Chapter 4
Surface Water Hydrology

This chapter describes the changes to surface water due to the Long-Term Operations of the State Water Project (SWP) facilities in the Sacramento–San Joaquin Delta (Delta), Suisun Marsh, and Suisun Bay (Proposed Project). Changes to surface water hydrology, by themselves, are not considered a significant impact based on the Initial Study (provided in Appendix 3A, "Initial Study"). Description of potential changes to hydrology are presented to provide a basis for understanding the potential impacts on other secondary environmental resources evaluated in this Draft Environmental Impact Report (DEIR).

4.1 Environmental Setting

This chapter describes the surface water resources managed by the SWP and potential changes to surface water resources that could occur by implementing the proposed long-term SWP operations. The principal facilities of the SWP are Oroville Reservoir and related facilities, and San Luis Dam and related facilities, facilities in the Delta, the Suisun Marsh Salinity Control Gates (SMSCG), the California Aqueduct including its terminal reservoirs, and the North and South Bay Aqueducts. DWR holds contracts with 29 public agencies in northern, central, and southern California for water supplies from the SWP. Water stored in the Oroville facilities, along with water available in the Delta (consistent with applicable regulations) is captured in the Delta and conveyed through several facilities to SWP contractors. As such, changes to SWP operations at these facilities may result in changes to surface water hydrology in the lower Sacramento River, downstream from the Feather River confluence, the Delta and Suisun Bay, and exports from the Delta to south-of-Delta SWP water users. A CalSim 3 computer model was used to calculate flow conditions and storage volumes for reservoirs and rivers that would be affected by SWP operations.

As explained in Section 4.3, "Comparison of the Proposed Project with the Baseline Conditions," changes in surface water hydrology, by themselves, are not considered significant environmental impacts. Any environmental impacts that could result from the hydrologic changes described in this chapter, including impacts on water quality and biological resources, are analyzed in other chapters of this DEIR.

4.1.1 Sacramento River

Flows from the Sacramento River, Feather River, Sutter Bypass, and Natomas Cross Canal join upstream from Verona. When these flows exceed 62,000 cubic feet per second (cfs), a large portion of the flows enters the Yolo Bypass, a natural overflow area west of the Sacramento River, by spilling over Fremont Weir. The Sacramento River Flood Control Project modified the basin, allowing 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 (California Department of Water Resources 2013a). 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 Drainage Canal through the Knights Landing Ridge Cut (Figure 4-1).

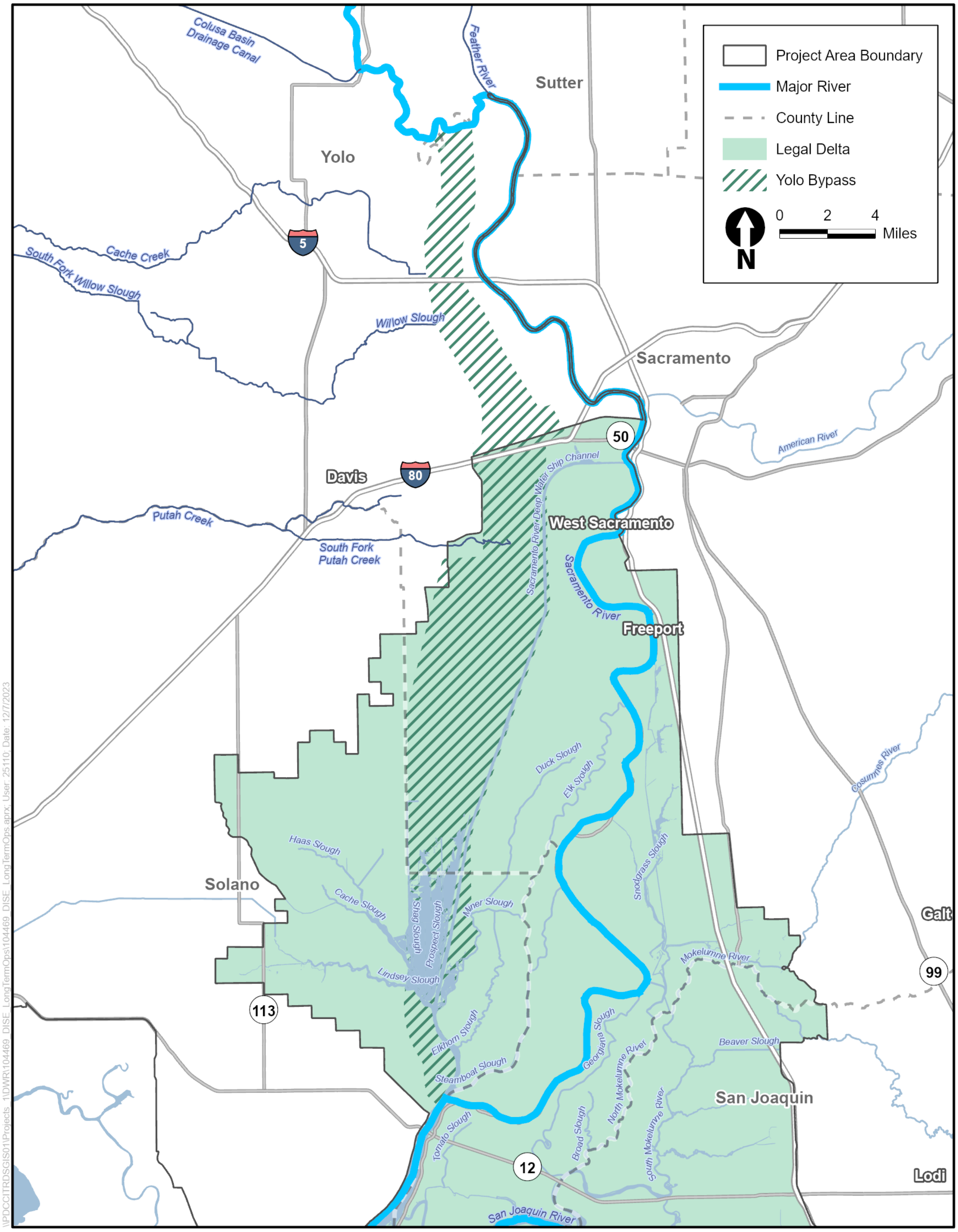


Figure 4-1. Map of Tributaries that Enter the Yolo Bypass

Figure 4-1 shows a map of all the tributaries that enter the Yolo Bypass. From the north, Colusa Basin drainage canal, Feather River, Cache Creek, Willow Slough, and American River connect to the Sacramento River. The Sacramento River flows south to the Cache Slough complex and into the Sacramento/San Joaquin River Delta.

The SWP operations only have direct impacts on the lower Sacramento River, downstream from the Feather River confluence. Releases from Oroville Dam flow down the Feather River, and the combined flows of the Sacramento and Feather rivers continue southward toward the Delta. Simulated results from the Baseline Conditions CalSim 3 model and recent historical observed data of flows in the Sacramento River at Freeport (near the northern boundary of the Delta) are shown in Figures 4-2 and 4-3. Simulated results are based on the 100-year simulation period. Figure 4-2 presents 100-year CalSim 3 model results in box-and-whisker format indicating the range of hydrology modeled for each month. Lines of historical observed flows at Freeport (water years [WY] 2008 to 2021) are overlaid atop the box-and-whisker plot. Figure 4-3 presents CalSim 3 model results of Freeport flow during Critical water years as black points and historical data of Critical water years in the 2008 to 2021 period as lines. These figures illustrate that the 100-year hydrology and simulated operations in CalSim 3 generally encompass the recent historical flows. Despite being generally representative of historical range, CalSim 3 and other models used in this analysis cannot be compared to historical data. CalSim 3 applies constant regulations, facilities, and demands to 100 years of hydrologic data. See Appendix 4A, "Model Assumptions," for more details regarding appropriate use of model results. As shown in the figures, flows in the Sacramento River generally peak during winter and spring storm events and stay low in summer and fall months due to less or no precipitation.

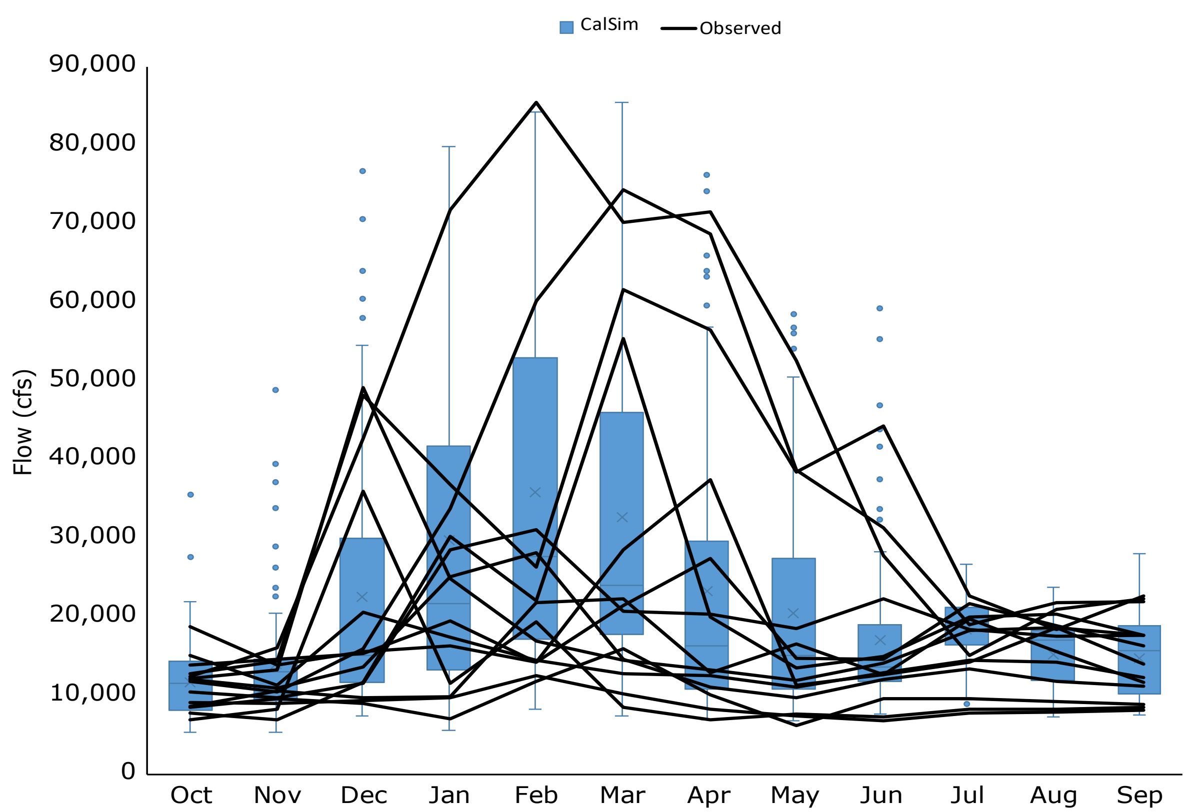


Figure 4-2. Sacramento River at Freeport, Historical and Modeled Baseline Conditions Flow

Figure 4-2 shows the flow, from 0 to 90,000 cfs, of the Sacramento River at Freeport station. Flows are depicted from October (left) to September (right). Both observed and the 100-year CalSim 3 model are represented with the highest flows, about 82,000 cfs, from January to March.

4.1.2 Sacramento and San Joaquin Bay-Delta

The Delta and Suisun Marsh and Bay encompass about 1,315 square miles and convey about 40 percent of water draining from the state (California Department of Water Resources 2013b). The Delta and Suisun Marsh and Bay are a complex of channels and islands at the confluence of the Sacramento and San Joaquin rivers. The SWP uses 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 (including the Yolo Bypass), the San Joaquin River, and eastside tributaries that flow directly into the Delta (Mokelumne, Calaveras, and Cosumnes rivers). About 77 percent of the water enters the Delta from the Sacramento River system, about 15 percent enters from the San Joaquin River system, and about 8 percent enters from the eastside tributaries (Mokelumne, Calaveras, and Cosumnes rivers) (California Department of Water Resources 1994).

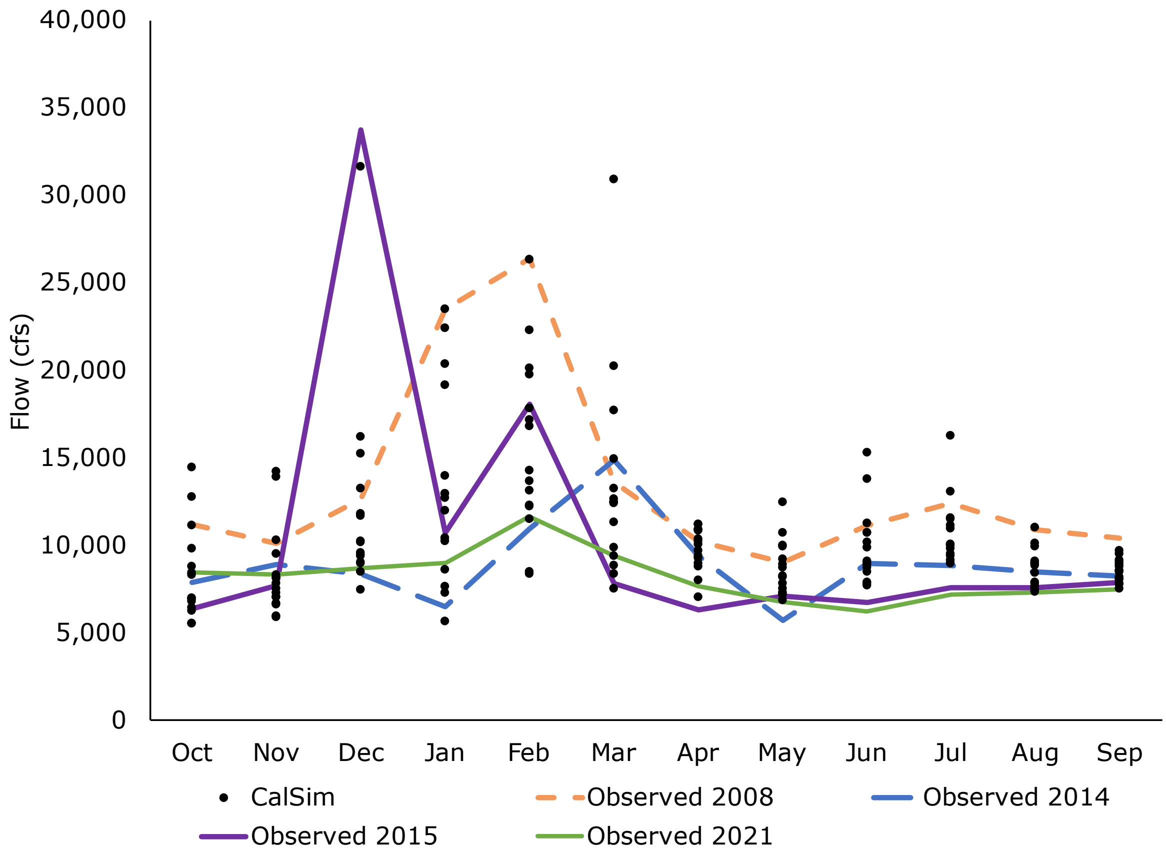


Figure 4-3. Sacramento River at Freeport, Critical Year Historical and Modeled Baseline Conditions Flow

Figure 4-3 shows the flow, from 0 to 40,000 cfs, from the Sacramento River at Freeport station. Flows are depicted from October (left) to September (right). The figure shows observed flows from 2008, 2014, 2015, and 2021 and the 100-year CalSim 3 model during critical water years. December 2015 shows the highest flows at about 34,000 cfs with the CalSim 3 model just below.

Water flow paths in the north Delta and central Delta primarily are determined by flows in the Sacramento River; however, operations of the south Delta pumps can alter the direction of flow in the central Delta from a westward direction to a southerly flow path toward the south Delta pumps.

Flow paths in the Delta are also affected by operation of the federal Delta Cross Channel (DCC) gates, which divert flows from the Sacramento River (upstream of Walnut Grove) to the lower Mokelumne River, and through the central and South Delta in Old and Middle rivers to the channels near the south Delta pumps. Generally, opening the DCC gates can reduce salinity in some central and south Delta channels, particularly in the summer months, through the transport of relatively lower-salinity Sacramento River water into the central Delta (California Department of Water Resources et al. 2013).

Salinity in Suisun Bay is primarily affected by Delta outflow to the bay and tidal inflows from San Francisco Bay. Salinity within Suisun Marsh is similarly affected by inflows from the Delta, Suisun Bay inflows, and the use of the SMSCG, which are located on Montezuma Slough near Collinsville. Gates are operated to restrict the inflow of high-salinity flood-tide water from Grizzly Bay into the marsh, but allow freshwater ebb-tide flow from the mouth of the Delta to pass through. Gate operations lower salinity in Suisun Marsh channels and result in a net movement of water from east to west. When Delta outflow is low to moderate and the gates are not operating, net movement of water is from west to east, resulting in higher-salinity water in Montezuma Slough.

The San Joaquin River, the second largest contributor to Delta freshwater inflows, enters the Delta from the south and flows toward the north and west. San Joaquin River channel flow volume and directions are affected by tides, local in-Delta water diversions, Central Valley Project (CVP) operations, and SWP operations (California Department of Water Resources et al. 2013). 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 on a daily basis (California Department of Water Resources 2013b).

In addition to tides, local in-Delta water diversions, CVP operations, and SWP operations influence Delta hydraulics, including periodic reverse flows (flows upstream towards the San Joaquin River) in Old and Middle rivers. The measurement of reverse flows in Old and Middle rivers is referred to as OMR. Reverse flows also occur in the False River in the west Delta and Turner Cut in the San Joaquin River. Reverse flows can cause more saline water to move farther inland (California Department of Water Resources et al. 2013).

To maintain water levels in several south Delta waterways, historically the California Department of Water Resources (DWR) installs seasonal temporary rock agricultural barriers, as described in Section 2.1.3.7, “Agricultural Barriers.” Tidal flows in the south Delta have a major influence on Delta surface water circulation.

4.1.3 SWP and CVP Delta Water Facilities

Water flows through the south Delta towards the approach channel for the CVP Jones Pumping Plant and the five radial gates that allow water to flow into the 31-thousand-acre-foot (TAF) Clifton Court Forebay (CCF). CCF regulates water flows into the Banks Pumping Plant. The downstream aqueduct capacity limits the Banks Pumping Plant to 10,300 cfs; however, the rate of diversion of water into the CCF is generally restricted to 6,680 cfs as a three-day average inflow to the CCF and 6,993 cfs as a one-day average inflow, in accordance with regulatory conditions of the U.S. Army Corps of Engineers. The SWP is allowed to export an additional 500 cfs between July 1 and September 30 in some water years when SWP exports are reduced to protect listed fish species. In addition, the SWP is allowed to increase diversions by up to one-third of the San Joaquin River flow at Vernalis or 10,300 cfs (whichever is lower) during the period from mid-December to mid-March when Vernalis flow exceeds 1,000 cfs.

The CVP Jones Pumping Plant has a permitted diversion capacity of 4,600 cfs; however, the operating capacity is limited to 4,200 cfs in a lower portion of the downstream Delta-Mendota Canal.

Water conveyed from the SWP Banks Pumping Plant and CVP Jones Pumping Plant flows in aqueducts to deliver water to downstream users. A portion of the water from the pumping plants flows to the 2.027-million-acre-foot (MAF) San Luis Reservoir, operated jointly by the U.S. Bureau of Reclamation (Reclamation) and DWR (up to 1.062 MAF of SWP water and up to 0.965 MAF of CVP water). San Luis Reservoir storage generally increases in late fall through early spring when south-of-Delta demands are lower than in the summer. Water from the San Luis Reservoir is released into the California Aqueduct, which conveys water supplies southward to the Central Coast, Antelope Valley, and Southern California. The first segment of the California Aqueduct extends downstream from San Luis Reservoir to a location near Kettleman City. This upstream segment is called the San Luis Canal and is owned jointly by the SWP and CVP. The remaining portions of the California Aqueduct are owned by SWP.

Decision 1641 (D-1641) authorized the joint use of the Jones and Banks pumping plants (referred to as the Joint Point of Diversion) with conditional limitations, staged implementation, and required response coordination plans related to maintaining south Delta water elevations for local riparian water users and south and central Delta water quality in accordance with regulatory criteria by state agencies.

Simulated results from the Baseline Conditions CalSim 3 model and recent historical observed data of total Delta exports (sum of the Jones Pumping Plant and Banks Pumping Plant) are shown in Figures 4-4 through 4-6. Simulated results are based on the 100-year simulation period. Figure 4-4 presents 100-year CalSim 3 model results in box-and-whisker format indicating the range of modeled exports for each month. Black lines of historical exports (WY 2008 to 2021) are overlaid atop the box-and-whisker plot. Baseline Conditions CalSim 3 model results of Delta exports during Dry water years are shown in Figure 4-5 as black points and historical data of Dry water years in the 2008 to 2021 period as lines. Figure 4-6 shows similar information for Critical water years.

These figures illustrate that the 100-year hydrology and simulated operations in CalSim 3 generally encompass the recent historical exports. Actual exports in 2014, 2015, and 2021 were outside the modeled range. Export data during these years represent operations under stressed water supply conditions. DWR and Reclamation filed Temporary Urgency Change Petitions (TUCPs) to temporarily modify requirements in their water rights permits in response to the drought conditions in 2014, 2015, and 2021. As noted in Appendix 4A, Attachment 8, "Model Limitations," CalSim 3 results differ from real-time operations under stressed water supply conditions. The CalSim 3 model cannot make unique real-time policy decisions (e.g., TUCPs) under extreme circumstances that the actual (human) operators perform.

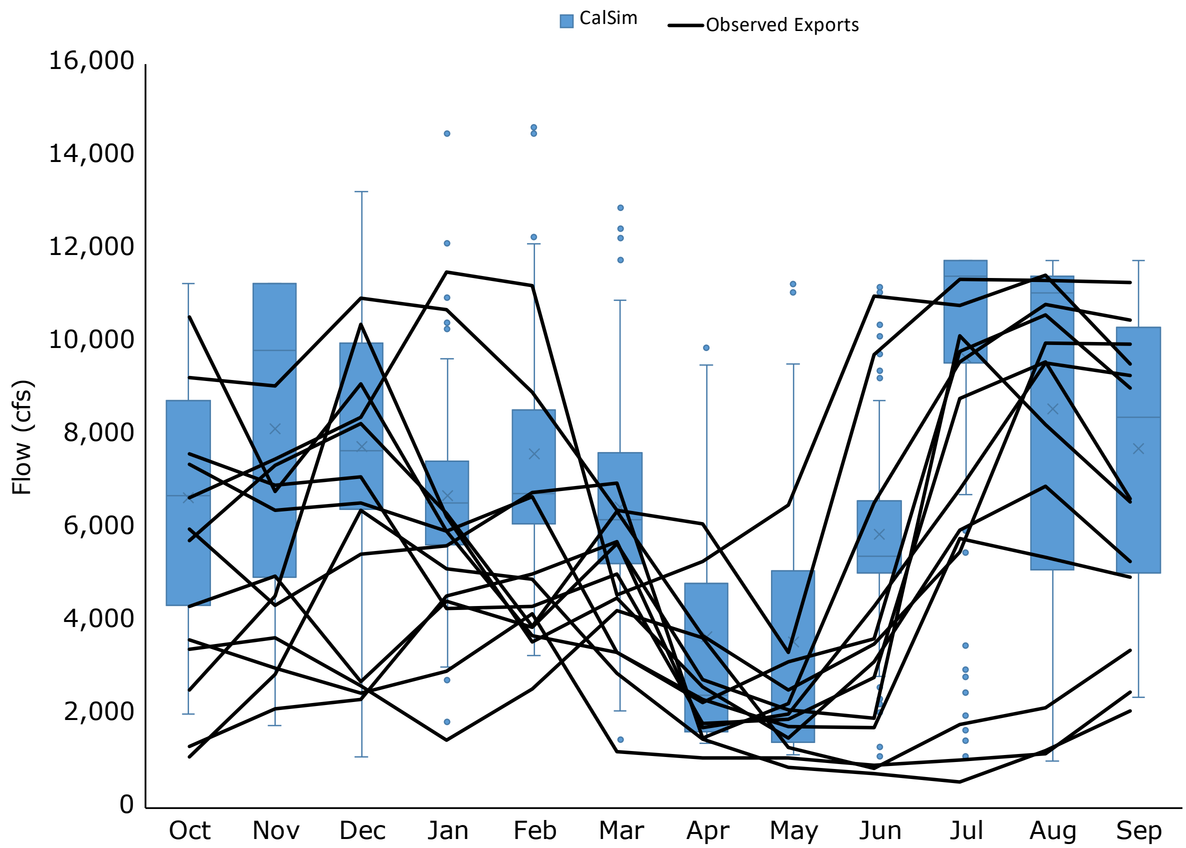


Figure 4-4. Total Delta Exports, Historical and Modeled Baseline Conditions

Figure 4-4 shows the flow, from 0 to 16,000 cfs, for the total Delta exports. Exports are depicted from October (left) to September (right). Observed exports are greatest from July to November and gradually decline from December to May. The CalSim 3 100-year model of the Baseline reflects a similar trend to the observed data.

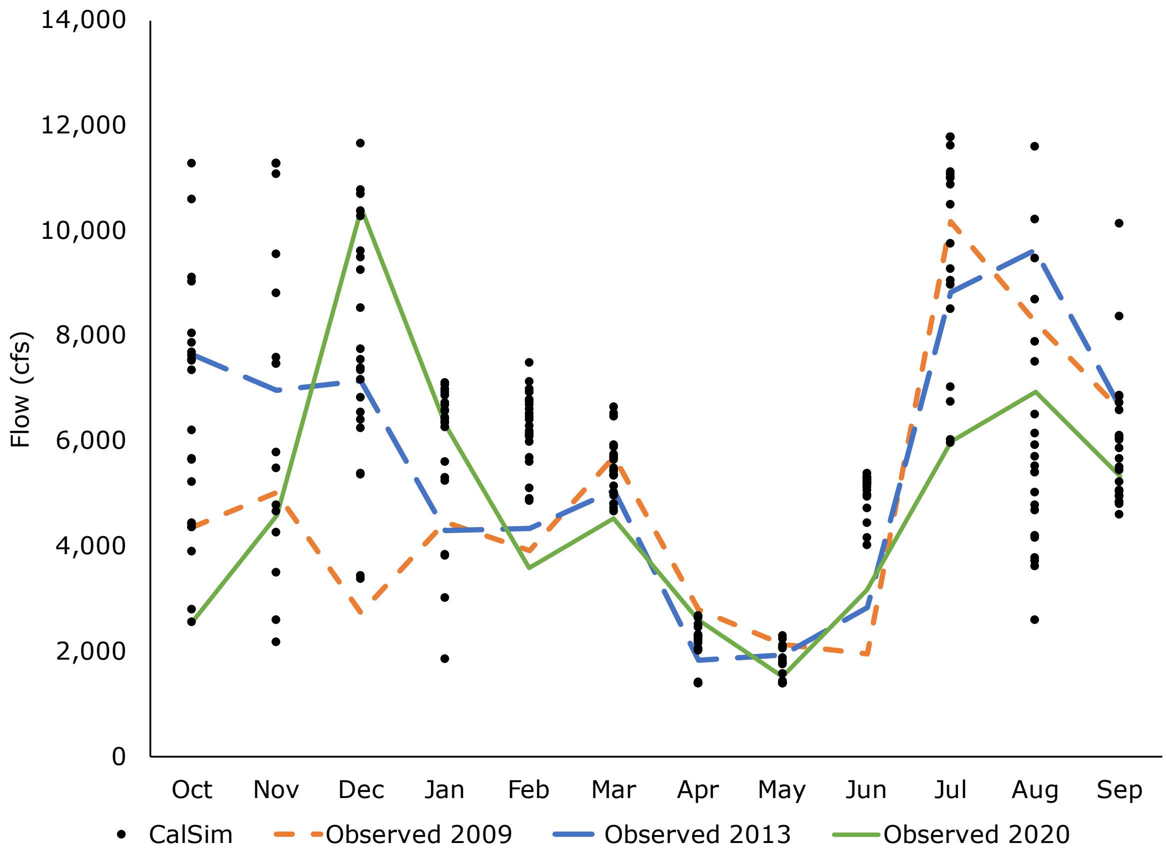


Figure 4-5. Total Delta Exports, Dry Year Historical and Modeled Baseline Conditions

Figure 4-5 shows the flow, from 0 to 14,000 cfs, for the total Delta exports during Dry water years for the years 2009, 2013, and 2020 compared to the CalSim 3 100-year model. Exports are depicted from October (left) to September (right). The highest exports were observed in July 2009, August 2013, and December 2020 all around 10,000 cfs. The lowest exports were observed in June 2009, April 2013, and May 2020. The CalSim 3 100-year model reflects a similar trend to the observed data.

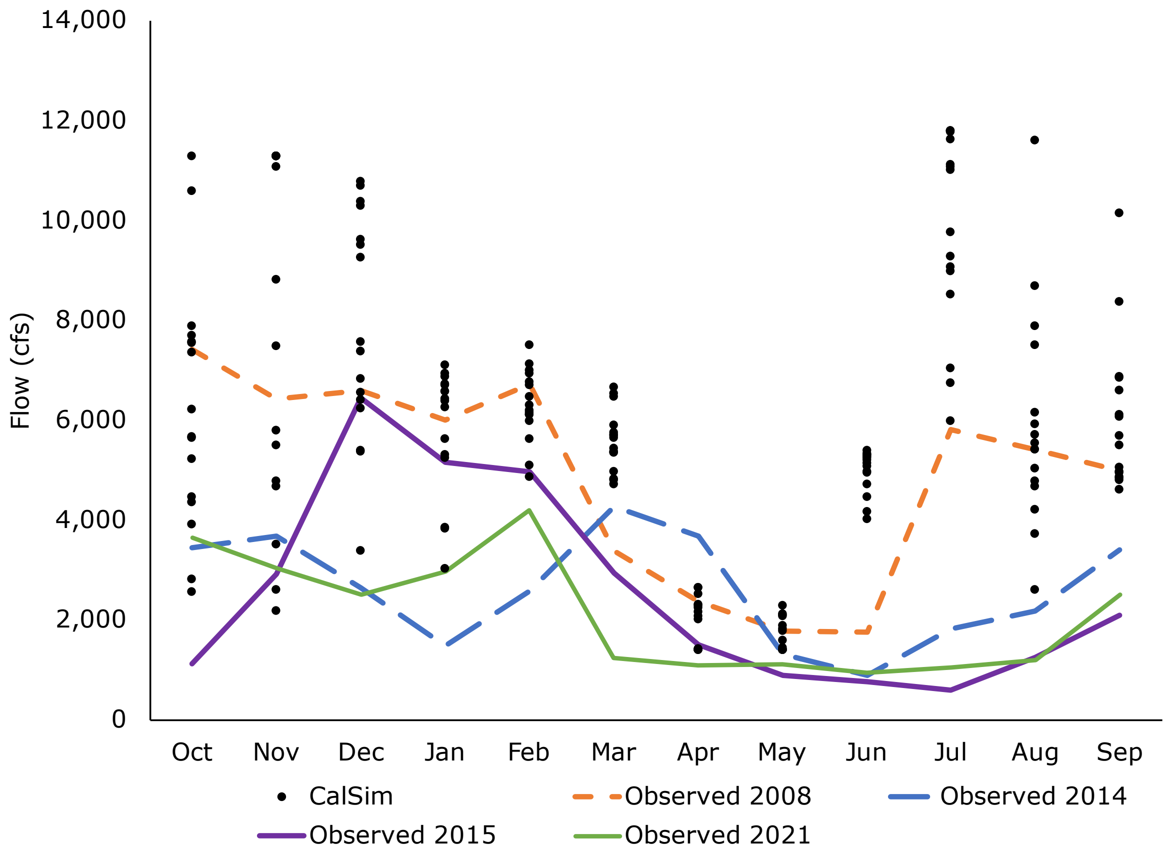


Figure 4-6. Total Delta Exports, Critical Year Historical and Modeled Baseline Conditions

Figure 4-6 shows the flow, from 0 to 14,000 cfs, for the total Delta exports during Critical water years for the years 2008, 2014, 2015, and 2021 compared to the CalSim 3 100-year model. Exports are depicted from October (left) to September (right). The highest exports were observed from July to February in 2008 and December 2015, from about 7,500 cfs to 5,500 cfs. The lowest exports were observed in April through August of 2014, 2015, and 2021, from about 2,500 cfs to 900 cfs. The CalSim 3 100-year model reflects a similar trend to the observed data but has several outliers predicting higher exports from July to December.

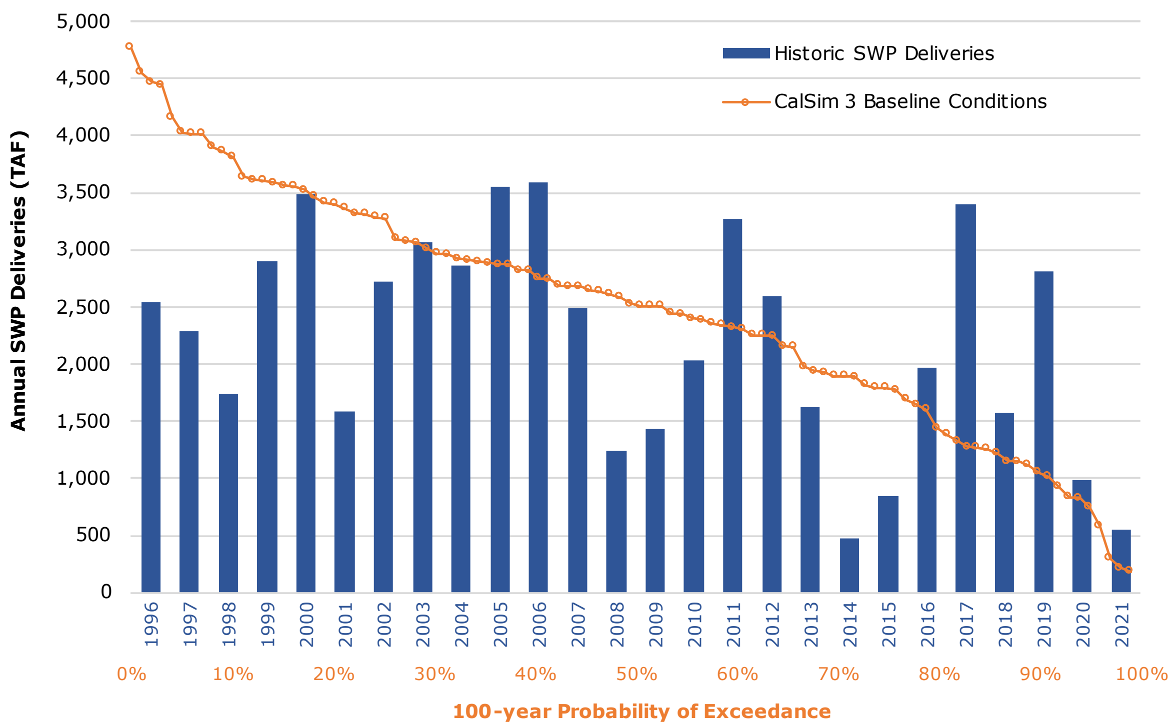
4.1.4 Water Supplies Used by State Water Project Water Users

The SWP water supplies are the only water supplies available to some water users, including communities served by the Antelope Valley–East Kern Water Agency. Other SWP water users rely on other surface water supplies and groundwater. However, when the SWP water supplies are limited because of lack of precipitation, the other surface water supplies are also limited.

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

In an effort to strengthen water supply reliability, water agencies have been making improvements to regional and local water supplies 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, including the recent Bay Area Regional Water Supply Reliability project, providing conveyance opportunities between several SWP water users in the San Francisco Bay Area.

Figure 4-7 shows the modeled Baseline Conditions and historical annual SWP deliveries. The probability of exceedance of the modeled annual SWP deliveries for the 100 years from the Baseline Conditions CalSim 3 simulation are plotted (orange line) along with the recent historical annual SWP deliveries (blue columns) in the figure. While CalSim 3 results cannot be compared to historical observed data, this figure shows that the CalSim 3 deliveries are representative of recent historic deliveries because modeled and observed are in the same range.



Recent historical deliveries are shown as blue columns for 1996 to 2021. Modeled deliveries are plotted as probability of exceedance curve (orange line) using the 100-year results. Historical deliveries for the years 1996–2008 are provided for reference; the Baseline Conditions CalSim 3 model is representative of the regulatory conditions in the years 2009 through 2021.

Figure 4-7. Annual Total SWP Deliveries, Historical and Modeled Baseline Conditions

4.2 Regulatory Setting

The Water Quality Control Plan (WQCP) for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary is a key regulation related to surface water flow in the potential environmental impact area. D-1641 of the WQCP obligates DWR and Reclamation to meet specific water quality and flow requirements. Flow requirements include standards for exports, real-time DCC operations, river flows, and Delta outflow. The impact analysis in this chapter considers the flow objectives in D-1641 of the Bay-Delta WQCP.

4.3 Comparison of the Proposed Project with the Baseline Conditions

This section describes the changes to hydrology associated with the Proposed Project compared to the Baseline Conditions.

The Proposed Project would modify baseline operations, 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 impacts on designated beneficial uses. Where applicable, estimated SWP contributions to hydrologic changes are provided. The approach and methodology for estimating SWP contributions to change are provided in Appendix 4A, “Model Assumptions.”

Discussions of the potential impacts on designated beneficial uses and other environmental resources are presented in separate sections, as appropriate. For example, estimated changes to Delta outflow could affect surface water quality or aquatic resources, which are further discussed in Chapter 5, “Surface Water Quality,” and Chapter 6, “Aquatic Biological Resources,” respectively. Therefore, the changes in Delta outflow are discussed in this section as part of the analysis of hydrology, while the potential influence of the change to Delta outflow on water quality or aquatic resources and associated habitat is presented in Chapters 5 and 6, respectively.

4.3.1 Thresholds of Significance

The thresholds of significance used for this comparison represent a refinement of the criteria in the California Environmental Quality Act (CEQA) Guidelines Appendix G, Section X, “Hydrology and Water Quality,” to make them more effective at evaluating the mechanisms that could lead to potentially significant environmental impacts based on the details of the Proposed Project. Based on Appendix G of the CEQA Guidelines, the Proposed Project would result in a potentially significant impact on surface water if any of the following occur:

- Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the Proposed Project may impede sustainable groundwater management of the basin.
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would:
- Result in substantial on- or off-site erosion or siltation on- or off-site

- Substantially increase the rate or amount of surface water in a manner that would result in flooding on- or off-site
- Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff
- Impede or redirect flood flows

4.3.2 Method of Analysis

Changes to surface water hydrology were modeled with CalSim 3. Details regarding the CalSim 3 model are provided in Appendix 4A, "Model Assumptions." Detailed modeling results using the CalSim 3 computer model for all water year types and long-term averages are provided in Appendix 4B, "Model Results."

4.3.3 Comparison of Sacramento River Flows into Delta, Delta Outflow, and OMR Flow

This section provides an overview of changes to surface water hydrology under the Proposed Project compared to the Baseline Conditions for Sacramento River at Freeport, Delta outflow, and OMR flow. As described in Sections 4.1.2 and 4.1.3, flows in the Delta are a result of coordinated SWP and CVP operations. While this discussion focuses on assessing potential changes in surface water hydrology under the Proposed Project (i.e., due to SWP operations), existing CVP operations must also be modeled with CalSim 3 to appropriately represent conditions in the Delta. Plots comparing changes to long-term average flow and descriptions for noteworthy monthly changes under various water year types at each of these locations are presented below.

4.3.3.1 Sacramento River at Freeport

As shown in Figure 4-8, CalSim 3 model results indicate that over the 100-year simulation period, Sacramento River inflow to the Delta under the Proposed Project would generally resemble inflow under the Baseline Conditions in all months.

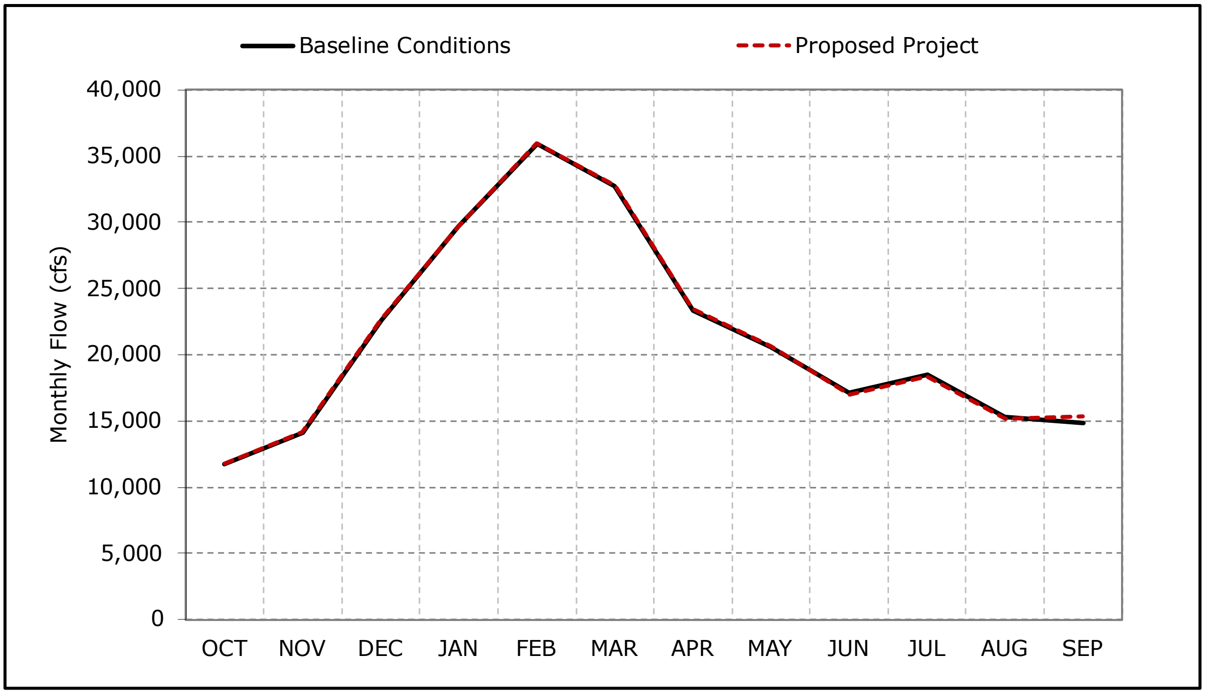


Figure 4-8. Sacramento River at Freeport, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project Operations

Figure 4-8 shows the flow, from 0 to 40,000 cfs, for Sacramento River inflow to the Delta under the Proposed Project compared to Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project generally resembles inflow under the Baseline Conditions in all months.

Proposed operations would increase Sacramento River flow in September in Wet and Above Normal water years by roughly 983 cfs (5 percent) and 1,714 cfs (9 percent), respectively. This increase in flow is due to the replacement of the 100 TAF block of water in the 2020 SWP Incidental Take Permit (ITP) Condition 8.19 with alternative protective actions, including updates to the Summer-Fall Habitat Actions, revised SMSCG operations, and additional Voluntary Agreement outflow commitments under the Proposed Project.

For SMSCG operation, the Baseline Conditions assumes a continuous 60- or 30-day operation of the SMSCG that is initiated in either June or July depending on salinity conditions the previous month. The purpose of the SMSCG operation is to pump fresher water from the Sacramento/San Joaquin confluence into Suisun Marsh, which tends to make the confluence incrementally more saline. The CalSim 3 model compensates for this increase in salinity at the confluence by increasing the outflow through increased releases or reduced exports and results in a water cost associated with the operation. The Proposed Project has a similar initiation of SMSCG.

The 100-TAF block of water that would be managed adaptively in the 2020 SWP ITP required generalized assumptions for the CalSim modeling (i.e., the Baseline Conditions). As such, the CalSim modeling assumed that at least 20 TAF would be added to outflow in August of Wet and Above Normal years, with the remainder, 80 TAF, backed into Oroville for actions in the following year, unless storage conditions indicated an increased risk of spill, in which case that remainder water was added to outflow as well. This block of water is not included in the Proposed Project, allowing greater end-of-August storage at Oroville to be followed by increased releases from Oroville in September of Wet and Above Normal years. As part of the transition from the Baseline Conditions to the Proposed Project, DWR has committed to a one-time release of a block of water during the summer–fall period for Delta Smelt habitat in 2025 if it is not deployed in 2024, except if 2025 is a Critical water year. The modeling does not include this action because it would only occur once. As a result, Sacramento River flow at Freeport under the Proposed Project may be slightly higher than the modeled values during the summer–fall of 2025.

In Below Normal, Dry, and Critical water years, Sacramento River flow under the Proposed Project will remain similar to the flow under the Baseline Conditions. Based on the changes described above, the Proposed Project would not result in an increase to the frequency of reverse flow conditions on the Sacramento River near Freeport compared to the Baseline Conditions.

Based on these modeled differences in surface water flow for the Sacramento River at Freeport, the Proposed Project would not substantially affect surface water resources at this location relative to the Baseline Conditions.

4.3.3.2 Delta Outflow

Under the Proposed Project, Delta outflow would remain similar in all months other than August. Delta outflow long-term average monthly flow patterns under the Baseline Conditions and the Proposed Project over the 100-year simulation period are shown in Figure 4-9.

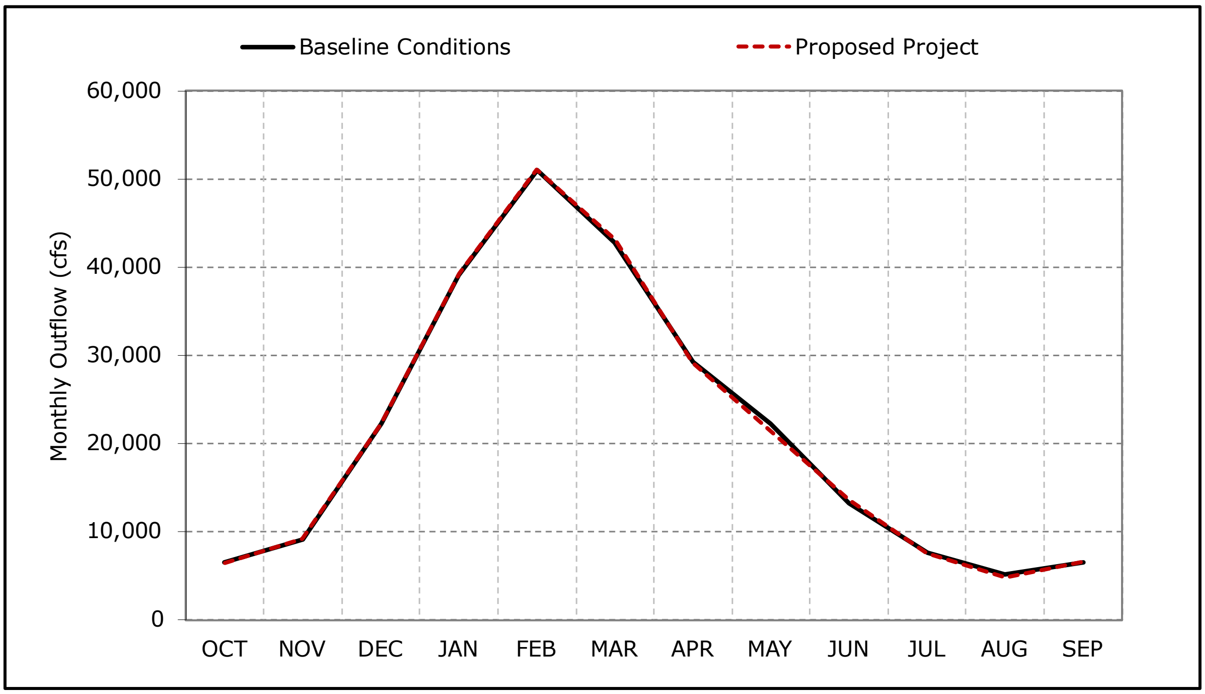


Figure 4-9. Delta Outflow, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project Operations

Figure 4-9 shows the flow, from 0 to 60,000 cfs, for Delta outflow under the Proposed Project compared to the Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project would remain similar to outflow under the Baseline Conditions in all months.

With the Proposed Project, Delta outflow would be reduced in August for non-critical water years when compared to the Baseline Conditions. Delta outflow would be reduced in this month because export patterns and reservoir releases would change under the Proposed Project. This change is due to the replacement of the 100-TAF block of water in the 2020 SWP ITP Condition 8.19 with alternative protective actions referenced in Section 4.3.3.1, "Sacramento River at Freeport." As noted in the prior section, the CalSim 3 model assumes this action occurs in August. As such, in Wet, Above Normal, Below Normal, and Dry years, Delta outflow decreases by up to 776 cfs (12 percent) in August under the Proposed Project with the replacement of this action. The large relative change in August is primarily due to the low flow conditions in the Baseline Conditions. It is important to note that Delta outflow may be slightly higher than modeled values under the Proposed Project during some portion of the summer–fall of 2025 (during the transition from the Baseline Conditions to the Proposed Project) if 2025 is not a Critical water year. In Below Normal water years, Delta outflow under the Proposed Project would decrease by 1,084 cfs (6 percent) in May. This decrease in Delta outflow is due to the OMR actions highlighted in the following section. In Above Normal water years, Delta outflow increases by 817 cfs (8 percent) in September due to additional storage being available in this month.

Based on these modeled differences in Delta outflow, the Proposed Project would not substantially affect surface water resources relative to the Baseline Conditions.

4.3.3.3 Old and Middle River Flow

Long-term average monthly OMR flow would be negative in all months because of south Delta CVP and SWP pumping operations over the 100-year simulation period, as shown in Figure 4-10. For the descriptions of changes in OMR flow under the Proposed Project, increases and decreases are highlighted with respect to absolute changes in magnitude. For example, a change to a more negative OMR flow is described as a relative increase in the magnitude of the flow. As OMR flow in certain water years may be near zero, switch from positive to negative, or vice-versa, relative changes to this action may be misleading. Therefore, all changes to OMR flow are described as absolute changes between the Proposed Project and the Baseline Conditions.

The Longfin Smelt (*Spirinchus thaleichthys*) entrainment protections described in the 2020 SWP ITP are not explicitly modeled in the Baseline Conditions. These entrainment protections are assumed to be covered by the OMR actions for winter-run Chinook Salmon (*Oncorhynchus tshawytscha*) and Central Valley steelhead (*Oncorhynchus mykiss*) because they share the same OMR flow requirement during the same season under the Baseline Conditions. Additional protections, specific to the Longfin Smelt, are based on coordination between DWR and the California Department of Fish and Wildlife. They do not have explicit triggers and flow requirements that could be incorporated into an operational model. Therefore, OMR flow may be lower (i.e., less negative) and Delta exports may be lower in the Baseline Conditions than the modeled values during the winter and spring months. However, the Longfin Smelt entrainment protections only apply to SWP exports. As such, it is uncertain if and how much OMR flow and Delta exports may decrease under the Baseline Conditions.

With the Proposed Project, the long-term average monthly OMR flow, as modeled, would increase in April, May, and September and decrease in January, February, March, and June. Mean monthly long-term average flow increases of up to 787 cfs are modeled in May, with decreases of up to 328 cfs in June. As the OMR flow is affected by SWP and CVP exports from the Delta, the SWP proportion of changes to OMR are calculated. The SWP proportion (i.e., the ratio of SWP Banks Pumping Plant exports to total exports) of changes to long-term average monthly OMR flow may range between 38 and 100 percent, depending on the months highlighted above. The approach for estimating the SWP proportion to changes in OMR flow and monthly proportion to changes for each water year type as well as long-term average are detailed in Appendix 4A, "Model Assumptions."

In Wet water years, OMR flow would increase by 106 cfs in March, 187 cfs in April, 1,275 cfs in May, and 1,033 cfs in September when compared to OMR flow under the Baseline Conditions. In March, April, and May of Wet water years, increases in flow under the Proposed Project are the result of high flow offramps in the Delta Smelt (*Hypomesus transpacificus*) OMR actions, revisions to the protective fish actions, as well as the addition of winter-run Chinook Salmon and steelhead weekly loss thresholds to the Proposed Project. In addition to changes in OMR management, the replacement of the export curtailments for spring maintenance flows from the Baseline Conditions with the Spring Delta Outflow Action in the Proposed Project also plays a role in these increasing flows. September increases in OMR flow may be attributed to the replacement of the 100 TAF block of water in the 2020 SWP ITP Condition 8.19 with alternative protective actions under the Proposed Project. OMR flow would decrease by 189 cfs in January and 248 cfs in June under the Proposed Project. The extension of existing and additional species-specific protections under the Proposed Project can be attributed to these decreases in OMR flow. The SWP proportion of OMR changes may range between 39 and 100 percent, depending on the months highlighted for Wet water years.

In Above Normal, Below Normal, and Dry water years, OMR flow would increase by up to 577 cfs in April and 1,032 cfs in May under the Proposed Project. In April and May of Above Normal and Below Normal water years, OMR changes under the Proposed Project are primarily the result of the revisions and additions to the OMR management protective fish actions. In April and May of Above Normal, Below Normal, and Dry water years, changes in OMR flow are also largely driven by the Spring Delta Outflow Action under the Proposed Project. In Above Normal water years, OMR flow would also increase by 827 cfs in September compared to flows under the Baseline Conditions for the same reason described for Wet water years.

OMR flow decreases of up to 561 cfs in February, 576 cfs in March, and 465 cfs in June would occur in Above Normal, Below Normal, and Dry water years under the Proposed Project. For February, March, and June, decreases in OMR flow occur as a result of the revisions and additions to the OMR management protective fish actions. In March of these water year types, the replacement of the export curtailments for spring maintenance flows from the Baseline Conditions with the Spring Delta Outflow Action in the Proposed Project contributes to the decrease in flows. The additional triggering of actions under these changes results in an overall decrease in OMR flow during these months for these water year types. The SWP proportion of OMR changes under the Proposed Project may range from 33 to 100 percent, depending on the months highlighted for Above Normal, Below Normal, and Dry water years.

In Critical water years, OMR flow would increase by 122 cfs in April and 229 cfs in May. Conversely, OMR flow would decrease by 408 cfs in January with the Proposed Project. Changes that occur during these months can be attributed to the revisions and additions to the OMR management protective fish actions under the Proposed Project, with increases in flow resulting from a decrease in actions being triggered and vice versa. The SWP proportion of OMR changes under the Proposed Project may range from 59 to 100 percent, depending on the months highlighted for Critical water years.

Based on these modeled differences in surface water flow for the Old and Middle rivers, the Proposed Project would not substantially affect surface water resources at this location relative to the Baseline Conditions.

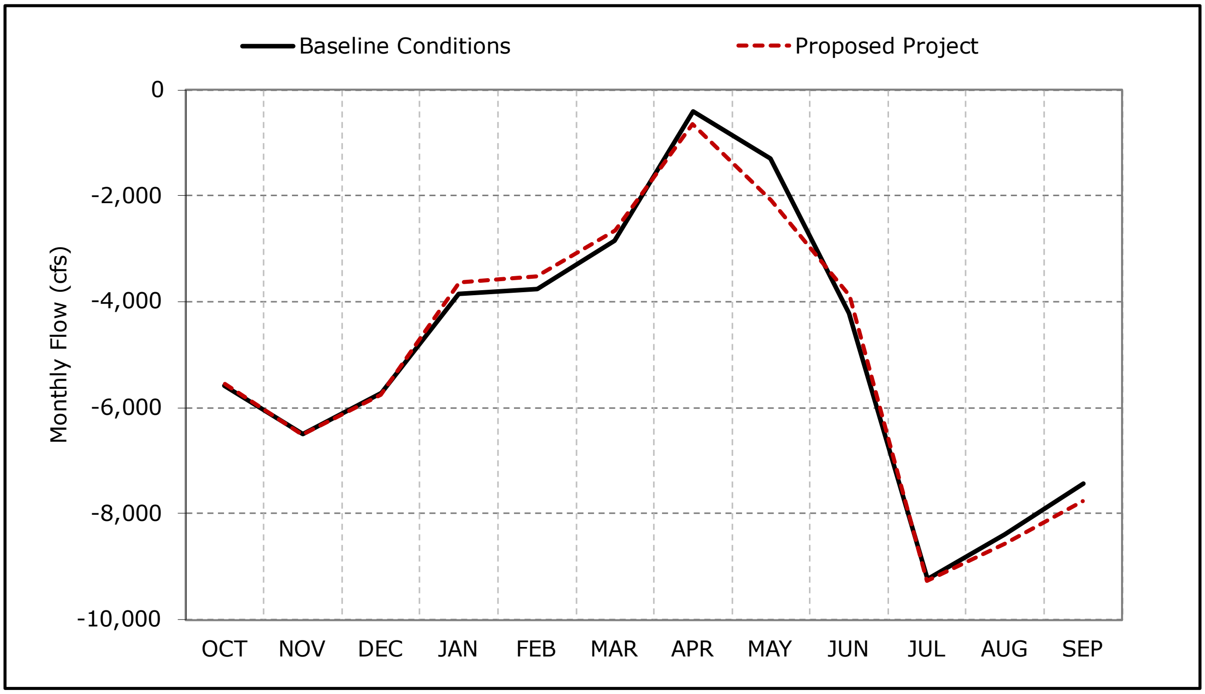


Figure 4-10. Old and Middle River Flow, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project Operations

Figure 4-10 shows the flow, from -10,000 cfs to 0 cfs, for OMR flow under the Proposed Project compared to the Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project would generally remain similar to outflow under the Baseline Conditions in all months with slight deviations in February, May, and September.

4.3.3.4 CEQA Conclusion

Based on the analysis above, surface water hydrology would remain within the range of historical operations under the proposed long-term operation of the SWP. Groundwater supplies, including groundwater recharge potential, under the Proposed Project would also remain within the range of historical conditions. Furthermore, the proposed long-term operation of the SWP would not include construction of new or modification of existing SWP facilities. As such, the Proposed Project would not alter existing drainage or river courses, create additional impervious surfaces that would induce or accelerate erosion or siltation, increase the rate or amount of surface runoff that subsequently would result in flooding, exceed the capacity of existing or planned stormwater systems or substantial sources of polluted runoff, or alter or impede the existing conveyance of flood flows. No impact would occur.

4.3.3.5 Mitigation

None required.

4.3.4 Comparison of SWP Banks Pumping Plant Exports

SWP Banks Pumping Plant monthly export patterns under the Baseline Conditions and the Proposed Project over the 100-year simulation period are shown in Figure 4-11. Changes to exports between December and June coincide with the changes presented in Section 4.3.3.3, "Old and Middle River Flow." Increases in exports in August and September can be attributed to the replacement of the 100 TAF block of water in the 2020 SWP ITP Condition 8.19 with alternative protective actions. With the Proposed Project, SWP south Delta long-term average exports at Banks Pumping Plant would potentially increase by 17 TAF (18 percent) in April, 49 TAF (59 percent) in May, and 24 TAF (11 percent) in September. A potential pumping decrease of 13 TAF (6 percent) in March and 8 TAF (6 percent) in June would occur with the Proposed Project.

In Wet and Above Normal water years, the SWP Banks Pumping Plant exports under the Proposed Project would potentially increase by up to 47 TAF (100 percent) in April, 78 TAF (49 percent) in May, and 66 TAF (20 percent) in September. In Above Normal water years, SWP Banks Pumping Plant exports would potentially decrease by 20 TAF (9 percent) in February, 27 TAF (13 percent) in March, and 13 TAF (8 percent) in June compared to exports under the Baseline Conditions.

In Below Normal and Dry water years, SWP Banks Pumping Plant exports under the Proposed Project would potentially increase by 29 TAF (61 percent) in April and 61 TAF (109 percent) in May. Exports would potentially decrease by up to 12 TAF (5 percent) in December (Dry water years only), 14 TAF (10 percent) in February, 40 TAF (22 percent) in March, and 10 TAF (9 percent) in June.

In Critical water years, SWP Banks Pumping Plant exports would potentially increase by 9 TAF (21 percent) in April, 15 TAF (41 percent) in May, and 1 TAF (7 percent) in August compared to exports under the Baseline Conditions. Exports would potentially decrease by 16 TAF (10 percent) in January, 8 TAF (5 percent) in February, 5 TAF (11 percent) in June, and 3 TAF (8 percent) in July. Additional details are provided in Appendix 4B, "Model Results."

Over the long-term, average modeled annual SWP Banks Pumping Plant pumping is increasing by about 57 TAF (2 percent) under the Proposed Project compared to the Baseline Conditions. Based on the modeled differences for SWP Banks Pumping Plant, the Proposed Project would not substantially affect surface water resources at this location relative to the Baseline Conditions.

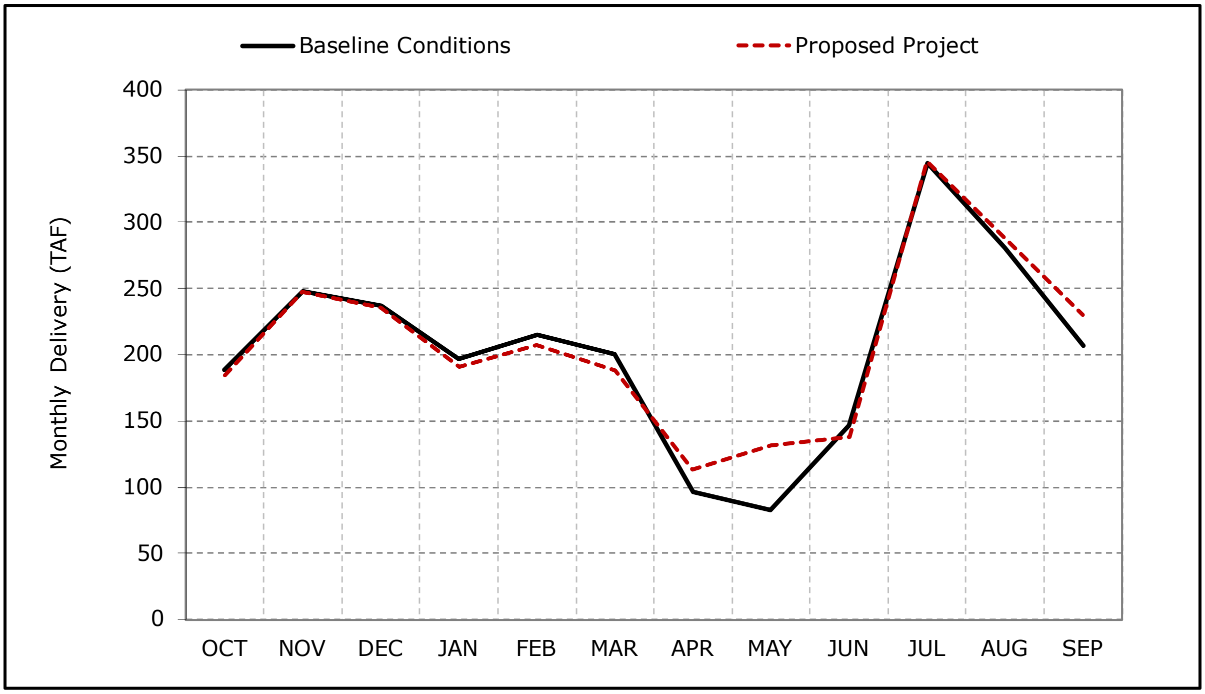


Figure 4-11. SWP Banks Pumping Plant Exports, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project Operations

Figure 4-11 shows monthly delivery rates, from 0 TAF to 400 TAF, for SWP Banks Pumping Plant under the Proposed Project compared to the Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project would generally remain similar to monthly delivery amounts under the Baseline Conditions in all months with the largest increase from baseline in April and May.

4.3.4.1 CEQA Conclusion

Based on the analysis above, surface water hydrology would remain within the range of historical operations under the proposed long-term operation of the SWP. Groundwater supplies, including groundwater recharge potential, under the Proposed Project would also remain within the range of historical conditions. Furthermore, the proposed long-term operation of the SWP would not include construction of new or modification of existing SWP facilities. As such, the Proposed Project would not alter existing drainage or river courses, create additional impervious surfaces that would induce or accelerate erosion or siltation, increase the rate or amount of surface runoff that subsequently would result in flooding, exceed the capacity of existing or planned stormwater systems or substantial sources of polluted runoff, or alter or impede the existing conveyance of flood flows. No impact would occur.

4.3.4.2 Mitigation

None required.