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Real-Time Salinity Management Program Draft Framework

Contributors:

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- Central Valley Regional Water Quality Control Board
- San Joaquin Valley Drainage Authority
- Grassland Resource Conservation District
- San Luis & Delta-Mendota Water Authority/Grassland Bypass Project

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ABBREVIATIONS AND ACRONYMS

Act	Water Supply, Reliability, and Environmental Improvement Act
Basin Plan	Water Quality Control Plan for the Sacramento and SJR Basins
Bay-Delta Plan	1995 Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary
BFMM	Best Feasible Management Measures
BMP	Best Management Practice
CALSIM	California Simulation computer model
CDFW	California Department of Fish and Wildlife
CVP	Central Valley Project
CV Water Board	Central Valley Regional Water Quality Control Board
CWA	Federal Clean Water Act
Delta	Sacramento San Joaquin Delta
DMC	Delta Mendota Canal
DWR	California Department of Water Resources
D-xxxx	SWRCB Decision xxxx
EC	electrical conductivity
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
GBP	Grassland Bypass Project
GRCD	Grassland Resource Conservation District
GWD	Grassland Water District
LSJR	Lower San Joaquin River
Public Law 108-361	Water Supply, Reliability, and Environmental Improvement Act
Reclamation	United States Department of the Interior, Bureau of Reclamation
RTMP	Real Time Management Program
SJR	San Joaquin River

SWRCB	California State Water Resources Control Board
TMDL	total maximum daily load
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Water Board	Central Valley Regional Water Quality Control Board
WDR	Waste Discharge Requirement

Units

AF	acre-feet
cfs	cubic feet per second
°F	degrees Fahrenheit
kW	kilowatt
MAF	million acre-feet
mg/L	milligram per liter
µS/cm	microSiemens per centimeter
mmhos/cm	millimhos per centimeter
mS/cm	milliSiemens per centimeter
ppm	part per million

1.0 Introduction

The San Joaquin River and its tributaries are highly developed, with dams capturing and diverting much of the natural flow under most conditions. The San Joaquin River also serves as the natural drain for the San Joaquin Valley Basin. As a result, the quality of water in the SJR is influenced by agricultural practices, irrigation water supplies, and naturally occurring groundwater containing salts that return water to the River. The salinity objective at Vernalis has been met since 1994. The Westside San Joaquin River Watershed Coalition, RTMP Group, stakeholders, and Reclamation recognize that by partnering, sharing technical resources, and developing the Real Time Management Program for salinity they can maximize their ability to control f their water discharges and meet the salt and boron water quality objectives prescribed by the Central Valley Regional Water Quality Control Board (CV Water Board).

Stakeholders have shown their support for the development of a RTMP to provide technical assistance for monitoring and database management, forecasting river assimilative capacity, and identifying best feasible management measures (BFMM) for the management of SJR salinity. A successful RTMP requires the commitment by stakeholders for further development, implementation and management of sensor monitoring networks, forecast modeling tools, and program planning and coordination.

1.1 Description of the Project Area

The geographic scope of the salt and boron TMDL[1] is limited to a 130-mile reach of the LSJR extending from downstream of the Mendota Dam to the Airport Way Bridge near Vernalis (Figure 1-1). The LSJR watershed is defined as the area draining to the SJR downstream of the Mendota Dam and upstream of Vernalis. For basin planning purposes, the LSJR watershed excludes areas upstream of dams on the major Eastside reservoirs: New Don Pedro, New Melones, Lake McClure, and similar Eastside reservoirs in the LSJR system (including all land within Tuolumne and Mariposa Counties). The southeastern boundary of the TMDL project area is formed by the LSJR (from the Friant Dam to the Mendota pool). The LSJR Watershed, as defined here, drains approximately 2.9 million acres, which includes approximately 1.4 million acres of agricultural land use. An overall map of the location is presented in Figure 1-1[2].

[1] TMDL is a regulatory term in the U.S. Clean Water Act describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. Alternatively, TMDL is an allocation of that water pollutant deemed acceptable to the subject receiving waters

[2] Source: San Francisco Estuary Institute, http://www.sfei.org/sites/default/files/FIG1-1.GIF

Figure 1-1. Central Valley Project Location

The CV Water Board and State Water Board have 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. In 2004, the CV Water Board adopted a resolution[3] amending the Water Quality Control Plan for the Sacramento River and SJR Basins (Basin Plan). The amendment called for control of salt and boron discharges into the SJR. The amendment includes standards for loading capacity[4] and the allocation requirements of a TMDL, The salinity TMDL water quality objectives for the SJR at Vernalis, measured as electrical conductivity (EC), are 700 µS/cm and 1000µS/cm during irrigation and non-irrigation seasons, respectively. The TMDL prioritizes actions to meet the TMDL by entities responsible for sources of salt and boron. (See Figure 1-2). Appendix A presents a summary of regulatory actions for salinity management.

Reclamation, as operator of the CVP, including the DMC, is subject to the CV Water Board's requirements for managing salt and boron discharges to the LSJR. Other nonpoint source (NPS) discharges, such as from irrigated agriculture, must also comply.

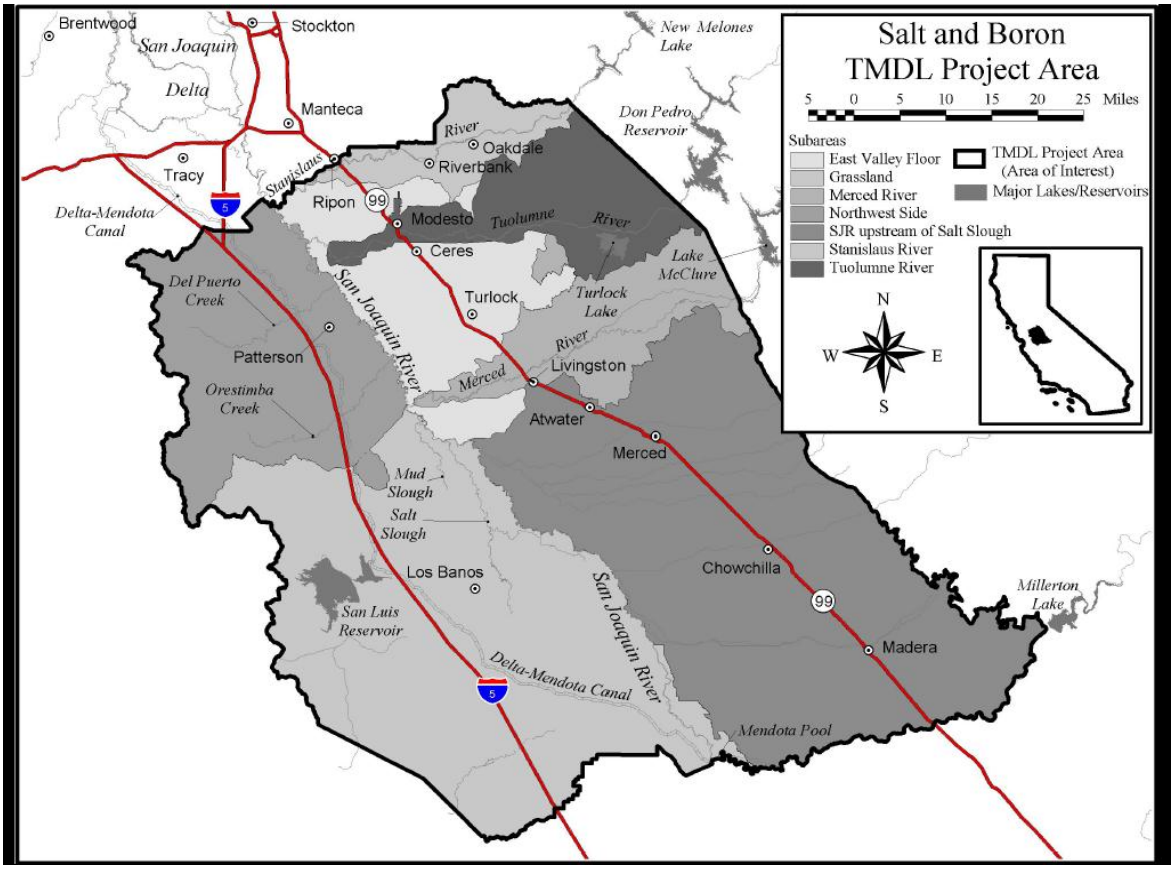
The Basin Plan Salt and Boron TMDL amendment presented four means to achieve compliance. NPS dischargers may comply with the proposed control program by meeting any one of the following conditions:

- Cease discharge to surface waters
- Discharges must not exceed 315 µS/cm electrical conductivity
- Operate under a waste discharge requirement for salt
- Operate under a waiver of waste discharge requirement by participating in a RTMP.

The CV Water Board developed a timeline for implementation with control actions on the most significant sources of salt and boron discharges to the LSJR (See Figure 1-2). Priority for implementation of load allocations to control salt and boron discharges will be given to subareas with the greatest unit area salt loading (tons per acre per year) to the LSJR. The priorities established in Table 1-1 will be reviewed every six years from the effective date of this control program. The Basin plan contains descriptions of the watersheds and TMDL sub-areas.

3 Resolution No. R5-2004-0108,
4 The greatest amount of a pollutant that a waterbody can assimilate and still meet water quality standards.

Figure 1-2. TMDL Project Area



The priority compliance schedule from the TMDL is shown in Table 1-1.

Table 1-1. Priorities for Compliance with Salt and Boron TMDL

Subarea ID No.	Name of Subarea	Subarea Priority 2006[1]	Date for Compliance-Wet through Dry Year Types	Date for Compliance-Critical Year Types
1	SJR Upstream of Salt Slough	Low	July 2022	July 2026
2	Grassland	High	July 2014	July 2018
3	East Valley Floor	Low	July 2022	July 2026
4	Northwest Side	High	July 2014	July 2018
5	Merced River	Low	July 2022	July 2026
6	Tuolumne River	Medium	July 2018	July 2022
7	Stanislaus River	Low	July 2022	July 2026
NA	Delta Mendota Canal[2]	High	July 2014	July 2018

Source: 2008 TMDL Amendment

[1]Implementation priority- number of years after effective date to comply: High 8-14 years; Medium14 -16 years; Low 16-20 years.

[2]DMC is not a subarea, but is operated by Reclamation who is a supplier of water.

Salt loads were identified in the TMDL for each of the 7 subareas and DMC shown in Table 1-1. However there was no breakdown to individual entities within a given subarea. Within given subareas there may be multiple entities. For example in the Grassland subarea there are multiple water agencies including federal and exchange water contractors and public and private wetlands areas. The proportion in the TMDL is by acreage, and that is the only method identified for proportioning the TMDL loads. In

addition, there are several components to the loads including a base load allocation, CVP supply water relaxation and a consumptive use allowance. This makes ongoing allocation of the TMDL loads to the entities within a subarea difficult and complicated.

1.2 Purpose

The purpose of this framework is to provide a roadmap for implementing the RTMP. This document outlines a suite of actions for salinity management as part of the RTMP that if implemented would:

- Allow export of salt loads in accordance with the provisions in the Basin Plan from surface waters during times of river assimilative capacity
- Reduce the reliance on New Melones Reservoir for meeting water quality objectives for salinity at Vernalis[5]
- Install monitoring stations for the purpose of monitoring flow and electrical conductivity and estimating load, and use modeling tools to simulate conditions within the SJR watershed.
- Establish an organizational approach for the continuing development, implementation and coordination of activities to implement the RTMP.

1.3 Problem Statement

The SJR is on the California Clean Water Act Section 303(d) list of impaired waters due to elevated concentrations of salinity and boron. As context for the adoption of the TMDL in 2004, the 2004 TMDL Staff Report described effects of salinity within the basin, as follows:

“Since the 1940s, mean annual salt concentrations in the SJR at the Airport Way Bridge near Vernalis have doubled and boron levels have increased significantly. Water quality monitoring data collected by the Regional Board and other governmental agencies including the United States Geological Survey (USGS), Department of Water Resources (DWR), and Reclamation indicates that water quality objectives for salinity and boron are frequently exceeded during certain times of the year and under certain flow regimes. Consequently, the river no longer supports all of its designated beneficial uses.

The salinity and boron water quality impairment in the river has occurred, in large part, as a result of water development coupled with agricultural land use and associated agricultural discharges in the watershed. Upstream river flows have been diminished by the construction and operation of dams and diversions. Diverted natural river flows have been replaced with poorer quality (higher salinity) imported water that is primarily used

[5] In accordance with Public Law 108-361

for irrigating crops. Surface and subsurface agricultural discharges are the largest sources of salt and boron loading to the river. During the irrigation season, the river is heavily influenced by irrigation return flows. Water quality generally improves downstream as better quality tributary flows dilute salt and boron concentrations."[6]

Since the TMDL was adopted there have been significant changes in freshwater releases and the effects of subsequent regulatory programs on discharges.

2.0 Background

2.1 The San Joaquin River Basin

The SJR Basin (Basin) drains an area of approximately 13,500 square miles. Runoff in the Basin is dominated by snowmelt and rainfall from the Sierra Nevada Range and its foothills on the east side of the Basin. The SJR and three tributaries on the east side of the Basin, the Merced River, the Tuolumne River, and the Stanislaus River, provide most of the natural drainage from the Basin to the Sacramento-San Joaquin Delta (Figure 1-1). The predominant land use in the SJR Basin is irrigated agriculture although there are also discharges from managed wetlands, municipalities and industry. An important source of irrigation water on the west side of the valley is imported water from the Sacramento-San Joaquin Delta. The east side tributaries and groundwater provide the majority of the irrigation water supply to the east-side of the San Joaquin Valley.

Drainage discharges and operational spill from agricultural lands and wetlands, together with accretions, are conveyed through a system of canals, creeks and sloughs to the SJR. Managed wetland areas in the Basin can contribute between 8% and 12% of the salt loading to the SJR, as measured at the Vernalis compliance monitoring station, depending on water year type. Discharges originating from irrigated agriculture in the Basin have historically contributed up to 65%. However, actions since the adoption of the TMDL by the Grassland Bypass Project have reduced the total salinity load at Vernalis by approximately 17% and recent programs in the Grassland Resource Conservation District have led to further reductions.

Dilution of drainage from the west-side tributaries is provided by the eastside tributary rivers – the Merced, Tuolumne and Stanislaus. Flows within the eastside tributaries are regulated to a large degree by upstream reservoirs which, in turn, are operated according to predetermined rules and release schedules. These rules and release schedules are followed to provide flood damage reduction and flows to benefit fish and wildlife, contract and water right water supplies, hydropower, water quality control; and

[6] Excerpt from Appendix 1: Technical TMDL Report for Salt and Boron in the Lower San Joaquin River, September 2004 Final Draft Staff Report, Section 1.0

recreation. The relative timing of agricultural and wetland salt loading and reservoir releases from east-side tributaries continue to affect the ability of the SJR to meet salinity objectives of 700 uS/cm during the irrigation season (April – August) and 1,000 uS/cm during the non-irrigation season(September – March).

2.2 Current and Ongoing Impacts to Water Quality

The Vernalis objectives are currently set as a 30-day running average concentration: 700 µS/cm from April 1 – August 31 and 1,000 µS/cm from Sept 1 – March 31. Figure 2-1 shows the 30-day running average EC at Vernalis from 1985 through 2012. It should be noted that there have been no exceedances since 1994. Since there are two seasons for the Vernalis objective, the first data point for the 30-day average starts 30 days after the beginning of the season. For example the first data point for the April 1 – August 31 season is April 30 and the last data point is August 31. There would be no data points from April 1 through April 29 because there cannot be a 30 day average calculated.

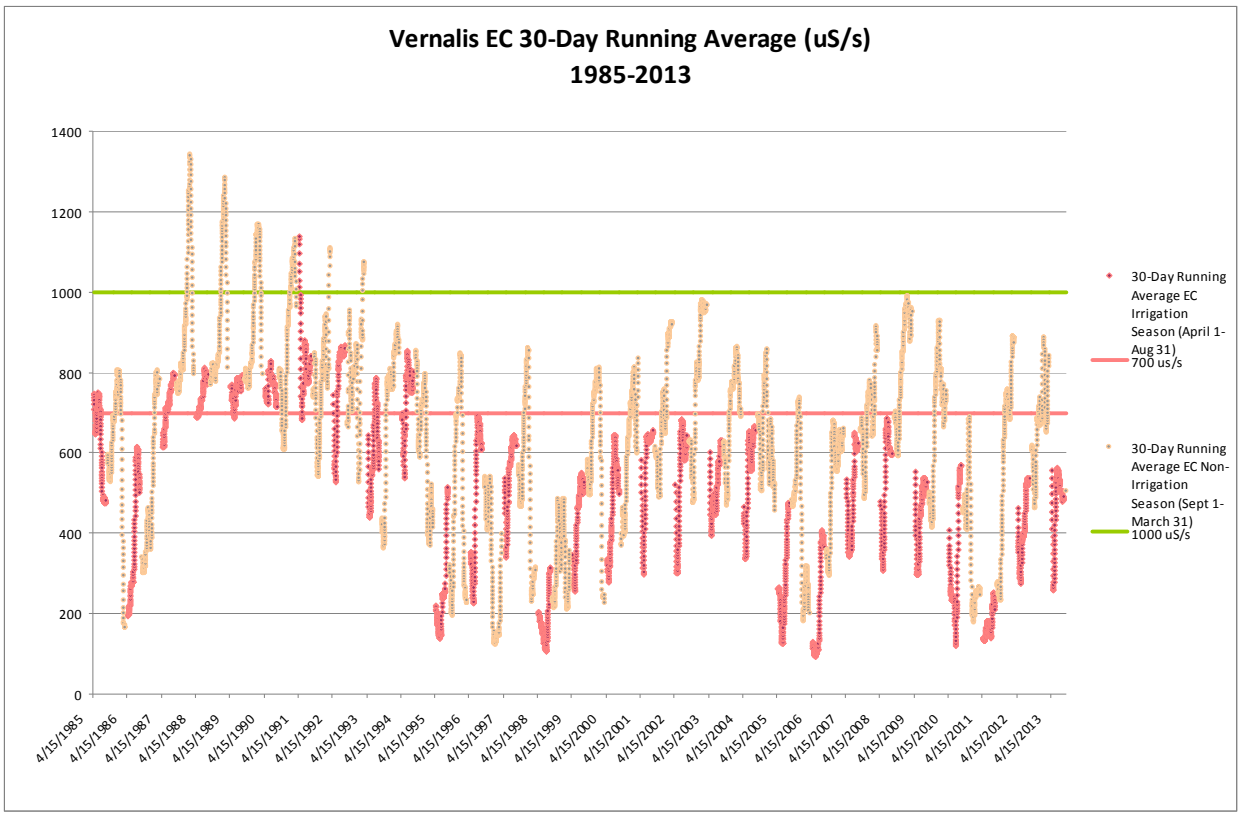


Figure 2-1. 30-day Running Average EC for the SJR at Vernalis.

The goal under a real-time management program is to manage salt loads that appear above the irrigation and non-irrigation season objectives in the graph so they are discharged when there is assimilative capacity in the river. Figure 2-1 shows the 30 day running average at Vernalis for a 1 year period October 92 through September 93. Assimilative capacity is represented by the white regions beneath the dashed line concentration objectives and above the green/yellow concentration at a point in time. These measures, coupled with decreased discharges resulting from various regulatory control programs and increased flows from the San Joaquin River Restoration Project and other likely flow regulations, are expected to achieve the TMDL loading.

2.3 Future Activities that will Affect Salinity

Most planned activities within the San Joaquin Basin have the potential to affect salinity concentrations within the river. The San Joaquin River Restoration Program, San Joaquin River flow negotiations, Vernalis flow objective, Irrigated Lands Regulatory Program, likely cropping patterns and changes, timing of tributary reservoir releases, etc. will all affect the timing and magnitude of salinity within the SJR.

2.4 Water Quality Regulation to Date

The CV Water Board Basin Plan for the Sacramento and SJR made a provision for real-time control of salinity in the SJR:

> "*3. The Regional Water Board will adopt a waiver of waste discharge requirements for salinity management, or incorporate into an existing agricultural waiver, the conditions required to participate in a Regional Water Board approved RTMP. Load allocations for nonpoint source dischargers participating in a Regional Water Board approved RTMP are described in Table IV-4.4. Additional waiver conditions will include use of Regional Water Board approved methods to measure and report flow and electrical conductivity. Participation in a Regional Water Board approved RTMP and attainment of salinity and boron water quality objectives will constitute compliance with this control program."* [7]

Stakeholders within the San Joaquin Basin can choose to participate in the RTMP or accept Waste Discharge Requirements (WDR) from the Water Board.

The technical TMDL adopted a methodology that divided the San Joaquin Basin into seven drainage sub-basins that share both hydrologic and institutional characteristics and which allowed the CV Water Board, charged with implementation of the TMDL, to

[7] Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins, Actions and Schedule to Achieve Water Quality Objectives, Agricultural Drainage Discharges in the San Joaquin River Basin, Control Program for Salt and Boron Discharges into the Lower San Joaquin River, pg. IV-32.01

develop a phased approach for compliance. Subareas such as the Grasslands subarea and the Northwest Side subarea – that were historically the most significant contributors of salt to the River - were placed first in line for compliance, with a compliance date of July 28, 2014 in Wet through Dry Year Types and July 28, 2018 in Critical Year Types (See Table 1-1). The subareas located on the east-side of the SJR and the subareas upstream of Lander Avenue were provided four to eight additional years for compliance in Wet through Dry Year Types with compliances dates of July 28, 2018 and July 28, 2022 and eight to twelve additional years in Critical Year Types with compliance on July 28, 2022 and July 28, 2026.

3.0 Real Time Management Program

3.1 Management Agency Agreement

Reclamation entered into a Management Agency Agreement (MAA) with the CV Water Board in December 2008 as a result of Regional Board Staff Report and TMDL identifying significant contribution to salinity in the SJR watershed from Reclamation's delivery of CVP water imported through the Delta Mendota Canal. Reclamation included an Action Plan which lists the activities Reclamation planned to implement to meet water quality objectives in the SJR at Vernalis, including the facilitation of a real-time management program. Virtually all of the activities within that Action Plan have been completed. A Phase II MAA will be the mechanism that will document Reclamation's ongoing compliance with the TMDL. The draft Phase II MAA is being developed and is expected to be available in early 2014.

3.2 Irrigated Lands Regulatory Program

Stakeholders within the San Joaquin Valley have formed coalitions to comply with the Irrigated Lands Regulatory Program. The Westside San Joaquin River Watershed Coalition and the East San Joaquin Water Quality Coalition represent the majority of lands within the TMDL Project area. These Coalitions have been required to implement TMDL's within their respective areas.

3.3 Grassland Bypass Project

The Grassland Basin Drainers are organized to implement the Grassland Bypass Project subject to waste discharge requirements issued by the CV Water Board. Updated requirements will include the obligation to implement TMDL's applicable within the area served by the Grassland Bypass Project. It should be noted that reductions of discharges from agricultural lands in the Grasslands subarea participating in the Grassland Bypass Project are already at or very near load requirements.

3.4 CV-SALTS

In July 2008, after approval of the salt and boron TMDL for the SJR, the Water Board and San Joaquin Valley stakeholders created the Central Valley Salinity Coalition (CVSC), a legal non-profit organization. Its purpose is to organize, facilitate and fund efforts needed to fulfill the goals of the Basin Plan. This coalition created the Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS) program to give Central Valley stakeholders a forum for participation in the creation of a Valley-wide salt and nutrient management plan. The CV-SALTS program subsequently created the Lower San Joaquin River Committee (LSJRC) to accomplish the task of determining upstream water quality objectives and compliance points in accordance with the Basin Plan. CVSC coordinates the meetings of the CV-SALTS committees, maintains an independent web site, and manages the projects originating from this effort. Information and materials regarding the stakeholder committees and other activities, including the meeting schedule, are posted on their website: www.cvsalinity.org.

3.5 RTMP Framework MOU

Parties participating in the RTMP Framework will be organized under a Memorandum of Understanding. The initial participants are expected to be the Westside San Joaquin River Watershed Coalition on behalf of participating agencies and individuals within its boundaries and the Grassland Basin Drainers on behalf of all of its participants, along with Reclamation and other Cooperating Agencies that wish to participate. The MOU will allow for participation by districts, coalitions, or individuals in each of the other identified sub-basins, who may join at the outset or later on. These parties are collectively referred to as the "RTMP Participants" or the "Stakeholders." The MOU will be executed by July 28, 2014.

3.6 Phased Approach

An important concept for development of real time management is "assimilative capacity." Assimilative capacity can be defined as the mass load of a pollutant that can be safely discharged to receiving water without exceeding the water quality objective or standard for that pollutant. A RTMP is a set of water monitoring and management actions coordinated in conjunction with real time forecasts of river water quality to time salt discharges during optimum assimilative capacity.

Phase 1 – Accomplishments and Initiation Phase (Completed prior to first compliance date of July 28, 2014)

- Documentation of the monitoring stations used in the River Forecast Model.
- Develop a River Forecast Model approach for the RTMP.

- Operation and maintenance requirements for the monitoring stations, along with costs and funding sources will be outlined.
- Documentation of pilot study that includes existing activities and monitoring in the Mud Slough drainage area (including the drainage of the Grassland Resource Conservation District and the Grassland Bypass Project).
- A MOU will be developed to organize participants and provide a mechanism for additional participants.

Phase 2 - Development Phase (Begin at first compliance date and complete in 12 months)

- Stakeholders participating in the RTMP will demonstrate and refine salinity management methods using the current projects. The Grassland Resource Conservation District demonstration project of networked monitoring and controls can be scaled up and adapted to serve the larger area in the Grassland and Northwest side subareas; the Grassland Bypass Project can provide ongoing information on salinity control techniques.
- Participants throughout the program will improve the existing monitoring stations, install additional stations, and cooperate to further develop a model to be used for forecasting SJR assimilative capacity.
- Initial participants in the RTMP will cooperate under the MOU including developing approaches for funding the necessary activities.
- Outreach will continue for additional stakeholders.

Phase 3 – Early implementation phase (Complete by 36 months from first compliance date)

- One or more cooperating agencies or other entities will conduct programmatic weekly forecasting of assimilative capacity in the SJR. Data sharing is of utmost importance to the successful implementation of RTMP; key stakeholders will be asked to share the appropriate information throughout the basin.
- The RTMP participants will analyze the need for additional infrastructure and identify necessary funding requirements.
- A key component of this phase will be the development and recommendation of specific additional management practices needed to better coordinate the real time operation of discharges to the San Joaquin River.
- Outreach will continue for additional stakeholders.

Phase 4 Implementation Phase (Completed by 60 months from first compliance date)

- RTMP Participants will be implementing monitoring, data networking, management practices and utilizing the forecast model to coordinate the timing of discharges.
- RTMP participants will be addressing Long-term funding and management needs.
- The future level of participation by additional regulated parties in the real time management program is difficult to predict. It is anticipated, however, since the alternative will be fixed load allocations, the coordinated and collaborative approach envisaged under a RTMP would be more cost-effective in the long term and additional parties would join by their Basin Plan compliance date.
- It is further anticipated that Phase 4 continuous implementation will bring about improvements to data processing, quality assurance and the river assimilative capacity forecast modeling.

4.0 Additional Information on Program Implementation

The stakeholder group has written and the CV Water Board has approved Real-Time Management Framework as program guidance for salinity management and compliance with the TMDL. Stakeholders throughout the watershed have implemented projects to reduce salinity within the SJR. These actions will be coordinated through participation in the Steering Committee under the MOU for the real-time management participants.

Several initiatives within the SJR watershed (San Joaquin River Restoration Program, Vernalis flow standard, Irrigated Lands Regulatory Program, etc.) will influence salinity within the TMDL project area. A goal of the RTMP will be to facilitate information sharing between each initiative within the San Joaquin watershed to minimize duplication.

4.1 Real-Time Management Framework

Reclamation entered into a MAA with the CV Water Board in 2008. In this agreement Reclamation agreed to lead the effort to develop stakeholder interest in a real time management program. Actions performed by Reclamation to achieve this goal include participation in CV-SALTS, conducting public meetings, supporting real-time monitoring station development and developing a SJR salinity forecasting model. Reclamation and stakeholders have also collaborated to draft the Real Time Management Framework, which will serve as a reviewed and approved program guideline for the real-time management program within the watershed.

Stakeholders from the western San Joaquin watershed have worked in collaboration with Reclamation and DWR to develop the RTMP for the SJR. The Framework

document will be released for public comment through the CV-SALTS LSJR committee. A phased approach was chosen after consultation with CV Water Board staff to provide flexibility to develop and implement the most appropriate methods.

The techniques required to collect and transmit flow and stage data are well established. State and Federal agencies such as the DWR, Reclamation and USGS measure flow and stage routinely for a variety of applications. Only the California Data Exchange Center (CDEC), a separate operations division within the DWR, provides river stage and flood warning information on a real time basis. Agencies, such as the U.S. Army Corps of Engineers, utilize this information to determine reservoir release schedules during high runoff periods.

A unique aspect of this application of RTMP that is not replicated by a current program is the continuous and integrated system of data error checking and validation.

4.2 Current On-going Projects

4.2.1 Grassland Resource Conservation District (GRCD) Wetland Areas

The real-time water quality monitoring program within the GRCD has provided water quality and flow data to the U.S. Fish and Wildlife Service, CA Department of Fish and Wildlife and the private wetland managers for over a decade. The network has been publically available since 2005, has expanded to over 45 monitoring stations, and characterizes water quality and quantity both entering, within, and leaving the Grassland Wetland Complex. The network has also proven to be a tremendous resource for decision support and water accounting within the wetland areas.

A Quality Assurance/Quality Control protocol was developed in collaboration with the USBR and is implemented to maintain the integrity of the monitoring network and insure data is representative and comprehensive. The Quality Assurance protocol for continuous data collection and processing was based on the protocol adopted for the Grasslands Bypass Project and previous assessments administered by GWD including the Irrigated Lands Regulatory Program (ILRP) Agricultural Waiver Monitoring Program, and SWRCB funded project, *Adaptive, Coordinated Real-Time Management of Wetland Drainage* (Agreement # 04-312-555-1).

This project has improved upon these protocols by utilizing real-time data (15 minute) through the YSI EcoNet commercial website and the NIVIS Data Center. This allowed more frequent assessment of sensor performance at each of the monitoring stations and rapid response to problems identified through the continuous inspection of the data. Given the highly variable flow conditions at these monitoring stations and the high susceptibility for fouling by algae, sediment or vegetation, the web enablement has helped to reduce station “down-time” and resulted in more representative and

comprehensive data sets than has been observed during previous efforts. Currently the program, under a cooperative agreement with USBR, is transitioning to WISKI, an improved time series management platform from KISTERS, which will provide for improved quality assurance and data management ultimately resulting in more representative real time data and time savings. WISKI's mass data calculation, optimized database and transfer capabilities will enable the storage, visualization and analysis of data more efficiently for the program.

In addition to providing monthly progress reports on operations, GWD provides semi-annual reports on the dynamics of water and salt load entering and leaving the wetland complex. The network has proven to be a tremendous decision support resource for minimizing salt load to the SJR without compromising the productivity of the wetland complex. With cooperation from private landowners, CDFW and USFWS management staff, the project has moved forward smoothly. Many of the private landowners, CDFW and USFWS management staff, as well as GWD water management staff now utilize the monitoring network acknowledging its utility to assist in water conservation and water quality management decision support. The utilization of the monitoring network by the local wetland community has been instrumental in advancing the concept of real-time water quality monitoring based decision support in this region. Management and Stakeholder adoption of the monitoring network emphasizes the importance of a publicly accessible web enabled real-time water quality monitoring data.

Wetland water tenders and managers now utilize the real time monitoring network continuously to maximize water conservation and monitor water quality within the wetland complex and discharges to the SJR.

Reclamation is completing development of a visualization tool for GRCD. The visualization tool utilizes a Geographic Information System to help the GRCD understand the spatial distribution of water flow, salt discharges and river flows (assimilative capacity). This tool technology will be available for adaptation if stakeholders wish to visualize the salt movement within their watershed; the GRCD pilot project serves as an example of how real-time monitoring tools can be used to manage water discharges.

The GRCD real-time study serves as an example to stakeholders within the Basin of the information and sensor technologies that may be required to implement a RTMP. GRCD can offer guidance to those who are implementing similar programs. Costs associated with this program, including equipment acquisition, installation, quality assurance, and data management are currently in excess of $5 million. Approximate annual programmatic costs are currently in the range of $500,000.

4.2.2 Grassland Bypass Project/Panoche Drainage District

Reclamation has invested more than $33 million since 2001 in systematic data-gathering, research, and development of the San Joaquin River Improvement Project (SJRIP) that is part of the Grassland Bypass Project (GBP) and is owned and operated by Panoche Drainage District and Firebaugh Canal Water District. In addition approximately $107 million in Federal, State and farmer funds has been invested in the GBP and the SJRIP. Other types of drainage management investments include landowner, district, and state supported investments in the conversion of 70% of the irrigated acres to drip irrigation, installation of tailwater recirculation systems, installation of District recirculation systems, and projects to reduce system losses at the District level. These investments have resulted in a long-term reduction in the amount of saline agricultural drain water that is discharged to the SJR estimated to be 17% of the total average annual salt load at Vernalis. Federal and match funds have built infrastructure to apply most of this drain water to salt tolerant crops within the SJRIP, and provide mitigation for environmental effects.

The metric for success has been the significant reduction in the loads of salts that are discharged to the river that can be attributed to the drainage management activities, including the SJRIP. The diminishing monthly and annual load objectives have been specified in the 2009 Use Agreement[8], with the goal of full elimination of these discharges by 31 December 2019 and incentives for earlier full elimination. As discussed above, participants in the Grasslands Bypass Project implemented agricultural best management practices and area wide measures to reroute drainage and reduce the total selenium load discharged to the SJR. The measures were initially implemented to control selenium; reduced salt loads are an additional benefit. The Grasslands Bypass Project implemented the following best management practices:

- Rerouting of agricultural subsurface drainage water around wetlands to the SJR via the San Luis Drain, a concrete-lined bypass.
- Improved management practices to achieve selenium objectives in the main stem of the SJR below the Merced River.
- Achieved short-term load reductions by October 2010; discharges not meeting objectives will be prohibited by 2019.

Reclamation and the San Luis and Delta-Mendota Water Authority developed a Use Agreement that states that the San Luis Drain will be closed if annual load targets are exceeded by more than 20 percent and no acceptable explanation is provided. The CV

[8] 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 to December 31, 2019. Agreement No. 10-WC-20-3975

Water Board adopted three selenium TMDLs, developed a Waste Discharge Requirement permit that required Grasslands Area Farmers to reduce the discharge of selenium below pre-GBP levels, and established a plan to guide coordinated implementation of these requirements.

The Grasslands Bypass Project was instrumental in improving cooperation between federal, state and local agencies to address regional water quality issues. The oversight committee includes the USBR, USFWS, USEPA, California Department of Fish and Wildlife, and the Regional Water Board. The Contra Costa Water District helped to negotiate terms of the San Luis Drain Use Agreement. In addition, the San Luis and Delta-Mendota Water Authority represent the Grasslands Area Farmers, the USGS provided technical support and the Environmental Defense Fund provided support in developing the project.

4.2.3 Model Development

The SJR Forecast Model for assimilative capacity in the LSJR will also be updated before the regulatory deadline in 2014. Reclamation has funded a contractor to update the model interface and create training materials for the use of the model. The updated model uses the US EPA's Watershed Analysis Risk Management Framework (WARMF) model. This updated forecast model will serve to predict the assimilative capacity of the SJR at an appropriate interval, currently every two weeks. This vital information can be utilized by the real-time management group, in conjunction with visualization tools, to plan and coordinate discharges into the SJR at times of optimum assimilative capacity. Initially, three agencies have volunteered to run this model during start up, and provide the information every week on a rotational basis: Reclamation, the CA Department of Water Resources, and the Central Valley Regional Water Board.

When fully developed, the aforementioned tools will be used by the real time management program stakeholders in the following basic salinity management process: the sensor network will provide real time data, visualization tools will present real-time water EC and flow data, and SJR forecast model will present real-time and simulated river assimilative capacity for water discharge planning.

4.2.4 List of Monitoring Stations.

The key initial monitoring stations for the RTMP are listed below. A map is shown in Figure 4-1.

Discharge Sites:

Westside locations:

- Del Puerto Creek
- Hospital Creek

- Ingram Creek
- Los Banos Creek at Highway 140
- Marshall-Spanish-Moran Drains
- Mud Slough at Hwy 140
- San Luis Drain at Outlet (Site B)
- Mud Slough near Gustine Site D
- Newman Wasteway
- Ramona Lake
- Westley Wasteway
- Salt Slough near Stevinson
- Salt Slough at Wolfsen Rd
- Orestimba Creek near Crows Landing

Eastside locations:

- Modesto ID Lateral 4 Spill
- Modesto Irrigation District Lateral 5 Spill
- Modesto Irrigation District Lateral 6 Spill
- Modesto Irrigation District Main Drain to Stanislaus River
- Turlock Irrigation District Harding Drain
- Turlock Irrigation District Lateral 2 Spill
- Turlock Irrigation District Lateral 6 & 7 at levee
- Turlock Irrigation District Westport Drain

Tributary Sites:

- San Joaquin River at Hwy 140 (nr Stevinson)
- Merced River nr Stevinson
- Tuolumne River at Tuolumne City
- Stanislaus River at Koetitz Ranch

River Sites:

- San Joaquin River nr Crows Landing
- San Joaquin River nr Patterson

- San Joaquin River at Maze Rd Bridge
- San Joaquin River at Vernalis

Diversion Sites:

- Patterson ID
- West Stanislaus ID

Wastewater Treatment Plants:

- Modesto WWTP

Reference: USBR, Water Budget, Westside Salt Assessment, California, Mid-Pacific Region, December 2012