23.	23.	24.	25.	25.	26.	26.
220.34	218	27.	28.	28.	29.	29.	30.	31.	31.	32.	33.
221.34	219	33.	34.	36.	37.	38.	39.	40.	42.	43.	44.
222.34	220	45.	46.	47.	49.	50.	51.	52.	53.	55.	56.
223.34	221	57.	58.	59.	60.	62.	63.	64.	65.	66.	68.
224.34	222	69.	70.	71.	72.	73.	74.	74.	75.	76.	77.
225.34	223	78.	79.	80.	81.	82.	83.	84.	85.	86.	87.
226.34	224	88.	89.	90.	91.	92.	93.	94.	94.	95.	96.

* NAVD88 column inserted in Reclamations's area-capacity tables by adding 2.34 to existing NGVD29 elevations

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
227.34	225	97.	98.	99.	100.	100.	101.	102.	103.	104.	104.
228.34	226	105.	106.	107.	108.	108.	109.	110.	111.	112.	112.
229.34	227	113.	114.	115.	116.	116.	117.	118.	119.	120.	120.
230.34	228	121.	122.	123.	123.	124.	125.	125.	126.	127.	128.
231.34	229	128.	129.	130.	131.	131.	132.	133.	133.	134.	135.
232.34	230	136.	136.	137.	138.	138.	139.	140.	141.	141.	142.
233.34	231	143.	144.	145.	146.	147.	148.	150.	151.	152.	153.
234.34	232	154.	155.	157.	158.	159.	160.	161.	162.	163.	165.
235.34	233	166.	167.	168.	169.	170.	172.	173.	174.	175.	176.
236.34	234	177.	179.	180.	181.	183.	184.	185.	186.	188.	189.
237.34	235	190.	192.	193.	194.	196.	197.	198.	200.	201.	202.
238.34	236	204.	205.	206.	208.	209.	210.	211.	213.	214.	215.
239.34	237	217.	218.	219.	220.	221.	222.	223.	224.	225.	226.
240.34	238	228.	229.	230.	231.	232.	233.	234.	235.	236.	237.
241.34	239	238.	239.	241.	242.	243.	244.	245.	246.	247.	248.
242.34	240	249.	250.	251.	253.	254.	255.	256.	257.	258.	259.
243.34	241	260.	261.	262.	263.	264.	265.	266.	267.	268.	269.
244.34	242	270.	271.	272.	273.	274.	275.	276.	277.	278.	278.
245.34	243	279.	280.	281.	282.	283.	284.	285.	286.	287.	288.
246.34	244	289.	290.	291.	292.	294.	295.	296.	297.	298.	299.
247.34	245	300.	301.	303.	304.	305.	306.	307.	308.	309.	310.
248.34	246	312.	313.	314.	315.	316.	317.	318.	319.	320.	322.
249.34	247	323.	324.	325.	326.	327.	328.	329.	330.	331.	332.
250.34	248	333.	334.	335.	336.	337.	339.	340.	341.	342.	343.
251.34	249	344.	345.	346.	347.	348.	349.	350.	351.	352.	353.
252.34	250	354.	356.	357.	358.	359.	360.	362.	363.	364.	365.
253.34	251	366.	368.	369.	370.	371.	372.	373.	375.	376.	377.
254.34	252	378.	379.	381.	382.	383.	384.	385.	387.	388.	389.
255.34	253	390.	392.	393.	395.	396.	398.	399.	401.	402.	404.
256.34	254	405.	407.	408.	410.	411.	413.	414.	416.	417.	419.
257.34	255	420.	422.	423.	425.	426.	428.	429.	431.	432.	434.
258.34	256	435.	437.	438.	439.	441.	442.	443.	445.	446.	447.
259.34	257	449.	450.	452.	453.	454.	456.	457.	458.	460.	461.
260.34	258	462.	464.	465.	467.	468.	469.	471.	472.	473.	475.
261.34	259	476.	477.	479.	480.	481.	483.	484.	485.	486.	488.
262.34	260	489.	490.	492.	493.	494.	495.	497.	498.	499.	501.
263.34	261	502.	503.	505.	506.	507.	508.	510.	511.	512.	514.
264.34	262	515.	516.	518.	519.	521.	522.	524.	525.	527.	528.
265.34	263	530.	531.	533.	534.	536.	537.	539.	540.	542.	543.
266.34	264	545.	546.	548.	549.	551.	552.	554.	555.	557.	558.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88 9:11:25

THE AREA TABLE IS IN ACRES THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
267.34	265	560.	561.	563.	564.	565.	567.	568.	570.	571.	572.
268.34	266	574.	575.	577.	578.	579.	581.	582.	584.	585.	587.
269.34	267	588.	589.	591.	592.	594.	595.	596.	598.	599.	601.
270.34	268	602.	604.	605.	606.	608.	609.	611.	612.	613.	615.
271.34	269	616.	618.	619.	621.	622.	623.	625.	626.	628.	629.
272.34	270	630.	632.	633.	635.	636.	638.	639.	640.	642.	643.
273.34	271	645.	646.	648.	650.	651.	653.	654.	656.	658.	659.
274.34	272	661.	663.	664.	666.	668.	669.	671.	673.	674.	676.
275.34	273	677.	679.	681.	682.	684.	686.	687.	689.	691.	692.
276.34	274	694.	695.	697.	699.	700.	702.	703.	705.	707.	708.
277.34	275	710.	711.	713.	714.	716.	718.	719.	721.	722.	724.
278.34	276	726.	727.	729.	730.	732.	733.	735.	737.	738.	740.
279.34	277	741.	743.	744.	746.	747.	749.	750.	752.	753.	754.
280.34	278	756.	757.	759.	760.	762.	763.	765.	766.	767.	769.
281.34	279	770.	772.	773.	775.	776.	778.	779.	780.	782.	783.
282.34	280	785.	786.	788.	789.	791.	793.	794.	796.	797.	799.
283.34	281	800.	802.	803.	805.	806.	808.	810.	811.	813.	814.
284.34	282	816.	817.	819.	820.	822.	824.	825.	827.	828.	830.
285.34	283	831.	833.	835.	836.	838.	839.	841.	843.	844.	846.
286.34	284	848.	849.	851.	853.	854.	856.	857.	859.	861.	862.
287.34	285	864.	866.	867.	869.	871.	872.	874.	875.	877.	879.
288.34	286	880.	882.	884.	886.	887.	889.	891.	893.	894.	896.
289.34	287	898.	900.	901.	903.	905.	906.	908.	910.	912.	913.
290.34	288	915.	917.	919.	920.	922.	924.	926.	927.	929.	931.
291.34	289	932.	934.	936.	938.	940.	942.	944.	946.	948.	950.
292.34	290	952.	954.	956.	958.	960.	962.	964.	966.	968.	970.
293.34	291	972.	974.	976.	978.	980.	982.	984.	986.	988.	990.
294.34	292	992.	994.	997.	999.	1001.	1004.	1006.	1008.	1011.	1013.
295.34	293	1015.	1018.	1020.	1022.	1025.	1027.	1029.	1032.	1034.	1036.
296.34	294	1039.	1041.	1043.	1046.	1048.	1050.	1053.	1055.	1057.	1059.
297.34	295	1062.	1064.	1067.	1069.	1072.	1074.	1076.	1079.	1081.	1084.
298.34	296	1086.	1089.	1091.	1094.	1096.	1099.	1101.	1103.	1106.	1108.
299.34	297	1111.	1113.	1116.	1118.	1121.	1123.	1125.	1128.	1130.	1133.
300.34	298	1135.	1138.	1140.	1143.	1145.	1147.	1150.	1152.	1155.	1157.
301.34	299	1160.	1162.	1165.	1167.	1170.	1172.	1174.	1177.	1179.	1182.
302.34	300	1184.	1187.	1189.	1192.	1194.	1197.	1199.	1201.	1204.	1206.
303.34	301	1209.	1211.	1214.	1216.	1219.	1221.	1223.	1226.	1228.	1231.
304.34	302	1233.	1236.	1238.	1240.	1243.	1245.	1247.	1250.	1252.	1254.
305.34	303	1257.	1259.	1262.	1264.	1266.	1269.	1271.	1273.	1276.	1278.
306.34	304	1280.	1283.	1285.	1287.	1290.	1292.	1294.	1297.	1299.	1301.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE AREA TABLE IS IN ACRES — THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
307.34	305	1304.	1306.	1309.	1311.	1313.	1316.	1318.	1321.	1323.	1326.
308.34	306	1328.	1330.	1333.	1335.	1338.	1340.	1343.	1345.	1347.	1350.
309.34	307	1352.	1355.	1357.	1359.	1362.	1364.	1367.	1369.	1372.	1374.
310.34	308	1376.	1379.	1381.	1384.	1386.	1389.	1391.	1394.	1396.	1399.
311.34	309	1401.	1403.	1406.	1408.	1411.	1413.	1416.	1418.	1421.	1423.
312.34	310	1426.	1428.	1431.	1433.	1435.	1438.	1440.	1443.	1445.	1448.
313.34	311	1450.	1453.	1455.	1458.	1460.	1463.	1466.	1468.	1471.	1473.
314.34	312	1476.	1478.	1481.	1484.	1486.	1489.	1491.	1494.	1496.	1499.
315.34	313	1501.	1504.	1507.	1509.	1512.	1514.	1517.	1519.	1522.	1525.
316.34	314	1527.	1530.	1532.	1535.	1538.	1540.	1543.	1546.	1548.	1551.
317.34	315	1554.	1557.	1559.	1562.	1565.	1567.	1570.	1573.	1575.	1578.
318.34	316	1581.	1583.	1586.	1589.	1591.	1594.	1597.	1599.	1602.	1605.
319.34	317	1607.	1610.	1613.	1616.	1618.	1621.	1624.	1627.	1630.	1632.
320.34	318	1635.	1638.	1641.	1643.	1646.	1649.	1652.	1655.	1657.	1660.
321.34	319	1663.	1666.	1668.	1671.	1674.	1677.	1679.	1682.	1685.	1688.
322.34	320	1691.	1694.	1696.	1699.	1702.	1705.	1708.	1711.	1714.	1717.
323.34	321	1720.	1723.	1726.	1729.	1731.	1734.	1737.	1740.	1743.	1746.
324.34	322	1749.	1752.	1755.	1758.	1761.	1764.	1767.	1769.	1772.	1775.
325.34	323	1778.	1781.	1785.	1788.	1791.	1794.	1797.	1800.	1803.	1807.
326.34	324	1810.	1813.	1816.	1819.	1822.	1825.	1829.	1832.	1835.	1838.
327.34	325	1841.	1844.	1847.	1851.	1854.	1857.	1860.	1863.	1866.	1870.
328.34	326	1873.	1876.	1880.	1883.	1887.	1890.	1894.	1897.	1900.	1904.
329.34	327	1907.	1911.	1914.	1918.	1921.	1925.	1928.	1932.	1935.	1939.
330.34	328	1942.	1946.	1949.	1952.	1956.	1959.	1963.	1966.	1970.	1973.
331.34	329	1977.	1980.	1984.	1988.	1992.	1996.	1999.	2003.	2007.	2011.
332.34	330	2015.	2018.	2022.	2026.	2030.	2034.	2037.	2041.	2045.	2049.
333.34	331	2053.	2056.	2060.	2064.	2068.	2072.	2075.	2079.	2083.	2087.
334.34	332	2090.	2095.	2099.	2103.	2107.	2112.	2116.	2120.	2124.	2128.
335.34	333	2132.	2137.	2141.	2145.	2149.	2153.	2158.	2162.	2166.	2170.
336.34	334	2174.	2178.	2183.	2187.	2191.	2195.	2199.	2203.	2208.	2212.
337.34	335	2216.	2220.	2224.	2229.	2233.	2237.	2241.	2245.	2249.	2254.
338.34	336	2258.	2262.	2266.	2270.	2275.	2279.	2283.	2287.	2291.	2295.
339.34	337	2300.	2304.	2308.	2312.	2316.	2320.	2325.	2329.	2333.	2337.
340.34	338	2341.	2346.	2350.	2354.	2359.	2363.	2367.	2372.	2376.	2380.
341.34	339	2385.	2389.	2393.	2398.	2402.	2406.	2411.	2415.	2420.	2424.
342.34	340	2428.	2433.	2437.	2441.	2446.	2450.	2454.	2459.	2463.	2467.
343.34	341	2472.	2476.	2480.	2484.	2489.	2493.	2497.	2502.	2506.	2510.
344.34	342	2514.	2519.	2523.	2527.	2531.	2536.	2540.	2544.	2549.	2553.
345.34	343	2557.	2561.	2566.	2570.	2574.	2578.	2583.	2587.	2591.	2595.
346.34	344	2600.	2604.	2609.	2614.	2618.	2623.	2627.	2632.	2637.	2641.

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2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88 9:11:25

THE AREA TABLE IS IN ACRES THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
347.34	345	2646.	2650.	2655.	2660.	2664.	2669.	2673.	2678.	2683.	2687.
348.34	346	2692.	2697.	2701.	2706.	2710.	2715.	2720.	2724.	2729.	2733.
349.34	347	2738.	2743.	2748.	2753.	2758.	2763.	2768.	2773.	2777.	2782.
350.34	348	2787.	2792.	2797.	2802.	2807.	2812.	2817.	2822.	2827.	2832.
351.34	349	2837.	2842.	2847.	2852.	2856.	2861.	2866.	2871.	2876.	2881.
352.34	350	2886.	2891.	2897.	2902.	2908.	2913.	2918.	2924.	2929.	2935.
353.34	351	2940.	2945.	2951.	2956.	2961.	2967.	2972.	2978.	2983.	2988.
354.34	352	2994.	2999.	3005.	3010.	3015.	3021.	3026.	3031.	3037.	3042.
355.34	353	3048.	3054.	3060.	3066.	3072.	3078.	3084.	3090.	3096.	3102.
356.34	354	3108.	3114.	3120.	3126.	3132.	3138.	3144.	3150.	3156.	3162.
357.34	355	3168.	3175.	3181.	3187.	3193.	3199.	3205.	3211.	3217.	3223.
358.34	356	3229.	3236.	3243.	3250.	3257.	3265.	3272.	3279.	3286.	3293.
359.34	357	3300.	3307.	3315.	3322.	3329.	3336.	3343.	3350.	3357.	3365.
360.34	358	3372.	3379.	3386.	3393.	3400.	3407.	3415.	3422.	3429.	3436.
361.34	359	3443.	3451.	3458.	3466.	3473.	3481.	3489.	3496.	3504.	3511.
362.34	360	3519.	3527.	3534.	3542.	3549.	3557.	3564.	3572.	3580.	3587.
363.34	361	3595.	3602.	3610.	3617.	3625.	3633.	3640.	3648.	3655.	3663.
364.34	362	3670.	3679.	3687.	3695.	3703.	3711.	3719.	3727.	3735.	3743.
365.34	363	3752.	3760.	3768.	3776.	3784.	3792.	3800.	3808.	3817.	3825.
366.34	364	3833.	3841.	3849.	3857.	3865.	3873.	3881.	3890.	3898.	3906.
367.34	365	3914.	3923.	3932.	3941.	3949.	3958.	3967.	3976.	3985.	3994.
368.34	366	4003.	4012.	4020.	4029.	4038.	4047.	4056.	4065.	4074.	4083.
369.34	367	4091.	4100.	4109.	4118.	4127.	4136.	4145.	4154.	4162.	4171.
370.34	368	4180.	4188.	4197.	4205.	4213.	4222.	4230.	4238.	4246.	4255.
371.34	369	4263.	4271.	4279.	4288.	4296.	4304.	4313.	4321.	4329.	4337.
372.34	370	4346.	4354.	4362.	4370.	4379.	4387.	4395.	4403.	4412.	4420.
373.34	371	4428.	4436.	4443.	4451.	4458.	4466.	4473.	4481.	4488.	4496.
374.34	372	4503.	4511.	4518.	4526.	4533.	4541.	4548.	4556.	4563.	4571.
375.34	373	4578.	4586.	4593.	4601.	4608.	4616.	4623.	4631.	4638.	4646.
376.34	374	4653.	4660.	4668.	4675.	4682.	4690.	4697.	4704.	4712.	4719.
377.34	375	4726.	4733.	4741.	4748.	4755.	4763.	4770.	4777.	4785.	4792.
378.34	376	4799.	4806.	4814.	4821.	4828.	4836.	4843.	4850.	4858.	4865.
379.34	377	4872.	4880.	4888.	4895.	4903.	4911.	4918.	4926.	4934.	4942.
380.34	378	4949.	4957.	4965.	4972.	4980.	4988.	4996.	5003.	5011.	5019.
381.34	379	5026.	5034.	5042.	5050.	5057.	5065.	5073.	5080.	5088.	5096.
382.34	380	5104.	5111.	5118.	5126.	5133.	5141.	5148.	5156.	5163.	5171.
383.34	381	5178.	5186.	5193.	5201.	5208.	5215.	5223.	5230.	5238.	5245.
384.34	382	5253.	5260.	5268.	5275.	5283.	5290.	5298.	5305.	5312.	5320.
385.34	383	5327.	5334.	5341.	5348.	5355.	5362.	5369.	5376.	5383.	5390.
386.34	384	5397.	5404.	5411.	5418.	5425.	5431.	5438.	5445.	5452.	5459.

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2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88 9:11:25

THE AREA TABLE IS IN ACRES THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
387.34	385	5466.	5473.	5480.	5487.	5494.	5501.	5508.	5515.	5522.	5529.
388.34	386	5535.	5543.	5550.	5558.	5565.	5573.	5580.	5588.	5595.	5603.
389.34	387	5610.	5618.	5625.	5632.	5640.	5647.	5655.	5662.	5670.	5677.
390.34	388	5685.	5692.	5700.	5707.	5715.	5722.	5729.	5737.	5744.	5752.
391.34	389	5759.	5767.	5774.	5782.	5790.	5797.	5805.	5812.	5820.	5827.
392.34	390	5835.	5842.	5850.	5858.	5865.	5873.	5880.	5888.	5895.	5903.
393.34	391	5911.	5918.	5926.	5933.	5941.	5948.	5956.	5964.	5971.	5979.
394.34	392	5986.	5993.	6001.	6008.	6015.	6022.	6029.	6037.	6044.	6051.
395.34	393	6058.	6065.	6072.	6080.	6087.	6094.	6101.	6108.	6116.	6123.
396.34	394	6130.	6137.	6144.	6151.	6159.	6166.	6173.	6180.	6187.	6195.
397.34	395	6202.	6209.	6217.	6224.	6231.	6239.	6246.	6254.	6261.	6269.
398.34	396	6276.	6283.	6291.	6298.	6306.	6313.	6321.	6328.	6335.	6343.
399.34	397	6350.	6358.	6365.	6372.	6380.	6387.	6395.	6402.	6410.	6417.
400.34	398	6424.	6432.	6440.	6447.	6455.	6462.	6470.	6478.	6485.	6493.
401.34	399	6500.	6508.	6515.	6523.	6531.	6538.	6546.	6553.	6561.	6569.
402.34	400	6576.	6584.	6591.	6599.	6607.	6614.	6622.	6629.	6637.	6645.
403.34	401	6652.	6660.	6668.	6676.	6684.	6692.	6700.	6709.	6717.	6725.
404.34	402	6733.	6741.	6749.	6757.	6765.	6773.	6781.	6789.	6797.	6805.
405.34	403	6813.	6821.	6829.	6837.	6846.	6854.	6862.	6870.	6878.	6886.
406.34	404	6894.	6902.	6911.	6919.	6928.	6936.	6945.	6953.	6962.	6970.
407.34	405	6979.	6987.	6995.	7004.	7012.	7021.	7029.	7038.	7046.	7055.
408.34	406	7063.	7072.	7080.	7089.	7097.	7106.	7114.	7122.	7131.	7139.
409.34	407	7148.	7156.	7163.	7171.	7179.	7187.	7195.	7202.	7210.	7218.
410.34	408	7226.	7234.	7241.	7249.	7257.	7265.	7272.	7280.	7288.	7296.
411.34	409	7304.	7311.	7319.	7327.	7335.	7343.	7350.	7358.	7366.	7374.
412.34	410	7381.	7389.	7396.	7404.	7411.	7419.	7426.	7433.	7441.	7448.
413.34	411	7456.	7463.	7470.	7478.	7485.	7493.	7500.	7507.	7515.	7522.
414.34	412	7530.	7537.	7544.	7552.	7559.	7567.	7574.	7581.	7589.	7596.
415.34	413	7604.	7611.	7618.	7625.	7632.	7639.	7646.	7652.	7659.	7666.
416.34	414	7673.	7680.	7687.	7694.	7701.	7708.	7715.	7722.	7729.	7736.
417.34	415	7743.	7750.	7757.	7764.	7771.	7778.	7785.	7792.	7799.	7806.
418.34	416	7813.	7819.	7826.	7833.	7840.	7846.	7853.	7860.	7866.	7873.
419.34	417	7880.	7887.	7893.	7900.	7907.	7913.	7920.	7927.	7934.	7940.
420.34	418	7947.	7954.	7960.	7967.	7974.	7981.	7987.	7994.	8001.	8007.
421.34	419	8014.	8021.	8027.	8033.	8040.	8046.	8052.	8059.	8065.	8071.
422.34	420	8078.	8084.	8090.	8097.	8103.	8109.	8116.	8122.	8128.	8135.
423.34	421	8141.	8147.	8154.	8160.	8166.	8173.	8179.	8185.	8192.	8198.
424.34	422	8204.	8211.	8218.	8225.	8231.	8238.	8245.	8252.	8258.	8265.
425.34	423	8272.	8279.	8285.	8292.	8299.	8305.	8312.	8319.	8326.	8332.
426.34	424	8339.	8346.	8353.	8359.	8366.	8373.	8380.	8386.	8393.	8400.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE AREA TABLE IS IN ACRES

THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
427.34	425	8407.	8417.	8427.	8437.	8448.	8458.	8468.	8478.	8489.	8499.
428.34	426	8509.	8519.	8530.	8540.	8550.	8560.	8571.	8581.	8591.	8601.
429.34	427	8612.	8622.	8632.	8642.	8653.	8663.	8673.	8684.	8694.	8704.
430.34	428	8714.	8722.	8730.	8738.	8746.	8754.	8762.	8770.	8778.	8786.
431.34	429	8794.	8802.	8810.	8818.	8826.	8834.	8842.	8850.	8858.	8866.
432.34	430	8874.	8882.	8890.	8898.	8906.	8914.	8922.	8930.	8938.	8946.
433.34	431	8954.	8961.	8968.	8976.	8983.	8990.	8997.	9005.	9012.	9019.
434.34	432	9026.	9034.	9041.	9048.	9055.	9063.	9070.	9077.	9084.	9092.
435.34	433	9099.	9106.	9113.	9121.	9128.	9135.	9142.	9150.	9157.	9164.
436.34	434	9171.	9178.	9185.	9192.	9199.	9205.	9212.	9219.	9226.	9232.
437.34	435	9239.	9246.	9253.	9260.	9266.	9273.	9280.	9287.	9294.	9300.
438.34	436	9307.	9314.	9321.	9327.	9334.	9341.	9348.	9355.	9361.	9368.
439.34	437	9375.	9382.	9388.	9395.	9402.	9408.	9415.	9421.	9428.	9435.
440.34	438	9441.	9448.	9455.	9461.	9468.	9474.	9481.	9488.	9494.	9501.
441.34	439	9508.	9514.	9521.	9528.	9534.	9541.	9547.	9554.	9561.	9567.
442.34	440	9574.	9580.	9587.	9593.	9600.	9606.	9613.	9619.	9626.	9632.
443.34	441	9639.	9645.	9652.	9658.	9665.	9671.	9678.	9684.	9691.	9697.
444.34	442	9704.	9710.	9717.	9723.	9730.	9736.	9743.	9749.	9756.	9762.
445.34	443	9769.	9775.	9782.	9788.	9794.	9800.	9807.	9813.	9819.	9825.
446.34	444	9832.	9838.	9844.	9851.	9857.	9863.	9869.	9876.	9882.	9888.
447.34	445	9894.	9901.	9907.	9913.	9920.	9926.	9932.	9938.	9945.	9951.
448.34	446	9957.	9963.	9970.	9976.	9982.	9989.	9995.	10001.	10007.	10014.
449.34	447	10020.	10026.	10032.	10039.	10045.	10051.	10057.	10064.	10070.	10076.
450.34	448	10083.	10089.	10095.	10101.	10108.	10114.	10120.	10126.	10133.	10139.
451.34	449	10145.	10152.	10158.	10164.	10170.	10177.	10183.	10189.	10195.	10202.
452.34	450	10208.	10214.	10220.	10226.	10232.	10239.	10245.	10251.	10257.	10263.
453.34	451	10270.	10276.	10282.	10288.	10295.	10301.	10307.	10313.	10320.	10326.
454.34	452	10332.	10338.	10345.	10351.	10357.	10363.	10370.	10376.	10382.	10388.
455.34	453	10395.	10401.	10407.	10413.	10419.	10425.	10431.	10437.	10443.	10449.
456.34	454	10455.	10461.	10467.	10473.	10479.	10485.	10491.	10497.	10503.	10509.
457.34	455	10515.	10521.	10527.	10533.	10539.	10545.	10551.	10557.	10563.	10569.
458.34	456	10575.	10580.	10586.	10591.	10597.	10603.	10608.	10614.	10620.	10625.
459.34	457	10631.	10637.	10642.	10648.	10654.	10659.	10665.	10671.	10676.	10682.
460.34	458	10688.	10693.	10699.	10705.	10710.	10716.	10722.	10727.	10733.	10739.
461.34	459	10744.	10750.	10756.	10761.	10767.	10773.	10778.	10784.	10790.	10795.
462.34	460	10801.	10807.	10812.	10818.	10824.	10829.	10835.	10841.	10846.	10852.
463.34	461	10858.	10863.	10869.	10875.	10880.	10886.	10892.	10897.	10903.	10909.
464.34	462	10914.	10920.	10926.	10931.	10937.	10943.	10948.	10954.	10960.	10965.
465.34	463	10971.	10977.	10982.	10988.	10994.	10999.	11005.	11011.	11016.	11022.
466.34	464	11028.	11033.	11039.	11045.	11050.	11056.	11062.	11067.	11073.	11079.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88 9:11:25

THE AREA TABLE IS IN ACRES THE ELEVATION INCREMENT IS IN ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
467.34	465	11084.	11091.	11096.	11102.	11107.	11113.	11118.	11124.	11129.	11135.
468.34	466	11140.	11146.	11151.	11157.	11162.	11168.	11173.	11179.	11184.	11190.
469.34	467	11195.	11201.	11206.	11212.	11217.	11223.	11228.	11234.	11239.	11245.
470.34	468	11251.	11257.	11263.	11270.	11276.	11283.	11289.	11296.	11302.	11309.
471.34	469	11315.	11322.	11328.	11335.	11341.	11348.	11354.	11361.	11367.	11374.
472.34	470	11380.	11387.	11393.	11400.	11406.	11413.	11419.	11426.	11432.	11439.
473.34	471	11445.	11451.	11457.	11464.	11470.	11476.	11482.	11488.	11494.	11501.
474.34	472	11507.	11513.	11519.	11525.	11531.	11537.	11544.	11550.	11556.	11562.
475.34	473	11568.	11574.	11580.	11587.	11593.	11599.	11605.	11611.	11617.	11623.
476.34	474	11630.	11636.	11642.	11647.	11653.	11659.	11664.	11670.	11676.	11682.
477.34	475	11687.	11693.	11699.	11704.	11710.	11716.	11722.	11727.	11733.	11739.
478.34	476	11744.	11750.	11756.	11762.	11767.	11773.	11779.	11785.	11790.	11796.
479.34	477	11802.	11807.	11813.	11819.	11825.	11830.	11836.	11842.	11847.	11853.
480.34	478	11859.	11865.	11870.	11876.	11882.	11887.	11893.	11899.	11905.	11910.
481.34	479	11916.	11922.	11928.	11933.	11939.	11945.	11950.	11956.	11962.	11968.
482.34	480	11973.	11978.	11983.	11989.	11994.	11999.	12005.	12010.	12015.	12020.
483.34	481	12026.	12031.	12036.	12042.	12047.	12052.	12058.	12063.	12068.	12073.
484.34	482	12079.	12084.	12089.	12095.	12100.	12105.	12110.	12116.	12121.	12126.
485.34	483	12132.	12137.	12142.	12147.	12152.	12157.	12162.	12167.	12173.	12178.
486.34	484	12183.	12188.	12193.	12198.	12203.	12208.	12213.	12218.	12223.	12228.
487.34	485	12233.	12238.	12243.	12248.	12253.	12258.	12263.	12268.	12273.	12278.
488.34	486	12283.	12288.	12293.	12298.	12303.	12308.	12313.	12318.	12323.	12328.
489.34	487	12333.	12338.	12343.	12348.	12353.	12358.	12363.	12368.	12374.	12379.
490.34	488	12384.	12389.	12394.	12399.	12404.	12409.	12414.	12419.	12424.	12429.
491.34	489	12434.	12439.	12444.	12449.	12454.	12459.	12464.	12469.	12474.	12479.
492.34	490	12484.									

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE CAPACITY TABLE IS IN ACRE FEET THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET		0	.1	.2	.3	.4	.5	.6	.7	.8	.9
NAVD88	NGVD29										
192.34	190	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
193.34	191	0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
194.34	192	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
195.34	193	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
196.34	194	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
197.34	195	1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
198.34	196	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
199.34	197	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
200.34	198	2.	2.	2.	3.	3.	3.	3.	3.	3.	3.
201.34	199	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
202.34	200	3.	3.	3.	3.	3.	4.	4.	4.	4.	4.
203.34	201	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
204.34	202	4.	4.	4.	4.	4.	5.	5.	5.	5.	5.
205.34	203	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
206.34	204	5.	5.	6.	6.	6.	6.	6.	6.	6.	6.
207.34	205	6.	6.	6.	6.	6.	6.	6.	6.	7.	7.
208.34	206	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
209.34	207	7.	7.	7.	8.	8.	8.	8.	8.	8.	8.
210.34	208	8.	8.	8.	9.	9.	9.	9.	9.	9.	9.
211.34	209	10.	10.	10.	10.	10.	10.	11.	11.	11.	11.
212.34	210	11.	11.	12.	12.	12.	13.	13.	13.	14.	14.
213.34	211	15.	15.	16.	16.	17.	18.	18.	19.	20.	20.
214.34	212	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
215.34	213	31.	32.	33.	34.	35.	36.	38.	39.	40.	41.
216.34	214	42.	44.	45.	46.	47.	49.	50.	51.	53.	54.
217.34	215	55.	57.	58.	59.	61.	62.	64.	65.	67.	68.
218.34	216	69.	71.	73.	74.	76.	78.	79.	81.	83.	85.
219.34	217	87.	89.	92.	94.	96.	98.	101.	103.	106.	109.
220.34	218	111.	114.	117.	120.	122.	125.	129.	132.	135.	138.
221.34	219	141.	145.	148.	152.	156.	159.	163.	167.	172.	176.
222.34	220	180.	185.	190.	194.	199.	204.	210.	215.	220.	226.
223.34	221	231.	237.	243.	249.	255.	261.	268.	274.	281.	287.
224.34	222	294.	301.	308.	315.	323.	330.	337.	345.	352.	360.
225.34	223	368.	376.	384.	392.	400.	408.	417.	425.	434.	442.
226.34	224	451.	460.	469.	478.	487.	496.	505.	515.	524.	534.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE CAPACITY TABLE IS IN ACRE FEET THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
227.34	225	543.	553.	563.	573.	583.	593.	603.	614.	624.	634.
228.34	226	645.	655.	666.	677.	687.	698.	709.	720.	731.	743.
229.34	227	754.	765.	777.	788.	800.	812.	823.	835.	847.	859.
230.34	228	871.	883.	896.	908.	920.	933.	945.	958.	970.	983.
231.34	229	996.	1009.	1022.	1035.	1048.	1061.	1074.	1088.	1101.	1114.
232.34	230	1128.	1142.	1155.	1169.	1183.	1197.	1211.	1225.	1239.	1253.
233.34	231	1267.	1281.	1296.	1310.	1325.	1340.	1355.	1370.	1385.	1400.
234.34	232	1416.	1431.	1447.	1462.	1478.	1494.	1510.	1526.	1543.	1559.
235.34	233	1576.	1592.	1609.	1626.	1643.	1660.	1677.	1694.	1712.	1729.
236.34	234	1747.	1765.	1783.	1801.	1819.	1837.	1856.	1874.	1893.	1912.
237.34	235	1931.	1950.	1969.	1989.	2008.	2028.	2048.	2067.	2087.	2108.
238.34	236	2128.	2148.	2169.	2190.	2210.	2231.	2252.	2274.	2295.	2316.
239.34	237	2338.	2360.	2382.	2404.	2426.	2448.	2470.	2492.	2515.	2537.
240.34	238	2560.	2583.	2606.	2629.	2652.	2675.	2699.	2722.	2746.	2769.
241.34	239	2793.	2817.	2841.	2865.	2889.	2914.	2938.	2963.	2987.	3012.
242.34	240	3037.	3062.	3087.	3112.	3138.	3163.	3188.	3214.	3240.	3266.
243.34	241	3292.	3318.	3344.	3370.	3396.	3423.	3449.	3476.	3503.	3530.
244.34	242	3557.	3584.	3611.	3638.	3665.	3693.	3720.	3748.	3775.	3803.
245.34	243	3831.	3859.	3887.	3915.	3944.	3972.	4001.	4029.	4058.	4087.
246.34	244	4115.	4144.	4173.	4203.	4232.	4261.	4291.	4321.	4350.	4380.
247.34	245	4410.	4440.	4470.	4501.	4531.	4562.	4592.	4623.	4654.	4685.
248.34	246	4716.	4747.	4779.	4810.	4842.	4873.	4905.	4937.	4969.	5001.
249.34	247	5033.	5065.	5098.	5130.	5163.	5196.	5229.	5262.	5295.	5328.
250.34	248	5361.	5395.	5428.	5462.	5495.	5529.	5563.	5597.	5631.	5665.
251.34	249	5700.	5734.	5769.	5803.	5838.	5873.	5908.	5943.	5978.	6013.
252.34	250	6049.	6084.	6120.	6156.	6192.	6227.	6264.	6300.	6336.	6373.
253.34	251	6409.	6446.	6483.	6520.	6557.	6594.	6631.	6669.	6706.	6744.
254.34	252	6781.	6819.	6857.	6895.	6934.	6972.	7011.	7049.	7088.	7127.
255.34	253	7166.	7205.	7244.	7283.	7323.	7363.	7403.	7443.	7483.	7523.
256.34	254	7563.	7604.	7645.	7686.	7727.	7768.	7809.	7851.	7892.	7934.
257.34	255	7976.	8018.	8060.	8103.	8145.	8188.	8231.	8274.	8317.	8360.
258.34	256	8404.	8447.	8491.	8535.	8579.	8623.	8667.	8712.	8756.	8801.
259.34	257	8846.	8891.	8936.	8981.	9026.	9072.	9118.	9163.	9209.	9255.
260.34	258	9301.	9348.	9394.	9441.	9488.	9534.	9581.	9629.	9676.	9723.
261.34	259	9771.	9818.	9866.	9914.	9962.	10010.	10059.	10107.	10156.	10204.
262.34	260	10253.	10302.	10351.	10401.	10450.	10499.	10549.	10599.	10649.	10699.
263.34	261	10749.	10799.	10849.	10900.	10951.	11001.	11052.	11103.	11155.	11206.
264.34	262	11257.	11309.	11361.	11412.	11464.	11517.	11569.	11621.	11674.	11727.
265.34	263	11780.	11833.	11886.	11939.	11993.	12046.	12100.	12154.	12208.	12263.
266.34	264	12317.	12371.	12426.	12481.	12536.	12591.	12646.	12702.	12758.	12813.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88 9:11:25

THE CAPACITY TABLE IS IN ACRE FEET THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
267.34	265	12869.	12925.	12981.	13038.	13094.	13151.	13208.	13264.	13321.	13379.
268.34	266	13436.	13493.	13551.	13609.	13667.	13725.	13783.	13841.	13900.	13958.
269.34	267	14017.	14076.	14135.	14194.	14253.	14313.	14372.	14432.	14492.	14552.
270.34	268	14612.	14672.	14733.	14793.	14854.	14915.	14976.	15037.	15098.	15159.
271.34	269	15221.	15283.	15345.	15407.	15469.	15531.	15593.	15656.	15719.	15781.
272.34	270	15844.	15907.	15971.	16034.	16098.	16161.	16225.	16289.	16353.	16418.
273.34	271	16482.	16546.	16611.	16676.	16741.	16806.	16872.	16937.	17003.	17069.
274.34	272	17135.	17201.	17267.	17334.	17400.	17467.	17534.	17601.	17669.	17736.
275.34	273	17804.	17872.	17940.	18008.	18076.	18145.	18213.	18282.	18351.	18420.
276.34	274	18490.	18559.	18629.	18699.	18768.	18839.	18909.	18979.	19050.	19121.
277.34	275	19191.	19263.	19334.	19405.	19477.	19548.	19620.	19692.	19764.	19837.
278.34	276	19909.	19982.	20055.	20128.	20201.	20274.	20347.	20421.	20495.	20569.
279.34	277	20643.	20717.	20791.	20866.	20940.	21015.	21090.	21165.	21240.	21316.
280.34	278	21391.	21467.	21543.	21619.	21695.	21771.	21847.	21924.	22001.	22077.
281.34	279	22154.	22231.	22309.	22386.	22464.	22541.	22619.	22697.	22775.	22853.
282.34	280	22932.	23010.	23089.	23168.	23247.	23326.	23406.	23485.	23565.	23644.
283.34	281	23724.	23805.	23885.	23965.	24046.	24127.	24207.	24288.	24370.	24451.
284.34	282	24533.	24614.	24696.	24778.	24860.	24942.	25025.	25107.	25190.	25273.
285.34	283	25356.	25439.	25523.	25606.	25690.	25774.	25858.	25942.	26026.	26111.
286.34	284	26196.	26280.	26365.	26451.	26536.	26621.	26707.	26793.	26879.	26965.
287.34	285	27051.	27138.	27225.	27311.	27398.	27485.	27573.	27660.	27748.	27836.
288.34	286	27924.	28012.	28100.	28189.	28277.	28366.	28455.	28544.	28633.	28723.
289.34	287	28813.	28903.	28993.	29083.	29173.	29264.	29354.	29445.	29536.	29628.
290.34	288	29719.	29811.	29903.	29994.	30087.	30179.	30271.	30364.	30457.	30550.
291.34	289	30643.	30736.	30830.	30924.	31018.	31112.	31206.	31301.	31395.	31490.
292.34	290	31585.	31681.	31776.	31872.	31968.	32064.	32160.	32257.	32354.	32451.
293.34	291	32548.	32645.	32743.	32840.	32938.	33036.	33135.	33233.	33332.	33431.
294.34	292	33530.	33629.	33729.	33829.	33929.	34029.	34129.	34230.	34331.	34432.
295.34	293	34534.	34635.	34737.	34839.	34942.	35044.	35147.	35250.	35353.	35457.
296.34	294	35561.	35664.	35769.	35873.	35978.	36083.	36188.	36293.	36399.	36505.
297.34	295	36611.	36717.	36824.	36930.	37037.	37145.	37252.	37360.	37468.	37576.
298.34	296	37685.	37793.	37902.	38012.	38121.	38231.	38341.	38451.	38562.	38672.
299.34	297	38783.	38894.	39006.	39118.	39229.	39342.	39454.	39567.	39680.	39793.
300.34	298	39906.	40020.	40134.	40248.	40362.	40477.	40592.	40707.	40822.	40938.
301.34	299	41054.	41170.	41286.	41403.	41520.	41637.	41754.	41871.	41989.	42107.
302.34	300	42226.	42344.	42463.	42582.	42701.	42821.	42941.	43061.	43181.	43301.
303.34	301	43422.	43543.	43664.	43786.	43908.	44030.	44152.	44274.	44397.	44520.
304.34	302	44643.	44767.	44890.	45014.	45138.	45263.	45387.	45512.	45637.	45763.
305.34	303	45888.	46014.	46140.	46266.	46393.	46520.	46647.	46774.	46901.	47029.
306.34	304	47157.	47285.	47413.	47542.	47671.	47800.	47929.	48059.	48189.	48319.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE CAPACITY TABLE IS IN ACRE FEET THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
307.34	305	48449.	48579.	48710.	48841.	48972.	49104.	49235.	49367.	49500.	49632.
308.34	306	49765.	49898.	50031.	50164.	50298.	50432.	50566.	50700.	50835.	50970.
309.34	307	51105.	51240.	51376.	51512.	51648.	51784.	51921.	52057.	52194.	52332.
310.34	308	52469.	52607.	52745.	52883.	53022.	53160.	53299.	53439.	53578.	53718.
311.34	309	53858.	53998.	54139.	54279.	54420.	54561.	54703.	54845.	54987.	55129.
312.34	310	55271.	55414.	55557.	55700.	55843.	55987.	56131.	56275.	56420.	56564.
313.34	311	56709.	56854.	57000.	57145.	57291.	57437.	57584.	57730.	57877.	58025.
314.34	312	58172.	58320.	58468.	58616.	58764.	58913.	59062.	59211.	59361.	59511.
315.34	313	59661.	59811.	59962.	60112.	60263.	60415.	60566.	60718.	60870.	61022.
316.34	314	61175.	61328.	61481.	61634.	61788.	61942.	62096.	62251.	62405.	62560.
317.34	315	62715.	62871.	63027.	63183.	63339.	63496.	63653.	63810.	63967.	64125.
318.34	316	64283.	64441.	64599.	64758.	64917.	65076.	65236.	65396.	65556.	65716.
319.34	317	65877.	66037.	66199.	66360.	66522.	66684.	66846.	67009.	67171.	67334.
320.34	318	67498.	67661.	67825.	67990.	68154.	68319.	68484.	68649.	68815.	68981.
321.34	319	69147.	69313.	69480.	69647.	69814.	69982.	70149.	70318.	70486.	70655.
322.34	320	70823.	70993.	71162.	71332.	71502.	71672.	71843.	72014.	72185.	72357.
323.34	321	72529.	72701.	72873.	73046.	73219.	73392.	73566.	73740.	73914.	74088.
324.34	322	74263.	74438.	74613.	74789.	74965.	75141.	75318.	75495.	75672.	75849.
325.34	323	76027.	76205.	76383.	76562.	76740.	76920.	77099.	77279.	77459.	77640.
326.34	324	77821.	78002.	78183.	78365.	78547.	78729.	78912.	79095.	79278.	79462.
327.34	325	79646.	79830.	80015.	80200.	80385.	80571.	80756.	80943.	81129.	81316.
328.34	326	81503.	81690.	81878.	82066.	82255.	82444.	82633.	82822.	83012.	83202.
329.34	327	83393.	83584.	83775.	83967.	84159.	84351.	84544.	84737.	84930.	85124.
330.34	328	85318.	85512.	85707.	85902.	86097.	86293.	86489.	86686.	86882.	87080.
331.34	329	87277.	87475.	87673.	87872.	88071.	88270.	88470.	88670.	88871.	89072.
332.34	330	89273.	89474.	89676.	89879.	90082.	90285.	90488.	90692.	90897.	91101.
333.34	331	91306.	91512.	91718.	91924.	92130.	92337.	92545.	92752.	92961.	93169.
334.34	332	93378.	93587.	93797.	94007.	94217.	94428.	94640.	94852.	95064.	95276.
335.34	333	95489.	95703.	95917.	96131.	96346.	96561.	96776.	96992.	97209.	97425.
336.34	334	97643.	97860.	98078.	98297.	98516.	98735.	98955.	99175.	99395.	99616.
337.34	335	99838.	100060.	100282.	100504.	100728.	100951.	101175.	101399.	101624.	101849.
338.34	336	102075.	102301.	102527.	102754.	102981.	103209.	103437.	103665.	103894.	104124.
339.34	337	104353.	104584.	104814.	105045.	105277.	105508.	105741.	105973.	106206.	106440.
340.34	338	106674.	106908.	107143.	107378.	107614.	107850.	108086.	108323.	108561.	108798.
341.34	339	109037.	109275.	109515.	109754.	109994.	110235.	110475.	110717.	110958.	111201.
342.34	340	111443.	111686.	111930.	112174.	112418.	112663.	112908.	113154.	113400.	113646.
343.34	341	113893.	114140.	114388.	114637.	114885.	115134.	115384.	115634.	115884.	116135.
344.34	342	116386.	116638.	116890.	117142.	117395.	117649.	117902.	118157.	118411.	118666.
345.34	343	118922.	119178.	119434.	119691.	119948.	120206.	120464.	120722.	120981.	121240.
346.34	344	121500.	121760.	122021.	122282.	122544.	122806.	123068.	123331.	123595.	123859.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE CAPACITY TABLE IS IN ACRE FEET — THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
347.34	345	124123.	124388.	124653.	124919.	125185.	125452.	125719.	125986.	126254.	126523.
348.34	346	126792.	127061.	127331.	127601.	127872.	128144.	128415.	128687.	128960.	129233.
349.34	347	129507.	129781.	130055.	130330.	130606.	130882.	131158.	131435.	131713.	131991.
350.34	348	132269.	132548.	132828.	133108.	133388.	133669.	133951.	134233.	134515.	134798.
351.34	349	135081.	135365.	135650.	135935.	136220.	136506.	136792.	137079.	137367.	137655.
352.34	350	137943.	138232.	138521.	138811.	139102.	139393.	139684.	139976.	140269.	140562.
353.34	351	140856.	141150.	141445.	141740.	142036.	142333.	142630.	142927.	143225.	143524.
354.34	352	143823.	144122.	144423.	144723.	145025.	145326.	145629.	145932.	146235.	146539.
355.34	353	146843.	147149.	147454.	147760.	148067.	148375.	148683.	148992.	149301.	149611.
356.34	354	149921.	150232.	150544.	150856.	151169.	151483.	151797.	152112.	152427.	152743.
357.34	355	153060.	153377.	153694.	154013.	154332.	154651.	154971.	155292.	155614.	155936.
358.34	356	156258.	156581.	156905.	157230.	157555.	157882.	158208.	158536.	158864.	159193.
359.34	357	159523.	159853.	160184.	160516.	160849.	161182.	161516.	161851.	162186.	162522.
360.34	358	162859.	163196.	163535.	163874.	164213.	164554.	164895.	165237.	165579.	165922.
361.34	359	166266.	166611.	166957.	167303.	167650.	167997.	168346.	168695.	169045.	169396.
362.34	360	169747.	170100.	170453.	170807.	171161.	171516.	171872.	172229.	172587.	172945.
363.34	361	173304.	173664.	174025.	174386.	174748.	175111.	175475.	175839.	176204.	176570.
364.34	362	176937.	177304.	177672.	178042.	178411.	178782.	179154.	179526.	179899.	180273.
365.34	363	180648.	181023.	181400.	181777.	182155.	182534.	182913.	183294.	183675.	184057.
366.34	364	184440.	184824.	185208.	185593.	185979.	186366.	186754.	187143.	187532.	187922.
367.34	365	188313.	188705.	189098.	189491.	189886.	190281.	190678.	191075.	191473.	191872.
368.34	366	192272.	192672.	193074.	193476.	193880.	194284.	194689.	195095.	195502.	195910.
369.34	367	196319.	196728.	197139.	197550.	197962.	198375.	198789.	199204.	199620.	200037.
370.34	368	200454.	200873.	201292.	201712.	202133.	202555.	202977.	203401.	203825.	204250.
371.34	369	204676.	205103.	205530.	205959.	206388.	206818.	207249.	207680.	208113.	208546.
372.34	370	208980.	209415.	209851.	210288.	210725.	211163.	211602.	212042.	212483.	212925.
373.34	371	213367.	213810.	214254.	214699.	215144.	215591.	216038.	216485.	216934.	217383.
374.34	372	217833.	218284.	218735.	219187.	219640.	220094.	220548.	221004.	221460.	221916.
375.34	373	222374.	222832.	223291.	223751.	224211.	224672.	225134.	225597.	226060.	226524.
376.34	374	226989.	227455.	227921.	228389.	228857.	229325.	229794.	230264.	230735.	231207.
377.34	375	231679.	232152.	232626.	233100.	233575.	234051.	234528.	235005.	235483.	235962.
378.34	376	236442.	236922.	237403.	237885.	238367.	238850.	239334.	239819.	240304.	240790.
379.34	377	241277.	241765.	242253.	242742.	243232.	243723.	244214.	244707.	245200.	245693.
380.34	378	246188.	246683.	247179.	247676.	248174.	248672.	249171.	249671.	250172.	250674.
381.34	379	251176.	251679.	252183.	252687.	253193.	253699.	254206.	254713.	255222.	255731.
382.34	380	256241.	256751.	257263.	257775.	258288.	258802.	259316.	259831.	260347.	260864.
383.34	381	261382.	261900.	262419.	262938.	263459.	263980.	264502.	265025.	265548.	266072.
384.34	382	266597.	267123.	267649.	268176.	268704.	269233.	269762.	270292.	270823.	271355.
385.34	383	271887.	272420.	272954.	273488.	274024.	274559.	275096.	275633.	276171.	276710.
386.34	384	277249.	277789.	278330.	278871.	279413.	279956.	280500.	281044.	281589.	282134.

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2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE CAPACITY TABLE IS IN ACRE FEET — THE ELEVATION INCREMENT IS ONE TENTH FOOT

NAVD88	NGVD29 ELEV. FEET	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
387.34	385	282681.	283228.	283775.	284324.	284873.	285422.	285973.	286524.	287076.	287628.
388.34	386	288181.	288735.	289290.	289845.	290402.	290959.	291516.	292075.	292634.	293194.
389.34	387	293754.	294316.	294878.	295441.	296004.	296569.	297134.	297700.	298266.	298834.
390.34	388	299402.	299970.	300540.	301110.	301682.	302253.	302826.	303399.	303973.	304548.
391.34	389	305124.	305700.	306277.	306855.	307433.	308013.	308593.	309174.	309755.	310338.
392.34	390	310921.	311505.	312089.	312675.	313261.	313848.	314435.	315024.	315613.	316203.
393.34	391	316794.	317385.	317977.	318570.	319164.	319758.	320353.	320949.	321546.	322144.
394.34	392	322742.	323341.	323941.	324541.	325142.	325744.	326347.	326950.	327554.	328159.
395.34	393	328764.	329370.	329977.	330585.	331193.	331802.	332412.	333022.	333633.	334245.
396.34	394	334858.	335471.	336085.	336700.	337316.	337932.	338549.	339167.	339785.	340404.
397.34	395	341024.	341644.	342266.	342888.	343511.	344134.	344758.	345383.	346009.	346636.
398.34	396	347263.	347891.	348519.	349149.	349779.	350410.	351042.	351674.	352307.	352941.
399.34	397	353576.	354211.	354847.	355484.	356122.	356760.	357399.	358039.	358680.	359321.
400.34	398	359963.	360606.	361250.	361894.	362539.	363185.	363832.	364479.	365127.	365776.
401.34	399	366426.	367076.	367727.	368379.	369032.	369685.	370339.	370994.	371650.	372307.
402.34	400	372964.	373622.	374281.	374940.	375600.	376261.	376923.	377586.	378249.	378913.
403.34	401	379578.	380244.	380910.	381577.	382245.	382914.	383584.	384254.	384925.	385597.
404.34	402	386270.	386944.	387618.	388294.	388970.	389647.	390324.	391003.	391682.	392362.
405.34	403	393043.	393725.	394408.	395091.	395775.	396460.	397146.	397832.	398520.	399208.
406.34	404	399897.	400587.	401277.	401969.	402661.	403354.	404049.	404743.	405439.	406136.
407.34	405	406833.	407531.	408231.	408931.	409631.	410333.	411036.	411739.	412443.	413148.
408.34	406	413854.	414561.	415268.	415977.	416686.	417396.	418107.	418819.	419532.	420245.
409.34	407	420960.	421675.	422391.	423108.	423825.	424543.	425262.	425982.	426703.	427424.
410.34	408	428146.	428869.	429593.	430318.	431043.	431769.	432496.	433224.	433952.	434681.
411.34	409	435411.	436142.	436873.	437606.	438339.	439073.	439807.	440543.	441279.	442016.
412.34	410	442754.	443492.	444232.	444972.	445712.	446454.	447196.	447939.	448683.	449427.
413.34	411	450172.	450918.	451665.	452412.	453160.	453909.	454659.	455409.	456160.	456912.
414.34	412	457665.	458418.	459172.	459927.	460683.	461439.	462196.	462954.	463712.	464472.
415.34	413	465232.	465992.	466754.	467516.	468279.	469042.	469806.	470571.	471337.	472103.
416.34	414	472870.	473638.	474406.	475175.	475945.	476715.	477487.	478258.	479031.	479804.
417.34	415	480578.	481353.	482128.	482904.	483681.	484458.	485237.	486015.	486795.	487575.
418.34	416	488356.	489138.	489920.	490703.	491487.	492271.	493056.	493841.	494628.	495415.
419.34	417	496202.	496991.	497780.	498569.	499360.	500151.	500942.	501735.	502528.	503322.
420.34	418	504116.	504911.	505707.	506503.	507300.	508098.	508896.	509695.	510495.	511295.
421.34	419	512096.	512898.	513701.	514504.	515307.	516112.	516916.	517722.	518528.	519335.
422.34	420	520142.	520950.	521759.	522568.	523378.	524189.	525000.	525812.	526625.	527438.
423.34	421	528252.	529066.	529881.	530697.	531513.	532330.	533148.	533966.	534785.	535604.
424.34	422	536424.	537245.	538067.	538889.	539712.	540535.	541359.	542184.	543009.	543836.
425.34	423	544662.	545490.	546318.	547147.	547977.	548807.	549638.	550469.	551301.	552134.
426.34	424	552968.	553802.	554637.	555473.	556309.	557146.	557984.	558822.	559661.	560500.

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2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88 9:11:25

THE CAPACITY TABLE IS IN ACRE FEET THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET		0	.1	.2	.3	.4	.5	.6	.7	.8	.9
NAVD88	NGVD29										
427.34	425	561341.	562182.	563024.	563867.	564712.	565557.	566403.	567250.	568099.	568948.
428.34	426	569799.	570650.	571502.	572356.	573210.	574066.	574923.	575780.	576639.	577498.
429.34	427	578359.	579221.	580083.	580947.	581812.	582678.	583544.	584412.	585281.	586151.
430.34	428	587022.	587894.	588766.	589640.	590514.	591389.	592265.	593142.	594019.	594897.
431.34	429	595776.	596656.	597537.	598418.	599300.	600183.	601067.	601952.	602837.	603723.
432.34	430	604610.	605498.	606387.	607276.	608166.	609057.	609949.	610842.	611735.	612629.
433.34	431	613524.	614420.	615317.	616214.	617112.	618010.	618910.	619810.	620711.	621612.
434.34	432	622514.	623417.	624321.	625226.	626131.	627037.	627943.	628851.	629759.	630668.
435.34	433	631577.	632487.	633398.	634310.	635222.	636136.	637049.	637964.	638879.	639795.
436.34	434	640712.	641630.	642548.	643467.	644386.	645306.	646227.	647149.	648071.	648994.
437.34	435	649918.	650842.	651767.	652692.	653619.	654546.	655473.	656402.	657331.	658260.
438.34	436	659191.	660122.	661054.	661986.	662919.	663853.	664787.	665722.	666658.	667595.
439.34	437	668532.	669470.	670408.	671347.	672287.	673228.	674169.	675111.	676053.	676996.
440.34	438	677940.	678884.	679830.	680775.	681722.	682669.	683617.	684565.	685514.	686464.
441.34	439	687415.	688366.	689317.	690270.	691223.	692177.	693131.	694086.	695042.	695998.
442.34	440	696955.	697913.	698871.	699830.	700790.	701750.	702711.	703673.	704635.	705598.
443.34	441	706562.	707526.	708491.	709456.	710423.	711389.	712357.	713325.	714294.	715263.
444.34	442	716233.	717204.	718175.	719147.	720120.	721093.	722067.	723042.	724017.	724993.
445.34	443	725969.	726946.	727924.	728902.	729882.	730861.	731842.	732823.	733804.	734786.
446.34	444	735769.	736753.	737737.	738722.	739707.	740693.	741680.	742667.	743655.	744643.
447.34	445	745632.	746622.	747613.	748604.	749595.	750587.	751580.	752574.	753568.	754563.
448.34	446	755558.	756554.	757551.	758548.	759546.	760545.	761544.	762544.	763544.	764545.
449.34	447	765547.	766549.	767552.	768556.	769560.	770565.	771570.	772576.	773583.	774590.
450.34	448	775598.	776607.	777616.	778626.	779636.	780647.	781659.	782671.	783684.	784698.
451.34	449	785712.	786727.	787742.	788758.	789775.	790792.	791810.	792829.	793848.	794868.
452.34	450	795889.	796909.	797931.	798953.	799976.	801000.	802024.	803049.	804074.	805100.
453.34	451	806127.	807154.	808182.	809210.	810239.	811269.	812300.	813331.	814362.	815395.
454.34	452	816428.	817461.	818495.	819530.	820565.	821601.	822638.	823675.	824713.	825752.
455.34	453	826791.	827831.	828871.	829912.	830954.	831996.	833039.	834082.	835126.	836170.
456.34	454	837216.	838261.	839308.	840355.	841402.	842451.	843499.	844549.	845599.	846649.
457.34	455	847700.	848752.	849805.	850858.	851911.	852965.	854020.	855076.	856132.	857188.
458.34	456	858245.	859304.	860362.	861421.	862480.	863540.	864601.	865662.	866723.	867786.
459.34	457	868849.	869912.	870976.	872040.	873105.	874171.	875237.	876304.	877371.	878439.
460.34	458	879508.	880577.	881646.	882717.	883787.	884859.	885931.	887003.	888076.	889150.
461.34	459	890224.	891298.	892374.	893450.	894526.	895603.	896681.	897759.	898837.	899917.
462.34	460	900996.	902077.	903158.	904239.	905321.	906404.	907487.	908571.	909655.	910740.
463.34	461	911826.	912912.	913998.	915086.	916173.	917262.	918350.	919440.	920530.	921621.
464.34	462	922712.	923803.	924896.	925988.	927082.	928176.	929270.	930366.	931461.	932558.
465.34	463	933654.	934752.	935850.	936948.	938047.	939147.	940247.	941348.	942449.	943551.
466.34	464	944654.	945757.	946860.	947965.	949069.	950175.	951280.	952387.	953494.	954602.

"FOLSOM LAKE - CENTRAL VALLEY PROJECT - CALIFORNIA" (ACAP92) COMPUTED 8/16/2006 9:11:25

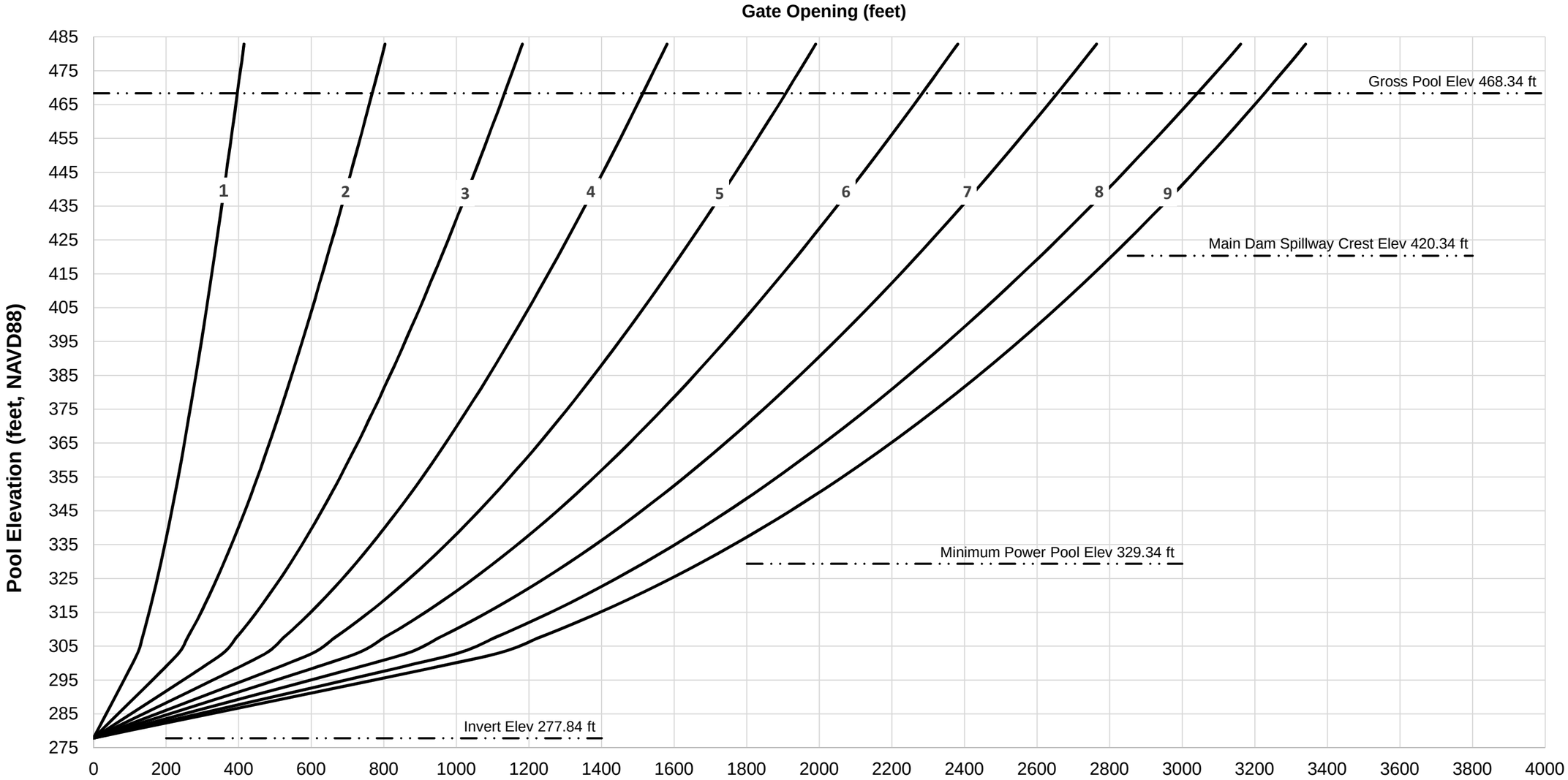
2005 AREA-CAPACITY TABLES, PROJECT DATUM, 2.34 FEET LESS THAN NAVD88

THE CAPACITY TABLE IS IN ACRE FEET THE ELEVATION INCREMENT IS ONE TENTH FOOT

ELEV. FEET NAVD88	NGVD29	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
467.34	465	955710.	956819.	957928.	959038.	960149.	961260.	962371.	963483.	964596.	965709.
468.34	466	966823.	967937.	969052.	970167.	971283.	972400.	973517.	974634.	975753.	976871.
469.34	467	977991.	979110.	980231.	981352.	982473.	983595.	984718.	985841.	986964.	988089.
470.34	468	989213.	990339.	991465.	992592.	993719.	994847.	995975.	997105.	998235.	999365.
471.34	469	1000496.	1001628.	1002761.	1003894.	1005028.	1006162.	1007297.	1008433.	1009570.	1010707.
472.34	470	1011844.	1012983.	1014122.	1015261.	1016402.	1017543.	1018684.	1019826.	1020969.	1022113.
473.34	471	1023257.	1024402.	1025547.	1026693.	1027840.	1028987.	1030135.	1031284.	1032433.	1033583.
474.34	472	1034733.	1035884.	1037036.	1038188.	1039341.	1040494.	1041648.	1042803.	1043958.	1045114.
475.34	473	1046270.	1047427.	1048585.	1049744.	1050903.	1052062.	1053222.	1054383.	1055545.	1056707.
476.34	474	1057869.	1059032.	1060196.	1061361.	1062526.	1063691.	1064857.	1066024.	1067191.	1068359.
477.34	475	1069528.	1070697.	1071866.	1073036.	1074207.	1075379.	1076550.	1077723.	1078896.	1080069.
478.34	476	1081244.	1082418.	1083594.	1084770.	1085946.	1087123.	1088301.	1089479.	1090658.	1091837.
479.34	477	1093017.	1094197.	1095378.	1096560.	1097742.	1098925.	1100108.	1101292.	1102476.	1103661.
480.34	478	1104847.	1106033.	1107220.	1108407.	1109595.	1110784.	1111973.	1113162.	1114352.	1115543.
481.34	479	1116734.	1117926.	1119119.	1120312.	1121505.	1122700.	1123894.	1125090.	1126286.	1127482.
482.34	480	1128679.	1129876.	1131075.	1132273.	1133472.	1134672.	1135872.	1137073.	1138274.	1139476.
483.34	481	1140678.	1141881.	1143084.	1144288.	1145493.	1146698.	1147903.	1149109.	1150316.	1151523.
484.34	482	1152730.	1153939.	1155147.	1156356.	1157566.	1158776.	1159987.	1161198.	1162410.	1163623.
485.34	483	1164836.	1166049.	1167263.	1168477.	1169692.	1170908.	1172124.	1173340.	1174557.	1175775.
486.34	484	1176993.	1178211.	1179430.	1180650.	1181870.	1183090.	1184311.	1185533.	1186755.	1187977.
487.34	485	1189200.	1190424.	1191648.	1192872.	1194097.	1195323.	1196549.	1197776.	1199003.	1200230.
488.34	486	1201458.	1202687.	1203916.	1205145.	1206375.	1207606.	1208837.	1210069.	1211301.	1212533.
489.34	487	1213766.	1215000.	1216234.	1217469.	1218704.	1219939.	1221175.	1222412.	1223649.	1224887.
490.34	488	1226125.	1227363.	1228602.	1229842.	1231082.	1232323.	1233564.	1234806.	1236048.	1237290.
491.34	489	1238533.	1239777.	1241021.	1242266.	1243511.	1244757.	1246003.	1247249.	1248497.	1249744.
492.34	490	1250992.									

Manual Revised September 2017 Sheet 16 of 16 Capacity Table Plate A-2

- DRAFT -



Notes:

1. Ratings are for one of the four gates.
2. Parameter is gate opening in feet.
3. Invert elevation is 277.84 feet.
4. Datum is NAVD88 = NGVD29 + 2.34 feet.

Prepared by MVB

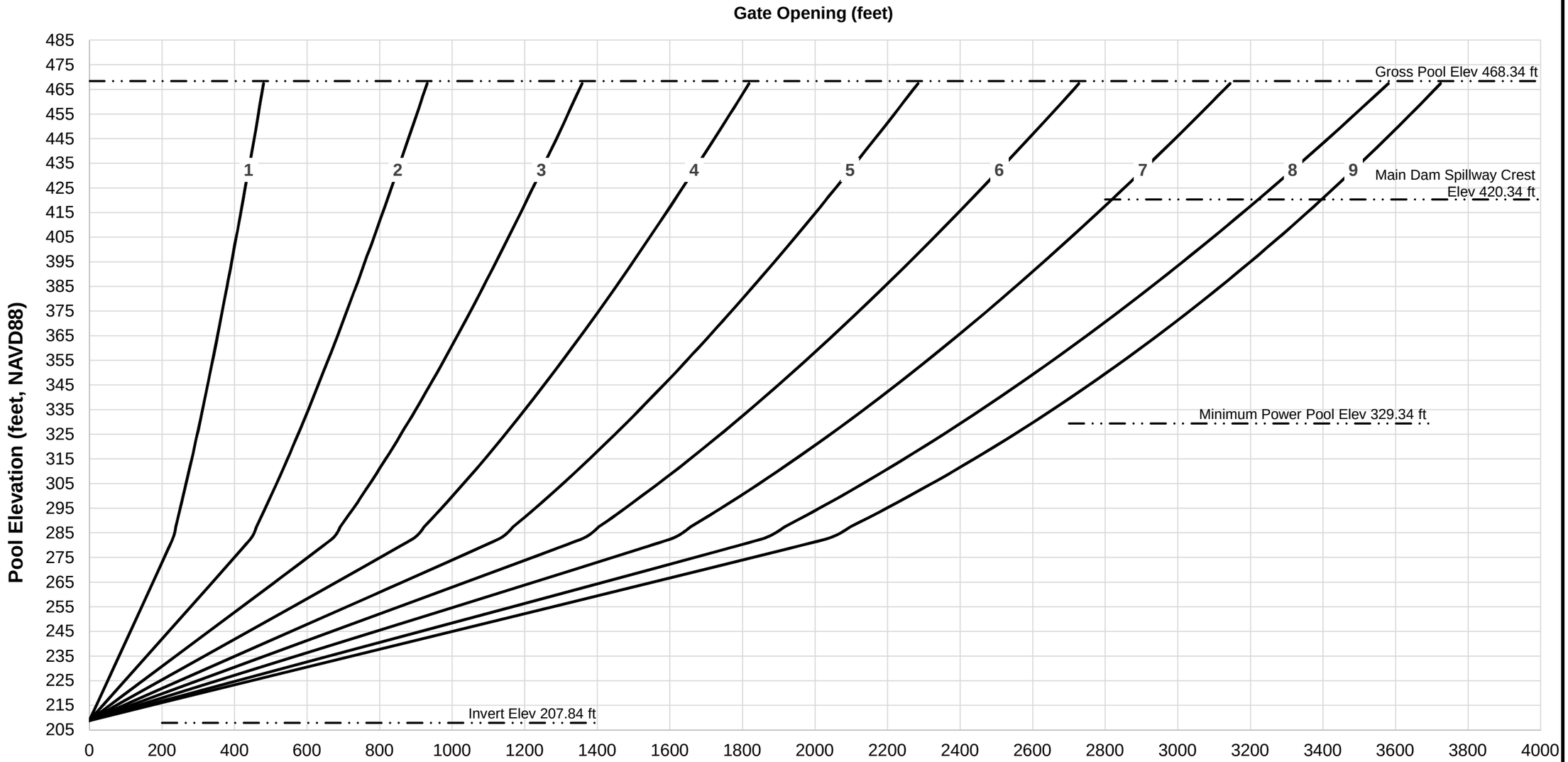
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

OUTLET DISCHARGE CURVES

ONE OF FOUR UPPER TIER OUTLETS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



Notes:

1. Ratings are for one of the four gates.
2. Parameter is gate opening in feet.
3. Invert elevation is 207.84 feet.
4. Datum is NAVD88 = NGVD29 + 2.34 feet.

Prepared by MVB

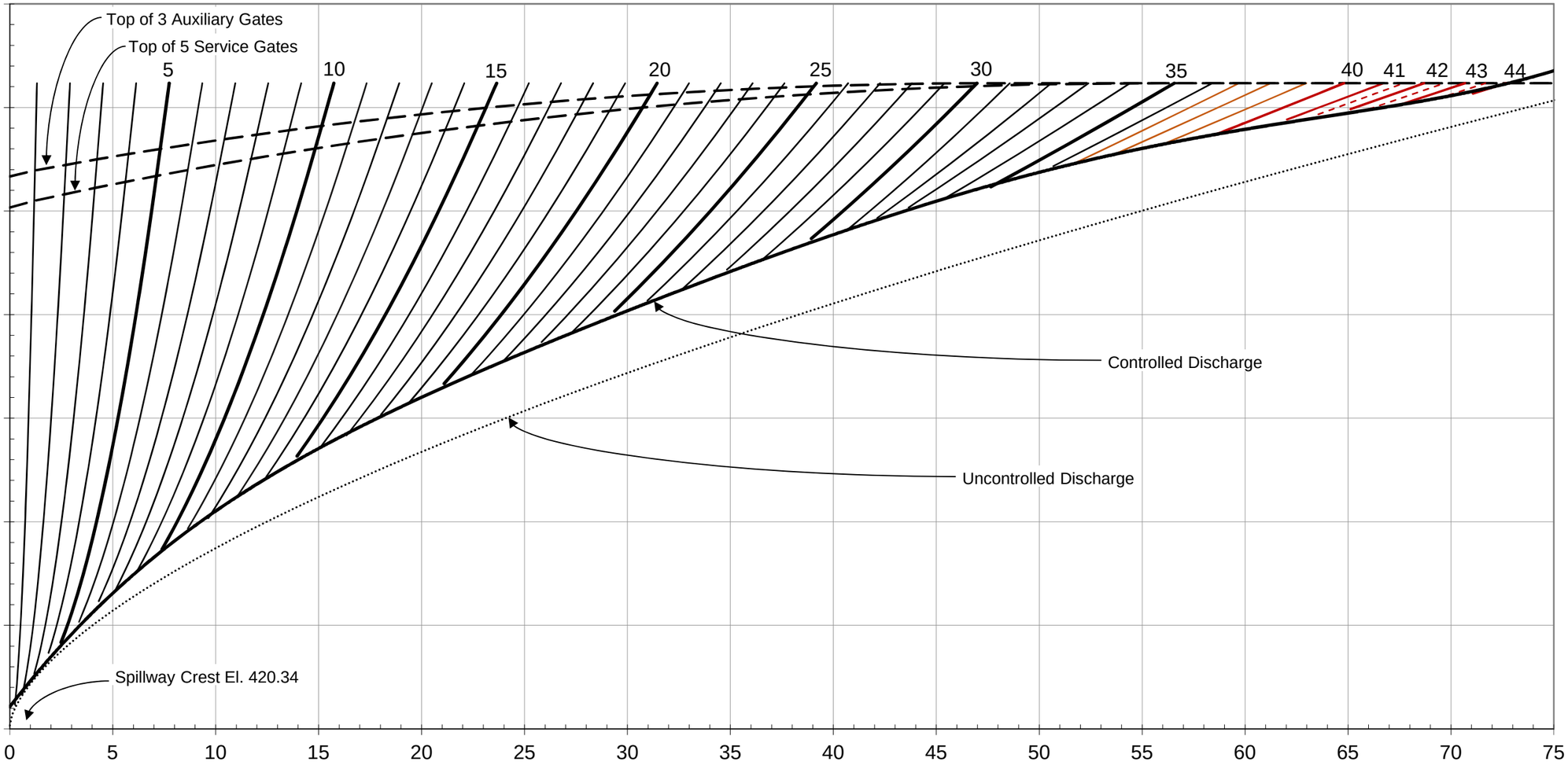
FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

OUTLET DISCHARGE CURVES

ONE OF FOUR LOWER TIER OUTLETS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

- DRAFT -



Notes:

1. Ratings are for one of the eight gates with adjacent gates operating.
2. Parameter is gate opening (hoist chain travel) in feet.
3. Gate seat elevation is 419.5 feet.
4. At such times as the water flows free (below bottom of spillway gates), the discharge is indicated by "uncontrolled discharge" regardless of gate opening. Therefore, unless precautionary measures are taken, flow may suddenly increase as the water surface falls within 2 feet of uncontrolled discharge curve.
5. Caution advised for gate opening greater than 35 feet open.
6. Datum is NAVD88 = NGVD29 + 2.34 feet.

Prepared by EAT / MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

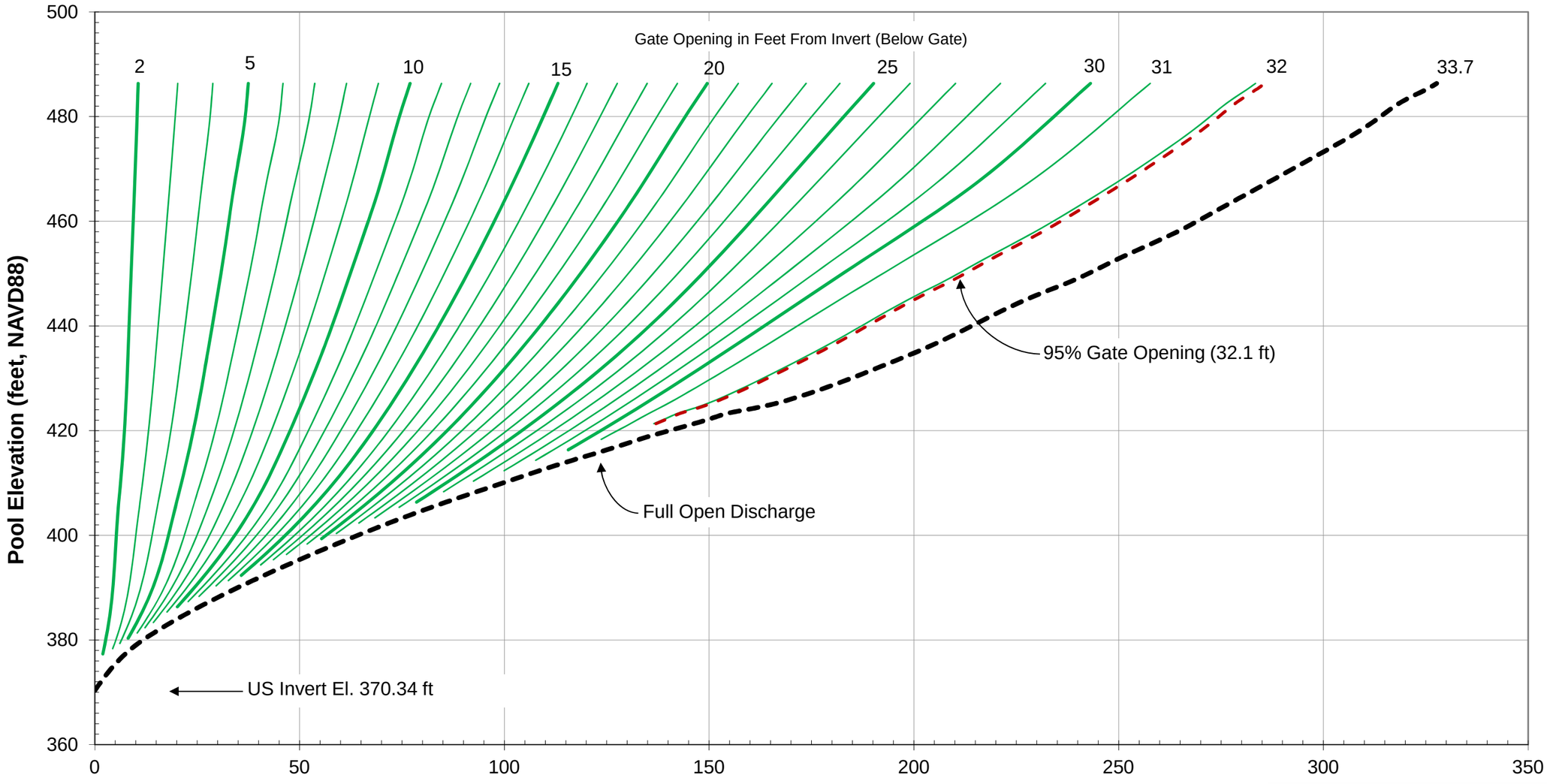
MAIN DAM SPILLWAY DISCHARGE CURVES

ONE OF EIGHT SPILLWAY GATES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017

- DRAFT -



Ratings are for all six submerged tainter gates.

Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

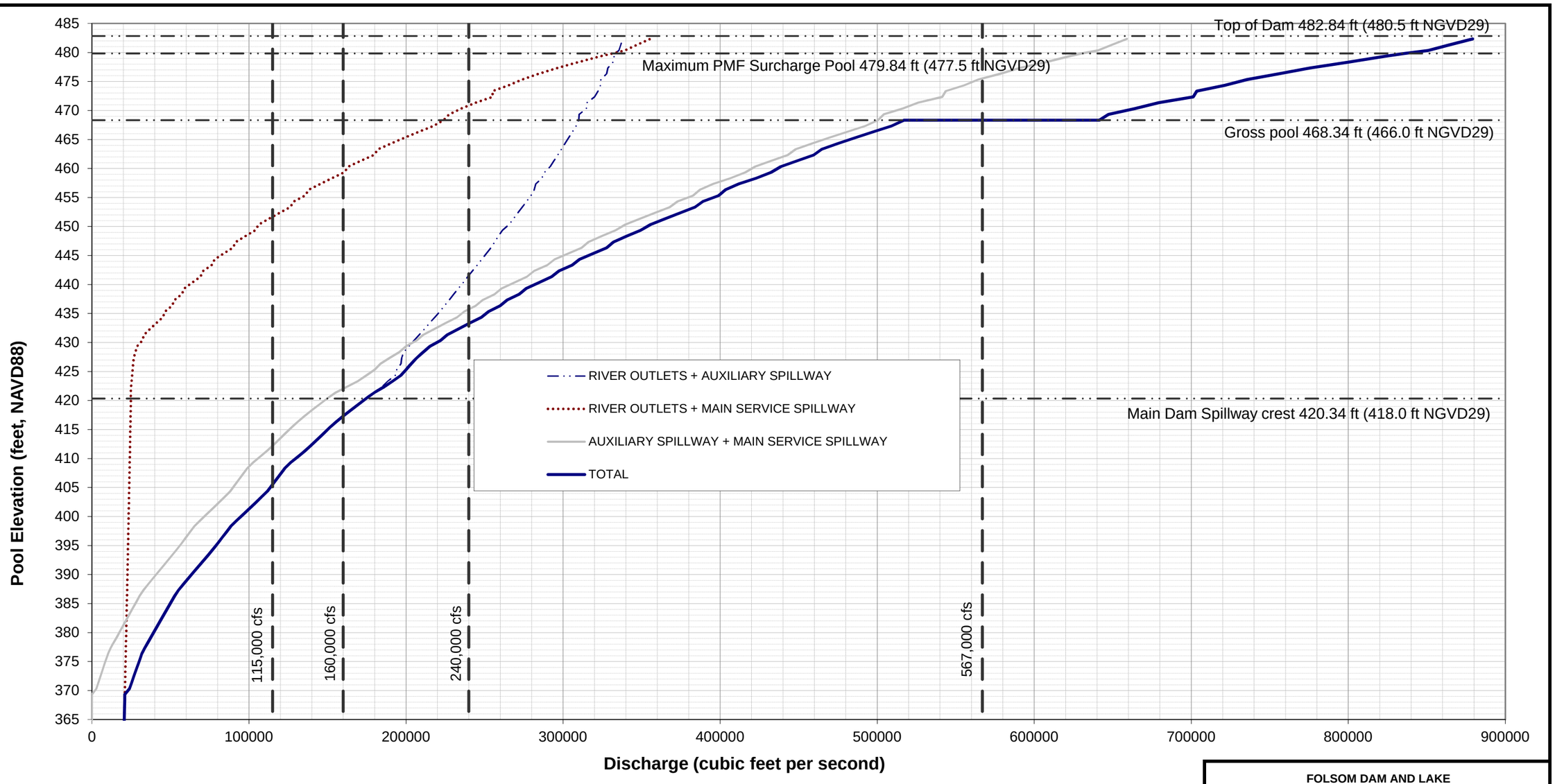
AUXILIARY SPILLWAY DISCHARGE CURVES

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017

PLATE A-5

- DRAFT -



NOTES:

The capacity of the three emergency gates has been excluded from the total capacity curve while the pool elevation is at or below 468.34 ft (466.0 ft NGVD29).

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

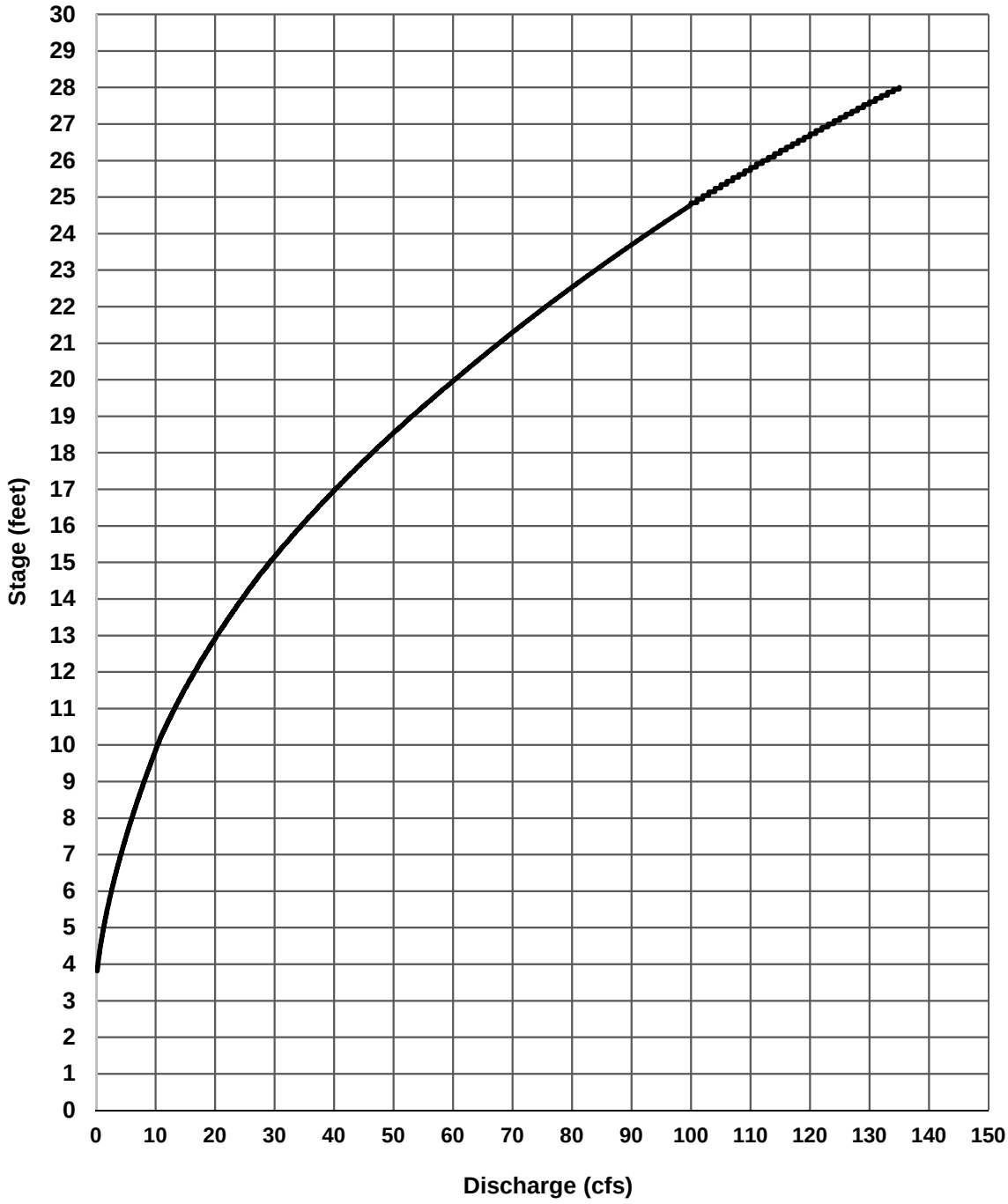
TOTAL RELEASE CAPACITY

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Prepared by MVB

Revised September 2017 PLATE A-6

- DRAFT -



Note:

Datum of gage is 71.53 feet

National Geodetic Vertical Datum of 1929

Prepared by MVB

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

DISCHARGE RATING CURVE

AMERICAN RIVER AT FAIR OAKS, CA
USGS STATION NO. 11446500

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Revised September 2017 PLATE A-7

DISTRICT PHASE SPK SUP A to ER 500-1-1 Chapter 4

OPERATIONAL DATA REQUIREMENTS

FOLSOM DAM AND LAKE, AMERICAN RIVER, CALIFORNIA

	PROJECT PHASE	PROJECT STATUS CRITERIA	PROJECT BASIN CONDITION	HYDRO-METEORLOGICAL DATA REQUIREMENTS*
NORMAL OPERATIONS	IV	a. Daily inflow less than 8,000 sfd	No flood threat	Daily data furnished by 0200 hrs.
		b. Daily inflow equal to OR greater than 8,000 sfd and less than 20,000 sfd	Forecast storms with potential flood control space encroachment	
EMERGENCY WATCH	III	Daily inflow equal to OR greater than 8,000 sfd and less than 20,000 sfd OR flood control encroachment of 25% or greater	Forecast storms with flood control space encroachment	Daily data same as for IV b. plus hourly data. Forecast inflow when available from CNRFC.
PARTIAL ACTIVATION	II	Inflow equal to OR greater than 20,000 cfs and AND/OR flood control encroachment of 25% or greater	Storm in progress with flood control space encroachment, flood control releases are being made from reservoir	Daily data same as for IV b. plus hourly data. Forecast inflow when available from CNRFC.
FULL ACTIVATION	I	Declared emergency	Severe flood threat, flood flows occurring, emergency declared by District Engineer	Daily data same as for IV b. plus hourly data. Forecast inflow when available from CNRFC.

* OPERATIONAL DATA:

Reclamation daily and hourly data:

(1) Elevation, storage, outflow, inflow, and precipitation at the dam

(2) Reclamation anticipated outflow changes

CNRFC data when available:

(1) Forecasted inflow

FOLSOM DAM AND LAKE
AMERICAN RIVER, CALIFORNIA

OPERATIONAL DATA REQUIREMENTS

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

FIGURE A - FLOOD CONTROL DIAGRAM

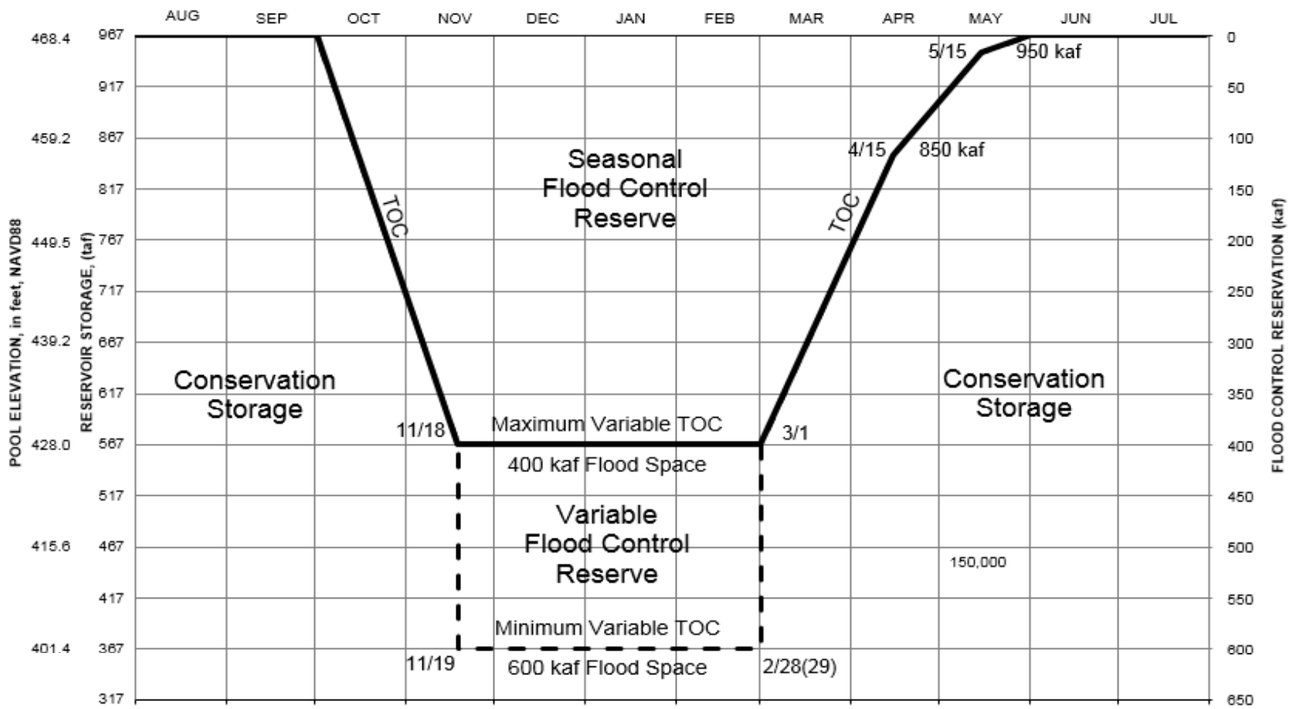
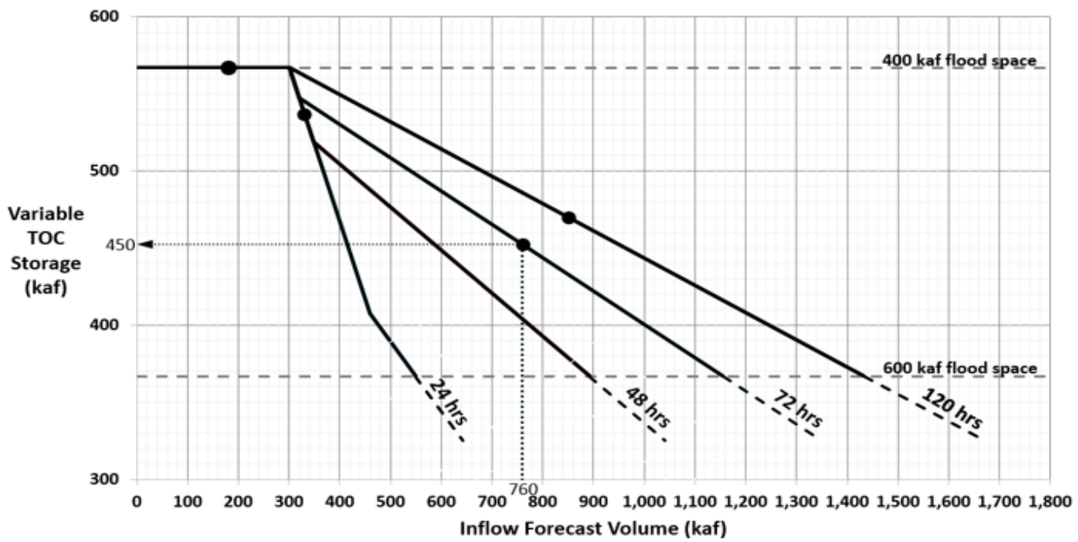


FIGURE B - VARIABLE TOP OF CONSERVATION



USE OF FLOOD CONTROL DIAGRAM (FIGURE A)

Folsom Dam and Lake shall be operated for flood control in accordance with the Flood Control Diagram and the accompanying Emergency Spillway Release Diagram (ESRD). Water stored within Flood Control Reserve (FCR) space shall be released as rapidly as possible subject to the Release Schedule (Table A), except when releases greater than 115 kcfs are required by the ESRD. The Corps of Engineers may direct flood releases to be increased or decreased from the prescribed release when warranted by existing conditions or by high confidence forecast information provided by NWS-CNRFC.

COMPUTATION OF VARIABLE TOP OF CONSERVATION (FIGURE B)

From Nov. 19 to Feb. 28/29 the Top of Conservation (TOC) storage will vary based on forecasted inflow volumes. These are developed by the NWS-CNRFC for the purpose of supporting Folsom Dam flood operations, will reflect forecasted inflows over the next 24, 48, 72, and 120 hours, and will reflect a value of non-exceedance probability (NEP) specified by the Corps. Volumes will be provided once per day during normal operations, and once per six hours once the 120-hour volume exceeds 300 kaf. Figure B provides relationships relating inflow forecast volume to variable TOC storage for each duration.

FIGURE B - INSTRUCTIONS: Locate each of the four forecast volumes on the horizontal axis. Place the four forecast volumes on the respective duration curves. For each forecast volume, identify the corresponding candidate TOC storage value on the vertical axis. Of the four candidate TOC storage values, the lowest value is the adopted variable TOC storage value. The corresponding FCR value is given by: FCR = 966.9 kaf - variable TOC storage.

FIGURE B - EXAMPLE: Inflow forecast volumes of 180, 330, 760 and 850 kaf are provided, corresponding to 24, 48, 72, and 120 hours respectively. As shown in Figure B, the volumes are located on the horizontal axis, and placed on the corresponding curves (indicated by large dots). Corresponding candidate TOC storage values are read from the vertical axis. The lowest value is given by the 72-hour volume. This value (450 kaf) is therefore the adopted variable TOC storage value. The corresponding FCR value is: FCR = 966.9 kaf - 450 kaf = 546.9 kaf.

TABLE A - FOLSOM RELEASE SCHEDULE

Date	Storage Condition	Description
Mar. 1 to Nov. 18	Storage > TOC	EVACUATE SEASONAL FLOOD CONTROL RESERVE Release peak inflow for current event.
Nov. 19 to Feb. 28/29	Storage > TOC	EVACUATE VARIABLE FLOOD CONTROL RESERVE Release greater of peak inflow for current event or Table B release.
All year	Storage < TOC	Non-flood operations.

RAMPING RATES

Releases between 8 kcfs and 30 kcfs will not be increased by more than 10 kcfs during any 2-hour period.
Releases between 30 kcfs and 115 kcfs will not be increased by more than 30 kcfs during any 2-hour period.
Releases between 8 kcfs and 115 kcfs will not be *decreased* by more than 10 kcfs during any 2-hour period.

TABLE B - FORECAST-BASED RELEASES

INFLOW FORECAST VOLUMES	RELEASE
120-hr volume < 300 kaf	8 kcfs
120-hr volume > 300 kaf	25 kcfs
72-hr volume > 300 kaf	50 kcfs
48-hr volume > 300 kaf	80 kcfs
24-hr volume > 300 kaf and inflow >= 115 kcfs	115 kcfs

1 kcfs = 1,000 cfs, 1 kaf = 1,000 acre-feet

FOLSOM DAM AND LAKE
American River, California

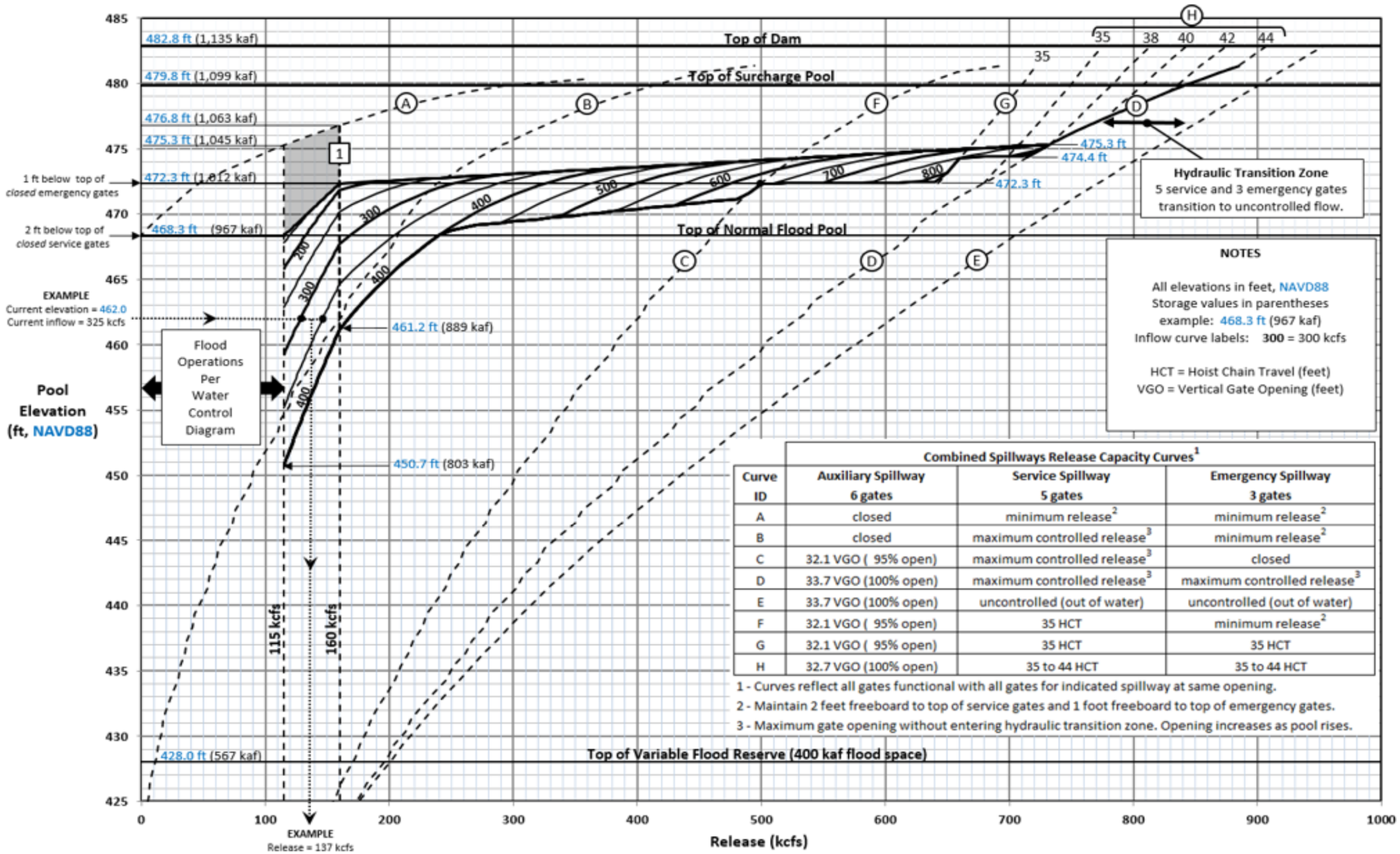
WATER CONTROL DIAGRAM

APPROVED _____

APPROVED _____

Effective Date _____ File No. _____

EMERGENCY SPILLWAY RELEASE DIAGRAM



NOTES

All elevations in feet, NAVD88
Storage values in parentheses
example: 468.3 ft (967 kaf)
Inflow curve labels: **300** = 300 kcfs

HCT = Hoist Chain Travel (feet)
VGO = Vertical Gate Opening (feet)

Combined Spillways Release Capacity Curves[1]

Curve ID	Auxiliary Spillway 6 gates	Service Spillway 5 gates	Emergency Spillway 3 gates
A	closed	minimum release[2]	minimum release[2]
B	closed	maximum controlled release[3]	minimum release[2]
C	32.1 VGO (95% open)	maximum controlled release[3]	closed
D	33.7 VGO (100% open)	maximum controlled release[3]	maximum controlled release[3]
E	33.7 VGO (100% open)	uncontrolled (out of water)	uncontrolled (out of water)
F	32.1 VGO (95% open)	35 HCT	minimum release[2]
G	32.1 VGO (95% open)	35 HCT	35 HCT
H	32.7 VGO (100% open)	35 to 44 HCT	35 to 44 HCT

1 - Curves reflect all gates functional with all gates for indicated spillway at same opening.
2 - Maintain 2 feet freeboard to top of service gates and 1 foot freeboard to top of emergency gates.
3 - Maximum gate opening without entering hydraulic transition zone. Opening increases as pool rises.

OPERATING INSTRUCTIONS

The Emergency Spillway Release Diagram (ESRD) is used to determine if releases greater than 115 kcfs are required, and if so, to specify the minimum required release. The steps below should be initiated whenever water is stored above elevation 450.7 ft NAVD88.

1) Estimate current reservoir inflow in kcfs.

   Estimate inflow, based on change in storage and release made over previous 2 hours, or greater period if necessary to obtain reliable measurements.

2) Enter the ESRD with current inflow (in kcfs) and current pool elevation (ft, NAVD88), to compute the minimum required release value.

   EXAMPLE: For a current inflow estimate of 325 kcfs and current pool elevation of 462.0 ft NAVD88, the emergency release value is found as follows. The bounding inflow curves on the ESRD are the 300 kcfs and 325 kcfs. The points at which both curves intersect the horizontal line corresponding to elevation 462.0 ft are identified. On the horizontal line between these points, the location of the point corresponding to inflow 325 kcfs is estimated. For this point, the ESRD minimum release value of 137 kcfs is read on the X axis.

3) Once releases based on the ESRD are initiated, gate changes shall be made in accordance with the criteria found herein until the required outflow drops to 115 kcfs. Use the Water Control Diagram to determine release of 115 kcfs or less.

4) While communication systems are functional, Reclamation and Corps shall consult before releases greater than 160 kcfs are made. This is indicated by **line 1** on diagram. The **shaded area** indicates surcharge which may be used during final recession of the event.

SCHEDULE FOR EMERGENCY SPILLWAY RELEASES

POOL RISE/FALL	POOL ELEVATION	DS LEVEES	INDICATED RELEASE	ACTION
n/a	Less than 450.7	Intact	0 to 115 kcfs	Follow Water Control Diagram
Rising	450.7 – 476.8	Intact	115 kcfs to 160 kcfs	Increase outflows to indicated release at a rate of 30 kcfs per two hours. Notify local authorities that evacuation of areas adjacent to downstream levees should be initiated. Do not reduce outflow while pool is rising.
Rising	Greater than 461.2	Intact	Greater than 160 kcfs	Increase outflow to indicated release but not greater than 160 kcfs until 6 hours has elapsed since flows greater than 115 kcfs were initiated. Maximum rate of increase is 50 kcfs per 30 minutes (100 kcfs per hour) for releases ranging between 160 kcfs to 360 kcfs. Maximum rate of increase is 200 kcfs per hour for releases greater than 360 kcfs.
Falling	Greater than 450.7	Intact	The lesser of 125% of inflow or maximum event release	Make indicated release but do not reduce outflows below 115 kcfs until the reservoir pool has dropped below elevation 450.7.
Falling	Greater than 450.7	Inoperative	The lesser of 125% of inflow or maximum event release	Make indicated release but do not reduce outflows below 50 kcfs until the reservoir pool has dropped below elevation 450.7.

FOLSOM DAM AND LAKE
American River, California

EMERGENCY SPILLWAY RELEASE DIAGRAM

APPROVED _____

APPROVED _____

Effective Date _____ File No. _____

PLATE A-10

- DRAFT -

WATER CONTROL MANUAL
FOLSOM DAM AND LAKE

American River
California

EXHIBIT B

FIELD WORKING AGREEMENT
FOR
FLOOD CONTROL OPERATION
OF
CENTRAL VALLEY PROJECT DAMS AND RESERVOIRS
IN
CALIFORNIA

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

December 1987
Manual Revised September 2017

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- DRAFT -

FIELD WORKING AGREEMENT
BETWEEN
DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION
AND
DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS
FOR
FLOOD CONTROL OPERATION
OF
CENTRAL VALLEY PROJECT DAMS AND RESERVOIRS
IN
CALIFORNIA

THIS agreement, made and entered into this 4th day of August, 1978, between the Bureau of Reclamation and the Corps of Engineers,

WITNESSETH THAT:

WHEREAS, the Department of the Interior, acting through the Bureau of Reclamation, represented by its appropriate Regional Director, has constructed or assumed operation of Federally constructed dams and reservoirs on the Sacramento and San Joaquin Rivers and their tributaries, and is responsible for normal operation and structural safety of the projects, and

WHEREAS, the Department of the Army, acting through the Corps of Engineers, represented by its appropriate District and Division Engineers, is responsible for the flood control operation plans of said dams and reservoirs in accordance with Section 7 of the 1944 Flood Control Act (33 U.S.C. 709) and as promulgated in Code of Federal Regulations, Title 33, Part 208.11, and

WHEREAS, there is a need for a working agreement to insure a clear understanding of the flood control regulations and information exchange required for the projects operation.

NOW, THEREFORE, it is mutually understood and agreed by and between the parties hereto that the Central Valley Project will be operated in accordance with the following criteria:

(a) Conservation operations shall be in accordance with Bureau of Reclamation criteria as determined by the Regional Director or his designated representative.

(b) Storage space in the Central Valley Project shall be made available on a seasonal basis and operated for flood control in accordance with the Flood Control Diagrams currently in force.

(c) Emergency operation shall be in accordance with the procedure set forth on the Emergency Spillway Release Diagrams or procedures currently in force.

(d) The Regional Director is responsible for the safety of the dam and appurtenant facilities and for regulation of reservoirs in the Central Valley Project during surcharge storage utilization. Emphasis upon the safety of the dam is especially important in the event surcharge storage is utilized, which results when the total storage space reserved for flood control is exceeded. Any assistance provided by the Corps of Engineers concerning surcharge regulation is to be utilized at the discretion of the Regional Director, and does not relieve the Regional Director of the responsibility for safety of the dams in the Central Valley Project.

(e) Revisions of the Flood Control or Emergency Spillway Release Diagrams and procedures may be developed as necessary by parties of this agreement. Each such revision shall be effective on the date specified.

(f) Except as necessary in order to comply with Emergency Operation procedures, the flood control regulations shall not be construed to require dangerously rapid changes in magnitude of releases. Releases will be made in a manner consistent with requirements for protecting the dam, reservoir and appurtenances from major damages.

(g) Any water impounded in the flood control space defined by the Flood Control Diagrams shall be evacuated as rapidly as can be safely accomplished without causing downstream flows to exceed the controlling rates; i.e., releases from the reservoir shall be restricted insofar as practicable to quantities which, in conjunction with uncontrolled runoff downstream of the dams, will not cause water levels to exceed the controlling stages currently in force. Although conflicts may arise with other purposes, such as hydropower, the plan of regulation may require releases to be completely curtailed in the interest of flood control or safety of the projects.

(h) The Regional Director shall procure such current basic hydrologic data and make such current determinations of required flood control space and releases at the reservoir as are required to accomplish the flood control objectives.

(i) The Regional Director shall keep the District Engineer advised of such reservoir operating data as the District Engineer may request. The minimum data required is reservoir storage, inflow, releases and streamflow at control points designated by the Flood Control Diagrams on a daily basis.

(j) The flood control regulations are subject to temporary modification by the Corps of Engineers if found necessary in time of emergency. Requests for and action on such modifications may be made by the fastest means of communication available. The action taken shall be confirmed in writing the same day to the office of the Regional Director and shall include justification for the action.

(k) The Regional Director may temporarily deviate from the flood control regulations in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Corps of Engineers and shall include justification for the action. Continuation of the deviation will require the express approval of the Division Engineer.

IN WITNESS WHEREOF, the parties hereto have caused this memorandum of agreement to be executed as the day and date first above written.

CORPS OF ENGINEERS

By: William E. Vanderburg
Division Engineer
South Pacific Division

BUREAU OF RECLAMATION

By: M. A. Cattino
Acting Regional Director
Mid Pacific Region

- DRAFT -

WATER CONTROL MANUAL
FOLSOM DAM AND LAKE

American River
California

EXHIBIT C

CODE OF FEDERAL REGULATIONS
TITLE 33, PART 208, SECTION 11

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

December 1987
Manual Revised September 2017

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prevent restriction of bridge openings and, where practicable, shall provide for temporary raising during floods of bridges which restrict channel capacities during high flows.

(2) *Operation.* Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor.

(Sec. 3, 49 Stat. 1571, as amended; 33 U.S.C. 701c)

[9 FR 9999, Aug. 17, 1944; 9 FR 10203, Aug. 22, 1944]

§208.11 Regulations for use of storage allocated for flood control or navigation and/or project operation at reservoirs subject to prescription of rules and regulations by the Secretary of the Army in the interest of flood control and navigation.

(a) *Purpose.* This regulation prescribes the responsibilities and general procedures for regulating reservoir projects capable of regulation for flood control or navigation and the use of storage allocated for such purposes and provided on the basis of flood control and navigation, except projects owned and operated by the Corps of Engineers; the International Boundary and Water Commission, United States and Mexico; and those under the jurisdiction of the International Joint Commission, United States, and Canada, and the Columbia River Treaty. The intent of this regulation is to establish an understanding between project owners, operating agencies, and the Corps of Engineers.

(b) *Responsibilities.* The basic responsibilities of the Corps of Engineers regarding project operation are set out in the cited authority and described in the following paragraphs:

(1) Section 7 of the Flood Control Act of 1944 (58 Stat. 890, 33 U.S.C. 709) directs the Secretary of the Army to prescribe regulations for flood control and navigation in the following manner:

Hereafter, it shall be the duty of the Secretary of War to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations: *Provided,* That this section shall not apply to the Tennessee Valley Authority, except that in case of danger from floods on the lower Ohio and Mississippi Rivers the Tennessee Valley Authority is directed to regulate the release of water from the Tennessee River into the Ohio River in accordance with such instructions as may be issued by the War Department.

(2) Section 9 of Public Law 436–83d Congress (68 Stat. 303) provides for the development of the Coosa River, Alabama and Georgia, and directs the Secretary of the Army to prescribe rules and regulations for project operation in the interest of flood control and navigation as follows:

The operation and maintenance of the dams shall be subject to reasonable rules and regulations of the Secretary of the Army in the interest of flood control and navigation.

NOTE: This Regulation will also be applicable to dam and reservoir projects operated under provisions of future legislative acts wherein the Secretary of the Army is directed to prescribe rules and regulations in the interest of flood control and navigation. The Chief of Engineers, U.S. Army Corps of Engineers, is designated the duly authorized representative of the Secretary of the Army to exercise the authority set out in the Congressional Acts. This Regulation will normally be implemented by letters of understanding between the Corps of Engineers and project owner and will incorporate the provisions of such letters of understanding prior to the time construction renders the project capable of significant impoundment of water. A water control agreement signed by both parties will follow when deliberate impoundment first begins or at such time as the responsibilities of any Corps-owned projects may be transferred to another entity. Promulgation of this Regulation for a given project will occur at such time as the name of the project appears in the FEDERAL REGISTER in accordance with the requirements of paragraph 6k. When agreement on a water control plan cannot be reached between the Corps and the project owner after coordination with all interested parties, the project name will be entered in the FEDERAL REGISTER and the Corps of Engineers plan will be the official water control plan until such time as differences can be resolved.

(3) Federal Energy Regulatory Commission (FERC), formerly Federal Power Commission (FPC), Licenses.

(i) Responsibilities of the Secretary of the Army and/or the Chief of Engineers in FERC licensing actions are set forth in reference 3c above and pertinent sections are cited herein. The Commission may further stipulate as a licensing condition, that a licensee enter into an agreement with the Department of the Army providing for operation of the project during flood times, in accordance with rules and regulations prescribed by the Secretary of the Army.

(A) Section 4(e) of the Federal Power Act requires approval by the Chief of Engineers and the Secretary of the Army of plans of dams or other structures affecting the navigable capacity of any navigable waters of the United States, prior to issuance of a license by the Commission as follows:

The Commission is hereby authorized and empowered to issue licenses to citizens * * * for the purpose of constructing, operating and maintaining dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary or convenient for the development and improvement of navigation and for the development, transmission, and utilization of power across, along, from or in any of the streams or other bodies of water over which Congress has jurisdiction * * * *Provided further*, That no license affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the dam or other structures affecting navigation have been approved by the Chief of Engineers and the Secretary of the Army.

(B) Sections 10(a) and 10(c) of the Federal Power Act specify conditions of project licenses including the following:

(1) *Section 10(a).* "That the project adopted * * * shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of waterpower development, and for other beneficial public uses * * *."

(2) *Section 10(c).* "That the licensee shall * * * so maintain and operate said works as not to impair navigation, and shall conform to such rules and regulations as the Commission may from time to time prescribe for the protection of life, health, and property * * *."

(C) Section 18 of the Federal Power Act directs the operation of any navigation facilities built under the provision of that Act, be controlled by rules and regulations prescribed by the Secretary of the Army as follows:

The operation of any navigation facilities which may be constructed as part of or in connection with any dam or diversion structure built under the provisions of this Act, whether at the expense of a licensee hereunder or of the United States, shall at all times be controlled by such reasonable rules and regulations in the interest of navigation, including the control of the pool caused by such dam or diversion structure as may be made from time to time by the Secretary of the Army, * * *.

(ii) Federal Power Commission Order No. 540 issued October 31, 1975, and published November 7, 1975 (40 FR 51998), amending §2.9 of the Commission's General Policy and Interpretations prescribed Standardized Conditions (Forms) for Inclusion in Preliminary Permits and Licenses Issued Under part I of the Federal Power Act. As an example, Article 12 of Standard Form L–3, titled: "Terms and Conditions of License for Constructed Major Projects Affecting Navigable Waters of the United States," sets forth the Commission's interpretation of appropriate sections of the Act, which deal with navigation aspects, and attendant responsibilities of the Secretary of the Army in licensing actions as follows:

The United States specifically retains and safeguards the right to use water in such amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operations of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, * * * and the Licensee shall release water from the project reservoir at such rate * * * as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned.

(c) *Scope and terminology.* This regulation applies to Federal authorized flood

control and/or navigation storage projects, and to non-Federal projects which require the Secretary of the Army to prescribe regulations as a condition of the license, permit or legislation, during the planning, design and construction phases, and throughout the life of the project. In compliance with the authority cited above, this regulation defines certain activities and responsibilities concerning water control management throughout the Nation in the interest of flood control and navigation. In carrying out the conditions of this regulation, the owner and/or operating agency will comply with applicable provisions of Pub. L. 85-624, the Fish and Wildlife Coordination Act of 1958, and Pub. L. 92-500, the Federal Water Pollution Control Act Amendments of 1972. This regulation does not apply to local flood protection works governed by § 208.10, or to navigation facilities and associated structures which are otherwise covered by part 207 (Navigation Regulations) of title 33 of the code. Small reservoirs, containing less than 12,500 acre-feet of flood control or navigation storage, may be excluded from this regulation and covered under § 208.10, unless specifically required by law or conditions of the license or permit.

(1) The terms *reservoir* and *project* as used herein include all water resource impoundment projects constructed or modified, including natural lakes, that are subject to this regulation.

(2) The term *project owner* refers to the entity responsible for maintenance, physical operation, and safety of the project, and for carrying out the water control plan in the interest of flood control and/or navigation as prescribed by the Corps of Engineers. Special arrangements may be made by the project owner for "operating agencies" to perform these tasks.

(3) The term *letter of understanding* as used herein includes statements which consummate this regulation for any given project and define the general provisions or conditions of the local sponsor, or owner, cooperation agreed to in the authorizing legislative document, and the requirements for compliance with section 7 of the 1944 Flood Control Act, the Federal Power Act or other special congressional act. This information will be specified in the water control plan and manual. The letter of understanding will be signed by a duly authorized representative of the Chief of Engineers and the project owner. A "field working agreement" may be substituted for a letter of understanding, provided that the specified minimum requirements of the latter, as stated above, are met.

(4) The term *water control agreement* refers to a compliation of water control criteria, guidelines, diagrams, release schedules, rule curves and specifications that basically govern the use of reservoir storage space allocated for flood control or navigation and/or release functions of a water control project for these purposes. In general, they indicate controlling or limiting rates of discharge and storage space required for flood control and/or navigation, based on the runoff potential during various seasons of the year.

(5) For the purpose of this regulation, the term *water control plan* is limited to the plan of regulation for a water resources project in the interest of flood control and/or navigation. The water control plan must conform with proposed allocations of storage capacity and downstream conditions or other requirements to meet all functional objectives of the particular project, acting separately or in combination with other projects in a system.

(6) The term *real-time* denotes the processing of current information or data in a sufficiently timely manner to influence a physicial response in the system being monitored and controlled. As used herein the term connotes * * * the analyses for and execution of water control decisions for both minor and major flood events and for navigation, based on prevailing hydrometeorological and other conditions and constraints, to achieve efficient management of water resource systems.

(d) *Procedures*—(1) *Conditions during project formulation.* During the planning and design phases, the project owner should consult with the Corps of Engineers regarding the quantity and value of space to reserve in the reservoir for flood control and/or navigation purposes, and for utilization of the space, and other requirements of the license,

permit or conditions of the law. Relevant matters that bear upon flood control and navigation accomplishment include: Runoff potential, reservoir discharge capability, downstream channel characteristics, hydrometeorological data collection, flood hazard, flood damage characteristics, real estate acquisition for flowage requirements (fee and easement), and resources required to carry out the water control plan. Advice may also be sought on determination of and regulation for the probable maximum or other design flood under consideration by the project owner to establish the quantity of surcharge storage space, and freeboard elevation of top of dam or embankment for safety of the project.

(2) *Corps of Engineers involvement.* If the project owner is responsible for real-time implemenetation of the water control plan, consultation and assistance will be provided by the Corps of Engineers when appropriate and to the extent possible. During any emergency that affects flood control and/or navigation, the Corps of Engineers may temporarily prescribe regulation of flood control or navigation storage space on a day-to-day (real-time) basis without request of the project owner. Appropriate consideration will be given for other authorized project functions. Upon refusal of the project owner to comply with regulations prescribed by the Corps of Engineers, a letter will be sent to the project owner by the Chief of Engineers or his duly authorized representative describing the reason for the regulations prescribed, events that have transpired, and notification that the project owner is in violation of the Code of Federal Regulations. Should an impasse arise, in that the project owner or the designated operating entity persists in noncompliance with regulations prescribed by the Corps of Engineers, measures may be taken to assure compliance.

(3) *Corps of Engineers implementation of real-time water control decisions.* The Corps of Engineers may prescribe the continuing regulation of flood control storage space for any project subject to this regulation on a day-to-day (real-time) basis. When this is the case, consultation and assistance from the project owner to the extent possible will be expected. Special requests by the project owner, or appropriate operating entity, are preferred before the Corps of Engineers offers advice on real-time regulation during surcharge storage utilization.

(4) *Water control plan and manual.* Prior to project completion, water control managers from the Corps of Engineers will visit the project and the area served by the project to become familiar with the water control facilities, and to insure sound formulation of the water control plan. The formal plan of regulation for flood control and/or navigation, referred to herein as the water control plan, will be developed and documented in a water control manual prepared by the Corps of Engineers. Development of the manual will be coordinated with the project owner to obtain the necessary pertinent information, and to insure compatibility with other project purposes and with surcharge regulation. Major topics in the manual will include: Authorization and description of the project, hydrometeorology, data collection and communication networks, hydrologic forecasting, the water control plan, and water resource management functions, including responsibilities and coordination for water control decision-making. Special instructions to the dam tender or reservoir manager on data collection, reporting to higher Federal authority, and on procedures to be followed in the event of a communication outage under emergency conditions, will be prepared as an exhibit in the manual. Other exhibits will include copies of this regulation, letters of understanding consummating this regulation, and the water control agreements. After approval by the Chief of Engineers or his duly authorized representative, the manual will be furnished the project owner.

(5) *Water control agreement.* (i) A water control diagram (graphical) will be prepared by the Corps of Engineers for each project having variable space reservation for flood control and/or navigation during the year; e.g., variable seasonal storage, joint-use space,

or other rule curve designation. Reservoir inflow parameters will be included on the diagrams when appropriate. Concise notes will be included on the diagrams prescribing the use of storage space in terms of release schedules, runoff, nondamaging or other controlling flow rates downstream of the damsite, and other major factors as appropriate. A water control release schedule will be prepared in tabular form for projects that do not have variable space reservation for flood control and/or navigation. The water control diagram or release schedule will be signed by a duly authorized representative of the Chief of Engineers, the project owner, and the designated operating agency, and will be used as the basis for carrying out this regulation. Each diagram or schedule will contain a reference to this regulation.

(ii) When deemed necessary by the Corps of Engineers, information given on the water control diagram or release schedule will be supplemented by appropriate text to assure mutual understanding on certain details or other important aspects of the water control plan not covered in this regulation, on the water control diagram or in the release schedule. This material will include clarification of any aspects that might otherwise result in unsatisfactory project performance in the interest of flood contol and/or navigation. Supplementation of the agreement will be necessary for each project where the Corps of Engineers exercises the discretionary authority to prescribe the flood control regulation on a day-today (real-time) basis. The agreement will include delegation of the responsibility. The document should also cite, as appropriate, section 7 of the 1944 Flood Control Act, the Federal Power Act and/or other congressional legislation authorizing construction an/or directing operation of the project.

(iii) All flood control regulations published in the FEDERAL REGISTER under this section (part 208) of the code prior to the date of this publication which are listed in §208.11(e) are hereby superseded.

(iv) Nothing in this regulation prohibits the promulgation of specific regulations for a project in compliance with the authorizing acts, when agreement on acceptable regulations cannot be reached between the Corps of Engineers and the owner.

(6) *Hydrometeorological instrumentation.* The project owner will provide instrumentation in the vicinity of the damsite and will provide communication equipment necessary to record and transmit hydrometeorological and reservoir data to all appropriate Federal authorities on a real-time basis unless there are extenuating circumstances or are otherwise provided for as a condition of the license or permit. For those projects where the owner retains responsibility for real-time implementation of the water control plan, the owner will also provide or arrange for the measurement and reporting of hydrometeorological parameters required within and adjacent to the watershed and downstream of the damsite, sufficient to regulate the project for flood control and/or navigation in an efficient manner. When data collection stations outside the immediate vicinity of the damsite are required, and funds for installation, observation, and maintenance are not available from other sources, the Corps of Engineers may agree to share the costs for such stations with the project owner. Availability of funds and urgency of data needs are factors which will be considered in reaching decisions on cost sharing.

(7) *Project safety.* The project owner is responsible for the safety of the dam and appurtenant facilities and for regulation of the project during surcharge storage utilization. Emphasis upon the safety of the dam is especially important in the event surcharge storage is utilized, which results when the total storage space reserved for flood control is exceeded. Any assistance provided by the Corps of Engineers concerning surcharge regulation is to be utilized at the discretion of the project owner, and does not relieve the owner of the responsibility for safety of the project.

(8) *Notification of the general public.* The Corps of Engineers and other interested Federal and State agencies, and the project owner will jointly sponsor public involvement activities, as appropriate, to fully apprise the general public of the water control plan. Public meetings or other effective means of

notification and involvement will be held, with the initial meeting being conducted as early as practicable but not later than the time the project first becomes operational. Notice of the initial public meeting shall be published once a week for 3 consecutive weeks in one or more newspapers of general circulation published in each county covered by the water control plan. Such notice shall also be used when appropriate to inform the public of modifications in the water control plan. If no newspaper is published in a county, the notice shall be published in one or more newspapers of general circulation within that county. For the purposes of this section a newspaper is one qualified to publish public notices under applicable State law. Notice shall be given in the event significant problems are anticipated or experienced that will prevent carrying out the approved water control plan or in the event that an extreme water condition is expected that could produce severe damage to property or loss of life. The means for conveying this information shall be commensurate with the urgency of the situation. The water control manual will be made available for examination by the general public upon request at the appropriate office of the Corps of Engineers, project owner or designated operating agency.

(9) *Other generalized requirements for flood control and navigation.* (i) Storage space in the reservoirs allocated for flood control and navigation purposes shall be kept available for those purposes in accordance with the water control agreement, and the plan of regulation in the water control manual.

(ii) Any water impounded in the flood control space defined by the water control agreement shall be evacuated as rapidly as can be safely accomplished without causing downstream flows to exceed the controlling rates; *i.e.*, releases from reservoirs shall be restricted insofar as practicable to quantities which, in conjunction with uncontrolled runoff downstream of the dam, will not cause water levels to exceed the controlling stages currently in force. Although conflicts may arise with other purposes, such as hydropower, the plan or regulation may require releases to be completely curtailed in the interest of flood control or safety of the project.

(iii) Nothing in the plan of regulation for flood control shall be construed to require or allow dangerously rapid changes in magnitudes of releases. Releases will be made in a manner consistent with requirements for protecting the dam and reservoir from major damage during passage of the maximum design flood for the project.

(iv) The project owner shall monitor current reservoir and hydro- meteorological conditions in and adjacent to the watershed and downstream of the damsite, as necessary. This and any other pertinent information shall be reported to the Corps of Engineers on a timely basis, in accordance with standing instructions to the damtender or other means requested by the Corps of Engineers.

(v) In all cases where the project owner retains responsibility for real-time implementation of the water control plan, he shall make current determinations of: Reservoir inflow, flood control storage utilized, and scheduled releases. He shall also determine storage space and releases required to comply with the water control plan prescribed by the Corps of Engineers. The owner shall report this information on a timely basis as requested by the Corps of Engineers.

(vi) The water control plan is subject to temporary modification by the Corps of Engineers if found necessary in time of emergency. Requests for and action on such modifications may be made by the fastest means of communication available. The action taken shall be confirmed in writing the same day to the project owner and shall include justification for the action.

(vii) The project owner may temporarily deviate from the water control plan in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Corps of Engineers and shall include justification for the action. Continuation of the deviation will require the express approval of the Chief

of Engineers, or his duly authorized representative.

(viii) Advance approval of the Chief of Engineers, or his duly authorized representative, is required prior to any deviation from the plan of regulation prescribed or approved by the Corps of Engineers in the interest of flood control and/or navigation, except in emergency situations provided for in paragraph (d)(9)(vii) of this section. When conditions appear to warrant a prolonged deviation from the approved plan, the project owner and the Corps of Engineers will jointly investigate and evaluate the proposed deviation to insure that the overall integrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigations and evaluations have been conducted to the extent deemed necessary by the Chief of Engineers, or his designated representatives, to fully substantiate the deviation.

(10) *Revisions.* The water control plan and all associated documents will be revised by the Corps of Engineers as necessary, to reflect changed conditions that come to bear upon flood control and navigation, e.g., reallocation of reservoir storage space due to sedimentation or transfer of storage space to a neighboring project. Revision of the water control plan, water control agreement, water control diagram, or release schedule requires approval of the Chief of Engineers or his duly authorized representative. Each such revision shall be effective upon the date specified in the approval. The original (signed document) water control agreement shall be kept on file in the respective Office the Division Engineer, Corps of Engineers, Department of the Army, located at division offices throughout the continental USA. Copies of these agreements may be obtained from the office of the project owner, or from the office of the appropriate Division Engineer, Corps of Engineers.

(11) *Federal Register.* The following information for each project subject to section 7 of the 1944 Flood Control Act and other applicable congressional acts shall be published in the FEDERAL REGISTER prior to the time the projects becomes operational and prior to any significant impoundment before project completion or * * * at such time as the responsibility for physical operation and maintenance of the Corps of Engineers owned projects is transferred to another entity:

(i) Reservoir, dam, and lake names.

(ii) Stream, county, and State corresponding to the damsite location.

(iii) The maximum current storage space in acre-feet to be reserved exclusively for flood control and/or navigation purposes, or any multiple-use space (intermingled) when flood control or navigation is one of the purposes, with corresponding elevations in feet above mean sea level, and area in acres, at the upper and lower limits of said space.

(iv) The name of the project owner, and

(v) Congressional legislation authorizing the project for Federal participation.

(e) *List of projects.* The following tables, "Pertinent Project Data—Section 208.11 Regulation," show the pertinent data for projects which are subject to this regulation.

LIST OF PROJECTS

[Non-Corps projects with Corps Regulation Requirements]

Project name[1] (1)	State (2)	County (3)	Stream[1] (4)	Project purpose[2] (5)	Storage 1000 AF (6)	Elev limits feet M.S.L.		Area in acres		Authorizing legis.[3] (11)	Proj. owner[4] (12)
						Upper (7)	Lower (8)	Upper (9)	Lower (10)		
Agency Valley Dam & Res	OR	Malheur	N Fork Malheur R.	FICR	60.0	3340.0	3263.0	1900	0	PL 68–292	USBR.
Alpine Dam	IL	Winnebago	Keith Cr	F	0.6	796.0	760.0	52	0	PWA Proj	Rkfd, IL.
Altus Dam & Res	OK	Jackson	N Fork Red R	F	19.6	1562.0	1559.0	6800	6260	PL 761	USBR.
				IMR	132.6	1559.0	1517.5P	6260	735		
Anderson Ranch Dam & Res.	ID	Elmore	S Fk Boise R	FEI	423.2	4196.0	4039.6	4740	1150	Act of 1930 53 Stat 1187.	USBR.
Arbuckle Dam & Res	OK	Murray	Rock Cr	F	36.4	885.3	872.0	3130	2350	PL 594	USBR.
				MRC	62.5	872.0	827.0	2350	606		
Arrowrock Dam & Res	ID	Elmore	Boise R	FI	286.6	3216.0	2974.0	3100	200	Act of 1902 32 Stat 388.	USBR.
Bear Cr Dam	MO	Marion Ralls	Bear Cr	F	8.7	546.5	520.0	540	0	PL 83–780	Hnbl, MO.
Bear Swamp File Brook (Lo).	MA	Franklin	Deerfield R	E	6.9	870.0	830.0	152	115	FERC 2669	NEPC.
Bear Swamp PS (Upper)	MA	Franklin	Deerfield R Trib	E	8.9	1600.0	1550.0	118	102	Fed Pwr Act	NEPC.
Bellows Falls Dam & Lk	VT	Cheshire	Connecticut R	E	7.5	291.6	273.6	2804	836	FERC 1885	NEPC.
Big Dry Creek and Div	CA	Fresno	Big Dry Cr & Dog Cr.	F	16.2	425.0	393.0	1530	0	PL 77–228	Rclm. B CA.
Blue Mesa Dam & Res	CO	Gunnison	Gunnison R	FER	746.5	7519.4	7393.0	9180	2790	PL 84–485	USBR
Boca Dam & Res	CA	Nevada	Little Truckee R	I	32.8	5596.5	5521.0	873	52	PL 61–269	USBR.
				FI	8.0	5605.0	5596.0	980	873	PL 68–292	
Bonny Dam & Res	CO	Yuma	S Fork Republic R.	F	126.2	3710.0	3672.0	5035	2042	PL 78–534	USBR.
				ICR	39.2	3672.0	3636.0	2042	331	PL 79–732	
Boysen Dam & Res	WY	Fremont	Wild R	F	150.4	4732.2	4725.0	22170	19560	PL 78–534	USBR.
				FEIO	146.1	4725.0	4717.0	19560	16960		
				EIO	403.8	4717.0	4685.0	16960	9260		
Brantley Dam & Res	NM	Eddy	Pecos R	FIRO	348.5	3283.0	3210.7	21294	38	PL 92–515	USBR.
Brownlee Dam & Res	OR ID	Baker Washington	Snake R	FE	975.3	2077.0	1976.0	13840	6650	FERC No 1971–C	ID Pwr.
Bully Cr Dam & Res	OR	Malheur	Bully Cr	FI	31.6	2516.0	2456.8	1082	140	PL 86–248	USBR.
Camanche Dam & Res	CA	San Joaquin	Mokelumne R	FRIE	200.0	235.5	205.1	7600	5507	PL 86–645	EB-MUD.
				RIE	230.9	205.1	92.0	5507	0		
Canyon Ferry Dam & Lk	MT	Lewis Clark	Missouri R	F	99.5	3800.0	3797.0	33535	32800	PL 78–534	USBR.
				FEI	795.1	3797.0	3770.0	32800	24125		
				EI	711.5	3770.0	3728.0	24125	11480		
Cedar Bluff Dam & Res	KS	Trego	Smoky Hill R	F	191.9	2166.0	2144.0	10790	6869	PL 78–534	USBR.
				IMCR	149.8	2144.0	2107.8	6869	2086		
Cheney Dam & Res	KS	Sedgwick	N Fork Ninnescah R.	F	80.9	1429.9	1421.6	12420	9540	PL 86–787	USBR.
				MC	151.8	1421.6	1392.9	9540	1970		
					0.0	0.0	0.0	0	0		

Clark Canyon Dam & Res ..	MT	Beaverhead	Beaverhead R	F	79.1	5560.4	5546.1	5900	5160	PL 78–534	USBR.
				FI	50.4	5548.1	5535.7	5160	4495		
				I	126.1	5535.7	5470.6	4495	220		
Del Valle Dam & Res	CA	Alameda	Alameda Cr	F	37.0	745.0	703.1	1060	710	PL 87–874	DWR.
				FIM	1.0	703.1	702.2	710	700		CA.
				IMR	29.0	702.2	635.0	700	275		
Don Pedro Dam & Lk	CA	Tuolumne	Tuolumne R	FIER	340.0	830.0	802.0	12900	11260	PL 78–534	M&T.
				EIR	1381.0	802.0	600.0	11260	3520		Irr.
					308.0	600.0	342.0	3520	29		
East Canyon Dam & Res ...	UT	Morgan	East Canyon Cr	FEIM	48.0	5705.5	5578.0	684	130	PL 81–273	USBR.
Echo Dam & Res	UT	Summit	Weber R	FEIM	74.0	5560.0	5450.0	1455	0	PL 81–83	USBR.
Emigrant Dam & Res	OR	Jackson	Emigrant Cr	FIR	39.0	2241.0	2131.5	801	80	PL 83–606	USBR.
Enders Dam & Res	NE	Chase	Frenchman Cr	F	30.0	3127.0	3112.3	2405	1707	PL 78–534	USBR.
				ICR	34.5	3112.3	3082.4	1707	659	PL 84–505	
Folsom Dam & Lk	CA	Sacramento	American R	FEIM	400.0	466.0	427.0	11450	9040	.....	USBR.
				EIM	610.0	427.0	210.0	9040	0		
Fort Cobb Dam & Res	OK	Caddo	Pond (Cobb) Cr	F	63.7	1354.8	1342.0	5980	4100	PL 419	USBR.
				IMCR	78.3	1342.0	1300.0	4100	337		
Foss Dam & Res	OK	Custer	Washita R	F	180.6	1668.6	1652.0	13140	8800	PL 419	USBR.
				IMRC	243.8	1652.0	1597.2	8800	1360		
Friant Dam & Millerton Lk ..	CA	Fresno	San Joaquin R ...	FEIM	390.5	578.0	466.3	4850	2101	PL 75–392	USBR.
										PL 76–868	
Galesville Dam	OR	Douglas	Cow Cr	FEMCR	42.2	1881.5	1780.0	760	150	FERC No. 71	Dgls, CO.
										61001	
Gaston Dam & Res	NC	Halifax	Roanoke R	FE	63.0	203.0	200.0	22500	20300	Fed Pwr Act	VA Pwr.
		Northampton									
Glen Elder Dam & Waconda Lk.	KS	Mitchel	Solomon R	F	722.3	1468.3	1455.6	33682	12602	PL 78–534	USBR.
				IM	204.8	1455.6	1428.0	12602	3341	PL 79–526	
Glendo Dam & Res	WY	Platte	N Platte R	F	271.9	4653.0	4635.0	17990	12370	PL 78–534	USBR.
				EIM	454.3	4635.0	4570.0	12370	3130		
Grand Coulee Dam & FDR Lk.	WA	Okanogan Grant	Columbia R	FEI	5185.5	1290.0	1208.0	82280	45592	PL 89–561	USBR.
H Neely Henry Dam & Res	AL	Calhoun St. Clair	Coosa R	FE	49.7	508.0	502.5	11235	7632	PL 83–436	AL Pwr.
Harris Dam & Res	AL	Randolph	Tallapoosa R	FE	215.0	793.0	785.0	10661	9012	PL 89–789	AL Pwr.
Heart Butte Dm & Lk Tschida.	ND	Grant	Heart R	F	147.9	2094.5	2064.5	6580	3400	PL 78–534	USBR.
				IO	69.0	2064.5	2030.0	3400	810		
Hells Canyon Dam & Res ..	OR	Wallowa	Snake R	EN	11.7	1688.0	1683.0	2380	2280	FERC No 1971–A ...	ID Pwr.
	ID	Adams									
Hoover Dam & Lk Mead	NV	Clark Mohave	Colorado R	F	1500.0	1229.0	1219.6	162700	156500	PL 70–642	USBR.
	AZ			FEIMCAR	15.8	1219.6	1083.0	156500	83500		
Hungry Horse Dam & Res	MT	Flathead	S Fork Flathead R.	FEI	2982.0	3560.0	3336.0	23800	5400	PL 78–329	USBR.
Indian Valley Dam & Res ...	CA	Lake	N Fork Cache Cr	FIMR	40.0	1485.0	1474.0	3975	3734	PL 84–884	Yolo FC&W.
				IMR	260.0	1474.0	1334.0	3734	308		
Jamestown Dam & Res	ND	Stutsman	James R	F	185.4	1454.0	1429.8	13210	2090	PL 78–534	USBR.
				IQ	28.1	1429.8	1400.0	2090	160		
Jocassee Dam & Res	SC	Pickens	Keowee R	PRFC	1160.0	1110.0	1080.0	7565	6815	FERC 2503	USBR Pwr.
Keowee Dam & Lk	SC	Pickens	Keowee R	FPMCAR	392.0	800.0	775.0	18372	13072	FERC 2503	Duke Pwr.
Kerr Dam Flathead Lk	MT	Lake	Flathead R	FER	1210.0	2893.0	2883.0	125560	120000	FERC No 5	MT Pwr.

LIST OF PROJECTS—Continued

[Non-Corps projects with Corps Regulation Requirements]

Project name[1] (1)	State (2)	County (3)	Stream[1] (4)	Project purpose[2] (5)	Storage 1000 AF (6)	Elev limits feet M.S.L.		Area in acres		Authorizing legis.[3] (11)	Proj. owner[4] (12)
						Upper (7)	Lower (8)	Upper (9)	Lower (10)		
Kerr Dam & Lk Hudson (Markham Ferry Project).	OK	Mayes	Grand Neosho R	F	244.2	636.0	619.0	18800	10900	PL 76–476	GRD Auth.
				E	46.6	619.0	599.0	10900	4500		
Keyhole Dam & Res	WY	Crook	Belle Fourche R	F	140.5	4111.5	4099.3	13730	9410	PL 78–534	USBR.
				IQ	185.8	4099.3	4051.0	9410	820		
Kirwin Dam & Res	KS	Phillips	N Fork Solomon R.	F	215.1	1757.3	1729.3	10640	5080	PL 78–534	USBR.
				ICR	89.6	1729.2	1697.0	5080	1010	PL 79–732; PL 79–526.	
Lake Kemp Dam & Res	TX	Wichita	Wichita R	F	234.9	1156.0	1144.0	23830	15590	SD 144	WF&C.
				MI	268.0	1144.0	1114.0	15590	3350		WID2.
Leesville Dam & Res	VA	Campbell Pittsylvnia.	Roanoke R	EQ	37.8	613.0	600.0	3235	2400	Fed Pwr Act	Appl Pwr.
Lemon Dam & Res	CO	La Plata	Florida R	FIM	39.0	8146.0	8023.0	622	62	PL 84–485	USBR.
Lewis M Smith Dam & Res	AL	Walker Culman	Sipsey Fork; Black Warrior R.	F	280.6	522.0	510.0	25700	21200	Fed Pwr Act	AL Pwr.
				E	394.3	510.0	488.0	21200	15097		
Little Wood	ID	Blain	Little Wood R	FI	30.0	5237.3	5127.4	572	0	PL 84–993	USBR.
Logan Martin Dam & Res	AL	Talladega	Cossa R	F	245.3	477.0	465.0	26310	15260	PL 83–436	AL Pwr.
				E	67.0	465.0	460.0	15263	11887		
Los Banos Dam & Detention.	CA	Merced	Los Banos Cr	R	20.6	327.8	231.2	467	0		USBR.
Los Banos Dam & Detention Res.	CA	Merced	Los Banos Cr	F	14.0	353.5	327.8	619	467	PL 86–488	USBR.
Lost Creek Dam & Res	UT	Morgan	Lost Cr	FEIM	20.0	6005.0	5912.0	385	93	PL 81–273	USBR.
Lovewell Dam & Res	KS	Jewell	White Rock Cr	F	50.5	1595.3	1582.6	5025	2986	PL 78–534	USBR.
				ICR	24.9	1582.6	1571.7	2986	1704	PL 79–732	
Marshall Ford Dam & Res	TX	Travis	Colorado R	F	778.8	714.0	681.0	29060	18955	PL 73–392	LCRA
				NEIM	810.5	681.0	618.0	18955	8050	PL 78–534	
Mayfield Dam & Res	WA	Lewis	Cowlitz R	FER	21.4	425.0	415.0	2250	2030	FPC No 2016–A	Tac WN.
McGee Creek Dam & Res	OK	Atoka	McGee Cr	F	85.3	595.5	577.1	5540	3810	PL 94–423	USBR.
				MCR	108.0	577.7	515.1	3810	370		
Medicine Cr Dam Harry Strunk Lk.	NE	Frontier	Medicine Cr	F	52.7	2386.2	2366.1	3483	1840	PL 78–534	USBR.
				ICR	26.8	2366.1	2343.0	1840	701	PL 84–505	
Mossyrock Dam Davisson Lk.	WA	Lewis	Cowlitz R	FER	1397.0	778.5	600.0	11830	4250	FERC No 2016–B	Tac. WN
Mt Park Dam Tom Steed Res.	OK	Kiowa	W Otter Cr	F	20.3	1414.0	1411.0	7130	6400	PL 90–503	USBR.
				MRC	89.0	1411.0	1386.3	6400	1270		
Navajo Dam & Res	NM	San Juan Rio Arriba	San Juan R	FEIRO	1036.1	6085.0	5990.0	15810	7400	PL 84–485	USBR.
New Bullards Bar Dam & Res.	CA	Yuba	Yuba R	FEIMR	170.0	1956.0	1918.3	4809	4225	PL 69–298	YCWA.
				EIMR	790.9	1918.3	1447.5	4225	129		

New Exchequer Dam & Lk	CA	Tuolumne	Merced R	FEIR	400.0	867.0	799.7	7110	4849	PL 86-645	Mrcd. Irr.
				EIR	451.6	799.7	660.0	4849	1900		
				IR	171.0	660.0	467.0	1900	150		
New Melones Dam & Lk	CA	Tuolumne	Stanislaus R	FEIMR	450.0	1088.0	1049.5	12500	10900	PL 87-874	USBR.
		Calaveras		EIMR	1870.0	1049.5	808.0	10900	3500		
				IMR	300.0	808.0	540.0	3500	0		
Northfield Mt (Up) PS	MA	Franklin	Connecticut	E	14.0	965.0	938.0	196	134	FERC 1889	WMEC.
Norton Dam & Kieth Sebelius Lk.	KS	Norton	Prairie Dog Cr	F	98.8	2331.4	2304.3	5316	2181	PL 78-534	USBR.
				IMRC	30.7	2304.3	2280.4	2181	587	PL 79-526	
										PL 79-732	
Ochoco Dam & Res	OR	Crook	Ochoco Cr	FICR	52.5	3136.2	0.0	1130	130	PL 84-992	USBR.
Oroville Dam & Lk	CA	Butte	Feather R	FEIMAR	750.0	900.0	848.5	15800	13346	PL 85-500	CA.
				EIMAR	2788.0	848.5	210.0	13346	0		
Pactola Dam & Res	SD	Pennington	Rapid Cr	F	43.1	4621.5	4580.2	1230	860	PL 78-534	USBR.
				IM	55.0	4580.2	4456.1	860	100		
Palisades Dam & Res	ID	Bonneville	Snake R	FIE	1202.0	5620.0	5452.0	16100	2170	PL 81-864	USBR.
Paonia Dam & Res	CO	Gunnison	Muddy Cr	FIR	17.0	6447.5	6373.0	334	120	PL 80-177	USBR.
										PL 84-485	
Pensacola Dam Grand Lake O' the Cherokees.	OK	Mayes	Grand (Neosho) R.	F	525.0	755.0	745.0	59200	46500	PL 77-228	Grd. Auth.
				E	1192.0	745.0	705.0	46500	17000		
Pineview Dam & Res	UT	Weber	Odgen R	FEIM	110.0	4900.0	4818.0	2874	0	PL 81-273	USBR.
Platoro Dam & Res	CO	Conejos	Conejos R	F	6.0	10034.0	10027.5	947	920	PL 76-640	USBR.
				IR	54.0	10027.5	9911.0	920	0		
Priest Rapids Dam & Res	WA	Grant	Columbia R	FER	44.0	486.0	481.5	7600	6500	FERC No 2114-A	Grnt. PUD.
Prineville Dam & Res	OR	Crook	Crooked R	FIRC	233.0	3257.9	3114.0	3997	140	PL-84-992	USBR.
Prosser Cr Dam & Res	CA	Nevada	Prosser Cr	C	8.6	5703.7	5661.0	334	86	PL 84-858	USBR.
				FC	20.0	5761.0	5703.7	745	334	PL 85-706	
Pueblo Dam & Res	CO	Pueblo	Arkansas R	F	93.0	4898.7	4880.5	5671	4640	PL 87-590	USBR.
				IR	261.4	4880.5	4764.0	4640	421		
Red Willow Dam Hugh Butler Lk.	NE	Frontier	Red Willow Cr	F	48.9	2604.9	2581.8	2682	1629	PL 78-534	USBR.
				IRC	27.3	2581.8	2556.0	1629	787	PL 85-783	
										PL 84-505	
Ririe Dam & Res	ID	Bonneville	Willow Cr	FIRC	99.0	5119.0	5023.0	150	360	PL 87-874	USBR.
Roanoke Rapids Dam & Res.	NC	Halifax	Roanoke R	EC	16.8	132.0	128.0	4600	4100	FPC 2009	VA. Pwr.
Rocky Reach Dam Lk Entiat.	WA	Chelan	Columbia R	FER	36.0	707.0	703.0	9920	9490	FERC No 2145	Chln PUD.
Rocky River PS Lk Candlewood.	CT	Litchfield	Housatonic R	E	142.5	430.0	418.0	5608	4692	FERC 2576	CLPC.
Ross Dam & Res	WA	Whatcom	Skagit R	E	1052.0	1602.5	1475.0	11700	4450	FERC 553	Stfl.
Sanford Dam & Lk Meredith	TX	Hutchison	Canadian R	F	462.1	2965.0	2941.3	21640	17320	PL 81-898	USBR.
				IMCRO	761.3	2941.3	2860.0	17320	4500		
Savage River Dam & Res	MD	Garrett	Savage R	FMA	20.0	1468.5	1317.0	366	0	PL 78-534	Ptmc Comm.
Scoggins Dam Henry Hagg Lk.	.....	.....	Scoggins Cr	FIR	56.3	305.8	235.3	116	4	PL 89-596	USBR.
Shadehill Dam & Res	SD	Perkins	Grand R	F	218.3	2302.0	2271.9	9900	4800	PL 78-534	USBR.
				IO	80.9	2271.9	2250.8	4800	2800		
Shasta Dam Lk	CA	Shasta	Sacramento R	FEIA	1300.0	1067.0	1018.6	29570	23894	PL 75-392	USBR.
				EIA	3241.0	1018.6	735.8	23894	2200		
Shepaug Dam & Lk	CT	Litchfield	Housatonic R	E	5.0	200.0	172.0	1882	1125	FERC 2576	CLPC.

LIST OF PROJECTS—Continued

[Non-Corps projects with Corps Regulation Requirements]

Project name [1] (1)	State (2)	County (3)	Stream [1] (4)	Project purpose [2] (5)	Storage 1000 AF (6)	Elev limits feet M.S.L.		Area in acres		Authorizing legis. [3] (11)	Proj. owner [4] (12)
						Upper (7)	Lower (8)	Upper (9)	Lower (10)		
Smith Mtn Dam & Res	VA	Bedford Franklin Roanoke Pittsylvnia	Roanoke R	E	40.8	795.0	793.0	20600	20200	Fed Pwr Act	Appl Pwr.
Stampede Dam & Res	CA	Sierra	Little Truckee R	FEM	22.0	5949.0	5942.1	3430	3230	PL 84–858	USBR.
				EM	199.4	5942.0	5798.0	3230	210		
Starvation Dam and Res	UT	Duchesne	Strawberry R	FIM	165.3	5712.0	5595.0	3310	689	PL 84–485	USBR.
Stevens Creek Dam & Res	GA	Columbia	Savannah River	P	10.5	187.5	183.0	4300	0	FERC 2535	SC E&G.
Stevenson Dam Lk Zoar	CT	Litchfield	Housatonic R	E	5.0	108.0	80.0	1148	516	FERC 2576	CLPC.
Summer Dam & Lk	NM	De Baca	Pecos R	FI	51.4	4261.0	4200.0	2835	0	PL 83–780	USBR.
Tat Momolikot Dam & Lake	AZ	Pinal	Santa Rosa Wash.	FIC	198.5	1539.0	1480.0	11790	0	PL 89–298	BIA.
Tiber Dam & Res	MT	Liberl Toole	Marias R	F	400.9	3012.5	2993.0	23150	17890	PL 78–534	USBR.
				FIQ	268.0	2993.0	2976.0	17890	13790		
				IQ	121.7	2976.0	2966.4	13790	11710		
Trenton Dam & Res	NB	Hitchcock	Republican R	F	134.1	2773.0	2752.0	7940	4922	PL 78–534	USBR.
				IRC	99.8	2752.0	2720.0	4922	1572	PL 84–505	
Turners Falls (Low) Dam & Lk.	MA	Franklin	Connecticut R	E	8.7	185.0	176.0	2110	1880	FERC 1889	WMEC
Twin Buttes Dam & Lake	TX	Tom Green	Concho R	F	454.4	1969.1	1940.2	23510	23510	PL 85–152	USBR
				IM	150.0	1940.2	1885.0	9080	670	PL 78–534	
Twitchell Dam & Res	CA	Santa Barbara	Cuyama R	F	89.8	651.5	623.0	3671	2556	PL 83–774	USBR
				IM	135.6	623.0	504.0	2556	0		
Upper Baker Dam Baker Lk	WA	Whatcom	Baker R	FE	184.6	724.0	674.0	4985	2375	PL 89–298	Pgt
										FERC 2150B	P&L
Vallecito Dam & Res	CO	La Plata	Los Pinos R	FEI	125.4	7665.0	7582.5	2720	350	PL 81–288	USBR
										PL 88–292	
Vernon Dam & Lk	VT	Windham	Connecticut R	E	18.3	220.1	212.1	2550	1980	FERC 1904	NEPC
Wanapum Dam & Res	WA	Grant	Columbia R	FER	151.6	571.5	560.0	14300	13350	FERC No 2114–B	Grnt PUD
Warship Dam & Rockport	UT	Summit	Weber R	FEIM	61.0	6037.0	5930.0	1077	121	PL 81–273	USBR
Warm Springs Dam & Res	OR	Malheur	Middle Fork Malheur R.	FICR	191.0	3406.0	3327.0	460	90	PL 78–534	Valo USBR
Waterbury Dam & Res	VT	Washington	Little R	FP	27.7	617.5	592.0	1330	890	PL 78–534	VT
Webster Dam & Res	KS	Rocks	S Fork Solomon R.	F	183.4	1823.7	1892.5	8480	3772	PL 78–534	USBR
				IRC	72.1	1892.5	1860.0	3772	906	PL 79–526	
										PL 79–732	
Weiss Dam & Res	AL	Cherokee	Coosa R	F	397.0	574.0	564.0	50000	30200	PL 83–436	AL Pwr
				E	148.4	564.0	558.0	30200	19545		
Wells Dam L Pateros	WA	Douglas	Columbia R	FER	74.0	781.0	771.0	10000	8000	FERC No 2149	Dgls PUD

Wilder Dam & Lk	VT	Windsor	Connecticut R	E	13.3	365.0	360.0	3100	2240	FERC 1893	NEPC
Yellowtail Dam & Bighorn Lk.	MT	Big Horn	Bighorn R	F	258.3	3657.0	3640.0	17280	12600	PL 78-534	USBR
				FEIQ	240.3	3640.0	3614.0	12600	6915		PUD
				EIQ	336.1	3614.0	3547.0	6915	4150		

[1] Cr—Creek; CS—Control Structure; Div—Diversion; DS—Drainage Structure; FG—Floodgate; Fk—Fork; GIWW—Gulf Interconstal Waterway; Lk—Lake; L&D—Lock & Dam; PS—Pump Station; R—River; Res—Reservoir

[2] F—Flood Control; N—Navigation; P—Corps Hydropower; E—Non Corps Hydropower; I—Irrigation; M—Municipal and/or Industrial Water Supply; C—Fish and Wildlife Conservation; A—Low Flow Augmentation or Pollution Abatement; R—Recreation; Q—Water Quality or Silt Control

[3] FCA—Flood Control Act; FERC—Federal Energy Regulatory Comm; HD—House Document; PL—Public Law; PW—Public Works; RHA—River & Harbor Act; SD—Senate Document; WSA—Water Supply Act

[4] Appl Pwr—Appalachian Power; Chln PUD—Chelan Cnty PUD 1; CLPC—CT Light & Power Co; Dgls PUD—Douglas Cnty PUD 1; DWR—Department of Water Resources; EB-MUD—East Bay Municipal Utility Dist; GRD—Grand River Dam Auth; Grnt PUD—Grant Cnty PUD 2; Hnbl—city of Hannibal; LCRA—Lower Colorado River Authority; M&T Irr—Modesto & Turlock Irr; Mrcd Irr—Merced Irr; NEPC—New England Power Co; Pgnt P&L—Pugent Sound Power & Light; Pmc Comm—Upper Potomac R Comm; Rclm B—Reclamation Board; Rkfd—city of Rockford; Stl—city of Seattle; Tac—City of Tacoma; Vale USBR—50% Vale Irr 50% USBR; WF&CWID—City of Wichita Falls and Wichita Cnty Water Improvement District No. 2; WMEC—Western MA Electric Co; YCWA—Yuba City Water Auth; Yolo FC&W—Yolo Flood Control & Water Conserv Dist.

(Sec. 7, Pub. L. 76-534, 58 Stat. 890 (33 U.S.C. 709); the Federal Power Act, 41 Stat. 1063 (16 U.S.C. 791(A)); and sec. 9, Pub. L. 83-136, 68 Stat. 303)

[43 FR 47184, Oct. 13, 1978, as amended at 46 FR 58075, Nov. 30, 1981; 55 FR 21508, May 24, 1990; 79 FR 13564, Mar. 11, 2014]

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WATER CONTROL MANUAL
FOLSOM DAM AND LAKE

American River
California

EXHIBIT D

GUIDANCE ON THE PREPARATION OF DEVIATIONS FROM APPROVED WATER CONTROL PLANS

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

December 1987
Manual Revised September 2017

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- DRAFT -

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION CORPS OF ENGINEERS
1455 Market Street
San Francisco, California 94105-2195

CESPD-RBT

REGULATION
No. 10-1-04

18 December 2014

Engineering and Design
GUIDANCE ON THE PREPARATION OF DEVIATIONS
FROM APPROVED WATER CONTROL PLANS

1. PURPOSE. This document establishes the protocol for reporting deviations from approved Water Control Plans for water control projects within the South Pacific Division (SPD). Each major subordinate command (MSC) is responsible for establishing guidance as outlined in ER 1110-2-1400 with respect to water control management policy including deviation. It defines coordination, review, and approval procedures between SPD and District offices. Approval from SPD must be obtained for deviations.

2. APPLICABILITY. The following is applicable to all South Pacific Division Districts and field-operating activities having civil works responsibilities.

3. REFERENCES. Authority and guidance can be found in Appendix A and B of Draft ER 1110-2-240 (enclosure):

4. OVERVIEW.

a. Water Control Manuals are prepared for USACE-owned reservoir projects. Water Control Manuals are also prepared for non-USACE projects where USACE has flood control or navigation responsibilities. The Water Control Manual provides guidance and instruction for project personnel and serves as a reference for others who may be involved with, responsible for, or affected by project water control regulation. The Water Control Manual includes the Water Control Plan and is compliant with the objectives and provisions of authorizing legislation and applicable USACE project reports. The Water Control Manual generally describes how a reservoir will be regulated, incorporates allowable flexibility for a broad variety of runoff and climatic conditions to achieve authorized project purposes and covers the regulation of the project over the entire regime of pool elevations and conditions.

b. Water Control Plans are developed to ensure that operations of reservoirs, locks and dams, re-regulation, and major control structures and interrelated systems conform to

objectives and specific provisions of authorizing legislation and applicable USACE reports, including any applicable authorities established after project completion. Water Control Plans are prepared with appropriate consideration of federal law that relates to the operation of federal facilities, as well as the requirements of Water Control Manuals. Thorough analyses are performed to establish optimal Water Control Plans within prevailing constraints. Formulation of these plans requires a comprehensive knowledge of project purposes, history, authorizing legislation, USACE policies and regulations, system effects, hydrology, meteorology, operations and physical constraints/capabilities of project features. Prior to approval and implementation, the proposed Water Control Plan is released for public review and comment. Generally, this proceeds concurrently with the NEPA public review process.

The Water Control Plan consists of coordinated regulation schedules for project/system regulation, provisions for collection and dissemination of data, guidelines for preparation of detailed operating instructions, guidelines to assure project safety, and actions to fulfill regulatory requirements.

Deviations – Water Control Manuals contain a provision authorizing the operating agency to deviate temporarily from operations prescribed in the project's approved Water Control Plan when necessary to alleviate critical situations or to realize increased benefits during an operation season without significantly affecting the fulfillment of the projects authorized purposes. These deviations are intended to address special and unique circumstances including dam safety issues. The competing goals and complex interactions of interested groups/agencies can cause even seemingly inconsequential deviations from an approved plan to lead to unforeseen life safety and environmental impacts, and legal complications. This regulation serves to assist the District in preparing their deviation requests. It outlines a minimum set of considerations that need to be addressed when making a recommendation to deviate from an approved Water Control Plan.

Deviations generally fall into three categories: emergency, unplanned, and planned deviations. Regardless of the type of deviation, the basic tenets of a deviation must adhere to safe operation to include operational/structural integrity, not endanger the dam, mitigate risk of downstream flooding, not unnecessarily store water in the pool, and not compromising the safety of persons or property downstream. Also any deviation must be consistent with project authorization and within existing authorities.

5. TYPES OF DEVIATIONS.

a. *Emergency Deviations.* An emergency deviation from an approved Water Control Plan is one that is required to mitigate an immediate threat to public health and safety, property, project, or the environment. Each Water Control Manual generally contains provisions for dealing with emergency situations. If the Water Control Manual contains provisions for emergency situations, water control action taken in accordance with those provisions would not be considered a deviation from the Water Control Plan. However, for those situations not covered in the Water Control Manual, these are considered emergency deviations and demand immediate action. Request for and approval of emergency deviation may be

transmitted to SPD by telephone or electronic media. Necessary actions may then be immediately taken under emergency conditions with the approval of the District Commander. A written confirmation describing the deviation and the conditions that required the action shall be forwarded to the SPD Commander as soon as practicable.

An emergency situation could include: drowning and other accidents, assistance to local authorities responding to an emergency (e.g. police and fire departments), failure of operations facilities, chemical spills, treatment plant failures, and other temporary pollution or water quality problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. Such deviations generally last from a few hours to a few days.

b. Unplanned Deviations. Each Water Control Manual generally contains provision for dealing with a wide range of unplanned occurrences that are not considered emergencies. The need for unplanned deviations can arise due to unforeseen conditions that do not allow sufficient time for a full analysis prior to the deviation. These types of unplanned deviations could arise due to construction, maintenance, inspection or flood control needs. Such deviations generally last from a few hours to a few days. Each request for an unplanned deviation should be analyzed on its own merits, with an evaluation of factors such as impacts to potential failure mode and consequences, upstream watershed conditions, potential flood threat, condition of the lake, possible alternative measures, and potential adverse effects on the overall regulation of the project for the authorized purposes. Requests for and approval of unplanned deviations may be transmitted by telephone or electronic media. Follow-up written documentation explaining the deviation and its cause shall be furnished as soon as practicable to the SPD Senior Regional H&H/Water Control Engineer with notification to (cc'ed) the District and SPD Dam Safety Officers. Unplanned deviation should follow the guidance and process of a planned deviation. It is recognized that unplanned deviation may require expedited review/approval due to the circumstances. Hence, early notification to SPD is of utmost importance.

c. *Planned Deviations.* Planned deviations cover other deviations not addressed by an emergency or unplanned deviation. Planned deviations for Dam Safety Action Classification (DSAC 1-3) dams shall comply with ER 1110-2-1156, chapter 24 – Dam Safety Considerations for Storage Allocation, Reallocation, and related Studies of. A major deviation that would result in increased water storage at a DSAC 1,2, or 3 requires HQ approval. Planned Deviations are categorized into two types – Planned Minor and Planned Major.

1. *Planned Minor.* Minor deviation is limited by i) flood control pool elevation will not vary more than 2 feet from what would have been the water surface elevation under the approved Water Control Plan or ii) storage difference from approved Water Control Manual will not exceed 5% of the total storage. Minor deviation should not last more than 10 days. Longer minor deviation must be coordinated with the SPD Senior Regional H&H/Water Control Engineer.

2. *Planned Major.* All other planned deviations are considered major deviations.

A risk and uncertainty (Section 8.b.3) analysis shall be performed to determine potential consequences of the deviation. Depending on the circumstances and availability of data, this could be qualitative or quantitative. Best effort should be used to attempt a qualitative analysis.

6. OFFICE OF RECORD. The originating District's water control management office will be responsible for maintaining all relevant records documenting the deviation.

7. GENERAL INFORMATION FOR PREPARING DEVIATIONS.

a. Time to Prepare Deviations. District offices should also inform potential agencies/entities that the lead time required to assemble the necessary information required to evaluate a deviation request may be on the order of months (normally due to the required environmental analysis and the public review process). Thus, the request to the District should be made well in advance of the proposed initiation date from the deviation. The requesting agency/entity should also be made aware that approval of the deviation request would depend upon such things as a review of the impacts (e.g., environmental, hydrologic, legal, etc.). The deviation request should also be coordinated with the District Dam Safety Officer.

b. Coordinating with SPD Staff. Preparation of a deviation package is a time consuming and costly undertaking. Incomplete or inadequate package impacts timing for approvals. District personnel are to coordinate any questions or concerns about potential deviations, and discuss any atypical situations with their SPD counterparts early in the process before the package submittal. The necessary technical review will be conducted at the District level with review certification provided to SPD. In an emergency situation, a formal quality certification will most likely not be required. A written confirmation describing the deviation and the conditions that required the action shall be forwarded to the division commander as soon as practicable.

c. Non-Corps Projects. Deviation requests from non-Corps (Section 7 the Flood Control Act of 1944, as amended) projects must be prepared with the approval of the project owner. This is required because project owners are responsible for assuring that the project is operated as prescribed in the Water Control Plan developed in concert with the USACE flood control requirements. The owner is also ultimately responsible for dam safety at the project and for funding of the project.

d. Environmental Requirements. Each deviation request shall include a summary of identified environmental effects of the proposed deviation, and a statement of how the proposal complies with pertinent environmental requirements, including but not limited to the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Clean Water Act (CWA), and the Clean Air Act (CAA). NEPA documentation requirements may be met by preparation of an Environmental Assessment (EA) of the proposed action, concluding with a Finding of No Significant Impact (FONSI). If the EA discloses significant impacts to the human environment that are complex, extensive

and/or that cannot be readily avoided, minimized, or mitigated; development and coordination of an Environmental Impact Statement (EIS) is required, concluding with a Record of Decision (ROD). This and related decisions will be coordinated with senior environmental staff in the District's and Division's Planning Divisions, to include senior ecologists. If an existing EIS/ROD or EA/FONSI accurately covers the action, and if there have been no environmental changes since that documentation, there may be reliance and reference to this documentation for purposes of environmental compliance. If those NEPA documents are more than five years old, such reliance is improper. Updated NEPA documentation is required to include full coordination with resource agencies and the public. The scope and type of NEPA documentation will be coordinated with Planning and Office of Counsel. Supporting environmental documents shall be included in the deviation request package when it is submitted. Subject NEPA documents will be accompanied, as applicable, by a Biological Assessment and final Biological Opinion, and a letter from U.S. Fish & Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS) concurring there is not likely to be adverse effect on listed or other significant species. A 404(b)(1) evaluation under the CWA may also be required. In the case of emergency deviations, the emergency provisions and requirements of the various environmental laws shall be followed as practicable. Deferred compliance does not mean compliance is avoided, but rather that it may be delayed or mitigated. Any significant impacts of reoperation, moreover, must be identified, managed and mitigated after the fact regardless of the urgency of such emergency activities. Foresight, planning ahead and timely coordination with resource agencies, therefore, is of utmost importance and priority.

e. *Recurring Deviation.* Recurrent or prolonged planned deviation may indicate the need for a formal change to the water control plan. Deviations that occur in three or more consecutive years, or three or more times within a five-year period, must be fully coordinated with USACE Headquarters.

8. ROLES AND RESPONSIBILITIES

a. SPD DISTRICTS

Preparation of Deviations. Processing of a deviation request as outlined in the approved Water Control Manual and in accordance with this regulation originates at the District Water Control Management office. The District Commander may delegate signature authority for requesting deviations from approved Water Control Plans to the appropriate functional division head or designated representative. Consultation with the District staffs, including engineering, planning, environmental, economics, operations, construction and legal must take place. The following information shall be submitted in written form to the SPD Commander or designee for consideration of the deviation:

(1) Description of the proposed deviation, including purpose, proposed change from the approved water control plan, duration, and other details about the deviation.

(2) The implications of adhering to the water control plan and of employing the proposed deviation.

(3) Alternative deviation plan (or plans) to include the application of risk and uncertainty in the analysis and the consequences of each.

(4) Effects of the proposed deviation on project and system operation, and on other project purposes such as flood control, hydropower, water quality, water supply, navigation, recreation, or fish and wildlife.

(5) Review of the existing Potential Failure Mode Analysis (PFMA) for the dam and an analysis of the effect of the deviation on the probability of failure and consequences associated with the deviation.

(6) The potential flood threat with and without the proposed deviation.

(7) Current and predicted maximum storage, elevation, river stage, and other pertinent information with and without the deviation.

(8) Review of the alternative (or alternatives) under provisions of pertinent laws and regulations, including, but not limited to, the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), Clean Water Act (CWA), National Historic Preservation Act (NHPA), Clean Air Act (CAA), etc., when and as applicable.

(9) A description of the coordination that has been done with affected entities, both USACE and non-USACE, and the effect on other local, regional, state, tribal, and federal agencies.

(10) Written comments from agencies, organizations, businesses, and individuals who may be impacted by, or supportive of the proposed change in flows, including federal, state, and local agencies; tribes; industries, organizations, and other stakeholders; and the public.

(11) Discussion of any other relevant issues.

(12) District Commander's, or designee's, recommendation.

In addition, requirements for submission of an exception to ER 1110-2-1156, Chapter 24, if required, shall conform to the submission requirements contained therein. Also, Appendix B.1 - District Engineer Quality Certification must be signed and submitted with the package.

b. SOUTH PACIFIC DIVISION

Approval of Deviations. Approval for deviations must be obtained from the SPD Commander or designee prior to their implementation. Approval for exceptions to Chapter 24 of ER 1110-2-1156 for deviations that increase water storage at DSAC 1, 2, or 3 dams shall be obtained from the HQUSACE Dam Safety Officer. Such request will be submitted through

command channels to the SPD USACE Regional Integration Team (RIT) in Washington, DC. As noted in paragraph 5.a, an emergency deviation situation may warrant an immediate action as outlined in the Water Control Manual. Necessary actions under emergency conditions may then be taken immediately upon telephone or electric media notification to SPD and with approval of the District Commander. A written confirmation describing the deviation and conditions that required the action shall be forwarded to the SPD Commander as soon as practicable.

Approval of all unplanned and planned deviation must be obtained prior to implementation of the deviation. Planned deviation must be approved in writing. Unplanned deviations may be approved via telephone, e-mail, fax or other appropriate communication methods with written documentation provided as soon as practicable. Unplanned and Planned major deviation must be approved by the Division Commander or designee (Deputy Commander), hence may require more time and coordination. Approval of planned minor deviation will be given by the SPD Senior Regional H&H/Water Control Engineer or his/her immediate supervisor.

9. PREPARING EMERGENCY DEVIATIONS

a. Emergency deviations are the only type of deviation that do not require prior approval from SPD, and must only be used if events warrant an immediate emergency action, such that time constraints render impractical notification to the SPD. However, even in an emergency situation, the District shall notify the SPD of the action as soon as possible, and shall comply with all applicable requirements.

b. A record of the emergency deviation shall be developed at the district office and transmitted to the SPD office within a day of the action taken.

c. Procedures for emergency deviations: (1)

(1) Take the necessary action.

(2) Contact SPD as soon as possible to describe the action taken and the cause (NOTE: The order of (l) and (2) may be reversed depending on the nature of the emergency). Continuation of the deviation will require SPD approval.

(3) The District shall provide written confirmation to the SPD office within 21 days of the deviation. The correspondence shall include the items outlined section 7.b (as applicable).

(4) The SPD shall respond within 7 days of the District's notification of the emergency deviation.

10. PREPARING PLANNED (UNPLANNED) DEVIATIONS.

a. The District shall inform SPD (Senior Regional H&H/Water Control Engineer)

within 2 days of receiving a request for a proposed deviation. If the District is requesting the deviation, notification to SPD should be made as soon as practicable.

b. At least 21 days prior to the proposed action, the District shall transmit a deviation request package to the SPD offices. The deviation request package shall include the items in section 8.a. This package may be initially transmitted electronically.

c. If the District submits a complete quality package with all required documentation, SPD will review the proposal and approve or disapprove the District's deviation request within 7 days. Early, detailed, coordination and transmittal of documents to SPD may expedite the processing time.

d. For unplanned deviation, the District will notify SPD as soon as possible of a request for a proposed deviation. SPD will make an expedited effort to review/approve the deviation based on the project's needs.

MARK TOY, P.E.
BG, USA
Commanding

APP A-District Engineer's Certification for Emergency Deviation
APP B.1 – District Approval Certification for Major Deviation
APP B.2 – Division Approval Certification for Major Deviation
APP C – Division Approval Certification for Minor Deviation

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REGULATION No. 10-1-04
18 December 2014

APPENDIX A

DISTRICT ENGINEER'S CERTIFICATION
For Emergency Deviation

COMPLETION OF QUALITY CONTROL ACTIVITIES
The District has completed the review/analysis of the emergency water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in this analysis have been completed. A written confirmation describing the deviation and the conditions that required the action was forwarded to the SPD Commander on (*insert date*).

GENERAL FINDINGS

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality control certification for this deviation request.

(Signature) *(Date)*
Chief, District Engineering Division

(Signature) *(Date)*
Chief, District Asset Management (Operation) Division

(Signature) *(Date)*
Chief, District Planning (Environmental) Division

CERTIFICATION OF LEGAL REVIEW*
The request for a water control deviation from the approved Water Control Plan report for *indicate name of project*, has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

(Signature) *(Date)*
Chief, District Counsel

DISTRICT COMMANDER CERTIFICATION
All issues and concerns resulting from technical review of the water control deviation have been resolved. A written confirmation describing the deviation and the conditions that required the action shall be forward to the Division Commander as soon as practicable. **This deviation is approved.**

(Signature) *(Date)*
District Commander

REGULATION No. 10-1-04
18 December 2014

APPENDIX B.1
(To be completed by District)

DISTRICT APPROVAL CERTIFICATION
For Major Planned (Unplanned) Deviation

COMPLETION OF QUALITY CONTROL ACTIVITIES

The District has completed the review/analysis of the water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in this analysis have been completed.

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality control certification for this deviation request.

_____ *(Signature)* _____ *(Date)*
Chief, District Engineering Division

_____ *(Signature)* _____ *(Date)*
Chief, District Asset Management (Operation) Division

_____ *(Signature)* _____ *(Date)*
Chief, District Planning (Environmental) Division

_____ *(Signature)* _____ *(Date)*
Chief, District Environmental Resources Branch

CERTIFICATION OF LEGAL REVIEW*

The request for a water control deviation from the approved Water Control Plan report for *indicate name of project,* has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

_____ *(Signature)* _____ *(Date)*
District Counsel

QUALITY CERTIFICATION

All issues and concerns resulting from technical review of the water control deviation have been resolved. This deviation is recommended for approval.

_____ *(Signature)* _____ *(Date)*
District Commander

APPENDIX B.2
(To be completed by Division)

DIVISION APPROVAL CERTIFICATION
For Major Planned (Unplanned) Deviation

COMPLETION OF QUALITY ASSURANCE ACTIVITIES

The Division has completed the review/analysis of the water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality assurance activities appropriate to the level of risk and complexity inherent in this analysis have been completed.

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality assurance certification for this deviation request.

_____ *(Signature)* _____ *(Date)*
Chief, SPD Business Technical Division

_____ *(Signature)* _____ *(Date)*
Chief, SPD Civil Work Integration Division

_____ *(Signature)* _____ *(Date)*
Chief, SPD Planning (Environmental) Division

CERTIFICATION OF LEGAL REVIEW*

The request for a water control deviation from the approved Water Control Plan report for *indicate name of project,* has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

_____ *(Signature)* _____ *(Date)*
Chief, SPD Office of Counsel

DIVISION COMMANDER APPROVAL

_____ *(Signature)* _____ *(Date)*
Division Commander

REGULATION No. 10-1-04
18 December 2014

APPENDIX C

DIVISION APPROVAL CERTIFICATION
For Minor Planned (Unplanned) Deviation

COMPLETION OF QUALITY CONTROL ACTIVITIES

The District has completed the review/analysis of the water control deviation from the Approved Water Control Plan for *(Project Name and Location)*. Certification is hereby given that all quality control activities appropriate to the level of risk and complexity inherent in this analysis have been completed.

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, data and the reasonableness of the results. The undersigned recommends certification of the quality control certification for this deviation request.

_____ *(Signature)* _____ *(Date)*
Chief, District Engineering Division

_____ *(Signature)* _____ *(Date)*
Chief, District Asset Management (Operation) Division

_____ *(Signature)* _____ *(Date)*
Chief, District Planning (Environmental) Division

_____ *(Signature)* _____ *(Date)*
Chief, District Environmental Resources Branch

CERTIFICATION OF LEGAL REVIEW*

The request for a water control deviation from the approved Water Control Plan report for *indicate name of project,* has been fully reviewed by the Office of Counsel, and is approved as legally sufficient.

_____ *(Signature)* _____ *(Date)*
District Counsel

DIVISION APPROVAL

_____ *(Signature)* _____ *(Date)*
SPD Senior Regional H&H/Water Control Engineer