# Technical Appendix D: Assessment of Water Unavailability Issues Within the Legal Delta

This appendix provides additional background information used to evaluate water unavailability in the Legal Delta portion of the Sacramento-San Joaquin Delta (Delta) Watershed.

The most recent version of this appendix was dated June 27, 2002. With this update, no substantive changes have been made, but additional potential refinements to this appendix are planned for early 2023 following a workshop and comment period to receive public input.

## Introduction

The evaluation of water unavailability for diversion in the Legal Delta is complex due to a number of factors, including (1) the considerations of tidal influence on freshwater residence time and location in the Legal Delta and on water quality (e.g., its suitability for agricultural use), (2) the operations of the State Water Project (SWP) and Central Valley Project (CVP) (collectively the Projects) that release previously stored water from upstream reservoirs for use upstream and in the Legal Delta, over which water they retain claim and control for various beneficial uses, and (3) depletions of water in the Legal Delta due to evaporation from open water and transpiration of aquatic, riparian, and irrigated vegetation, which there are challenges measuring and estimating.

Notwithstanding the inherent challenges of administering the water rights system within those complex circumstances, the Division of Water Rights (Division) has continued to seek and accept input on how to refine the Water Unavailability Methodology for the Delta Watershed (Methodology) and to apply the Methodology within the Legal Delta. Those efforts to refine and fairly apply the Methodology will continue, as authorized under the drought emergency regulations currently in place.

In evaluating valuable critiques of the Methodology, the State Water Resources Control Board (State Water Board or Board) recognizes that not all challenges in application can be resolved based on currently available data. The State Water Board is also continuing to support long-term initiatives to improve Legal Delta water use data to address lingering drought response challenges. Under current circumstances of persistent drought within the Delta watershed, however, this appendix is appropriate to support implementation of the drought emergency regulations.

Since the beginning of June 2022, the Projects have been required to release previously stored water to meet water quality objectives in the Legal Delta. Those storage releases were necessary through until early December 2022 to maintain water quality in the Delta as required by State Water Board Decision 1641 (D-1641). Thus, it is vital to protect such storage releases from unlawful, unreasonable, or out-of-priority diversions that would interfere with protecting water quality in the Delta. The Methodology supported significantly deeper curtailments within the Delta watershed starting in July of 2022 and extending through the remainder of the dry season, not only to protect water quality but also to fairly administer the water rights priority system.

The Methodology accounts only for freshwater natural flows from the Sacramento and San Joaquin watersheds as part of the considered supplies and excludes any water supplies from tidal inflows to the Delta. The reason for that exclusion, which has been challenged by numerous comments, is that saline water entering the Delta from the San Francisco Bay via tidal action is assumed to be of insufficient quality to be usable for agricultural or municipal purposes.

The June 27, 2022 version of this appendix was updated from earlier versions in the following ways: (1) the Legal Delta consumptive use estimates were updated to be consistent with the demands in the Methodology, including consistent return flow assumptions; (2) the natural and abandoned Legal Delta inflow were updated to include forecasted data consistent with the information in the Methodology; and (3) other observed conditions were updated to reflect conditions in 2022 where available. Although the drought emergency regulation allows for further refinement to the Methodology and, potentially, consistent refinements to this technical appendix, this revision continues to support use of the Methodology to address the continuing drought.

On July 14, 2022, the Office of the Delta Watermaster convened a meeting among parties who have offered both critiques of this appendix and suggestions for further refinements to discuss implementation strategies that respond to the current drought and protect Delta water quality. On July 20, 2022, the State Water Board approved the revision and renewal of the Emergency Curtailment Regulation to Protect Water Supplies in the Sacramento-San Joaquin Delta Watershed. On August 12, 2022, the Office of Administrative Law approved the regulation, which became effective upon filing with the Secretary of State on the same day. The regulation incorporates by reference the Water Unavailability Methodology for the Delta Watershed report dated June 27, 2002, including Technical Appendix D, and authorizes the use of the Methodology described in that report, or comparable tools, to evaluate water unavailability in the Delta watershed for purposes of curtailments.

# Appropriate Use of Hydrodynamic Models

Hydrodynamic models may provide useful insights into the complex movement of water within the Legal Delta when appropriately applied and validated. However, hydrodynamic models do not provide a sufficient answer to the basic mass balance problem of water unavailability for diversion. Hydrodynamic models such as the Department of Water Resources (DWR) Delta Simulation Model II (DSM2) may provide fingerprinting results showing that some water diverted in the Legal Delta entered the Legal Delta months prior; however, these results do not provide useful guidance on when water is available or not available for users to divert, which must be informed by mass balance accounting. Additionally, it is not feasible to complete hydrodynamic model simulations for every update of the forecasted hydrology and analyze the results for each of the thousands of water rights and specific points of diversion in the Legal Delta.

# Residence Time

Simple flow volumes and estimates of residence times based on inflow that are applied broadly to the Legal Delta also may not provide a sufficient answer to inform determinations regarding water unavailability because they do not account for mixing from tidal action and consumptive water use within the Legal Delta. Mixing of water, particularly in Suisun Bay, makes the mixed water from that source too salty for beneficial use far earlier than simple residence times and fingerprinting may suggest because they may not correctly consider the effects of even small volumes of very saline water. For example, half of the water at a particular location could come from water that entered from the Sacramento River spanning several months, but if the other half came from Suisun Bay, with an electrical conductivity (EC) of 20,000 microsiemens per centimeter (µs/cm), the water would have an EC of just over 10,000 µs/cm and would be unusable for almost all purposes.

Fortunately, bathymetry data available as a result of recent improvements in digital elevation models (USGS 2017) can be used to better understand the effects of extremely low Delta outflow on water unavailability and water quality in the Legal Delta. To improve hydrodynamic models in the Delta, the U.S. Geological Survey (USGS) and Inter-Agency Ecological Program (IEP) sponsored the development of a 10-meter horizontal grid of bathymetry in the Legal Delta region (USGS 2007). The survey determined the volume and area for the various regions of the Legal Delta shown in Figure 1 below.

**Figure 1. Map of Legal Delta Regions and Suisun Bay (USGS 2007), with D-1641 Delta Outflow Compliance Locations (red), Relevant CDEC Gages (blue), and Other Points of Interest Added**

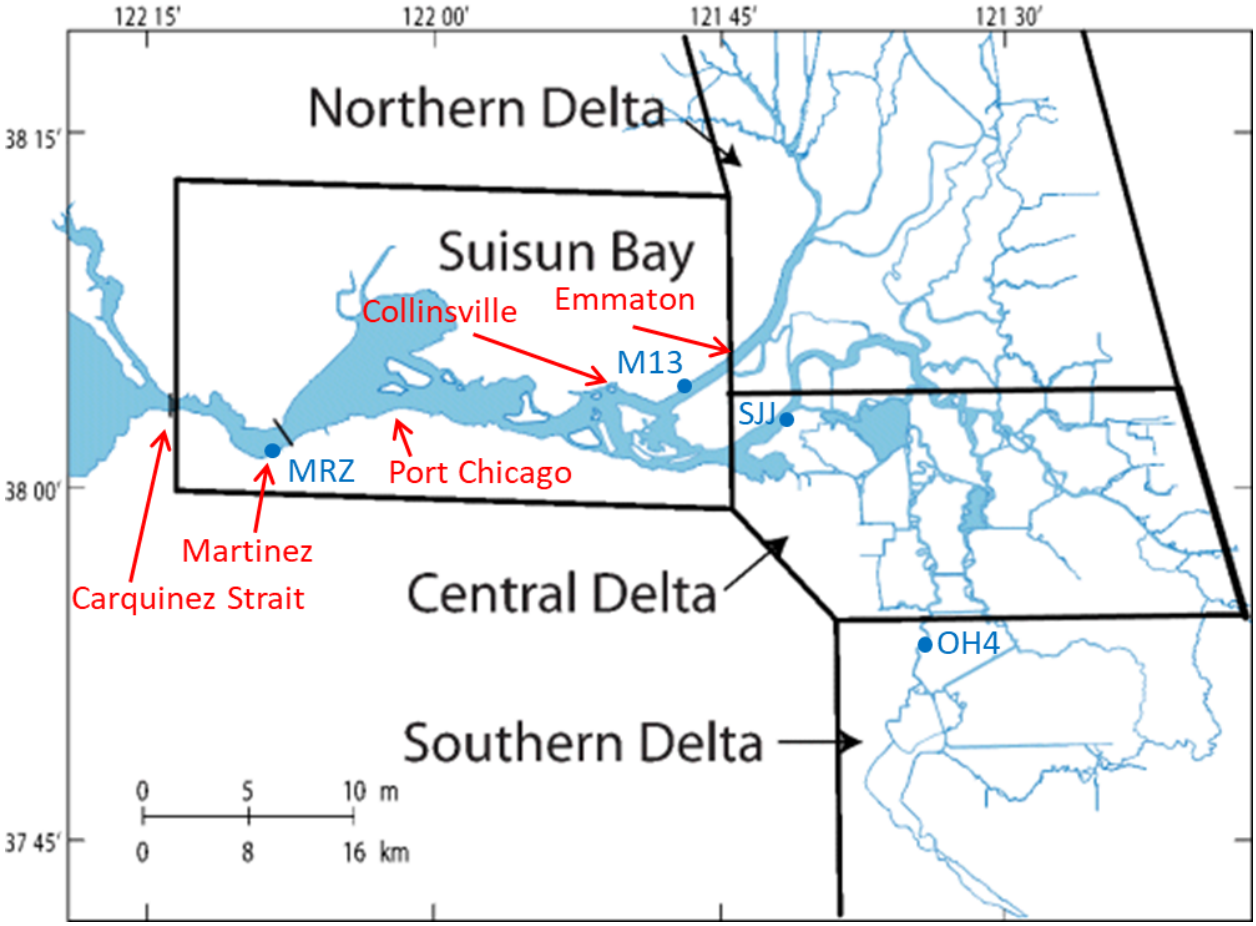



Table 1 contains the summary areas and volumes from the USGS report, with a conversion to volumes in thousand acre-feet (TAF). Table 1 also contains tidal flux volumes based on variable tidal ranges for the four regions from California Data Exchange Center (CDEC) river stage gages for July 2021. The tidal variation is greatest to the west in Suisun Bay and decreases in the Northern, Central, and Southern regions of the Legal Delta.

**Table 1. Legal Delta and Suisun Bay Channel Volumes and Tidal Flux**

| **Region** | **Water Surface Area** (million meters$^2$) | **Volume** (million meters$^3$) | **Water Surface Area** (acres) | **Volume** (TAF) | **Tidal Range** (feet) | **Tidal Flux*** (TAF/day) | **Tidal Mixing Time**** (days) |
|---|---|---|---|---|---|---|---|
| Suisun Bay | 165 | 954 | 40,772 | 773 | 3.6 | 297 | 2.6 |
| Northern Delta | 74 | 407 | 18,286 | 330 | 2.9 | 108 | 3.1 |
| Central Delta | 66 | 267 | 16,309 | 216 | 2.4 | 78 | 2.8 |
| Southern Delta | 10 | 28 | 2,471 | 23 | 2.4 | 12 | 2.0 |
| ***Total*** | ***316*** | ***1,656*** | ***78,085*** | ***1,343*** | | ***494*** | ***2.7*** |
| ***Total without Suisun Bay*** | ***150*** | ***702*** | ***37,066*** | ***569*** | | ***197*** | ***2.9*** |
| Areas and volumes from USGS (2007). | | | | | | | |
| Tidal ranges from CDEC river stage data for gages MRZ, M13, SJJ, and OH4 (see Figure 1): https://cdec.water.ca.gov/dynamicapp/wsSensorData | | | | | | | |

*Tidal flux is the volume of water exchanged each day, which is calculated by multiplying water surface area by the tidal range multiplied by the frequency (i.e., twice per day).
**The tidal mixing time is calculated by dividing the channel volume by the tidal flux.

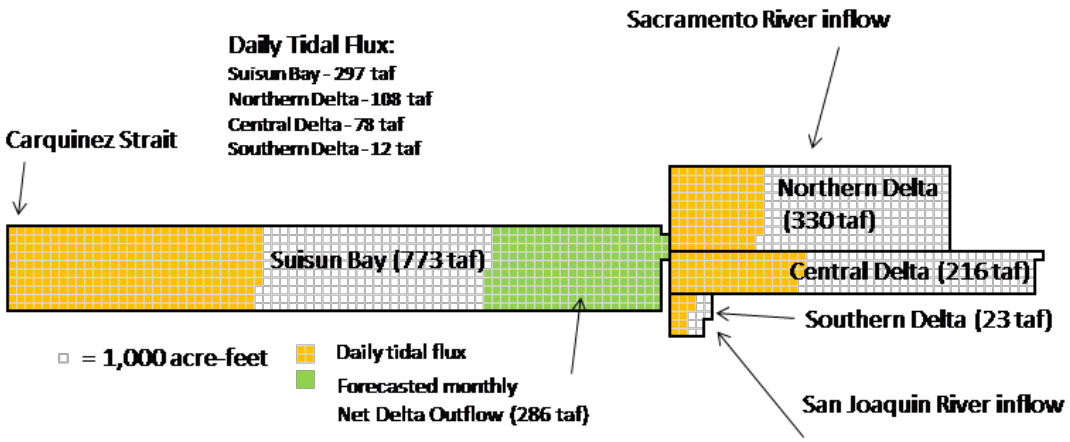
The Stockton and Sacramento Deep Water Ship Channels were deepened and widened for navigation, altering Delta hydrodynamics by increasing tidal flow volumes and therefore increasing seawater dispersion into the Delta (CCWD 2010). These large channels, not present in the early part of the century, are part of the reason that channel volumes are so much bigger in the Northern and Central Delta than the Southern Delta.

Table 1 may suggest, based on volume alone, that a pool of water in Suisun Bay and the Delta could provide a prolonged water supply in the Legal Delta. However, Table 1 also shows that an amount of water equal to the entire volume of Suisun Bay is exchanged by the tides over less than three days. Similarly, in each of the Legal Delta regions an amount of water greater than the total channel volume is exchanged by the tides every three days (less than two days in the Southern Delta). The large tidal influence greatly reduces the residence time of fresh water in the Legal Delta and the mixing has a large effect on the water quality (as discussed in the next section).

Figure 2 shows the four regions of the Legal Delta scaled according to their channel volumes. Superimposed on the graphic are scaled representation of each region's tidal flux and U.S. Bureau of Reclamation (Reclamation) forecasted net Delta outflow to Suisun Bay in July 2022 to maintain water quality; it is this positive net outflow that inhibits saltwater from flowing into the Delta. This schematic shows how large the daily tidal flux is in comparison to the volume of the regions of the Legal Delta. For example, the daily tidal flux in the Southern Delta is equal to approximately half its channel volume. Figure 2 makes three things visually clear:

1. The diurnal ebb and flow of the tides is overwhelmingly larger than the net freshwater outflow,
2. The tidal flux is significantly larger than the total volume of water in Suisun Bay and regions of the Legal Delta, and
3. The volume of water in Southern Delta channels is modest compared to the volume of water in Suisun Bay and other regions of the Legal Delta.

**Figure 2. Schematic of Suisun Bay and Legal Delta Regions with Scaled Channel Volumes, Daily Tidal Flux, and Forecasted Net Delta Monthly Outflow, July 2022**




Irrigated, riparian, and aquatic vegetation consumes a large volume of water from Delta channels. Consumptive use of water applied to crops in the Legal Delta can be estimated using the 2018 reports of diversion and use filed by diverters in the Legal Delta, as represented by demand data in the Methodology. To account for return flows, a reduction factor based on CalSim 3 results has been applied to demands throughout the Delta watershed (see Section 2.2.11 of the Methodology report). Legal Delta reported diversions in 2018 are summarized in Table 2 below. Table 2 shows that demand for consumptive water use in the Southern Delta is very large, especially in comparison to the corresponding channel volumes in Table 1.

**Table 2. Demand for Consumptive Use Distributed by Legal Delta Region, May-October 2022**

| **2018 Demand** (TAF) | **Suisun Bay** (TAF) | **Northern Delta** (TAF) | **Central Delta** (TAF) | **Southern Delta** (TAF) | ***TOTAL*** *(TAF)* |
|---|---|---|---|---|---|
| May | 1 | 75 | 36 | 59 | *171* |
| June | 0 | 121 | 56 | 81 | *258* |
| July | 0 | 142 | 63 | 83 | *288* |
| August | 0 | 109 | 46 | 63 | *218* |
| September | 0 | 74 | 24 | 40 | *138* |
| October | 0 | 44 | 16 | 16 | *76* |

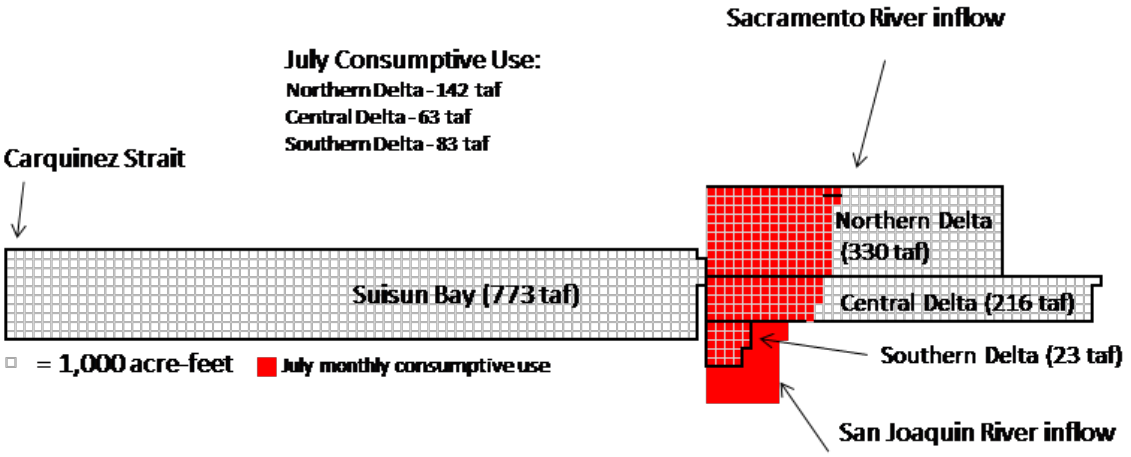
Monthly water demands within each Legal Delta region are shown as a percent of channel volume in Table 3 below. Table 3 shows that demand for consumptive water use in the Southern Delta is more than three times (360%) the volume of water in the Southern Delta channels in the months of June and July and just under that in May and August. Therefore, without considering the twice daily tidal flux discussed above, and without considering diversions by the Projects from Clifton Court Forebay and the Jones Pumping Plant, there are three full exchanges of water in the Southern Delta that are attributable to consumptive use if no diversions are curtailed. Without considering tidal flux, the total volume of water in the Southern Delta channels would be consumed in about 10 days throughout May, June, July, and August.

**Table 3. Monthly Depletions as a Percent of Channel Volume, May-October 2022**

| **Month** | **Reported Total Delta Demand for Consumptive Use** (TAF) | **Northern Delta** | **Central Delta** | **Southern Delta** |
|---|---|---|---|---|
| May | 171 | 23% | 17% | 257% |
| June | 258 | 37% | 26% | 351% |
| July | 288 | 43% | 29% | 360% |
| August | 218 | 33% | 21% | 273% |
| September | 138 | 22% | 11% | 175% |
| October | 76 | 13% | 7% | 68% |

Figure 3 shows the July consumptive use from Table 3 for different regions of the Legal Delta in relation to their channel volumes. Figure 3 clearly shows how the volume of consumptive use in the Southern Delta greatly exceeds the volume of water that can be stored in Southern Delta channels.

**Figure 3. Schematic of Suisun Bay and Legal Delta Regions with Scaled Channel Volumes and Consumptive Use, July 2022**

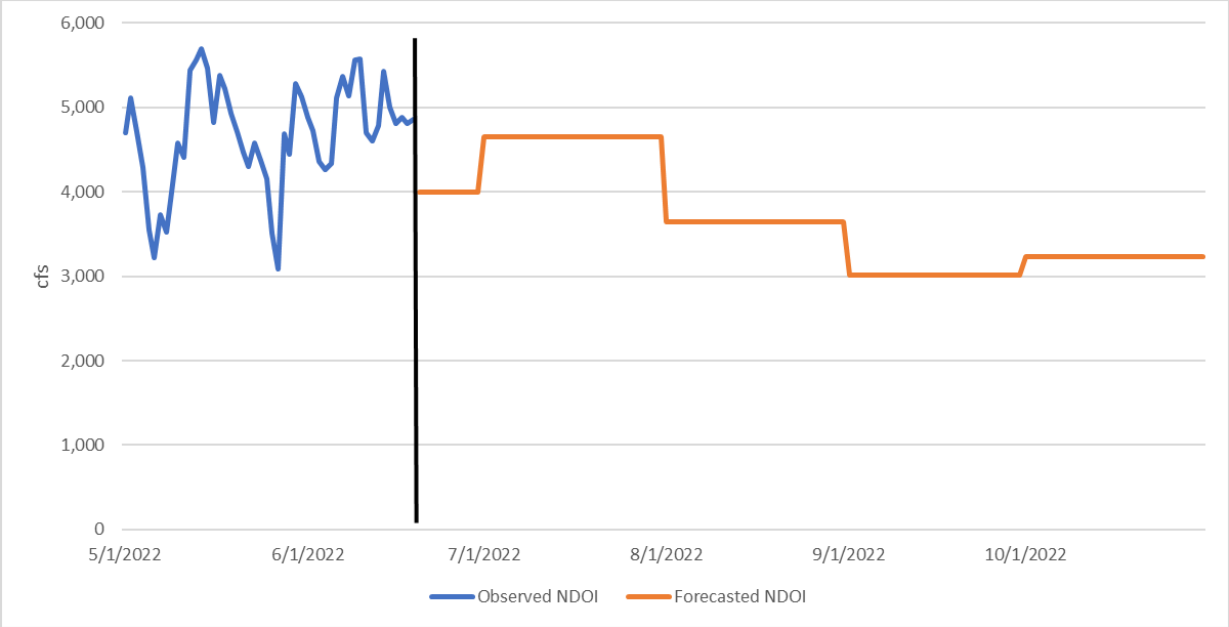



Simple estimates of residence time that only consider the total volume of the Legal Delta and inflow overestimate the residence time because they do not consider the enormous twice daily tidal flux, the variable channel volumes in different regions of the Delta, or consumptive water use.

# Water Quality

In addition to decreased residence times attributable to tidal flux and consumptive use, the effects of reduced Delta outflow on water quality must also be considered for determining water unavailability. Although there would always be water present in the channels of the Delta, in the absence of releases of water from reservoir storage by the Projects the water in the Delta channels would not necessarily be of suitable quality for agricultural or municipal use. One of the principal purposes of the Projects is to release adequate water to maintain Delta outflow at levels sufficient to impede water in Suisun Bay from entering the Delta. During low flow conditions, the typical minimum flow needed to maintain a freshwater barrier to repel salinity from entering the Delta is a calculated net Delta outflow of 3,000 to 5,000 cubic feet per second (cfs). Flows in this range and higher have been maintained to prevent salinity intrusion during May and June of 2022 and are forecasted to be maintained for this purpose in July through October of 2022 (see Figure 4). Flows approaching and lower than 3,000 cfs, even for short periods, can result in salinity intrusion into the Delta.

**Figure 4. Net Delta Outflow, May 1-June 19 Recorded Values and June 20-October 31 Forecasted Values by the U.S. Bureau of Reclamation**



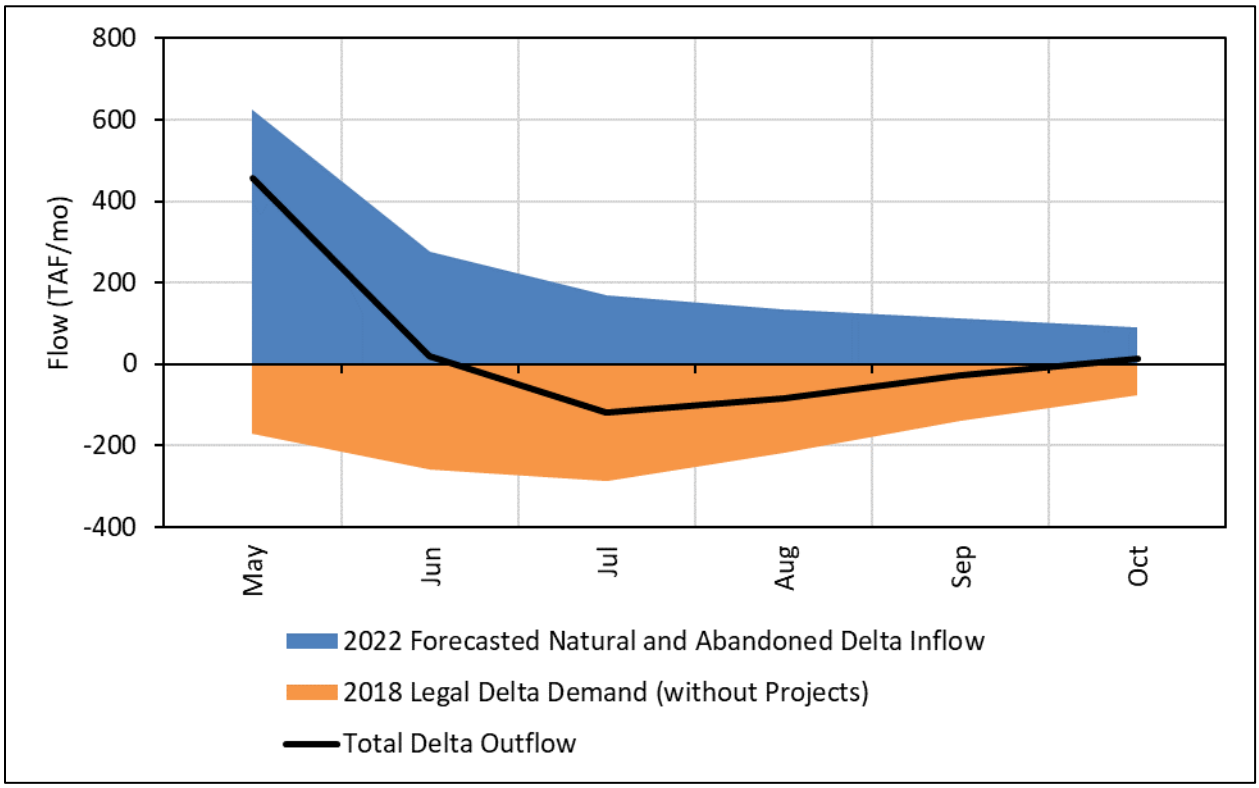

Absent Project storage releases, water quality in much of the Delta would be of a quality unsuitable for agriculture throughout much of the summer. While historical records of similarly dry periods may show that water was of sufficient quality for use throughout the summer, these periods did not include changes to the geography such as the deepening of ship channels or the increase in demand by other senior water users upstream, both of which have further degraded water quality.

The Methodology estimates water supply available to meet demand throughout the watershed. To determine the water supply available in the Legal Delta, the supply required to meet upstream demands senior to Legal Delta diverters is subtracted from the total watershed supply. While supply estimates are available on a daily timestep from the California Nevada River Forecast Center (CNRFC), the reported demand data is only available on a monthly timestep. If curtailments are issued based on watershed-wide unavailability in both the Sacramento and San Joaquin River watersheds based on the allocation priorities embedded in the Methodology, then the calculated Delta outflow met by natural and abandoned flows is zero. Because the Methodology first allocates water to meet any existing water right demands, the only time there is any excess natural and abandoned flow to contribute to calculated Delta outflow is when all demands are satisfied based on the watershed-scale analysis in at least one watershed (either the Sacramento or San Joaquin).

Without the release of Project water from storage, the only Legal Delta inflow would be from remaining natural and abandoned flows after upstream demands senior to Legal

Delta users have been met. If Legal Delta depletions remained the same, they would be met by natural and abandoned flows until those are fully consumed, and calculated Delta outflow would decrease to zero and then go negative if demands were not curtailed. Figure 5 shows the effect that removing Project water would have on calculated Delta outflow, going from positive in June to negative in July, August, and September assuming no diverters in the Legal Delta were curtailed other than the Projects. In the absence of previously stored Project water, calculated Delta outflow becomes negative (reverse Delta outflow) over these three months because inflow of natural and abandoned flow decreases while Legal Delta depletions increase from May through July.

**Figure 5. Forecasted Natural and Abandoned Legal Delta Inflow for May-September 2022, Assuming CNRFC 50% Exceedance Hydrology and Legal Delta Demands without the Projects, May-October 2022***




*June 18-30 and July-October supply represented by 50% exceedance forecasts from CNRFC issued on June 18, 2022.

As shown in Table 4 below, Legal Delta inflow from natural and abandoned flows exceed Legal Delta consumptive use in May and June. Therefore, these inflows could have provided the water consumptively used in the Legal Delta. In July, August, and September, however, consumptive use in the Legal Delta is forecasted to exceed natural and abandoned inflows by upwards of 100 TAF/month.

**Table 4. Calculated Net Delta Outflow without Project Inflows, May-October 2022**

| Month | Natural and Abandoned Legal Delta Inflow* (TAF) | Legal Delta Consumptive Use** (TAF) | Calculated Net Delta Outflow (TAF) | Calculated Net Delta Outflow (cfs) |
|---|---|---|---|---|
| May | 626 | 171 | 455 | 7,405 |
| June | 277 | 258 | 19 | 325 |
| July | 168 | 288 | -120 | -1,955 |
| August | 134 | 218 | -84 | -1,368 |
| September | 111 | 138 | -27 | -448 |
| October | 89 | 76 | 13 | 220 |

*June 18-30 and July-October supply represented by 50% exceedance forecasts from CNRFC issued on June 18, 2022.
**Excluding Project demands.

Without Project storage releases, there will not be enough natural and abandoned Legal Delta inflow in July through September 2022 to prevent the net inflow of water from Suisun Bay into the Delta. Instead of the net Delta outflow of 4,652 cfs forecasted by Reclamation for July (see Figure 4), there would be a negative calculated net Delta outflow in July through September. Inflow of higher saline water from the west would be particularly large in the Southern Delta because it has disproportionately small channel volumes relative to its depletions. Table 5 shows that specific effect in the Southern Delta, where consumptive use exceeds natural and abandoned inflows from the San Joaquin River in June through October. The combined net inflow into the Southern Delta from the Central Delta and Suisun Bay for these five months, absent Project water from the San Joaquin River, would be 212 TAF – nearly ten times the 23 TAF volume of Southern Delta channels.

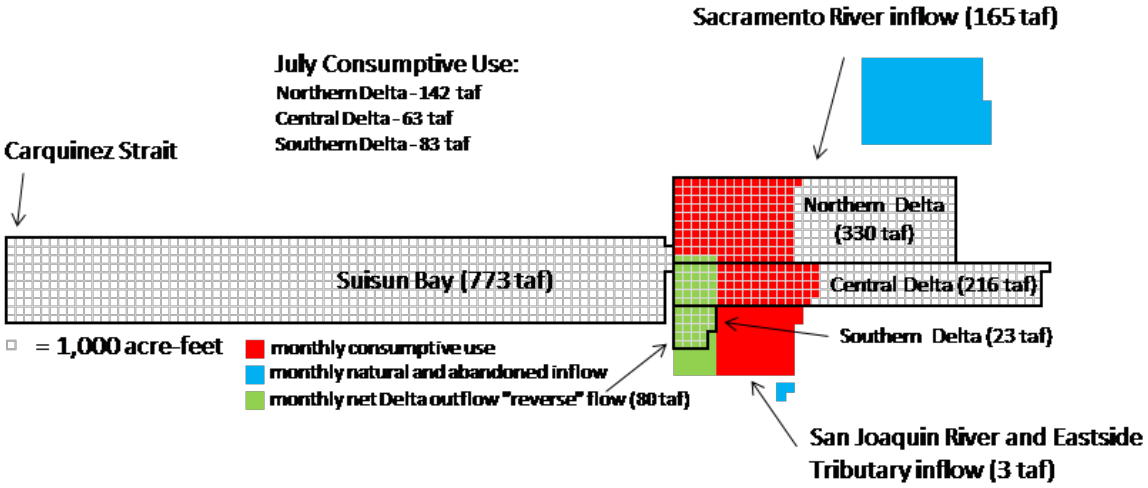
**Table 5. Calculated Southern Delta Replacement Water with No Previously Stored Project Releases, May-October 2022**

| Month | **Natural and Abandoned San Joaquin River Inflow to Legal Delta*** (TAF) | **Southern Delta Consumptive Use**** (TAF) | **"Replacement" Inflow to Southern Delta** (TAF) |
|---|---|---|---|
| May | 69 | 59 | -10 |
| June | 50 | 81 | 30 |
| July | 3 | 83 | 80 |
| August | 3 | 63 | 60 |
| September | 2 | 40 | 39 |
| October | 3 | 16 | 12 |
| Sum | 129 | 341 | 212 |

*June 18-30 and July-October supply represented by 50% exceedance forecasts from CNRFC issued on June 18, 2022.
**Excluding Project demands.

Figure 6 shows forecasted conditions for July 2022 without Project water entering the Legal Delta. The figure shows consumptive use in the three Legal Delta regions relative to their channel volumes, the volume of natural and abandoned Legal Delta inflow, and calculated net (reverse) Delta outflow in July. The forecasted volume of Sacramento River natural and abandoned flow (165 TAF) is less than the combined Northern and Central Delta consumptive use (142 + 63 = 205 TAF). The volume of San Joaquin River natural and abandoned flows (3 TAF) is a small fraction of Southern Delta consumptive use (83 TAF). This shows that, with continued uncurtailed Legal Delta diversions and in the absence of Project water, the Northern, Central, and Southern Delta channels would be pulling water from Suisun Bay. Figure 6 shows that there would be calculated negative net Delta outflow from the Central and Southern Delta because consumptive use would be disproportionately higher than freshwater inflow.

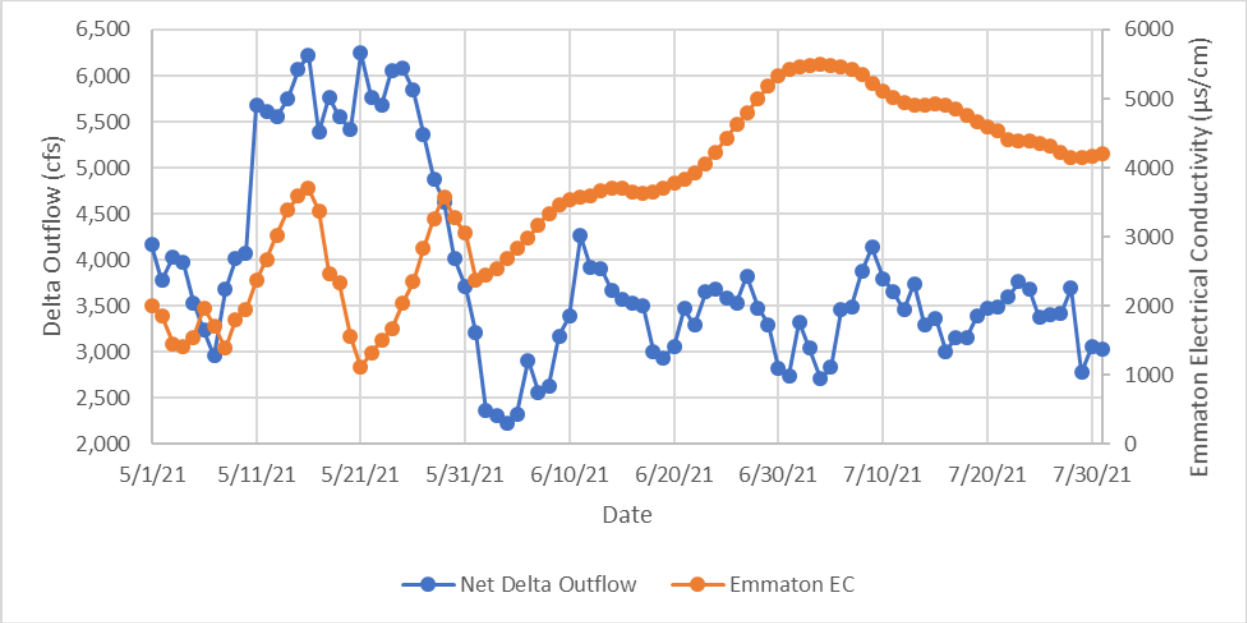
**Figure 6. Schematic of Suisun Bay and Legal Delta Regions with Scaled Channel Volumes, Consumptive Use, Forecasted Natural and Abandoned Legal Delta Inflow, and Calculated Net Delta Outflow Reverse Flow, July 2022**




# Estimation of Water Quality in the Legal Delta Without Previously Stored Project Water

This section presents a discussion of Legal Delta water quality absent Project operations. Without the presence of upstream Project storage releases, diversions in the Southern Delta that exceed inflows from upstream would cause water from Suisun Bay and the Central Delta to enter the Southern Delta. For example, the average EC in the far western boundary of the Delta, at Emmaton (see Figure 1), was approximately 2,200 µs/cm in May 2021, when the calculated average net Delta outflow was over 5,000 cfs. The EC increased to an average of over 4,000 µs/cm in June and July 2021, when the calculated average net Delta outflow dropped to an average 3,300 cfs (see Figure 7 below). This relatively large increase in salinity occurred in response to a relatively small reduction in calculated net Delta outflow from 5,000 to 3,300 cfs. This minimal Delta outflow was still enough to maintain a freshwater barrier between Suisun Bay and the Delta, but salinity increased at Emmaton due to more water from Suisun Bay being mixed with Sacramento River water.

**Figure 7. Historical Recorded Net Delta Outflow and Electrical Conductivity at Emmaton, May-July 2021**




The EC at the eastern boundary of Suisun Bay, downstream of Emmaton, would have been far higher if there had been no Delta outflow to freshen water in Suisun Bay. Further west in Suisun Bay, the average EC from May through July 2021 was 11,000, 20,000, and 31,000 µs/cm at Collinsville, Port Chicago, and Martinez, respectively (east to west, see Figure 1).

Without previously stored Project releases, higher natural and abandoned flows in May 2022 would have started the season with sufficient water quality; however, without the benefit of Project water flowing into the Delta, the high EC water from Suisun Bay would intrude into the Delta in June and July. It does not take much of this high salinity water to have a large effect on water quality: a 50/50 mix of 20,000 µs/cm water from central Suisun Bay would result in a mixed water quality of over 10,000 µs/cm, assuming there was no salt in the other components of the mix.

Without Project water, conditions in the Southern Delta in July-September 2022 would be far worse than a 50/50 mix of Martinez-quality water because there would be very little low-salinity water present to mix with. Only 3 TAF of natural and abandoned San Joaquin River water is forecasted to be available in the Southern Delta in July 2022 (see Table 5), while consumptive use is 83 TAF (see Table 2). Only 4 percent of the monthly consumptive use would have been met by low-salinity water from the San Joaquin River. The other 96 percent would have to have been met with water that flowed into the Southern Delta through the Central Delta from Suisun Bay. A 90/10 mix of Martinez and San Joaquin River water could approach 18,000 µs/cm.

Although some salt-tolerant crops can continue to be grown with relatively saline water, doing so requires very high leaching fractions to move the salts through the root zone. The types of soils in the Southern Delta do not provide the high leaching requirements needed to support high salinity irrigation water, and salt-tolerant crops are not generally grown in the Southern Delta. Even if such crops were grown in the Southern Delta and such leaching were possible, there is nowhere for the leached water to go except back into the Southern Delta channels. With no net Delta outflow, the Southern Delta is a closed system where the salt levels would continue to rise.

Slight to moderate restrictions on use are generally considered for irrigation water with salinity between 700 and 3,000 µs/cm, with severe restrictions for salinity over 3,000 µs/cm (Ayers and Westcot, 1985). Determining the sensitivity of crops to highly saline water is not a simple matter because the effect on the crop is based on the salinity in the root zone, which can be higher than the salinity of applied irrigation water. This is because soil salinities generally increase as water is consumed by the plant and salts are left behind in the soil.

Sensitive crops start showing declines in yield for soil-water salinities (soil extract EC) over 2,000 µs/cm, with 100 percent yield reduction at 8,000 µs/cm. Moderately sensitive crops start showing reductions at 3,000 µs/cm, with 100 percent reduction at 16,000 µs/cm. Moderately tolerant and tolerant crops start showing reductions at 7,000 and 10,000 µs/cm, with 100 percent reduction at 24,000 to 32,000 µs/cm (Hoffman 2010). These effects would occur at lower thresholds of applied water salinity depending on initial soil salinity and leaching fractions of the soils, among other things. In 2007, less than ten percent of the crops grown in the Southern Delta were moderately tolerant or tolerant (Hoffman 2010).

An additional problem associated with applying highly saline water to crops is that salts will eventually have to be flushed from the root zone before yields can be restored. When that occurs, the salts will continue to impair the use of the receiving water as an agricultural supply until such time as all the salts are flushed from channels in the Delta.

# Conclusions

Although there will always be water in the Legal Delta channels that are at or below sea level, by July 2022 the quality of the water in those channels would be too salty for agricultural or municipal beneficial uses absent the releases of previously stored water by the Projects as required by D-1641. This analysis shows that when tidal flux, consumptive use, Delta outflow, the operations of the Projects, and water quality are considered, the assumptions regarding Legal Delta residence time and water quality in the Water Unavailability Methodology are reasonable.

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