California Department of Fish and Wildlife
Natural Resources Agency
State of California

Addendum to: Habitat and Instream Flow Evaluation for Steelhead in the Ventura River Study Plan (January 2017)

May 2017

Summary

The Study Plan: Habitat and Instream Flow Evaluation for Steelhead in the Ventura River (CDFW 2017) outlines the approach that will be used by the California Department of Fish and Wildlife (Department) to evaluate instream flow needs for Southern California steelhead trout (*Oncorhynchus mykiss*; herein referred to as steelhead) in the Ventura River, in Ventura and Santa Barbara counties. The California Water Action Plan[1] (CWAP) outlines ten actions and associated sub-actions to address water management challenges and promote reliability, restoration, and resilience in the management of California's water. Included in action four of the CWAP, the Department and State Water Resources Control Board (Water Board) are directed to implement a suite of actions to enhance instream flows within five priority watersheds. The Ventura River is among these five priority streams.

At a Ventura River Watershed Council meeting on March 2, 2017, the Department presented the Ventura River Study Plan. Following the meeting comments were received that expressed concerns over the limited scope of the study plan, specifically in the lower Ventura River. In response to comments, the Department added an additional 17 study sites in the lower mainstem Ventura River. These sites occur from the San Antonio Creek confluence pool to Shell Road. This addendum reflects revisions made to the overall study plan, and outlines the site selection process and the methods used to evaluate the additional sites.

Background

The additional project area, also known as the "live reach" in the lower Ventura River, begins just above the confluence with San Antonio Creek and extends downstream past Foster Park. This reach is generally characterized by the occurrence of upwelling groundwater, which provides a consistent source of cool water (Normandeau 2015) for aquatic habitat. This upwelling, depending on rainfall patterns and groundwater conditions, can continue from the confluence of San Antonio Creek, downstream through Casitas Springs, to Foster Park (Entrix 2003, Walter 2015). The live reach provides important aquatic and overall ecological habitat for resident fish and wildlife, as well as important rearing and spawning habitat for the anadromous steelhead in the lower mainstem Ventura River (Normandeau 2015).

[1] More information about Proposition 1 and the California Water Action Plan can be found at http://resources.ca.gov/california_water_action_plan/

Revision to Study Plan

The goal of this addition to the study plan is to evaluate the 17 new sites to enhance instream flows to support critical habitat for fish and wildlife species in the lower Ventura River. The Department will evaluate the following objectives to achieve this goal:

- Identify movement and survival flows for steelhead and various lifestages
- Identify ecological/benthic invertebrate productive riffle flows
- Identify aquatic ecological habitat maintenance flows
- Identify low-flow cut off threshold values

The Department will utilize two methods, the Habitat Retention Method (HRM; CDFW 2016), and Wetted Perimeter Method (WPM; CDFW 2013a), to recommend flow criteria and meet the objectives outlined above. The selected methods are summarized below.

Site Selection

Department staff surveyed the live reach for habitat types that met the criteria for site selection for the HRM and WPM. These criteria are outlined in the Department SOP's for HRM and WPM (CDFW 2013a, 2016). Following the surveys, transects were established at every location (i.e., 17 of 17 sites) in the live reach that were deemed suitable for flow evaluation.

The added sites include (Figure 1):

- Three sites between the San Antonio Creek confluence pool and the levee pool
- Six sites between the levee pool and Foster Park
- Eight sites between Foster Park and Shell Road

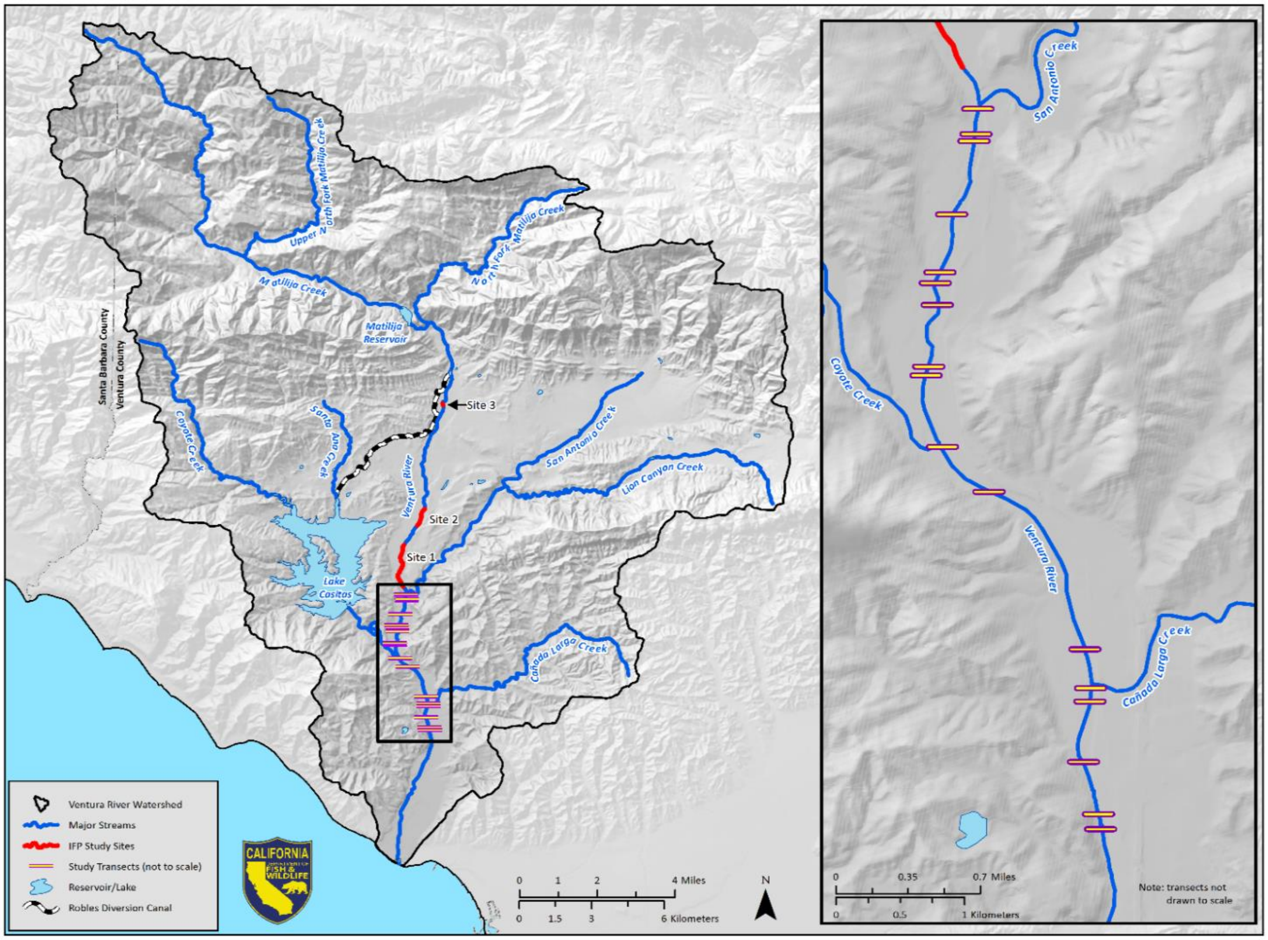

Figure 1. Map of additional sites on the lower Ventura River.

Methods

The following methods will be applied to evaluate flows in the lower Ventura River.

Habitat Retention Method

The Habitat Retention Method (HRM) is a single transect biology-based method (Nehring 1979; CDFW 2016) used to estimate hydraulic characteristics (i.e., average depth, average velocity, wetted perimeter, and hydraulic radius; Table 1) over a range of flows. HRM will be used to evaluate fish passage/habitat connectivity and overall habitat maintenance flows at riffle sites where appropriate.

Table 1. Key flow parameters used to determine flow criteria using HRM in riffle habitats. Percent wetted perimeter is relative to bankfull conditions.

Bankfull width (ft)	Average depth (ft)	Average velocity (ft/sec)	Wetted perimeter (%)
1-20	0.2	1.0	50
21-40	0.2-0.4	1.0	50
41-60	0.4-0.6	1.0	50-60
61-100	0.6-1.0	1.0	70

Once a minimum of three representative riffle sites are selected (CDFW 2016), cross-sectional transects are established at the hydraulic control point of selected riffles with a headpin and a tailpin positioned on the left bank and right bank, at or above the bankfull elevation. A bed elevation survey is then completed for each transect using an auto level and stadia rod (CDFW 2013b) using differential leveling techniques. After the bed profile survey, water surface elevation and riffle length are determined. Discharge and survey data are paired to estimate hydraulic properties using Manning's equation for open channel flow.

Bed elevation data are used to calculate the flow area (A), wetted perimeter (P), hydraulic radius (R), and channel slope (S), while flow data are used to calculate the discharge (Q) for the cross-section. These values are then used to calculate the Manning's Roughness Coefficient (n) using the Manning's equation for open channel flow, given below:

$$Q = \left(\frac{1.486}{n}\right) AR^{\frac{2}{3}}S^{\frac{1}{2}}$$

The commercially available software program Northwest Hydraulic Consultants (NHC) Hydraulic Calculator (HydroCalc; Molls 2010) is based on Manning's equation and can be used to develop rating curves for discharge and hydraulic parameters. When the criteria for depth and at least one other parameter are met, then flows are deemed suitable for habitat connectivity and aquatic ecosystem habitat maintenance.

Wetted Perimeter Method

The Wetted Perimeter Method (WPM) will be used to assess riffle productivity in riffles with rectangular streambed profiles (CDFW 2013a). Riffle sites are targeted because they are typically shallow, depth-sensitive areas of a stream that are most impacted by changes in flow. Riffles are also critical habitats for benthic macroinvertebrate production, an important food source for salmonids, and other aquatic species. Transects are placed at the hydraulic control of each riffle, and are surveyed at approximately five flows to develop discharge vs wetted perimeter relationship curves using an empirical design. Alternatively, the discharge vs wetted perimeter relationship curves may be generated using hydraulic modeling.

The sampling transects are initially established with a headpin and tailpin positioned on the left bank and right bank at each transect. The transect length is measured from headpin to tailpin, and the length from wetted edge to wetted edge is measured to obtain the wetted width. Beginning at the left bank wetted edge, the water depth is measured across the transect at 1-ft intervals, or smaller intervals as needed, to the right bank wetted edge. A flow measurement must be recorded for each WPM transect measurement. Flow will be measured near the site using a flow meter and top setting rod, or by pairing nearby gage flow data with the days and times the streambed was surveyed.

Once wetted perimeters and associated flows for the streambed cross-sections are obtained for the range of important flows (CDFW 2013c), a wetted perimeter discharge curve is developed by plotting wetted perimeter against discharge. The breakpoint and incipient asymptote, as thresholds of important habitat conditions, are then identified to determine instream flow needs necessary for maintaining ecological and riffle productivity flows. The WPM is typically used in conjunction with other flow analysis methods to develop a more holistic instream flow regime for environmental purposes.

References

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