Study 4

Influence of Paleochannels on Seepage

Public Draft
2013 Monitoring and Analysis Plan

SAN JOAQUIN RIVER RESTORATION PROGRAM

September 2012

August 2012

San Joaquin River Restoration Program

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1. Statement of Need

The *Stipulation of Settlement in NRDC, et al., v. Kirk Rodgers, et al.* (Settlement), and legislation call for releases of additional water from Friant Dam, a combination of channel and structural improvements along the San Joaquin River between Friant Dam and the confluence of the Merced River, the reintroduction of spring- and/or fall-run Chinook salmon, and water supply projects for Friant Division long-term contractors. Before the release of full Restoration Flows in 2014, a program of Interim Flows to collect data began with releases starting October 1, 2009, under the conditions specified in State Water Resources Control Board Temporary Transfer of Water Order WR-2009-0058-DWR (Water Year (WY) 2010 Order). The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) applied for and received a second 1-year temporary transfer (Temporary Transfer of Water Order for WY 2011 Interim Flows). Both the legislation and the Water Rights Orders include requirements for seepage management. The Seepage Management Plan includes requirements for Interim Flow operations and locations of seepage concern, and identifies potential projects (seepage mitigation measures) to allow for increased Interim Flows and avoidance of seepage impacts.

The Restoration Goal of the Settlement requires the conveyance of flows through the San Joaquin River from Friant Dam to the Merced River confluence. Channel capacity, including impacts from high groundwater tables, will limit the ability to convey flows until projects are developed and implemented to relieve constraints. The Settlement identified a number of these projects, but some of the constraints will remain unknown until flows reach high enough rates to identify additional problem areas. To support conveyance of flows, the San Joaquin River Restoration Program (SJRRP) will reduce or avoid adverse seepage impacts through recommendations to limit, reduce, or divert Interim Flows in real-time and through development of projects to improve conveyance.

2. Background

The Seepage Management Plan (SMP) of the SJRRP includes locations of identified risks, fields, or parcels that may experience seepage impacts due to Interim or Restoration flows. Some locations experience seepage at flows below full Restoration Flows, and these locations constrain flows in the river channel. The SMP provides initial locations to evaluate for seepage projects to increase channel capacity. Projects may include a variety of real estate parcels or physical actions.

Physical projects depend on multiple site-specific conditions, including soil types. Soil textures along the San Joaquin River include alluvial deposits from both the Sierra Nevadas and the Coast Range. Thick clay and hardpan layers are found along with sand deposits from former river channels. Topography in the area is such that the Riverside, Poso, and Columbia canals are on high ground, the river channel is between the canals, and elevations slope off to either side. Sand deposits, including paleochannels or sand stringers, may carry surface water from the San Joaquin River underground and create problems farther away from the river channel, necessitating changes in project design. This study will address whether (1) paleochannels exist along the San Joaquin River, (2) the extent of any paleochannel influence on seepage extent, and (3) changes to project design necessitated by existence of paleochannels at a site.

3. Anticipated Outcomes

The study will result in two outcomes, including the following:

- Appropriate methodology to identify shallow soil texture differences and seepage

- Approximate locations of sand stringers along the San Joaquin River, their depths and widths, how they may influence seepage from the SJRRP, and potential design considerations when developing conveyance projects in these areas.

4. Methods

The sand stringer issue along the San Joaquin River will be addressed in three steps: (1) reviewing existing aerial photo and map information, (2) conducting fieldwork to identify depths, widths, and potential use of sand stringers for conveying seepage, and (3) performing modeling based on field data to determine the potential for sand stringers or paleochannels to conduct seepage away from the river.

Existing information sources, including aerial photos from 1937, 1938, 1984, 1998, 2004, 2010, and 2011, and historical maps identifying sloughs from 1854, 1887, 1912, 1914, 1919, and 1930, will be used to identify potential locations of paleochannels or other sand deposits along the San Joaquin River. This records review step will identify potential sites for field work and assess overall how many properties and potential seepage project sites may be affected.

For the fieldwork portion, a combined sedimentological and geophysical methodology will be followed, similar to that described by Bersezio et al., 2007. A 3-dimensional map will be developed of the river architecture, employing existing cone penetration testing (CPT) records, electrical resistivity tomography (ERT) and electromagnetic induction (EM).

An initial control site for data collection (Figure 1) will be chosen where a historical river channel (or in this case, historical river channel and subsequent canal) exists that is now buried, where only field crops are grown to minimize metal resistance. This site will be sampled only a few days after irrigation. Threshold characteristics of target materials will be determined from the site. ERT and data will be collected at several cross sections across an existing paleochannel to identify the signals of target materials. ERT data will be collected at 1-meter and 2-meter spacings to identify which spacing provides best data quality in the least time. Hand-auger and/or CPT testing will be used to field-verify soil types. Comparing soil samples from boreholes with geophysical methods will allow refinement of methods to differentiate between wet sands and clays.

Processing software will be used to analyze ERT results and determine appropriate spacing to use given depth of paleochannels, sensitivity of the data set to errors, and complexity of the paleochannel cross sections. These variables will be weighed to decide appropriate electrode spacing for further test sites. EM 31 data will be analyzed and compared to ERT data, resulting in an initial assessment of the most accurate and quickest geophysical method.

Figure 1: Property 1 Electrical Resistivity Tomography Lines

At two test locations (Figures 2 and 3), several ERT lines will be analyzed. EM 31 readings will be taken at the same spacing as the ERT electrodes, and hand augers will be drilled at key locations along the cross section. Comparing verification data with geophysics will result in a methodology report that will determine which of these methods is best to use to characterize 3-dimensional subsurface features given the field constraints, including shallow groundwater levels with high salinity and ongoing agricultural practices.

Water is flowing in the San Joaquin River adjacent to Property 2 (Figure 2), which will allow the signatures of wet sands versus clays to be identified. ERT lines near the flowing river channel will be conducted and hand augers used. This will also be verified by EM 31 readings. Results from all test locations will be analyzed. Verification with CPTs will be conducted.

A site-specific groundwater model will be built with MODFLOW to test the ability of a sand stringer with a depth, width, and location observed in the field, to conduct seepage farther away from the river than otherwise predicted. Soil texture information obtained in the field will be used as inputs for the groundwater model. One-dimensional hydraulic modeling will be used for San Joaquin River hydraulic head inputs.

Finally, drainage engineers will be consulted to develop design recommendations based on the extent of predicted impact identified by photo and map review, fieldwork, and modeling.

Figure 2: Property 2 Electrical Resistivity Tomography Lines

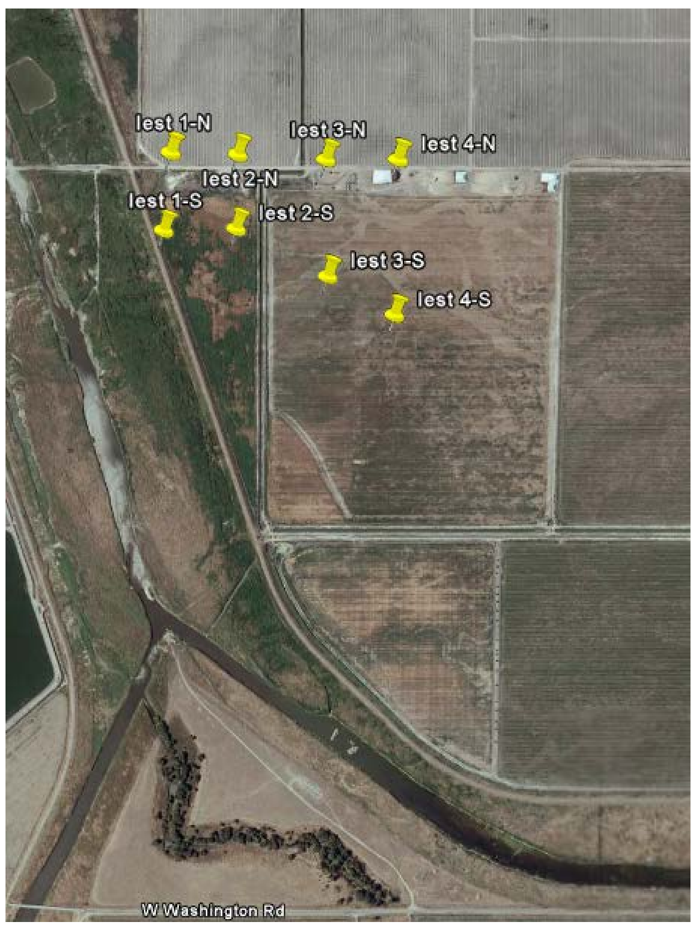

Figure 3: Property 3 Electrical Resistivity Tomography Lines

5. Schedule

Fieldwork is expected to occur from June through September 2012, subject to landowner access and irrigation schedules. Analysis will occur during and after this period. Modeling will be conducted in winter 2012/spring 2013. A draft report is anticipated for the 2012 Annual Technical Report (ATR) in March 2013.

6. Budget

Fieldwork, labor, and travel is budgeted at $60,000 (15 days in the field multiplied by three people).

7. Deliverables

Deliverables include a Draft and Final Report to be included in the ATR, and a methodology report.

8. Point of Contact/Agency and Responsibilities

Katrina Harrison, PI, Reclamation: point of contact
Matt Burgess, Co-PI, U.S. Geological Survey: fieldwork/equipment

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