Sediment Transport in Tributary Creeks of the San Joaquin River

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Two large tributaries, Cottonwood Creek (CTK) and Little Dry Creek (LDC), enter the San Joaquin River below Friant Dam. These two tributaries are thought to be the only substantially sources of sediment other than the streambed and river banks of the mainstem San Joaquin River, yet there is little known about the sediment supply from them. 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 delivery to the channel. To address this knowledge gap, the USGS began monitoring sediment in water year (WY) 2012. Monitoring included four automatic pump samplers, two hydrophone monitoring systems (to record sounds of gravel and cobble-size bedload transport), water-level loggers, terrestrial LiDAR, and GPS-surveying. Suspended-sediment samples were collected during storm events and analyzed. In addition, field observations over the last five years at Little Dry Creek have helped to understand the complex hydraulics in this heavily altered channel system.

Annual discharge on these creeks is highly variable and low or no flow can occur for multiple consecutive years on these tributary creeks. Discharge during most of the study period (WY2012 to present) has been very low.
However, during the last winter, several small storms occurred in both watersheds. Maximum discharge reached 270 cfs (7.65 m^3/s) on CTK and 445 cfs (12.60 m^3/s) on LDC. In over 29 years of records, the highest discharge recorded on these creeks was 1,004 and 5,000 cfs, respectively, so the recent storms were relatively mild.

During the recent storm events, approximately 56 suspended-sediment-concentration (SSC) samples were collected from LDC, 53 from the LDC canal, and 32 from CTK using ISCO automatic pump samplers. Samples were analyzed for SSC, particle-size distribution (PSD), and loss on ignition. Two methods were used to determine SSC: filtration and decanting. PSD was determined by using a laser-diffraction particle size analyzer. Of those samples collected, D50 ranged from 0.01 to 0.10 mm on LDC canal and 0.01 to 0.04 mm on CTK. Analysis of the audio data recorded by using the hydrophones suggested that coarse (gravel and cobble) bedload was not mobilized at either creek. At CTK, only small patches of sand were observed following storm events indicating that at those flows, low rates of bedload transport occurred. At LDC, however, fresh sand deposits were observed in much of the reach. Channel modifications and abandoned gravel pits near the LDC reach, which is downstream of the streamgage, substantially alters the hydrology and sediment transport—particularly after consecutive dry years. It appears that one of the abandoned gravel pits diverted a large portion of water (approximately 700 ac-ft) and sediment during the first storm of the season. This could reduce the overall contribution of fine sediment to the mainstem; however, the overall impact the channel modifications have on sediment dynamics has yet to be determined.