August 25, 2019

Comprehensive Operations Plan and Monitoring Special Study

Prepared by the Department of Water Resources and the U.S. Bureau of Reclamation

In Accordance with the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary—December 12, 2018

This Comprehensive Operations Plan (COP) and Monitoring Special Study (MSS) describes current and potential future actions that fully address the impacts of the State Water Project (SWP) and Central Valley Project (CVP) export operations on water levels and flow conditions that may affect salinity conditions in the southern Delta, including the availability of assimilative capacity for local sources of salinity. The COP includes detailed information regarding the configuration and operations of facilities relied upon in the COP and identifies performance goals for these facilities.

Comprehensive Operations Plan

Current SWP/CVP Operations

Exports

The Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation) operate the State Water Project and Central Valley Project (collectively Projects), respectively, in compliance with the terms and conditions contained in their water rights permits and licenses issued by the State Water Resources Control Board (SWRCB). In December 1999 (and amended in March 2000), the SWRCB issued Water Rights Decision 1641 (D-1641), which amended the associated water rights permits with additional terms and conditions to protect beneficial uses in the Delta. This included assigning responsibility to DWR and Reclamation for meeting specific water quality and flow objectives (DWR, 2006). In addition, DWR and Reclamation must also comply with regulatory requirements, as applicable, contained in, but not limited to:

- 2008 U.S. Fish and Wildlife Service Biological Opinion for Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP)
- 2009 National Marine Fisheries Service Biological Opinion on the Long-Term Operations of the Central Valley Project and State Water Project for listed species under the Endangered Species Act (ESA)
- 2008 California Department of Fish and Wildlife Incidental Take Permit for Longfin Smelt

With the passage of time and increased knowledge, these requirements have been modified and generally are more stringent. As such, DWR and Reclamation have had to alter prior operational practices to continue to achieve the Projects' purposes while still complying with all the mandated requirements and modifications thereto.

Since 2005, when the interior south Delta water quality objectives changed from 1.0 EC to 0.7 EC during April-August, exceedance of the objectives occurred more frequently, primarily at the Old River near Tracy Road Bridge station. DWR and Reclamation were assigned partial responsibility by the SWRCB to

meet these water quality objectives because it was known at the time that local degradation issues were also influencing water quality in the South Delta. Both DWR and Reclamation demonstrated to the SWRCB the Projects' inability to take effective actions to remedy the exceedances through Project operations or the operation of the Temporary Barriers Project. Testimony by DWR during the 2016 California WaterFix hearings[1] provided historic data showing the percentage of time Delta water quality objectives were exceeded. DWR testified that D-1641 objectives that the SWP/CVP are responsible for were exceeded 1.5 percent of the time from 1995 through 2015. Of that 1.5 percent, almost 90% of these exceedances occurred at the three interior southern Delta objective locations, with most exceedances occurring at the Old River at Tracy Road Bridge station, where exceedances occurred 16.8% of the time. Had the objective been 1.0 EC year-round, as currently adopted in the 2018 WQCP, exceedances at the Old River at Tracy Road Bridge station would have occurred half as often—about 8 percent of the time. These percentages are small, and the timing of occurrences are fundamental in contemplating the magnitude of the exceedance problem and its impact on beneficial users of the water, which in turn should be the basis of determining the availability and reasonableness (scope, cost, and effectiveness) of any actions taken to remedy the problem.

CVP and SWP Operations Impacts on South Delta Salinity

Reclamation and DWR have submitted numerous studies and reports in past years (Attachment 1) showing that the CVP and SWP do not contribute to adverse salinity conditions in the south Delta and cannot alter their operations to produce a measurable change in south Delta salinity at the compliance stations. These studies and reports show that in the past water quality at Vernalis was degraded, in part, due to increased agricultural drainage upstream and that local salt loading in the immediate south Delta region has increased significantly, most notably in the Sugar Cut/Paradise Cut area However, salt loads from upstream sources, mostly on the west-side of the San Joaquin River Basin have steadily declined since September 1996 with the implementation of the Grassland Bypass Project (Figure 1). This was the largest source of salt loading to the San Joaquin River. Programs such as CVSALTS have also been implemented with the goal of reducing agricultural drainage upstream of Vernalis by using water conservation practices such as drip irrigation and increased reuse of agricultural drainage on the westside of the San Joaquin River Basin. These practices, in part implemented in response to the Irrigated Lands Program, have reduced the total volume of both surface and subsurface drainage while also increasing the salinity concentration of agricultural return flows. Increased reuse of return flows on seasonal wetlands can also degrade the quality of return flows. However, the net effect should be to reduce the salt loading to Vernalis and the salinity measured at monitoring stations further downstream in the Delta. This fact has been borne out by a sharp reduction in exceedances of salinity objectives at Vernalis.

A report prepared in April 2011 also determined that the use of dilution flows alone is not feasible due to the prohibitive amount of water needed to assure complete compliance at the three interior Delta stations.

[1] Department of Water Resources Testimony for SWRCB Hearing on DWR and Reclamation Request for a Change in Point of Diversion for California WaterFix, DWR-61, (John Leahigh, DWR) 5/31/16

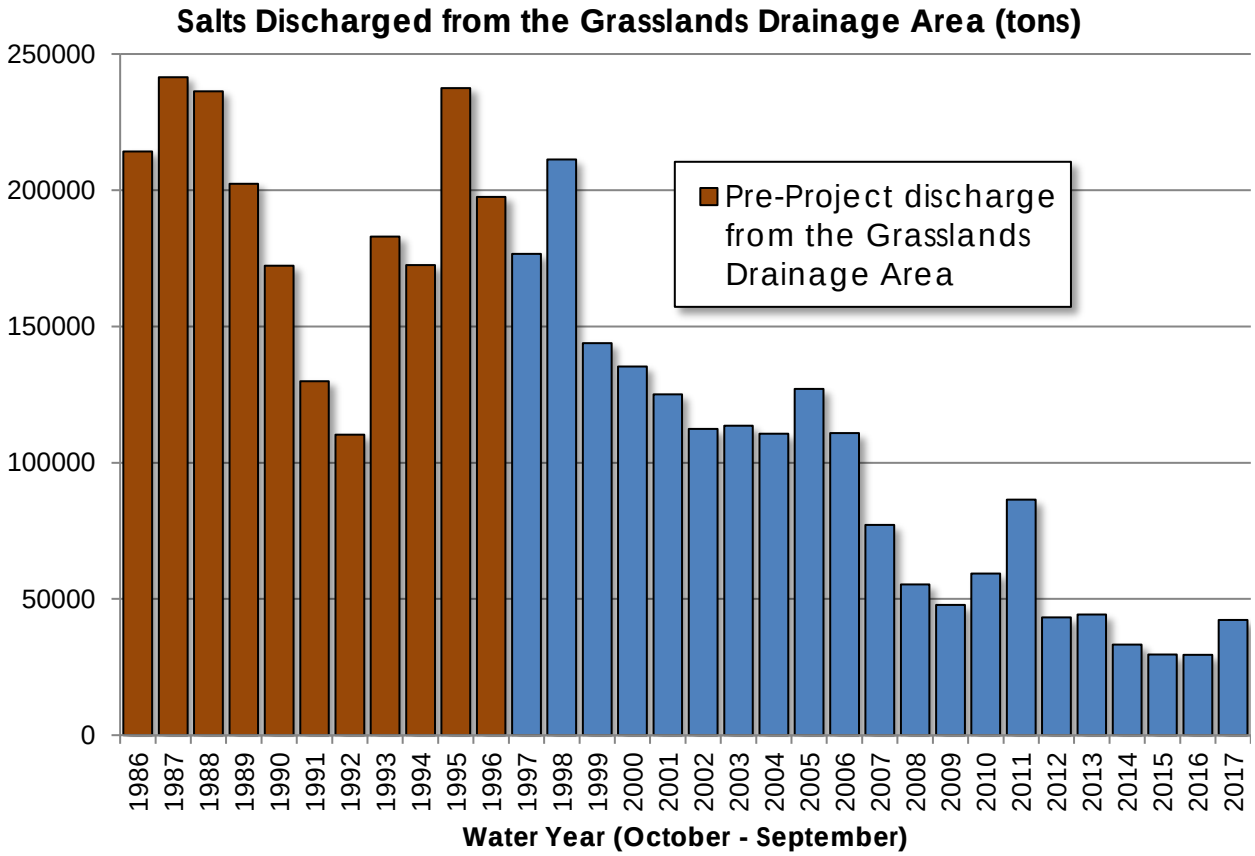

Figure 1. Annual salt loading from agricultural water districts in the Grasslands Subarea since 1986. Implementation of the Grassland Bypass Project in Sept 1996 has resulted in a greater than 80% reduction in salt loading from the Grasslands Subarea owing to diversions into the SJRIP reuse area. This subarea was the largest contributor of salt loading to the SJR prior to 1996.

Temporary Barriers Project

DWR has been constructing the South Delta Temporary Barriers Project (TBP) for many years. The TBP consists of annual construction of three temporary rock agricultural barriers in the south Delta during the irrigation season and a fish barrier in the spring and fall at the Head of Old River. The TBP has been in place since 1992 and the Head of Old River Barrier (HORB) has been installed in most years since 1968. The purposes of the barriers are to improve water levels, water circulation, water quality, and anadromous fish migration. The locations of the agricultural barriers are Middle River (MR) near Victoria Canal, Old River near Tracy (ORT), and Grant Line Canal at Tracy Blvd (GLC). The barriers are constructed with riprap rock in the spring and removed by November 30 each year.

The agricultural barriers predominantly serve to protect upstream water levels. Each barrier has six or nine 48-inch diameter culverts with tidally-operated flap gates on the upstream end to allow flood tides to pass while restricting ebb flows. By trapping the high tide, upstream water levels are protected. The agricultural barriers operation is limited to tying open the flap gates on the culverts at all three barriers and closing the center section at GLC. This operation is typically done to improve circulation when water quality is poor but is done at the expense of reduced water level protection. Due to Delta smelt and out-migrating salmonid concerns, culvert flap gates are tied open until there is a need for upstream water level

protection. Similarly, the center section of GLC is not closed until there is a need for water level protection and approval is received from USFWS, NMFS, and CDFW. Additional water level protection for diverters on Middle River can be accomplished by raising the weir crest elevation from 3.3 feet to 4.3 feet NAVD after Delta smelt concerns have passed and USFWS approval is received.

The HORB restricts most San Joaquin River flow into Old River. Consequently, the spring HORB is operated with all eight 48-inch culvert slide gates opened to allow as much water into the South Delta as possible while still providing protection for juvenile outmigrating salmonids. Without substantial spring San Joaquin River flow entering the South Delta, local sources of salinity may accumulate, especially in Old River.

Water conservation practices and an overall reduction in agricultural return flow to the San Joaquin River from west-side sources have reduced the overall flow in the San Joaquin River and the ability of these flows to counter tidal inflow and advection of salt through Old River when the HORB is not in place. One of the conclusions from the San Joaquin River Dissolved Oxygen TMDL Upstream Studies was that this reduction in advective flow through the Stockton Deep Water Ship Channel exacerbated dissolved oxygen sag at critical times of the year for outmigrating salmonids. While the salinity TMDL encourages San Joaquin River Basin stakeholders to reduce salt loading to the River, this load reduction produces less flow in the River during the dry season working against cost-effective measures addressing the Dissolved Oxygen TMDL.

The Fall Head of Old River Barrier restricts flow into the South Delta when water temperature may still be elevated, and agricultural demand is still high. In order to help prevent cyanobacteria blooms and allow more water into the South Delta to meet agricultural demand culvert slide gates have been opened with CDFW approval. Absent water level or water quality problems, including cyanobacteria blooms, all culvert slide gates remain closed to benefit immigrating adult salmonids and some water enters Old River via a shallow weir notch and flow leaking through the rock.

Barrier operations are coordinated with stakeholders and regulators through DWR/Reclamation monthly coordination calls, weekly barrier update emails, and through close daily coordination with South Delta Water Agency (SDWA). Weekly hydrodynamic modeling is conducted, and the results are shared with stakeholders and regulators. When forecasted water level are at or near the target elevations, SDWA is advised to work closely with their members and document all water level issues. Through documented water level issues, DWR is then able to seek approval to act if needed, including tidally operating the flap gates, closing the center section of GLC, and raising Middle River.

Potential Future Operations/Actions

South Delta Improvements Program

Because the TBP has very limited operational actions or flexibility, DWR and Reclamation have proposed replacing the TBP with permanent operable gates. These permanent operable gates would give DWR much more operational flexibility and were proposed in the South Delta Improvement Program (SDIP). The SDIP Final EIS/EIR details the water quality benefits of SDIP based on modeling. These benefits include salinity improvements because the permanent gates would allow more of the flood tide to pass the barriers and would have the ability to force circulation. Although the EIR was certified in 2006, project implementation has been delayed due to a NMFS requirement in their 2009 SWP-CVP Long

Term Operations Biological Opinion to conduct a 3-year study of the effects of the Temporary Barriers on out-migrating juvenile salmonids prior to reinitiating consultation on the permanent gates. The study has been recently completed and the report provided to NMFS contains recommendations for replacing the temporary rock barriers with operable gates to reduce the rock barriers' impact on migrating salmonids. Planning for a revised and updated SDIP is being reinitiated by DWR.

Since permanent solutions like SDIP will take years to plan, permit and implement, DWR continues to evaluate ways to improve the TBP. Current environmental permits for the TBP allow for streamlined integration of design change provided the changes are limited to barrier weir crest elevations and/or conveyances through the barriers. DWR has performed many modeling investigations, including the investigations that led to the MR raise, to determine how the TBP can be operated to improve water level protection and water quality. Historically the ORT barrier has been operated to improve water quality by tying open culvert flap gates, but the benefits were not measurable in the monitoring network and tying open flap gates reduces water level protection. Through coordination with SDWA, TBP operations prioritize water levels over quality. If modeling and analysis indicate a likely benefit of modifying weir heights or changing conveyances and those modifications can be reasonably implemented, DWR will seek approval to make the recommended design changes.

Water Quality Studies

Current and Completed Studies

DWR has conducted many studies to investigate sources of high salinity, particularly at the Old River at Tracy Road Bridge compliance station in the South Delta, including agricultural drainages. DWR staff also used groundwater quality data in the South Delta to evaluate the effects of discharges into Old River and surrounding channels on EC compliance at Old River at Tracy Road Bridge. DWR also conducted higher spatial-resolution salinity transects on Old River and evaluated the effects of SWP operations on South Delta salinity.

A South Delta Salinity Study (completed in April 2018) built on previous studies conducted in the South Delta and further explored salt-load transport in relation to the Old River at Tracy Road Bridge compliance station. Specifically, DWR used existing and newly installed water quality monitoring stations in the South Delta to collect total dissolved solids (TDS) data along with flow data, then calculated the salt-load direction and magnitude in Old River and surrounding channels that may contribute to the high salinity measured at Old River at Tracy Road Bridge. Attachment 1 provides information on these studies.

Summary of Studies informing South Delta Salinity

DWR, Reclamation, and other stakeholders are encouraged by the SWRCB in the 2018 WQCP to engage in efforts to synthesize existing information regarding salinity challenges in the southern Delta that may be helpful to revisions and updates to the COP.

Attachment 1 addresses this synthesis and provides a summary of studies that includes data collection, Delta modeling studies, and analysis. It contains information on the physical system—flows in channels, exports, inflows, water quality, channel bathymetry, agricultural diversions, returns, water quality, and temporary barriers. It also includes studies which have investigated possible solutions to the water quality

issues including low-head pumps and recirculation. This information provides a current level of understanding of the system and will help determine whether additional types of studies may be needed to understand the level of SWP/CVP operational impacts to updated objectives and to discuss possible solutions as needed.

The Attachment 1 table was initially developed in 2018 at the request of the Delta Watermaster to aid in the Delta Science Program review. Due to changes in websites, the links to documents were updated and short summaries of studies are included. Additionally, all documents have been placed in one location and can be found at https://data.cnra.ca.gov/dataset/south-delta-studies-reference, California Natural Resources Agency open data site.

Salinity Fingerprint Analyses in the South Delta

In 2015, Richard Denton prepared the report "Delta Salinity Constituent Analysis" for the State Water Contractors. This report describes a method to identify the source of salinity through mineral composition. For example, seawater has a ratio of Chloride to Sulfate of about 7:1 and San Joaquin River water (sampled at Vernalis) has a Chloride to Sulfate ratio close to 1:1. The sample's mineral composition is referred to as a "Fingerprint."[2]

Beginning in June 2018, DWR NCRO began collecting discrete water samples of standard minerals at seven South Delta stations (OH1, ORX, GLE, PDUP, PDC, SGA, & TWA). The sample results will be used to identify and investigate sources of local salt loading in South Delta channels. Additional sample sites would be required to investigate salt loading in the Middle River compliance reach. The limiting resource for additional sampling is labor, as equipment and analysis costs are low, but sample collection and processing are fairly time-intensive.

Evaluation of Salinity Patterns and Effects of Tidal Flows and Temporary Barriers in South Delta Channels

In the report "Evaluation of Salinity Patterns and Effects of Tidal Flows and Temporary Barriers in South Delta Channels" Dr. Russ Brown analyzed electrical conductivity, stage and flow data in the south Delta for the period of 2009-2013. The report presents a detailed evaluation of extensive 15-minute data and evaluates the likely inflow locations of higher salinity source water measured in Old River between the Head of Old River and the Delta-Mendota Canal Old River Intake. The data analysis suggests that both Paradise Cut and Sugar Cut (tidal sloughs) are likely sources of higher salinity water that mixes with Old River water. The report also identifies regulatory options and compares several physical alternatives that might be implemented to reduce the high salinity often measured at the Old River at Tracy Road Bridge EC monitoring station. The data in this report provides evidence that control of salinity in Old River between the Head of Old River and the Delta Mendota Canal intake is not possible through export reductions or current barrier operations. However, other physical alternatives including operable gates (SDIP) and changes in channel connections and configurations could utilize tidal energy to transport salts downstream out of tidal sloughs and Old River.

[2] Denton, R. 2015. Delta Constituent Analysis. Oakland, CA. Prepared for: State Water Project Contractors Authority.

Potential Future Water Quality Studies

The analyses of salinity flux, local loading, fingerprinting, and compliance plausibility would benefit from data collection complimentary to the existing water quality network:

- High Speed Electrical Conductivity (EC) Transects with GPS mapping
- Source Sampling to build a fingerprint of local salt sources
  - Return Water (ag)
  - Effluent

Agency Coordination/Outreach

Current Activities

DWR conducts monthly South Delta Conference Calls with SDWA, Reclamation and SWRCB staff. DWR also conducts weekly operations meeting that include CCWD staff. The participants are DWR SWP operators, CVP operators, and CCWD staff. Items discussed include current SWP and CVP exports, which intake CCWD is using, Los Vaqueros operations, what factors are controlling operations, and updates to CCWD facilities that may affect SWP and CVP operations.

Future Proposed Activities

DWR and Reclamation will schedule an initial meeting with SDWA, CCWD, SWRCB staff, along with other interested parties such as State and federal resource agencies and local stakeholders. The primary agency attendees shall discuss the COP and further development and refinement of the COP. DWR will facilitate this meeting. Future meetings, as agreed to by the involved agencies/parties, will be scheduled as needed.

DWR and Reclamation will continue holding monthly South Delta Conference Call coordination meetings with SDWA and SWRCB staff. Other interested local stakeholders, when identified by SDWA to DWR, may be included in the monthly coordination meetings. DWR will also continue conducting weekly operations meetings with CCWD staff and will use both these monthly and weekly meetings to discuss south Delta water quality and COP related information.

Monitoring Special Study

Current Monitoring Activities

The Bay-Delta Plan 2018 amendments instruct DWR and Reclamation to work with the SWRCB staff and other stakeholders to develop and implement a special study to characterize the spatial and temporal distribution and associated dynamics of water level, flow, and salinity conditions in the southern Delta waterways. Many studies have already been conducted in the past that have explored south Delta hydrodynamics and water quality to determine the SWP and CVP impacts on these conditions and are discussed in this COP text and referenced in the attachments. As of the date of this COP, DWR and Reclamation are not aware of ongoing or planned studies to further investigate these conditions in the south Delta.

SWP and CVP Water Quality Monitoring

DWR and Reclamation utilize both real-time monitoring and DSM2 modeling to meet the water quality objective for agricultural beneficial uses for the southern Delta identified in D-1641. This objective, as

currently adopted, requires DWR and Reclamation to maintain a maximum 30-day running average EC of 1.0 mmhos/cm from September 1 through March 31 and 0.7 mmhos/cm from April 1 through August 31 at the following stations; San Joaquin River at Brandt Bridge (BDT), Old River near Middle River (UNI), Old River at Tracy Road Bridge (ORT), and the San Joaquin River at Airport Way Bridge, Vernalis (VER).

Weekly DSM2 modeling is performed to forecast the trend of EC at these locations for approximately three weeks beyond the simulation start date. Measured EC readings are used as a basis for evaluating how well the model is forecasting the EC at these locations. If DWR and Reclamation anticipate EC to increase above the mandatory maximum, adjustments would be made to SWP and CVP operations, where possible and effectual, to try to counteract this anticipated increase. During the irrigation season and in accordance with Condition A.9 of Board Order WR 2010-0002, DWR and Reclamation notify the SWRCB and SDWA of a potential exceedance of the water quality objective. If we are unable to avoid exceeding the water quality objective, DWR and Reclamation notify the SWRCB and SDWA of the date and severity of the exceedance consistent with the mutually agreed protocols.

In addition to these direct notifications, DWR and Reclamation provide daily summaries (via the web) of measured EC readings at the southern Delta compliance locations, as well as various other operationally important locations. DWR and Reclamation also provide a summary of other D-1641 standards that are applicable on that day, the current status of our compliance with these standards, and other information pertinent to SWP and CVP operations. These summaries can be found using the following link:

https://water.ca.gov/Programs/State-Water-Project/Operations-and-Maintenance/Operations-and-Delta-Status

DWR also submits a monthly summary to the SWRCB reporting salinity levels at the southern Delta water quality monitoring stations in accordance with Cease and Desist Order WR 2006-0006.

TBP Water Level Monitoring

DWR utilizes both real-time water level monitoring and DSM2 water level modeling to meet operational objectives for the TBP. Starting in the spring DWR performs weekly DSM2 water level simulations and monitors actual water levels at specific south Delta locations. On Middle River the Middle River at Howard Road station (MHR) has a water level concern elevation of 2.6 feet NAVD, on Grant Line Canal, the Doughty Cut above Grant Line Canal Barrier station (DGL) has a concern elevation of 2.3 feet NAVD, and on Old River the Old River at Tracy station (OLD) has a concern elevation of 2.3 feet NAVD. Weekly plots of actual measured water levels for one week prior to the simulation and modeled elevations for about three weeks beyond the simulation start date are prepared. These weekly plots are shared with south Delta stakeholders and regulators in weekly Temporary Barriers Project update emails. If water levels during the simulation period are at or below the concern elevation, DWR expeditiously coordinates with SDWA, CDFW, and Federal fish agencies in anticipation of a need to fully close or otherwise operate the barriers. With the required environmental approvals, DWR operates the barriers first by releasing culvert flap gates to tidal operation at MR and ORT, closing the center section of GLC, releasing the culvert flap gates at GLC to tidal operation, and finally raising the Middle River Barrier from 3.3 ft NAVD to 4.3 feet NAVD. During the time when TBP operational changes are being requested from the fish agencies, DWR coordinates closely with SDWA because in some cases operational actions

such as the closing of the center section of GLC require documented water level complaints from SDWA diverters. If water level complaints persist after all TBP operational changes have been made, other actions are considered such as changes in the priority of Clifton Court Gate operations.

Proposed New Actions/Studies

Developing and Implementing Monitoring Special Study

DWR and Reclamation will work with the SWRCB staff, SDWA, CCWD, and local stakeholders to identify special studies that would provide practicably attainable data useful in identifying sources of salinity and should SWP and/or CVP operations be identified as a major contributing source propose modified operations to alleviate those identified water quality concerns.

New EC Compliance Monitoring

Shifting salinity compliance in the south Delta from compliance points to compliance reaches may require reevaluation of the south Delta water quality monitoring network. Increased coverage or increased resiliency may be necessary, depending on the determined method to measure compliance in the Southern Delta. For example, if reach compliance is based on an average from multiple stations, back-up measures, such as a second sensor and relay, should be incorporated into the existing stations. The addition of periodic high-speed EC transects between sites to help validate and develop an accurate 3-D model of the channel EC may be another helpful solution to determine sources of salinity throughout the channels, develop reasonably practicable methods to measure salinity, and assess that mechanisms to achieve compliance criteria are attainable.

Attachment 1

Summary of Studies informing South Delta Salinity

August 2019

Studies Informing Southern Delta Salinity	Sacramento Flow Effects	San Joaquin River at Vernalis Flow & Water Quality Effects	Export Effects	Barriers & Null Zones	Salinity Contributions within the Delta	Studies Investigating Ways to Improve South Delta Salinity	General Information Documents
1 **Department of Water Resources Testimony for SWRCB Public Hearing on June 25, 2009 Regarding Modeling Project Operations' Effects in the South Delta, June 25, 2009, DWR-06, WR 2006-0006 Hearing (Tara Smith)** This document and animations were originally given as testimony for the SWRCB Public Hearing on June 25, 2009 regarding southern Delta salinity. It describes the hydrodynamic processes within the Delta using flow and particle tracking results from Delta Simulation Model 2 (DSM2). The particle tracking animations evaluated flow patterns given constant Sacramento River and San Joaquin flows while varying export levels from high exports to zero exports with the temporary barriers. Additionally, particle tracking animations for permanent gates were shown. Animations of salinity from planning simulations (1995 LOD) were shown for a group of wetter years and a group of dry years. Slides showing the flow patterns were presented. The report also built upon previous information provided to the board on 2002 and 2003 historical and modified historical (changing levels of exports and Sacramento flows) DSM2 simulations presenting flow patterns and EC results. Conclusions were the following. (1) Exports have minimal impact and control on the specific D-1641 water quality objectives in the south Delta. (2) South Delta Objective locations are dominated by San Joaquin River water quality in in Delta return sources. (3) Temporary barriers and permanent gates can move water upstream by using the flood tide. (4) Temporary barriers are limited in the amount of water that can be moved upstream. (5) Sacramento River water movement upstream of the exports into the south Delta is dependent on how the tidal flow can be manipulated by gates or barriers. (6) Increases in Sacramento flow cannot significantly improve the salinity at the south Delta objective locations. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/wr2006_0006/docs/exhibits/mod_dwr6.pdf https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/47af601d-44be-47a7-818d-c1e988d2593c	X		X				
2 **Investigation of the Sacramento-San Joaquin Delta Report No. 4 Quantity and Quality of Waters Applied to and Drained from the Delta Lowlands (DWR July 1956)** Report 4 was to determine the monthly and seasonal quantities of water applied to the irrigated crops in the Delta Lowlands and to determine the extent and sources of degradation in quality of the channel waters as they move from the Sacramento River to the Tracy Pumping Plant. The study estimated a water and salt budget for Delta lowlands over the period of March to October 1955. The report concluded that, due to seasonal differences in drainage water salinity, the Delta Lowlands act as a salt reservoir, storing salts obtained largely from the channels during the summer and returning accumulated salts to the channels during the winter. Thus, Delta lowlands agriculture practices were presented as enhancing rather than degrading Sacramento River water as it moves to the Tracy Pumping Plant. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/mussietal_cdo/exhibits/mussi_9h.pdf		X			X		
3 **South Delta Water Quality 6-21-2012 (Parviz Nader-Tehrani, Subir Saha)** This presentation looks at a 2011 case study based on actual observed EC at a number of South Delta Locations. The main conclusion of this case study is to illustrate that Paradise Cut is a major source of water quality degradation at Old River Tracy station, which historically has had the greatest occurrences of exceedances of water quality D-1641 objectives. 2011 was a very high flow water year. At high flows in San Joaquin River was (above 15,000 cfs), water spills over from San Joaquin River through the rock weir and into Paradise Cut. In absence of flushing flows through Paradise Cut, observed EC data at Old River at Tracy Road show spikes, which coincides with spikes in EC on Paradise Cut. There were no salinity spikes anywhere upstream of Old River at Tracy Road Station. Observed data indicates that as long as there were flushing flows through Paradise Cut, salinity spikes disappear. Once the flushing flows stopped (around end of April), Observed data clearly indicated a fairly quick build-up of salinity in Paradise Cut over the course of a few weeks. This case study clearly demonstrates that null zones are not the cause of high salinity at Old River at Tracy Station. There just couldn't have been a null zone during such high flow period. There is a major local source of Salinity within Paradise Cut causing degradation of water quality at Old River at Tracy Station. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/b461094a-bf27-4d4b-9a51-15edb320c8b6		X					

4	**South Delta Water Quality Effects of Paradise Cut 2017 (Parviz Nader-Tehrani)** 2017 was an extreme wet year. San Joaquin River was high enough to have water spill through the rock weirs and into Paradise Cut. This presentation focuses on observed EC data to show that once the San Joaquin River flow went below around 15,000 cfs, the flushing flows through paradise Cut stopped and there was a fairly quick buildup of salt in Paradise cut. This salt buildup in turn affected the salinity at Old River at Tracy Road station. So, while the San Joaquin River flow was fairly high throughout the summer, there was a noticeable difference in observed EC values at Old River at Tracy Road and Old River Above Doughty Cut. Under such high flows, it was clear there were no "Null Zones" and yet there was clear evidence that the local high salinity sources were affecting water quality degradation at Old River at Tracy Road. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/addfd73d-8ffc-45a6-a89d-215580cd6f28		X					
5	**Evaluation of Dilution Flow to Meet Interior South Delta Water Quality Objectives – USBR (April 2011)** The Draft Objectives Technical Report included an evaluation of the relationship between Vernalis and South Delta, and some of this information is referred to in this Special Study. The flow evaluation documented in this special study occurred in three phases. The report by Reclamation meets the objectives of the Requirement 7 of the Cease and Desist Order WR 2006-006 regarding compliance of the federal and state water projects with the South Delta agricultural objectives for salinity. The remaining objectives of the requirement is reported in a separate study by DWR on the installation of low lift pumps at one or more of the temporary barriers. The report talks about "salinity buffer" – an operational salinity goal at Vernalis that is lower than the salinity objective to ensure compliance with the objective. The report also analyses a few cases to determine a surrogate target at Vernalis that could be operated to achieve water quality objectives at the three south Delta locations. The report talks about the scenarios where Vernalis surrogate target was unnecessarily triggered even when EC objective exceedances occurred at Old River compliance locations, as well as, the San Joaquin River at Brandt Bridge, highlighting potential inexactness of such approach. In addition, range of dilution flow needs, based on recent data as well as based on CALSIM, are also presented. The analysis performed also states that using dilution flows to achieve full compliance with the South Delta objectives would likely require an unreasonable amount of water. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/1bd4e579-ffab-4949-b032-997ced178945		X					
6	**Department of Water Resources Testimony for SWRCB Hearing on Cease and Desist Order Investigation of the Factors affecting Water Quality at Brandt Bridge, Middle River at Union Point, and Old River at Tracy, DWR-20, 10/14/05, (Tara Smith).** This document was given as testimony at the Cease and Desist hearings in October 2005. It provided information on water quality and source water using observed data and DSM2. The analyses included: an evaluation of water quality degradation due to in Delta sources using field data at Vernalis, Brandt Bridge, and Mossdale; an evaluation of source water at Brandt Bridge, Old River at Tracy and Middle River at Union Point using DSM2 simulations of historical conditions; and an evaluation of the effects of State Water Project pumping on water quality at Brandt Bridge, Old River at Tracy, and Middle River at Union Point by varying pumping in DSM2 simulations of otherwise historical simulations. The results of the studies demonstrated that the three locations are heavily dependent on San Joaquin River water and in Delta returns. It was shown, from the DSM2 historical simulations that water at the Brandt Bridge location is composed entirely of San Joaquin River water and in Delta returns unless there is reverse flow at Brandt Bridge. Analysis using field data indicated the average degradation from Vernalis to Brandt Bridge is approximately 8%. For the Middle River at Union Point Station and the Old River at Tracy Station, the DSM2 historical simulations demonstrated that unless San Joaquin flow is low, the water at those two locations consist entirely of San Joaquin water and in Delta returns when the barriers are not installed. When the barriers are installed, there are a number of factors that potentially can affect the improvement or degradation in water quality and large changes in exports do not always result in a significant change in water quality. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/delta_salinity/exhibits/dwr/dwr20.pdf		X	X				

7	**Flows and Salinity in the South Delta, PowerPoint Presentation, DWR (Tara Smith) January 6, 2011** This document was given as a presentation to the SWRCB January 6, 2011. The document used historical DSM2 simulations and flow stations in the south Delta to describe flow patterns and salinity. It also referenced the May 2007 DWR report written by Barry Montoya regarding agricultural discharge sites, municipal point sources of salinity, and groundwater salinity. Regarding flow, the key points were the following. The San Joaquin River flows downstream into the south Delta. Exports are downstream of the objective locations. Barriers utilize tidal energy to move water upstream into the south Delta. Increases in San Joaquin flow do not result in a proportional increase in flow at Old River at Tracy. Regarding salinity, the key points were the following. Salinity in the south Delta is primarily dominated by the San Joaquin River and in Delta sources. Reduction in exports and/or additional Sacramento flow alone cannot cause significant changes in water quality at the south Delta objective locations. Circulation of "Sacramento side" water can be moved upstream to affect the water quality at two of the three objective locations by the use of temporary barriers. Water quality at Brandt Bridge cannot be significantly affected by changes in Sacramento flow, export reduction or gates. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/sds_srjf/sjr/docs/dwr_flows_salinity010611.pdf		X					X
8	**Department of Water Resources Testimony for SWRCB Hearing on Cease and Desist Order Modification Regarding the South Delta Temporary Barriers Project, DWR-05, WR 2006-0006 Hearing (Mark Holderman)** Testimony that explains to the State Water Resources Control Board how the Temporary Barriers Project (TBP) operates to help improve local water quality in the south Delta. Three flow control barriers (or "agricultural barriers") are designed to help maintain water levels and improve circulation in south Delta channels during the irrigation season so that south Delta farmers can adequately divert water. These agricultural barriers mitigate for the adverse effects of lowered water levels in some southern Delta channels caused by SWP and CVP Delta diversions pumping. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/wr2006_0006/docs/exhibits/mod_dwr5_corrected.pdf				X			
9	**South Delta Null Zone Study, Chapter 4, Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh, DWR (2012)** The purpose of this study was to analyze, through hydrodynamic modeling of variants of 20 years of historical conditions, to what extent CVP and SWP exports and the installation and operation of DWR's temporary south Delta agriculture barriers influence water levels and the occurrence of null zones in south Delta channels. Reaches studied were in Middle and Old rivers. The study found that null zones would occur without CVP and SWP exports and without barriers, though infrequently. With historical CVP and SWP exports and the installation of agricultural barriers, the locations and frequency of occurrence of null zones change, but to a relatively small extent. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/490526a4-b0d7-492c-b49d-a1f3b3526820				X			
10	**Delta Constituent Analysis. Oakland, CA. Prepared for: State Water Project Contractors Authority. (Denton 2015)** In 2015, Richard Denton prepared the report "Delta Salinity Constituent Analysis" for the State Water Contractors. This report identifies a method to identify the source of salinity through mineral composition. For example, seawater has a ratio of Chloride to Sulfate of about 7:1 and San Joaquin River water (sampled at Vernalis) has a Chloride to Sulfate ratio close to 1:1. The sample's mineral composition is referred to as a "Fingerprint." https://data.cnra.ca.gov/dataset/e7142b22-43f3-4257-93f5-fbe8cf68d4e0/resource/96d6cef2-cdaf-4414-bc1c-e769883d02a2/download/29_denton_2015_delta_salinity_constituents_report.pdf					X		

11	**Evaluation of Salinity Patterns and Effects of Tidal Flows and Temporary Barriers in South Delta Channels – ICF on behalf of DWR (September 2016)** Author Dr. Russ Brown analyzed electrical conductivity, stage and flow data in the south Delta for the period of 2009-2013. The report presents a detailed evaluation of extensive 15-minute data and evaluated the likely inflow locations of higher salinity source water measured in Old River between the Head of Old River and the Delta-Mendota Canal Old River Intake. The data analysis suggests that both Paradise Cut and Sugar Cut (tidal sloughs) are likely sources of higher salinity water that mixes with Old River water. The report also identifies regulatory options and compares several physical alternatives that might be implemented to reduce the high salinity often measured at the Old River at Tracy Boulevard EC monitoring station. Through analysis of actual collected data this report provides evidence that control of salinity in Old River between the Head of Old River and the Delta Mendota Canal intake is not possible through export or barrier operations though physical alternatives including operable gates and changes in channel connections and configurations could utilize tidal energy to transport salts downstream out of tidal sloughs and Old River. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/0971adfb-52d9-4c12-afc0-4034cb2b8dd4				X			
12	**Delta Island Drainage Investigation Report, California DWR (1990)** This report presents preliminary results of an ongoing investigation of the impacts Delta island drainages have on the quality of drinking water supplies taken from the Delta over two consecutive dry years, 1987 and 1988. The study was prompted by observed high trihalomethane formation potential in island drainages. The scope of the investigation was: the quality and quantity of Delta island drain water; the processes that the affect the quality and quantity of island drainages; and the water quality impacts in the channels and at drinking water supply intakes due to Delta island drainages. Compared to Delta river samples, drain samples were found to: contain heavier and larger sized humic substances; have 4 times greater THMFP and 10 or more times more DBPs; and have a higher potential to form THM. Drainage was estimated to contribute 40 to 45% of the TFPC in the Delta during the irrigation months and 38 to 52% during the winter leaching period. During summers of critical water years, the volume of Delta lowland drainage can be significant compared to total river inflow from the Sacramento and San Joaquin rivers or the amount of Delta exports. Impacts of island drainage on Delta waters vary with location and hydrology within the Delta. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/416f3e52-84d2-4a6d-b0ee-a7a1acc7c3e0					X		
13	**Drainage-Return, Surface-Water Withdrawal, and Land-Use Data for the Sacramento-San Joaquin Delta, with Emphasis on Twitchell Island, California, By William E. Templin and Daniel E. Cherry, USGS (1997)** Two years of partial data on drainage returns and surface water withdrawals were presented for 15 regions of the Delta and in detail for Twitchell Island. Also, results from a 1991 Delta land use study were compared to one from 1968. Drainage return estimates for most the Delta totaled about 430 TAF for 1995. For Twitchell Island in 1995, drainage return estimates totaled about 11.2 TAF and about half of the siphons totaled about 2.4 TAF. Land use surveys showed that from 1968 to 1991, native vegetation in the Delta decreased by 25 percent (about 40,000 acres) and grain and hay crops increased by 340 percent (about 71,000 acres). https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/41be1f89-6947-44c5-a4f9-2e8f9315fcc7					X		
14	**Delta Island Drainage Volume estimates 1954-1955 versus 1995-1996, Marvin Jung and Quy Tran, DWR (1998)** This report updates the plan by DWR to provide information needed by DWR estimates of Delta consumptive use and channel depletions by deploying multiple salinity and groundwater level monitoring sensors, contingent upon acquiring Temporary Entry Permits. Forty-four wells at 34 sites, all originally part of two now-defunct DWR seepage monitoring programs, have been chosen for this effort. These wells span the north and south Delta. All but 6 wells were found in good shape. Sensors with data loggers have been deployed in nine wells with conductivity, TDS, temperature and pressure data being collected. Twelve additional sensors will be installed by the end of August 2019. After an initial testing phase, data will be uploaded to Hydstra. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/424aa11b-67c4-4d36-87f6-0c49f6ea6a88					X		

15	**Revision of Representative Delta Island Return Flow Quality for DSM2 and DICU Model Runs, DWR (2000)** Delta drain water quality data collected by DWR's MWQI program from 1982 through 1997 was analyzed in order to develop representative monthly values in the Delta Island Consumptive Use (DICU) model's 142 subregions. Data processed were: EC, TDS, Ca, Mg, Ns, Cl, SO_4, DOC, UVA-254nm, THMFP, bromide, and chloride. Three regions in the Delta were identified as to DOC levels: low, mid and high. The mid and high range regions correspond to Delta lowlands. Linear relationships between DOC, THFMP and UVA were developed. Three regions in the Delta were identified as to EC levels: North, West and Southwest. Correlations were found for each region between EC, TDS, bromide, Ca, Cl Mg, Na and SO4. The averaging of data by month and region collapses a large spread in the data. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/b5062101-4298-4018-ac26-f97127320f57					x		
16	**Sources of Salinity in the South Sacramento-San Joaquin Delta, Barry Montoya, Memo Report, DWR (2007)** This memo seeks to better understand the sources of salinity in the south Delta, in particular in the San Joaquin River from Vernalis to the head of Old River and then down to the SWP and CVP export locations. In order to do this, it: identifies discharges to Old River, Grant Line Canal and the San Joaquin River from Vernalis to Old River; characterizes the discharge volume and salinity trends; and quantifies salinity increases between Vernalis and Old River. The study approximately 74 discharge sites along the waterways immediately upstream of the SWP and CVP export sites in the south Delta. Most of the discharges were agriculture drainage, followed by treated sewage, urban runoff and groundwater effluence. The discharges were relatively saline and were proposed to be raising the salinity of water flowing from Vernalis on the San Joaquin River to the export sites via Old River and Grant Line Canal. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/4dc60146-12e8-4cfa-a209-552fb8bde27a					x		
17	**South Old River Salinity Transect Study, Technical Memorandum Report, DWR (2012)** Surface-salinity transects were conducted in South Old River (SOR) over a two-year peiod to better characterize water quality impacts from discharge and tributary inputs. The objective was to provide a detailed analysis of salinity throughout SOR with a focus on inputs influencing the Tracy Boulevard Bridge compliance station where water quality standards have been applied. The compliance station at Tracy Boulevard Bridge was repeatedly influenced by the transitory nature of passing impacted waters from upstream sources that resulted in wide-ranging conductivity fluctations and increases. Conductivity was highest farther downstream due to the continued accumulation of additional saline inputs. Based on the data presented, no one location along SOR is suitable for providing conductivity measurements that are representative of the entire waterway. is https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/b6345824-70a8-4e9c-bd68-25c96aef3566					x		

18	**Department of Water Resources Testimony for SWRCB Hearing on Cease and Desist Order Report on San Joaquin Drainage Programs 1, DWR-18A, (Jose Faria, DWR) 10/14/05** This report on San Joaquin Drainage Programs by DWR summarizes many programs and funding that it has engaged in order to reduce the volume and concentration of saline discharges to the San Joaquin River (SJR). The report cites actions by DWR, USBR and others to improve SJR water quality and states that SWRCB should consider the information presented in this report in determining if DWR and Reclamation have taken actions within their control to meet the Delta standards.Although DWR is not responsible for meeting Vernalis standards established by the SWRCB in D-1641, it has been given responsibility for meeting salinity standards at the Brandt Bridge and Delta stations. Improvements in SJR water quality will help achieve water quality at these locations. Since 1995, salinity conditions have improved partly due to hydrologic conditions and because of additional measures taken by DWR and USBR. These measures listed in the report include New Melones Reservoir releases and VAMP flow releases at Vernalis, and by controlling discharge of saline water into the SJR upstream of Vernalis.One of the measures is Real-time management to maximize the assimilative capacity of the SJR. Currently DWR has assumed responsibility for funding most of the Real-time Water Quality Monitoring Program for the San Joaquin River. One important activity of this program is forecasting flow and salinity conditions on the SJR so that decision makers can take advantage of assimilative capacity of the river when available.Other measures cited in the report are: on-farm management activities to reduce subsurface drainage and ongoing efforts to improve wetland discharges. These include the West Side Regional Plan, USBR's San Luis Drainage Feature Reevaluation to provide drainage service to the San Luis Unit of the Central Valley Project and the Integrated On-Farm Drainage Management Program that DWR and collaborating agencies maintain.The report concludes that evidence presented in this report demonstrates that DWR has taken proactive measures to help meet water quality objectives at the lower SJR compliance points. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/delta_salinity/exhibits/dwr/dwr18a.pdf					X		
19	**Delta-Mendota Canal Recirculation Feasibility Study – USBR (2010)** The State Water Resources Control Board, as part of D-1641, required USBR to evaluate the feasibility and impacts of recirculating water from the Delta-Mendota Canal (DMC) into the lower San Joaquin River. The report indicates DMC Recirculation is not feasible. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/sds_srjf/sjr/sjr_recirculation_study.shtml						X	
20	**Low Head Pump Salinity Control Study – DWR (April 2011)** This report was focusing on the feasibility of installing low head pumps in conjunction with temporary barriers in the south Delta. The purpose of the low-head pumps would be to improve water quality (salinity) through improved water circulation to operate in tandem with the temporary barriers. The study findings include results of DSM2 modeling, conceptual engineering layouts, the practicality of constructing permanent or temporary pump facilities estimated planning level costs, and an assessment of regulatory requirements and permitting. The modeling assumed that there would be no Leakage through the rock barriers (leakage could reduce the efficiency of the low head pumping) The study concluded that Low head pumping used in conjunction with the temporary barriers has the potential to improve water quality at the compliance stations in the south Delta. The least estimated capitalized cost to achieve the 96% reduction in exceedences at Old River near Middle River and about a 40% reduction in exceedences at Old River at Tracy Road Bridge was $232.8 million (2011 estimate) with an initial capital cost of $168.1 million and an annual cost of $4.5 million. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/lhscs_rpt.pdf						X	
21	**Temporary Barrier Monitoring Reports, DWR (2002-2015)** These yearly reports present continuous water quality data at 13 locations in the south Delta, including immediately upstream and downstream of the temporary agricultural barrier sites. Data consists of water temperature, dissolved oxygen, pH, specific conductance, turbidity and chlorophyll. The reports present standard descriptive statistics graphs of daily averages to show seasonal patterns. Differences between locations and over time are highlighted. Differences in specific conductance are explained in terms of changes in San Joaquin River inflow. A conclusion is made as to whether the temporary barriers had any effect on any of the water quality parameters by comparing levels before and after installation of the barriers. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/a9b21caa-e8b3-467e-83b4-e2a5ff6e28c7							X

22	**Department of Water Resources Comments Regarding Southern Delta Salinity Objectives (Topic 10) State Water Resources Control Board Workshop on Amending the 1995 Bay Delta Water Quality Control Plan, DWR -18C – 10/14/05** This document includes DWR comments in response to the question of whether SWRCB should amend the 1995 Bay-Delta Water Quality Control Plan (WQCP) with regards to changing the Southern Delta salinity objectives for agricultural beneficial uses to: (1) modify the 0.7 EC and 1. 0 EC objectives to be more reflective of salinity tolerances of crops currently grown in the Southern Delta; (2) modify the methodology for determining compliance with the Southern Delta objectives to ensure protection of agricultural beneficial uses; and/ or (3) modify the effective period of the 0.7 EC and 1.0 EC objectives. The Department of Water Resources recommended that SWRCB not change the salinity objectives at that time. However, DWR recommended that the SWRCB modify the WQCP Program of Implementation to recognize that implementation of the more stringent 0.7 EC objective would not be required at the three interior Southern Delta stations (Old River at Tracy Road Bridge, Old River at Middle River, and San Joaquin River at Brandt Bridge) until: (1) permanent operable barriers were constructed and, (2) after more information is obtained to determine if the 0.7 EC objective was reflective of the water quality needed for crops in the Southern Delta. DWR also pointed out that the permanent operable gates were much more effective than temporary rock barriers at controlling salinity in the Southern Delta channels. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/delta_salinity/exhibits/dwr/dwr18c.pdf								X
23	**Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 23rd Annual Progress Report to the State Water Resources Control Board. California Department of Water Resources, Office of State Water Project Planning. DSM2 Fingerprinting Methodology** This document describes the DSM2 Finger-Printing methodology. The approach can be effectively used to identify the sources of water at a specific point in the Delta. The approach can also be used to estimate the concentration of any conservative constituent without rerunning DSM2. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/16e4b2c5-8cac-4767-9788-c3c0edfbe3b0								X
24	**Estimation of Delta Island Diversions and Return Flows, February 1995, DWR** This report describes a computer model, DICU (Delta Island Consumptive Use), that provides estimates of agricultural diversions and return flows and qualities. These estimates are then used as input to Bay-Delta hydrodynamic, water quality and particle tracking models. The DICU model uses information on land use, farming practices and climatic conditions to estimate Delta diversion and return volumes. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/9a294255-c214-4d1e-bd27-a800c43cad7b								X
25	**Description of historical DSM2 Particle Tracking Animation With Temporary Barriers Installed in South Delta, October 13, 2005, DWR-20C** The movement of Sacramento River water into the south Delta when the temporary agriculture barriers are installed was studied by modeling particle tracking and volumetric fingerprints under two historical periods. At San Joaquin River at Brandt Bridge and Middle River at Union Point, the San Joaquin River dominates as source of water over the study periods. However, at Old River at Tracy Road, the Sacramento River and San Joaquin River alternately dominate depending upon San Joaquin River flow at Vernalis, combined SWP and CVP pumping, and south Delta barrier configuration. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/e88306e3-ec08-4f95-8b25-9beaebf0e955 https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/delta_salinity/exhibits/dwr/historical_dsm2.wmv								X

26	**Department of Water Resources Testimony for SWRCB Hearing on Cease and Desist Order Agriculture in the Southern Delta, DWR-21, 10/14/05 (Paul Marshall)** Testimony provided to the SWRCB regarding agriculture in the south Delta, background on the origins of the south Delta salinity objectives, and arguments for changing the salinity objective to more adequately protect beneficial uses of water in the south Delta. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/delta_salinity/exhibits/dwr/dwr21.pdf							**X**
27	**Department of Water Resources Comments on SWRCB SED (Mark Holderman) 3-20-13** Summary of the points presented:1.Temporary Barriers improve water levels in South Delta and more than compensate for the effects of the project. 2. Temporary Barriers improve circulation. 3. For most periods, the sources of water at Old River at Tracy Road originate from San Joaquin River and local agricultural drainage. The only exception is when there is a barrier at head of Old River. 4. Null zones occur with and without project at about the same frequency. 5. Null zones do not equal poor water quality. 6. Using 2011 (high flow period) observed data, it is demonstrated that poor water quality in Paradise Cut is directly affecting salinity at Old River at Tracy Road. In absence of flushing flows though Paradise Cut, there was a fairly immediate increase in salinity in Paradise Cut, suggesting that there is some sort of an extremely active high salinity local source inside Paradise Cut, which in turn degraded water quality at Old River at Tracy Station. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/06e8441b-6154-45b3-80f8-2ab8ee2cea12		**X**					
28	**Delta Island Consumptive Use Monitoring 2019 Status Update, Juan Escobar, Memo Report, DWR (2009)** This report updates the plan by DWR to provide information needed by DWR estimates of Delta consumptive use and channel depletions by deploying multiple salinity and groundwater level monitoring sensors, contingent upon acquiring Temporary Entry Permits. Forty-four wells at 34 sites, all originally part of two now-defunct DWR seepage monitoring programs, have been chosen for this effort. These wells span the north and south Delta. All but 6 wells were found in good shape. Sensors with data loggers have been deployed in nine wells with conductivity, TDS, temperature and pressure data being collected. Twelve additional sensors will be installed by the end of August 2019. After an initial testing phase, data will be uploaded to Hydstra. https://data.cnra.ca.gov/dataset/south-delta-studies-reference/resource/391a64fe-77f6-4c54-967c-ed2856647784					**X**		