OFFCHANNEL RECONNECTION PROJECT

Study Goals and Objectives

The OffChannel Experimental Reconnection Project will inform the ASRP by helping answer the question: will increasing the level of connection between the mainstem river and an offchannel area during high flow season affect flow and stage sufficiently to reduce the seasonal thermal profile (disrupt thermocline) and improve the seasonal oxygen profile in summer? A secondary objective is to answer the question: how does the increased level of offchannel connection influence native and exotic aquatic and semi-aquatic species richness and densities?

With increased connectivity, we anticipated a shift toward a greater range in stage, a generally lower seasonal water temperature profile, and potentially a generally higher seasonal dissolved oxygen profile. We expected that these physical shifts will promote greater native species composition and abundance, and a shift toward fewer exotic species or numbers. Our pre- and post-monitoring on a suite of aquatic or aquatic-associated vertebrates should enable us to determine whether these restoration efforts favor native over exotic species.

Methods / Study Design

This project is a BACI (before-after control-impact) design study. We will enhance the connection between the mainstem and offchannel areas at two treatment sites. In addition to monitoring conditions pre- and post-treatment at these sites, we will also monitor the same conditions at two unmanipulated reference sites over the same time frame. One reference site will be isolated and have no hydrologic connection except potentially during extreme events. The other reference site will have yearly connection below flood stages. Each site will have at least two years of pre-treatment and two years of post-treatment monitoring, allowing us to account for natural environmental variability in our treatment response. We will evaluate the response in water quality, water elevation, native and exotic aquatic and semi-aquatic species, and habitat conditions.

Data collection: Monitoring for focal amphibians was conducted using a combination of egg mass (EM) and offchannel extensive surveys (OE). We used visual encounter surveys for EM as these are the most common and effective way to monitor amphibian presence and breeding abundance. We conducted EM surveys at water depths of up to 1m supplemented with dip net sampling in both permanent and temporary ponds. Because dipnet sampling efficiency can be limited for some fishes, we added one electrofishing survey to the EM effort starting in 2016. For all aquatic vertebrates encountered, we recorded the identity and life stage of all species.

OE surveys were conducted over two-days exclusively in the permanent ponds and were designed primarily for fishes and turtles, but also detected invasive American Bullfrog. These involved 10 evenly spaced vegetation transects where vegetation composition, percent cover, water temperatures, deepest depth, visibility, wetted widths, and distance between transects were recorded. Animal sampling involve dip net surveys, minnow traps, and fyke nets. All traps were left overnight and retrieved the next day and captured animals were processed and released. One electrofishing survey identical to that performed for the EM surveys was added to each extensive survey beginning in June 2016.

We recorded incidental observations on other highly aquatic species like American Beaver and River Otter. We also established permanent photopoint stations around each pond to photo archive gross water level, vegetation, and habitat changes. At each photopoint photographs were taken at 30° increments covering the full 360° in late winter/early spring, summer and fall

Modeling by Watershed Science & Engineering (WSE): WSE was contracted for hydraulic modeling to support preliminary designs for the enhancement of hydraulic reconnection between the Chehalis and the chosen offchannel sites. Accurate hydraulic analysis is crucial to understand current conditions and the potential benefits and impacts of the proposed project. To provide this analysis, the RiverFlow2D (2D) numerical hydraulic model created by WSE in 2019 will be used to simulate hydraulic conditions at each project site. To do this, additional topographic or bathymetric data will be incorporated into the model terrain and it will be calibrated against USGS gage data to develop hydrologic data for each site including time series of daily flows and flow duration curves. Design flood flows will be estimated for the 2-, 10-, 25-, 100-, and 500-year floods. From the transposed flow record estimate additional flow values at each project site including the 50%, 75%, and 90% exceedance winter flows.

Summary of Results

Here we discuss preliminary modeling to date. Final modeling and preliminary designs pending from WSE and will be discussed in subsequent reporting.

Selected Sites

We have selected our two control (071 Howanut & 182 Sanders) and two reconnection sites (086 Hoxit & 174 Chehalis). The Hoxit site is one of our study locations that will receive reconnection (**Figure 1**). This site is owned by both WDFW and the Chehalis Tribe near River Mile 37 and was one of our intensively studied offchannel sites from 2016-2017. This site already has all the water monitoring stations established and a wealth of baseline physical data to inform reconnection impacts. The other reconnection site is 174 Chehalis (**Figure 1**). This site is owned by the Chehalis Tribe near River Mile 43 and was originally surveyed in 2017 during our offchannel work and added to this project in 2022. Water monitoring equipment has been established at this site.

Figure 1. The Hoxit study site (left) and the 174-Chehalis site (right) are targeted for enhanced upstream reconnection. Upstream is towards the bottom of each photograph.

We have selected the Sanders site as a reference site (**Figure 2**). This site was part of our offchannel work in 2017 and is near River Mile 47. This site is privately-owned and is connected up and downstream each year during regular winter flows. Water monitoring equipment has been setup at this site. We have also selected the Howanut site near the

Figure 2. The Sanders site (left) and Howanut site (right) were selected as reference comparison sites and will not be reconnected. Sanders is connected up and downstream seasonally whereas Howanut is disconnected except in extreme flows.

confluence of the Black River and Chehalis at River Mile 48 as our entirely disconnected reference site (**Figure 2**). This site was part of our offchannel work in 2015 and 2016 and has multiple years of existing survey data available. This property is owned by the Chehalis Tribe and a private landowner and is rarely connected. Water monitoring equipment has been established at this site.

OFFCHANNEL HABITAT MONITORING:

Pre-restoration monitoring is staggered between sites aligning to when they were initiated into the project and will continue until the reconnection interventions begin. After construction is finalized, we will conduct two years of post-restoration monitoring. Through fall 2022 we have documented 4-5 native amphibians (to the exclusion Western Toads) at all four sites. Each site is occupied by non-native American Bullfrogs. Native fish species composition ranges from 4-8 species. Olympic Mudminnow and Three-spined Stickleback are the only species captured at all sites. Non-native fish composition includes 4-6 species. All sites contain Bluegill, Pumpkinseed, Largemouth Bass, and Brown Bullheads.

RECONNECTION MODELING WATERSHED SCIENCE & ENGINEERING (WSE):

For the Hoxit site, the upstream connection has a threshold elevation of 52.5 feet, which corresponds to a flow of approximately 13,000 cfs in the mainstem Chehalis River (**Figure 3**). For 174-Chehalis, the threshold elevation for the upstream connection is 68.0 feet, which corresponds to a flow of approximately 4,700 cfs in the mainstem Chehalis River (Figure 3). Frequencies of current hydraulic connections are shown in Table 1.

Five preliminary options were developed for Hoxit. The lowering of the upstream connection(s) from 52ft to 49ft in the most extreme model will increase our daily connection from 19 days/year to 49 days/year and increase connection time from 5 to 13.3% of the time and increase volume up to 161% over current (Figure 4). Once the team decides on which preferred option is most desired and feasible, a final model for that alternative will be created and preliminary design produced by WSE.

Site 174-Chehalis hydraulic modeling is less developed than Hoxit but will have similar data. Additional data are needed due to the changes in the river at this location since the lidar was collected in 2012. These changes are resulting in an increasing gravel bar at the most likely place to increase reconnection. The development of this gravel bar suggests that reconnecting at this site will not cause a durable reconnection. As such, we need to look at enhancing a further

upstream area outside this depositional area for increased longevity of the project reconnection (Figure 5). Some of these data was collected in 2023, but more is still needed to refine the model.

We anticipate that model and preliminary design to be completed in the upcoming year.

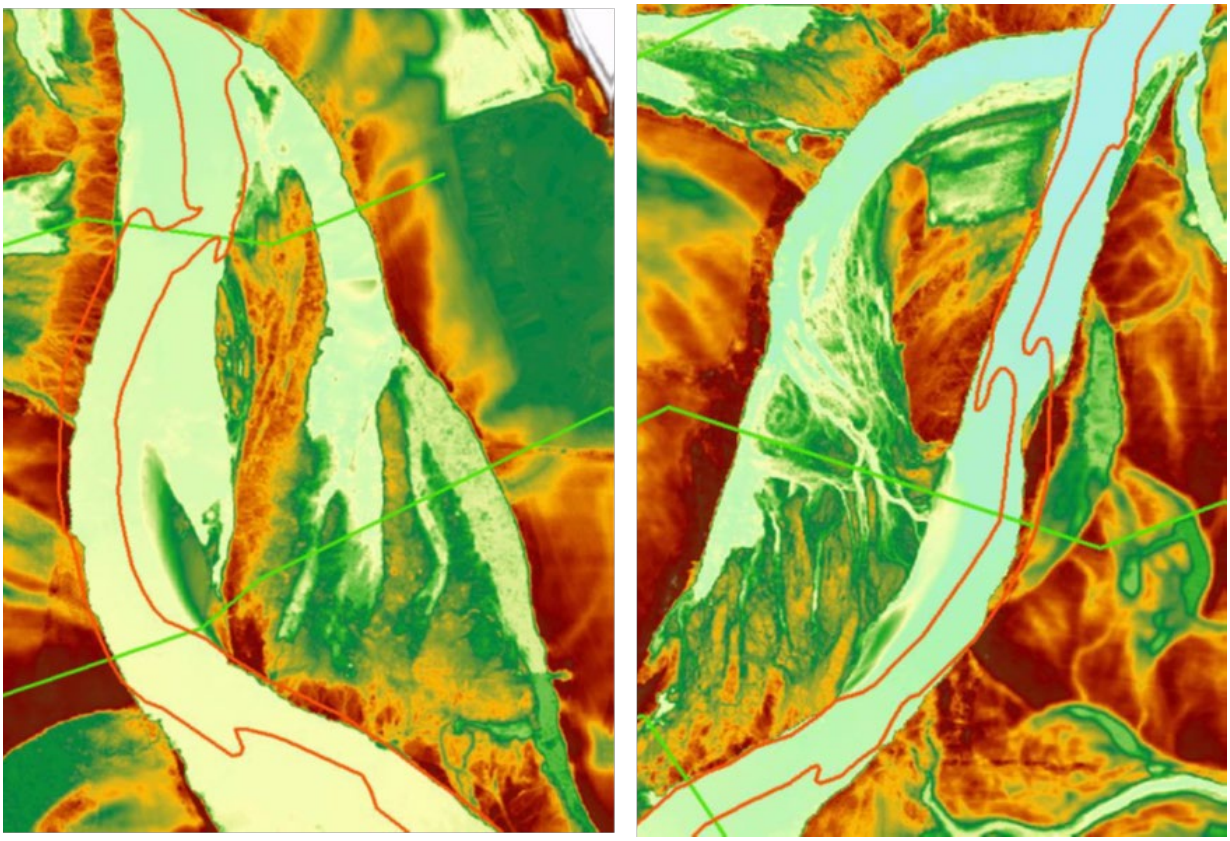

Figure 3. Current Conditions for Hoxit (left) and 174-Chehalis (right) with the 2012 LiDAR, the 1D model cross sections (green) and the 2019 NAIP bank lines (orange).

Site	Hydraulic Connection Location	Threshold Elevation, feet	Threshold flow, cfs	% of time connected, from daily data	% of time connected, from 15-min data
Hoxit	Downstream	46.6	4,300	30.8%	31.1%
	Upstream	52.5	13,000	6.8%	6.6%
174	Downstream	64.9	3,250	38.7%	38.9%
	Upstream	68.0	4,700	28.1%	28.5%

Table 1. Frequencies of hydraulic connection for existing conditions at Hoxit and Site 174.

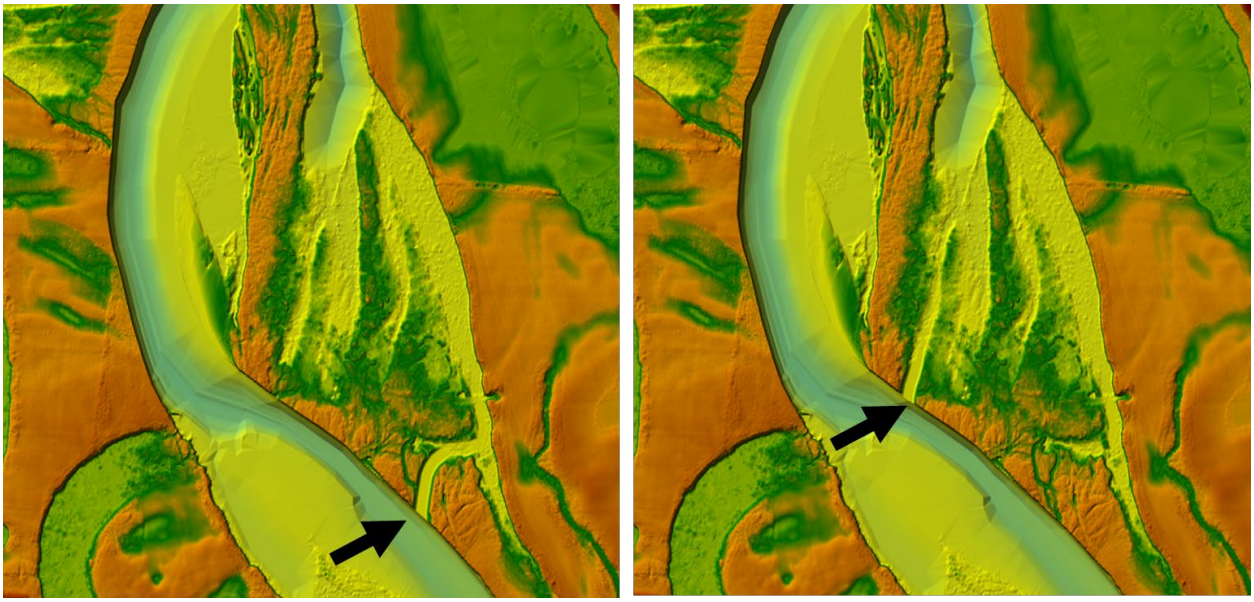

Figure 4. Lowest Connection Elevation 49ft shown at further downstream (left) and further upstream (right) locations

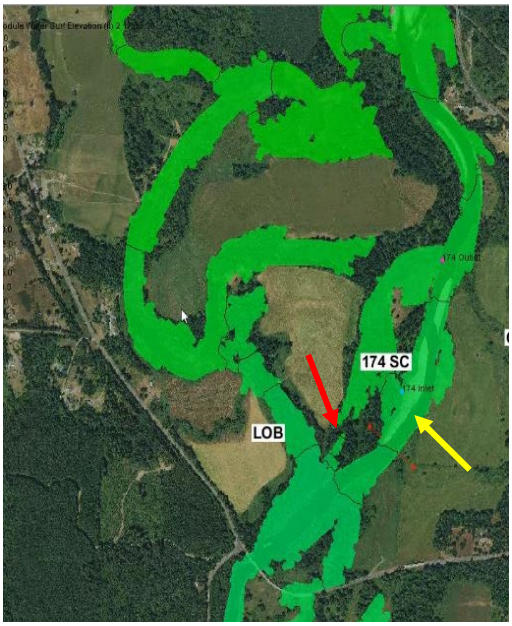

Figure 5. Current conditions seen at 14-16k CFS which is 3 times per year for 10days. The yellow arrow indicates increasing aggregation gravel at the initial site for increasing connection. Red arrow is location currently being looked at.

Discussion

The offchannel reconnection project is progressing but is still multiple years out from implementing the experimental reconnection. We are collecting sufficient biological data and hydrological data pre-implementation to inform the impact of artificially reconnecting offchannel habitats to the river. However, the scale of these experiments and the dynamic nature of the

streams (e.g., the production of a gravel bar pre-implementation) underscores the challenge for this work.

Adaptive Management

This experiment represents a case study that can inform Steering Committee decisions around projects that connect or reconnect offchannel habitats to streams. The goal of this work is to improve habitat conditions for native species and reduce conditions that support exotic species. Although the treatment has yet to be implemented for this study, our experience of site selection, modeling, and observing sites change dynamically during pre-implementation monitoring underscores the challenges of large-scale restoration efforts and the need for iteratively refining our science and habitat enhancement work for the ASRP. Ultimately, this work could point towards a habitat enhancement method that could be used throughout the Chehalis Basin, but such an effort may be challenging to implement.