Protocol for Mapping Spawning Gravels in the Bear River Downstream of Camp Far West

This document details the methods used by SSWD, the Licensee, to assess the abundance of salmonid spawning gravels in the Bear River downstream of Camp Far West Reservoir and the non-project diversion impoundment.

Sampling Frame:

The Bear River, from the non-project diversion impoundment downstream to its confluence with the Feather River was divided into 36 contiguous sample units 750m in length. Only units upstream of the point at which the Bear River passes underneath the Highway 70 Bridge were included in the spawning gravel study, since results of redd surveys conducted in 2016 and 2017 showed that no spawning occurs downstream of that point. Therefore, the sampling frame for the gravel study consisted of 30 contiguous 750m units.

Data Collection Method:

Due to the extensive amount of potential spawning gravels observed during redd surveys, a two-tiered approach to characterizing spawning gravels was devised and implemented. The first tier was termed "primary gravels," and this was defined as gravels with a D_{50} particle size between 0.11 in. and 5.9 in. (2.8-150mm) that exist in appropriate habitat types (e.g. riffles, runs, pool tails) within the Low Flow Active Channel (LFAC) or wetted habitat. These are gravels that are readily available for Chinook salmon to spawn in. The second tier was termed "secondary gravels", and was defined as gravels with a D_{50} range between 0.11 in. and 5.9 in. that exist outside the LFAC but within the bank full channel (i.e. dry gravel, but accessible at higher flows). These are gravels that may be used by Chinook salmon at elevated winter flows, or may be redistributed to the LFAC and primary habitats by large magnitude runoff events.

Primary Gravel Assessment

In each sample unit, surveyors assessed primary gravels at three points within the 750m unit: the center of the unit (375m), a point between the center and upstream boundary (625m), and a point between the center and downstream boundary (125m). Figure 1 provides a visual representation of the sample frequency. At each of these points, surveyors visually assessed immediate areas upstream and downstream the surrounding LFAC habitat for the presence of spawning gravels. If spawning gravels were identified, surveyors visually estimated the amount of spawning gravels as a percent of the total available habitat. Surveyors then conducted a pebble count, collected velocity measurements at 60 percent depth along a transect spanning the wetted channel, and measured the width of the wetted channel. If no spawning gravels were identified at a sample point, surveyor still measured the width of the wetted channel, but no velocity measurements or pebble counts were conducted.

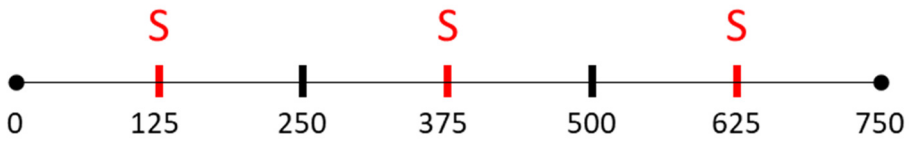

Figure 1. Sample frequency diagram for 750m unit. Red 'S' signifies locations where a gravel assessment was collected.

Secondary Gravel Assessment

To assess secondary gravels, surveyors picked one of the three sample points in a sample unit at random and visually assessed the secondary habitat on both banks at that point for the presence of spawning gravels. If spawning gravels were identified, surveyors visually estimated the amount of gravels present as a percent of the total available habitat. Surveyors then measured the width of the secondary channel on both banks from the wetted edge to the bank full channel. No other measurements were recorded for secondary habitats.

Data Analysis:

Data for primary and secondary spawning gravels were analyzed separately.

Primary Gravels

Primary spawning gravels were grouped into non-pool (i.e. riffle, run, glide) and pool habitats. This first category habitat separation was implemented because pool habitat only contributes a small portion of spawning gravel in the pool tailout and skewed the greater contribution of other habitat types. By separating the two groups a more representative analyses was achieved. Each group was then characterized by aggregating gravel percent estimates by river mile and calculating the weighted average gravel percent for each river mile, where wetted-channel width was the weighting component. Utilizing wetted-channel width as the weighting component constrains the contribution of data points with small width values (i.e. a small channel with a high percentage of spawning gravels contributes less to the calculated average).

Secondary Gravels

Secondary spawning gravels were characterized using a method similar to that was employed for primary gravels. Data were aggregated by river mile and the weighted average gravel percent was calculated by river mile. Width was still employed as the weighting component, but the width used was the width measured from the wetted edge to the bank full channel.