

Memorandum

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TO: Michael Johnson, LSJRC Manager

COPY TO: Lower San Joaquin River Committee
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SUBJECT: **Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR):**
Task 6 – Long-term Monitoring and Reporting Program

INTRODUCTION

This technical memorandum (TM) is submitted on behalf of the LWA Team¹ to fulfill the requirements of Task 6 in the Scope of Work for the *Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River* (Workplan). Task 6 includes the following subtasks:

- Subtask 6.1 Develop goals for a long-term monitoring and reporting program.
- Subtask 6.2 Prepare a monitoring program to evaluate compliance with water quality objectives (WQOs) and the effectiveness of the implementation program.

Information generated in the Task 4 Report, *Implementation Planning for Proposed Salinity Objectives*, October 5, 2015, (Task 4 Report) was used to support the development of this Lower San Joaquin River Salinity Related Long-term Monitoring Program (LSJR Monitoring Program). Due to the extensive network of existing electrical conductivity (EC) and boron monitoring locations in LSJR (Reach 83²), it is anticipated that the LSJR Monitoring Program may be able to rely on these existing programs as the primary source of data.

¹ The LWA Team consists of the following firms: Larry Walker Associates, Carollo Engineers, Kennedy/Jenks Consultants, Systech Water Resources, PlanTierra, Luhdorff and Scalmanini Consulting Engineers, Ascent Environmental, and Dr. Richard Howitt.

² From the mouth of the Merced River to Vernalis.

California Water Code (CWC) Section 13242 requires implementation programs designed to achieve WQOs to include a description of the surveillance to be carried out in order to determine compliance with the objectives. The information that will be incorporated into Chapter V of the Central Valley Regional Water Quality Control Board's (Central Valley Water Board) Water Quality Control Plan (Basin Plan) Surveillance and Monitoring section is presented in this TM.

BACKGROUND

Based on the information developed pursuant to the Task 4 Report, the LSJR Committee (LSJRC) is proposing an EC WQOs and Performance Goal for seasonal and water year considerations in Reach 83 of the LSJR (the Preferred Alternative)³, as shown in **Table 1**. The Preferred Alternative WQO and recommended Performance Goal are protective of the existing agricultural irrigation supply (AGR) beneficial use and the potential municipal and domestic supply (MUN) beneficial use designated in Reach 83. The WQO and Performance Goal consider agriculture's seasonal demands for water diverted from Reach 83, while at the same time accounting for the fact that ambient water quality conditions are greatly influenced by the hydrologic conditions, including the presence of return flows and reservoir releases, in the San Joaquin River Basin. While this TM includes recommendations for a monitoring program based on the Preferred Alternative, the recommendations would also be applicable to the other alternatives evaluated in Task 4. Additionally, the Basin Plan already has boron WQOs established for LSJR Reach 83.

Electrical Conductivity

The Preferred Alternative includes an EC WQO of 1,550 $\mu\text{mhos/cm}$. Compliance with the WQO in Reach 83 shall be evaluated as a 30-day running average at Crows Landing. The WQO would apply as indicated in **Table 1**, except during an "extended dry period". An Extended Dry Period is defined as follows:

An Extended Dry Period is defined using the State Water Resources Control Board's (SWRCB's) San Joaquin Valley "60-20-20" Water Year Hydrologic Classification⁴ included in revised Water Right Decision 1641 to assign a numeric indicator to a water year type as follows (SWRCB 2000):

- Wet – 5
- Above Normal – 4
- Below Normal – 3
- Dry – 2
- Critically Dry – 1

The indicator values will be used to determine when an Extended Dry Period is in effect:

³ Section 6.1, Task 4 Report

⁴ The method for determining the San Joaquin Valley Water Year Hydrologic Classifications (e.g., critical, dry, below normal, above normal, wet) is defined in the SWRCB Revised Decision 1641, March 2000, Figure 2, page 189. This method uses the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level using the best available data published in the California Department of Water Resources' ongoing Bulletin 120 series.

- An Extended Dry Period shall begin when the sum of the current year’s 60-20-20 indicator value and the previous two year’s 60-20-20 indicator values total six (6) or less.
- An Extended Dry Period shall be deemed to exist for one water year (12 months) following a period with an indicator value total of six (6) or less.

Table 1: LSJR Reach 83 EC Objective and Performance Goal for Seasonal and Water Year Considerations (µmhos/cm).

Water Year Type	Irrigation Season		Non-irrigation Season
	March – June	July - October	November - February
Wet	1,350 (Performance Goal ¹)		1,550 (WQO ¹)
Above Normal	1,350 (Performance Goal ¹)		1,550 (WQO ¹)
Below Normal	1,350 (Performance Goal ¹)	1,550 (WQO ¹)	
Dry	1,350 (Performance Goal ¹)	1,550 (WQO ¹)	
Critical	1,550 (WQO ¹)		

1. The EC Performance Goal and EC WQO are subject to relaxation during an Extended Dry Period (see definition above).

During an Extended Dry Period (defined above), the following shall be taken into consideration to ensure that beneficial uses are protected in Reach 83 of the LSJR (as measured at Crows Landing):

- Protection of the potential MUN beneficial use: The EC WQO shall be the Short Term specific conductance secondary MCL level contained in the Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin. (Currently incorporated from Table 64449-B of 22 CCR § 64449 at the level of 2,200 µmhos/cm as the average of the previous four (4) consecutive quarterly samples).
- Protection of the AGR beneficial use: The EC WQO shall be 2,470 µmhos/cm as a 30-day running average (derived from the Hoffman model results for 75% crop yield for almonds, 5th percentile rainfall, and 15% leaching fraction).
- Implementation of the Extended Dry Period EC WQO relaxation and/or EC concentrations in Reach 83 above 1,550 µmhos/cm shall not result in requirements for increased water quality releases from New Melones Reservoir to meet Vernalis EC objectives.

The Preferred Alternative also includes the implementation of an EC Performance Goal⁵ of 1,350 µmhos/cm that is recommended to be established throughout the irrigation season for specific water year types (see **Table 1**). Attainment of the EC Performance Goal in Reach 83 shall be monitored using the 30-day running average at Crows Landing. The 1,350 µmhos/cm EC value was established as a Performance Goal because:

⁵ The Performance Goal will be used to measure progress towards achievement of EC levels during certain water year types and times of the year that are of higher quality than the proposed EC WQO for Reach 83 of the LSJR.

- The WARMF modeling of the Planned Bundle (Planned Alternative) indicates that, after full implementation of the key actions underway within the LSJR Basin, the ambient water quality within Reach 83 of the LSJR will not exceed an EC value of 1,350 $\mu\text{mhos/cm}$ at Crows Landing. However, due to model uncertainty, the WQO was set at 1,550 $\mu\text{mhos/cm}$ which is the value that is reasonably protective of the AGR (irrigation supply water) beneficial use based on Hoffman modeling results (95% crop yield for almonds, 5th percentile rainfall, 15% leaching fraction).
- Agricultural supply water at 1,350 $\mu\text{mhos/cm}$ or lower would provide a higher level of protection during the irrigation season based on Hoffman modeling results.
- Water quality at 1,350 $\mu\text{mhos/cm}$ or better would also help to maintain the soil salinity balance by flushing salt accumulated below the root zone during Extended Dry Periods.

The EC Performance Goal and the Extended Dry Period exception included in the Preferred Alternative are advanced in recognition of the existing AGR and potential MUN beneficial uses that must be supported for the water diverted from Reach 83, as well as the seasonal and annual hydrologic conditions that affect both the quantity and quality of the water in the LSJR. The Performance Goal will be used to measure progress toward achievement of EC levels during the irrigation season of non-Extended Dry Periods when EC levels lower than the EC WQO would be beneficial to agriculture and are considered achievable. The Extended Dry Period exception exists to allow discharges to the LSJR to occur under hydrologic conditions (e.g., low flows and elevated EC levels) when it is anticipated that agriculture will value water availability over water quality. A detailed discussion of the project alternatives considered, including the Preferred Alternative, is provided in Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR): Task 4 – Implementation Planning for Proposed Salinity Objectives (LWA 2015a).

Compliance with the proposed EC WQO is based on a 30-day running average that considers the seasonal components of hydrologic conditions and beneficial uses. Alternatives, including monthly averages and annual averages, were also considered; however, a change in averaging period would not likely change the recommended sample collection frequency considering the availability of high frequency (15 minute) EC measurements throughout the LSJR.

Boron

The existing WQOs for boron in Reach 83 are shown in **Table 2**.

Table 2. Lower San Joaquin River Boron Water Quality Objectives.

Period of Applicability	Maximum (mg/L)	Monthly Mean (mg/L)	Critical ^[a] WY Monthly Mean (mg/L)
March 15 th through September 15 th	2.0	0.8	1.3
September 16 th through March 14 th	2.6	1.0	1.3

^[a] – Table IV-3, Basin Plan

Implementation Program

The program of implementation to meet the proposed EC WQO primarily includes the following, already initiated, actions within the San Joaquin River:⁶

- Implementation of Components of the Real Time Management Program (RTMP) – RTMP facilitates the control and timing of wetland, agricultural drainage, and/or other discharges to the LSJR to coincide with periods when the LSJR has capacity to assimilate additional salt up to the EC WQO.
- Full Implementation of the Grassland Bypass Project – The Grassland Bypass Project prevents discharge of subsurface agricultural drainage water into wildlife refuges and wetlands in central California. The Grassland Bypass Project is scheduled for completion at the end of 2019.

MONITORING PROGRAM GOALS

The primary goals of the LSJR Monitoring Program are to evaluate:

- 1) Compliance with the salinity WQOs and Performance Goal in Reach 83 of the LSJR⁷; and
- 2) The effectiveness of the implementation program.⁸

Based on the information developed in Task 4, these LSJR Monitoring Program goals were expanded into the following, more specific, assessment goals:

- Assess compliance with the EC and boron WQOs in Reach 83 of the LSJR⁹ (primary goal No. 1);
- Characterize long-term changes/trends in the ambient EC and boron concentrations within Reach 83 of the LSJR (primary goals No. 1 and No. 2);
- Assess the effectiveness of the implementation program management actions in controlling salt and boron in Reach 83 (primary goal No. 2); and
- Use the LSJR Monitoring Program results to identify potential revisions to the WQOs, Performance Goal, and/or implementation program (primary goals No. 1 and No. 2).

These assessment goals may be modified in the future based on additional information and/or the adaptive management of the implementation program.

EXISTING MONITORING PROGRAMS

Existing monitoring efforts in the LSJR are significant and include continuous (typically 15 minute interval) sensors and sample collection at numerous locations within Reach 83 and immediately upstream in the San Joaquin River, Stanislaus River, Tuolumne River, Merced River, Orestimba Creek, Mud Slough, and Salt Slough. The Central Valley Water Board, the United States Geological Survey (USGS), the California Department of Water Resources (DWR), and the United States Bureau of Reclamation (USBR) all conduct routine flow and EC

⁶ Section 6.2, Task 4 Report

⁷ Primarily electrical conductivity (EC) and boron

⁸ Section 6.2, Task 4 Report

⁹ Compliance with the EC WQOs will be based on a 30-day running average

and/or boron monitoring that can be used to augment the LSJR Monitoring Program. Upstream tributary sites and diversions were not considered in this evaluation because they do not immediately address the assessment goals. If additional management actions within the upstream tributary drainage areas are identified, these sites may be further considered at that time.

The following monitoring programs are or have collected samples that may be used to address the LSJR Monitoring Program assessment questions:

- The Central Valley Water Board previously collected boron and EC samples through the Surface Water Ambient Monitoring Program (SWAMP); however, this monitoring work was completed in 2011.
- The San Joaquin River Real-time Water Quality Management Program (RTMP) uses telemetered stream stage and salinity data and computer models to simulate and forecast water quality conditions along the LSJR. Its goal is to maximize export of salt from the San Joaquin Valley while minimizing high quality releases made specifically for meeting San Joaquin River salinity objectives. DWR, and USBR are cooperating agencies in this program, which has established an extensive network of flow and salinity (EC) continuous (15 minute interval) sensors in the San Joaquin River and all major upstream tributaries. These continuously measured data are reported through the California Data Exchange Center (CDEC).
- Monitoring by the United States Bureau of Reclamation and the San Luis & Delta- Mendota Water Authority for the Grassland Drainage discharge to the San Luis Drain is part of the 2010 use agreement (Agreement No. 10-WC-20-2975) that refers to the 2001 Waste Discharge Requirements (Grassland WDR, Order No. 5-01-234) monitoring program. The 2001 WDR was rescinded and replaced by Order R5-2015-0094 which requires weekly EC and boron sampling on the San Joaquin River and other upstream tributaries. This WDR monitoring characterizes the effects of the Grassland Bypass Project to reduce selenium and boron loading to surrounding wetlands and refuges, as well as the San Joaquin River.
- The Irrigated Lands Regulatory Program (ILRP) requires monitoring through a WDR for agricultural non-point discharges. The Westside San Joaquin River Coalition 2014 WDR includes boron and EC monitoring on the San Joaquin River upstream of Reach 83. Other ILRP WDRs includes upstream tributary monitoring.
- The City of Turlock and City of Modesto publically owned treatment works (POTWs) monitor EC¹⁰ at locations above and below their discharges between Crows Landing and Maze Road during periods of discharge.

Table 3 and **Table 4** summarize the best available data in the mainstem of Reach 83 and the immediate proximity. The data are of high quality and are readily available through the CDEC or the California Environmental Data Exchange Network (CEDEN). **Figure 1** identifies the locations of each of these San Joaquin River mainstem sites.

¹⁰ Receiving water is monitored during periods of POTW discharge.

Table 3. Electrical Conductivity and Boron Monitoring in the Lower San Joaquin River.

	Source	CEDEN	CEDEN	CDEC	CDEC	CDEC	CEDEN
	Program	SWAMP	Grasslands	Real-Time Program			ILRP
	Agency	Central Valley Water Board	USBR	DWR	USBR	USGS	WSJRC
	Frequency	Weekly	Weekly	Continuous	Continuous	Continuous	Monthly
	Flow¹¹	Yes	Yes	Yes	Yes	Yes	Yes
	EC	Yes	Yes	Yes	Yes	Yes	Yes
Location	Boron	Yes	Yes	No	No	No	Yes
Vernalis	Site ID	541SJC501		SJR	VER	VNS	
	Begin Date	1995		2005	1999	1999	
	End Date	2011		Present	Present	Present	
Maze Road	Site ID	541STC510		MRB			
	Begin Date	1995		2007			
	End Date	2011		Present			
Patterson	Site ID	541STC507		SJP			
	Begin Date	1995		2000			
	End Date	2011		Present			
Crows Landing Bridge	Site ID	535STC504	535STC504			SCL	
	Begin Date	1995	2011			2004	
	End Date	2011	Present			Present	
Newman [Flow Only]	Site ID					NEW [flow]	
	Begin Date					1995	
	End Date					Present	

Note: POTW river monitoring currently comprise weekly EC grab samples upstream and downstream of the effluent outfalls during periods of discharge. Both effluent outfalls are between the Merced and Tuolumne rivers. The Regional Board has recently been modifying NPDES permits to include the option of participating in the Delta Regional Monitoring Program in lieu of receiving water monitoring.

¹¹ Flow monitoring is not required by this effort but is useful for assessing the Preferred Alternative WQO and recommended Performance Goal.

Table 4. Electrical Conductivity and Boron Monitoring in the San Joaquin River Upstream of Reach 83.

	Source	CEDEN	CEDEN	CDEC	CDEC	CDEC	CEDEN
	Program	SWAMP	Grasslands	Real-Time Program			ILRP
	Agency	Central Valley Water Board	USBR	DWR	USBR	USGS	WSJRC
	Frequency	Weekly	Weekly	Continuous	Continuous	Continuous	Monthly
	Flow ¹²	Yes	Yes	Yes	Yes	Yes	Yes
	EC	Yes	Yes	Yes	Yes	Yes	Yes
Location	Boron	Yes	Yes	No	No	No	Yes
Hills Ferry	Site ID	541STC512					
	Begin Date	1985					
	End Date	2007					
Fremont Ford	Site ID	541MER538	541MER538			FFB	
	Begin Date	1995	2011			2004	
	End Date	2011	Present			Present	
Stevenson/Lander Ave.	Site ID	541MER522		SJS			541MER522
	Begin Date	1995		2000			2011
	End Date	2011		Present			Present

Note: POTW river monitoring currently comprise weekly EC grab samples upstream and downstream of the effluent outfalls during periods of discharge. Both effluent outfalls are between the Merced and Tuolumne rivers. The Regional Board has recently been modifying NPDES permits to include the option of participating in the Delta Regional Monitoring Program in lieu of receiving water monitoring.

¹² Flow monitoring is not required by this effort but is useful for assessing the Preferred Alternative WQO and recommended Performance Goal.

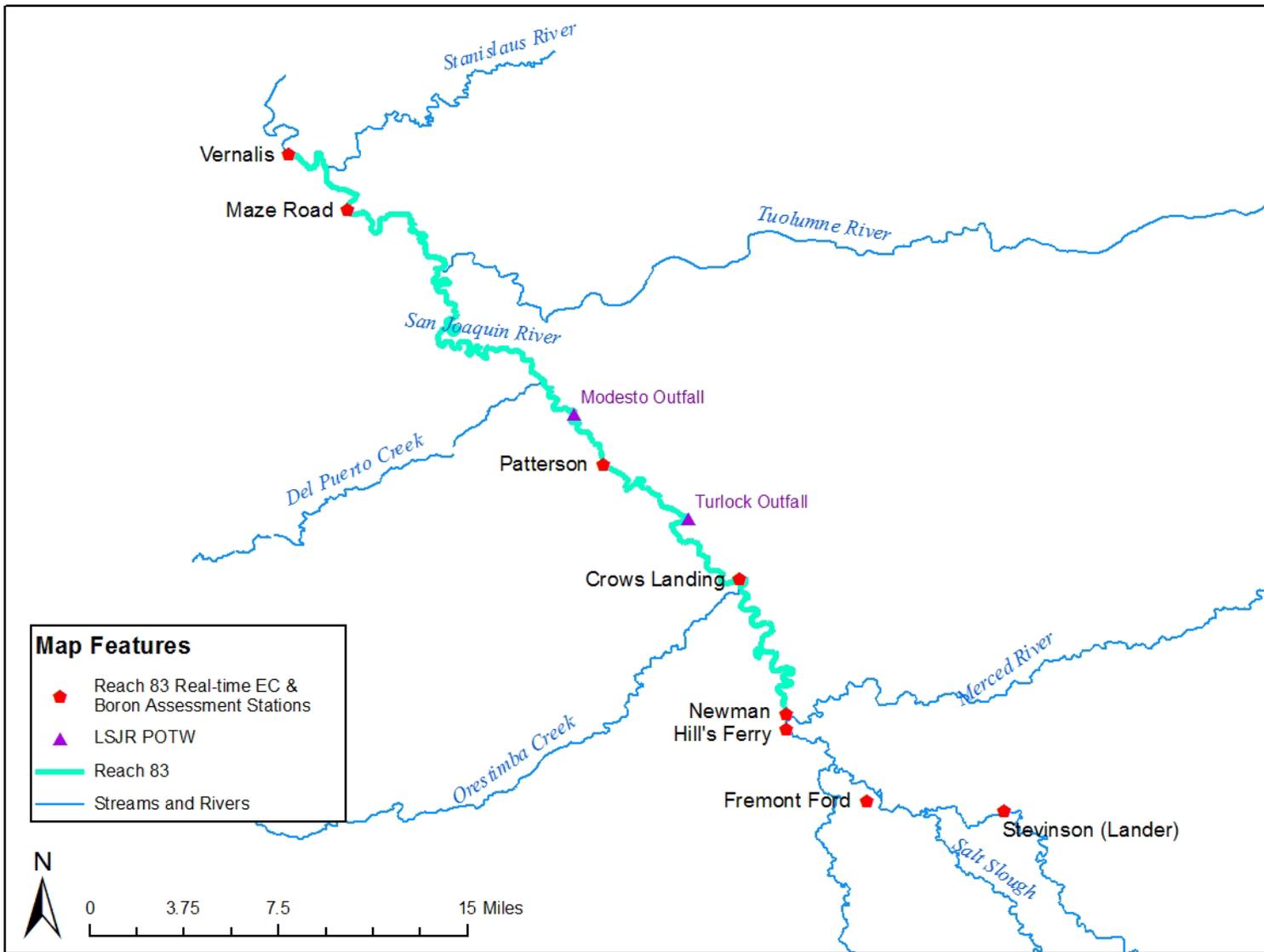


Figure 1. Project Location, Management Action Areas, and Sampling Locations.

Effectiveness Assessment of Management Actions by Other Groups

The effectiveness of the Grassland Bypass Project will be characterized through the WDR monitoring performed by USBR in the San Joaquin River, Mud Slough, and the San Luis Drain. These WDR data are sufficient to characterize loads of salinity and boron from most significant management action areas, thus, no further monitoring is necessary.

The RTMP effectiveness will be assessed through RTMP sensors and ongoing assessments at Vernalis and other locations. Additionally, changes in discharges to Reach 83 will also be assessed through salinity compliance reporting by POTWs and other regulated entities.

PROPOSED LONG-TERM MONITORING AND REPORTING PROGRAM

The availability of existing monitoring program data and the ability to answer the four assessment goals (described above) comprised the criteria considered to develop the proposed monitoring program.

Availability of Existing Monitoring Data

The previous section summarized readily available data (**Table 3** and **Table 4**) in and adjacent to LSJR Reach 83 (**Figure 1**). The eight San Joaquin River locations and the two POTW data sources were considered for inclusion in the monitoring program. There are other active and inactive monitoring locations that could be included, especially for assessment of the management actions. However, the identified locations consist of established sites with a historic record of monitoring and readily available data through CEDEN, CDEC, and Central Valley Water Board reporting and were chosen to assist in the primary goal of compliance with the salinity-related WQOs and Performance Goal in Reach 83 of the LSJR. The location, type, and frequency of sample collection are further developed through consideration of the four assessment goals.

Assessment Goal Consideration

The proposed monitoring program should address all four of the assessment goals, which support the two primary goals.

Assess Compliance with the EC and Boron Water Quality Objectives

The first LSJR Monitoring Program primary goal is to assess compliance with the proposed EC and existing boron WQOs. The goal will also facilitate the assessment of compliance with the recommended EC Performance Goal. The Preferred Alternative WQO and Performance Goal for EC will require either the use of continuous sensors or daily sample collection to obtain the data necessary to calculate accurate 30-day running averages. To evaluate the existing boron WQOs would initially require sample collection on a weekly basis for comparison to the monthly average, to determine variability, and to determine if existing water quality frequently nears or exceeds the criteria.

Characterize Long-term Changes/Trends in the Ambient EC and Boron Concentrations within Reach 83 of the LSJR

Trends are best assessed with higher frequency data collection, especially if the system experiences changing flow conditions and has a large number of factors that could contribute to

the concentration and loading of salinity and boron. Trends in the data collected can be assessed through statistical comparisons that determine if differences over time are random in nature or systematic. Less frequent quarterly or annual sample collection would not adequately characterize the effects of management actions, dam releases, or climate change over time relative to the rate of change and overall variability of flow, weather conditions, and water resource management. While more frequent data collection improves statistical power to identify changes in complex systems, the assessment duration, data variability, and the magnitude of the change in conditions are also considerations when designing sample collection plans. Without specified assessment periods or allowable condition changes, the existing LSJR sensor data collection programs provide reasonable statistical power for future assessments.

Assess the Effectiveness of the Implementation Program Management Actions in Controlling Salt and Boron

The management actions could be considered factors in the system affecting the downstream water quality. In this way assessment of the WQOs attainment measures the effectiveness of these programs, especially if other factors in the system (e.g. stream conditions, groundwater contributions) are well known. Because the existing management actions are expected to have significant benefits to downstream salt loads, attainment of the proposed and existing WQOs and recommended Performance Goal can indicate successful management action implementation. In cases where management actions make only small changes, it may not be possible to statistically identify changes in these downstream “integrator” sites. Future smaller scale studies at the management action locations could provide direct measurement of load reductions and effectiveness of the individual management action. Management actions should be evaluated both on the downstream water quality changes as well as the downstream load changes.

Use the LSJR Monitoring Program Results to Identify Potential Revisions to the WQOs and/or implementation Program

Revisions to WQOs and the implementation program would be based on a number of sources including data collected under the LSJR Monitoring Program. The LSJR monitoring program should provide data sufficient to characterize WQO and Performance Goal attainment, including the duration and magnitude of WQO and Performance Goal exceedances, if any. Data collection should support existing and expected modeling efforts that are used to characterize water flow and quality conditions and evaluate implemented, planned, and proposed management actions.

Based on the aforementioned information in this report, it was determined that the recommended LSJR Monitoring Program goals can be met through existing monitoring locations, constituents, and sample collection frequency. Future management actions should include sufficient assessment monitoring to characterize their benefit to both water quality and salt load reductions. The recommended approach is shown in **Table 5** and **Table 6** and described below.

Electrical Conductivity

The Preferred Alternative EC WQO and Performance Goal would, at a minimum, require daily sample collection on LSJR at Maze Road and Crows Landing. While daily sample collection would be sufficient to calculate a 30-day running average, daily average values capture time-of-day bias and changes that may occur during a day. Daily average values at these locations should be calculated by existing programs based on sensor values that are field calibrated and supplemented with calibration measurements as is done as part of the RTMP. Existing stations at

the proposed locations can provide these data. Thus, no additional sample collection would be necessary. **Table 5** summarizes the recommended monitoring locations, collection entity, type, and frequency.

Table 5. Recommended Electrical Conductivity Monitoring Locations, Collection Approach, and Frequency.

San Joaquin River Location	Sample Collection Entity	EC WQO Assessment	Sample Collection Type	Sample Collection Frequency
Maze Road	DWR	30 day running average	continuous sensor	15 minute data to calculate daily average
Crows Landing Bridge	USGS			

Locations

The existing USGS and DWR continuous EC sensors within LSJR Reach 83 can be used to characterize compliance at the proposed locations:

- Maze Road - characterizes water quality between the Tuolumne and Stanislaus Rivers, and
- Crows Landing - characterizes water quality between the Merced and Tuolumne Rivers.

Selection of these two sites sufficiently characterizes Reach 83 with respect to the location of major tributaries and point sources, and includes the WQO compliance point for the proposed action (Crows Landing) and a location upstream (Maze Road) of the Vernalis compliance point (see **Figure 1**). The downstream boundary of the LSJR, Vernalis, could also be used to characterize the portion of Reach 83 downstream of the Stanislaus River. This location may be used to characterize the overall condition of the LSJR.

Frequency

The RTMP sensors report values every 15 minutes that can be used to calculate a daily average value and the resultant 30-day rolling average or another WQO compliance period that may be identified. Until the variability in the data is determined, the “continuous” data are recommended because of their availability, use within the RTMP, and higher resolution to better characterize variability and trends or the effects of management actions.

Boron

Compliance with the existing Basin Plan WQOs for maximum and monthly average boron concentrations can be assessed at Crows Landing Bridge using the weekly Grassland’s sample collection. Apart from Crows Landing Bridge, there are no other active monitoring locations where weekly boron samples are collected within the LSJR Reach 83. **Table 6** summarizes the recommended monitoring locations, collection entity, type, and frequency.

Table 6. Recommended Boron Monitoring Locations, Collection Approach, and Water Quality Objective Assessment.

San Joaquin River Location	Sample Collection Entity	Boron WQO Assessment	Sample Collection Type	Sample Collection Frequency
Maze Road	None	TBD	None	None

Crows Landing Bridge	Grasslands Project	Calculation of monthly average based on available weekly samples WQO and single sample comparisons to maximum WQO	Discrete grab samples	Weekly
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Locations

The boron WQO applies to the entirety of Reach 83 and does not specifically identify one compliance point. An assessment program would then ideally consider the three sections above and below the Stanislaus and Tuolumne River as was proposed for EC. However, sample collection at the Crows Landing Bridge can be used to assess beneficial use protection, as it would be expected to have the highest boron concentration. Attainment of the boron objective at this location suggests downstream attainment, where the influence of the Tuolumne and Stanislaus Rivers would improve water quality. Upstream management actions include those upstream of Reach 83, and resultant changes would be adequately characterized by upstream monitoring in coordination with Crows Landing Bridge monitoring. If results exceed the boron Basin Plan WQOs at Crows Landing Bridge, then additional locations at Maze Road and Vernalis may be considered to further characterize LSJR Reach 83.

Frequency

Until the Grassland Bypass Project is completed and sufficient time has elapsed to demonstrate continuous compliance, weekly sample collection is recommended for the purpose of calculating a monthly average. Reliable boron continuous sensors are not currently available; however, surrogate relationships between parameters such as EC and boron may be further evaluated to better understand trends and the effect of implementation programs.

Changes to the monitoring program could be made as part of the WQO assessment process and should be targeted to address specific trend changes, characterize specific segments, or better evaluate specific sources or management actions. Design of this additional monitoring would be based on existing data, modeling information, and best professional judgment to meet the monitoring objectives. For example, if an episodic exceedance of boron occurred for unknown reasons at Crows Landing Bridge during the same month in multiple years, additional sample collection of upstream tributaries could be scheduled for that month in the following year(s). Also, additional sample collection in that month at Maze Road and Vernalis would further characterize Reach 83 WQO objective compliance. In many cases data collected by others would be sufficient and additional sample collection might not be necessary.

Finally, the proposed LSJR Monitoring Program and other existing efforts as described above will provide a robust data set that can be used to measure the cumulative effect of all salinity management actions. As a result, no new monitoring to assess the effectiveness of a specific management action is recommended at this time. However, because the monitoring program relies on other external programs, it is important that those efforts are supported and tracked, especially where improvements or changes are proposed.

REPORTING

Data for the RTMP sensors (USBR, USGS and DWR) are reported and archived through CDEC. There is currently no specific SWAMP guidance for continuous sensors; however, the continuous sensor programs used by these agencies follow the intent of the SWAMP Quality Assurance Project Plan (QAPP) approach. Without implementation of continuous data QA

computer software, continuous sensor data should be reviewed to identify out-of-range results in the 15 minute interval dataset and the performance of calibration samples should be considered. Boron and EC grab samples reported through CEDEN by the Grassland Bypass Project are collected according to their QAPP requirements and are consistent with SWAMP guidance as approved by the Central Valley Water Board in support of the Grassland Project Revised Monitoring Program document.¹³

To meet requirements of the Federal Clean Water Act and section 303(c) and Water Code section 13240, the Central Valley Water Board reviews the water quality standards contained in the Basin Plans every three years. However, the Basin Plan section IV LSJR Salt and Boron implementation specifies “The Regional Water Board will review and update the load allocations and waste load allocations by 28 July 2012 and every 6 years thereafter.” While this is specific to the TMDL allocations, it is a more feasible review cycle to observe trends in ambient water quality and the protection of beneficial uses for both the proposed EC WQO and the existing boron WQO. Thus, the six year review cycle tied to TMDL assessment is recommended unless stakeholders initiate or request a more frequent assessment or the Central Valley Water Board identifies another schedule or process to perform this assessment. Establishment of a regional monitoring program as it becomes available could change monitoring regimes in the future.

Adaptive management of the monitoring and assessment program may be necessary based on the Central Valley Water Board’s review of WQO attainment. Recommended monitoring or assessment actions from this review may be performed by other stakeholders or regulated parties. Actions initiated by other regulatory programs (e.g., Grassland Bypass Project, NPDES permits, etc.) should be evaluated in light of the goals and proposed components of this program.

REFERENCES

Larry Walker Associates (LWA). 2015. *Task 4 – Implementation Planning for Proposed Salinity Objectives*. Final Report dated October 5, 2015. Prepared for San Joaquin Valley Drainage Authority. Submitted by Larry Walker Associates, in association with Systech Water Resources, Carollo Engineers, and PlanTierra.

¹³ http://www.usbr.gov/mp/grassland/documents/gbp_2013_rev_mon_plan.pdf