SEDIMENT TRANSPORT MONITORING DURING A CONTROLLED FLOW RELEASE IN THE TRINITY RIVER, CALIFORNIA

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ABSTRACT: Northern California's Trinity River has up to 90% of its annual streamflow impounded and diverted by Lewiston and Trinity Dams. Upstream sources of sediment are trapped and the magnitude and frequency of peak flows are greatly reduced. Winter storms cause free flowing tributaries to deliver sediment to a mainstem typically too low to re-distribute bedload (stored in deltas) and suspended load (stored in-channel throughout reach). Riparian encroachment associated with flow regulation results in an extensive, cascading, geomorphic response leading to reduced salmonid habitat quality. One step toward mitigating downstream impacts is to introduce gravel at select locations and regulate pulse-flows to mobilize artificial and natural (tributary delta) sediment sources below the dam and to flush stored fines from the streambed.

The Trinity River Restoration Program, with the US Bureau of Reclamation, funded the WY2004 Sediment Monitoring Project to investigate the effectiveness of a six-week 6,000 cfs stepped flow release for:

(1) Mobilization and transport of tributary deltas,
(2) Re-distribution of gravel augmentation sources,
(3) Flushing fine sediments from the reach.

Graham Matthews and Associates employed the following approach to assess flow release effectiveness:

(1) Establish four sediment sampling stations along the mainstem Trinity to assess sediment delivery to and from three bounded reaches. Stations were equipped with:
- Temporary cableway for deploying cataraft-based sampling platforms
- Continuous turbidimeter
- 7 days suspended sediment (D-74) and bedload sampling (6" Helley-Smith)

(2) Associated projects facilitated relevant assessments:
- Volumetric surveys of tributary deltas
- Annual total sediment discharge from the three largest tributaries in the reach

Continuous discharge records were obtained for all but one site from adjacent USGS gaging stations. Transport rates from suspended and bedload samples were overlain with the hydrograph. Sedigraphs were constructed through the sampled points to compute total sediment load for each station. Bedload transport rates varied up to 100% during a given sampling day. At all but one station (where turbidities and concentrations were extremely low), the turbidity trace was determined as the most accurate method (r^2 = 0.92 to 0.99) for predicting continuous suspended sediment concentration, thence continuous suspended load. Where data had been collected previously, WY2004 sediment transport was compared to historic rates.

Size analysis allowed partial loads to be computed for: > 8 mm, 0.5-8 mm and < 0.5 mm. Total loads increased downstream by nearly an order of magnitude, from 2,540 to 20,500 tons. At the upstream-most station, 67% of the total load was >8 mm versus 25% at the downstream-most station. Up to 79% of the total bedload transported during the release was transported during the 10-day 6,000 cfs flow bench. More variability in bedload transport rates was encountered on the first day of 6,000 cfs than at any other time during the release. While bedload transport is inherently highly variable, in a supply-limited reach (such as the upstream sites on the Trinity River) greater sampling effort should be applied to the rising limb and peak flow bench in order to more accurately measure sediment loads.