

Aquatics Monitoring and Evaluation Program

2019 Annual Report (Final)

Lewis River Hydroelectric Projects
FERC Project Nos. 935, 2071, 2111 and 2213



Fatmeter being used to measure muscle lipid content on a winter steelhead.
Photo by Chris Karchesky

PacifiCorp
&
Public Utility District No.1 of Cowlitz County

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1.0 INTRODUCTION

The purpose of this report is to document the results the Aquatics Monitoring and Evaluation Program associated with the Lewis River Hydroelectric Project (Project) in 2019. The Project begins approximately 10 miles east of Woodland, Washington (Figure 1.0-1), and consists of four impoundments. The sequence of the four Lewis River impoundments upstream of the confluence of the Lewis and Columbia rivers is: Merwin, Yale, Swift No. 2, and Swift No.1. These four impoundments are licensed separately by the Federal Energy Regulatory Commission (FERC). Merwin (FERC No. 935), Yale (FERC No. 2071), and Swift No. 1 (FERC No. 2111) are owned and operated by PacifiCorp. Swift No. 2 (FERC No. 2213) is owned by Public Utility District No. 1 of Cowlitz County (Cowlitz PUD) and is operated by PacifiCorp in coordination with the other projects. Combined, the Lewis River Project has a generation capacity of 606 megawatts.

On June 26, 2008, the FERC issued Orders approving the Settlement Agreement (SA) and granting new Licenses for PacifiCorp and Cowlitz PUD (Utilities) for operating the Project (PacifiCorp and Cowlitz PUD 2004). Among the conditions contained the SA was that the Utilities were to develop a master monitoring and evaluation plan (the M&E Plan) to implement the terms of Section 9 of the SA. The primary focus of the M&E Plan was to monitor and evaluate the effectiveness of aquatic Protection, Mitigation and Enhancement (PM&E) Measures, and to assess achievement of the Reintroduction Outcome Goals. Anadromous fish reintroduction goals were established in the SA for spring Chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon, and steelhead (*O. mykiss*) for the portion of the Lewis River located upstream of Merwin Dam. The overarching outcome goal for reintroduction identified in the SA is to:

“... achieve genetically viable, self-sustaining, naturally reproducing, harvestable populations of anadromous fishes above Merwin Dam greater than minimum viable populations.”

The intent of the M&E Plan was also to provide the methods to monitor and evaluate adult fish spawning escapement, fish passage facility hydraulic performance, flow and ramping rates, resident and anadromous fish interactions, and bull trout and kokanee populations.

The M&E Plan was to be developed in consultation with the Lewis River Aquatics Coordination Committee (ACC), and was to address the tasks, methods, frequency, and duration of those tasks necessary to accomplish the monitoring and evaluation items outlined in the SA (Sections 9.2 through 9.8). Performance standards defined in Section 4 of the SA provide the benchmark for the various M&E Plan items (Table 1.0–1). The original M&E Plan was finalized and approved by the ACC in June 2010 (PacifiCorp and Cowlitz PUD 2010). According to the SA, the Utilities shall Consult with the ACC as necessary, but no less often than every five years, to determine if modifications to the M&E Plan are warranted. The first revision of this plan was completed in 2017, and was fully implemented that year (PacifiCorp and Cowlitz PUD 2017). This version serves as the current M&E Plan for work conducted in 2019.



Figure 1.0-1. An overview of key features of the North Fork Lewis River Hydroelectric Project area located in southwest Washington.

Table 1.0-1. Reintroduction performance standard definitions and benchmark values.

Performance Standard	Definition¹	Benchmark Value
Adult Trap Efficiency (ATE)	The percentage of adult Chinook, coho, steelhead, bull trout, and sea-run cutthroat that are actively migrating to a location above the trap and that are collected by the trap.	Determined by the ACC to be 98%
Collection Efficiency (CE)	The percentage of juvenile anadromous fish of each of the species designated in Section 4.1.7 ² that is available for collection and that is actually collected.	99.5%
Collection Survival (CS)	The percentage of juvenile anadromous fish of each of the species (designated in Section 4.1.7) collected that leave the Release Ponds alive.	Smolts > 99.5% Fry > 98% Adult Bull Trout > 99.5%
Injury	Visible trauma (including, but not limited to hemorrhaging, open wounds without fungus growth, gill damage, bruising greater than 0.5 cm in diameter, etc.), loss of equilibrium, or greater than 20% descaling . “Descaling” is defined as the sum of one area on one side of the fish that shows recent scale loss. This does not include areas where scales have regenerated or fungus has grown.	< 2% for smolts
Overall Downstream Survival (ODS)	The percentage of juvenile anadromous fish of each of the species designated in Section 4.1.7 that enter the reservoirs from natal streams and survive to enter the Lewis River below Merwin Dam by collection, transport and release via the juvenile fish passage system, passage via turbines, or some combination thereof (calculated as provided in Schedule 4.1.4. of the Settlement Agreement).	Interim > 80% > 75% after installation of Yale Downstream Collector
Upstream Passage Survival (UPS)	Percentage of adult fish of each species (designated in Section 4.1.7) that are collected that survive the upstream trapping-and-transport process. For sea-run cutthroat and bull trout, “adult” means fish greater than 13 inches in length.	> 99.5%
Active Tag	Tag type that detects and tracks movement of fish (e.g. radio tag, hydroacoustics tag)	N/A

¹ Definitions are taken from Settlement Agreement for the Lewis River Hydropower Projects (PacifiCorp and Cowlitz PUD 2004)

² Species designated in Section 4.1.7 of the Settlement Agreement are spring Chinook, winter steelhead, coho, bull trout and sea-run cutthroat trout.

2.0 Monitoring and Evaluation Objectives

The tasks, methods, frequency and duration of sampling, assumptions, and reporting requirements are outlined for twenty-two objectives in the M&E Plan. The objectives are as follows:

- Objective 1 Quantify overall juvenile fish downstream survival (ODS) which includes reservoir survival, collection survival, transport survival, and survival at the release ponds
- Objective 2 Quantify FSC collection efficiency
- Objective 3 Quantify the percentage of juvenile fish available for collection that are not captured by the FSC and that enter the powerhouse intakes
- Objective 4 Quantify juvenile and adult collection survival
- Objective 5 Quantify juvenile injury and mortality rates during collection at the FSC (includes injury and mortality of adult bull trout, adult sea-run cutthroat, and steelhead kelts)
- Objective 6 Quantify the number, by species, of juvenile and adult fish collected at the FSC
- Objective 7 Estimate the number of juveniles entering Swift Reservoir
- Objective 8 Develop index of juvenile migration timing
- Objective 9 Quantify adult upstream passage survival
- Objective 10 Quantify adult trap efficiency at each upstream fish transport facility (emphasizes analysis of the Merwin Adult Trapping Facility)
- Objective 11 Quantify the number, by species, of adult fish collected at the projects (emphasizes Merwin Dam)
- Objective 12 Develop Estimates of ocean recruits
- Objective 13 Develop performance measures for index stocks
- Objective 14 Document upstream and downstream passage facility compliance with hydraulic design criteria
- Objective 15 Determine spawn timing, distribution and abundance of transported anadromous adults

- Objective 16 Evaluate lower Lewis River wild fall Chinook and chum populations (*Note: Objective 16, because it is a lower Lewis River monitoring activity, was moved in the 2017 from the M&E Plan to become Objective 16 in the Hatchery and Supplementation Plan – see M&E Plan Objective 21 below.*)
- Objective 17 Monitor bull trout populations
- Objective 18 Determine Interactions between reintroduced anadromous salmonids and resident fish (Upstream of Merwin Dam)
- Objective 19 Document Project compliance with flow, ramping rate and flow plateau requirements
- Objective 20 Determine when reintroduction outcome goals are achieved
- Objective 21 Develop a Hatchery and Supplementation Plan (H&S) to support and protect Lewis River native anadromous fish populations and provide harvest opportunity
- Objective 22 Develop a Coordination Table that cross-references Objectives of the Hatchery and Supplementation Plan and the Monitoring and Evaluation Plan

All annual reporting for M&E Plan objectives is contained in this report. However, the National Marine Fisheries Service (NMFS) has designated anadromous fish populations for the North Fork Lewis basin that include naturally produced fish from the entire North Fork Lewis basin (i.e., both upstream and downstream of the Project). Therefore, evaluation of the anadromous fish reintroduction program, as measured by population status, requires that data collected from the monitoring efforts outlined in the M&E Plan be combined with those in the Lewis River Hatchery and Supplementation (H&S) Plan (PacifiCorp Energy and Cowlitz PUD 2014). The development of the H&S Plan monitoring objectives are summarized in the M&E Plan as part of Objective 21. The results of the H&S Plan are reported annually in the H&S Program Annual Operations Report, which is a standalone document for reporting.

The Lewis River Fish Passage Program Annual Report documents the results of various monitoring objectives related to evaluating the anadromous fish reintroduction program and outcome goals. The 2019 annual report can be found in Appendix A of this report.

Monitoring of bull trout (*Salvelinus confluentus*) populations affected by the Project is stipulated in Objective 17 of the M&E Plan. The goals of this monitoring program are to: 1) inform management decisions; and 2) provide information to assist in gauging whether recovery goals and objectives for bull trout are being met. The Lewis River Bull Trout Annual Operating Plan identifies the specific monitoring actions that will be implemented by the utilities each year to achieve the monitoring objectives. Each year the plan is developed in consultation with the United States Fish and Wildlife Service (USFWS) and the Lewis River Bull Trout Recovery Team (LRBTRT). The Lewis River Bull Trout 2019 Annual

Operations Report can be found in Appendix B of this report. The Lewis River Bull Trout 2020 Annual Operation Plan is provided as Appendix C.

Since 1979, PacifiCorp biologists, along with various state and federal agencies, have conducted annual surveys to estimate spawning escapement of kokanee in Cougar Creek, a tributary to Yale Reservoir. This annual monitoring effort, which is stipulated in Section 9.7 of the SA, continued in 2019. The Yale Reservoir Kokanee 2019 Escapement Report is provided as Appendix D.

Objective 22 of M&E Plan provides a summary of all monitoring efforts for the North Fork Lewis River, including those called for by both the M&E Plan and the H&S Plan. Table 2.0-1 below summarizes each of the M&E Plan objectives, any performance goal stipulation, current methods for assessment, and results for the 2019 monitoring period. Table 2.0-1 also includes a reference for each objective on where the reporting can be found in more detail, and whether the objective is related to monitoring work being completed through the H&S Plan. A similar reference is provide for each objective associated in the current H&S Plan (PacifiCorp and Cowlitz PUD 2014) in Table 2.0-2.

Table 2.0-1. Coordination table summarizing the Monitoring and Evaluation Plan objectives in 2019.

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 1 Task 1.1	Estimate Overall Downstream Survival (ODS) for anadromous fish species above Swift No. 1 Dam	Juvenile ODS $\geq 80.0\%$	ODS is currently measured from the head of Swift Reservoir to the exit of the Release Ponds located downstream of Merwin Dam for coho, spring Chinook, steelhead and sea-run cutthroat trout using PIT tag mark-recapture methods. Reservoir survival (S_{RES}), collection survival (S_{COL}), and transport survival (S_{TRAN}) were multiplied and used to estimate ODS for each species.	<u>Estimated 2019 ODS:</u> Coho = 42.3% $\pm 3.0\%$ Chinook = 24.4% $\pm 5.7\%$ Steelhead = 8.2% $\pm 3.2\%$ Cutthroat = 7.6% $\pm 7.4\%$	In 2019, all estimates of ODS were below the $\geq 80.0\%$ performance goal. A total of 1,064 coho, 223 Chinook, 280 steelhead, and 51 cutthroat were tagged and released as part of the ODS evaluation. Of these fish, 481 coho, 56 Chinook, 23 steelhead, and 4 cutthroat were recaptured at the FSC and passed downstream.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 2 Task 2.1	Estimate Swift Floating Surface Collector (FSC) Collection Efficiency (Pce)	Juvenile Pce \geq 95.0%	Collection efficiency (Pce) at the FSC is currently measured using fish tagged with biotelemetry tags (radio or acoustic) and released at the head of Swift Reservoir. Tagged fish that subsequently enter the Zone of Influence (ZOI) near the entrance of the FSC are considered available for collection. The proportion of those fish that are subsequently captured in the FSC is Pce.	<u>Estimated 2019 Pce:</u> Coho = 64% \pm 10% Chinook = 51% \pm 11% Steelhead = 27% \pm 10%	In 2019, Pce was evaluated with acoustically tagged coho, Chinook, and steelhead out-migrants. Estimates of Pce among coho and spring Chinook were the highest observed since the commissioning of the FSC in 2012; however, the 95% performance standard was not met for any species in 2019.	Annual Fish Passage Program 2019 Annual Report	Not Related
M&E - 3 Task 3.1	Quantify the percentage of juvenile fish available for collection that are not captured by the Swift FSC and that enter the powerhouse intakes	Monitoring	Not be quantified until downstream collection facilities are installed at Yale and Merwin Dams. Once these facilities are operational, the M&E Plan will be updated to include study protocols to determine turbine entrainment and loss.	Not required to be monitored in 2019	Assessing the proportion of fish entering the intake of the Swift No.1 Powerhouse is required under Section 9.2.1(f) of the SA and identified as Objective 3 of the M&E Plan. However, this M&E Objective will not be quantified until downstream passage facilities are installed at Yale and Merwin Dams.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 4 Task 4.1	Estimate juvenile and adult combined collection and transport survival rates (CS)	Fry ≥98.0% Smolt ≥99.5% Bull Trout (all) ≥9.5% Steelhead Adult Kelt = no performance goal identified	Combined survival (CS) from the time the fish enter the FSC to their release downstream of Merwin Dam is estimated by determining mortality of fish after capture in the FSC (S _{COL}) in addition to mortality after transport to the Woodland Release Ponds (S _{TRANS}). CS is applicable to juvenile salmonids and adult bull trout and steelhead kelts. Only S _{COL} was calculated for fry as they are not intended to be transported downstream.	<u>Estimated 2019 S_{COL}:</u> Coho Fry = 97.9% ± 0.5% Chinook Fry = 98.4% ± 3.0% Steelhead Fry = 100.0% ± 0.0% Cutthroat Fry = 100.0% ± 0.0% <u>Estimated 2019 CS:</u> Coho Smolt = 94.0% Chinook Smolt = 97.7% Steelhead Smolt = 99.8% Cutthroat (<13 inches) = 97.7% Cutthroat (>13 inches) = 100.0% Bull Trout = 100.0% Steelhead Kelts = 73.4%	Overall, the combined collection and transport survival rates (CS) for juvenile salmonids did not meet the performance standard for smolt and parr (≥99.5 percent). Individual rates calculated for smolts of each species ranged from 94.0% for coho to 99.8% for steelhead Overall, fry survival rates met the performance standard (≥98.0 percent), though coho fry survival (S _{COL}) was just slightly lower than the standard at 97.9 percent.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 5 Task 5.1	Determine Collection Injury Rate at the Swift FSC (P_{CINJ}) for juvenile salmonids and adult bull trout and steelhead kelts	Injury rate $\leq 2.0\%$ for all fish examined	Injury rates are determined by daily examination of sampled fish captured in the Swift FSC.	<u>Estimated 2019 S_{CINJ}:</u> Coho (Fry) = $0.84\% \pm 0.34\%$ Chinook (Fry) = $0.0\% \pm 0.0\%$ Steelhead (Fry) = $0.0\% \pm 0.0\%$ Cutthroat (Fry) = $0.0\% \pm 0.0\%$ <i>COMBINED Fry: $0.81\% \pm 0.33\%$</i> Coho (Smolt and Parr) = $0.38\% \pm 0.02\%$ Chinook (Smolt and Parr) = $0.19\% \pm 0.06\%$ Steelhead (Smolt and Parr) = $0.10\% \pm 0.07\%$ Cutthroat (Smolt and Parr) = $0.32\% \pm 0.2\%$ <i>COMBINED Smolt (and Parr) = $0.34\% \pm 0.02\%$</i> Steelhead Kelts = $1.6\% \pm 3.04\%$ Bull Trout = $0.0\% \pm 0.0\%$	Combined annual injury rates for all examined salmonids met the required performance standard of $\leq 2.0\%$. However, injury rates for individual species and life-staged varied. Debris accumulation in both the smolt flume and adult tank was the primary source of injury in 2019.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 6 Task 6.1	Calculate juvenile and adult collection numbers using Swift FSC subsampling	Monitoring	The total number of fish collected is determined through directing fish into subsampling tanks for physical enumeration. Subsampling rate is based on the amount of time fish are directed into subsampling tanks by automated gates and expanded based on the total amount of time the FSC is operated within a discrete time interval	<u>Estimated Total Juvenile:</u> Coho = 99,057 (juv), 138 (adult) Chinook = 10,951 (juv), 87 (adult) Steelhead = 3,021 (juv), 84 (kelt) Cutthroat = 1 (fry), 903 (<13"), 44 (>13") Bull Trout = 5	A total 118,612 salmonids were captured by the Swift FSC in 2019. Of these fish, 111,702 were transported and released downstream of Merwin Dam. Sample rates were adjusted to between 10% to 25% during peak outmigration season. Subsampling occurred on 106 days of operation; from April 11 through July 7, and again from October 22 through November 4, 2019. During the rest of the season, daily subsampling was set to 100%.	Annual Fish Passage Program 2019 Annual Report	H&S Objective 14
M&E - 7 Task 7.1	Estimate the timing and number of juvenile salmonids entering Swift Reservoir from the Upper North Fork Lewis River subbasin	Monitoring	Operate screw trap located at the head of Swift Reservoir from approximately March 1 through June 30 to estimate number of outmigrates entering the reservoir by estimating trap efficiency using mark-recapture. Because unsampled periods and reservoir tributaries are not accounted for in this analysis, this information serves as an annual index that could be compared over the same general time period among years.	<u>Mean Bootstrap total estimates:</u> Coho = 144,514 (peak in mid-Jun) Chinook = 14,414 (peak in mid-June) Rainbow/Steelhead = 15,900 (variable, fry peak in early-July) Cutthroat = 1,050 (variable) Bull Trout = 1,121 (variable, fry peak in early-March)	The screw trap was operated continuously at Eagle Cliff from March 5 to July 19, 2019 and checked daily, but was it was off from April 7 to April 14 due to heavy debris loads during the peak spring runoff. Over 8,000 naturally produced salmonids were captured. The majority of coho, Chinook, and rainbow trout/steelhead were < 60 mm FL. The bulk of juvenile coho and Chinook passed the trap from mid-May to early-July. Rainbow/steelhead and cutthroat trout, and Bull Trout passed the trap over a more protracted period with no single distinct peak. However, a pulse of Bull Trout fry were captured in March, as well as a pulse of rainbow/ steelhead fry in July.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 7 Task 7.2	Estimate the number of juveniles entering Swift Reservoir	Monitoring	Mark-recapture estimate of total juveniles that enter Swift Reservoir relies on PIT tagged fish marked at the Eagle Cliff screw trap (Task 7.1 above) as well as additional fish PIT tagged at the Swift FSC that released at the head of Swift Reservoir, and subsequently recaptured at the Swift FSC	<u>Total estimates (not including fish ≤60 mm FL):</u> Coho = 213,531 (95% CI = 14,472) Chinook = 44,186 (95% CI = 10,614) Steelhead = 36,463 (95% CI = 16,314) Cutthroat = 12,089 (95% CI = 21,603)	Total estimates only consider fish parr size and greater (i.e., >60 mm FL), which could be PIT tagged. Comparing these estimates to the number of juveniles estimated to pass Eagle Cliff during screw trapping operations in 2019 (Task 7.1 above) suggest that the majority of juvenile fish enter Swift Reservoir during times when the screw trap was not in operation and/or from other reservoir tributaries located down-reservoir of the Eagle Cliff trap.	Annual Fish Passage Program 2019 Annual Report	Not Related
M&E - 8	Develop index of juvenile migration timing	Monitoring	The Lewis River Aquatic Coordination Committee (ACC) determined that, although this Objective was specifically called for in the Settlement Agreement, this metric is already covered by M&E Plan Objective 6 and does not need to be duplicated.	See M&E Plan Objective 6	Overall, the run timing in 2019 followed a normal frequency distribution, with peak migration occurring in late-May and a minor peak in late-October. Over 90% of all fish collected at the Swift FSC in 2019 were collected between April 1 and June 30.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 9 Task 9.1	Quantify adult upstream passage survival (UPS)	UPS ≥ 99.5%	UPS for adult fish being transported upstream is measured through the direct enumeration of adult fish at the Merwin Fish Capture and Transport Facility (MFCF) and at the adult fish release site above Swift Dam. Any dead fish recovered at trapping or the release sites upstream were identified to species and examined for signs of physical injury, to the extent possible.	<u>2019 UPS:</u> Coho (early - S) = 99.7% Coho (late - N) = 99.9% Spring Chinook = 94.5% Steelhead = 99.8% Cutthroat = 100%	For the 2019 upstream passage season, 10 early (S) coho, 1 late (N) coho, 6 spring Chinook, and 2 BWT winter steelhead mortalities were observed. No cutthroat mortalities were observed.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 10	Quantify adult trap efficiency (ATE) at each upstream fish transport facility	ATE ≥ 98%	ATE is defined as the percentage of adult fish that are actively migrating that are successfully captured. In 2019, only winter steelhead were evaluated at the base of Merwin Dam. Mark-recapture of radio tagged adults was used to estimate collection efficiency. Fish that were collect at the trap, tagged, and then subsequently release back downstream to pass again were classified as non-naive. Adult fish collected and tagged downstream that had not already approached the fish facility were classified as naive.	<u>2019 MFCF ATE:</u> Winter steelhead (naïve) = 95% (± 6%) Winter steelhead (non-naïve) = 85% (± 7%)	A fifth year of evaluation was completed in 2019 for blank wire tag (BWT) winter steelhead with two study groups: naïve and non-naïve. Naïve being fish that had not been captured at the Merwin Trap previously and non-naïve being fish that had been previously caught and tagged at the Merwin Trap and released downstream. Spring Chinook and coho ATE were not measured in 2019.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 11 Task 11.1	Quantify the number, by species, of adult fish collected at Merwin Dam (MFCF)	Monitoring	Censes (direct count). The MFCF is operated and the number of fish recorded daily.	<u>2019 MFCF Count:</u> Coho (early - S) = 2,612 Coho (late - N) = 762 Spring Chinook = 998 Fall Chinook = 309 Summer Steelhead = 1,865 Winter Steelhead = 1,896 Cutthroat = 45 Sockeye Salmon = 11 Rainbow Trout = 6	A total 8,495 fish were captured at the MFCF in 2019.	Annual Fish Passage Program 2019 Annual Report	Not Related
M&E - 12	Develop estimates of ocean recruits	Threshold Levels for Ocean Recruit Hatchery Produced Adults: Spring Chinook = 12,800 Steelhead = 13,200 Coho = 60,000 Naturally Produced Adult: Spring Chinook = 2,977 Steelhead = 3,070 Coho = 13,953	Methods vary to estimate adult return sizes produced. The purpose behind this objective is largely to inform decisions about the size of the hatchery programing the future as natural production through reintroduction efforts is expected to increase. The ACC agreed to change the ocean recruits definition so that jacks are not included or counted as part of the ocean recruits analysis (March 9, 2005 ACC meeting).	Not completed in 2019	It will take at least five years of analysis before investigators can confidently report ocean recruit numbers and begin evaluating hatchery goals for the Lewis River. Since adult returns of natural-origin fish from the upper Lewis River have not occurred in numbers large enough for meaningful analysis, this metric will be postponed until larger natural-origin adult returns are realized. Given dramatic improvements in collection efficiency of out-migrants at the FSC in 2019, it is anticipated that this analysis will begin in 2024.	Annual Fish Passage Program 2019 Annual Report	Related to hatchery production goal for target species if natural ocean targets met

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 13 Task 13.1	Develop performance measures for index stocks	Monitoring	The H&S Plan recommends that other Lower Columbia River stocks be used as index groups to determine whether the success or failure of the Lewis River reintroduction program is the result of in-basin or out-of-basin factors. This would be determined by comparing the survival rates of hatchery and natural-origin fish produced in other basins (such as the Cowlitz River) with releases made in the Lewis River.	Not completed in 2019	Since adult returns of natural-origin fish from the upper Lewis River have not occurred in numbers large enough for meaningful analysis, this metric will be postponed until larger natural-origin adult returns are realized.	Annual Fish Passage Program 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 14 Task 14.1	Document upstream and downstream passage facility compliance with hydraulic design criteria	Verification	The objective of the hydraulic evaluation was to verify that the performance of the built passage facilities met the performance goals set for the design by NMFS criteria. The hydraulic evaluation for the Swift FSC was completed in 2013; and, for the MFCF, completed in 2014.	Both the Swift FSC and MFCF met the design intent and specified criteria for hydraulic performance.	This task is complete	2012 Hydraulic Evaluation of Swift Reservoir Fish Screen (Alden and R2 Resources 2013) Hydraulic Evaluation Report - MFCF (MWH 2014)	Not Related
M&E - 15 Task 15.1	Determine spawner abundance, timing and distribution of transported anadromous adults (spring Chinook and coho)	Monitoring	Determined by conducting spawning surveys across approx. 33% of all accessible habitat upstream of Swift Dam each year and making total redd estimates based on a stratified random one-stage cluster sampling design	Coho redds counted = 182 Total coho redd estimate = 1,280 Spring Chinook redds counted = 6 Coho primarily spawned in the NF Lewis River mainstem and Muddy River watershed, and to a lesser extent in Swift Reservoir Tributaries and Pine Creek. Spring Chinook spawned in the Muddy River watershed and Mainstem NF Lewis River.	Low stream flows and low reservoir conditions limited coho spawning in Swift Reservoir tributaries; however, coho redds were well distributed throughout the total accessible stream network. Early coho spawning peaked in the 2nd half of October, and late coho primarily spawned in December. Incidental to coho surveys, 6 redds were attributed to spring Chinook spawning in early October. Note that spawning surveys were not conducted in September due to the low number of Chinook transported upstream.	Annual Fish Passage Program 2019 Annual Report	H&S Objective 15

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 15 Task 15.2	Determine spawner abundance, timing and distribution of transported anadromous adults (winter steelhead)	Monitoring	Due to limited access and anticipated heavy snow accumulations during the spawning season for winter steelhead, a combination of aerial radio telemetry surveys, fixed-station radio antennas, aerial red counts, and single pass electrofishing surveys for young-of-the-year steelhead (during the following summer) are used.	Not completed	Data entry, QA/QC, summary and analysis is still ongoing for aerial flight data for winter steelhead. No ground surveys were completed for winter steelhead in 2019 due to poor road conditions and inaccessibility of most of the upper basin due to snow pack.	Annual Fish Passage Program 2019 Annual Report	H&S Objective 15
M&E - 16	Evaluate Lower Lewis River wild fall Chinook and chum populations	Monitoring	See H&S Plan (2014) Objective 16	See H&S Plan Annual Report (2019) Objective 16	The ACC made a decision to separate tasks originally identified in the Settlement Agreement into monitoring upstream of Merwin dam (M&E Plan Tasks) and monitoring downstream of Merwin dam (H&S Plan Tasks). Because of that distinction, this section, which is a downstream activity, has been transferred to the H&S Plan.	Hatchery and Supplementation Program 2019 Annual Operations Report	H&S Objective 16

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 17	Monitor bull trout populations	Monitoring	In 2019, monitoring included: Swift Reservoir bull trout estimates via mark-resight; Redd surveys in Pine, Rush and Cougar creeks; operate PIT antennas in select areas; Video camera monitoring in Cougar Creek; temperature monitoring of spawning streams; and Yale Tailrace bull trout capture and transport upstream.	NOREMARK estimate for 2019 on-hold due to assumption verification. Survival estimates of Swift adult bull trout population by use of a Barker model and Cormack Jolly-Seber were 55% and 70% respectively. Redd count within Pine Creek drainage were highest on record (110-Pine Creek, 52-P8). The redd count within in Rush Creek remained low (12), while the redd count within Cougar Creek was stable as compared to prior year's (19). Yale tailrace sampling had zero catch for the second season in a row, while PIT detections were again heavily skewed to the Pine system, with very few detections in Rush Creek.	Bull trout monitoring within the Lewis River basin in 2019 remained relatively consistent to what was accomplished and observed during the previous monitoring year. Bull trout spawning tributaries were electrofished for juveniles in the early summer, wired for passive PIT antennas, and sampled for redds over the course of the spawning run. For the first time since a handling moratorium was put into place in 2016, bull trout were collected and tagged from the head of Swift Reservoir. 103 fish were handled, with 73 new tags put out. This collection activity drives the NOREMARK estimate, as well as estimates of Survival. Demographic information is also gathered. Sampling in this area occurs on a 3-year cycle, with the next round slated for year 2022.	Lewis River Bull Trout 2019 Annual Operations Report	H&S Objectives 1 & 13

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 18	Determine interactions between reintroduced anadromous salmonids and resident fish (upstream of Merwin Dam)	Monitoring	PacifiCorp to monitor the interaction between reintroduced anadromous salmonids and resident fish species. Of specific interest, is the possible effect resident trout released in Swift Reservoir may have on reintroduced salmonids and the effect of anadromous fish introductions on the kokanee populations in Yale Lake. Additionally, concern was expressed that anadromous fish may impact the health and viability of ESA listed bull trout populations. This task is one of the assignments of the Fish Passage Feasibility Study conducted by the US Geological Survey (USGS) and University of Washington (UW), Department of Fisheries. The final report was issued in December 2016 (PacifiCorp 2016).	The USGS/UW group completed their analysis and provided results as follows: 1) Used existing data and empirical data to identify the structure of food webs in the three reservoirs; 2) Provided estimates of predation potential and consumption of juvenile salmonids by resident native and non-native species across different seasons; 3) Provided estimates of potential competition among different resident species and anadromous salmonids for resources; 4) Quantified spatial overlap within Pine Creek and habitat use by anadromous smolts and resident fishes; and, 5) Provided estimates of predation and competition among species in Pine Creek using stable isotope methods.	This task was deemed complete based on this previous effort, however the M&E subgroup suggested that this effort be repeated to assess interactions once the reintroduction program is fully operational.	Annual Fish Passage Program 2019 Annual Report	H&S Objectives 1 & 13

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 19	Document Project compliance with flow, ramping rate and flow plateau requirements	Monitoring	PacifiCorp agreed to document project flow, ramping rate, flow plateau, and flood storage requirements of the new License for the Project. The monitoring locations for stream flow-requirements are at the USGS Ariel Gage No. 14220500 downstream of Merwin Dam, and two sites in the Lewis River bypass reach below Swift No. 1 Dam. Flood storage requirements are monitored at each of the project dams.	Flow Releases in the Bypass Reach was in excess of the required minimum flow for the duration of the year for the upper release point. There were no spill events at the Swift project in 2019. At the Constructed Channel, flows were maintained at the per set 14 cfs year round; no minimum flow excursions were recorded in 2019. Flows for the Merwin Project were met or exceeded as stipulated in the FERC license with noted exceptions outlined in the annual report. There were no ramp rate excursions downstream of Merwin Dam, as measured at the USGS Ariel Gage No. 14220500. Flows below Merwin Dam were reduced beyond the minimum flow requirement on July 24, 2019, to July 31, 2019 due to drought conditions in coordination with the FCC.	Details on reporting this objective in 2019 are contained the ACC/TCC Annual Report.	ACC/TCC 2019 Annual Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 20	Determine when reintroduction outcome goals are achieved	Yet to be defined as a numeric adult goal that dictates when run-size is sufficient for achieving both recovery and harvest goals. Until the Services develop numeric goals, the natural adult abundance targets presented under M&E Plan Objective 12 (Ocean Recruits) will be used as the benchmarks for determining the success of the reintroduction effort.	Table will be jointly developed by PacifiCorp and the ACC	Not completed in 2019	The Lewis River Settlement Agreement notes: "...the Services, after discussion with the ACC, shall determine how they will assess whether Reintroduction Outcome Goals have been met, e.g., metric, model, qualitative factors ("Evaluation Methodology"). The determination shall take into account the variability of the factors influencing the success of the comprehensive aquatics program over time such as cycles of ocean conditions and will include an appropriate temporal component in developing and applying the Evaluation Methodology."	None	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
M&E - 21	Develop a Hatchery and Supplementation Plan	Develop and maintain H&S Plan	A plan has been established and is revised and updated on a 5-year cycle by the Hatchery and Supplementation ACC subgroup. The current plan was updated in 2014. A major component of the H&S Plan is an Annual Operating Plan (AOP) that is generated by the H&S Plan subgroup of the ACC. The steps and timeline for developing the AOP are described in the H&S Plan.	The current version of the H&S Plan (2014) was used in 2019 and results are summarized in Table 2.0-2 below.	The current version of the H&S Plan (2014) contains seventeen (17) objectives.	Hatchery and Supplementation Program 2019 Annual Operations Report	All
M&E - 22	Develop a coordination table that cross references objectives of the H&S and Aquatic M&E Plans	Develop and maintain the coordination table	Complete	This table represents the results of this objective for 2019	Complete, this table represents the results of this objective	Lewis River Monitoring and Evaluation Program 2019 Annual Report	All

Table 2.0-2. Coordination table summarizing the Hatchery and Supplementation Plan objectives in 2019.

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
H&S - 1	Evaluate the effects of hatchery plants on reintroduced species and bull trout	Monitoring			This objective was moved to the Aquatic Monitoring and Evaluation Plan in 2016 and serves only as a placeholder until the H&S Plan is updated in 2020.	Lewis River Bull Trout 2019 Annual Operations Report	M&E Objective 17 & 18
H&S - 2	Determine adult composition proportion of hatchery origin spawners (pHOS) of late winter steelhead, coho and spring Chinook downstream of Merwin Dam	Based on HSRG guidelines, hatchery origin fish shall not make up more than 5 to 30 percent of the total natural spawning population depending on the designation of that population	Steelhead: Multi-state mark recapture model (Lebreton 2009) Salmon: Pooled carcass surveys to determine origin.	<u>2019 Coho pHOS:</u> Coho = 53% mainstem NF Lewis River Coho = 30% surveyed NF Lewis R. Tributaries <u>2019 late Winter Steelhead pHOS:</u> Insufficient data to derive estimate <u>2019 spring Chinook pHOS:</u> Insufficient data to derive estimate	USGS has developed a model to estimate pHOS for late winter steelhead that are marked and released from tangle netting. Data for 2018 will be published once available. Data for 2019 was not sufficient in quality to derive an estimate. Estimates for fall Chinook are provided by WDFW once available.	Hatchery and Supplementation Program 2019 Annual Operations Report	M&E Objective 16
H&S - 3	Develop and monitor protocols to reduce hatchery effects on juvenile native and ESA listed species present downstream of Merwin Dam	Monitoring	Conduct morphological sampling of smolts - volitional and at the end of forced release periods. Length, weight, smolt index and K factor are determined.	Various, see report for results	In hatchery monitoring is used to establish the potential for effects post release and determine whether hatchery fish are exhibiting signs of precocity. Including milting rates, comparisons between volitional and forced release groups and smolt indexing.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
H&S - 4	Estimate juvenile release behavior or residualism after release downstream of Merwin Dam	Monitoring	Ongoing, periodic radio telemetry evaluations to monitor emigration rates. Screw trap evaluations to monitor emigration rates.	Not implemented in 2019	Methods to quantify residualism after release from the Lewis River hatcheries were not implemented in 2019. However, the monitoring and use of several hatchery surrogate metrics has been included in the most recent draft of the H&S Plan.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related
H&S - 5	Produce an annual hatchery operations report	Annual Reporting	Ongoing, annual report produced annually by May of each year as part of the hatchery contract.	Complete	The annual hatchery operations report is provided in Appendix H to the Hatchery and Supplementation Program 2019 Annual Operations Report .	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related
H&S - 6	Monitor rearing conditions to be consistent with producing a high quality smolt that emigrates quickly with a relatively high rate of survival	Monitoring	Upgrades to improve flow and density indices have been implemented at all three facilities. SAR values are currently reported for all species by WDFW and as part of the ocean recruit analysis once a methodology is affirmed.	Awaiting coded wire tagged (CWT) spring Chinook adult return data for reporting	Objectives 6 and 8 of the H&S Plan were combined into one rearing and release evaluation involving several treatment groups of spring Chinook. The methodology for this evaluation is described in the 2019 H&S AOP. Results from this evaluation will come primarily from observed CWT adult return rates (SAR's) to the traps and recovered from the spawning grounds. No data are available yet for analysis in this report. As returns begin to be documented, this report will provide updates on an annual basis and provide a project end report providing analysis of all return years when available.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
H&S - 7	Monitor hatchery upgrades	Monitoring	Routine monitoring is provided through annual planning meetings with hatchery staff.	All projects as prescribed by the Agreement have been completed.	Upgrades include pond reconstruction, modification to intakes and sorting facilities and controls upgrades.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related
H&S - 8	Adopt release strategies that are consistent with HSRG and HGMP recommendations	Monitoring	Release strategies conform to proposals contained in each HGMP and will continue to conform with any HGMP modifications once approved by NOAA.	Awaiting CWT return data for reporting	Refer to the summary under H&S Plan Objective 6.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related
H&S - 9	Monitor production levels and program release numbers	Monitoring	Annual meetings with hatchery staff and review of annual hatchery reports to ensure consistency with FERC production levels. Exceptions are noted in PacifiCorp's Hatchery and Supplementation Annual Operating Report.	<u>2018 Brood Year Actual Production (% of Target Production):</u> spring Chinook = 95% Coho = 110% Winter steelhead = 108% Late winter steelhead = 90% Summer steelhead = 137% Rainbow trout = 88% Kokanee = 101%	Actual production exceeded production targets slightly for coho, winter steelhead and kokanee in 2019, but was less than production targets for spring Chinook, late winter steelhead, and rainbow trout. Summer steelhead actual production was substantially greater than the production target.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
H&S - 10	Submit and gain HGMP approval for all hatchery programs on the Lewis River	Approval of HGMP	Submit HGMPs to NOAA for approval	Awaiting submittal to NOAA	No HGMP's were submitted to NOAA for approval in 2019	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related
H&S - 11	Routinely monitor effective population size for returning native winter steelhead and the potential for "Ryman-Laikre" effects on native winter steelhead population from supplementation activities.	Monitoring	Genetic sampling.	Awaiting data analysis by NOAA	Analysis of tissue samples submitted to NOAA has not yet been provided.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related
H&S - 12	Develop sampling protocols for supplementation program returns to traps and from in-river capture	Monitoring	Ongoing as updated annually in the H&S Annual Operating Plan	No data required	Protocols presented in Appendix A and B of the Annual Operating plan provide how fish are sorted and sampled	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
H&S - 13	Effects of upstream adult and juvenile supplementation on ESA listed species	Monitoring	Recommend removing or deferring this objective to M&E Plan Objective 17 "Determine interactions between reintroduced anadromous salmonids and resident fish"	Details on reporting for this M&E Plan objective in 2019 are contained the Lewis River Bull Trout Annual Operations Report.	This objective was moved to the M&E Plan.	Lewis River Bull Trout 2019 Annual Operations Report	M&E Objective 17 & 18
H&S - 14	Estimate juvenile and adult abundance of winter steelhead, coho and spring Chinook downstream of Merwin Dam	Monitoring	Steelhead Adults: Redd Survey using sex ratio and redd/female Salmon Adults: Carcass sampling using either total recoveries and expansion factor or mark-recapture methodologies (opercle tag) to estimate abundance (Jolly-Seber). Juvenile Salmon and Steelhead: Annually operate screw traps to estimate outmigration	<u>2019 Spawning Survey Estimates downstream of Merwin Dam:</u> Late winter steelhead = 500 spawners spring Chinook = no estimate Coho carcass in mainstem NF Lewis R. = 83 <u>2019 Tributary Coho Counts per Reach:</u> Ross Cr. Reach 1 = 13 redds, 10 carcs Houghton Cr. Reach 1 = 14 redds, 2 carcs Houghton Cr. Reach 2 = 0 redds, 0 carcs Hayes Cr. Trib 2 Reach 1 = 0 redds, 0 carcs	Screw traps were not operated downstream of Merwin Dam during 2019 as recommended by WDFD.	Hatchery and Supplementation Program 2019 Annual Operations Report	M&E Objective 6

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
H&S - 15	Determine spatial and temporal distribution of spawning winter steelhead, spring Chinook and coho downstream of Merwin Dam	Monitoring	Redd Surveys to identify location (GPS) and quantity (density and distribution metrics)	<u>Mainstem NF Lewis R. Coho 2019 Carcs % of total count:</u> Reach 1 = 16% , Reach 2 = 7%, Reach 3 = 7%, Reach 4 = 18%, Reach 5 = 52% <u>Mainstem NF Lewis R. late winter steelhead redds 2019 % of total count:</u> Reach 1 = 10%, Reach 2 = 27%, Reach 3 = 8%, Reach 4 = 12%, Reach 5 = 44% :	Coho redd surveys were not conducted in 2019 for the mainstem NF Lewis River downstream of Merwin Dam due to the inability to differentiate coho redds from the much more numerous fall Chinook redds. Over 50% of coho carcasses observed in the NF Lewis R. mainstem were observed in Reach 5 and the fewest were observed in Reaches 2 and 3. Coho redds and carcasses were observed in Ross Creek and Houghton Creek reaches, but not in Hayes Creek Tributary 2. Most late winter steelhead redds were observed in Reaches 2 and 5 of the mainstem NF Lewis R. No Chinook data is available for 2019.	Hatchery and Supplementation Program 2019 Annual Operations Report	M&E Objective 15 Task 15.1 & Task 15.2
H&S - 16	Evaluate fall Chinook and chum populations downstream of Merwin Dam	Monitoring	Use of Jolly-Seber open population mark recapture model for abundance; including redd and live counts for spatial and temporal distribution	No data provided by WDFW in 2019	No data provided by WDFW in 2019	Hatchery and Supplementation Program 2019 Annual Operations Report	M&E Objective 16

Objective No. Task No.	Objective Description	Performance Goal	Method	2019 Data	Summary	Results Source Reference	Relation between M&E and H&S
H&S - 17	Annual review of existing and proposed harvest regulations (if any) to determine if recommendations are warranted to protect supplementation program objectives	Review	Review of published and proposed annual harvest regulations	No recommendations provided by ACC or ATS	No recommendations were received by the ATS or ACC during 2019.	Hatchery and Supplementation Program 2019 Annual Operations Report	Not Related

3.0 LITERATURE CITED

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- PacifiCorp and Cowlitz PUD. 2017. Aquatic Monitoring and Evaluation Plan for the Lewis River. Prepared by PacifiCorp and the Public Utility District No.1 of Cowlitz County. Version 2. April 3, 2017.

APPENDICES

APPENDIX A

**LEWIS RIVER FISH PASSAGE PROGRAM – 2019 ANNUAL REPORT -
Saved as a separate file**

APPENDIX B

**LEWIS RIVER BULL TROUT 2019 ANNUAL OPERATIONS REPORT -
Saved as a separate file**

APPENDIX C

**LEWIS RIVER BULL TROUT 2020 ANNUAL OPERATIONS PLAN -
Saved as a separate file**

APPENDIX D

**YALE RESERVOIR KOKANEE 2019 ESCAPEMENT REPORT -
Saved as a separate file**