Lake Merwin and Swift Creek Reservoir Tributary Streams Bull Trout Limiting Factors Analysis

70% Draft

Prepared for

PACIFICORP ENERGY
A DIVISION OF PACIFICORP

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1.0 INTRODUCTION

As a component of the Lewis River Hydroelectric Project's Settlement Agreement (PacifiCorp 2004), PacifiCorp agreed to conduct a limiting factors analysis (LFA) for bull trout (*Salvelinus confluentus*) occurring in the tributaries to Lake Merwin and Swift Creek Reservoir and to finalize this evaluation in consultation with the Aquatics Coordination Committee (ACC). Specifically, Section 5.5 of the Settlement Agreement states:

> *By the second anniversary of the Effective Date, PacifiCorp shall provide a limiting factors analysis for bull trout occurring in Lake Merwin tributary streams and Swift Creek Reservoir tributary streams and finalize this evaluation in Consultation with the ACC. If the Licensees, in Consultation with the ACC and with the approval of USFWS, determines that one or more locations have the potential to provide long-term, sustainable habitat for critical life stages of bull trout, the ACC may implement enhancement measures through the use of the Aquatics Fund as described in Section 7.5 below [of the Settlement Agreement].*

According to the *Bull Trout LFA Scope of Work* issued by PacifiCorp in January, 2006, the LFA should seek to answer (at a minimum) the following key questions:

1) Other than known bull trout streams associated with Merwin and Swift Creek reservoirs, do other streams exist at either project that can potentially provide long-term spawning, incubation, and rearing habitat?
2) Are the habitat conditions in each potential tributary suitable for any one of the critical life stages of bull trout?
3) Do bull trout reside in these other streams?
4) Of the potential streams that do exist, what are the limiting factors that can be attributable to the absence of bull trout?
5) Are there any physical changes that can be made to potential streams lacking bull trout to provide for colonization by existing bull trout stocks?

To address these questions, Meridian Environmental, Inc. (Meridian) prepared a draft study plan in consultation with PacifiCorp, the U.S. Fish and Wildlife Service (USFWS), and the Washington Department of Fish and Wildlife (WDFW). The Revised Study Plan (incorporating agency comments, dated September 19, 2006) and responses to agency comments on the first draft study plan (dated April 21, 2006) are provided in Appendix A and Appendix B, respectively. The significant flood in November 2006 prevented biologists from completing some field work necessary to finalize this report. When field conditions allow, the remaining surveys will be conducted, and the analysis finalized in coordination with the Bull Trout LFA technical group (comprised of biologists from Meridian, PacifiCorp, WDFW, USFWS, and Mobrand/Jones and Stokes). Once the analysis is finalized, a revised report will be submitted to the ACC for review.

1.1 EXISTING LEWIS RIVER BULL TROUT INFORMATION

This section briefly summarizes existing information describing bull trout populations in the Lewis River basin to provide a context for this study. Unless otherwise cited, this summary is derived primarily from USFWS (2006, pages 68 to 71). Bull trout (*Salvelinus confluentus*) within the coterminous United States were listed as threatened pursuant to the Endangered Species Act (ESA) of 1973 as amended, on November 1, 1999 (64 FR 58910). Local populations of bull trout in the Lewis River basin (collectively grouped together) are designated as one of the 97 core areas that form the Columbia River Interim Bull Trout Recovery Unit.

Currently, reproducing populations of bull trout within the Lewis River Core Area (Figure 1) are known to spawn in the Pine Creek and Rush Creek drainages, both of which flow into the upper North Fork Lewis River upstream of Swift Creek Reservoir, and in Cougar Creek which flows into Yale Lake. A genetic study performed by Neraas and Spruell (2004, pages 7 to 8) showed that the spawning population of bull trout in Pine Creek is genetically distinct from the population in Rush Creek, and that the population in Cougar Creek is genetically indistinguishable from the Pine and Rush Creek populations. These data suggest that the Cougar Creek population is composed largely of bull trout that have moved downstream from Swift Creek Reservoir into Yale Lake.

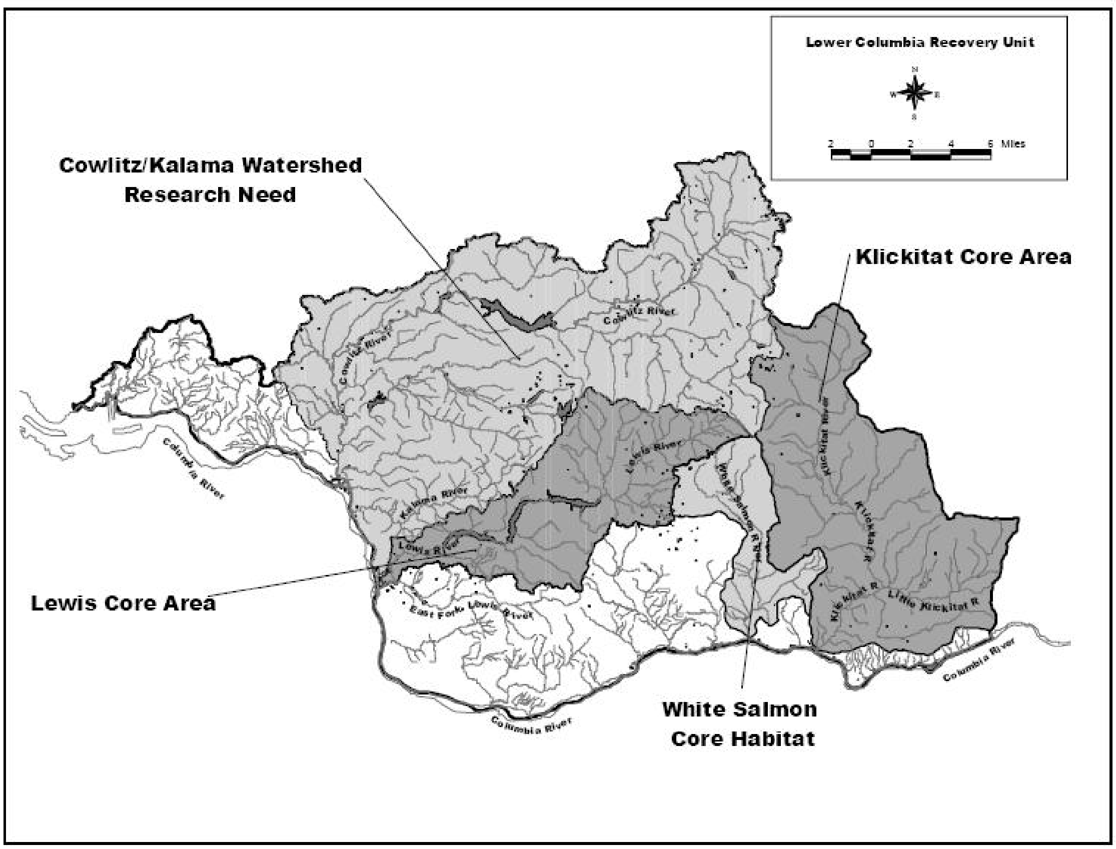


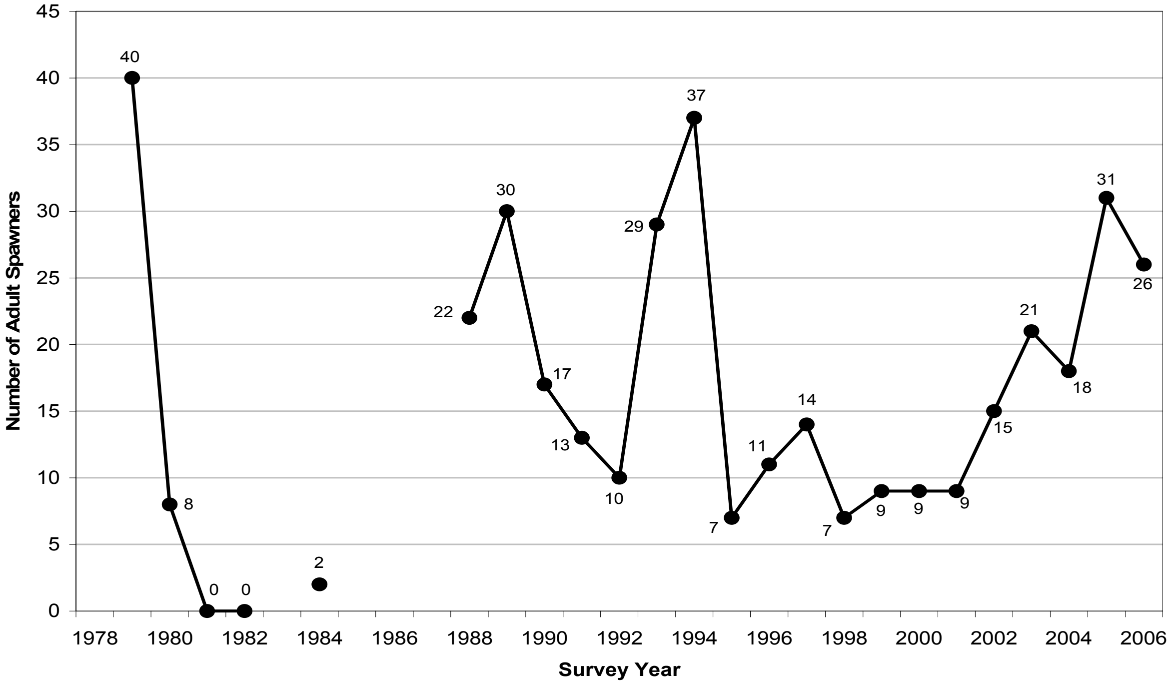
Figure 1. Lower Columbia River bull trout recovery unit.

Cougar Creek is the only known bull trout spawning and rearing tributary to Yale Lake. A habitat limiting factors study conducted during project relicensing further suggested that other tributaries to Yale Lake would not support successful bull trout egg incubation under several habitat management scenarios, primarily because high water temperatures during egg incubation would limit egg survival (Pratt 2003, page AQU 19-i). Although bull trout are routinely observed seasonally in the Yale Dam tailrace (the upstream end of Lake Merwin), they have not been observed spawning or rearing in Lake Merwin tributaries. It is thought that the bull trout residing in Lake Merwin originated from Yale Lake and moved downstream past Yale Dam through the turbines or over the spillway. Similar to the Cougar Creek genetic assessment, bull trout sampled from Lake Merwin were indistinguishable from Pine and Rush creek fish (Neraas and Spruell 2004, page 8).

Bull trout exhibit resident and migratory life-history patterns through much of their current range. Resident bull trout complete their entire life cycle in the tributary streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juveniles rear for several years before migrating to one of 3 habitats: (1) lakes or reservoirs (adfluvial); (2) rivers (fluvial); or (3) in certain coastal areas, to saltwater (anadromous). Bull trout in the Lewis River basin appear to exhibit an adfluvial life history pattern. Spawning occurs in headwater tributaries in the fall. Juveniles typically rear in these tributaries for 1 to 3 years and then migrate into the Project reservoirs in the spring. Although, some young-of-the-year bull trout have been documented migrating out of Rush Creek (J. Byrne, WDFW, ScCS PowerPoint presentation 2006, unpublished data). These fish then remain in the reservoirs until about age 4 or 5 when they become sexually mature and move back into the tributaries to spawn. After spawning, adults return to the reservoirs to over-winter.

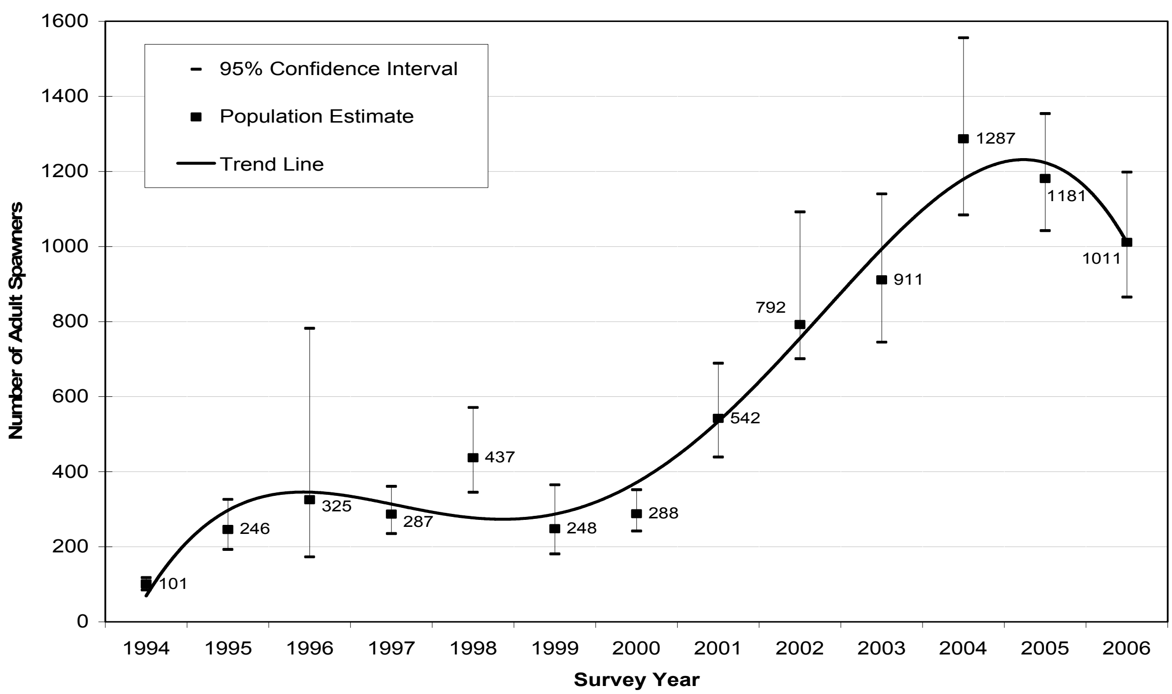
Spawning adfluvial bull trout in Yale Lake migrate into Cougar Creek from the middle of August through early September and spawn from late September through early October (USFWS 2002, page 12). Bull trout residing in Swift Creek Reservoir migrate into tributary streams from late May through early-August, and are believed to spawn from early August through the middle of September (USFWS 2002, page 11). Throughout their range, bull trout fry usually emerge from the gravel from mid-January to late February. Emigration of juveniles from the tributaries to Swift Creek Reservoir and Yale Lake is believed to occur primarily from mid-May through June (USFWS 2002, page 11).

The estimated Cougar Creek adult spawning population has ranged annually from 0 to 40 individuals based on annual adult counts conducted from 1979 to 2006 (Figure 2). The adult spawning population within Swift Creek Reservoir (Pine and Rush creek local populations combined) is currently greater than about 1000 fish, and adult abundance generally has been increasing over the past decade (Figure 3). As there are no upstream passage facilities between the three reservoirs and there is thought to be no spawning habitat in tributaries of Lake Merwin, PacifiCorp, in cooperation with the WDFW, annually net and transport bull trout from the Yale tailrace (Lake Merwin) to the mouth of Cougar Creek (the only Yale Lake spawning tributary). As of the end of 2006, 102 bull trout have been captured in the Yale tailrace since the program began in 1995; yearly captures ranged from 0 to 19 fish (Lesko and Doyle 2007, page 8).



Source: Lesko and Doyle 2007, page 11.

Figure 2. Annual peak counts of bull trout spawners observed in Cougar Creek from 1979 to 2006.



Source: Lesko and Doyle 2007, page 4.

Figure 3. Estimated bull trout spawning population in Swift Creek Reservoir from 1994 to 2006.

1.2 STUDY OBJECTIVE

Although local populations of bull trout in the Lewis River basin upstream of Swift Creek Reservoir have been generally increasing, their long-term persistence depends almost entirely on habitat conditions in two relatively small spawning streams: Rush Creek and Pine Creek. The accessible reach of Rush Creek is fairly short (approximately 1.7 miles in length), making it particularly susceptible to stochastic events such as landslides or from deterministic events such as climate change and attendant potential effects on stream flow and water temperature. Pine Creek, Muddy River, and the upper mainstem Lewis River, while much longer than Rush Creek, are vulnerable to massive debris flows from Mt. St. Helens, or debris flows of unstable sediments (exposed during the 1980 eruption) during periodic flood events (USFWS 2006, page 71). According to the Bull Trout Draft Recovery Plan (USFWS 2002, page vii), establishing additional local populations in the Lewis River Core Area is essential for recovery in order to spread the risk of population decline or local population extirpation due to deterministic or stochastic events. Identification of other potential tributaries which could support local populations is considered a Priority 1 Action (i.e. highest priority level) under the Draft Recovery Plan.

The Draft Recovery Plan (USFWS 2002, page vii) specifically recommends a limiting factors study of lower Speelyai Creek and three stream reaches accessible from Yale Lake (Rain Creek, Ole Creek, and the Lewis River bypass reach). In response to this recommendation, PacifiCorp conducted an *Evaluation of Three Proposed Management Scenarios to Enhance Three Potential Bull Trout Nursery Habitats, Accessible to Lake Merwin and Yale Lake, Lewis River* (Pratt 2003). This evaluation found that none of the three management intervention proposals would result in bull trout production in the study streams, primarily because high water temperatures during egg incubation would limit egg survival (Pratt 2003, page AQU 19-i). The Draft Recovery Plan further recommends a limiting factors analysis for "other potential sites within the Lewis Core Area which have, or could support suitable habitat conditions if restored" (USFWS 2002, page vii). According to the Draft Recovery Plan, key information gaps that need to be addressed in the Lower Columbia Recovery Unit include: (1) specific information on the suitability of potential spawning and rearing areas in each basin, (2) increased inventory in each basin to establish the current distribution, and (3) a complete limiting factors analysis to identify site specific actions needed to recover bull trout within each system (USFWS 2002, page v).

The objective of this study is to answer each of the key questions presented in the B*ull Trout LFA Scope of Work* issued by PacifiCorp in January, 2006 (see Section 1.0) and to address the key information gaps described in the Draft Recovery Plan for those tributaries entering Swift Creek Reservoir and Lake Merwin that have the potential to provide at least some accessible habitat. Specifically, this study addresses four fundamental questions:

1. Do the tributaries to Swift Creek Reservoir and Lake Merwin contain suitable bull trout spawning, incubation, and rearing habitat?
2. Do bull trout currently inhabit these tributaries?

3. If these tributaries do not contain suitable spawning, incubation, and rearing habitat, what are the limiting factors?
4. Could these limiting factors be adequately addressed through habitat restoration actions so that the habitat could support long-term bull trout spawning, incubation, and rearing?

Studying those tributaries not known to contain bull trout will help determine if new local populations are becoming established in Swift Creek Reservoir and Lake Merwin tributaries or if existing tributary habitats have the potential to allow bull trout colonization through habitat restoration. Lake Merwin bull trout are not considered a local population under the Draft Recovery Plan, and spawning areas are not known to exist in Lake Merwin tributaries (USFWS 2002, page 18). Because no study was conducted to support this conclusion, this investigation will address this information gap.

1.3 STUDY AREA

The study area for this investigation includes the accessible reaches of 16 tributaries to Lake Merwin and Swift Creek Reservoir that were identified in the *Assessment of Potential Anadromous Fish Habitat Upstream of Merwin Dam* (PacifiCorp and Cowlitz PUD 2004, page AQU 4-9 to AQU 4-11) as having habitat that could be accessible to anadromous salmonids, but that were not known to contain bull trout (Figure 4). These “candidate” tributaries include Marble, Rock, Canyon, Cape Horn, Indian, Jim, M4, Brooks, M14 and Buncombe Hollow creeks (tributaries to Lake Merwin); and Diamond, Swift, Range, Drift, S10, and S15 Creeks (tributaries of Swift Creek Reservoir). The alpha-numeric stream designations for streams not named on USGS 7.5 minute series topographic maps are the same designations used in the relicensing studies (PacifiCorp and Cowlitz PUD 2004, page AQU 4-9 to AQU 4-11). This study does not include the upper North Fork Lewis River and tributaries that are known to be used by bull trout, as these areas are currently being assessed by other long-term monitoring studies.

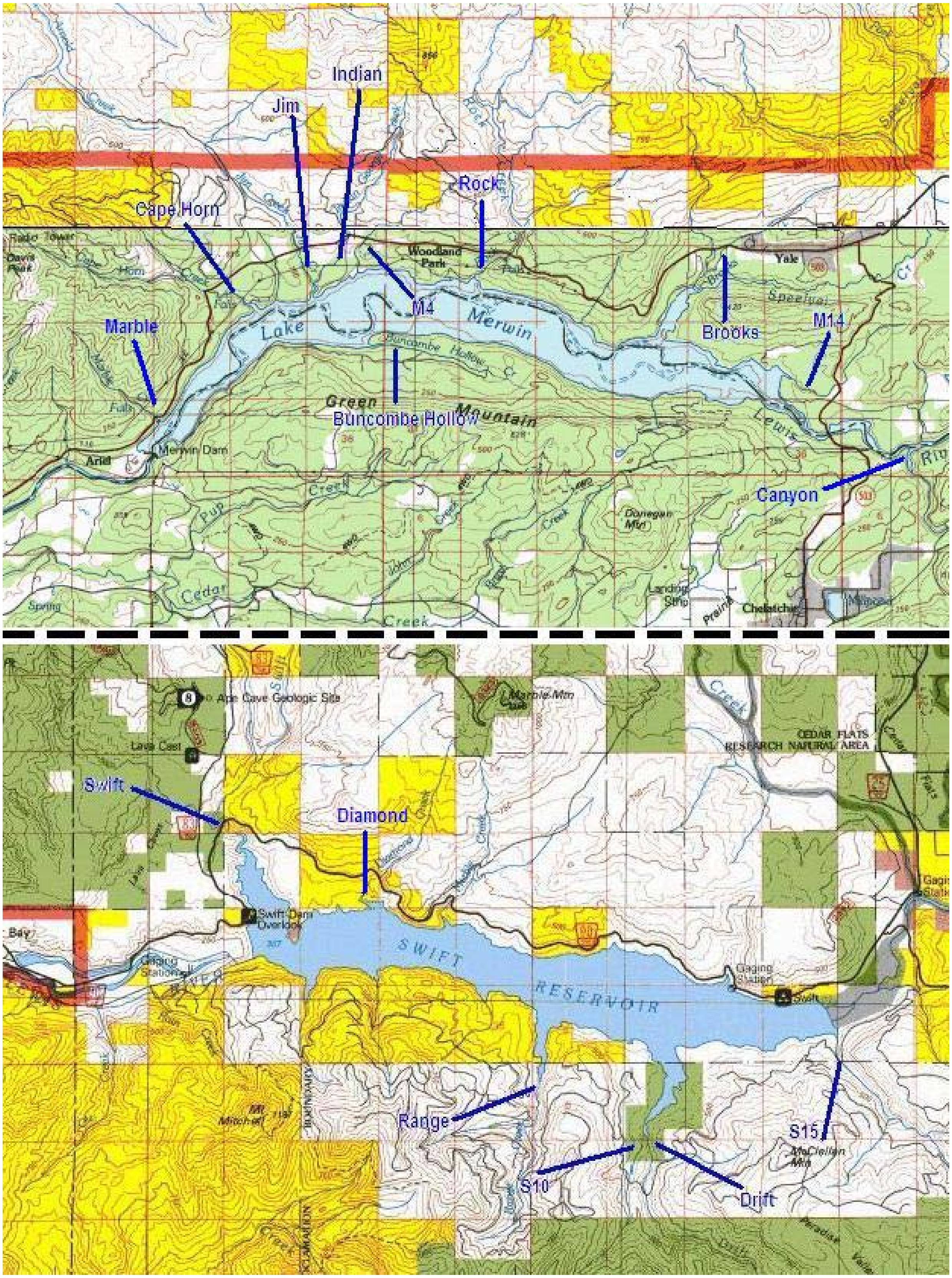


Figure 4. Lake Merwin and Swift Creek Reservoir tributary stream locations.

2.0 METHODS

The overall study approach was to review existing habitat information, collect additional field data to fill habitat information gaps, and to use this data to perform a qualitative habitat assessment to identify limiting factors in streams with the greatest potential to support bull trout spawning, incubation, and rearing. We also conducted a bull trout presence/absence survey in a short list of streams that at least met the “marginal” habitat suitability criteria for bull trout. In this section, we summarize the methods used to perform these tasks (see Appendix A, Revised Study Plan, for further details).

2.1 INITIAL TRIBUTARY HABITAT RANKING BASED ON EXISTING INFORMATION (OFFICE PHASE)

Existing streamflow, channel gradient (including natural barriers), and water temperature information for the 16 candidate tributaries was evaluated during an “office phase”. This data was used to develop an initial short list of potential bull trout streams entering Lake Merwin and Swift Creek Reservoir, as these habitat factors appear to be some of the best predictors of potential bull trout use (Dunham et al. 2003, page 901 and 902). The goal of this first task was to minimize the amount of field work needed to identify streams that could potentially provide long-term spawning, incubation, and rearing habitat. Primary sources of information included the data sheets developed during the *Assessment of Potential Anadromous Fish Habitat Upstream of Merwin Dam* (AQU 4) (PacifiCorp and Cowlitz PUD 2004, pages AQU 4-9 to AQU 4-11), USFS habitat surveys, existing water temperature data, and USGS 7.5 minute quadrangles.

Using this existing information and bull trout habitat requirements described in the scientific literature, each tributary entering Lake Merwin and Swift Creek Reservoir was then categorized as having “optimal”, “marginal”, “poor”, or “unknown” potential to support bull trout spawning, incubation, and rearing according to the criteria presented in Table 1. Water temperature was believed to be the best predictor of potential bull trout use (Dunham et al. 2003, page 901 and 902). Streams that ranked as “poor” for at least one parameter listed in Table 1 were eliminated from further consideration. We assumed that if “optimal” and “marginal” criteria for flow, gradient, and water temperature were not met, there was little chance that restoration efforts would create suitable habitat for bull trout spawning and rearing. All streams which ranked as "optimal", "marginal", or "unknown" were carried forward to the field phase for additional data collection.

It should be noted that the “optimal” water temperature and flow criteria used in Table 1 are the same as those currently being used by the USFWS to model and map potential bull trout spawning and early rearing “habitat patches” in the Lewis River basin[1]. The more conservative “marginal” ranking included in Table 1 was designed to capture those streams that have sub-optimal habitat conditions, but that may be capable of supporting at least some bull trout spawning and rearing through habitat restoration. To be conservative (i.e. so as to not exclude areas that may have some bull trout habitat potential), streams meeting both the “optimal” and "marginal" criteria were carried

[1] The USFWS was driven to use elevation and basin size as surrogates for water temperature and perennial streamflow due to the lack of available data for most streams.

forward and further assessed during the field data collection phase of this study. Streams categorized as "unknown" were also carried forward to the field phase.

Table 1. Initial bull trout habitat ranking categories.

Habitat Parameter	Optimal	Marginal	Poor	Unknown
Flow	Perennial	Perennial	Seasonal[1]	Observations of late summer flow do not exist
Gradient	≤12%[4]	<20%	≥20%[2]	Unknown barrier presence
Maximum water temperature by mid-November[3] (spawning)	≤10°	≤13°	>13°C	Continuous water temperature data through the fall do not exist
Maximum water temperature (summer rearing)	≤16°C	≤18°C	>18°C	Continuous water temperature data through the summer do not exist

1 Based on AQU-4 study results (pages AQU 4-9 to AQU 4-11) and anecdotal information (Pers. comm. J. Byrne, WDFW, July 2006), accessible reaches for all study streams are likely perennially flowing.
2 Based on AQU-4 study results (pages AQU 4-9 to AQU 4-11), accessible reaches for all study streams are <20% in gradient.
3 Spawning may occur in Lewis River tributaries through November (Pers. comm. J. Byrne, WDFW, July 2006).
4 Gradient of Rush Creek, known bull trout spawning tributary in the Lewis River basin

2.2 FIELD SURVEY OF OPTIMAL, MARGINAL, AND UNKNOWN STREAMS

The habitat requirements of bull trout are often expressed as the four Cs: cold, clean, complex, and connected habitat. Cold temperatures, clean water (that is relatively free of sediment and contaminants), complex channel characteristics (such as abundant large wood and undercut banks), and large patches of habitat that are well connected by unobstructed migratory pathways, are all needed to promote the conservation of bull trout at multiple scales ranging from the coterminous to the local stream population level (USFWS 2006, page 22). Following these guidelines, we assessed water temperature, habitat complexity, and presence of migration barriers in those tributaries that met the "optimal", "marginal", or "unknown" criteria described in Table 1.[2]

2.2.1 Temperature Monitoring using In-Situ Loggers

Water temperature data loggers (Onset Tidbit®) were deployed in all study streams that met the initial "optimal", "marginal", or "unknown" criteria. In relatively small tributaries (accessible habitat lengths that were less than one mile), one temperature logger was placed at the mouth of the tributary. In tributaries with accessible reaches longer than one mile, two temperature loggers were deployed: one at the mouth of the tributary and one in the middle to upper end of the accessible reach (see Appendix D for tributary maps and logger locations). Sixteen temperature loggers were deployed by mid-July of 2006, with the intent of collecting data through mid-November of 2006 in order to measure water temperatures during the summer rearing period through the end of the potential spawning period. Each temperature logger was attached inside a piece of 2-

[2] The Draft Recovery Plan chapter pertaining to the Lewis River Core Area also recognizes the need to identify habitat that could potentially be used to support additional local populations in the Lewis River basin by assessing water temperature, flow regime, and habitat characteristics.

inch-diameter PVC pipe approximately 6-inches in length in order to protect the logger. The logger was secured inside the PVC pipe using plastic zip-ties. The PVC pipe containing a logger was secured to a 4-foot long rebar stake that was driven approximately 2.5 to 3 feet into the stream channel. Temperature loggers were set to record data once every half-hour (i.e. 48 measurements per day). Approximately once a month, each data logger was field downloaded and immediately re-launched. As temperature data was collected, downloaded, and summarized through the summer, streams that were found to have daily maximum temperatures over 18°C, were ranked as "poor" and dropped from further phases of data collection. We did, however, continue to collect temperature data using the in-situ loggers for these streams throughout the study period.

2.2.2 Cold Water Refugia Survey

As requested by the USFWS, a cold water refugia survey was also conducted in all tributaries where temperature loggers were deployed. The purpose of this survey was to determine how the in-situ logger measurements represented water temperature in the accessible reach of each tributary and to determine if patches of suitable cold water habitat (refugia) were present that were not detectable by the in-situ temperature loggers. Theses surveys involved walking the accessible reach of each tributary and taking hand-held thermometer readings approximately every 150 feet. Cold water refugia surveys were conducted in mid-August for streams that rated as "poor" based on the in-situ logger data to determine if cold water habitat existed upstream that may meet the "marginal" or "optimal" criteria for summer rearing. For streams where the in-situ loggers showed that the streams would meet "marginal" or "optimal" criteria for summer rearing temperature, the cold water refugia survey was postponed until mid-September to determine if reaches of colder water may be upstream of an in-situ logger. This task was requested by the USFWS in response to their review of the first draft study plan.

2.2.3 Bull Trout Presence/Absence Survey

Bull trout presence/absence surveys were conducted in all tributaries that met either the “optimal” (i.e. ≤16°C) or "marginal" (i.e. ≤18°C) criteria for summer rearing water temperature following guidance presented in Peterson et al. (2002). The presence/ absence survey was lead by a Meridian fisheries biologist with over five years of direct bull trout sampling experience to ensure accurate fish identification. The entire reach of each survey tributary was sampled for bull trout because most accessible reaches were less than one mile long. Snorkeling was used in those tributaries with sufficient depth to allow direct observation without fish handling. Electrofishing was used in tributaries that were too shallow to effectively snorkel. During snorkel surveys, all pools and other habitats with sufficient depth and lack of turbulence were sampled. Only daytime snorkeling was conducted due to the remote location and safety constraints (all snorkel survey tributaries were only accessible by boat or steep hazardous trails. All surveys (electrofishing and snorkeling) started at the mouth of each tributary and proceeded upstream to the impassable barrier. Additionally, an electrofisher was used to sample tributary margin, off-channel, and side channel habitat in each reach that was snorkle-surveyed. Because the objective was to determine bull trout presence or absence, other fish species were not specifically enumerated. They were, however, recorded with general notes taken on species and abundance by size-class.

2.2.4 Tributary Habitat Inventory

Detailed habitat surveys were also planned in all tributaries that met either the "optimal" or "marginal" bull trout spawning and rearing habitat criteria using the USFS Region 6 survey protocol (USFS 2006). These surveys were designed to quantify those habitat attributes that may be limiting to bull trout and that could be improved through habitat restoration. The habitat surveys were originally scheduled for late-September/early-October, coinciding with the peak bull trout spawning period in the Lewis River basin. A barrier survey in the reservoir drawdown zone was also planned to determine if barriers were exposed during reservoir drawdown that would preclude adult bull trout from migrating upstream to spawn. Due to the overall lack of stream flow in several streams and the lack of bull trout observations from the presence/absence surveys conducted in September (see Section 3.0), we delayed habitat surveys until November, which is suspected to be the latter part of the potential bull trout spawning period in the Lewis River basin (personal communication, J. Byrne, WDFW, July 2006). A significant flood event occurred the week of November 6, 2006, when the habitat surveys were scheduled to begin.

Following the flood event, we attempted to survey the "optimal" or "marginal" tributaries at flows similar to those observed just prior to the flood in order to represent potential early-November spawning habitat. Unfortunately, flows remained too high to conduct habitat surveys until the week of December 4, 2006. We were able to habitat survey Brooks and S10 creeks before the flows rose again, precluding habitat surveys in Drift and Swift creeks. These two streams have not been surveyed to date due to either extremely high flows or lack of boat ramp access caused by low reservoir levels[3]. Habitat in the remaining two streams will be habitat surveyed as soon as conditions allow. All habitat data has been collected per the USFS Region 6 protocol and summarized using an MS Access 2000 database program developed by Moore et al. 2005, which was designed to be compatible with USFS Region 6 protocol habitat data. The Moore et al. (2005) program was used because the USFWS Region 6 data summary program is not accessible to the general public. Photographs of representative habitat units and riparian conditions were also taken for each reach.

2.3 QUALITATIVE HABITAT ANALYSIS

[Note to reviewers: The QHA analysis will be conducted after habitat surveys are complete]

In general, QHA provides a structured, "qualitative" approach to analyzing the relationship between a given fish species and its habitat. It uses a systematic assessment of several aquatic habitat attributes (sediment, water temperature, etc.) that are thought to be key to biological production and sustainability. Habitat attribute findings are then considered in terms of their influence on a given species and life stage.

[3] Drift and Swift creeks are only accessible by boat in winter, although Swift Creek is accessible by a steep trail during snow-free periods.

Following completion of the field habitat surveys, the QHA method will be used to conduct a limiting factors analysis on each tributary examined with “optimal” or “marginal” potential for bull trout spawning and rearing. In this study, the QHA will rely largely on the habitat survey data combined with the expert knowledge of natural resource professionals with bull trout experience in the Lewis Rive basin. It will be used to rate the quality of potential bull trout spawning, incubation, and rearing habitat conditions in each study tributary.

A series of tables will be produced that (1) describe the physical habitat of each study tributary, (2) establish an hypothesis concerning how species may interact with the available habitat, and (3) identify where habitat restoration and/or protection activities may be the most productive in order to promote long-term bull trout spawning, incubation, and rearing habitat in the study streams. When we conduct the QHA analysis (scheduled for the spring of 2007) the Bull Trout LFA technical group will share their local expert knowledge to rate the different habitat values.

3.0 RESULTS

3.1 INITIAL TRIBUTARY HABITAT RANKING

Based on a preliminary assessment of available flow, gradient, and barrier data from PacifiCorp and Cowlitz PUD (2004, pages AQU 4-9 to AQU 4-11) there were 7 independent tributaries to Lake Merwin and 5 independent tributaries to Swift Creek Reservoir that were potentially accessible to bull trout and contained perennial flowing water (Table 2). Marble, Rock, and Canyon creeks (Lake Merwin tributaries), and Diamond Creek (Swift Creek Reservoir tributary) were ranked "poor" based on the initial assessment of available data and were eliminated from further evaluation (Table 3). Rational for eliminating these streams from further analysis is presented in Table 3.

Table 2. Independent tributaries to Lake Merwin and Swift Creek Reservoir potentially accessible to bull trout that were carried forward to the water temperature monitoring phase.

Reach Name	Length of Accessible Habitat (ft)	Average Bankfull Width (ft)	Average Gradient (%)
LAKE MERWIN			
Cape Horn Creek	1,744	23.3	6.5
Jim Creek	3,140	21.5	3.4
Indian George Creek	4,760	21.9	5.0
Buncombe Hollow Creek	4,168	10.9	3.9
M4	3,900	11.5	10.0
Brooks Creek	5,714	19.5	4.0
M14	6,507	35.7	2.5

Reach Name	Length of Accessible Habitat (ft)	Average Bankfull Width (ft)	Average Gradient (%)
SWIFT CREEK RESERVOIR			
Swift Creek	1,639	NS	8.4
Range Creek	3,486	45.1	8.9
S10	1,855	24.7	6.8
Drift Creek	8,506	48.1	11.2
S15	6,680	29.7	6.7

NS = not surveyed
M4, B1, M14, S10, and S15 represent code names given to tributaries are unnamed on 7.5 minute USGS topographic maps.

Table 3. Streams assessed in PacifiCorp and Cowlitz PUD (2004) ranked as "poor" for bull trout spawning, incubation, and rearing in this study.

Reach Name	Length of Accessible Habitat (ft)	Average Bankfull Width (ft)	Average Gradient (%)
Marble Creek[1]	40	15.2	2.0
Rock Creek[2]	320	47.5	6.1
Canyon Creek[3]	0	not surveyed	not surveyed
Diamond Creek[4]	655	20.8	10.0

1 Marble Creek contains only 40 feet of accessible habitat downstream from a 40-foot high falls. It is highly unlikely that only 40 feet of habitat, at a relatively low elevation (<300 feet above sea level), would support long-term spawning, incubation, and rearing habitat for bull trout.

2 The lowermost 200 feet of accessible habitat in Rock Creek has an average gradient of <1 percent. The remaining accessible 150 feet has an average gradient of approximately 20 percent. It is highly unlikely that only 200 feet of habitat, at a relatively low elevation (<300 feet above sea level), would support long-term spawning, incubation, and rearing habitat for bull trout.

3 Numerous waterfalls located at the mouth and throughout the lower 1,000 feet of Canyon Creek block fish access into Canyon Creek from Lake Merwin.

4 Diamond Creek is a high gradient tributary to Lake Merwin (16.5 percent for first 200 feet, and 8 percent for the remaining 455 accessible feet from the mouth). Habitat in the accessible portion is dominated by shallow, high gradient riffles with occasional pocket pools. Cobble and small boulder are the dominant substrate types. Gravel is extremely limited. Because of its relatively short length, high gradient, and low summer flow of 0.5 cfs observed during the AQU-4 Study, Diamond Creek appears to contain only a limited amount of salmonid habitat, and would not likely support long-term spawning, incubation, and rearing habitat for bull trout.

While there were some available water temperature data for the 12 streams that were carried forward in analysis (Table 2), there was not enough continuous monitoring data throughout a summer and fall period to classify each tributary using our summer rearing or fall spawning water temperature criteria (Table 1). As a result, these streams were rated "unknown" for temperature. Consequently, all 12 streams listed in Table 2 were carried forward to the water temperature monitoring phase described below.

3.2 WATER TEMPERATURE MONITORING

As described in Section 2.2.1, water temperature was monitored in all streams listed in Table 2 using in-situ temperature loggers to further classify each tributary as "optimal", "marginal", or "poor" based on the criteria listed in Table 1. While the majority of water temperature loggers were lost during the November flood event, temperature data were collected for all streams in Table 2 extending into late September, making it possible to rate the streams using the summer rearing temperature criteria and also to examine spawning temperatures during the first half of the known Lewis River bull trout spawning period.

Temperature data collected through late-September are summarized in Table 4. As denoted by the gray shading, eight of the 12 streams had summer maximum water temperatures >18°C, and therefore, ranked "poor" for juvenile bull trout summer rearing. Brooks and Drift creeks (yellow shading) both ranked as "marginal" for summer bull trout rearing (summer maximum water temperatures (>16°C and ≤18°C). Swift and S10 creeks (green shading) both ranked "optimal" for bull trout summer rearing (summer maximum water temperatures ≤16°C); both of these streams were continually less than 12°C throughout the summer.

As of late-September, Swift Creek was the only accessible tributary that met the "optimal" criteria for both summer rearing (≤16°C) and fall spawning (≤10°C) (Table 2). Water temperatures in S10 Creek met the "optimal" criteria for summer rearing (≤16°C) and the "marginal" criteria for spawning (≤13°C). Brooks and Drift creeks met the "marginal" criteria for summer rearing (≤18°C), and as of mid-September, met the "marginal" criteria for bull trout spawning. As these four streams (Brooks, Drift, S10, and Swift creeks) appeared to meet both the summer rearing and fall spawning temperature criteria (for either "marginal", "optimal", or a combination of both), they were carried forward to the tributary habitat survey phase.

Temperature loggers recovered after the November flood included the single logger located in Cape Horn Creek and both loggers from M14 Creek. Both streams dropped below 13°C by the beginning of October, and were generally between 8 to 10°C by mid-November when the temperature loggers were recovered. However, both of these streams ranked "poor" because summer rearing temperatures were greater than 18°C (Table 4).

Table 4. Summary of In-situ Temperature Data.

(green, yellow, and gray shading corresponds to streams that meet criteria for optimal, marginal or poor temperature criteria, respectively)

	Tributary name / continuous data collection period	Brooks mouth 6/28/06-9/20/06	Brooks upper 6/28/06-9/20/06	Buncombe Hollow mouth 6/29/06-9/20/06	Cape Horn upper end 7/13/06-9/20/06	Indian George mouth 6/28/06-9/18/06	Jim mouth 6/28/06-9/18/06	M4 mouth 6/28/06-9/20/06	M14 mouth 6/28/06-9/20/06	M14 upper end 6/28/06-9/20/06	Drift mouth 7/14/06-9/21/06	Drift mid 7/14/06-9/21/06	Range mouth 7/14/06-9/22/06	S10 mouth[3] 7/14/06-9/19/06	S15 mid 7/14/06-9/21/06	Swift mouth 7/14/06-9/19/06
	No. days continuously monitored[1]	84	84	83	69	82	82	82	84	84	69	69	70	67	69	67
Percent of Observations Exceeding Temperature Value	6.0°C															100.0
	7.0°C															81.0
	8.0°C													100.0		41.8
	9.0°C											100.0	100.0	99.9		15.0
	10.0°C	100.0	100.0		100.0						100.0	93.0	99.6	57.8	100.0	2.9
	11.0°C	99.6	96.5	100.0	97.9	100.0	100.0	100.0	100.0	100.0	93.6	83.1	91.9	4.4	98.0	0.5
	12.0°C	90.3	74.9	97.1	84.3	98.2	96.0	99.7	95.6	98.9	84.6	56.6	83.1	0.0	88.4	0.0
	13.0°C	48.6	38.0	89.1	55.6	90.0	83.0	94.8	81.4	95.0	58.8	27.2	57.9		74.8	
	14.0°C	20.8	18.8	73.4	24.0	68.1	47.7	75.4	58.5	88.5	27.1	11.3	31.3		49.6	
	15.0°C	4.7	5.6	49.5	9.7	30.6	20.2	48.9	28.7	76.2	10.7	4.3	12.7		28.3	
	16.0°C	0.6	0.8	25.1	3.7	11.9	7.7	24.5	12.6	55.6	4.3	1.0	5.8		13.2	
	17.0°C	0.0	0.2	10.6	0.8	4.7	3.3	8.9	4.1	41.4	1.6	0.0	1.9		5.6	
	18.0°C		0.0	4.2	0.1	1.1	0.9	4.1	0.8	26.7	0.0		0.1		2.4	
	19.0°C			1.2	0.0	0.03	0.0	1.1	0.0	14.2			0.0		0.8	
	20.0°C			0.2		0.0		0.2		6.1					0.0	
	21.0°C			0.0				0.0		3.0						
	22.0°C									1.0						
Temperature (°C)	Summer max	16.7	17.2	20.0	18.1	19.1	18.8	20.4	18.8	23.5	17.6	17.0	18.2	11.8	19.8	11.5
	Max after Aug 31	14.7	15.8	16.6	14.5	15.6	15.1	16.6	15.1	18.4	13.8	13.5	14.4	11.0	15.1	8.2
	Min after Aug 31	11.2	10.3	11.4	10.6	11.8	11.2	11.8	11.1	11.4	10.3	9.2	9.7	9.0	10.5	6.2
Number of Days	Max exceeded 18°C	0	0	7	1	2	2	7	2	49	0	0	1	0	6	0
	Max exceeded 16°C	2	5	42	7	21	8	40	21	71	8	5	10	0	27	0
	After Aug 31 max exceeded 13°C[2]	12/20	15/20	17/20	12/20	16/18	14/18	16/18	16/20	18/20	8/21	6/21	10/22	0/19	12/21	0/19
	After Aug 31 daily max was ≤10°C[2]	0/20	0/20	0/20	0/20	0/18	0/18	0/18	0/20	0/20	0/21	1/21	0/22	5/19	0/19	19/19

[1]Temperature continuously monitored using Onset Tidbit® loggers recording temperature every 0.5 hours.
[2]Number is a ratio of days counted matching criteria to total days continuously monitored after August 31.
[3]Only data from the mid-point logger exists. The logger deployed at the mouth of S15 Creek was stolen before being downloaded.

3.3 COLD WATER REFUGE SURVEY

Cold water refugia surveys were conducted between mid-August and mid-September in 11 of the candidate streams. Cape Horn Creek (Figure 4) was the only tributary not surveyed due to private property access issues.

No cold water refugia were observed during the longitudinal surveys in streams that rated "poor" for summer rearing temperature (i.e. >18°C). For the most part, water temperatures throughout the longitudinal survey of each tributary differed by less than ±1.0°C from the in-situ temperature logger at the mouth of the tributary (Table 5). In general, streams that rated "poor" for summer rearing based on the in-situ logger data became slightly colder (about 0.5°C) or slightly warmer upstream (Figure 5, top chart).

Relatively large differences in the longitudinal temperature profiles were found in M14 Creek. This creek becomes much cooler as the water flows downstream, which is atypical from the general trend of stream warming in the downstream direction. The headwaters of M14 Creek flows through a pasture with no shade, where it appears to receive a large amount of solar radiation. As M14 Creek flows into a steep wooded ravine, several small wetland seeps trickle into the channel, substantially cooling the creek. Based on the cold water refugia survey and the in-situ logger data, M14 Creek cooled by about 4°C in an approximately 3,500-foot reach during the warmest part of the year. The daily maximum water temperature at the coolest site exceeded 18°C during the sampling period (Table 4); therefore, M14 rates as "poor" for summer rearing water temperature.

Another exception was Brooks Creek, where a tributary (B1 Creek) was about 1°C cooler than the mainstem Brooks Creek upstream of the B1 tributary confluence. This flow contribution cools lower Brooks Creek by about 1°C. Brooks Creek, already rated as "marginal" for summer rearing and spawning, therefore was carried forward to the tributary habitat survey phase.

Because all streams that ranked "poor" for summer rearing water temperature (based on the in-situ logger data) were found not to have cold water refugia, they were dropped from further analysis. These streams were Buncombe Hollow, Cape Horn, Indian George, Jim, M4, M14, Range and S15 creeks. We conclude that warm water limits potential bull trout rearing within these streams. There is little chance that habitat restoration or protection would substantially alter this condition, making long-term bull trout spawning, incubation, or rearing unlikely.

Based on the in-situ logger data and the cold water refugia survey, Brooks, Swift, S10, and Drift creeks could potentially support bull trout spawning and rearing. Therefore, these streams were carried forward to the bull trout presence/absence and tributary habitat survey phases to determine if bull trout are present and to quantify additional physical habitat parameters that may limit their production within these streams.

Table 5. Cold water refugia survey attributes.

Reach Name	Survey Attributes			In-Situ Logger Data During Survey			Hand-held Thermometer Data	
	Date	Duration (hrs:min)	Distance (ft)	Δ at Lower Site (°C)	Distance to Upstream Logger (ft)	Δ at Upper Site (°C)	Max Δ Measured During Survey (°C)	Δ Measured Between Start and End Point (°C)
AUGUST 17-18, 2006 SURVEY								
Buncombe Hollow Creek	8/17/2006	1:40	3,000	+0.2	NA	NA	0.25	0.25
Indian George Creek	8/17/2006	2:20	4,200	+0.2	NA	NA	0.25	0.25
Jim Creek	8/17/2006	1:40	3,000	0.0	NA	NA	0.25	0.25
M4 Creek	8/17/2006	1:40	3,000	+1.1	NA	NA	0.5	0.5
M14 Creek	8/17/2006	1:47	3,000	+0.1	3,000	+0.5	3.5	3.5
Range Creek	8/18/2006	2:15	3,450	+0.2	NA	NA	0	0
S15 Creek	8/18/2006	1:44	6,600	NA	3,000	+0.8	0.5	0.5
SEPTEMBER 18-21, 2006 SURVEY								
Brooks Creek	9/18/2006	3:20	3,600	+0.3	4,000	+0.5	2.5	0
S10	9/19/2006	1:00	1,950	0.0	NA	NA	0	0
Swift	9/19/2006	2:21	1,950	+0.6	NA	NA	1.0	0.5
Drift	9/21/2006	3:15	8,400	0.0	4,000	+0.2	1.5	1.0

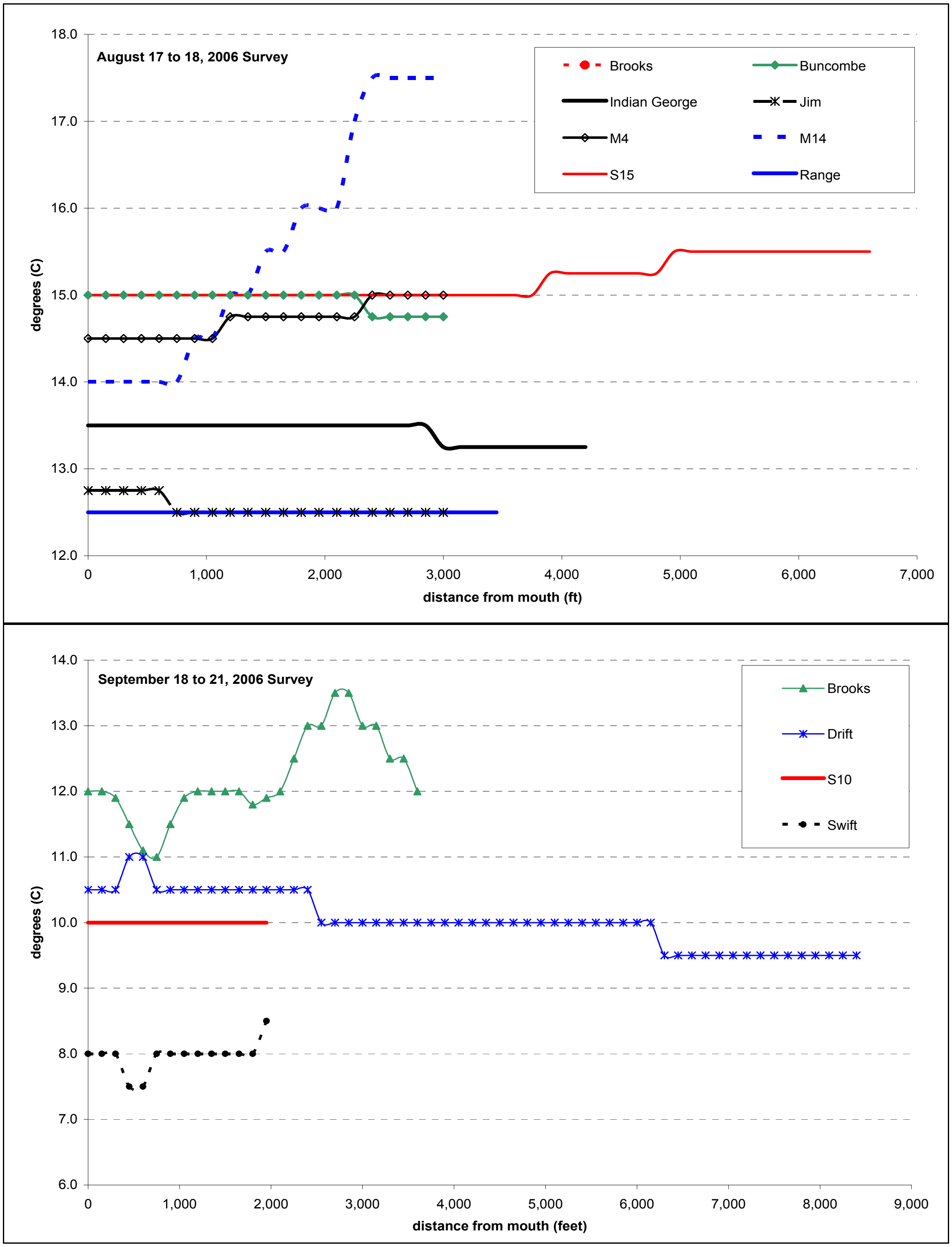


Figure 5. Cold water refugia survey longitudinal temperature profiles.

3.4 BULL TROUT PRESENCE/ABSENCE SURVEY

Bull trout presence/absence surveys were conducted in the four tributaries that had summer maximum water temperatures of ≤18°C (Brooks, Swift, S10 and Drift creeks) (Figure 3). We also conducted bull trout presence/absence surveys in three streams (Range, Jim, and Indian George creeks) that exceeded this temperature criteria for only one or two days during the monitoring period. These three streams were sampled to test the validity of our summer rearing water temperature ranking criteria (Table 1). Our hypothesis was that juvenile bull trout would not be present in streams with daily maximum water temperatures that exceed 18°C. Presence/absence surveys were performed between September 19 and September 28, 2006. In addition, we conducted an exploratory snorkel survey of Swift Creek on August 31, 2006 assisted by volunteers attending the 2006 *Salvelinus confluentus* Curiosity Society (ScCS) meeting.

Due to low flow conditions (estimated at less than 1.5 cfs), single pass electrofishing was used to determine bull trout presence/absence in the accessible reaches of Brooks, S10, Jim, Indian George, and Range creeks. Daytime snorkel surveys were used to determine presence/absence in Swift and Drift creeks because they had sufficient flow. Daytime surveys were conducted in both streams because of their remote location and difficult access terrain. We also used single pass electrofishing to sample the margins of Drift and Swift creeks, although we were only able to safely electrofish approximately 1,000 feet of margin habitat in Swift Creek (approximately 60 percent of the potentially accessible reach).

3.4.1 Results of Lake Merwin Tributary Surveys

Lake Merwin tributaries surveyed for bull trout presence/absence were Brooks, Indian George, and Jim creeks. No bull trout were observed or captured in these streams. During the presence/absence surveys, flows at the mouth of each tributary were estimated to be approximately 1.5 cfs in Jim Creek, 0.5 cfs in Indian George Creek, and less than 0.5 cfs in Brooks Creek.

Approximately 900 feet upstream from its mouth, Brooks Creek was actually intermittent and flows were so low that fish could not enter the creek from Lake Merwin. During the September 19, 2006 survey, Brooks Creek upstream of the B1 Creek confluence was dry with intermittent isolated pools extending about 2,000 feet before flowing water was again present. However, during the cold water refugia survey on September 18, 2006, Brooks Creek was observed to have continuous surface flow, although at a low level and B1 Creek was dry upstream of the confluence.

We observed approximately 5 adult kokanee spawners and 1 adult Chinook salmon (approximately 600 mm in length) holding in Lake Merwin at the mouth of Brooks Creek. We did not find kokanee spawners in Brooks Creek, providing further evidence that flow was too low for fish to enter the creek. We also observed 5 kokanee spawners in the lower 300 feet of Jim Creek. In all three streams we found numerous cutthroat trout ranging from young-of-the-year (50 mm in length) to presumed adults (up to about 200 mm in length). Density of cutthroat trout was similar in all three streams and was approximately several hundred cutthroat trout per 300 lineal feet of stream, comprised primarily of young-of-the-year. Sculpin were ubiquitous throughout the accessible reaches. We also observed one adipose fin-clipped hatchery rainbow trout (approximately 120 mm in length) approximately 1,000-feet upstream from the mouth of Indian George Creek.

3.4.2 Results of Swift Creek Reservoir Tributary Surveys

Swift Creek Reservoir tributaries surveyed for bull trout presence/absence included Swift, S10, Range, and Drift creeks. During the ScCS meeting on August 31, 2006, snorkel surveyors in Swift Creek observed four large bull trout ranging from approximately 400 to 600 mm in length. All four bull trout in the lower 800-feet of the accessible reach (the accessible reach is approximately 1,600 feet long). Snorkel surveyors also observed large cutthroat/rainbow trout and large whitefish. While electrofishing margin habitat in Swift Creek on September 19, surveyors captured 15 to 20 juvenile cutthroat trout, one whitefish, and sculpin. Attempts were made to re-snorkel Swift Creek on two separate occasions in mid- to late-September, but due to turbidity, surveys were not possible. Swift Creek surveys and bull trout observations are discussed in more detail in Section 3.4.3.

During bull trout presence/absence surveys conducted in S10, Range, Drift, and Swift creeks between September 19 to 28, 2006, flow was estimated to be less than 0.5 cfs in S10 Creek (intermittent to approximately 0.5 cfs); less than 1.5 cfs in Range Creek; 4 to 5 cfs in Drift Creek, and greater than 15 cfs in Swift Creek. Flow was so low during the survey of S10 Creek that most of the accessible reach had no surface flow. Although several isolated pools were present in S10 Creek, low flow appeared to preclude migration of fish into the creek during the survey period.

During the presence/absence surveys, Meridian and PacifiCorp biologists observed hundreds of juvenile coho in S10, Drift, and Range creeks; however, none were observed in Swift Creek. Coho density was highest in S10 Creek, with more than 100 juvenile coho estimated per 300 lineal feet of stream. Juvenile coho were present all the way up to the impassible barriers on each stream (i.e. present throughout the accessible reaches). Many small isolated pools within S10 Creek had numerous juvenile coho (more than 50 fish in individual pools). In Range and S10 creeks, surveyors observed hundreds of cutthroat trout, ranging from young-of-the-year (50 mm in length) to presumed adults (up to about 200 mm in length). Most cutthroat trout observed were young-of-the-year. Density of cutthroat trout within Range and S10 creeks was similar, and was approximately several hundred cutthroat trout per 300 lineal feet of stream. Sculpin were ubiquitous throughout the accessible reaches. Cutthroat trout density within Drift Creek was much less than observed in Range and S10 creeks.

Surveyors observed one large redd in Drift Creek, located approximately 3,000 feet upstream from its mouth. The redd was approximately 3-feet wide and 6-feet long, made of large gravel and small cobble, and located mid-channel in a pool tailout. The origin of the redd is not known, as no large adult salmonids were observed in the area. Fish of the size necessary to build a redd this large and that are known to have been present upstream of Swift Dam during the survey include adfluvial bull trout, coho, and a few Chinook salmon. Coho and Chinook were trucked upstream from the lower Lewis River and released into Swift Reservoir as part of the re-introduction effort.

3.4.3 Swift Creek Bull Trout Observations

The four large bull trout observed in Swift Creek during the ScCS snorkel survey on August 31 (ranging from 400 to 600 mm in fork length) were all in the lower 800-feet of the accessible reach. To our knowledge, this is the first observation of bull trout in Swift Creek proper, although they are thought to rear in the Swift Creek arm of Swift Reservoir (USFWS 2006, page 69). These fish are also within the size range of bull trout observed spawning in Rush and Pine creeks, suggesting that these fish were potentially reproductively mature. The late August observations are within the known Lewis River basin bull trout spawning period.

On September 19, an electrofishing survey was conducted along the margins of Swift Creek in an attempt to locate juvenile bull trout. None were observed or captured during sampling. Although some margin habitat with large woody debris was sampled for fish, only a few juvenile cutthroat trout, sculpin, and one whitefish were captured. During sampling, surveyors specifically avoided electrofishing larger pools to prevent disturbing any potential bull trout spawners. Surveyors did observe an approximately 400 mm bull trout in a riffle/rapid adjacent to some margin habitat that was being sampling for juveniles.

Surveyors also attempted to snorkel survey Swift Creek on September 19 to count adult bull trout during the potential spawning period and to look for redds. Due to high turbidity levels that reduced underwater visibility, snorkeling was not possible. While Swift Creek was clear during August 31 snorkel survey, following a brief rain event, turbidity increased dramatically. Turbidity levels were checked at the mouth of Swift Creek on September 22 and September 27 after several days without rain. Although turbidity levels appeared to be lower, they were still not favorable for snorkeling. On September 22, a biologist did capture 2 adult bull trout >400 mm in length at the mouth of Swift Creek using a barbless hook and line.

Presented below is a summary of the notes taken during the ScCS snorkel survey on August 31, 2006 when bull trout were first observed in Swift Creek. The general habitat description does not reflect current conditions. A debris torrent washed through Swift Creek in November 2006, extensively altering the stream channel conditions documented in August and September.

- Snorkelers: Jason Shappart (Meridian), George Gilmour (Meridian), Jeff Chan (USFWS), Karen Meyers (USFWS), Bao Le (Grant County PUD)

- Snorkled reservoir within approximately 250 feet of the mouth of Swift Creek and the entire creek from the mouth to the 80-foot falls located about 1,600 feet upstream of the mouth.

- Temperature at survey start at stream mouth = 7°C at 10:15 am; 8.5°C at stream mouth at 1:37 pm

- Habitat unit at mouth = rapid with cobble/small boulder substrate
  Unit length = approx 125-feet
  Wetted width = approx. 25 to 30-feet; bank full width = approx. 50-feet
  Average unit depth = approx. 1.5-feet; max. depth = approximately 2-feet

- Habitat from the stream mouth to barrier falls is steep (4 to 8 percent gradient), with many rapids and cascades, extensive areas of habitat not conducive to snorkeling due to velocity and bubble curtains, a few large scour pools were present (approximately 6) and gravel was limited. Habitat was similar to Rush Creek where many bull trout are thought to be produced.

- Observed 2 bull trout (approximately 400 mm in length) in stream at mouth in riffle/rapid unit (observed by B. Le, J. Chan, and G. Gilmour).

- Observed 1 bull trout (400 mm in length) in first big pool approximately 300-feet upstream from mouth (observed by J. Chan and J. Shappart). Note that this pool was filled in and covered by at least 10 feet of bedload during the November 2006 flood.

- Observed 1 bull trout (600 mm in length) approximately 800-feet upstream from mouth in scour pool unit (observed by G. Gilmour and J. Shappart).

- Observed possibly 1 more bull trout (400 mm ?) between 300 to 500-feet upstream of mouth, but might have been a fish previously counted (observed by J. Chan).

- Falls over bedrock approximately 900-feet upstream from mouth; 4 to 5-feet high falls with big plunge pool at base (over 6-feet deep). No bull trout were observed above this small falls, although many large rainbow/cutthroat trout (300 to 350 mm) were present. No whitefish were observed upstream of the small falls. This small falls is potentially passable by large bull trout and rainbow/cutthroat trout. Note that a large log jam >6 feet high now sits on top of this small falls.

- Fewer than 20 rainbow/cutthroat trout less than 150 mm long were observed in the creek, but schools of rainbow/cutthroat of this size were observed in the reservoir at the creek mouth.

- Several large rainbow/cutthroat trout (300 to 400 mm) were observed downstream of the small falls, with 10 or more large fish in some of the larger pools (more fish than above the small falls). Many large whitefish (up to 450 mm) were observed downstream of the small falls, with more than 15 whitefish in some of the larger pools.

3.5 TRIBUTARY HABITAT INVENTORY

Brooks, S10, Drift, and Swift creeks were the only tributaries entering Swift Creek Reservoir and Lake Merwin that met the criteria needed to move into the habitat survey phase. The November 2006 flood substantially altered aquatic habitat conditions in three of these streams (S10, Drift, and Swift creeks). In the following paragraphs, we briefly describe some general observations of aquatic habitat conditions in these streams made in previous years and during the summer 2006 water temperature monitoring and fish presence/absence surveys. We then compare this information with the quantitative habitat data collected after the November 2006 flood event. Summary tables of the quantitative habitat survey data are also presented for Brooks and S10 creeks. Due to poor survey conditions after the November flood (primarily high flows, heavy snow, and low reservoir conditions precluding the use of the Swift Reservoir boat launch), we have not yet been able to conduct habitat surveys in Swift or Drift creeks. We will survey these tributaries as soon as flow and access conditions allow, and then update this draft report with the results.

3.5.1 Brooks Creek

The 1999 habitat survey of the accessible length of Brooks Creek and its major tributary B1 Creek (reported in PacifiCorp and Cowlitz PUD, 2004, AQU-4 Appendix 1, sheet 08, Brooks Creek and sheet 09, B1) states:

> *Brooks Creek is a moderate gradient (4.0 percent average slope) 2nd order stream with an "A/B" Rosgen channel type. Fish habitat in the accessible portion of this stream is comprised of 9-to 20-foot-wide cobble and small boulder dominated riffles. Spawning gravel is common throughout the lower portion of the stream. Cover in the form of LWD and overhanging vegetation is abundant. The channel appears stable and the riparian area provides excellent stream shade. Overall, Brooks Creek contains very good salmonid habitat. B1 Creek (unnamed tributary to Brooks Creek) is a moderate to high gradient (average 7.0 percent slope) 2nd order tributary to Brooks Creek with an "A" Rosgen channel type. Habitat conditions in the accessible portion of B1 were similar to those found in Brooks Creek. Low summer flows would likely limit the production of anadromous salmonids (coho and steelhead) in this stream.*

The 1999 survey also reported an average bankfull width of 19.5 feet and an accessible length of 5,714 feet in Brooks Creek, an average bankfull width of 23.4 feet and accessible length of 2,650 feet in B1 Creek (PacifiCorp and Cowlitz PUD 2004, pages AQU 4-9).

Based on qualitative observations made during the summer 2006 (pre-flood), the 1999 survey results continued to accurately reflect summer habitat conditions in both Brooks and B1 creeks, except for the density of large woody debris. Large woody debris was not "abundant" in the summer of 2006 prior to the flood, as there were few key pool-forming pieces of large wood per mile. Overall, the November 2006 flood event did not appear to cause substantial habitat changes in Brooks and B1 creeks. Although it was apparent that flow over-topped the active channel bank by approximately 1 to 2 feet, there did not appear to be substantial bedload scour or deposition; however, several trees did fall into Brooks Creek providing additional large woody debris.

Under post-flood conditions, the channel gradient throughout the accessible reach of Brooks Creek (including B1 Creek) averages 4.4 percent (Table 6). Approximately 70 percent of the accessible reach is located in a moderate V-shaped valley with a narrow valley floor (constrained by hill slopes). The remaining 30 percent of the reach is located within a broad valley floor and is constrained by alternating terraces. The valley width index averages 2.2 (i.e. ratio of the width of the active stream channel to the width of the valley floor), but ranged from 1 to 7, indicating some flood plains exists within the valley floor (Table 6). Riparian vegetation is dominated by shrubs (primarily Himalayan blackberry and salmonberry), while the vegetation on the hill slopes is dominated by mixed coniferous and deciduous forest (primarily western red cedar and red alder). Several houses are located along the accessible reach within 300 feet of the stream channel. We also observed approximately 10 submersible irrigation pumps scattered along the upper portion of the accessible reach. Most of the accessible habitat is comprised of fast-water units, primarily rapids and riffles (Table 7) (Photos 1 and 2).

Table 6. Brooks Creek channel, pool, LWD, and other habitat metrics.

Channel Metrics	**Avg. Wetted**	**Avg. Active**	**Avg. Flood Prone**
Width (ft)	11.2	16.4	45.3
Depth (ft)	1.3	2.6	4.3
Pool Summary	**Total**	**No. /Mile**	**No. /Mile**
No. Pools	20	15.8	15.9
No. Pools ≥3 ft deep	3	2.4	2.4
No. of Complex Pools (≥3 LWD pieces present)	1	0.8	0.8
Pool Frequency (channel widths/pool)		20.4	
Avg. Residual Pool Depth (ft)		1.7	
LWD Summary	**Total**	**No./ Mile**	
No. Pieces ≥ 10 ft x 0.5 ft	72	58	
Volume (ft^3)	6,778	5,396	
No. Key Pieces (≥ 40 ft x 2 ft)	2	1.6	
Misc. Habitat Metrics			
Avg. Unit Gradient		4.4	
Width:Depth Ratio		6.8	
Slow Water:Fast Water Unit Ratio		0.14	
Entrenchment (active channel width:flood prone width)		2.7	
Bank Condition (% actively eroding)		7%	
% Undercut Banks		3%	
Shade (% stream enclosed)		60%	

Note: includes B1 Creek

Photo 1. Brooks Creek typical fast water habitat unit on December 6, 2006.

Photo 2. B1 Creek typical fast water habitat unit on December 7, 2006.

Table 7. Brooks Creek micro-habitat unit metrics.

Habitat Type	No. Units	Total Length (ft)	Avg. Wetted Width (ft)	Avg. Depth (ft)	No. Large Boulders	Total Wetted Area (ft^2)	% Total Habitat	Substrate (% of Wetted Area)					
								Silt/ Organic	Sand	Gravel	Cobble	Boulder	Bed Rock
Side Channel/Off Channel	1	102	5.9	dry	0	592	0.8%	9	27	9	55	0	0
Lateral Scour Pool	6	318	13.4	2.3	11	5,455	7.5%	17	16	29	30	8	0
Plunge Pool	8	112	13.8	3.2	11	1,614	2.2%	22	7	33	35	0	3
Straight Scour Pool	6	118	13.4	2.4	12	1,657	2.3%	20	11	25	41	2	0
Riffle	12	1548	10.5	0.8	17	19,486	26.7%	9	6	34	50	0	0
Riffle with Pockets	2	449	8.5	0.5	2	4,046	5.5%	26	31	12	32	0	0
Rapid	23	2749	10.8	0.8	143	30,548	41.9%	8	4	17	67	4	0
Cascade	8	1043	8.9		213	8,274	11.4%	8	1	12	42	37	0
Falls over Log	3	7	13.8	0.3	2	86	0.1%	10	12	39	27	13	0
Culvert Crossing	3	249	4.9	0.9	0	1,194	1.6%	10	0	23	58	10	0
Total[a] / Average[b] :	55[a]	6,694[a]	11.2[b]	1.3[b]	411[a]	72,953[a]		12[b]	7[b]	23[b]	49[b]	7[b]	0[b]

Note: includes B1 Creek tributary
[a] total
[b] average

3.5.2 S10 Creek

The 1999 habitat survey of the accessible length of S10 Creek (reported in PacifiCorp and Cowlitz PUD, 2004, AQU-4 Appendix 1, sheet 26, S10) states:

> *S10 Creek (unnamed) is a high gradient (6.8 percent average slope) 2nd order stream with an "A" Rosgen channel type. Fish habitat in the accessible portion of S10 is dominated by relatively high gradient riffles with occasional pocket pools. Cobble and small boulders are the dominant substrate type. Numerous low flow migration obstacles were observed throughout the surveyed reach. These low flow obstacles would be passable at higher flows. However, summer low flows (0.5 cfs) appear to be a major limiting factor for salmonids. Overall, this stream contained very poor anadromous fish habitat.*

The 1999 survey also reported the average bankfull width as 24.7 feet and the accessible length as 1,855 feet (PacifiCorp and Cowlitz PUD 2004, pages AQU 4-10). The 1999 survey results accurately reflect the pre-flood habitat conditions in S10 Creek during the summer of 2006, with exception of fish habitat quality. Contrary to the 1999 survey conclusion that S10 likely contained very poor habitat for anadromous fish, we observed hundreds of juvenile coho distributed throughout the accessible length, many of which were in small isolated pools. The observed natural production of coho indicates that this tributary can support spawning and rearing coho salmon.

The November 2006 flood substantially altered the habitat in S10 Creek. S10 Creek is constrained on both sides by moderately steep slopes. The active channel fills most of the narrow valley bottom. Prior to the flood, both stream banks and constraining slopes were stable and not actively eroding, and riparian vegetation (such as vine-maple, alder, and salmonberry) was thick along both sides. The flood resulted in vegetation and bank scour along over 50 percent of the entire accessible stream length (see results below for actively eroding stream bank condition). The flood scoured the hill slope toe on both sides of the creek, exposing vertical cuts of about 6 to 8 feet in height (Photo 3). This scour also caused numerous small sloughs/landslides. More than 100 large trees, 1.5- to 4-feet diameter-at-breast-height (dbh), fell into the creek within the 1,500-foot accessible length. It appears that major bedload deposition occurred; few pools remain within the accessible length compared to pre-flood conditions, although some large new scour pools were formed (primarily associated with new large woody debris) in areas previously observed to be riffles.

Under post flood conditions, the S10 Creek channel is steep, with an average gradient of 8.1 percent (Table 8) and is within a moderate V-shaped valley with a narrow floor. The stream channel is constrained by hill slopes on both sides of the channel. The valley width index is 1.0 (i.e. ratio of the width of the active stream channel to the width of the valley floor) indicating there is little or no floodplain. The riparian vegetation is dominated by shrubs (such as salmonberry and devils club), while the slopes are dominated by mature coniferous trees (probably second or third-growth) averaging approximately 2 to 3 feet dbh. Most of the habitat is comprised of fast-water units (primarily boulder cascades and rapids, Photo 3); 4 pools were present in the accessible reach, which was approximately 1,500 feet long (Table 9).

Photo 3. S10 Creek typical fast water habitat unit and vertical cut-bank on December 8, 2006.

Table 8. S10 Creek channel, pool, LWD, and other habitat metrics.

Channel Metrics	**Avg. Wetted**	**Avg. Active**	**Avg. Flood Prone**
Width (ft)	13.1	24.3	27.9
Depth (ft)	1.5	2.6	5.2
Pool Summary	**Total**	**No. /Mile**	**No. /Mile**
No. Pools	4	14.2	16.4
No. Pools ≥3 ft deep	3	10.6	12.4
No. of Complex Pools (≥3 LWD pieces present)	1	3.5	4.2
Pool Frequency (channel widths/pool)		15.4	
Avg. Residual Pool Depth (ft)		3.1	
LWD Summary	**Total**	**No./ Mile**	
No. Pieces ≥ 10 ft x 0.5 ft	137	562	
Volume (ft^3)	29,158	3,389	
No. Key Pieces (≥ 40 ft x 2 ft)	50	206	
Misc. Habitat Metrics			
Avg. Unit Gradient		8.1%	
Width:Depth Ratio		8.8	
Slow Water:Fast Water Unit Ratio		0.07	
Entrenchment (active channel width:flood prone width)		1.2	
Bank Condition (% actively eroding)		58%	
% Undercut Banks		1%	
Shade (% stream enclosed)		91%	

Table 9. S10 Creek micro-habitat unit metrics.

Habitat Type	No. Units	Total Length (ft)	Avg. Wetted Width (ft)	Avg. Depth (ft)	No. Large Boulders	Total Wetted Area (ft^2)	% Total Habitat	Substrate (% of Wetted Area)					
								Silt/ Organic	Sand	Gravel	Cobble	Boulder	Bed Rock
Side Channel/Off Channel	none							NA					
Plunge Pool	3	43	16.1	4.5	4	678	3.3%	25	10	33	33	0	0
Straight Scour Pool	1	26	20.0	2.4	0	495	2.5%	29	7	36	29	0	0
Glide	1	30	5.9	1.6	0	172	0.9%	38	13	25	25	0	0
Riffle	3	226	11.2	1.0	16	2,453	12.0%	22	15	24	39	0	0
Rapid	2	302	12.1	0.9	32	3,809	18.6%	14	6	16	54	10	0
Cascade	9	856	13.8	0.8	118	12,772	62.5%	16	0	16	42	25	0
Falls over Bedrock	1	7	5.9	0.6	0	43	0.2%	0	0	0	0	0	100
Total[a] / Average[b]:	**20[a]**	**1,489[a]**	**13.1[b]**	**1.5[b]**	**170[a]**	**20,422[a]**		**19[b]**	**5[b]**	**21[b]**	**38[b]**	**12[b]**	**5[b]**

[a] total
[b] average

3.5.3 Swift Creek

Data from a USFS study conducted in 1995 were summarized in PacifiCorp and Cowlitz PUD, (2004, AQU-4 Appendix 1, sheet 23, Swift Creek) and state:

> *Swift Creek is a high gradient (8.4 percent average slope) 4th order stream with an "A" Rosgen channel type. Fish habitat in the accessible portion of Swift Creek is comprised of a mixture of high gradient riffles (52 percent) and pools (42 percent). Cobble and small boulders are the dominant substrate types. Large, stable LWD and spawning gravel is extremely limited. An 80-foot-high waterfall at 1,639 feet blocks the upstream migration of fish into the upper watershed.*

The 1995 survey also reported the average bankfull width as 29.8 feet and the accessible length as 1,639 feet (PacifiCorp and Cowlitz PUD 2004, pages AQU 4-10). The 1995 USFS survey results reflect the steep gradient, lack of gravel and large wood, but did not match our summer 2006 observations of habitat conditions with respect to riffle/pool ratio. The 1995 data summary reported that 42 percent of the habitat was comprised of pools; however, we only observed about 6 pools in the accessible reach (prior to the flood), comprising less than about 5 percent of available habitat by either length or surface area.

Prior to the November 2006 flood, substrate was a fairly equal mixture of cobble, bedrock, and large boulders. A few large pieces of wood and two log jams were present, but provided little habitat function. From the mouth upstream about 900 feet to the small fall, the habitat consisted primarily of long riffles and rapids, 2 scour pools, and 1 large plunge pool at the base of the small 5-foot falls.

A large washout occurred on upper Swift Creek at the Forest Road 83 crossing during the November 2006 flood (http://www.fs.fed.us/gpnf/recreation/autumn-colors/fall-2006-flood-images-02.shtml). Based on the washout photos and our observations at the Swift Creek mouth in mid-November 2006, it is apparent that a large sediment/debris torrent washed through Swift Creek in early November 2006. The large scour pool where the temperature logger was located (approximately 300 feet upstream from the mouth) was buried by approximately 10 feet of bedload. The lower riffle sections are now steep rapids created by the bedload deposition. Sediment filled in about 800 linear feet of reservoir within the Swift Creek Arm up to about the reservoir full pool level. Prior to the flood, the maximum water depth in this area was about 30 feet deep or more.

Detailed post-November 2006 flood habitat surveys have not been completed for Swift Creek due to unsurveyable flow conditions and difficult access. This section will be updated after conditions allow the survey to be safely completed.

3.5.4 Drift Creek

Data from a USFS study conducted in 1995 were summarized in PacifiCorp and Cowlitz PUD, (2004, AQU-4 Appendix 1, sheet 27, Drift Creek) and stated:

> *Drift Creek is a moderate to high gradient (average 11.2 percent slope) 3rd order stream with an "A/B" Rosgen channel type. Fish habitat in the accessible portion of Drift Creek contains an estimated 41.6 pools/mile, well above USFS Regional Standards. The streambed substrate is dominated by gravel and cobble. LWD is extremely limited. The riparian area adjacent to Drift Creek has been impacted by past timber harvest activities. Stream shading is poor; however, summer water temperatures are well within the State standard.*

The 1995 survey also reported the average bankfull width as 48.1 feet and the accessible length as 8,506 feet (PacifiCorp and Cowlitz PUD 2004, pages AQU 4-10). The 1995 results are not consistent with habitat observed during the summer of 2006, including stream slope, pool abundance, and substrate. For example:

1. The average slope of the lower 4,000 feet averages about 3 percent, and the upper 4,000 feet of the accessible reach averages about 4 percent (based on visual observations during 2006 temperature and fish presence/absence surveys and USGS 7.5 minute topographic map information), not 11 percent as reported by the 1995 study.
2. Very few pools were observed during the 2006 presence/absence surveys, probably less than 20 pools per mile.
3. Very little gravel was observed. The substrate was primarily cobble in the lower half of the accessible reach and large cobble/boulder in the upper half of the accessible reach.

At this time, the extent of flood alterations to habitat in the accessible reach of Drift Creek is unknown because the detailed habitat survey has not yet been conducted. However, we observed the formation of a large scour pool in the area where the lower temperature logger was located (approximately 300 feet upstream from the mouth). This area was formerly a riffle, but several pieces of large wood were recruited to this location during the flood, creating a scour effect, resulting in a scour pool with a residual depth of about 3 feet.

Detailed post-November 2006 flood habitat surveys have not been completed for Drift Creek due to high flow conditions and difficult access after the flood. This section will be updated after conditions allow the survey to be completed.

3.6 QHA ANALYSIS

This task has not yet been conducted because it requires data from the habitat surveys, which are not yet complete. As noted previously, when we perform the QHA analysis, the Bull Trout LFA technical group (comprised of biologists from Meridian, PacifiCorp, WDFW, USFWS, and Jones and Stokes) will share their local expertise to rate the various habitat values.

4.0 DISCUSSION

4.1 WATER TEMPERATURE MONITORING RESULTS AND BULL TROUT PRESENCE/ABSENCE

As described in Section 3.4.2, bull trout were only found in Swift Creek during the 2006 bull trout presence/absence surveys. Swift Creek is the only tributary in this analysis that met the "optimal" criteria (Table 1) for both summer maximum rearing temperatures (≤16°C) and fall spawning temperatures (≤10°C), and that had sufficient flow for fish to enter the stream from the reservoir during the late summer and early fall. Swift Creek had approximately 5 to 10 times the amount of base flow than the next largest study tributary that met at least the "marginal" criteria (Drift Creek). The fact that we found no bull trout in the three streams with temperatures barely exceeding 18°C (rated as "poor" for juvenile bull trout rearing) supports the hypothesis that tributaries with water temperatures exceeding 18°C would not contain bull trout.

Results of this study are also consistent with other studies conducted in the upper Lewis River basin in which bull trout were not found in streams with maximum temperatures >17.5°C, but were found in streams with temperatures <16°C. For example, Clearwater BioStudies snorkeled 4 streams in the upper Lewis River basin for bull trout presence/absence (Big Rock, Swampy, Big Spring, and Cussed Hollow creeks); however, water temperature was only continuously monitored using an electronic logger in Cussed Hollow Creek (Clearwater BioStudies 2002, page 3 and 14). Cussed Hollow Creek had a summer maximum temperature of 17.6°C and no bull trout were found in the stream (Clearwater BioStudies 2002, page 18 and 14). Bull trout were not found in any of the streams sampled during this study.

A temperature monitoring study conducted by Hiss et al. (2005) summarized water temperature data for Pine and Rush creeks where bull trout spawning and rearing is known to occur. A temperature logger in Rush Creek (upstream of FR 90 bridge) had a maximum temperature of 9.8°C in 1994 within known spawning and rearing habitat (Hiss et al. 2005, page 24). Data from the summer of 2005 showed that water temperatures in Rush Creek were <13°C (J. Byrne, WDFW, ScCS PowerPoint presentation 2006, unpublished data). Hiss et al. (2005, page 23 to 28) also summarized daily maximum water temperatures for several locations (covering various years during summer) throughout the Pine Creek drainage that is known to provide bull trout spawning and rearing habitat. The daily maximum water temperature at all sites was <16°C.

Results from Dunham et al. (2003)[4] can provide further insight into stream temperature and bull trout occurrence. The focus of Dunham and Chandler (2001, page 2) was on small bull trout (<150 mm in length) and spawning and early rearing habitat throughout Washington. The distribution of small bull trout was thought to represent the distribution of spawning and early rearing habitat, factors most essential for population persistence. These habitats are also used year round by bull trout, so habitat conditions must be suitable at all times. Dunham et al. (2003, page 895) modeled the distribution of small

[4] Dunham et al. 2003 is an expansion of work originally reported in Dunham and Chandler 2001.

bull trout in relation to maximum summer water temperatures, occurrence of native and non-native salmonids, large wood, undercut banks, levels of fine sediment, and stream width (an index of stream size). This collection of variables reflects a broad spectrum of potential habitat-related influences on bull trout that have been referenced in the literature. Dunham and Chandler (2001, page 4) sampled 109 sites within 6 streams across a broad range of environmental variation throughout the state of Washington, sampling habitat characteristics and occurrence of bull trout in streams ranging from the Blue Mountains in southeast Washington to streams on the Olympic Peninsula in western Washington. Model selection analysis using logistic regression indicated that summer maximum temperature was the most likely factor to explain patterns of occurrence for juvenile bull trout (Dunham and Chandler 2001, page 15). Dunham et al. (2003, page 897 and 898) reported that of 109 samples sites scattered throughout Washington, the maximum daily temperature at which small bull trout were found was 17.5°C. The Dunham et al. (2003, page 900) model predictions of small bull trout presence/absence imply that although bull trout may be present at potentially lethal temperatures, the probability of occurrence is relatively low (e.g., 50 percent) at maximum daily temperatures above approximately 14 to 16°C. The probability of small bull trout occurrence does not become high (e.g., 75 percent) until the maximum daily temperature drops to approximately 11 to 12°C (Dunham et al. 2003, page 900).

The results of the presence/absence survey and temperature monitoring conducted in the tributaries to Lake Merwin and Swift Creek Reservoir under this study are consistent with results presented in Dunham et al. (2003), as we also found no bull trout in streams sampled with maximum water temperatures >17.5°C (i.e. Indian George, Jim, Range and Drift creeks). Similarly, Dunham et al. (2003, page 901) predicted less than a 50 percent chance that small bull trout would occur in streams with maximum water temperatures >16°C. Both Brooks Creek and the upper portion of Drift Creek had maximum temperatures above 16°C and we found no bull trout in these streams. The only stream that we found bull trout (i.e. Swift Creek) had a maximum temperature of 11.5°C during summer of 2006. Based on a summer maximum temperature of 11.5°C, the Dunham et al. (2003, page 900) Washington-specific presence/absence model predicts about a 75 percent chance of small bull trout presence. However, we did not find small bull trout (i.e. <150 mm) in Swift Creek. We only observed large bull trout between 400 to 600 mm. These observations of reproductive-sized bull trout holding in Swift Creek during the known Lewis River spawning period strongly suggests that these fish may have been staging to spawn in Swift Creek. Yet the lack of juvenile bull trout suggests that either bull trout are not spawning in Swift Creek or that a few attempt to spawn, and some other factors limit spawning/incubation success and recruitment to the juvenile rearing stage. Potential limiting factors will be identified in consultation with the USFWS, WDFW, and PacifiCorp after the habitat survey is complete and the QHA analysis is performed.

In 2006, S10 Creek had summer maximum water temperature of 11.8°C. The Dunham et al. (2003, page 901) Washington-specific presence/absence model predicts about a 75 percent probability that juvenile bull trout would be present in S10 Creek. We found no small or large bull trout in S10 Creek. This absence may be due to low flows during the normal spawning period observed for Pine and Rush creeks (i.e. August and September). Flow during this period was intermittent within the accessible reach of S10 Creek, precluding upstream migration (note that low flow also limited access into Brooks Creek during this time period).

Buncombe Hollow, Cape Horn, Indian George, Jim, M4, M14, Range and S15 creeks all rated "poor" for bull trout juvenile rearing because each had summer maximum water temperatures >18°C and contained no appreciable cold water refugia. Based on the results of Dunham et al. (2003) there is a low probability that juvenile bull trout would be found in streams with maximum water temperatures >18°C in Washington. Therefore, we conclude that all streams rated as "poor" for bull trout summer rearing water temperatures have a low probability of providing long-term bull trout spawning, incubation, and rearing habitat. We further conclude that there is no feasible habitat restoration or protection strategy to substantially lower a stream's water temperature regime to the level that Dunham et al. (2003) suggests would be much more likely to support juvenile bull trout (i.e. 14 to 16°C or colder). Therefore, we conclude that Buncombe Hollow, Cape Horn, Indian George, Jim, M4, M14, Range and S15 creeks have little or no potential to provide successful long-term bull trout spawning, incubation, and rearing habitat and have dropped these streams from further analysis.

Based on the in-situ logger data and cold water refugia surveys, Brooks, Swift, S10, and Drift creeks could potentially support rearing juvenile bull trout. This conclusion is based on the presence of relatively cool summer maximum water temperatures, with S10 and Swift creeks having the greatest potential due to temperatures less than 12°C during summer. Therefore, these four streams will be carried forward to the QHA phase to determine if there are other habitat factors that may limit spawning, incubation, and rearing potential within these streams. This next phase will assess whether habitat restoration actions may alleviate any limiting factors and promote successful spawning, incubation, and rearing.

In order to perform the QHA analysis described in the Revised Study Plan (Appendix A), habitat surveys still need to be completed in Swift and Drift creeks. Once these surveys are finished, we will conduct the QHA analysis in cooperation with the Bull Trout LFA technical group (comprised of biologists from Meridian, PacifiCorp, WDFW, USFWS, and Mobrand/Jones and Stokes) to rate the different habitat values that influence bull trout spawning, incubation, and rearing success. Limiting factors will be identified, and potential habitat restoration actions will be recommended in the final draft report.

4.2 QHA ANALYSIS OF HABITAT LIMITING FACTORS

To be completed.

4.3 INTEGRATION WITH YALE LAKE LFA FINDINGS PRESENTED IN PRATT (2003)

To be completed.

5.0 RECOMMENDATIONS

To be completed.

6.0 REFERENCES

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Appendix A

Lake Merwin and Swift Creek Reservoir Tributary Streams Bull Trout Limiting Factors Analysis - Revised Study Plan

September 19, 2006

Appendix B

Comments and Responses on First Draft Study Plan (April 21, 2006)

USFWS Email Comments and Associated Responses Addressing the Draft Bull Trout LFA Study Plan

From: LouEllyn_Jones@fws.gov
Sent: Monday, May 22, 2006 8:44 AM
To: Shrier, Frank
Cc: Jeffrey_Chan@fws.gov; Joe_Hiss@fws.gov; byrnejbb@dfw.wa.gov
Subject: Comments on the Bull trout limiting factors analysis study proposal

Hi Frank.

Jeff Chan and I looked at the study proposal, although we didn't delve deeply into the details of the model. We believe Jim Byrne did a good job at bringing attention to some of the unique differences between the general model parameters and what might be present in the Lewis system. Is it possible to "tweak" the model to take some of these into account, and explore what alternate outputs might result?

One thing Jim didn't raise is the way in which they propose to evaluate/collect temperature data in some of the candidate tributaries (see section 4.2 Task 2). By placing just a single temperature logger at
the mouth of a stream, or a temperature logger at the mouth and mid-point of a stream, they may not be able to capture unique cold water features that could actually support bull trout. Given the unique hydrology seen in Cougar Creek, there may be similar features (but at a much smaller scale) in other streams. The whole stream may not need to be at an "optimal" temperature to successfully support a bull trout population. Bull trout are certainly known for homing in on unique cold water features within a stream for spawning, overwintering, and refugia. This might mean that potential use within a particular stream might be more patchy in nature as opposed to uniform. This is actually the case in many bull trout systems.

Since temperature is such a key driver for successful bull trout spawning and rearing, and we likely have a limited number of candidate streams within the Lewis, we think it is important to put in the extra effort up front to do a more comprehensive assessment of water temperature within these streams to make sure potential cold water features don't get missed.

Lou Ellyn Jones
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510 Desmond Drive
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fax: 360-753-9008

From: jshappart@meridianenv.com
Sent: Tuesday, May 23, 2006 2:13 PM
To: Shrier, Frank
Subject: Re: Comments on the Bull trout limiting factors analysis study proposal

Hi Frank,

Thanks for forwarding Lou Ellyn's email.

Regarding Lou Ellyn's first comment, I am not exactly sure what model she is referring to. Is she referring to the USFWS patching model or the QHA method included in our draft Bull Trout LFA Study Plan? As discussed in our study plan, the QHA method "relies largely on qualitative habitat survey data combined with the expert knowledge of natural resource professionals with experience in a given local area to describe physical conditions in the target stream and to create a hypothesis about how the habitat would be used by a given fish species". As the QHA method will rely on local expert knowledge from local biologists such as you, Eric, Jim, Lou Ellyn, etc., the evaluation parameters will be "tweaked" to account for local conditions. If Lou Ellyn's comment deals directly with the USFWS patching model, I'm not sure it needs to be addressed in our study plan. Maybe she could shed some light on this subject.

The second comment regarding unique cold water features raises an important point. I have personally struggled with this issue many times in the past, especially when I worked for ODFW assessing bull trout water temperature and habitat relationships throughout Oregon. Water temperature as a bull trout habitat identifier is a difficult thing to address and it all revolves around the spatial scale and resolution that is needed to answer the question (meet the study objective). So what exactly is the question? In this case, I believe that the question revolves around what is needed to provide long-term spawning, incubation, and rearing habitat. How much habitat are we looking for? Are we looking for a 300 foot-long reach that can support spawning and rearing, a 1/4 mile-long reach, or a 1/2 mile-long reach?

As I see it, the primary objective of the Bull Trout LFA is to identify those tributaries to Lake Merwin and Swift Creek Reservoir that have the greatest potential to support long term bull trout spawning and rearing (i.e. increase abundance in the core area). Because of this, I think we should focus our efforts on those reaches that are relative long (greater than 1/4 mile or so) and that can support substantial spawning and rearing, and not spend a lot of time trying to find 100 or 200 foot-long reaches, here or there, that have cooler water temperatures.

Lou Ellyn also suggests that the "whole stream" need not have "optimal" temperatures to successfully support a bull trout population. To avoid only looking at the best (i.e. optimal) habitat, our LFA study plan includes a "marginal" habitat category that will allow us to consider streams that did not fall into what is generally considered "the best or optimal" habitat for bull trout. We consider our marginal habitat to be "on the fringe" of what is considered potential bull trout habitat.

All of the streams that will be assessed during our bull trout LFA (listed in Table 3 of the Study Plan) are relatively small (60% have less than 3/4 of a mile of accessible habitat from the reservoir). The longest tributary, Drift Creek, has 1.6 miles of accessible habitat. Given these short lengths, we believe that one temperature logger at the mouth of each stream that is less than one mile long will adequately describe temperatures in the accessible reaches. For the few longer streams with greater than 1 mile of accessible habitat we will place two thermographs to split the reach in half.

We believe that this strategy will adequately describe the water temperature regime in each target stream. However, if the group is still interested in identifying short reaches of cool water refugia, we could conduct a series longitudinal "spot checks" for cool water temperatures in the target streams during the summer low flow period (say a warm day in late August), and compare these longitudinal temperature data to what is recorded on the loggers at the mouth and upper end of each stream (if applicable). We could then review these data with the group during the QHA analysis. We also welcome any other alternative suggestions to address this issue. I hope this helps. Please don't hesitate to call or email me with any questions or comments.

Cheers,

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From: LouEllyn_Jones@fws.gov]
Sent: Friday, June 09, 2006 9:17 AM
To: Shrier, Frank
Cc: Jeffrey_Chan@fws.gov
Subject: Re: FW: Comments on the Bull trout limiting factors analysis study proposal

Frank: I'm not sure I ever responded to this. I was referring to the model that was attached to the study plan, which sounds like the QHA.

Lou Ellyn Jones
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From: Lesko, Erik
Sent: Friday, June 02, 2006 8:55 AM
To: Shrier, Frank; 'George Gilmour'
Cc: McCune, Kimberly; Olson, Todd
Subject: RE: Scan from a Xerox Document Centre

In reading the comments [WDFW Comment Letter] I believe that electrofishing has proven itself effective in the Lewis without harming juveniles. I have never seen Jim electrofish the Lewis and believe this is opinion rather than field testing. We were successful at obtaining genetic samples from both Cougar and Pine with the shocker. We would need to get into these streams prior to spawning however. Also, I do not know if we were planning on collecting any genetic samples, but because we are going to be sampling P8 this year (as part of the bull trout plan) I anticipate collecting fin clips from that population. By the way, we only find brook trout in the bypass reach area, some of which are large (>12 inches). Lastly, their screw trap results in Rush Creek do not reflect what the population size was in Rush Creek, therefore it is incorrect for them to make statements like 80 percent migrated from Rush Creek as YOY.

Erik Lesko
(503) 813-6624

From: George Gilmour
Sent: Tuesday, June 13, 2006 4:15 PM
To: byrnejbb@dfw.wa.gov
Cc: frank.Shrier@Pacificorp.com; Jason Shappart
Subject: Lewis River Bull Trout LFA Comments

Jim,

Frank Shrier recently sent us a copy of your comments on the Lewis River Bull Trout LFA study plan. We appreciate your detailed review and understand that you have some concerns regarding our approach (specifically, the use of EDT rules). In short, we included the EDT rules in our study plan only to provide a general description of bull trout habitat requirements. We fully recognize that many of these "rules" do not apply to bull trout in the Lewis River core area, as Lewis River bull trout have relatively unique life histories and habitat preferences/tolerances. Please understand that our proposed QHA analysis will rely not only on the water temperature and habitat data collected in the field this summer, but on the expert knowledge of biologist like you, Lou Ellyn, Frank, Erik, and others with experience in the basin. We will then use this local bull trout knowledge and our field data in our QHA analysis to develop a thorough understanding of potential bull trout habitat, identify any limiting factors (including reservoir related limiting factors), and recommend possible enhancement measures. QHA is not EDT and the assumptions that we will use in our analysis will be developed and refined by all parties involved in the study.

Rather than respond to all of your comments in a detailed letter, Jason Shappart and I thought it might be more productive to have a discussion during an informal conference call. Does this work for you? Are you available this week or next week? If so, please let me know a good day and time.

Thank you,

George Gilmour
Fisheries Biologist
Meridian Environmental, Inc.
(206) 522-8282

From: Shrier, Frank
Sent: Monday, July 31, 2006 10:16 AM
To: ggilmour@meridianenv.com; jshappart@meridianenv.com; Erik.Lesko@PacifiCorp.com; kmalone@jsanet.com; shelley_spalding@fws.gov; LouEllyn_Jones@fws.gov ; Joe_Hiss@fws.gov ; BYRNEJBB@DFW.WA.GOV
Cc: Todd.Olson@PacifiCorp.com
Subject: Lewis River Implementation LFA conference call.doc

I've attached some notes that George recorded from the LFA conference call on July 21st. These are not official notes but they did serve to capture the main points of the call and gave me an opportunity to review what was said. I understand that Lou Ellyn also took some notes. I've added in responses to George's and, if anything, these responses will serve to keep the conversation going. I'm assuming there will be a follow-up call.

--

Lewis River Draft Bull Trout LFA Study Plan
Conference Call Notes
July 21, 2006 (10:00 am to 12:00 pm)

[Note: Frank Shrier comments on conference call notes are highlighted in yellow.]

Attendees:
George Gilmour (MEI)
Jason Shappart (MEI)
Erik Lesko (PacifiCorp)
Kevin Malone (Mobrand/Jones and Stokes)
Chip McConnaha (Mobrand/Jones and Stokes)
Shelley Spalding (USFWS)
LouEllyn Jones (USFWS)
Joe Hiss (USFWS)
Jim Byrne (WDFW)

General conference call discussion regarding the LFA Scope of Work:

1. The agency participants were not in full agreement with the existing scope of the LFA. In general, the agency participants felt that a comprehensive approach to assessing bull trout limiting factors in the Lewis River basin should be developed in collaboration with the USFWS and WDFW. We noted that it was not our position to discuss the overall scope of the LFA and that our task was to respond to the scope of work as it was presented in PacifiCorp's RFP and described in the Settlement Agreement. The agency participants understood this, but would like to meet with PacifiCorp to discuss the overall scope.

2. In addition to the tributaries to Lake Merwin and Swift Reservoir, the agency participants thought that the LFA should include streams that are known to contain bull trout (i.e. Rush and Pine creeks) to serve as reference reaches and also to evaluate limiting factors and to assess actions that could be implemented to enhance habitat in those streams that already contain bull trout.

3. All agency participants felt that in addition to tributary habitat, reservoir limiting factors should be addressed in this study. Chip McConnaha's response to this was that the QHA could be modified if needed to address reservoir habitat. We agreed to survey the reservoir drawdown zones for any potential barriers to upstream migration but felt that it was not our position recommend any modifications to the scope.

4. Jim Byrne also felt strongly that Yale Reservoir and tributaries should be included and that all the reservoir habitat and ecological interactions in the reservoirs should be included in the limiting factors analysis. LouEllyn Jones and Shelley Spalding felt that this LFA should at least discuss how this effort is consistent with the Yale LFA analysis and results (conducted by Karen Pratt) to provide a "big picture" view of bull trout limiting factors in the Lewis River basin. We noted that we could add the information included in Karen's report to our LFA report.

The SA is clear that Yale is not included. That is because Karen Pratt already did that analysis.

This is the actual SA language:

5.5 Bull Trout Limiting Factors Analysis. By the second anniversary of the Effective Date, PacifiCorp shall provide a limiting factors analysis for bull trout occurring in Lake Merwin tributary streams and Swift Reservoir tributary streams and finalize this evaluation in Consultation with the ACC. If the Licensees, in Consultation with the ACC and with the approval of USFWS, determine that one or more locations have the potential to provide long-term, sustainable habitat for critical life stages of bull trout, the ACC may implement enhancement measures through the use of the Aquatics Fund as described in Section 7.5 below.

Since the parties in this meeting were not at the settlement negotiations, let me add this. The request to conduct a limiting factors analysis for bull trout came from WDFW following review of Karen Pratt's work and with the intent to complete the other two reservoir tributaries so that we had a complete picture of the spawning and rearing potential in the reservoir area. Rush and Pine creeks were not added to the mix since they were already undergoing observation and there was known presence. Because of this and because of the need to stay true to the SA intent, I cannot agree to work that is significantly outside the present scope. If the meeting participants would still like to meet and discuss this issue, I am happy to oblige.

5. Kevin Malone commented that it would be valuable to link this study with the salmon re-introduction effort in terms of monitoring effects of the reintroduction on bull trout.

6. The agency participants were concerned that electrofishing may have adverse effects on bull trout, especially in relatively warm water. Although we felt there was little risk to bull trout associated with electrofishing (based on past sampling experience), we agreed to use night snorkel surveys in some of the larger tributaries and large pools (if possible).

Agency recommended changes to the draft bull trout LFA study plan based on the July 21, 2006 conference call consensus:

1. Add language regarding how the Yale Lake LFA is related to this study (where applicable).
   It's OK to add this to the discussion section of the final report
2. Add language on why all the streams from AQU 4 were not carried forward in to the list of streams to be initially assessed in this study (Table 4 of the Bull Trout LFA Study Plan).
   An explanation is warranted
3. For temperature monitoring, add language that all streams (in Table 4) will be monitored this year, and that in the late summer, a cold water refugia verification survey will be conducted that will involve walking the accessible reaches of each stream and taking hand-held thermometer readings (every 100 to 200 feet or so) to determine if any cold water refugia are present and to generally see how the thermograph data matches up with the stream temperature profile during the late summer.
   OK

4. The initial bull trout habitat ranking category (Table 2 of the study plan) for spawning should be for the time frame of mid-November, not the end of September.

Why so late? Is this intended to be a redd survey?

5. The criteria for maximum temperature is good and streams should be excluded from further analysis if the temperature is clearly greater than 18°C, but if there are only a few readings over 18°C, then a group decision will be made on whether to rank the stream as "poor" and excluded it from further analysis.

This could only be determined by group consensus after the field season – not a practical solution

6. Some verbiage should be added that all the accessible habitat is <20% gradient, this category is not really applicable, but may justify why some of the AQU 4 streams were not included in this LFA study.

OK

7. Shelly Spalding felt that the seasonal stream criteria may not be justified, but the consensus was that if one is looking at spawning and rearing streams that the greatest potential would be in perennial streams. No final resolution to this issue was clear, but most if not all of the streams (1st draft of the LFA Study Plan, Table 3) are probably perennial according to Jim Byrne so it would not really be an issue.

8. For the presence/absence surveys, night snorkeling will be used based on safety and appropriateness, i.e. if it is too shallow then electrofishing will be used.

OK with safety and practicality in mind

9. Before the habitat surveys occur, we will have a meeting to identify parameters to be surveyed in order to make sure that we collect data for parameters that participants anticipate will be used in the QHA.

OK

10. Have meetings during the QHA phase to develop habitat rules for the analysis.

OK

Additional information to supply to participants:

1. Provide AQU 4 study, or link to study, and data sheets, etc. to agency participants (Meridian will do this).

2. Revise the study plan and send it out for review to participants (Meridian will do this).

3. Prepare a written response to Jim Byrne's comment letter (Meridian will do this).

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
2108 Grand Blvd. • Vancouver WA 98661 • (360) 696-6211 • Fax (360) 906-6776/6777

May 25, 2006

Mr. Frank Shrier
PacifiCorp
825 NE Multnomah St.
Portland, OR 97232

SUBJECT: Comments on the Lake Merwin and Swift Creek Reservoir Tributary Streams Bull Trout Limiting Factors Analysis draft study plan.

Frank
Dear ~~Mr. Shrier;~~

Washington Department of Fish and Wildlife thanks PacifiCorp for the opportunity to review and comment on this Bull Trout Limiting Factors Analysis (LFA) draft study plan. After careful review we would recommend caution when comparing bull trout populations and habitat in the Lewis Basin with what is found to be excellent or classic bull trout habitat in other parts of the Intermountain West.

The assumptions made for bull trout and EDT outside the lower Columbia River Basin may not be appropriate for the Lewis River since Lewis River bull trout thrive in what would appear to be marginal or inhospitable conditions elsewhere. The heavy weighting of substrate, stability and side channels could be inappropriate as level two attributes for the Lewis River Basin; as there is very little spawning gravel and side channels on bull trout streams in this basin. The out-of-basin species habitat rules additionally may not be appropriate here. The limiting factors analysis does not address the time bull trout reside in the reservoir and any negative interactions associated with winter drawdown. The limiting factors analysis should be made on Lewis River specific criteria not a generalized stream EDT template.

This document describes the plan to draft a Bull Trout Limiting Factors Analysis for Swift and Merwin Reservoirs. It contains a large section on bull trout biology and habitat needs for most of this species range. However, the life history and habitats described are generalized and not specific to the Lewis River Basin. Rush and Pine Creeks have habitats very different from what is usually associated with bull trout in other river basins. A majority of the document discusses the methodology of EDT analysis for bull trout. The EDT analysis of bull trout is for generalized bull trout populations and may not apply to specific conditions found in Rush, Pine and Cougar Creeks, or in the Muddy system, which vary dramatically from bull trout habitat documented elsewhere. We are asking that recovery efforts be based on the specific habitat needs for bull trout found in the Lewis River, not from somewhere else out of the basin.

Section 2.0 (page two), discusses generalized bull trout habitat requirements; temperature, channel stability, substrate and gradient. Bull trout populations in the Lewis River system tend to survive in habitats generally not associated with bull trout in the intermountain west. Lewis River fish can be found in high gradient, unstable streams with limited gravel and high amounts of fine moving substrate (ash and pumice). Some streams have been subject to volcanic lahars and ash deposition which seldom apply to bull trout elsewhere and these conditions may not be built into the EDT analysis. WDFW requests the limiting factors analysis be more specific to Lewis River streams and not merely an attempt to place Lewis River bull trout into an existing EDT (stream only-reservoir exclusive) template.

Section 3.0 (page four), references generalized bull trout life history timing. WDFW believes much of the timing suggested is inaccurate for Lewis River populations and requests the study plan better reflect Lewis River life histories. In recent (2002-2005) field seasons, WDFW found later spawn timing in Rush and Pine Creeks, than that proposed in this draft. In 2002 and 2005, we found bull trout in Rush Creek and Rush Creek Hole through mid-October. In 2003, we saw bull trout in Cougar Creek from 9/11 through 11/13; in 2004 from 8/27 through 10/15 when flows were too high to safely snorkel; and in 2005 from 8/4 through 11/23. In 2004 and 2005, we found bull trout young-of-year (YOY) migrating into our downstream migrant trap starting in mid-March and throughout the summer. Numbers of YOY peaked in March and April. Emigration of juveniles to the reservoir also persists later than that suggested in the draft.

The Study Plan Approach 4.0 (page four), consists of three logical tasks and timeframes. Task 1 (4.1) consists of a data collection and analysis. Task 2 (4.2) (page six), is actual fieldwork with habitat data collection. Our experience is that Lewis River juvenile bull trout are not visible during daytime, but have a nocturnal lifestyle. We typically observe them during night snorkeling. Waters in the basin have generally low conductivity making electroshocking bull trout in the Lewis difficult. Juveniles reside in the gravel or litter along stream margins. They can be shocked but are not otherwise seen. Since conductivities are so low often fish are shocked at high voltage and pulse. Great care is necessary operating electroshockers at optimal voltage amperage and frequency levels to capture bull trout without harming them. WDFW recommends that night snorkeling surveys be used. Night snorkel surveys, where safety conditions permit, are the best way to document bull trout presence.

Joe Hiss, USFWS, has recently completed a review of stream temperatures in the Lewis River basin. This document may provide some guidance as to criteria for optimal, and marginal streams.

4.3 QHA Analysis, Task 3 (page seven), will determine which optimal or marginal streams to conduct the limiting factors analysis. Again, in the Lewis River, bull trout reside in habitats not normally associated with bull trout elsewhere (low altitude, high gradient, poor gravel, constant substrate shift etc.). These unique Lewis River attributes must be incorporated into the decision making process. Streams such as Rush and Pine Creeks, cannot be ruled out due to high gradient, or poor substrate as they serve as the bastions of bull trout in the basin.

In 4.4 Task 4: Prepare Draft and Final Bull Trout LFA Report, (page eight), the schedule indicates a draft report will be delivered to the Aquatic Coordination Committee (ACC) by Oct. 15. WDFW data indicates bull trout are still actively spawning during this time frame. This due date will not reflect the full duration of bull trout spawning. WDFW recommends adjusting the completion of the report to reflect the full duration of spawning.

Appendix One, Section 2.3.2 (page five), discusses intra-specific interactions and discusses specifically inter-cohort cyclical patterns of juvenile abundance. We have not observed such cyclical patterns from our decade of adult estimates. However, little research on juvenile life history has occurred in the Lewis River Basin. WDFW would like to see emphasis on juvenile life history, particularly in the Pine Creek drainage. The potential exists that Pine Creek may contain both adfluvial and resident bull trout populations. It would be desirable if distinctions in bull trout in this drainage could be detected (genetically) and determine if these 150-350 mm fish interact. Therefore, we recommend a genetic study be designed and funded to address these issues.

Section 2.3.3 (page six), on the hybridization section details the negative impacts of brook trout. However, most brook trout in the Lewis system do not share waters with bull trout. Most of the brook trout populations are located above Lower Falls and above impassible barriers on Pine Creek where adfluvial bull trout cannot reach. WDFW does not believe inter-specific habitat overlap and resultant genetic hybridization is a major issue for the Lewis River bull trout populations. If brook trout interactions are perceived as a potential problem, WDFW requests genetic studies be conducted on apparent hybrids and on brook trout captured in waters with bull trout.

Section 2.3.5 (page seven); harvest, harassment and poaching may have the greatest impact as a limiting factor. Skamania County has permitted residential housing to be developed on bull trout rearing and spawning streams. This development has the potential for negative human–bull trout interactions in key areas of the basin. This situation is in flux as the County struggles to provide residential development yet preserve fish and wildlife habitats and values. Enhanced enforcement efforts, increased funding, and a strong time commitment will be key to dealing with these issues.

Section 2.4.1 (page eight), on Channel Stability implies bull trout have a limited range of substrates they tolerate. Spawning habitats in Rush, Pine and Cougar Creeks appear marginal at best yet bull trout have been thriving in these streams. Cougar Creek shows volcanic influence and both Pine Creek and the Muddy River, have had volcanic lahars stream through them, leaving pumice and ash as substrate. We have never observed redds in Pine Creek and few redds have been observed in Cougar Creek.
Section 2.4.2 (page nine), sedimentation studies typically involve fine silt and do not deal with coarser pumice and volcanic ash seen in Pine, Cougar creeks and in the Muddy.
Section 2.4.3 discusses the importance of cover and structure. Pine Creek is virtually devoid of cover and the structure changes dramatically on a yearly basis. Spawning may occur in pine Creek tributaries and this deserves increased attention.

Table 2 (page 21). We have not observed evidence of intra or inter-specific competition in our adult estimates. In most if not all locations where bull trout are present in the Lewis we have not observed brook trout. Brook trout are generally located above impassible barriers to adfluvial bull trout.

In Appendix A: Bull Trout Life Stages it should be recognized that the majority (80%) of Rush Creek juveniles migrate from this creek to the mainstem Lewis as YOY. In Appendix Table B1. We observed bull trout juveniles leaving Rush Creek over a nine-week period and we probably missed the beginning of the out migration in February.

On page 21 of the Qualitative Habitat Assessment (QHA) User's Guide Version 1.1 it states, *"As presently constituted, QHA is designed for use with streams and stream habitat characteristics. It does not contain a module for dealing with adfluvial populations once these enter a lake or reservoir."* It appears this is not an appropriate methodology. All adult Lewis River bull trout spend half the year in reservoirs.

Bull trout juveniles in the upper Lewis predominantly spend only one to two years in the mainstem before entering the reservoir. Much of their lifetime is spent in the reservoirs – areas not covered by EDT analysis. The effect of winter reservoir drawdown could have definite negative effects on bull trout (stranding, predation issues, loss of riparian habitat, etc), yet under present EDT analysis this is not addressed. Since adult bull trout spend six months in the reservoir and subject to a drastic habitat change, this must be considered as a potential limiting factor. Yet fluctuations in water level are not addressed in the proposed LFA. The effects of reservoir draw down must be addressed in the LFA. Any assumptions about bull trout habitat requirements in the reservoirs will need the full agreement of the ACC.

Thank you for the opportunity to review and comment on the draft plan. We hope you find our comments helpful. If you have any questions or comments please contact Jim Byrne, Area Fish Biologist, at (360) 906-6751.

Sincerely,

Craig Burley
Region 5 Fish Program Manager

Meridian Environmental's Response to WDFW's comments on the Draft LFA Study Plan (letter dated May 25, 2006)

Comment 1: *The assumptions made for bull trout and EDT outside the lower Columbia River basin may not be appropriate for the Lewis River since Lewis River bull trout thrive in what would appear to be marginal or inhospitable conditions elsewhere* (and other comments dealing with EDT bull trout rules presented in Appendix 1).

Response 1: We are not proposing to use EDT in the Lewis River Bull Trout LFA. The EDT rules presented in Appendix 1 of the LFA Study Plan were included only to provide additional information on bull trout life history and habitat requirements. We propose to use QHA, which relies heavily on local expert knowledge to rate life history and habitat parameters. Ratings for life stages and habitat attributes will be developed in consultation with the agency participants that have extensive local knowledge in to ensure that life history and habitat use assumptions are appropriate for Lewis River basin bull trout. We are fully aware that bull trout in the Lewis River use habitat not considered as optimal for bull trout in other parts of the species distribution.

Comment 2: *The limiting factors analysis does not address the time bull trout reside in the reservoir and any negative interactions associated with winter drawdown.*

Response 2: As noted in the Lewis River Projects Settlement Agreement and in the LFA Study Plan, the purpose of the LFA is to assess tributaries to Lake Merwin or Swift Creek Reservoir. Specifically, the Settlement Agreement states:

> *By the second anniversary of the Effective Date, PacifiCorp shall provide limiting factors analysis for bull trout occurring in Lake Merwin tributary streams and Swift Creek Reservoir tributary streams and finalize this evaluation in Consultation with the ACC. If the Licensees, in Consultation with the ACC and with the approval of USFWS, determines that one or more locations have the potential to provide long-term, sustainable habitat for critical life stages of bull trout, the ACC may implement enhancement measures through the use of the Aquatics Fund as described in Section 7.5 below [of the Settlement Agreement].*

The primary questions being asked by the LFA are: Do other streams exist in either reservoir that can potentially provide long-term spawning, incubation, and rearing habitat for bull trout? Are bull trout present? What are the limiting factors in these streams? Are there any changes that could be made to these streams to allow bull trout spawning and rearing? The LFA does not focus on reservoir habitat. However, reservoir drawdown does have the potential to create drawdown-zone migration barriers in the late summer and fall that would not allow adult bull trout to migrate into tributaries that may be suitable for spawning and rearing. To address this concern, we have agreed to conduct a drawdown zone barrier survey during the fall of 2006 in those tributaries that meet either the optimal and marginal habitat criteria identified in the LFA Study Plan. However, drawdown issues were discussed at length during relicensing, and it should be recognized that reservoir drawdown will occur into the future to provide flood control and power generation. Future project operations, including drawdown, were supported by WDFW in the Settlement Agreement.

Comment 3: References to bull trout life history timing in Section 3.0 of the LFA Study Plan do no reflect data collected by WDFW. *WDFW believes much of the timing suggested is inaccurate for Lewis River populations and requests the study plan better reflect Lewis River life histories.*

Response 3: In Section 3.0 of the Bull Trout LFA Study Plan, we used the information from the recent relicensing studies and the current annual bull trout monitoring reports produced by PacifiCorp (reviewed by WDFW). Where life history timing affects the QHA analysis, we will use all available data that agency participants can provide, as well as local expert knowledge to insure the QHA is most applicable to local Lewis River basin bull trout population characteristics.

Comment 4: *Our experience is that Lewis River juvenile bull trout are not visible during daytime, but have a nocturnal lifestyle. We typically observe them during night snorkeling. Waters in the basin have generally low conductivity making electroshocking bull trout in the Lewis difficult. Juveniles reside in the gravel or litter along the stream margins. They can be shocked but not otherwise seen. Since conductivities are so low often fish are shocked at high voltage and pulse. Great care is necessary operating electroshockers at optimal voltage amperage and frequency levels to capture bull trout without harming them. WDFW recommends that night snorkeling surveys be used. Night snorkel surveys, where safety conditions permit, are the best way to document bull trot presence*

Response 4: We appreciate your comment and have modified the LFA Study plan to incorporate night snorkeling; however, if a stream is generally too shallow to snorkel or if night snorkeling presents safety concerns, then electrofishing will be used following the AFS recommended protocol (Peterson et al. 2002). As soon as one bull trout is encountered in a particular stream, the survey will cease, as presence will have been established.

Please note that USFWS Bull Trout Research and Monitoring Group used single-pass electrofishing during the summer of 2006 throughout the upper Lewis River basin to determine juvenile bull trout presence/absence within known bull trout habitats in order to validate their bull trout suitable spawning and rearing habitat "patching" model.

Please also note that we have used electrofishing in the Lewis River basin in the past to collect bull trout genetic samples in both Pine and Rush creeks, with no mortalities or external injuries noted. In addition, these fish (primarily fry) were relatively easy to capture. We also used multi-pass electrofishing methods following the AFS recommended protocol to conduct surveys within the Siouxon Creek subbasin of the Lewis River. These methods were approved by both WDFW and USFWS. Meridian biologists have over 15 years each of electrofishing experience, sampling numerous streams for bull trout throughout the Pacific Northwest. We are very aware of the care that must be exercised when electrofishing for bull trout so as not to cause injury or mortality, while maintaining acceptable capture efficiencies.

Comment 5: *Joe Hiss, USFWS, has recently completed a review of stream temperatures in the Lewis River basin. This document may provide some guidance as to criteria for optimal and marginal streams.*

Response 5: We appreciate your comment and have reviewed the referenced report. In addition, we have reviewed the criteria recently used by the USFWS for the bull trout habitat patching model covering the entire Lewis River basin. The habitat criteria used in the LFA Study Plan is consistent with these efforts.

Comment 6: *QHA Analysis, Task 3 (page 7), will determine which optimal or marginal streams to conduct the limiting factors analysis. Again, in the Lewis River, bull trout reside in habitats not normally associated with bull trout elsewhere (low altitude, high gradient, poor gravel, constant substrate shift, etc.). These unique Lewis River attributes must be incorporated into the decision making process.*

Response 6: We understand your concern and note that QHA will not be used to determine which optimal or marginal streams are analyzed. As the first sentence in Section 4.3 of the LFA Study Plan states "QHA...will be used to conduct a limiting factors analysis on each stream examined with “optimal” or “marginal” potential." In other words, all streams ranked "optimal" or "marginal" will be analyzed for limiting factors using QHA. The QHA will rely heavily on local expert opinion and site specific Lewis river data provided by WDFW, the USFWS, and PacifiCorp. The only streams that will not be analyzed using QHA are streams that meet the "poor" criteria. The "poor" criteria are streams with >20% average gradient for the length of accessible habitat, are seasonally flowing, have >18°C stream temperatures in the summer, and have temperatures >13°C by mid-November.

Comment 7: *In 4.4 Task 4: Prepare Draft and Final Bull Trout LFA Report, (page 8), the schedule indicates a draft report will be delivered to the Aquatic Coordination Committee (ACC) by Oct. 15. WDFW data indicates bull trout are still actively spawning during this time frame. This due date will not reflect the full duration of bull trout spawning. WDFW recommends adjusting the completion of the report to reflect the full duration of spawning.*

Response 7: The schedule has been revised to address your comment. Please note that we are not proposing to conduct detailed spawning surveys in the tributaries to Lake Merwin and Swift Creek Reservoir; however, we will note any spawning activity observed during the scheduled habitat surveys in the fall. The presence/absence surveys are primarily for juveniles, which would indicate bull trout do currently use a particular tributary for spawning.

Comment 8: *WDFW would like to see emphasis on juvenile life history, particularly in the Pine Creek drainage. The potential exists that Pine Creek may contain both adfluvial and resident bull trout populations. It would be desirable if distinctions in bull trout in this drainage could be detected (genetically) and determine if these 150-350 mm fish interact. Therefore, we recommend a genetic study be designed and funded to address these issues.*

Response 8: Although we recognize the value of genetic studies in the upper Lewis River basin, streams already known to contain bull trout (i.e. Pine Creek, Rush Creek, the upper Lewis River, and the Muddy River) were not included in PacifiCorp’s Scope of Work for this study. As a result, evaluations in these streams were not included in the Bull trout LFA Study Plan.

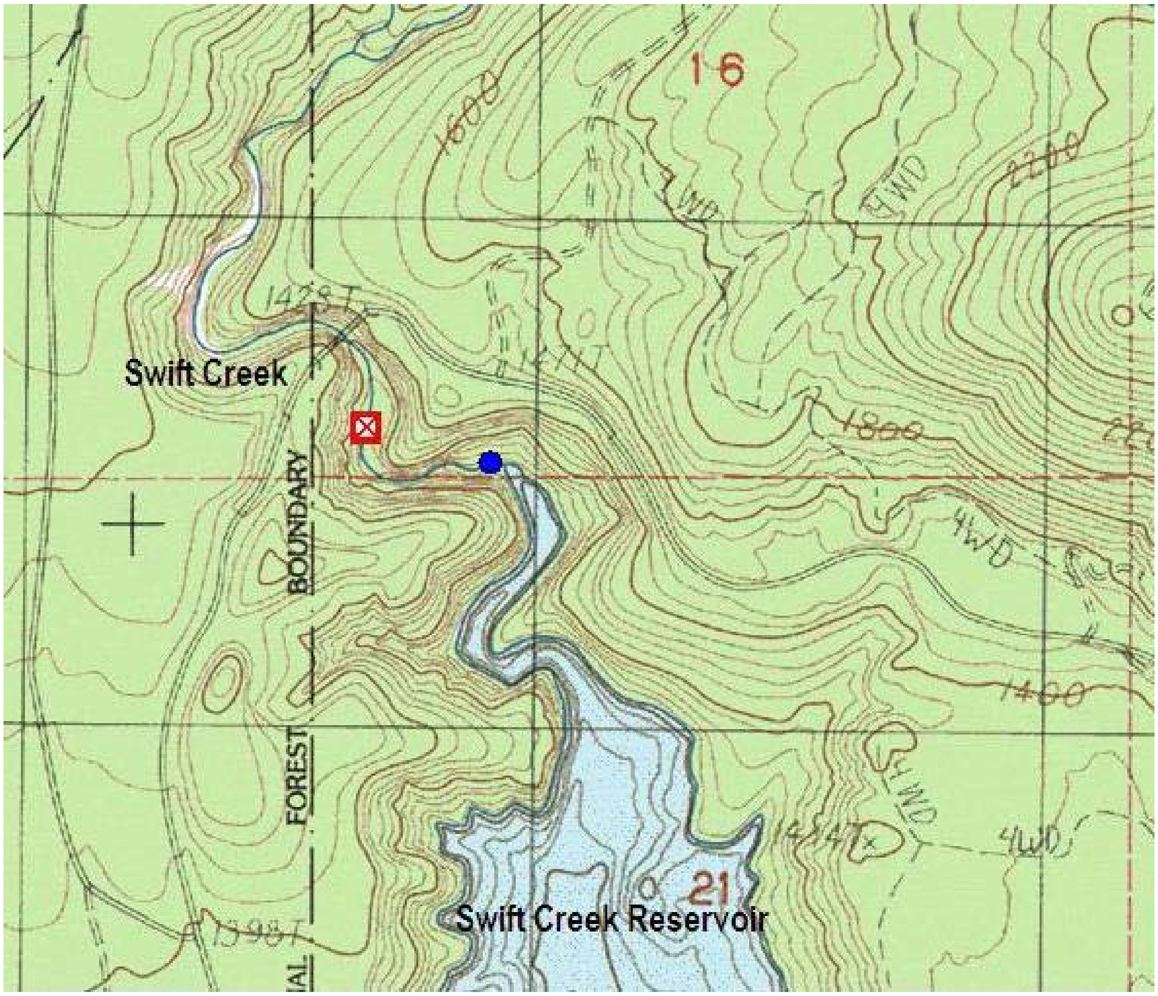
Comment 9: *On page 21 of the Qualitative Habitat Assessment (QHA) users Guide Version 1.1 it states, “As presently constituted, QHA is designed for use with streams and stream habitat characteristics. It does not contain a module for dealing with adfluvial populations once these enter the lake or reservoir.” It appears this is not an appropriate methodology. All adult Lewis River bull trout spend half of the year in reservoirs.*

Response 9: The LFA is designed to address limiting factors within the tributaries to Lake Merwin and Swift creek reservoir not within the reservoir habitat. The Settlement Agreement language calls for a "...limiting factors analysis for bull trout occurring in Lake Merwin tributary streams and Swift Creek Reservoir tributary streams". Regardless, QHA can be modified to incorporate lake or reservoir habitats.

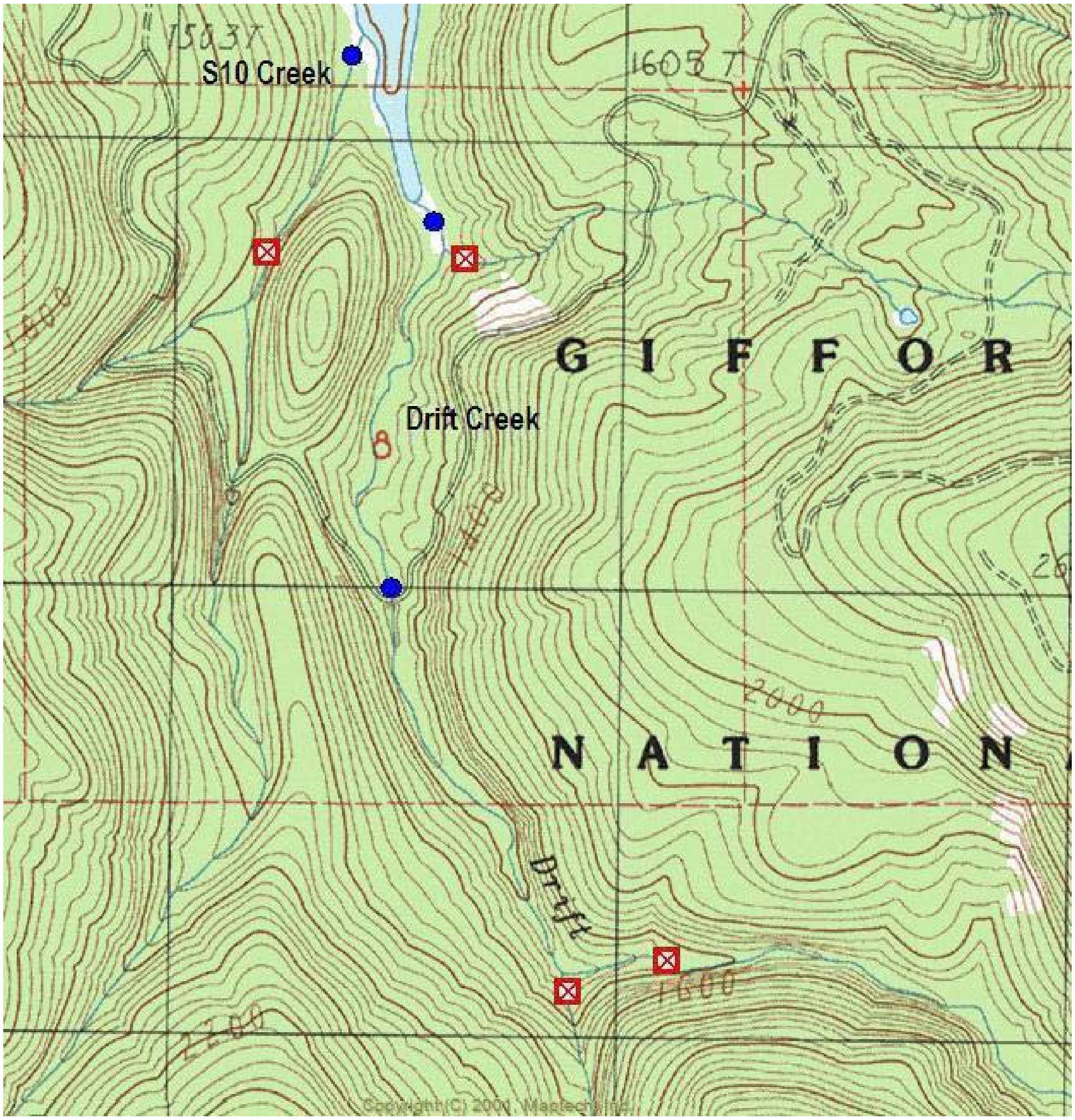
Appendix C

Stream Maps

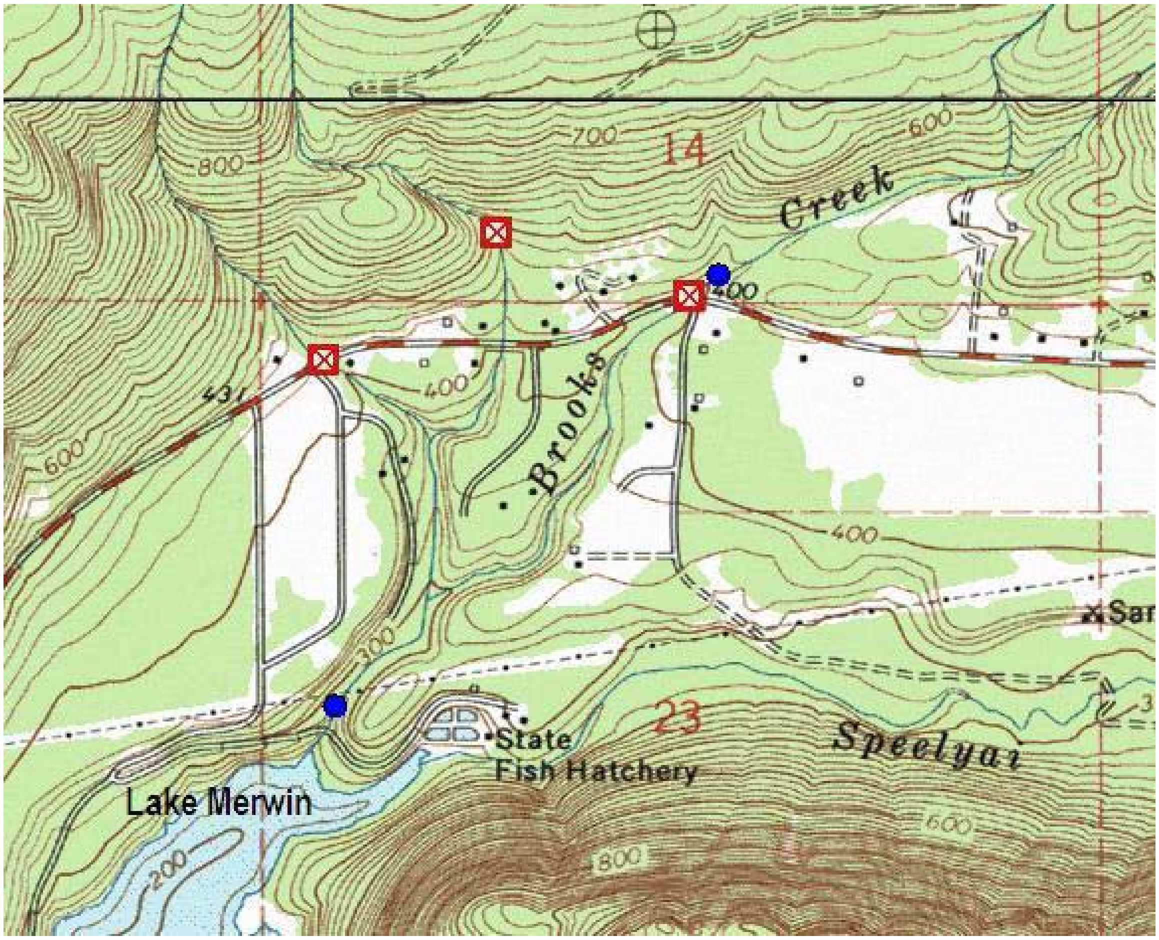
Swift Creek (blue-dot = temperature logger site, red-x = barrier)



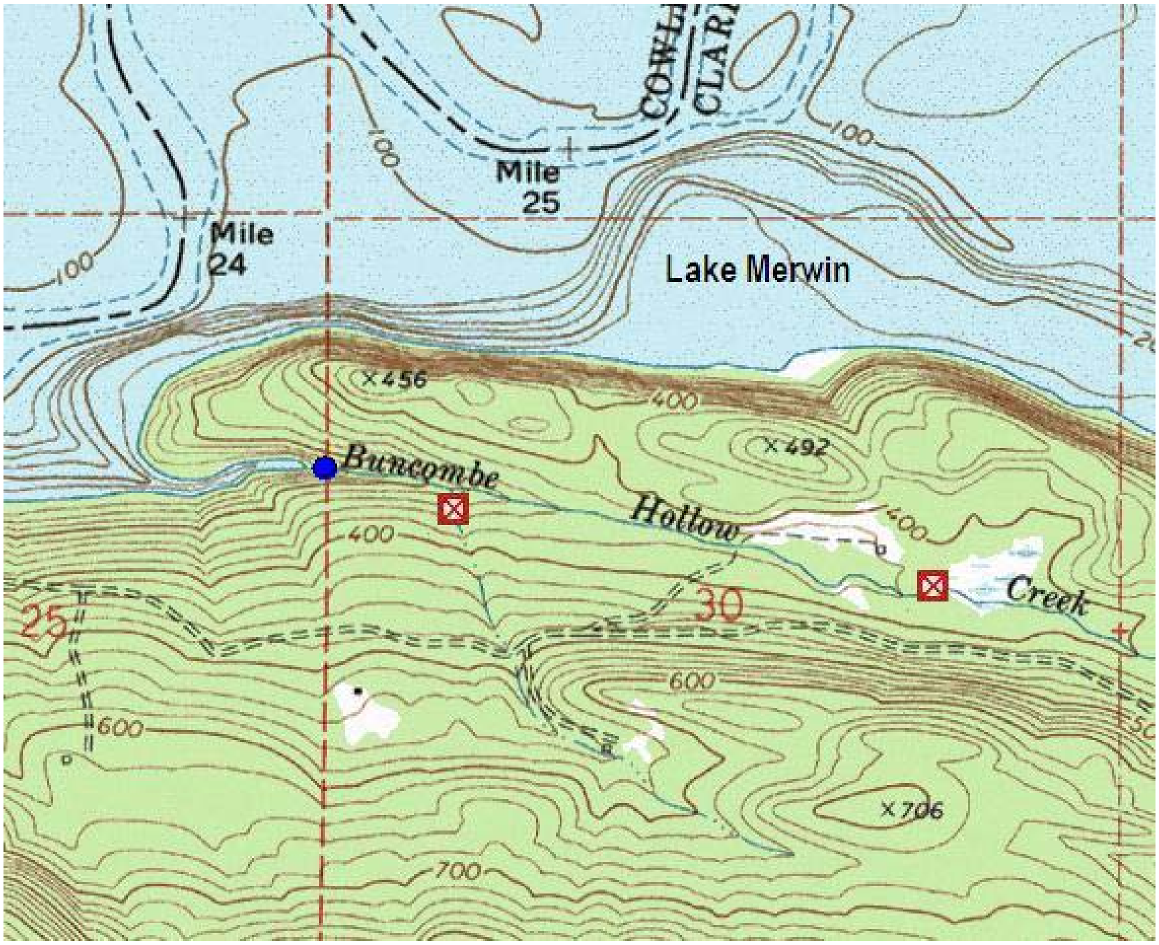
S10 and Drift creeks (blue-dot = temperature logger site, red-x = barrier)



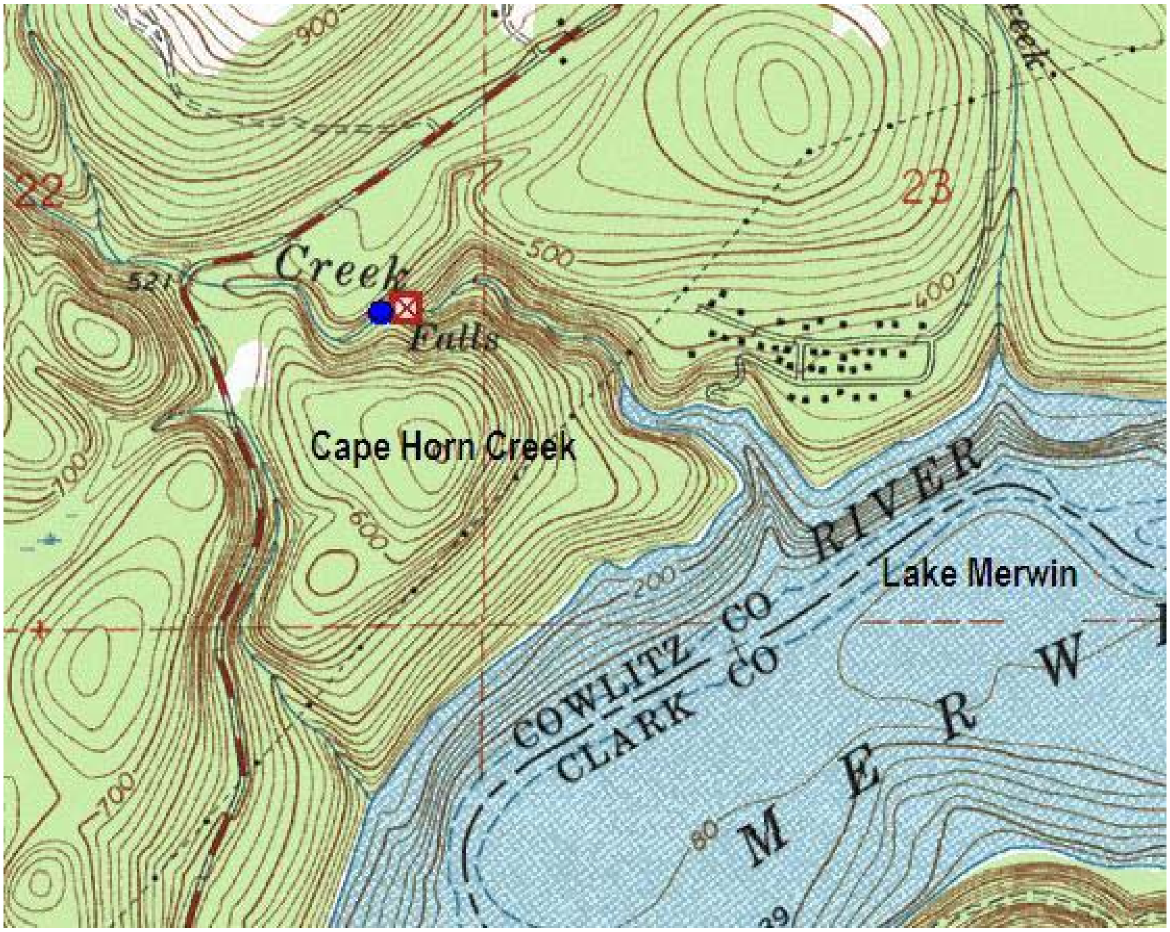
Brooks Creek (blue-dot = temperature logger site, red-x = barrier)



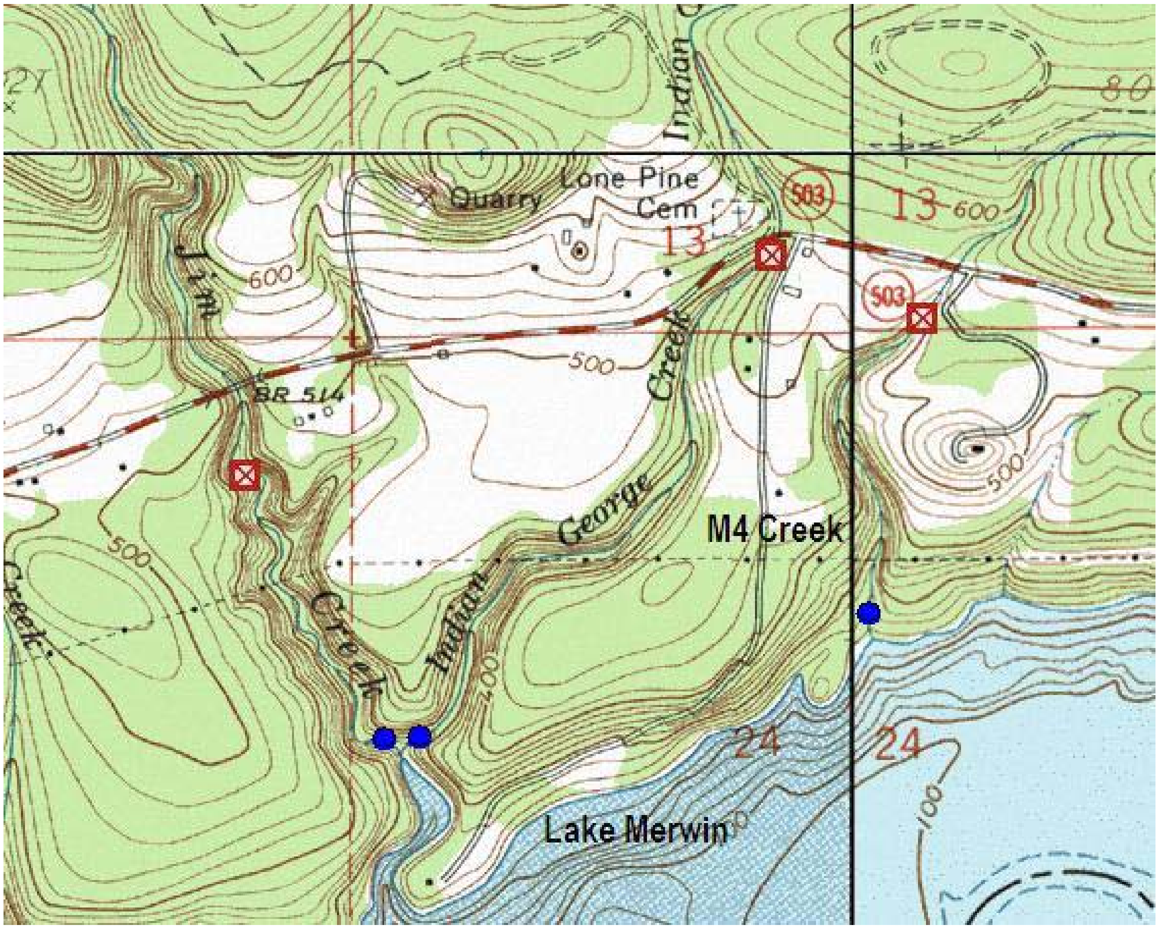
Buncombe Hollow Creek (blue-dot = temperature logger site, red-x = barrier)



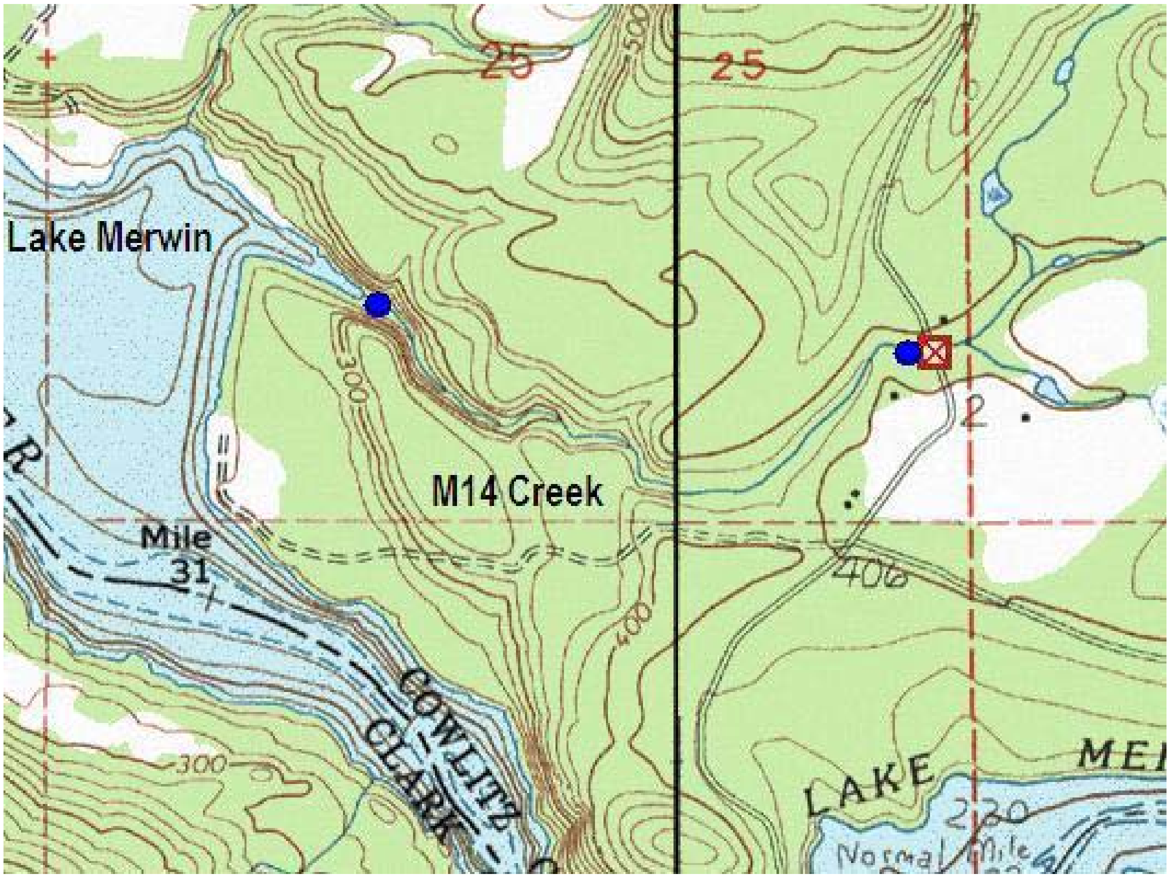
Cape Horn Creek (blue-dot = temperature logger site, red-x = barrier)



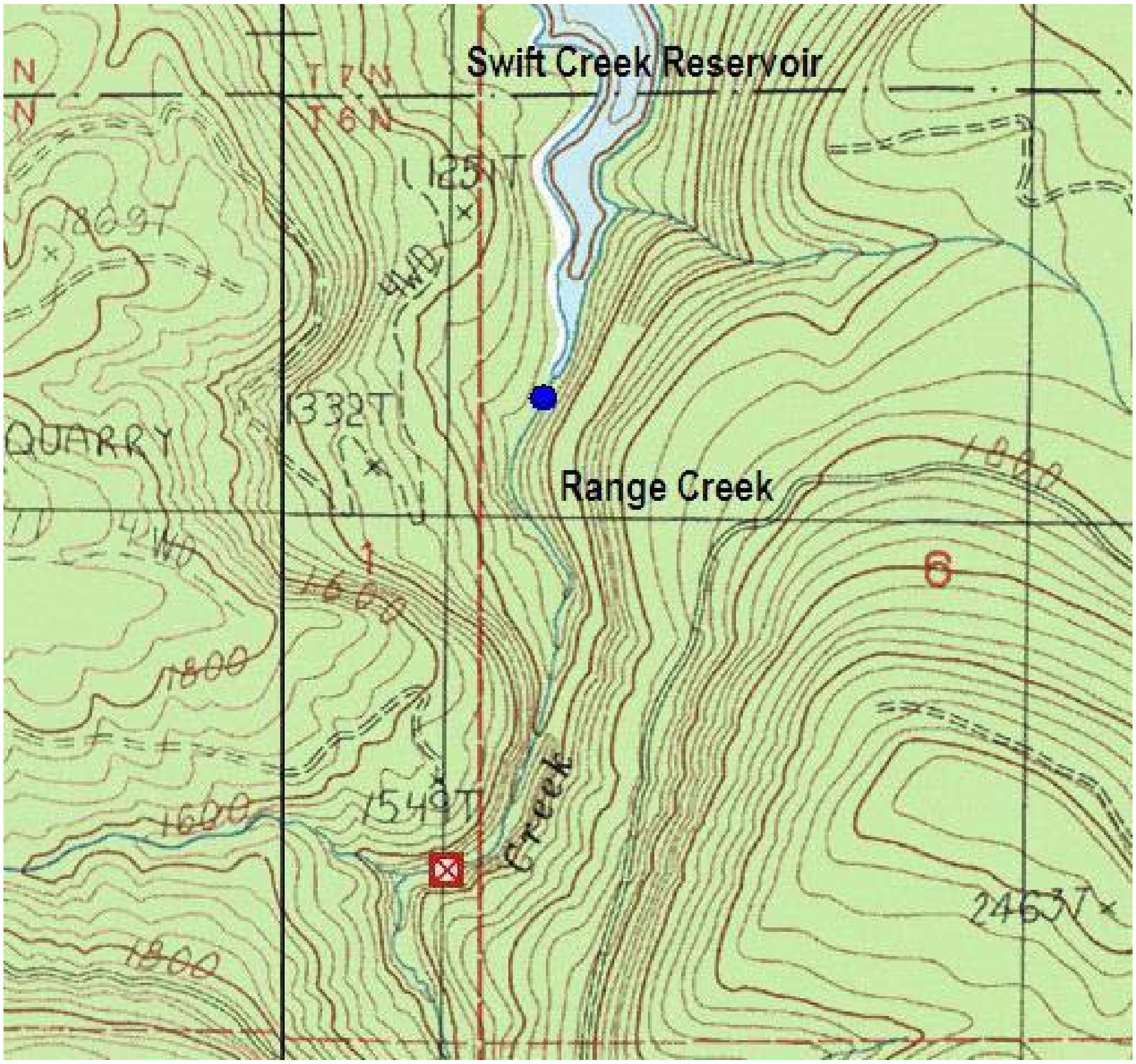
Jim, Indian, and M4 creeks (blue-dot = temperature logger site, red-x = barrier)



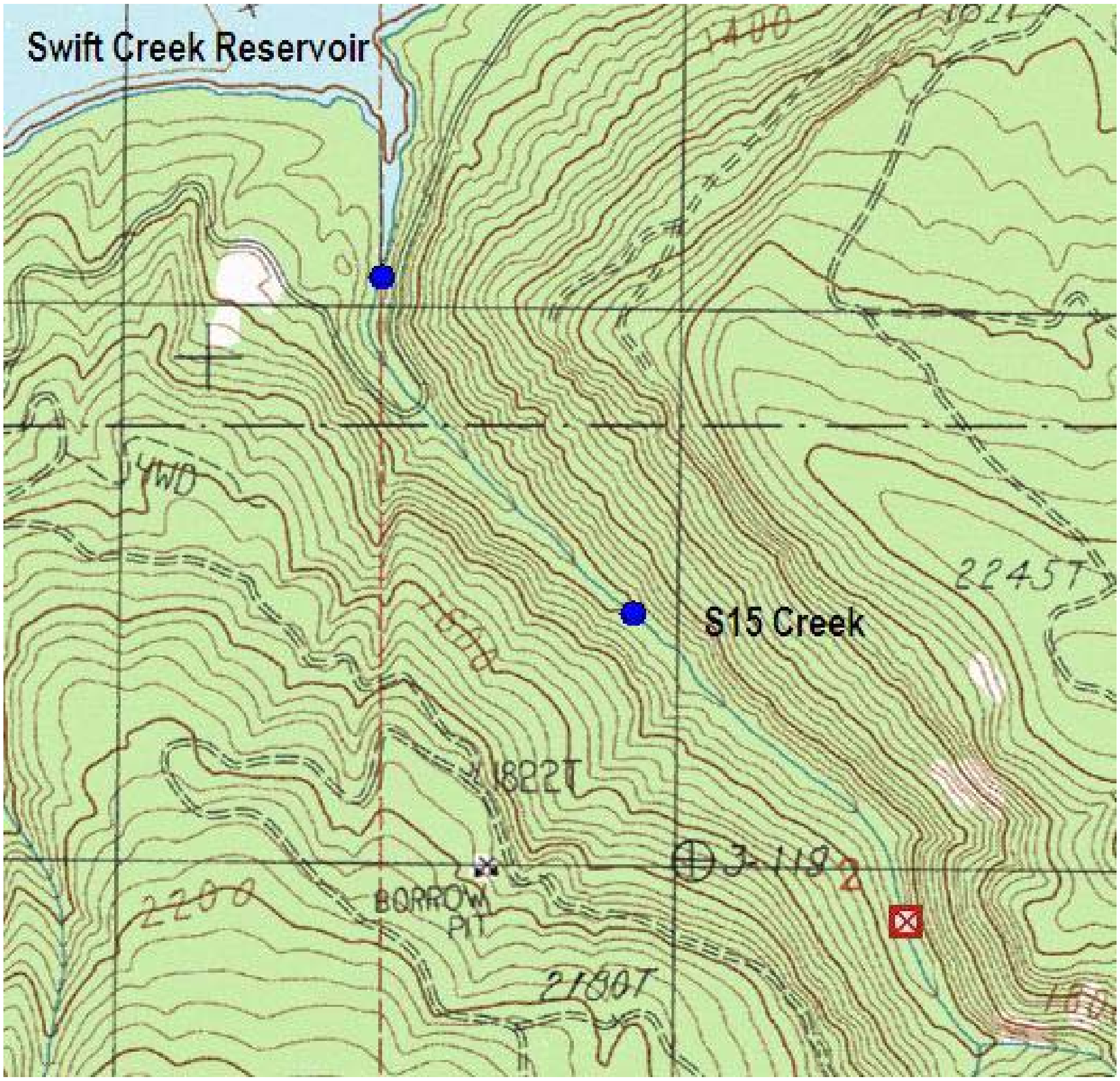
M14 Creek (blue-dot = temperature logger site, red-x = barrier)



Range Creek (blue-dot = temperature logger site, red-x = barrier)



S15 Creek (blue-dot = temperature logger site, red-x = barrier)



Appendix D

Stream Photographs

To be completed for final draft report.