BUREAU OF RECLAMATION

2021 Management Agency Agreement Annual Report

October 1, 2020 – September 30, 2021

U.S. Department of the Interior 2021

Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Abbreviations and Acronyms

Action Plan	Actions to Address the Salinity and Boron TMDL Issues for the Lower San Joaquin River November 2008
Basin Plan	Water Quality Control Plan for the Sacramento and San Joaquin River Basins, 5th Edition
BMP	Best Management Practices
BO	Biological Opinion
CALFED	California Bay-Delta Authority
CVO	Central Valley Operations
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CV Water Board	Central Valley Regional Water Quality Control Board
CV-SALTS	Central Valley Salinity Alternatives for Long Term Sustainability Stakeholder Group
D-1641	State Water Resources Control Board Decision 1641
DF	Base Design Flow
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
EC	Electrical Conductivity
GBP	Grassland Bypass Project
GDA	Grassland Drainage Area
GDF	Goodwin Dam Flow
GWD	Grassland Water District
LSJR	Lower San Joaquin River
LSJRC	Lower San Joaquin River Committee

MAA	Management Agency Agreement
MID	Modesto Irrigation District
MOU	Memorandum of Understanding
NOAA	National Oceanic and Atmospheric Administration
mg/L	milligram(s) per liter (parts per million)
PTMS	Program to Meet Standards
Reclamation	United States Department of the Interior Bureau of Reclamation
Regression Model	inverse gradient regression model
RFC	California-Nevada River Forecast Center
RTMP	Real Time Management Program
SJR	San Joaquin River
SJRIP	San Joaquin River Water Quality Improvement Project
SJVDA	San Joaquin Valley Drainage Authority
State Water Board	State Water Resources Control Board
TAF	Thousand Acre-Feet
TDS	Total Dissolved Solids
TID	Turlock Irrigation District
Title XVI	Title XVI of the Reclamation Projects Authorization and Adjustment Act of 1992 (P.L. 102-575), provides funding specifically for water reuse projects in 17 western states and Hawaii
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
VAMP	Vernalis Adaptive Management Plan
WARMF	Watershed Analysis Risk Management Framework
WQO	Water Quality Objective
WRDP	Westside Regional Drainage Plan

2021 MAA Summary of Reclamation Activities

Purpose

The Central Valley Regional Water Quality Control Board's (CV Water Board) Control Program for Salt and Boron Discharges into the Lower San Joaquin River (LSJR), also known as the Salt and Boron Total Maximum Daily Load (TMDL), was approved, and placed into effect on September 10, 2004. In response to the Salt and Boron TMDL, the U.S. Bureau of Reclamation (Reclamation) developed the salinity management plan titled *Actions to Address the Salinity and Boron TMDL Issues for the Lower San Joaquin River* (Action Plan) and entered into a Management Agency Agreement (MAA) with the CV Water Board on December 22, 2008. The MAA described Reclamation's actions to meet the obligations allocated to it by the Salt and Boron TMDL for the LSJR. In the MAA, Reclamation agreed to implement the Action Plan. Figure 1 shows seven TMDL subareas for salt load management in the LSJR Basin.

Reclamation and the CV Water Board revised the MAA on December 4, 2015. The revised MAA does not reference the Action Plan. However, Section 2.3d of the revised MAA states that "Reclamation actions will be detailed in an Annual Work Plan and submitted along with a Status of Activities to Date from the previous year."

This report summarizes activities conducted by Reclamation in fiscal year (FY) 2021 in conjunction with the related elements outlined in the revised MAA. The original Action Plan described Reclamation's past practices and procedures to mitigate and manage adverse impacts of salt and boron imported into the San Joaquin Basin via the Delta-Mendota Canal (DMC) to help achieve compliance with the objectives contained in the CV Water Board's *Water Quality Control Plan for the Sacramento River and the San Joaquin River Basins – 5th Edition* (Basin Plan). Reclamation reported the activities in quarterly reports as agreed to in the 2008 MAA. In the 2015 revised MAA (referred to as the MAA from here forward), Reclamation activities are now reported at the end of each calendar year in the Annual Report and activities planned for the next fiscal year are proposed in the Annual Work Plan.

Organization of the Annual Report

The Annual Report provides a synopsis of the various activities performed by Reclamation in accordance with the MAA. Action categories include Providing Flows to the System, Salt Load Reductions, and Phased Program Activities. For each action a brief description and list of activities are provided. The Annual Report includes calculations of salt loads based on DMC deliveries and calculations of assimilative capacity provided through dilution flows. The *Compliance Monitoring and Evaluation Plan,* dated May 2010 and submitted in 2010, outlines the criteria and methodology for determining DMC loads and credits.

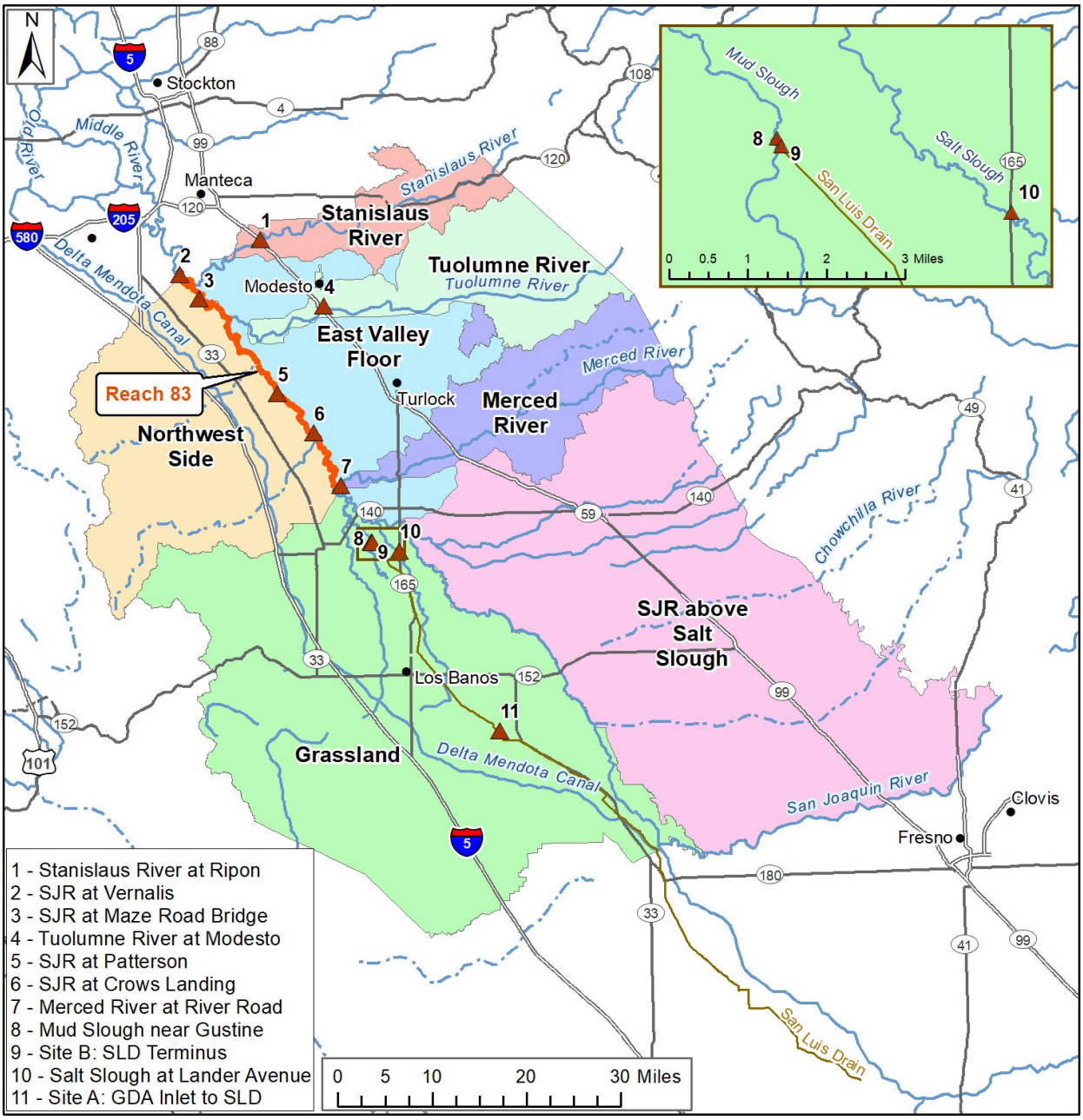

Figure 1. TMDL Subareas for Salt Load Management in the LSJR Basin

Providing Flows to the System

In 2000, Reclamation agreed to the provisions in the State Water Resources Control Board's (State Water Board) revised Decision 1641 (D-1641), which require the release of flows from New Melones Reservoir (Figure 2) to meet the Vernalis salinity objectives. Historically, Reclamation has provided both fishery and water quality dilution flow to the San Joaquin River (SJR) from New Melones Reservoir and through purchases for the Vernalis Adaptive Management Plan (VAMP) or the Central Valley Project Improvement Act (CVPIA). The SJR Agreement, which included

provisions to acquire spring and fall pulse flows for the VAMP, expired on December 31, 2011. Reclamation continued to provide interim spring pulse flows for the SJR through a two-year agreement with Merced Irrigation District, which expired on December 31, 2013. During this timeframe, stakeholders within the watershed, including Reclamation, initiated the San Joaquin Tributary Settlement Process to formulate a collaborative solution to present as an alternative to the State Water Board's new proposed SJR flow standard.

New Melones Reservoir Operations – Provision of Dilution Flow

In the Flood Control Act of October 1962, Congress reauthorized and expanded the function of the Melones Reservoir (P.L. 87-874) to become a multipurpose reservoir constructed by the U.S. Army Corps of Engineers and operated by the Secretary of the Interior as part of the Central Valley Project (CVP), thus creating the New Melones Reservoir. Reclamation signed a Memorandum of Understanding (MOU) with the CV Water Board in 1962 to schedule water releases from New Melones to maintain a dissolved oxygen level of 5 milligrams per liter (mg/L) in the Stanislaus River at the Ripon monitoring station, downstream of the reservoir. The multipurpose objectives of the reservoir now include flood control, irrigation, municipal and industrial water supply, power generation, fishery enhancement, water quality improvement, and recreation. Since June of 2009, New Melones Reservoir has been operated by Reclamation to meet the National Marine Fisheries Service Biological Opinion (BO). The BO addresses the effects of the continued operation of the CVP and the California State Water Project on the various runs of Chinook salmon, Central Valley steelhead, and green sturgeon, and their designated critical habitats.

Figure 2. New Melones Reservoir

The Basin Plan was amended in 2004 to include a control program for salt and boron discharges into the LSJR. The control program dictated that through the MAA between Reclamation and the CV Water Board, Reclamation would either (a) meet DMC salinity load allocations, or (b) provide dilution flows to create additional salt load assimilative capacity in the LSJR equivalent to DMC salt

loads in excess of their allocation. Items 12 and 13 in the Salt and Boron Water Quality Control Program include the following statements:

> **Item 12**. Salt loads in water discharged into the LSJR or its tributaries for the express purpose of providing dilution flow are not subject to load limits described in this control program if the discharge:
>
> a) Complies with salinity Water Quality Objectives (WQOs) for the LSJR at the Airport Way Bridge near Vernalis;
>
> b) Is not a discharge from irrigated lands; and
>
> c) Is not provided as a water supply to be consumptively used upstream of the San Joaquin River at the Airport Way Bridge near Vernalis.
>
> **Item 13**. Entities providing dilution flows, as described in item 12, will obtain an allocation equal to the salt load assimilative capacity provided by this flow. This dilution flow allocation can be used to: 1) Offset salt loads discharged by this entity in excess of any allocation or; 2) trade, as described in item 10. The additional dilution flow allocation provided by dilution flows will be calculated as described in Table IV-8 (CV Water Board 2018).

Activities

Reclamation continues to operate its New Melones facilities to comply with State Water Board D-1641, New Melones Interim Plan of Operations, the applicable BOs, and the Stanislaus River at Ripon monitoring station dissolved-oxygen criteria.

Quantification Methodology: Table IV-4.4 (CV Water Board 2017) states that dilution flow allocations should be calculated as follows:

$$A_{dil} = Q_{dil} \times (C_{dil} - WQO) \times 0.8293$$

Where:

A_{dil} = Monthly assimilative capacity provided by a dilution flow (expressed as salt load) in tons per month

Q_{dil} = Dilution flow rate in thousand acre-feet (TAF) per month [above base flows]

C_{dil} = Electrical conductivity (EC) of the dilution flow in micro-Siemens per centimeter (µS/cm)

WQO = Salinity water quality objective for the LSJR at Airport Way Bridge near Vernalis in µS/cm

Table 1 lists data and monthly calculations for the past year. Data for flow releases from Goodwin Dam, the Stanislaus River, "design flows," and salinity at Orange Blossom Bridge are used to calculate the monthly dilution flow allocations. When Goodwin Dam flows are less than base design flows, the flows are adjusted to equality to set assimilative capacity for the month to zero. The water-year type is estimated based on the 75% probability of exceedance found in California Department of Water Resources (DWR) Water Supply Index Forecasts (https://cdec.water.ca.gov/reportapp/javareports?name=WSI) for the San Joaquin Valley. The 75% exceedance flow forecast for May 1, 2021, is 1.3, which classifies 2021 as a "critically dry" year. In 2021 the SJR Valley floor received 50% of the average seasonal rainfall.[1]

Table 1. Salt Load Assimilative Capacity of Goodwin Dam Releases to the San Joaquin River, Water Year 2021

	Goodwin Dam Flow (GDF)[a] TAF	Base Design Flow (DF)[b] TAF	Qdil =GDF-DF TAF	WQO[c] µS/cm	Monthly Average EC at Orange Blossom Bridge (Cdil)[d] µS /cm	Monthly Assimilative Capacity Adil, tons
October 2020	38	10	28	1,000	70	21,595
November 2020	14	14	0	1,000	70	0
December 2020	12	13	0	1,000	75	0
January 2021	13	9	4	1,000	74	3,072
February 2021	21	8	13	1,000	85	9,865
March 2021	20	9	11	1,000	79	8,402
April 2021	44	28	16	1,000	70	12,340
May 2021	45	28	17	700	61	9,009
June 2021	79	0	79	700	57	42,084
July 2021	92	0	92	700	57	49,058

[1] https://www.cnrfc.noaa.gov/monthly_precip_2021.php

	Goodwin Dam Flow (GDF)[a] TAF	Base Design Flow (DF)[b] TAF	Qdil =GDF-DF TAF	WQO[c] µS/cm	Monthly Average EC at Orange Blossom Bridge (Cdil)[d] µS /cm	Monthly Assimilative Capacity Adil, tons
August 2021	55	0	55	700	53	29,533
September 2021	18	1	17	1000	55	9,093
Total						194,050

[a] https://www.usbr.gov/mp/cvo/reports.html

[b] Reclamation 2010 Compliance Monitoring and Evaluation Plan

[c] State Water Board Decision 1641

[d] http://cdec.water.ca.gov/dynamicapp/staSearch

Water Resources and Water Quality Regulation

The CVPIA, signed into law on October 30, 1992, modified priorities for managing water resources of the CVP. The CVPIA altered the management of the CVP to elevate fish and wildlife protection, restoration, and enhancement as a co-equal priority with water supply for agriculture and municipal and industrial purposes while recognizing other associated benefits such as power generation. To meet water acquisition needs under CVPIA, the U.S. Department of the Interior developed a Water Acquisition Program as a joint effort between Reclamation and the U.S. Fish and Wildlife Service. The program's purpose is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the Department of the Interior's ability to meet regulatory water quality requirements.

Activities

Reclamation did not acquire any additional water for water quality purposes in 2021.

Salt Load Reductions

Reclamation is under a court order to provide drainage to the San Luis Unit on the west side of the San Joaquin Valley. As part of this effort, Reclamation historically supported the Westside Regional Drainage Plan (WRDP) through grants and in-kind services. Incidental salt load reduction actions have included the Grassland Bypass Project (GBP)(ended on December 31, 2020), implementation of the WRDP, and the following conservation programs: Water Conservation Field Services Program, WaterSMART Water and Energy Efficiency Grants (formerly Water 2025 Grants

Program), and the California Bay-Delta Authority (CALFED) Bay-Delta Water Use Efficiency Program. Although most of these programs were not initiated as salt load reduction efforts, their successful implementation has resulted in measurable reduced salt loading to the lower SJR.

Grassland Bypass Project (GBP)

The GBP was a multi-agency stakeholder project currently based upon the 2009 Use Agreement[2] between Reclamation and the San Luis and Delta-Mendota Water Authority to manage and reduce the volume of agricultural drainage water produced within the Grassland Drainage Area (GDA). The Project used a 28-mile section of the San Luis Drain to convey this drainage water to Mud Slough, a tributary of the SJR. Annual and monthly reductions in allowable selenium load discharge to Mud Slough were part of the negotiated Use Agreement and were successfully met over the past 20 years of the project. All selenium drainage loading from the GDA to Mud Slough ceased on December 31, 2020 after which all subsurface drainage was diverted to the 6,500 acre San Joaquin River Improvement Project (SJRIP) facility. The Interagency Data Collection and Review Team and the San Joaquin Valley Drainage Authority (SJVDA) negotiated a provision to allow flood flows to be conveyed by the San Luis Drain during unusual precipitation events to prevent widespread flooding of the GDA watershed. The GBP has been a highly successful example of agency and stakeholder cooperation to slowly phase out the non-point source environmental pollutant selenium from the water quality impaired SJR.

Activities

- Although the GBP was specifically designed to address selenium non-point source loading to the SJR, the GBP also significantly reduced the drainage discharge loading of salt and boron. The SJRIP now receives all subsurface drainage water from the GDA. The SJRIP has slowly expanded its footprint to accommodate continued inflow as the salinity has increased on some of the acreage and alfalfa crop production has been replaced with Jose tall wheatgrass – a more salt tolerant crop that is in high demand from local livestock producers but has less economic return than alfalfa.
- Prior to Water Year 1996, more than 191,000 tons of salts and 357 tons of boron were discharged annually from the GDA to the LSJR.
- During Water Year 2021, 11,000 tons of salts and 45 tons of boron were discharged from the GDA to the San Luis Drain.
- These significant reductions are the result of selenium-reduction activities conducted by the Grassland Area Farmers with the support of Reclamation to develop and operate the SJRIP reuse area.

[2] U.S. Bureau of Reclamation and the San Luis and Delta-Mendota Water Authority, December 22, 2009. Agreement for Continued Use of the San Luis Drain for the Period January 1, 2010, through December 31, 2019. Agreement No. 10- WC-20-3975.

- During Water Year 2021, approximately 151,000 tons of salts and 283 tons of boron were displaced to the SJRIP. Absent the collaboration between Grassland Area Farmers and Reclamation, these loads would have been discharged to the LSJR.

Figure 3 shows the progressive reduction of salts discharged from the GDA[3] due to agricultural flow diversion to the SJRIP.

Figure 4 shows the progressive reduction of boron discharged from the GDA. For Water Year 2021, 45 tons of boron was discharged to the LSJR from the GDA and approximately 283 tons were displaced to the SJRIP.

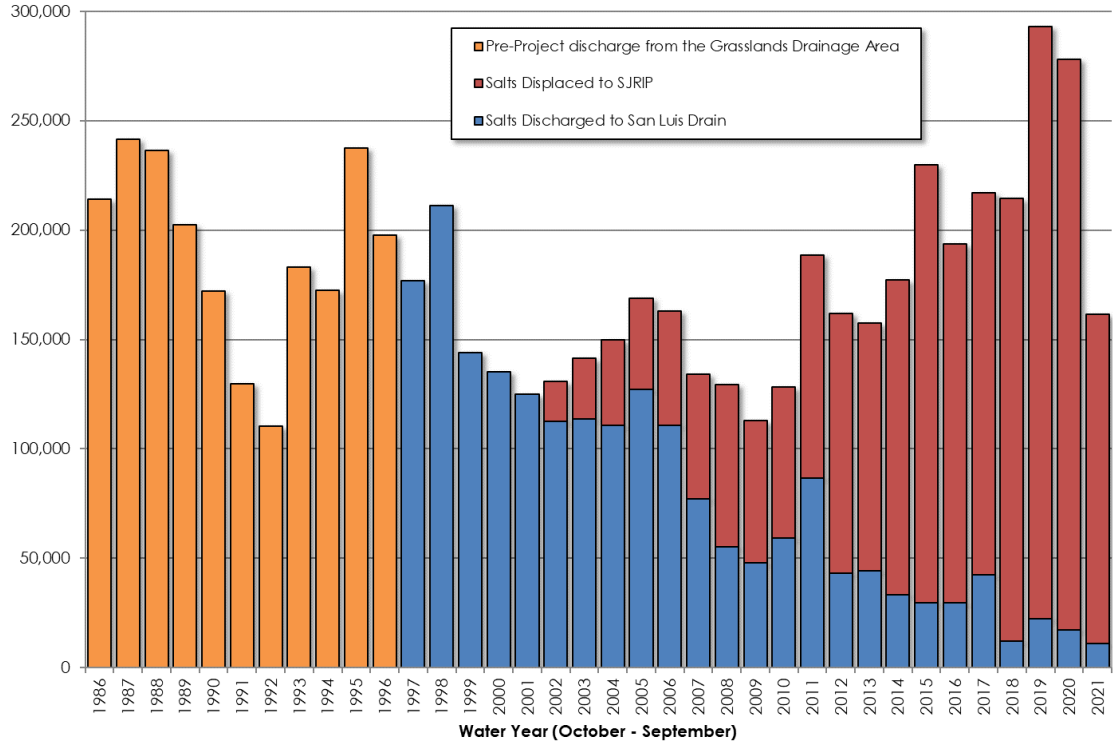

Figure 3. Salts Discharged from the Grassland Drainage Area (tons)

[3] Data Sources: CV Water Board (pre-project), Reclamation, and Summers Engineering.

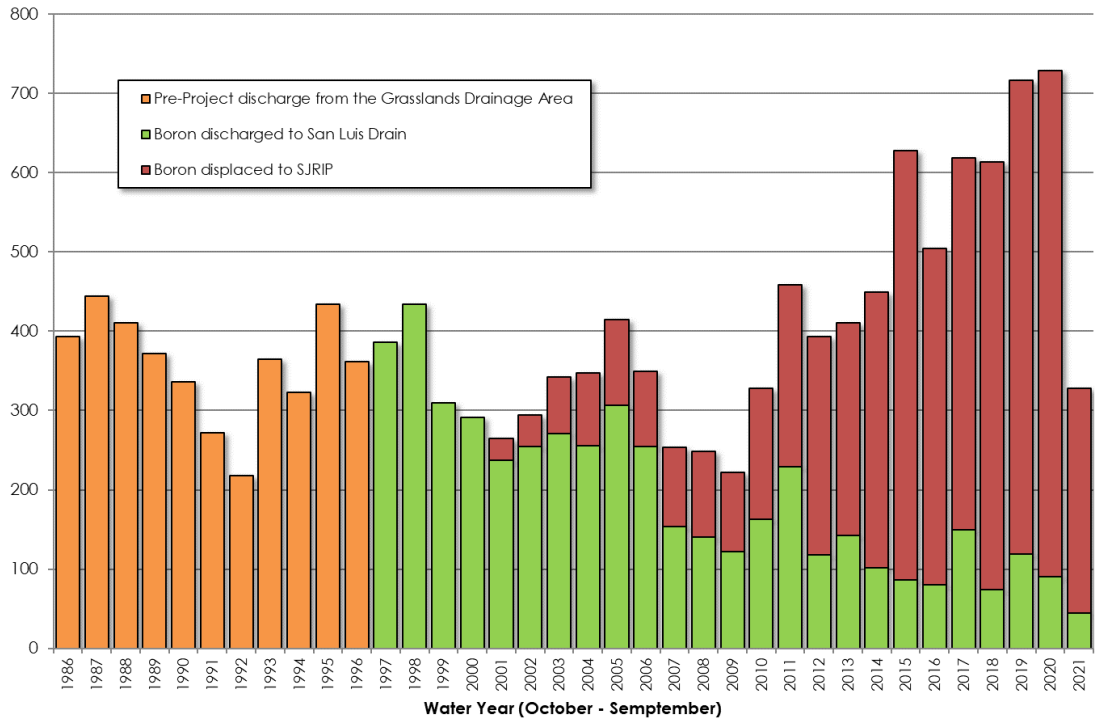

Figure 4. Boron Discharged from the Grassland Drainage Area (tons)

- The current GBP operates as a storm water management project under the CV Water Board Order R5-2019-0077, which has recently been updated. Runoff from winter rainstorms on the GDA has been conveyed through the San Luis Drain.
- Reclamation continues to collect and analyze water samples from nine sites for selenium, boron, salts, nutrients, and molybdenum, and continues to operate auto-samplers in the San Luis Drain and in the river at Crows Landing.

Westside Regional Drainage Plan

The WRDP is a local stakeholder program developed by integrating all consistent elements of drainage management developed by government and local agencies and private partnerships. The original efforts of the WRDP focused on reducing selenium discharges to the SJR. The initial goals of the WRDP have been met although the original plan did not recognize the importance of real-time monitoring and management in the success of this initiative.

Additional Activities Benefiting Salt Management

- The GDA continues to implement activities associated with the WRDP and SJRIP. The SJRIP reuses subsurface agricultural drain water from the GDA to irrigate salt-tolerant crops such as Jose tall wheatgrass, alfalfa, and pistachio trees.
- The San Luis Demonstration Treatment Facility Plant was shut down for renovations on December 31, 2018. Reclamation posted a solicitation to retrofit the feed pumps and other

aspects of the solids waste handling system at the demonstration plant on July 22, 2019. Construction is ongoing.

- Reclamation has provided approximately $45 million in past funding to the SJRIP and continues to support reuse activities at the facility.
- Reclamation will continue to fund activities in the western San Joaquin Valley through the WaterSMART Program. The competitive grant program has been expanded beyond the drought resiliency and water and energy efficiency themes to include watershed management that is better aligned with the goals and cyberinfrastructure themes of real-time water quality management.
- Del Puerto Water District has completed a $12.075 million grant for reuse of municipal recycled wastewater from the eastside of the San Joaquin Valley as an agricultural water supply. Treatment plants operated by the cities of Turlock and Modesto provided the reclaimed effluent that was piped to Del Puerto Water District. The success of this program could be replicated in other regions of the San Joaquin Valley to the mutual benefit of the cities involved and irrigated agriculture.
- For Water Year 2021 (October 2020 through September 2021), Grassland Basin Drainers report a displacement of 19,515 acre-feet of agricultural drainage water to the SJRIP, containing 151,000 tons of salts and 283 tons of boron. Absent the SJRIP, these salt and boron loads would have been discharged into the LSJR.

Water Conservation Efforts Benefiting Salt Management

The water use efficiency program includes several grant programs which fund actions to assure efficient use of existing and new water supplies. Activities to improve water use efficiency can alter the magnitude and scheduling of water diversions from Reclamation canals providing additional benefits. These activities can also result in reduced discharge of agricultural drainage and associated pollutants, improving water quality in receiving waters such as the SJR. Although Reclamation is not always able to quantify the benefits of the various funded projects with respect to salt load reduction, these projects all contribute to the agency's water conservation efforts in the Basin. Funding for approximately 100 projects in the San Joaquin Valley have been awarded through programs such as WaterSMART, the Reclamation/Natural Resources Conservation Service partnership, and the CALFED Bay-Delta Restoration Program. Most of these programs have required quantifiable benefits and measurable performance measures since 2006.

The funding Reclamation provided in FY 2021 is listed in Table 2.

Table 2. Fiscal Year 2021 Reclamation Funding

No.	Funding Program	FY 2021 Allocation
I.	Program to Meet Standards • Provided financial assistance to GWD for providing support in the real-time management program by collecting and providing data to Reclamation and for providing stakeholder coordination • Systech Water Resources Inc. is developing a new auto-data retrieval and process tool with an interface for WARMF model input in FY 2021. The new tool will be available to use in FY 2022 • University of California at Merced provided technical support and stakeholder coordination via a Cooperative Ecosystem Studies Unit agreement • Reclamation staff provided technical support and project management activities	$750,000
II.	Title XVI 2021 additional funding of following projects • Monterey One Water - Pure Water Monterey - Groundwater Replenishment Project • Del Puerto -The North Valley Regional Recycled Water Program • Sac Regional County - South Sac County Agriculture & Habitat Lands Recycled Water Program • City of Pismo Beach - Central Coast Blue • Water Soquel Dist. Feasibility Santa Cruz City • Santa Margarita Water District	$43,044,555

Phased Program Activities

The MAA lists several actions that are intended to improve management of salt and boron loads in the SJR. These actions have been phased in coordination with SJR Basin stakeholders, and each of these phases has been associated with primary goals. These phases and goals were recognized in the most recent Work Plans developed jointly with the San Joaquin Real- Time Management Program (RTMP) Steering Committee (Reclamation 2018, 2019, 2020, 2021). This reorganization of the description of activities has helped to make the annual reporting of program activities and accomplishments easier to follow and understand. The RTMP Steering Committee meets quarterly and includes both East- and Westside San Joaquin Basin stakeholders, agency personnel, and consultants.

Phases 1 and 2 of the RTMP were focused on initiation (Phase 1) and an early development phase (Phase 2) that tackled monitoring station design, installation, and operation (Goal 1); engaging stakeholder participation (Goal 2); stakeholder cooperation to seek grants and other external funding

(Goal 3); and initial development of a watershed-level water quality simulation and water quality forecasting tool that would provide essential decision support for salt load assimilative capacity determination and salt load management (Goal 4). Phase 2 of the San Joaquin RTMP occurred from March 31, 2015, to March 31, 2016. Some goal elements from Phase 2 have been carried forward into Phases 3 and 4.

Phase 3 of the RTMP was the early implementation phase, which concluded in March 2018. Goals under this phase included programmatic weekly forecasting of assimilative capacity in the SJR by one or more cooperating RTMP entities (Goal 1); initiation of data-sharing activities between and among stakeholder entities and information technology innovations to facilitate secure and reliable data flows (Goal 2); periodic analysis of additional infrastructure needs and funding requirements through feedback from the MOU Steering Committee (Goal 3); development and recommendation of specific additional management practices needed to better coordinate the real-time operation of discharges to the SJR (Goal 4); and proactive outreach to current and prospective stakeholder entities in the Basin, specifically those who have not participated in the RTMP to date.

Phase 4 of the RTMP is the implementation phase, in which activities that started in Phases 2 and 3 become fully realized and are formalized as part of an ongoing RTMP. There are technical and institutional components to Phase 4 of the RTMP. Under Phase 4, RTMP participants continue to implement and upgrade monitoring, data networking, and management practices as needed. The WARMF salt load assimilative capacity forecasting model is expected to be utilized by stakeholders to coordinate the timing of drainage discharges to the river with available salt load assimilative capacity (Goal 1); RTMP participants also continue to address long-term funding and project needs (Goal 2); and the RTMP current membership may expand to include all regulated parties that includes both direct and indirect dischargers of salt to the SJR (Goal 3). Ongoing implementation may bring about technical improvements to data processing, quality assurance, and the SJR assimilative capacity forecast modeling (Goal 4).

Ongoing Phase 3 Activity Summary (April 2016 – September 2021)

Goal 1: Model-Based Forecasting of Salt Assimilative Capacity

Reclamation has actively supported the development of SJR salinity forecasting models, including the WARMF model, to estimate daily river salt assimilative capacity and to provide decision support for real-time salinity management at the watershed level. The model allows substitution of real-time, continuous data of flow and salt loads from tributaries and water district diversions. The accuracy of salt load assimilative capacity forecasts requires both the provision of recent flow and salinity data and information on anticipated management actions that could impact flow and salinity over the two-week forecast period. The accuracy of these forecasts is a direct function of the stakeholder willingness to share information in a timely manner and take interest in the disseminated forecasts.

In addition, starting in FY 2018 and continuing through FY 2021, Reclamation has been using a simple, data-driven Regression model for estimating EC at all three compliance monitoring stations (Vernalis, Maze Road Bridge, and Crows Landing) on the SJR. The new compliance monitoring station at Maze Road Bridge specifically recognizes the reach upstream of Vernalis to protect riparian diverters along Reach 83. One advantage of this simplified, data-driven approach focused just on SJR salinity, is that forecasts can be more easily automated. The basis for the inverse gradient

Regression model is the relationship between the river's flow and its EC such that: (1) EC decreases when stream flow increases, and vice versa and (2) the EC's rate of change is proportional to the river's change in flow rate. The inverse gradient Regression model has provided good forecast accuracy, as demonstrated in a recent internal report produced by Dr. Michael Tansey that compares the daily Regression forecasts and WARMF model forecasts with observations of flow and EC (Tansey Report 2020). A peer-reviewed journal article was recently published in *Water* that summarizes major findings of this report and demonstrates the use of both forecasting models during April 2021 when the 30-day running average EC objective at Crows Landing was exceeded for several weeks (Quinn, Tansey, and Lu 2021). Results of the analysis for the years 2018 to 2020 suggested that the Regression model performed similarly to the WARMF model for forecasting EC at the Vernalis and Crows Landing compliance monitoring stations. The Regression model can provide reliable forecasts that are less time-consuming to perform and a valid alternative to WARMF model forecasts of salinity in the SJR.

However, as a tool for stakeholder decision support in the case of non-compliance with river salinity objectives at the Crows Landing monitoring site, the WARMF model provides more information on the current state of the system – a necessary requirement to manage salinity load management actions.

Recent forecasts performed during September 2021 – where severe drought conditions in the SJR have threatened cutbacks or even termination of irrigation diversions from the river and have encouraged more on-farm reuse of drainage – have created problems for the Regression model. The Regression model relies upon a static inverse relationship between flow and EC, where an increase in flow is associated with a corresponding decrease in river EC. This response function is unique for each compliance monitoring station. However, in the current circumstances, cutback or curtailment of SJR diversions results in greater flow of water at the Maze Road Bridge and Vernalis compliance monitoring stations. The EC also increases since the increased flow carries more salt load. This violates the central assumption made by the Regression model. The WARMF model outperforms the Regression model in these circumstances and outperforms the flow forecasts made by the River Forecast Center that are based largely on the relationships between sequential flow monitoring stations along the main stem of the SJR.

On March 22, 2021 the measured EC in the SJR at Vernalis had risen to 1,137 μS/cm and the regular WARMF and Regression's 14-day forecasted EC at Vernalis was forecasted to be over 700 μS/cm in the upcoming month of April 2021. WARMF is a physical based watershed model that represents the real LSJR watershed system. It incorporates real-time data and forecasts to drive the simulations of inflows, diversions, irrigation, and drainage throughout the watershed. For model inputs with no forecast data available, WARMF uses typical observed values for the time of year to drive the simulation. On March 29, 2021 WARMF provided a 30-day forecast of Vernalis EC using historical data, including the annual draw down of wetlands and resulting decrease of flow and salinity load form Mud Slough, flow releases for fish in the Tuolumne River, and releases for fish and water quality from New Melones Reservoir. The WARMF forecast correctly anticipated that salinity would keep decreasing in the SJR in April 2021, meaning that the 30-day average EC at Vernalis would be met without any additional releases from New Melones Reservoir. The April 2021 decreases in flow and salt loading from Mud Slough and fish flows from Don Pedro Reservoir on the Tuolumne River incorporated in the WARMF forecast did actually occur, providing water

managers valuable and accurate information to guide decisions. The 30-day average salinity in the SJR at Vernalis met the water quality criteria in a validation of the RTMP.

Goal 2: Data Assimilation Automation and Centralization

Continued development work was undertaken in FY 2021 to improve data assimilation from State, Federal, and private water and water quality data web portals. The initiative to update data assimilation software, that began in late 2019, has introduced new subroutines that appear as buttons in the WARMF model graphical user interface that help to streamline and make more reliable the creation of WARMF model input data files. The ongoing work in FY 2021 was undertaken with the view of encouraging greater stakeholder access and involvement in the salt load assimilative capacity forecasting process.

Goal 3: Identification of Necessary Funding for Additional Infrastructure

Reclamation continues to participate in work on two Proposition 84 grants led by GWD and the SJRDA entitled: (a) "Optimizing Real-Time Management of Combined Surface and Subsurface Drainage Return Flows from Seasonally Managed Wetlands in the San Joaquin River Basin" and (b) "Real-Time Management of Surface and Subsurface Drainage Return Flows to Benefit Sustainable San Joaquin River Flow and Water Quality." The main objective of both grants has been to upgrade the monitoring hardware and cyberinfrastructure needed to move the real-time salinity management program into the implementation phase. Site installation upgrades have been completed in GWD. Diversion monitoring sensor installations have been completed downstream of pumps in both Patterson and West Stanislaus Irrigation Districts. As a sign of District cooperation on the RTMP both Districts chose to integrate the new water quality monitoring instruments with their existing supervisory control and data acquisition systems, that have been designed for flow monitoring and real-time water delivery throughout each District. Both Districts provide 15-minute and daily mean data reports to the Reclamation program each Monday morning in advance of results from the WARMF and Regression models being posted on Reclamation's website. This report contains daily flow, EC, and salt loading imported into the District as well as hourly flow and EC data and several other water quality parameters of interest to District landowners that include turbidity, nitrate, and pH/oxidation reduction potential. Drainage monitoring site installations measuring flow and EC sites in both Patterson and West Stanislaus Irrigation Districts were completed recently. Diversion flow and EC data as well as a weekly data report from the District's supervisory control and data acquisition system is being provided on the District website.

Goal 4: Development and Recommendation of Specific Additional Management Practices to Better Coordinate the Real-Time Operation of Discharges to the SJR

The RTMP is described in the TMDL as a stakeholder-driven effort to use real-time water quality and flow data to support water salinity management decisions to maximize the use of assimilative capacity in the SJR. Reclamation has been working with SJR stakeholders and participants in the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) initiative to support the development of a stakeholder-driven RTMP. Ongoing work on Goal 4 has been performed following the CV-SALTS Lower San Joaquin River Committee (LSJRC)'s development of salinity objectives for Reach 83 of the LSJR (Merced River inflow to Vernalis). Patterson Irrigation District and GWD currently use real-time sensor technology to both reduce drainage export to the SJR and reuse agricultural and wetland return flows, reducing DMC diversions. Drainage monitoring sites at Spanish Land Grant Drain and Marshall Road Drain allow the District access to flow and EC data

that provides decision support for operation of pumps to intercept this drainage and return it to Marshall Road Reservoir for reuse.

A multimillion-dollar drainage reuse system was completed in GWD in 2020 that is now operational. The real-time monitoring network monitors the EC of the intercepted drainage water and pumps the drainage water upslope to a pond where it is blended with surface water deliveries. The EC concentrations of the diverted wetland drainage is continuously monitored to ensure the blended water doesn't exceed salinity influent guidelines. Salinity that's too high could negatively impact wetland moist-soil plant habitat in the long-term. Reclamation is documenting other examples of stakeholder initiated real-time salinity management activities as we are made aware of them. The GWD wetland drainage recirculation system may be replicated in the State and Federal refuges if sufficient funding is made available and water supply allocations continue to be suboptimal.

Goal 5: Continued Outreach for Additional Stakeholders

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) are required to obtain full compliance with the RTMP in accordance with the Basin Plan's Salt and Boron Control Program in 2018. It wasn't until 2019 that TID and MID agreed to report operational spill and drainage return flow and EC data routinely for the eight discharge locations into the SJR and its major tributaries, the Stanislaus and Tuolumne Rivers. These return flows can add significant salt load assimilative capacity to the SJR and are critical for the development of accurate forecasts, especially during certain times of the year when the flow/EC Regression relationship is less reliable. In these instances, the WARMF model could provide better forecasts if reliable flow and EC data from these monitoring sites are available. MID has participated in the RTMP by providing daily operational spill and EC data for three sites each quarter. In the case of TID, flow data has been provided since 2018. However, it wasn't until 2020, with the completion of EC sensor upgrades, that TID became able to provide both flow and EC data. These data are also being provided quarterly upon request. The flow and EC data from MID and TID have been used to update WARMF model input files.

Reclamation continues to receive daily flow forecasts at Vernalis, Crows Landing, and Maze Road Bridge from the California-Nevada River Forecast Center (RFC) operated by the National Oceanic and Atmospheric Administration (NOAA). NOAA analysts in the RFC receive daily updates on reservoir release schedules from east-side reservoir operators and maintain a simple flow model for estimating reliable tributary outflow to the SJR. Although the RFC model does not include EC forecasts, the RFC flow forecasts significantly improve the reliability of 14-day projections made with both the Regression and WARMF models. Interaction with the RFC has also informed both Central Valley Operations (CVO) staff and NOAA analysts on the MAA water quality forecasting activities. This coordination led CVO to continue support for several important long-term San Joaquin Basin monitoring stations, including those at Mud Slough, Salt Slough, Crows Landing, and Fremont Ford.

Participation in the CV-SALTS Program and involvement in planning for the CV-SALTS Prioritization and Optimization Study has been an important component of Reclamation's salinity management program. The CV-SALTS stakeholder group, which includes representatives from industry, agriculture, environmental justice communities, municipalities, and State and Federal regulatory agencies, is a collaborative basin- planning effort aimed at developing and implementing a comprehensive salinity and nutrient management program for the Central Valley. The Salt and

Nitrate Control Program for the Central Valley, a Basin Plan amendment crafted by CV-SALTS, was adopted by the CV Water Board in 2018 and the State Water Board in 2019. The plan uses regulation to: (1) create management zones to control and reduce nitrate in Central Valley groundwater while supplying potable water to impacted communities and (2) implement the phased Salt Control Program guided by the results of the upcoming 10-year long Prioritization and Optimization Study. This study will help to identify projects and management practices that are most likely to achieve long-term, salt sustainability in the Central Valley. The Control Program for Salt and Boron Discharges into the LSJR will remain in effect as an element of the overall Salt and Nitrate Control Program for the Central Valley.

Reclamation experienced staff turnover during FY 2021, which limited participation in the CV-SALTS Executive Committee meetings; however, Reclamation has filled the open position and plans to attend all CV-SALTS Executive Committee meetings during FY 2022. In prior years, Reclamation also participated in CV-SALTS sub-committees, including the Technical Advisory Committee and LSRC. It is anticipated that the Technical Advisory Committee will be revived to oversee modeling studies that will play an important role in the Prioritization and Optimization Study. Models that will likely be used – the U.S. Geological Survey (USGS) CVHM2 model and the WARMF model for the SJR Basin – are models that have been supported and enhanced with Reclamation funding during FY 2021.

The Reclamation RTMP was approached by GWD, which has an interest in developing its own salinity management plan under the conservative salinity permitting approach outlined in the CV-SALTS Prioritization and Optimization Study. Part of the motivation for taking this approach was to align salinity management actions more closely with the Groundwater Sustainability Plan developed for the Grassland Ecological Area and Grassland Subarea and to have a modeling tool capable of simulating surface and groundwater hydrology as well as salt loading to provide the basis for future decision-making. The WARMF model, initially developed for the SJR dissolved oxygen TMDL and significantly enhanced under Reclamation's Program to Meet Standards (PTMS), has been suggested as a suitable tool for this initiative. Reclamation has offered technical support to GWD and is developing a suite of training materials in support of this effort.

Phase 4 Activity Summary (April 2018 to Present)

Phase 4 activities include actions initiated during Phase 3 of the program that have been continued, as described above. In Phase 4 additional actions are being encouraged and supported that will lead to more widespread adoption of RTMP practices and better cooperation and coordination among stakeholders. Phase 4 also involves an institutional component to secure long-term funding and technical expertise to ensure continued success of the RTMP.

Goal 1: Continue to implement/upgrade monitoring and data networks and to support real-time management practices. Use salt load assimilative capacity forecasting to coordinate the timing of discharges to the river.

A successful RTMP requires telemetered networks of flow and salinity sensors along the main stem of the SJR and in watersheds draining to the SJR. The networks allow easy access to data, promote data sharing, and provide knowledge of scheduled releases from the reservoirs that discharge into eastside streams that are tributary to the SJR. Real-time quality assurance is essential to avoid posting erroneous data and to encourage data sharing.

- Reclamation has continued to provide funding and technical support to GWD for the continued development of its RTMP. GWD operates approximately 25 real-time web-based flow and water quality monitoring stations. With the help of additional grant funding through Proposition 84, the District has been able to restore and upgrade monitoring with state-of-the-industry instrumentation. The previous sensor network was more than a decade old and relied on the EcoNet telemetry system, discontinued in 2018. GWD now uses HydroMetCloud Data Services available through Sutron Corporation. The GWD instrumentation upgrade parallels the rehabilitation of a similar sensor network operated by the SJVDA along the SJR. By design, the same state-of-the-art sensor instrumentation and data collection platforms are being used by both projects.
- Real-time data for GWD and the SJVDA projects can be accessed on the HydroMetCloud web portal that lists both project sites:
  For GWD: http://hydrometcloud.com/ User: RTWQ@gwdwater Password: Grassland
  For the SJVDA: http://hydrometcloud.com/ User: sjvda-RTM Password: Realtime2020
- Reclamation continues to support its own online web portal where river flow and EC forecasts can be accessed. The site was redesigned to allow easy access from a smartphone by entering "Reclamation PTMS" in a search engine such as Google.com. This web application was demonstrated at stakeholder meetings in 2020 and 2021.

Goal 2: Continue to address long-term funding and project needs.

In 2019, Reclamation assisted UC Merced and wetland stakeholders in obtaining a Delta Ecosystem Restoration Grant to improve mercury and salt monitoring and management in the Grassland Ecological Area. The proposal, entitled "Integrated Science and Management of Nutrient, Salt, and Mercury Export from San Joaquin River Wetland Tributaries to the Delta," focuses on salt and mercury loading from two wetland impoundments in the Los Banos Wildlife Management Area and modeling potential management strategies to optimize control of both pollutants using the WARMF model. The project is characteristic of the type of collaboration and data sharing envisaged at the onset of the RTMP. Results of the three-year study will be applicable to all wetlands within the Grassland Ecological Area. GWD has provided support for this project by allowing additional water quality sensors, provided by UC Merced, to be mounted on their InSITU Aquatroll sonde at site SL1, which measures the flow and EC of supply water to the Los Banos refuge. This type of cooperation is an example of what we aim to achieve with the RTMP.

Goal 3: Expand real-time management program membership to include all regulated parties, including both direct and indirect dischargers of salt to the San Joaquin River.

The RTMP has, to date, focused on those subareas of the SJR Basin that directly discharge salt loads to the SJR. Grant funding over the past decade has supported flow and salinity loading monitoring at a number of agricultural drainage monitoring stations on the westside of the Basin and from seasonally managed wetlands. The California Department of Fish and Wildlife and the Grassland Resource Conservation District operate under Best Management Practices (BMP) to reduce the salt loads in discharges from managed wetlands into the SJR. Reclamation has provided resources to support the development of the real-time monitoring networks in GWD and we anticipate greater involvement from the State and Federal refuges during FY 2022 through stakeholder outreach efforts.

- Reclamation continues to support the network of real-time flow and water quality monitoring stations that provide flow and EC data at major GWD inlets and outlets as well as along the water distribution network.
- Reclamation funding for the GBP was $760,000 in FY21,[4] including $200,000 to the USGS to monitor five stations on the LSJR and tributary sloughs.
- Reclamation has secured funding for flow monitoring upgrades to the Mud and Salt Slough stations. The USGS will procure SONTEK acoustic Doppler transducers and complete the installation of these instruments by December 31, 2021. The use of these instruments will eliminate flow estimation errors associated with occasional backwater conditions where high river stage impedes tributary inflow and leads to unrealistic elevated flows. By measuring velocity directly these incidents can be eliminated, producing a more accurate data record and reducing staff time associated with additional field visits for data quality assurance.

Reclamation is working more closely with DWR (Fresno) to obtain better intelligence on current monitoring and site conditions at Maze Road Bridge. Water quality monitoring at this site was enhanced recently to include additional water quality parameters of interest to stakeholders. However, current low flow conditions have created challenges for DWR for both flow and water quality monitoring, which have led to instances of erroneous and missing data during 2021. Reclamation has adopted estimation techniques including making use of the current DWR rating table to estimate flow and EC at this important compliance monitoring station. The WARMF model, which is able to estimate a water mass balance using all available tributary and diversion data along the SJR has also been used to make these compliance assessments. During FY 2021 there were no recorded instances of exceedance of the Maze Road Bridge EC objectives.

Although, as described above, TID and MID provide quarterly flow and EC data reports electronically that can be used to update the relevant files in the WARMF model, Reclamation continues to work on protocols and an agreement with these entities that will allow provision of the data on or near a real-time basis. The long-term goal is to be able to completely automate data updating from these sources to the WARMF model.

An important data factor for accurate SJR salt load assimilative capacity forecasting is the estimation and forecasting of SJR diversions. The three largest diverters have the capability of removing more than half the flow in the SJR when flow at Vernalis is less than 1,000 cfs. Changes in volumes diverted from the SJR at the Patterson and West Stanislaus Irrigation District pump stations on the west side of the SJR can significantly impact SJR EC at the compliance monitoring stations at Maze Road Bridge and Vernalis. The SJVDA, through Proposition 84 grant funding, has made flow and EC data readily available at the Patterson and West Stanislaus ID stations during FY 2021 as previously described, in advance of weekly forecasts of flow and EC at the three compliance monitoring stations.

[4] The funding allocation is not specifically a part of the MAA RTMP but yields salinity benefits in the LSJR.

Goal 4: Continue technical improvements to data processing, quality assurance, and the SJR assimilative capacity forecast modeling.

Reclamation has continued to investigate further automation of data acquisition to reduce the data processing steps needed for WARMF model forecasts and simplifying the WARMF graphical user interface to reduce the model's learning curve while retaining model performance. The WARMF model relies on a very large array of both publicly accessible and more restricted data to reliably perform weekly forecasts of flow and EC. For the westside drainage stations Reclamation and the SJVDA have worked closely with Patterson and West Stanislaus Irrigation Districts to automate data collection to allow eventual migration of these data to the WARMF model using existing monitoring site telemetry resources and a web portal hosted by HostGator.com. This initiative has the added benefit of demonstrating to stakeholders the direct use of real-time data and helping to build confidence in the performance of the WARMF model.

Data quality assurance has always been a major constraint to implementation of the RTMP. Stakeholders are reluctant to share erroneous data for potential liability reasons. Poor data quality assurance also has potential to diminish stakeholder trust in the data and their willingness to utilize the data and the forecast model results for decision support. GWD used the hydrologic data management software WISKI for their own internal data quality assurance needs for several years. However, the maintenance of the WISKI-based system was a financial challenge for a small water district that could not afford dedicated personnel assigned to this task.

Ongoing collaboration with UC Merced and their wetland methylmercury and salinity management project has resulted in the development of a real-time data management system HEC-DSSVue that has been adapted for simple data quality assurance checks and error correction processing and that has potential for use by the SJVDA and GWD for their needs. The US Army Corps of Engineer's software is in the public domain and well documented. Customized Python scripts have been developed to work with HEC-DSSVue and the HOSTGATOR web portal (as CRON job scripts) to process raw data to produce daily mean flow and EC data files for direct import to the WARMF model. At present the most recent data from the SJVDA westside drainage stations and 10 years of data from GWD have been loaded into the HEC-DSSVue database. A user manual is under development to provide essential information to other potential users of this new real-time data quality assurance software.

Central Valley Project Deliveries Load Calculation

Brief Description: The CVP delivers water to both the Grassland and Northwest subareas, as described in the Basin Plan, through the DMC, the San Luis Canal, and the San Joaquin River/Mendota Pool. Most CVP water is pumped from the Delta into the DMC through the Jones Pumping Plant located near Tracy, California. CVP water is conveyed south to DMC Check 13 near Santa Nella, California, where water is either mixed with the State Water Project in O'Neill Forebay and then either pumped into San Luis Reservoir for later delivery through the DMC, or San Luis Canal, or conveyed further south to the DMC terminus at the Mendota Pool. During periods of drought, groundwater and river water are pumped into the DMC at several locations. The calculation methods used in this report are provisional, and some elements in this report do not include estimations of benefits at this time. Reclamation submitted the *Compliance Monitoring and Evaluation Plan* (Reclamation 2010), which outlines the criteria and methodology for determining DMC loads and credits, to the CV Water Board.

Quantification Methodology: The monthly amount of CVP water supply delivered to each district is prorated according to the area of each district within either the Grassland subarea, Northwest subarea, or outside of these subareas. The monthly mean salinity of CVP water is calculated from average daily measurements taken at three locations along the DMC. The salinity of CVP water delivered to each district is associated with the salinity monitoring site closest to the district's turnout along the DMC.

The Basin Plan allocates a salt load to Reclamation for water delivered to the Grassland and Northwest subareas. This background load allocation is calculated according to Table IV-8 as shown in the following equation:

$$LA_{DMC} = Q_{DMC} \times 52 \text{ mg/L} \times 0.00136$$

Where:

LA_{DMC} = Load Allocation of salts, in tons

Q_{DMC} = monthly amount of CVP water delivered to Grassland and Northwest subareas, in acre-feet

52 mg/L = "background" salinity of water in the San Joaquin River released at Friant Dam (per the Basin Plan) measured as total dissolved solids (TDS)

0.00136 = factor for converting units into tons

Actual DMC salt loads are calculated by the following equation:

$$L_{DMC} = Q_{DMC} \times C_{DMC} \times 0.00136$$

Where:

L_{DMC} = Actual DMC Load, in tons

Q_{DMC} = monthly amount of water delivered to Grassland and Northwest Subareas, in acre-feet

C_{DMC} = monthly average of salinity of the water delivered to Grassland and Northwest subareas, in mg/L TDS

0.00136 = factor for converting units into tons

Each subarea's Q_{DMC} is calculated and then paired with the associated monthly average TDS for that reach, so the equation becomes:

$$L_{DMC} = 0.00136 \times \Sigma(Q_{DMC} \times C_{DMC})_{\text{Subareas}}$$

This equation is then broken into calculations for each subarea based on the source of CVP water. Table 3 lists the salt loads of CVP water delivered to the Grassland and Northwest subareas and an estimate of the salts delivered in excess of the monthly load allocation.

Table 3. Calculation of DMC Allocations and Loads

Water Year	Water Year Type	San Joaquin River and Mendota Pool Salt Load from CVP (Grassland Subarea; 1,000 tons)	Delta-Mendota Canal Salt Load from CVP (Grassland Subarea; 1,000 tons)	San Luis and Cross Valley Canal Salt Load from CVP (Grassland Subarea; 1,000 tons)	Total Flow (Grassland Subarea; 1,000 acre-feet)	Load Allocation (Grassland Subarea; 1,000 tons)	Actual Load – Load Allocation (Grassland Subarea; 1,000 tons)	San Joaquin River and Mendota Pool Salt Load from CVP (Northwest Subarea; 1,000 tons)	Delta-Mendota Canal Salt Load from CVP (Northwest Subarea; 1,000 tons)	Total Flow (Northwest Subarea; 1,000 acre-feet)	Load Allocation (Northwest Subarea; 1,000 tons)	Actual Load – Load Allocation (Northwest Subarea; 1,000 tons)	Total Excess Load from CVP (1,000 tons)
2016	Dry	275.4	89.9	36.2	873.4	61.7	339.8	20.5	15.5	92.8	6.6	29.5	369.2
2017	Wet	147.5	57.8	20.1	1,031.4	72.9	152.6	9.3	11.0	122.8	8.7	11.6	164.1
2018	Below Normal	219.7	117.6	41.6	1,112.1	78.6	300.4	16.9	18.5	114.9	8.1	27.3	327.7
2019	Wet	167.2	75.7	27.7	1,023.0	72.3	198.3	12.1	11.8	109.6	7.7	16.2	214.5
2020	Dry	224.5	99.2	39.4	1,006.1	71.1	293.6	17.8	20.2	110.9	7.8	30.5	324.1
2021	Critical	266.4	104.8	43.7	777.8	55.0	361.4	19.5	29.1	95.6	6.8	41.7	403.1

Report of Annual Work Plan Activity Performance

Reclamation has met schedule milestones for the MAA and performance of actions for assisting SJR stakeholders in managing salt loads and offsetting the DMC salt load into the SJR. New Melones Reservoir continues to be operated in accordance with D-1641 water quality requirements.

During 2021, Reclamation continued to support the development and use of the WARMF-based 14-day forecasts for EC and discharge. The following two tasks were planned in FY 2021 and FY 2022:

1. WARMF model recalibration based on the most recent available data. The current WARMF model was originally set up and calibrated from 2005- 2007 for the Stockton Deep Water Ship Channel Dissolved Oxygen TMDL upstream studies. Since that time, there have been important changes to the watershed.

2. WARMF self-calibration and automation to closely match the model simulation to observations of flow and EC by using the most recent real-time data from the same day. The calibration using the most recent real-time data will significantly improve the model's forecasting accuracy. There are several time series inputs to the WARMF model for which observation data is not available but are important parts of the flow and salt balances on the SJR. These include seepage losses from the San Joaquin and Stanislaus Rivers, unknown saline inflow to the SJR, and operational spills from the TID and MID. Systech will develop utility programs which read the WARMF river output file and measured data files to determine the imbalance between simulated and measured flow and salt load in the SJR at the compliance monitoring stations to make required adjustments. Under most conditions, this will result in a better match between the model simulated flow and EC and observed data on the day before the forecasts are made. Unlike the Regression model that obtains SJR flow updates from the RFC daily – the WARMF model runs continuously. Having the ability to adjust initial conditions can help to improve WARMF model flow and EC forecasting performance.

The WARMF model has been made more accurate in 2020-2021 using the most recent available observation and analytical data of seepage losses from the SJR, seepage losses from the Stanislaus River, spill of relatively fresh water from the TID, and salt load discharges to the SJR of unknown origin.

Reclamation has not complied with the TMDL, which requires that excess salt loads delivered to the LSJR via the DMC be offset by its dilution flows. New Melones Reservoir releases added 194,000 tons of salt assimilative capacity to the SJR (Table 1). Combined with the 151,000 tons salt load displacement to SJRIP, the salt assimilative capacity was smaller than the total excess salt load associated with 2021 CVP operations, 401,000 tons of salt (Table 3).

The Salt and Boron Control Program states that "Participation in a Regional Water Board approved real-time management program and attainment of salinity and boron water quality objectives will constitute compliance with this control program." Compliance with the EC WQO suggests compliance with the boron WQO. Figure 5 shows that Reclamation has maintained annual compliance with the salinity WQO at Vernalis. In Figure 5, the 30-day running average of SJR EC at

Vernalis exceeded the regulatory limit of 700 µS/cm during April 1-19, 2021. Compliance with the regulatory EC limit at Vernalis is determined starting 30 days after the seasonal change in the regulatory limit (i.e., the 30-day running average adjustment begins each year on May 1). Therefore, the SJR EC at Vernalis was in full compliance with regulatory limits throughout Water Year 2021.

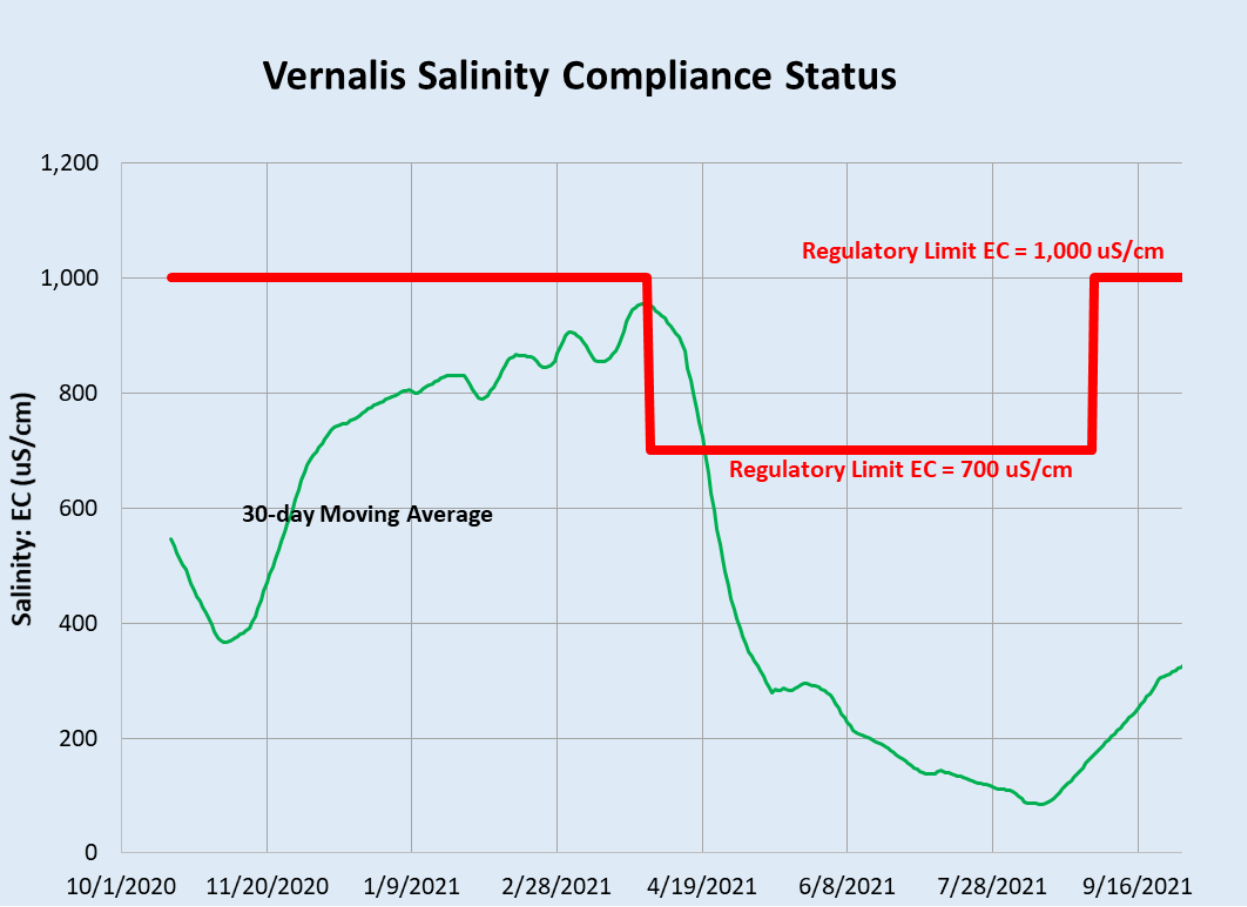

Figure 5. Water Year 2021 30-Day Average EC (µS/cm) and WQO

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