Study 22

San Joaquin River Tributary Sediment Transport and Geomorphology Study

Public Draft
2013 Monitoring and Analysis Plan

September 2012

22.0 San Joaquin River Tributary Sediment Transport and Geomorphology Study

22.1 Statement of Need

The purpose of this study is to quantify the sediment input from two major tributaries, Cottonwood Creek and Little Dry Creek, to the San Joaquin River downstream from Friant Dam. The amount and type of sediment contributed from the two major tributaries is not well understood but likely will play a substantial role in the sediment budget of the San Joaquin River, given the lack of upstream sediment supply due to Friant Dam. The amount and timing of fine and coarse sediment contributed by these tributaries can be critically important for aquatic and riparian species, which are a focus of the SJRRP.

22.2 Background

One of the main concerns with respect to tributary sediments on the San Joaquin River downstream from Friant Dam is the potential adverse effect on salmonids. The effects of fine sediment supply on salmonids depend primarily on the size of the sediment and the timing of its addition to the channel (Chapman, 1988; Kondolf, 2000). While coarse sediment between the range of 10 mm to 55 mm is needed for spawning by adults (Chapman, 1988; Kondolf and Wolman, 1993) and for cover by juveniles (review in Kondolf 2000), fine sediment and sand can have a detrimental effect, both on emergence and juvenile rearing quality (Chapman, 1988; Kondolf, 2000; Suttle et al., 2004). In particular, the timing of sediment supply is important, since the eggs must incubate for several months before emergence (Chapman, 1988), which makes them susceptible during this time. If it is supplied after egg deposition, fine sediment and sand can filter down through the framework gravels to plug pore spaces, decreasing permeability and inhibiting the flow of adequate water to eggs or alevins located in the redd (Kondolf, 2000). Relatively small amounts of fines, 10 percent to 30 percent, can significantly decrease incubation and emergence rates (Chapman, 1988). The size of fine sediment that significantly decreases survival of incubating eggs varies, but is generally considered to be less than 1 mm (Kondolf, 2000), though sizes up to 9.5 mm have also been found to decrease survival rates (Chapman, 1988). Herein, fine sediment is defined as that finer than 0.063 mm, sand sizes range from 0.063 to 2 mm, and coarse sediment is defined as larger than 2 mm.

At a larger reach-scale, tributary sediment inputs below dams can create sediment continuity issues in the main stem stream, particularly associated with the creation of delta deposits at the tributary mouth (because flood flows that could transport tributary sediments have been reduced or eliminated). For example, on the Trinity River below the Trinity and Lewiston dams in Northern California, the Rush Creek tributary created a delta that resulted in a pool several kilometers long and was a significant barrier to main stem bedload continuity (Wilcock et al., 1996). In addition, tributary inputs can influence bar dynamics and downstream bedload transport by supplying fine and coarse sediment inputs and altering downstream bed grain size distributions.

The proposed study will focus on quantifying the sediment inputs from Little Dry Creek and Cottonwood Creek because these two tributaries have large watersheds, approximately 188 square kilometers and 130 square kilometers, respectively. As such, these tributaries have potentially large sediment loads that could significantly influence sediment dynamics on the main stem San Joaquin River below Friant Dam. The primary research objective of this study is to quantify the rate, timing, and grain size distribution of sediment entering the main stem San Joaquin from these two tributaries. As part of this primary objective, we will also examine potential sediment continuity issues in the tributaries (e.g., capture by gravel pits) as well as the main stem (e.g., deltas at tributary mouths).

22.3 Methods

To quantify the topography of the tributaries immediately upstream from their confluence with the San Joaquin River as well as their deltas, a combination of Terrestrial Laser Scanning and topographic surveys (including monumented cross sections) will be performed. At a minimum, the tributary stream topography within 200 meters of the confluence, and at least 100 meters upstream and downstream along the main stem San Joaquin River will be surveyed with Terrestrial Laser Scanning. The Terrestrial Laser Scanning and cross-section datasets will be used to estimate delta volumes, as inputs into bedload and total load calculations, and as a baseline dataset for future studies and monitoring by SJRRP. Historical aerial photography at the tributary confluences (already collected and rectified by Reclamation) will be used to evaluate historical changes in the tributaries and their deltas near the confluences.

To evaluate the tributaries upstream from their confluences with the San Joaquin River, a geomorphic analysis will be conducted using field surveys, 2007 mapping of Reach 1A performed by DWR via photogrammetry, 2008 DWR bathymetric surveys, geomorphic mapping, and measurements of grain size distributions. Of particular interest for this study is the sediment transport continuity through the lower reaches of Little Dry Creek, which flows through several abandoned gravel mining pits. A recent reconnaissance trip to the lower reaches of Little Dry Creek during a moderate flow event (approximately 100 cfs) indicated that at least two of the abandoned gravel pits were nearly full of sediment, such that sediment was passing freely through this reach. Sediment supply to the lower reaches of Little Dry Creek, downstream from the discharge weir at the North Friant Road Bridge, will be estimated using calculations of bedload and total load, as well as the sediment basin dredging records from the Fresno Metropolitan Flood Control District (Paul Allen, 2011).

Sand and coarse sediment transport will be sampled with several Bunte-type samplers (Bunte et al., 2007). The Bunte samplers have a significant advantage over traditional bedload samplers, in that the Bunte traps can be deployed for lengthy periods of time (up to several days) and do not require active human presence. This feature is particularly attractive given the flashy nature of the tributaries and the difficulty in getting to the field sites in time for discharge events. Potential sites for the Bunte samplers include the tributaries immediately upstream from their confluences with the San Joaquin, as well as the discharge weir on Little Dry Creek at the North Friant Road Bridge.

22.4 Schedule

The proposed study period covers 3 years, WY 2011 through 2013. A multiple-year study is necessary due to the flashy nature of these tributaries and hydrologic variability between water years. Terrestrial Laser Scanning and cross-section surveys will be conducted annually during low main stem flows following winter high flows. Sediment samplers will be deployed during the winter wet season in all 3 years (if samplers can be procured in time for WY 2011 events). Data analysis and transport calculations will occur in the summer and fall of each year following the winter/spring fieldwork. A final report will be prepared documenting the study results following the third year of fieldwork (due September 30, 2013). Information and presentations will be provided to SJRRP staff on an ongoing basis that will be timed to provide adequate information for flow release planning for each water year.

22.5 Budget

Table 22-1 lists the estimated costs for this study.

Table 22-1.
Study Estimated Costs

	FY11	FY12	FY13
Labor/benefits			
Hydrologic Technician GS-6	2,421	2,421	2,421
Research Hydrologist GS-12	34,840	29,863	41,620
Research Hydrologist GS-13	5,434	5,434	5,434
Travel/shipping	3,000	3,000	3,000
Sediment lab analyses	1,260	1,260	1,260
Equipment and supplies (sediment samplers, Laser Scanner rental)	8,100	3,400	3,400
Subtotal	55,055	45,378	57,135
Indirect costs	51,191	42,193	49,645
TOTAL	**$106,246**	**$87,571**	**$106,780**

Key:
FY = fiscal year

22.6 Points of Contact/Agency

The points of contact for this study are Drs. Scott Wright and J. Toby Minear at the USGS.

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22.7 Deliverables

A USGS report and/or journal article will be prepared as the final product. Interim information will be provided in the form of presentations to the SJRRP staff. In addition, the collected field data and calculations completed in this study will be made available to the SJRRP.

22.8 References

Allen, Paul. 2011. Personal Communication. Fresno Metropolitan Flood Control District (FMFCD). January 21, 2011.

Bunte, Kristin, Kurt W. Swingle. Steven R. Abt. 2007. Guidelines for using bedload traps in coarse-bedded mountain streams: Construction, installation, operation, and sample processing. Gen. Tech. Rep. RMRS-GTR-191. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 91 p.

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Kondolf, G.M. 2000. Assessing salmonid spawning gravel quality. Transactions of the American Fisheries Society, 129, 262-281.

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Wilcock, P.R., G.M. Kondolf, W.V.G. Matthews, and A.F. Barta. 1996. Specification of sediment maintenance flows for a large gravel-bed river. Water Resources Research 32(9), 2911 – 2921.

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