Study 26

Effect of Altered Flow Regime on Channel Morphology in Reach 1A

Public Draft
2014 Monitoring and Analysis Plan

SAN JOAQUIN RIVER
RESTORATION PROGRAM

September 2013

26.0 Effect of Altered Flow Regime on Channel Morphology in Reach 1A

26.1 Statement of Need

The problem statements for smolt survival and mature spawners indicate the need for monitoring flow conditions and meso-habitats with the intention to maintain conditions that encourage food production, growth while rearing, protection from predators, and holding pools within Reach 1A. Channel boundary features are critical to salmonids throughout their freshwater life stages. The texture of the bed dictates successful incubation and emergence, flow complexity is beneficial to juvenile rearing, deep pools provide temperature and predation refuge and holding habitat, and overhanging banks provide protection from predation. Since the effect of Restoration Flows on the existing channel is not known, the Interim Flows provide the opportunity to measure changes in pertinent channel boundary features from which trends can be observed, computational models validated, and, in the end, predictions made as to changes in the availability of specific habitat types based on flow conditions.

26.2 Background

SJRRP flows will be altered compared to the previous 60 year's hydraulic regime. Aspects of the channel boundary that are significant for salmon habitat quality, and that might change because of alteration of the flow regime, include pool depths; riffle/bar heights; bank location, height, and character; and bed texture.

Channel form features such as pools and bars affect flow complexity that is bioenergetically favorable to both adult and juvenile salmon (Trush et al., 2000). Edgewater areas are important for juvenile salmon rearing and pools are necessary resting places for adults returning to spawn. With current understanding of sediment mobility and flow stresses in Reach 1A, it is difficult to predict whether the increased duration of high flows will scour pools more deeply or make them shallower with sediment scoured from riffles immediately upstream.

In addition, the bed surface will undergo changes through scour and deposition as a result of sediment transport processes. These processes are known to present a risk to incubating embryos more typically found within bar and riffle subsurfaces. When scour occurs to the egg pocket depth, the eggs lose their protection from the effects of bed material transport. Additionally, subsequent deposition alters the texture of the material overlying the egg pocket (Haschenburger, 1999; Lapointe, et al., 2000; May, et al., 2009). Understanding how these features will be transformed by the Restoration Flows is necessary for assessing the altered flow regime's impact on adult and juvenile salmon habitat.

26.3 Anticipated Outcomes

Results from the study of Interim and Restoration flows will be used to determine trends in instream habitat that are a consequence of the altered flow regime. Management will be able to use these results when considering trade-offs between differing hydrographs.

26.4 Methods

Ongoing studies (i.e., spawning area bed mobility and incubation habitat monitoring) include scour chains, repeated channel cross-sectional surveys, and bed texture measurements that will also be used to monitor channel geometry and bed textural change that result from Interim Flows and later Restoration Flows. In addition, a flow and sediment transport model calibrated and validated as part of the bed mobility study can be extended to predict channel evolution and future habitat suitability. Furthermore, tracer travel distance patterns will provide requisite insight into maintenance of the pool depths and riffle distance patterns. To the extent to which these methods are relevant to this study plan they are described below.

26.4.1 Bed Material Characterization

Bed material will be sampled using McNeil sampler, pebble count, and photographic techniques for characterizing the texture of the bed surface and estimating the texture of sediment supply. Samples will be collected in the proximity of previous samples to monitor change with time. Resampled locations will be used to validate the channel evolution model's prediction of bed textural change.

26.4.2 Topographic Surveys

If significant mobility of particles occurs on the riffles – as observed in the bed mobility study – in the planned high-flow releases, channel-spanning cross-sections will be topographically surveyed across riffles and pools after each high flow event. Comparisons of each cross section over time will determine the response to flow events. If topographic change is observed to affect habitat characteristics the survey data will be used to calculate a digital terrain model for validating the calibrated FaSTMECH channel evolution model. Baseline topographic surveys performed early in the Interim Flow period will be used as the initial input for the channel's computational grid. Repeated topographic surveys of channel spanning cross sections will be used to validate the model's channel evolution prediction.

Enhanced bank erosion seems unlikely in Reach 1A because of the reinforcement of banks by dense riparian trees and shrubs. However, if banks become undermined below the rooting depth, changes will be monitored and the spatial extent of the changes in habitat quality (refugia) and in local sediment production will be evaluated, which would provide a small augmentation of gravel supply.

26.4.3 Scour Chains

Sets of anchored scour chains will be installed at riffles to measure the occurrence and depth of scour and subsequent deposition during events for which we will be able to compute local shear stress from the calibrated and validated flow model. The location and depth of scour and deposition will not only be an indication of the process of how the bed responds to the limited number of high flows monitored, but will present an opportunity to test the ability to model such changes with a mobile bed simulation based on bed load transport modeling. Therefore, these results will provide information for validating and calibrating channel evolution prediction models that can then be extended throughout the reach.

26.4.4 Mobile-Bed Modeling

If the topographic changes are large enough to be biologically significant, the response will be modeled through sediment transport calculations. Mobile-bed modeling will require that higher resolution bathymetry be obtained of one or more sample reaches and the calibration of the 2D flow and sediment transport model, as was done in the Merced River, for which flow and sediment supply's influence on the production of juvenile habitat quality was explained. In the Merced River case, collaboration with biologists assisted with modeling the bioenergetic quality of rearing habitat based on the definition of the 2D flow fields. On the basis of a high-resolution bathymetric survey of one or more San Joaquin pools, the same technique can be applied to evaluating pool habitat and the potential for changes in it (Figure 26-1). For more information on the development of the flow and sediment transport model see the Reach 1A Spawning Area Gravel Mobility Study (Study 29).

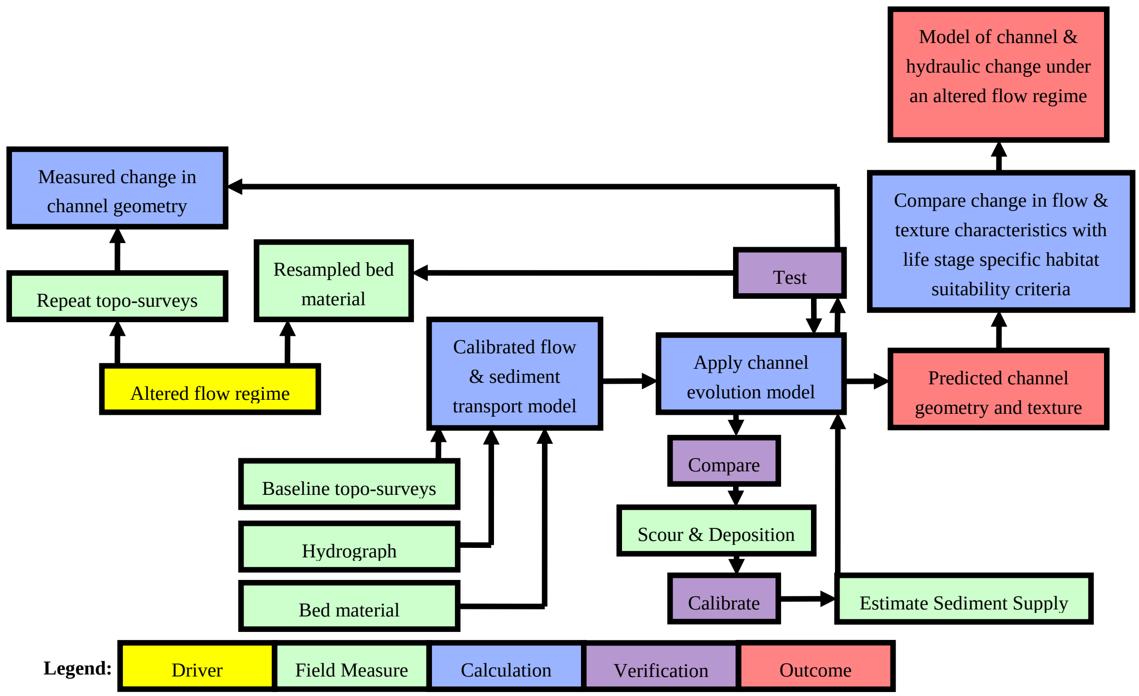

Figure 26-1.
Flow Diagram for Predicting Habitat Suitability Resulting from an Altered Flow Regime and Limited Sediment Supply

26.5 Schedule

Topographic surveys began in of January 2010. Scour chains were installed in 2011 and more are being installed in 2012. Development of the flow and sediment transport model has commenced and will continue through fall 2012, after which the channel evolution model can be calibrated and validated upon obtaining scour chain results.

26.6 Deliverables

A report detailing investigation activities, analysis, results, and conclusions will be prepared following the bed mobility report upon which this study depends. This report will be presented as a technical memorandum and is anticipated in 2014.

26.7 Point of Contact/Agency

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26.8 References

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