Lewis River Bull Trout (*Salvelinus confluentus*) Annual Operations Plan

North Fork Lewis River – 2019

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

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April 12, 2019

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I. INTRODUCTION

Monitoring of bull trout populations in the North Fork Lewis River (Figure 1.0) has occurred annually since 1989. Monitoring activities are a collaborative effort between PacifiCorp and the Public Utility District No. 1 of Cowlitz County, Washington (Cowlitz PUD), federal, and state resource agencies.

On September 15, 2006, the U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (BiOp) including associated Incidental Take Statement for the operation of the Lewis River hydroelectric projects. Though there are no specific Annual Operating Plan requirements included within the BiOp, there are specified annual monitoring activities and reporting requirements with respect to bull trout within the basin.

On June 26, 2008 (effective date), the Federal Energy Regulatory Commission (FERC) issued new 50-year operating licenses for all Lewis River hydroelectric projects. Article 401(a) of the new licenses requires completion of an all-encompassing Monitoring & Evaluation Plan (M&E Plan) for the North Fork Lewis River. The M&E Plan was finalized and implementation begun in 2010. Recently the M&E Plan underwent a five year evaluation and rewrite. New bull trout monitoring mandates were established and those are listed below. Within this M&E Plan are provisions for the annual monitoring of bull trout specifically addressed by 9.6.2 of the Lewis River Settlement Agreement (SA) which states,

"The Licensees shall include in the M&E Plan elements to monitor and evaluate PM&E Measures relating to bull trout, including specific methods and measures to be used in monitoring bull trout populations, including, but not limited to, tagging and snorkel surveys."

As required under section 2.17, Objective 17 of the Lewis River M&E Plan, the Utilities are to develop an Annual Operating Plan (AOP) that contains at minimum, specific elements to address the following five objectives:

- Demographic Characteristics.
- Vital Rates
- Spatial Distribution
- Movement Patterns
- Genetic Diversity

This AOP and the contents found therein was collaboratively developed by the Utilities and representatives from the USFWS, Washington Department of Fish and Wildlife (WDFW), and United States Forest Service (USDA-FS) as members of the Lewis River

Bull Trout Recovery Team (LRBTRT), and may adaptively change in the future per their direction or as new scientific information becomes available.

For 2019, the following nine programs are proposed for action, and one program proposed for hold.

1. Swift Reservoir Bull Trout Migration Snorkel Peak Count and Survival (S) Estimates
2. Yale Tailrace Collection and Transportation
3. Swift Bypass Reach Collection and Transportation – on hold
4. Fixed Half-duplex Passive Integrated Transponder (PIT) Antenna Arrays in Pine, Rush, Rush Creek hole of the Lewis River mainstem, P8, and Cougar Creeks
5. Cougar Creek Spawning Population Estimate
6. Comprehensive Bull Trout Redd Surveys of Pine Creek, Pine Creek Tributary P8, P10, and Rush Creek
7. Partial weir with underwater video camera in Cougar Creek
8. Temperature monitoring of bull trout spawning streams in the upper Lewis River
9. Assessment to Estimate Observer Error within Monitoring Methods in the Lewis River

A schedule of activities and estimated effort to complete each task is provided in the task descriptions below. Many of the tasks or programs are designed to estimate the number of bull trout present in either known spawning locations (e.g. Cougar Creek) or in tailrace areas (e.g. Yale). Spawner survey data are used to identify population risks (e.g., sharp declines in numbers) and, if necessary, to help develop appropriate management actions to protect these populations and stem any declines.

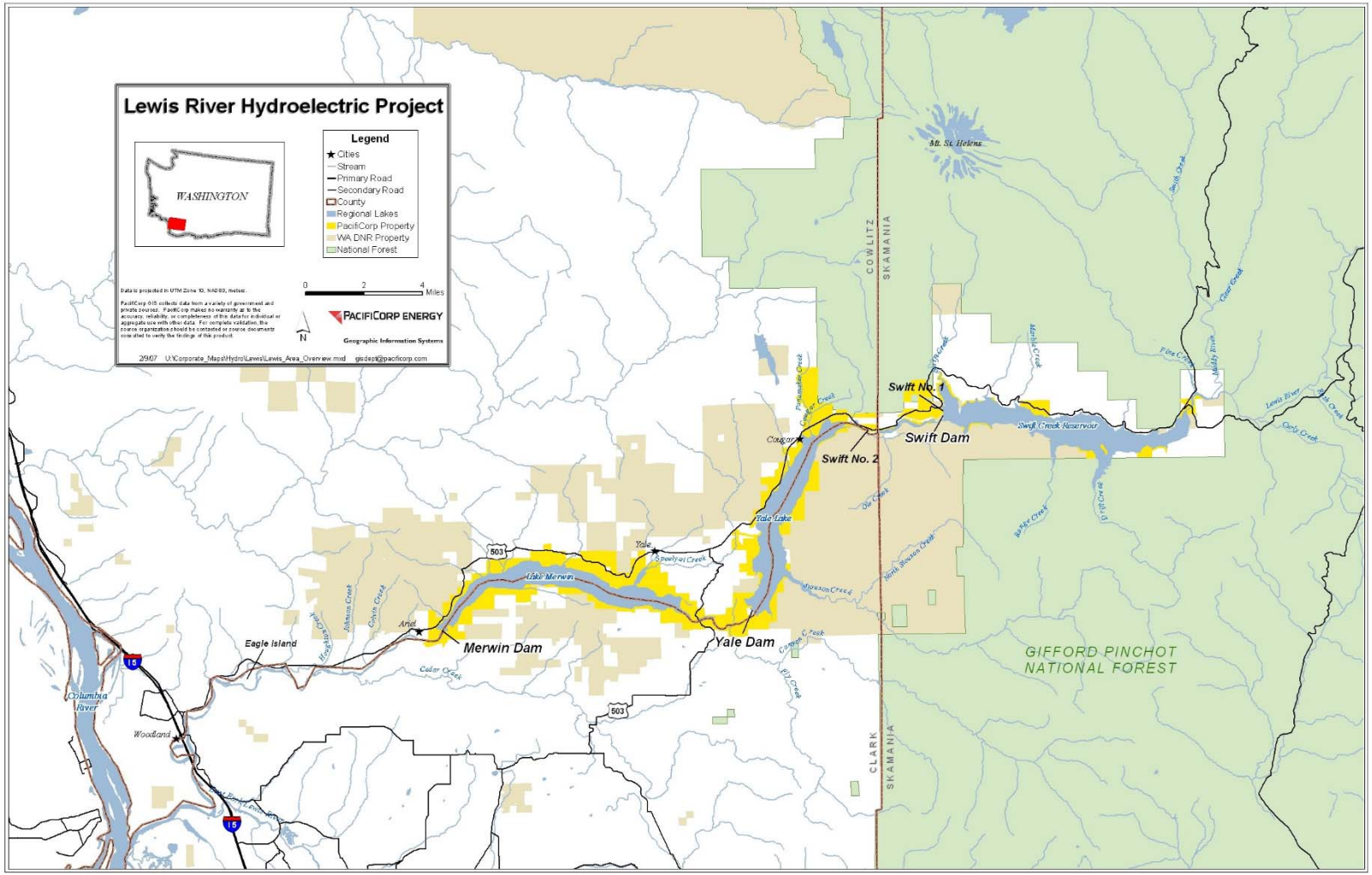

Figure 1.0 – Map of study area

II. PROPOSED MONITORING PROGRAMS

2.1 SWIFT RESERVOIR ADULT BULL TROUT ESTIMATES

Swift Reservoir Adult Bull Trout Migration Estimate

Radio tracking studies in 1990, 1991 and 1994 revealed a pre-migrant congregation of bull trout at the Swift Reservoir headwaters (Eagle Cliffs). The studies further indicated that most tagged bull trout migrated into either Rush or Pine Creeks (tributaries to the Lewis River mainstem), with Rush Creek being preferred. These behavioral patterns have allowed the use of a Peterson type estimator to document the number of migrants ascending the North Fork Lewis River (Lewis River) from the Eagle Cliffs area. Historically the annual estimate of bull trout migrants has been a joint effort between PacifiCorp, the U.S. Forest Service (USFS), the Washington Department of Fish and Wildlife (WDFW) and the USFWS. In 2017, based on compelling evidence of scientific handling having a detrimental effect on overall survival, the LRBTRT decided to limit pre-spawn handling of bull trout adults and sub-adults. As part of that, it was decided then that the Swift Reservoir adult bull trout migration estimate be conducted on a once every 3-year rotation. 2019 will mark the first time since 2016 that these activities have occurred.

The Peterson type estimator uses software program NOREMARK® developed by Gary White of Colorado State University to estimate migratory abundance. NOREMARK® computes estimates of population size for a closed population with a known number of marked animals and one or more re-sighting surveys (White 1996). To fulfill the marking aspect of the estimator, pre-migrant bull trout are captured and tagged in May, June, and July using tangle nets consisting of dyed green 6# monofilament, with depths of approximately 2 meters (m), varying lengths of 25 – 40 m, and varying mesh sizes of 2.5 – 7.5 centimeter (cm) stretch. With the use of boats, nets are either drifted along the bottom in the Eagle Cliffs area (Figure 2.1-1) or set and allowed to passively fish unattended for up to 10 minutes. Angling, when appropriate, may also be employed to capture staging bull trout.

Once a bull trout becomes entangled in the net, the net is retrieved and the captured bull trout is released from the net and placed in a live well. In 2019, to further address potential bias of non-migrating tagged fish, only bull trout **450 mm** or larger will be marked with **two** chartreuse colored 3-inch Floy® anchor tags. Historically bull trout as small as 360 mm have been Floy® tagged as part of this Program. Through the use of instream Passive Integrated Transponder (PIT) tag antennas at various sites throughout the basin since 2002, researchers now know that the occurrence of bull trout less than 450 mm in fork length making spawning migrations is extremely infrequent, yet the addition of the 360 mm – 449 mm size-class within the migration estimate can greatly skew the estimates precision from one year to the next. Care will be taken during re-sight snorkel surveys to only count marked and unmarked bull trout that are greater than 450 mm in fork length.

The goal of the two Floy® tags is to test the assumption of tag loss and the rate at which it occurs. During snorkel activities, sample crews will pay special attention to the amount of

chartreuse tags observed on bull trout (NOREMARK® recapture survey methodology) to directly assess any in-season tag loss.

The goal of these activities is to capture and Floy® tag 100 individual bull trout larger than 450mm. This collection goal may be adaptively managed mid-season based on extenuating circumstances or collection constraints (e.g. surveys called off based on high number of in-season recaptures or high water volume in collection area limiting the number of bull trout available to be caught for tagging purposes). Depending on unforeseen factors, the 100-fish collection goal may not be achieved from one year to the next.

In addition to Floy® tagging, the WDFW initiated a PIT-tagging program for captured bull trout in 2002. Historically, bull trout larger than 120 mm were tagged with a full-duplex (FDX) 12 mm PIT-tag in the dorsal sinus. Since 2011, to coincide with half-duplex (HDX) PIT antennas installed in upper North Fork Lewis River tributaries, all captured bull trout larger than 300 mm have been tagged with a half-duplex PIT-tag. Bull trout greater than 300 mm fork-length (FL) will be tagged with a 23 mm half-duplex PIT-tag in the dorsal sinus, while bull trout 120 mm to 299 mm fork length will be tagged with a 12 mm FDX PIT-tag in the dorsal sinus in hopes of later recapture.

To tag bull trout greater than 300 mm FL with a 23 mm HDX PIT tag, a small incision just wide enough to accommodate the diameter of the tag (appr. 3.85 mm) will be made with a scalpel just anterior to the dorsal sinus and the tag will then gently be pushed toward the caudal peduncle into the sinus (Tranquilli et. al 2003). Captured bull trout less than 300 mm FL will be tagged with a 12 mm FDX PIT tag in the dorsal sinus by means of a syringe type PIT tag injector.

Bull trout recaptures greater than 300 mm previously tagged with a full-duplex PIT tag in their dorsal sinus will be tagged with an additional half-duplex PIT tag in the sinus on the opposite side of the fish and posterior to the original FDX tagging location. This tagging location has been identified since 2010 as being a suitable long-term tagging location where the two different types of PIT tag signals will not interfere with one another. If the recaptured FDX PIT tagged bull trout is less than 300 mm no additional tag will be inserted. PIT-tags are an alternative marking tool for captured bull trout with the intent to provide long-term survival, abundance, biological, and migratory data for individual fish.

In conjunction with tangle netting activities, PacifiCorp will weigh each captured bull trout larger than 120 mm. This information will serve three purposes: First, weight-length ratios can be calculated (K factors) for each fish (Fulton 1902); secondly, this information can be compared to previous years to determine if changes in the annual average K-factor exist and whether these changes can be correlated with any population trends observed; and thirdly, with previously PIT-tagged bull trout, researchers will be able to determine individual length and weight gain which may provide information on reservoir conditions and productivity since an individual's last capture.

Also, as part of the biological data handling process, captured bull trout in 2019 will be assessed for gender and sexual maturity by means of a portable veterinarian ultrasound system. This vital demographic information will be used in conjunction with spawning tributary PIT antennas as currently no sex ratio of migrating bull trout on the Lewis River exists.

Depending on river flow conditions, weekly snorkel surveys will be conducted eight times from July through September of the confluences of Rush Creek, Muddy River, and Pine Creek with the North Fork Lewis River (Figure 2.1-1). During each snorkel count, biologists will be equally spaced and trained to follow the methods used to snorkel the "Rush Creek Hole" to alleviate double-counting fish.

Annual Swift Reservoir Adult Bull Trout Survival (S) Estimate

Detections of previously tagged bull trout at fixed PIT antenna arrays located in Rush, Pine, and P8 Creeks, the Swift Floating Surface Collector (FSC), and Rush Creek hole of the mainstem upper Lewis River will be used to assess migration patterns, preferred habitat and to generate estimates of the following using the population structure software program MARK (White and Burham 1999):

- Probability of participating in a spawning migration
- Probability of detection during spawning
- Annual Survival (S)

Swift and Yale Reservoir Effective Population (N_e) Size Evaluation

It was decided collectively by the Lewis River Bull Trout Group during the planning meeting phase of construction of this document to no longer evaluate Effective Population Size and Genetic Estimation of Breeder Population on an annual basis. Instead, in order to better maximize time and resources, this analysis will be performed on a 3-year cycle with the next date of completion occurring in 2020. This 3-year check-in is expected to be sufficient in assessing Effective Population as the temporal cycle proposed will never skip a generation. Age 0 juvenile bull trout samples will continue to be collected from established sampling locations on an annual basis to further relative abundance trend data as well as have samples on hand to retroactively analyze if the need arises. Methods for data collection to possibly evaluate N_e at a future date are below.

Estimation of effective population size can provide information on the level of genetic variation within a population and how fast genetic variation may be lost through genetic drift (Luikart et al. 2010). The effective population size represents the size of an ideal population that would have the same rate of loss of genetic variation as the observed population (Wright 1931). Although general guidelines for minimum effective population sizes have been suggested (e.g., the 50/500 rule; Franklin 1980), evaluating temporal trends in estimates of N_e are often more useful than determining whether a population meets some minimum threshold number. For example, a population that shows a large decrease in N_e over the course of one or two generations could be experiencing a genetic bottleneck or decline in abundance. Alternatively, an increase in effective size following implementation of new management actions could be one indication that the population is responding positively (Pers. Comm. Pat DeHaan, USFWS).

To evaluate N_e it is anticipated genetic tissue from 30-50 juvenile bull trout from the same cohort (presumably age 0) will need to be attained from utilized spawning tributaries (Cougar, Pine and Rush creeks, Figure 2.1-1). In order to get maximum genetic representation, fish captures will

also need to be spatially balanced along the length of usable habitat within the stream (Pers Comm. Pat DeHaan, USFWS).

To collect tissue samples from juvenile bull trout, two biologists will conduct electrofishing surveys with a Smith-Root® model LR-24 backpack electrofisher. All electrofishing activities will follow protocols as recommended by the electrofishing unit manufacturer and the National Marine Fisheries Service's (NMFS) Guidelines for Electrofishing Waters Containing Salmonids listed under the Endangered Species Act (NOAA 2000). To minimize impact and incidental injury to collected juvenile bull trout, the electrofisher will be set to straight DC current and voltage settings will be turned to the lowest output possible to capture fish.

A small clip of tissue from the upper lobe of each bull trout's caudal fin will be preserved in labeled vials filled with 95 percent ethanol. The size of fin clip will be relative to the size of fish captured. Regardless of fish size, at no time will the tissue sample be greater than 1 square centimeter. All captured fish will also be measured to their caudal fork and capture location recorded. Tissue samples will then be sent to the USFWS Abernathy Conservation Genetics Lab for genotypic and N_e analysis.

Also, during bull trout juvenile collection, all encountered coho juveniles captured during electrofishing surveys will be enumerated and recorded to get a proportion of coho juveniles to bull trout juveniles residing within the same habitat. A sub-sample of captured coho will also be measured to their caudal fork.

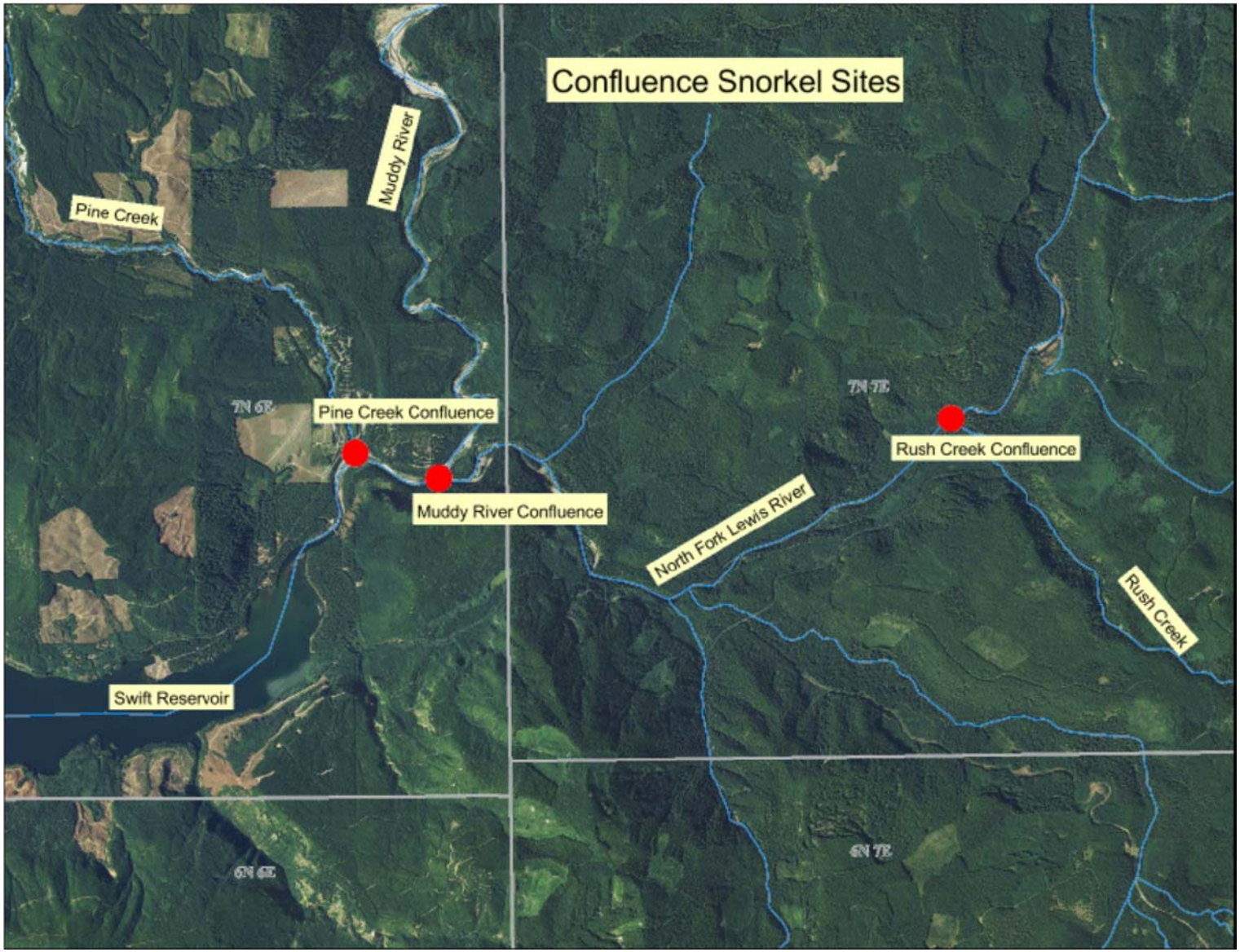

Figure 2.1-1. Snorkel sites (recapture) associated with the Swift Reservoir bull trout migration estimate

2.2 YALE TAILRACE COLLECTION AND TRANSPORTATION

PacifiCorp annually collects and transports 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 at the Yale tailrace since the program began in 1995. Of these, 126 have been transferred to Cougar Creek, twenty were left in Merwin Reservoir for various monitoring efforts, nine were mortalities while being held at Merwin Hatchery during 2003 capture efforts and two were transported to Swift Reservoir per their laboratory assessed genetic assignment.

To capture bull trout from the Yale tailwaters, 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 remain the method employed to date. Tangle nets are tied to the powerhouse wall or shoreline and then stretched across the tailrace area using a jet boat. The nets are then allowed to sink to the bottom (about 30 feet). Depending on conditions or capture rate, the nets are held by hand on one end or allowed to fish passively. The maximum time nets are allowed to fish is 10 minutes.

Upon capture of a bull trout, the fish is immediately removed from the net (usually by cutting the monofilament strands) and placed in a live well. Once biological information is gathered (length, weight, general fish condition) and a PIT-tag is inserted using the same methods and protocols as described in Section 2.1 of this Plan, the bull trout is placed in either an aerated holding box, or a live cart in the stream. After collection activities are completed for the day, the captured bull trout are transported to a waiting truck with transport tank.

All maiden Yale tailrace bull trout captures in 2019 will be transported upstream and released into Yale Reservoir. Encountered recaptures (verified by PIT tag) will be transported to their genetically identified reservoir of origin.

It is proposed for 2019 to continue netting during the same historical time-frame of June – August, but only net at the frequency of once per month for a total of three bull trout netting events (Table 2.2-1).

Netting typically occurs between the hours of 0800 and 1200; however, powerhouse generation schedules may cause netting activities to occur in the afternoon. During fish collection, powerhouse generators are taken off-line to enable deployment of nets. In years past biologists have netted for longer periods, however, capture efficiency drops substantially and very few if any fish are captured after about two hours of effort in the tailrace.

<u>Alternative Capture Methodology</u>

At this time no other capture method has been as feasible or efficient as tangle nets in capturing bull trout from the Yale tailrace waters. PacifiCorp continues research on possible alternative methods of effective capture and transport. However, upon investigation of each concept or pilot tests conducted at other Northwestern dams, PacifiCorp has not been successful in finding a better alternative to the current method. Therefore, future capture techniques will continue to use tangle nets as the preferred method unless a better method emerges or formal fish passage is constructed at Yale dam.

2.3 SWIFT BYPASS REACH COLLECTION AND TRANSPORTATION

In 1999, PacifiCorp and the WDFW began netting the Swift No. 2 powerhouse tailrace as part of Yale enhancement measures filed with the Yale license application to FERC in April 1999. However, due to the canal breach in May 2002 and subsequent low reservoir conditions, there was no netting at the Swift No. 2 powerhouse from 2001-2005; netting resumed in 2006. Due to the low capture numbers at Swift No. 2 (two fish in 1999 and zero since then) and large numbers of bull trout in the Swift Bypass Reach from July through October, the Swift No. 2 tailrace netting effort was relocated to the Swift Bypass Reach in 2007. Since the onset of netting activities in the Swift Bypass Reach (Figure 2.3-1) in 2007, 209 bull trout have been captured and tagged.

Based in part on the previously mentioned compelling evidence of negative handling effects, and the fact that upstream and downstream bull trout passage from Yale Reservoir to Swift Reservoir and vice versa will be implemented at the very latest by year 2025, the LRBTRT advised that this collection and haul program be halted indefinitely moving forward. No bull trout will be captured and handled from the Swift Bypass Reach and held at Merwin hatchery while awaiting genetic assignment in 2019.

2.4 HALF-DUPLEX PASSIVE INTEGRATED TRANSPONDER TAG - FIXED ANTENNA ARRAYS

Fixed PIT tag antenna arrays will be used to further evaluate Lewis River bull trout spatial and temporal distribution, migration patterns related to spawning events, survival (S), and spawning site fidelity. Arrays will be constructed near the mouths of Pine, Rush, P8, and Cougar Creeks, as well as in the Rush Creek hole of the upper Lewis River mainstem in 2019 (Figures 2.4-1 and 2.4-2).

Due to the greater read-range, flexible antenna construction scenarios, lower power consumption, and more affordable cost, a stream-width HDX system will be utilized in each identified spawning tributary location, except for in Rush Creek hole where a small, proximity antenna will be strategically placed. Depending on stream flow conditions, antennas will be placed in each creek in July and taken out of the creek the first week of November, in an attempt to capture the entire bull trout spawn time-frame.

Each stream PIT antenna system will consist of one stream-width HDX PIT tag antenna. Conducive to higher detection efficiencies and as much as practically possible, antennas will be placed in a shallow area of each stream. Each stream antenna will consist of a rubber-coated 1/0-gauge welding cable or 10 gauge speaker wire. All stream antennas will be designed as stream-spanning swim thru loops. An Oregon RFID RI-Acc-008B antenna tuner box will be attached to the 1/0-gauge copper welding cable or 10-gauge copper wire. Copper coax from the tuner box will then connect to an Oregon RFID RI-RFM-008 reader board and data logger. The antenna at Cougar Creek will be hooked up to electricity on-site which will then be passed through a 110-volt AC to 12-volt DC converter for continuous power. The antennas at the remaining stream sites will be powered by two or three 12-volt deep-cycle batteries in parallel which will require

replacement every two-three weeks. Some sites, if location is conducive, will also receive power from one or two 90-120 watt solar panels. Solar panels will be run to a charge controller which will then be connected to 12-volt batteries.

Due to the large spatial area encompassing the Rush Creek hole, no stream-width antenna like those located in Pine, Rush, P8, and Cougar creeks are possible at this location. Instead, a Biomark® 1.6 m diameter wagon wheel proximity antenna will be utilized at this location. This type of antenna reads both HDX and FDX tags and has a nominal read-range of 30-45 cm. Unlike the stream-width antennas that cover the entire stream-width and interrogate all tagged bull trout that ascend and descend the stream at that location, the proximity antenna will simply be anchored on the bottom centrally within the Rush Creek hole, in hopes that tagged fish will at some point in their holding residency at this location come into close proximity of the antenna. Given the known behavior of bull trout in the basin to congregate in large numbers in this area, and given their propensity to benthically orient themselves within the stream, researchers hope that a small unobtrusive antenna in this location will garner numerous tag interrogations.

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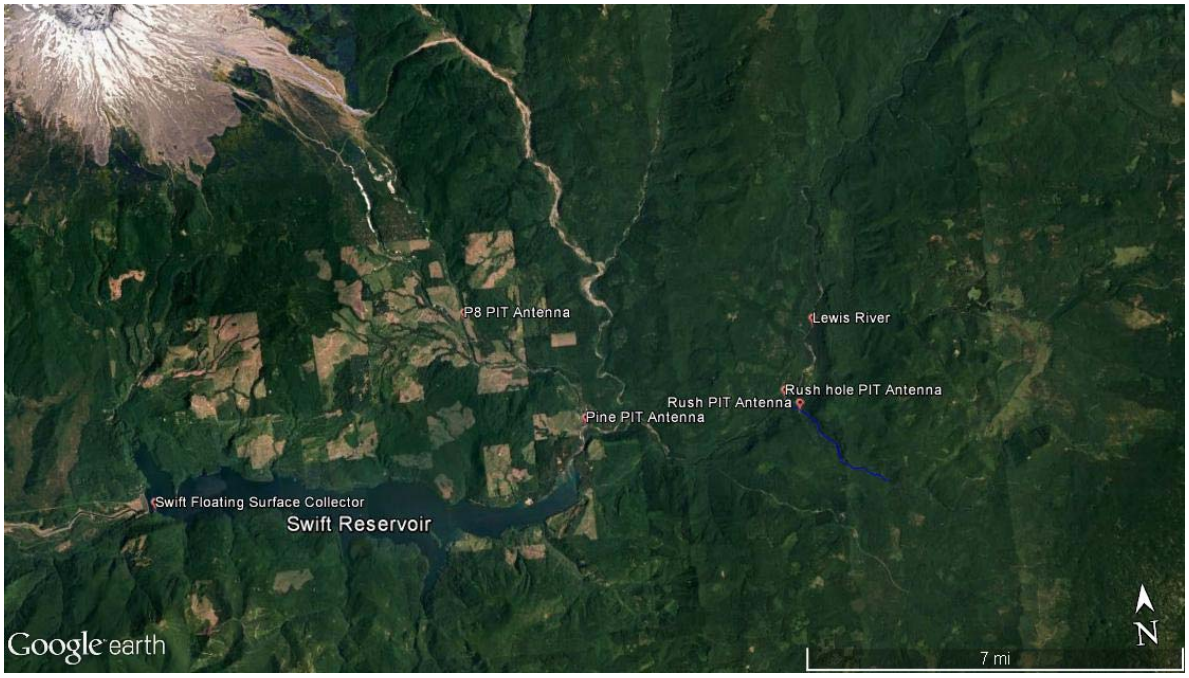

Figure 2.4-1. Fixed PIT-tag antenna stream sites upstream of Swift dam planned for 2019

Figure 2.4-2. Fixed PIT-tag antenna sites downstream of Swift Reservoir planned for 2019

2.5 COUGAR CREEK SPAWNING ESTIMATE

Since 1979, PacifiCorp biologists, along with various state and federal agencies, have conducted annual surveys to estimate spawning escapement of kokanee (*Oncorhynchus nerka)* in Cougar Creek, a tributary to Yale Reservoir. Along with the kokanee counts, bull trout (since 1979) and bull trout redds (since 2007) are also counted, as their spawn-time overlaps with that of kokanee.

Surveys are performed by one or two biologists, and the entire length of Cougar Creek is surveyed – a distance of about 2400 m (Figure 2.5-1). Bull trout spawner population estimates have ranged from 0 to 40 fish from foot surveys (since 1979) and between 38 and 58 fish based on redd counts (since 2007). This variability is due in part to sampling error, but is also indicative of a low spawning run size. Results of Cougar Creek kokanee surveys are reported annually and provided in the Aquatic Coordination Committee/Terrestrial Coordination Committee Annual Report.

Sampling effort in 2019 will be consistent with historical efforts to date. Depending on high water levels or other environmental issues (water turbidity), surveys will consist of bull trout redd counts every 10 days from September thru October; or until bull trout or new redds are no longer observed (Table 2.6-1). Live bull trout within the stream will continue to be enumerated, but the surveys will focus on locating redds. Redds will be mapped using a GPS and flagged until no longer visible to avoid double counts. Along with a population estimate, these surveys will also allow for a better understanding of bull trout spawning habitat characteristics.

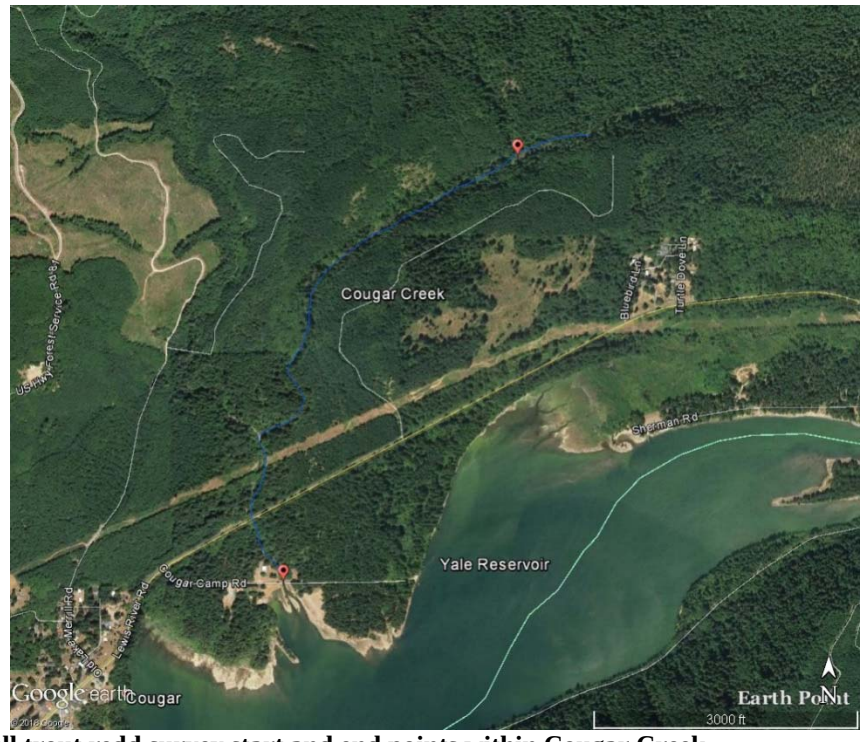

Figure 2.5-1. Bull trout redd survey start and end points within Cougar Creek.

2.6 REDD SURVEYS OF PINE CREEK TRIBUTARY P8 AND P10, PINE CREEK MAINSTEM AND RUSH CREEK

The Utilities propose to continue bull trout redd surveys within P8 (Figure 2.6-1) in 2019 in order to build upon existing abundance trend data. Surveys will be conducted within the first one mile of the stream. Depending on high water levels or other environmental issues (water turbidity), surveys will plan to be performed once every ten days in September and October (Table 2.6-1). All redd surveys will be consistent with methodologies performed on Cougar Creek for bull trout (Section 2.5).

Along with the ten day rotation of surveys within P8, and depending on high water levels or other environmental issues (water turbidity) Rush, P10 and Pine creeks will also be surveyed on a ten day rotation for bull trout redds (Figure 2.6-1). Pine Creek and P10 surveys will encompass the entire creek to its anadromous fish barrier, while surveys within Rush Creek will extend from the stream mouth upstream to the Forest Road Bridge at approximately river mile 0.5. As this will be a census count of redds, survey methodology will follow methods identified within Section 2.5 of this Plan.

Though no barrier exists on Rush Creek at the Forest Road 90 Bridge, upstream of this point the habitat becomes mainly bedrock and river gradient greatly increases. With this change of gradient survey conditions become exceedingly more difficult and concerns for surveyor safety become an issue.

Objective 19 of the Monitoring and Evaluation Plan highlights the need for information to be collected concerning resident and anadromous fish interactions. A portion of Objective 19 specifically seeks an assessment of later spawning coho (*O. kisutch*) superimposing redds over previously constructed bull trout redds. To evaluate this, bull trout redds observed during P8 redd surveys in 2019 will be uniquely visually marked in order to assess if and any disturbance occurs to the bull trout redd egg pocket by later spawning coho.

Along with standard flagging and taking of a GPS point of each identified bull trout redd during 2019 surveys, detailed notes and additional flagging spatially demarcating bull trout redd egg pockets (redd mound) will also be taken and hung. The detailed notes and additional flagging will give a visual cue to where within the stream the egg pocket lies even after natural hydrologic and biological processes have returned the stream bottom to a more natural appearance.

Redd surveys of P8, depending on high water levels or other environmental issues (water turbidity), will be extended through November to encompass the early and late-run coho spawn timeframe and each bull trout redd recorded from earlier surveys will be re-visited and assessed for new excavation over the egg pocket.

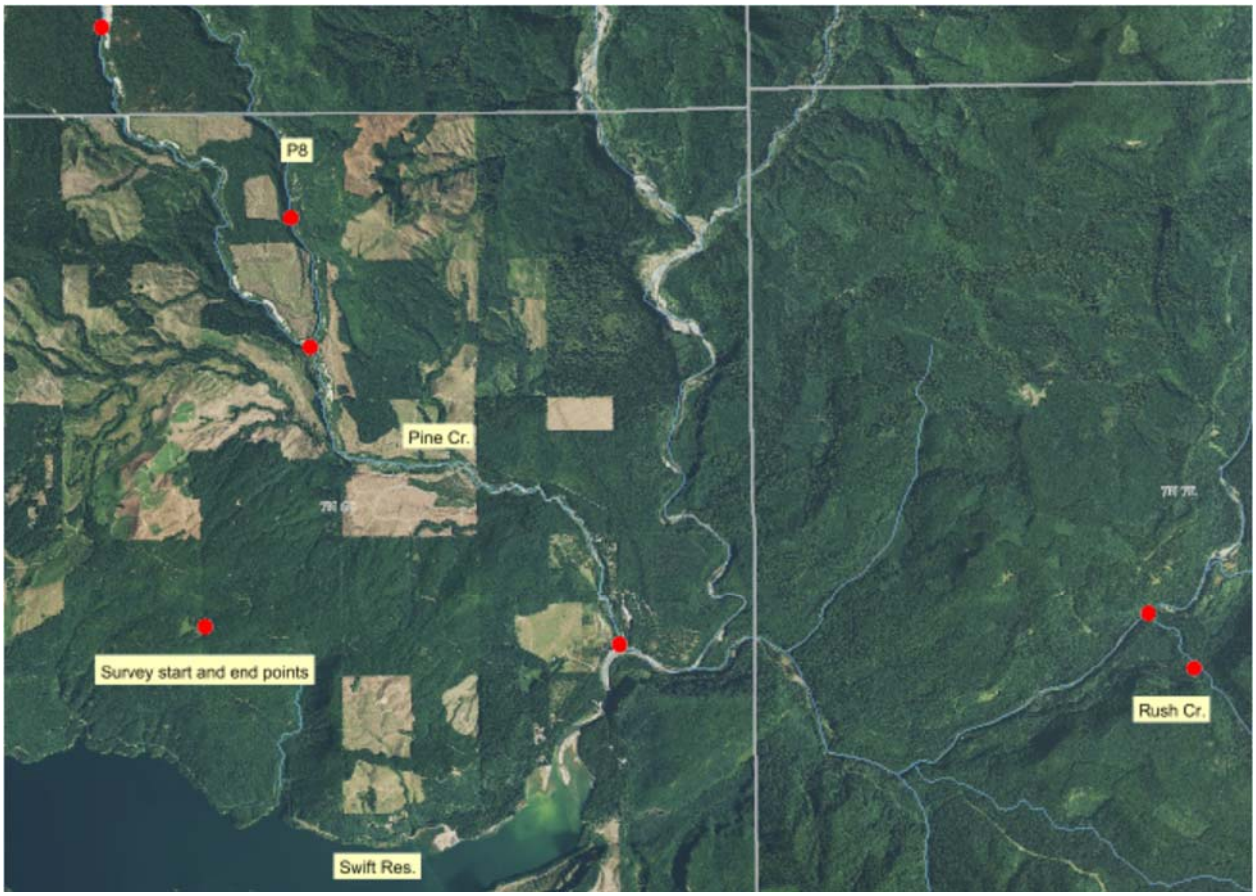

Figure 2.6-1. Bull trout redd survey reaches within the Pine Creek system and Rush Creek for 2019.

2.7 UNDERWATER VIDEO CAMERA IN COUGAR CREEK DURING THE SPAWNING MIGRATION PERIOD

In order to get a true count of bull trout that ascend Cougar Creek during the bull trout spawn timeframe, a partial weir with an associated underwater video camera will be installed within the creek the second week of July and attempt to stay in operation through October 31, 2019. This information will be correlated to redd surveys performed of this reach to finely tune the number of bull trout associated with each redd.

In order to funnel bull trout nearer to the underwater camera lens, a partial weir consisting of polyvinyl chloride pickets will be constructed in Cougar Creek near its confluence with Yale Reservoir (Cougar Creek PIT antenna site, Figure 2.4-2). The weir will consist of multiple separate panels that will terminate to either side of a swim thru box. The underwater video camera will be housed in this swim thru box located near the center of the channel. The weir will divert migrating bull trout in the direction of the swim thru box and into the cameras field of vision. An underwater light will be utilized in conjunction with the underwater camera in order to better identify fish.

All video footage will be recorded by either a motion detecting or standard Digital Video Recorder (DVR) and saved to either an external hard drive or Secure Digital memory card (SD card). If

motion detection is utilized, sensitivity on the DVR will be set to capture all expected migrating fish size-ranges in the study area (60mm +). The camera, lights, and recording instruments will be powered on-site by 110v hard power.

Recorded video footage will be viewed; upstream and downstream bull trout movement and the associated count of bull trout that ascended Cougar Creek during the recording time-frame will be assessed. The background within the cameras field of vision in the swim thru box that houses the underwater camera will be solid white with solid black vertical lines spaced equidistant apart. The distance between each solid black line will be known and in this way approximate length of each migrating bull trout will also be assessed.

2.8 TEMPERATURE MONITORING OF BULL TROUT SPAWNING STREAMS IN THE UPPER LEWIS BASIN

In order to better understand bull trout spawn migration timing and how it correlates to stream temperature, Onset Tidbit® temperature data loggers will be remotely deployed in strategic locations of the Upper Lewis River basin in 2019.

Starting June 15, temperature data loggers will be deployed at the mouth of Pine Creek, P8, P10, Rush Creek, Eagle Cliff hole of the Lewis River mainstem and the mainstem upper Lewis River just upstream of its confluence with Rush Creek. Thermographs will be quality assured/quality controlled by the manufacturer prior to deployment and will be set to record continuous hourly temperature readings at each identified location. Thermographs will be recovered and taken out of each stream location by the first week of November.

2.9 ASSESSMENT TO ESTIMATE OBSERVER ERROR WITHIN MONITORING METHODS ON THE LEWIS RIVER

In order to understand how sampling error may influence metrics of bull trout abundance across different survey methods, an estimate of observer error within bull trout redd and snorkel surveys will be generated during the 2019 field season. Key to this assessment will be to identify how observer error differs across different levels of bull trout abundance and across different streams, particularly given inherent differences in stream characteristics and water clarity.

Methods to assess observer error with concern to redd surveys will comprise of the following:

- Study will occur on all major bull trout spawning tributaries in the basin, Cougar, Rush, P8, P10, and Pine creeks.
- All flagging indicating locations of redds from previous years or previous surveys will be removed prior to study surveys.
- Assessment will occur across three separate time periods to capture the range of bull trout abundance, one survey during an early period and one during the typical peak spawning period, and one towards the latter half of the migration period.
- Streams will be broken down into distinct reaches based on historical spawning information with reaches delineated by flagging.

- Surveys will be conducted by observers on the same day or consecutive days to minimize additional redds being constructed.
- Each observer will walk each reach/stream and take GPS coordinates and notes of location of each redd. No flagging will be used.

Methods to assess observer error with concern to snorkel surveys will comprise of the following:

- Assessment will occur at areas where bull trout stage prior to spawning including Eagle Cliffs and the confluences of Muddy River and Pine and Rush creeks.
- Study will occur across three time periods to capture the range of bull trout abundance at these locations, time periods will be driven by previous snorkel data.
- Boundaries of areas to be snorkeled will be clearly demarcated by flagging.
- Three experienced bull trout snorkelers will conduct the study. Snorkeler will proceed to snorkel entire section and estimate the size of all bull trout observed by 100 mm increments and record on an underwater slate. Data from each snorkeler will not be reviewed by other snorkelers until after the study survey.
- Each snorkeler will conduct survey of a specific site within the same day and separated by approximately one hour.

Both sets of data will be analyzed using mixed model approaches (Zuur et al. 2007). Through this approach, estimates of signal noise ratio will be estimated to identify the most robust and precise approach for monitoring. In addition, variance decomposition methods will be used to identify the magnitude of different sources of error (e.g., observer, density, etc.). By delineating sampling efforts by stream/location, it will be also possible to identify how sampling error varies by population. Contrasting the two measures of abundance will provide insights into the effectiveness of different approaches to detect changes in bull trout abundance, provide benchmarks to compare such measures with the effectiveness of previous abundance monitoring data (i.e., mark-recapture), and allow managers to refine monitoring approaches to focus on the most effective approach for monitoring multiple bull trout populations in the Lewis River.

III. Reporting

An Annual Report detailing all activities and corresponding data gathered concerning this 2019 Annual Bull Trout Operating Plan, will be included in the Aquatic Coordination Committee/Terrestrial Coordination Committee Annual Report submitted to FERC in the spring of 2020.

IV. References

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V. Agency Comments

No agency comments were received by the due date of April 5, 2019.