WATERSHED HEALTH ASSESSMENT: SKOOKUMCHUCK RIVER EARLY ACTION REACH (EAR) MONITORING

Study Goals and Objectives

This assessment provides pre and post physical habitat data for the final restoration activities for the Skookumchuck River downstream of Skookumchuck Dam from approximately river mile 18.6 to 19.6 and 21.6 to 21.7 (the Project Reach). This project is one of five Early Action Reach projects being implemented as part of the Chehalis Basin Strategy Aquatic Species Restoration Plan (ASRP). The purpose of the Early Action Reach projects is to demonstrate to stakeholders the restoration techniques and scale of restoration envisioned by the ASRP.

The following impaired processes and limiting factors for fish and wildlife species in the Project Reach were identified as such:

- Reduced in-channel structure (e.g., wood)
- Modified sediment delivery, transport, and temporary storage
- Reduced floodplain connectivity and function
- Reduced riparian condition and function

Table 1 summarizes the restoration actions and identifies how the actions could address the impaired processes and limiting factors and related indicators or physical habitat metrics.

Table 1. Restoration actions, stream processes and limiting factors addressed.

Restoration actions	Processes addressed	Limiting factors addressed	Assessment Indicators
Install large wood structures in the river	Improves in-channel structure • Promotes floodplain connectivity • Retains and sorts sediments	Increases diversity and complexity of inchannel habitats (e.g., creates deep pools) • Promotes connectivity with and formation of off-channel habitats • Deflects flows and slows erosion to protect riparian plantings	• Instream spatial complexity • Instream large woody debris (LWD) • Instream substrate composition

Remove bank armoring or other geomorphic impediments to process	Allows for channel migration and formation of habitats • Allows recruitment of wood and coarse sediment • Promotes floodplain connectivity	Increases diversity and complexity of inchannel habitats • Promotes connectivity and formation of floodplain and off-channel habitats	• Instream large woody debris (LWD) • Instream substrate composition
Install native riparian forest plantings	Increase large wood recruitment over time for in-channel structure • Increases bank erosion resistance • Reduces solar heating of river over long term • Improves food web cycling and function	Increases diversity and complexity of inchannel habitats • Increases diversity and complexity of offchannel habitats • Provides insects, detritus to food web • Provides nesting and foraging habitats for wildlife • Increases shading and localized air temperature reductions	• Instream large woody debris (LWD) • Riparian condition

Methods / Study Design

Two reach scale surveys of physical habitat, water quality and bioassessment were conducted in 2019 (pre-construction), 2020 (mid-construction) and again in 2022 (post-construction). Physical habitat was sampled according to Status and Trends Monitoring for Watershed Health and Salmon Recovery: Quality Assurance Monitoring Plan. Measurements fall into 2 broad categories, those collected at 11 equidistant transects and those collected while traversing the length of the site. Site length is 20 bankfull widths (≥ 150 m and ≤ 2 km).

These features were measured at each of 11 equidistant transects:
- Bankfull width
- Bankfull depth cross-section
- Bankfull height
- Wetted width
- Substrate size composition
- Embeddedness
- Fish cover percentage by category
- Bank quality (instability)
- Canopy cover (shade by densiometer)

Additional measurements of substrate, embeddedness, and width among 10 secondary transects, located mid-way between the 11 primary transects are collected. While travelling up or down the length of the site, the field crew measured thalweg depth at each of 100 equidistant points. Raw habitat data are recorded in electronic field forms loaded on tablets. The data are uploaded directly into our Watershed Health database, where 262 habitat metrics are calculated and reported. More information about the habitat metrics and the methods are provided here: Dictionary of Metrics for Physical Habitat: Definitions and

Calculations Used for Watershed Health Monitoring and Related Studies. The metrics outlined in table 2 are initially being suggested to describe and track physical impaired processes and limiting factors in relation to restoration actions. Variability of metrics are described in Signal vs Noise for Watershed Health Monitoring Habitat Metrics, 2009-2019.

The Skookumchuck reach scale restoration project was meant to address the following 5 indicator sub-categories are considered:

1. Instream spatial complexity
2. Instream large woody debris (LWD)
3. Instream substrate composition
4. Instream bank conditions
5. Riparian condition

Table 2. Physical habitat indicators and associated attributes and metrics.

Indicator	Attribute	Units	Definition
Instream spatial complexity	Wetted width	m	Average wetted width of main channel
	Bankfull width	m	Average of bankfull width of main channel
	% Pools	%	Percent of habitat identified as pool
	Pool Depth	cm	Average depth of pools
	Relative bed stability	NA	Index of erosion potential
Instream LWD	LWD Frequency	Count/100m	Count of large wood debris per 100 m
	LWD Volume	m3/m2	Volume per 100 m of all pieces of large woody debris
Instream substrate composition	% Fine Sediment	%	Percent of all transects with a substrate size class of fine sediment
	% Sand/Fines	%	Percent of all transects with a substrate size class of Sand or Silt/Clay
	Embeddness	%	Percent of substrate covered by fine sediment
	Particle Size	mm	geometric mean substrate diameter

Summary of Results

Table 3 presents a selection of physical habitat metrics related to limiting factors described above collected from within the project reach from river mile 18.6 to 19.6 and 21.6 to 21.7. As many of these limiting factors are expected to progress towards improvement over time, additional metrics should be evaluated as additional years of data are collected.

Table 3. Summary select metrics describing changing in physical habitat within project reach from 2019 through 2022.

Attribute	**Year**		
	2019	**2021**	**2022**
Mean Wetted Width (m)	18.5	16.9	20.1
Mean Bankfull Width (m)	27.2	29.7	29.6
% Pools	67.5	70	72
Mean Pool Depth (cm)	121.9	124.2	138.2
Relative bed stability	0.12	0.017	0.024
LWD Pieces 100m (#/100m)	18.2	39.4	40.4
LWD Site Volume (m3/m2)	136.3	272.0	453.5
% Sand/Fines	47.1	52.3	43.9
Mean embeddedness (%)	68.2	72.2	65.5
Partial size (mm)	0.9	1.5	1.5

Discussion

Although many of the physical habitat metrics presented in table 3 responded in a predictable way based on the restoration actions, it should be noted that one year of post-restoration monitoring is insufficient for assessing effectiveness. The immediate effects of adding large wood to the project reach was apparent however subsequent positive changes to other instream habitat conditions that are more favorable to biological species will take time to stabilize and mature.

Adaptive Management

Expectations for what a restoration project can accomplish in terms of habitat improvements should be calibrated to the project's spatial scale and evolution over time. A long-term monitoring period is needed to allow the project to be exposed to a range of flows and give vegetation time to pass form the critical establishment period to a more mature phase. The geomorphic success of this project may not be properly evaluated until such flows occur. In addition, riparian vegetation may take many years of growth before its success in bank stabilization or providing stream shade and temperature reductions can be evaluated with any confidence. Any upstream and downstream project effects will likely require a series of high flows before they become apparent.