Yale Hydroelectric Project
FERC Project No. P-2071

Before the
United States of America
Federal Energy Regulatory Commission

Application for License Amendment

Volume I of V
Initial Statement and Exhibits A, C, D, and G

PACIFICORP
A BERKSHIRE HATHAWAY ENERGY COMPANY

January 2020

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Yale Hydroelectric Project
(FERC No. P-2071)

APPLICATION FOR LICENSE AMENDMENT

This application for license amendment for the Yale Hydroelectric Project (FERC No. P-2071) consists of the following volumes:

Volume I

Initial Statement
Exhibit A – Project Description
Exhibit C – Project Installation and Proposed Schedule
Exhibit D – Costs and Financing
Exhibit G – Project Maps

Volume II

Exhibit E – Environmental Report

Volume III

Appendices to Exhibit E

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Volume V

CONFIDENTIAL – Cultural Resource Summary for the Merwin, Yale and Swift No. 1 Projects

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Initial Statement

Yale Hydroelectric Project
(FERC No. P-2071)

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**BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION**

PACIFICORP PROJECT NO. P-2071

APPLICATION FOR NON-CAPACITY AMENDMENT OF LICENSE FOR A MAJOR PROJECT - EXISTING DAM

INITIAL STATEMENT

(Pursuant to 18 CFR § 4.201)

1. PacifiCorp (PacifiCorp, Licensee, or Applicant) applies to the Federal Energy Regulatory Commission (FERC or Commission) for a non-capacity amendment of the license for the Yale Project (Project) as described in the enclosed exhibits.

2. The exact name, business address, and telephone number of the Applicant are:

   PacifiCorp
   825 N.E. Multnomah St., Suite 1800
   Portland, Oregon 97232

   The exact name and business address of each person authorized to act as agents for the Applicant in this application are:

   Todd Olson
   Director of Compliance, Renewable Resources
   PacifiCorp
   825 N.E. Multnomah St., Suite 1800
   Portland, OR 97232
   (503) 813-6657
   todd.olson@pacificorp.com

3. The Applicant is a domestic corporation organized under the laws of the State of Oregon and Licensee for the Yale Hydroelectric Project designated as (FERC No. P-2071) in the records of the Federal Energy Regulatory Commission, original license issued on October 29, 1956. The Commission issued a new license for the Project on June 26, 2008.

4. The amendments of license proposed and the reason(s) why the proposed changes are necessary:

   Ordering Paragraphs (F) and (G) of the Project license incorporate the fishway prescriptions submitted by National Marine Fisheries Service ("NMFS") and the United States Fish and Wildlife Service ("USFWS" collectively with NMFS, the "Services") under Section 18 of the Federal Power Act. Among these prescriptions was an obligation to construct an upstream fish passage facility at the Project on or before June 26, 2025, the

17th anniversary of the date FERC issued the new license. These fishway prescriptions were developed collaboratively among PacifiCorp, the Services, and other stakeholders in a comprehensive Settlement Agreement ("Agreement"). The Agreement also provided that should the Services determine, after review of new information, that the fish passage facilities into or out of Yale Lake or Merwin Lake are inappropriate, PacifiCorp would establish an "In Lieu Fund" to support mitigation measures for anadromous salmonids in lieu of passage.

Moreover, Article 401(b) of each FERC license includes a list of fish passage conditions that, if modified, would require a license amendment. The lists in Article 401(b) identify the Section 18 fish passage prescriptions that cover the Merwin and Yale Reservoir Facilities. In Article 401(b) of the licenses, FERC acknowledged that because of the provisions in the Agreement relating to the Services' review of fish passage, changes to the fish passage conditions could be required:

> Certain conditions in the appendices contemplate unspecified long-term changes to project operations, requirements, or facilities for the purpose of protecting and enhancing environmental resources. These changes may not be implemented without prior Commission authorization granted after the filing of an application to amend the license.

<u>New Information Regarding Fish Passage</u>

Beginning in November 2011, PacifiCorp and Public Utilities District No. 1 of Cowlitz County ("Cowlitz PUD" together with PacifiCorp, the "Utilities") began consultation with the members of the Lewis River Aquatic Coordination Committee ("ACC") over the development of new information to submit to the Services for their determination if the additional fish passage facilities identified in the Agreement and in the Section 18 prescriptions were appropriate (the "New Information"). The Utilities submitted the New Information to the Services on June 24, 2016. A detailed description of the consultation with the ACC during preparation of the New Information is included Exhibit E.

The Services responded on April 11 and 12, 2019, providing the Utilities with a preliminary determination under Section 4.1.9 of the Settlement Agreement. Specifically, NMFS proposed and USFWS concurred in the following actions:

1) To forego construction of the Merwin Downstream Facility (Section 4.6 of the Settlement Agreement) and the Yale Upstream Facility (Section 4.7);

2) To require PacifiCorp to establish the In Lieu Fund consistent with the requirements of Section 7.6 of the Settlement Agreement; and

3) To defer a decision whether to construct the Yale Downstream Facility (Section 4.5) and the Swift Upstream Facility (Section 4.8) until 2031 and 2035, respectively, so that performance of in lieu habitat restoration could be considered in that future decision.

The Services directed that restoration efforts supported by the In Lieu Fund (the "In Lieu Program") focus on stream reaches upstream of the Swift reservoir that benefit three salmon species listed under the Endangered Species Act (ESA): (coho salmon [Oncorhynchus kisutch], winter steelhead [O. mykiss], and spring Chinook salmon [O. tshawytscha]). The Services identified the following reaches known to support all three species since reintroduction efforts began in 2012:

- Clearwater River (8.37 kilometers [km])
- Clear Creek (22.96 km)
- North Fork of the Lewis River (22.69 km)
- Drift Creek (1.52 km)

In addition, the USFWS, in an April 12, 2019, letter, directed the Utilities to proceed immediately with the development of the following fish passage measures for bull trout (*Salvelinus confluentus*) pursuant to Section 4.10 of the Settlement Agreement:

- Yale Downstream Bull Trout Passage Facility
- Swift Upstream Bull Trout Passage Facility
- Yale Upstream Bull Trout Passage Facility

USFWS elected to defer a decision on whether to require construction of the Merwin Downstream Bull Trout Passage Facility to evaluate whether bull trout have increased sufficiently in number in the Merwin reservoir to warrant construction. A determination by the USFWS regarding the Merwin Downstream Bull Trout Passage Facility is not due before 2025.

Requested License Amendments

Given the Services' preliminary determinations, the Utilities are engaging in the following activities:

- Development of an In Lieu Program Strategic Plan that will guide identification, selection and implementation of mitigation actions in the Lewis River in consultation with the Settlement Agreement parties;
- Development of an In Lieu Program Monitoring Plan that will guide the review and reporting of Strategic Plan actions;
- Development of a Biological Assessment to inform any required Endangered Species Act and Magnuson-Stevens Act consultation with the Services in support of the license amendment; and
- Preparation of a Bull Trout Passage Plan outlining designs for bull trout facilities in consultation with the U.S. Fish and Wildlife Service and the Settlement Agreement parties.

In addition to these activities, subject to the Services' final determinations, the Utilities seek non-capacity amendments to the Lewis River Project Licenses and the incorporated fishway prescriptions. These amendments are necessary to enable construction of bull trout facilities, construction of mitigation projects within the Project boundaries, and changes in the nature and timing of the construction of fishways prescribed under Section 18 of the Federal Power Act.

Required Exhibits

For this non-capacity amendment, consistent with the requirements of 18 CFR § 4.201(c), only those exhibits applicable to the proposed changes necessary to implement the Service's In-Lieu Determination are provided.

Exhibit A - Project Description – Enclosed within Volume I

Exhibit B - Project Operations – The non-capacity amendment proposed in this application will have no impact on Project operations and, accordingly, Exhibit B is not provided.

Exhibit C - Project Installation and Proposed Schedule – Enclosed within Volume I

Exhibit D - Costs and Financing – Enclosed within Volume I

Exhibit E - Environmental Analysis – Enclosed within Volume II, appendices to Exhibit E are provided in Volume III

Exhibit F - Project Drawings – Enclosed within Volume I

Exhibit G - Project Boundaries – Enclosed

5. (i) The statutory or regulatory requirements of the state in which the project would be located that affect the project as proposed with respect to bed and banks and the appropriation, diversion, and use of water for power purposes are:

- Section 404 Permit – US Army Corps of Engineers
- In-water Work Protection Plan Approval – Washington Department of Ecology
- General Construction Stormwater Permit – Washington Department of Ecology
- Hydraulic Project Approval – Washington Department of Fish and Wildlife
- Shoreline, Critical Areas and Land Use Approvals – Clark County / Skamania County
- Aquatic Land Lease – Washington Department of Natural Resources

(ii) The steps which the applicant has taken or plans to take to comply with each of the laws cited above are: The full list of permits required to implement the Services' determinations will be developed following final design completion. The Utilities will obtain all necessary permits prior to construction.

6. PacifiCorp is the owner of all existing project facilities

SUBSCRIPTION

This Application for License Amendment for the Yale Project, FERC Project No. P-2071 is executed in the State of Oregon, County of Multnomah, by Todd Olson, Director of Compliance Renewable Resources, PacifiCorp, 825 NE Multnomah St., Suite 1800, Portland, Oregon, 97232, who, being duly sworn, deposes and says that the contents of this application are true to the best of his/her knowledge or belief and that he/she is authorized to execute this application on behalf of PacifiCorp.

The undersigned has signed his application this ____ day of __________, 2020.

____
Todd Olson
Director of Compliance, Renewable Resources

VERIFICATION

Subscribed and sworn to before me, a Notary Public of the State of Oregon this ____ day of ____________, 2020

____
Notary Public – Kimberly L. McCune

My Commission Expires ____________________

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EXHIBIT A – PROJECT DESCRIPTION

**Yale Hydroelectric Project
(FERC No. P-2071)**

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Note to reader – This document revises the current Yale Hydroelectric Project Exhibit A on file with the Federal Energy Regulatory Commission. All proposed revisions are identified in track changes.

A.1.0 Introduction

In compliance with the Code of Federal Regulations (18 CFR, Parts 4 and 16), PacifiCorp Energy applied to the Federal Energy Regulatory Commission (FERC) to re-license the Yale Hydroelectric Project, FERC Project No. P-2071, which PacifiCorp Energy currently owns and operates, on the North Fork Lewis River, in the State of Washington. The initial license for the Yale Project was issued on April 30, 1951 and expired on April 30, 2001. The current license, effective June 1, 2008, and expiring May 31, 2058, was issued under Order Issuing New License (123 FERC ¶62,257) on June 26, 2008. An Order on Rehearing (125 FERC ¶ 61,046) was issued October 16, 2008.

Exhibit A – Project Description

This Exhibit A is a description of the Yale Project. It includes the location, general configuration, physical composition, and dimensions of the project structures. The description also includes information on the turbine-generator unit, as well as appurtenant civil, mechanical, and electrical equipment.

Exhibit A is organized in five sections that follow the sequence of information requested in the CFRs. Following this introduction, the existing facilities are described in Section 2.0. In Section 3.0, proposed modifications are described. Section 4.0 contains a statement regarding lands of the United States within the project boundary. Section 5.0 contains reference cites.

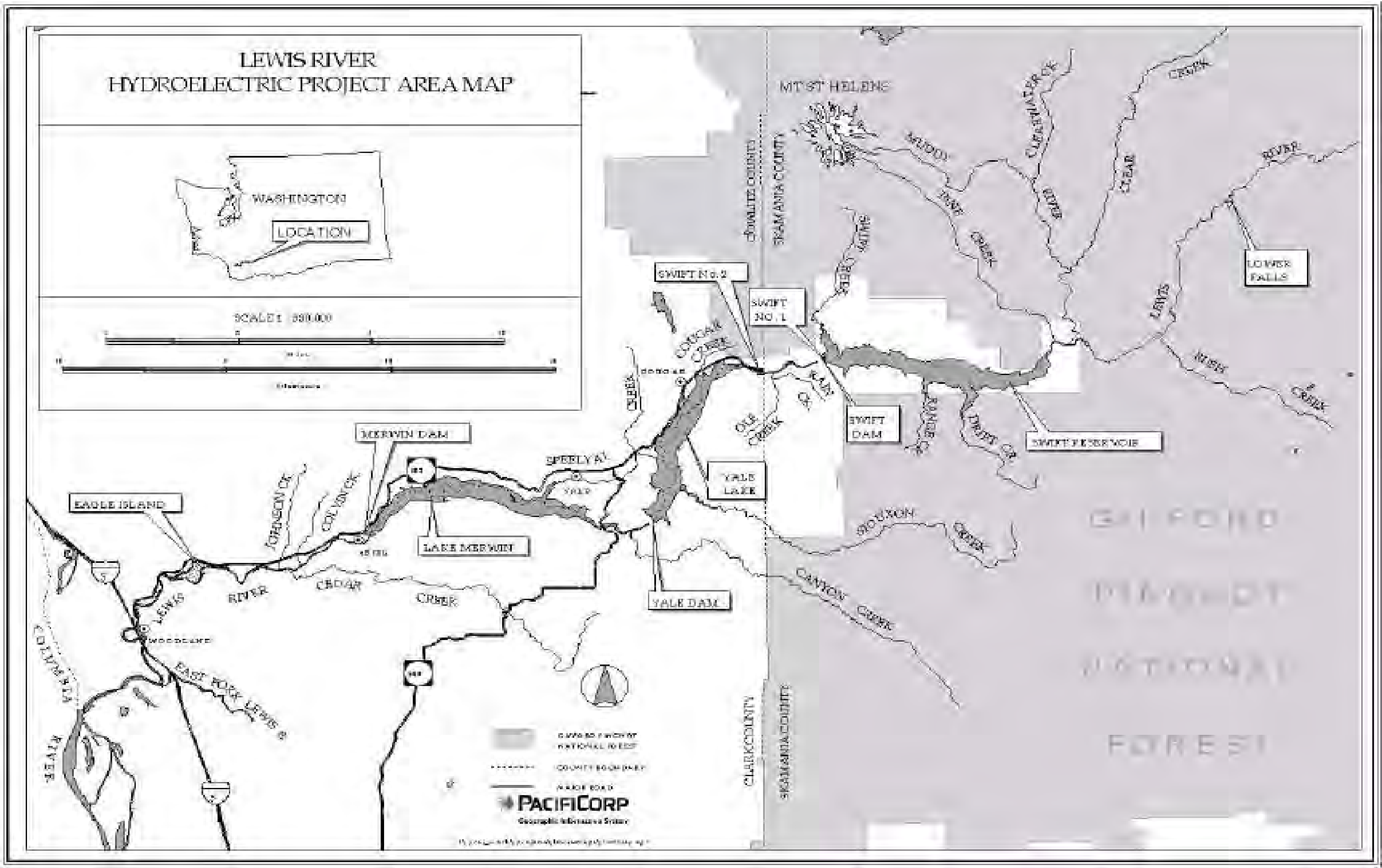

Figure A.1.0-1 Lewis River Hydroelectric Projects Area Map

A.2.0 Existing Structures

The Yale Hydroelectric Project is located on the North Fork Lewis River at the upstream end of Lake Merwin at river mile (RM) 34. The site is approximately 23 miles east of Woodland, Washington and 45 miles northeast of Portland, Oregon, about 35 miles upstream of the confluence of the North Fork Lewis River with the Columbia River. The Yale Project location within the North Fork Lewis River drainage basin is shown on Figure A.1.0-1.

The major components of the Yale Project include a reservoir, a main embankment dam, a low earth-fill saddle dam, a concrete chute-type spillway, and a 2-unit powerhouse. The significant project data are listed in Table A.2.0-1. A description of the civil, mechanical, and electrical systems for the major project components and their physical and operating conditions are as follows.

Table A.2.0-1 Yale Project Data

GENERAL		
Plant Name	Yale	
FERC Project No./License Expiration	2071/2001	
Location	Yale, Washington	
Stream Name	North Fork Lewis River	
Minimum Flow Requirement (cfs)	None	
Plant Data		
Plant Capacity, kW at 0.90 PF	134,000	
Number of Units	2	
Rated Net Head	240 feet	
Plant Discharge	9,640 cfs	
Average Annual Generation (Gross)	553,947 MWh (30-years 1958-1987)	
CIVIL SYSTEMS		
Reservoir		
Name	Yale Lake	
Drainage Area	596 square miles	
Maximum Storage Capacity @ El.	402,000 ac-feet	
Usable Storage Capacity	190,000 ac-feet	
Maximum Normal Elevation	490.0 feet msl	
Normal Summer Operating	490.0-480.0 feet msl	
Normal Minimum Operating	470.0 feet msl	
Minimum Operating Elevation	430.0 feet msl	
Minimum of Record	435.65 feet msl (February 1957)	
Minimum Pool	430.0 feet msl	
Dams		
Name	Yale dam	Saddle dam
Type	Zoned embankment	Zoned embankment
Height	323 feet	40 feet
Length	1,500 feet	1,600 feet
Instrumentation	Crest monuments Vee-notched weir Abutment piezometers	Downstream piezometers
Diversion Tunnel		
Size	30-foot diameter horseshoe shaped	
Length	1,530 feet	
Liner Type	Concrete	
Other Features	Concrete plug at 1,276 feet from outlet	
Future Intake		
Location	81 feet north of diversion tunnel plug	

Table A.2.0-1 Yale Project Data (continued)

Features currently present	Circular cofferdam and rock formation grouting	
Cofferdam Outside Diameter	76 feet	
Cofferdam Top Elevation	431.3 feet msl	
Intake Structure		
Width	95 feet	
Length	38 feet	
Height	100 feet	
Intake Invert Elevation	400 feet msl	
Gates		
Number	2	
Type	Roller bulkhead	
Size	13.33 x 17 feet	
Hoist Capacity	100 tons	
Instrumentation (monitoring discontinued since 1997 Part 12)	Tilt plates (2) Float wells	
Intake Fish Barrier Net		
Mesh Size	½ inch	
Length	700 feet	
Height	95 feet	
Penstocks		
Diameter	Varies-16 to 18.5 feet	
Length	1,111 feet (Unit 1) 1,206 feet (Unit 2)	
Liner Type	Unit 1	Unit 2
	Steel (985 feet) Concrete (126 feet)	Steel (1,093 feet) Concrete (113 feet)
Powerhouse		
Type	Semi-outdoor	
Width	151 feet	
Length	57 feet	
Draft Tube Gates		
Type	Slide	
Size	10' 1.5" x 17' 11"	
Gantry Crane		
Type	Outdoor	
Span	65 feet	
Main Hook Capacity	235 tons	
Auxiliary Hook Capacity	30 tons	
Draft Tube Gates Hoist Capacity	10 tons	
Spillway		
Type	Gated concrete ogee/chute	
Crest Length	195 feet	
Crest Elevation	460 feet msl	

Table A.2.0-1 Yale Project Data (continued)

Gates		
Number	5	
Type	Tainter	
Size	39 x 30 feet	
Fish Barrier Net	370 feet x 55 feet	½" mesh
Discharge Capacity	194,000 cfs (PMF) at pool elevation	
Tailrace	Lake Merwin	
Plant Access Road		
Length	2.2 miles (from State Route 503)	
Surface Type	Asphalt/gravel	
Concrete bridge over spillway chute	110 foot span	
MECHANICAL SYSTEMS		
Turbine		
Unit Number	1	2
Manufacturer	S. Morgan Smith/ American Hydrorunner	S.Morgan Smith/American Hydrorunner
Turbine Capacity	73,300 kW at 240 feet	73,300 kW at 240 feet
Maximum Turbine Discharge	4,820 cfs at 240 feet	4,820 cfs at 240 feet
Maximum Turbine Output	86,800 kW at 240 feet	86,800 kW at 240 feet
Type	Vertical Francis	Vertical Francis
Speed (nameplate)	150 rpm	150 rpm
Runner Discharge Diameter	144 inches	144 inches
Wicket Gate Circle Diameter	173 inches	173 inches
Wicket Gate Height	32.25 inches	32.25 inches
Distributor Centerline Elevation	236.0 feet msl	236.0 feet msl
Draft Tube Type	High moody spreading- cone	High moody spreading- cone
Year Disassembled and Overhauled	1986 turbine overhaul 1996 turbine overhaul, runner replaced	1987 turbine overhaul 1995 turbine overhaul, runner replaced
Governor	Woodward cabinet	Woodward cabinet
Piezometer Taps		
Spiral Case Inlet	4-1/4" Orifices	4-1/4" Orifices
Winter-Kennedy	4-1/4" Orifices	4-1/4" Orifices
Lube Oil Systems	Turbine guide bearing Thrust/generator lower guide bearing Upper generator guide bearing	Turbine guide bearing Thrust/generator lower guide bearing Upper generator guide bearing
High-Pressure Lift System	Yes	Yes
Cooling and Service Water System	Generator cooling Thrust bearing cooling Seal water	Generator cooling Thrust bearing cooling Seal water
Draft Tube Depression System	Yes	Yes

Table A.2.0-1 Yale Project Data (continued)

Compressed Air System		
Compressors		
Number	2	
Manufacturer/Model No.	Gardner-Denver/WBE 1006	
Speed	870 rpm	
Number of Cylinders	2	
Motors		
Type	Induction	
Manufactured/Model	GE/5K 1445BX4	
Capacity	40 hp	
Speed	875 rpm	
Air Receivers		
Number	2	
Volume	110 cubic feet (each)	
Plant Drains and Dewatering System		
Plant Sump Dimensions, (LxWxH)	7.5' x 13' x 48'	
Sump Pumps		
Number/Type	1/Vertical	
Capacity	1,000 gpm	
Motor	25 hp	
Dewatering Pumps		
Number/Type	2/Vertical	
Capacity	5,000 gpm (each)	
Motor	125 hp	
Oil Separation Provisions	None	
Domestic Water and Sanitary Waste System		
Domestic Water	Chlorinated Service and Cooling Water	
Water Heater Number/Capacity	1-80 gallons 1-25 gallons	
Sanitary Waste Treatment	3,000 gallon septic holding tank	
Fire Detection and Protection		
Plant Fire Detection System	None	
Generator Fire Suppression System	Carbon dioxide (bottles removed)	
Plant Interior Fire Protection System	None	
Sire Fire Protection System	None	

Table A.2.0-1 Yale Project Data (continued)

HVAC System		
Heating		
Powerhouse	Rejected generator heat	
Control Room	Electric heater	
Ventilation		
Powerhouse	Natural circulation	
Generator Cover	Ventilation fans	
Air Conditioning		
Control Room	Window unit	
Lube Oil Filtration System		
Filter Type	Bowser Figure 7D Multi-compartment	
Oil Storage Tank Capacity	9,000 gallons	
ELECTRICAL SYSTEMS		
Generator		
Unit Number	1	2
Manufacturer	General Electric	General Electric
Rating		
kVA at 60 C	74,400	74,400
Power Factor	0.90	0.90
Insulation Class		
Stator	F	F
Field	B	B
Generator Capability		
kVA	74,400	74,400
kW at 0.90 PF	67,000	67,000
Temperature Rise, C, Stator	75	75
Temperature Rise, C, Field	80	80
Year Installed	1952	1952
Year Disassembled and Overhauled	1986-Rewind	1987-Rewind
Exciter		
Manufacturer	ABB Model Unitrol "P"	ABB Model Unitrol "P"
Static Excitation System	325 kW at 250 V dc	325 kW at 250 V dc
Bus Duct		
Type	Non-segregated	Non-segregated
Rating, amp/phase	4,000	4,000
Generator Breakers	SF6 (1992)	SF6 (1992)

Table A.2.0-1 Yale Project Data (continued)

Protective Relays	General Electric	
480 Volt System	Switchgear Station control centers Headgate load center Spillgate load center	
120 Volt System		
Transformers		
Type	Dry/Single Phase	
Voltage	480-120/240 volts	
Rating, kVA	37.5 (Powerhouse 2 total); 15 (Headgate); 15 (Spillways)	
Panelboards	120/240 V	
DC System		
Battery		
Number of Cells	60	
Voltage, V	125 dc	
Rating, amp-hr	240	
Number of Chargers	1 @ 50 amp 1 @ 25 amp	
Panelboard	120 V dc	
Emergency Generator		
Type	Propane Engine	
Voltage	480 volts	
Rating	100 kW	
Transformers		
Station Service Transformers		
Type	Oil-fill/three-phase	
Number	2	
Rating	1,750 kVA (Auxiliary No. 1) 3,750 kVA (Auxiliary No. 2)	
Voltage	13,800/480 volts	
Generator Step-up Transformers		
Number	4 (includes one spare)	
Type	Oil-filled/single/phase	
Rating	138,000 kVA	
Voltage	13,200/115,000 volts	
Manufacturer	General Electric	
Year Installed	1953	
Lighting	Incandescent and fluorescent lamps	
Plant Control and Instrumentation System	Landis and Gyr LG 6800 MODICON PLC	
Communication System	Analog Microwave	
Security	Fencing Locked gates and doors/video cameras	

A.2.1 Civil Systems

A.2.1.1 Reservoir

The reservoir formed by Yale Dam (Yale Lake) is approximately 10.5 miles long and has a surface area of 3,800 acres at elevation 490 feet msl, the normal maximum operating level of the reservoir. The reservoir's gross storage capacity at this elevation is 402,000 acre-feet with a usable storage capacity of 190,000 acre-feet. The drainage area for the reservoir is 596 square miles.

A.2.1.2 Dams

A.2.1.2.1 Yale Dam

The main dam for the project is a zoned embankment resting on bedrock with a crest length of 1,305 feet and a maximum height of 323 feet. The embankment consists of an upstream sloping central impervious core supported by sandy gravel shells. The upstream surface slope of the dam is 2.5 horizontal to 1 vertical, and the downstream slope is 2 horizontal to 1 vertical. The dam crest is at elevation 503 feet msl. A concrete arch section is provided at the downstream toe to limit the downstream extent of the dam and permit the powerhouse to be located approximately 150 feet closer to the intake. The arch section is 77 feet high and composed of concrete arch rings.

The instrumentation at the main dam monitors vertical crest movements, seepage flows, and piezometric pressures in the left abutment. Twelve monuments along the crest of the dam are surveyed annually by PacifiCorp to monitor dam settlement. Yale Dam and left abutment seepage flows are measured at the vee-notched weir near the powerhouse. Five piezometers are used to monitor the piezometric levels in the left abutment of the dam.

A.2.1.2.2 Saddle Dam

Saddle Dam is located about 0.25 mile north of the main dam on the right bank. This dam is constructed on a sandy clay layer overlaying an alternating sequence of sandy gravel, sandy clay, and sand and consists of a central impervious core with random fill in the outer shell sections. The saddle dam is 1,600 feet long with a maximum height of approximately 40 feet and 3 horizontal to 1 vertical side slopes. The dam crest is at elevation 503 feet msl. The upstream slope is protected from erosion by a 2 to 3-foot layer of riprap, while the downstream slope has a grass surface.

A.2.1.3 Diversion Tunnel and Future Intake

A.2.1.3.1 Diversion Tunnel

To implement the construction of the main dam, river flows were diverted past the project through a concrete-lined, 30-foot-diameter, horseshoe-shaped tunnel beneath the right portion of the dam. The diversion tunnel is 1,530 feet long and excavated in rock approximately 90 feet below the base of Yale Dam.

The headworks of the tunnel include an approach channel, approximately 200-feet-long and 100-feet-wide, and a gated inlet structure for control of the river flow to the diversion tunnel during construction of the dam. The inlet structure is constructed of reinforced concrete, has an invert at elevation 245 feet msl, and contains two 16-foot-wide by 23-foot-high closure gates and two 4-foot-wide by 5-foot-high inlet bypass gates. The gated inlet structure section of the diversion tunnel transitions into the 30-foot-diameter, horseshoe-shaped diversion tunnel approximately 60 feet downstream of the tunnel entrance.

The main portion of the diversion tunnel is lined with concrete a minimum of 1 foot thick. The tunnel is plugged at the location of the dam’s grout curtain approximately 1,276 feet from the tunnel outlet with a 30-foot-long section of concrete. The rock formation along the tunnel upstream of the plug is also pressure grouted. The tunnel outlet discharges into an open channel adjacent to the end of the spillway concrete apron. The open channel is approximately 50 feet wide and 320 feet long and intersects the main river channel approximately 400 feet downstream from the powerhouse.

A.2.1.3.2 Future Intake

The original project construction included a circular foundation and cofferdam for potential expansion of the project in the future. The center of the future intake is approximately 81 feet from the centerline of the diversion tunnel near the tunnel plug.

The foundation and cofferdam are constructed of reinforced concrete and consist of a ring beam founded on rock with outside and inside diameters of 76 and 64 feet, respectively. The top of the ring beam is at elevation 380 feet msl. The ring beam supports a circular wall that forms the upper portion of the cofferdam. The circular wall has an outside diameter of 76 feet and varies in thickness from 12 to 18 inches. The top of the wall extends to elevation 431.3 feet msl, 1.3 feet above the reservoir’s low water level.

Construction for the future intake also included pressure grouting the rock formation below the cofferdam and between the cofferdam to an area downstream of the diversion tunnel plug. Grouting of the rock formation would control groundwater inflow during construction of the future intake structure and connecting tunnel to the existing diversion tunnel.

A.2.1.4 Intake Structure

A.2.1.4.1 Structure

The intake structure is on the left bank of the reservoir near the left abutment of the main dam crest. The intake structure is accessible from a bridge that extends from the plant access road to the structure. The vertical concrete and steel-framed structure is 95 feet wide and 38 feet long. Full height trashracks screen the flow to the turbines, and 2 roller bulkhead gates are provided for dewatering the 2 parallel penstocks constructed in the left abutment. The trashracks are composed of 10-foot by 8-foot steel-framed, removable panels with 2.5-inch by 3/8-inch bars spaced on four-inch centers. The concrete deck of the intake structure is at elevation 500 feet msl and is designed for a 150 pound/square foot live load or an H-20 truck load. The two 17-foot by 13.33-foot rectangular openings to the penstocks at the bottom of the structure have an invert at elevation 400 feet msl, which is 90 feet below reservoir's maximum operating level. An access well and air inlet are also provided downstream of each gate.

Instrumentation at the intake structure allows monitoring of structure movement and reservoir levels. Two tilt plates are installed on the structure to record any deflections which may occur. Float wells are also installed at the intake structure to measure the reservoir level and the differential head across the trashracks. The recorded water levels are wired to the Yale powerhouse control room for observation by the plant operators. No mechanical trash cleaning equipment is installed at the intake structure.

A.2.1.4.2 Gates and Hoists

The intake structure is equipped with two 13.33-foot wide by 17-foot high roller bulkhead gates. The gates are constructed with structural steel members filled with concrete for ballast. The gates are hoist-operated and are used to dewater the penstocks for inspection and maintenance purposes. When the gates are not closed, they are suspended directly above the penstock openings.

The intake structure bulkhead gates are raised and lowered with 100-ton hoists driven by 20 hp motors at a speed of 2 fpm. Each hoist system is designed for outdoor service and is supported from a fixed, structural steel-framed gantry located at each gate slot approximately 30 feet above the intake structure deck. Hoist operation can be controlled locally or remotely from the powerhouse. The hoists have recently been rehabilitated and are in good working condition. The intake structure gate and hoist systems are designed to operate under full unbalanced conditions with the reservoir water level at elevation 490 feet msl.

A.2.1.4.3 Intake Fish Barrier Net

A fish barrier net with ½-inch mesh is located upstream of the intake to reduce entrainment of federally listed fish in the flow through the powerhouse. The net spans approximately 700 feet from a rock anchor on the reservoir bank upstream of the left abutment to a cast-in-place concrete anchor on the crest of the dam. The height of the net is 95 feet near the center of the span. The bottom of the net is weighted by a steel chain and is anchored by six 3,600-pound concrete blocks spaced 50 feet apart. The net is supported by foam-filled floats and is fixed in position.

A.2.1.5 Penstocks

Water is delivered from the reservoir to the generating units via two penstocks originating at the intake structure and terminating at the turbine spiral cases in the powerhouse. The penstock for Unit 1 is 1,111 feet long, while the penstock for Unit 2 is 1,206 feet long.

The penstocks for the Unit 1 and 2 turbines were originally lined with a 16-foot-diameter steel liner which extended upstream for 282 feet and 247 feet, respectively. The remainder of each penstock is concrete-lined with an internal diameter of 18.5 feet. The steel liners were subsequently extended in both penstocks, and the length of the Unit 1 penstock steel liner is 985 feet, while the steel liner for Unit 2 is 1,093 feet. The diameter of the steel liners varies between 16 and 18 feet with the majority of the extension having an 18-foot-diameter.

The centerline elevations for the penstocks are 409.25 feet at the intake and 236 feet at the powerhouse. The penstocks are horizontal at the intake and extend about 100 feet before dropping at a 9% grade for about 650 feet (measured horizontally). The penstocks then slope at a 52% grade for about 225 feet (measured horizontally) to connect to a 200-foot horizontal section which terminates at the turbine spiral case.

The penstocks are accessible through an 8-foot-high by 10-foot-wide by 110-foot-long access tunnel located at about the midpoint of each penstock. The access tunnel entrance is located on the left abutment immediately downstream of the dam at elevation 340 feet msl. The tunnel is accessible from the powerhouse by a road that crosses the downstream slope of the dam.

A.2.1.6 Powerhouse

A.2.1.6.1 Structure

The powerhouse is parallel to the river on the left bank immediately downstream of the concrete arch which forms the toe of the dam. The concrete, semi-outdoor type structure is 151 feet long and 57 feet wide and houses 2 turbine generator units.

The design and construction of the powerhouse included provisions for the future addition of two similar units downstream. The foundation for the future addition was completed up to elevation 205 feet msl during initial construction.

The turbine floor (elevation 244 feet msl) provides access to the turbine pit and to the lower powerhouse galleries that access the penstocks and draft tubes. The turbine floor also provides space for the turbine generator auxiliary systems including cooling water, compressed air receivers and piping, and station drainage. The powerhouse operating floor (elevation 257 feet msl) is at ground level and provides access to the generators and control room. The operating floor level also includes the governor, motor control center, air compressors, and draft tube depression system controls as well as toilet and locker room facilities and a laydown area for unit maintenance. The roof (elevation 274.5 feet msl) contains hatches for the outdoor gantry crane to access the laydown area, turbine generator units, and the turbine floor level.

The powerhouse is provided with draft tube gates for dewatering the turbine water passageways. The draft tube gates are 10.125 feet high by 17.9 feet wide and are raised and lowered by the gantry crane hoist. The draft tube gates weigh approximately 13,000 pounds each and are designed to be installed or removed under balanced water conditions. Under normal turbine operating conditions, a 20,000-pound concrete cover beam is placed over the slots to seal the draft tube, and the draft tube gates are dogged off above the draft tube for storage.

A.2.1.6.2 Gantry Crane

The powerhouse facility includes an outdoor type, traveling gantry crane for unit maintenance and raising and lowering the draft tube gates. The crane spans 65 feet across the powerhouse and has main and auxiliary hook capacities of 235 and 30 tons, respectively. A 10-ton hoist is also provided on the downstream end for handling the draft tube gates and concrete draft tube slot cover beams. Crane rails, approximately 195 feet long, allow the gantry crane to travel the full length of the powerhouse and the adjacent unloading area.

A.2.1.7 Spillway

A.2.1.7.1 Structure

The concrete gravity, chute type spillway adjoins the right abutment of Yale Dam. The spillway is 1,650 feet long. The length of the spillway is comprised of a 400-foot ogee and transition section, a 650-foot rectangular concrete chute on a 10% grade, and a 600-foot section of exposed bedrock. The concrete gravity ogee section has a crest at elevation 460 feet msl. The spillway discharges into the river about 1,200 feet downstream of the powerhouse. The downstream section of the spillway is formed in the exposed bedrock and is used for energy dissipation.

A spillway bridge provides access to the dam and powerhouse. The bridge is a steel- framed structure with a reinforced concrete deck and is supported by the spillway piers. The bridge is approximately 250 feet long with a deck at elevation 502.75 feet msl and is currently posted as having a 20-ton limit. The design loads used for the bridge were based on 1 of the following conditions:

Lorain MS-254 W Crane Unit loaded with 10 kips on a 30-foot boom at a 20-foot radius; or H-20 Highway Loading, 1 truck on any span, with a 30 percent impact included.

A.2.1.7.2 Gates and Hoists

The spillway is equipped with five 39-foot-wide and 30-foot-high motor-operated Tainter gates. Each gate is controlled by a 5 hp motor and is powered from the station service power supply. The spillway gates can be controlled locally or remotely from the Yale powerhouse or the Merwin Control Center. A propane engine type generator, set rated at 60 kW, is installed in a small building adjacent to the spillway to automatically start and provide power for gate operation if the station service power supply is interrupted.

A.2.1.7.3 Spillway Fish Barrier Net

A barrier net is located upstream of the spillway to reduce entrainment of federally listed fish during low-volume spill flows. The net spans the spillway from a rock anchor on the reservoir bank upstream of the right abutment to near the end of a concrete training wall at the left of the spillway. The net is secured to the reservoir bottom by drilled and grouted rock anchors spaced at 25 feet. The net is supported by floats that are supplied by air from a compressor rated at 10 cubic feet per minute located in the spillway control building on the dam. The net is normally maintained in the raised position and it is designed to pass flows up to 6,000 cubic feet per second. At higher flows, the air is released from the floats to lower the net to a submerged position. The valves controlling the supply of air to the net can be operated remotely from the Merwin Control Center or locally at the spillway.

A.2.1.8 Tailrace

The powerhouse tailrace is formed by the upper reach of Lake Merwin. The tailrace channel is approximately 3 miles long before it opens up into the main body of Lake Merwin. The Merwin dam and powerhouse are approximately 14.5 miles downstream of the Yale powerhouse.

The tailrace channel is naturally rock lined and approximately trapezoidal in shape. The invert of the channel at the powerhouse is about 208 feet and water flows from east to west. The draft tube discharge enters the tailrace perpendicular to the tailrace. At the maximum tailwater level for 2 unit operation under normal conditions, the tailrace water surface is about 210 feet across and the depth is approximately 32 feet.

A.2.1.9 Plant Access Road

The Yale Project is located about 2.2 miles east of State Highway 503. A new access road and bridge crossing the lower end of the spillway chute were constructed in 1998. The access road to the project is paved for a distance of about 1.7 miles from the highway and the remaining portion is gravel surfaced. The gravel surface is scheduled to be chip- sealed in 1999. The original powerhouse access road crossed the spillway bridge and main dam crest, wound around the hill above the powerhouse, and approached the powerhouse from the downstream side; it is barricaded and no longer in service. Access to the powerhouse is currently provided on the downstream face of the main dam and begins in the vicinity of the spillway bridge. This route was formerly used as emergency access to reach the powerhouse and spillway gates. A gravel surfaced parking area is provided at the powerhouse for employees and visitors.

Access to the Saddle dam is provided by a second 0.75-mile-long paved road branching off the project access road at a point approximately 1 mile from State Highway 503.

A.2.1.10 Future Bull Trout Passage

Bull Trout fish passage facilities are planned for two locations as described below.

A.2.1.10.1 Future Upstream Bull Trout Passage – Yale Tailrace

The Upstream Bull Trout Passage Facility will be located at the upstream end of the Merwin Reservoir attached to the far downstream end of the powerhouse. Access to the trap is across the powerhouse deck adjacent to the tailrace. This trap purpose is to capture upstream migrating bull trout for truck transport around Yale Dam.

The trap is a concrete structure that consists of a series of three pools leading to a hopper pool. An adjustable "V" gate leads from the upstream most pool, Pool 2, into the Hopper Pool. A refuge box within the Hopper Pool fabricated from pickets with a 1-inch clear protects small fish. The hopper is intended to be raised to a level such that the water level in the hopper is raised 40 inches above the powerhouse deck to allow bull trout to be netted from the hopper and placed into a tote for transport to transport truck. After removal of bull trout, the hopper can be raised to access a slide gate mounted on the bottom of the hopper which leads to an 8-inch diameter hose which has a release point into a second hopper. Non-transported fish can be released into this hopper which is then lowered into the Yale tailrace for release of fish via trap door on bottom of the hopper.

Flow is regulated into the trap through baffled diffuser gratings located in the bottom of the Hopper Pool and Pool 2. The pump sump is fed by two cylindrical screens that comply with National Marine Fisheries Service and US Fish and Wildlife Service criteria (NMFS Anadromous Salmonid Passage Facility Design, 2011 – Sections 11.1 through 11.8). A hoist and track system allows the screens to be pulled up to the deck level for maintenance.

A.2.1.10.2 Future Downstream Bull Trout Passage – Yale Forebay

The Downstream Bull Trout Passage facility is located adjacent and upstream of the intake structure for the Yale Powerhouse. Facility purpose is to collect downstream migrating bull trout for truck transport downstream of Merwin Dam. The facility is a "Merwin" type trap.

The trap consists of a series of nets and net pens fabricated out of 0.5 inch nylon mesh. The exclusion net blocks fish from entering the Yale intake. A lead net connected to the exclusion net guides intercepted fish into the trap through a "V" type opening. Fish then pass into the pot section of the trap then through a small opening into a spiller section of the trap which is a holding net pen. A refuge box fabricated from pickets with a 1-inch clear spacing is located within the holding pen to protect small fish.

A.2.2 Major Mechanical Systems

A.2.2.1 Turbine

The Yale powerhouse contains 2 vertical Francis turbines, manufactured by S. Morgan Smith Company and installed in 1953.

The original rating of the turbines was 80,500 hp at 250-foot net head and 150 rpm. The Unit No. 2 and No. 1 turbine runners were replaced in 1995 and 1996, respectively. Runner replacement increased each turbine's capacity to 73,300 kW (98,250 hp) at a net head of 240 feet. Unit speed remains the same at 150 rpm.

The Unit No. 2 turbine-generator set has a peak efficiency of 89.1 percent at 73 MW (82 percent wicket gate position). This is an increase in unit efficiency of 7.1 percent over the previous runner at the respective maximum efficiency point. In addition, the maximum output of the unit increased by 17.5 MW (an increase of 27.2 percent) from 64.3 MW to 81.8 MW. The ability to pass additional flow through the unit increased from 4,239 cfs to 4,820 cfs (at a net head of 240 feet) at maximum wicket gate opening. The new turbine runner exceeds both the manufacturer's contractually guaranteed turbine output and the turbine efficiency guarantees.

A formal acceptance test was not performed on Unit No. 1 following installation of the new runner. A comparison of the 2 identical runners was made by observing the gate position, outputs, and flows of both units during operation. In this manner it was confirmed that both runners are identical and are performing with similar capabilities and efficiencies. Performance tests have been conducted on Yale Unit No. 2 to determine the actual performance of the replacement runner during commissioning of the unit.

Each turbine is provided with a carbon steel spiral case and elbow moody draft tube, both with man doors for maintenance access. The turbine distributor includes the cast steel stay ring having 20 vanes, 20 cast carbon steel wicket gates, embedded fabricated steel discharge ring, carbon steel fabricated head cover, gate ring, and gate mechanism operated by 2 double-acting servomotors. A shell type oil-lubricated guide bearing and mechanical packing box are supported on the head cover. The turbines are designed to operate in air with the draft tube depressed as a synchronous condenser or motor and are provided with piping and systems for runner seal cooling water. Each turbine pit is provided with a gravity drain through a stay vane to drain leakage water to the station sump.

A.2.2.2 Governor

A Woodward cabinet actuator style mechanical hydraulic governor is provided to serve Units 1 and 2. Governor systems for both units are housed in a single cabinet between the 2 units. The governor systems are normally operated as one common system but can be operated as separate systems. Two 150-gpm horizontal rotary gear type hydraulic pumps driven by 40-hp motors maintain pressure in two 900-gallon pressure tanks. Nominal system pressure is 300 psi. A permanent magnet generator (PMG) mounted on top of the generator provides the speed signal to the governor. Trip and reset speeds are 187 rpm and 157 rpm, respectively (per Woodward drawings). A speed switch which closes at 30 rpm is also located in the PMG, and a second speed switch is used to lock out the creep detection circuits.

The governor is provided with the following controls and instruments:

Controls	Instruments
Speed droop control	Tachometer
Gate limit control	Air brake pressure gauge
Speed adjust control	Oil pressure gauge
Air brake control	
Transfer valve	Gate limit and position indicator
Isolating valve	Speed adjust position indicator
Oil pump echelon	Isolating valve indicator
Oil pump continuous/intermittent	Oil level gauge
Creep detector	

A manually operated water-driven emergency oil pump can be used to close the turbine wicket gates in the event of loss of oil pressure.

A.2.3 Major Electrical Systems

A.2.3.1 Generator

The Yale generators were manufactured by General Electric and installed in 1953. Each generator was originally rated at 60,000 kVA, 13,200 V, 60º C maximum temperature rise and was capable of 115% continuous overload to 69,000 kVA. The generator rotors and stators were originally constructed with Class B insulation, which insulation has a limiting temperature rise of 80 C. The generator stators have been rewound with Class F coil insulation, and are rated at 74,400 kVA at 60 C. The limiting temperature rise for the stator Class F insulation is 75º C. A generator heat run test conducted in 1991 indicated that the 80º C field temperature limit is reached at a generator output of 80,000 kVA, while the stator temperature at 80,000 kVA is approximately 50º C. Therefore, the generator output is limited to 80,000 kVA by the existing field windings, although the stator windings have additional capability. Based on the heat run test, the generator can be operated up to the following output levels without exceeding the temperature limits:

kVA	Power Factor	kW
80,000	1.00	80,000
80,000	0.95	76,000
80,000	0.90	72,000

The Yale generators are vertical, recirculating, air-cooled units with single-pass water coolers.

A.2.3.2 Exciter and Automatic Voltage Regulator

The main and pilot exciters and the automatic voltage regulators, manufactured by General Electric, were installed in 1953. They were replaced in 1996 and 1995, respectively, with ABB 325 kW at 250 Vdc Excitation Systems.

These systems have automatic voltage regulators and power system stabilizers. The maintenance schedule for the automatic voltage regulator is the same as that for the exciters.

The non-segregated phase bus duct was manufactured by General Electric and was installed in 1953. It is rated at 3,000 amperes per bus.

The plant is equipped with 2 runs of 3,000-ampere bus duct. The non-segregated phase bus duct is in good condition. A section of bus duct was open during a recent site inspection. The bus duct enclosure was free of debris, and the exposed section of bus duct appeared to be in good condition. This bus duct was upgraded with the new turbine runner to 4,000 amperes.

The original oil-filled generator breakers were replaced in 1992 with new SF6 breakers manufactured by ABB and rated at 4,000 amperes, 13.8 kV. The new breakers are operating satisfactorily.

A.2.3.3 Transmission Line

The Yale Project includes a single 115 kilovolt (kV) primary transmission line that extends 10.5 miles to connect the Yale substation with an interconnected transmission system near the Merwin plant (Figure A.2.3-1).

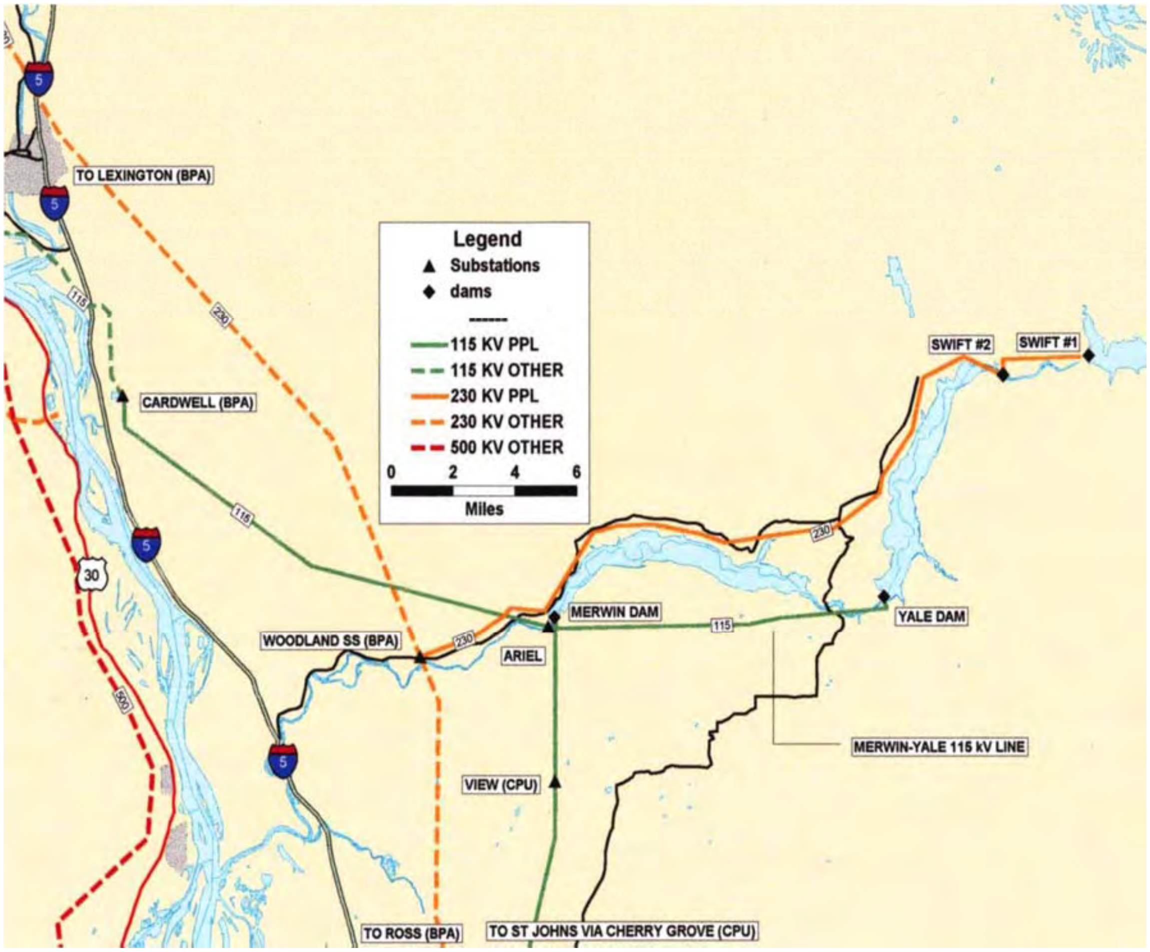

Figure A.2.3-1 Yale Project Transmission Line

A.3.0 Proposed Changes to Project Facilities

~~PacifiCorp has studied the feasibility of upgrading the existing project auxiliary equipment and systems to improve plant reliability, operation, and safety. Several upgrades have been made since 1995, following completion of the resource utilization study (Black & Veatch 1995). These upgrades are listed in Table C.2.0-2 of Exhibit C. No additional changes to major project facilities which would affect plant output are currently being considered.~~ At this time, PacifiCorp is not proposing any major modifications or upgrades. However, the Company will continue to evaluate the potential for project upgrades and modifications as future market and other conditions change to ensure the most cost-effective, efficient and environmentally balanced use of the water resources available.

A.4.0 Lands of the United States

Federal lands (public lands and reservations of the United States) within the Yale Project boundary total 202.9 acres. Of those acres, 38.7 acres are managed by the Bureau of Land Management

(BLM); this includes approximately 2.4 acres that are occupied by Project transmission lines. The remaining 164.2 acres are lands that are managed by the State of Washington and Clark County, subject to Section 24 of the Federal Power Act. Federal lands are identified as:

- Part of the NW 1/4 of the NE 1/4 of Section 32, Township 6N Range 4E, WM, totaling 38.7 acres (BLM; 2.4 acres of transmission line and 36.3 acres of non-transmission line)
- Part of the NE 1/4 of Section 21, Township 6N Range 4E, WM, totaling 111.8 acres (Clark Co., Section 24)
- Part of the E 1/2 of the SE 1/4 of Section 34, Township 7N Range 4E, WM, totaling 52.4 acres (State of Washington, Section 24)

A.5.0 Literature Cited

Black & Veatch 1995. Resource Utilization Study. Yale Hydroelectric Project

(FERC No. P-2071). Prepared for PacifiCorp, Portland, Oregon.

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EXHIBIT C – PROJECT INSTALLATION AND PROPOSED SCHEDULE

Yale Hydroelectric Project
(FERC No. P-2071)

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List of Tables

C.1.0 Introduction

This Exhibit C identifies project installation and proposed schedule. Because PacifiCorp seeks a non-capacity amendment and consistent with 18 CFR 4.201(c), only the information impacted by the proposed amendment is included.

C.2.0 Construction History

C.2.1 General Description

The Yale Hydroelectric Project is one of three PacifiCorp projects located on the North Fork of the Lewis River, approximately 28 miles east of Woodland, Washington and 53 miles northeast of Portland, Oregon. The Project site is 34 miles upstream of the confluence of the North Fork Lewis River with the Columbia River. The Yale Project is one of four facilities on the Lewis River. The other three projects are Swift No. 1 (FERC Project No. 2111), Swift No. 2 (FERC Project No. 2213) and Merwin (FERC Project No. 935). The Merwin Hydroelectric Project is located at RM 19.5, the Swift Hydroelectric Project No. 2 is located at RM 44, and the Swift Hydroelectric Project No. 1 is located at RM 47. Swift No. 1, Yale and Merwin are owned and operated by PacifiCorp. Swift No. 2 is owned by the Cowlitz County Public Utility District No 1 (Cowlitz PUD) and maintained and operated by PacifiCorp under contract.

C.2.2 Historical Overview

Investigation of the power production potential of the Lewis River date back to at least 1909 and site explorations were started as early as 1914. Northwestern Electric Company, a predecessor of Pacific Power and Light (PP&L), obtained a preliminary permit from the Federal Power Commission (FPC) to investigate the Yale Project site in 1922. In late 1928, Northwestern Electric Company filed an expanded application for a preliminary permit with the FPC to investigate a comprehensive development of four sites on the Lewis River: Ariel, Basket, Swift and Muddy Creek. Three of the 4 projects have been constructed and are now known as, respectively, Merwin, Yale, and Swift No. 1 and Swift No. 2 (initially proposed as a single project). The fourth project, Muddy, is no longer being considered for development.

C.3.0 Proposed Changes to Project Facilities

As part of this application for license amendment, PacifiCorp will construct the Yale Downstream and Yale Upstream Bull Trout Fish Collection Facilities. The downstream facility will be located in the forebay to the Yale Powerhouse intake, just upstream of Yale dam and within the project reservoir. The upstream facility will be located at the Yale Powerhouse, collecting fish from the project tailrace area.

Facility design, permitting and construction are key components of the project each needing the appropriate amount of time to complete. Table C.3.0-1 provides the proposed schedule of development and construction for the Yale Downstream Bull Trout Fish Collection Facility. Given the uncertainty of when the FERC will issue an Order Amending License, the schedule is identified in time after Order issuance. In general, schedule will provide for construction and initiation of operation of facility by January 1, 2021 as identified in the US Fish and Wildlife Service

April 12, 2019 preliminary determination letter.

Table C.3.0-1. Proposed Schedule of Development and Construction for Yale Downstream Bull Trout Fish Collection Facility

Item	Date
Design	3 months of Order issuance
Permitting	6 months of Order issuance
Procure Contractor	7 months of Order issuance
Fabrication of materials	11 months of Order issuance
Construction of facility	12 months of Order issuance
Project Completion / In Service	January 1, 2021

Similar to the downstream facility identified above, facility design, permitting and construction are key components of the upstream facility project each needing the appropriate amount of time to complete. Table C.3.0-2 provides the proposed schedule of development and construction for the Yale Upstream Bull Trout Fish Collection Facility. Given the uncertainty of when the FERC will issue an Order Amending License, the schedule is identified in time after Order issuance. In general, schedule will provide for construction and initiation of operation of facility by

January 1, 2025 as identified in the US Fish and Wildlife Service April 12, 2019 preliminary determination letter.

Table C.3.0-2. Proposed Schedule of Development and Construction for Yale Upstream Bull Trout Fish Collection Facility

Item	Date
Design	1 year of Order issuance
Permitting	2.5 years of Order issuance
Procure Contractor	3.0 years of Order issuance
Fabrication of materials	3.5 years of Order issuance
Construction of facility	4 years of Order issuance
Project Completion / In Service	January 1, 2025

EXHIBIT D – COSTS AND FINANCING

Yale Hydroelectric Project
(FERC No. P-2071)

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List of Tables

D.1.0 Introduction

This Exhibit D is a statement of costs and financing. Because PacifiCorp seeks a non-capacity amendment and consistent with 18 CFR 4.201(c), only the information impacted by the proposed amendment is included. The cost of implementing the projects identified in the amendment will not materially affect the value of project power.

D.2.0 Capital and O&M Costs of Proposed Project Modifications and Resource Enhancement Measures (18 CFR 4.51(e)(3)-(4))

The non-capacity amendment seeks approval of activities related to the Services' preliminary determinations with regard to fish passage and necessary to any identical or substantially similar final determinations once the Services issue those, expected 2020. Implementing the determinations will require project modifications and resource enhancement measures. Detailed information regarding these project modifications and resource enhancement measures are included in the following documents:

- Merwin In-Lieu Strategic Plan
- Lewis River Basin Implementation Monitoring Plan
- Bull Trout Passage Plan

These documents are provided in Volume III of the application.

The estimated capital and O&M cost of the non-power resource enhancements is $54,747,000 (see Table D.2.0-1).

Table D.2.0-1. Capital and O&M Cost Estimates for Project Modifications and Enhancements

Project Costs (Escalated dollars in thousands)	
Category	**Costs** *
Aquatics	$54,747
Terrestrial	$0
Cultural	$0
Recreation	$0
Socioeconomics	$0
Flood Operations	$0
TOTAL	**$54,747**

* Based on 39-year analysis period beginning in 2020.

D.3.0 Annual Costs of the Project

The estimated levelized annual cost of operating the Lewis River Merwin, Yale and Swift No. 1 Hydroelectric Projects is presented in Table D.3.0-1. Estimated costs are provided for PacifiCorp's collective Lewis River Hydroelectric Development as the three projects are operated and maintained by a single operations/maintenance crew.

Table D.3.0-1. Estimated Annual Cost of Future Project Operations over a 40-year Period.

Description	Levelized Annual Cost (in thousands)*
CONTINUING OPERATIONS	
Sunk Costs	
Net Investment of $286 M	
Cost of Capital	$11,102
Income and Property Taxes	3,528
Depreciation and Amortization	6,639
Total Fixed Cost	$21,269
Capital	
Planned Investment of $1,040 M	
Cost of Capital	$11,818
Income and Property Taxes	4,364
Depreciation and Amortization	11,887
Total Fixed Cost	$28,069
O&M	
Operations and Maintenance of $758 M	$16,399
Subtotal	$65,737
IMPLEMENTATION COSTS	
Capital	
Planned Investment of $208 M	
Cost of Capital	$4,019
Income and Property Taxes	1,484
Depreciation and Amortization	3,087
Total Fixed Cost	$8,590
Lost Generation	$0
Operations and Maintenance of $117M	$2,533
Subtotal	$11,122
TOTAL	**$76,859**

* Based on a 39-year analysis with inflation

D.4.0 Sources and Extent of Financing and Annual Revenues

PacifiCorp has the resources for financing and sufficient annual revenues to provide for the current capital needs associated with the continued operation of the project and those needs associated with the license amendment. If additional financing is necessary, the capital will be financed using the company’s traditional sources of debt and common equity.

Annual financial information is provided in our annual report to shareholders and in FERC Form 1.

EXHIBIT G – PROJECT MAP

**Yale Hydroelectric Project
(FERC No. P-2071)**

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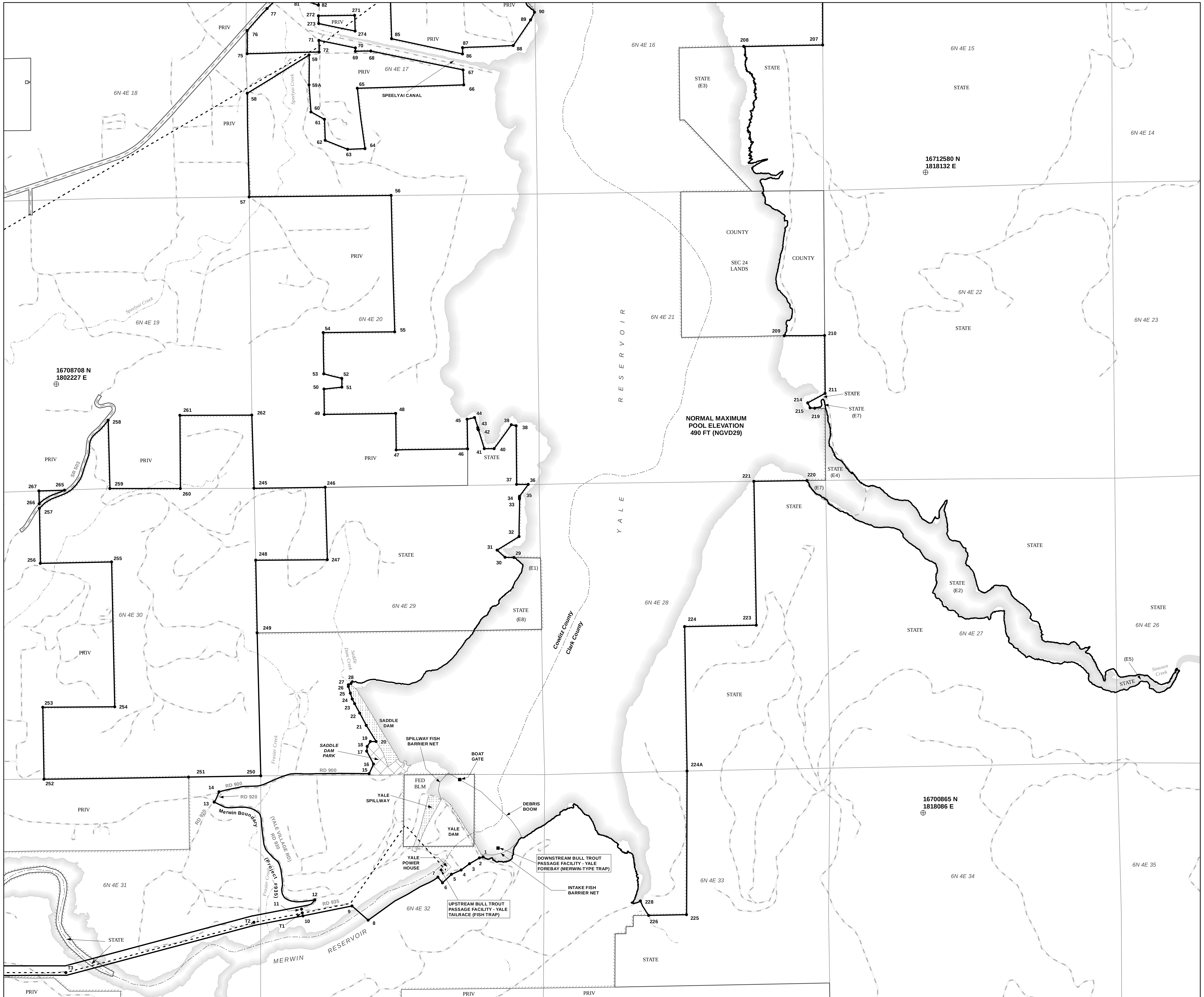
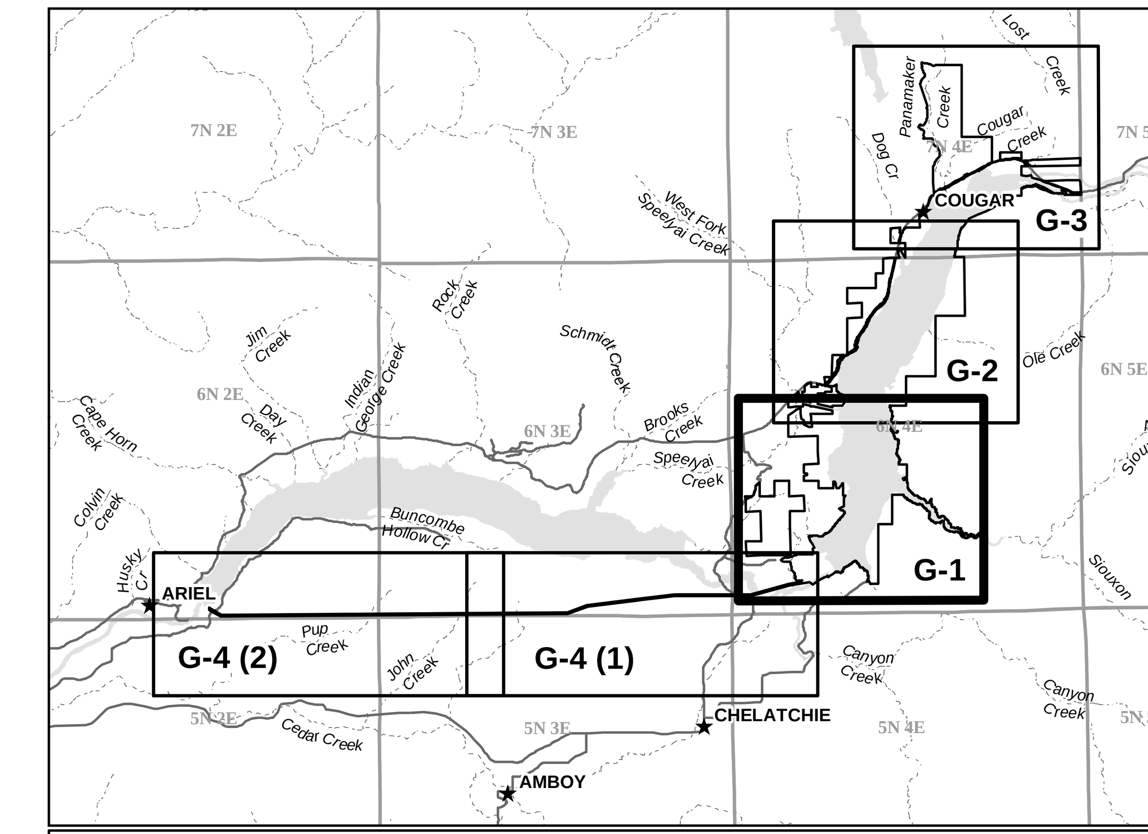
DESCRIPTION OF PROPOSED EXHIBIT G REVISIONS YALE HYDROELECTRIC PROJECT (FERC NO. P-2071) APPLICATION FOR LICENSE AMENDMENT

As part of the application for license amendment for the Yale Hydroelectric Project (FERC No. P-2111), PacifiCorp is proposing to revise the current Exhibit G drawings to include proposed facilities, such that all principal Project works necessary for operation and maintenance of the Project are identified within the exhibit drawings. No changes to the FERC Project boundary are proposed.

The revised Exhibit G drawings consist of a single sheet; Exhibit G-1, Yale Hydroelectric Project FERC No. P-2071 License issued June 26, 2008. It has been revised to include the Upstream Bull Trout Passage Facility – Yale Tailrace (Fish Trap) and Downstream Bull Trout Passage Facility – Yale Forebay (Merwin-Type Trap). Exhibit G-2 through G-4 (2) have no proposed modifications.





Location Map

State of Washington, Willamette Meridian

1:175,000

0 1 2 Miles

- ★ City
- ⊕ Reference Point *
- • Boundary Point **
- Road
- Trail
- Trail Begin/End
- PacifiCorp Transmission Line
- Project Boundary
- PacifiCorp Ownership
- Non-PacifiCorp Ownership
- Conservation Covenant
- Park or Campground
- PacifiCorp Facility
- County
- Stream
- Water Body
- Township/Range
- Section
- Lots

Reference Point coordinates are in UTM Zone 10, NAD 83, US feet.
*** Boundary Point numbers correspond to boundary description table.*

I hereby state that the project boundary represented on this drawing is developed with reasonable accuracy in accordance with FERC requirements. Data has been developed by PacifiCorp's GIS department from a variety of sources including Federal, State, County, and PacifiCorp GIS sources including orthophotos. No field surveys were conducted. All reasonable efforts have been made to ensure that positional accuracy conforms to National Map Accuracy Standards for maps at 1:24000 scale.

Public Land Survey data are approximately located and are based on the Willamette Meridian. Property lines are approximately located.

MAP TEXT ABBREVIATIONS:
- SEC 24 = Section 24 Reservation under Federal Power Act
- FED = Federally Owned Land
- STATE = State Owned Land
- PRIV = Privately Owned Land
- BLM = Bureau of Land Management
- USFS = USDA Forest Service
- E# = Easement/Property Rights (see sheet G-6)

Federal land (public lands and reservations of the U.S.) included within the project boundary is 204.4 acres and consists of:

1)	BLM (transmission line)	2.4 acres
2)	BLM (non-transmission line)	36.4 acres
3)	Sec 24 (Clark County)	111.8 acres
4)	Sec 24 (State of Washington)	53.8 acres

PACIFICORP

PacifiCorp has reviewed the Project boundary shown herein. PacifiCorp either owns in fee simple or possesses the flowage easements or property rights* for all lands drawn on this map that are inside the boundary.

* Property rights to be obtained/updated for areas shown as PacifiCorp Interest Lands.

NO.	DATE	OLD FERC NO.	DESCRIPTION
1c	11/2019	P-2071-1007	Lewis River Bull Trout Passage Plan; SA Section 4.10
1b	10/16/08 & 11/9/15	P-2071-1007	Order on Rehearing-Lic. Art. 403 land acquisition & Order granting extension of time to submit rev. Exh G
0	05/28/2009		Order Approving Exhibits

Exhibit G - 1 **Rev. 1c**

Yale Hydroelectric Project FERC No. 2071
License Issued June 26, 2008

Project Boundary

Original Drawing Dated June 1, 2007
Scale as shown

1,000 500 0 1,000 2,000 Feet

N

REVIEW DRAFT
NOVEMBER 2019

FERC Drawing No. P-2071-1007

Yale Hydroelectric Project
FERC No. P-2071

Before the
United States of America
Federal Energy Regulatory Commission

Application for License Amendment

Volume II of V
Exhibit E – Environmental Report

A BERKSHIRE HATHAWAY ENERGY COMPANY

January 2020

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Yale Hydroelectric Project
(FERC No. P-2071)

APPLICATION FOR LICENSE AMENDMENT

This application for license amendment for the Yale Hydroelectric Project (FERC No. P-2071) consists of the following volumes:

Volume I

Initial Statement
Exhibit A – Project Description
Exhibit C – Project Installation and Proposed Schedule
Exhibit D – Costs and Financing
Exhibit G – Project Maps

Volume II

Exhibit E – Environmental Report

Volume III

Appendices to Exhibit E

Volume IV

Exhibit F – Vicinity and Preliminary Design Drawings (CEII Not for Public Release)

Volume V

CONFIDENTIAL – Cultural Resource Summary for the Merwin, Yale and Swift No. 1 Projects

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EXHIBIT E – ENVIRONMENTAL REPORT

Yale Hydroelectric Project
(FERC No. P-2071)

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E.1.0 Introduction

In compliance with 18 CFR Part 4, Subpart L, PacifiCorp and Public Utility District No. 1 of Cowlitz County (Cowlitz PUD) (the "Utilities") are applying to the Federal Energy Regulatory Commission (FERC) for non-capacity amendments to the licenses for the Merwin Project (FERC No. 935), Yale Project (FERC No. 2071), Swift No. 1 Project (FERC No. 2111), and Swift No. 2 Project (FERC No. 2213) located on the North Fork of the Lewis River in Cowlitz, Clark, and Skamania Counties, Washington. The Merwin, Yale and Swift No. 1 Projects are owned and operated by PacifiCorp. The Swift No. 2 Project is owned by Cowlitz PUD and operated by PacifiCorp in coordination with the other Lewis River Projects. The Merwin, Yale, Swift No. 1, and Swift No. 2 projects are referred to as the "Projects." The current licenses for the Projects were issued on June 26, 2008 and expire on May 31, 2058.

Pursuant to 18 CFR 4.51, Exhibit E of this Application provides background information regarding applicable environmental resources and discusses the potential environmental effects of the proposed action. For the purposes of this non-capacity amendment, discussion is limited to those specific resource areas that may be affected by the proposed action. Because the proposed action is not expected to affect soils and geology, recreational resources, land use, or aesthetics, these sections are not addressed.

E.1.1 Proposed Action

The Utilities seek non-capacity amendments to their licenses in response to the April 11, 2019 and April 12, 2019 preliminary determinations of the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS), respectively, regarding fish passage under Section 4.1.9 of the comprehensive relicensing settlement agreement among the Utilities, USFWS, NMFS, and other stakeholders ("Settlement Agreement"). In particular, subject to the Services' final determinations, the Utilities seek to amend their licenses and the incorporated fishway prescriptions to direct the following:

- Implementing a habitat restoration program in lieu of constructing fish passage facilities into and out of Merwin Reservoir (the In Lieu Program)(PacifiCorp);
- Delaying decisions regarding the appropriateness of constructing fish passage facilities into and out of the Yale Reservoir until 2031 and 2035; and
- Constructing the Yale Downstream, Yale Upstream, and Swift Upstream bull trout passage facilities.

Implementing the Services' final determinations will require project modifications and resource enhancement measures. Detailed information regarding these project modifications and resource enhancement measures are included in the following documents:

- Merwin In-Lieu Strategic Plan
- Lewis River Basin Implementation Monitoring Plan
- Bull Trout Passage Plan

These documents are provided in Volume III of this amendment application.

E.2.0 Consultation and Compliance

The draft application for license amendment was distributed to the following resource agencies and stakeholders for a 90-day comment period on February 5, 2020. Comments will be due on May 13, 2020.

American Rivers
City of Woodland
Clark County
Confederated Tribes and Bands of the Yakama Nation*
Cowlitz County
Cowlitz Indian Tribe*
Cowlitz-Skamania Fire District No. 7
Fish First
Lewis River Aquatic Coordination Committee Representatives
Lewis River Citizens at-Large
Lewis River Community Council
National Marine Fisheries Service*
National Park Service
North Country Emergency Medical Service
Public Utility District No. 1 of Cowlitz County, Washington
Rocky Mountain Elk Foundation, Inc.
Skamania County
The Lower Columbia Fish Recovery Board
The Native Fish Society
Trout Unlimited
USDA Forest Service*
United States Bureau of Land Management
United States Fish and Wildlife Service*
Washington Department of Ecology*
Washington Department of Fish and Wildlife*
Washington State Recreation and Conservation Office, formerly known as Washington Interagency Committee for Outdoor Recreation
Woodland Chamber of Commerce

* Denotes consultation party for purposes of 18 C.F. R. § 4.38(a)(7).

Comments received in response to the draft application are summarized in the Response to Comments Table provide in Volume I of the application. Individual comment letters are also included in Volume I. TO BE PREPARED FOLLOWING DRAFT APPLICATION COMMENT PERIOD

E.3.0 General Description of the Locale (18 CFR 4.51(f)(1))

The North Fork Lewis River basin lies on the flanks of the southern Cascade Mountains of Washington State. The river flows in a general southwesterly direction from its source on the slopes of Mount Adams and Mount Saint Helens in the Gifford Pinchot National Forest (GPNF), to the Columbia River downstream of Woodland, Washington. The river is 93 miles long with a total elevation drop of 7,900 feet. The drainage basin is 1,050 square miles with a mean elevation of 2,550 feet mean sea level (msl). Slopes in the upper basin are generally steep, with areas in the lower basin being less steep and characterized by rolling hills and flat woodland bottomlands.

The North Fork Lewis River basin has a complex geologic history, having undergone Tertiary volcanism, several glaciations, and interglacial erosion and deposition. Soils in the basin are predominantly well drained and medium-textured and were derived from volcanic ash or were formed in sediments derived from mixed volcanic rocks and ash. The basin has been subject to major natural landscape altering processes in the recent past. Debris avalanches, mudflows, and lahars are common on Mount St. Helens and Mount Adams and the (Tilling et al. 1990). Streams affected by recent mudflows are continuing to process sediment and woody debris and have changed from narrow channels into wide, braided unable channels with high sediment and wood loads. Riparian vegetation along these channels was lost, but has slowly recovered as sediment loads have decreases with time (PacifiCorp 2005b).

Basin lands provide winter range for deer and elk; mink, beaver and amphibians are common in wetlands and riparian/riverine habitats. Numerous species of birds, including waterfowl, raptors and passerines can be found throughout the watershed. The North Fork Lewis River and its tributaries provide habitat for several salmonid species, including bull trout, cutthroat, and steelhead trout, Chinook, coho and chum salmon, and whitefish.

The climate in the North Fork Lewis River basin is influenced by the Pacific Ocean to the west and the Cascade Range to the east. Average annual precipitation varies from 45 inches near Woodland to over 140 inches on Mount Adams. The majority of the precipitation occurs during the rainy fall and winter months, with snow falling at higher elevations of the basin. Summers (July through mid-October) are generally drier. Snowfall is minimal at lower elevations, but can exceed 200 inches per year at elevations over 3,000 feet. In the warmest summer months, afternoon temperatures range from the middle seventies to the lower eighties, with nighttime temperatures in the fifties.

The Lewis River watershed is located in an area dominated by natural resources based land uses such as forestry, recreation, and agriculture. As a result, population densities are generally low within the basin. The largest urban center, the City of Woodland, is located near the mouth of the Lewis River, approximately 20 miles north of Vancouver,

Washington. Other towns in the Lewis River basin include Cougar, Ariel, Yale, Chelatchie, Amboy, Yacolt and La Center (Wade 2000). None of these settlements have populations exceeding 2,000 and their economies are primarily dependent upon logging, agriculture, and recreation. There are three private communities located around Swift Reservoir. The largest of these is Northwoods on the eastern shore of the reservoir with 206 homes. Yale Reservoir has private development clustered around the Beaver Bay area, the Town of Cougar and the Speelyai Canal. There is significant private land ownership around Merwin Reservoir.

PacifiCorp owns 15,163 acres of land within the FERC boundaries of the Merwin, Yale and Swift No. 1 projects. Cowlitz PUD owns 664 acres of land within the FERC boundaries of the Swift No. 2 project. The majority of the land is managed for wildlife habitat as mitigation for the construction of and continued operation of the hydroelectric projects. The hydroelectric projects fall in the following order from downstream to upstream: Merwin, Yale, Swift No. 2, and Swift No. 1. Swift No. 2 is owned by Cowlitz PUD and is operated by PacifiCorp as part of the larger Lewis River hydroelectric system. Descriptions of the Lewis River Projects are provided below:

- The Merwin Project is a 136-megawatt power generating facility with a 313-foot high concrete arch dam (Merwin Dam) and a 4,040-acre reservoir (Lake Merwin). The tailrace of the Merwin Dam discharges into the North Fork Lewis River, and the forebay is downstream of the Merwin reservoir.
- The Yale Project is a 134-megawatt power generating facility with a 323-foot high earthen dam (Yale Dam) and a 3,780-acre reservoir (Yale Lake). The tailrace of the Yale Dam discharges into the Merwin reservoir, and the forebay is downstream of Yale reservoir.
- The Swift No. 1 Project is a 240-megawatt power generating facility with a 512-foot earthen dam (Swift Dam) and a 4,600-acre reservoir (Swift reservoir). The discharge from this facility is transported to the 70-megawatt Swift No. 2 power generation facility via the 3-mile Swift Canal and then returned to the Swift bypass reach and/or Yale reservoir. The Swift bypass reach includes a natural channel of the North Fork Lewis River.
- The Swift No. 2 Project is a 73.1-megawatt power generating facility. The Project lies between the Swift No. 1 and the Yale hydroelectric projects on the North Fork Lewis River. The Swift No. 2 Project consists of a power canal, intake structure, penstocks, powerhouse, tailrace discharge channel, substation and transmission line. The canal is 2.8-miles long, with a surface area of approximately 53 acres and a capacity to hold approximately 922 acre-feet of water. The Swift No. 2 powerhouse discharges to Yale reservoir.

The focus of the proposed action discussed in this Exhibit is the locations of proposed habitat restoration efforts (through the implementation of an in-lieu fund) and locations for the proposed bull trout passage facilities. Consistent with the direction provided by the Services, the Utilities would focus on stream reaches upstream of Swift reservoir for habitat restoration that benefits coho salmon (*Oncorhynchus kisutch*), winter steelhead (*O. mykiss*), and spring Chinook salmon (*O. tshawytscha*). The bull trout passage facilities would be located immediately upstream and downstream of the Yale Dam and downstream of the Swift No. 1 Project. No aspects of the proposed action will occur or be constructed within the FERC boundary of Swift No. 2.

E.4.0 Environmental Analysis

E.4.0.1 Water Use and Quality (18 CFR 4.51 (f)(2))

E.4.0.1.1 Long-term Impacts to Water Use and Quality

Continued operations of the Projects include, but are not limited to, flow changes in the lower Lewis River. The three-reservoir, four-project system is operated to achieve optimum benefits for power production and flood management and to provide for natural resources in the basin, such as fish, wildlife, and recreation. The Projects utilize the water resources within the North Fork Lewis River sub-basin from elevation 50 feet above mean sea level at the Merwin Project tailwater to 1,000 feet above mean sea level at Swift No. 1 normal pool. The total usable storage in the reservoirs is 814,000 acre-feet. The total installed capacity for the Projects is 583 megawatts. Operations of the Projects have not materially changed since 2007 and there are no operational changes associated with the proposed action; therefore, no changes or effects to water quantity are anticipated.

Because the proposed action will have no effects on water quantity, there are no anticipated effects to several of the water quality parameters (with the exception of localized temporary water quality impacts associated with construction as noted below in section 4.1.2) including temperature, dissolved oxygen and total dissolved gas. The conditions and effects originally evaluated in the 2006 FEIS will persist. Similarly, since the proposed action will not alter the current anadromous fish passage program activities (to date, the Utilities have provided partial fish passage at the Projects by transporting adult salmon and steelhead from downstream of Merwin Dam into 82 miles of habitat in the uppermost reservoir upstream of Swift Dam and by transporting juveniles collected from Swift Reservoir to downstream of Merwin Dam), there will be no anticipated changes to chemical contamination and nutrients. The conditions of partial passage will persist. Long-term, water quality may improve as a result of in-lieu habitat restoration projects like culvert and road removals that are currently sources of runoff, erosion, and sedimentation.

Thorough characterizations of water quality were provided in the 2006 FEIS (FERC 2006), the 2018 U.S. Geological Survey (USGS) report - Development of New Information to Inform Fish Passage Decisions at the Yale and Merwin Hydro Projects on the Lewis River, Washington (USGS 2018), the Lewis River Hydroelectric Projects 2018 Annual Report (PacifiCorp and Cowlitz PUD 2019b), and the various Biological Assessments prepared for the projects and relicensing (PacifiCorp 2005a, 2005b, 2012, 2019), and include data pertaining to water temperature, sediment and turbidity, chemical contamination and nutrients, dissolved oxygen, and total dissolved gas. These reports are summarized below to characterize on-going water quality conditions.

Sediment from lahars and ash fall associated with volcanic activity at Mount St. Helens, Mount Hood, and the Indian Heaven volcanic field have largely contributed to sediment input in the Lewis River. The eruption of Mount St. Helens caused mudflows carrying nearly 18 million cubic yards of water, mud, and debris to sweep down Swift Creek, Pine Creek, and the Muddy River, and it ultimately ended up in the Swift reservoir (Tilling et al. 1990). The sediment has been and continues to be transported through the watershed into the lower Lewis River and Columbia River. Current sediment inputs to streams in the watershed are due to land management practices such as timber harvest, farming, grazing, road building, and urbanization. Natural processes that also contribute to sediment input include volcanic eruptions and forest fires (PacifiCorp 2005b).

High runoff and heavy rain in the Lewis River basin often create high turbidity in the reservoirs and streams. Merwin, Swift, and Yale Dams trap a large majority of those high sediment loads, resulting in lower rates of suspended sediments than would have naturally occurred in the Lewis River downstream of Merwin Dam (PacifiCorp 2005b). According to the USGS (2018), the fine sediment values collected in most streams were low except for Little Creek and Pepper Creek, tributaries to the Swift reservoir, where the fine sediment values exceeded tolerant levels for salmonids (Bryce et al. 2010). The turbidity criterion outlined in WAC 173-201A-200(1)(e), states there can be no more than a 10 percent increase over background when the background is more than 50 nephelometric turbidity units (NTUs) and no more than 5 NTU increase over a background when the background is 50 NTUs or less. According to the Lewis River Hydroelectric Projects Water Quality Management Plan (PacifiCorp 2013), the turbidity levels in the tributaries upstream of Swift Dam during the dry summer months were generally low, with a range of 1 to 2 NTUs, and were comparatively high during the rainy season from November through April. Turbidity levels in the Merwin reservoir during the summer months were similar to the summer NTU range recorded in the upper tributaries (less than 2 NTUs), but the winter and spring month turbidity levels reached a maximum of 4 NTUs (PacifiCorp 2013).

E.4.0.1.2 Short-term (Construction-related) Impacts to Water Use and Quality

The proposed action includes installation of bull trout passage facilities within the reservoirs, and In Lieu habitat restoration activities within tributaries upstream of Swift Reservoir. As a result, the proposed action could result in temporary increases in turbidity and sedimentation during in-water construction as discussed below. The proposed action will not alter the Projects' consumptive water use.

Construction of the various project elements, including instream placement of large woody debris (LWD), floodplain reconnection, and road removal activities, could temporarily introduce fine sediments and turbidity into the streams through erosion and sedimentation. However, sedimentation and turbidity effects will be short-term and limited to areas where construction activities occur within or adjacent to rivers and streams.

The extent of turbidity effects will vary for each activity, depending on the extent of work conducted within the wetted channel, the ability to effectively isolate the work area and prevent sediment from entering the main channel, fish salvage activities, and other Best Management Practices (BMPs) that will be implemented to minimize turbidity and sediment effects to listed fish. For example, work areas around LWD placement sites in the tributaries will likely be isolated and dewatered, and fish will be salvaged prior to construction. Elevated turbidity in the stream may occur when the work area is re-watered and connected to the main channel; however, effects to water quality should be minimal due to the short-term nature and minor amount of elevated turbidity that would be reasonably expected. With actions such as floodplain reconnection or development, turbidity effects may be more substantial. Although work will also likely be conducted in the dry, floodplain reconnection often requires earth-moving activities that can loosen sediment and make it more mobile. When a new floodplain or channel is re-watered and connected with the flow of the main channel, a flush of sediment may occur that results in elevated turbidity. This is expected to be temporary in nature but could carry greater volumes of sediment into the stream channel than other smaller-scale activities.

Minimization measures and BMPs will be implemented to limit and minimize the amount of construction-related turbidity from the project site. Contractors will limit the extent of construction-related turbidity based upon permit requirements and mixing zones will vary in length based on stream flow. Turbidity will be monitored during project activities to minimize impacts. Should construction-related turbidity levels exceed permitted levels above background, construction will halt and the BMPs will be inspected and modified as necessary to achieve compliance.

E.4.1 Fish, Wildlife and Botanical Resources (18 CFR 4.51(f)(3))

E.4.1.1 Fish Resources

The Lewis River provides habitat for several salmonid species, including bull trout (*Salvelinus confluentus*), cutthroat trout (*Oncorhynchus clarkii*), steelhead (*O. mykiss*), Chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), chum salmon (*O. keta*), Pacific eulachon (*Thaleichthys pacificus*), and mountain whitefish (*Prosopium williamsonii*). Other fish, such as white sturgeon (*Acipenser transmontanus*), threespine stickleback (*Gasterosteus aculeatus*), lamprey (*Lampetra* sp. and/or *Ichthyomyzon* sp.), sculpin (*Cottus* sp.), and suckers (*Catostomus* sp.) are also common. Several non-native fish species are also present, including brook trout (*Salvelinus fontinalis*), tiger muskellunge (*Esox lucius* x *E. masquinongy*), and bass (*Micropterus* sp.) (PacifiCorp 2012).

Endangered Species Act (ESA) listed species under the jurisdiction of NMFS may occur in areas potentially affected by the proposed action, including: the Lower Columbia River Evolutionarily Significant Unit (ESU) Chinook salmon, Lower Columbia River ESU coho salmon, Columbia River ESU chum salmon, Lower Columbia River Distinct Population Segment (DPS) steelhead, and Southern DPS eulachon. Critical habitat for all the species listed above and designated essential fish habitat (EFH) for Pacific Salmon (Chinook and coho salmon, specifically) is also present within potentially affected areas. Due to a lack of suitable habitat within the affected area, the proposed action will have no effect on the Southern DPS of green sturgeon (*Acipenser medirostris*), which was listed as threatened on April 7, 2006 (71 FR 17757). Critical habitat for green sturgeon was designated in October 2009. No critical habitat for green sturgeon is present within the potentially affected areas.

Bull trout, an ESA listed species under the jurisdiction of USFWS, also may occur in areas potentially affected by the proposed action. Designated critical habitat for bull trout occurs within the affected area. The Utilities have developed the Merwin In-Lieu Strategic Plan to provide a framework for implementing the Merwin In-Lieu Program (see Volume III of this application). Key assessments of watershed processes, habitat, and fish production were completed (e.g., EDT analysis, watershed assessment, limiting factors analysis, identification of restoration opportunities in priority EDT reaches) in support of the planning effort (PacifiCorp 2016). Priority restoration types and locations have been identified in the mainstem North Fork Lewis River and tributaries upstream of Swift reservoir, including: Clearwater River (8.37 km), Clear Creek (22.96 km), North Fork Lewis River (22.69 km), and Drift Creek (1.52 km) (Figure 2 in Section 2.1.2). The four targeted restoration action categories identified include: 1) LWD placement, 2) side channel and floodplain restoration and development, 3) riparian restoration (including invasive removal, riparian planting, livestock exclusion), and 4) road removal.

E.4.1.1.1 Long-term Impacts to Fish

As part of this application, bull trout fish passage facilities will be constructed at three facilities, including: 1) the Yale Downstream Bull Trout Passage Facility in the forebay of Yale Dam, 2) the Yale Upstream Passage Facility at the upper end of Merwin reservoir near the base of Yale Dam and 3) the Swift Upstream Bull Trout Facility in the upper end of the Swift bypass reach near the base of Swift Dam. These facilities will provide upstream and downstream passage for adult and sub-adult bull trout. The netting, trapping, and transporting of bull trout related to these facilities will result in additional handling of all species of fish intentionally and unintentionally captured by the devices, which could have an adverse effect; however, the design of fish per day at each facility is relatively low at 5 adult and 5 sub-adult bull trout for each facility. While the facilities will be designed for continuous year around operations, it is expected that operations at the Yale downstream facility will occur from March through June, with operations at the two upstream facilities occurring from May through October, during adult bull trout migration and spawning period. Adverse effects to non-targeted species may occur as a result of handling, however best management practices in the handling of fish will minimize negative effects that may occur. Although some adverse effects to bull trout may occur as a result of handling, the beneficial effects of improved passage for bull trout and associated access to suitable habitat, will likely offset any negative effects that may occur.

In addition to bull trout fish passage facilities, and included within this application, is implementation of the Merwin In-Lieu Program Strategic Plan (see Volume III of application for Plan). Habitat changes are expected to occur over time as a result of implementing restoration actions under the Merwin In-Lieu Program, including improvements to instream complexity, soil stabilization, and overwater shading, all of which are expected to result in beneficial effects for listed salmonids greater than expected with anadromous fish passage into Merwin Reservoir. Studies indicate that the restoration actions identified for implementation under the Merwin In-Lieu Program have the potential to ameliorate temperature increases and flow changes related to climate change and to increase salmon resilience to the effects of climate change. Program actions will result in positive long-term benefits such as:

- Removal of barriers and improved connectivity with instream, off-channel, and floodplain habitat;
- Development of instream complexity and off-channel habitat;
- Improvements to riparian vegetation corridors and plant species composition; and
- Reduction or elimination of impacts to streams and riparian areas from roads.

E.4.1.1.2 Short-term Impacts to Fish

Construction of the various project elements, including bull trout passage facilities, instream placement of LWD, floodplain reconnection, and road removal activities, could temporarily introduce fine sediments and turbidity into the streams in the action area through erosion and sedimentation. However, sedimentation and turbidity effects will be short-term and limited to areas where construction activities occur within or adjacent to rivers and streams in the action area. The extent of turbidity effects will vary for each activity, depending on the extent of work conducted within the wetted channel, the ability to effectively isolate the work area and prevent sediment from entering the main channel, fish salvage activities, and other BMPs that will be implemented to minimize turbidity and sediment effects to fish. Elevated turbidity has been reported to cause physiological stress, reduce growth, and adversely affect survival of ESA-listed fish. While juveniles of many salmonid species thrive in rivers and estuaries with naturally high concentrations of suspended solids, studies have shown that suspended solids concentration (as well as the duration of exposure) can be important factors in assessing risks posed to salmonid populations (Servizi and Martens 1987). However, the effects will be short-term and localized in nature, and they are not expected to elevate turbidity levels high enough to have behavioral effects on ESA-listed species.

Underwater noise will be propagated only when water levels are greater than 2 feet due to the amplitude of the sound waves (WSDOT 2019). Water levels are likely to be shallow within tributaries where restoration actions may be implemented, allowing work areas to be isolated and dewatered prior to construction. Water depths greater than 2 feet occur in reservoir habitats and may be exposed to elevated noise levels as a result of the construction of bull trout passage facilities. Underwater noise can affect fish in a range of ways from behavioral, to bodily injury, to lethal effects, depending on the type of noise-generating activities being conducted. For the activities of the proposed action bodily injury and lethal effects by noise-generating activities is not expected. Behavior effects are most likely and would consist of fish fleeing the immediate area. As a result, normal behavior associated with rearing, foraging, or migrating may be affected. Since all in-water work will be conducted during an approved window, the potential for listed fish being in the immediate vicinity of noise-generating activities during project construction is low; however, it is possible that fish will be present. The resulting potential effects are likely to be short-term in nature and will not result in any permanent or long-term effects to listed fish. Activities that could result in mortality (i.e. blasting) will not be employed as part of the proposed action.

Prior to construction, the in-water work areas will be isolated with sheet piles, sand bags, inflatable bags, or other suitable methods, as practicable. However, there may be in-water work areas associated with the bull trout fish passage facilities in the reservoirs that cannot effectively be isolated for fish removal due to site conditions and water depth. If work area isolation or dewatering are employed, any fish present within the in-water work area will be removed prior to dewatering. Biologists will follow the fish exclusion protocols and standards approved by the NMFS (2000) and the USFWS (2012) for safe capture and removal of fish from the isolated work area. Implementation of the approved standardized protocols will minimize the likelihood of injury or mortality during the salvage operations. If pumps are used to temporarily bypass water or to dewater residual pools or cofferdams, pump intakes shall be screened to prevent aquatic life from entering the intake.

The proposed project results in a delay of anadromous fish passage into Yale reservoir and associated tributaries or a delay in habitat improvement projects within the Lewis River Basin, beyond what was previously considered in earlier assessments. A deferred decision on the action to implement will delay benefits to anadromous fish populations in the North Fork Lewis River Basin if fish populations increase such that aquatic habitat becomes limited. Partial passage is currently provided, allowing for upstream passage from Merwin Dam to upstream of Swift Dam and allowing for downstream passage from Swift Dam to downstream of Merwin Dam.

E.4.1.1.3 Long-term Impacts to Fish Habitat

Restoration actions that involve in-reservoir work, in-stream work, including installation of passage facilities, LWD placement and floodplain reconnection, will directly affect fish habitat.

The placement of LWD in stream channels and the reconnection or creation of side channels or off-channel habitat will permanently alter existing stream habitat and will result in temporarily elevated turbidity levels during construction. However, these restoration activities will also result in long-term beneficial effects in the form of improved habitat complexity (e.g., pool development and increased off-channel habitat) to better support adult fish by providing more resting and spawning areas and to support juvenile fish with enhanced cover habitat and rearing areas.

Long-term beneficial effects are expected to occur as a result of restoration actions. They may include, but not be limited to (USFS 2018):

- Restoration of access to historic habitats through removal of impassable barriers;
- Creation of more complex habitats through the addition of wood and boulder structures to streams and floodplains;
- Increased stream length, floodplain connectivity, and riparian vegetation corridors through channel reconstruction and reconnection of side channels;
- Reduction or elimination of impacts to streams and riparian areas from roads; and
- Restoration of riparian plant species composition.

E.4.1.1.4 Short-term (Construction-related) Impacts to Fish Habitat

Installation of the work area isolation structures associated with instream work will dewater and temporarily displace streambed habitat at the stream restoration and fish passage improvement locations. Although the effect will be temporary in nature, an impact to prey species (invertebrates) is likely to occur. Instream isolation could result in an immediate and direct loss of benthic productivity within the dewatered construction zone; however, macroinvertebrates will likely recolonize the area through downstream drift and aerial recolonization following the completion of the in-water work.

Road removal will result in temporary effects to habitat due to elevated turbidity during construction. The duration and extent of the impacts will depend upon the proximity of the roadway to the stream channel and will be minimized through the implementation of BMPs. Although temporary turbidity impacts will occur, road removal will result in long-term reductions of runoff and sediment inputs to streams, which will improve habitat conditions over the long term. Areas where roads are removed will be replanted with native vegetation to further stabilize soils. Riparian planting activities will be conducted in conjunction with other restoration activities or as stand-alone actions. While some soil disturbance and non-native invasive species removal will occur within riparian areas, impacts to in-stream habitat are expected to be temporary in nature and minimal. Affected areas will be replanted with native vegetation, which will result in long-term beneficial effects to fish habitat by providing shade and delivery of organic material, including LWD, to the streams.

E.4.1.2 Wildlife and Botanical Resources

The Lewis River Hydroelectric Projects straddle the boundary between the Puget Trough and the Southern Washington Cascades physiographic provinces. The Puget Trough area consists primarily of rolling hills and terraces. Ridges separated by steep, dissecting valleys characterize the Southern Washington Cascades (Franklin and Dyrness, 1988). Area vegetation is supported by a temperate maritime climate. With elevations ranging from about 200 feet near Eagle Island to over 1,000 feet upstream of Swift Creek reservoir, the projects are entirely within the western hemlock vegetation zone, which is characterized by coniferous forest dominated by Douglas-fir, western hemlock, and western red cedar.

Land use practices significantly influence vegetation associated with the Lewis River Projects. Lands around Swift reservoir are relatively unaffected by development and include a patchwork of managed timberlands consisting of various age classes of coniferous forest typical of the western hemlock vegetation zone. Around Yale and Merwin reservoirs, pastures, farmlands, and small residential and recreational developments are interspersed with large areas of managed timberlands and deciduous forest stands. Along the lower river downstream of Merwin Dam, the effects of development are most pronounced; the area is dominated by a riparian deciduous and mixed deciduous-coniferous forest surrounded by residential and recreation developments and agricultural lands. Washington Department of Fish and Wildlife (WDFW) has designated a number of cover types in the vicinity of the Lewis River Projects as priority habitats, including: caves, freshwater wetlands, fresh deepwater, streams, old-growth and mature forest stands, Oregon white oak woodlands, riparian areas, rural open space, areas with abundant snags and logs, and talus. Surveys for rare plants in the vicinity of the projects were conducted in 1997, 2000, and 2001, and located only one rare taxa: the green-fruited sedge (*Carex interrupta*).

The Lewis River supports a variety of terrestrial species, including 16 amphibians, 4 reptiles, 103 birds, and 13 mammals (PacifiCorp 2006). Elk (*Cervus elaphus*) and black-tailed deer (*Odocoileus hemionus hemionus*) frequent the Lewis River valley. In addition, the Townsend's chipmunk (Eutamias merriami) and Douglas' squirrel (*Tamiasciurus douglasii*) occur in conifer forests within the basin. Evidence of beaver (*Castor canadensis*) was noted in wetlands, and mink (*Mustela vison*) occur in wetland and riparian areas. Although not common, the black bear (*Ursus americanus*), bobcat (*Lynx rufus*), river otter (*Lutra canadensis*) and coyote (*Canis latrans*) are also present in the basin.

The USFWS provided an official list of species identified as threatened, endangered, candidate, or proposed on August 14, 2019. According to the list, terrestrial mammals and birds that can be found in the North Fork Lewis River watershed include gray wolf (*Canis lupus*), North American wolverine (*Gulo gulo luscus*), marbled murrelet (*Brachyramphus marmoratus*), northern spotted owl (*Strix occidentalis caurina*), streaked horned lark (*Eremophila alpestris strigata*), and yellow-billed cuckoo (*Coccyzus americanus*). Golden paintbrush (*Castilleja levisecta*) and water howellia (*Howellia aquatilis*) are threatened flowering plants that are on the list, as well as whitebark pine (*Pinus albicaulis*). Due to a lack of suitable habitat within the action area, the proposed project will have no effect on gray wolf, North American wolverine, marbled murrelet, streaked horned lark, yellow-billed cuckoo, golden paintbrush, water howellia, and whitebark pine. No critical habitat for these species is present within the potentially affected areas. Only northern spotted owl is known to occur in the affected area and has designated critical habitat present.

Bald eagles (*Haliaeetus leucocephalus*), although no longer listed under the Endangered Species Act, remain federally protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act and state protected by the Bald Eagle Protection Law of 1984. Bald eagles use the Project vicinity for both wintering and breeding. Wintering eagles begin to arrive in Washington in October, with most adults arriving in November and December and juveniles arriving in January (Buehler 2000). Winter use is likely related to forage availability, particularly fish, along the Lewis

River and nearby drainages. Nest activity and productivity varies from year to year. In Washington, surveys by WDFW conducted in 2005 showed that nearly all (97%) surveyed bald eagle nests occurred within 3,000 feet of shoreline (Stinson et al. 2007).

State endangered, state threatened, state sensitive, and state candidate species designated by the WDFW also have the potential to occur within the affected area. These species include Larch Mountain salamander (*Plethodon larselli*), Van Dyke's salamander (*Plethodon vandykei*), Cascade torrent salamander (*Rhyacotriton cascadae*), Oregon spotted frog (*Rana pretiosa*), western toad (*Bufo boreas*), common loon (*Gavia immer*), northern goshawk (*Accipter gentilis*), pileated woodpecker (*Dryocopus pileatus*), Vaux's swift (*Chaetura vauxi*), Townsend's big-eared bat (*Corynorhinus townsendii*), wolverine (*Gulo gulo*), fisher (*Martes pennanti*), and gray wolf (*Canis lupus*).

The Washington Department of Natural Resources (WDNR) maintains a list of plant species of conservation concern through the Washington Natural Heritage Program (WNHP). In Clark, Cowlitz, and Skamania counties, 73 vascular plant species of conservation concern have the potential to occur. In 2012, PacifiCorp identified 12 fungi species, 20 non-vascular plants, and 51 vascular plants considered by the U.S. Forest Service to be sensitive species with the potential to occur within the Lewis River Basin (specifically within Gifford Pinchot National Forest). Several element occurrences for state sensitive plants occur within the affected area: Rainier pseudocyphellaria lichen (*Pseudocyphellaria rainierensis*), jelly lichen (*Collema nigrescens*), and kidney lichen (*Nephroma occultum*) (WDNR 2019).

E.4.1.2.1 Long-term Impacts to Wildlife

Because daily and seasonal reservoir level fluctuations would continue, the ongoing effects on wildlife would remain. Winter drawdowns result in a large barren stretch of land, limiting the access to water by wildlife, especially medium sized mammals such as rabbits and raccoons that require cover for protection from predation.

Restoration activities are anticipated to result in long-term benefits for wildlife in the Lewis River basin by improving availability of prey and aquatic habitat resources. No long-term impacts to northern spotted owl are expected to occur from the proposed action.

E.4.1.2.2 Short-term (Construction-related) Impacts to Wildlife

Construction activities related to in-lieu restoration actions and development of bull trout facilities will require the use of trucks and other equipment. These activities will result in increased levels of noise and human activity in the project area, potentially resulting in auditory or visual disturbance of wildlife during the construction or implementation of these projects.

The construction of bull trout passage facilities will occur within areas that are already developed for existing hydroelectric facilities and existing roads will be used to access the sites. Wildlife in the vicinity of existing facilities or roads will likely not experience significant disturbance related to these activities, as they are likely habituated to the normal range of sounds and anthropogenic activities associated with these facilities and roads.

The USFWS has noted that spotted owl nesting behaviors will be disrupted by visual disturbance related to activities that occur in close proximity to active nest sites during the early portion of the spotted owl nesting season, which is defined as March 1 to July 15 in Washington (USFWS 2013). Early nesting season behavior includes nest site selection, egg laying, incubation, and brooding of nestlings to the point of fledging (Forsman et al. 1984). Although there could be visual disturbance as a result of these activities, it is expected to be very unlikely. The USFWS has determined that if spotted owls select nest sites in close proximity to existing roads, no impacts to northern spotted owl would be anticipated from use of those roadways

Construction activities occurring during the latter half of the spotted owl nesting season from July 16 to September 30 are not expected to disrupt nesting spotted owls (USFWS 2013). During the late nesting season, juvenile spotted owls have fledged and are able to thermoregulate and to fly short distances, and they are no longer completely dependent upon the adults for daily feedings (Forsman et al. 1984). If an adult or juvenile are flushed at this stage of development, it is not likely to reduce the fitness or ability of juveniles to survive (USFWS 2013). Therefore, the biological effects of noise and visual disturbance that occurs during the late nesting season are considered insignificant.

Construction activities required to implement in-lieu restoration activities and develop bull trout passage facilities will require the use of construction equipment that will likely elevate in-air noise. The USFWS (2013) has identified a distance of 0.25 mile for ground-based activities that are likely to affect spotted owls and a distance of 65 yards from an active nest where ground-based activities are likely to disrupt nesting behaviors. LWD placement or other restoration activities that are currently "to be determined" are planned to occur on Drift Creek and the Muddy River (Figure 2, Section 2.1.2) and will result in noise-elevating activities within 0.25 mile of known spotted owl site centers. Any in-stream work associated with these activities will be conducted during the in-water work window (likely August 1 through August 30), which would occur toward the end of the nesting season and is not expected to affect spotted owls. Construction of bull trout facilities will also result in noise from equipment use; however, these activities will occur within existing facilities and will use existing roadways. Based on information presented in Tempel and Guttiérez (2003), Delaney et al. (1999), and Kerns and Allwardt (1992), the USFWS notes that spotted owls that select nest sites in close proximity to open roads either are undisturbed by or habituate to the normal range of sounds and activities associated with these roads; therefore, no impacts to northern spotted owl are anticipated from the development of the bull trout passage facilities.

The most sensitive time of year for bald eagles is during the nest-building, egg laying and incubating periods (January – May) when eagles are most susceptible to disturbance and nest abandonment. Construction activities may cause visual and noise disturbances to nesting eagles; however, in-water work will be limited to outside of the nesting season after young have fledged and is not expected to affect bald eagles. Appropriate buffer distances for construction activities will be followed for activities occurring during the breeding season around active bald eagle nests. If buffer distances or time of year restrictions cannot be followed, an eagle permit will be obtained from the USFWS.

In-water work and associated work isolation and dewatering activities will temporarily impact aquatic habitat used by amphibians, aquatic turtles, and other riparian-dependent wildlife. Instream isolation could result in an immediate and direct loss of benthic productivity within the dewatered construction zone. Highly mobile wildlife is anticipated to flee the immediate area of the work zone, which may temporarily affect behaviors like foraging or breeding. In-stream work activities have the potential to directly harm amphibian eggs and larvae as result of the proposed action; however, this impact is not anticipated to affect the long-term health of these populations due to the generally high fecundities of this taxa and localized nature of the work within the overall river basin.

E.4.1.2.3 Long-term Impacts to Vegetation and Wildlife Habitat

Because daily and seasonal reservoir level fluctuations would continue, the ongoing effects on shoreline vegetation would continue. Fluctuations at Project reservoirs have resulted in a minimal vegetated littoral zone, an extremely narrow zone of riparian vegetation, and a low number of hydrophytic plant species.

Restoration actions that involve in-reservoir work, in-stream work, including installation of passage facilities, LWD placement and floodplain reconnection, will directly affect aquatic habitat. The placement of LWD in stream channels and the reconnection or creation of side channels or off-channel habitat will permanently alter existing stream habitat and will result in temporarily elevated turbidity levels during construction. However, these restoration activities will also result in long-term beneficial effects in the form of improved habitat complexity (e.g., addition of LWD, boulders, and gravel) for aquatic life, such as amphibians, aquatic turtles, and riparian-dependent mammals.

Fish habitat improvements would likely increase fish production, which would provide more food for wildlife that feed on fish including black bears, bald eagles, osprey (*Pandion haliaetus*), and common mergansers (*Mergus merganser*). Many species of birds eat salmon eggs, fry, and fingerlings.

E.4.1.2.4 Short-term (Construction-related) Impacts to Vegetation and Wildlife Habitat

Construction of proposed in lieu restoration projects adjacent to stream channels, floodplains, or roadways would increase the amount of temporarily disturbed vegetation and disturbed soils in the project vicinity, potentially increasing the amount of erosion or sediment loading into project waters. Fish habitat enhancements would require the loss of some vegetation and riparian habitat and temporary disturbance of wildlife, however overall it would be a benefit to wildlife in the project areas. It is possible that the proposed action may impact individual plants of conservation concern, but the impact is not anticipated to result in loss of viability of plant populations or species.

Construction related to bull trout passage facilities will occur at existing project facilities. Existing infrastructure and roads would be used to access sites for operational and maintenance activities, limiting impacts to vegetation or wildlife habitat. The only disturbance would be related to temporary shoreline access for installing, operating, and maintaining the facilities.

With the development and implementation of erosion control plans, it is anticipated that there would only be minor amounts of erosion during and following construction. The revegetation of disturbed areas following construction would further decrease the amount of loose soils available to erode and enter the reservoirs. Development and adherence to revegetation guidelines and use of species appropriate vegetation would further protect the soil, water quality and upland habitat.

No spotted owl habitat is expected to be removed or altered a result of these activities. By following appropriate time of year restrictions and buffer distances for construction activities, the FERC and the Utilities have determined that the project activities, as proposed, are not anticipated to affect bald eagles.

E.4.2 Historical and Archaeological Resources (18 CFR 4.51(f)(4))

E.4.2.1 Long-term Impacts to Historical and Archaeological Resources

Ongoing operations of the Projects will continue to generate the same effects on historical and archaeological resources that were considered in the 2006 FEIS, including both known and yet-to-be-identified historic properties and archaeological sites. For example, fish runs will continue to be managed by humans rather than natural, which will perpetuate the ongoing cultural impacts evaluated in the 2006 FEIS. Similarly, facility modifications and new construction can alter historic structures, and archaeological sites will be affected by reservoir erosion and ground disturbing construction activities, as evaluated in the 2006 FEIS. The 2006 FEIS evaluated the cultural, archaeological and historical resources throughout the basin and described the planned protections of cultural resources outlined in the Lewis River Historic Properties Management Plan (HPMP) (HRA 2017), new license terms, and consultation requirements associated with the relicensing. These protections apply to and are not altered by the currently proposed action.

E.4.2.2 Short-term (Construction-related) Impacts to Historical and Archaeological Resources

Archaeological and historic sites near those areas potentially affected by the proposed activities are vulnerable to damage as a result of construction activities, erosive effects of human and equipment traffic, and the effects of unauthorized artifact collectors. Following the process defined in the HPMP, prior to commencing any ground-disturbing activities, appropriate consultation will be completed with the cultural resource coordinator and any other agencies and government bodies to ensure regulatory compliance, adequate protection of historical and archaeological resources, and to avoid adverse effects on these resources. Construction will also be subject to the terms of the Project’s inadvertent discovery plan (IDP), which is included in the HPMP and is designed to guide contractors and PacifiCorp personnel in the event archaeological items area exposed during ground-disturbing activities (HRA 2017:Appendix G). In general, the IDP provides for work stoppage and defines how the find will be investigated in consultation with the FERC, DAHP, and the Tribes (and the State Physical Anthropologist, in the case of human remains). PacifiCorp personnel working on the Lewis River Projects participate in annual cultural resources awareness training and are familiar with the IDP.

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Yale Hydroelectric Project
FERC No. P-2071

Before the
United States of America
Federal Energy Regulatory Commission

Application for License Amendment

Volume III of V
Exhibit E – Appendices

PACIFICORP
A BERKSHIRE HATHAWAY ENERGY COMPANY

January 2020

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Yale Hydroelectric Project
(FERC No. P-2071)

APPLICATION FOR LICENSE AMENDMENT

This application for license amendment for the Yale Hydroelectric Project (FERC No. P-2111) consists of the following volumes:

Volume I

Initial Statement
Exhibit A – Project Description
Exhibit C – Project Installation and Proposed Schedule
Exhibit D – Costs and Financing
Exhibit G – Project Maps

Volume II

Exhibit E – Environmental Report

Volume III

Exhibit E – Appendices

Volume IV

Exhibit F – Vicinity and Preliminary Design Drawings (CEII Not for Public Release)

Volume V

CONFIDENTIAL – Cultural Resource Summary for the Merwin, Yale, and Swift No. 1 Projects

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EXHIBIT E – APPENDICES

Yale Hydroelectric Project
(FERC No. P-2071)

DRAFT LEWIS RIVER MERWIN IN LIEU PROGRAM STRATEGIC PLAN

January 2020

Prepared for:

PacifiCorp

825 N.E. Multnomah Street, Suite 1800

Portland, OR 97232

&

Public Utility District No. 1 of Cowlitz County

961 12th Ave

Longview, WA 98632

Prepared by:

Meridian Environmental, Inc.

Cramer Fish Sciences – An Employee Owned Consulting Company

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1.0 Introduction

PacifiCorp and the Public Utility District No. 1 of Cowlitz County ("Cowlitz PUD", together with PacifiCorp, the "Utilities") own and operate the four Lewis River Hydroelectric Projects (the "Projects") located on the North Fork of the Lewis River in Cowlitz, Clark, and Skamania Counties, Washington. The Federal Energy Regulatory Commission (FERC) licenses the four Projects separately. The Merwin (Project No.935), Yale (Project No. 2071), and Swift No.1 (Project No. 2111) Projects are owned and operated by PacifiCorp. The Swift No. 2 Project (Project No. 2213) is owned by Cowlitz PUD and operated in coordination with the other Projects by PacifiCorp.

On June 26, 2008, FERC issued new licenses for the Projects. During the relicensing process, the Utilities entered into a comprehensive settlement agreement with the Services and other stakeholders (the "Settlement Agreement"). The Settlement Agreement includes fish passage requirements for each project that were incorporated into the Project licenses as fishway prescriptions under Section 18 of the Federal Power Act. The Settlement Agreement also includes a provision that allows the Utilities to present new information to the Services regarding whether the construction of the fish passage facilities is appropriate. In the event that the Services determine, after review of such new information, that fish passage is inappropriate, PacifiCorp is required to create an "In Lieu Fund" to support habitat restoration and the Utilities are required to construct certain facilities for bull trout passage.

The Utilities provided new information regarding the appropriateness of fish passage at the Projects to the Services on June 24, 2016. The Services responded on April 11 and 12, 2019, providing the Utilities with a preliminary determination under Section 4.1.9 of the Settlement Agreement. Specifically, NMFS proposed and USFWS concurred in the following actions:

1) To forego construction of the Merwin Downstream Facility (Section 4.6 of the Settlement Agreement) and the Yale Upstream Facility (Section 4.7);

2) To require PacifiCorp to establish the In Lieu Fund consistent with the requirements of Section 7.6 of the Settlement Agreement; and

3) To defer a decision whether to construct the Yale Downstream Facility (Section 4.5) and the Swift Upstream Facility (Section 4.8) until 2031 and 2035, respectively, so that performance of in lieu habitat restoration could be considered in that future decision.

The Services directed that restoration efforts supported by the In Lieu Fund (the "In Lieu Program") focus on stream reaches upstream of the Swift reservoir that benefit three salmon species listed under the Endangered Species Act (ESA): (coho salmon [*Oncorhynchus kisutch*], winter steelhead [*O. mykiss*], and spring Chinook salmon [*O. tshawytscha*]). The Services identified the following reaches known to support all three species since reintroduction efforts began in 2012:

- Clearwater River (8.37 kilometers [km])
- Clear Creek (22.96 km)
- North Fork of the Lewis River (22.69 km)
- Drift Creek (1.52 km)

In addition, the USFWS, in an April 12, 2019, letter, directed the Utilities to proceed immediately with the development of the following fish passage measures for bull trout (*Salvelinus confluentus*) pursuant to Section 4.10 of the Settlement Agreement:

- Yale Downstream Bull Trout Passage Facility
- Swift Upstream Bull Trout Passage Facility
- Yale Upstream Bull Trout Passage Facility

USFWS elected to defer a decision on whether to require construction of the Merwin Downstream Bull Trout Passage Facility to evaluate whether bull trout have increased sufficiently in number in the Merwin reservoir to warrant construction. A determination by the USFWS regarding the Merwin Downstream Bull Trout Passage Facility is not due before 2025.

The Utilities have prepared this Strategic Plan in response to the Services' preliminary decision. This Strategic Plan is consistent with the requirements of Section 7.6.3 of the Lewis River Settlement Agreement. This Strategic Plan also provides the framework and processes for implementation of the Lewis River Merwin In Lieu Program (In Lieu Program), a fish habitat restoration program to be conducted on the mainstem North Fork Lewis River and tributaries upstream of Swift Dam.

With completion of trap and haul fish passage facilities in 2013, fish passage is provided from Merwin Dam to areas upstream of Swift Dam for spring Chinook salmon, coho salmon, and winter steelhead. Approximately 120 km of stream habitat in the upper Lewis River watershed is available to transported salmon and steelhead (Figure 1).

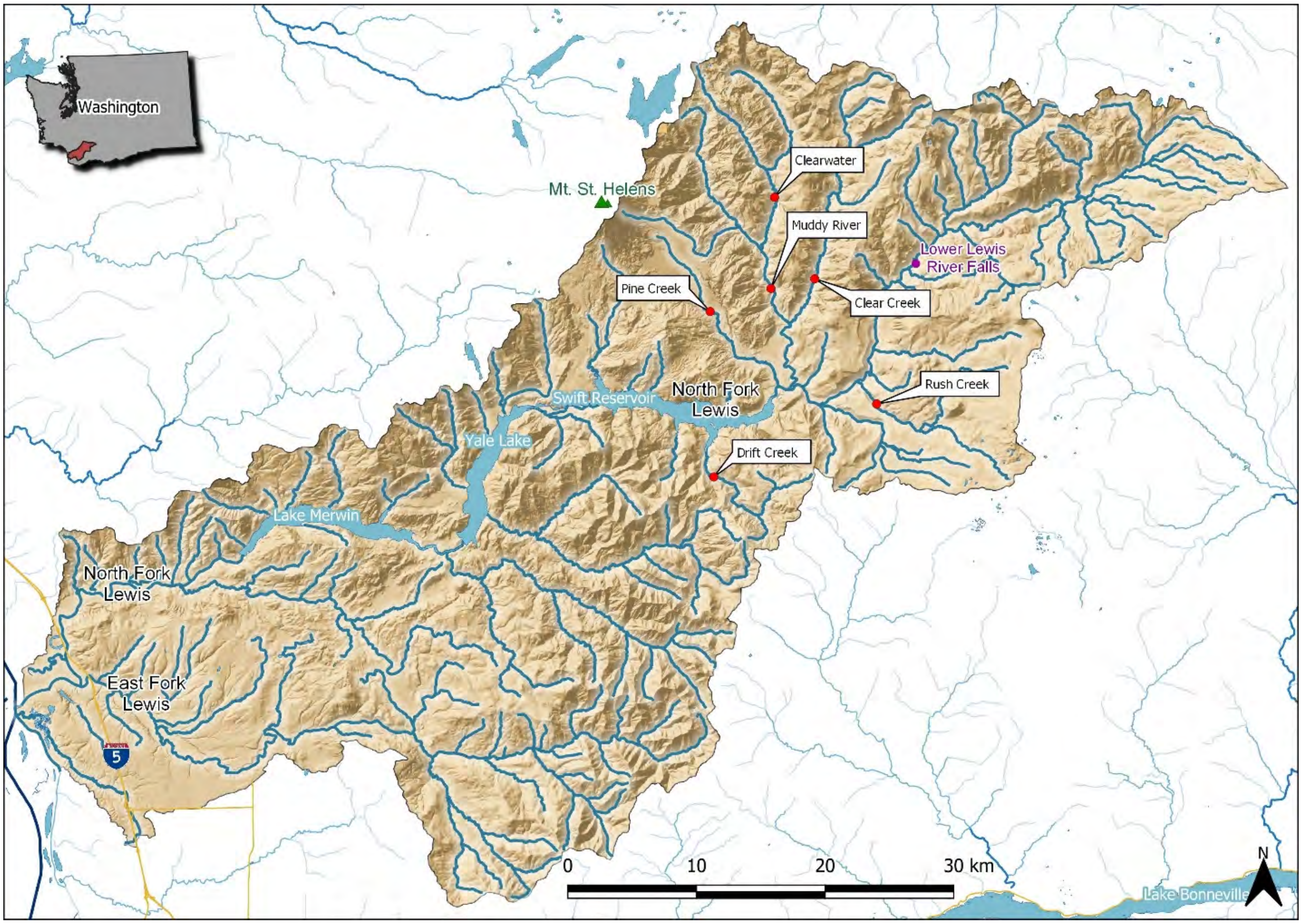


Figure 1. Lewis River Basin and major tributaries.

This Strategic Plan is intended to guide the expenditure of In Lieu Fund monies and the development and implementation of a broad range of aquatic habitat restoration activities in the upper Lewis River watershed, with focus on the sub-basins listed above by the NMFS. This Plan strives to be consistent with and supportive of the Lower Columbia Salmon Recovery Plan (LCFRB 2010) and to dovetail with other regional and local salmon recovery efforts. Previous restoration work in the Lewis River watershed has been completed by the U.S. Forest Service, Lower Columbia Fish Recovery Board (LCFRB), Cowlitz Indian Tribe, Washington Department of Fish and Wildlife, Lower Columbia Fish Enhancement Group and Fish First.

The approach for this Strategic Plan, and ultimately for the yet-to-be prepared Habitat Restoration Plan (HRP), is to use existing information from contemporary studies and analyses, monitoring and evaluation programs, local and technical expertise, and as needed, environmental data from additional fieldwork, to identify specific habitat restoration treatments for individual stream reaches.

Several additional steps are required before this Plan becomes operative. First, the Utilities will apply for non-capacity license amendments for the Projects. Second, the Services must make a final determination under Section 4.1.9 of the Settlement Agreement regarding the appropriateness of reintroduction or fish passage into Lake Merwin and Yale Lake and will do so as part of the Projects' license amendment processes. If the Services' final determination affirms its preliminary determination from April 2019, PacifiCorp will be required (a) to pursue habitat restoration funding in lieu of construction and operation of anadromous fish passage facilities into and out of Lake Merwin and (b) to proceed with alternative bull trout passage facilities as required by Section 4.10 of the Settlement Agreement. Similarly, if the Services' final determination affirms its preliminary one, the Services will defer a decision to construct anadromous fish passage facilities into and out of Yale Lake. Third, the Services must submit to FERC, as part of the Projects' license amendment processes, corresponding revisions to their Federal Power Act section 18 fishway prescriptions; if FERC approves the Utilities' non-capacity amendment applications, those revised fishway prescriptions must be incorporated into the amended licenses. Accordingly, after the Services make a final determination and FERC acts on the requested license amendments to comport with that determination, the Utilities will then execute the requirements of its licenses for the Projects as amended by FERC, including through operation of this Plan.

1.1 Document Organization

This Plan outlines roles and responsibilities of the Utilities and other stakeholders, the progress to date and steps to complete an HRP, and the approach for implementing the restoration plan and program. As described in Section 2.0 of this Plan, it is the intent of the Utilities, Services, and Aquatic Coordination Committee (ACC) to develop a framework for an HRP that will include reach and site-specific recommendations for restoration and enhancement measures. The HRP ultimately will provide individual project details sufficient to develop requests for bids by prospective contractors to construct habitat improvement projects.

The implementation section of this Strategic Plan details program administration and oversight, permitting, and the methods to identify, prioritize, approve, and then implement aquatic habitat improvement projects based on biological benefits, cost, and certainty of success. To track the progress of the Merwin In Lieu Program, this Plan also identifies reporting actions at various program milestones.

1.2 Roles and Responsibilities

1.2.1 Utilities

As owners of the Lewis River Hydroelectric Projects, PacifiCorp and Cowlitz PUD are ultimately responsible and accountable to FERC to ensure that restoration actions comply with project licenses and all applicable legal requirements. Additionally, PacifiCorp is required by Section 7.6.1 of the Settlement Agreement to fund the In Lieu Program in the amounts set forth in Table 1.

Table 1. Merwin In Lieu Program funding[1].

Name	Date	Funding
Merwin Downstream (11th Anniversary)	June 2019	$3 million
Merwin Downstream (12th Anniversary)	June 2020	$3 million
Merwin Downstream (13th Anniversary)	June 2021	$4 million
Yale Upstream (14th Anniversary)	June 2022	$1.25 million
Yale Upstream (15th Anniversary)	June 2023	$1.25 million
Yale Upstream (16th Anniversary)	June 2024	$1.25 million
Yale Upstream (17th Anniversary)	June 2025	$1.25 million

[1]Note: Payments to begin with issuance of FERC License Order; amounts to include current and unpaid prior years if necessary. Monetary values in the table are in 2004 dollars and will be escalated to current year value as required by Section 7.7.3 of the Lewis River Settlement Agreement.

1.2.2 Program Administrator

The Utilities will contract a Program Administrator (PA) to facilitate and implement the Merwin In Lieu Program. A key role of the PA will be to develop the HRP in consultation with the Services and the ACC, then implement that plan. The HRP will identify restoration/habitat improvement projects or "treatments" for key mainstem and tributary reaches upstream of Swift Dam. Such projects can then be prioritized by the Services and ACC. Following project selection, the PA will announce requests for proposals (RFPs) to perform selected habitat improvement projects and to secure needed permits (see Section 3.3). The PA will review and select submitted project bids then seek approvals from a to-be-established Technical Advisory Committee (TAC), the Services and the ACC. To facilitate this process, the PA will be available to assist applicants in the bidding process. The PA will prepare a report summarizing the responding bids for consideration by the TAC and lead the ranking and selection of project bids that best achieve goals and outcomes. The purpose of the TAC is to carefully consider project bids then recommend contractors to complete identified restoration/habitat improvement projects to the ACC. The PA will be the contact for all RFPs regarding status of application, including forwarding technical questions to and posting of responses from the TAC (see below).

The PA will provide day to day oversight and management of financial and technical elements of the In Lieu Program. Major roles and responsibilities will include the following:

- Preparation of RFPs
- Evaluation of proposals
- Contractor selection and contracting
- Preparation of bid documents
- Liaison to ACC, TAC, and Utilities
- Public outreach and response to media inquiries

Development and oversight of the proposal/bid process will be a critical role of the PA. Related activities will include:

- Dissemination and announcement of RFPs;
- Informing contractor recipients of selection;
- Managing financial, administrative, and contractual aspects of awards;
- Monitoring progress of all projects to ensure they successfully reach stated objectives; and
- Providing quarterly and annual financial and technical reports to the ACC.

The PA will promote individual projects through press releases and other media and community outreach. The PA will develop a Community Outreach plan to identify objectives, target audiences, and methods (i.e., presentations, media releases, website postings, site/project tours, etc.). Additionally, the PA will solicit matching funding to those provided by the Utilities, leveraging these existing funds for habitat improvement grants or other funding elsewhere in the Lewis River watershed (downstream of Merwin Dam and including the East Fork Lewis River watershed) and mainstem Columbia River.

Reports will be provided by the PA to the ACC and Utilities on a quarterly and annual basis. The PA's reports will include review of project accomplishments, summary of any monitoring data collected to date (by the PA or others), partnership accomplishments, and financial status of the program. The latter will include business plan tracking, and grant recipient six-month and final reports. The Utilities will include the PA's annual reports in their annual Aquatic Coordination Committee/Terrestrial Coordination Committee report to FERC.

Utility funded habitat enhancement projects will be conducted above Swift Reservoir (or tributaries draining to Swift Reservoir, e.g., Drift Creek). However, consistent with regional recovery goals, matching funds contributed by others will be unrestricted and available for enhancement projects elsewhere in the Basin, including reaches downstream of Merwin and in the mainstem Columbia River. This availability will encourage coordination and cooperation on large scale projects in the lower mainstem and estuary. Additionally, engagement of a PA into the Merwin In Lieu Program presents a unique opportunity to connect Lewis River habitat projects with lower-river projects, resulting in a more coordinated conservation planning effort with basin wide implications.

1.2.3 Technical Advisory Committee

The Technical Advisory Committee (TAC) will be facilitated and administered by the PA and will be comprised of experienced technical experts with knowledge of fish species and habitat requirements in the region, preferably the Lewis River Basin. The TAC will establish annual program priorities consistent with the HRP (i.e., the specific habitat work to be completed), respond (via the PA) to questions from prospective project contractors, and review project bids and provide recommendations to ACC.

1.2.4 Aquatic Coordination Committee

The Lewis River Aquatic Coordination Committee (ACC) will continue to function in a technical oversight and peer review capacity prior to and during implementation of this Plan and subsequent HRP. The ACC will have various levels of engagement with the PA, including but not limited to:

- Providing a sub-group of habitat experts to review and support completion of a draft HRP;
- Reviewing and approving a final HRP;
- Supporting HRP actions within respective ACC representative's organization.

2.0 In Lieu Habitat Restoration Plan

2.1 HRP Background and Status

This section provides goals, objectives, and a framework for the HRP, recognizing that much of the groundwork has been completed through the New Information Report developed by the Utilities and ACC over the last several years (PacifiCorp 2016, Al-Chokhachy 2018).

Effective basin-wide restoration plans include several key steps and components to ensure success (Roni and Beechie 2013). These include: 1) setting clear watershed restoration goals, 2) assessing and inventorying watershed conditions, 3) identifying degraded habitat (problems) and potential restoration opportunities, selecting priority sub-watersheds or reaches, 4) selecting appropriate restoration actions and projects within these sub-basins or areas, 5) prioritizing restoration actions, 6) designing restoration and monitoring projects, 7) implementing restoration and monitoring projects, and 8) analysis, reporting and adaptive management (Figure 2). In the Lewis River Basin, Ecosystem Diagnosis and Treatment (EDT) model outputs were used during Step 2 (assess and inventory watershed conditions) to focus the assessment on the highest priority reaches and watersheds draining into those reaches (EDT sheds). Steps 1 through 6 require technical input for final restoration plan development, while Steps 7 and 8 focus on implementation. Considerable progress has been made on identification of restoration opportunities and restoration actions (Steps 2 through 5; PacifiCorp 2016).

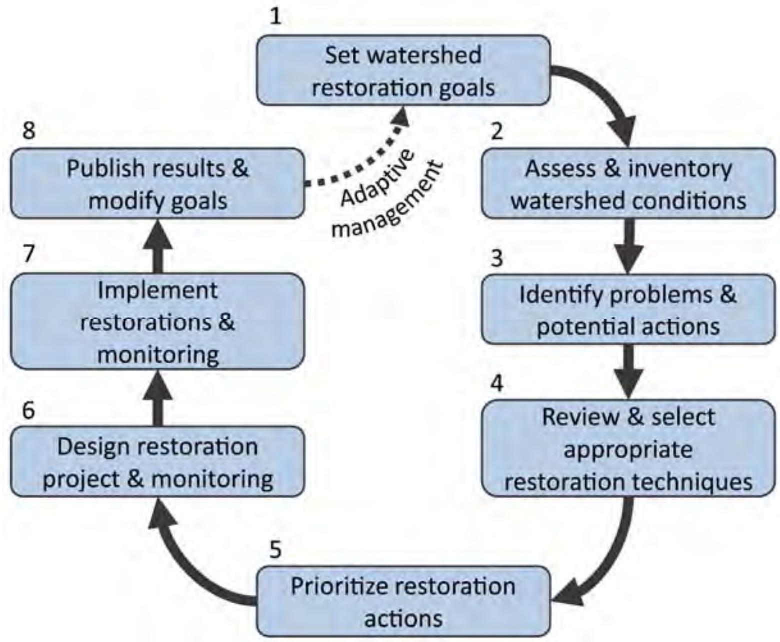


Figure 2. Steps for designing a successful restoration program. ***Source: Roni et al. 2018; Roni and* Beechie *2013.***

As documented in the New Information Report submitted to FERC and the Services in 2016, key assessments of watershed processes, habitat, and fish production have been completed (e.g., EDT analysis, watershed assessment, limiting factors analysis, identification of restoration opportunities in priority EDT reaches) (PacifiCorp 2016). These efforts examined watershed and reach-scale habitat processes, conditions and restoration opportunities throughout the Lewis River Basin where EDT analysis predicted the largest increases in abundance of Chinook, coho, and steelhead. Thus, Steps 1 through 4 in the restoration process (Figure 2) have largely been completed. The next step is site visits to priority reaches to assess conditions, confirm restoration opportunities, and prepare preliminary designs, and to prioritize restoration actions so they can be used as a basis for RFPs to prospective contractors. These reaches are:

- Clearwater River (8.37 km)
- Clear Creek (22.96 km)
- North Fork of the Lewis River (22.69 km)
- Drift Creek (1.52 km).

Enhancing and protecting these reaches recommended by the Services will focus on strongholds, or areas with the highest quality habitat and highest densities of spawning spring Chinook, steelhead, and coho. Recent EDT modeling and the watershed assessment evaluated reaches in all three sub-basins (Merwin, Yale, and Swift) (PacifiCorp 2016). Because of the size of the Lewis River Basin and the sheer number of EDT reaches (>150), EDT model outputs were used to identify the 25 highest priority reaches throughout the basin (16 are upstream of Swift) that would produce the largest increase in spring Chinook, coho, and steelhead. A process-based watershed assessment to identify degraded habitat (e.g., lack of wood or pools, high fine sediment), disrupted watershed processes (e.g., high road density, disconnected floodplain, loss of side channels), and restoration opportunities was then completed for areas flowing into those reaches. This watershed assessment information was coupled with a watershed-scale limiting factors analyses to determine limiting life-stage and habitat for spring Chinook, coho, and steelhead in order to identify initial restoration opportunities. Reaches defined by the Services as a priority for in lieu habitat restoration are primarily areas of high-quality habitats.

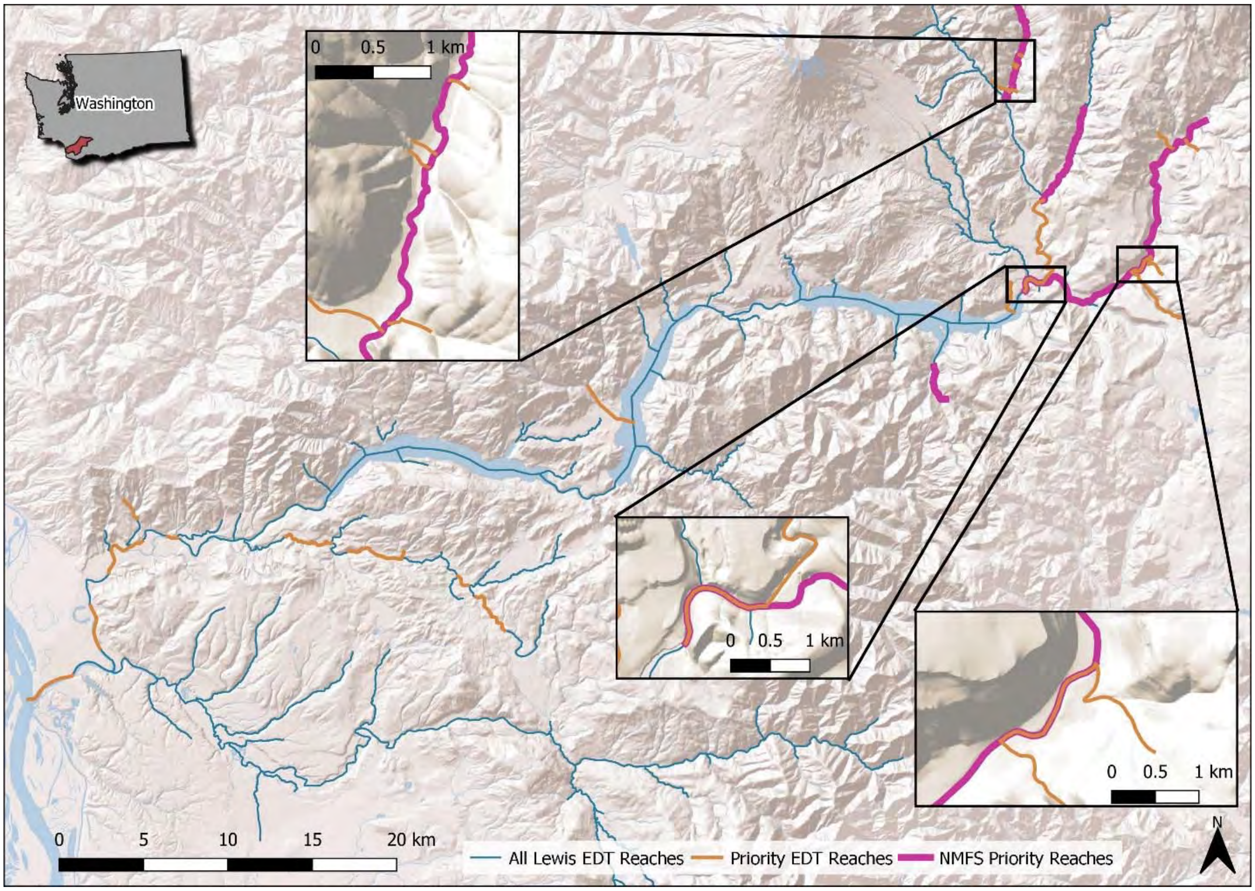


Figure 3. Map of priority EDT reaches initially identified in PacifiCorp (2016) and those identified by the NMFS. The insets show where there is overlap between the two sets of priorities. The watershed around the EDT reaches are the assessment and restoration units associated with each priority reach.

Combining the highest priority EDT reaches from the 2016 watershed assessment with those identified by the Services provides a strategy that both protects high quality habitat and restores processes and habitat in the highest priority areas (Figure 4). Given the broader watershed assessment conducted initially, Steps 2 through 4 in Figure 2 will be revisited and fine-tuned as part of the process to develop, finalize, and implement the HRP consistent with the Services' recommendation to focus on streams upstream of Swift Dam. These will include reaches listed above, and possibly others, since it is likely that restoration monies will not be exhausted on these four reaches given the amount of high quality habitat they contain (see Figure 2 above).

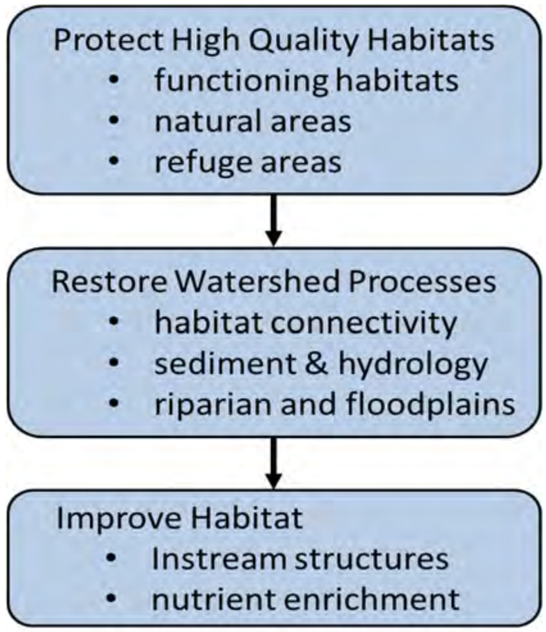


Figure 4. Strategy for prioritizing restoration projects based on protecting the highest quality habitat first and then restoring processes and habitats (based on Roni et al. 2008).

Key steps in the HRP development process were outlined in Figure 2; progress to date on the background studies and analyses is shown below (Table 2). Next steps (including steps 6, 7, and 8 in Figure 2) are discussed in Section 3, Implementation.

Table 2. Status of steps in restoration process outlined in Figure 2, and parties responsible in parentheses.

Step in Restoration Process	Status
Restoration goal	Support re-establishment and improvement of the form and function of aquatic habitats of the Lewis River that collectively promote large-scale environmental benefits, substantial increases in numbers of ESA listed salmon and steelhead, and achievement of the Lewis River SA Outcome Goal (Defined in Settlement).
Assess watershed conditions (processes)	Completed for 25 highest priority EDT reaches in the Lewis River Basin; to be updated for areas upstream of Swift (TBD).
Identify problems and restoration opportunities (reaches)	Completed for priority EDT reaches for entire Lewis River Basin; to be updated to include any additional reaches defined by the Services and upstream of Swift (TBD).

Step in Restoration Process	Status
Review and identify techniques	Site visits to confirm recommendations from Cramer assessment and proposed preliminary designs (TBD).
Prioritize restoration actions	Once list of restoration opportunities has been identified, projects to be ranked to allow development of RFPs (PA, ACC, TAC).
Design restoration (RFP) and monitoring	Restoration RFP(s) to be issued for projects (PA). Monitoring design completed; to be updated based on updated reaches and specific actions (TBD).
Implement restoration and monitoring	Proposed projects to be ranked and selected for funding (PA, ACC, TAC). Monitoring to be implemented well in advance of restoration.
Report results and adaptively manage restoration program	Annual reports of restoration actions implemented (PA) and results of monitoring (TBD). Use results to fine tune restoration strategy and priorities (ACC, TAC).

Note: ACC = Aquatic Coordination Committee, PA = Project Administrator, TAC = Technical Advisory Committee, TBD = Responsible party to be determined.

2.2 Restoration Goals and Objectives

The overall goal of the HRP will be to support re-establishment and improvement in the form and function of aquatic habitats of the Lower Columbia River watersheds[1] that collectively promote large-scale environmental benefits, substantial increases in numbers of ESA listed salmon and steelhead and achieve the Lewis River SA Outcome Goal. In addition, the HRP should focus on process-based habitat restoration strategies to promote long-term salmon and steelhead habitat recovery. Specific objectives include:

a) Consistency with the Lower Columbia Salmon Recovery Plan. Planning, to the extent possible, will be integrated with strategies developed under other regional processes to recover salmon, steelhead, and bull trout listed under the federal ESA.
b) Collaboration and consultation with interested representatives of the Lewis River ACC. Final Plan will have support of these entities and be approved by FERC.
c) Planning based on existing laws, rules, or ordinances created for the purpose of protecting, restoring, or enhancing fish habitat, including the Shoreline Management Act, Chapter 90.58 RCW, the Growth Management Act, Chapter 36.70A RCW, and the Forest Practices Act, Chapter 76.09 RCW.
d) Consideration of habitat projects (within NMFS priority reaches) which have previously been identified and have great expected benefit but have not been implemented ("low hanging fruit").
e) Implementation through approvals of the ACC, facilitated by the PA through a defined process.

[1] Areas under the purview of the Lower Columbia River Fish Recovery Board.

f) Acquisition of additional funding for habitat restoration/protection efforts in the Lower Columbia River area.
g) Use of an Adaptive Management cycle to integrate new information as it becomes available.

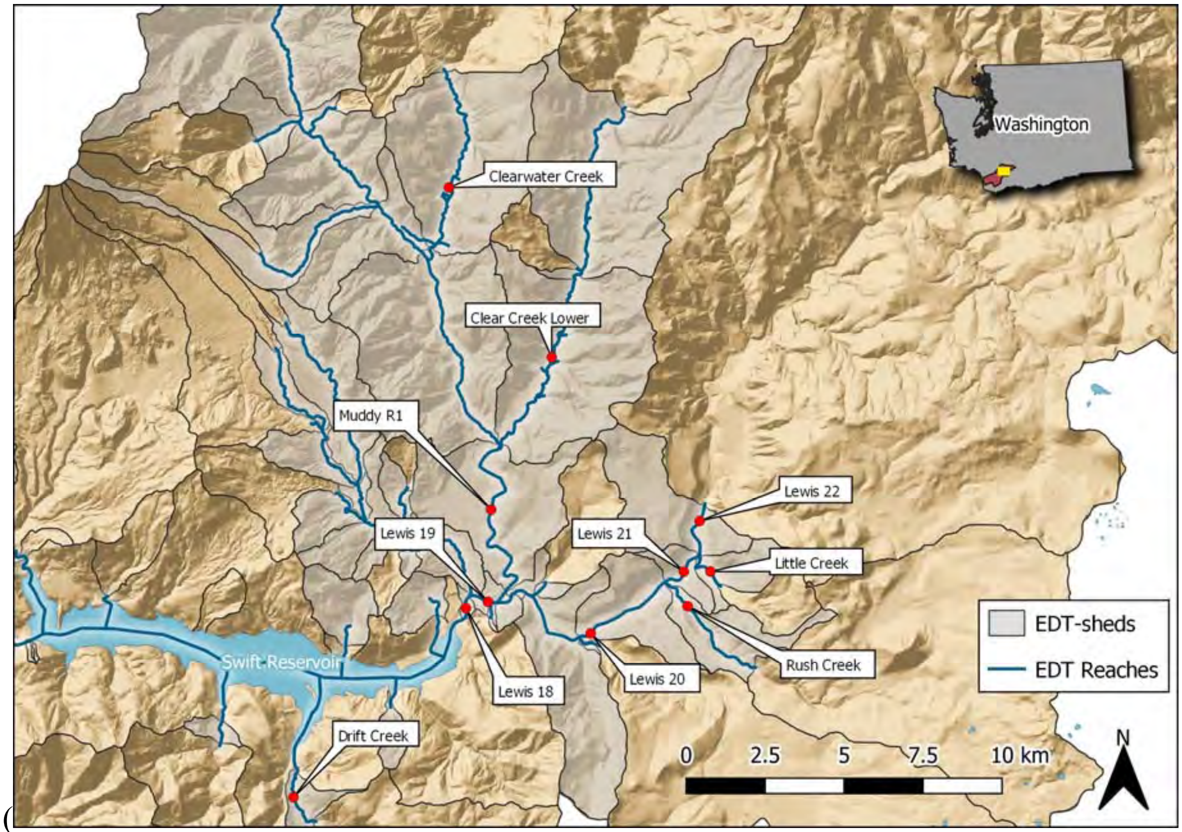
Several principles will guide implementation of the HRP, including:

- Focus efforts on identifying and prioritizing actions that achieve multiple objectives;
- Consider without prejudice, available actions that benefit aquatic habitat form and function;
- Consider actions that provide resilient habitat over changing conditions;
- Achieve goals and objectives in a cost-effective and efficient manner;
- Strive to ensure that overlap and duplication of efforts is avoided;
- Ensure actions are coordinated and integrated with other planning efforts in the watershed and other activities adjacent to the planning area;
- Facilitate and promote active participation by those entities affected by actions and key decisions;
- Keep affected entities informed of key decisions and outcomes;
- Work cooperatively to achieve the goal and all objectives of the plan;
- Strive to ensure planning actions are integrated into federal, state, and local decision-making processes; and
- Work to broaden public awareness and support of the plan; demonstrate positive outcomes.

2.3 Watershed Assessment

Following the clear definition of goals and objectives, the next step in developing the HRP would be to complete a watershed assessment for key upper Lewis River areas. As noted above and summarized in Table 2, the Merwin In Lieu Program will build on the considerable work over the last several years to develop an updated watershed assessment for target reaches. Prior studies include habitat surveys, fish-habitat models, and watershed assessments completed for the Lewis River Basin (Table 3; PacifiCorp 2016). Watershed assessments for Pacific salmon restoration typically include: 1) a synthesis, analyses, and assessment of historic and current conditions, evaluation of lost or inaccessible habitat, assessment of functioning and impaired watershed processes (e.g., riparian, hydrology, sediment); and 2) a fish habitat model (e.g., EDT, limiting factors model, life cycle model) to assist in determining current and potential fish production potential.

As part of the additional information developed in lieu of fish passage (PacifiCorp 2016), available data and information on habitat conditions and watershed processes were assimilated and assessed at a reach (EDT reaches) and sub-basin scale (EDTsheds and Merwin, Yale, and Swift sub-basins). Considerable information has been collected, and a watershed assessment was completed with available information. To help assess conditions in EDT reaches and floodplain and upslope processes, EDT reach breaks were used to define upslope contributing watersheds, landscape conditions, and their spatial connection to streams in the valley bottoms. These "EDTsheds" or sub-watersheds were the unit used to assess watershed and reach-scale processes



(Figure 5). Using available data on road density, sediment supply, riparian cover, channel type, and floodplain connectivity and condition, key watershed process impairments in each EDTshed were assessed, including riparian function and condition (seral stage, shade, LW), sediment production from roads and mass wasting, and floodplain conditions. This information was then used to identify watershed process and habitat impairments and restoration opportunities (see Section 2.4).

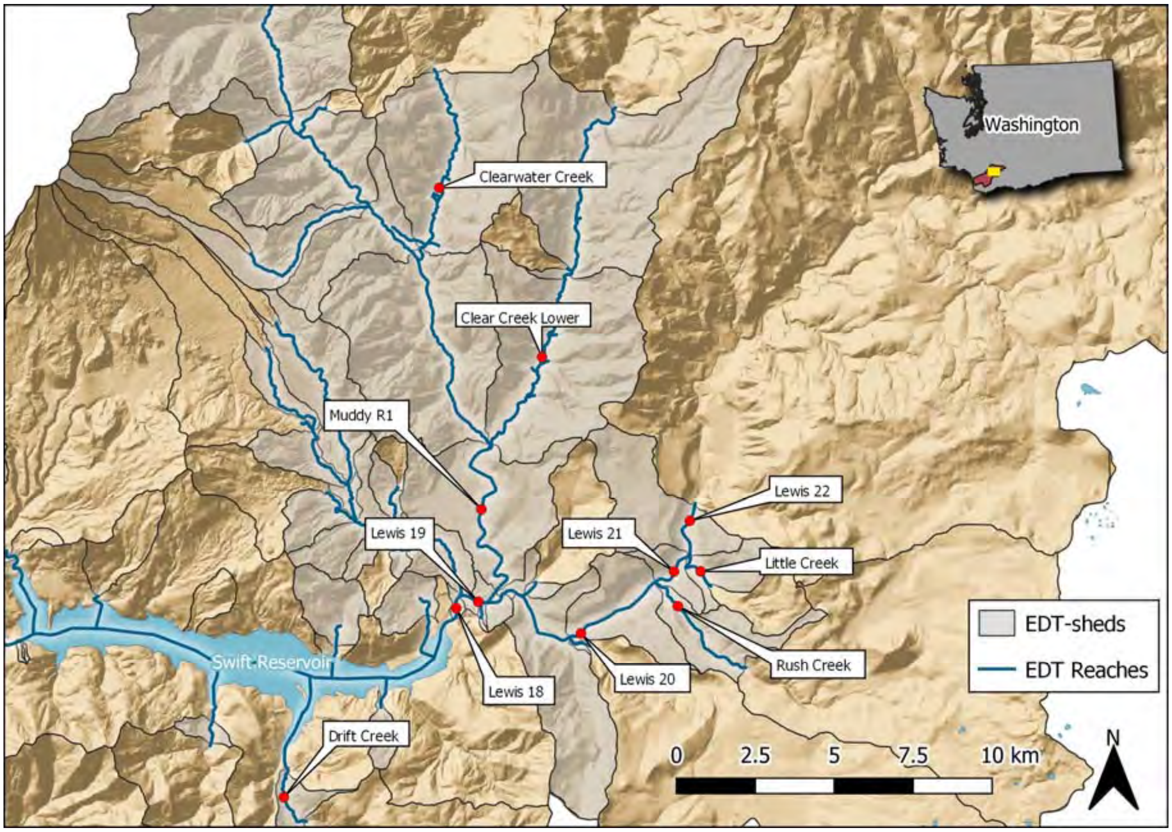


Figure 5. Map of North Fork Lewis River upstream of Swift Dam showing reaches and surrounding drainage area (EDTsheds). Using upstream and downstream EDT reach breaks, EDTsheds encompass areas draining into the reach including upslope, floodplain and riparian areas. The EDTsheds represent units for assessment of watershed and riverine processes and habitat, and units for identification and planning of restoration actions.

As noted previously, an EDT model of reach and sub-basin-specific current and potential salmon and steelhead production potential was also completed (PacifiCorp 2016). The EDT model is a habitat-based model that synthesizes available habitat data and professional opinion to assess current in-channel conditions, and to forecast future conditions. It also provides reach specific ratings of current and potential habitat conditions (e.g., pools, large wood, fine sediment) that are used in the watershed assessment. The EDT model is particularly useful for prioritizing reaches for restoration and recovery (McElhaney et al. 2010; Roni et al. 2018). The EDT model also provides a useful tool to assimilate available instream habitat data. For the North Fork Lewis River and its major sub-basins (Lower North Fork, Merwin, Yale, and Swift), in addition to the EDT model, a capacity-based limiting factors assessment was conducted to help determine which habitats were limiting specific life-stages in different sub-basins, and to help identify restoration opportunities (PacifiCorp 2016). Table 3 summarizes the existing data sources and their contribution to the watershed assessment, and what other steps in the restoration process these data sources may assist with answering (Figure 2). Additional detail on the methods, data sources, and results of the assessment are provided in PacifiCorp (2016).

Table 3. Summary of major information and data sources, coverage, and whether they provide data to help assess habitat conditions, identify limiting life-stage and habitat, identify restoration opportunities, prioritize reaches and restoration actions, or provide background (PacifiCorp 2016).

Description of Data/Info	Geographic Coverage	Assess Instream Habitat	Assess Watershed Process	Limiting Life Stage or Habitat	Rest. I.D.	Prioritiz-ation	Back-ground Info
Fish or Habitat Models							
EDT outputs and source data	Basin	X		X		X	X
Salmon PopCycle Model	Basin						X
Assessments							
Integrated Watershed Assessment	Basin		X				X
Shoreline Master Plan, B.A.s	N.F. Lewis						X
Recovery Planning reports/data	Lower				X	X	X
Watershed Assessment Models	Basin		X		X		
LW assessment	Lower	X					
Channel types	Basin		X		X		X
Monitoring Data							
Habitat and LW	Upper Basin		X		X		X
Parr, smolt, spawner, etc.	Various						X
Other habitat survey data	Various						X

Recognizing that many of the key components of a traditional watershed assessment have been completed (e.g., assessment of processes and habitat, fish-habitat model), additional guidance on priority reaches from the Services requires that three key steps be revisited: 1) confirm priority reaches and sub-basins, 2) summarize watershed assessment data for any additional reaches not covered by the watershed assessment as well as the drainage area upstream of these reaches (PacifiCorp 2016), and 3) review and confirm restoration opportunities and recommended actions (discussed below).

2.4 Identification of Problems and Restoration Opportunities

Information from the watershed assessment, habitat data used for EDT analysis, and information on the processes and habitat restored by different restoration techniques was used to identify potential degraded habitat and initial restoration opportunities (Table 4. Initial recommendations for restoration measures and rationale for selecting specific measures for priority EDT reaches upstream of Swift Dam. Reaches highlighted as a priority for the In Lieu Fund by NMFS are denoted. Lewis 18, 19, and 21 were both priority EDT and NMFS priority reaches. Modified from Appendix D in PacifiCorp 2016. Additional reaches may be considered in the final strategic plan.

Reach	Restoration Measure Initially Recommended	Rational for selecting restoration measure
Lewis 18 (NMFS)	LW	Low LW and percent pool
Lewis 19 (NMFS)	LW, side channels	Low LW, percent pool and channel type
Lewis 20 (NMFS)	To be determined	
Lewis 21 (NMFS)	LW, road removal or restoration	Low percent pool, LW, high sediment yield
Lewis 22 (NMFS)	To be determined	
Lewis 23 (NMFS)	To be determined	
Drift Creek (NMFS)	To be determined	
Muddy R 1	Side channels, LW	Low LW scores, and island braided channel type
Clear Creek Lower (NMFS)	To be determined	
Clearwater Creek (NMFS)	To be determined	
Clearwater Tributaries	NA (high levels of fines appears to be due to headwaters in blast zone of Mt. St. Helens.	Mt. St. Helens blast zone appears to be source of sediment
Rush Creek	Protection (steep channel)	Steep channel
Little Creek	LW	Poor LW and pool area
Spencer Creek	LW	Poor LW and pool area
Crab Creek	LW	Poor LW and pool area

below). Sources of information used to identify potential restoration actions in these reaches included:

- EDT outputs for priority reaches;
- Limiting habitat and life stage from limiting factors analysis;
- Watershed assessment data from previous analysis on riparian, sediment, and hydrologic condition;
- Geomorphic channel characteristics and channel type provided by Beechie and Imaki (2014);
- Information on watershed processes and habitats improved by various restoration strategies (Roni et al. 2013a); and
- Information on specific reaches from previous recovery planning efforts (Keefe et al. 2004; LCFRB 2010).

First, data on disrupted processes and degraded habitats, including whether the channel exhibited deviation from the expected channel conditions in the absence of human disturbance were examined. Then, the limiting habitat and life stage for a sub-basin, and any previous information from recovery plans, information on processes in the upstream areas contributing to the EDT sheds, were used to make initial recommendations for restoration in priority reaches. Therefore, identification of problems and restoration opportunities (Step 3 in Figure 2) has largely been completed for priority EDT reaches, but data will need to be summarized and opportunities updated for any additional reaches identified by NMFS or other stakeholders. This will include examination of the influence of upstream conditions and processes on these reaches.

2.5 Selection of Restoration Actions and Projects

Following identification of restoration opportunities, the next step in designing the HRP will be to select appropriate restoration actions and projects (Step 4 in Figure 2). As noted above, restoration opportunities have been identified for the 25 highest priority EDT reaches (Table 4. Initial recommendations for restoration measures and rationale for selecting specific measures for priority EDT reaches upstream of Swift Dam. Reaches highlighted as a priority for the In Lieu Fund by NMFS are denoted. Lewis 18, 19, and 21 were both priority EDT and NMFS priority reaches. Modified from Appendix D in PacifiCorp 2016. Additional reaches may be considered in the final strategic plan.

Reach	Restoration Measure Initially Recommended	Rational for selecting restoration measure
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Lewis 23 (NMFS)	To be determined	
Drift Creek (NMFS)	To be determined	
Muddy R 1	Side channels, LW	Low LW scores, and island braided channel type
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Clearwater Tributaries	NA (high levels of fines appears to be due to headwaters in blast zone of Mt. St. Helens.	Mt. St. Helens blast zone appears to be source of sediment
Rush Creek	Protection (steep channel)	Steep channel
Little Creek	LW	Poor LW and pool area
Spencer Creek	LW	Poor LW and pool area
Crab Creek	LW	Poor LW and pool area

This work will need to be completed for any additional reaches identified by the Services or through finalization of the HRP.

As noted in Table 4 and shown in Figure 6 below, there are four potential types of restoration actions across multiple reaches and locations, including:

1. Floodplain restoration to create and reconnect side channels
2. Large wood placement to increase pools, habitat complexity, and fish cover
3. Riparian planting to increase shade and delivery of organic material (leaf litter, wood)
4. Road removal or restoration to reduce instream sediment (including culvert removal)

Large wood placement and floodplain restoration (reconnection or construction of side channels) will be the two most common restoration actions. As discussed in the In Lieu Program Monitoring Plan (a companion to this Strategic Plan), these are actions for which monitoring will address both biological and implementation effectiveness. Riparian planting will be conducted as part of certain large wood or floodplain restoration projects. Road restoration, if necessary, would be limited to a few tributary areas. These four restoration types focus on improving and increasing quality of juvenile salmonid rearing habitat though they will also improve spawning habitat. The limiting factors analysis indicated that there was adequate spawning habitat upstream of Swift Dam, and that the amount or quality of summer and winter rearing habitat were limiting Chinook, coho, and steelhead production. Thus, methods of improving or increasing the amount of spawning habitat, such as gravel addition, are not proposed above Swift Dam.

Restoration measures recommended in Table 4 are planning level recommendations. To confirm that restoration opportunities do exist in these reaches and to identify specific restoration approaches will require more detailed field investigations. First, site visits would be needed to confirm existing habitat, geomorphic, and hydraulic conditions—any potential constraints to restoration. Second, based on these detailed surveys, specific restoration measures would be identified within reaches and preliminary designs and site maps prepared for each reach. This would entail a process similar to that used by the Lower Columbia Fish Recovery Board for the East Fork of the Lewis and Wind River, and the Colville Tribe for the Sanpoil (Timm et al. 2017), and planned by others (see Appendix 1 for examples from East Fork Lewis, Wind River, and Sanpoil).

Field reviews and assessment would produce reach summaries with a list of specific restoration actions, locations, and conceptual designs for each priority reach and key information needed to develop RFPs for final project design and implementation (e.g., project construction). These elements will support the specific RFPs to be developed and issued to prospective contractors to complete final design and to implement and construct habitat improvement projects. Baseline data on reach conditions and processes from the field assessment will also assist with both implementation and effectiveness monitoring.

Table 4. Initial recommendations for restoration measures and rationale for selecting specific measures for priority EDT reaches upstream of Swift Dam. Reaches highlighted as a priority for the In Lieu Fund by NMFS are denoted. Lewis 18, 19, and 21 were both priority EDT and NMFS priority reaches. Modified from Appendix D in PacifiCorp 2016. Additional reaches may be considered in the final strategic plan.

Reach	Restoration Measure Initially Recommended	Rational for selecting restoration measure
Lewis 18 (NMFS)	LW	Low LW and percent pool
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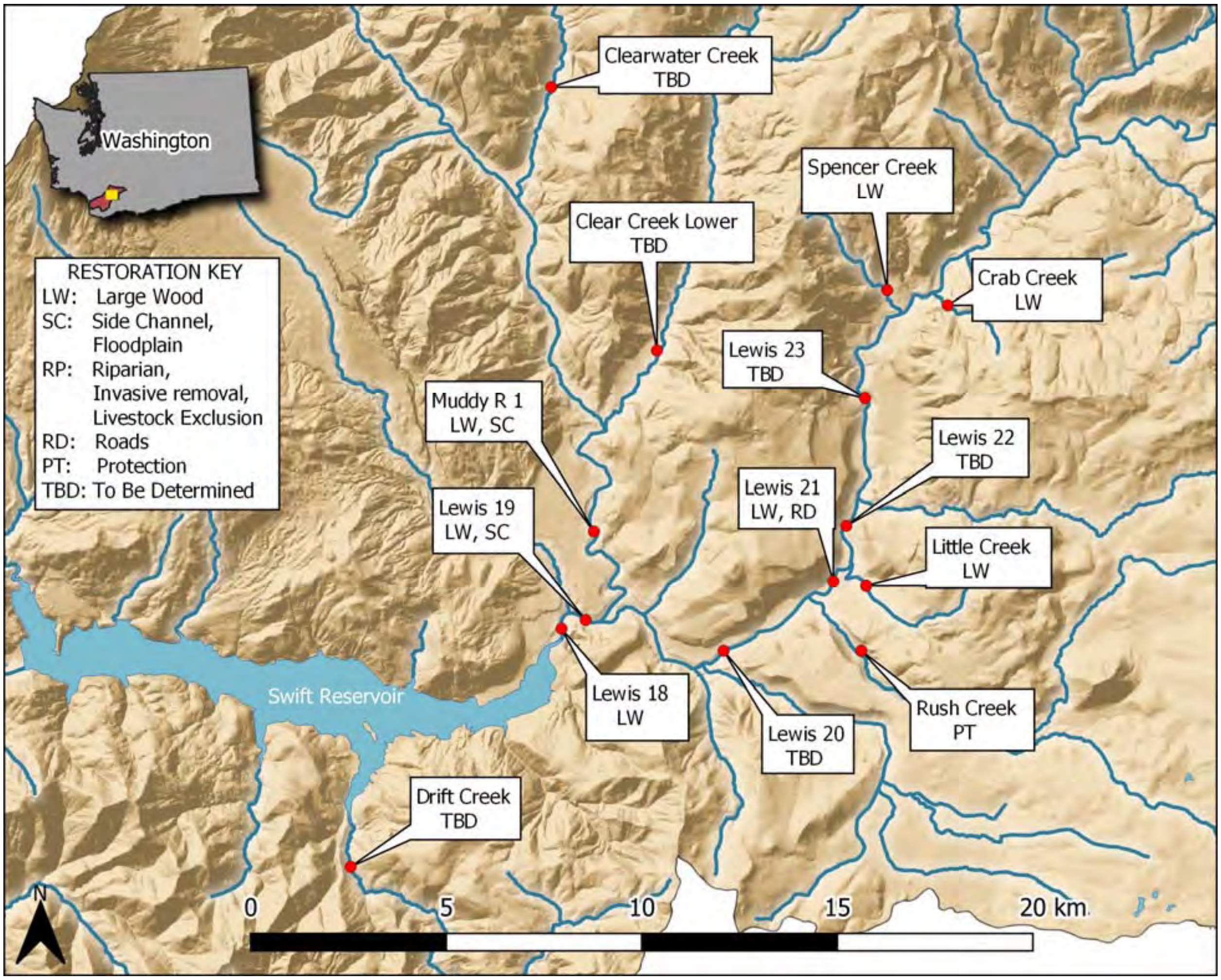

Figure 6. Map of the North Fork of the Lewis River upstream of Swift Dam showing initial priority EDT reaches and recommended restoration measures (PacifiCorp 2016). Reaches with TBD were identified by NMFS as a priority for the In Lieu Program and preliminary restoration measures still need to be identified.

2.6 Project Ranking

Once preliminary projects and designs have been determined, the projects need to be prioritized or ranked to determine the order for funding and implementation (Step 5 in Figure 2). There are several key steps in the prioritization process to ensure there is a transparent, effective, and repeatable process for prioritizing projects (Figure 7). A critical step in this process will be agreeing upon the criteria to prioritize (rank) for funding. Consistent with the goals and objectives of the In Lieu Program, these will include: the expected increase in juvenile and adult spring Chinook, coho, and winter steelhead abundance (based on existing EDT outputs); whether the project benefits all three focal species; the degree that it would provide resilient habitat over changing conditions (restore processes); cost effectiveness; and many other technical and non-technical criteria (e.g., access and feasibility).

As noted above, the highest ranked projects will benefit all three focal species. Equally important from an ecological and regulatory standpoint is the potential impact, if any, on federally listed bull trout. For example, projects that could lead to increased superimposition of coho spawning on bull trout redds are not desirable. Maps showing known bull trout spawning areas will be reviewed and recent observations will be discussed with bull trout biologists (e.g., Lewis River Bull Trout Working Group) prior to finalizing project rankings.

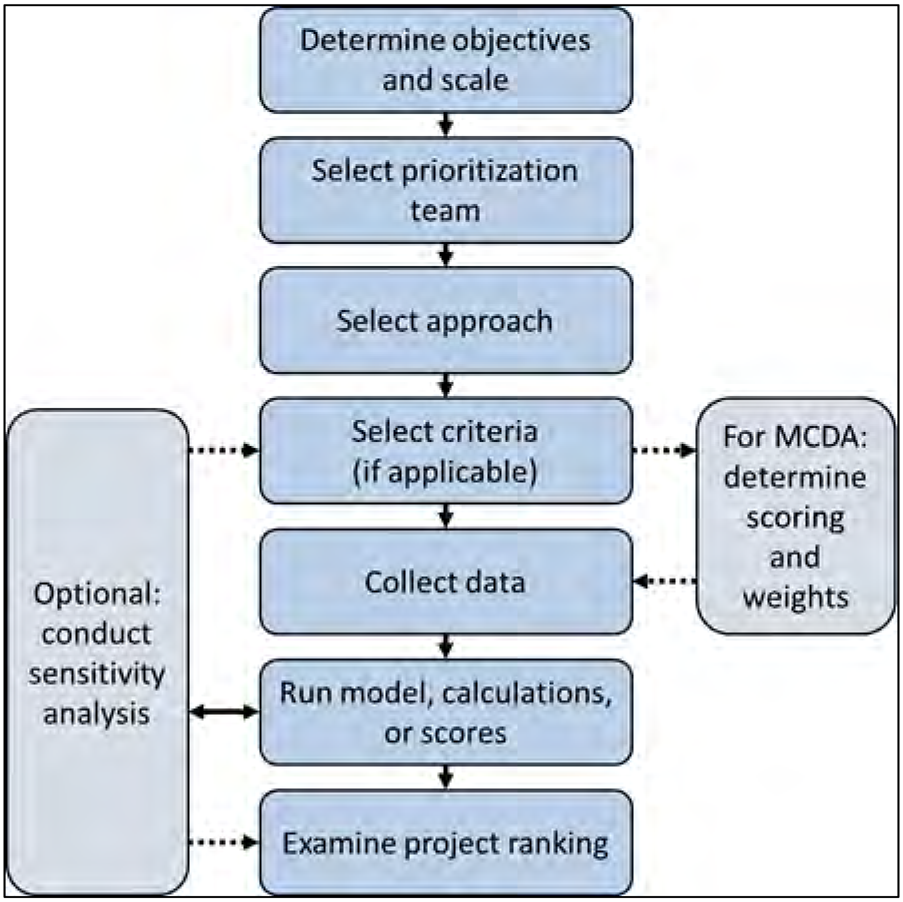

Figure 7. Key steps in the prioritization process to ensure a transparent and repeatable process for prioritizing restoration projects (Roni et al. 2013b).
Note: MCDA= Multi-criteria decision analysis

It should be noted that project prioritization often leads to a numerical ranking of projects. However, there are often only a few points difference between projects that are highest ranked. Typically in practice, and for the Lewis River HRP, ranking will be used to place projects or reaches in order of high priority (i.e., 10 highest scoring projects), medium priority, and low priority (Beechie et al. 2008; Roni et al. 2013b). While many restoration programs prioritize dozens or even hundreds of small projects (100 to 1000 m long), the HRP will be designed so that most restoration measures in a reach and associated EDTshed (drainage area) are packaged as one project or action. In cases of an equal ranking, NMFS and/or USFWS will have the final decision as to which project receives funding.

3.0 Implementation

3.1 Project Prioritization for Funding

Prioritization of restoration projects will occur at three points in the process leading to project construction: 1) definition of priority reaches, including field visits to confirm opportunities and constraints; 2) once site visits and preliminary restoration plans are outlined, the ACC will prioritize projects (reaches) for funding, and 3) scoring/prioritization of project bids/proposals submitted to the PA and decisions for funding.

As noted in Section 2, site visits to priority reaches are to confirm existing habitat, geomorphic, and hydraulic conditions and potential constraints to restoration. These surveys would result in specific restoration measures/actions, preliminary designs, and site maps prepared for each reach. Documentation would be similar to that prepared for the Lower Columbia Fish Recovery Board for the East Fork of the Lewis and Wind River, and the Colville Tribe for the Sanpoil (Timm and Roni 2018) (see Appendix 1 for excerpts from these submittals).

Following development of preliminary designs for target reaches, projects would be ranked and scored to allow development of RFPs. As noted in Section 2 (Table 2), this process would be conducted collaboratively by the PA, ACC, and TAC.

The ranking process used for the Merwin In Lieu Program will align closely with the Lower Columbia River Salmon and Steelhead ESA Recovery Plan (NMFS 2013) and will draw from similar approaches elsewhere in the region. The example below (Table 4) is from the Upper Columbia and Sanpoil Habitat Restoration Plan developed by the Colville Tribe (Timm and Roni 2018). Proposed projects were scored (1-5) in several categories, including:

- Restores process
- Site access and logistics
- Economics
- Cultural significance and socio-economics
- Ameliorates climate change

Relevant scoring criteria developed for use in other regional habitat programs can help inform a prioritization process for the Merwin In Lieu Program. Criteria include:

- Fit to Salmon Recovery Strategy
    - Alignment with recovery plan
- Certainty of Success
    - Scope and approach
    - Coordination, sequence of events, uncertainties
    - Qualifications, community support and stewardship
- Benefit to Fish

    - Target population and stream reach
    - Protection, access and restoration
- Cost and Benefit
    - Reasonable cost
    - Available match or in-kind contribution (not a requirement)

As noted in Section 2, while many restoration programs prioritize dozens or even hundreds of small projects, it is expected that RFPs issued for the Merwin In Lieu Program will be for project packages; for example, a series of restoration measures in a reach and associated EDTshed (drainage area). This would reduce costs of contractor mobilization/de-mobilization and allow prioritization to be conducted on either individual projects or on a reach basis.

Table 4. Example of scoring criteria from the Upper Columbia and Sanpoil Habitat Restoration Plan (Timm and Roni 2018).

	Score (1 to 5)				
Criterion	**1**	**2**	**3**	**4**	**5**
Restores processes (based on Roni et al. 2013b)	Restores neither processes nor habitat	Restores physical habitat	Restores 1 or 2 processes (connectivity, riparian, hydrology, sediment, floodplain)	Restores more than two processes	Restores process and habitat or protects fully functioning habitat
Site access and logistics	Helicopter only (no roads or staging)	No roads within 0.5 km of site, but staging area if equipment/ supplies/ LW brought in by helicopter	Roads within 0.5 km of site. No staging area.	Roads within 0.5 km of site. Good staging area.	Roads and staging area adjacent to site
Land ownership ≤ 100 m from reach	Private, reservation fee, or tribal allotment with unwilling landowner or more than 6 landowners	Public ownership or tribal trust uncooperative/ restricted or 5 to 6 landowners	Public ownership cooperative partner (Federal, State, County, City) or 3 or 4 different landowners	Private, reservation fee, tribal allotment, with willing owner/allottee or 1 or 2 different landowners	Tribal trust lands (entire site)
Cultural significance and socio-economics	Adverse effect to historic properties/ cultural properties with no mitigation	Adverse effect to historic properties/ cultural resources with mitigation	No adverse effect to historic properties, but adverse to cultural resources or vice versa, with mitigation	No adverse effect to historic properties or cultural resources	No effect and benefits to cultural resources (i.e., re-establishes first foods)

	Score (1 to 5)				
Criterion	**1**	**2**	**3**	**4**	**5**
Ameliorates climate change (based on Beechie et al. 2012)	No effect on low flow, peak flow, temperature, or redband trout resilience	Ameliorates climate effect on either peak flow, low flow, temperature, or redband trout resilience	Ameliorates climate effect on 2 of the following: peak flow, low flow, temperature, or redband trout resilience	Ameliorates climate effect on three of the following: peak flow, low flow, temperature, or redband trout resilience	Ameliorates climate effect on all of the following: peak flow, low flow, temperature, red-band trout resilience

A critical step in the scoring will be to determine whether criteria are given equal weight. Assuming relatively few criteria (five as in the above example), it's preferable that they be given equal weight, particularly because reaches have already been screened as highest priority under EDT modeling, and weighting would make scoring and ranking less transparent. Scoring can be done collectively at a meeting/workshop among participants noted above, or by each member of the team; these scores must then be combined or averaged to report the final result (Roni et al. 2013a). Inclusion of cultural or socioeconomic criteria may require support from specialists outside of the TAC or ACC.

3.2 RFP Process

The PA will develop RFPs for projects identified in the Final HRP. The PA will promote individual projects and the program as a whole through press releases and other media and community outreach. The PA will develop a Community Outreach plan to identify objectives, target audiences, and methods (i.e., presentations, media releases, website postings, site/project tours, etc.). These activities will help solicit matching resources to funding provided by the Utilities, leveraging Utility funds. Such matching values can then be used for habitat improvement grants or other funding elsewhere outside the upper Lewis River watershed (e.g., mainstem Columbia River).

Following issuance of the RFPs, the PA will coordinate follow-up activities, which may include:

- Pre-proposal meetings with PA staff
- Site visits with potential contractors
- Proposal presentations by short-listed applicants
- Development of comment matrices by TAC members and PA staff
- Evaluation of proposals

Given that reach-specific projects will be developed and ranked prior to issuance of RFPs, applicants will be bidding on final design and construction of pre-defined restoration measures, either individually or for a group of projects in a target reach. Consequently, project needs will have already been determined. Individual contractor project proposals will therefore be evaluated on criteria such as those in use by National Fish and Wildlife Foundation for restoration projects funded by PacifiCorp under the Klamath Coho Plan:

> ***Technical Merit.*** Objectives, approach, and scope of work are clear and technically sound and can be completed on schedule given reasonably foreseeable constraints (e.g., weather conditions, flows, operational conditions). The proposal is sufficient for reviewers to fully understand and evaluate the technical merits of the project (e.g., detailed project plans and designs).
>
> ***Cost.*** Total cost is reasonable based on costs of similar project types.
>
> ***Organization Qualifications.*** The project manager and other key personnel have experience and expertise required for the project, and individual roles and responsibilities are well defined and appropriate. The proposal demonstrates relevant field experience, completed projects, published reports, or other materials. Licensed professionals are identified for design, construction, or oversight of on-the-ground activities.
>
> ***Additional Project Scope and Funding.*** Project scope and benefit/value through assistance from other funding sources, such as matches from Federal, foundation, or private sources.
>
> ***Private Landowner Partnership, if applicable.*** Description of required partnerships with private landowners (if applicable) and provide documentation that the landowners are willing to provide access and agree to the work done on their property.

3.3 Permitting

This Plan assumes the contractor will be responsible for securing all project permits, with support as needed from the PA. The latter may include coordination of pre-application meetings, issuance of guidance materials along with RFPs, and response to questions from contractors during the project design phase.

Permits that may be required for projects constructed in Skamania County within or along tributaries to Swift reservoir are described below. Available streamlining processes for restoration projects are also described (Section 3.3.1).

Shoreline Permit. Under the State of Washington's Shoreline Management Act (RCW 90.58), Skamania County issues shoreline development permits for activities that occur along rivers, streams, and lakes.

Critical Areas Permit. Per the Washington State Growth Management Act (RCW 36.70A.030(5)), "critical areas" include a) wetlands; b) areas with a critical recharging effect on aquifers used for potable water; c) fish and wildlife habitat conservation areas; d) frequently flooded areas; and e) geologically hazardous areas. Skamania County has adopted a Critical Areas Ordinance to regulate activities in these areas.

Section 404 Permit. A permit under Section 404 of the Clean Water Act is required from the U.S. Army Corps of Engineers (USACE) to conduct any activity that might result in a discharge of dredge or fill material into water or non-isolated wetlands or excavation in water or non-isolated wetlands. Construction activities may be covered by the Corps Regional General Permit #8 for Aquatic Restoration, a streamlined permitting process that avoids the need for an individual permit (see below).

Section 401 Water Quality Certification. Issuance of a Section 404 permit triggers the need for a water quality certification under Section 401 of the Clean Water Act from the Washington State Department of Ecology (Ecology). Certification indicates that Ecology anticipates that the applicant's project will comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority.

Aquatic Resources Use Authorization Notification. The Washington State Department of Natural Resources requires a permit for use or occupancy of state-owned aquatic lands.

General Construction Stormwater Permit *(Ecology)*. Covers activities disturbing one or more acres (including grading, stump removal, demolition), and discharge of stormwater to a receiving water (e.g., wetlands, creeks, rivers).

Section 7 Endangered Species Act Consultation (NMFS/USFWS). ESA compliance for potential project impacts to Bull Trout, Lower Columbia River steelhead, or other listed anadromous fish species may be achieved through individual (project-specific) consultation, or under a programmatic take permit, either for the Merwin In Lieu Program as a whole or under the U.S. Army Corps of Engineers Regional General Permit #8 (see below). The goal is to have a single consultation on this program, and additional informal consultations if new information arises requiring consideration of affects not considered in the biological opinion(s).

The Merwin In Lieu Program and associated monitoring program will be evaluated during consultation between FERC and the Services. On June 6, 2019, the FERC designated the Utilities as non-federal representatives for the purposes of conducting informal consultation with the Services. The FERC, however, remains ultimately responsible for all findings and determinations regarding the effects of the project on any federally listed species or critical habitat.

Hydraulic Project Approval *(HPA, WA State Department of Fish and Wildlife [WDFW]).* RCW 77.55 requires that any person, organization, or government agency wishing to conduct any construction activity that will use, divert, obstruct, or change the bed or flow of state waters must do so under the terms of a permit issued by the WDFW.

SEPA Checklist. Under the State Environmental Policy Act (SEPA), local governments and state agencies use the SEPA checklist to determine whether impacts of a proposed project are likely to be significant, and whether an environmental impact statement (EIS) needs to be prepared for further analysis.

NEPA. For projects on the Gifford Pinchot National Forest, the US Forest Service will be the lead Federal agency for NEPA. It will be the responsibility of the Contractor to obtain services or dedicate appropriate resources to ensure NEPA compliance is completed as determined by the USFS and coordinated with the PA. NEPA compliance for habitat restoration is likely to meet the criteria for a streamlined Categorical Exclusion.

With the exception of the stand-alone SEPA checklist and NEPA documentation, applications for all of the above permits may be submitted through the single Joint Aquatic Resources Permit Application (JARPA).

3.3.1 Streamlined Permits

Streamlined permitting processes are available at both state and federal levels that are designed to reduce both application requirements and agency review time. Currently available streamlining processes are summarized below.

Exemption for Washington State Fish Habitat Improvement Projects. Under RCW 77.55.181, an applicant may qualify for a streamlined permit process with no local government fees if the project is designed to enhance fish habitat. Qualifying applicants are entitled to a streamlined HPA process, exemption from SEPA, and exemption from all local government permits and fees. A completed application package must be sent concurrently to WDFW and applicable local government planning and permitting departments. Local governments have 15 days to provide comments to WDFW regarding whether the project(s) qualifies.

Projects must involve at least one of the objectives below and have a letter of approval from WDFW or other approved state or local agency.

- Fish passage barrier removal (human caused)
- Streambank restoration using bioengineering techniques
- Woody debris placement or other in-stream structures that benefit naturally reproducing fish stocks

Application for the exemption is made through the JARPA process and is submitted to WDFW and the local agency (likely Skamania County).

US Army Corps of Engineers (USACE) Regional General Permit 8 – U.S. Forest Service Region 6 Aquatic Restoration Program Within the State of WA. The USACE Regional General Permit (RGP) 8 authorizes 11 restoration activities in waters of the U.S. designed to maintain, enhance, and restore watershed functions that affect aquatic species. It is anticipated that work to be conducted under the Merwin In Lieu Program can be authorized under this RGP, which includes activities below as well as others:

- Fish passage restoration
- Large wood, boulder, and gravel placement
- Channel reconstruction/relocation
- Off- and side-channel habitat
- Streambank restoration

RGP-8 covers actions that occur on Forest Service lands as well as non-Forest Service lands when the action is located immediately adjacent to a National Forest Unit and the project helps to achieve USFS aquatic restoration goals. RGP-8 provides coverage under both the ESA and the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The Biological Opinions (BO) prepared by the NMFS dated April 25, 2013, and the USFWS dated July 1, 2013 cover all actions that could be implemented under the Merwin In Lieu Program. Associated mandatory terms and conditions apply to in-water work, work area isolation, equipment operation, and bank/vegetation disturbance. Activities meeting the criteria for RGP-8 are covered by a Section 401 water quality certification issued by Ecology on February 21, 2017.

As described in the RGP, reporting is the responsibility of the USFS and involves annual reports as well as a review meeting with the Corps and Ecology to discuss the annual monitoring report, conduct site visits, and collectively determine if RGP objectives are being met. Applicants will need to confirm applicability of RGP-8 with the PA.

3.4 Reporting and Milestones

Contractors selected to construct projects funded under the Merwin In Lieu Program will be required to provide progress reports during construction, including information on dewatering and fish relocation. If federally listed salmon are encountered or taken during construction, the Contractor will notify the PA and provide a report identifying the total number of any salmon captured, relocated, injured, and killed for each restoration project, or group of projects that the Contractor is involved in. Retention of salmon mortalities must be in accordance with agency requirements, until specific instructions are provided by the PA in consultation with the Services.

Any fuel spills during construction, regardless of quantity, will require immediate reporting to both the PA and Merwin Hydro Control Center. Other reporting requirements and associated milestones will be clearly stated in contract bid documents. These will include progress reports at Draft and Final Design, and monthly reports submitted with invoices to the PA.

Annual reporting of completed restoration actions and of implementation and effectiveness monitoring will provide critical information for adaptive management of the Merwin In Lieu Program and the HRP.

3.5 Adaptive Management

A number of steps will be used to help adaptively manage the Merwin In Lieu Program. First, pace and cost of restoration should be used to revisit priorities annually. Second, results of restoration implementation monitoring should be used to modify specific project designs to incorporate lessons learned to maximize project physical and biological effectiveness. In addition, these results should help indicate the type of restoration actions that are most effective and can be used to fine tune restoration funding priorities. Third, there are many other ongoing restoration efforts and effectiveness monitoring programs elsewhere in the region (e.g., Sanpoil noted above, Columbia River Basin and Salmon Recovery Funding Board effectiveness monitoring). Results of this monitoring should also be considered in fine tuning restoration priorities and designs.

Methods and reporting with regard to project effectiveness are described in the Lewis River Basin Implementation Monitoring Plan. Monitoring results will be presented annually to the ACC and, if necessary, the criteria for prioritization revisited, and remaining restoration projects reprioritized. As needed, changes made in terms of project type or location will be reflected in new RFPs.

3.6 Preparers

Mike Bonoff
Meridian Environmental, Inc.
Senior Aquatic Scientist
mbonoff@meridianenv.com
(503) 888-7264

Phil Roni, Ph.D.
Cramer Fish Sciences
Principal Scientist
Watershed Sciences Lab
phil.roni@fishsciences.net
(206) 612-6560

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Appendices

Appendix 1. Examples of refined restoration measures and restoration plans based on site visits.

A.1 Example from Sanpoil River

Project Name: Upper Columbia and Sanpoil Restoration **Project Rank 22**

Reach Name: Sanpoil 4C

Figure B-54. Overview of Sanpoil 4C reach. This mainstem reach meanders across the valley floor between State Highway 21 on the west side, and East Sanpoil Road on the eastern side of the valley.

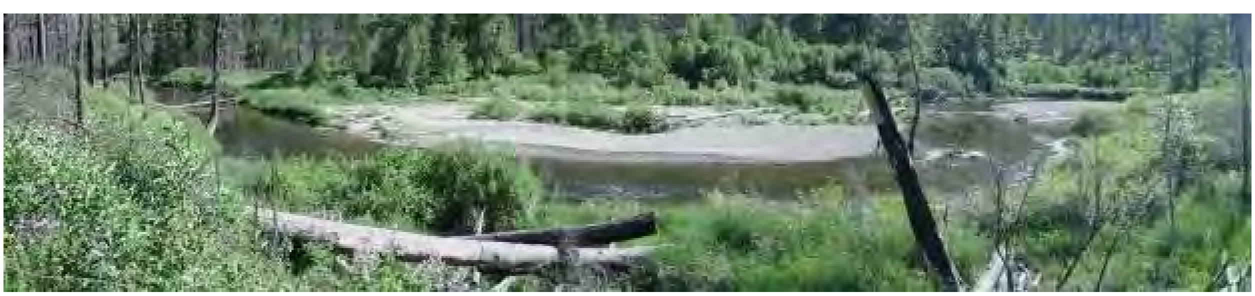


Figure B-55. Representative habitat quality of Sanpoil 4C reach. Lots of gravel and LW interactions are apparent as the river meanders across the valley floor.

Location and Site Description: Sanpoil 4C drains approximately 15 km^2 and flows approximately 43 km down to the confluence with the Columbia River. The priority reach is approximately 5,350 m long. It is characterized predominantly by meandering channel morphology (Figure B-54). Bankfull width is approximately 20 m, with a floodplain width of approximately 360 m. Average channel gradient varies with channel type and ranges between approximately 1% and 3%. There is no human infrastructure in the reach aside from the roads that run along both sides of the valley. Habitat quality is generally very high in this reach (Figure B-55). This is in large part due to the massive sediment load being processed in this reach due to the April 2017 flood. Suggestions for restoration in this reach are limited to strategic ELJs that would keep the river away from the State Highway 21 road prism and encourage floodplain habitat engagement on the east side of the river.

Revised Restoration:

Protection, possible ELJs.

Preliminary Restoration Assessment:

LW, riparian restoration, floodplain reconnection, upland forest restoration.

Special Considerations:

There is excellent access and staging at the top of the reach from either side of the river. Large wetlands adjacent to the channel make direct access to the channel less certain elsewhere in the reach. Land ownership has not been verified.

Species and Life Stage Benefit:

Holding habitat for pre-spawn adult fish, spawning, and egg incubation.

Prioritization Criteria Addressed

- Protects fully functioning habitat and restored floodplain processes.
- Access and staging are excellent at the top of the reach, but less certain downstream.
- Land ownership is unknown.
- Relatively high Culturally Significant Resources scores.
- There may be some limited Climate Change Amelioration benefits to this project, depending upon the extent of ELJ placement.

Data Gaps/ Needs:

Specific landowner information and willingness to participate in livestock fencing and riparian plantings needs to be gathered.

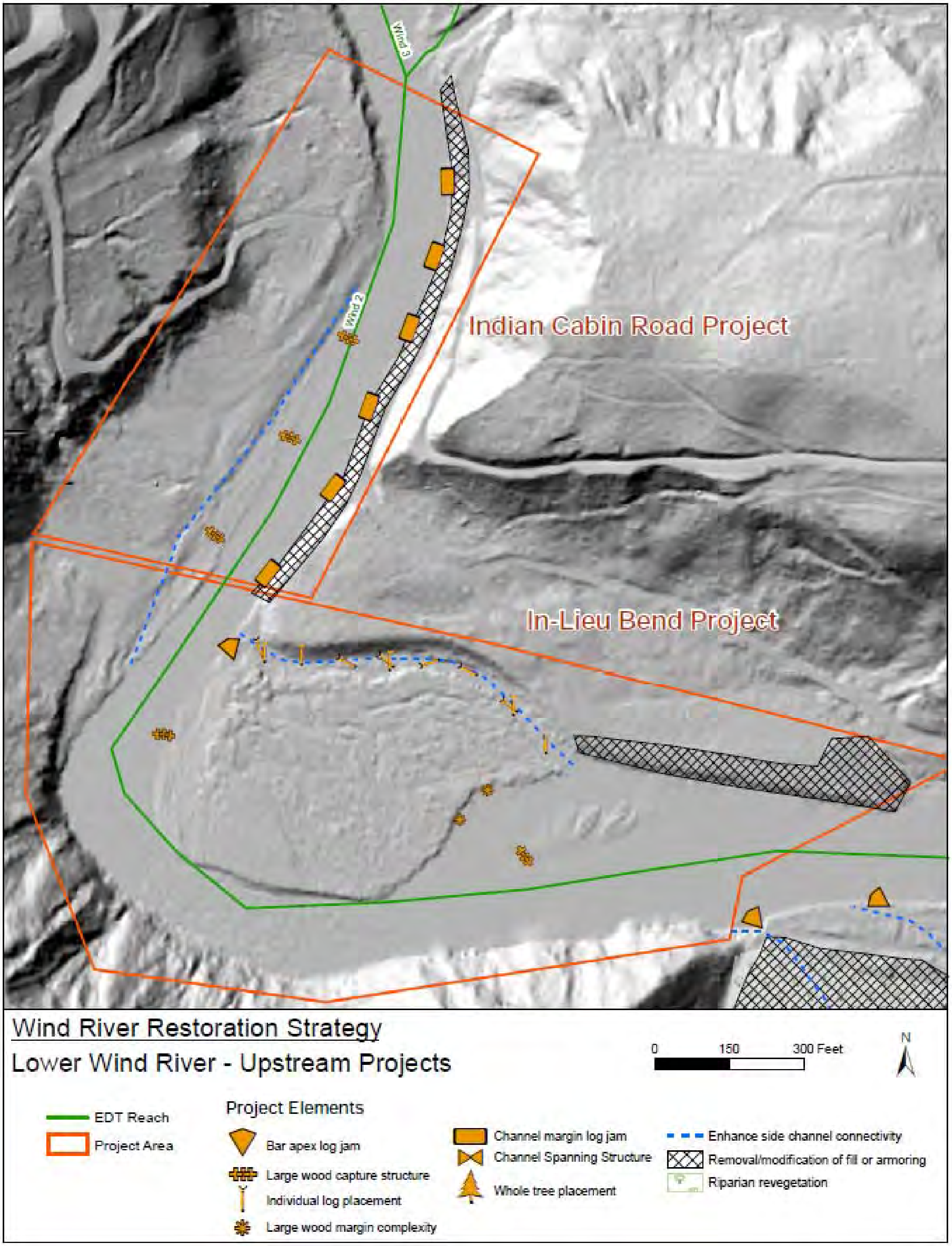
A.2 Example from Wind River Restoration Plan

Project Name: In Lieu Bend **Project ID**: W3

Site Description:
This site is on a bend in the river. The inside of the bend contains side-channel scars and a backwater area at the downstream end. There is a large wood jam at the upstream end of the side-channel scar complex.

Project Description:
Could reposition the wood in the jam, and use select excavation, to increase activation of the side channel. Could also redistribute wood into mainstem jams or into the existing backwater area downstream. Could add wood to mainstem channel margins and to the apex of the mid-channel island downstream. Work with tribes to enhance riparian conditions and margin habitat at the In lieu fishing area.

Special Considerations:
It is important to avoid any main channel work that would increase erosion of the high and erodible right bank. In lieu fishing uses will need to be considered.



Wind 3
Wind 2
Indian Cabin Road Project
In-Lieu Bend Project
Wind River Restoration Strategy
Lower Wind River - Upstream Projects
0
150
300 Feet
N
EDT Reach
Project Area
Project Elements
Bar apex log jam
Large wood capture structure
Individual log placement
Large wood margin complexity
Channel margin log jam
Channel Spanning Structure
Whole tree placement
Enhance side channel connectivity
Removal/modification of fill or armoring
Riparian revegetation

A.3 Example from East Fork of the Lewis

East Fork Lewis River Restoration Plan

Project Name: Off-channel Restoration **Project ID:** EF 05

Reach Name: EF Lewis 8B **River Mile:** 14

Site Description:
This site is located on Boy Scouts property. There is a small tributary that enters the mainstem on the river left bank that contains cool water input during the summer. Temperatures in the tributary were 10ºF cooler than the mainstem at the time of the survey. There is good adjacent spawning in the mainstem. Site observations and temperatures suggest suitable groundwater connectivity for an off-channel project.

Project Description:
Create an off-channel area connected to the mainstem at low summer flows that is sourced by hyporheic flow and flow from the small perennial tributary. Enhance the quantity and quality of habitat features including bank complexity and cover and instream woody debris. At least one low-flow season of groundwater monitoring is recommended as part of design. Dissolved oxygen and mineral content should be monitored.

Special Considerations:
Private land (Boy Scouts of America). No project will be conducted at this site without full landowner willingness. Any potential landowner concerns, such as erosion, flooding, or safety considerations should be addressed as specific design criteria.

Major Life Stages Addressed:
Coho – fry colonization, juvenile rearing
Fall Chinook – fry colonization
Steelhead – juvenile rearing

Limiting Factors Addressed:
Habitat diversity, key habitat quantity, temperature

Data Gaps / Needs:
Should measure dissolved oxygen

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LEWIS RIVER BASIN IMPLEMENTATION MONITORING PLAN

For Habitat Restoration in Lieu of Fish Passage

January 2020

Prepared for:

PacifiCorp

825 N.E. Multnomah Street, Suite 1800

Portland, OR 97232

&

Public Utility District No. 1 of Cowlitz County

961 12th Ave

Longview, WA 98632

Prepared by:

CRAMER FISH SCIENCES

An Employee Owned Consulting Company

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1.0 Introduction

PacifiCorp and the Public Utility District No. 1 of Cowlitz County ("Cowlitz PUD", together with PacifiCorp, the "Utilities") own and operate the four Lewis River Hydroelectric Projects (the "Projects") located on the North Fork of the Lewis River in Cowlitz, Clark, and Skamania Counties, Washington. The Federal Energy Regulatory Commission ("FERC") licenses the four Projects separately. The Merwin (Project No.935), Yale (Project No. 2071), and Swift No.1 (Project No. 2111) Projects are owned and operated by PacifiCorp. The Swift No. 2 Project (Project No. 2213) is owned by Cowlitz PUD and operated in coordination with the other Projects by PacifiCorp.

On June 26, 2008, FERC issued new licenses for the Projects. During the relicensing process, the Utilities entered into a comprehensive settlement agreement with the Services, Tribes and other stakeholders (the "Settlement Agreement"). The Settlement Agreement includes fish passage requirements for each project that were incorporated into the Project licenses as fishway prescriptions under Section 18 of the Federal Power Act. The Settlement Agreement also includes a provision that allows the Utilities to present new information to the Services regarding whether the construction of the fish passage facilities is appropriate. In the event that the Services determine, after review of such new information, that fish passage is inappropriate, PacifiCorp is required to create an "In Lieu Fund" to support habitat restoration and the Utilities are required to construct certain facilities for bull trout passage.

The Utilities provided new information regarding the appropriateness of fish passage at the Projects to the Services on June 24, 2016. The Services responded on April 11 and 12, 2019 providing the Utilities with a preliminary determination under Section 4.1.9 of the Settlement Agreement. Specifically, NMFS proposed and USFWS concurred in the following actions:

1) To forego construction of the Merwin Downstream Facility (Section 4.6 of the Settlement Agreement) and the Yale Upstream Facility (Section 4.7);

2) To require PacifiCorp to establish the In Lieu Fund consistent with the requirements of Section 7.6 of the Settlement Agreement; and

3) To defer a decision whether to construct the Yale Downstream Facility (Section 4.5) and the Swift Upstream Facility (Section 4.8) until 2031 and 2035, respectively, so that performance of in lieu habitat restoration could be considered in that future decision.

The Services directed that restoration efforts supported by the In Lieu Fund (the "In Lieu Program") focus on stream reaches upstream of the Swift reservoir that benefit three salmon species listed under the Endangered Species Act (ESA): (coho salmon *Oncorhynchus kisutch*, winter steelhead *O. mykiss*, and spring Chinook salmon *O. tshawytscha*). The Services identified the following reaches known to support all three species since reintroduction efforts began in 2012:

- Clearwater River (8.37 kilometers [km])
- Clear Creek (22.96 km)
- North Fork of the Lewis River (22.69 km)
- Drift Creek (1.52 km)

In addition, the USFWS, in an April 12, 2019, letter, directed the Utilities to proceed immediately with the development of the following fish passage measures for bull trout *Salvelinus confluentus* pursuant to Section 4.10 of the Settlement Agreement:

- Yale Downstream Bull Trout Passage Facility
- Swift Upstream Bull Trout Passage Facility
- Yale Upstream Bull Trout Passage Facility

USFWS elected to defer a decision on whether to require construction of the Merwin Downstream Bull Trout Passage Facility to evaluate whether bull trout have increased sufficiently in number in the Merwin reservoir to warrant construction. A determination by the USFWS regarding the Merwin Downstream Bull Trout Passage Facility is not due before 2025.

Several additional steps are required before this Plan becomes operative. First, the Utilities will apply for non-capacity license amendments for the Projects. Second, the Services must make a final determination under Section 4.1.9 of the Settlement Agreement regarding the appropriateness of reintroduction or fish passage into Lake Merwin and Yale Lake and will do so as part of the Projects' license amendment processes. If the Services' final determination affirms its preliminary determination from April 2019, PacifiCorp will be required (a) to pursue habitat restoration funding in lieu of construction and operation of anadromous fish passage facilities into and out of Lake Merwin and (b) to proceed with alternative bull trout passage facilities as required by Section 4.10 of the Settlement Agreement. Similarly, if the Services' final determination affirms its preliminary one, the Services will defer a decision to construct anadromous fish passage facilities into and out of Yale Lake. Third, the Services must submit to FERC, as part of the Projects' license amendment processes, corresponding revisions to their Federal Power Act section 18 fishway prescriptions; if FERC approves the Utilities' non-capacity amendment applications, those revised fishway prescriptions must be incorporated into the amended licenses. Accordingly, after the Services make a final determination and FERC acts on the requested license amendments to comport with that determination, the Utilities will then execute the requirements of its licenses for the Projects as amended by FERC, including through operation of this Plan.

This Monitoring Plan has been developed to evaluate the performance of the Merwin In Lieu Program including those habitat enhancement projects the Merwin In Lieu Program will select and is expected to install over the next 5 to 8 years. This is in addition to other ongoing monitoring being conducted to comply with the Projects' FERC licenses and the Lewis River Settlement Agreement, including monitoring adult returns, smolts, and their survival (PacifiCorp and Cowlitz PUD 2017). The actions of this Monitoring Plan are to be conducted in a timely manner. Monitoring results can be used for three major purposes: 1) adaptive management during the implementation of the Merwin In Lieu Program, 2) determine if the Merwin In Lieu Program has improved habitat conditions enough to produce increases in salmon and steelhead estimated by the EDT model, and 3) to inform the Services decision on Yale Downstream and Swift Upstream Facilities in 2031 and 2035, respectively. Given the overlap of many objectives of the ongoing Lewis River Monitoring & Evaluation (M&E) program, monitoring of the Merwin In Lieu Program will be closely coordinated with existing monitoring efforts to gain efficiencies, ensure consistency of methods, and minimize costs.

An important component of any large river restoration program is project and reach-scale monitoring of completed restoration actions to determine whether restoration projects 1) were built as originally designed, and 2) produced the desired improvements in physical habitat (form and function). These are commonly referred to as implementation and effectiveness monitoring, respectively. If feasible, validation monitoring—assessing whether the changes in physical habitat are producing desired biological results and objectives (e.g., producing more juvenile or adult fish) — can also be an important third component (MacDonald et al. 1991; Roni 2005). In addition, other types of ongoing monitoring, such as status and trend monitoring (e.g., water quality monitoring, spawner surveys, smolt trapping) can provide supplemental information that can help inform design and findings of effectiveness and validation monitoring (Table 1).

Table 1. Types of monitoring, objectives, and examples targeting fish habitat restoration (adapted from MacDonald et al. 1991; Roni 2005).

Monitoring types (other names)	Objectives	Examples
Baseline	Characterizes existing biota, chemical, or physical conditions for planning or future comparisons	Fish presence, absence, or distribution
Status	Characterizes the condition (spatial variability) of physical or biological attributes across a given area	Abundance of fish at time *x* in a watershed
Trend	Determines changes in biota or conditions over time	Spawner surveys and temporal trends in abundance
Implementation (administrative, compliance)	Determines if project was implemented as planned	Did contractor place number and size of logs as described in plan?

Effectiveness	Determines if actions had desired effects on watershed, physical processes, or habitat	Did pool area increase?
Validation (research, sometimes considered part of effectiveness)	Evaluates whether the hypothesized cause and effect relationships between restoration action and response (physical or biological) were correct	Did change in pool area lead to desired change in fish or biota abundance or productivity?

Evaluating the success of individual river restoration actions such as instream structure placement or livestock exclusion has a long history (e.g., Shetter et al. 1949; Hunt 1976; Cederholm et al. 1997; Roni et al. 2015); whereas basin-wide monitoring has been less frequently attempted (Weber et al 2018; Roni et al 2018). Recent publications reviewing both individual and programmatic evaluations provide guidelines and recommendations for design and implementation to help ensure success of monitoring programs for large scale restoration as intended by the Merwin In Lieu Program (Weber et al. 2018; Roni et al. 2013; Roni et al. 2018). In addition, other publications have outlined the key steps for designing effective implementation and effectiveness monitoring (e.g., Roni et al. 2005, 2013; 2018). These steps include defining goals and objectives, the scale of monitoring and inference, the appropriate design and replication, monitoring parameters and sampling scheme, and implementation and reporting (Figure 1).

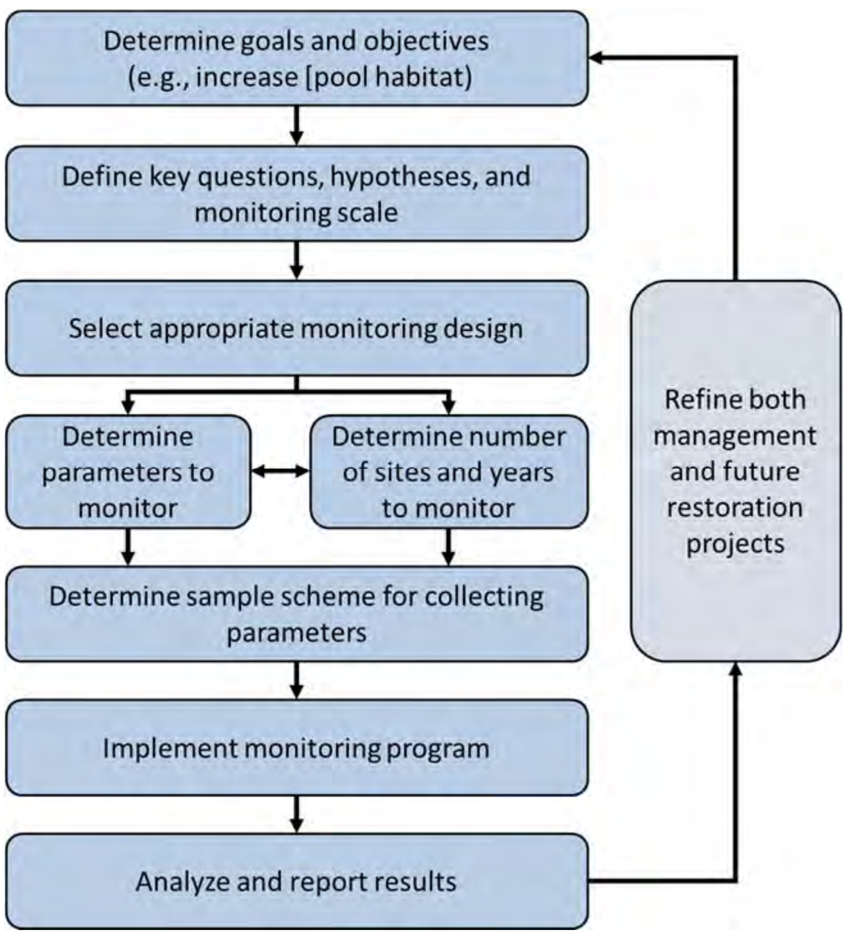

Figure 1. Steps for designing a successful monitoring program to evaluate restoration success (Roni et al. 2015).

This document outlines the monitoring plan for the Merwin In Lieu Program, including detailed information on each step identified in Figure 1. In addition, we describe expected outcomes, and next steps. We focus on implementation and effectiveness monitoring of restoration actions at the project and reach scale[1]. Biological monitoring is also possible for some restoration action types to determine localized changes in reach-scale abundance of juvenile salmonids (parr) related to floodplain restoration (side channel creation or reconnection) and large wood placement—two restoration techniques expected to be widely used in the Merwin In Lieu Program. Therefore, we also describe supplemental biological monitoring that will be conducted to evaluate reach-scale salmon and steelhead parr responses in late summer and winter. Summer and winter parr rearing habitat are thought to be limiting production of all three species above Swift Dam (PacifiCorp 2016), though additional habitat surveys are needed to accurately quantify the total amount of rearing habitat. Determining population level (watershed) responses of spring Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch*, and winter steelhead *O. mykiss* adults and smolts is equally important, but more challenging given the relatively short timeframe provided to evaluate performance of enhancement actions. However, we also describe approaches for monitoring population level response to the In Lieu Program upstream of Swift Dam and the preferred population level monitoring approach we will implement. Because the exact restoration locations have not been determined, we provide a framework for physical and biological monitoring with the understanding that some specifics will need to be modified once final restoration locations and designs have been determined.

1.1 Habitat Restoration Goals and Monitoring Objectives

The goals and objectives of the monitoring program must be based on the overarching goal of the Merwin In Lieu Program, to increase adult Chinook salmon, coho salmon, and winter steelhead abundance in the North Fork of the Lewis River. That goal is consistent with the "Reintroduction Outcome Goal" of the Lewis River Settlement Agreement "… to achieve genetically viable, self-sustaining, naturally reproducing, harvestable populations above Merwin Dam greater than minimum viable populations."

In their April 11 and 12, 2019 letters to PacifiCorp and Cowlitz County PUD (the Utilities), the Services issued a preliminary decision to defer a decision on completion of Yale downstream and Swift upstream passage facilities to 2031 and 2035, respectively, stating that this decision "would ensure that habitat restoration funding used in lieu of passage facilities in Lake Merwin perform

[1] In this context, a project refers to the localized area where site-specific restoration takes place (typically 500 m to a few kilometers), while a reach typically covers from a few to tens of kilometers.

as proposed within the new information submitted…”. Therefore, an additional goal with respect to the schedule is to provide results on restoration effectiveness by 2031 or sooner. If one assumes that the earliest restoration might occur is 2022, and that most restoration would not occur until 2025, monitoring should be designed to detect a physical response to restoration within three to five years of restoration project construction.

Assessments including ecosystem diagnosis and treatment (EDT) and a limiting factors analysis, along with a review of existing habitat, sediment, riparian, and other data, were used to identify initial restoration opportunities within the Lewis River Basin for reaches with the highest potential to increase adult salmon and steelhead abundance (Table 2; Appendix D in PacifiCorp 2016). In addition, in their determination of fish passage feasibility and recommendation to implement the Merwin In Lieu Program, NMFS identified four streams upstream of Swift Dam where restoration should occur (Clear Creek, Clearwater Creek, Drift Creek, and the mainstem North Fork of the Lewis River) (Table 2;Figure 2). The next steps are to 1) revisit reaches in Table 2 and NMFS' recommended tributaries to determine priority areas for restoration, and 2) do detailed site visits of each of the reaches to confirm project feasibility and develop preliminary designs. Table 2 provides a list of the type of actions that would occur in the priority reaches. Moreover, this list can be used to develop the goals and questions for the monitoring program.

As indicated in the Merwin In Lieu Program Strategic Plan and Table 2 below, there are four potential types of restoration actions across multiple reaches and locations including:

1. Floodplain restoration to create and reconnect side channels
2. Large wood (LW) placement to increase pools, habitat complexity, and fish cover
3. Riparian planting to increase shade and delivery of organic material (leaf litter, wood)
4. Road removal or restoration to reduce instream sediment (including culvert removal)

Large wood placement and floodplain restoration (reconnection or construction of side channels) will be the two most common restoration actions. They are also the two actions for which monitoring can address some key biological questions in a reasonable time frame (i.e., less than 10 years). Riparian planting will be conducted as part of some LW or floodplain restoration projects and road restoration likely limited to a few tributary areas. These actions largely focus on improving and increasing quality of juvenile rearing habitat though they will also enhance spawning and rearing habitat quality. They are consistent with the limiting factors analysis which indicated that there was adequate spawning habitat upstream of Swift Dam, and that amount, or quality of summer and winter rearing habitat were limiting Chinook, coho, and steelhead production. Thus, gravel addition or other methods of improving or increasing amount of spawning habitat are not proposed above Swift Dam.

The objectives of this monitoring plan are three fold:

1) to develop an approach to determine whether restoration projects were built as intended and have met their design and physical habitat objectives, both at the project level and reach scale;

2) to determine reach-scale response of juvenile salmonids to habitat restoration actions and population-level response of smolts and adults to all habitat improvement actions above Swift Dam; and

3) to determine if restoration has improved habitat conditions enough to produce increases in salmon and steelhead estimated by the EDT model.

Ultimately, the results of the monitoring will be used to adaptively manage the In Lieu Program and inform the decision on Yale Downstream and Swift Upstream Facilities in 2031 and 2035.

Table 2. Initial recommendations for restoration measures and rationale for selecting specific measures for priority EDT reaches upstream of Swift Dam. Reaches highlighted as a priority for the In Lieu Fund by NMFS are denoted. Lewis 18, 19, and 21 were both priority EDT and NMFS priority reaches. Modified from Appendix D in PacifiCorp 2016. Additional reaches may be considered in the final strategic plan.

Reach	Restoration Measure Initially Recommended	Rational for selecting restoration measure
Lewis 18 (NMFS)	LW	Low LW and percent pool
Lewis 19 (NMFS)	LW, side channels	Low LW, percent pool and channel type
Lewis 20 (NMFS)	To be determined	
Lewis 21 (NMFS)	LW, road removal or restoration	Low percent pool, LW, high sediment yield
Lewis 22 (NMFS)	To be determined	
Lewis 23 (NMFS)	To be determined	
Drift Creek (NMFS)	To be determined	
Muddy R 1	Side channels, LW	Low LW scores, and island braided channel type
Clear Creek Lower (NMFS)	To be determined	
Clearwater Creek (NMFS)	To be determined	
Clearwater Tributaries	NA (high levels of fines appears to be due to headwaters in blast zone of Mt. St. Helens.	Mt. St. Helens blast zone appears to be source of sediment
Rush Creek	Protection (steep channel)	Steep channel
Little Creek	LW	Poor LW and pool area
Spencer Creek	LW	Poor LW and pool area
Crab Creek	LW	Poor LW and pool area

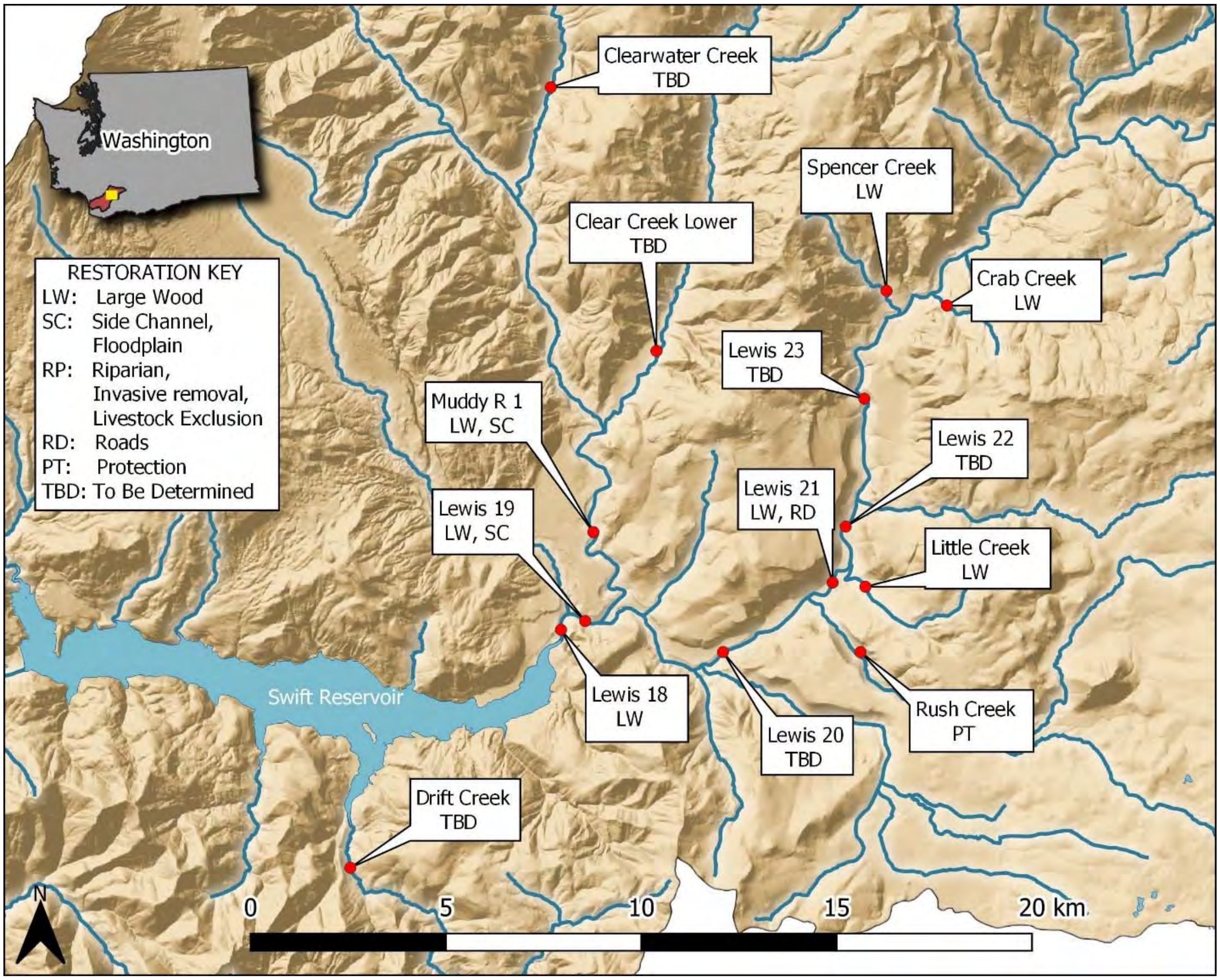

Figure 2. Map of the North Fork of the Lewis River upstream of Swift Dam showing initial priority EDT reaches and recommended restoration measures (PacifiCorp 2016). Reaches with TBD were identified by NMFS as a priority for the In Lieu Program and preliminary restoration measures still need to be identified.

1.2 Key Questions and Scale

Based on the initial list of reaches and restoration actions and the goals and objectives of the Merwin In Lieu Program, we defined the following questions to be answered by the monitoring program for each of the restoration actions:

Large wood and floodplain projects

1. Was each project implemented as originally designed and if not, why? [project-scale question] (Implementation Monitoring)

2. Did each project have the desired physical response within the target time frame, e.g., 3-5 years post-treatment? [project-scale question] (Effectiveness Monitoring)

3. Is the suite of projects implemented across a reach (~2 to 10 kilometers in length) leading to desired improvements in physical habitat (pool and side channel area) across response reaches? [reach-scale question] (Effectiveness Monitoring)

4. For LW and floodplain restoration projects, has the number of juvenile fish increased in restored vs. unrestored reaches in summer or winter? (Validation Monitoring)

Road removal or restoration projects

1. Was each project implemented as originally designed and if not, why? [project-scale question] (Implementation Monitoring)?

2. Have fine sediment levels, fine sediment infiltration, residual pool depth, and scour improved in downstream response reaches 3, 5, 7 or 10 years after road removal?

Riparian planting projects

1. Is the number, location, and species of plantings consistent with the proposal and planting plan? If not, why?

2. What is the planting survival rate in year 3, 5 and 7?

3. Has riparian cover, structure, and shade improved since project implementation?

Population level response to all projects

1. Has restoration of habitat under the In Lieu Program resulted in a statistically significant increase in the numbers of smolts produced, the number of successful spawners (number of breeders), and smolts per spawner, for salmon and steelhead in the Swift Basin? (Validation Monitoring)

2. Has restoration led to improvements in habitat to support juveniles and adults at levels predicted by EDT model?

1.3 Monitoring Design and Replication

Basic monitoring designs that have been successfully used for programmatic evaluation of restoration typically use before-after (BA), before-after control-impact (BACI), and extensive post-treatment (EPT) experimental designs (Table 3.).

Table 3. Description of major approaches for monitoring and evaluating the effectiveness of regional restoration programs and the experimental designs they use. Modified from Roni et al. 2018.

Monitoring approach or design	Experimental design(s)	Description
Multiple Before-After Control-Impact (mBACI)	BA or BACI	Evaluation of multiple-projects using a before-after or before-after control-impact and standardized data collection methods so the data are analyzed collectively rather than by individual projects. Thus, including multiple treatment (impact) and control reaches or watersheds.
Extensive Post-treatment (EPT)	EPT (of treatment and control site)	Evaluation of multiple projects post-treatment (after restoration has occurred) using paired-treatment (restored) and control reaches and standardized data collection methods.
Intensively Monitored Watershed (IMW)	Various, most often BACI or BA	Evaluation of restoration efforts (cumulative effects of multiple projects or effects of large-scale projects) throughout a watershed, using standardized data collection methods, to determine the wider response of biota and physical habitat.
Hybrid	Combination of BACI, BA, or EPT	Use of any combination of the approaches to evaluate effectiveness of restoration projects or techniques. A combination of designs (BACI or BA and EPT) can also be used to monitor different indicators within the same project.

Each approach and design has its strengths and weaknesses (Table 4). However, a recent global review of approaches for evaluating entire restoration programs recommended a hybrid approach that uses a combination of a BACI or BA design and an EPT design as most appropriate depending upon the restoration actions and what type of physical and biological metrics are to be measured (Roni et al. 2018). Based on this review, and experience with the Salmon Recovery Funding Boards Project Effectiveness Monitoring Program (SRFB PE) and Bonneville Power Administration's Action Effectiveness Monitoring (AEM) Program, this Plan recommends monitoring physical response to LW and floodplain restoration using a simple BACI design, monitoring of riparian planting (if it occurs) and road removal using a BA design, and monitoring of reach-scale juvenile fish abundance to LW and floodplain projects using an EPT design (Table 5). As we discuss in detail in the population level monitoring section, because of lack of a suitable control basin, population level monitoring will use a BA design.

Table 4. Attributes of different approaches for evaluating effectiveness of regional restoration programs. Modified from Roni et al. (2018).

Attribute	Multiple before-after control-impact (mBACI)	Extensive post-treatment (EPT)	Intensively monitored watershed (IMW)	Hybrid
Can examine interannual variation in response?	Yes	No	Yes	Yes
Provides info on why some projects are more effective than others?	Yes	Yes	No	Yes
Results are broadly applicable?	Yes	Yes	No	Yes
Requires standardized data collection?	Yes	Yes	Yes	Yes
Length of monitoring (years)	5+	1-3	15+	3+
Cost (low, medium, or high)	H	M	H	M
Level (scale) of inference	Project & Program	Program	Program	Program

Table 5. Recommended monitoring designs for each restoration type. Year -1 refers to baseline monitoring one year before actual on the ground restoration, and Year 1 refers to monitoring one year after restoration.

Restoration type	Question	Design	Years	Sites
Large wood	Implementation	BA	-1, 1	All (10+)
	Effectiveness	BACI	-1, 3, 5	All (10+)
	Validation	EPT	5	All (10+)
Floodplain	Implementation	BA	-1, 1	All (10+)
	Effectiveness	BACI	-1, 3, 5	All (10+)
	Validation	EPT	5	All (10+)
Road removal	Implementation	BA	-1, 1	All
	Effectiveness	BA	-2, -1, 3, 5, 10	All
Riparian planting	Implementation	BA	-1,1	All
	Effectiveness	BA	-1,3, 5, 7, 10	All
Population monitoring	Validation	BA	3 to 5 before, 10 or more after	All

1.3.1 Reach-Scale Approach

Implementation monitoring will occur before and after restoration at the project (site) scale (specific location of restoration). If the restoration occurs in late summer, it is possible that the before-monitoring could occur in the same calendar year as the actual restoration. However, in many cases, due to the timing of actual on the ground restoration, pre-project monitoring would likely occur one year before on the ground restoration. Moreover, collecting baseline site and reach scale data 1 year before project implementation will provide important data necessary for project design while providing important base-line data on topography, elevation, channel form, and other data needed to evaluate project success. Temporal replication or a control site is not needed for implementation monitoring because it is largely focusing on assuring projects were constructed as designed. As such, it is sometimes referred to as compliance monitoring.

Physical effectiveness monitoring will use a BACI design, occur at the reach-scale, and monitor treatment and control reaches before and after restoration. When BA or BACI designs are used to monitor reach-scale biological changes (e.g., fish, macroinvertebrates), two or more years of pre-project monitoring and several years of post-project monitoring are needed to detect changes in biota[2]. However, for physical habitat metrics (e.g., pool area, depth, fine sediment levels) monitored as part of LW and floodplain restoration projects, interannual variability is much lower, and one year of pre-project monitoring is sufficient to quantify pre-project conditions. Similarly, monitoring of riparian restoration can be done with one year of pre-project monitoring. Road removal or restoration projects, which target reducing fine sediment and, in some cases, scour require at least two years of pre-project monitoring due to interannual variation in scour and fine sediment infiltration. Currently riparian restoration measures are not proposed for any of the priority EDT reaches identified above Swift Dam. However, we provide monitoring design and methods for riparian projects should they be identified as a restoration measures needed for some priority reaches when the In Lieu Program is finalized. Moreover, it is possible that riparian planting will occur as part of some floodplain restoration projects.

Another key component of the monitoring design is the total number of projects that will be monitored. Given the list of priority reaches, the number of projects implemented may be relatively low (e.g., < 25) and require monitoring of all projects rather than a random sample. The multiple BACI (mBACI) design used for effectiveness monitoring of floodplain and LW projects will provide information on individual projects before and after and can be rolled up for multiple projects (Roni et al. 2018). Studies that have used an mBACI design have often monitored less than a dozen projects (Baldigo et al. 2008; Roni et al. 2018). Given the need for information on physical effectiveness of individual projects and all projects combined, and the number of projects to be implemented, all floodplain and LW projects implemented as part of the Merwin In Lieu Program will be evaluated using an mBACI design.

[2] Note population monitoring of smolts and successful spawning adults using a BA or BACI design will require 3 or more years of pre-project data, this is discussed in detail in the Population Level Approach section.

Assessing whether changes in physical habitat are producing the desired biological results – validation monitoring – is equally important. The EPT design has proven highly successful to evaluate LW and floodplain projects both in the U.S. (Roni and Quinn 2001; Morley et al. 2005) and more recently in Europe (Haase et al. 2013; Hering et al. 2015; Göthe et al. 2016). Typically, this EPT design requires sampling 10 or more treatment and control pairs well after restoration has occurred. Treatments and controls are located 100m or more apart to ensure little movement of fish between paired-reaches (Roni and Quinn 2001; Roni 2019). Rather than providing detailed information about individual projects, it focuses on sampling a large number of projects to examine the average response to restoration for a group of projects. Additionally, because of the extensive spatial replication (i.e., large number of projects sampled), correlation analysis can be used to explain what restoration project characteristics produce the largest responses (Roni et al. 2005; 2018).

How many sites (paired treatments and controls) are necessary to detect a significant response depends upon the desired effect size and the variability of parameters of interest. Studies employing this design have successfully used as few as 6 to more than 30 sites to detect a significant response with this design, with most studies using 10 or more (Roni et al. 2005; 2013; 2018). Based on recently collected data from 29 wood placement projects in the Columbia River Basin (Clark et al. 2019), we estimate that approximately 8 sites would need to be sampled to detect a 50% percent increase in pool area, or 21 sites to detect a 50% increase in juvenile Chinook salmon abundance at treatment (restored) sites[3]. It should be noted that Clark et al. (2019) sampled sites across the Columbia River Basin, and we expect variability to be lower among sites within the Lewis River Basin. For example, if we use just the sites in the Upper Columbia Chinook salmon ESU (Twisp, Methow, Entiat, and Wenatchee basins, sampled by Clark et al. [2019]), the standard deviation of the juvenile fish response is much lower (1.85 vs. 2.48), and our sample size estimate is 12 sites to detect a 50% increase in juvenile Chinook numbers. Thus, consistent with previous studies, a sample size of 10 or more sites should be sufficient to detect a juvenile fish response using an EPT design and we will sample all LW and floodplain sites implemented under the Merwin In Lieu Program (it is expected that more than 10 sites will be restored within priority reaches and streams). The EPT design requires sampling all sites (treatment control pairs) once three or more years after restoration has occurred and thus data will be collected in a one- to two-year period. It can also be repeated at a later time so see if the average response changes over longer time frames.

A key component of the monitoring design will be selecting suitable control and treatment reaches. The treatment (restored) reach is determined by the restoration program and project, but location of a suitable control for a treatment reach will need to be determined once treatment areas are specifically defined. In general, a suitable control reach will be located 100 meters or more upstream of the treatment, though typically not more than two to five kilometers depending upon

[3] We used a two-tailed power analysis for a *t*-test (Zar 2009); alpha = 0.05, beta = 0.20 and a standard deviation for difference in pool area of 1.51 and 2.48 for juvenile Chinook salmon.

channel width (Roni et al. 2005; 2013; Roni 2019). This is to ensure minimal movement of fish between treatment and controls during low flow when sampling typically occurs. It is important that treatment and control reaches are similar (within ~10%) in channel type, gradient, confinement, bankfull width, elevation, riparian vegetation type (prior to treatment), land use, and other factors. The selection of suitable treatments and controls is particularly critical for the EPT design, which depends upon having paired control reaches that are similar to the treatment reach before it was restored. If no suitable control reach can be located, then the project will not be included in the monitoring program. The length of the reaches monitored at floodplain and LW projects should be a minimum of 20 times the bankfull width (BFW) or 500 meters in length, whichever is greater[4]. Many projects may span reaches that are several kilometers in length and exceed 20 times bankfull width. In these cases, to assure an adequate portion of the project is sampled, treatments and control reaches should be at least 50% of the restoration project length. In addition, to these data collected at the project and reach-scale, baseline data from recently required LiDAR and the updated assessment in the In Lieu Program, will provide information on broader-scale processes that may influence project physical effectiveness.

1.3.2 Population Level Approach

Approaches that can be used to monitor a population level response of salmon and steelhead to habitat restoration in a basin include:

1. Before-after control-impact (BACI) monitoring of parr, smolt, and adult salmon and steelhead
2. Before and after (BA) monitoring of parr, smolt, and adult salmon and steelhead
3. Basin-scale habitat monitoring
4. Rerun EDT or other models
5. Genetic monitoring

The main question that population level monitoring above Swift Dam would be designed to answer is:

Has restoration of habitat under the In Lieu Program resulted in a statistically significant increase in the numbers of smolts produced and adult salmon and steelhead successfully spawning above Swift Basin?

Because of the complexity and challenges of implementing population level monitoring, we first describe the potential approaches and their feasibility for evaluating the In Lieu Program before describing the preferred approach we will implement. As noted previously, restoration goals for the In Lieu Program and the locations of the actual restoration actions still need to be confirmed. These goals will influence the specifics of the populations level monitoring but are unlikely to influence the different options for population level evaluation of the In Lieu Program.

[4] 20 times bankfull width is considered the minimum reach length for monitoring changes in physical habitat and channel morphology (Harrelson et al. 1994; Rosgen 1994)

1.3.2.1 BACI monitoring of parr, smolt, and adult salmon and steelhead

Before-after control-impact (BACI) monitoring of smolts and adults before and after restoration in paired treatment (impact or restored) and control watersheds, has long been considered the best option for evaluating effects of management actions on fish and aquatic habitat (Bilby et al. 2005; Roni et al. 2015; Bennett et al. 2016). This is in part because of the success of early forestry studies that used this design. This monitoring approach is sometimes called the IMW (Intensively Monitored Watersheds) approach. Unfortunately, a number of studies have demonstrated the need for a long-time frame (>10 years) and logistical challenges associated with this (Reeves et al. 1997; Johnson et al. 2005; Roni et al. 2015; Bennett et al. 2016). Studies have also indicated that this approach is most tractable for small watersheds (< ~100 km^2) with intensive restoration such as that completed by Solazzi et al. (2000) on the Oregon Coast.

There are several challenges for implementing this design to evaluate biological response to the In Lieu Program for any salmon or steelhead life stage. First, the design requires paired treatment and control watersheds. A control watershed could be outside of the basin, but it would require a similar history of fish passage and reintroduction, and similar watershed characteristics. There appears to be no suitable control watershed outside the North Fork Lewis River basin that has similar fish passage and reintroduction and no restoration or other management actions planned. Therefore, an in-basin control is needed. Given that habitat restoration for the In Lieu Program is targeted upstream of Swift Dam, the best option would be two similar watersheds draining into Swift Reservoir—one that would have intensive restoration and one that would serve as a control. This is problematic because the restoration is likely to occur across several tributaries and there do not appear to be two similar streams that could serve as paired treatment and control watersheds. Treatment and control reaches will be monitored as part of project-level effectiveness, but this is reach-scale and not population or watershed level monitoring. Second, this design requires having adequate pre-project data on parr, smolts, or adults prior to restoration. That is not to say that smolt traps and parr and spawner surveys and possibly PIT tagging of fish to measure survival could not be initiated now to collect at least three or more years of pre-project data in specific tributaries. However, this approach would still require finding adequate treatment and control watersheds and focusing at least some of the restoration in one watershed. Third, is the time needed to detect a response. As noted previously, the IMWs do not have a great track record for this, and most have not been able to detect a response within 10 years and many suggest that more than 10 years of post-project monitoring will be needed to detect a response (Roni et al. 2015, 2018; Bennett et al. 2016). Assessment of adequate sample size and power needed to detect a population fish response would require data on interannual variability in treatment and control watersheds. Thus, the BACI design does not appear to be the most tractable approach for evaluating a population level response to the In Lieu Program.

1.3.2.2 Before and after (BA) monitoring of parr, smolt, and adult salmon and steelhead

Another option is simple before-after monitoring of juvenile (parr), smolt, and adult salmon and steelhead produced upstream of Swift Dam before and after restoration. This requires data on fish abundance or survival and habitat before and after restoration. Adult releases upstream of Swift Dam have been ongoing since 2013 (Table 6), though these are mostly hatchery (HOR), with some natural origin returning (NOR) adult coho salmon. Through 2018, spring Chinook and steelhead have been almost all HOR fish. In addition, juvenile spring Chinook salmon have been stocked in tributaries to the North Fork of the Lewis upstream of Swift Dam since 2012 (Table 6). There are two potential challenges for implementing the BA design. The first is that it is not clear if all the habitat has been fully colonized or if the fish numbers are still increasing. Moreover, there are targets set for the minimum number of fish transported upstream (e.g., 7,500, 2,000, and 500 for coho, spring Chinook, and winter steelhead, respectively) and to date, primarily HOR are trucked upstream to approach reintroduction targets. Thus, the transported fish do not represent the adults produced by existing habitat before restoration, which means it will be inappropriate to use them to compare to the number of adults post restoration to determine the success of habitat restoration under the In Lieu Program. The second challenge is, regardless of the reintroduction program, without a control it is difficult to tell if any response is due to the restoration or due to other factors. An out of basin control could be selected to account for natural variability, but in addition to issues noted above, it would not control for any changes due to the reintroduction program (transport of adults upstream). The current Lewis River Aquatic Monitoring and Evaluation Plan suggests a number of candidate populations of coho, steelhead and Chinook in the Lower Columbia region that might serve as reference populations (PacifiCorp and Cowlitz County PUD No. 1. 2017)

Ongoing efforts to enumerate smolts produced from upstream of Swift Dam, include the floating surface collector (FSC) and the Eagle Cliff Rotary Screw Trap (Table 6; Table 7). While the data from the Eagle Cliff Screw Trap appear useful, the trap has relatively low efficiency (1 to 15%), is operated for a shorter period of time (April to June) than the FSC, and its efficiency varies greatly by species and flow. The FSC data appear to be a better representation of the fish produced by all tributaries to the Swift Basin, and changes made in initial years of operation have improved efficiency (Table 7). Fish are unlikely to exit Swift Reservoir unless they enter the FSC. Therefore, smolts that are not collected in the FSC either spend another year in the reservoir and emigrate as larger smolts or residualize in the reservoir. Because of this, it is problematic to use FSC efficiency estimates to estimate total smolt production.

To examine the number of years of data needed to detect a response using a simple before-after design, we used two methods: one based on a *t*-test and means and the other based on linear regression and trends before and after restoration. First, we looked at the number of years required to detect a stated difference in population means using *t*-tests (Zar 2010). Sample sizes were estimated separately for each species using smolt data from the FSC and number of adults transported upstream of Swift Dam. We estimated sample sizes for smolts, adults, and for coho, smolts per spawner. We only looked at smolts per spawner for coho, because sufficient data were not available for steelhead or Chinook. All *t*-test estimates were based on single-sided tests, with a stated significance level of 0.05, and a desired power of 0.8. We analyzed three effect sizes due to restoration representing 25, 50, and 100% increases in mean population (Table 8). A number of improvements have been made to increase trap efficiency over the years, particularly in the first few years. We excluded 2013 and 2014 data from our power analysis for this reason. These estimates suggest that 4 to 7 years of monitoring would be needed to detect a 50% increase in adult salmon or steelhead. However, this assumes the existing pre-project data on adults released upstream of Swift Dam represent adult production from naturally produced juveniles, which they are not. Instead the upper basin has been stocked with primarily adult hatchery fish produced downstream of Merwin Dam. Because of this, the interannual variability in adult salmon and steelhead is much less than would be expected in a natural system, resulting in less time needed to detect a change.

Table 6. Estimated number of adult and juvenile salmon and steelhead transported and released upstream of Swift Dam 2012 to 2018. Data from Lewis River Fish Passage Program annual reports. The majority of adult coho and all spring Chinook and steelhead were hatchery origin fish (HOR). Targets for adult planting upstream of Swift Dam are 7,500, 2,000, and 500 for coho, spring Chinook, and steelhead, respectively. Thus, these data should not be considered adult returns from juvenile fish produced upstream of Swift Dam. Adult counts include jacks.

	Adults			Juveniles
Year	Coho	Chinook	Steelhead	Chinook
2012	0	0	0	15,440
2013	7,035	579	741	98,896
2014	9,179	0	1,033	65,012
2015	3,754	0	1,223	157,666
2016	7,346	0	772	29,900
2017	6,813	1,110	592	53,470
2018	7,060	700	1,225	

Table 7. Estimated smolts collected at Swift Floating Surface Collector (FSC) and associated trap efficiency. Fish cannot exit Swift Reservoir unless they enter the FSC so it is difficult to use FSC efficiency to estimate total smolt production. Trap efficiency for the Eagle Cliff Screw Trap is highly variable and not available for all species and not reported. Data from Annual Fish Passage Program Reports tables 3.1.3, 3.2.1 and 3.2.3.

	Floating Surface Collector Smolts			FSC Efficiency			Eagle Cliff Screw Trap		
Year	Coho	Chinook	Steelhead	Coho	Chinook	Steelhead	Coho	Chinook	Steelhead
2013	15,074	1,431	166	--	--	--	16,098	161	43
2014	7,659	2,164	539	29%	<1%	25%	189	214	96
2015	25,555	5,305	1,282	12%	<1%	19%	19,622	37	181
2016	48,333	3,114	2,095	31%	<1%	24%	7,164	77	3,832
2017	14,924	5,523	1,724	27%	11%	20%	33,385	20	2,366
2018	36,039	4,250	7,869	40%	24%	49%	22,974	588	3,195

Sample size estimates for smolts captured in the FSC, suggest that anywhere from 5 to 46 years of post-project monitoring would be needed to detect a 50% increase in smolt production at 0.05 level of significance. Years needed to detect a 25% response would be larger, while detection of a 100% increase or doubling of smolt numbers would require smaller sample sizes. Using a less stringent 0.10 level of significance would require slightly smaller samples sizes (Table 8). Similarly, if one looks at coho smolts per spawner, the required number of years of monitoring is lower, though the use of smolts per spawner potentially multiplies any biases in smolts and adult estimates. Other combinations of effect size, power, and level of significance can be examined if desired.

Table 8. Results from preliminary power analysis to determine the number of years of post-treatment (restoration) that would need to be monitored to detect various levels of increased population (effect size) at a 0.05 and 0.10 level of significance (α) and a power of 0.80 (1-β) for adults, smolts, and smolts per spawner (coho only). Number of years are rounded up to nearest year. FSC = Floating Surface Collector.

Data set	Species	Power	Effect size	Years(n) α = 0.05	Years(n) α = 0.10
Adults	Steelhead	0.8	25%	18	13
Adults	Steelhead	0.8	50%	5	4
Adults	Steelhead	0.8	100%	3	2
Adults	Coho	0.8	25%	14	10
Adults	Coho	0.8	50%	5	3
Adults	Coho	0.8	100%	2	2
Adults (zeros removed)	Chinook	0.8	25%	25	19
Adults (zeros removed)	Chinook	0.8	50%	7	5
Adults (zeros removed)	Chinook	0.8	100%	3	2
FSC smolts (last four yrs.)	Steelhead	0.8	25%	182	133
FSC smolts (last four yrs.)	Steelhead	0.8	50%	46	34
FSC smolts (last four yrs.)	Steelhead	0.8	100%	13	9
FSC smolts (last four yrs.)	Coho	0.8	25%	43	31
FSC smolts (last four yrs.)	Coho	0.8	50%	12	9
FSC smolts (last four yrs.)	Coho	0.8	100%	4	3
FSC smolts (last four yrs.)	Chinook	0.8	25%	13	9
FSC smolts (last four yrs.)	Chinook	0.8	50%	4	3
FSC smolts (last four yrs.)	Chinook	0.8	100%	2	2
Smolts per spawner (no jacks)	Coho	0.8	25%	8	6
Smolts per spawner (no jacks)	Coho	0.8	50%	3	3
Smolts per spawner (no jacks)	Coho	0.8	100%	2	2

It is worth noting that these estimates assume that the full physical and biological effect of restoration has occurred and there was not lag time in response to restoration or the restoration actions did not occur over several years. Including years while restoration is occurring will likely reduce the ability to detect a significant change.

Given that implementation of restoration projects will likely occur over a 5 to 8 year period, additional years of data will likely be needed to detect a response. To demonstrate this, we built a bootstrap power estimator (Manly 2007, 2011) and tested the impact of including years during restoration implementation (construction) or a lag time in restoration response using Chinook smolt data from the FSC. This analysis demonstrated that including one sample that had a less than 50% response, could reduce statistical power by roughly one third (see Appendix 1 for details) unless additional years of data are collected. This highlights that the estimates from above are likely conservative and, despite its wide use for analysis of before-after and BACI studies, the *t*-test approach may not be the best suited for examining watershed-scale response to restoration that occurs over a protracted period.

Given the restoration project timeline and the limitations of comparing the means before and after restoration, an analysis of trends in fish abundance may be more appropriate. To estimate the number of years of monitoring needed to detect a response in smolts using a trend analysis, we simulated future FSC smolt data and used a linear regression to test if there was statistical evidence for differing intercepts, or slope coefficients between the "before" and "after" data. Tests were run for multiple extra years of data to quantify the effect additional sampling years has on the ability to detect a difference between smolt numbers pre- and post-restoration. We tested three trends: 5, 10, and 15% annual growth rates which, after five years, equate to roughly 28, 61, and 100% increases to the population. We considered each species separately, and all bootstrap estimations relied on 1,000 simulations (Table 8). Given the issues with adult data, we focused on the smolt data from the FSC for all three species as well as coho smolts per spawner. Overall, the bootstrap estimates show the number of years of monitoring post-treatment (restoration) increases as our effect size decreases from a 15% to 5% annual level of increase. For a trend of 15% annual increase, it could be as little as seven years of post-treatment monitoring for spring Chinook to more than 45 years for steelhead at 0.05 level of significance. The variability in the data is largely driving the number of years of data needed to detect a significant trend, though using a less conservative 0.10 level of significance also reduces the number of years of post-treatment monitoring needed (Table 9). Moreover, if one examines coho smolts per spawner, which has lower interannual variability than smolts, even fewer years of post-treatment monitoring are needed. The benefit of the trend analysis versus comparing means before and after restoration is that all monitoring data during restoration can be used and should not limit our ability to detect a change. In either case, there are at least two important caveats. First, for the largest effect size, estimated sample sizes are less than one generation for some species, which is probably not realistic and a minimum of 5 years post-treatment monitoring will be needed. Second, given that to date the FSC has an efficiency of less than 50%, the number of smolts collected and passed downstream of Swift Dam do not represent total smolt production.

Table 9. Results from bootstrap estimations of years of post-treatment monitoring needed to detect population trends in smolt production or smolts per spawner (coho only; no jacks) given a power of 0.80 (1-β) and a 0.05 or 0.10 level of significance (α). FSC = Floating Surface Collector.

Data set	Species	Effect size	Power	Years (n) α= 0.05	n Years(n) α= 0.10
FSC-last four years	Coho	15% annual	0.8	12	8
FSC-last four years	Coho	10% annual	0.8	16	11
FSC-last four years	Coho	5% annual	0.8	25	20
Smolts per spawner	Coho	15% annual	0.8	6	5
Smolts per spawner	Coho	10% annual	0.8	8	6
Smolts per spawner	Coho	5% annual	0.8	131	11
FSC-last four years	Chinook	15% annual	0.8	7	5
FSC-last four years	Chinook	10% annual	0.8	10	7
FSC-last four years	Chinook	5% annual	0.8	16	13
FSC-last four years	Steelhead	15% annual	0.8	45	13
FSC-last four years	Steelhead	10% annual	0.8	>45	18
FSC-last four years	Steelhead	5% annual	0.8	>45	30

1.3.2.3 Basin-scale habitat monitoring

While not true population level monitoring, monitoring the improvement in habitat conditions across the Swift Basin could be used as a surrogate for monitoring fish response. This would be based on the premise that, given all the confounding factors and long timeframe needed to detect a fish response, measuring an improvement in habitat is tractable and a reasonable substitute for fish. This would demonstrate whether the In Lieu Program has significantly improved conditions for salmon and steelhead in the Swift Basin. This would require surveying habitat across all anadromous fish streams in the Swift Basin either as census or at randomly selected sites using generalized random tessellation stratified (GRTS) sampling. The surveys would be conducted before and after all restoration is completed to quantify the impact habitat restoration actions have had on the habitat quantity and quality. These surveys would include measuring and quantifying the amount and quality of different habitat types (e.g., side channel, pool, riffle, glide) and amount of habitat for different salmonid life stages (e.g., summer, winter, spawning). While habitat surveys were done in selected tributaries upstream of Swift to populate the EDT model, they were not comprehensive. These habitat data could be used to estimate juvenile and adult capacity using EDT, limiting factors, or other similar habitat models.

1.3.2.4 Run EDT or other models

Another approach would be to rerun the EDT model or the limiting factors model for the reaches where restoration is planned (PacifiCorp 2016), with new data collected once the restoration has been completed. The resulting number of spawners, juvenile capacity, survival, or other EDT population metrics supported by newly improved habitat could be compared to the original predictions made prior to implementation of the restoration to see if they meet or exceed original predictions. This would be a model-based approach, but consistent with information used to make the preliminary decision for the In Lieu Program. A potential short-coming is that the most recent

(2016 to 2018) model runs of EDT are not entirely based on detailed habitat data for all tributaries in the Swift Basin. Use of this approach would require high quality habitat data for the entire Swift Basin or, at a minimum, where restoration will occur and rerun EDT before the restoration occurs. The habitat could then be remeasured after restoration to ensure that the comparison of model runs was based on consistently high quality data before and after restoration. Consistent assumptions about passage efficiency, survival, and other factors would need to be used for before and after restoration model runs. As part of physical monitoring of the In Lieu Program, habitat data will be collected in reaches where restoration will occur both before or after restoration. Thus, data for at least the reaches scheduled for restoration will already be collected as part the monitoring of the habitat monitoring of the In Lieu Program.

1.3.2.5 Genetic monitoring

Similar to the monitoring used to determine the success of a reintroduction program and effective population size, genetic mark-recapture monitoring based on parentage and/or relatedness-based analysis could be used to determine whether the number of adults successfully contributing to the population (effective breeders) on an annual basis has increased following restoration (Rawding et al. 2014; Schreier et al. 2015; Whiteley et al. 2015; Steele et al. 2019). This would require collecting tissue samples (fin clips or other material) from all or a sub-sample of adult salmon and steelhead passed upstream of Swift Dam several years before and after restoration occurs (ideally 5 years before and 5 years after restoration). Tissues samples from a subsample of smolts collected at the Eagle Cliff Screw Trap or the FSC would also be collected before and after restoration. Parentage analysis would allow direct observation of which adults are successfully contributing offspring to the population (number of breeders), the proportion of spawners present that successfully reproduce, and how many juveniles are produced from successful spawners (smolts per breeder). This is important given the current FSC efficiency which is below 50% and the population above Swift Dam will need to be supplemented with hatchery fish until trap efficiency improves. Several FSC modifications have been made and additional actions are underway to improve the efficiency of the facility. The genetic monitoring will be particularly important for steelhead, which may see contributions not only from anadromous adults but resident rainbows and, because of their variation in smolt age, smolts from a single breeder outmigrating over multiple years.

Prior to initiating genetic monitoring, an analysis of the number of juveniles that need to be sampled at the FSC for each species needs to be conducted. The genetic sampling could be taken a step further and tissue samples could be collected from female carcasses in restored and unrestored reaches before and after restoration or from fry or parr rearing in restored and unrestored reaches. These data could be compared to parentage of smolts sampled in the trap to see if the number of successful spawners (breeders) increases in restored reaches following restoration and whether the smolts per breeder or spawner increased. However, collected tissue samples from carcasses in many reaches before and after restoration is labor intensive and pre-project evaluations necessitate that fish are currently spawning in areas potentially scheduled for restoration. Thus, while collecting samples from adults passed upstream and sub-sampling juveniles at out-migration traps is straightforward, strategic collections of carcasses to support In Lieu Program evaluation would need to be tested for feasibility and efficacy. In addition, some modification of the frequency and extent of spawner surveys under the current Lewis River Aquatic Monitoring and Evaluation Plan may be needed to ensure spawner surveys occur in restored reaches annually.

1.3.2.6 Recommended Population Monitoring Approach

Each of the five potential population monitoring approaches described above has strengths and weaknesses (Table 10). The BACI approach, while often recommended, is not feasible for the In Lieu Program unless it was conducted on a few small tributaries. The BA monitoring of adults or smolts per spawner seems attractive in part because sample size estimates suggest 5-7 years of post-restoration monitoring might be needed to detect a 50% increase. However, the pre-restoration adult data are largely planted hatchery origin fish and do not likely represent a true baseline. Any fish monitoring using simple before-after design should focus on smolts enumerated with the FSC using a trend analysis for smolts and smolts per spawner. This seems tractable for coho and Chinook smolts though it may take 10 to 20 years to detect a response and even longer for steelhead given the variability in current pre-project (restoration) data. However, at less stringent level of significance ($\alpha = 0.10$), a response for Chinook and coho smolts may be detectable in less than 10 years assuming response is 50% or greater. Similarly, examining smolts per spawner may allow detecting a change sooner, though that is dependent on accurate data on smolts and adults. Monitoring smolts and adults assumes there will be adult fish to transport above Swift, which may not be the case for spring Chinook. The numbers of adults in particular could be influenced by changing climate and low ocean survival. Habitat monitoring can be done at a basin scale and, while fish numbers could be inferred from the habitat data, it is not a direct population measure. Rerunning the EDT model for the specific reaches where restoration will occur should be relatively straightforward assuming new habitat data are collected, though similar to habitat monitoring, it is not a direct measurement of fish response. Genetic monitoring of the effective breeding size is a promising approach that would require collecting genetic data on all or most of adults transported upstream of Swift and a subset of smolts collected at the FSC.

One of the advantages of the population level monitoring versus reach or project level monitoring of salmon and steelhead response to restoration, is that viable salmon population (VSP) parameters (i.e., abundance, productivity, spatial structure, and diversity) used to determine conservation and listing status of salmon (McElhaney et al. 2000, Crawford and Rumsey 2011), can be monitored with some of these approaches. Most of the approaches except the basin-scale habitat monitoring look at fish abundance. Population growth rate and smolts per breeder or spawner (productivity) would be examined with the BA approach and genetic monitoring. Genetic mark-recapture monitoring (sometimes called parentage-based tagging) could be expanded to examine spatial structure and diversity though these would not likely be expressed until several generations, particularly if supplementation with hatchery fish continues. Moreover, spatial structure and diversity are likely better suited for examining success of the reintroduction program than they are as measures of success of habitat restoration.

Given these strengths and weaknesses of different approaches and limitations of adult and smolt data, using a combination of approaches is the best method to measure population level response to the In Lieu Program. Therefore, the following will be conducted: 1) before and after monitoring of smolts using the FSC to measure changes in smolt numbers and smolts per adult over the long-term, and 2) begin collecting genetic samples from all or a suitable sample of adults transported upstream of Swift Dam (2020) and a subset of juveniles at FSC (2021) to measure successful breeders and smolts per breeder, and 3) using before and after habitat data collected in restored reaches and EDT modeling to determine if habitat improvements can support juveniles and adults at or above levels predicted by EDT model before restoration. While no true control exists for before and after monitoring of smolts and adults, trends in smolts and smolt to adult production from nearby watersheds will be useful for informing whether changes in smolt and adult metrics are due to restoration or other larger climatic or regional conditions (e.g., climate change, poor ocean conditions). The reference populations described in the Lewis River Aquatic Monitoring and Evaluation Plan should be good candidates for this purpose. The genetics sampling will be important not only for determining influence of restoration on survival, but also important information on reproductive success and contribution of hatchery and natural origin fish. Finally, given that there will likely not be enough time post-restoration to detect a response in smolts or smolts per spawner, the third component, EDT modeling, will be particularly important for informing the in lieu decision for Yale facilities.

Table 10. Summary of strengths and weaknesses or challenges in implementing five different approaches for monitoring population level response the In Lieu Program.

Approach	Strengths	Weaknesses/Challenges
BACI	• Widely accepted approach	• No control • Most successful on very small watersheds
BA – adults, or smolts FSC	• Data readily available, counted since 2012 • Additional before data will be collected prior to restoration • Measures two VSP parameters (abundance and productivity)	• Adult data do not represent returns but planting of fish • Smolts – trap efficiency, progeny of planted adults, some fish residualize or out-migrate in later years • Lack of control watersheds means that other factors may be responsible for any increase detected • Some modifications to current smolt and adult monitoring protocols may be needed
Habitat	• Direct measure of what restoration will change	• Does not directly measure fish numbers • To be truly population level, would need to measure all anadromous habitat

Approach	Strengths	Weaknesses/Challenges
	• Restored reaches will be monitored as part of In Lieu Program • Could be used as basis to rerun EDT or other models post-restoration to estimate capacity	• Does not measure any VSP parameters
EDT	• In lieu decision partly based on EDT predictions, could be easily rerun following restoration • Measures two VSP parameters (abundance and productivity)	• Model based approach, will need to rerun before restoration with new data
Genetics	• Focuses on effective population size or breeders and smolts per breeder • Relatively easy to measure • Useful for larger Lewis River program • Could be used to measure all four VSP parameters	• No previous data are available for coho and Chinook, a subsample of steelhead are currently sampled to examine introgression with resident fish • Limited time to collect pre-restoration data • Some modifications of existing monitoring and evaluation needed

1.4 Monitoring Parameters and Sampling Approaches

1.4.1 Large Wood Placement

The objective of LW placement projects in the Lewis River Basin is to create pools and increase pool area and quality (complexity, depth) by increasing the amount of LW interacting with the low-flow channel. Implementation monitoring of LW projects is fairly straightforward and entails counting the number and pieces of LW and LW structures observed after restoration and comparing those to the original proposal and design. These metrics can be quantified adequately with traditional habitat surveys, though improved mapping abilities with LiDAR (fixed wing or drone) or real time kinematic (RTK) GPS or total station provide more accurate and precise quantification of channel morphology and habitat units than a traditional habitat survey. Therefore, this Plan includes conducting detailed habitat surveys of the active channel in treatment and control reaches using an RTK GPS coupled with LiDAR data to survey and map channel morphology, topography, and classify habitat units (Bangen et al. 2014; CHaMP 2016; Roni et al.2019*a*) (

Table 11). Habitat units will be identified and classified into pools, riffles, glides and other habitat units using a modification of the Hawkins et al. (1993) protocol (CHaMP 2016).

To help understand if placed LW had the desired effect, monitoring will use the geomorphic unit tool (GUT) (Wheaton et al. 2015), which provides a detailed mapping of micro-habitat and geomorphic conditions within the active channel and allows one to see the type of geomorphic conditions (e.g., bowl, trough, saddle, mound, bank/wall) created by LW or structure. More importantly, it helps explain why a structure has or has not created the desired geomorphic change. In addition, areas of sediment erosion and deposition can also be quantified by using geomorphic change detection (Wheaton et al. 2010).

Juvenile fish abundance will be enumerated during summer (mid-July to mid-September) and winter (January to mid-March) low flow using standard snorkel survey protocols widely used to monitor and evaluate juvenile salmonid abundance (Thurow 1994; Roni and Fayram 2000)[5]. This will include two or more snorkelers entering the downstream end of a reach and slowly moving upstream in unison through channel units, stopping to occasionally relay the observed fish numbers, sizes, species, and micro-habitat associations (e.g., slow or fast water, off-channel or side channel habitat, LW or boulder association) to the data recorder.

Table 11. Summary of monitoring protocols (surveys) and key parameters and metrics calculated for each restoration type.

	Survey type (protocol)	Parameters and metrics
Large wood placement	Large wood	Number, length, width, volume, location, function (Roni and Quinn 2001; Clark et al. *In press*)
	Channel morphology and topography	Habitat type (e.g., pool, riffle, glide, cascade), area, and volume, residual pool depth (Lisle 1987; Hawkins et al. 1993; CHaMP 2016), morphological quality index (MQI; Rinaldi et al. 2018), change in DEM, geomorphic change, geomorphic unit tool (GUT) (Bangen et al. 2014; Wheaton et al. 2015)
	Snorkel surveys	Summer (mid-July to mid-Sept) and winter (January to mid-March) juvenile fish abundance by species (fish/m^2) (Thurow 1994; Roni and Fayram 2000).
Floodplain restoration	Large wood	Number, length, width, volume, location (low flow, bankfull, floodplain), function (pool forming, cover)
	Channel morphology and topography	Habitat type (e.g., pool, riffle, glide, cascade), area, and volume, residual pool depth (Lisle 1987; Hawkins et al. 1993; CHaMP 2016); morphological quality index (MQI; Rinaldi et al. 2018); change in DEM, geomorphic change, geomorphic unit tool (GUT) (Bangen et al. 2014; Wheaton et al. 2015); side channel length, area, number of junctions, ratio, wetted area at bankfull flow (Beechie et al. 2017).
	Snorkel surveys	Summer (mid-July to mid-Sept) and winter (late Dec to early March) juvenile fish abundance by species (fish/m^2) (Thurow 1994; Roni and Fayram 2000).
Road removal	Channel Morphology/ Long-profile	Residual pool depth (Lisle 1987), Long-profile habitat survey(Mossop and Bradford 2006)
	Sediment (egg boxes, bulk samples,	Percent fines bulks samples, depth to fines (V*; Lisle and Hilton 1992); scour and fine sediment infiltration (Johnson et al. 2012), sediment size (Wolman 1954)

[5] Summer snorkel surveys would occur during daytime while, winter surveys would need to be conducted at night as juvenile salmonids are nocturnal when temperatures are below 9℃ (Roni and Fayram 2000). Snorkel surveys have been used widely to evaluate juvenile salmonid response to restoration particularly where there are listed fish species.

	Survey type (protocol)	Parameters and metrics
	pebble counts)	
Riparian planting	Plant survival	Planting survival, growth, browse damage
Population level monitoring of all project	Smolts abundance (FSC), Genetic mark-recapture sampling of smolts and adults	Smolt number by species, parentage, effective population size, number of successful breeders, and smolts per breeder, smolts per spawner

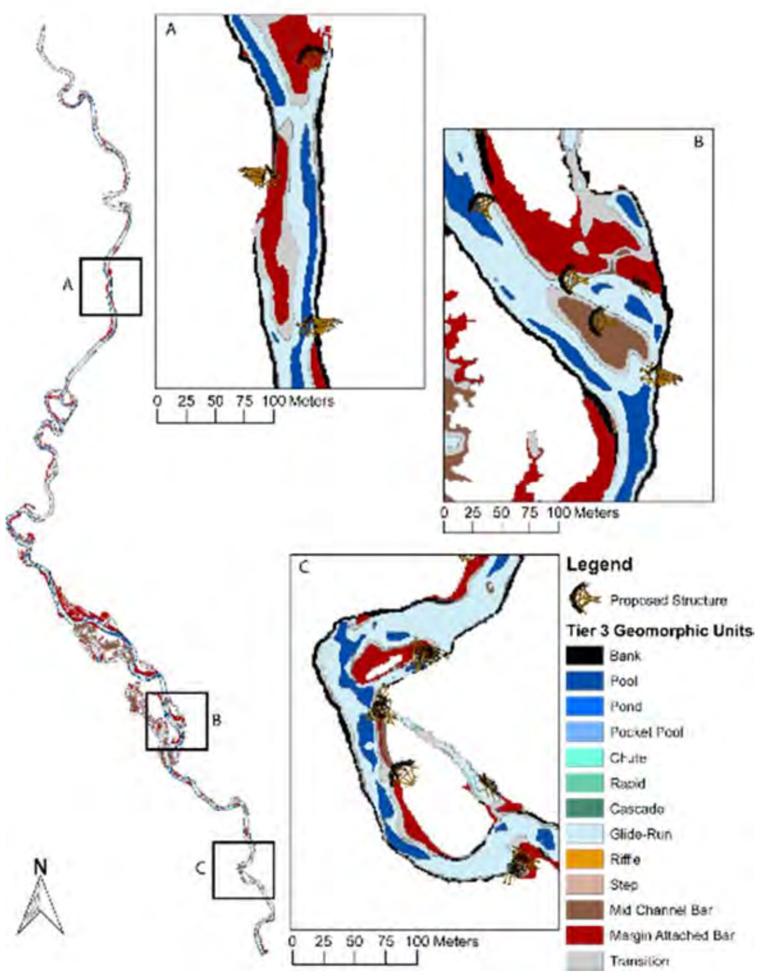

Figure 3. Example of pre-restoration geomorphic units in the Middle Entiat River bankfull channel delineated using topographic data (Lidar combined with RTK GPS), the geomorphic unit tool (GUT) and proposed location of LW structures. Repeating the surveys and GUT analysis post-treatment will allow researchers to determine if the structures have or have not met their design objectives.

1.4.2 Floodplain Restoration

Floodplain restoration projects, likely to consist of reconnecting and constructing side channels and assisted by LW structures, will use the same physical and biological methodologies as LW projects. However, in addition to information on habitat and channel morphology collected using an RTK GPS, floodplain connectivity and quality and side channel functionality will also be measured and quantified based on LiDAR data collected using either a drone or a fixed wing aircraft. In addition to the GUT and other methods of estimating geomorphic change, before and after restoration conditions will be compared using the multi-metric morphological quality index (MQI) developed by Rinaldi et al. (2018). The topographic survey will allow characterization of floodplain extent and connectivity at multiple flows (Figure 4). Metrics developed for monitoring floodplains in Puget Sound outlined by Beechie et al. (2017), including side channel length, area, number of junctions, ratio, wetted area at bankfull flow, will be used.

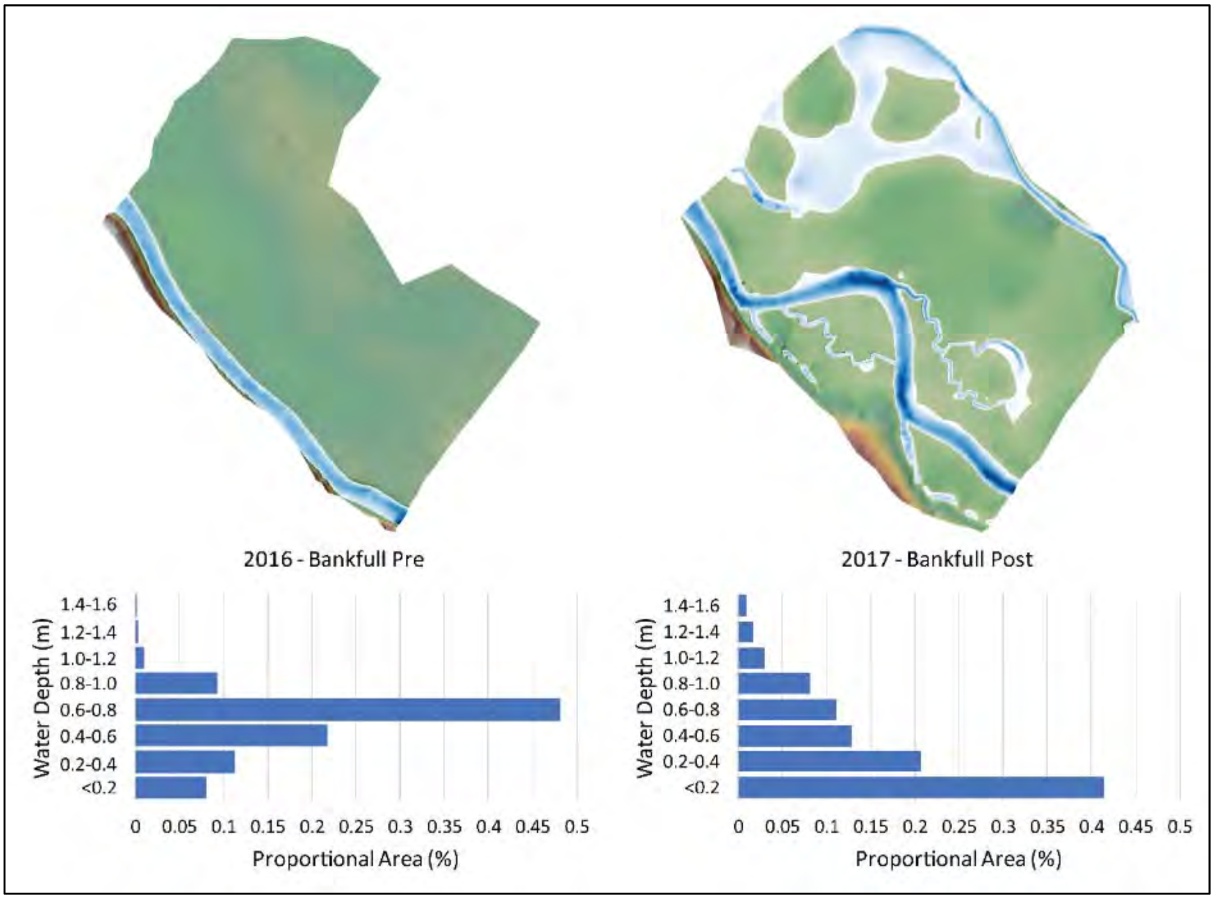

Figure 4. Example of a topographic survey output showing water depth distribution at bankfull flow before and after floodplain restoration for Catherine Creek, Oregon.

1.4.3 Road Removal

While removal of forest roads can be used to reduce both landslides and fine sediment (Beechie et al. 2005), road removal projects in the Lewis River Basin have been identified primarily to reduce levels of fine sediment caused by high road density. Thus, monitoring will focus on determining the in-channel parameters and metrics most likely to respond to changes in road density and sediment delivery, including: fine sediment levels, scour, sediment size (e.g., D16, D50, D84) (Wolman 1954), fine sediment infiltration (Johnson et al. 2012), residual pool depth (Lisle 1987), and fine sediment in pools (Lisle and Hilton 1992)

Table 11).These will be monitored in the response reach immediately downstream of the proposed road removal project(s) and upstream of any major tributaries. The exact extent and location of the reach will need to be determined once the road removal projects have been identified. A longitudinal profile type habitat survey will be used to characterize pool quality and channel morphology and quantify changes in residual depth and pool quality (Lisle and Hilton 1992; Mossop and Bradford 2006). Scour and fine sediment infiltration into spawning gravels will be examined using scour chains and Whitlock-Vibert boxes as described by Johnson et al. (2012). Bulk shovel sediment samples and pebble counts in pool tailouts/riffle crests will be collected to estimate particle size and further characterize fine sediment levels before and after road restoration (Wolman 1954; Grost et al. 1991).

1.4.4 Riparian Planting

As noted previously, riparian monitoring will initially focus largely on whether planting followed the contractor's planting plan, followed by longer term periodic monitoring to examine plant survival and riparian structure, cover and shade. This would require simple before and after monitoring of the riparian planting at multiple belt transects at each planting site. Methods would be based on the protocol for monitoring riparian and invasive vegetation removal projects in the interior Columbia River Basin (Roni et al. 2019b), which is based on methods of Harris (2005; Lennox et al. (2011), Merritt et al. (2017) and others. The number of transects at each site would depend on the length along the stream with a target of 20 percent of the reach length (Lennox et al. 2011; Gornish et al. 2017). Species composition, vegetation cover, and canopy cover would be measured within each belt transect and all plantings marked on first post-treatment survey so that plant survival could be measured. Additionally, bud browse, beaver damage, living or dead condition, and evidence of planting (tubing, marking, mulch, or fencing) would be recorded. Surveys would occur during the summer months (July and August).

1.4.5 Population Level Biological Monitoring

Smolts and Adult Enumeration

Monitoring of smolts at the FSC and adults have been ongoing since 2013 as part of the Settlement Agreement and are described in detail in the overall Aquatic Monitoring and Evaluation Plan for the Lewis River (PacifiCorp and Cowlitz County PUD No. 1 2017). As noted previously, collection of genetic material either as fin clips, swabs of slime, or other tissue will be collected from suitable sample of adult salmon and steelhead passed above Swift Dam, and juveniles collected at the floating surface collector.

Genetic sampling

Collecting tissue samples from all adults and juveniles for genetic analysis would be ideal, but cost prohibitive and not necessary to accurately estimate population size (number of successful breeders). The ideal sample size will be a trade-off between cost, what is operationally feasible, and required sample size needed to estimate the number of breeders with a desired level of accuracy. Unfortunately, estimating sample sizes to accurately estimate number of successful breeders is not as straightforward as other power or sample size estimations because two separate sample sizes effect the analysis: the number of adult breeders tagged (sampled), and the number of juveniles sampled. However, the estimate relies on a Petersen estimator (Seber 1982), which defines an estimate of the coefficient of variation for the population estimate based on three values: 1) the number of animals in the system (escapement), 2) the number of animals tagged in the first sampling event (adults genotyped), and 3) the number of animals sampled in the second sampling event (juveniles sampled). Note, that each juvenile sampled is really two samples due to having two parents, and thus, two potential genotypes to match. Although this formula is a rough approximation, it does provide some guidance on the overall sample sizes required, and the trade-offs between adult and juvenile samples. For demonstration purposes, we used the approach to estimated coefficient of variation (CV) of the population estimate (i.e. number of breeders) based on different combinations of adults and juvenile samples assuming the number adult salmon or steelhead is 1,000, 5,000, or 10,000 (Figure 5). Note that there are multiple combinations that result in similar levels of CV. For example, for an escapement of 5,000, genetic sampling of 1,500 adults and 250 juveniles would lead to similar precision (as measured by CV) as genetic sampling of 500 adults and sampling 1000 juveniles.

This approach provides preliminary estimates of sample size for genetic population monitoring of salmon and steelhead for the In Lieu Program for planning purposes. However, these estimates are likely conservative because the number of adults released upstream of Swift Dam are known and we are trying to determine how many of these successfully reproduced. Thus, rather than genetic-mark-recapture to estimate spawner abundance (Rawding et al. 2014), we are focused on parentage and kinship analysis to determine successful breeders and smolts per breeder. This should require a smaller number of samples than estimated above. To more accurately predict the number of samples needed in absence of actual data, a simulation approach could be used. This more focused analysis can integrate population and site-specific parameters to more accurately represent the conditions of the study. Multiple simulations can be run to test the sensitivity of the population estimate to various parameter assumptions and sampling levels (e.g. Bootstrapping). It is also important to note that the sampling and analysis is more complicated for steelhead than Chinook or coho, because of the more complex juvenile life history and the possibility of resident *O. mykiss* contributing to the population. Operationally, sample sizes can be refined once sampling begins and the level of effort and cost required to collect and process juvenile vs. adult samples in the Lewis River becomes clear.

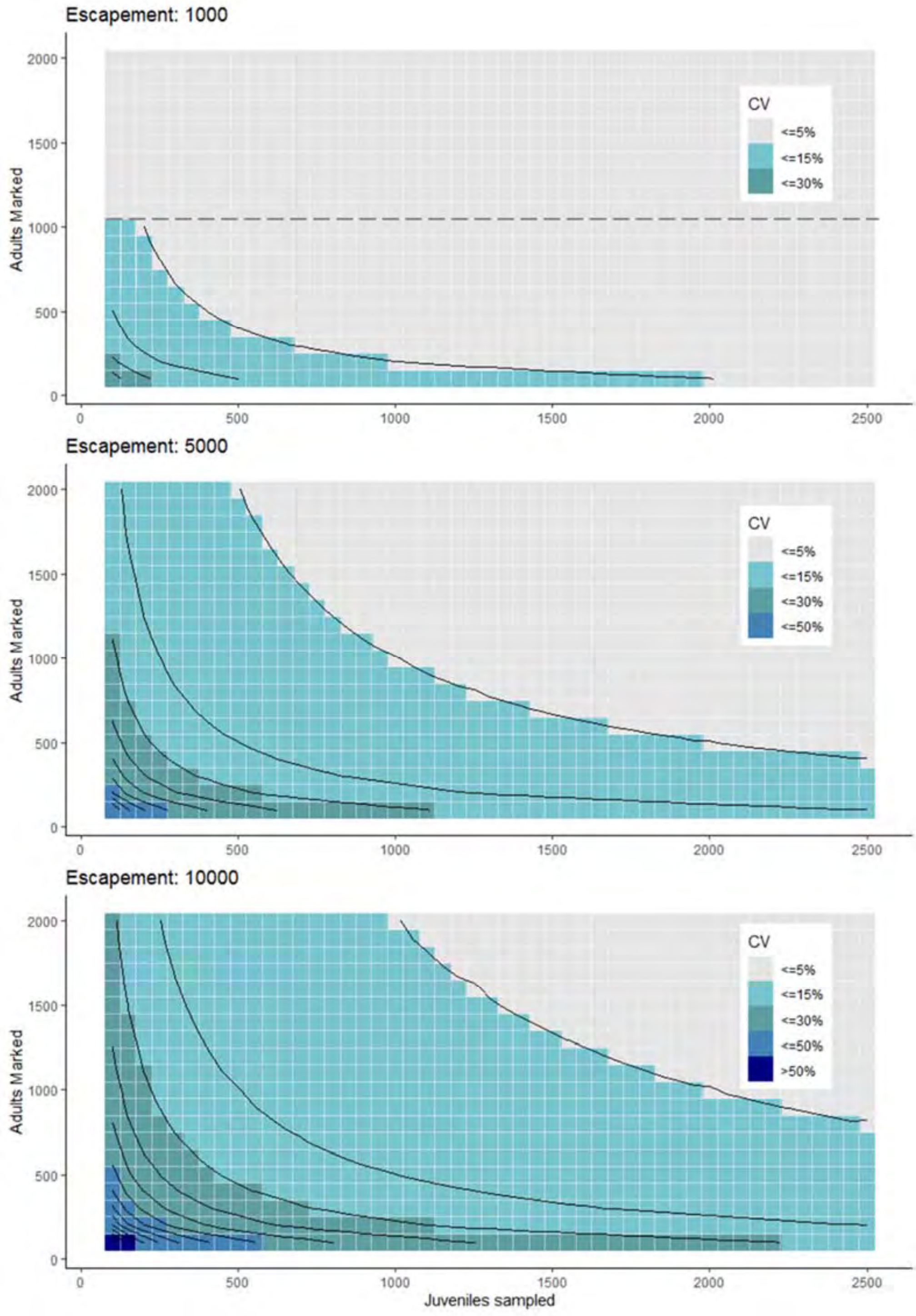

Figure 5. Estimated coefficient of variation for the breeder population estimate using formula from Seber (1986) that relies on escapement, adults sampled, and juveniles sampled. Results are shown for three levels of escapement (panels) and for a variety of adult and juvenile salmon and steelhead sample sizes (x and y axes). Contour bands show areas of similar CV (coefficient of variation). For an escapement of

1,000 (top graph), dashed line indicates that the total number of adults samples cannot exceed total escapement.

EDT Modeling Before and After Restoration

The habitat data needed for this approach will be collected in reaches scheduled for restoration under the In Lieu Program as part of the physical monitoring described above. The stream habitat data will be collected before restoration for stream reaches scheduled for restoration[6]. The EDT model for these streams and reaches will be rerun prior to restoration to estimate population metrics of juvenile and adult productivity, capacity, abundance and diversity for Coho, Chinook and steelhead. This model run will define baseline conditions prior to restoration. Post-stream restoration habitat data will be collected in the same streams as for the baseline. The EDT model will be rerun for each species and the population metrics again calculated. The percent difference in each population metric for the baseline and restoration model runs will define the “lift” in population performance expected from stream restoration for each reach and individual stream.

2.0 Data Management, Analysis, and Reporting

Many programs for monitoring the effectiveness of large restoration programs have failed because of poor implementation, including poor information on location of projects and improper management and reporting of data. Thus, a crucial component of this monitoring program will be data management, analysis and reporting. First, all data will be collected on tablets (iPad or similar) and electronic field forms that prevent data entry errors. The quality assurance and quality control (QA/QC) procedures will be built into the data forms with limited value selection (e.g., select from a list of values), value checks (e.g., values must be an integer), and missing data highlighted to flag any unusual or missing entries. Thus, before leaving the field, the field crew can assure there are no errors and do a final QA/QC. The data will be uploaded into a SQL database for storage and analysis.

Data analysis for implementation monitoring of all project types will be simply reporting deviations from proposed design in tabular and graphical format. Analysis of effectiveness monitoring of floodplain and LW projects will be done with a mixed-effects BACI model (Underwood 1992; Downes et al. 2002; Schwarz 2015). The mixed-effects model is considered the most robust method for analyzing data collected using a BACI and BA design (Downes et al. 2002; Schwarz 2015). EPT validation monitoring data on fish use for floodplain and LW projects will be analyzed with a combination of paired t-tests and correlation analyses. The paired t-test provides a robust analysis of the average response across all projects, while the correlation analysis

[6] In earlier model runs, habitat data was summarized primarily by stream. In new runs, the habitat data will be organized consistent with the boundaries of the restoration area in each stream. This approach will allow researchers to estimate population parameter change at the reach, stream and basin scales for any life stage.

will allow examining why some projects produced larger (or smaller) responses than others (Roni et al. 2013, 2018). BA designs used for riparian planting and road removal will be analyzed using trend analysis and t-tests. Population level monitoring of smolts, effective breeders, and smolts per breeder and spawner will be analyzed using both t-test and trend-based analysis as described in population level monitoring section.

It will be important for the monitoring team to report on progress annually to keep the Utilities, Program Administrator, and ACC up to date, and to adaptively manage both the monitoring and, more importantly, the Merwin In Lieu Program. Therefore, standard scientific reports with the following sections will be provided by May 31 of each year:

1. Executive summary
2. Background
3. Methods
4. Results
5. Discussion
6. Adaptive management recommendations
7. References

The results, as noted above, will be presented annually to the ACC. This will help ensure the Merwin In Lieu Program focuses on key questions and parameters and will help ensure the project stays on track and provides critical information to adaptively manage the restoration program.

3.0 Expected Outcomes, Potential Challenges, and Next Steps

3.1 Expected Outcomes

Based on results of other monitoring programs evaluating restoration effectiveness, we expect pool area and quality (e.g., residual pool depth, woody cover), and morphology (MQI) to increase significantly three to five years after LW placement. Similarly, we expect to see increases in pool area, residual pool depth, MQI, side channel number, area, connectivity, and total wetted area and area of floodplain inundated at bankfull flows following restoration. EPT monitoring of LW and floodplain projects should also show higher levels of juvenile salmonids in restored reaches three to five years after restoration. Monitoring road removal projects will be more protracted, but we would expect residual pool depth to increase and scour, percent fine sediment, fine sediment infiltration, to decrease 5 to 10 years after restoration. Riparian monitoring results should show growth and survival of plantings following restoration consistent with regional rates for natural vegetation as sites with similar elevation, precipitation, and aspect. The population level monitoring will be on a longer time frame and we do not expect to be able to detect a significant response until five or more years after the In Lieu Program has been completed above Swift Dam.

3.2 Relation to Ongoing Monitoring

Existing efforts to enumerate smolts with the FSC and transport adult salmon in steelhead above Swift Dam will provide important data for monitoring population level response to the In Lieu Program (Table 12).Monitoring outmigrating smolts in the screw trap in the North Fork Lewis River upstream of Swift Reservoir will provide additional information on numbers, timing, and, if genetic samples are collected from some of these fish, number of successful breeders. Redd and spawner surveys can be used to examine differences in fish use before and after restoration in restored reaches (though this will require long-term monitoring before and after restoration [10 or more years]), and that restoration occurs in areas used for spawning.

Table 12. Summary of existing smolt and adult salmon, steelhead, and bull trout monitoring in the North Fork Lewis River Basin that are relevant to evaluating restoration effectiveness.

Monitoring	Dates	Description and Metrics
Screw Trap	March - June	Annual monitoring of smolts and juvenile salmonid outmigrants in the North Fork Lewis River above Swift Reservoir. (Screw trap is located in river at head of reservoir). Metrics – juvenile abundance, productivity, and diversity (e.g., variation in age structure, life stage, migration timing, genetic characteristics, etc.).
Swift Floating Surface Collector	Year round	Counting number and time of downstream migrating juvenile (fry, parr, smolts) and adult salmonids at Swift Dam. Metrics – juvenile abundance, productivity, and diversity (e.g., variation in age structure, life stage, migration timing, genetic characteristics, etc.).
Adult fish count arriving at Merwin Dam	Year round	Daily counting of adult bull trout, Chinook, coho, sea-run cutthroat trout, and steelhead. Metrics – adult abundance, productivity, and diversity (e.g., , variation in age structure, sex ratio, run timing, stock composition, and ocean survival).
Spawning ground surveys	Sept. – Dec. (Chinook and coho), March - June (steelhead)	Counting redds, carcasses and spawning adult coho and Chinook salmon and steelhead in tributaries to Swift Reservoir[1]. Steelhead redd surveys are combined with radio tracking to determine steelhead spawner distribution and timing. Metrics – spawner success, redd density and distribution, spatial structure and spawn timing diversity.

[1] Spawner surveys are conducted on a rotating three year panel with a third of streams surveyed each year. Thus spawner surveys are not conducted on all streams every year.

Bull trout redd surveys	Sept. - November	Bull trout redd and spawner counts in Pine Creek (mainstem, P8 and P10), Rush Creek, and Cougar Creek. Metrics – spawner abundance, redd density and distribution, spatial structure and spawn timing diversity.
Bull trout effective population size monitoring	July	Electrofishing in select reaches of Pine, Rush, and Cougar creeks to collect tissue samples. All juvenile salmonids are measured and enumerated. Metrics – juvenile abundance, spatial structure, and effective population size (from tissue samples and genetic analysis)

3.3 Potential Challenges

Most of the challenges for the monitoring program are related to the population level monitoring and the need for minor modification of the current smolt and adult monitoring. These include accurate separation and enumeration of parr and smolts at the FSC, additional spawner surveys, genetic samples from adults and juveniles, and identification of suitable reference populations. First, the efficiency of the FSC at collecting and enumerating smolts has been steadily improving, but still below target levels of 95%. The FSC segregates fish collected into three tanks (fry/parr, smolts, and adults) based on size class (60 to 120 mm, 121 mm to 220 mm, and greater than 220 mm) and it is likely that some of fish in fry tank are actually smolts or pre-smolts (parr that will smolt shortly). Moreover, since fish generally do not exit Swift Reservoir other than through the FSC except in rare spill events, there are some very large 2+ coho and potentially 2+ Chinook smolts. Therefore, additional sampling and analysis will be needed to accurately enumerate the number of smolts in recent years (2013 to 2019), and address differences in collection efficiency among years to ensure total smolt numbers are accurate. Another minor challenge is that current spawner surveys are done with a three year rotating panel, and data on whether spawners regularly use areas planned for restoration may be limited. This can be addressed by ensuring that annual spawner surveys occur in those streams where restoration occurs. This should be a relatively minor addition to the current spawners surveys assuming that areas where restoration occurs are accessible during spawning season.

Genetic sampling for parentage and kinship analysis will require collecting material (fin clips or tissue) from both adults transported upstream and juveniles collected at the FSC and possibly the Eagle Cliff smolt trap. Genetic samples are currently collected from a subset of adult steelhead transported upstream to look at introgression with resident rainbows, but samples need to be collected from adult Chinook and coho. This is attainable given all adult fish passed upstream of Swift Dam are handled. Collection of samples from juveniles may require some minor modifications of current protocol at the FSC to ensure a representative portion of the fish are sampled. However, a subsample of all fish are already measured to get length information, and tissue samples can be collected from these fish. As noted previously, steelhead pose an additional challenge because of their complex life history and additional samples of fry or parr from the spawning grounds may be needed.

Finally, broad-scale changes in climate, ocean survival, or other factors may influence the number of returning adults and result in either larger than expected or lower than expected adult returns. Low numbers of adult returns or fish released above Swift Dam could complicate detection of trends or changes in population levels due to restoration. In part, focusing on the number of successful breeder and smolts per breeder (reproductive success and survival) will account for this. However, we could see higher smolts per breeder at low population levels due to density dependence rather than a response to restoration. This can be partially but not completely addressed by using data on smolts and adults from reference populations defined in the Aquatic Monitoring and Evaluation Plan. Rerunning EDT in restored stream reaches before and after restoration is designed to serve as backup if population level monitoring is unable to detect a change or requires monitoring many years beyond the In Lieu Program to detect a response to restoration.

3.4 Next Steps

As noted previously, once the Merwin In Lieu Habitat Restoration Plan has been completed and the specific reaches and restoration actions identified, the key aspects of this monitoring plan need to be finalized. This includes locating potential treatment and control areas, refining field methods depending upon the total length of stream to be restored, developing a specific schedule for collection of pre- and post-restoration data collection, and developing a detailed budget for the monitoring. These activities would all be defined within 3 to 6 months of completion of the In Lieu Habitat Restoration Plan. Collection of genetic material (fin clips, slime) from adults released upstream of Swift Dam and smolt captured in the FSC should begin as soon as possible so that at least three years of baseline pre-project data can be collected before on the ground habitat restoration begins occurring. There are also some rapidly developing technologies such as environmental DNA (eDNA) and remote sensing mapping methods (e.g., radar, fluid lensing) that are not currently useful for implementation and effectiveness monitoring, but may be perfected in the next few years. Accordingly, these technologies should be re-examined as the monitoring plan is being finalized to see if they have advanced enough to be useful for monitoring restoration effectiveness.

3.5 Preparers

Phil Roni, Ph.D.
Cramer Fish Sciences
Principal Scientist
Watershed Sciences Lab
phil.roni@fishsciences.net
(206) 612-6560

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Lewis River Bull Trout Passage Plan

January 2020

North Fork Lewis River

Merwin Hydroelectric Project (P-935)
Yale Hydroelectric Project (P-2071)
Swift No. 1 Hydroelectric Project (P-2111)
Swift No. 2 Hydroelectric Project (P-2213)

Prepared by:
Jeremiah Doyle, PacifiCorp
&
Public Utility District No. 1 of Cowlitz County
&

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I. INTRODUCTION

PacifiCorp and the Public Utility District No. 1 of Cowlitz County ("Cowlitz PUD", together with PacifiCorp, the "Utilities") own and operate the four Lewis River Hydroelectric Projects (the "Projects") located on the North Fork of the Lewis River in Cowlitz, Clark, and Skamania Counties, Washington. The Federal Energy Regulatory Commission (FERC) licenses the four Projects separately. The Merwin (Project No. 935), Yale (Project No. 2071), and Swift No. 1 (Project No. 2111) Projects are owned and operated by PacifiCorp. The Swift No. 2 Project (Project No. 2213) is owned by Cowlitz PUD and operated in coordination with the other Projects by PacifiCorp.

On June 26, 2008, FERC issued new licenses for the Projects. During the relicensing process, the Utilities entered into a comprehensive settlement agreement with the Services, Tribes and other stakeholders (the "Settlement Agreement"). The Settlement Agreement includes fish passage requirements for each project that were incorporated into the Project licenses as fishway prescriptions under Section 18 of the Federal Power Act. The Settlement Agreement also includes a provision that allows the Utilities to present new information to the Services regarding whether the construction of the fish passage facilities is appropriate. In the event that the Services determine, after review of such new information, that fish passage is inappropriate, PacifiCorp is required to create an "In Lieu Fund" to support habitat restoration and the Utilities are required to construct certain facilities for bull trout passage.

The Utilities provided new information regarding the appropriateness of fish passage at the Projects to the Services on June 24, 2016. The Services responded on April 11 and 12, 2019, providing the Utilities with a preliminary determination under Section 4.1.9 of the Settlement Agreement. Specifically, NMFS proposed and USFWS concurred in the following actions:

1) To forego construction of the Merwin Downstream Facility (Section 4.6 of the Settlement Agreement) and the Yale Upstream Facility (Section 4.7);

2) To require PacifiCorp to establish the In Lieu Fund consistent with the requirements of Section 7.6 of the Settlement Agreement; and

3) To defer a decision whether to construct the Yale Downstream Facility (Section 4.5) and the Swift Upstream Facility (Section 4.8) until 2031 and 2035, respectively, so that performance of in lieu habitat restoration could be considered in that future decision.

The Services directed that restoration efforts supported by the In Lieu Fund (the "In Lieu Program") focus on stream reaches upstream of the Swift reservoir that benefit three salmon species listed under the Endangered Species Act (ESA): (coho salmon [*Oncorhynchus kisutch*], winter steelhead [*O. mykiss*], and spring Chinook salmon [*O. tshawytscha*]). The Services identified the following reaches known to support all three species since reintroduction efforts began in 2012:

- Clearwater River (8.37 kilometers [km])
- Clear Creek (22.96 km)
- North Fork of the Lewis River (22.69 km)
- Drift Creek (1.52 km)

In addition, the USFWS, in an April 12, 2019 letter, directed the Utilities to proceed immediately with the development of the following fish passage measures for bull trout (*Salvelinus confluentus*) pursuant to Section 4.10 of the Settlement Agreement:

- Yale Downstream Bull Trout Passage Facility
- Swift Upstream Bull Trout Passage Facility
- Yale Upstream Bull Trout Passage Facility

USFWS elected to defer a decision on whether to require construction of the Merwin Downstream Bull Trout Passage Facility to evaluate whether bull trout have increased sufficiently in number in the Merwin reservoir to warrant construction. A determination by the USFWS regarding the Merwin Downstream Bull Trout Passage Facility is not due before 2025.

Several additional steps are required before this Plan becomes operative. First, PacifiCorp and Cowlitz PUD will apply for non-capacity license amendments for the Projects. Second, the Services must make a final determination under Section 4.1.9 of the Settlement Agreement regarding the appropriateness of reintroduction or fish passage into Lake Merwin and Yale Lake and will do so as part of the Projects' license amendment processes. If the Services' final determination affirms its preliminary determination from April 2019, PacifiCorp will be required (a) to pursue habitat restoration funding in lieu of construction and operation of anadromous fish passage facilities into and out of Merwin Reservoir and (b) to proceed with alternative bull trout passage facilities as required by Section 4.10 of the Settlement Agreement. Similarly, if the Services' final determination affirms its preliminary one, the Services will defer a decision to construct anadromous fish passage facilities into and out of Yale Reservoir. Third, the Services must submit to FERC, as part of the Projects' license amendment processes, corresponding revisions to their Federal Power Act section 18 fishway prescriptions; if FERC approves the Utilities' non-capacity amendment applications, those revised fishway prescriptions must be incorporated into the amended licenses. Accordingly, after the Services make a final determination and FERC acts on the requested license amendments to comport with that determination, the Utilities will then execute the requirements of its licenses for the Projects as amended by FERC, including through operation of this Plan.

Upon final approval of this Plan, the Utilities will prepare final engineering designs for each fish passage facility and submit the same to the USFWS and the FERC for approval. Upon receipt of approval, the Utilities will obtain all necessary permits and commence construction of the facilities. Operation of new facilities will follow approved protocols to assure safe passage for bull trout.

II. PROJECT AREA

Monitoring of bull trout populations in the North Fork Lewis River (Figure 1.0) is a collaborative effort among the Utilities and federal and state resource agencies which has occurred annually since 1989. These monitoring activities occur on the North Fork Lewis River and its tributaries upstream of Merwin Dam commencing at river mile (RM) 19.5 and ending at Lower Falls, a complete anadromous and resident fish barrier at RM 72.5. The North Fork Lewis River upstream of Merwin Dam is influenced by three reservoirs created by hydroelectric facilities; 4,000 surface acre Merwin Reservoir, 3,800 surface acre Yale Reservoir, and the largest and furthest upstream 4,600 surface acre Swift Reservoir. From Lower Falls downstream, the North Fork Lewis is free-flowing for approximately 12 miles until the river reaches the head of Swift Reservoir at RM 60. A map of the Project area is shown in Figure 1.0.

Currently, bull trout inhabit all three hydroelectric project reservoirs on the Lewis River, with only three known spawning locations - Cougar Creek, a tributary to Yale Reservoir, and Pine and Rush Creeks which are located upstream of Swift Reservoir (Dehaan and Adams 2011). Each of these areas contain local populations which are genetically unique. No known spawning tributary or local population exists within Merwin Reservoir. The majority of the bull trout population resides upstream of Swift No. 1 dam, and the population levels decrease as one proceeds downstream.

The Plan addresses activities at three distinct locations - one for downstream activities and two for upstream activities. Downstream bull trout passage activities will take place at the forebay of the Yale Project, located at 34.2. Upstream bull trout passage activities will occur at the Yale Project tailrace and the upstream end of the Swift Bypass Reach, located at RM 34.2 and RM 50.9 respectively.

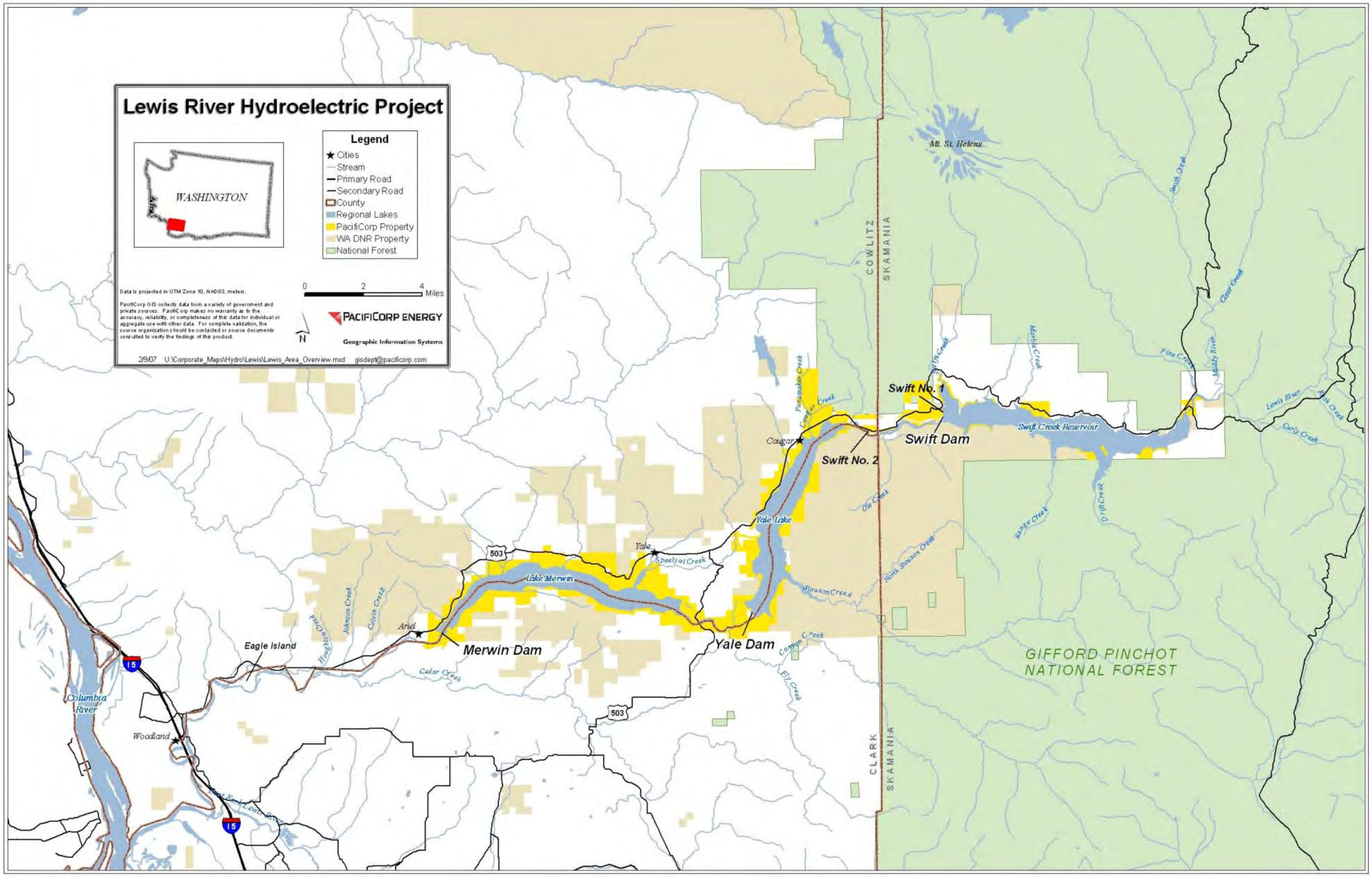

Figure 1. Map of North Fork Lewis River Project Area.

III. SUMMARY OF PREVIOUS BULL TROUT COLLECTIONS

Yale Tailrace

Since 1995, PacifiCorp has annually collected and transported bull trout from the Yale powerhouse tailrace (Merwin Reservoir) to the mouth of Cougar Creek, a Yale Reservoir tributary. A total of 162 bull trout have been captured from the Yale tailrace over this 24-year period. This collection effort occurs annually during the months of May-August. The actual number of collection events have fluctuated during that period from once a week sampling to once a month (Figure 3.0-1).

To capture bull trout from the Yale tailrace, monofilament tangle nets (6.5 cm stretch), trammel nets, beach seines, and angling have all been used. Tangle nets have proven to be the most effective and as such have been utilized for most collection events.

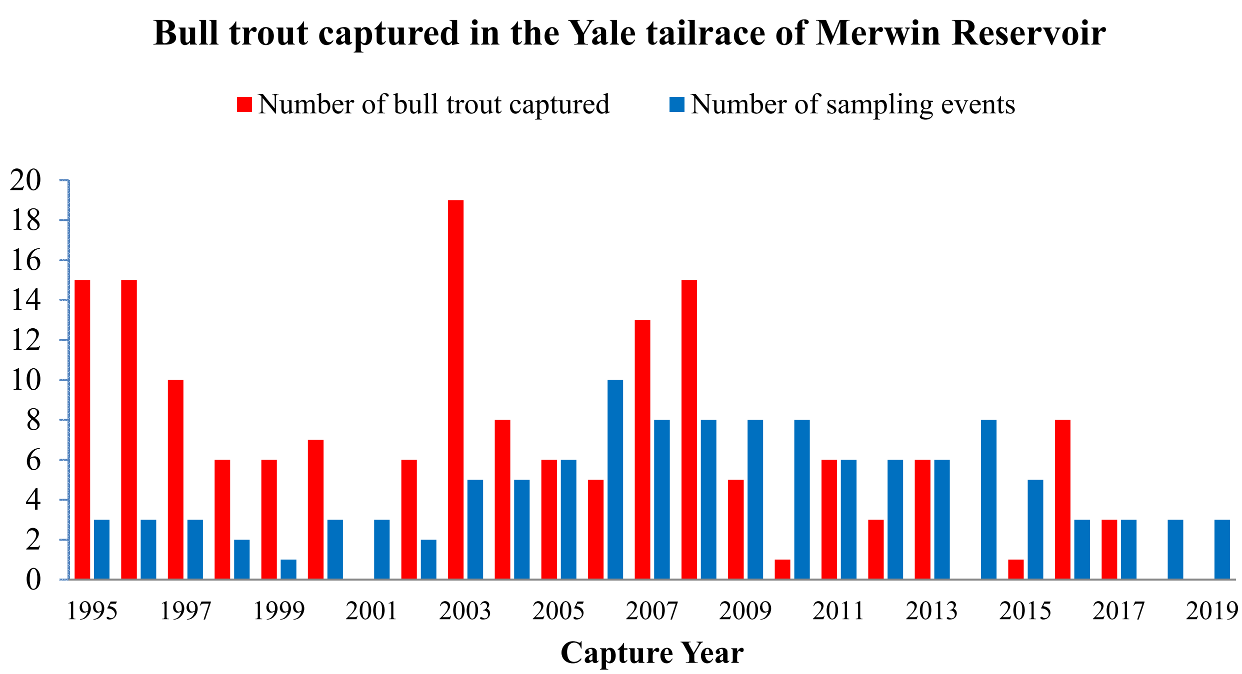

Figure 3.0-1. Historical capture numbers and effort to achieve capture of bull trout within the Yale tailrace 1995-2019

Yale Upper Reservoir and Swift Bypass Reach

Collection activities in the Yale upper reservoir and Swift bypass reach occurred annually from 2007-2016. During that period a total of 209 bull trout were captured. Capture efforts occurred in and around the head of Yale Reservoir and throughout the Swift Bypass Reach between the months of June-August. These events occurred on a weekly or bi-weekly basis (Figure 3.0-2). Review of this collection activity provided compelling data identifying the negative impacts of capture and handling. Accordingly, in 2017, the Lewis River Bull Trout Recovery Team, (a working group comprised of regional biologists/representatives from USFWS, WDFW, USFS, and USGS) who annually review and consult on bull trout monitoring activities in the Lewis River basin, recommended that collection activities in this location be put on hold until the construction of fish passage facilities described in this Plan.

Starting in 2011, all collected bull trout were held in tanks at a fish hatchery while rapid response genetic analysis was performed and local population identified. Based on the rapid response genetic results, bull trout were transported and released into either Yale or Swift reservoir (Figure 3.0-2).

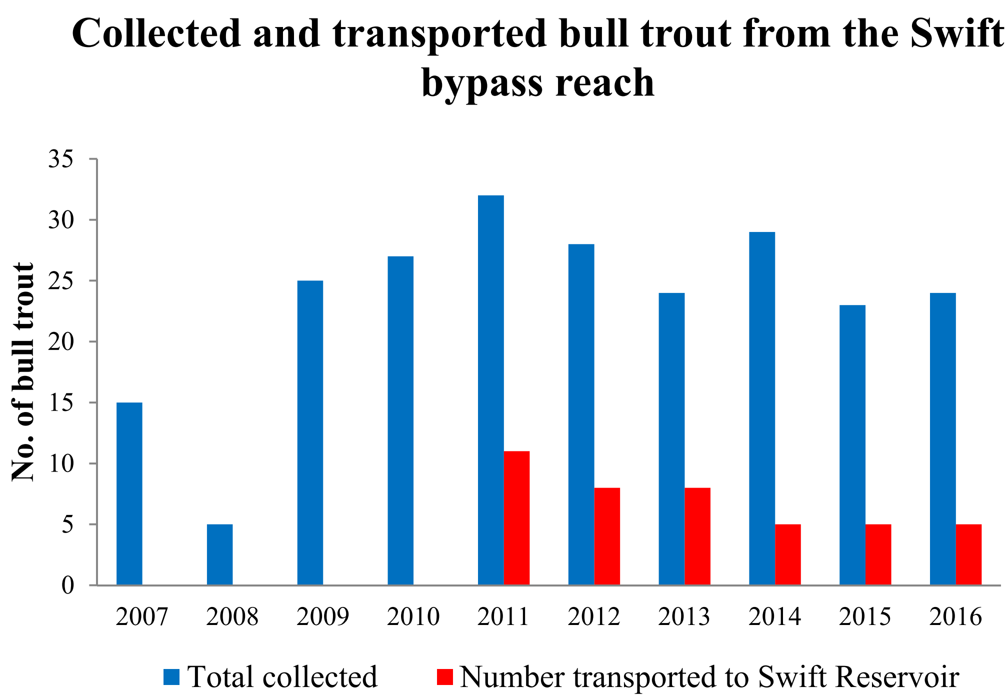

Figure 3.0-2. Historical bull trout capture and transported numbers from within the Swift Bypass Reach 2007-2016.

Swift Lower Reservoir

Minimal data currently exists concerning juvenile abundance upstream of and within Swift Reservoir. Data concerning migration rates of juvenile bull trout through the reservoir is also sparse and limited to fish encountered at the Swift Floating Surface Collector (FSC). The FSC was put into operation in late 2012. Originally the FSC operated continuously throughout the year; however, since 2015, it operates based on reservoir water quality conditions, typically mid-October through mid-July. Since operation on the FSC began in December of 2012, very few juvenile bull trout have been handled (Figure 3.0-3). During periods of high fish outmigration numbers, with the exception of a daily subsample of fish (subsample percentage dependent on overall collection numbers), all fish that enter the FSC are simply collected into raceways then transferred to trucks for transport downstream to the Woodland Release Ponds, near Woodland, WA. Given this limited evaluation of the fish transported to the release ponds during this time of high congregation of out-migrants, it is likely that additional bull trout have been collected at the FSC and taken downstream of Merwin Dam. This situation was anticipated and accepted by the USFWS through its approval of the Lewis River Fish Downstream Transportation Plan (2009).

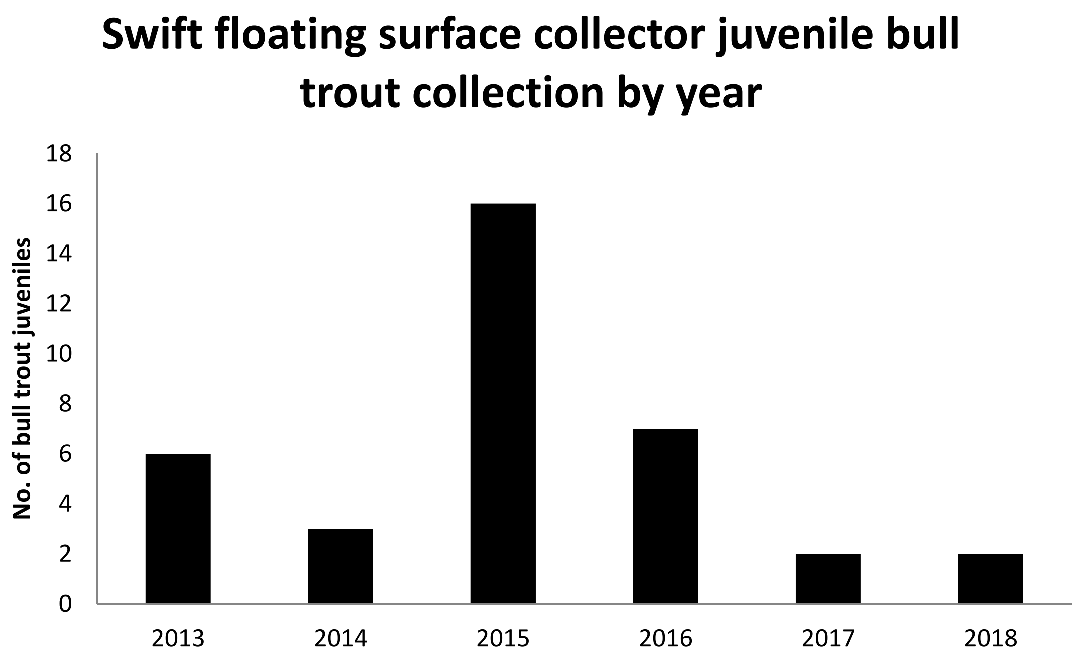

Figure 3.0-3. Annual handled juvenile bull trout at the Swift Floating Surface Collector 2013-2018.

Yale downstream

Of the three local bull trout populations residing within the Lewis River Core Area, only one is found within Yale Reservoir, primarily inhabiting Cougar Creek. This population is small, with annual redd counts ranging from 12-29 redds. No juvenile bull trout data concerning abundance or migration rates through the reservoir for this local population currently exists, but it is expected that the abundance and migration rate is small.

Merwin downstream

Numerous presence/absence and habitat surveys conducted on tributaries to Merwin Reservoir since 1996 have observed no bull trout juveniles and no suitable bull trout spawning habitat. Seasonal water temperature monitoring (May-November) of all tributaries to Merwin Reservoir occurred in 2006 as well as in 2016. Deployed in-situ water temperature thermographs recorded hourly temperature measurements for all sites during both years of study. Only one small 4th Order stream was found to have water temperatures suitable to initiate spawning during the bull trout spawn timeframe (September-October). Unfortunately, this stream is surface water driven and as such is intermittent for the majority of late summer/early fall. Kokanee (*Oncorhynchus nerka*) have similar thermal requirements (albeit a bit less stringent) and spawn during the same timeframe as bull trout, and although kokanee inhabit Merwin Reservoir in abundance, no natural kokanee spawning has ever been observed in any tributary to Merwin Reservoir.

Total catch metrics and period of collection for collection sites at the Yale Tailrace, Swift Bypass Reach, and the Swift Floating Surface Collector can also be found in the table below (Table 3.0).

Table 3.0. Capture and handling metrics for period of collection at each respective collection site.

Activity	Date Range	Total Fish Collected over Period	Average # of Collection Events per Year	Range # of Fish Collected per Year	Average # of Fish Collected per Year	Total Capture Mortalities	Total Hatchery Held Mortalities	Cumulative Total Mortalities	Average Mortalities per Year
Yale Tailrace Netting (Adults) (Merwin Res.)	**1995 - 2018**	**162**	**5**	**0-19**	**7**	**4**	**9**	**13**	**0.5**
Swift No. 2 Tailrace/Swift Bypass Reach Netting (Adults) (Yale Res.)	**2007 - 2016**	**232**	**7**	**5-32**	**23**	**1**	**3**	**4**	**0.4**
Swift Floating Surface Collector (Juveniles) (Swift Res.)	**2013 - 2018**	**36**	**n/a**	**2-16**	**6**	**2**	**n/a**	**2**	**0.3**

IV. PROPOSED BULL TROUT FISH PASSAGE FACILITIES

The design of the upstream and downstream bull trout passage facilities are described generally in the Settlement Agreement. Section 4.10.1 describes the nature of the downstream facilities as follows:

> *The Yale and Merwin Downstream Bull Trout Facilities shall be similar in magnitude and scale to modular floating Merwin-type collectors and are not intended to be passage facilities of the same magnitude and expense as the Yale Downstream Facility and the Merwin Downstream Facility described in Sections 4.5 and 4.6 (recognizing that monies shall be contributed to the In Lieu Fund described in Section 7 below in lieu of constructing those passage facilities).*

Similarly, Section 4.10.2 describes the upstream facilities:

> *The Yale and Swift Upstream Bull Trout Facilities are not intended to be passage facilities of the same magnitude and expense as the Yale Upstream Facility and the Swift Upstream Facility described in Sections 4.7 and 4.8 (recognizing that monies shall be contributed to*

> *the In Lieu Fund described in Section 7 below in lieu of constructing those passage facilities). PacifiCorp (for Yale) and the Licensees (for Swift No. 2) shall select an alternative passage facility design for the Yale and Swift Upstream Bull Trout Facilities, in Consultation with the ACC and with the approval of USFWS, and PacifiCorp (for Yale) and the Licensees (for Swift No. 2) shall construct and provide for the operation of such passage facilities for the remaining term of the respective New Licenses. The Licensees shall follow the provisions of Sections 4.1 through 4.1.3 as applicable when developing designs for the facilities.*

The bull trout passage facilities described below were designed consistent with the requirements of the Settlement Agreement.

Merwin Upstream (Yale tailrace)

Location Description

This trap is intended for capturing upstream migrating bull trout from the Merwin Reservoir and is located off the downstream corner of the Yale powerhouse within the tailrace. This location is depicted on Sheet 1 of the conceptual drawings located in Appendix A. The location is at the upstream-most terminus of the Merwin Reservoir that is not directly subject to the turbulence from flow discharged from the draft tubes of the Yale powerhouse.

Design considerations

A number of considerations were taken into account while developing the design for a trap at this location. These include: operating season, the intended life of the facility, the hydraulic conditions, and the type and number of fish expected to be trapped. Additional information regarding this site is included in Appendix B – Technical Memorandum, Criteria for Bull Trout Passage Facilities.

The operating season is anticipated to extend from May through October. However, the trap can be operated year-round with no difference in the operating conditions other than winterizing mechanical systems for cold weather operation. Because tailrace water elevation varies from 230 feet to 240 feet mean sea level the trap must operate over a range of 10 feet to assure the trap will operate within the 5 to 95 percent exceedance levels for any month throughout the year. The facility will be designed for a 50-year life with a focus on durability and ease of operation.

Based on the previous studies and data noted above, only a few bull trout are expected to be captured on any given day; however, a significant number of kokanee may enter the trap. The trap design for fish per day at this location is five adult bull trout, five sub-adult bull trout, 1,000 kokanee, and 10 other trout species. Special consideration is given to managing the potentially large number of kokanee that could be encountered. Provisions at the trap will be made to first discourage kokanee from entering the trap by establishing hydraulic conditions that are difficult for them to overcome while encouraging bull trout to enter. Secondly, the trap hopper will be outfitted with the means to readily return kokanee in the hopper to the tailrace.

The trap will be located at the far downstream end of the powerhouse with egress to the trap across the powerhouse deck adjacent to the tailrace. The gantry crane for the powerhouse uses this space and depending on where it is positioned the deck clearance is limited to eight feet of width. Once beyond this deck the haul route consists of a paved two-lane road.

Alternatives considered

Several trap concepts were considered for this site, with initial consideration of full fish ladder concepts leading to the selected pool and adjustable weir concept. Fish ladders have the advantage of being a relatively fixed structure such as a vertical slot or Denil ladder with few moving parts. A series of ladder pools could lead up to a hopper for removing the fish. However, the 10 feet of operational variation of the tailwater would require at least 10 pools with a total length of 100 feet for a conventional ladder (at 10 percent grade), or 50 feet length of Denil ladder (at 20 percent grade) to provide passage at the low tailwater condition. The high tailwater condition would flood out most of the ladder resulting in a significantly different passage condition. Flow in a ladder type trap would tend to be a fixed flow between 15 and 25 cubic feet per second (cfs) depending on the configuration of the ladder. Once built the ladder would be relatively in-flexible with respect to varying the hydraulic conditions in order to better attract bull trout with a secondary goal of excluding kokanee. As a result of these disadvantages, a more flexible pool and adjustable weir concept was selected.

Preferred alternative with conceptual design drawings

The preferred alternative at this location consists of a series of three pools leading to a hopper pool. This alternative is depicted on Sheets 1 through 5 of the conceptual drawings located in Appendix A. The three pools leading to the hopper are 7-feet square with 2-foot wide slots between the pools and the tailwater. Each slot includes a telescoping weir that is capable of being adjusted to achieve 0.5 to 1.5 feet of head drop across the weir over the 95 to 5 percent tailwater exceedance conditions during the bull trout trap operating season and with a flow ranging from 20 to 40 cfs. This tailwater range is 10 feet, from 230 to 240 feet of elevation. The invert of the pools are set such that an Energy Dissipation Factor (EDF) of 4 ft*lbs per sec per cf is not exceeded while operating the trap at the low tailwater condition, with a flow of 40 cfs, and a head across the weirs of 1.5 feet. The flexibility of varying the flow along with the head drop across the weirs is intended to allow the trap hydraulic conditions to be optimized for encouraging the passage of bull trout while discouraging access to kokanee.

Fish that reach the upper pools will pass through an adjustable "V" gate from the upstream most pool, Pool 2, into the Hopper Pool. This gate can be closed such that the upstream panel is flush with the wall of the Hopper Pool to allow the hopper to be raised above the gate. A refuge box fabricated from pickets with a 1-inch clear spacing will be placed in the hopper to protect small fish. When the trap is operating at low tailwater and the head across the weirs is 0.5 feet; the volume in the Hopper Pool is 520 cf. The volume required to hold the design limit of bull trout, other trout species, and kokanee is 108 cf. As the hopper is raised the volume decreases. When the hopper is raised out of the water the hopper will dewater to a volume of 54 cf as water flows out the perforated upper walls. The volume required to transport the design limit of bull trout, trout, and kokanee is 65 cf. The hopper is intended to be raised to a level such that the water level in the hopper is raised 40 inches above the deck to allow bull trout to be netted from the hopper and placed into a tote for transport. See Sheet 5 in Appendix A for a depiction of the raised hopper. After all the bull trout are removed from the hopper, the hopper can be raised to a level to access a slide gate mounted on the bottom of the hopper which leads to an 8-inch diameter hose. The hose directs fish into a "Kokanee Hopper" that is positioned over the tailrace. Fish are flushed into this hopper and the hopper is lowered into the tailrace (see Section V below for description of upstream trapping protocols). A trap door in the bottom of the hopper is released by a float mechanism and the empty hopper is raised back up to the deck to be re-deployed.

Flow is regulated into the trap through baffled diffuser gratings located in the bottom of the Hopper Pool and Pool 2. The grating area is 49 square feet and allows up to 24.5 cfs of flow to be discharged into either pool while maintaining a diffuser velocity at 0.5 feet per second (fps). The flow into each pool is controlled through a 36-inch gate that releases water from a pool that the supply pump discharges into. The supply pump is a 50 horsepower (hp) axial flow pump with a variable speed drive to provide a range of flow from 20 to 40 cfs while establishing a range of heads across the weirs between 0.5 to 1.5 feet. The pump is placed in a sump configured to meet the recommended width, length, and submergence requirements described in the Hydraulic Institute Standard for Pump Intake Design.

The pump sump is fed by two cylindrical screens that comply with NMFS and USFWS criteria (NMFS Anadromous Salmonid Passage Facility Design, 2011 – Sections 11.1 through 11.8). The screens shown are manufactured by Intake Screens Inc. (ISI) which make cylindrical screens that are automatically cleaned by rotating the screens against brushes. The screens are sized to achieve a balanced approach velocity of 0.3 fps while operating at a total flow of 40 cfs. A hoist and track system allows the screens to be pulled up to the deck level for maintenance.

If additional attraction flow is deemed beneficial then the proposed trap configuration can include a pump station on the south side of the facility that would supply diffuser panels in the entrance pool. This addition includes a 7-feet square floor diffuser (49 sf) and two 2.2 feet wide by 17.5 feet high wall diffusers (77 sf) positioned in the entrance pool on either side of the weir gate leading to the next upstream pool. The combined capacity of these diffusers is 100 cfs (maximum accommodated by the proposed layout). The flow to the diffusers would be supplied by a 100 hp axial flow pump rated for 100 cfs and controlled by a variable frequency drive (VFD). The VFD allows the pump to operate over a range of 40 to 100 cfs. This entrance pool flow combined with the upstream trap flow results in a total attraction flow over a range of 60 to 140 cfs. The pump sump would be supplied by two cylindrical screens like those previously described (ISI NMFS compliant fish screens) with dimensions of 48-inches in diameter by 17 feet long. This additional flow may not be needed or may not be beneficial, therefore the trap could be fabricated to readily accept the expanded flow capability later in time. This could be done by fabricating plenums for transferring the flow, providing the baffles and diffuser grating, and bolt on flanges for adding on the expanded pump sump, pump, and screens.

Performance testing of the facility will be conducted during the startup and commissioning phase after construction is substantially complete. The testing will include the operation of the pumps, fish screens, weir gates, and hoists to verify the specified operational performance of the individual trap components. The calibration of the instrumentation will be tested to insure proper feedback on limit switches, equipment proximity transmitters, and water level transmitters. The control system will be tested to verify that equipment and instrumentation is properly integrated with the system controller. Overall trap performance testing will be performed after all the individual systems have been documented to be working as designed. The overall performance testing will include a hydraulic evaluation that develops performance curves for the pumps, the diffuser panels, and the gates relative to measured hydraulic differentials. The tested conditions will be documented in an operator's manual, so the trap operators have a clear understanding of how to vary the pump speed, diffusers, and gate position to achieve the desired head and flow conditions at the trap entrance and between each of the upstream pools. This testing will allow the trap to be tuned to optimize the capture of bull trout while discouraging the entry of kokanee.

Upon implementation of Section 4.10 of the Lewis River Settlement Agreement, the Utilities will provide for monitoring of performance as provided in Section 9 of the agreement, and make necessary and appropriate Facility Adjustments and Facility Modifications in consultation with the ACC and approval of USFWS to the new facilities pursuant to sections 4.1.4 and 4.1.6 provided that such modifications shall not require installation of a different type of passage facility.

Yale Upstream (Swift Bypass Reach Upper Release Point)

Location description

This trap is intended for upstream migrating bull trout from the Yale Reservoir and is located at the Upper Release Point within the Swift Bypass Reach. This location is depicted on Sheet 6 of the conceptual drawings located in Appendix A. The location is at the upstream-most end of the waterway that fish can access in the Yale Reservoir.

Design considerations

Design considerations for a trap at this location include; the intended life of the facility, exposure to spill events, the hydraulic conditions, the type and number of fish expected to be trapped, and transport of trapped fish. Additional information regarding this site is included in Appendix B.

The anticipated operating season extends from May through October and has little impact on the trap other than reducing the risk of exposing the trap to spill events that are more likely to occur in the late fall, winter and early spring. Year-round operation would result in the need to remove components of the trap prior to spill events in excess of 5,000 cfs to avoid damage and facilitate possible bedload removal. This level of spill typically occurs about once every two years and the spill event can be anticipated several days in advance.

The trap is intended to have a life of 10 years. After 10 years, a review of the trap facility condition should be conducted.

The hydraulic conditions at the trap are relatively constant for the 95 to 5 percent exceedance flow conditions. These constant conditions are a result of the flow at this location being regulated through a gate operated to maintain a steady flow based on a set point from a flowmeter in the piping leading from the Swift No. 1 tailrace. This facility supplies most of the water to the Swift

Bypass Reach that leads into Yale Reservoir. The facility is designed to operate between 50 and 100 cfs. The design flow used for the trap is 76 cfs. The water surface elevation at this site is based on a hydraulic control in the engineered river channel just downstream of the flow supply facility and will remain steady since the flow is held steady.

Only a few bull trout are expected to be captured on any given day; however, a significant number of kokanee may enter the trap, although much fewer than what is expected at the Merwin Upstream Trap. The design of fish per day at this location is five adult bull trout, five sub-adult bull trout, 200 kokanee, and 10 trout.

The trap will be located to the west of the Swift powerhouse. Vehicle access to the trap will be from the gravel road on the riverside of the Swift Canal. Access to the road and then onto trap site is near the Swift Canal Bridge.

Alternatives considered

A fish ladder concept was considered as an alternative to the selected picket barrier trap at this location. A ladder could be used to lead up to a hopper pool. The hydraulic change is not that great and a few pools could be used to exclude kokanee and provide depth for the hopper pool. Flow from the existing supply structure could be split between the ladder and an entrance pool. The flow associated with the ladder would not be able to vary significantly from the design condition. A ladder results in a relatively permanent structure and when Swift Dam spill events occur it could be inundated and likely impacted with bedload and other sediment which would be difficult to clean out. The picket barrier type trap has been used successfully in similar applications, lends itself to a limited working life, and can be removed from site when damaging spill events are more likely to occur.

Preferred alternative with conceptual design drawings

The preferred alternative at this location consists of a picket barrier leading to a trap with a hopper. This alternative is depicted on sheets 6 through 8 of the conceptual drawings located in Appendix A. The trap uses an existing trapezoidal concrete channel located just downstream of the flow release facility energy dissipation features. The concrete trapezoidal channel is currently filled with bedload that will be excavated.

Two wings of picket barriers will block off the upstream approach and guide fish to an adjustable “V” gate into the hopper. The pickets will consist of 1.25-inch (1.66-inch outside diameter) schedule 40 aluminum pipe spaced 2.66 on center to yield a 1-inch clear opening. The pickets will be oriented at a 45-degree angle and extend 2 feet above the water surface. Picket supports include 4-inch diameter horizontal aluminum pipe. Flow baffle panels will be placed both upstream of the pickets and in the energy dissipation channel to distribute an even flow of 61 cfs through the pickets and 15 cfs through the trap hopper. The panels will consist of a steel plate with 3-inch diameter holes and a porosity of approximately 15 percent. The flow passing through the pickets results in a slot velocity of 1 fps. The flow through the trap hopper results in an entrance velocity of 1.5 fps through the “V” trap entrance. Average velocity through the hopper is 0.6 fps and in the channel downstream of the trap the velocity is 0.5 fps.

Fish will pass through an adjustable "V" gate into the hopper. This gate can be closed such that the upstream panel is flush with the wall of the hopper pool housing. A slide gate in the wall of the hopper allows the hopper to be raised up by the jib crane. When the trap is operating the volume in the hopper is 162 cf. The volume required to hold the design limit of bull trout, trout, and kokanee is 28 cf. A refuge box fabricated from pickets with a 1-inch clear spacing will be in the hopper to protect small fish. As the hopper is raised the volume decreases. When the hopper is raised out of the water the hopper will dewater to a volume of 54 cf as water flows out the perforated upper walls. The volume required to transport the design limit of bull trout, trout, and kokanee is 17 cf. The hopper can be positioned at the upper level by the jib crane to allow bull trout to be netted from the hopper and placed into a tote for transport. Kokanee and trout can be netted out and released back into the pool downstream of the barrier (see Section V below for upstream trapping protocols).

The picket barriers, the hopper, the hopper housing and "V" gate, and flow baffle panels will be anchored to the concrete deck by 6-inch steel pipe posts. The anchorage will include 8-inch pipe sleeves fixed by various components that fit over the post and are pinned in place. The pins will include tethers to allow pulling the pins from the shore. Lifting harnesses will also be included that allow connecting a crane or boom truck to each component without requiring that personnel enter the water. The components include the hopper, the trap box, three baffle panels, and two picket barriers. The heaviest piece is the largest baffle panel which will likely weigh not more than 4000 lbs. The components can be managed by a typical 25-ton boom truck or crane which can pick the deployed components then set them above spill level on a raised pad adjacent to the trap. Site improvements include a concrete block wall to create a raised storage pad near the trap. This configuration will allow all the components to be readily removed and stored at a location up on the bank outside the area that could be inundated during a Swift Dam spill event associated with high river flows. After a high flow event, the channel will likely need to be excavated. The posts described above will be robust enough to remain in place during a high flow event and any resulting post-event excavation activity. An extreme event that inundates the channel with bedload could result in as much as 400 cubic yards (cy) of bedload that would require removal. A large excavator, such as a 70,000 lb PC300 operating with two dump trucks (10 cy capacity) would likely take about two days to restore the channel. Site improvements include access along the south side of the channel to remove bedload. This type of spill event may last up to a week. A possible scenario could result in shutting down the trap and removing components three days before spill, seven days of spill, two days of bedload removal, and two days of re-installation resulting in a total of two weeks of trap outage. Note that during periods of high spill bull trout are likely to move away from this area and not be entering the trap even if it was available.

Performance testing of the facility will be conducted during the startup and commissioning phase after construction is substantially complete. The testing will include velocity measurements along the downstream face of the picket barriers and at the trap entrance to verify that acceptable velocities along the barrier and that the desired discharge from the trap entrance is achieved. The hydraulic conditions will be documented if modifications are considered for future operation to re-distributing flow through the trap and picket barriers.

Upon implementation of Section 4.10 of the Lewis River Settlement Agreement, the Utilities will provide for monitoring of performance as provided in Section 9 of the agreement, and make necessary and appropriate Facility Adjustments and Facility Modifications in consultation with the ACC and approval of USFWS to the new facilities pursuant to sections 4.1.4 and 4.1.6 provided that such modifications shall not require installation of a different type of passage facility.

Yale Downstream (Yale forebay)

Location description

This trap is intended for downstream migrating bull trout from the Yale Reservoir and is located adjacent to the intake structure for the Yale Powerhouse. This location is depicted on Sheets 9 and 10 of the conceptual drawings located in Appendix A. The location is at the downstream-most location that is accessible to fish in Yale Reservoir.

Design considerations

Design considerations for a trap at this location include; the intended life of the facility, coordination with existing debris boom and exclusion net, the hydraulic conditions, the type and number of fish expected to be trapped, and transport of trapped fish. Additional information regarding this site is included in Appendix B.

The expected operating season extends from March through June, but the trap can be readily operated year-round. The reservoir level typically fluctuates over a 5 to 95 percent exceedance range of 227 to 240 feet. This range of 13 feet has little impact on the operation of the trap other than managing the anchorage to keep the trap within a reasonable location relative to the existing forebay exclusionary net.

The trap is behind the reservoir debris boom and outside the influence of the spillway, therefore flood events are of reduced concern.

Only a few bull trout are expected to be captured on any given day; however, a significant number of kokanee may enter the trap although much fewer than what is expected at the Merwin Upstream Trap.

The trap will be located at the west end of the Yale Reservoir. Access to the trap will require a boat to be launched from the Saddle Dam or Yale Park boat launch. The boat will need to pass through a boat gate in the debris boom to reach the trap located on the upstream side of the intake exclusion net.

Performance testing of the facility will be conducted during the startup and commissioning phase after construction is substantially complete. The testing will include verification that the net geometry is within tolerance of the design configuration, that the panels are flat and that the openings are the correct size and depth. The testing will also include load testing the anchor lines to ensure that the anchor are secure to the design capacity.

Upon implementation of 4.10 of the Lewis River Settlement Agreement, the Utilities will provide for monitoring of performance as provided in Section 9 of the agreement, and make necessary and appropriate Facility Adjustments and Facility Modifications in consultation with the ACC and approval of USFWS to the new facilities pursuant to sections 4.1.4 and 4.1.6 provided that such modifications shall not require installation of a different type of passage facility.

Alternatives considered

Section 4.10.1 of the Lewis River Settlement Agreement calls for a “Merwin” type trap at this location, several trap and net locations were considered during development of the initial drawings, but discounted due to access, safety and concern for any better viability of success.

Preferred alternative with conceptual design drawings

The preferred alternative at this location of a “Merwin” type trap is depicted on Sheets 9 through 11 of the conceptual drawings located in Appendix A. The trap is fabricated out of 0.5 inch nylon mesh. The trap is intended to intercept fish swimming along the exclusion net adjacent to the Yale dam and intake. Fish will be intercepted by a 30-foot deep by 150-foot long section of net called the Lead Net that will be connected to the exclusion net. The intercepted fish will be guided into the Heart of the trap through a 3-foot wide by 12-foot deep “V” type opening. The Lead and Heart nets of the trap are supported by a line of individual floats and weighted by chain at the bottom. Fish then pass into the Pot section of the trap which is a 16-foot square by 17-foot deep net pen. The Pot leads to the 16-foot square by 17-foot deep section of net called the Spiller. The Pot and Spiller are supported by an 18-inch diameter HDPE floating frame. A refuge box fabricated from pickets with a 1-inch clear spacing will be hung in the Pot and Spiller to protect small fish. The 4,400 cf volume of the net pens provide ample holding capacity for all anticipated fish.

The trap will be secured by shore anchors and one lake anchor. Lines of synthetic rope will extend to a floating buoy. The buoy will be connected to the respective anchor with a length of chain.

The sag of the chain will maintain tension on the system and maintain the position of the trap. Fish are retrieved from the trap by pulling up the bottoms of the Pot and Spiller pens from a boat. Any captured bull trout will be placed into totes for transport. All other captured fish species will be placed back into Yale Reservoir (see Section VI below for downstream trapping protocols).

V. UPSTREAM TRAPPING PROTOCOLS

Yale Tailrace

The Yale Tailrace bull trout collection facility will be a permanent structure with pump supplied water attractant as described in Section IV and depicted on Sheets 1 through 5 of the conceptual drawings located in Appendix A. Trapped fish will ultimately end up in a holding pool. The holding pool will include a box made up of pickets to segregate large and small fish. This refuge will have 1-inch clear openings formed by pickets to partition trapped bull trout into two groups to keep fish larger than 450 millimeters (mm) from preying on smaller bull trout.

This facility can be operated year around with fish collection expected to occur during the adult bull trout migration and spawn timeframe, May-October. The trap can be operated continually 24 hours a day, seven days a week. Given focus of facility is bull trout passage for seasonally migrating fish, it is proposed that the facility be shut down and not operated November-April.

Swift Bypass Reach

The Swift Bypass Reach Upstream Bull Trout Collection Facility will be located at the siphon discharge channel at the terminus of the Swift Bypass Reach (e.g., "Upper Release Point"). The siphon conveys water directly from the Swift Power Canal and is regulated by a gate modulated with an actuator to maintain a flow set point based on a flowmeter signal. The flow is dependent on time of year, ranging from 51-76 cubic feet per second (cfs). This fish collection facility will consist of a picket barrier that leads fish into a hopper type trap. The trap is described in Section IV and depicted on Sheets 6 through 8 of the conceptual drawings located in Appendix A. A box made up of separator bars with 1-inch clear spacing within the tank will prohibit fish greater than 450 mm from accessing part of the holding tank, thus providing a refuge area for smaller bull trout.

This facility can be operated year around with fish collection expected to occur during the adult bull trout migration and spawn timeframe, May-October. The trap can be operated continually 24 hours a day, seven days a week. Given focus of facility is bull trout passage for seasonally migrating fish and concerns with high flow inundation impacts associated with spill from Swift Dam, it is proposed that the facility be shut down and not operated November-April.

Handling Protocols

Each holding pool(s) within an upstream trapping facility will be checked once per day when in operation. Based upon prior sampling in the Yale Tailrace since 1995 and Swift Bypass since 2007, it is not anticipated that large numbers of bull trout will be encountered at a collection facility on a daily basis (Table 3.0).

All collected bull trout will be scanned for a passive integrated transponder (PIT) tag. If no PIT tag is found (maiden capture), collected bull trout will be tagged with a 23 mm half-duplex PIT tag in the dorsal sinus if >250 mm fork length. If collected bull trout is <250 mm fork length, it will be tagged with a 12 mm full-duplex PIT tag in the same dorsal sinus location. All maiden captured bull trout will be measured to their caudal fork as well as tissue sampled for genetic local population identification, to be analyzed at a later date. It is not anticipated that collected bull trout will be held longer than 24 hours prior to transport.

A data sheet detailing all prior handled bull trout and their associated PIT tag codes as well as associated genetic local population assignment will be available to the biologist monitoring the facilities. If a trap collected bull trout is scanned and found to contain a PIT tag, the code will be compared to the prior handled bull trout PIT tag code sheet and the local population for that fish will be identified. Given that upstream fish collection facilities are at the upstream terminus of a given reservoir area, collected fish will be considered to be exhibiting upstream migrating behavior and will be transported to the next upstream reservoir.

All other collected species will be handled according to species and size of fish. Any kokanee captured will be returned to reservoir of capture. Any coho, spring Chinook, or steelhead captured will be released as follows: Large fish (FL > 320 mm) will be assumed to be migrating upstream and will be transported to Swift Reservoir; small fish (FL < 320 mm) will be transported downstream of Merwin Dam to the Woodland Release Ponds similar to those juveniles collected at the Swift Floating Service Collector.

Transport Protocols

After biological sampling, captured fish may be loaded onto a fish transport truck. Bull trout collected from the Yale Tailrace facility will be transported and released upstream into Yale Reservoir preferably at the Cougar Creek Campground boat launch. If, due to low reservoir levels the Cougar Campground boat launch is unusable, fish will be released at Saddle Dam boat launch. Bull trout collected from the Swift Bypass Reach trap will be transported and released into Swift Reservoir at the Eagle Cliff fish release location. Eagle Cliff is the preferred release location, but if unusable due to low water levels or some other unseen logistical situation, then the Swift Forest Campground boat launch will be utilized. Loading densities will follow protocols as set forth by the Washington Department of Fish and Wildlife (WDFW) and the National Oceanic and Atmospheric Administration (NOAA) fisheries office of one gallon per every pound of fish. It is anticipated given expected trap numbers that a 250-gallon tank fish truck will be adequate to handle the daily catch. If in the future, capture numbers increase and the 250-gallon tank is no longer adequate, then a 1,800 gallon tank fish truck will be utilized. A partition will be built into the tank of the fish truck to accommodate hauling fish of differing sizes. Due to predation concerns, at no time will fish greater than 450 mm fork length be held or transported in a tank with fish less than 450 mm fork length.

The fish transportation trucks are equipped with oxygen tanks providing supplemental oxygen flow through air stones. Oxygen flow will be initiated within the tank prior to fish transfer into tank. Each truck also has a recirculating system to help manage dissolved oxygen levels during transport. Oxygen will be initially set to meter about two liters per minute. Dissolved oxygen is to be checked within fifteen minutes of completion of fish loading into tank, and monitored regularly until fish are released at the designated location. If there is a problem and fish are in distress the driver will increase the oxygen level and return to the departed collection facility or proceed to the release site depending on which is closer. Dead fish should not be released, instead, they should be returned to the collection facility. Per USFWS Biological Opinion (USFWS, 2006), the USFWS will be notified of any bull trout mortalities within 24 hours of initial finding.

Prior to fish release at any site, water temperature will be checked. The receiving water temperature measured 1-foot below the water surface should be less than 18˚C. There should not be more than a 3˚C change from the holding tank water to the receiving water. If there is a greater than 3˚C difference, then the water in the tank should be tempered. If there is a large difference between tank water and receiving water (stream water), tempering may not be able to resolve this issue in a timely manner. Rather than tempering the tank water, the driver will move onto each sites' respective secondary release location.

Once adult fish are released the fish truck driver will record visual observations, documenting the date and time of release, and any unusual release conditions (e.g. water temperature differential, predators in the area, etc.).

Given fish transportation trucks stay within the North Fork Lewis River basin, there is no need to disinfect the truck tanks between trips. At the end of the day, however, and per WDFW recommendation, the transport truck tanks are rinsed with VIRKON disinfectant and virucide.

VI. DOWNSTREAM TRAPPING PROTOCOLS

Yale Reservoir - Forebay

A Merwin-type net system with trap will be placed in the Yale forebay upstream of the Yale powerhouse intakes. The proposed facility is described in Section IV and depicted on Sheets 9 through 11 of the conceptual drawings located in Appendix A. At the request of the Lewis River Aquatic Coordination Committee, the Utilities have considered other downstream trapping methods, however given direction provided in section 4.10.1 of the Settlement Agreement, expected low collection numbers of downstream migrating bull trout, access and safety concerns, the Utilities support a modular floating Merwin-type collector.

As no mechanism currently exists to measure juvenile bull trout abundance or use of Yale Reservoir, the Swift Floating Surface Collector (FSC) located upstream in Swift Reservoir was utilized for comparison purposes in an attempt to better understand numbers of juvenile fish that could be encountered within each reservoir. The FSC was put into operation in late 2012, and since that time has either run continuously throughout the year, or until recently on a seasonal duration of continual operation from mid-October through June. During that time, and though the bulk of the bull trout population in the basin resides in and upstream of Swift Reservoir, very few juvenile bull trout have been collected (Figure 3.0-3).

Given the anticipated low capture numbers, this facility, while operation year around is possible, is proposed to be operated on a seasonal basis from March-June, during the typical juvenile fish out-migration period. As this is a floating, volitional entry trap, trapping operations will be 24 hours, 7 days per week.

Handling Protocols

During the operating period the holding trap will be checked by boat daily for any captured fish. Captured juvenile bull trout will be biologically sampled (fork length, genetic material, PIT tag if FL >80 mm) and then transported within an oxygenated tank aboard the boat to a waiting fish transport truck where collected fish will be taken down stream and released at the Woodland Release Ponds. Any coho, spring Chinook, or steelhead captured will be released as follows: Large fish (FL > 320 mm) will be transported upstream to Swift Reservoir; small fish (FL ≤ 320 mm) will be transported downstream of Merwin Dam to the Woodland Release Ponds similar to those juveniles collected at the Swift Floating Service Collector. Should steelhead kelts be captured, they also will be transported downstream of Merwin Dam for release at the Woodland Release Ponds.

Other incidentally captured fish species including kokanee will be liberated in Yale Reservoir outside of the influence of the trap.

VII. PERMITTING

Prior to construction of bull trout fish passage facilities identified above, the Utilities must obtain federal, state and local permits. Specific permits may include:

- Section 404 Permit – US Army Corps of Engineers
- In-water Work Protection Plan Approval – Washington Department of Ecology
- Hydraulic Project Approval – Washington Department of Fish and Wildlife
- Shoreline, Critical Areas and Land Use Approvals – Clark County / Skamania County
- Aquatic Land Lease – Washington Department of Natural Resources

The Utilities anticipate that it will take 12 – 18 months to obtain all required permits.

APPENDIX A – Drawings

VICINITY PLAN

SCALE: 1" = 60'

60 0 30 60

SCALE: 1"= 60'

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DATE 07/16/2019	
ENG FEP/R2	DES FEP/R2
DR DEP/R2	CH DEP/R2
APPROVAL	

LEWIS RIVER BULL TROUT PASSAGE
MERWIN UPSTREAM @ YALE TAILRACE

VICINITY PLAN

PACIFICORP HYDRO

SCALE: AS NOTED | SHEET 1 OF 11 | REV.

R2 Resource Consultants, Inc.
REDMOND, WA

PLOT SCALE: 1 = 1:1

REFERENCE DRAWINGS	DRAWING No.

No.	DATE	REVISION	BY	CHK	APP

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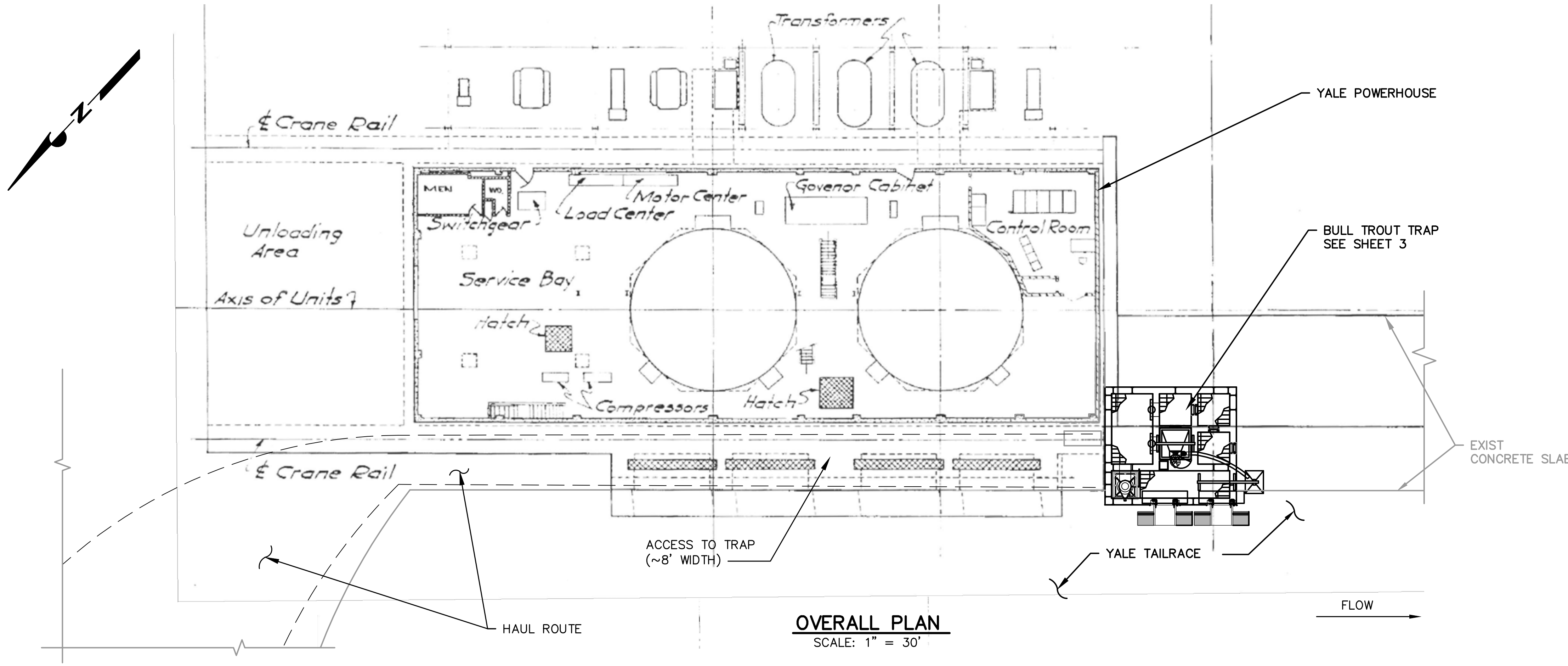
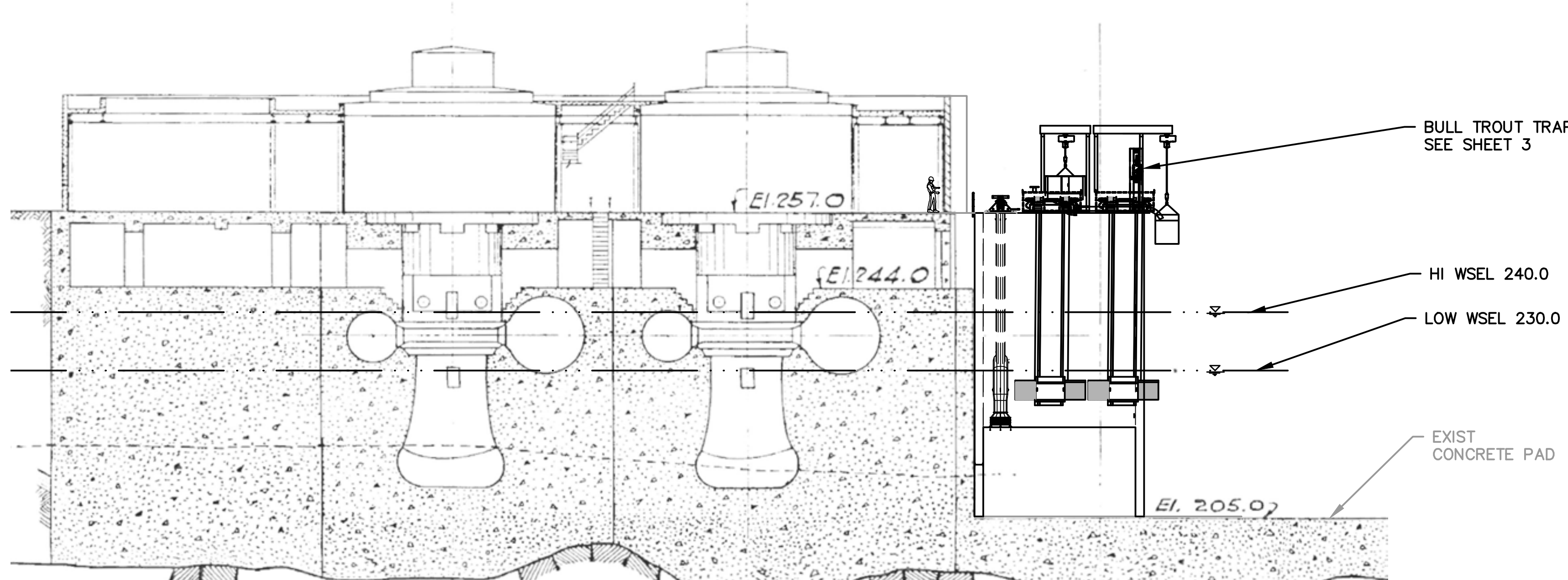


OVERALL PLAN

SCALE: 1" = 30'



OVERALL PROFILE

SCALE: 1" = 30'

30 0 15 30

SCALE: 1"= 30'

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DATE 07/16/2019	
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APPROVAL	

LEWIS RIVER BULL TROUT PASSAGE
MERWIN UPSTREAM @ YALE TAILRACE

OVERALL PLAN AND PROFILE

PACIFICORP HYDRO

SCALE: AS NOTED | SHEET 2 OF 11 | REV.

R2 Resource Consultants, Inc.
REDMOND, WA

PLOT SCALE: 1 = 1:1

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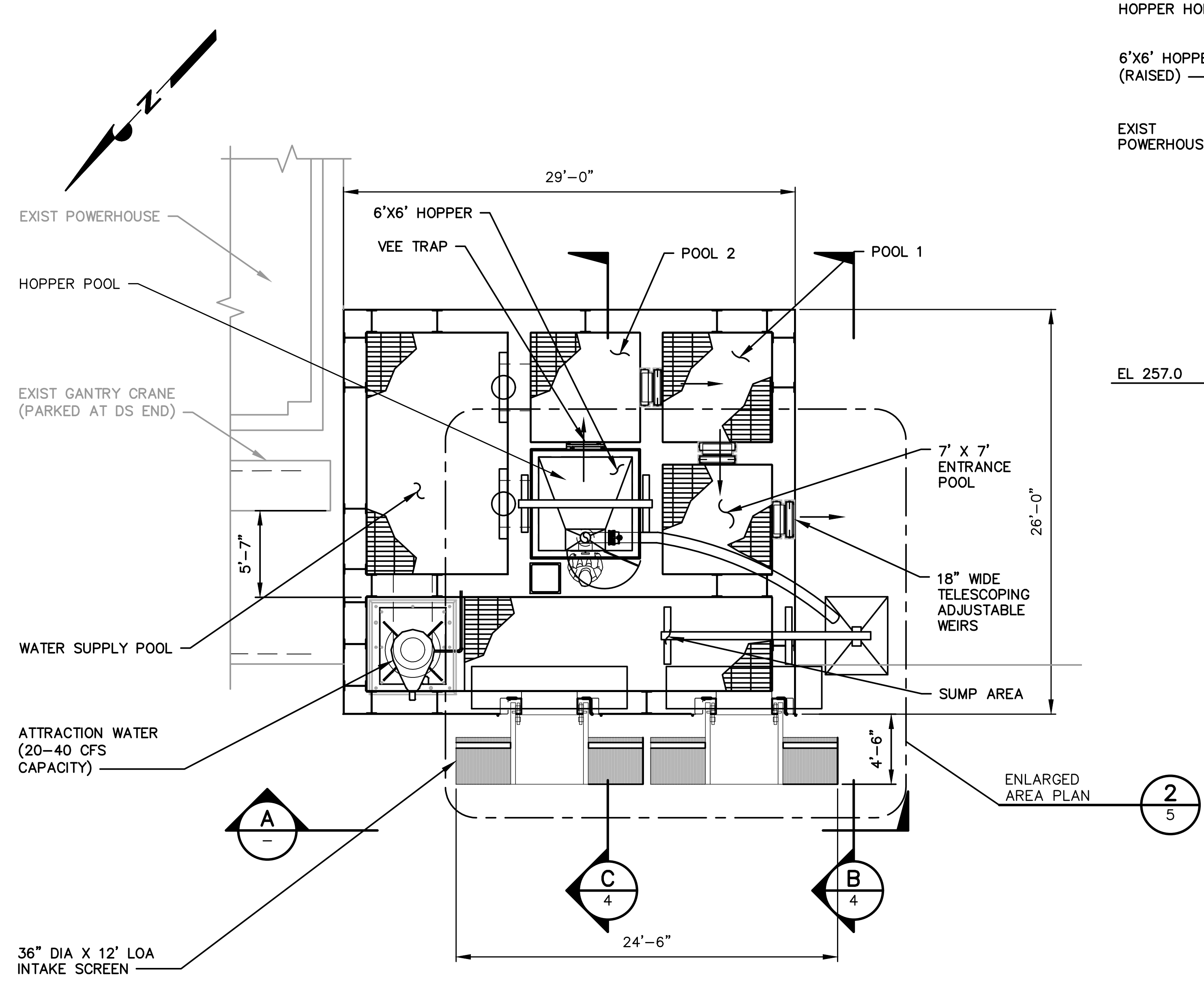
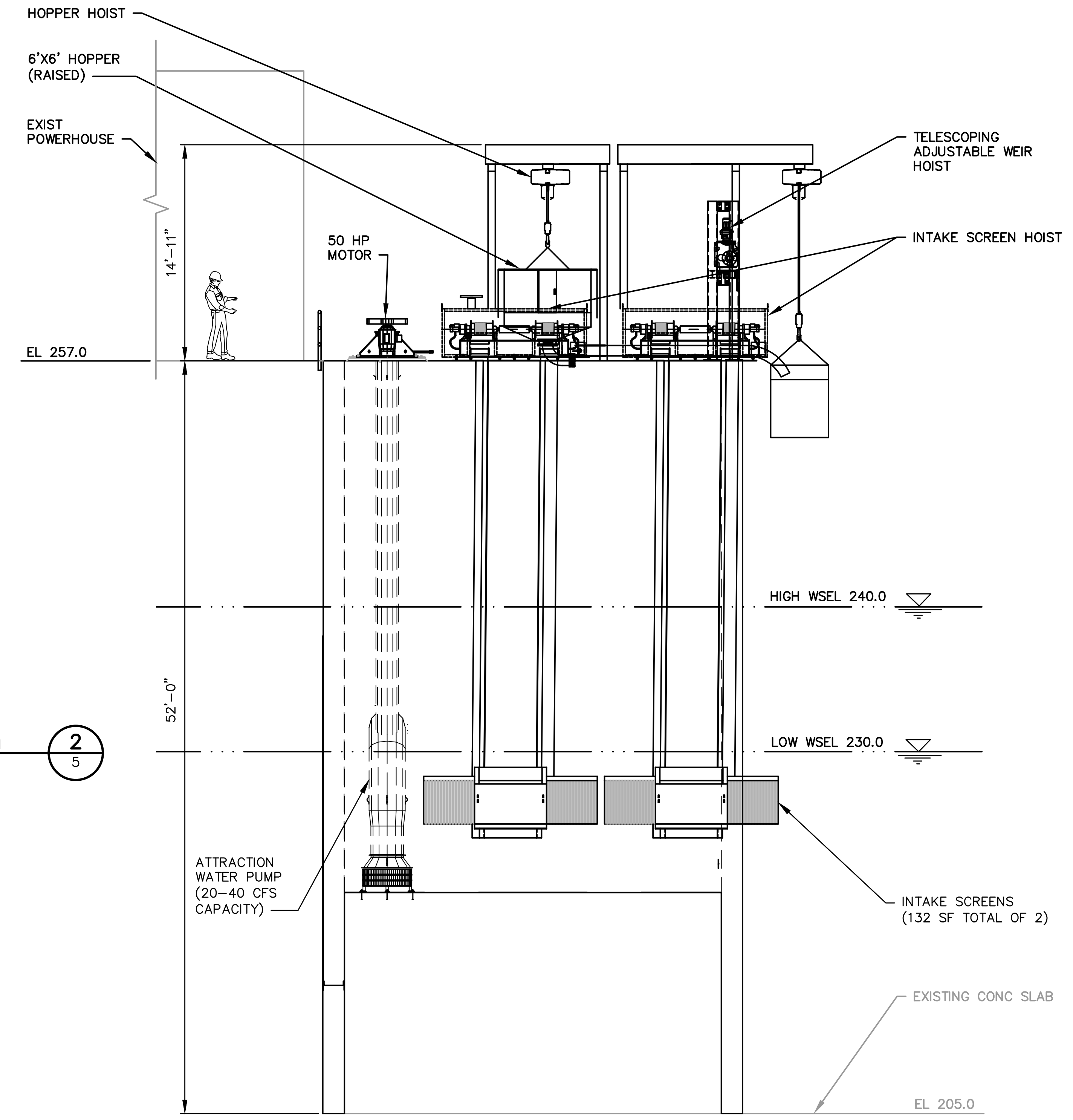


PLAN

SCALE: 1" = 10'

NOTES:

1. SEE SHEET 5 FOR TRAP PERFORMANCE NOTES.



ELEVATION–FRONT

A
–

SCALE: 1" = 10'

10 0 5 10
SCALE: 1"= 10'

Resource Consultants, Inc.
REDMOND, WA

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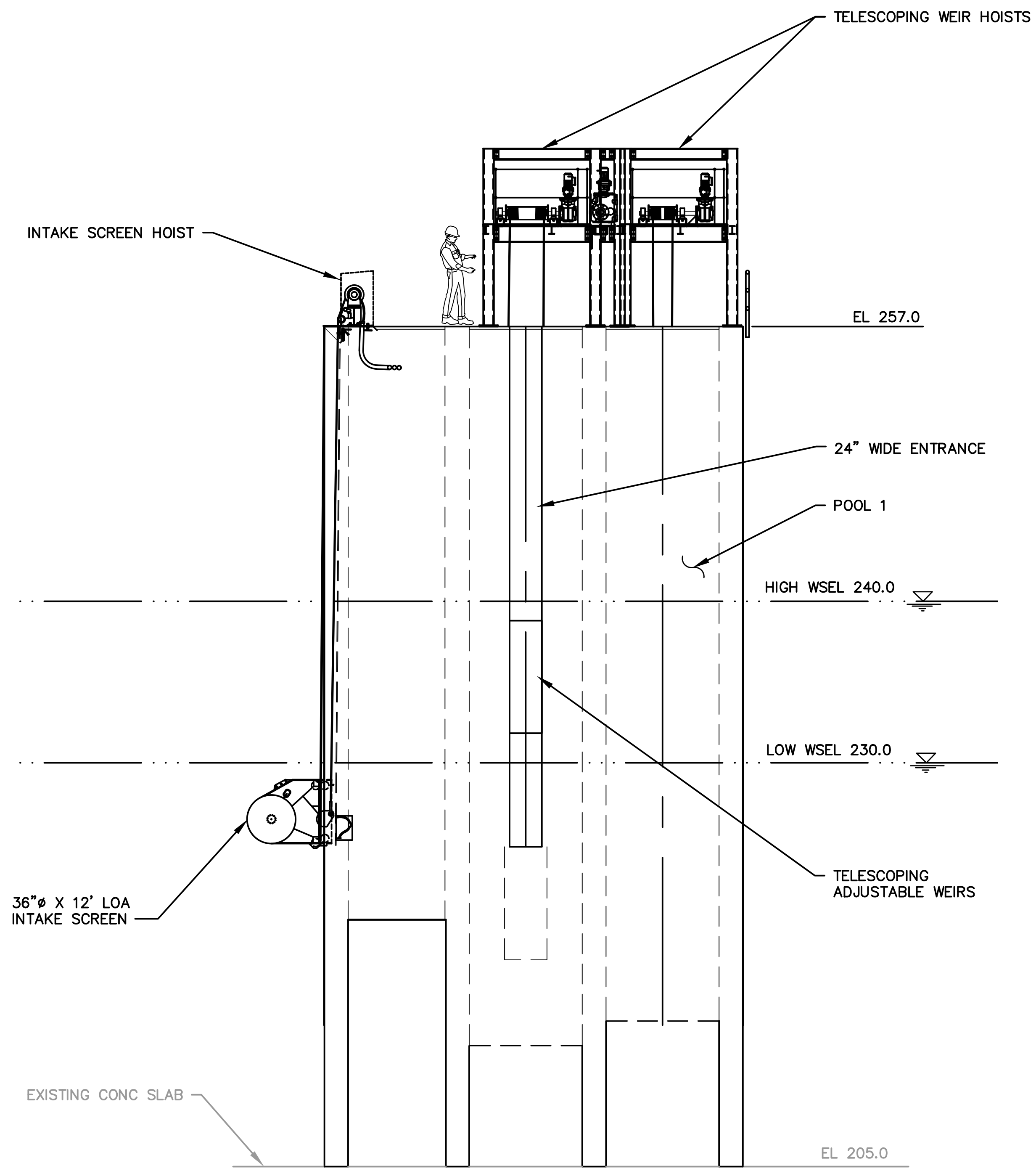
LEWIS RIVER BULL TROUT PASSAGE
MERWIN UPSTREAM @ YALE TAILRACE

PLAN AND ELEVATION

PACIFICORP HYDRO

SCALE: AS NOTED SHEET 3 OF 11 REV.

PLOT SCALE: 1 = 1:1



ELEVATION–ENTRANCE (B / 3)
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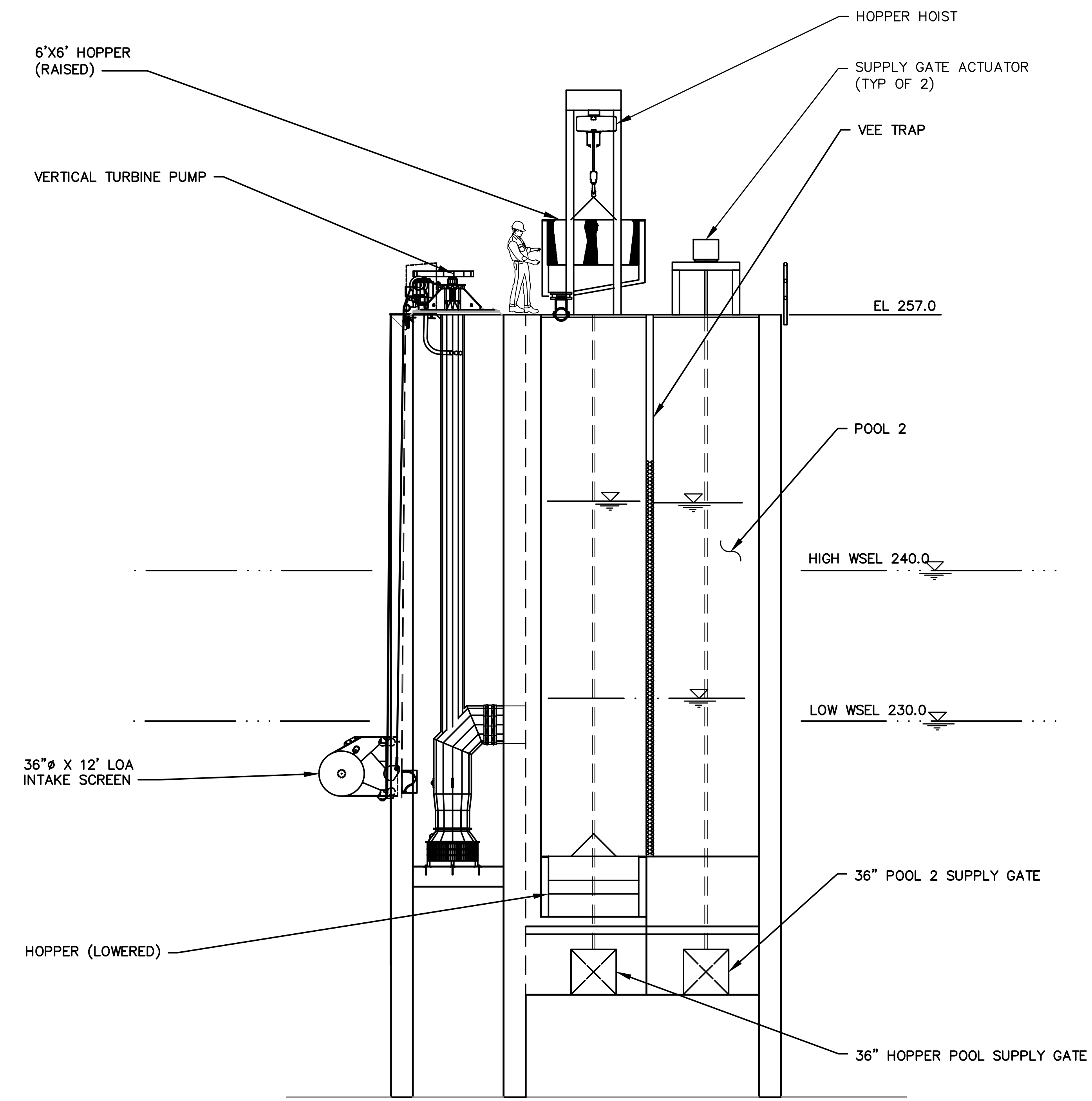

SECTION (C / 3)
SCALE: 1" = 10'

10 0 5 10
SCALE: 1"= 10'

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LEWIS RIVER BULL TROUT PASSAGE
MERWIN UPSTREAM @ YALE TAILRACE

ELEVATION AND SECTION

PACIFICORP HYDRO

SCALE: AS NOTED SHEET 4 OF 11 REV.

PLOT SCALE: 1 = 1:1

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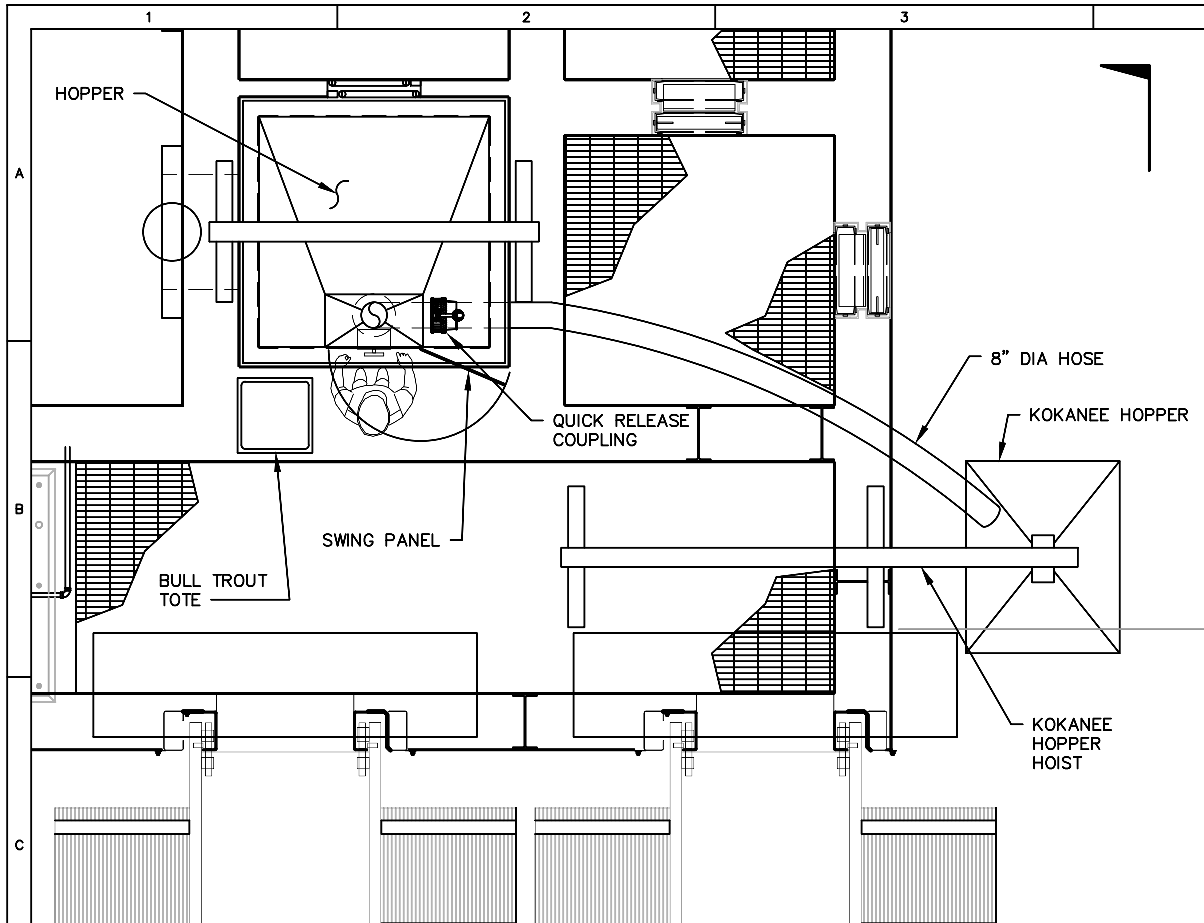
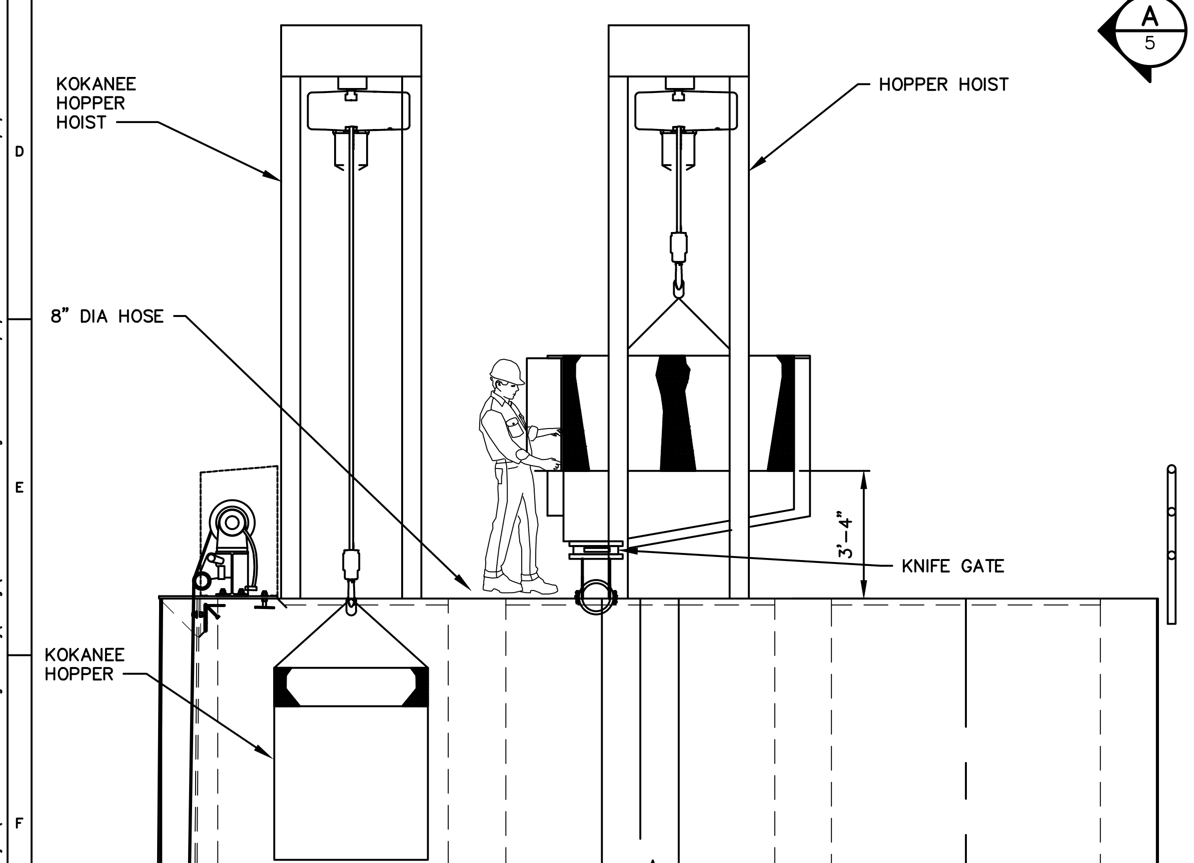
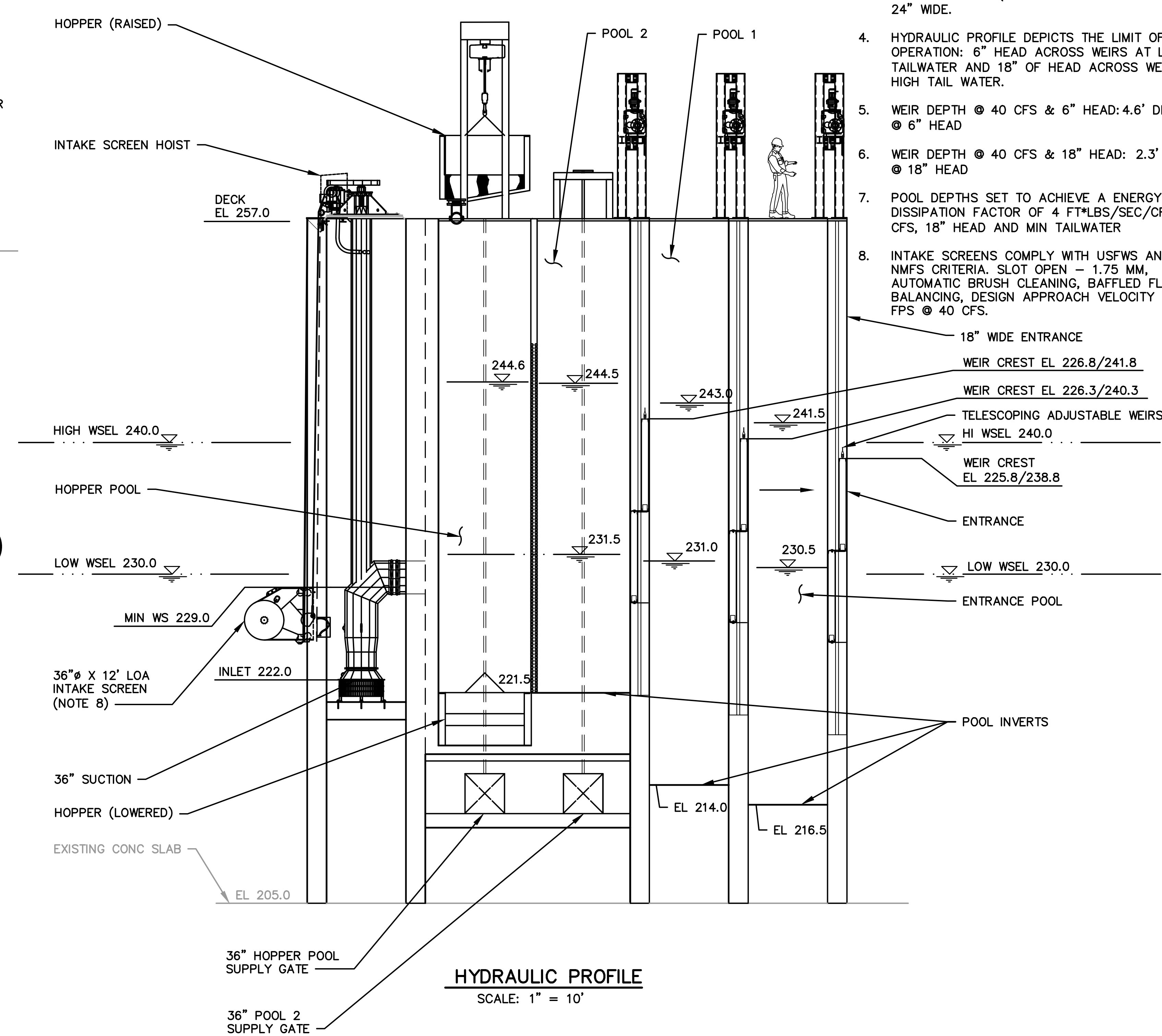


ENLARGED PLAN 2/3
SCALE: 1" = 5'



ELEVATION–SIDE A/5
SCALE: 1" = 5'



HYDRAULIC PROFILE
SCALE: 1" = 10'

10 0 5 10
SCALE: 1"= 10'

NOTES:

1. TRAP FLOW: 20–40 CFS.
2. OPERATION SEASON: MAY–OCTOBER.
3. HOPPER: 6' X 6' X 4.5' DEEP RESULTING:
   SUBMERGED VOL: 520 CF (520 – 4 LB FISH)
   TRANSPORT VOL: 54 CF (100 – 4 LB FISH)
3. ENTRANCE WEIR (AND WEIRS BETWEEN POOL): 24" WIDE.
4. HYDRAULIC PROFILE DEPICTS THE LIMIT OF OPERATION: 6" HEAD ACROSS WEIRS AT LOW TAILWATER AND 18" OF HEAD ACROSS WEIRS AT HIGH TAIL WATER.
5. WEIR DEPTH @ 40 CFS & 6" HEAD: 4.6' DEPTH @ 6" HEAD
6. WEIR DEPTH @ 40 CFS & 18" HEAD: 2.3' DEPTH @ 18" HEAD
7. POOL DEPTHS SET TO ACHIEVE A ENERGY DISSIPATION FACTOR OF 4 FT*LBS/SEC/CF @ 40 CFS, 18" HEAD AND MIN TAILWATER
8. INTAKE SCREENS COMPLY WITH USFWS AND NMFS CRITERIA. SLOT OPEN – 1.75 MM, AUTOMATIC BRUSH CLEANING, BAFFLED FLOW BALANCING, DESIGN APPROACH VELOCITY – 0.3 FPS @ 40 CFS.

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APPROVAL	

LEWIS RIVER BULL TROUT PASSAGE
MERWIN UPSTREAM @ YALE TAILRACE

PLAN, ELEV & HYDRAULIC PROFILE

PACIFICORP HYDRO

SCALE: AS NOTED SHEET 5 OF 11 REV.

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REDMOND, WA

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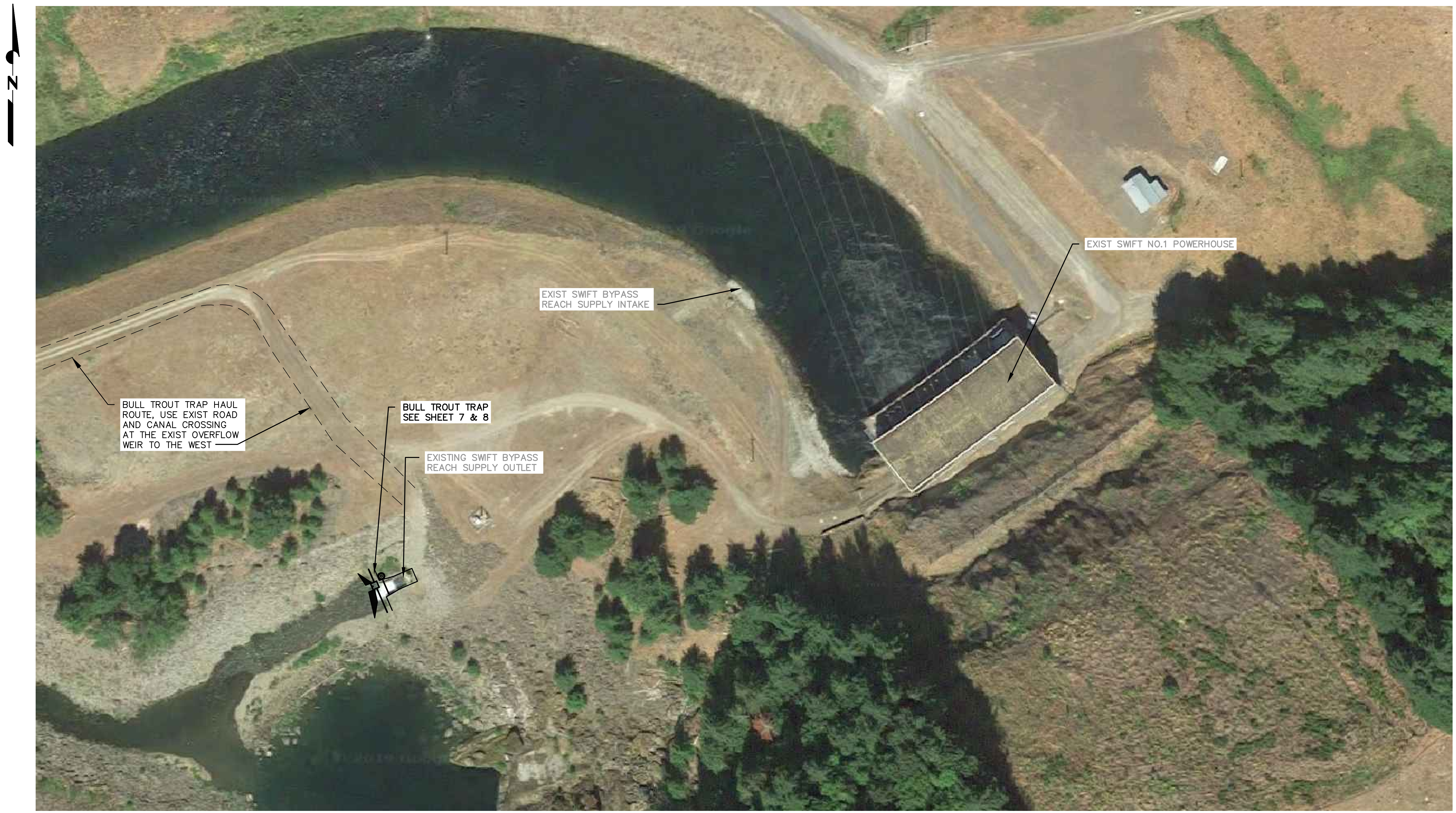

VICINITY PLAN

SCALE: 1" = 100'

100 0 50 100

SCALE: 1"= 100'

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APPROVAL	

LEWIS RIVER BULL TROUT PASSAGE
YALE UPSTREAM @
SWIFT BYPASS REACH
VICINITY PLAN

PACIFICORP HYDRO

SCALE: AS NOTED | SHEET 6 OF 11 | REV.

R2 Resource Consultants, Inc.
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PLOT SCALE: 1 = 1:1

REFERENCE DRAWINGS	DRAWING No.

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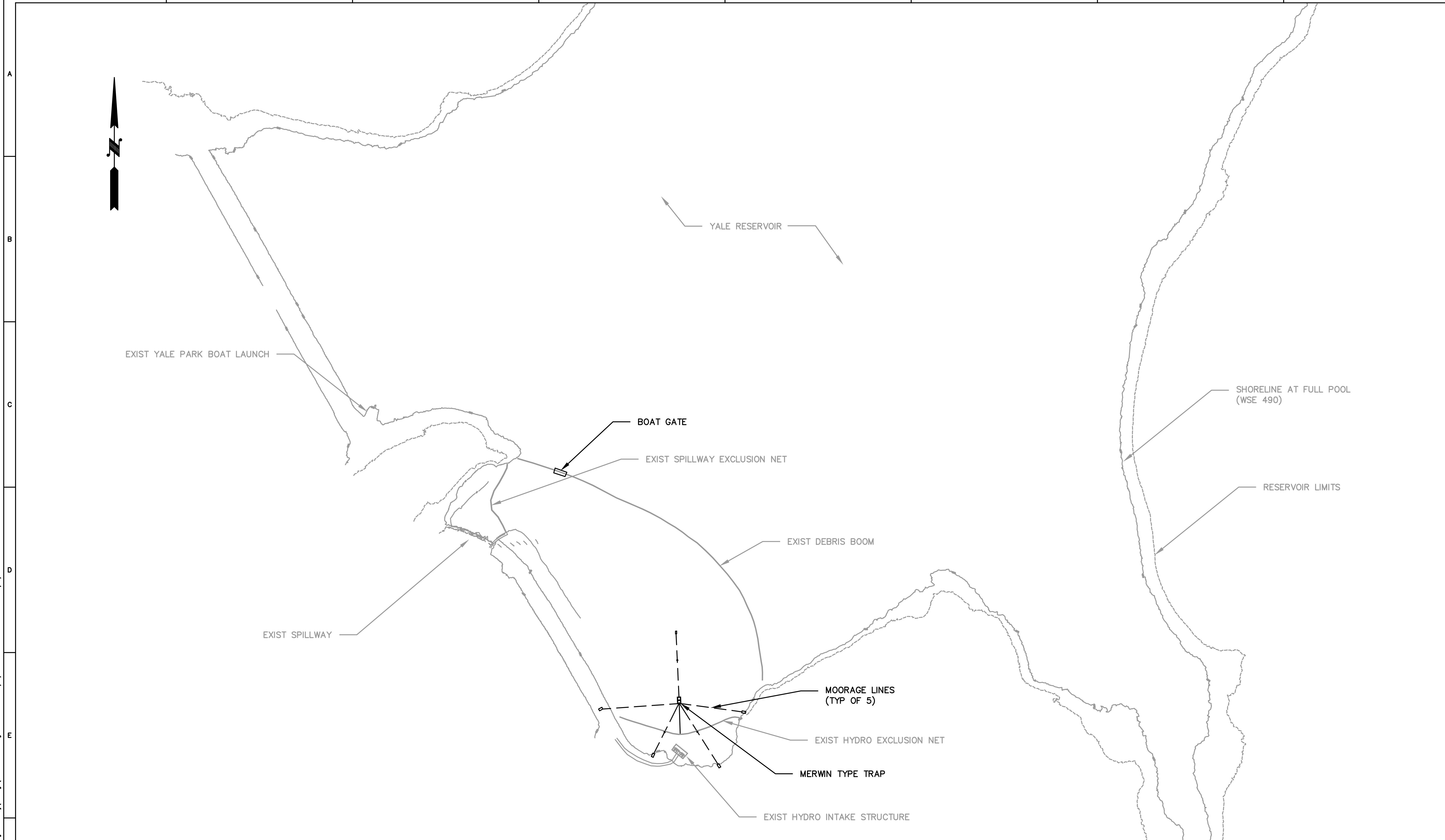

VICINITY PLAN
SCALE: 1" = 500'

500 0 250 500
SCALE: 1"= 500'

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LEWIS RIVER BULL TROUT PASSAGE
YALE DOWNSTREAM @ YALE INTAKE

VICINITY PLAN

PACIFICORP HYDRO

SCALE: AS NOTED SHEET 9 OF 11 REV.

R2 Resource Consultants, Inc.
REDMOND, WA

PLOT SCALE: 1 = 1:1

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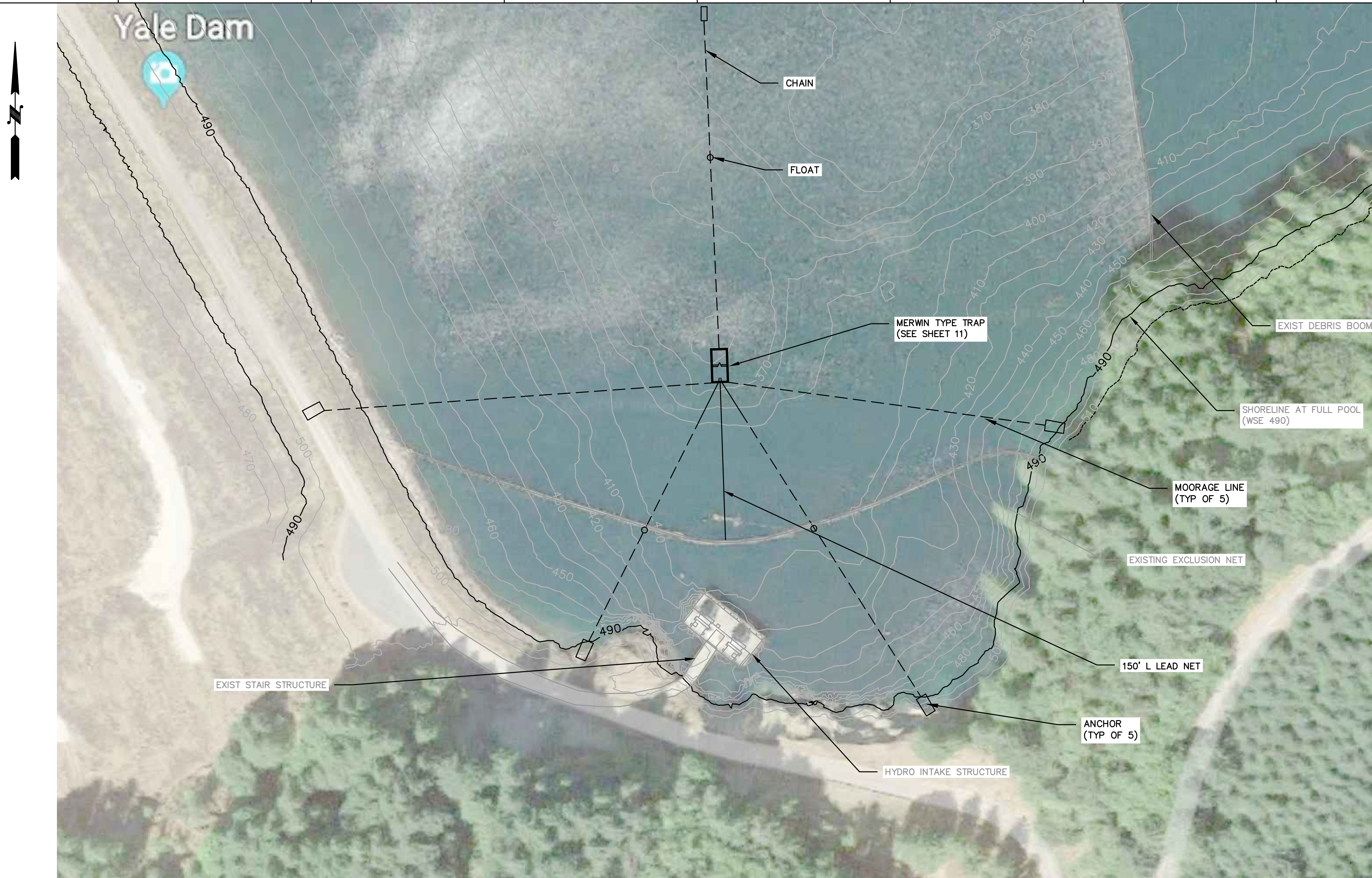

SITE PLAN

SCALE: 1" = 100'

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SCALE: 1"= 100'

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APPROVAL	

LEWIS RIVER BULL TROUT PASSAGE
YALE DOWNSTREAM @ YALE INTAKE

SITE PLAN

R2 Resource Consultants, Inc.
REDMOND, WA

PACIFICORP HYDRO

SCALE: AS NOTED SHEET 10 OF 11 REV.

PLOT SCALE: 1 = 1:1

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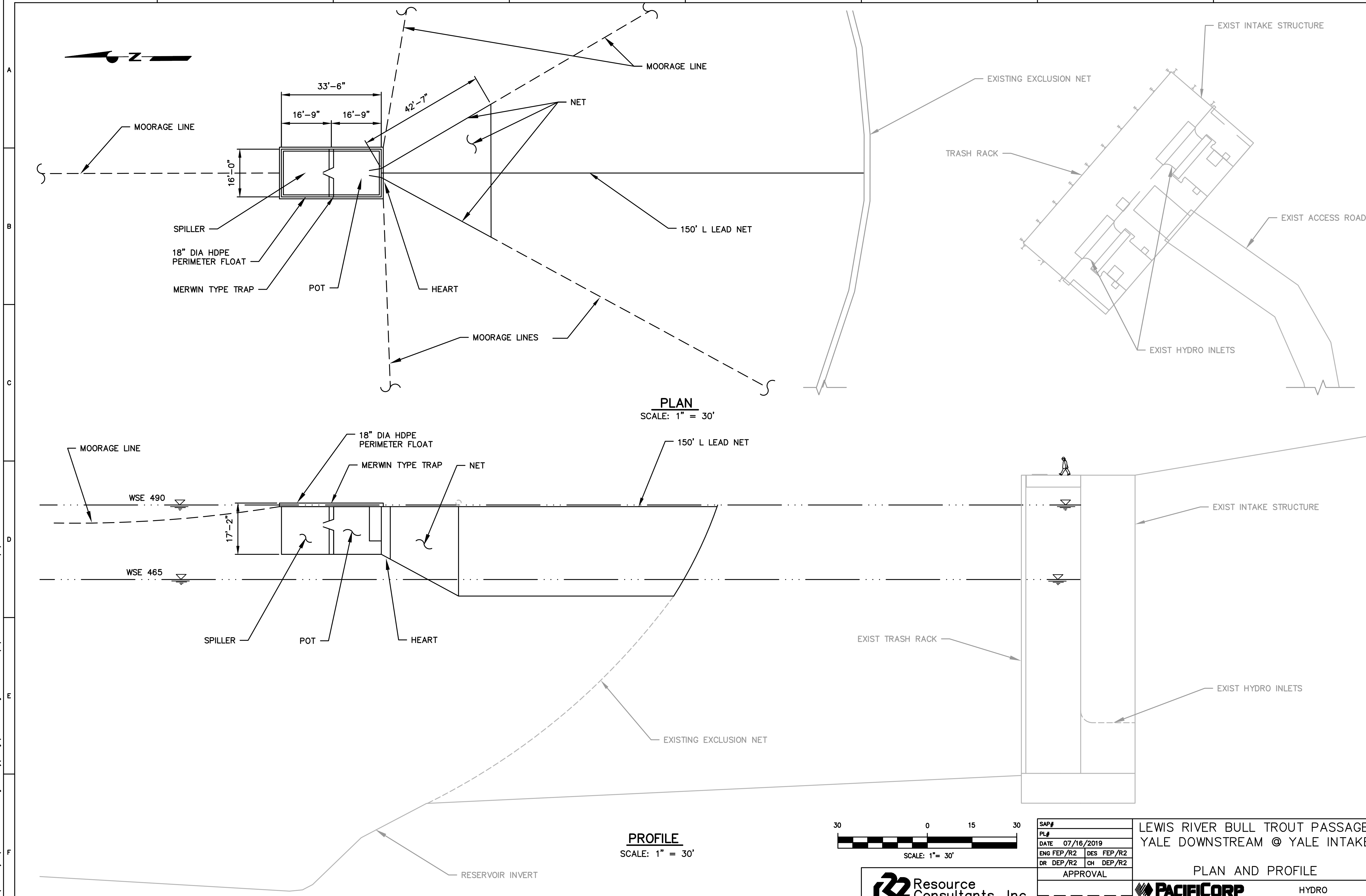

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APPROVAL

LEWIS RIVER BULL TROUT PASSAGE
YALE DOWNSTREAM @ YALE INTAKE

PLAN AND PROFILE

R2 Resource Consultants, Inc.
REDMOND, WA

PACIFICORP
HYDRO

SCALE: AS NOTED | SHEET 11 OF 11 | REV.

PLOT SCALE: 1 = 1:1

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APPENDIX B - Technical Memorandum, Criteria for Bull Trout Passage Facilities

RESOURCE CONSULTANTS INC.
15250 NE 95TH STREET
REDMOND, WA 98052
425.556.1288
r2usa.com

Technical Memorandum

Date: October 2, 2019 Project Number: 2241.01/TM001

To: Ian McGrath, PacifiCorp

From: Frank Postlewaite, P.E.

Cc: Dana Postlewait, P.E.

Project: Lewis River Bull Trout Passage

Subject: Criteria for Bull Trout Passage Facilities

This Technical Memorandum presents supporting criteria for the Lewis River Bull Trout Passage Plan and, in particular, the preliminary design of Bull Trout passage facilities to be constructed at three locations at the Lewis River Hydroelectric Project. The three locations for Bull Trout trapping facilities are presented and described. These descriptions include similar facilities that may be applicable at each site. The site locations are followed by an outline of criteria used to guide the preliminary design.

1. Locations

The locations that are selected for Bull Trout passage facilities include the two upstream facilities followed by the downstream facility. The first facility that is presented is located at the Yale Tailrace adjacent to the downstream side of the powerhouse to provide upstream passage from the Merwin Reservoir. The second facility is located at the upstream end of the Swift Bypass reach to provide upstream passage from the Yale Reservoir. The last location is at the Yale Forebay adjacent to the hydro intake structure which provides downstream passage from the Yale Reservoir. Figure 1 depicts these locations.

1. Merwin Upstream @ Yale Tailrace (Section 1.1)
2. Yale Upstream @ Head of Swift Bypass Reach (Section 1.2)
3. Yale Downstream @ Yale Forebay (Section 1.3)

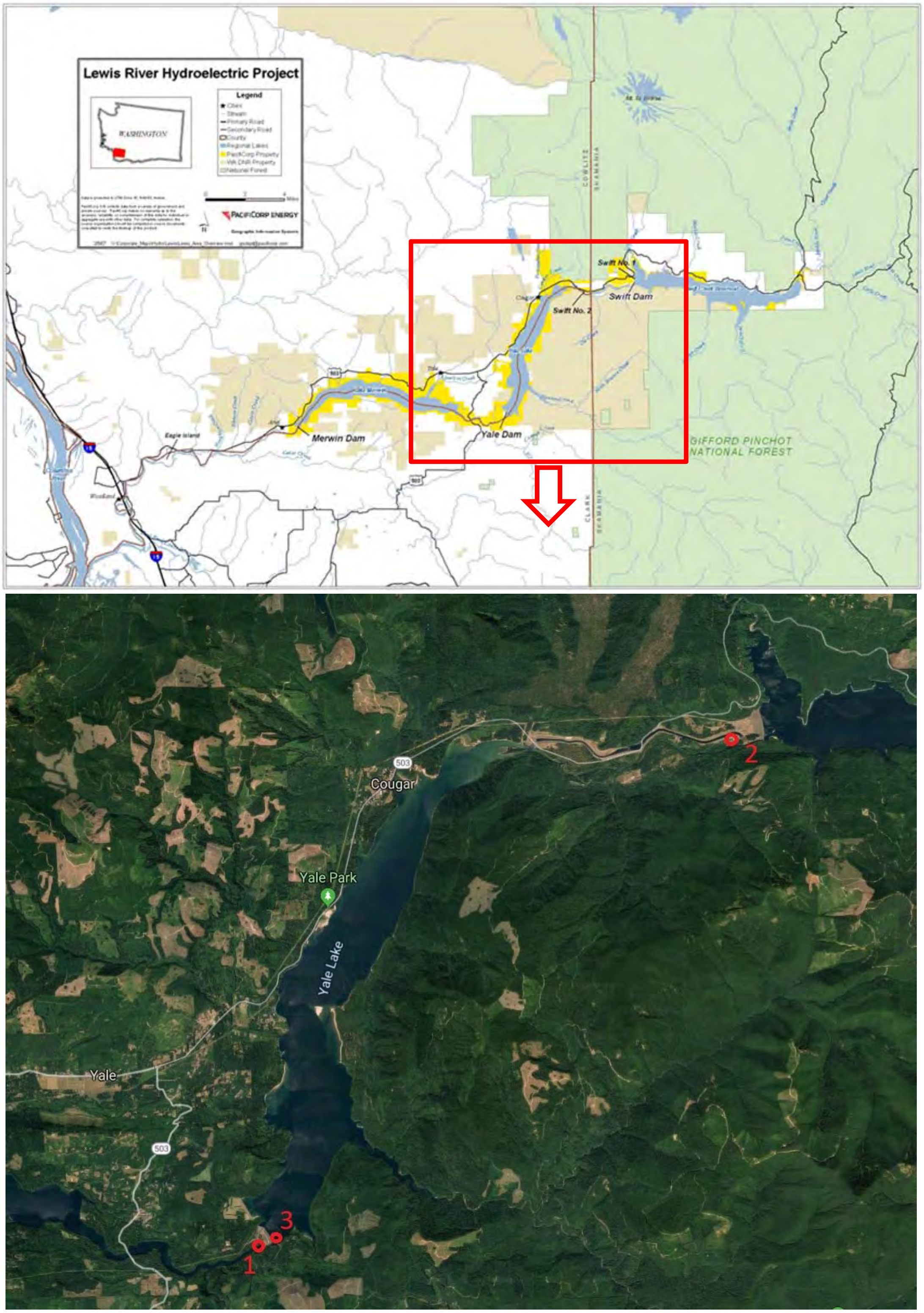

Figure 1. Bull Trout passage locations.

1.1 Yale Tailrace (Upstream Migrants)

The Yale Tailrace location is at the upstream end of the Merwin Reservoir adjacent to the Yale powerhouse. The trap is intended for capturing Bull Trout that intend to migrate upstream from the Merwin reservoir. Figure 2 depicts the tailwater area at a relatively full pool condition. Figure 3 depicts the Merwin Reservoir downstream of the powerhouse. Figure 4 depicts the downstream wall of the Yale powerhouse where the trap is anticipated to be installed.

Figure 2. Yale Powerhouse.

Figure 3. Yale Powerhouse looking downstream.

Figure 4. Downstream wall of Yale Powerhouse.

The following outline presents information that is used to guide the design at this specific location (Section 2 presents general criteria applicable to all locations):

1. Upstream season (May – October)
2. Permanent structure
3. Tailwater fluctuation: 10.0 feet (see Figure 5)

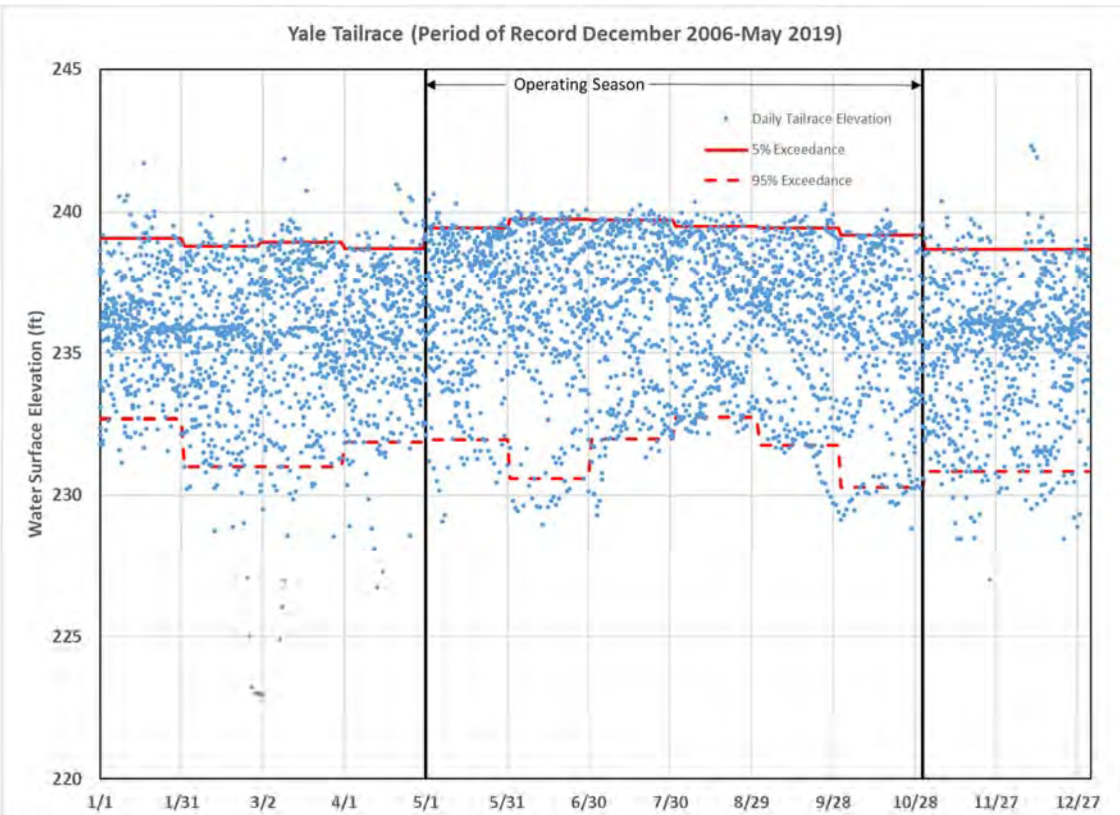

Figure 5. Yale tailwater elevations for Bull Trout migration timing.

4. Multiple pools with adjustable flow and head conditions
5. Adjustable head range across pool weirs: 0.5 to 1.5
6. Screened auxiliary water pump station
    a. Screen to meet NMFS and USFWS criteria
    b. 1.75 slot openings
    c. 0.4 feet per second maximum design approach velocity.
    d. Automatic brush screen cleaning (triggered on timer and differential)

7. Attraction flow: 20 to 40 cfs
8. US entrance attraction flow orientation: Jet oriented parallel to bank of river or reservoir
9. Entrance width: 2.0 ft
10. Minimum Flow Depth: 2.0 ft
11. Minimum pool dimensions: 7 feet wide x 7 feet long
12. Use hopper style mechanism for fish transport.
13. Refuge area in holding pool: 1-inch spacing (removable basket)

1.2 Swift Bypass Reach (Upstream Migrants)

The Swift Bypass Reach location is at the uppermost end of the reach at the control structure that draws water from the Swift No.1 Tailrace and supplies water to the reach. The trap is for capturing Bull Trout that intend to migrate upstream from the Yale reservoir and the Swift Bypass Reach. Figures 6 and 7 depict this location.

Figure 6. Swift bypass reach (looking downstream from the flow control structure).

Figure 7. Swift bypass reach (looking upstream from the flow control structure).

The following outline presents information that is used to guide the design at this location.

1. Outlet of Reach Water Supply
    a. Inverted Siphon
    b. Flow Meter used to modulate gate to maintain desired flow
    c. Inundated during spill events in excess of 5,000 cfs
    d. Subject to significant bedload movement at spill events in excess of 5,000 cfs
    e. Regulated flow in 50 to 100 cfs range (design flow of 76 cfs)
2. Upstream Season (May – October)
3. Bypass Design Flow: 76 cfs
4. Can operate up to a 5,000 cfs Spill Event
    a. Probability of Spill during operation: very low for operating period
    b. Removable or robust features are needed to prevent damage
5. Semi-Permanent Facility (10-year life)
6. Picket barriers:

a. NOAA 5.3.2.1: Openings < or equal to 1 inch and the average design river velocity through pickets should be less than 1.0 ft/s for all design flows, with maximum velocity less than 1.25 ft/s, or half the velocity of adjacent passage route flows whichever is lower. The average design velocity is calculated by dividing the flow by the total submerged picket area over the design range of stream flows

7. Picket Barrier leading to a live box (hopper)

Example – Graves Creek

There is a successful bull trout trap using a picket barrier located on Graves Creek, a stream in Montana. Figures 8, 9, and 10 depict the Graves Creek project that utilized picket barriers on a stream for effectively traps adult Bull Trout migrating upstream to spawn.

Figure 8. Graves Creek Bull Trout trap looking downstream.

Figure 9. Graves Creek Bull Trout trap looking upstream.

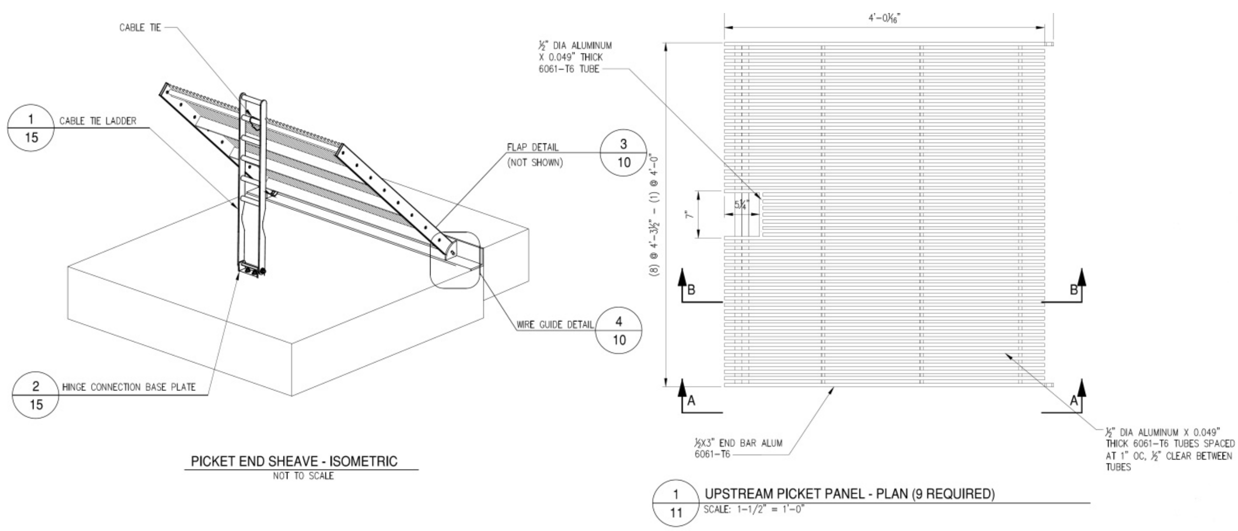

Figure 10. Upstream picket barrier panel at Graves Creek.

Graves Creek Features:

1. Design flow: 60 cfs
2. Live box: 10 cfs
3. Picket spacing 0.5" clear downstream panels / .75" upstream panels
4. Pickets:
    a. 38.3 ft long x 4 ft
    b. Area 153 sf maximum.
    c. 50% open area clean
    d. 0.8 fps slot velocity clean

1.3 Yale Forebay (Downstream Migrants)

The Yale Forebay location is at the downstream end of the Yale Reservoir adjacent to the hydro intake structure. The trap is intended for capturing Bull Trout seeking to migrate downstream from the Yale reservoir. Figure 11 depicts the intake structure and associated exclusion net at near full pool condition. Figure 12 depicts the construction of the intake structure. Figure 13 presents an isometric depiction of the Merwin type trap intended for use at this location.

Figure 11. Yale hydro intake structure at high pool.

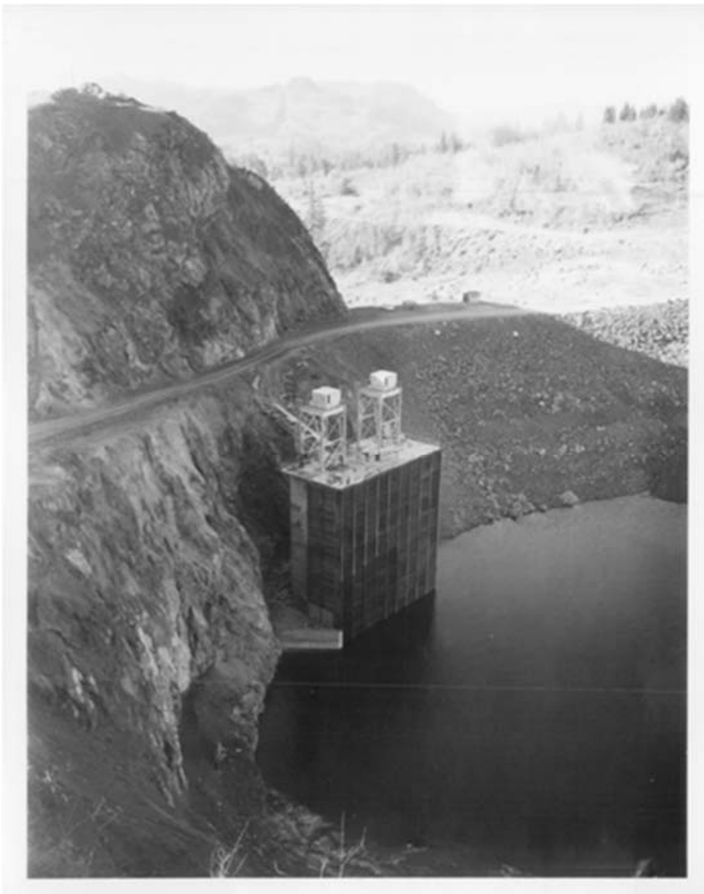

Figure 12. Yale hydro intake structure at low pool during construction.

The following outline presents information that is used to guide the design at this location:

1. "Merwin Trap" type net assembly
2. Located adjacent to the hydro intake
3. Integrated with the exclusion net
4. Passive trap (no induced flow)
5. Serviced by boat
6. Water surface elevation range 227 to 240 feet.

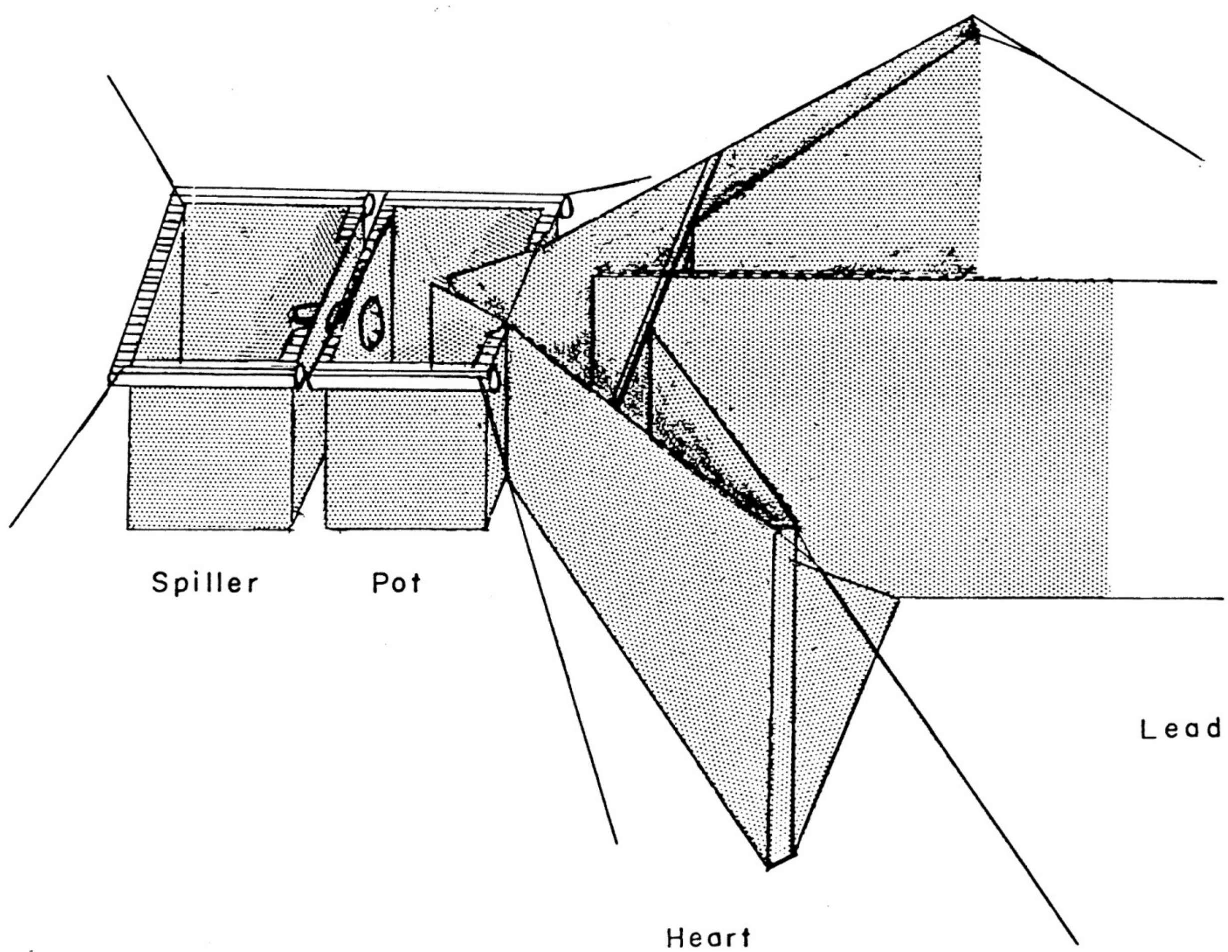

Figure 13. Lake Merwin floating trap (Hamilton – Use of Hydroelectric Reservoir for Rearing of Coho Salmon, 1970).

2. Criteria

The following outline presents criteria that are used to guide the general design.

1. Target species – Bull Trout
2. Other species – Kokanee, trout
3. Average fish size:
    a. Adult Bull Trout – 4 lb/fish
    b. Sub-adult Bull Trout – 1 lb/fish
    c. Kokanee – 0.4 lb/fish
    d. Trout – .75 lbs/fish
4. Upstream Bull Trout trapping season (May – October)
5. Downstream Bull Trout trapping season (March – June)
6. Max design day fish capture:
    a. Yale Upstream - Swift bypass reach:
        i. Adult Bull Trout – 5 fish/day (20 lb/day)
        ii. Sub-adult Bull Trout – 5 fish/day (5 lb/day)
        iii. Kokanee – 200 fish/day (80 lb / day)
        iv. Trout – 10 fish/day (7.5 lb / day)
    b. Yale Downstream - Yale forebay:
        i. Sub-adult Bull Trout – 2 fish/day (2 lb/day)
        ii. Northern Pike Minnow – 100 fish/day (2 lb/day)
    c. Merwin Upstream - Yale tailrace:
        i. Adult Bull Trout – 5 fish/day (20 lb/day)
        ii. Sub-adult Bull Trout – 5 fish/day (5 lb/day)
        iii. Kokanee – 400 fish/day (160 lb / day)
        iv. Trout – 10 fish/day (7.5 lb / day)
7. Holding pool volume:
    a. NOAA 6.5.1.2: 0.25 cf / lb of fish (1.9 gal / lb of fish @ temp < 50°F)
8. Holding pool flow:
    a. NOAA 6.5.1.3: 0.67 gpm / adult anadromous fish

9. Holding and transport volume segregation:
    a. Differentiate fish at 450 mm fork length
    b. Bull Trout girth (width) at 450 mm fork length: 3.2 inches (see Figure 14).
    c. Clear opening bar width: 1.0 inches

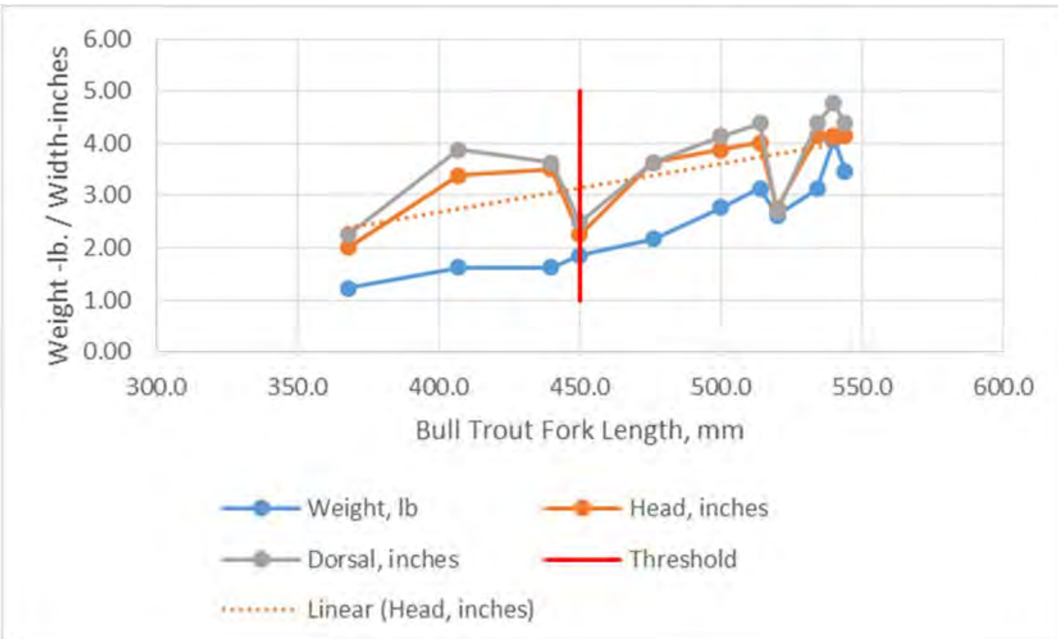

Figure 14. Bull Trout biometrics from 11 fish at Upper Baker FSC on 5/15/2019.

10. Transport volume:
    a. 1 gal/lb of fish (2019 Bull Trout passage plan)
    b. NOAA 6.5.1.2: 0.15 cf / lb of fish (1.1 gal / lb of fish)
11. Transport truck appurtenances:
    a. Oxygen (tank and air stone)
    b. Recirculation system:
        i. Bell: turnover of volume every 5 – 7 minutes (36 to 50 gpm for 250 gal truck)
        ii. NOAA 6.5.1.3 0.67 gpm per adult fish (7 gpm for 10 fish)
    c. Dissolved oxygen monitoring
12. Transport temperature conditions:
    a. Receiving water < 18°C (64.4°F) 16°C max recommended

   b. Temperature difference < 3°C
   c. Tempering required if differential exceeds 3°C
13. Transport trucks available:
    a. 250 gallon (223 lbs of fish)
    b. 1,800 gallon (1636 lbs of fish)
14. Truck disinfection:
    a. Treat daily with 12.5% bleach diluted 1 part to 6,000 parts water (5.3 fl oz per 250 gallons)
    b. Dechlorinate with sodium thiosulfate (160 g / 250 gallons)
    c. Test chlorine residual (should make sure sodium thiosulfate residual is zero also)
15. Upstream season: May thru October (spawning migration)
16. Downstream season: March thru June (smolt outmigration)
17. Trap operation:
    a. 24 hour per day 7 days per week during season
    b. Checked daily
18. Sampling activities:
    a. PIT tag scanning
    b. PIT tag un-tagged fish (23mm tag for fish > 250mm / 12mm for fish<250mm)
    c. Sample genetic material
    d. Measure fork length

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Response to Comments regarding August 2019 versions of the Draft Lewis River Merwin In-Lieu Program Strategic Plan and Draft Lewis River Basin Implementation Monitoring Plan

Yale Hydroelectric Project
(FERC No. P-2071)

January, 2020

Responses to Comments Received on Draft Lewis River In-Lieu Program Strategic Plan - ACC 30 day Review Draft Dated August 1, 2019

Date	Commenter	Comment Number	Comment	Response
9/3/2019	Jim Byrne Trout Unlimited	1	Trout Unlimited has decided not to respond to your 30-day review of the Lewis River Basin Implementation Monitoring Plan, Merwin In-Lieu Strategic Plan, and Lewis River Bull Trout Passage Concepts document at this time. Needed information was incomplete, timeline unrealistic. We believe the ACC has a definite role in approving the implementation and monitoring plans, and we intend to participate in doing so. We do not believe the Alternative Dispute Resolution (ADR) will be completed before your requested timeline and it would be foolish to comment prior to a final accepted plan. Also, since the determinations of the Federal Services are preliminary, we recommend that the review period for these documents be postponed. Both Services seem disengaged and unable to provide final decisions in a timely manner. USF&WS has not consulted on the Yale bull trout passage plan with the bull trout recovery team, or the ACC; as directed in their own proposal. When we fully understand the USF&WS expectations, including how they will meet key sections of their Lewis River bull trout Recovery Plan; then we will engage at that time.	Draft documents were provided to ACC for standard 30-day review period. Future actions taken by the Utilities regarding ACC review of documents will be under consideration of ADR outcome, Settlement Agreement consultation requirements, recommendations of the Services, and FERC requirements.
9/3/2019	Steve Manlow, CRFRB	2	The outcome of the ADR process may substantively change the scope and scale of management approaches. In light of this, the ACC's role in approval of the implementation and monitoring plans, and the fact that the Services determinations are preliminary, we recommend that the review period for these documents be postponed until after all ADR processes are concluded, and the Services make final decisions. Once final decisions are made, we will be able to provide more meaningful and focused feedback on these documents.	Draft documents were provided to ACC for standard 30-day review period. Future actions taken by the Utilities regarding ACC review of documents will be under consideration of ADR outcome, Settlement Agreement consultation requirements, recommendations of the Services, and FERC requirements. Some of this process will take place prior to the Services making their final decision.
9/3/2019	Eli Asher, Cowlitz Tribe	3	The Tribe will not provide detailed review comments on the draft Lewis River Basin Implementation Monitoring Plan and draft Merwin In-Lieu Strategic Plan at this time. Both draft plans are fatally flawed in their failure to address NMFS' directions within its April 11, 2019 preliminary determination, but more importantly, the plans have been drafted prematurely and may be rendered unnecessary by ongoing disputes among Settlement Agreement parties. Six Settlement Agreement parties, constituting a majority of currently active ACC participants, have filed Notices of Dispute with FERC that have direct bearing on the need for the plans. Additionally, NMFS' preliminary determination on fish passage through the Lewis River Project clearly states that restoration and monitoring plans would require ACC approval "if and when [the] proposed decision becomes final." NMFS and USFWS have declined to make final determinations on fish passage to date, and PacifiCorp and Cowlitz PUD have declined to seek or obtain "necessary consent from the Agreement parties" per NMFS' direction. Given these circumstances, the Tribe contends that ACC review and/or approval of the plans is inappropriate at this time.	Unfortunately the letter from the Cowlitz Tribe does not identify how the draft Strategic Plan and draft Monitoring Plan are "fatally flawed". Draft documents were provided to ACC for standard 30-day review period. Future actions taken by the Utilities regarding ACC review of documents will be under consideration of ADR outcome, Settlement Agreement consultation requirements, recommendations of the Services, and FERC requirements. Some of this process will take place prior to the Services making their final decision. Given the Utilities are preparing the actions plans to support the Services preliminary decisions - none of which are in currently in final form, it is premature at this point for the Utilities to seek or obtain consent from parties.
9/3/2019	Tom Wadsworth District Fish Biologist; Kessina Lee Region 5 Director WDFW	4	Given the uncertain outcome of the ADR process, it is premature for WDFW (or the ACC) to approve any of the aforementioned plans until the ADR process is completed.	Draft documents were provided to ACC for standard 30-day review period. Future actions taken by the Utilities regarding ACC review of documents will be under consideration of ADR outcome, Settlement Agreement consultation requirements, recommendations of the Services, and FERC requirements. Some of this process will take place prior to the Services making their final decision.
9/3/2019	Tom Wadsworth District Fish Biologist; Kessina Lee Region 5 Director WDFW	5	**Monitoring Plan**: will not accomplish the goals necessary to address requirements detailed in the Services' April 11, 2019, letter [citation removed]. If the ADR process does not result in a change to the Services' April 11, 2019, pre-decision, WDFW proposes that a review of the monitoring plan proceed after the ADR process is complete.	Unfortunately the WDFW letter does not identify how the draft Monitoring Plan will not accomplish the goals necessary to address requirements detailed in the Services April 11, 2019 letters. However, the Utilities expect to provide the SA parties an additional opportunity to review the draft monitoring plan prior to submittal to FERC.

Responses to Comments Received on Draft Lewis River In-Lieu Program Strategic Plan - ACC 30 day Review Draft Dated August 1, 2019

Date	Commenter	Comment Number	Comment	Response
9/3/2019	Tom Wadsworth District Fish Biologist; Kessina Lee Region 5 Director WDFW	6	**In-Lieu Strategic Plan**: WDFW will want to engage in the Technical Advisory Committee, if and when it is formed after the completion of the current pending ADR process.	Comment noted. As per the Draft Strategic Plan, parties to the SA will be provided the opportunity to participate in the TAC.
9/3/2019	Tom Wadsworth District Fish Biologist; Kessina Lee Region 5 Director WDFW	7	**Bull Trout Fish Passage Concepts document:** WDFW appreciates PacifiCorp beginning to develop these concepts. We strongly encourage the Utilities to utilize the Lewis River Bull Trout Recovery Team in reviewing these concepts and future designs. As a reminder, per Settlement Agreement Section 4.1.2, WDFW expects to be provided a 45-day comment period for the 30% and 60% passage designs when available. Again, WDFW believes it is premature to begin reviewing these designs prior to completing the ADR process.	The Utilities agree with engaging the Lewis River Bull Trout Recovery Team in considering future fish passage facilities and associated operations. The Draft Bull Trout Passage drawings were provided to the LRBTRT on July 24, 2019 prior to submittal of the Draft Bull Trout Passage Plan to the ACC on August 1, 2019 for 30-day review. The Draft Plan was also provided to non-ACC team members on August 1, 2019. The Utilities are willing to meet with the team to discuss content of the Draft Plan. Upon final determination by the Services that such bull trout passage facilities be constructed, the Utilities will develop 30% and 60% design drawings for review as identified in the Settlement Agreement.

Responses to Comments Received on Draft Lewis River In-Lieu Program Strategic Plan - ACC 30 day Review Draft Dated August 1, 2019

Date	Commenter	Comment Number	Comment	Response
8/27/2019	Joshua Ashline, NMFS	1	*Pg 5, 1.2.2 Program Administrator...The PA will provide day to day oversight and management of financial and technical elements of the ILP. Major roles and responsibilities will include the following:* How is this group funded?	Funding of the PA to be provided by the Utilities separate from In-Lieu Fund contributions.
8/27/2019	Joshua Ashline, NMFS	2	*Pg 6. first paragraph, Additionally, the PA will solicit matching funding to those provided by the Utilities, leveraging these existing funds for habitat improvement grants or other funding elsewhere in the Lewis River watershed (downstream of Merwin Dam and including the East Fork Lewis River watershed) and mainstem Columbia River.* In-lieu monies will not be spent in locations below Merwin, so why leverage money for projects in the lower river?	Per the Services April 12, 2019 direction, Utility funded in-lieu projects will be conducted upstream of Swift Reservoir (or tributaries draining to Swift Reservoir, e.g., Drift Creek). However, consistent with regional recovery goals, matching funds contributed by others will be unrestricted and available for enhancement projects elsewhere in the Lewis River Basin, including reaches downstream of Merwin and in the mainstem Columbia River. This availability will encourage coordination and cooperation on large scale projects in the lower Columbia River mainstem and estuary.
8/27/2019	Joshua Ashline, NMFS	3	*Pg. 8, Item 8, Publish results & modify goals* Will there be a requirement to publish scientific journal articles from this effort? Given the scale/scope of these projects, the restoration community would benefit from dissemination of results/outcomes outside of gray literature.	The Utilities had not planned to require publications from the effort; however, past experience suggests that contractors will seek to publish papers in cooperation with the Utilities. Given the scope of the program, the Utilities can strongly encourage publishing results in an effort to inform the restoration community.
8/27/2019	Joshua Ashline, NMFS	4	*Pg.17 item 4, Road removal or restoration to reduce instream sediment (including culvert removal).* Is this a new restoration action? I don't recall reading about road removal/restoration/culvert removal prior to this document	Road restoration was mentioned in the New Information Report as a type of restoration, e.g., Table 5 p. 487 showing actions specifc to identified limiting factors.
8/27/2019	Joshua Ashline, NMFS	5	*Pg. 19, Table 4, Swift Campground Creek - Roads* How does Swift Campgroud Creek make this list? Was the original EDT analysis used, instead of the re-run completed in September 2018. This creek goes dry in the summer, and doesn't support all three species of salmon.	Swift Campground Creek has been removed from Table 4. The EDT analysis completed in early 2016 was used to produce this Table. In the 2016 analysis, it was assumed that the stream had the potential to produce all three species (coho, Chinook and steelhead) based on agency input and data review. Future field surveys as part of the HRP are expected to identify status and opportunities in Swift Campground Creek.
8/27/2019	Joshua Ashline, NMFS	6	*Pg 20, Section 2.6 .....whether the project benefits all three focal species; the degree that it would provide resilient habitat over changing conditions (restore processes);Project Ranking* May have missed this, adults or juveniles or both?	Both - However the Utilities suggest that juveniles be the focus.
8/27/2019	Joshua Ashline, NMFS	7	Pg. 20, *Project Prioritization...* Who will have the final decision on which in-lieu projects get funded if scores end up similar? Consensus/NMFS/ACC?	As shown in the Draft Strategic Plan on page 19, In the cases of an equal ranking, NMFS and/or USFWS will have the final decision as to which project receives funding.
8/27/2019	Joshua Ashline, NMFS	8	*Pg 21, Ranking process used for the Merwin ILP...* it is crucial that ranking criteria clearly state how closely they align with the recovery plans for the Lewis River and Columbia River.	Agree, edits to In-Lieu Strategic Plan reflect this; see pp. 11 and 20.
8/27/2019	Joshua Ashline, NMFS	9	*Pg. 27, last paragraph….The USACE Regional General Permit (RGP) 8 authorizes 11 restoration activities in waters of the U.S. designed to maintain, enhance,.....* Would this mechanism work only for USFS lands? If so, other project would need to go through a different consultation mechanism.	The RGP may be used for projects on non-USFS lands - from RGP 8 text: ...."covers actions on non-Forest Service lands when the action is located immediately adjacent to a National Forest Unit and the project helps to achieve USFS aquatic restoration goals. Non-Federal land projects must follow all elements of the proposed activities and the conservation measures described in this RGP. The USFS will ensure that actions covered by this RGP on non-Federal lands undergo the same process and compliance as projects occurring on National Forest Unit lands". https://www.nws.usace.army.mil/Portals/27/docs/regulatory2/RGPs/2017%20RGP%208%20Final%20text.pdf?ver=2018-01-22-172549-503

Responses to Comments Received on Draft Lewis River Basin Implementation Monitoring Plan - ACC 30 day Review Draft Dated August 1, 2019

Date	Commenter	Comment Number	Comment	Response
8/27/2019	Joshua Ashline, NMFS	1	*Page 4. Determining population level (watershed) responses* Our preliminary determination letter specifically asks for population level response monitoring.	The text of the Draft Monitoring Plan has been revised to include an approach for population level response monitoring. In particular, we revised objectives and questions (page 9 and 10), discuss different options for population monitoring and approach selected (pages 15 to 25), and methods (page 29 to 32),
8/27/2019	Joshua Ashline, NMFS	2	*Page 5. Restoration actions* Will restoration reaches be restored to "template" conditions, as described in the EDT analysis included in the new information package?	The initial goal is to restore each stream chosen to template conditions identified in the EDT analysis, understanding that some template conditions such as riparian cover cannot ultimately be achieved in a short period of time. While such actions may not have immediate template function, long-term benefits can be realized. However, please note that the NMFS letter (April 11, 2019) stated that at a *maximum (emphasis added here to highlight),* 3 of the limiting factors identified by the EDT analysis shall be addressed with restoration. If this is the case, then some reaches may not be restored to template conditions.
8/27/2019	Joshua Ashline, NMFS	3	*Pg. 5 Item 4. Road removal or restoration to reduce instream sediment (including culvert removal).* Same comment as the strategic plan... I don't recall seeing this type of restoration activity prior to these documents. Was road removal/restoration/culvert removal part of the new information report, and I missed/forgot about it?	Road restoration was mentioned in the New Information Report as a type of restoration, e.g., Table 5 p. 487 identifying actions specifc to identified limiting factors. See also response to similar comment in Draft Strategic Plan comment and response.
8/27/2019	Joshua Ashline, NMFS	4	*Pg. 6, Table 2. Swift Campground Creek, Road removal or restoration, High percent fines, campground area.* NMFS assumed that reaches would be restored to template conditions as presented in the EDT analysis. This is why we choose stream reaches that are known to support all three species of ESA listed salmonids.	See Comment 5
8/27/2019	Joshua Ashline, NMFS	5	*Pg. 6, Table 2. Swift Campground Creek,* Same comment as the strategic plan....Was the original EDT analysis used to populate this Table, not the revised version run in September 2018? Swift campground creek does not support Chinook, and if fully restored is projected to support very few coho and less than 10 steelhead	The EDT analysis completed in early 2016 was used to produce the Table. In the 2016 analysis it was assumed that the stream had the potential to produce all three species (coho, Chinook and steelhead) based on agency input and data review. However, Swift Campground Creek has an impassable culvert at Highway 90 located approximately 500 ft at full reservoir elevation. The Utilities have removed this stream from the list of high restoration potential streams.
8/27/2019	Joshua Ashline, NMFS	6	*Pg. 7. Key Questions and Scale...* Has the reach returned to template conditions post restoration? If not how close is the reach to template conditions? 50% there 75% there?	See response to Comment 2 above. Various post-treatment monitoring of the individual reaches will be conducted. Monitoring results will inform progress towards template. We also evaluate EDT population parameters in restored reaches before and after restoration and added text to clarify this (pages 10, 21, and 32).
8/27/2019	Joshua Ashline, NMFS	7	*Pg. 8, Large wood and floodplain projects, item 4.* how will you know that the restoration has increased abundance, and not just concentrated fish?	See Roni, P. 2019 review article in Fisheries magazine for a detailed discussion on this. There is little evidence to support concentration of fish due to restoration. Most studies show most juvenile salmonids do not move more than 100 meters at low flow (summer and winter low flow). Treatment and control reaches will be located 100+ m apart to assure little fish exchange at low flow. (*Roni 2019. Does river restoration increase fish abundance and survival or simply concentrate fish? The effects of project scale, location, and fish life history. Fisheries 44:7-19.)*
8/27/2019	Scott Hecht, NMFS	8	*Pg. 9, Table 3. BA or BACI* If a BACI is selected, have control reaches been identified for each of the restoration sites?	Not yet. The specific location of restoration treatments needs to first be confirmed. Control reaches will be selected after treatment locations are set.
8/27/2019	Joshua Ashline, NMFS	9	*Pg. 9, ….supplemental monitoring of reach-scale juvenile fish abundance to LW and floodplain projects using an EPT design (Table 5).* When can we expect the methods for this EPT design?	A description of the design and potential sample sizes is provided on pages 19 - 21 and sampling methods in pages that follow. Additional details will be provided once the specfic location of the restoration measures has been finalized.

Responses to Comments Received on Draft Lewis River Basin Implementation Monitoring Plan - ACC 30 day Review Draft Dated August 1, 2019

Date	Commenter	Comment Number	Comment	Response
8/27/2019	Joshua Ashline, NMFS	10	*Pg. 10, Table 4. Strengths and weaknesses of different approaches for evaluating effectiveness of regional restoration programs. Modified from Roni et al. (2018).* Curious- has there been a review of completed restoration projects in the Lewis basin or other similar, proximate basins that demonstrate success for LW and pools? If so, what can we learn from these?	There was a review of other restoration projects in the Lewis Basin in the New Information Reports (PacifiCorp 2016), but there was not necessary detailed monitoring data. The Utilities also have data from other projects throughout Washington state that demonstrate their success both in terms of physical response (pools) and fish numbers (juvenile salmonids). These studies provide recommendations on design and implementation as well.
8/27/2019	Joshua Ashline, NMFS	11	*Pg. 11, 2nd paragraph, ...Road removal or restoration projects, which target reducing fine sediment and in some cases scour, has only been considered to this point for Swift Campground Creek.* See my other comments about Swift Campground Creek, but I don't feel this is an appropriate restoration site.	See response to comment 4, above.
8/27/2019	Joshua Ashline, NMFS	12	*Pg. 11 …validation monitoring.* This is crucial, as this is what was requested in the preliminary decision letter.	The Draft Monitoring Plan text has been revised to address this comment. In particular, we revised objectives and questions (page 9 and 10), discuss different options for population monitoring and approach selected (pages 15 to 25), and methods (page 29 to 39).
8/27/2019	Joshua Ashline, NMFS	13	*Pg 12, last paragraph, ….In general, a suitable control reach will be located 100 meters or more upstream of the treatment, though typically not more than two to five kilometers depending upon channel width (Roni et al. 2005; 2013).* How similar do the two reaches channel widths need to be?	The reaches need to be similar in channel width, land use, flow, channel type etc. How similar channel width needs to be is a topic of debate but typically within ~10%.
8/27/2019	Joshua Ashline, NMFS	14	*Pg. 12, last paragraph, ...The selection of suitable treatments and controls is particularly critical for the EPT, which depends upon having paired control reaches that are similar to the treatment reach before it was restored.* Using the USGS data...is there enough data to identify treatment and control reaches that are similar to identify a starting point?	The USGS data does not cover all priority streams and reaches upstream of Swift Dam, but other existing data should allow initial determination of treatment and control reaches.
8/27/2019	Joshua Ashline, NMFS	15	*Pg. 13, top of page, baseline data from recently required Lidar and the updated assessment in the ILP, will provide information on broader-scale processes that may influence project physical effectiveness.* I thought the lidar dataset was incomplete for the Swift basin?	The Utilities propose that as part of the Monitoring Plan implementation, new Lidar surveys will be conducted over the upper Lewis basin tributaries.
8/27/2019	Joshua Ashline, NMFS	16	*Pg. 13, last paragraph, Juvenile fish abundance will be enumerated during summer (mid-July to mid-September) and winter (January to mid-March) low flow using standard snorkel survey protocols (Thurow 1994; Roni and Fayram 2000)3 .* I would like to see papers on observer bias in snorkel surveys. Identification of juvenile salmon is not easy when anesthetize, and lying flat in your hand. I'd like to see other sampling techniques researched before settling on snorkel surveys.	Snorkel surveys are widely used to enumerate juvenile salmonids in the Pacific Northwest and trained crews can easily identify juvenile Chinook, coho, steelhead, and cutthroat trout. The key is making sure snorkelers are well trained. The challenge is really if visibility is poor (less than 1.5 m) or in distinguishing among juvenile steelhead and cutthroat when they are fry or less than 60-70 mm. Snorkeling is also the preferred method where endangered species are present. Obviously, mark-recapture methods are the most accurate, but may be very time consuming and difficult in larger streams.

Responses to Comments Received on Draft Lewis River Basin Implementation Monitoring Plan - ACC 30 day Review Draft Dated August 1, 2019

Date	Commenter	Comment Number	Comment	Response
8/27/2019	Joshua Ashline, NMFS	17	*Pg. 17, last paragraph, The quality assurance and quality control (QA/QC) procedures will be built into the data forms with limited value selection (e.g., select from a list of values), value checks (e.g., values must be an integer), and missing data highlighted to flag any unusual or missing entries.* Perfect!	Thank you.
8/27/2019	Joshua Ashline, NMFS	18	*Pg. 19, first paragraph, ...EPT monitoring of LW and floodplain projects should also show higher levels of juvenile salmonids in restored reaches three to five years after restoration. Monitoring road removal projects will be more protracted, but we would expect residual pool depth to increase and scour, percent fine sediment, fine sediment infiltration, to decrease 5 to 10 years after restoration.* Abundance increase or concentration of fish?	Increase in abundance. See response to similar previous comment (comment 3 above).
8/27/2019	Joshua Ashline, NMFS	19	*Pg. 19, second paragraph, …..Redd and spawner surveys can be used to examine differences in fish use before and after restoration in restored reaches (though this will require long-term monitoring before and after restoration [10 or more years]), and that restoration occurs in areas used for spawning.* Will this monitoring be done? Or will it be given up on once the Yale decision is made? (8/27/19 Comment: How many years? 10 minimum, or does this value change dependent upon the future yale decision?	Redd and spawner surveys are conducted as part of PacifiCorp's existing Monitoring and Evaluation Plan. This monitoring activity is expected to continue throughout the In-Lieu implementation period and post-Yale decision.
8/27/2019	Joshua Ashline, NMFS	20	*Pg. 19 Table 7, Screw Trap* I'd like to see the methods used for the NFLR smolt trap, especially M/R for estimating the abundance of out migrants.	The smolt trap monitoring uses a pooled Peterson mark recapture methodolgy. Information on the North Fork Lewis River smolt trap monitoring and results can be found in *PacifiCorp's 2018 ACC/TCC annual report - Attachment E: Hatchery and Supplementation Program Annual Report* . Erik Lesko, PacifiCorp, can also provide more information on smolt trap monitoring.
8/27/2019	Joshua Ashline, NMFS	21	*Pg. 19 Table 7, Swift Floating Surface Collector* Will the FSC operate year round during the monitoring program or shut down in summer?	Current operations of the FSC will continue with the timing of summer shutdown determined by water temperature and daily fish collection numbers.
8/27/2019	Joshua Ashline, NMFS	22	*Pg. 20, first paragraph....There are also some rapidly developing technologies such as environmental DNA (eDNA) and remote sensing mapping methods (e.g., radar, fluid lensing) that are not currently useful for implementation and effectiveness monitoring, but maybe perfected in the next few years* . eDNA has been developed to the point to at least do some presence/absence work if applicable.	Correct. However it is not yet at the point that it can be used to estimate abundance or densities of fish.

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Yale Hydroelectric Project
FERC No. P-2071

Before the
United States of America
Federal Energy Regulatory Commission

Application for License Amendment

Volume IV of V
Exhibit F – Vicinity and Preliminary Design Drawings

PACIFICORP
A BERKSHIRE HATHAWAY ENERGY COMPANY

January 2020

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Yale Hydroelectric Project
(FERC No. P-2071)

APPLICATION FOR LICENSE AMENDMENT

This application for license amendment for the Yale Hydroelectric Project (FERC No. P-2071) consists of the following volumes:

Volume I

Initial Statement
Exhibit A – Project Description
Exhibit C – Project Installation and Proposed Schedule
Exhibit D – Costs and Financing
Exhibit G – Project Maps

Volume II

Exhibit E – Environmental Report

Volume III

Exhibit E – Appendices

Volume IV

Exhibit F – Vicinity and Preliminary Design Drawings (CEII Not for Public Release)

Volume V

CONFIDENTIAL – Cultural Resource Summary for the Merwin, Yale, and Swift No. 1 Projects

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EXHIBIT F – DESIGN DRAWINGS

The Federal Energy Regulatory Commission Order No. 630, issued February 21, 2003, provides that the material prepared for Exhibit F is critical energy infrastructure information (CEII) and should be filed with the Commission as confidential information pursuant to 18 CFR 388.112. Therefore, it is not provided in this copy of the draft application for license amendment.

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Yale Hydroelectric Project
FERC No. P-2071

Before the
United States of America
Federal Energy Regulatory Commission

Application for License Amendment

Volume V of V
CONFIDENTIAL -- Cultural Resource Summary for the Merwin, Yale, and Swift No. 1 Projects

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A BERKSHIRE HATHAWAY ENERGY COMPANY

January 2020

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Yale Hydroelectric Project
(FERC No. P-2071)

APPLICATION FOR LICENSE AMENDMENT

This application for license amendment for the Yale Hydroelectric Project (FERC No. P-2071) consists of the following volumes:

Volume I

Initial Statement
Exhibit A – Project Description
Exhibit C – Project Installation and Proposed Schedule
Exhibit D – Costs and Financing
Exhibit G – Project Maps

Volume II

Exhibit E – Environmental Report

Volume III

Exhibit E – Appendices

Volume IV

Exhibit F – Vicinity and Preliminary Design Drawings (CEII Not for Public Release)

Volume V

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CULTURAL RESOURCE SUMMARY FOR THE MERWIN, YALE, and SWIFT NO. 1

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