



**WATERSHED**

SCIENCE & ENGINEERING

110 Prefontaine Place South, Suite 508

Seattle, WA 98104

206-521-3000

# Memorandum

To: Jason Lundgren, Cascade Columbia Fisheries Enhancement Group  
From: Jeff Johnson, P.E, WSE and Chris Frei P.E., WSE  
Date: 9/25/2013  
Re: 25 Mile Creek Culvert Fish Passage Improvements – Concept Discussion

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Jason:

This memo is written in response to comments and questions raised by the project funders and Chelan PUD regarding the “roughened channel” design approach recommended to provide fish passage at the 25-Mile Creek crossing. Reviewer comments are included below (in blue), with responses following (in black):

1. There is a concern that at low flows, and maybe at higher flows, the water surface will go sub-grade just downstream of the culvert.

We are well aware that controlling porosity is a major issue within the reconstructed streambed, and included a number of elements in the roughened channel design specifically to limit the amount of flow that goes “sub-surface”:

Although the streambed material will be coarse, a significant volume of fine material is included in the grain-size distribution curve to help fill void spaces. We are proposing to install the streambed material in two lifts, with the fine fraction washed into the voids following each lift. We have also discussed adding an intermediate clay layer, but we have yet to consider this in detail. We first want to make sure everyone is on board with the general concept.

- 1A. Neither of the designs appeared to backwater the culvert outlet, which means the gradient and porosity will control the water surface elevation transition at the culvert outlet to the roughened channel.

Chelan County Public Works is concerned about reducing the capacity of the culvert and is therefore not in favor of raising the downstream channel bed to a level that would backwater the culvert. Therefore, our design at this time keeps the channel invert at the same elevation as the culvert apron. The County is planning to repair the floor of the culvert, which has worn to the point of exposing rebar. As part of that project, it may be possible to modify the floor of the culvert to improve fish passage, but that is not a task in the current investigation.

1B. Because one of the designs shows a steepened section just below the outlet, this is where we expect flow to either go sub-surface immediately (depending on the placement and selection of the finer fill material) or after time when the fines are eroded by high flows.

The general slope of the roughened channel will be a relatively consistent 5%, with some local variability created by the key boulder elements that form the step-pool morphology of the channel. The reach immediately downstream from the culvert will not be over-steepened when compared to the remainder of the reconstructed channel. In reviewing the drawings we provided we can see how it could be interpreted that the channel is over-steepened just downstream from the culvert. This however, was not our intent. We were only trying to show that the channel profile contains some variability to mimic a natural step-pool morphology.

1C. What is the certainty that the substrate used to build the channel will stay in place following high flow conditions?

Substrate selected for the roughened channel is based on a reference reach assessment of the channel immediately upstream of the culvert, and consideration of the hydraulic forces that will be present as flow exits the culvert. WSE classified channel material and key boulder structures within a sixty foot stream segment immediately upstream from the culvert. This reach has an average bed slope of 6% and exhibits a step-pool morphology similar to what we believe should be present downstream from the culvert following project construction. Currently, the channel downstream possesses small steps, but exhibits a morphology that is somewhere between a step-pool and plane-bed classification. Increased velocity at the culvert outlet due to pressure flow through the barrels was also considered. Additional boulder sized material was added to the stream bed mix to upsize the material to withstand the elevated hydraulic forces.

Although some shifting of material is expected and desired, large boulders that form the foundation of the channel should remain secure, even following significant events. That said, this is a sediment transport reach and smaller material at or near the surface of the bed will be transported downstream during events, but we expect most of it to be replaced by new material transported from upstream.

2. Would you please share with us why the roughened channel approach was selected over the log or rock weir approaches?

There are a number of reasons why the roughened channel approach was selected over the log or rock weir options. Primary among these is the resemblance of a roughened channel to the existing (natural) creek channel - which exhibits a step-pool morphology formed by large rock. The roughened channel design allows the reconstructed reach to resemble the natural system in both structure and function. Wood currently does not play a significant role in the structure of the existing channel within this reach, and we are concerned that weirs of any type, whether constructed with logs or rocks, would be prone to failure. It is our opinion that weirs are too fragile for this system and that the roughened channel is a far more robust solution. That said we would be open to adding some wood to the system as habitat elements.

3. The Forum recommends that you use rounded rock rather than angular rock.

Rounded rock is the preferred material for the roughened channel, including both channel bed material and key boulder elements. Rounded rock will be specified, assuming appropriately sized larger material is available. Limited use of angular riprap is shown in the plan set at the location of the downstream tie-in location, and to fill the floor of the scour hole that currently exists at the culvert outlet. Angular rock will be completely buried at both of these locations.

We appreciate the comments provided by the reviewers and are always open to new ideas and suggestions to make this project the best possible. Please feel free to keep the ideas flowing.

Thanks!

Jeff and Chris