RECLAMATION

Managing Water in the West

Annual Report, FY2015
January 1, 2015 – December 31, 2015

In compliance with the "Management Agency Agreement between the Central Valley Regional Water Quality Control Board and the United States Bureau of Reclamation" executed on December 4th, 2014

Goodwin Dam on the Stanislaus River, California

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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
Authority	San Luis & Delta-Mendota Water Authority
Basin Plan	Water Quality Control Plan for the Sacramento and San Joaquin River Basins, 4th Edition
BMP	Best Management Practices
BO	Biological Opinion
CALFED	California Bay-Delta Authority
CCID	Central California Irrigation District
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
Corps	U.S. Army Corps of Engineers
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
DMC	Delta-Mendota Canal
DSS	Decision Support System
DWR	California Department of Water Resources
EC	electrical conductivity
GBP	Grassland Bypass Project
GDA	Grassland Drainage Area
GOES	Geostationary Operational Environmental Satellites
GRCD	Grassland Resource Conservation District
GWD	Grassland Water District
LBNL	Lawrence Berkeley National Laboratory
LSJR	Lower San Joaquin River
MAA	Management Agency Agreement
MOU	Memorandum of Understanding
µS/cm	micro Siemens per centimeter

mg/L	milligram(s) per liter (parts per million)
PTMS	Program to Meet Standards
Reclamation	United States Bureau of Reclamation
RTMP	Real Time Management Program
Service	U.S. Fish and Wildlife Service
SJR	San Joaquin River
SJRIP	San Juan Recovery Implementation Program
SJTSP	San Joaquin Tributary Settlement Process
State Water Board	State Water Resources Control Board
TAF	thousand acre-feet
TDS	total dissolved solids
TMDL	total maximum daily load
VAMP	Vernalis Adaptive Management Plan
WARMF	Watershed Analysis Risk Management Framework
WARMF – SJR	Watershed Analysis Risk Management Framework San Joaquin River
WDR	Waste Discharge Requirement
WQO	water quality objective
WRDP	Westside Regional Drainage Plan
WSI	Water Supply Index
YSI	Yellow Springs Instrument Company

Reclamation San Joaquin River Salinity TMDL MAA Summary of Activities to Date, 2015

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 July 28, 2006. In response to the Salt and Boron TMDL, the United States 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 Lower San Joaquin River. In the MAA, Reclamation agreed to implement the Action Plan.

Reclamation and the CV Water Board revised the MAA on December 4th, 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 2015 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) in order 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 – 4th Edition* (Basin Plan). Reclamation reported the activities in quarterly reports as agreed to in the 2008 MAA. As agreed to in the revised MAA (referred to as the MAA from here forward), Reclamation activities will now be reported at the end of each calendar year in the Annual Report and activities for the next fiscal year proposed in the Annual Work Plan.

Organization of 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 Mitigation. For each action a brief description and list of activities are identified. The annual report includes calculations of salt loads based on DMC deliveries and calculations of assimilative capacity provided through dilution flows. The calculation methods used in this report are provisional and some elements in this report do not include estimations of benefits. The *Compliance Monitoring and Evaluation Plan,* dated May 2010 and submitted in 2010, outlines the criteria and methodology for determining DMC loads and credits.

Providing Flows to the System

In 2000, Reclamation agreed to the provisions in State Water Board's revised Decision 1641 (D-1641), which require the release of flows from New Melones Reservoir to meet the Vernalis

salinity objectives. Historically, Reclamation has provided both fishery and water quality dilution flows to the San Joaquin River from New Melones reservoir and through purchases for the Vernalis Adaptive Management Plan (VAMP) or the Central Valley Project Improvement Act. The San Joaquin River 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 San Joaquin River 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 to the State Water Board as an alternative to the State Water Board's new proposed San Joaquin River flow standard.

NEW MELONES RESERVOIR OPERATIONS – PROVISION OF DILUTION FLOW

Brief Description: In the Flood Control Act of October, 1962, Congress reauthorized and expanded the New Melones unit (P.L. 87-874) to a multipurpose unit to be built by the U.S. Army Corps of Engineers (Corps) and operated by the Secretary of the Interior as part of the Central Valley Project (CVP), thus creating the New Melones Unit. The multipurpose objectives of the unit include flood control, irrigation, municipal and industrial water supply, power generation, fishery enhancement, water quality improvement, and recreation. Since June of 2009, New Melones has been operated to meet the National Marine Fisheries Service Biological Opinion (BO) to Reclamation on 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 habitat.

Figure 1.New Melones Reservoir

The Sacramento and San Joaquin River Basin Plan was amended in 2004 to include a Control Program for Salt and Boron Discharges into the Lower San Joaquin River. Items 12 and 13 of the Salt and Boron Control Program state:

Item 12. Salt loads in water discharged into the Lower San Joaquin River (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 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 2004c).

Activities

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

Quantification Methodology: Table IV-8 (CV Water Board 2004c) states that dilution flow allocations are calculated as follows:

$A_{dil} = Q_{dil} * (C_{dil} – WQO) * 0.8293$

Where:

A_{dil} = dilution flow allocation in thousand tons[1] of salt per month

Q_{dil} = dilution flow volume in thousand acre-feet (TAF) per month – above base flows

C_{dil} = dilution flow electrical conductivity (EC) 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. The water-year type is estimated based on the 75% probability of exceedance found in California Department of Water Resources

[1] This is a typographical error in the Basin Plan Amendment. The units are actually tons.

(DWR) Water Supply Index Forecasts (http://cdec.water.ca.gov/cgi-progs/iodir/WSI) for the San Joaquin Valley. **The 75% exceedance forecast for December 1, 2015 is 1.5, which classifies 2015 as a critically dry year.**

Dilution Flow Allocation: WY2015 classified as a critically dry year.

Table 1: Goodwin Dam Monthly Dilution Flow Allocation, 2015

	Goodwin Dam Flow (GDF) [a] TAF	Base Design Flow (DF) [b] TAF	Q_{dil}, TAF GDF-DF=Q_{dil}	WQO[c], µS/cm	C_{dil} (monthly average EC at Orange Blossom Bridge) [d], µS/cm	Dilution Flow Allocation, A_{dil}, tons
January 2015	16	9	7	1000	86	-5,306
February 2015	17	8	9	1000	88	-6,807
March 2015	29	9	20	1000	91	-15,077
April 2015	29	28	1	700	81	-513
May 2015	9	9	0	700	76	0
June 2015	10	0	10	700	86	-5,092
July 2015	10	0	10	700	93	-5,034
August 2015	9	0	9	700	95	-4,516
September 2015	9	1	8	1000	93	-6,017
October 2015	26	8	18	1000	104	-13,375
November 2015	21	13	8	1000	106	-5,931
December 2015	13	13	0	1000	96	0
Total						-67,668

Source: Reclamation 2015a

[a] http://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/cgi-progs/staSearch

[e] In months where Goodwin Dam flow is less than Base Design flow the Base Design flow has been adjusted to match the Goodwin Dam flow. This action eliminates the dilution credit for that month.

WATER ACQUISITIONS

Brief Description: The Central Valley Project Improvement Act (CVPIA) signed into law on October 30, 1992, modified priorities for managing water resources of the CVP. 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, a joint effort by Reclamation and the U.S. Fish and Wildlife Service (Service). The program's purpose is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve Interior's ability to meet regulatory water quality requirements.

Activities

- Reclamation did not acquire any additional water this year.

Salt Load Reductions

Reclamation is under a court order to provide drainage to the San Luis Unit, on the west side of the Lower San Joaquin Valley. As part of this effort, Reclamation historically supported the Westside Regional Drainage Plan (WRDP) through grants and in-kind services. Salt Load Reduction Actions include the Grassland Bypass Project (GBP), 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.

GRASSLAND BYPASS PROJECT

Brief Description: The GBP is a multi-agency stakeholder project currently based upon the 2009 Use Agreement[2] between Reclamation and the San Luis and Delta-Mendota Water Authority (Authority) to manage and reduce the volume of agricultural drain water produced within the Grassland Drainage Area (GDA), and to use a 28-mile segment of the San Luis Drain to convey this drain water to Mud Slough, a tributary of the San Joaquin River. The GBP removed agricultural drainage water from most wetland water supply conveyance channels, facilitated drainage management that maintains the viability of agriculture in the GDA, and promoted continuous improvement in water quality in the San Joaquin River. The GBP is currently working to attain zero discharge of pollutants to the San Joaquin River. The progress and feasibility of attaining this goal will be assessed before the 2019 revision to operational documents and permits.

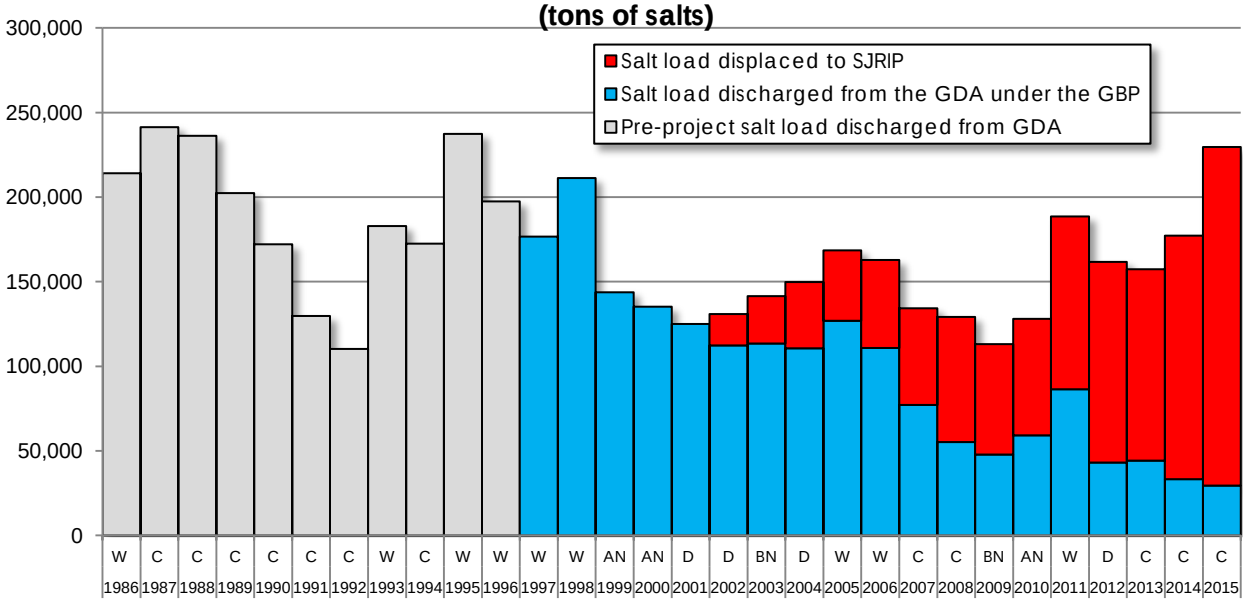
Activities

- The load of salts and boron discharged from the GDA has been significantly reduced through the implementation of the GBP in 1996 and the development of the San Joaquin River Improvement Project (SJRIP) in 2002.
- Prior to 1996, more than 183,000 tons of salts and 356 tons of boron were discharged annually from the GDA to the San Joaquin River.
- Preliminary data for WY 2015 (October 2014 – September 2015) indicate that more than 82 percent of the salts in GDA drain water (33,000 tons) were displaced to the SJRIP, with less than 4,600 tons of salts being discharged to the San Joaquin River.
- For Water Year 2015, we estimate that only 85 tons of boron were discharged to the San Luis Drain and more than 540 tons were displaced to the SJRIP.

[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

- The reduction of salts is the result of activities conducted by the Grassland Area Farmers including source control in the GDA, tail water recycling, and displacement of agricultural drainage water across the SJRIP re-use area.
- Preliminary data for WY 2016 (October 2015 – December 2016) indicate continued displacement of salts and boron with significant reductions in the loads discharged to the river from the GDA.
- Figure 2 shows the progressive reduction of salts discharged from the GDA.[3] During WY 2015, more than 200,000 tons of salts were displaced to the SJRIP, and less than 30,000 tons were discharged to the San Joaquin River.

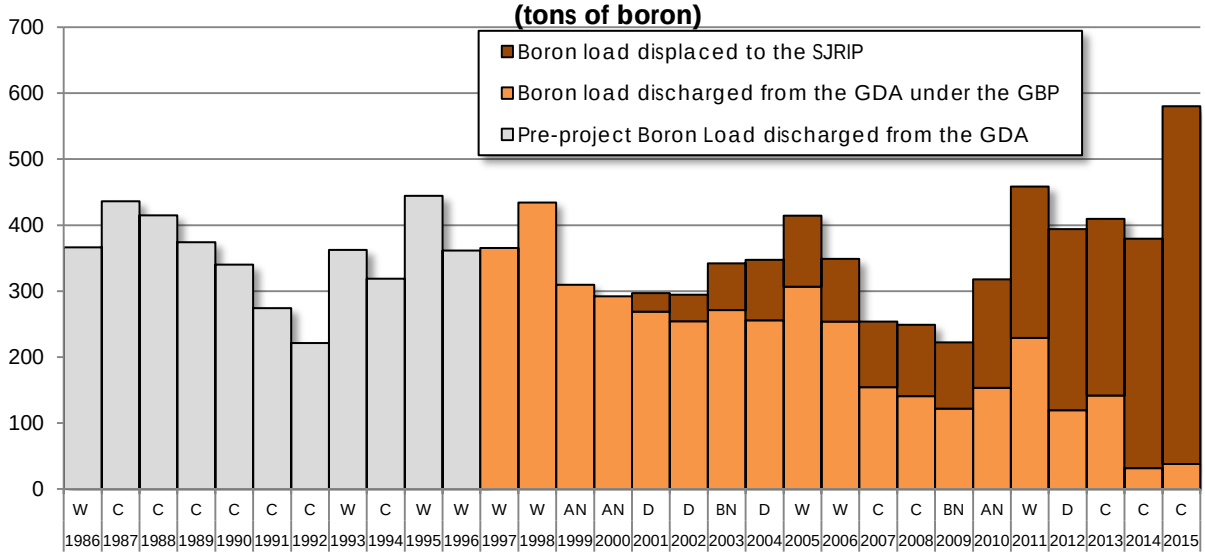
Figure 2. Salt Control under the Grassland Bypass Project (tons of salts)



- Figure 3 shows the progressive reduction of boron discharged from the GDA. For Water Year 2015, we estimate that only 38 tons of boron were discharged to the San Luis Drain and more than 540 tons were displaced to the SJRIP.

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

Figure 3. Boron Control under the Grassland Bypass Project (tons of boron)



- On July 31, 2015, the CV Water Board issued revised Waste Discharge Requirements (WDR)[4] for the discharge of agricultural subsurface drainage water into Mud Slough (north), a tributary of the San Joaquin River.
- Reclamation staff 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.
- The 2012-2014 GBP Annual Report has been written by the interagency Data Collection and review Team and will be published in early 2016. The 2015 annual report will be published in mid-2015.

  All data and reports associated with the GBP are posted on the GBP website that is maintained by the San Francisco Estuary Institute: http://www.sfei.org/gbp.

WESTSIDE REGIONAL DRAINAGE PLAN

Brief Description: The Westside Regional Drainage Plan (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 San Joaquin River. Success of the original effort prompted a proposal to expand the WRDP to go beyond regulatory requirements and eliminate selenium, boron, and salt discharges to the San Joaquin River, while maintaining productivity of agriculture lands in the San Joaquin valley and enhancing water supplies for the region. Reclamation provided $39 million in grant funding to implement the WRDP since 2002.

[4] California Regional Water Quality Control Board, Central Valley Region, July 31, 2015. Order R5-2015-0094 Waste Discharge Requirements for the San Luis & Delta-Mendota Water Authority and the United States Department of the Interior, Bureau of Reclamation. Surface Water Discharged from the Grassland Bypass Channel Project.

Activities

- Reclamation continues to administer three grants with Panoche Drainage District worth $11.5 million to implement the WRDP for source control activities, groundwater management, reuse of drain water and salt treatment/disposal. Negotiations have begun on a new grant worth $3.8 million.
- Panoche Drainage District has used most of this money to develop the SJRIP through construction of infrastructure, planting salt-tolerant crops, and environmental mitigation. For WY 2015, the District reports that it has displaced more than 33,000 acre-feet of agricultural drainage water, containing 200,000 tons of salts and 542 tons of boron. Absent the SJRIP, this water, salt, and boron would have been discharged to the Lower San Joaquin River.
- Preliminary data for WY 2016 (October 2015 – September 2016) indicate continued reductions in salt and boron discharged to the San Joaquin River through displacement to the SJRIP.

CONSERVATION EFFORTS

Brief Description: The water use efficiency program includes several grant programs which fund actions to assure efficient use of existing and new water supplies. Efficiency actions can alter the pattern of water diversions and reduce the magnitude of diversions, providing additional benefits. Efficiency actions can also result in reduced discharge of pollutant-laden effluent or drainage and therefore improve water quality. Although Reclamation is unable to quantify the benefits of the various funded projects as related to salinity reduction, the following information is provided to depict the agency's water conservation efforts in the basin. Through WaterSMART, the Reclamation/Natural Resources Conservation Service partnership and the CALFED Bay-Delta Restoration program Reclamation awarded approximately 86 projects in the San Joaquin Valley that required performance measures since 2006. As information is collected from these projects, quantifiable benefits may be determined in the future.

Activities

The 2015 WaterSMART Water and Energy Efficiency Program grants have been announced; Reclamation awarded one project within the San Joaquin basin in 2015.

<u>Central California Irrigation District, Molasses Ditch Lining Project</u>
Reclamation Funding: $300,000; Total Project Cost: $787,350;
The Central California Irrigation District in Stanislaus County, California, will replace approximately two miles of the earthen Molasses Ditch with a concrete lined canal. The District will also replace existing culverts with new pipe crossings at the proper elevations, construct a new water level control structure upstream of the canal split, and construct new headwork facilities. The project is expected to result in annual water savings of 476 acre-feet that is currently being lost to seepage. The District is also working with various farmers that are interested in working with the Natural Resources Conservation Service to convert to high efficiency irrigation systems once this project is completed

The CALFED Bay-Delta Program provides financial support to water efficiency projects with the objective of improving ecosystem health, water supply reliability and water quality.

Reclamation selected the following water use efficiency projects in the San Joaquin Basin in 2015:

Central California Irrigation District (Merced County)
Reclamation Funding: $600,000; Total Project Cost: $1,219,700
The District will construct a 20-acre recharge facility to recharge 500 acre-feet per year to the local groundwater basin. The lifetime water savings of the project are estimated to be 15,000 acre-feet. The annual savings of the project are estimated to be 500 acre-feet.

Firebaugh Canal Water District (Fresno County)
Reclamation Funding: $500,000; Total Project Cost: $1,097,000
The District will replace 1.5 miles of an unlined canal with a concrete-lined canal. The lifetime water savings of the project are estimated to be 6,240 acre-feet. The annual savings of the project are estimated to be 208 acre-feet.

Salt Load Management

The MAA lists several actions that are intended to manage salt and boron loads in the San Joaquin River. Reclamation actively supports the development of a San Joaquin River Forecast Model (currently the WARMF model) for assimilative capacity and the Real Time Management Program (RTMP) for the San Joaquin River.

RTMP – Development of Stakeholder-Driven Program

Brief Description: The RTMP is described in the TMDL as a stakeholder driven effort to use real-time water quality and flow monitoring data to support water management operations in order to maximize the use of assimilative capacity in the San Joaquin River. Reclamation is working with San Joaquin River stakeholders and CV-SALTS to support the development of a stakeholder-driven RTMP.

Activities

- Reclamation continues working to increase stakeholder involvement opportunities in developing a RTMP. During the last quarter of 2015 a meeting was held with a newly-formed stakeholder-led group whose purpose is implementation of real-time management practices on the west-side of the San Joaquin Basin. While the first meeting was primarily informational – this group will initially help to identify those practices that represent ongoing real-time water management activities that could be enhanced to include real-time salinity management. The group understands the importance of easing the financial and technical burden on stakeholders and finding means by which local support can be developed for real-time salinity management.
- The RTMP Framework document continues to be refined as stakeholder outreach gathers momentum and stakeholders develop greater awareness of the long-term economic and resource benefits of adopting real-time salinity management practices. This refinement

also helps to identify future potential funding sources for installation of new sensor networks, on both east and west sides of the San Joaquin Basin, as well as the enhancement of existing sensor networks. These activities help to improve communication of essential San Joaquin River salt load information between stakeholders, including both discharge to the River and removal through irrigation diversions and identify opportunities to optimize use of San Joaquin River salt assimilative capacity. Ultimately stakeholders benefit by exporting salt load to the limit of San Joaquin River assimilative capacity. The closer stakeholders can operate to the 30-day running average concentration objective the greater the potential allowable salt export. The Framework document stakeholder workgroup (including Reclamation) plan to conduct quarterly meetings to coordinate their efforts.

RTMP – TECHNICAL SUPPORT

Brief Description: A successful RTMP will require networks of sensors owned and operated by stakeholder groups within the basin that allow easy access to the data. Real-time quality assurance of this data is essential to encourage data sharing – so that an entity avoids liability-related issues if erroneous data is posted to the web. Towards this end Reclamation and technical consultant Berkeley National Laboratory have been working with KISTERS International Inc. to develop an easy-to-use, semi- automated data QA solution. The RTMP pilot study in Grassland Water District developed an application of the WISKI software, which allows data from the 50 stations in the district to be quality checked before being archived in their database. A server crash in early 2015 and the imminent sunset of the YSI-ECONet web reporting system has caused a setback in progress – however the pilot project fulfilled its original purpose by demonstrating the capability and long-term viability of this system for the San Joaquin River Basin. Previously reported work by Reclamation staff to develop a data visualization tool for flow, EC and salt load within Grassland Water District conveyance channels has now been emulated within the WARMF-Online web-based data and salinity forecast visualization tool. WARMF-Online is a web-based application developed by 34-North Inc. using their Open-NRM software platform that provides real-time access to continuous and discrete flow and EC data throughout the Basin as well as the means of visualizing flow, EC and salt load assimilative capacity forecasts. The current WARMF-Online application complements an EPA-sponsored, web-based information system focused on environmental data generated on the east-side of the San Joaquin Basin. By building upon

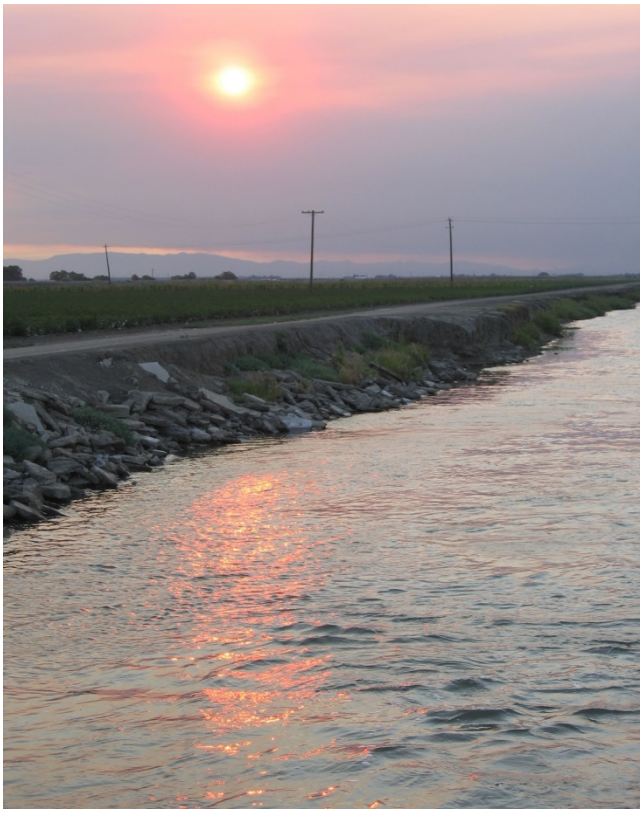


Figure 4. Newman Wasteway

existing capability we have sought to provide a "one-stop shop" for pertinent data essential for salt management decision making in the San Joaquin Basin.

Reclamation continues to support the development and maintenance of an expanding sensor network and is providing ongoing technical support to water districts willing to develop real-time salinity management capability. Data from this network is essential for the calibration and forecast skill of the WARMF-SJR simulation model. Activities during 2015 were focused on making the WARMF-SJR model more user-friendly and improving the capability of the model to simulate west-side return flows and seasonal wetland hydrology. Use of real-time irrigation and wetland return flow data will always produce superior forecasts to those produced by the model based on simple hydrologic assumptions – the model is designed to overwrite simulated flow and EC data with actual data whenever available. Reclamation is committed to continue development and enhancement of these tools during FY2016. During FY2016, as we move into Phase 3 of the cooperative Real-Time Implementation Plan we also plan to expand outreach to current and potential stakeholder data providers through entities such as the Westside Drainage Authority and East Side Drainage Coalition and strengthen cooperation with entities such as the California Department of Water Resources and the Westside Drainage Authority for routine weekly salt assimilative capacity forecasts. These activities will continue to be funded through the Program to Meet Standards, a CalFED funding authority (currently up to 700K annually). Important activities underway and contemplated for FY2016 are described below:

Activities

- Ongoing work at Lawrence Berkeley National Laboratory (LBNL) has been directed at performance testing new capabilities of the WARMF model and suggesting new opportunities to improve the reliability of the weekly forecast. LBNL is the primary provider of technical support for the real-time monitoring program and for the development of new sensor networks. Pond inflow and outflow data from managed wetlands in the Grassland Water District and in the Los Banos Wildlife Management Area complex covering the period 2007 – 2013 were analyzed and salt loading estimated. These data and data from the five GWD outlets were used to both guide the development and assess the improvements to simulation of managed wetland return flows from Grassland Water District.
- The visualization tool developed for Grassland Water District (GWD) in 2014 which obtained the last 31 days of hourly mean data after being processed by WISKI was used to guide the development of the same capability in WARMF-Online. The WISKI software was purchased for Grassland Water District in late 2013 was successfully re-installed on a new dedicated server in late 2015 after a server crash earlier in the year. Restoration of the 2015 data from archive on YSI-ECONet is underway. WISKI is scheduled to be purchased for use within Reclamation during FY2016 to help develop in-house expertise for training opportunities with stakeholders.
- The WARMF – Technical Review Team held regular meetings at the Regional Water Quality Control Board office during FY 2015. The objective of these monthly meetings has been to involve and receive feedback from interested parties regarding the current planned improvements to the WARMF-SJR forecast model and model interface and to guide the development of WARMF-Online. The improved WARMF-SJR Forecast

Model interface and linkage to WARMF-Online has made it easier to assemble the data sets and model inputs to make forecasts of SJR salt assimilative capacity. Activities during FY2016 will be directed at making WARMF-Online more intuitive which will be partly accomplished by continued development and refinement of user dashboards. These dashboards allow WARMF-Online developers to better understand the most effective organization and presentation of data and model forecasts for stakeholder decision making. Because the concept of salinity management is new to most stakeholders we envisage that an optimal system design and presentation will evolve through multiple iterations.

- LBNL and Reclamation continue to work closely with Systech Water Resources, Inc. to improve and update map resolution and watershed boundaries within the WARMF-SJR model. Systech Water Resources will begin the migration of the current map interface to an ARC-GIS compliant interface. The TRT team and LBNL will help to guide this transition.
- The United States Geological Survey was funded by Reclamation in 2011 to develop a highly disaggregated version of their CVHM model to be known as WESTSIM-HM. This model will continue to serve as a resource to the WARMF-SJR model since the WARMF-SJR model does not simulate the regional groundwater system. A significant source of salt load to the San Joaquin River is from subsurface drainage and groundwater accretions. River diversion data from district records that were imported and updated into the WARMF-SJR model have been shared with the WESTSIM-HM developers to more accurately depict the seasonality of surface water diversions from the river in both models. Obtaining real-time access to River diversion data, especially those diversions to Patterson, West Stanislaus and El Solyo Irrigation Districts will be a major goal of the Program in FY 2016.
- Historic west-side tributary return flow data were QA-checked, compiled in SHEF format and forwarded to CDEC. The ability to scan the historic data allows the analyst performing forecasts to check current real-time monitoring station data against historic records in order to quality check the reliability of the model simulated flows and EC. During FY 2016 Reclamation will strive to encourage more direct stakeholder involvement in the operation and maintenance of these west-side stations. During fall 2015 – Patterson Irrigation District (PID) became interested in obtaining real-time flow information from the monitoring stations at Moran, Marshall Road and Spanish Land Grant Drains. The District recently re-plumbed their distribution system to and from the Marshall Road Reservoir in an attempt to minimize return flows to the River. By minimizing operational spills or drainage return flows to the River, PID maximizes the beneficial use of scarce water supplies within the District. Reclamation will provide support as requested to develop real time monitoring within the district.

ASSISTANCE TO FEDERAL REFUGES AND OTHER WETLAND AREAS

The California Department of Fish and Wildlife (CDFW) and the GRCD operate under Best Management Practices (BMP) to reduce the salt loads in discharges from managed wetlands into the San Joaquin River. Reclamation also provides resources to support the development of a real-time monitoring network and other potential BMPs within Federal, State, and private managed wetlands.

Activities

- Reclamation continues to support the network of real-time flow and water quality monitoring stations that provide flow and EC data at major District water supply inlets and within the GWD.
- The decision by Xylem Inc. to cease support of YSI ECONet has created a setback to the continued development of the sensor network and long-term pilot real-time salinity program in Grassland Water District. The District maintains 50 continuous stations within the GWD boundary and at a small number of sites in the State and Federal refuges that all will require a new datalogger for data storage and modem for radio, satellite, CDMA or GOES telemetry. Berkeley National Laboratory has been working closely with the District to develop a long-term, cost effective solution. The average cost per modem/datalogger combination is approximately $4,500 depending on the combination of datalogger and model chosen. The District will need to perform this substitution upgrade in phases – the first phase covering the important "ag waiver sites" which account for more than 85% of the salt load discharged to the River from the GWD. Other sites will be upgraded as funding allows. Several potential options are actively being considered – both will involve the use of WISKI for database management and data storage and retrieval and WARMF-Online to substitute for the YSI-ECONet server. This migration will occur during the middle part of FY 2016.

PARTICIPATION IN CV-SALTS PROGRAM

Brief Description: The CV Water Board and State Water Board initiated a comprehensive effort to address salinity problems in California's Central Valley and adopt long-term solutions that will lead to enhanced water quality and economic sustainability. The CV-SALTS stakeholder group is a collaborative basin planning effort aimed at developing and implementing a comprehensive salinity management program. The goal of CV-SALTS is to maintain a healthy environment and a good quality of life for all Californians by protecting the state's most essential and vulnerable resource - water.

Activities

Reclamation continues to participate in the following sub-committees of the program: Executive, Technical Advisory, and Lower San Joaquin River. In addition:

- Reclamation continues to attend the Executive Committee Policy meetings.
- Reclamation participates in the Lower San Joaquin River Committee as they evaluate beneficial use designations and a potential amendment of the Basin Plan. The amendment would establish water quality objectives upstream of Vernalis as well as an implementation program to meet the objectives. A standing presentation on the progress of the San Joaquin River real-time management program is given during this meeting.

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 C.W. "Bill" 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* to the CV Water Board (Reclamation 2010) which outlines the criteria and methodology for determining DMC loads and credits.

Quantification Methodology: The monthly amount of CVP water supply delivered to each district is pro-rated 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

Summary of Allocations and Credits (CV Water Board 2004c):

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

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:

$$L_{DMC} = Q_{DMC} * C_{DMC} * 0.00136$$

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:

$L_{DMC} = 0.00136 * \Sigma(Q_{DMC} * C_{DMC})$ Subareas

This equation is then broken into calculations for each subarea based on the source of CVP water. Table 2 lists the monthly volumes of CVP water and salts delivered to the Grassland and Northwest subareas and an estimate of the salts delivered in excess of the Monthly Load Allocation.

Table 2. Calculation of DMC Allocations and Loads

Year	Water Year Type	Grassland Subarea						Northwest Subarea					Total
		San Joaquin River and Mendota Pool Deliveries from CVP, load in thousand tons	Delta- Mendota Canal Deliveries from CVP, load in thousand tons	San Luis and Cross Valley Canal Deliveries from CVP, load in thousand tons	Total Flow, thousand acre-feet	Load Allocation, thousand tons	Actual Load - Load Allocation, thousand tons	San Joaquin River and Mendota Pool Deliveries from CVP, load in thousand tons	Delta- Mendota Canal Deliveries from CVP, load in thousand tons	Total Flow, thousand acre-feet	Load Allocation, thousand tons	Actual Load - Load Allocation, thousand tons	Total Excess Load from CVP Deliveries, thousand tons
2012	Dry	326.3	107.9	58.5	1124.4	79.4	413.4	23.3	31.3	139.9	9.93	44.7	457.8
2013	Critical	355.8	98.8	51.8	1056.1	74.8	431.5	27.1	26.78	123.1	8.67	45	476.5
2014	Critical	302.1	55.3	49.1	675	48	407	22.5	23.5	81	5.7	45.9	399
2015	Critical	285.8	57.0	46.7	612	43	390	22.0	32.5	84	5.9	54.5	395

Source: Reclamation 2015b

Report of Annual Work Plan Activity Performance

Reclamation has met schedule milestones for the MAA and performance of actions that assist San Joaquin River Stakeholders in managing salt loads and offsetting the DMC salt load into the San Joaquin River. New Melones Reservoir has been operating in accordance with D-1641 water quality requirements.

A San Joaquin River forecast model and visualization tool have been developed to assist the RTMP group as they begin managing information for the purpose of managing discharges within the San Joaquin Basin. A continuing goal for Reclamation is to improve the accuracy and applicability of these tools. Reclamation has also provided funding and a contractor, 34 North, to create and maintain a website for San Joaquin River real time management activities. Stakeholders participating in the real time program will be given access to the website when requested. Reclamation will continue to support and promote real-time management to San Joaquin River stakeholders, while also participating in and supporting the real-time management memorandum of understanding (MOU) workgroup.

References

State Water Board D-1641 — Implementation of Water Quality Objectives for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; A petition to Change Points of Diversion of the Central Valley Project and the State Water Project in the Southern Delta; and A Petition to Change Places of Use and Purposes of Use of the Central Valley Project. State Water Resources Control Board, March 15, 2000.

CV Water Board 2004a — Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges Into the Lower San Joaquin River Draft Final Staff Report Appendix 1: Technical TMDL Report, Regional Water Quality Control Board Central Valley Region, July 4, 2004.

CV Water Board 2004b — Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River Final Draft Staff Report. Appendix D: Background Salt and Boron Loading, Appendix E: Alternate Methods For Calculating Salt Loading from the Northwest Side of the Lower San Joaquin River. Regional Water Quality Control Board Central Valley Region, July 4, 2004.

CV Water Board 2004c — Amendments to The Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for The Control of Salt and Boron Discharges into the Lower San Joaquin River Final Staff Report. Table IV-8 Summary of Allocations and Credits, Dilution Flow Allocations, Regional Water Quality Control Board Central Valley Region, September 10, 2004

Quinn, N.W.T. 2013 — Quinn, N.W.T., J. Herr, K. Van Woekhoven, T. Connor, N. Borel, H. Bergstrom and T. Murakami.. 2013. Opportunistic real-time management of saline drainage conjoined with San Joaquin River Restoration. Final Report, Regents of the University of California Agreement 442140-NQ-18214, HEADS, Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720

Keller C. 2014 — Forecasting and assessment of the WARMF model for real-time salinity management in the San Joaquin River. US Dept. of Energy Office and Science, Science Undergraduate Laboratory Internship (SULI), Summer 2014.

Keller C. et al., 2014 — WARMF Forecasting User's Manual. Version 2.1. US Bureau of Reclamation, August 7, 2014.

Reclamation 2010 — Compliance Monitoring and Evaluation Plan, In Compliance with the

"Management Agency Agreement between the Central Valley Regional Water Quality Control Board and the Bureau of Reclamation" executed on December 22, 2008. US Bureau of Reclamation, November 2010.

Reclamation 2015a Calculations for Annual Report, 2015, Table 1: Goodwin Dam Monthly Dilution Flow Allocations, US Bureau of Reclamation, Draft, December 11, 2015

Reclamation 2015b Delta-Mendota Canal Water Quality Monitoring Program Report for 2014. US Bureau of Reclamation, Draft, December 1, 2015.