APPENDIX B

2018 Coordinated Operation Agreement Addendum

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Acronyms and Abbreviations

AF/yr	acre-feet per year
Banks Pumping Plant	Harvey O. Banks Pumping Plant
BO	biological opinion
BSPP	Barker Slough Pumping Plant
CALFED	California Federal Bay–Delta
CCF	Clifton Court Forebay
CEQA	California Environmental Quality Act
cfs	cubic feet per second
COA	Agreement Between the United States of America and the State of California for Coordinated Operation of the Central Valley Project and the State Water Project" (Coordinated Operations Agreement)
CVP	Central Valley Project
D-893	SWRCB Water Rights Decision 893
D-1485	SWRCB Water Rights Decision 1485
D-1641	SWRCB Water Rights Decision 1641
DCC	Delta Cross Channel
Delta	Sacramento–San Joaquin Delta
DMC	Delta–Mendota Canal
DWR	California Department of Water Resources
ESA	Federal Endangered Species Act
FERC	Federal Energy Regulatory Commission
HOR	Head of Old River
HORB	Head of Old River Barrier
JPOD	Joint Point of Diversion
MAF	million acre-feet
MIDS	Morrow Island Distribution System
NBA	North Bay Aqueduct
NOE	Notice of Exemption
OMR	Old and Middle River
Reclamation	U.S. Bureau of Reclamation
RRDS	Roaring River Distribution System
SMPA	Suisun Marsh Preservation Agreement
SMSCG	Suisun Marsh Salinity Control Gates
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TBP	Temporary Barrier Project

Trinity River ROD	Trinity River Mainstem Fishery Restoration Record of Decision
USACE	U.S. Army Corps of Engineers
USDOI	U.S. Department of the Interior
WQCP	Water Quality Control Plan

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INTRODUCTION

The 1986 Coordinated Operation Agreement (COA)[1] is the agreement between the California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation) that governs how the State Water Project (SWP) and federal Central Valley Project (CVP) share water under their water rights and operate to meet specific water quality and outflow requirements in the Sacramento–San Joaquin Delta (Delta) (DWR and Reclamation 2018). It was based on negotiated principles of equitable sharing, arising from the requirement that their operations be coordinated and, as a matter of practical necessity, for two large projects to be able to operate together in a complex tidal estuary.

DESCRIPTION OF THE 1986 COA

Under the 1986 COA, the parties reduced the complexities of two large water projects in exporting water from the Delta to a simple agreed-on sharing of (1) rights to unstored water for export (55 percent CVP, 45 percent SWP), and (2) responsibility for providing stored water to meet Sacramento Valley in-basin uses under "balanced conditions" (75 percent CVP, 25 percent SWP), when both projects are operating to meet Delta standards. These provisions are contained in Article 6 of the agreement.

Many changes in conditions affecting operations and delivery capabilities of both projects have occurred since 1986, particularly in Delta water quality standards set by the SWRCB and based on Biological Opinions under the ESA, in CVP and SWP demand, and under the Central Valley Project Improvement Act of 1992. The COA was designed to respond to and work under a wide range of conditions except extreme drought; and it has been implemented successfully for more than 30 years. The COA also includes a provision for the sharing formulas to be updated to incorporate changing conditions. However, one item that the COA does not expressly address is sharing of export limits that have been imposed by the SWRCB and the federal ESA agencies since 1986. By informal agreement, the CVP and SWP have shared them equally.

KEY PROVISIONS IN THE 1986 COA

Several of the key provisions in the COA are described in the following descriptions.

SACRAMENTO VALLEY IN-BASIN USES

Sacramento Valley in-basin uses are defined in the COA as legal uses of water in the Sacramento Basin and the Delta. They include both diversion uses and regulatory uses, including SWRCB water quality and outflow standards.

[1] Agreement between the United States of America and the State of California for the Coordinated Operation of the Central Valley Project and the State Water Project.

Balanced and Excess Water Conditions

The COA defines balanced water conditions as periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flows approximately equal the water supply needed to meet Sacramento Valley in-basin uses plus Delta exports.

Excess water conditions are periods when it is mutually agreed that releases from upstream reservoirs plus unregulated flows exceed Sacramento Valley in-basin uses plus Delta exports. Reclamation's Central Valley Operations Office and DWR's SWP Operations Control Office jointly decide when balanced or excess water conditions exist. During excess water conditions, when sufficient water is available to meet all beneficial needs, the CVP and SWP are not required to supplement the supply with additional releases from storage.

Sharing Export Facilities and Limits

Sharing Export Facilities and Limits Article 10 of the COA contains provisions for both projects to share each other's export facilities for facility outages; for the SWP to wheel water for the CVP to make up losses from SWRCB Water Rights Decision 1485 (D-1485) striped bass pumping limits, if the SWP would not be adversely affected; for an exchange of SWP wheeling for CVP water; and for a general provision for negotiating other such agreements. Although Article 6 addresses the sharing of obligations to meet in-basin uses, the COA contains no express provision for sharing pumping limits, which have been imposed since 1995 and shared 50-50 between the two projects by informal agreement.

Key Provisions of the 2018 COA Addendum

DWR and Reclamation executed an Addendum to the COA on December 12, 2018 (COA Addendum). The COA Addendum amended four key elements of the COA:

- Article 6(c) in-basin uses
- Article 10(b) CVP use of Harvey O. Banks Pumping Plant (Banks Pumping Plant)
- Article 10(i) export restrictions
- Article 14(a) the periodic review

These elements were amended as follows.

Article 6(c)

Article 6(c) of the 1986 COA is amended to provide:

> *(c) Sharing of Responsibility for Meeting Sacramento Valley In-Basin Use with Storage Withdrawals During Balanced Water Conditions: Each party's responsibility for making available storage withdrawals to meet Sacramento Valley in-basin use of storage withdrawals shall be determined by multiplying the total Sacramento Valley in-basin use of storage withdrawals by the following percentages:*

	United States	State
Wet Years	80%	20%
Above-Normal Years	80%	20%
Below-Normal Years	75%	25%
Dry Years	65%	35%
Critical Years	60%	40%

The water year classifications described in this Article 6(c) shall be based on the Sacramento Valley 40-30-30 Index as most recently published through the Department of Water Resources' Bulletin 120.

In a Dry or Critical Year following two Dry or Critical Years, the United States and State will meet to discuss additional changes to the percentage sharing of responsibility to meet in-basin use.

ARTICLE 10(b)

Article 10(b) of the 1986 COA is amended to provide:

(b) The State will transport up to 195,000 acre-feet of Central Valley Project water through the California Aqueduct Reaches 1, 2A, and 2B no later than November 30 of each year by direct diversion or by rediversion of stored Central Valley Project water at times those diversions do not adversely affect the State Water Project purposes or do not conflict with State Water Project contract provisions. The State will provide available capacity at the Harvey O. Banks Pumping Plant ("Banks") to the Central Valley Project to divert or redivert 195,000 acre-feet when the diversion capacity at the south Delta intake to Clifton Court Forebay is in excess of 7,180 cubic feet per second during the July 1 through September 30, except when the Delta is in Excess Water Conditions during July 1 through September 30, the diversion capacity at the south Delta intake to Clifton Court Forebay is in excess of 7,180 cubic feet per second shall be shared equally by the State and the United States This Article does not alter the Cross-Valley Canal contractors' priority to pumping at the Harvey O. Banks Pumping Plant, as now stated in Revised Water Rights Decision.

ARTICLE 10(I)

Article 10(i) is added to the 1986 COA to provide:

(i) Sharing of Applicable Export Capacity When Exports are Constrained. During periods when exports are constrained by non-discretionary requirements imposed on the SWP and CVP south Delta exports by any federal or state agency, applicable export capacity shall be shared by the following percentages:

	United States	State
Balanced Water Condition	65%	35%
Excess Water Condition	60%	40%

ARTICLE 14(a)

Article 14(a) of the 1986 COA is amended to provide:

> *(a) Prior to December 31 of the fifth full year following execution of this agreement, and before December 31 of each fifth year thereafter, or within 365 days of the implementation of new or revised requirements imposed jointly on Central Valley Project and State Water Project operations by any federal or state agency, or prior to initiation of operation of a new or significantly modified facility of the United States or the State or more frequently if so requested by either party, the United States and the State jointly shall review the operations of both projects. The parties shall (1) compare the relative success which each party has had in meeting its objectives, (2) review operation studies supporting this agreement, including, but not limited to, the assumptions contained therein, and (3) assess the influence of the factors and procedures of Article 6 in meeting each party's future objectives. The parties shall agree upon revisions, if any, of the factors and procedures in Article 6, Exhibits Band D, and the Operation Study used to develop Exhibit B.*

In addition to the amended articles presented above, pursuant to Article 11, COA Exhibit A also was updated to conform with Delta standards, established by the SWRCB in the 1995 Water Quality Control Plan (WQCP) for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary, as implemented by SWRCB Water Rights Decision 1641 (D-1641). COA Exhibit B also was updated, based on a joint operations study of the amendments in the 2018 COA Addendum.

ARTICLE 14(c)

A new Article 14(c) is added to the Agreement to provide:

> *(c) Prior to December 31 of the fifth full year following execution of this agreement, and before December 31 of each fifth year thereafter, or within 365 days of the implementation of new or revised requirements imposed jointly on Central Valley Project and State Water Project operations by any federal or state agency, or prior to initiation of operation of a new or significantly modified facility of the United States or the State or more frequently if so requested by either party, the United States and the State jointly shall review the operations of both projects. The parties shall (1) compare the relative success which each party has had in meeting its objectives, (2) review operation studies supporting this agreement, including, but not limited to, the assumptions contained therein, and (3) assess the influence of the factors and procedures of Article 6 in meeting each party's future objectives. The parties shall agree upon revisions, if any, of the*

factors and procedures in Article 6, Exhibits B and D, and the Operation Study used to develop Exhibit B.

CEQA Compliance for the 2018 COA Addendum

As part of approving the 2018 COA Addendum, DWR completed and filed a Notice of Exemption (NOE) for the ongoing operations of the SWP, in accordance with the California Environmental Quality Act (CEQA). The NOE presented the following conclusions.

Projects that were approved and implemented before enactment of CEQA on November 23, 1970 are exempt from the act's requirements. The SWP was constructed in relevant part and was operational prior to November 23, 1970, and the operational scope of SWP activities was broad, providing DWR with wide discretion to determine how to deliver water to the SWP service area, including how to operate pumps, manage carryover storage, and coordinate with Reclamation's CVP operations.

DWR will continue to operate the SWP to deliver water within its service area, following execution of the COA addendum. The 2018 COA Addendum shifted responsibilities for meeting CVP and SWP obligations; these adjustments are within the original scope of the SWP. In other words, the provisions in the 2018 COA Addendum are a normal, intrinsic part of ongoing operations of the SWP.

Furthermore, neither exception for the exemption for ongoing project applies (see Sections 15261[a][1] and [2] of the State CEQA Guidelines). SWP operations have been ongoing for several decades, and a great amount of money has been spent to carry out these operations. Furthermore, execution of the 2018 COA Addendum was not to modify SWP operations so as to result in a new significant effect on the environment.

Purpose of this Discussion of Environmental Effects

The Appendix considers whether implementation of the 2018 COA Addendum affected flows entering and exiting the Delta by assessing the operational and hydrologic conditions that occurred under the 1986 COA and the 2018 COA Addendum. This assessment was done for the purpose of determining whether the baseline conditions, as described in the EIR, sufficiently represent Delta conditions before execution of the 2018 COA Addendum as well as the existing physical conditions in the Delta. This Appendix also discusses how the 2018 COA Addendum relates to a wide range of resource areas for public information purposes only.

ENVIRONMENTAL SETTING

The area considered in this analysis is defined by CVP facilities and service areas, and by SWP facilities and service areas, as shown in Figure 1-1 in the DEIR.

CVP Facilities

The CVP facilities affected by the 2018 COA Addendum are reservoirs on the Trinity, Sacramento, and American rivers and associated distribution facilities; the Mendota Pool on the San Joaquin River; the Jones Pumping Plant; the Delta–Mendota Canal (DMC); the San Luis Reservoir; the San Felipe Division; and the CVP service area that is served with water from these facilities.

Stored water in CVP reservoirs north of the Delta is provided to the Delta for delivery through the Contra Costa Canal and Jones Pumping Plant. The Contra Costa Canal originates at Rock Slough near Oakley and extends to the Martinez Reservoir. Water from the Contra Costa Canal is delivered to the Contra Costa Water District.

The Jones Pumping Plant in the south Delta lifts the water into the DMC, delivering water to CVP contractors who divert water directly from the canal, and to San Joaquin River exchange contractors who also divert directly from the San Joaquin River and the Mendota Pool. In addition, CVP water is conveyed to the San Luis Reservoir for storage and subsequent delivery to CVP contractors through the San Luis Canal and the DMC. From the San Luis Reservoir, water is conveyed through the Pacheco Tunnel to CVP contractors in Santa Clara and San Benito counties.

SWP Facilities

The SWP facilities that were affected by the COA Addendum included Lake Oroville on the Feather River; rivers, streams, canals, and aqueducts used to convey SWP water; and the SWP service area that relies on water from these reservoirs, specifically: Lake Oroville on the Feather River; the Banks Pumping Plant in the south Delta; the North Bay Aqueduct; the South Bay Aqueduct; the California Aqueduct; SWP reservoirs, including Lake Del Valle, the San Luis Reservoir, and Pyramid, Castaic, Silverwood, and Perris lakes; the SWP service areas in the Sacramento and San Joaquin valleys, the San Francisco Bay Area, the Central Coast region, and the Southern California region.

Hydrological Conditions Affected by CVP and SWP Operations

This discussion describes the surface water resources and water supplies managed by the SWP and CVP, and potential changes to surface water resources that occurred because of implementation of the 2018 COA Addendum. Changes to SWP and CVP operations may result in changes to surface water hydrology on the Trinity River, on the Lower Klamath River, and the the Central Valley region. Some rivers in these regions are regulated by SWP facilities, others by CVP facilities, while some others are used to convey SWP and/or CVP water supplies.

Tributaries to the Sacramento and San Joaquin rivers not affected by SWP and CVP operations also are briefly discussed, as they contribute to conditions in the Delta. Baseline CalSim II modeling results of flow conditions are provided for reservoirs and rivers that are affected by SWP and/or CVP operations.

For the San Francisco Bay Area, Central Coast, San Joaquin Valley, and Southern California water service areas, surface water streams generally are not used to convey SWP and CVP water supplies. The streams that are downstream from SWP and CVP water supply reservoirs generally receive either reservoir overflows in storm conditions or minimum instream flows related to water rights and/or aquatic resources beneficial uses. After the minimum instream flow requirements are fulfilled, the remaining volumes of water are provided to contracted water users or others. Changes in SWP and CVP water operations will not affect the need to meet minimum instream flows or high flows during storm conditions.

TRINITY RIVER

For this analysis, the Trinity River includes the reach from Trinity Lake to the confluence with the Klamath River. The Trinity River flows about 112 miles, from Lewiston Dam to the Klamath River through Trinity Country, Humboldt County, and the Hoopa Indian Reservation. A large portion of flows that enter Trinity and Lewiston lakes is exported to the Sacramento River watershed through CVP facilities. In December 2000, the U.S. Department of the Interior (USDOI), adopted the Trinity River Mainstem Fishery Restoration Record of Decision (Trinity River ROD), which restored Trinity River flow and habitat to produce a healthy, functioning, alluvial river system. Variable annual instream flow releases from Lewiston Dam range from 368,600 acre-feet per year (AF/yr) in critically dry years to 815,000 AF/yr in extremely wet years.

Trinity Lake storage varies in accordance with upstream hydrology, downstream water demands, and instream flow requirements. Reclamation maintains at least 600 thousand acre-feet (TAF) in the Trinity Reservoir, except during the 10 to 15 percent of the years when Shasta Lake also is drawn down.

The Lewiston Reservoir water storage volume is more consistent throughout the year because this afterbay is used to regulate flow releases to the Trinity Powerplant, Clear Creek Tunnel, Whiskeytown Lake, and other downstream uses.

LOWER KLAMATH RIVER

The Lower Klamath River flows 43.5 miles from the confluence with the Trinity River to the Pacific Ocean (USFWS et al. 1999). Downstream from the Trinity River confluence, the Klamath River flows through Humboldt County, Del Norte County, the Hoopa Indian Reservation, the Yurok Indian Reservation, and the Resighini Indian Reservation (USDOI and CDFG 2012).

No dams are on the Klamath River downstream from the confluence with the Trinity River. About 85 percent of the flows in the Lower Klamath River occur during winter months (USDOI and CDFG 2012). The Klamath River estuary extends from about 5 miles upstream from the Pacific Ocean (USDOI and CDFG 2012). This area generally is influenced by tidal action, where salt water can intrude up to 4 miles from the coastline, when tides are high and Klamath River flows are low.

SACRAMENTO RIVER

The Sacramento River flows about 351 miles, from north near Mount Shasta to the confluence with the San Joaquin River at Collinsville in the west Delta (Reclamation 2013a). The Sacramento River receives contributing flows from numerous major and minor streams and rivers that drain the basin. The Sacramento River also receives imported flows from the Trinity River watershed, as previously discussed. Waterways in the Sacramento Valley that could be affected by SWP and CVP long-term operations include the following:

- Clear Creek, from Whiskeytown Reservoir to its confluence with the Sacramento River
- Sacramento River, from Keswick Dam to the confluence with the San Joaquin River in the Delta
- Feather River, downstream from Oroville Reservoir to the confluence with the Sacramento River
- Yuba River, from New Bullards Bar Reservoir to the confluence with the Feather River

- Bear River, from Camp Far West Reservoir to the confluence with the Feather River
- American River, from Nimbus Dam to the confluence with the Sacramento River

Other waterways entering the Sacramento River between Red Bluff and the Feather River—including Antelope, Elder, Mill, Thomes, Deer, Stony, Big Chico, and Butte creeks—would not be affected by long-term SWP or CVP operations. No major storage or diversion structures have been constructed on Antelope, Elder, Mill, and Thomes creeks, although several small seasonal diversions have been established for irrigation, domestic use, and hydroelectric power generation (Reclamation 1997).

The East Park and Stony Gorge reservoirs store water for irrigation deliveries and are operated by Reclamation as part of the Orland Project, which is independent of the SWP and CVP. Black Butte Dam is operated by the U.S. Army Corps of Engineers (USACE) for flood control and irrigation supply. These actions are coordinated with the CVP.

Flows from other tributaries to the Sacramento, Cosumnes and Mokelumne rivers in the Sacramento Valley can affect SWP and CVP operations, particularly by contributing additional flows to the Delta. However, flows in these rivers would not be affected by changes in SWP or CVP operations. Therefore, hydrologic conditions on these water bodies are not described further in this document.

CVP Facilities on the Sacramento River

Whiskeytown Dam, a CVP facility, is about 16.5 miles downstream from the headwaters (Reclamation 1997). Whiskeytown Lake, which is formed by the dam, has a storage capacity of 0.241 million acre-feet (MAF) and regulates local runoff from Clear Creek and water conveyed from the Trinity River watershed.

Whiskeytown Lake storage is relatively constant because of agreements between Reclamation and the National Park Service to maintain certain winter and summer lake elevations for recreation. Whiskeytown Lake outflow variations were greater prior to 2006, when Trinity River restoration flows were implemented, reducing the amount of water available for conveyance to CVP water users.

Shasta and Keswick dams are on the Sacramento River at about River Miles 308 and 299, respectively. Shasta Lake, with a maximum storage capacity of 4.552 MAF, is formed by Shasta Dam. Water flows from Shasta Lake along the Sacramento River into the 0.0238 MAF Keswick Reservoir, which operates as an afterbay for Shasta Lake hydropower operations. A temperature control device at Shasta Dam was constructed between 1996 and 1998, to enable release of cold water without power bypass to the Sacramento River downstream from Keswick Reservoir.

Baseline long-term and critically dry-year average water storage volumes for Shasta Lake are shown in Figures 1 and 2. Shasta Lake storage varies in accordance with upstream hydrology, downstream water demands, and instream flow requirements.

Keswick Reservoir water storage volume is relatively stable because it regulates flow and is not designed to provide long-term water storage. Water released from Shasta Dam travels approximately 245 miles over 3 to 4 days to the northern Delta boundary near Freeport (Reclamation 2013a). The upper reach of the Sacramento River flows approximately 60 miles from Keswick Dam to Red Bluff. The middle reach of the Sacramento River flows approximately 160 miles from Red Bluff to the confluence with the Feather River. The lower reach of the Sacramento River flows for approximately 20 river miles between the confluence with the Feather River and Freeport, immediately downstream from the confluence with the American River. Baseline long-term and critically dry-year average flows in the Sacramento River below Keswick and at Freeport (downstream from the American River confluence and near the northern boundary of the Delta) are shown in Figures 3 through 6. Flows in the Sacramento River generally peak during winter and spring storm events.

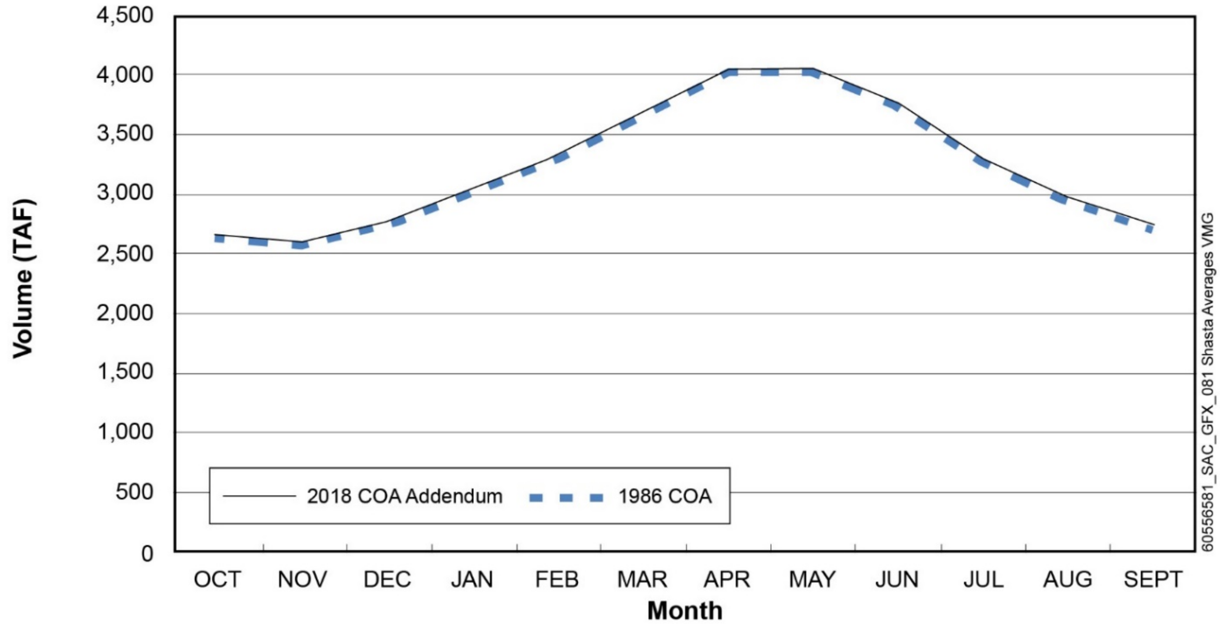

Figure 1. Shasta Lake, Long-Term Average Storage

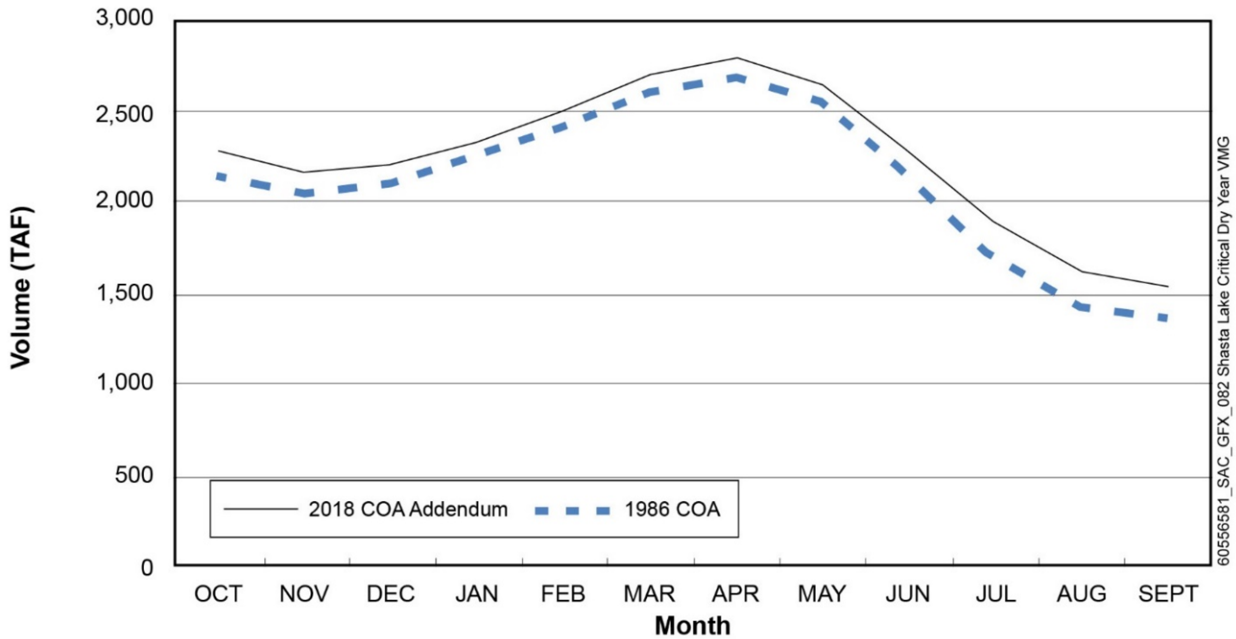

Figure 2. Shasta Lake, Critically Dry Year Average Storage

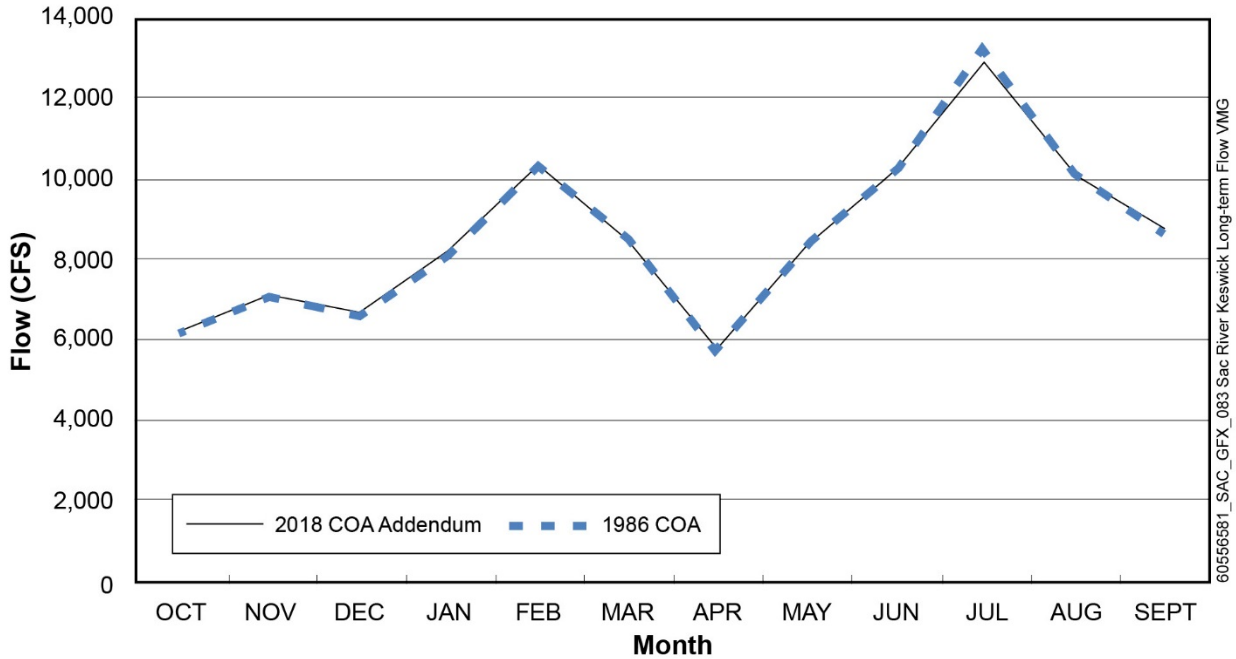

Figure 3. Sacramento River below Keswick, Long-Term Average Flow

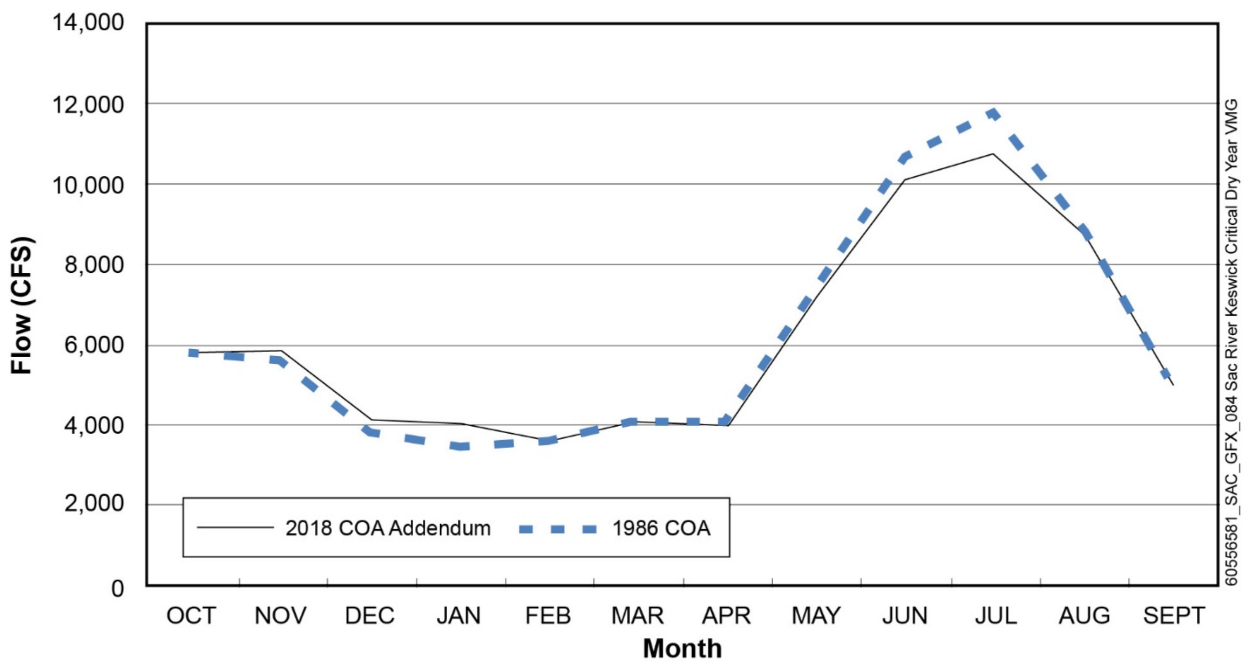

Figure 4. Sacramento River below Keswick, Critically Dry Year Average Flow

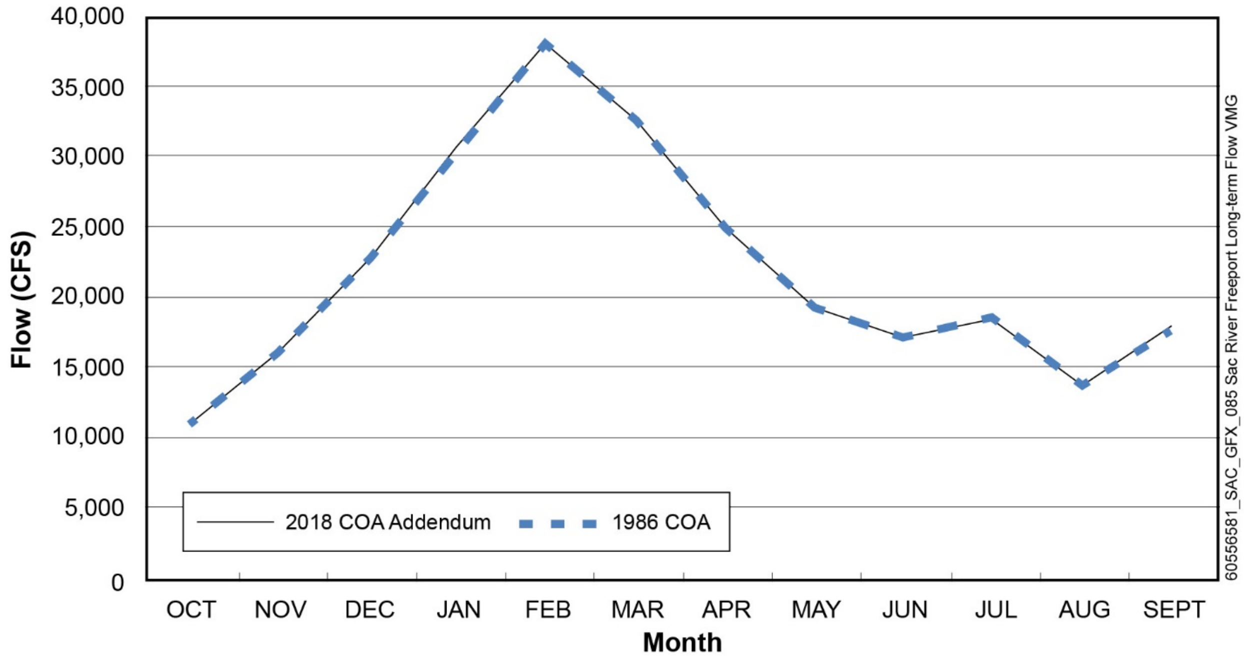

Figure 5. Sacramento River at Freeport, Long-Term Average Flow

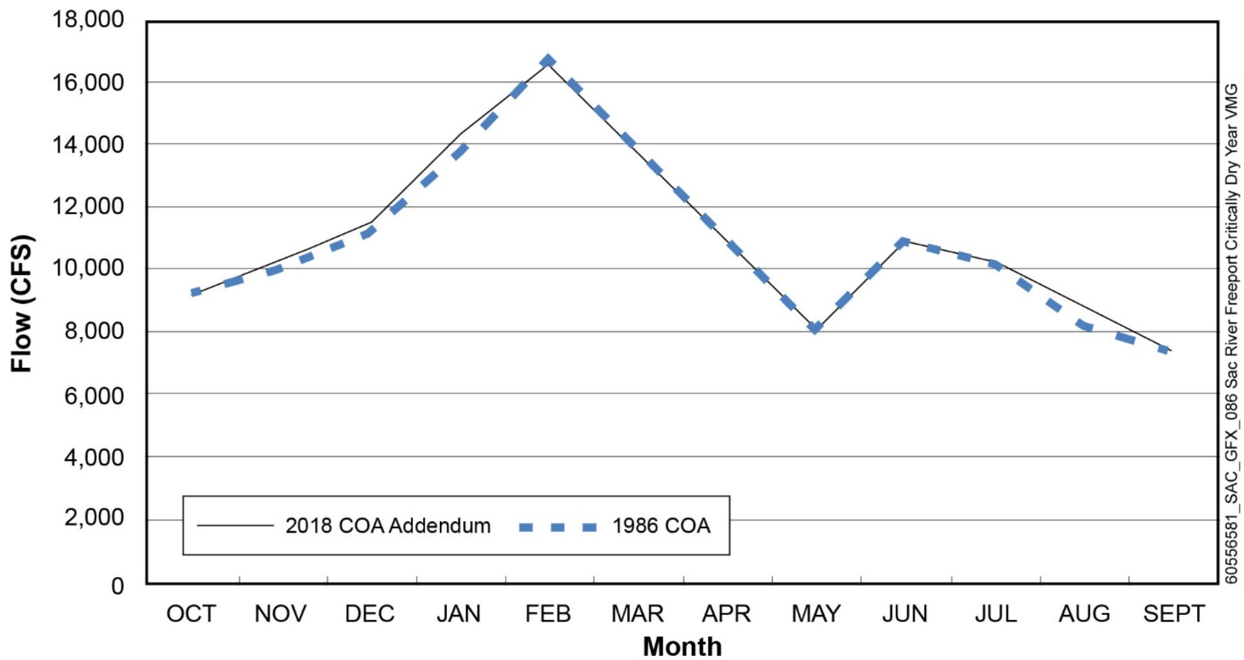

Figure 6. Sacramento River at Freeport, Critically Dry Year Average Flow

SACRAMENTO RIVER DRAINAGE FEATURES

The Sutter Basin overflow (Sutter Bypass), east of the Sacramento River and downstream from the Sutter Buttes, conveys floodwaters from the Butte Basin Overflow Area, Butte Creek, Wadsworth Canal, Reclamation Districts 1660 and 1500 drainage plants, State drainage plants, and Tisdale Weir to the confluence of the Sacramento and Feather rivers.

The Colusa Basin Drain provides drainage for a large portion of the irrigated lands on the western side of the Sacramento Valley in Glenn, Colusa, and Yolo counties; and conveys irrigation water to lands in this area. Water from the Colusa Basin Drain is discharged to the Sacramento River through the Knights Landing Outfall, a gravity flow structure, and prevents the Sacramento River from flowing into the Colusa Basin.

Flows from the Sacramento River, Feather River, Sutter Bypass, and Natomas Cross Canal join upstream from Verona. When the Sacramento River flows exceed 62,000 cubic feet per second (cfs), a large portion of the river flows over the Fremont Weir into the Yolo Bypass, a natural overflow area west of the Sacramento River. The Sacramento River Flood Control Project modified the basin, to allow Sacramento River flood flows to enter the Yolo Bypass over the Fremont and Sacramento weirs. The Yolo Bypass conveys floodwaters around the Sacramento metropolitan area and reconnects to the Sacramento River at Rio Vista. Tributaries entering the Yolo Bypass include flows from the Cache Creek Detention Basin, Willow Slough, and Putah Creek. Flows also enter the Yolo Bypass from the Colusa Basin, including flows from the Colusa Basin Drain through the Knights Landing Ridge Cut.

FEATHER RIVER

The Feather River is the largest tributary to the Sacramento River downstream from Shasta Dam (Reclamation 1997; DWR 2007). The Feather River enters the Sacramento River at Verona. At this location, the total flow of the Feather River includes water from the Yuba and Bear rivers.

Lake Oroville, the primary SWP water storage facility with a capacity of 3,500 TAF, is on the Feather River. Lake Oroville stores winter and spring runoff, which is released into the Feather River to meet SWP water demands. It also provides hydropower pump-back capability, to allow on-peak electrical generation and 750 TAF of flood control storage. Lake Oroville also provides water for recreation, freshwater releases to control salinity intrusion in the Delta, and water for fish and wildlife protection. Long-term and critically dry-year average water storage volumes for Lake Oroville are shown in Figures 7 and 8.

A maximum 17,400 cfs can be released from Lake Oroville through the Edward Hyatt Powerplant and Thermalito Power Canal into the Thermalito Diversion Pool. Water continues through the Thermalito Diversion Pool into the Feather River Fish Hatchery and the 11,768 AF Thermalito Forebay that was formed by the Thermalito Diversion Dam. Water then is released from the Thermalito Forebay through the Thermalito Powerplant into the Thermalito Afterbay and the low-flow channel of the Feather River. Water from the Thermalito Afterbay flows into the Feather River. Long-term and critically dry-year average flows in the Feather River are shown in Figures 9 and 10.

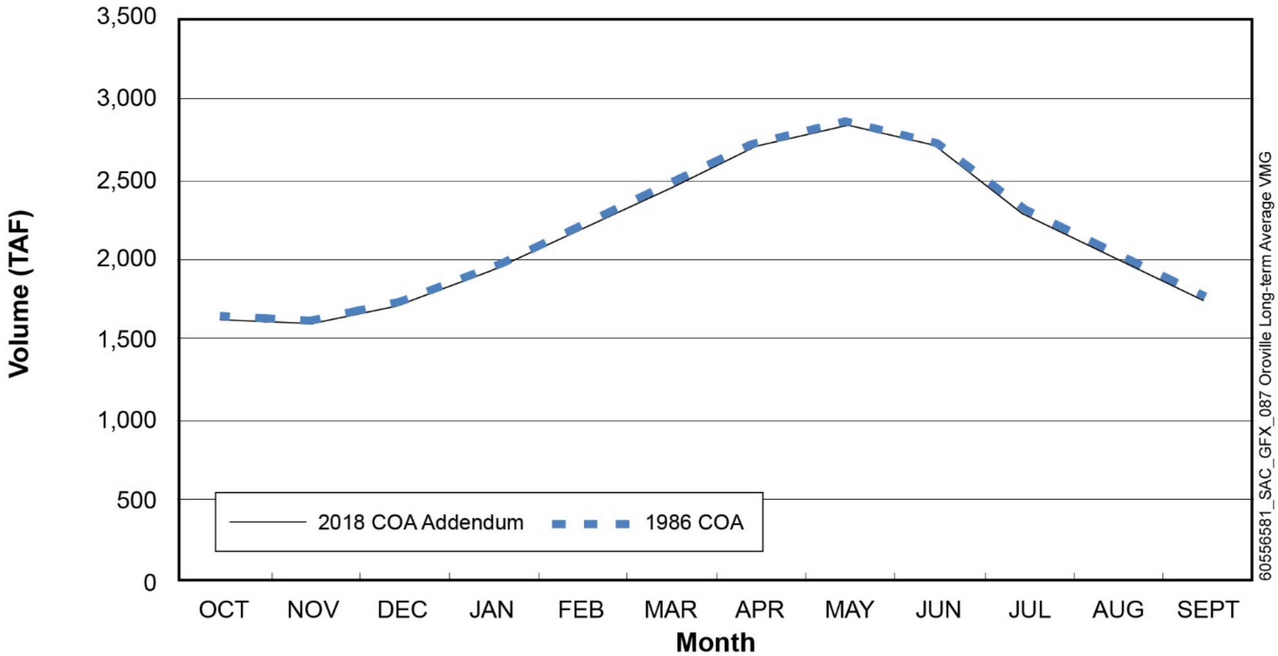

Figure 7. Lake Oroville, Long-Term Average Storage

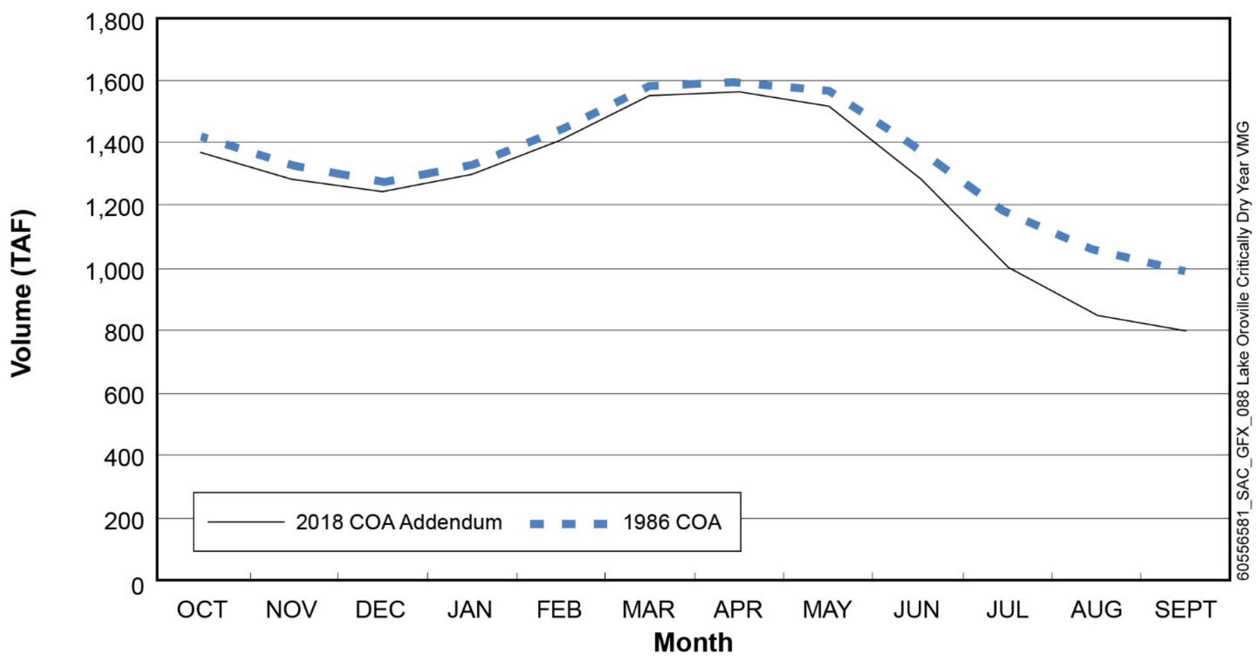

Figure 8. Lake Oroville, Critically Dry Year Average Storage

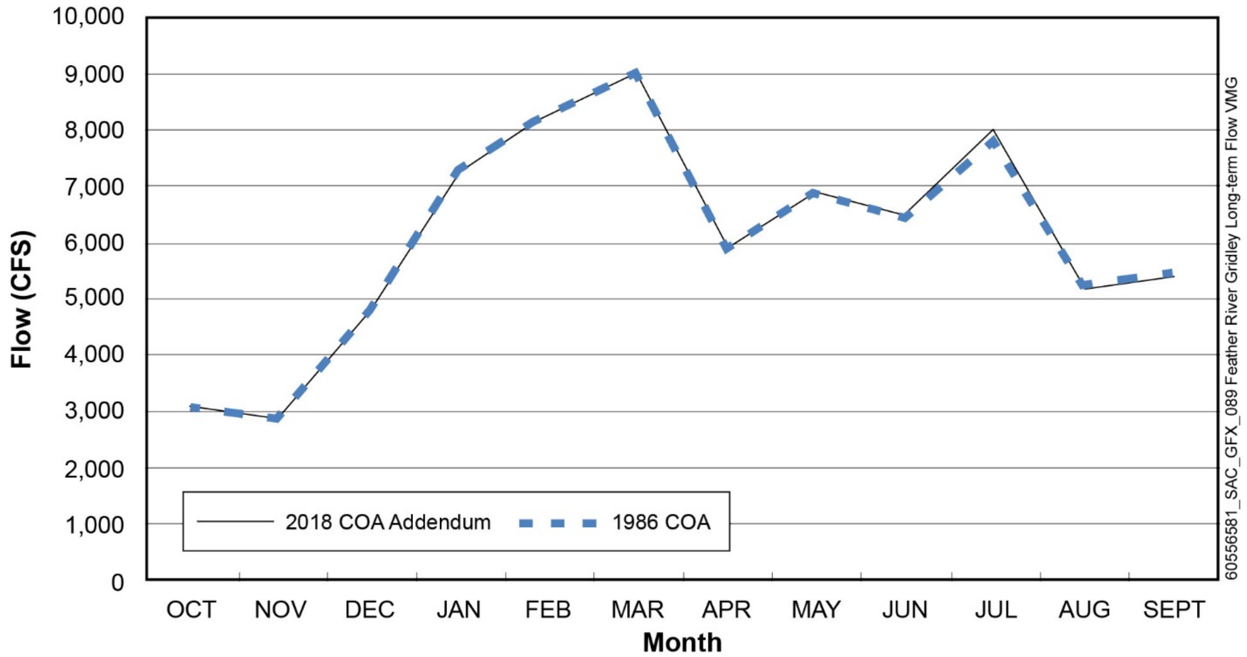

Figure 9. Feather River near Gridley, Long-Term Average Flow

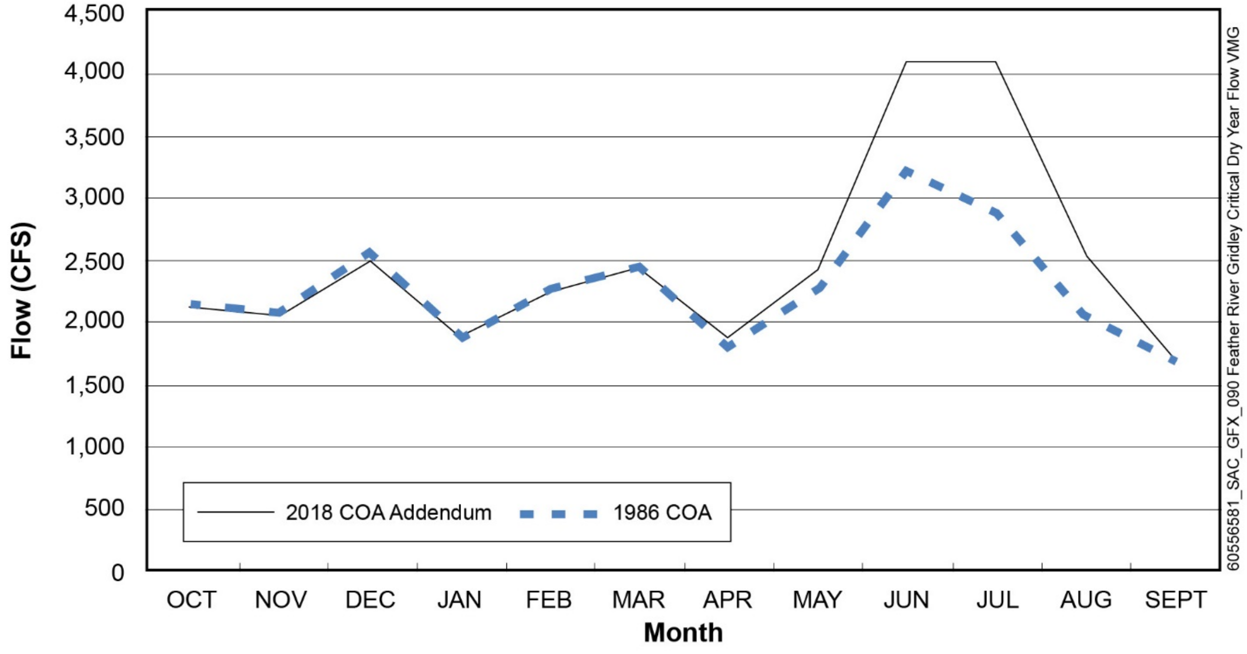

Figure 10. Feather River near Gridley, Critically Dry Year Average Flow

Operations of Oroville Dam are performed in accordance with a Federal Energy Regulatory Commission (FERC) license, Project No. 2100, which defines maximum allowable Feather River low-flow channel ramp-down release requirements to prevent rapid reductions in water levels that potentially could cause redd dewatering and stranding of juvenile salmonids and other aquatic organisms. Water releases from Lake Oroville also are affected by temperature criteria (Reclamation 2015).

AMERICAN RIVER FROM FOLSOM LAKE TO SACRAMENTO RIVER

Folsom Lake, a CVP facility formed by Folsom Dam, is 7 miles upstream from the CVP's Nimbus Dam (Reclamation et al. 2006). Folsom Lake has a capacity of 967 TAF. The American River flows 23 miles between Nimbus Dam and the confluence with the Sacramento River. The American River contributes about 15 percent of the flow in the lower Sacramento River.

Nimbus Dam creates Lake Natoma, a forebay built to re-regulate flows of the American River and direct water into the CVP's Folsom South Canal. Releases from Nimbus Dam to the American River pass through the Nimbus Powerplant, when releases are less than 5,000 cfs or the spillway gates for higher flows.

Historical water storage volumes for Folsom Lake for long-term and critically dry-year averages are shown in Figures 11 and 12.

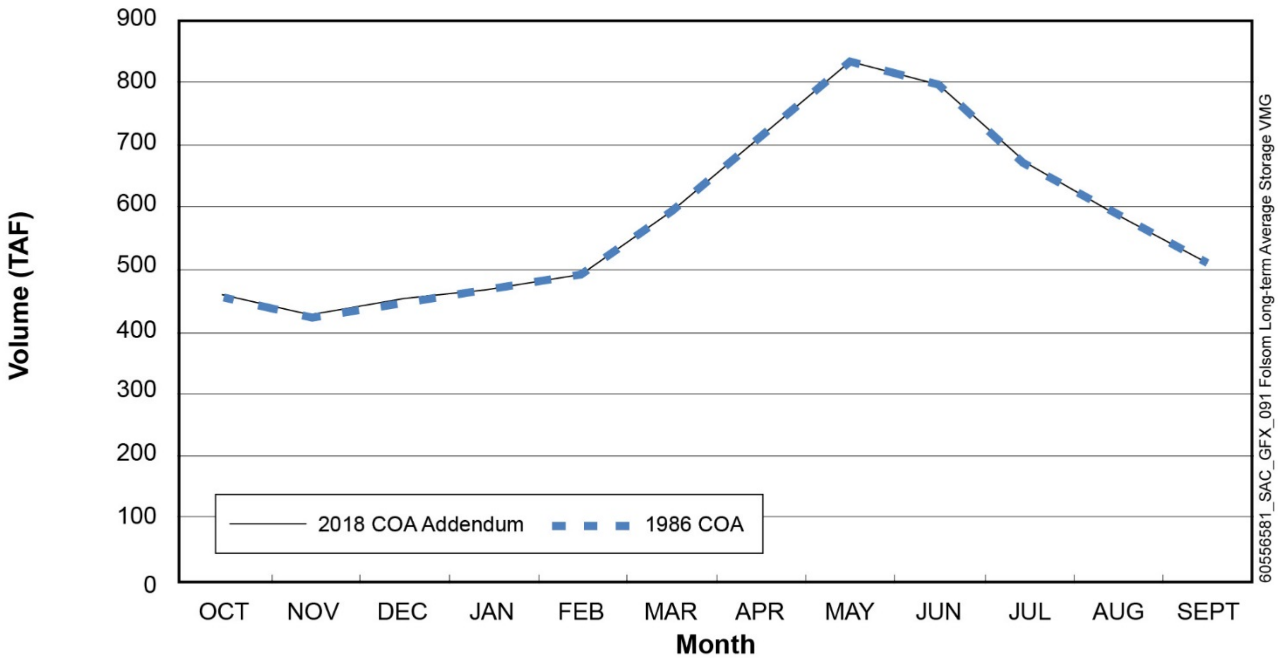

Figure 11. Folsom Lake, Long-Term Average Storage

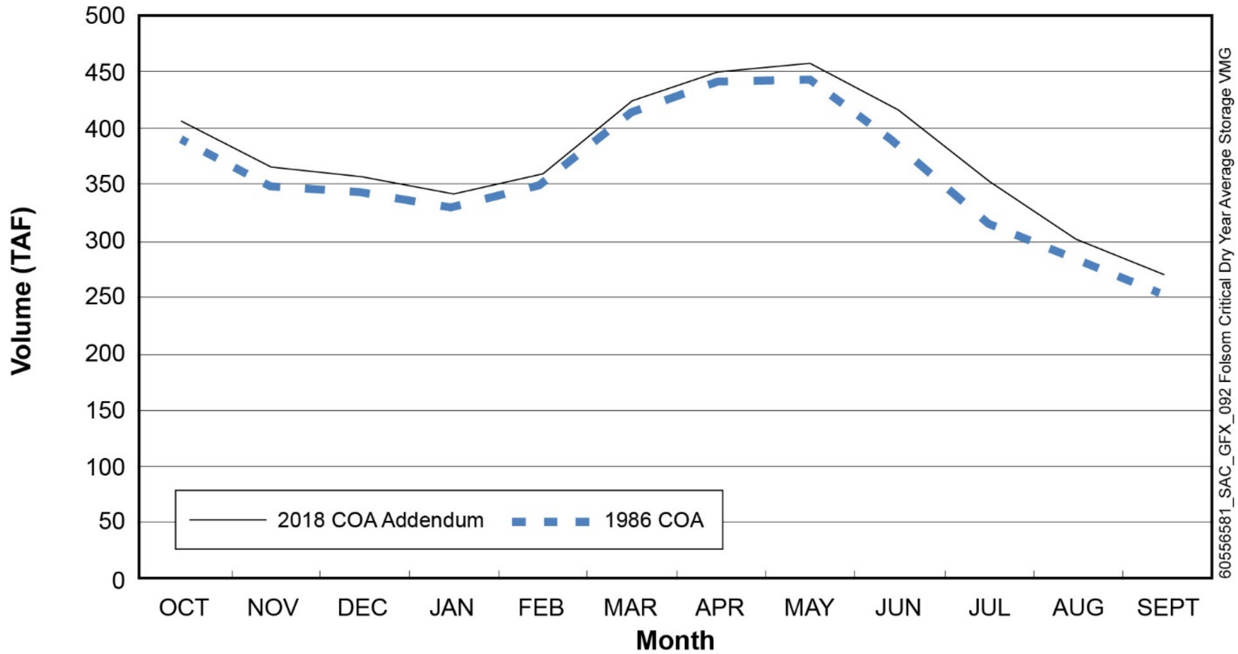

Figure 12. Folsom Lake, Critically Dry Year Average Storage

Flow patterns in the American River, downstream from Lake Natoma, are controlled by the coordinated operations of the SWP and CVP. Flows are managed to comply with American River instream flow requirements and Delta outflow and salinity requirements, as well as to contribute to CVP exports.

The minimum instream flow requirements of the lower American River are defined by SWRCB Water Rights Decision 893 (D-893), which states that releases ordinarily should not fall below 250 cfs between January 1 and September 15 or below 500 cfs at other times.

D-893 minimum flows rarely are the controlling requirements affecting CVP operations at Folsom Lake. Folsom Lake releases primarily are controlled during significant portions of a water year by flood control requirements or in coordination with other SWP and CVP releases, to meet CVP water supply and Delta water quality objectives. Folsom Lake releases generally exceed the D-893 minimum instream flow requirements, in all but the driest of conditions.

Reclamation operates Folsom Lake in compliance with Delta salinity and flow objectives, established to improve fisheries conditions. Weather conditions, combined with tidal action and local accretions from runoff and agricultural return flows, can affect Delta salinity conditions. Changes in salinity can require increases in spring Delta inflow to achieve required salinity standards. In accordance with federal and State regulatory requirements, the SWP and CVP frequently are required to release water from upstream reservoirs to maintain Delta water quality. As Folsom Lake is closer to the Delta than Lake Oroville and Shasta Lake, it generally is first to be used to meet Delta requirements.

Lower San Joaquin River

The Lower San Joaquin River flows about 100 miles from Friant Dam to the Delta. Flows in the San Joaquin River are regulated by the CVP's Friant Dam, which forms Millerton Lake. Millerton Lake has a capacity of 520 TAF. Flows downstream from Friant Dam are influenced by flows from tributary rivers and streams, including CVP operations at the New Melones Reservoir on the Stanislaus River. Flows on the San Joaquin River have changed since expiration of the Vernalis Adaptive Management Plan in 2012.

Operations of Millerton Lake and the CVP's Friant Division would not be modified by changes in SWP and CVP operations. Therefore, Millerton Lake and Friant Division are not addressed further in this document.

Two major tributaries, the Tuolumne and Stanislaus rivers, join the San Joaquin River between the confluence with the Merced River and Vernalis, at the southeastern boundary of the Delta. The flows in this reach are influenced by flow and water quality requirements at Vernalis as well as by discharges from the upstream reach and the two major tributaries.

The operating criteria for the New Melones Reservoir include limits set by water rights requirements, flood control operations, contractual obligations, federal requirements under the ESA, and the Central Valley Project Improvement Act. Reclamation operates the New Melones Reservoir to meet senior water rights and in-basin demands.

Required releases from the New Melones Reservoir include flows to meet flow and water quality requirements that are included in D-1641. This includes dissolved oxygen requirements in the Lower Stanislaus River, in accordance with the Central Valley Regional Water Quality Control Board's Basin Plan; minimum flow requirements, and the total dissolved solids requirement in the Lower San Joaquin River at Vernalis, in accordance with D-1641.

Delta and Suisun Marsh

The Delta and Suisun Marsh encompass about 1,315 square miles and convey about 40 percent of water draining from the state (DWR 2013a). The Delta and Suisun Marsh are a complex of channels and islands at the confluence of the Sacramento and San Joaquin rivers. The SWP and CVP use the Delta to convey water to State and federal pumps in the south Delta.

Inflows to the Delta occur primarily from the Sacramento River system, the San Joaquin River, and other eastside tributaries, including the Mokelumne, Calaveras, and Cosumnes rivers. About 77 percent of water enters the Delta from the Sacramento River, about 15 percent enters from the San Joaquin River, and about 8 percent enters from the eastside tributaries (DWR 1994). The daily, seasonal, and year-to-year differences in freshwater flows from the Sacramento and San Joaquin rivers and other Delta tributaries affect the Delta's water quality, particularly with regard to salinity (DWR et al. 2013).

The Sacramento River is the primary contributor to Delta freshwater inflows. North Delta channels convey Sacramento River and Yolo Bypass flows southerly and westerly. The Delta Cross Channel (DCC) gates divert flows from the Sacramento River to Snodgrass Slough and then to the Mokelumne River, where it flows into the central and south Delta. Circulation of water in the north and central Delta is determined primarily by flows in the Sacramento River; however, SWP and CVP operations alter the direction of natural flow in the central Delta, resulting in an altered flow path toward the south Delta pumps.

The San Joaquin River, the second largest contributor to Delta freshwater inflows, enters the Delta from the south. Although the natural direction of flow is toward the north and west, channel flows in the south Delta are sensitive to SWP and CVP export operations (DWR et al. 2013).

Tidal flows have a major influence on Delta surface water circulation. Flow in the Delta channels can change direction because of tidal exchange, ebbing, and flooding with the two tides per day. On average, tidal inflows to the Delta are approximately equal to tidal outflows. The tidal range can vary by about 30 percent between spring tide and neap tide conditions. Tidal flows at Martinez can be as high as 600,000 cfs. Because the Delta is tidally influenced, water surface elevations can vary from less than 1 foot in the east Delta to more than 5 feet in the west Delta (DWR 2013a) on a daily basis.

Tidal flows enter and leave the Delta along the combined Sacramento and San Joaquin rivers at Chipps Island. Farther upstream in the Delta, in the Old River near Bacon Island, tidal flows can be as high as 16,000 cfs, and at relatively upstream locations such as Freeport or Vernalis, riverine conditions dominate the tidal effects.

The SWP and CVP pumping plants can affect the direction of water flow in the Delta channels, particularly during periods of low freshwater inflow and large exports. Normally, net flows in the Delta travel westerly toward Suisun Bay and the San Francisco Bay. Diversion rates at the SWP and CVP south Delta intakes influence Delta hydraulics, changing direction of flow of some south Delta waterways. The most influential effects occur in the Old and Middle rivers (OMR), where flows are reversed during periods of south Delta pumping. Reverse flows also occur in the False River in the west Delta and Turner Cut in the San Joaquin River, causing more saline water to move farther inland (DWR et al. 2013).

Generally, opening the DCC gates can reduce salinity in some channels in the central and south Delta, particularly during the summer months, through transport of relatively lower salinity Sacramento River water into the central Delta (DWR et al. 2013).

Temporary Agricultural Barriers

The DWR South Delta Temporary Barrier Project (TBP) was initiated in 1991, to seasonally construct and demolish four rock barriers across several south Delta channels. These barriers were intended to maintain water levels in south Delta waterways and promote San Joaquin River salmon migration through the south Delta. The existing TBP consists of installing and removing temporary rock barriers at the following locations:

- Middle River, near Victoria Canal, about 0.5 mile south of the confluence of Middle River, Trapper Slough, and North Canal
- Old River, near Tracy, about 0.5 mile east of the DMC intake
- Grant Line Canal, about 400 feet east of the Tracy Boulevard Bridge
- Head of Old River (HOR), at the confluence of the Old River and the San Joaquin River

The temporary barriers on the Middle River, the Old River near Tracy, and Grant Line Canal are designed to improve water levels for agricultural diversions and are installed during the irrigation season. The Head of Old River Barrier (HORB) has been installed only from early September to November 30, when requested by CDFW if improvement of dissolved oxygen in the San Joaquin River is necessary. The HORB also has been installed in the spring months to improve out-migrating conditions for juvenile salmonids.

The agricultural barriers at the Middle River and the Old River can be installed as early as March 1, if the HORB is installed, and can be fully operated as early as April 1, if the HORB is installed, or May 15, if the HORB is not installed. From May 15 to May 31 (if the HORB is removed), the Middle River and the Old River barrier gates are opened. After May 31, the Middle River, the Old River, and Grant Line Canal barriers are permitted to be operational until they are completely removed by November 30.

SWP Barker Slough Pumping Plant

The SWP Barker Slough Pumping Plant (BSPP) diverts water from Barker Slough into the SWP's North Bay Aqueduct (NBA) for delivery to the Solano County Water Agency and the Napa County Flood Control and Water Conservation District. The 162.5 cfs NBA intake with a positive barrier fish screen is about 10 miles from the Sacramento River at the end of Barker Slough.

The NBA was designed to convey up to 175 cfs. However, the ability of the BSPP to deliver water is limited because a bio-film growth developed on its interior, restricting water conveyance to about 142 cfs. In addition, water quality in Barker Slough often is degraded, with elevated levels of coliform bacteria, organic matter, turbidity, and other pollutants during winter and spring rainfall events. This degradation limits the period that the BSPP can be operated.

The 2008 USFWS Biological Opinion (BO) reduced the total BSPP annual diversion to 71 TAF. In 2009, CDFW issued an incidental take permit for preservation of Longfin Smelt that restricted pumping rates during dry and critical dry years from January 15 to March 31.

South Delta Water Diversions

Delta channels have been modified, to allow transport of Delta inflow to south Delta diversions and reduce the effects of pumping on Delta water circulation and salinity intrusion. Water conveyance from the Sacramento River southward through the Delta to the south Delta intakes is aided by the DCC.

CVP Jones Pumping Plant

The CVP's Jones Pumping Plant, about 5 miles north of Tracy, has a permitted diversion capacity of 4,600 cfs and is connected to the end of a 2.5-mile-long, earth-lined intake channel that extends to the Old River. Water diverted at the Jones Pumping Plant is discharged to the DMC, which conveys the water about 117 miles to the Mendota Pool. The DMC has a capacity of 4,600 cfs at the Jones Pumping Plant and decreases to about 3,200 cfs at its terminus. Water exported by the Jones Pumping Plant also may be conveyed to and re-pumped into the O'Neill Forebay. Water then can be pumped into the San Luis Reservoir by the Gianelli Pumping-Generating Plant.

SWP Clifton Court and Banks Pumping Plant

The SWP facilities in the south Delta include the 31 TAF Clifton Court Forebay (CCF), about 10 miles northwest of the city of Tracy, and the Banks Pumping Plant. Water is diverted from the Old River into the CCF to provide storage for off-peak withdrawals from the CCF, moderating the effects of the pumps on flow and stage fluctuations in adjacent Delta channels, and collecting sediment before entering Banks Pumping Plant and the California Aqueduct.

The California Aqueduct transports water to the O'Neill Forebay, where it can be released either to the San Luis Canal or a portion of the California Aqueduct jointly owned by the SWP and CVP, or it can be pumped into the San Luis Reservoir. Water from the San Luis Reservoir subsequently is released to the San Luis Canal, which terminates near Kettleman City. From this location, the California Aqueduct continues to Southern California.

The capacity of the Banks Pumping Plant is 10,300 cfs. Permits issued by USACE regulate the rate of diversion of water into the CCF, normally restricted to 6,680 cfs as a 3-day average inflow to the CCF and 6,993 cfs as a 1-day average inflow. CCF diversions may be greater than these rates between December 15 and March 15, when the inflow into the CCF may be augmented by one-third of the San Joaquin River flow at Vernalis, if those flows are equal to or greater than 1,000 cfs.

In 2000, the maximum diversion rate was increased in July, August, and September, to recover export reductions resulting from actions taken to protect fisheries resources. The expanded maximum allowable daily diversion rate into the CCF was increased from 13,870 to 14,860 AF, and the 3-day average diversions from 13,250 to 14,240 AF (500 cfs per day equals 990 AF per day). Implementation of this action is contingent on meeting the conditions discussed next.

The increased diversion rate will not result in greater annual SWP water supply allocations than would occur in the absence of the increased diversion rate. Water pumped because of the increased capacity will be used only to offset reduced diversions that have occurred or will occur because of actions taken to benefit fisheries, and specifically:

- use of the increased diversion rate will be in accordance with all terms and conditions of existing BOs governing SWP operations; and
- all three temporary agricultural barriers (i.e., Middle River, Old River near Tracy, and Grant Line Canal) must be in place and operating when SWP diversions are increased.

Between July 1 and September 30, if the salvage of special-status fish species reaches a level of concern, the relevant fish regulatory agencies will determine whether the 500 cfs increased diversion may continue or will be stopped.

Banks Pumping Plant is operated to minimize its impact on power loads to the California electrical grid, to the extent practical. Generally, more pump units are operated during off-peak periods and fewer during peak periods with water stored temporarily in the CCF. Because the installed capacity of the pumping plant is 10,300 cfs, Banks Pumping Plant can be operated to reduce power grid impacts by running all available pumps at night and fewer during the higher energy-demand hours.

Long-term, dry-year, and critically dry-year average total exports (sum of Jones Pumping Plant and Banks Pumping Plant) are shown in Figures 13 through 15.

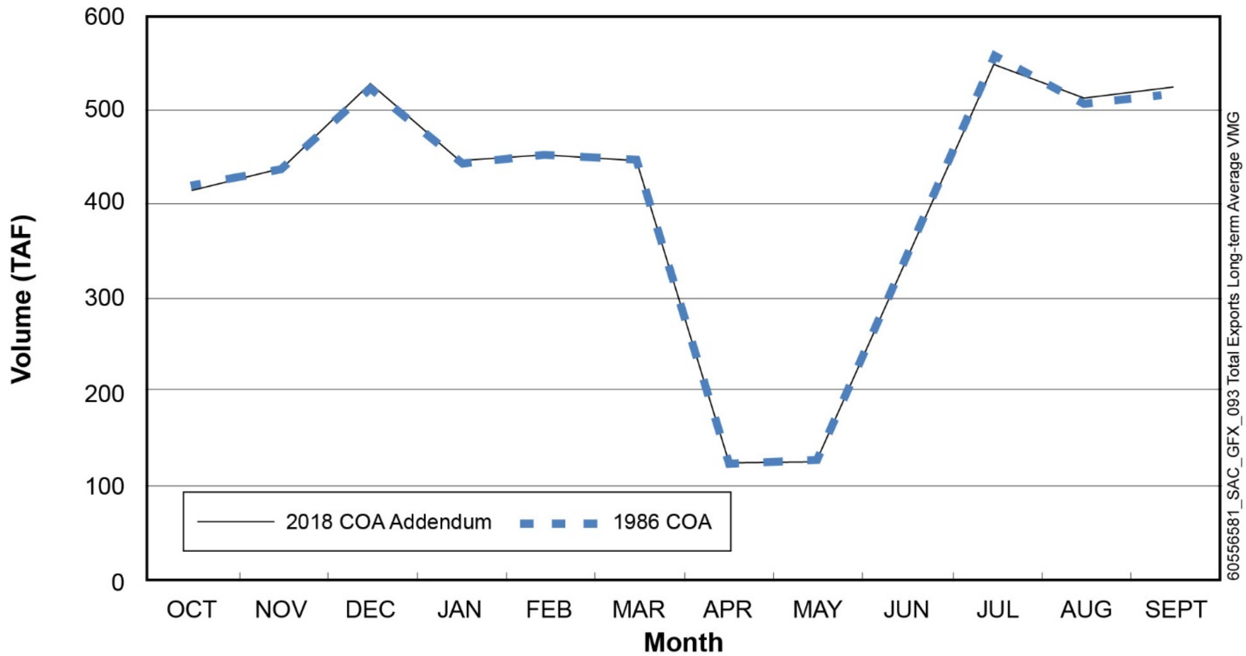

Figure 13. Total Exports, Long-Term Average Delivery

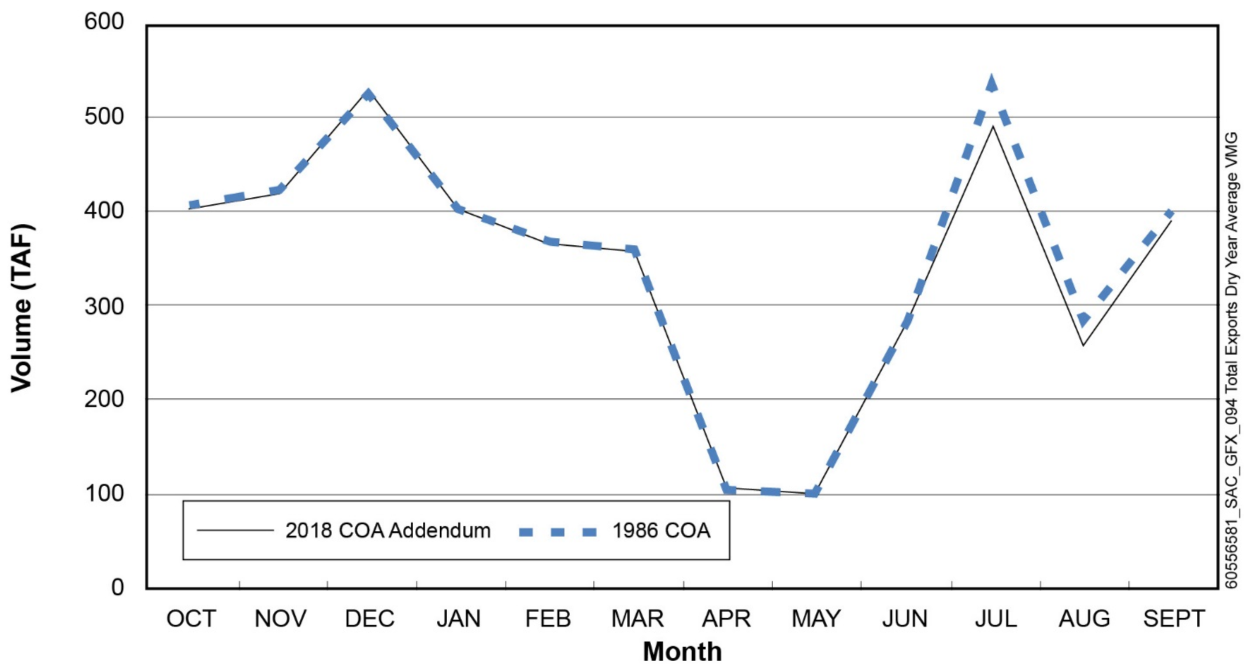

Figure 14. Total Exports, Dry Year Average Delivery

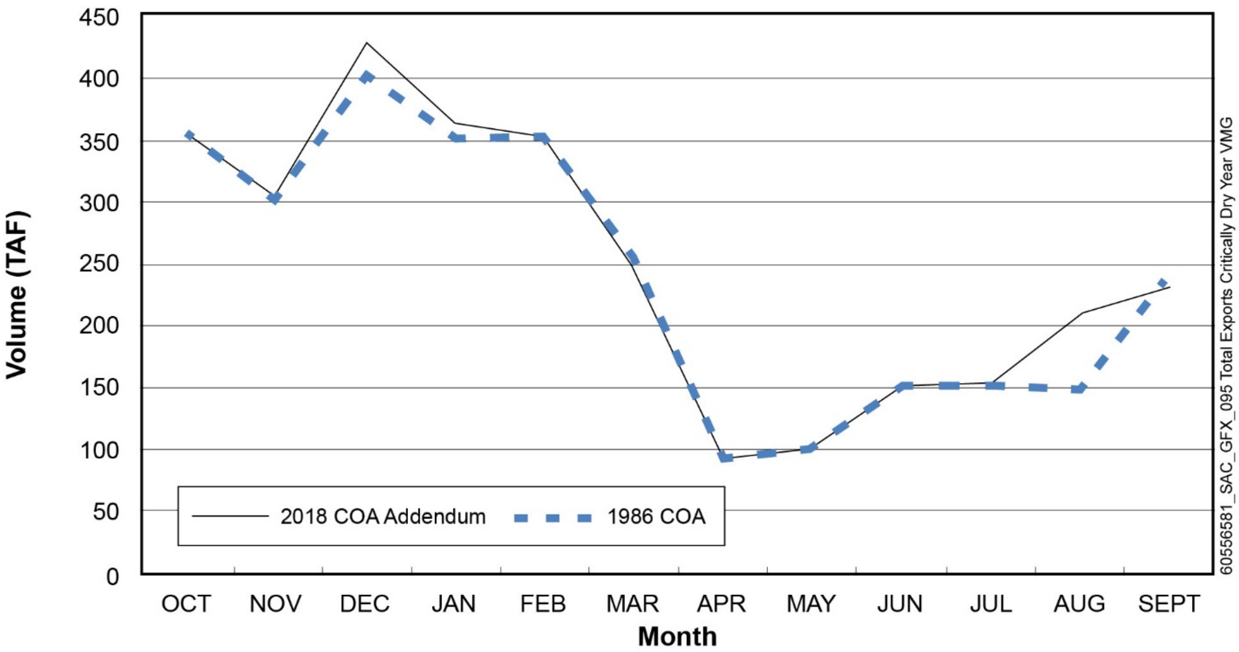

Figure 15. Total Exports, Critically Dry Year Average Delivery

Joint CVP and SWP Facilities in Suisun Marsh

The Suisun Marsh Preservation Agreement (SMPA) requires DWR and Reclamation to meet salinity standards, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements in accordance with D-1641 to implement and operate physical facilities in the Marsh.

Suisun Marsh Salinity Control Gates

The Suisun Marsh Salinity Control Gates (SMSCG) are on Montezuma Slough near Collinsville. The objective of SMSCG operation is to decrease the salinity of the water in Montezuma Slough by restricting the flow of higher salinity water from Grizzly Bay into Montezuma Slough during incoming tides and retaining lower salinity Sacramento River water from the previous ebb tide. This operation lowers salinity in Suisun Marsh channels and results in a net movement of water from east to west.

When Delta outflow is low to moderate and the gates are not operating, tidal flow past the gate is about 5,000 to 6,000 cfs while the net flow is near zero. When operated, flood tide flows are arrested while ebb tide flows remain in the range of 5,000 to 6,000 cfs. The net flow in Montezuma Slough becomes about 2,500 to 2,800 cfs.

The 2,800 cfs net flow induced by SMSCG operation is effective at moving higher salinity concentrations downstream in Montezuma Slough. Salinity is reduced by roughly 100 percent at Belden's Landing, and by lesser amounts farther west along Montezuma Slough. At the same time, the salinity field in Suisun Bay moves upstream as net Delta outflow is reduced by gate operation. Net outflow through the Carquinez Strait is not affected.

The USACE permit for the SMSCG requires that it be operated between October and May, only when needed to meet Suisun Marsh salinity standards. Historically, the gate has been operated as early as

October 1, although in some years (e.g., 1996) the gate was not operated at all. When the channel water salinity decreases sufficiently below the salinity standards, or at the end of the control season, the SWP and CVP provide unrestricted flow through Montezuma Slough.

Roaring River Distribution System

The Roaring River Distribution System (RRDS) was constructed between 1979 and 1980, to provide lower salinity water to 5,000 acres of private and 3,000 acres of CDFW-managed wetlands on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly islands. The RRDS includes a 40-acre intake pond that supplies water to Roaring River Slough. Motorized slide gates in Montezuma Slough and flap gates in the pond control flows through culverts into the pond. A flap gate and flashboard riser are at the confluence of the Roaring River and Montezuma Slough, to enable drainage back into Montezuma Slough for controlling water levels in the distribution system and to provide flood protection. Water is diverted into the Roaring River intake pond on high tides, to raise the water surface elevation in RRDS above the adjacent managed wetlands. Managed wetlands north and south of the RRDS receive water, as needed.

Morrow Island Distribution System

The Morrow Island Distribution System (MIDS) was constructed between 1979 and 1980 in southwestern Suisun Marsh, to channel drainage water from the adjacent managed wetlands for discharge into Suisun Slough and Grizzly Bay. The MIDS increases circulation and reduces salinity in Goodyear Slough.

The MIDS is used year-round but most intensively from September through June. When managed wetlands are filling and circulating, water is tidally diverted from Goodyear Slough just south of Pierce Harbor. Water is discharged into Grizzly Bay by way of the C-Line outfall and into the mouth of Suisun Slough by way of the M-Line outfall, rather than back into Goodyear Slough. This additional supply minimizes salinity increases that are caused by drainage water discharges into Goodyear Slough.

South of Delta Facilities

Both the SWP and CVP operate conveyance and storage facilities south of the Delta, conveying water supplies to their respective service areas and water users.

Delta–Mendota Canal/California Aqueduct Intertie

The connection between the DMC and the California Aqueduct allows water to flow between the SWP and CVP conveyance facilities. The DMC/California Aqueduct intertie achieves multiple benefits, including meeting current water supply demands, allowing maintenance and repair of the CVP Delta export and conveyance facilities, and providing operational flexibility to respond to emergencies.

San Luis Reservoir

The 2.027-MAF San Luis Reservoir, formed by Sisk Dam, is jointly operated by Reclamation and DWR, with about 0.965 MAF stored by the CVP and 1.062 MAF stored by the SWP. Generally, water is diverted into the San Luis Reservoir during late fall through early spring, when irrigation water demands are lower and are being met directly by Delta exports. By April or May, demands from both agricultural and M&I SWP water service contractors usually exceed the pumping rate at Banks Pumping Plant, and releases from the San Luis Reservoir to the SWP facilities are needed to supplement the Delta pumping at Banks Pumping Plant to meet SWP contractor demands.

Joint Point of Diversion

D-1641 authorized the SWP and CVP to jointly use the Jones and Banks pumping plants in the south Delta, with conditional limitations and required response coordination plans (referred to as Joint Point of Diversion [JPOD]). Use of JPOD is based on staged implementation. Each stage of JPOD has regulatory terms and conditions that must be satisfied to implement JPOD. All stages require a response plan to ensure that the water quality in the south and central Delta will not be significantly degraded through operations of the JPOD, to an extent that would cause injury to water users in the south and central Delta (Water Level Response Plan).

SWP and CVP Conveyance Facilities Downstream from the San Luis Reservoir

Water from the San Luis Reservoir is released into the California Aqueduct, which conveys water southward to Lake Perris in Riverside County. The first segment of the California Aqueduct downstream from the San Luis Reservoir is called the San Luis Canal. This canal is owned jointly by the SWP and CVP and extends from the San Luis Reservoir to Kettleman City. Near Kettleman City, the water is diverted into the SWP's Coastal Branch Aqueduct to serve agricultural areas west of the California Aqueduct and communities in San Luis Obispo and Santa Barbara counties.

The California Aqueduct continues into Southern California through the Edmonston Pumping Plant at the foot of the Tehachapi Mountains, which raises the water into Antelope Valley. At that location, the California Aqueduct divides into two branches; the East Branch and the West Branch. The East Branch conveys the water into Silverwood Lake in the San Bernardino Mountains, with a capacity of 73,000 AF of water. From Silverwood Lake, the water flows through the San Bernardino Tunnel to Lake Perris. Lake Perris, near the city of Riverside, provides up to 131,500 AF of storage and serves as a regulatory and emergency water supply facility for the East Branch. The East Branch Extension conveys water to San Gorgonio Pass Water Agency and the eastern portion of the San Bernardino Valley Municipal Water District. The West Branch conveys the water to Pyramid Lake in Los Angeles County. The water from Pyramid Lake is conveyed to the 324,000-AF Castaic Lake.

Water Supplies Used by Central Valley Project and State Water Project Water Users

The SWP and CVP water supplies are the only water supplies available to some water users, including many of the CVP's Sacramento River Settlement contractors, communities near Redding (Centerville, Clear Creek, and Shasta community services districts; Shasta County Water Agency), communities in the San Joaquin Valley (the cities of Avenal, Coalinga, and Huron), and some communities that are served by the Antelope Valley–East Kern Water Agency. Other SWP and CVP water users rely on other surface water supplies and groundwater. However, when the SWP and CVP water supplies are limited because of lack of precipitation, their other surface water supplies also are limited.

Several SWP and CVP water users also rely on other imported water supplies, including water from the Solano Project, used by the Solano County Water Agency; from the Hetch Hetchy Water Project used by the Alameda County Water District, Santa Clara Valley Water District, and Zone 7 Water Agency; the Mokelumne River used by the East Bay Municipal Utility District; and the Colorado River used by portions of the service area of the Metropolitan Water District of Southern California and Coachella Valley Water District.

These surface water supplies also are subject to reductions because of hydrologic conditions. In the case of water users who rely on Colorado River water supplies, Delta water is used to dilute the salts and trace elements (e.g., selenium) found in the Colorado River water supply, in addition to providing direct water supplies (Reclamation 2012).

In response to recent reductions in SWP and CVP water supply reliability, water agencies have been improving regional and local water supply reliability through enhanced water conservation efforts, wastewater effluent and stormwater recycling, construction of local surface water and groundwater storage facilities, and construction of desalination treatment plants for brackish water sources and ocean water sources. In addition, many agencies have constructed conveyance facilities to allow sharing of water supplies between communities. The Bay Area Regional Reliability partnership was formed in 2015 by six water districts and one water agency, to improve integrated regional water management and drought mitigation. This collaboration is providing conveyance opportunities between several SWP and CVP water users in the San Francisco Bay Area.

Exceedance plots of total SWP and CVP deliveries are shown in Figures 16 and 17. As shown, SWP deliveries would be reduced while CVP deliveries would increase. However, when total south of Delta exports are considered, as shown in Figure 13, total south of Delta deliveries would be reduced by about 2 TAF.

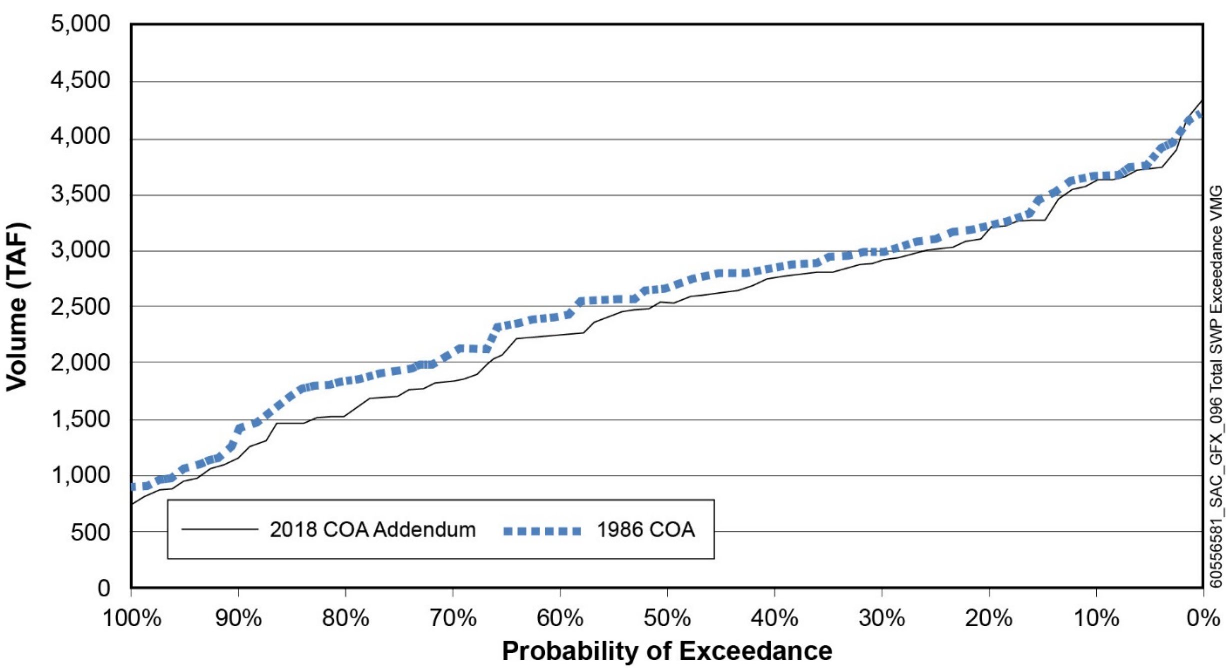

Figure 16. Exceedance Plot of Total SWP Deliveries

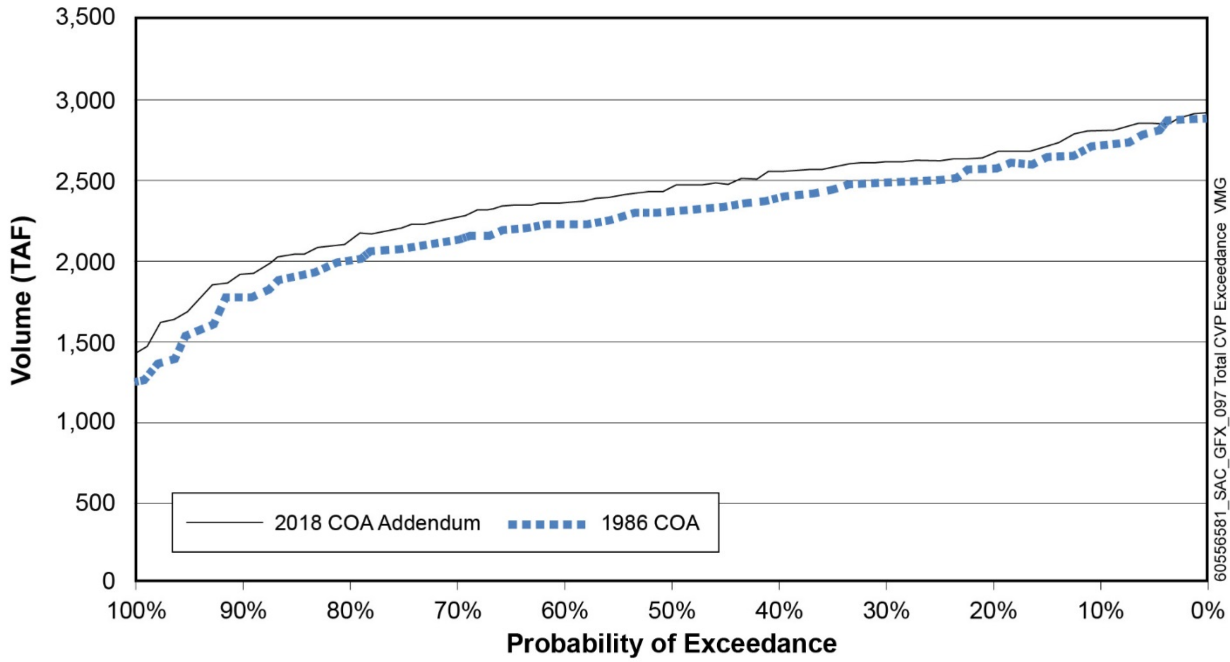

Figure 17. Exceedance Plot of Total CVP Deliveries

WATER TRANSFERS

Water transfers also are an integral part of water management. Historically, water transfers primarily were limited to in-basin transfers (e.g., Sacramento Valley to Sacramento Valley water users) (Reclamation 2013b; DWR et al. 2013). However, between 2001 and 2012, water transfers from the Sacramento Valley to areas south of the Delta increased to 298,806 AF, not including water transfers under the California Federal Bay–Delta (CALFED) Environmental Water Account Program (DWR et al. 2013). These transfers occurred in drier years, when water supplies were needed and capacity at the south Delta pumps was available.

In 2008, one of the first long-term water transfer agreements was approved by the SWRCB for the Lower Yuba River Accord. The plan was designed to protect and enhance fisheries resources in the Lower Yuba River, increase local water supply reliability, provide DWR with increased operational flexibility for protection of Delta fisheries, and provide additional dry-year water supplies to SWP and CVP water users.

In 2013, Reclamation approved an overall program for a 25-year time frame (2014 to 2038), to transfer up to 150,000 AF/yr of water from the San Joaquin River Exchange Contractors Water Authority to USDOI for refuge water supplies or SWP or CVP water users (Reclamation 2013b). Reclamation also approved a long-term water transfer program (2015 to 2024) from water sellers in the Sacramento Valley to water users in the San Francisco Bay Area and south of the Delta (Reclamation 2014b).

EFFECTS OF THE 2018 COA ADDENDUM

ANALYSIS OF EFFECTS–HYDROLOGY AND WATER SUPPLY

This section describes the changes to hydrology and water supply associated with implementation of SWP and CVP operations as regulated by the 2018 COA Addendum when compared to the 1986 COA. Detailed modeling results using the CalSim II computer model for all water-year types and long-term averages are provided in Appendix C.

The 2018 COA Addendum would modify operations and associated reservoir storage, downstream surface water flows, and diversions at selected SWP facilities and related waterways. Descriptions of estimated changes in hydrology are presented to provide a basis for understanding potential hydrologic effects on designated beneficial uses. Estimated changes in hydrology are summarized in the following discussions.

SACRAMENTO RIVER FLOWS DOWNSTREAM FROM THE FEATHER RIVER CONFLUENCE

The CalSim II model results indicate that flows of the Sacramento River downstream from the Feather River confluence would not change substantially with implementation of the 2018 COA Addendum. As shown in Figure 6, 2018 COA Addendum operations would result in surface water flows in the Sacramento River at Freeport similar to 1986 COA mean monthly flows. Changes to Sacramento River mean monthly flow would not exceed 1 percent. These changes would be within the range of model error.

During wet, above-normal, and below-normal water years, mean monthly Sacramento River flow at Freeport under 2018 COA Addendum operations is expected to vary, from a decrease of 1 percent (equal to a 6 cfs decrease in wet water years) to an increase of 2 percent (equal to a 30 cfs increase in above-normal water years), compared to 1986 COA conditions. During dry water years, mean monthly July flows would be reduced from 17,591 to 16,782 cfs (equal to 809 cfs or 5 percent), compared to 1986 COA conditions. In critical water years, mean monthly August flow would increase from 8,153 to 8,813 cfs (equal to 661 cfs or 8 percent).

SACRAMENTO–SAN JOAQUIN DELTA

To analyze conditions in the Delta, the following locations were assessed:

- Delta Outflow
- Old and Middle Rivers Flow
- Total Exports from Banks Pumping Plant

Delta Outflow

As shown in Figure 18, Delta outflow under 2018 COA Addendum operations would be similar to 1986 COA mean monthly flow conditions. Changes to Delta outflow mean monthly flow would not exceed 1 percent. These changes would be within the range of model error.

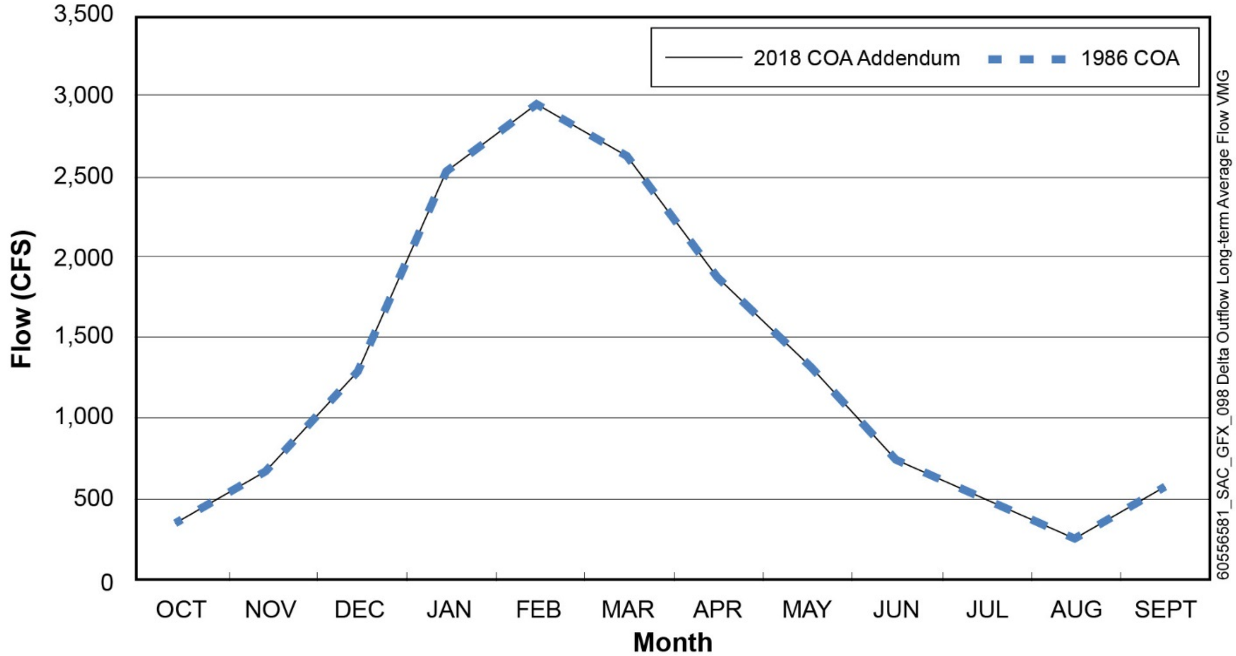

Figure 18. Delta Outflow With 2018 COA Addendum Operations

During wet, above-normal, below-normal, and dry water years, mean monthly flow at Freeport under 2018 COA Addendum operations would vary, from a decrease of 2 percent (equal to a 16 cfs decrease in above-normal water years) to an increase of 2 percent (equal to a 11 cfs increase in wet water years), compared to 1986 COA conditions. In critical water years, mean monthly August flows would be reduced by 279 cfs (7 percent).

Old and Middle Rivers Flow

Over the long term, OMR flow would be similar with the 2018 COA operations, compared to the 1986 COA conditions. The long-term average April flow would increase by 13 cfs. Changes to April OMR flow with 2018 COA Addendum operations would be within the range of model error, compared to 1986 COA conditions.

In wet water years, OMR flow would increase by 59 cfs (8 percent) in May under 2018 COA Addendum operations, compared to 1986 COA conditions. In the 11 other months, changes to OMR flow would vary from a decrease of 3 percent to an increase of 2 percent. In above-normal and below-normal water years, changes to OMR flow would vary, from a decrease of 4 percent to an increase of 3 percent. In dry water years, OMR flow would increase by 710 cfs (8 percent) in July and 391 cfs (8 percent) in August. In all other months of dry water years, changes to OMR flow would vary from a decrease of 2 percent to an increase of 1 percent. In critical water years, OMR flow would decrease by 365 cfs (7 percent) in December and 872 cfs (32 percent) in August, and would increase by 158 cfs (5 percent) in March.

Total Exports from Banks Pumping Plant

Over the long term, average annual Banks Pumping Plant exports would decrease by 190 cfs. These exports would decrease by 499 cfs (13 percent) in January, 374 cfs (9 percent) in February, 155 cfs (15 percent) in April, 142 cfs (15 percent) in May, and 400 cfs (15 percent) in June under 2018 COA operations, compared to 1986 COA conditions. In wet water years, Banks Pumping Plant exports would decrease by 358 cfs (7 percent) in January, 216 cfs (15 percent) in April, 229 cfs (15 percent) in May, 432 cfs (11 percent) in June, and 384 cfs (8 percent) in December under 2018 COA operations, compared to 1986 COA conditions. In above-normal water years, Banks Pumping Plant exports would decrease by 536 cfs (15 percent) in January, 389 cfs (9 percent) in February, 152 cfs (18 percent) in April, 123 cfs (16 percent) in May, and 510 cfs (17 percent) in June. In below-normal water years, Banks Pumping Plant exports would decrease by 547 cfs (17 percent) in January, 326 cfs (8 percent) in February, 127 cfs (16 percent) in April, 115 cfs (15 percent) in May, and 543 cfs (21 percent) in June. In dry and critical water years, Banks Pumping Plant exports would decrease by up to 602 cfs (20 percent) in January, up to 595 cfs (18 percent) in February, up to 456 cfs (17 percent) in March, up to 151 cfs (18 percent) in April, up to 112 cfs (15 percent) in May, up to 312 cfs (18 percent) in June, up to 547 cfs (24 percent) in July, and up to 700 cfs (58 percent) in August.

San Luis Reservoir

With implementation of 2018 COA Addendum operations, maximum and minimum annual storage at the San Luis Reservoir would decrease, compared to 1986 COA conditions (Figure 19). However, for the most part, the annual San Luis Reservoir storage range under 2018 COA Addendum operations would be similar to 1986 COA conditions, as shown in Figure 19. In years with limited annual San Luis Reservoir storage range, the storage range under 2018 COA Addendum operations would decrease, compared to 1986 COA conditions. These changes would be within the range of model error. Over the long term, the average San Luis Reservoir storage would be greater under 2018 COA operations, compared to the 1986 COA conditions, except in February and March, when storage would be similar (See Appendix C).

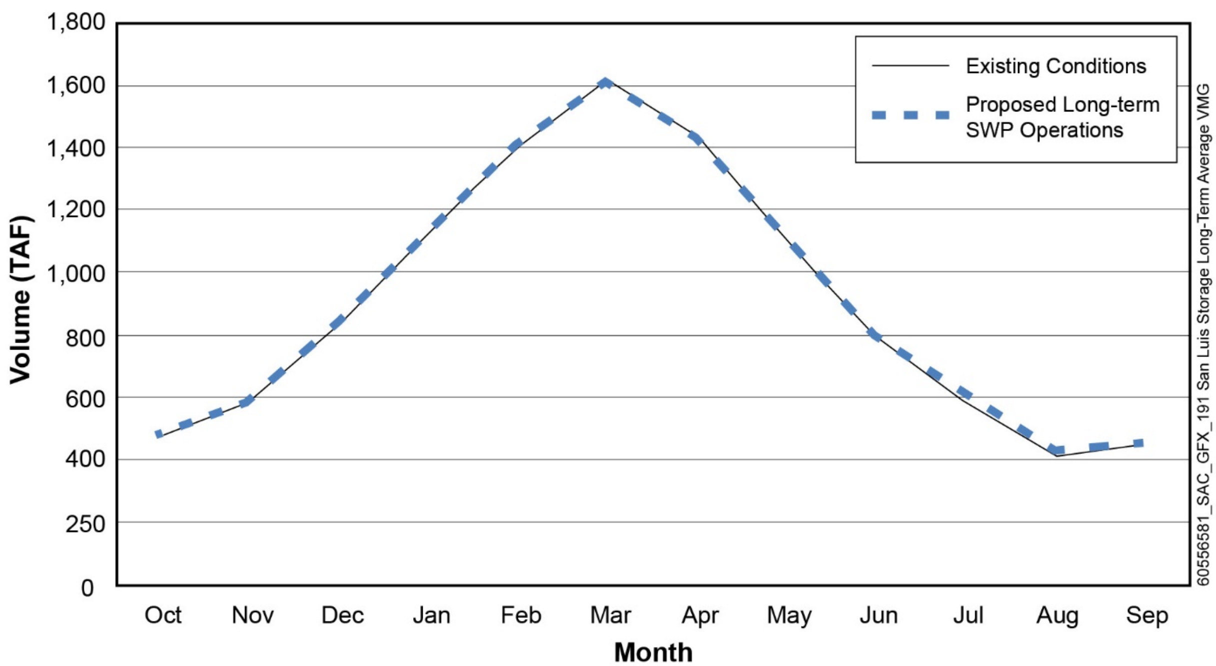

Figure 19. SWP Water Storage in San Luis Reservoir with 2018 COA Operations

SWP CONTRACT DELIVERIES

Table 1 shows the total annual SWP deliveries for 1986 COA conditions and 2018 COA operations for long-term average period and for dry and critical water years. An exceedance plot of SWP deliveries also is shown in Figure 16.

Table 1. Annual SWP Regional Deliveries, 2018 COA Addendum Compared to the 1986 COA

Region	Delivery Type[a]	Average (Annual)	1986 COA (TAF)	2018 COA (TAF)	Change from the 1986 COA to 2018 COA (TAF/%)
SWP FRSA	Contract Delivery	Long-Term[b]	952	952	0 (0%)
SWP FRSA	Contract Delivery	Dry and Critical[c]	908	908	0 (0%)
SWP M&I	Contract Delivery	Long-Term	31	30	-1 (-3%)
SWP M&I	Contract Delivery	Dry and Critical	22	20	-2 (-9%)
SWP Ag	Contract Delivery (including Article 21)	Long-Term	3	3	0 (-5%)
SWP Ag	Contract Delivery (including Article 21)	Dry and Critical	2	2	0 (-14%)
SWP M&I	Contract Delivery (including Article 21, includes transfers to SWP contractors)	Long-Term	209	202	-7 (-3%)
SWP M&I	Contract Delivery (including Article 21, includes transfers to SWP contractors)	Dry and Critical	134	125	-9 (-7%)
SWP M&I	Contract Delivery	Long-Term	43	40	-2 (-5%)
SWP M&I	Contract Delivery	Dry and Critical	26	22	-4 (-13%)
SWP M&I	Contract Delivery	Long-Term	82	77	-5 (-6%)
SWP M&I	Contract Delivery	Dry and Critical	50	42	-8 (-15%)
SWP Ag	Contract Delivery (including Article 21)	Long-Term	621	585	-36 (-6%)
SWP Ag	Contract Delivery (including Article 21)	Dry and Critical	365	310	-55 (-15%)
SWP M&I	Contract Delivery (including Article 21)	Long-Term	273	260	-14 (-5%)
SWP M&I	Contract Delivery (including Article 21)	Dry and Critical	175	155	-20 (-12%)
SWP M&I	Contract Delivery (including Article 21, includes transfers to SWP contractors)	Long-Term	1,311	1,242	-69 (-5%)
SWP M&I	Contract Delivery (including Article 21, includes transfers to SWP contractors)	Dry and Critical	867	763	-104 (-12%)
SWP Ag	Contract Delivery (including Article 21)	Long-Term	8	7	-1 (-6%)
SWP Ag	Contract Delivery (including Article 21)	Dry and Critical	5	4	-1 (-13%)
Total SWP Supplies	Contract Delivery (FRSA, Ag, and M&I from SWP and Sites Reservoir)	Long-Term	3,532	3,399	-133 (-4%)
Total SWP Supplies	Contract Delivery (FRSA, Ag, and M&I from SWP and Sites Reservoir)	Dry and Critical	2,555	2,352	-202 (-8%)

Notes:
a. Based on CALSIM-II modeling over an 82-year simulation period.
b. Long-Term is the average quantity from October 1921 through September 2003.
c. Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 dry and critical years from October 1921 through September 2003.
Ag = Agricultural
M&I = Municipal and Industrial

Average annual SWP deliveries would decrease by 133 TAF under 2018 COA operations, compared to the 1986 COA conditions. This decrease would be consistent with the long-term average annual decrease at Banks Pumping Plant of 135 TAF. Delivery decreases would greatest during below-normal, dry, and critical water years. In the dry and critical water years, average annual SWP deliveries under 2018 COA operations would decrease by 202 TAF (8 percent), compared to the 1986 COA conditions.

DISCUSSION

Implementation of SWP 2018 COA Addendum operations would result in a similar hydrologic and water supply pattern, compared to 1986 COA operations. Although limited changes to surface water hydrology were observed in the model, these changes would be minimal, and usually would be limited to 1 or 2 months in a water year.

The Banks Pumping Plant exports figure is the only output parameter exhibiting a significant change. Implementation of the 2018 COA Addendum operations would result in long-term average decreases, compared to 1986 COA conditions. Decreases to exports would improve water quality, reduce fish entrainment, and benefit other environmental resources.

Therefore, the hydrologic changes discussed above do not merit further analysis to assess potential changes to designated uses and other environmental resource.

ANALYSIS OF EFFECTS–WATER QUALITY

As described in the analysis of effects on hydrology and water supply, those changes would be negligible. Therefore, changes to water quality constituents, exceedance of water quality standards, or violations of waste discharge requirements would not occur.

Implementation of the COA 2018 operations would not include construction of new or modified facilities. Therefore, no changes would occur to flows into existing drainage systems or new sources of polluted runoff. Because the flow patterns under the 2018 COA Addendum operations would be similar to COA 1986 conditions, no changes would occur that would result in a conflict with water quality control plans.

Because the SWP operations corresponding to the 2018 COA Addendum operations would be similar to 1986 COA operations, no changes would occur to water quality.

The analysis of surface water hydrology demonstrates that implementation of the 2018 COA Addendum had no effect on surface waters upstream from the Delta, as shown in Figure 3 for the Sacramento River downstream from Keswick Dam; nor had an effect on surface waters in the Delta upstream from the south Delta pumps (Figure 5) for the Sacramento River at Freeport. Total south of Delta water exports would not change substantially with implementation of the 2018 COA Addendum. As shown in Figure 13, the combined CVP and SWP water diversion is very similar to the 1986 COA operations. The 2018 COA Addendum did affect the allocation of water between the CVP and SWP at the south Delta pumping facilities, as shown in Figures 16 and 17.

Because of implementation of the 2018 COA Addendum, CVP water deliveries would increase and SWP deliveries would decrease by an average annual 130 TAF. This decrease would represent about 5 percent of the average annual SWP deliveries.

Table 2 shows the results of the analysis of impact on the environmental resource topics that are listed in Appendix G of the State CEQA Guidelines, which were used in this analysis to provide a wide range of potentially relevant environmental topics. Tribal Cultural Resources, listed in Appendix G, was not considered in this analysis. Furthermore, two environmental resource topics are further addressed in the discussion following Table 2: Agriculture and Forestry Resources; and Population and Housing.

Table 2. Effects of the 2018 COA Addendum on Various Environmental Resource Topics

Environmental Topic	Potential Environmental Effect
Aesthetics	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect aesthetic resources. No change to aesthetic values or scenic vistas would occur.
Air Quality	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect cultural resources. Re-allocation of water supplies from the SWP to CVP would not reduce the volume of water diverted and delivered to agricultural and municipal/industrial water users. Therefore, energy consumed and associated air pollutant emissions required to deliver the supply only would vary based on the relative efficiency of the CVP facilities compared to the SWP facilities. No substantive change in air pollutant emissions would occur.
Biological Resources	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect terrestrial or aquatic resources. Re-allocation of water from the SWP to CVP would have no effect on Delta hydrology and water quality, and therefore no new adverse effect on Delta aquatic species. No adverse effect on terrestrial species would occur in SWP or CVP service areas.
Cultural Resources	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect cultural resources. Re-allocation of water from the SWP to CVP would have no new impact on cultural resources.
Energy	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect cultural resources. Re-allocation of water supplies from the SWP to CVP would not reduce the volume of water diverted and delivered to agricultural and municipal/industrial water users. Therefore, energy consumed to deliver the supply only would vary based on the relative efficiency of the CVP facilities compared to the SWP facilities. No substantive change in energy use would occur.
Geology and Soils	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect geological and soil resources. Re-allocation of water from the SWP to CVP would have no new adverse effect on geology and soils.
Greenhouse Gas Emissions	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would affect greenhouse gas emissions. Re-allocation of water supplies from the SWP to CVP would not reduce the volume of water diverted and delivered to agricultural and municipal/industrial water users. Therefore, energy consumed and greenhouse gas emissions required to deliver the supply only would vary based on the relative efficiency of the CVP facilities compared to the SWP facilities. No substantive change in greenhouse gas emissions would occur.
Hazards and Hazardous Materials	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would create new hazards or cause release of hazardous materials.
Land Use and Planning	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect existing land uses or land use plans.
Mineral Resources	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect mineral resources. No change to mineral resources would occur.
Noise	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect existing noise levels. SWP and CVP facilities would continue to operate within their respective historical range and would not generate new or louder noise emissions.

Environmental Topic	Potential Environmental Effect
Public Services	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect public services.
Recreation	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect recreational facilities or recreational opportunities.
Transportation	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect existing roadways, traffic, or levels of service. No change to transportation systems would occur.
Utilities and Service System	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would adversely affect utilities or other service systems. No change to existing utilities, levels of service, or quality of service would occur.
Wildfire	No Effect – No new construction or physical effect on CVP or SWP facilities would occur that would pose a wildfire risk or exacerbate fire risk. No change to existing wildfire risk or wildfire management would occur.

AGRICULTURE AND FORESTRY RESOURCES

The 2018 COA Addendum re-allocated an annual average 130 TAF of SWP water supplies to the CVP service area. If distributed proportionally to all CVP water users, about 92 percent of this volume (or 119 TAF of water) is expected to be made available to existing agricultural lands within the CVP service area (Reclamation 2018). The remainder would be made available to municipal and industrial land uses in the CVP service area.

Because these CVP water users historically have been subject to reduced water deliveries resulting from dryer hydrologic conditions and regulatory restrictions, the 130 TAF of water is expected to be applied as irrigation supplies to existing agricultural lands, or lands that have been retired recently because of limited water supplies.

The amount of water supply made available to the CVP is equivalent water volume capable of irrigating an area ranging from about 29,400 to 41,200 acres, depending on agricultural crop type and associated evapotranspiration requirements (Hanson 2010). This acreage is equivalent to about 0.9 to 1.3 percent of the total 3 million acres that are served by CVP water supplies for agricultural purposes.

The water provided to the CVP would not exceed existing maximum contract amounts for agricultural use. The additional water supply provided to the CVP by the 2018 COA Addendum equals about 0.4 percent of the maximum CVP agricultural historical water use of about 1,945,633 acres. Therefore, the increased CVP agricultural water supply provided by the 2018 COA Addendum would not substantially affect the acreage of agricultural lands in the CVP service area.

POPULATION AND HOUSING

As previously discussed for Agriculture and Forestry Resources, if distributed proportionally to all CVP water users, about two-thirds of the average annual 130 TAF of SWP supplies (or 86 TAF of water) is expected to be made available to existing agricultural lands within the CVP service area (Reclamation 2019a). The remainder (or about 43 TAF) would be provided for M&I land uses.

Based on an average of 100 gallons per day per capita for residential water use, 43 TAF of water would meet the needs of 51,300 people or about 17,950 residences with an average household of 2.86 people. This volume of water equals about 3.7 percent of the average annual M&I CVP water deliveries. This volume of water also equals about 2.5 percent of the maximum CVP M&I historical use.

Therefore, the increased CVP M&I water supply that would be provided by the 2018 COA Addendum would contribute to meeting M&I water demand to CVP water users that have been subject to reduced water deliveries resulting from dryer hydrologic conditions and regulatory restrictions. The additional water would not result in exceeding the maximum historical CVP M&I water use of 167 TAF.

The reduced water supplies available to SWP water contractors would need to be replaced by development of alternative water supplies, water conservation, or transfer of water supplies from other sources. Because the SWP provides water to about 27,000,000 people, the entire volume of water (130 TAF) re-allocated to the CVP would meet about 0.2 percent of the SWP M&I water demand. The reduced SWP volume of water would be negligible compared to the annual SWP M&I deliveries. Individual water contractors or retail water purveyors are expected to manage their respective systems accordingly, to compensate for the reduced water deliveries. Therefore, implementation of the 2018 COA Addendum would have no substantial effect on population and housing.

CONCLUSION

As concluded in the 2018 NOE, implementation of the 2018 COA Addendum would shift responsibilities for meeting obligations between the CVP and SWP. As demonstrated in this discussion, changes to surface water flow upstream from the Delta would be minimal. The shift in responsibilities would result in reduced SWP exports to south of Delta water users and an increase in export to CVP water users. These changes would be minor when compared to the total volume of water delivered by either the CVP or SWP. The minimal change to surface water hydrology and water deliveries would not induce new adverse effects on other environmental resources.

LONG-TERM OPERATION OF THE CALIFORNIA STATE WATER PROJECT

DWR is pursuing a California Endangered Species Act (CESA) Incidental Take Permit (ITP) for the long-term operations of the SWP. As a part of the analysis for the ITP, as well as for the associated CEQA environmental analysis, the proposed operations must be compared against baseline physical conditions.

One aspect of the baseline conditions is the manner in which the SWP and the CVP jointly operate to meet Delta regulatory requirements. The SWP and CVP share responsibility for these requirements as defined by the COA, which DWR and Reclamation executed in 1986 and subsequently modified in 2018 through an Addendum.

DWR has identified a baseline that includes the 2018 COA Addendum as opposed to the unmodified 1986 version of the COA. A baseline that includes the COA Addendum accurately represents the existing physical conditions in the Delta. In addition, CalSim II modeling results indicate that the flows entering and exiting the Delta are unaffected by execution of the 2018 COA Addendum. Therefore, using the 2018 COA Addendum as a baseline condition would sufficiently represent Delta conditions under D1641 and the 2008/2009 BiOps as well as under existing conditions.

CEQA Legal Requirements

Under CEQA, lead agencies refer to baseline physical conditions to determine whether a project's impact is significant. (CEQA Guidelines §15125). Similarly, the Director of CDFW makes CESA findings that take authorized by an ITP is consistent with statutory requirements, such as finding that the impacts of take will be minimized and fully mitigated. CDFW may refer to information in the Final Environmental Impact Report in making these findings. (Environmental Protection Information Center v. California Department of Fish and Wildlife (2008) 44 Cal.4th 459, 517).

The baseline consists of existing physical conditions and, generally, should consist of the conditions that exist at the time that the Notice of Preparation (NOP) is published. A lead agency may identify a different baseline "where existing conditions change or fluctuate over time, and where necessary to provide the most accurate picture practically possible of the project's impacts" so long as the different baseline is supported by substantial evidence. (CEQA Guidelines §15125(a)(1)).

The baseline that DWR has identified reflects the conditions at the time of NOP publication because DWR and Reclamation were operating under the 2018 COA Addendum before April 19, 2019. COA implementation is not a fluctuating condition in the Delta. The COA has been in place since 1986 and has been modified only once, through the 2018 COA Addendum. The COA Addendum was executed over four months before the NOP was published and will have been in effect for over a year before project implementation.

Tables 3 through 5 provide CalSim II modeling results that demonstrate that the physical condition in the Delta did not significantly change as a result of executing the 2018 COA Addendum.

Table 3. Delta Outflow (TAF), 1986 COA vs. 2018 COA Addendum

Study	Annual Average	Annual Average [Dry and Critical]	Spring Average [Mar – Jun]	Spring Average [Dry and Critical]
2018 Addendum	15,752	6,335	6,588	2,607
1986 COA	15,752	6,337	6,590	2,609
Change	0	-2	-2	-2

Table 4. SWP and CVP Exports (TAF), 1986 COA vs. 2018 COA Addendum

Study	Annual Average	Spring Average [Mar – Jun]	Annual Average [SWP]	Annual Average [CVP]
2018 Addendum	4,887	1,028	2,421	2,466
1986 COA	4,887	1,031	2,556	2,331
Change	0	-3	-135	135

Table 5. Old and Middle River Flows (CFS) in Late Spring, 1986 COA vs. 2018 COA Addendum

Study	Late Spring [Mar – Jun]	Late Spring [Dry and Critical]	Late Spring [Below Normal]	Late Spring [Above Normal]
2018 Addendum	-2,094	-2,805	-2,594	-2,252
1986 COA	-2,106	-2,817	-2,579	-2,256
Change	12	12	-15	4

OLD AND MIDDLE RIVER FLOWS

The following summary graphs present a selection of Delta related output in average monthly plots as well as exceedance plots. The comparison of OMR flows between the 1986 COA and the 2018 COA Addendum show that any differences are extremely small (Figures 20 to 26).

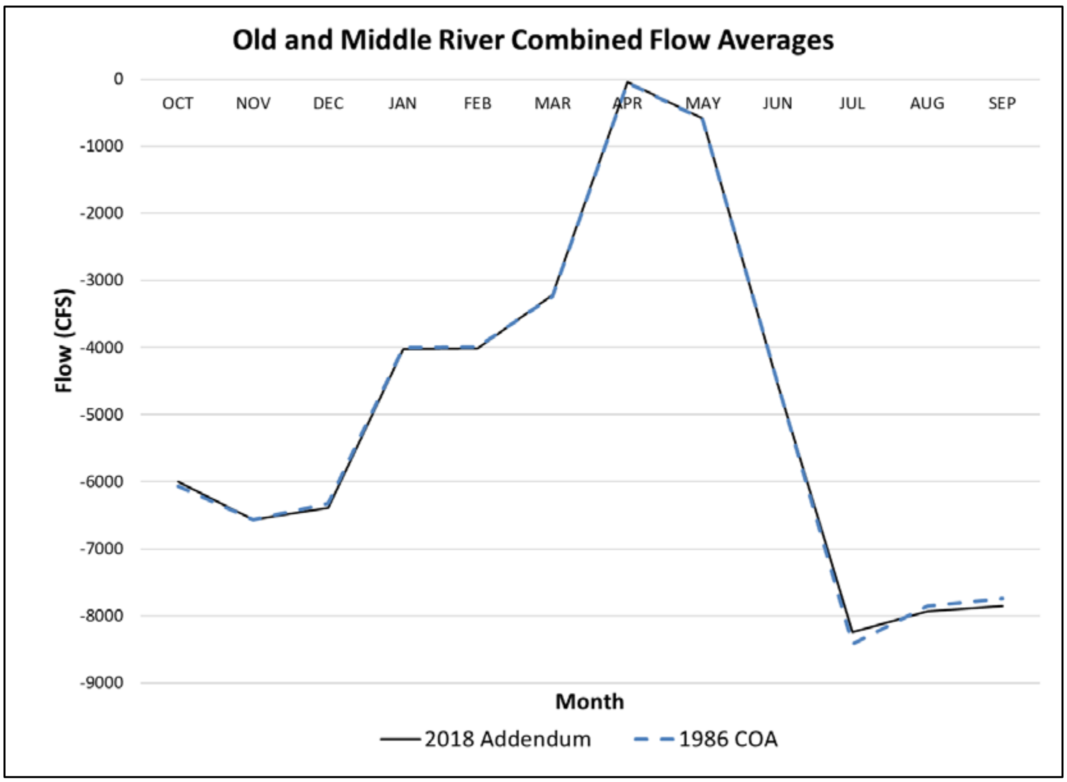

Figure 20. Monthly Average OMR Flow (CFS) for the 1986 COA and the 2018 COA Addendum

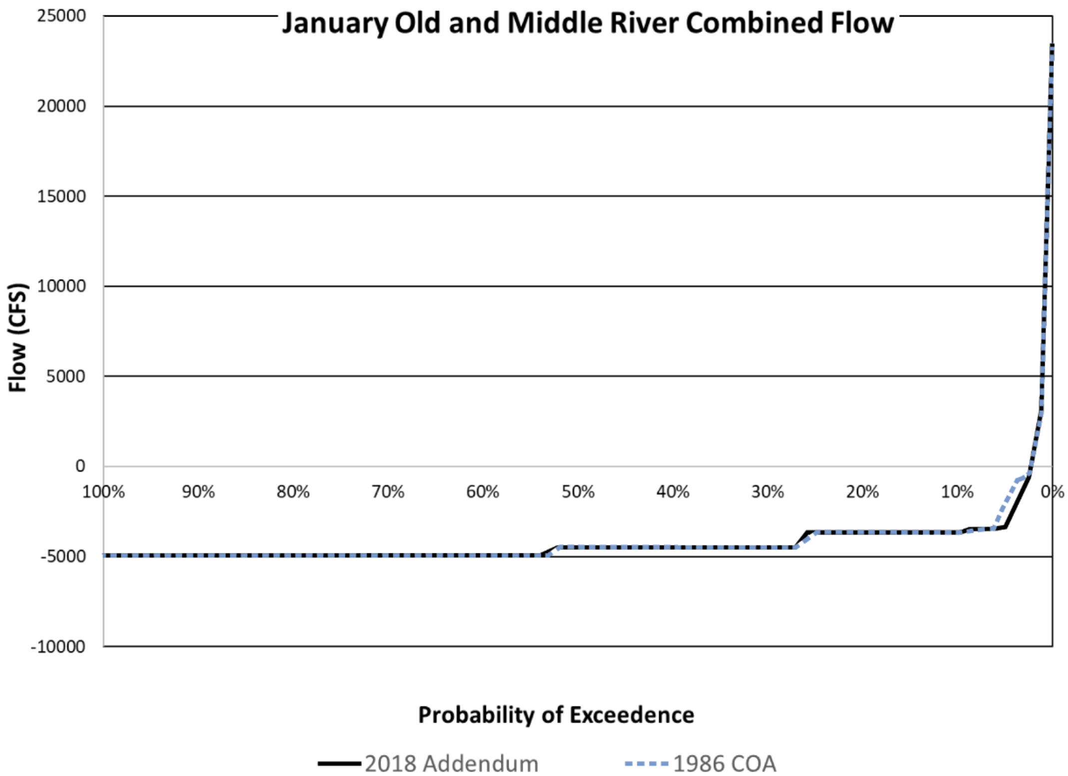

Figure 21. Exceedance Plot of OMR Flow (CFS) in January for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

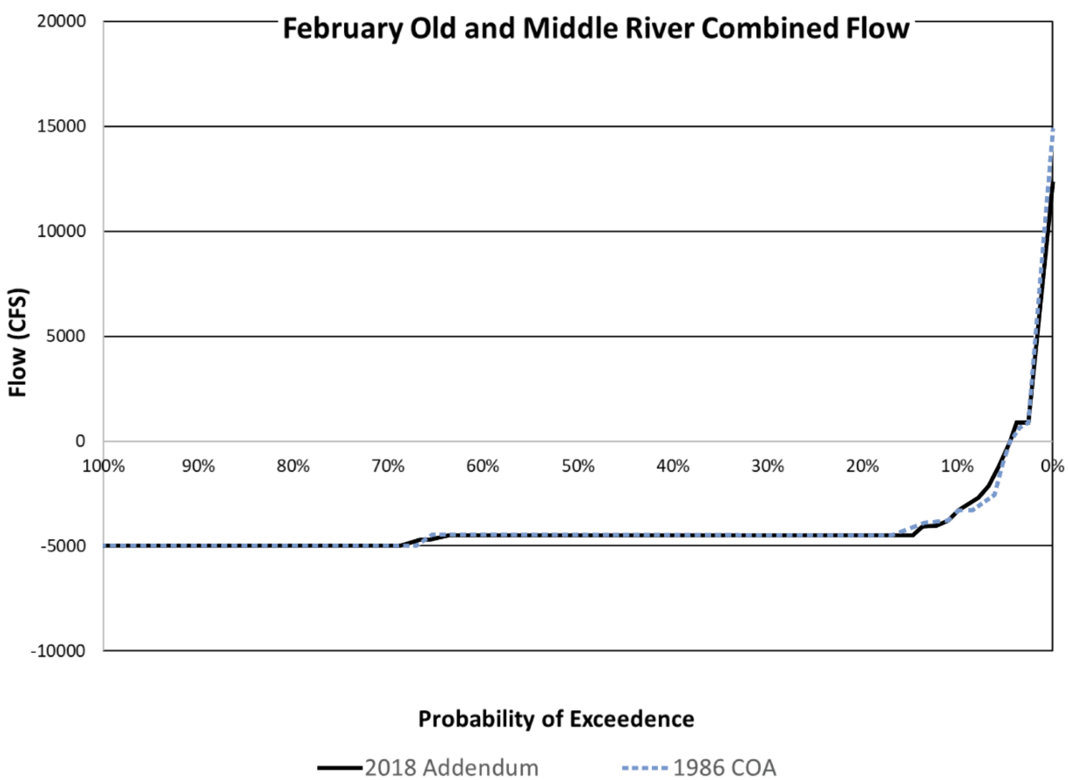

Figure 22. Exceedance Plot of OMR Flow (CFS) in February for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

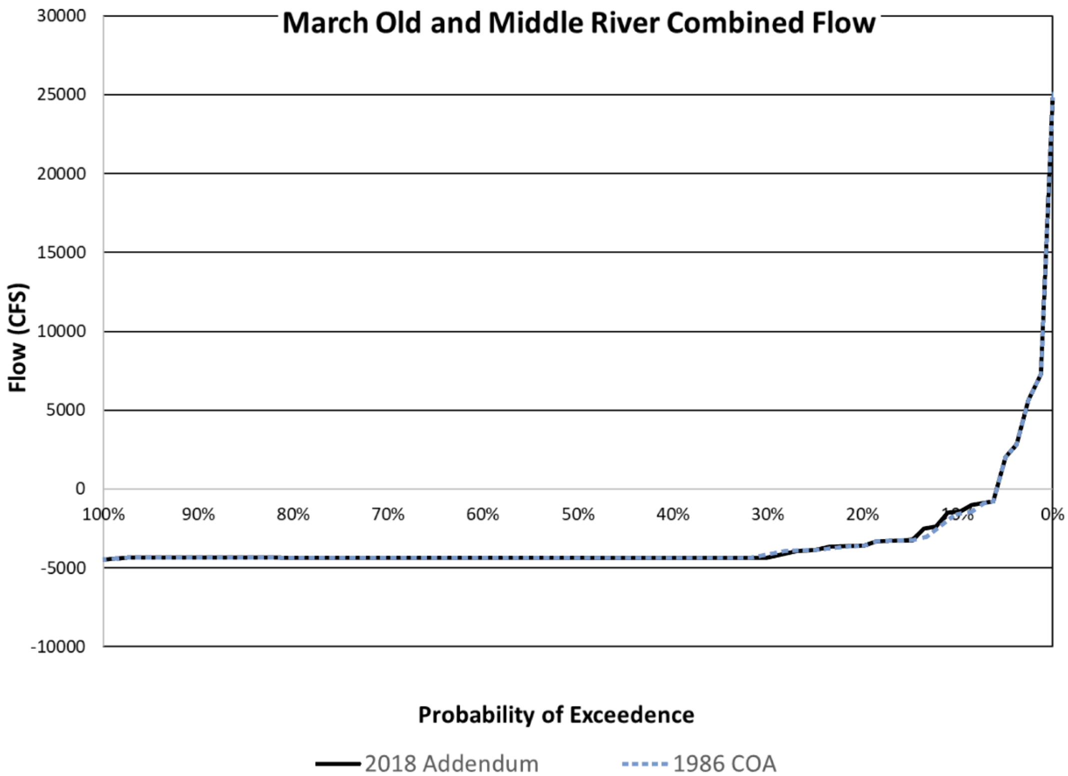

Figure 23. Exceedance Plot of OMR Flow (CFS) in March for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

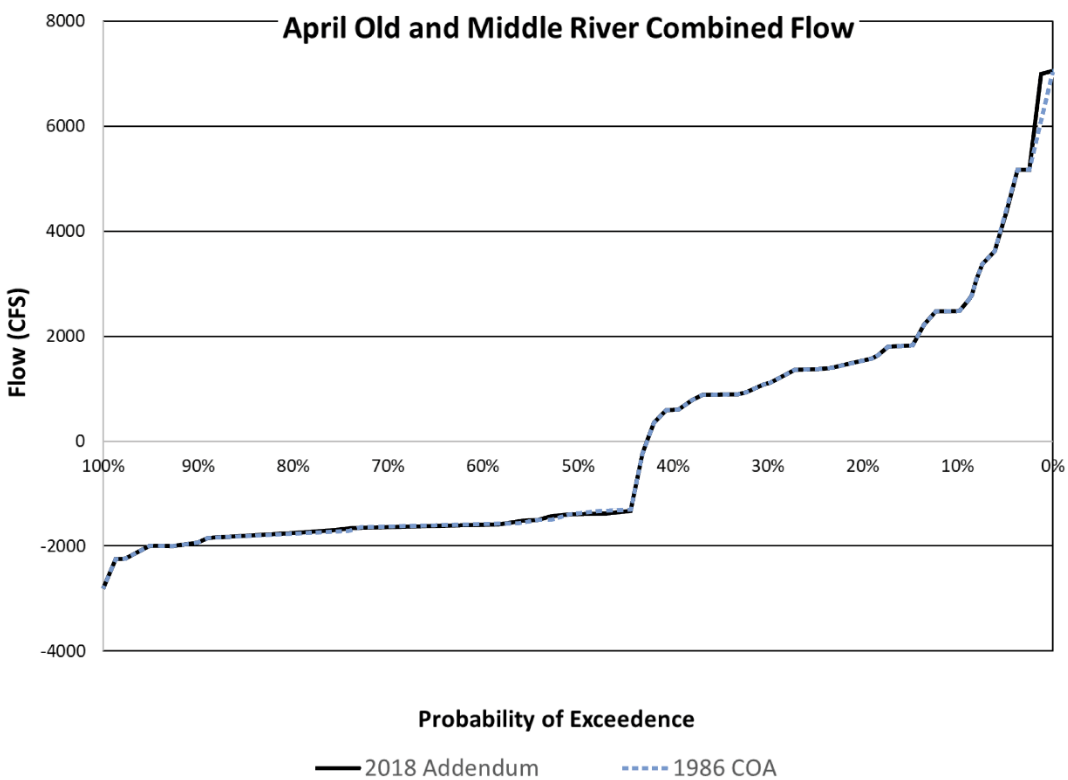

Figure 24. Exceedance Plot of OMR Flow (CFS) in April for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

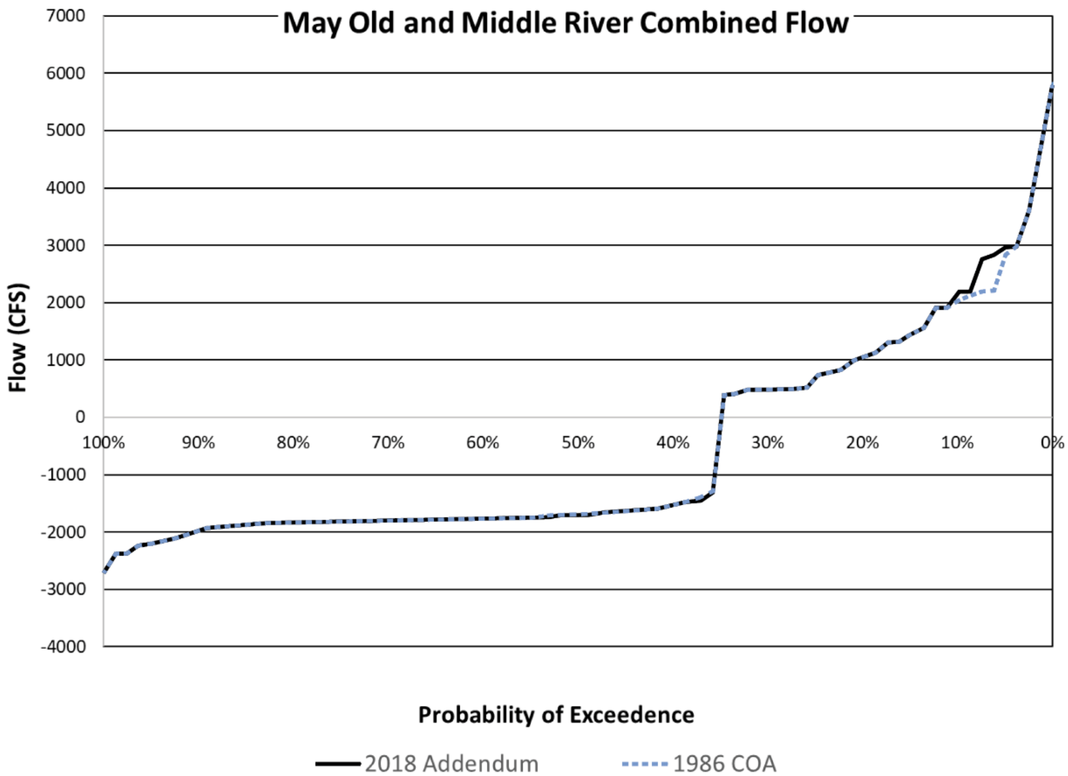

Figure 25. Exceedance Plot of OMR Flow (CFS) in May for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

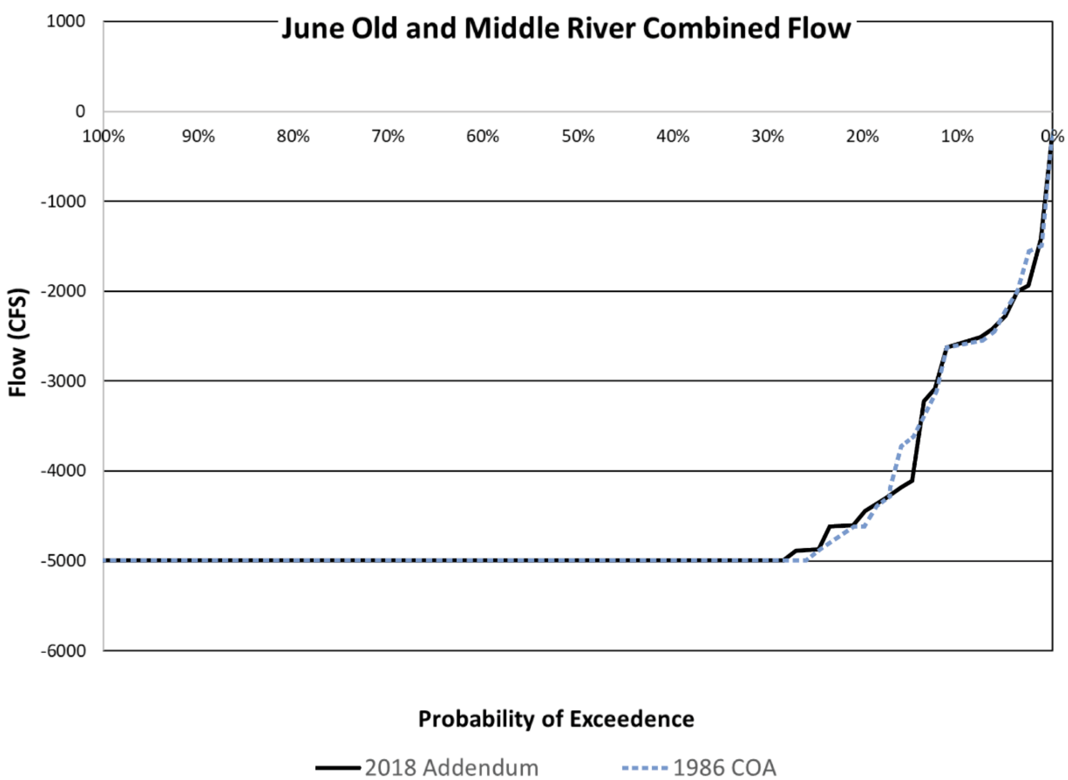

Figure 26. Exceedance Plot of OMR Flow (CFS) in June for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

DELTA OUTFLOW

The following summary graphs present a selection of Delta related output in average monthly plots as well as exceedance plots. The comparison of OMR flows between the 1986 COA and the 2018 COA Addendum show that any differences are extremely small (Figures 27 to 31).

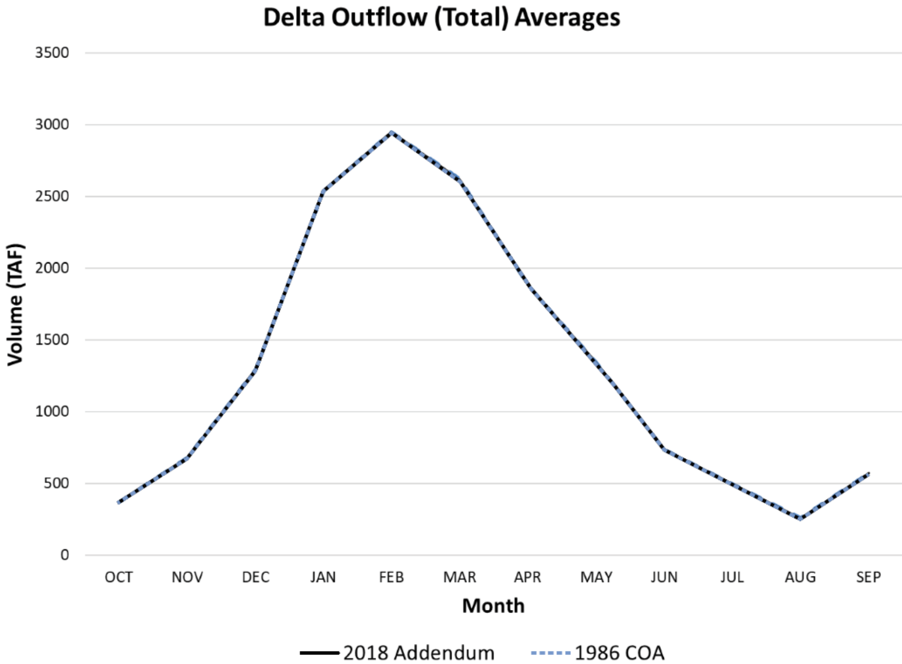

Figure 27. Monthly Average Delta Outflow Volume (TAF) for the 1986 COA and the 2018 COA Addendum

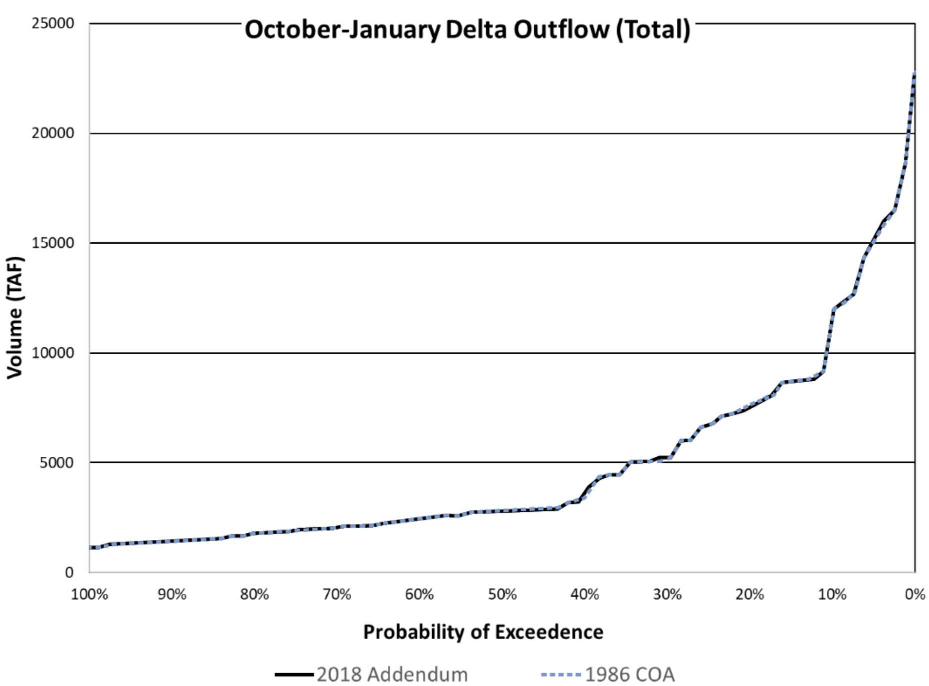

Figure 28. Exceedance Plot of Delta Outflow Volume (TAF) October to January for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

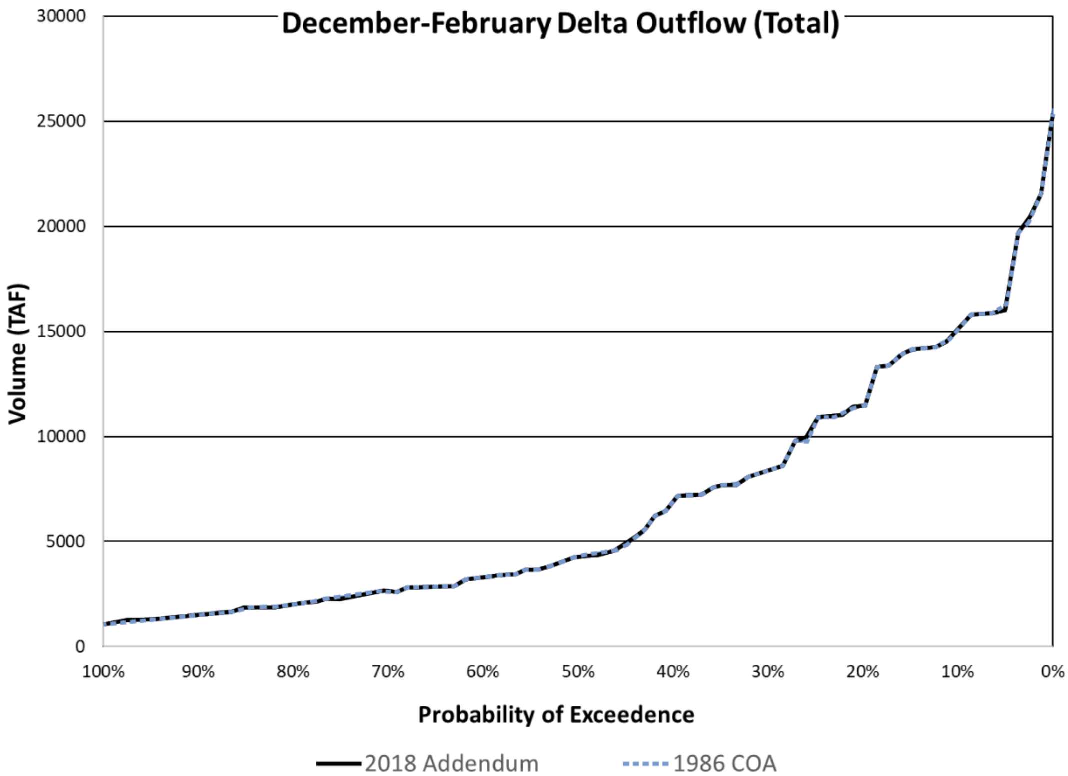

Figure 29. Exceedance Plot of Delta Outflow Volume (TAF) December to February for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

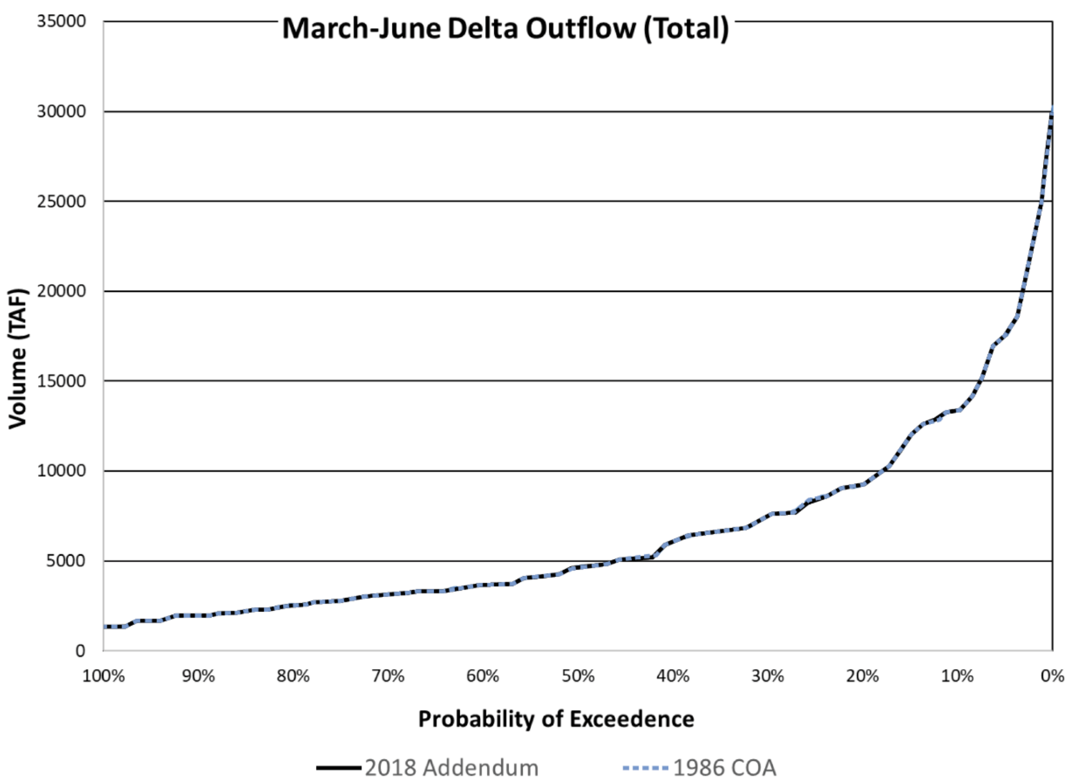

Figure 30. Exceedance Plot of Delta Outflow Volume (TAF) March to June for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

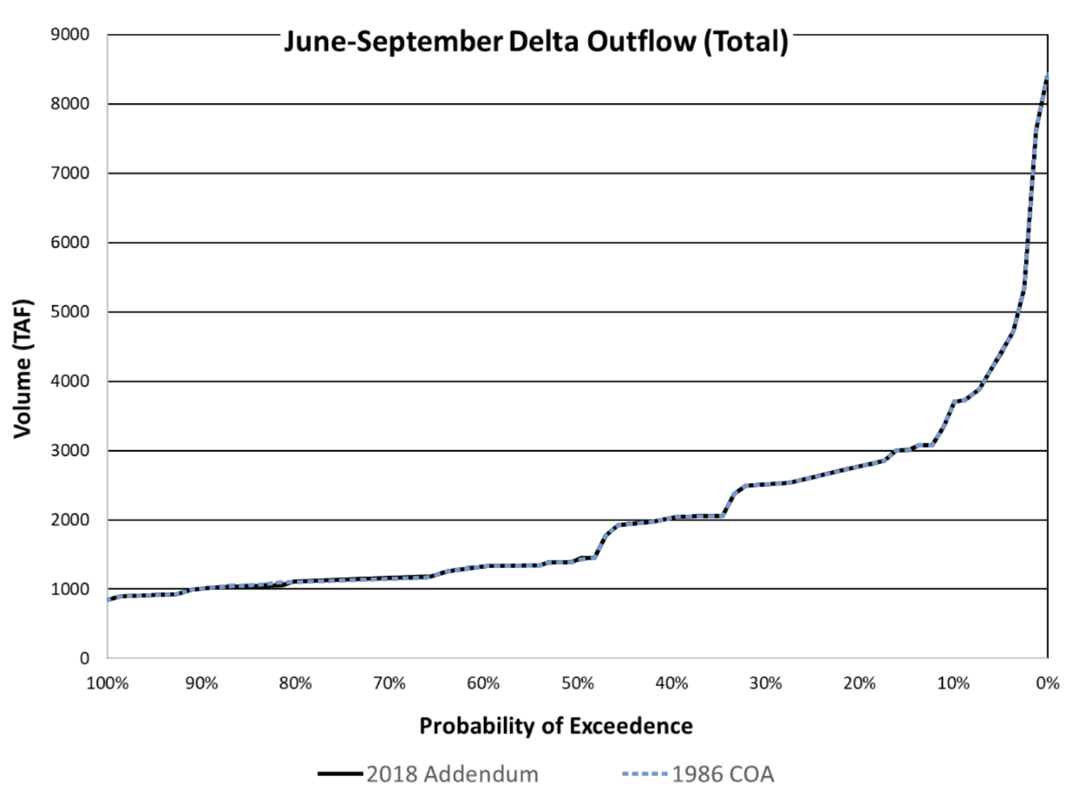

Figure 31. Exceedance Plot of Delta Outflow Volume (TAF) June to September for the 1986 COA and the 2018 COA Addendum Shows Virtually No Difference Between the Two Scenarios

CalSim II Modeling Output

Following an initial summary review of the modeling output described above, CDFW requested additional detail. The complete CalSim II model output for the 2018 COA Addendum and the 1986 COA studies are provided at https://cadwr.box.com/s/sic6jye14qlmat4inonj27j1syb0n8n2. Additionally, a compiled set of outputs can be found in Appendix A. Interpreting model output must be done so in the proper context, however, as explained below.

In order to better understand and correctly interpret CalSim II model results, it is extremely important that one be familiar with the proper use of the model and its limitations. A brief discussion on the proper use of CalSim II and DSM2 models and their limitations can be found in Nader-Tehrani (2017) (SWRCB DWR Exhibit 79; See pp. 29-43).

It is generally believed that the most appropriate format to present CalSim II model results are either in the form of:

- Long term average summary and year-type based summary tables and graphics showing monthly and/or annual statistics derived from the model results, or
- Cumulative exceedance probability monthly and/or annual model results shown only by rank/order or only by probability statistic.

Comparative statistics based on these two types of presentations are generally acceptable. Relying on absolute differences computed at a point in time between model results from an alternative and a baseline to evaluate impacts is an inappropriate use of model results (e.g. computing differences between the results from a baseline and an alternative for a particular day, month, or year within the period of record of simulation).

The modeling package in Appendix A and in the website identified above includes model results for a number of specific locations consistent with CDFW's request. CDFW also requested individual year comparisons, but those were not provided due to the reasons listed above. It is possible for CDFW or others to make those comparisons from the raw model output that is available at the provided link, but DWR has declined to provide such comparisons because drawing conclusions from absolute differences would be an inappropriate use of model results.

It is also important to note that, under extreme operational conditions, CalSim II will utilize a series of rules within the specified priority to reach a numerically feasible solution to allow for the continuation of the simulation. The outcome of these types of solutions in CalSim II may vary greatly depending upon the antecedent conditions from the previous time-step result. The model may reach a numerical solution, but the results of the simulation may not reflect a reasonably expected outcome (e.g., one that may occur following the exercise of judgment by authorized decision makers and coordination among appropriate agencies). In such cases, modeled flows may fall short of minimum flow criteria, salinities may exceed standards, diversions may fall short of allocated volumes and reservoir storages might reach extreme low levels, but actual flows may not reflect these conditions.

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