4.0 AQUATIC RESOURCES

Pursuant to requirements of 18 CFR (Sections 4.51 and 16.8), PacifiCorp has prepared a report on aquatic resources for the Yale Hydroelectric Project. This report contains the following elements:

- A description of aquatic resources in the North Fork Lewis River and Yale Project study area and factors that may affect existing aquatic resources;
- A summary of existing resource management plans and existing measures for aquatic resources; and
- A discussion of agency/tribal involvement related to aquatic resources.

A description of proposed enhancement and mitigation measures for aquatic resources, as well as continuing impacts and implementation, cost, and schedule information, is not included in this License Application. Basin-wide aquatic resource enhancement and mitigation measures are, however, scheduled to be identified and addressed as part of Endangered Species Act (ESA) consultation and through the basin watershed study (see Section 1.1).

4.1 EXISTING RESOURCES

The North Fork Lewis River supports a variety of aquatic resources, including both resident and anadromous fish populations. These resources were investigated during a 3-year period in 1996, 1997, and 1998 as part of the relicensing process.

Objectives of the aquatic resource studies were to: (1) add to the current information characterizing the existing resources of the study area (Figure 2.1-2); (2) evaluate project impacts on existing resources; and (3) identify methods and propose measures to protect and enhance aquatic resources. Studies included:

- Resident fish and macroinvertebrate surveys in the study area;
- Habitat surveys in selected tributaries within the study area, including Speelyai Creek;
- Entrainment study at Yale Dam to determine the rate and magnitude of fish entrainment at the spillway and turbine intakes;
- Creel and fish population surveys in Yale Lake;
- Bull trout population study in Cougar Creek; and
- Study of bull trout genetics in Swift Reservoir, Yale Lake, and Lake Merwin.

The following section describes resident and anadromous fishery resources of the North Fork Lewis River, and proceeds to a more detailed discussion of aquatic resources within the Yale Project study area. Federally listed threatened or endangered species, aquatic habitat, benthic macroinvertebrates, factors affecting aquatic resources, existing resource management plans and policies, and existing measures related to the Yale Project are also discussed in this section. Detailed study methods and results were presented previously in the draft FTR for Aquatic Resources (PacifiCorp 1998a).

4.1.1 Resident Fish Resources

Fish populations in Lake Merwin, Yale Lake, and Swift Reservoir are comprised of indigenous and introduced species. Lake Merwin contains kokanee *(Oncorhynchus nerka)*, coho salmon *(O. kisutch)*, cutthroat trout *(O. clarki)*, rainbow trout *(O. mykiss)*, bull trout *(Salvelinus confluentus)*, brook trout (*S. fontinalis*), mountain whitefish *(Prosopium williamsoni)*, northern pikeminnow *(Ptychocheilus oregonensis)*, largescale sucker *(Catostomus macrocheilus)*, sturgeon (*Acipenser transmontanus*), and sculpin *(Cottus* spp.*)*. In 1995, the WDFW introduced tiger musky *(Esox-masquinongy x lucius)* into Lake Merwin, both to enhance recreational fishing opportunities and help control salmonid predators (e.g., northern pikeminnow) in the reservoir. Tiger musky are sterile hybrid fish, and periodic hatchery supplementation is required to maintain this fishery.

The same species found in Lake Merwin reside in Yale Lake, except for tiger musky, sturgeon, and coho. Threespine stickleback *(Gasterosteus aculeatus)*, resident lamprey *(Lampetra* spp.*)*, and dace *(Rhinichthys* spp.*)* have also been captured in Yale Lake (PacifiCorp 1998a). Resident lamprey and dace were not identified to species during field surveys. In Swift Reservoir, rainbow trout dominate the fishery, the result of stocking approximately 1,000,000 hatchery rainbow fingerlings annually as required by Article 51 of the Merwin license (FERC No. 935). Swift Reservoir also supports brown trout *(Salmo trutta)*, brook trout, bull trout, whitefish, suckers, and sculpin. The recreational fishery in Yale Lake is dominated by kokanee salmon. Rainbow and cutthroat trout are also harvested in the lake (Graves 1983; PacifiCorp 1998a). Fish species known to occur in Yale Lake and the North Fork Lewis River upstream of Merwin Dam are listed in Table 4.1-1.

The principal fishery in Yale is kokanee. Rainbow trout have not been planted in Yale Lake since 1980, and the trout fishery is supported by rainbow that enter from Swift Reservoir during periods of spill (Graves 1983). Cutthroat trout are native to the Lewis River basin and occur in all 3 reservoirs.

A small population of native bull trout resides in Yale Lake (Graves 1983; PacifiCorp 1998a). In 1998, the Yale Lake population was identified as a depressed stock by WDFW in its Washington Salmonid Stock Inventory (WDFW 1998b). In June 1998, the USFWS listed the lower Columbia River Evolutionary Significant Unit (ESU) of bull trout, including Yale Lake bull trout, as a threatened species under the Endangered Species Act (ESA). To protect the existing bull trout population in Yale Lake, bull trout harvest has been illegal since 1992 (WDFW 1994).

Table 4.1-1. Fish species known to inhabit the North Fork Lewis River upstream of Merwin Dam.

Common Name	Genera - Species	Present in Yale Lake
kokanee salmon	*Oncorhynchus nerka*	X
coho salmon	*Oncorhynchus kisutch*	
rainbow trout	*Oncorhynchus mykiss*	X
cutthroat trout	*Oncorhynchus clarki*	X
bull trout	*Salvelinus confluentus*	X
brook trout	*Salvelinus fontinalis*	
brown trout	*Salmo trutta*	
mountain whitefish	*Prosopium williamsoni*	X
threespine stickleback	*Gasterosteus aculeatus*	X
northern pikeminnow	*Ptychocheilus oregonensis*	X
sculpin	*Cottus* spp.	X
dace	*Rhinichthys* spp.	X
largescale sucker	*Catostomus macrocheilus*	X
lamprey	*Lampetra* spp.	X
tiger musky	*Esox-masquinongy x lucius*	
sturgeon	*Acipenser transmontanus*	
bluegill	*Lepomis macrochirus*	
carp	*Cyprinus* spp.	

Modified from Faler and Bair 1992.
Includes information from PacifiCorp 1998a.

Fisheries in the 3 PacifiCorp reservoirs can be affected by project operations. Power generation and spill can result in a downstream recruitment of fish through the reservoirs. Spill generally occurs between December and February during periods of heavy rainfall and runoff, but does not occur every year. In Lake Merwin, Graves (1983) reported that total harvest in April following spilling in 2 winters (1977-78 and 1980-81) was 92 and 86 percent kokanee. Following 2 non-spill winters, harvest in April fell to 17 and 42 percent kokanee.

In Yale Lake, Graves (1983) found that fishing success and harvest were at least 50 percent lower following spill years than non-spill years. Her studies showed that kokanee migrated downstream from Yale Lake each year when discharge increased from mid-December through early April.

Rainbow trout planted in Swift Reservoir also pass into Yale Lake during periods of spill (Graves 1983). Following a spill from Swift Dam in winter 1977-78, 54 percent of fish harvested in Yale Lake in 1979 were fin clipped rainbow trout that had been planted in Swift Reservoir (Graves 1983).

Bull trout are also believed to emigrate downstream from Yale Lake during periods of spill and/or generation. Since the fall of 1995, WDFW and PacifiCorp staff have captured 46 adult bull trout in the Yale tailrace (Lake Merwin) using quick-set gill nets. Limited bull trout spawning habitat is available in Lake Merwin, and it is presumed that these fish originated from habitat located upstream from Yale Dam (letter from E. Lesko, PacifiCorp to J. Weinheimer, WDFW, Vancouver, Washington, November 1997). After capture, all bull trout are tagged and transported upstream to Yale Lake and released near the mouth of Cougar Creek, the only tributary to Yale Lake where bull trout are known to spawn.

The fish species of greatest importance to the agencies and interested parties within the Yale Project area are kokanee salmon, bull trout, and cutthroat trout. Anadromous fish species are limited to reaches of the North Fork Lewis River below Merwin Dam, outside of the Yale Project area. They are described in Section 4.1.2.

4.1.1.1 Kokanee

Kokanee are not indigenous to the Lewis River watershed. In the late 1950s, Swift Reservoir, Yale Lake, and Lake Merwin all were stocked with kokanee from Kootenay Lake, British Columbia, and Cultus Lake, Washington. Self-sustaining populations currently exist in Yale Lake and Lake Merwin.

Kokanee in Lake Merwin spawn primarily in the lower 500 feet of Canyon Creek, as a 10-foot-high natural barrier prohibits upstream passage beyond this point. Limited spawning also occurs in Speelyai Creek, a small tributary to Lake Merwin. It is thought that recruitment to Lake Merwin is largely a result of kokanee from Yale Lake that pass over the dam during periods of spill or through the turbines during power generation.

After receiving a proposal from WDFW that called for the modification of the existing fish stocking program in Lake Merwin and Swift Reservoir, PacifiCorp requested that FERC amend Merwin License Article 51 to require an annual stocking protocol that included 100,000 kokanee at 7 to 8 fish per pound in Lake Merwin. This modified program is scheduled to begin in 1999. If an insufficient quantity of kokanee is available in any given year, the Licensee will stock the corresponding number of rainbow trout at a size of 7 to 8 fish per pound.

Kokanee life history in Yale Lake has been described by Graves (1983) and is discussed here only in the context of relicensing issues. PacifiCorp has conducted kokanee spawning surveys in Cougar Creek annually since 1978. The surveys indicate large annual fluctuations in the spawning (and presumably the reservoir) population. Spawning estimates (excluding the years 1982 to 1984, when the fishery was affected by severe mud flows from the Mount St. Helens eruption) range from a high of 180,000 (1991) to a low of 17,900 (1997). The data also show a strong inverse relationship between spawning escapement and mean kokanee length; that is, the larger the spawning population, the smaller the mean length of spawning fish (Table 4.1-2) (letter from E. Lesko, PacifiCorp, to J. Weinheimer, WDFW, Vancouver, Washington, November 1997). Limited kokanee spawning has also been documented in the Swift No. 2 bypass reach and Ole Creek (PacifiCorp 1998a).

Table 4.1-2. Summary of data collected from Cougar Creek kokanee surveys from 1978 to present.

Spawning Year	Peak Count	Date	Estimated Escapement[1]	Number of Females[2]	Mean Length (mm) Females	Mean Fecundity[3]	Total Eggs	Egg-to-Adult % Survival[4]
1978	32,064	NA	70,541	35,270	325	582	20,535,132	0.27
1979	26,136	NA	57,499	28,750	300	515	14,812,369	0.09
1980	54,782	NA	120,520	60,260	275	448	27,009,827	0.02
1981	25,614	NA	56,351	28,175	300	515	14,516,530	0.15
1982	5,750	NA	12,650	6,325	375	716	4,530,092	1.24
1983	2,875	NA	6,325	3,163	359	673	2,129,438	4.93
1984	9,915	NA	21,813	10,907	329	593	6,466,900	2.16
1985	25,623	9/25/85	56,371	28,185	294	499	14,068,411	1.05
1986	47,680	10/10/86	104,896	52,448	264	419	21,962,076	0.44
1987	63,406	9/30/87	139,493	69,747	242	360	25,093,432	0.42
1988	66,865	10/3/88	147,103	73,552	254	392	28,827,775	0.63
1989	44,199	10/11/89	97,238	48,619	284	472	22,964,651	0.52
1990	47,859	10/9/90	105,290	52,645	270	435	22,891,055	0.75
1991	81,993	10/7/91	180,385	90,192	256	397	35,833,401	0.31
1992	54,801	10/2/92	120,562	60,281	260	408	24,595,894	0.11
1993	78,260	10/6/93	172,172	86,086	259	405	34,894,099	0.09
1994	49,830	9/21/94	109,626	54,813	269	432	23,686,890	0.08
1995	12,590	10/12/95	27,698	13,849	287	480	6,652,783	NA
1996	14,508	10/9/96	31,918	15,959	284	472	7,537,980	NA
1997	8,169	10/23/97	17,972	8,986	308	537	4,822,373	NA
1998	2,435	10/6/98	5,357	2,679	308	537	1,437,444	NA
MEAN	35,969		79,132	39,566	291	490	17,393,740	0.74

[1] Peak Count x 2.2 (Graves 1983)
[2] Assuming a 1:1 ratio
[3] From the model: Fecundity = -288.78 + 2.68 x length of female (Graves 1983)
[4] Estimated escapement of adults (3 year-olds) / Estimated number of eggs
NA = Data Not Available

WDFW manages the kokanee fishery in Yale Lake as a self-sustaining population that maximizes angler recreation. An average of 5,100 kokanee were harvested annually from 1978 to 1982 (Graves 1983).

In the early 1990s, Yale Lake anglers expressed concern about the small size of kokanee harvested from the lake. In 1992, WDFW responded to angler concerns by increasing kokanee harvest in the lake to 16 fish per angler per day, and extended the season to year-round. Since age 2+ and older kokanee exhibit strong density-dependent growth (Rieman and Myers 1992), it has been shown that by harvesting more kokanee, the size of harvestable fish would increase as intraspecific competition decreased. To date, this limit and extended season are still in effect.

Kokanee spawning estimates from Cougar Creek during the past several years have shown a moderate increase in female kokanee mean length, from 260 mm (1992) to 308 mm (1998) (Table 4.1-2). Spawning escapement during this period has declined substantially. Coincident with the decline in overall escapement, mean length of spawning female kokanee increased to levels that have not been exceeded since 1985 (Table 4.1-2 and Figure 4.1-1). The 1998 and previous years' spawning escapement data further support the inverse relationship between spawning escapement and mean length of female kokanee mentioned above.

To describe the existing recreational fishery in Yale Lake and to provide data to assist state fishery management, PacifiCorp initiated a comprehensive 1-year creel survey in April 1996 (PacifiCorp 1998a). The estimated harvest of kokanee in Yale Lake during the 1996-1997 season was 3,656 fish, or 76 percent of the total gamefish (salmonid) harvest (PacifiCorp 1998a). Most kokanee caught in 1996-1997 ranged between 220 and 300 mm in length.

Since both kokanee and bull trout spawn in Cougar Creek in September and October, there is concern that bull trout redds are disturbed by spawning kokanee. Several factors occur that may reduce interspecific impacts between spawning bull trout and kokanee:

- There is some degree of spatial separation as bull trout tend to spawn in the upper reaches of Cougar Creek and kokanee spawn in the lower portion of the creek.
- Kokanee deposit eggs in shallow (2-4 inch) redds, while bull trout deposit eggs in redds up to 12 inches deep (Faler and Bair 1992).
- Following hatching, kokanee fry move directly to the reservoir, whereas bull trout remain in the stream for 2 to 3 years (Faler and Bair 1992).

4.1.1.2 Bull Trout

All 3 Lewis River reservoirs support a remnant, native population of adfluvial bull trout. Adfluvial describes a species that uses a lake or reservoir rather than a river to complete its life cycle. It is believed that bull trout throughout most of Washington were at one time fluvial (i.e., requiring a river to complete their life cycle). However, many bull trout populations may have adopted an adfluvial life history as a result of dam construction in many river basins containing these species. The North Fork Lewis River population likely adopted the adfluvial life history following Merwin Dam construction in the 1930s (Faler and Bair 1992). Information describing bull trout populations in the Lewis River below Merwin Dam is limited. However, in the last 20 years, only 1 bull trout has been collected at the Lewis River Hatchery complex facility. This fish was trapped and identified in the fall of 1991 (pers. comm., Robin Nicolay, WDFW, Lewis Complex, March 1, 1999).

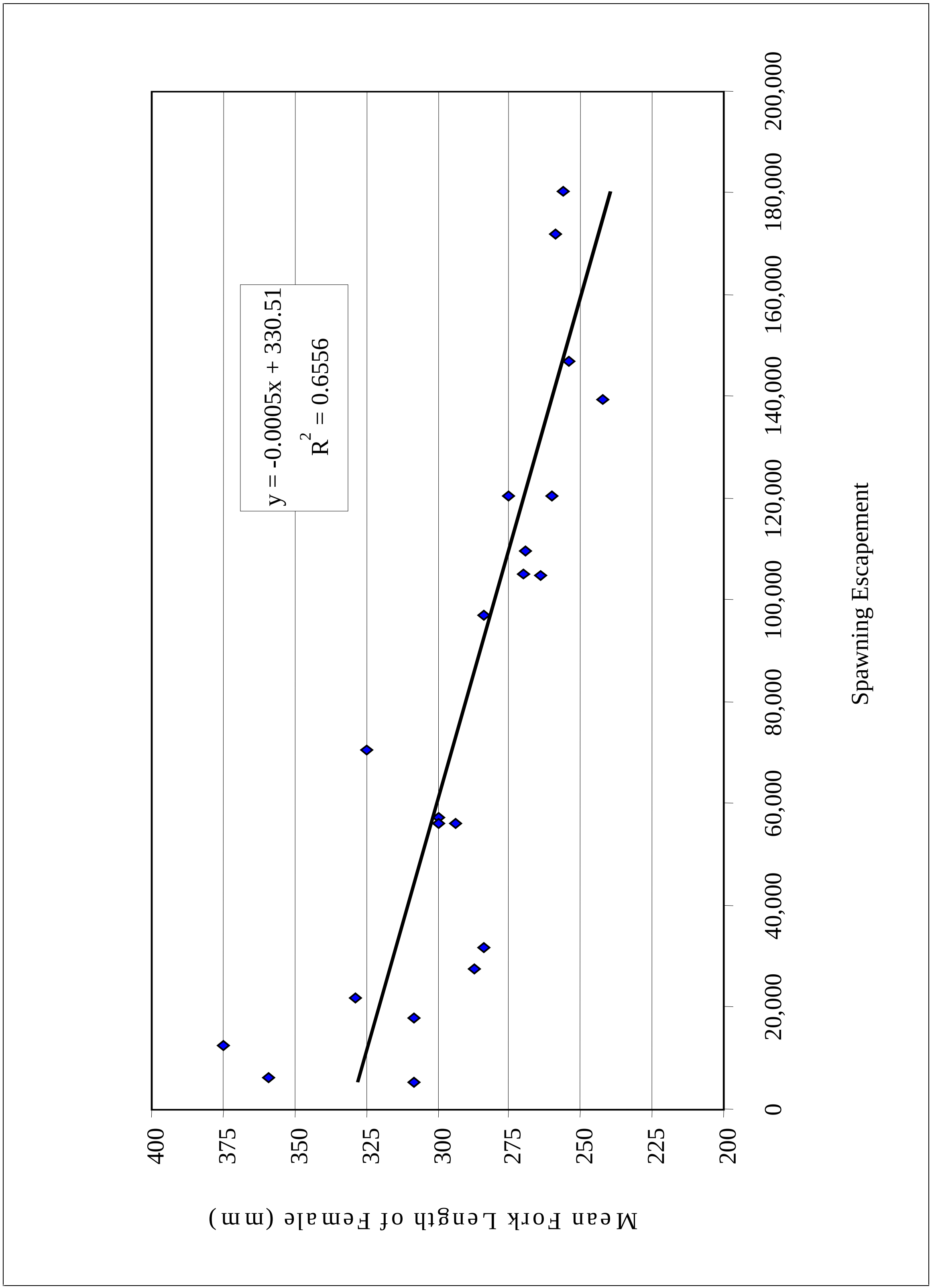

Figure 4.1-1. Relationship between mean kokanee fork length (female) and spawning escapement in Cougar Creek.

The life history of bull trout in the Lewis River upstream from Merwin Dam is similar to other populations throughout Washington and Oregon. Graves (1983) reported that most bull trout in Yale Lake spawn in Cougar Creek, a small, spring-fed stream originating from the base of Mount St. Helens. Spawning usually occurs from September through October. A similar spawning period was observed by PacifiCorp biologists in 1996 and 1997 (PacifiCorp 1998a).

According to recent PacifiCorp and USFS surveys in the Yale project area, known bull trout spawning is restricted exclusively to Cougar Creek (PacifiCorp 1998a; pers. comm., M. Faler, USFS, Gifford Pinchot National Forest, Vancouver, Washington, July 1995). The creek provides critical spawning and rearing habitat for bull trout. It is thought to be the only tributary to Yale Lake that supports spawning and juvenile rearing lifestages. Although low numbers of bull trout have been observed in the downstream end of Swift Canal between Swift No. 1 dam and Swift No. 2 powerhouse, spawning has not been documented in this area.

Based on the known habitat requirements of adult and juvenile bull trout (Goetz 1989, Rieman and McIntyre 1993), and on the results of habitat surveys conducted in 1996 and 1997 (PacifiCorp 1998a), the Swift No. 2 bypass reach is likely the only other Yale Lake tributary that could potentially support this species. A juvenile bull trout was captured in the Swift No. 2 bypass reach in September 1996 (PacifiCorp 1998a); however, based on annual snorkel surveys conducted since 1994, no spawning bull trout have ever been observed in this reach (pers. comm., E. Lesko, PacifiCorp fisheries biologist, January 1999).

Instream flows and fish habitat availability/suitability in the Swift No. 2 bypass reach will be further addressed as part of PacifiCorp's ESA consultation and basin-wide APEA process.

Cougar Creek Bull Trout Studies

PacifiCorp has consistently monitored and studied bull trout populations in Cougar Creek since 1988. During annual spawning surveys conducted between 1988 and 1997, PacifiCorp biologists observed an average of 19 bull trout (peak counts) in Cougar Creek (Table 4.1-3). Annual counts ranged from 7 (1995) to 37 (1994) fish (letter from E. Lesko, PacifiCorp to J. Weinheimer, WDFW, Vancouver, Washington, November 7, 1997).

Data collected by other researchers have shown that bull trout juveniles spend from 0 to 6 years in their natal streams (Pratt 1992, Goetz 1989). Studies conducted by WDFW in Yale and Swift reservoirs showed that juvenile bull trout were found to migrate from tributaries, including Cougar Creek, into the reservoirs at age 2+ or 3+ (Graves 1983).

Table 4.1-3 Peak bull trout spawning survey counts in Cougar Creek, 1988 through 1997.

Year	Peak Count
1988	22
1989	30
1990	17
1991	13
1992	10
1993	29
1994	37
1995	7
1996	11
1997	14
Average	**19**

While no site-specific data are available for bull trout in Yale Lake, adult adfluvial bull trout typically spend 2 to 3 years growing in the lake environment before migrating upstream to spawn (Pratt 1992, Goetz 1989, Fraley and Shepard 1988, Graves 1983). However, not all sexually mature bull trout in a population spawn annually (Pratt 1992, Fraley and Shepard 1988). Thus, spawning escapement data from Cougar Creek indicate only a percentage of the actual adult population in Yale Lake.

In fall of 1995, WDFW and PacifiCorp staff began an annual program to net adult bull trout from the Yale tailrace (located at the base of Yale Dam) and return these fish to Yale Lake. Fish captured in the tailrace are thought to have originated from Yale Lake and passed the dam, either through spill or turbine passage. Bull trout are captured using a 100-foot by 10-foot variable mesh gill net. Mesh sizes range from 0.75-inch to 2.0-inch stretch. Larger nets, in both area and mesh size, have been deployed in the past; however, they were less effective at capturing bull trout. Nets are tied to the powerhouse wall and then stretched across the tailrace area using power boats. The nets are then allowed to sink to the bottom. Depending on conditions or capture rate, the nets are either held by hand on one end, or allowed to fish unattended. The maximum time nets are allowed to fish before being pulled is less than 10 minutes. Upon capture of a bull trout, the fish is immediately freed of the net (usually by cutting) and placed in a live-well. Once biological information is gathered, the bull trout are placed in a 4-inch-diameter PVC tube partially filled with water. A rope is tied to the PVC tube, which allows hatchery crews on the catwalk to hoist the bull trout out of the tailrace area and into hatchery trucks. The entire process from capture to hatchery truck takes only a few minutes and no mortalities have been observed.

To date, a total of 46 bull trout have been captured in the tailrace, 33 of which have been released in or near the mouth of Cougar Creek in the hopes of facilitating successful spawning. All bull trout captured in gill nets were measured, floy tagged, anal fin clipped (for genetic testing in 1996-97), and inspected for tag scars and other marks. Visual inspection showed some minor abrasions and fin fraying (especially the caudal fin). However, there is no indication that these marks were caused by turbine operation (i.e., tailrace attraction). One tagged and recaptured bull trout was known to have been spilled from Yale into Merwin. This fish had abrasions and some fin fraying, but otherwise was considered healthy, as it had grown 120 mm in one year.

PacifiCorp recognizes that attraction is likely to occur at the Yale tailrace, given the substantial flow at full load (estimated velocity of 18 fps). However, given the configuration of the tailrace and turbine assembly, it is unlikely that adult bull trout or kokanee would be confined or injured in the tailrace or turbine area. When Yale is not generating, the wicket gates near the turbine runner are closed. During this time, there is a possibility that fish swim into the draft tube and into the turbine runner. Fish cannot, however, swim past the wicket gates and into the turbine spiral case. Upon start-up, the wicket gates are opened gradually. This gradual opening of the wicket gates allows water to flow into the runner assembly and begins to exert a force on the turbine runner. Given the inertia present in the runner assembly, it takes some time before the runner begins turning from the force of the water. This fact allows the turbine runner to be "flushed" with water prior to turning, which allows fish near the runner to also be flushed from the unit and into the tailrace. PacifiCorp expects that tailrace attraction will be an issue addressed as a component of ESA consultation and the Lewis River basin-wide studies.

In 1996 and 1997, PacifiCorp conducted a detailed 2-year study to enumerate the bull trout population using Cougar Creek. A vertical picket weir, designed to capture migrating adult bull trout in both upstream and downstream traps, was installed in lower Cougar Creek. During the study, all captured adult bull trout were tagged on the right side of the dorsal fin with green numerical identification tags (Floy tags) to determine the extent of repeat spawners during future stream surveys. A small piece of the anal fin was also removed from each captured bull trout for genetic analysis.

Bull trout sampling began on September 18, 1996. Higher than expected flows in September and October made sampling difficult, repeatedly breaching the sides of the weir, and allowing water to flow unimpeded around the traps. As a result, the weir was removed from the stream 27 days after installation. Only 3 fish were captured during the sampling period. All 3 bull trout were outmigrating adults. Captured fish ranged from 525 mm to 660 mm in length. One of the fish had been captured in the Yale tailrace and transported to the mouth of Cougar Creek just 20 days earlier. Due to the short sampling period, no assumptions could be made as to population size or run timing.

In 1997, sampling began on July 15, prior to the expected movement of adults into the system, and continued until October 17. A total of 14 adult bull trout were captured during 33 days of sampling at the weir. Lengths of captured bull trout ranged from 500 to 705 mm. Five of the 14 captured adult bull trout had been netted previously in the Yale tailrace and transported to the mouth of Cougar Creek. Five of the 14 bull trout were captured in the downstream trap, indicating that these fish had moved into the creek prior to July 15. Based on data collected during the PacifiCorp’s 1996-1997 study, the peak spawning period for the Yale Lake bull trout population is mid to late-September.

Adult bull trout are occasionally harvested illegally from Yale Lake. During PacifiCorp’s 1996-1997 creel survey, an adult bull trout was observed in an angler's creel. The fish was caught near Cougar Campground, at the mouth of Cougar Creek. During this same year-long survey, anglers reported catching and releasing 15 bull trout in Yale Lake.

In September 1996, during PacifiCorp's quantitative fish population survey, 2 bull trout were observed in the Swift No. 2 bypass reach. An adult bull trout was observed approximately 0.5 mile upstream from Yale Lake near the mouth of Ole Creek and a single juvenile bull trout was captured in a pool approximately 1 mile upstream from Yale Lake. Despite these observations, spawning has not been documented in this area and it is thought that this stream reach may be temperature-limited for adequate bull trout reproduction (PacifiCorp 1998a).

Bull Trout Genetics Study

Between 1996 and 1998, PacifiCorp conducted a bull trout genetics study to determine if genetic differences exist in bull trout populations collected from Swift, Yale, and Merwin reservoirs. Significant differences between sample groups would suggest that the groups are genetically isolated, or have unique adaptations specific to their environmental surroundings. Conversely, if no significant differences exist, then it is probable that genetic drift occurs or has occurred within the 3-reservoir system. This information is valuable because it provides insight into the inherent risks or effects of environmental change associated with each reservoir group.

The bull trout genetics information presented in the following paragraphs was summarized from Spruel et al. (1998) "Genetic Analysis of Lewis River Bull Trout." A copy of this final report was also provided to the agencies and interested parties in December 1998.

Three separate study areas were chosen to represent the 3 reservoir groups. Bull trout genetic samples were collected from fish captured in the upstream end of Lake Merwin (i.e., the Yale tailrace), Cougar Creek (a tributary to Yale Lake), and in the upper end of Swift Reservoir (including the mainstem North Fork Lewis River near the confluence of Rush Creek).

A total of 64 samples were collected from Swift, Yale, and Merwin reservoirs in the summer and early fall of 1996 and 1997. The goal was to collect 30 samples from each reservoir. However, capture efficiency was not as successful as anticipated in Lake Merwin and Yale Lake. In Swift Reservoir, all 30 samples were collected in 1996. In Merwin and Yale, 24 and 10 samples were collected, respectively.

Bull trout from Swift and Merwin were captured with gill nets. Passive gill net sets were used in Merwin. In Swift, both passive and active (drifting) sets were employed. A weir placed in Cougar Creek was used to capture bull trout from Yale Lake. Some seining was also conducted above the weir to capture fish migrating downstream after spawning. Passive gill net sets were allowed to fish for no more than 20 minutes (usually less).

For age estimation, the length of each fish was recorded before a tissue sample was removed from the anal or caudal fin (approximately 0.5 x 0.5 cm). The samples were preserved and labeled in vials containing 95 percent ethanol until DNA isolation for genetic analysis (Spruel et al. 1998).

Results of the genetic analysis showed that bull trout sampled from each of the 3 reservoirs on the Lewis River had similar amounts of genetic variation. However, pairwise comparisons of genotypic frequencies across all loci (Fisher 1954) indicated statistically significant differentiation between bull trout collected in Swift Reservoir and those collected in both Yale Lake ($P<0.05$) and Lake Merwin ($P<0.005$). No statistically significant differentiation was observed between bull trout in Yale and Merwin reservoirs (Spruel et al. 1998).

When compared to 60 other bull trout populations, the three populations from the Lewis River are more similar to each other than to any other populations. The three Lewis River populations fall into a larger group of genetically similar populations that we have called "coastal" but are fixed for an allele that is not found in other coastal populations (Spruel et al. 1998).

There are two possible explanations for the genetic differences between bull trout in Swift Reservoir and those in both Yale Lake and Lake Merwin. First, recent genetic drift may have resulted in different allele frequencies in these populations after they were separated by the construction of Swift Dam. Alternatively, the observed differences may reflect historical isolation between populations that had limited genetic exchange. It is impossible to differentiate these two hypotheses based strictly on allele frequencies. However, if the observed differences were strictly the result of genetic drift, we would expect the differentiation to be greatest in the smallest populations that have been isolated for the longest time. Swift Reservoir, on the other hand, probably contains at least as many individuals as the other sample sites, has levels of heterozygosity similar to the other populations, and is the most recently isolated. In addition, if drift were the primary cause of population differences, we would expect differentiation between random pairs of populations at different loci rather than between the same pairs of populations at two loci. The differentiation between Swift Reservoir bull trout and the other two sample sites at two loci is inconsistent with this expectation. The data suggest that historic differentiation may be responsible for genetic variation between Lewis River populations (Spruel et al. 1998).

Based on these data, the most conservative approach to management of bull trout in the Lewis River would be to consider the Swift Reservoir populations to be distinct from Merwin and Yale Reservoirs. However, if demographic data indicate that these populations are nearing population sizes that may lead to extinction, transfer of individuals between reservoirs within the Lewis River basin may be an appropriate action to prevent the loss of spawning population (Spruel et al. 1998).

4.1.1.3 Cutthroat Trout

Cutthroat trout are native to the Lewis River basin and are common in Yale Lake. Between 1978 and 1982, 5.5 percent of the fish harvested in Yale Lake were cutthroat trout (Graves 1983). Creeled fish during this period ranged from 152 to 520 mm in length. The estimated harvest of cutthroat trout in Yale Lake during the 1996-1997 season was 221 fish, or 4.6 percent of the total salmonid harvest (PacifiCorp 1998a). Most cutthroat trout caught in 1996-1997 ranged between 200 and 300 mm in length. The diet of the cutthroat trout population in Yale Lake consists of aquatic and terrestrial insects and, when available, kokanee eggs and fry (Graves 1983).

Cutthroat trout were the most abundant salmonid species captured during PacifiCorp's 1996-1997 fish population surveys in Yale Lake tributaries. In September 1996, the Swift No. 2 bypass reach contained an estimated 924 cutthroat trout greater than 65 mm in length (254 cutthroat trout per mile). One rainbow trout, 2 bull trout (1 adult and 1 juvenile), and 5 whitefish were the only other salmonids observed or captured in the bypass reach (PacifiCorp 1998a).

Cutthroat trout fry and adults were also captured in Ole Creek, Dog Creek, Speelyai Creek, and Panamaker Creek in 1996 and 1997 (Figure 2.1-2). No other salmonids were observed during sampling in these smaller tributaries. In 1995, the USFS observed low numbers of cutthroat trout in Cougar Creek (USFS 1995).

Like bull trout, the life history of cutthroat trout in the Yale Project study area is similar to other populations throughout Washington and Oregon. Spawning in streams within the study area most likely occurs in April and early May, with a peak around mid-April. Emergence occurs from late April to late May (Wydoski and Whitney 1979). Graves (1983) reported cutthroat spawning in tributaries in March and April at age 4.

4.1.2 Anadromous Fish Resources

4.1.2.1 Historical Background

Historically, the North Fork Lewis River upstream from Merwin Dam supported populations of spring and fall chinook salmon *(Oncorhynchus tshawytscha)*, coho salmon *(O. kisutch)*, chum salmon *(O. keta)*, and steelhead *(O. mykiss)* (WDF 1951, Chambers 1957). Following the construction of Merwin Dam in 1931 and Yale and Swift dams in 1953 and 1958, fish passage in the Lewis River was blocked at River Mile (RM) 20 (the Merwin Dam site).

When Merwin Dam was built, Pacific Power and Light (now PacifiCorp) and the Washington Department of Fisheries (WDF, now WDFW) constructed the Lewis River Hatchery and a fish collection facility at the base of Merwin Dam (Hamilton et al. 1970). For 28 years, adult anadromous fish that were collected at the base of Merwin Dam were transported upstream by truck, and either held at the Cougar Creek Hatchery substation (Lewis River Hatchery holding facility) for use as broodstock in the hatchery, or released into the upper watershed.

Fish that were released into the watershed above Merwin Dam (from 1931-1953) and then above Yale Dam (after 1953) and Swift Dam (after 1959) continued upstream to their natural spawning areas. The spillways and turbine outlets at each of these dams provided the only means of downstream passage for outmigrants (Hamilton et al. 1970, Smoker et al. undated, Chambers 1957). All Lewis River Hatchery smolts were released into the Lewis River below Merwin Dam.

With the exception of coho salmon, the early hatchery supplementation and fish transportation program was unsuccessful. During the early years of dam operation and hatchery production, spring and fall chinook trap catches decreased dramatically (Table 4.1-4). Early attempts to save the spring chinook stock through hatchery production failed, and by the mid-1950s, only fall chinook and coho salmon were trapped at Merwin Dam. Spring chinook completely disappeared from the trap catches, fall chinook run sizes declined, and only a remnant of the chum salmon run were known to spawn in the river below the Merwin facility. Unlike chinook and chum, the number of coho salmon collected at the Merwin facility was highly variable but stable throughout this 30-year period (Table 4.1-4). Historical data describing steelhead run sizes are limited; however, between 1933 and 1951, trap catches ranged from 47 to 1,629 fish (Table 4.1-4). It was thought that habitat losses and poor hatchery practices were the primary factors responsible for the early decline of the spring and fall chinook runs (Smoker et al. undated).

Table 4.1-4. The number of adult spring chinook, fall chinook, coho, and steelhead collected at the Merwin Dam fish collection facility (1933-1953).

Year	Spring Chinook	Fall Chinook	Coho	Steelhead
1933	2,046	1,031	29,264	350
1934	4,007	1,506	3,153	828
1935	2,710	1,296	1,231	1,366
1936	97	394	24,595	619
1937	151	65	8,859	47
1938	26	29	643	133
1939	850	232	19,814	311
1940	7,397	592	3,202	438
1941	259	332	7,032	214
1942	114	164	3,938	186
1943	145	287	7,375	208
1944	259	205	7,919	347
1945	540	427	4,858	267
1946	152	634	4,603	279
1947	132	627	10,664	649
1948	100	685	3,507	489
1949	19	476	5,947	86
1950	199	839	9,550	433
1951	18	1,903	2,917	1,629
1952	53	1,146	4,187	NA
1953	4	383	6,079	NA
NA = data not available				

Because of habitat losses related to the Merwin and Yale reservoirs and declining run sizes, the transportation of chinook into the upper watershed was discontinued in 1953; from that point on, all captured chinook were held to provide eggs for the Merwin Hatchery. The transportation of coho into the upper watershed continued until 1957, 2 years prior to the completion of Swift Dam. Following the construction of Swift Dam, the transportation of coho "appeared no longer tenable" (Hamilton et al. 1970). Consequently, migratory fish transport into the upper basin was discontinued.

In response to the loss of available habitat following the construction of Swift Dam, PacifiCorp and WDF conducted a series of studies to determine if it was feasible to rear coho salmon in Lake Merwin as a substitute for natural rearing (Hamilton et al. 1970). Coho fry and fingerlings reared at Speelyai Creek Hatchery were released into Lake Merwin and Speelyai Creek. During the period of outmigration, smolt collectors (including a skimmer mounted in the spillway of the dam, floating "Merwin" traps, and a floating skimmer) were installed at the outlet of the lake and in the outlet of Speelyai Creek. Capture efficiency of these traps varied from year to year, ranging from 31 to 70 percent of the "available smolts." Even with marked fish capture efficiencies as high as 70 percent, the number of migrant coho collected at the dam each year represented only a small portion of the fish released into the lake. Low survival, 0.8 to 2.8 percent in the lake and 5.7 to 19.2 percent in Speelyai Creek, was found to be the major cause of low migration numbers. Northern pikeminnow predation was believed to be the major cause of this low survival.

Of the marked coho collected in Lake Merwin and released downstream, 6.4 to 10.4 percent returned to the collection facility. However, most returned as "jacks" in the year of release. After 6 years of study (1959-1965), it was concluded that Lake Merwin could not be used "under present conditions" as a substitute for the natural environment for coho salmon (Hamilton et al. 1970). As a result, rearing of coho in Lake Merwin was abandoned in favor of hatchery production.

4.1.2.2 Existing Anadromous Fish Resources

Today, anadromous fish populations in the North Fork Lewis River are limited to the river downstream of Merwin Dam. With the exception of fall chinook, anadromous fish production in the North Fork Lewis River is hatchery based. There are 3 hatcheries on the river (Lewis River Hatchery, Speelyai Hatchery, and Merwin Hatchery). Lewis River Hatchery is located approximately 4 miles downstream from Merwin Dam, Speelyai Hatchery is located at the mouth of Speelyai Creek (Lake Merwin), and the Merwin Hatchery is located at the base of Merwin Dam.

Each hatchery produces and is managed for 1 or more anadromous fish stock(s). The Lewis River and Speelyai hatcheries produce spring chinook and Type-S (early returning southern) and Type-N (late returning northern) coho. The Lewis River Hatchery is one of the major coho producers in the Columbia River basin. The Speelyai Hatchery produces coho for both anadromous production and for the recreational fishery in Lake Merwin; it also serves as an intermediate site for rearing spring chinook destined for the North Fork Lewis River. The Merwin Hatchery produces steelhead (winter and summer-run), sea-run cutthroat trout, and rainbow trout. North Fork Lewis River steelhead are managed for both natural and hatchery stocks.

PacifiCorp provides funding for operations and maintenance (O&M) of all 3 Lewis River hatcheries. Cowlitz County PUD funds a portion of the Speelyai Hatchery O&M. The Lewis River Hatchery was built under the original Merwin license; PacifiCorp funds approximately 75 percent of the O&M for this facility. The Speelyai Hatchery was built as a mitigation facility for the Swift No. 1 and Swift No. 2 projects in 1960 and expanded in 1970 by PacifiCorp and Cowlitz County PUD, and Merwin Hatchery was built in compliance with Articles 50 and 51 of the current Merwin license (FERC No. 935, issued October 6, 1983). Funding for O&M ranges from 100 percent at the Merwin Hatchery to over 75 percent for Speelyai. Cowlitz County PUD provides the remaining funding of Speelyai O&M.

<u>Spring Chinook</u>

By the early 1900s, Columbia River salmon populations were declining from a combination of habitat loss and overfishing (WDFW 1994). Following the construction of Merwin Dam, native Lewis River spring chinook were virtually eliminated from the Lewis River basin (Table 4.1-4). In 1971, the Speelyai Hatchery began a program to re-introduce spring chinook (Carson stock) to the reach below Merwin Dam. Since then, releases have been made from the Lewis River hatchery (NPPC 1990).

Spring chinook stock sources and production levels have changed frequently since the early 1970s (NPPC 1990, WDF and WDG 1993). Broodstock for the hatcheries has originated from the Cowlitz, Kalama, Carson, Klickitat, and Willamette rivers. The stocks used currently are from the Cowlitz and Kalama rivers.

Hatchery releases of juvenile spring chinook have varied in number and size since the early 1970s. In the last 10 years, an average of 1.3 million spring chinook juveniles have been released annually. The majority of these releases have been yearlings. Prior to 1989, releases consisted of a mixture of fry, fall releases, and yearlings (Pettit 1997). Fish are generally released on-station (NPPC 1990).

Today, spring chinook are managed for hatchery production in the Lewis River, although some limited natural production does occurs in the lower river (WDFW 1994). From 1980 through 1997, the total adult spring chinook run size (including hatchery returns, natural escapement, and sport harvest) in the North Fork Lewis has ranged from 1,600 in 1996 to nearly 17,000 in 1987, with an average of approximately 6,300 fish (Table 4.1-5) (Pettit 1997, WDF and WDG 1993).

From 1980 through 1997, the natural escapement of adult fish, based on annual spawning ground counts, averaged about 1,700 fish, or approximately 15 to 20 percent of the total run size (Pettit 1997). Nearly all of the natural spawning on the Lewis River occurs in a 4-mile-long reach between Merwin Dam and the Lewis River Hatchery.

On March 24, 1999, NMFS listed chinook salmon in the lower Columbia River ESU as threatened under the Endangered Species Act (Federal Register, March 24, 1999). While considered a mixed stock, naturally spawning Lewis River spring chinook are included in this biological ESU (see Section 4.1.3).

Table 4.1-5. Escapement estimates for adult spring chinook, fall chinook, and coho salmon in the North Fork Lewis River (1980-1998).

Return Year	Spring Chinook [1]	Fall Chinook [2]	Coho [3]
1980	2,265	16,394	7,408
1981	2,964	19,297	4,669
1982	3,889	8,370	23,512
1983	3,669	13,540	17,775
1984	6,381	7,132	15,036
1985	4,116	7,491	10,770
1986	8,259	11,983	50,915
1987	16,547	12,935	12,424
1988	10,618	12,059	32,393
1989	12,019	21,199	48,355
1990	9,299	17,506	24,699
1991	8,334	9,060	92,718
1992	6,025	6,307	21,692
1993	8,194	7,025	10,432
1994	3,066	9,936	12,429
1995	3,758	11,415	2,440
1996	1,596	13,950	10,012
1997	1,905	8,670	18,514
1998	NA	6,173	17,654
Average	6,272	11,602	22,834

1. Combined hatchery escapement, natural escapement, and sport catch below Merwin Dam (Pettit 1997).
2. Naturally spawning fall chinook below Merwin Dam. No hatchery fall chinook have been planted since 1985. From Hawkins (1998), based on a peak count expansion of 5.27.
3. Both Type N and Type S coho. Numbers represent hatchery returns, no natural spawning (escapement) data are available (pers. comm., Shane Hawkins, WDFW, January 21, 1999).
NA = Data not currently available.

Fall Chinook

Lewis River wild fall chinook represent about 80 to 85 percent of the wild fall chinook returning to the lower Columbia River (NPPC 1990). This native stock of wild production has maintained a significant population with negligible hatchery influences (WDF and WDG 1993). Fall chinook are managed strictly for natural production in the Lewis River. No fall chinook have been planted since 1985.

Like the naturally spawning spring chinook, the majority of Lewis River fall chinook spawning takes place within the 4-mile reach of river between the Lewis River Hatchery and Merwin Dam, and in Cedar Creek. For the maintenance and enhancement of fall chinook in the Lewis River downstream from Merwin Dam, PacifiCorp operates the Merwin Project to provide a series of required seasonal minimum flows and ramping rates. These minimum flows and ramping rates are stipulated in Article 49 of the existing Merwin license. Because Lake Merwin is essentially a re-regulation reservoir with no annual drawdown, the volume of water discharged from Lake Merwin is similar to the volume of water discharged from Yale Lake. Consequently, the Yale and Swift projects are operated to maintain the pool elevation of Lake Merwin, while Lake Merwin is operated to maintain the required minimum flows and ramping rates in the lower river.

WDF estimated that the number of juvenile wild fall chinook migrating from the Lewis River from 1977-1979 and 1982-1987 ranged from a low of 1,540,000 in 1986 to a peak of 4,650,000 in 1983 (WDF and WDG 1993).

The total adult return to the Lewis River from 1980 through 1998 ranged from 6,200 in 1998 to 21,200 in 1989. The average escapement over this period was 11,600 fish (Table 4.1-5) (Hawkins 1998). The stock status of naturally spawning Lewis River fall chinook is considered healthy based on escapement trends (WDF and WDG 1993); however, chinook in the lower Columbia River ESU, including Lewis River fall chinook, were listed as threatened under the ESA on March 24, 1999 (Federal Register, March 24, 1999; see Section 4.1.3).

<u>Coho</u>

To meet WDFW harvest management requirements, coho salmon in the Lewis River are managed for two hatchery stocks: early run (Type S) and late run (Type N). Type S fish contribute more heavily to the southern ocean fisheries and Type N fish contribute more heavily to the northern ocean fisheries. Both Speelyai and Lewis River hatcheries rear Type N and Type S coho. Production goals are for about 1.2 million Type S yearlings and about 4.4 million Type N yearlings annually (NPPC 1990). Because of hatchery production, Lewis River coho are a mixed stock (NPPC 1990).

From 1980 to 1997, adult hatchery returns of both Type S and Type N coho have ranged from about 2,400 to 92,700, with an average of around 22,800 fish (Table 4.1-5). However, returns to the hatchery only account for a small portion of the adult coho produced in the basin since the bulk of the production (65-85 percent) is harvested in the mainstem Columbia River and Pacific Ocean (WDFW 1994). While natural spawning and sport catch estimates are unavailable for Lewis River coho, they are known to spawn in the mainstem Lewis River below Merwin Dam and in several tributaries including Ross, Cedar, Chelatchie, Johnson, and Colvin creeks (WDF and WDG 1993). Naturally spawned coho may comprise 5 to 10 percent of the total basin production of coho (WDFW 1994).

In response to 3 petitions seeking protection for coho salmon under the ESA, in October 1993 NMFS initiated a status review of coho in Washington, Oregon, and California. On July 25, 1995, NMFS determined that a coho listing was not warranted for the lower Columbia River/southwest Washington ESU. However, the ESU is designated as a candidate for listing, due to concern over specific risk factors (http://www.nwr.noaa.gov/1salmon/salmesa/cohoswwa.htm).

Chum

Historically, chum salmon were common in the Lewis River basin; for a 10-year period following the construction of Merwin Dam (1930-1940), the Lewis River Hatchery supplemented the wild run (WDF 1951). In 1951, WDF estimated the chum escapement to be about 3,000 fish. The run has since declined, and currently only a remnant population exists in the lower river. Hatchery supplementation has not occurred since 1940. Hatchery practices and habitat loss are believed to contribute to the decline of this stock (NPPC 1990).

On March 25, 1999, the NMFS listed chum salmon in the Columbia River ESU, including Lewis River chum, as threatened under the ESA (Federal Register: March 25, 1999) (see Section 4.1.3). NMFS will issue any protective regulations deemed necessary under Section 4(d) of the ESA for the listed ESUs in a separate rulemaking.

Steelhead

Summer and winter steelhead are indigenous to the Lewis River; historically, large numbers of winter steelhead were known to spawn and rear in the North Fork above RM 20. Few summer steelhead spawned in the North Fork (WDFW 1994, NPPC 1990).

Today, North Fork winter steelhead are thought to be native, but it is likely that some interbreeding has occurred with progeny from Elochoman, Chambers Creek, Cowlitz, and Skamania stocks that have been planted in the basin.

As mitigation for dam-related habitat loss in the upper basin, the Lewis River hatcheries began planting winter steelhead smolts in 1954 and summer steelhead smolts in 1968. Hatchery supplementation has continued to date; Lewis River steelhead are currently managed for both hatchery and wild production. The WDFW management goal is to maximize harvest of hatchery returns while optimizing natural production. Annual hatchery production goals are 125,000 summer steelhead smolts and 125,000 winter steelhead smolts (WDFW 1994).

Currently, there is very little wild steelhead production in the North Fork below Merwin Dam; wild steelhead returns account for approximately 7 percent of the total North Fork run size (WDFW 1994). Due to the low return of wild summer steelhead in the North Fork, no escapement goal has been established. The escapement goal for wild winter steelhead on the North Fork is 698 fish; however, total escapement estimates are unavailable (WDFW 1994).

From 1979-80 through 1994-95, angler catch of summer steelhead in the mainstem and North Fork Lewis River has averaged 2,932 fish. Catch of winter steelhead during this same period has averaged 1,508 fish (Table 4.1-6) (WDG and WDFW 1979-1995). Prior to 1994, all steelhead captured at the Lewis River Hatchery were returned to the river for angler harvest. Therefore, hatchery returns are not an accurate indicator of total production.

Table 4.1-6. Angler catch of summer run and winter run steelhead in the mainstem Lewis River and North Fork Lewis River (1979-80 through 1994-95).

Year[1]	Angler Catch				Total	
	Mainstem Lewis River		N. F. Lewis River			
	Summer Run	Winter Run	Summer Run	Winter Run	Summer Run	Winter Run
1979 – 1980	416	541	700	450	1,116	991
1980 – 1981	NA	NA	NA	NA	NA	NA
1981 – 1982	425	757	2,187	574	2,612	1,331
1982 – 1983	265	602	3,254	863	3,519	1,465
1983 – 1984	217	563	1,580	1,546	1,797	2,109
1984 – 1985	352	506	2,498	1,953	2,850	2,459
1985 – 1986	751	310	2,764	1,294	3,515	1,604
1986 – 1987	516	302	6,100	1,931	6,616	2,233
1987 – 1988	443	244	4,807	1,247	5,250	1,491
1988 – 1989	407	218	1,649	1,444	2,056	1,662
1989 – 1990	311	233	1,867	1,588	2,178	1,821
1990 – 1991	338	187	1,576	1,126	1,914	1,313
1991 – 1992	283	138	2,089	1,396	2,372	1,534
1992 – 1993	NA	NA	NA	NA	NA	NA
1993 – 1994	323	67	2,640	359	2,963	426
1994 – 1995	218	123	2,078	546	2,296	669
Average	376	342	2,556	1,166	2,932	1,508

1. May through April.
NA Data not available.

Steelhead in the lower Columbia River ESU, which includes naturally spawned populations and their progeny in the North Fork Lewis River below Merwin Dam, were listed as threatened by NMFS on March 19, 1998 (Federal Register, March 19, 1998). See Section 4.1.3.

4.1.2.3 Historical Upper Basin Anadromous Fish Habitat

Construction of the 3 Lewis River dams blocked anadromous fish passage into the upper watershed and inundated historical mainstem and tributary spawning and rearing habitat. The amount of anadromous habitat lost as a result of these projects has not been well documented. However, in 1956, WDF (Chambers 1957) attempted to quantify the amount of available "suitable spawning and rearing habitat" in the Lewis River watershed above Yale Dam.

This study found that accessible anadromous salmonid spawning and rearing habitat could be found in the mainstem Lewis River from the Yale Dam site to an "impassable falls above Chickoon Creek" (Lower Lewis River Falls), and in several upper basin tributaries including: Cougar Creek, Drift Creek, Range Creek, Muddy River, Clear Creek, Clearwater Creek, and Smith Creek (Table 4.1-7) (Chambers 1957). A map of known anadromous fish barrier locations in the upper basin was also developed as part of this study and is included in Appendix 4.1-1. To avoid making assumptions in the summarization of this WDF information, direct quotes describing the habitat condition in each stream reach are presented in Table 4.1-7. Speelyai Creek, which was not included in the 1956 survey area, also contained accessible anadromous fish habitat prior to the construction of Merwin Dam.

Another description of historical anadromous fish spawning locations in the upper Lewis River was included in a report developed in the 1950s by the WDF and WDG (Smoker et al. undated). Using data from WDF files and hatchery records, the WDF and WDG compiled information on the historical spawning locations of spring chinook, fall chinook, and "silver" salmon, chum salmon, and steelhead (Table 4.1-8).

Table 4.1-7. A summary of the major findings from the WDF document entitled "Report on the 1956 Survey of the North Fork Lewis River Above Yale Dam."

Stream Name	Major WDF Findings
Lewis River	"Between Bolt Camp (near Rush Creek) and Swift Creek there are approximately one million square feet that are considered suitable for chinook spawning. Limited silver salmon spawning areas are in the side channels and smaller tributaries, as well as in the lower stretch of Range Creek." "Swift Dam will flood all of the spawning areas in the upper Lewis River and those in Range Creek."
Cougar Creek	"contains silver spawning areas throughout its length."
Drift Creek	"provides some individual spawning areas in the lower stretch."
Range Creek	"has silver spawning areas throughout the lower mile which was examined."
Other Lewis River Tributaries	"From the preliminary survey it was found that falls impassable to fish are on the main Lewis River above Chickoon Creek, on Big Creek approximately 100 yards upstream from the confluence with the Lewis, on Curly Creek at the mouth, and on Swift Creek approximately two miles upstream. Rush, Pepper, Pine, Camp, and Drift Creeks are too precipitous and rocky to provide extensive areas suitable for spawning of salmon."
Muddy River	"Muddy River provides an additional approximately half a million square feet of chinook spawning area. There are some silver salmon spawning beds in the main stem Muddy, the side channels, and smaller tributaries."
Clear Creek	Clear Creek is "a major silver salmon spawning area." "This creek resembles Clearwater in possessing excellent conditions for silver salmon."
Clearwater Creek	Clearwater Creek is "a major silver salmon spawning area." "This is an excellent silver salmon spawning stream for the first three and one-half miles."
Smith Creek	Smith Creek is "a major silver salmon spawning area." "The spawning area in Smith Creek begins approximately one mile above the confluence with Muddy River and extends for about three miles upstream."
Source: Chambers 1957.	

Table 4.1-8. The historical spawning locations of fall chinook, coho, chum, and steelhead in the Lewis River prior to the construction of Merwin Dam.

Species	Spawning Location
Spring Chinook	"Lewis River headwater above the dam site."
Fall Chinook	"in the present (Merwin) reservoir area."
Coho	"in the present (Merwin) reservoir area."
Chum	"in the present (Merwin) reservoir area."
Steelhead	NA
Adapted from Smoker et al. undated.	

The WDF and WDG report (Smoker et al. undated) also included rough escapement estimates for each species; however, these estimates were based on relatively poor data including "early trap counts," "poor records," or in some cases "only one brood year." Consequently, these estimates are not thought to represent pre-project populations. Abundance and run timing data became much more reliable following the construction of the Merwin Dam fish collection facility.

PacifiCorp realizes that anadromous fish reintroduction will play a pivotal role in the relicensing of the Lewis River hydroelectric projects, and therefore intends to address this issue as a component of both ESA consultation and the basin-wide APEA process.

4.1.3 Threatened or Endangered Species

TES and aquatic species of concern in the Lewis River basin include bull trout, steelhead, chum salmon, fall chinook, and Columbia duskysnail, as discussed below.

On June 10, 1998, USFWS listed the Columbia River distinct population segment (DPS) of bull trout as threatened under the Endangered Species Act of 1973, as amended (ESA) (Federal Register: June 10, 1998). A "threatened species" is one which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The bull trout subpopulation located within the Yale Project area (Section 4.1.1.2) is included in the Columbia River DPS. According to the USFWS, designation of critical habitat cannot be determined at this time. Therefore, protection of bull trout habitat will be addressed through the recovery process and through the ESA consultation process to determine whether actions are likely to jeopardize the continued existence of the species (Federal Register, June 10, 1998).

On March 19, 1998, NMFS listed steelhead in the lower Columbia River ESU, which includes naturally spawned populations of steelhead (and their progeny) in the North Fork Lewis River, as threatened under the ESA (Federal Register, March 19, 1998). Proposed freshwater critical habitat for this steelhead ESU includes all waterways and substrates below longstanding, naturally impassable barriers and "several dams" that block access to former anadromous habitats. As of February 1999, proposed critical habitat is limited to the North Fork Lewis River below Merwin Dam (Federal Register, February 5, 1999).

On March 24, 1999, NMFS listed chinook salmon in the lower Columbia River ESU as threatened under the ESA. Like steelhead, this rule applies to all naturally spawned populations of spring and fall chinook salmon in the North Fork Lewis River below Merwin Dam. Given unresolved issues, NMFS determined at the time of the final listing that a critical habitat designation could not be determined. A final designation of critical habitat in this ESU is expected in March 2000.

On March 25, 1999, NMFS listed chum salmon in the Columbia River ESU, including naturally spawned Lewis River chum salmon, as threatened under the ESA (Federal Register, March 25, 1999). NMFS determined at the time of the final listing that a critical habitat designation could not be determined. As is the case for chinook, protective regulations deemed necessary under Section 4 (d) of the ESA will be issued in a separate rulemaking.

Columbia River bull trout and lower Columbia River steelhead, chinook, and chum salmon are listed as a “State Candidate Species” by the WDFW.

PacifiCorp is proposing to begin ESA consultation with the USFWS and NMFS. The intent is to address all the issues of concern with a multi-species approach. That is, bull trout and steelhead will be addressed concurrently as will any potential candidate fish species. With the assessment of the biology of each species and the resulting biological opinion or habitat conservation plan, measures will be developed to mitigate for any potential take by the 4 Lewis River projects, including Yale.

PacifiCorp held a process meeting with the USFWS on February 18, 1999. The purpose of this first meeting was to discuss which approach should be taken for consultation (Section 7 or 10), who will be the participants, and the time frame. PacifiCorp will be preparing a draft assessment of biological conditions for agency review by summer 1999. All participants in the Yale relicensing and the Lewis River basin APEA process will be kept informed of the ESA consultation progress.

A Columbia duskysnail, a member of the *Lyogyrus* genera (species unknown), was collected during a macroinvertebrate study in Cougar Creek in October 1997. The snail may be considered a species of concern (pers. comm., Dr. T. Frost, Deixus Consulting, Seattle, Washington, March 2, 1998). However, due to limited research efforts, there is currently an insufficient amount of data available to fully describe the abundance, ecology, and distribution of the *Lyogyrus* sp. This lack of data would most likely preclude any listing by state or federal agencies in the near future.

4.1.4 Aquatic Habitat

As part of relicensing studies, PacifiCorp completed aquatic habitat surveys in the Swift No. 2 bypass reach, Panamaker Creek, Ole Creek, Rain Creek, Dog Creek, and Speelyai Creek. The upper portion of Cougar Creek, immediately upstream of the point at which it emerges from its subterranean section, was also surveyed (Figure 2.1-2). The primary objective of these surveys was to describe the quality, quantity, and overall condition of aquatic habitat in these streams. Stream habitat in lower Cougar Creek and in Siouxon

Creek has been thoroughly described by USFS (1995) and Conklin (1992); therefore, these streams were not included in PacifiCorp's surveys.

A detailed quantitative habitat survey was completed in the Swift No. 2 bypass reach upstream from Yale Lake to collect baseline data needed for the development of possible enhancement measures. Less comprehensive assessments were completed in the lower reaches of the tributaries.

The following sections summarize habitat survey data collected by PacifiCorp. More detailed information on the survey methods, specific habitat characteristics, as well as maps and photographs, is provided in PacifiCorp (1998a).

4.1.4.1 North Fork Lewis River (Swift No. 2 Bypass Reach)

PacifiCorp's quantitative habitat survey in the Swift No. 2 bypass reach was completed in early September 1996, during low flow conditions. Currently, the 2.7-mile-long bypass reach has no minimum instream flow requirement. Except during spill events, all water leaving Swift Reservoir flows directly from the Swift No. 1 powerhouse into the Swift No. 2 power canal. The canal parallels the bypass reach for its entire length before entering the Swift No. 2 powerhouse, located at the upper end of Yale Lake. As a result of accretion from canal seepage and Ole Creek, water flows continually throughout most of the river channel. During PacifiCorp's habitat survey, surface flow at the downstream end of the bypass reach was estimated to be approximately 10 cfs. Flow decreased with distance upstream and eventually became intermittent near the base of Swift Dam.

The Swift No. 2 bypass reach contained 61 distinct habitat units, including 3 side channels and 2 dry channel segments (Table 4.1-9). Stream habitat was dominated by low-gradient riffles and glides, each of which comprised approximately one third of the total wetted habitat area. Seven relatively large pools comprised approximately one-fifth of the wetted habitat area, while 3 long side channels totaling 1.1 miles in length comprised 16 percent of the total wetted habitat area. Cascades comprised only 2 percent of the habitat.

Table 4.1-9. Pool:riffle:glide:cascade:side channel ratios based on surface areas for the Swift bypass reach.

Habitat Type	Total Area (acres)	Ratio (percent)
Pool	3.5	18
Riffle	6.6	34
Glide	5.6	29
Cascade	0.5	2
Side channel	3.0	16
Total	19.2	100

Percent pool area in the reach was below ideal target conditions (approximately 50 percent) for streams with comparable gradient (Peterson et al. 1992). However, the 7 relatively large, deep pools in the reach did appear to provide excellent cover and thermal refuge for fish. Riffles and glides appeared to provide substantial habitat for macroinvertebrate production as well as some salmonid spawning habitat. The 3 large side channels, which contained several beaver pond complexes, provide good off-channel rearing and refuge habitat for juvenile salmonids during some spill events.

The only total barrier to upstream or downstream migration of fish in the bypass reach was a 198-foot-long dry channel segment approximately 300 feet downstream from Swift Dam (PacifiCorp 1998a). This segment separated a large 150-foot-long pool at the upstream end of the reach from the rest of the wetted channel. There were no waterfalls or steps in the bypass reach.

Large woody debris (LWD) is limited in the bypass reach. Only 18 pieces of small brush (greater than 6 inches in diameter and greater than 20 feet in length) and 1 piece of large brush (greater than 12 inches in diameter and greater than 25 feet in length) were identified. Most of the small brush was recently toppled alder. Larger, more stable pieces of LWD were not encountered, and future recruitment of LWD into the bypass reach appears to be limited due to a lack of large trees in the riparian zone.

The bypass reach also contained a limited amount of cover (6 to 20 percent of the wetted habitat area) for salmonids. Effective cover is used by fish for various activities including predation avoidance, feeding, hiding, and avoiding adverse conditions. During the stream habitat survey, 6 types of cover for salmonids were rated in each habitat unit encountered: undercut banks, substrate, depth, overhanging vegetation, woody material, and turbulence. Nearly all of the instream cover in the bypass reach was provided by small boulders and water greater than 3 feet deep. Woody material was limited in the reach. Undercut banks, overhanging vegetation, and turbulence provided little to no cover in the reach.

Streambed substrate in the bypass reach was dominated by small boulders (10 to 40 inch) and cobble (2.5 to 10 inch). Large boulders (>40 inches) were also abundant. Some high-quality spawning gravel was present in the reach, of which most was downstream of the Ole Creek confluence. The percentage of streambed embeddedness was estimated at less than 35 percent for all habitat units in the bypass reach.

4.1.4.2 Tributaries to Yale Lake and the Swift No. 2 Bypass Reach

To provide additional information on the habitat affected by the project, PacifiCorp targeted several tributaries to Yale Lake and the Swift No. 2 bypass reach for qualitative habitat surveys. These surveys were designed to assess fish habitat quality parameters including flow, depth, substrate composition, cover, channel complexity, and migration barriers. Panamaker, Ole, Rain, Dog, and the upper portion of Cougar creeks were surveyed in early September 1996 during the low flow period (Figure 2.1-2). Speelyai Creek was surveyed in late August 1997.

Surveys in Panamaker, Rain, and Dog creeks started at the mouth of each stream and continued upstream for 0.5 mile. The survey in Ole Creek started at the mouth and continued upstream for a length of 1 mile. In Cougar Creek, the survey began at its subterranean section and continued upstream to a point where the channel became undefined (approximately 0.5 mile). Two reaches totaling 3.3 miles of fish habitat were surveyed in Speelyai Creek. One reach was located downstream from the Speelyai canal diversion; the other reach extended upstream from this point (Figure 2.1-2). The survey in Speelyai Creek was designed to determine the differences in fish habitat both upstream and downstream from the diversion.

Results of these habitat surveys are summarized in Table 4.1-10. More detailed descriptions of aquatic habitat in these streams are presented in PacifiCorp (1998a).

Table 4.1-10. Aquatic habitat characteristics in tributaries to Yale Lake and the Swift No. 2 bypass reach during low flow conditions.

Stream Name	Estimated Discharge	Average Gradient (%)	Bankfull Width (ft)	Migration Barriers	Habitat Description
Panamaker Creek	Intermittent to 0.5 cfs	3 - 10	40 - 60	Yes (RM 0.3)	Cobble and bedrock dominated pools, riffles, cascades, and falls (migration barriers). Gravel and cobble riffles in the lower portion of the reach.
Ole Creek	1 cfs	1 - 6	20	Yes (RM 0.8)	Cobble dominated pocket pools, riffles, and cascades/falls (migration barriers). Gravel and sand dominated disjunct pools in the lower portion of the reach.
Rain Creek	0 cfs (dry)	2 - 4	10	No	Cobble and gravel dominated clearly defined dry channel. No migration barriers when flow is present.
Dog Creek	intermittent to 0.25 cfs	3 - 5	30 - 50	Yes (RM 0.2)	Cobble dominated riffles and pools. One migration barrier at Lewis River Road.
Cougar Creek	0 cfs (dry)	20	10	Yes (RM 1.7)	Bedrock and boulder dominated dry channel. No fish habitat available during summer low flow.
Speelyai Creek	Intermittent to 30 cfs	1 - 4	40	Yes (RM 0.1)	Cobble dominated riffles, gravel and sand dominated glides and occasional pools. Flow is intermittent for 0.25 miles below the diversion; downstream from this point flow increases from 15 to 30 cfs.

4.1.5 Benthic Macroinvertebrates

At the request of fishery resource agencies, PacifiCorp assessed benthic macroinvertebrate communities in the Yale project vicinity. The health and diversity (biotic integrity) of macroinvertebrate populations were evaluated as an indirect measure of water quality and aquatic habitat condition.

Benthic macroinvertebrate samples were collected, processed, and analyzed using the ABA Rapid Bioassessment Methodology (Wisseman 1996). The methodology is designed to detect impacts and trends of biotic/habitat integrity in watersheds where monitoring objectives seek to document cumulative impacts from land management activities.

Benthic macroinvertebrate samples were collected at 3 riffle sites in the project vicinity on October 20, 1996. These sites were located at Cougar Creek, the Swift No. 2 bypass reach, and Siouxon Creek (PacifiCorp 1998a). The Siouxon Creek site was sampled at the farthest upstream point that could be accessed by boat but still within the inundation zone of Yale Lake. Samples were collected in a riffle area, but the site was still within the zone of influence of Yale Lake. All macroinvertebrate samples were processed in the ABA lab. Genus was utilized for most insects, although some of the better known and more distinct taxa were identified to species.

Each macroinvertebrate sample was rated using a total of 50 metrics (PacifiCorp 1998a). Each metric (e.g., total taxa richness) received a score based on the value calculated for the site. Higher individual metric scores indicated more positive or healthy conditions.

It is important to note that the ABA bioassessment evaluates a benthic invertebrate community based on what is considered to be "ideal" (as do most other bioassessments). The "ideal" community that the ABA bioassessment is based on is a mid-order mountain stream with the following characteristics:

- A dense riparian overstory providing heavy shading to the channel;
- A moderate to high gradient;
- Cobble and boulder substrates dominant (i.e., high roughness);
- A strong, perennial flow of cool or cold water;
- A relatively narrow and deep channel with high habitat complexity;
- A moderate to high amount of bole wood present to increase habitat complexity and aid retention of coarse particulate matter;
- High diatom production to support scrapers, and low filamentous algae production;
- High inputs of deciduous leaves and conifer needles;

- Low inputs of fine sediment;
- Limited scouring and resorting of substrates, but with an intermediate level of disturbance to increase habitat complexity;
- A hyporheic zone open to invertebrate colonization; and
- A high amount of "crevice space" around and under surface rocks.

Only a limited number of streams in old-growth forests in western North America possess the entire suite of ideal habitat/water quality conditions. Most forested watersheds display more limited or impaired habitat conditions even in the absence of human management activities. Sites that are more open, lower gradient, more riverine, or in larger streams will score lower.

Potential total scores for least impacted streams vary from region to region, and within a region. For example, western Cascade streams may tend to score higher than streams in interior mountain ranges.

The scoring used in the ABA bioassessment protocol is intended to grade most benthic aquatic communities lower than a theoretical "ideal." This increases sensitivity and allows a fuller range of final values to be obtained. General impairment categories have been assigned as follows:

- 80 to 100 percent - High habitat complexity, biotic integrity, taxa richness, percent of cold water adapted fauna, number of more specific microhabitat related taxa, etc.
- 60 to 79 percent - Moderate habitat complexity, biotic integrity, taxa richness, percent of cold water adapted fauna, number of more specific microhabitat related taxa. The scores point to some habitat limitations.
- 40 to 59 percent - Low habitat complexity, biotic integrity, taxa richness, percent of cold water adapted fauna, number of more specific microhabitat related taxa. The community reflects significant habitat and/or water quality limitations compared to the "ideal" headwater stream.
- Less than 40 percent - Severely impaired; the community has developed under habitat conditions that represent a severe departure from the ideal headwater conditions.

Table 4.1-11 presents a summary of the scores and analysis for each of the macroinvertebrate samples collected in the study area. Detailed information on individual scores, metric values, and total abundance is available in PacifiCorp (1998a).

Total bioassessment scores for macroinvertebrate samples ranged from 39 to 80 percent of maximum (Table 4.1-11). Samples collected at the Swift No. 2 bypass and Siouxon Creek had low habitat complexity and the scores reflect significant aquatic habitat and/or water quality limitations. Results from the Siouxon Creek sample reflect the effects of periodic inundation and de-watering by Yale Lake. The sample collected at Cougar Creek scored within the high habitat complexity category.

Table 4.1-11. Cumulative scores for Yale macroinvertebrate sample sites.

Site Number	Location	ABA Score	Percent of Max.
1	Cougar Creek	99	80
2	Swift No. 2 Bypass Reach	58	47
3	Siouxon Creek*	48	39

* Samples obtained from inundation zone of Yale Lake.

4.1.6 Factors Affecting Aquatic Resources

This section describes factors that may affect aquatic resources in the study area. The factors discussed in this section are Yale Project related (e.g., entrainment of fish into the Yale intake), and can directly affect fish resources and fish habitat in several ways. These factors include:

- Fish entrainment into the project intake and spillway;
- Blockage of upstream fish migration by Yale Dam;
- Aquatic habitat connectivity and instream flow in Speelyai Creek downstream from the diversion; and
- Harvest of fish by anglers.

PacifiCorp acknowledges the fact that numerous other hydroelectric project related and non-hydroelectric project related factors may affect aquatic resources within the Lewis River basin outside of the Yale Project study area. These factors will be thoroughly assessed as part of PacifiCorp's ESA consultation and basin-wide APEA process (Section 1.1).

4.1.6.1 Fish Entrainment into Project Intake and Spillway

The Yale Project intake structure and spillway are not equipped with fish screens. Consequently, these features have the potential to pass resident fish downstream into Lake Merwin during periods of generation and/or spill. Fish that pass through the turbines or over the spillway may survive and live in Lake Merwin, or may be killed or injured.

As part of relicensing studies, PacifiCorp conducted a split beam hydroacoustic evaluation to estimate the number of fish entrained into both the project's intake structure and spillway. Mean hourly fish entrainment into the intake structure during this study's 11-week sampling period (from January 20 to April 4, 1997) was 28.5 fish per hour (a total of 52,594 fish) (PacifiCorp 1998a).

Mean hourly fish entrainment over spillway gate number 3 during a single 24-hour forced spill event was 28.2 fish per hour (a total of 676 fish) compared to 32.8 fish per hour (786 fish) at the turbines. On a fish per thousand cubic feet per second (kcfs) volume basis, the spillway and turbines passed 9.2 fish/kcfs and 4.1 fish/kcfs, respectively. These data indicate that the spillway entrained fish at a rate more than double that of the turbine units. Increased juvenile passage through the spillway is probably a result of the relatively shallow depth of the spillway opening (30 feet) in comparison to the turbine intake (80 feet). Hydroacoustic data collected at the turbines, spillway, and reservoir all showed that the majority of the detected fish were located in the upper 30 feet of the water column.

Fish target strength data indicate that the mean weekly fish length of entrained fish ranged from 7 to 16 cm. For the entire 11-week study period, mean fish length was approximately 13 cm. Because hydroacoustics are unable to determine species composition, it was assumed that the majority of the fish entrained were kokanee—the most abundant species present in the reservoir. Given that the estimated size range of the entrained fish was 7 to 16 cm, it is unlikely that those fish being entrained during the observation period are bull trout. Bull trout juveniles typically migrate out of their natal stream between age 2+ and 3+ at a size of about 12 to 16 cm; however, the outmigration typically occurs in May to the middle of July (Shepard et al. 1984; Ratliff et al. 1996; Pratt 1992). Ratliff et al. (1996) observed adfluvial bull trout increasing fork length by as much as 167 mm per year once reaching the reservoir rearing stage. Since the entrainment study occurred from January to April, it is very likely that any bull trout entrained would have been in the reservoir for 6 to 11 months and would be around 20 to 30 cm in length at the time of the study. Age 2+ and 3+ bull trout collected in tributaries and creek inlets to Yale Lake in 1979 and 1980 ranged from 30 to 40 cm in length (Graves 1983).

The survival of juvenile fish passing through project spillways and turbines is not well documented. The only known survival study conducted at the project was performed in 1954 by the WDF (Shoenaman et al. 1954). In this study, the authors attempted to quantify the survival rate of juvenile fish through the Yale spillway. However, because of difficulties encountered in study design and implementation, the accuracy of the resulting survival estimate (46 percent) was deemed questionable by the authors. Thus, with no project-specific data available, survival rates must be inferred from data collected at other hydroelectric projects with similar facilities. Data presented in EPRI (1987) indicate that juvenile salmonid mortality resulting from passage through Francis turbine units with similar revolutions per minute (rpm) and head ranges between 9 and 39 percent. Fish survival from passage through spillway tainter gates has been estimated to be more than 98 percent for lower Snake River mainstem projects (Iwamoto et al. 1994). Because of the long chute and somewhat unique tailwater conditions present at the Yale spillway, lower survival rates are possible.

4.1.6.2 Blockage of Upstream Fish Migration by Yale Dam

As described above, fish residing in Yale Lake are transported downstream into Lake Merwin via spill and/or entrainment into the project intake. Once these fish enter Lake Merwin, upstream passage is blocked by Yale Dam and they are unable to re-enter Yale Lake. The net downstream movement of fish has the potential to affect the genetic viability of fishery resources within the Yale Project study area.

In 1995, PacifiCorp staff and WDFW began an annual program to net adult bull trout from the Yale tailrace and return these fish to Yale Lake, where it is thought they originated. To date, this program has met with some success, as several of these fish have been observed in the preferred spawning areas of Cougar Creek and 1 fish was observed spawning (PacifiCorp 1998a).

4.1.6.3 Aquatic Habitat Connectivity and Instream Flow in Speelyai Creek

Speelyai Creek is a small third order tributary to the North Fork Lewis River that flows southeast from its headwaters to join Lake Merwin at RM 29 (Figure 2.1-2). In the late 1950s, a diversion was constructed in Speelyai Creek to divert warm surface flows into Yale Lake and away from WDFW's Speelyai Creek Hatchery intake. This diversion, which is located approximately 4 miles upstream from the confluence of Speelyai Creek with Lake Merwin, diverts all water from the stream channel directly into Yale Lake via a 0.7 mile-long canal. As a result, the hatchery is able to draw upon cooler groundwater inflow that remains in the creek.

During PacifiCorp's Speelyai Creek habitat survey in September 1997, little or no flow was observed in a 0.25 mile long segment of channel downstream of the diversion (PacifiCorp 1998a). Downstream of this point, flow gradually increased in the channel to approximately 30 cfs near the mouth of the stream. This increasing flow resulted from numerous springs located throughout the reach. Overall, approximately 90 percent of the creek downstream from the diversion contained excellent salmonid habitat.

The relatively short, intermittent section of Speelyai Creek below the diversion reduces the amount of wetted habitat available to aquatic organisms and acts as both an upstream and downstream migration barrier. However, as designed, the diversion also serves to cool and stabilize water temperatures in the lower portion of the stream (Section 3.1). Cutthroat trout, being headwater specialists, may prefer the cooler temperatures. Temperatures recorded near the mouth of Speelyai Creek ranged from 7.8°C to 12.1°C. The maintenance of these lower temperatures is important for the operation of the Speelyai Creek Hatchery and native cutthroat trout that reside in the creek. WDFW and PacifiCorp each have a 15 cfs water right at the point of diversion. Historically, WDFW has neglected to use any of this water. Consultation regarding this issue is currently ongoing and will be addressed as part of PacifiCorp's watershed studies.

4.1.6.4 Harvest of Fish by Anglers

Yale Lake supports a very popular recreational salmonid fishery. During PacifiCorp's 1-year long 1996-1997 creel survey, an estimated 19,000 angler hours were expended to harvest approximately 4,800 gamefish (kokanee, cutthroat trout, and rainbow trout). The estimated total yield of salmonids over the 1-year period was approximately 3,200 pounds. This annual harvest is equal to approximately 36 percent of the estimated number of fish (includes fish species other than salmonids) in Yale Lake greater than 6 inches (15 cm) in length (PacifiCorp 1998a). The harvest of this many adult salmonids from Yale Lake may have a substantial effect on fish populations within the study area.

4.1.7 Existing Resource Management Plans

The land and aquatic resources within the North Fork Lewis River basin are managed by federal, state, and county agencies. A brief overview of the agencies and selected management plans that influence any proposed project changes or habitat measures considered by PacifiCorp is presented below. Additional information is presented in Section 8.1.3.

4.1.7.1 Federal Management

Federal management of fishery resources in the basin is the responsibility of the USFS-Gifford Pinchot National Forest, USFWS, and the NMFS.

United States Forest Service

Management responsibility of federal land within the project vicinity rests primarily with the Gifford Pinchot National Forest (GPNF). The Mount St. Helens National Volcanic Monument, adjacent to the project, is covered by the Land and Resource Management Plan for the Forest (USFS 1990). The Monument is analogous to a forest district and employs 2 fishery biologists responsible for managing fish resources. All federally owned forest land is managed under guidelines contained in the Northwest Forest Plan (USFS and BLM 1994). Standards and guidelines developed in this plan include an Aquatic Conservation Strategy (ACS) to maintain and restore the ecological health of watersheds and aquatic ecosystems contained within them.

The ACS provides protection for salmon and steelhead habitat within the range of anadromous fish by limiting land use in areas with unstable soils or landforms, protecting riparian areas, and limiting activities that would cause erosion along stream and river banks. The ACS also supports forest harvest practices that would ensure a natural supply of coarse woody debris to streams and provide shade and microhabitat protection to riparian areas.

U.S. Fish and Wildlife Service

The USFWS is the primary federal agency responsible for the conservation, protection, and enhancement of migratory birds, endangered species, certain marine mammals, and resident fish. To protect and enhance fish and wildlife habitat, the USFWS reviews land management plans and permit applications for activities such as timber harvest, stream alteration, and hydroelectric projects. The agency's primary emphasis in the North Fork Lewis River drainage has been limited to review of timber management plans and the protection of federally listed threatened, endangered, or sensitive species.

National Marine Fisheries Service

NMFS has the primary responsibility for anadromous salmonid species listed under the ESA. NMFS also evaluates the possible effects that proposed development actions may have on fisheries resources in the project vicinity. In addition, along with the USFWS, NMFS has the authority under the Federal Power Act (FPA) to mandate and set prescriptions for fish passage facilities at hydroelectric projects. At this time NMFS expects to reserve Section 18 authority under the FPA to prescribe upstream and downstream fish passage facilities for the Yale Project.

4.1.7.2 State Management

At the state level, the WDFW and Department of Natural Resources (DNR) have management responsibilities for fishery resources in the project vicinity.

Washington Department of Fish and Wildlife

WDFW is responsible for managing fisheries resources within the project vicinity. Management objectives of WDFW in the Lewis River basin are currently being directed by the Integrated Landscape Management (ILM) Planning Process for Fish and Wildlife in the Lewis-Kalama Watershed (WDFW 1995) and the Washington Wild Salmonid Policy (WDFW 1997).

The ILM focuses on state priority species and habitats. WDFW has prepared species plans with population and habitat objectives for managing 5 fish species (bull trout, kokanee, coho, steelhead, and chinook salmon). Of these, only kokanee and bull trout are present in the Yale study area.

The draft kokanee management plan for the ILM (Anderson 1994) states that the Yale Lake kokanee population could be manipulated to achieve balanced populations of optimally sized fish. Optimal-sized fish are not defined in the plan, but Rieman and Myers (1992) indicate that when maximum length of spawning kokanee averages 220 mm or less, population density is too high. Conversely, when maximum length of kokanee spawners exceeds 275 mm, the population may be in danger of collapsing.

Optimum size range needs to be determined for kokanee management in Yale Lake. In the interim, the maximum size of spawning kokanee should average between 250 and 275 mm (WDFW 1994). Despite angler concern that kokanee size in Yale Lake is too small, it may be that the population of harvestable kokanee is appropriately sized for lake management.

The ILM species plan for bull trout has not established escapement (spawning) goals for this species. Actions to protect bull trout include fishing closures in Cougar Creek, eliminating bull trout fishing in reservoirs, and ensuring that specific habitat objectives, as described in the Species Plan for the ILM (WDFW 1995) for protection of spawning, incubation, and rearing areas, are met and maintained.

In 1997, WDFW, in coordination with several tribes in the state, adopted the Washington Wild Salmonid Policy (WWSP). The goal of the WWSP is to protect, restore, and enhance the productivity, production, and diversity of wild salmonids and their ecosystems to sustain ceremonial, subsistence, commercial, and recreational fisheries, non-consumptive fish benefits, and other related cultural and ecological values (WDFW 1997). The WWSP describes a series of joint policies concerning the following:

- Spawner escapement
- Genetic diversity
- Ecological interactions
- Harvest management
- Culture production/hatcheries
- Habitat protection and management
- Basin hydrology and instream flow
- Water quality and sediment
- Stream channel complexity
- Riparian areas and wetlands
- Lakes and reservoirs
- Marine areas
- Fish access and passage
- Habitat restoration

WDFW defines a wild stock (wild salmonid) as "a stock that is sustained by natural spawning and rearing in the natural habitat, regardless of parentage." Currently, it is unclear how these specific policies will affect aquatic resources within the Yale project vicinity.

Department of Natural Resources

The DNR manages nearly 32,000 acres of land in the Siouxon basin, part of which is adjacent to eastern shoreline of Yale Lake. Siouxon Creek is a major tributary to Yale Lake. As part of the Siouxon Landscape Management Plan (DNR 1996), the DNR has designated riparian management zones to maintain and protect aquatic resources and water quality in basin streams. This plan is described in greater detail in Section 8.1.3.

4.1.8 Existing Measures

The following measures are included in PacifiCorp's existing Merwin or Yale license orders, or have been implemented subsequent to the issuance of the licenses, to protect aquatic resources within the Yale project vicinity and/or Lewis River.

Provisions of the relicensing agreement for the Merwin Project (License Order issued October 6, 1983) linked its management with that of PacifiCorp's other projects in the basin. Article 30 of the Yale license defines minimum storage space in Yale Lake, Lake Merwin, and Swift Reservoir to be provided for flood control. Articles 30 and 31 of the Yale license link operation of the 3 facilities, and Article 32 provides for protection of kokanee spawning habitat in Cougar Creek. These Yale license articles correspond to Articles 43, 44, and 51, respectively, of the Merwin license.

Article 49 of the Merwin license requires flows downstream of Merwin Dam to maintain and enhance the important natural producing fall chinook population. Since minimum flows provided under Article 49 can be in excess of natural flows in the North Fork Lewis River, the entire system of reservoirs may be affected by flow requirements under Article 49.

4.2 PROPOSED ENHANCEMENT MEASURES

Currently, there are no enhancement measures proposed to address aquatic resource issues in the Yale Project study area. The information presented in this License Application will be used by PacifiCorp and the agencies to identify measures that address the cumulative effects of all 4 hydroelectric projects in the watershed. By deferring Yale project-specific aquatic resource enhancement measures until the cumulative effects analysis is complete, PacifiCorp can prepare a broader-based enhancement package that incorporates the biological, hydrological, and operational interactions of all 4 projects in the basin.

4.3 AGENCY AND TRIBAL CONSULTATION

Agency, tribal, and public consultation regarding fisheries resource issues is summarized in this section. Comments received by PacifiCorp during the first stage of consultation are identified in Sections 4.3.1. Comments were received from the WDFW and USFWS on the Final Technical Report for Aquatic Resources (PacifiCorp 1998a). Comments on the draft License Application are summarized in Section 4.3.2. A general summary of the consultation process with regard to aquatic issues was presented earlier in Section 3.3.

4.3.1 Stage 1 and Stage 2 Consultation Prior to the Draft License Application

4.3.1.1 Bull Trout Distribution and Population Studies.

WDFW and the USFWS requested that PacifiCorp study the distribution of bull trout in the project vicinity, including populations in the Yale tailrace and the Swift No. 2 bypass reach. As described in Section 4.1, PacifiCorp has monitored and studied bull trout populations in Cougar Creek since 1988, and has conducted additional studies of bull trout during relicensing. In 1995, PacifiCorp, with WDFW, began an annual program to net adult bull trout from the Yale tailrace and return them to Yale Lake. In addition, a vertical picket weir was installed in Cougar Creek in September 1996, and again in July 1997. Data collected during monitoring periods at the weir indicate that bull trout enter Cougar Creek in mid-summer, and that peak spawning activity occurs in mid- to late-

September. Creel survey data and fish population surveys have also been used to assess the distribution and status of bull trout in the Yale project area (see Section 4.1.1.2). Additionally, PacifiCorp initiated a bull trout genetic study to determine whether genetic differences exist between the Swift, Yale, and Merwin populations of bull trout. PacifiCorp will continue to work closely with the resource agencies in assessing the status of and project effects on bull trout in the Lewis River basin during ESA consultation and concurrent watershed studies.

4.3.1.2 Entrainment at the Yale Project

WDFW and the USFWS requested studies to assess potential numbers of fish entrained in the Yale intake and spillway. PacifiCorp conducted a hydroacoustic study in the winter of 1997 to monitor entrainment rates at Yale Dam. A secondary objective of the study was to evaluate fish entrainment at one of the spillways during a controlled test spill. Results of the study were reported in the FTR for Aquatic Resources (PacifiCorp 1998a), and are summarized in Section 4.1.6.1. This study indicated that large numbers of fish move downstream into Lake Merwin through the Yale intake structure or, if the project is spilling, over the spillway. Data collected indicate that fish reside primarily in the upper 30 feet of the water column, and are more than twice as likely to be spilled than entrained in the turbine during periods of spill. Mean fish entrainment into the project intake structure was 28.5 fish per hour during the 11-week study, or a total of approximately 50,000 fish.

4.3.1.3 Instream Flows at the Swift No. 2 Bypass Reach

Resource agencies, including WDFW, USFWS, and WDOE, recommended that an agency approved Instream Flow Incremental Methodology (IFIM) study be conducted in the Swift No. 2 bypass reach (between Swift Dam and Yale Lake). In response to these First Stage comments, PacifiCorp stated that instream flows in this reach were associated with the Swift Project and not influenced by Yale project operations. Thus, no IFIM study was conducted. However, PacifiCorp recognizes that this is a watershed issue and will examine flows in the Swift No. 2 bypass reach studies in 1999.

4.3.1.4 Restoration of Anadromous Fish Access to the Upper Lewis River Watershed

The WDFW, USFWS, and conservation groups requested that PacifiCorp address the feasibility of restoring fish access to the North Fork Lewis River and its tributaries. PacifiCorp considered this request outside of the scope of Yale relicensing but will work closely with agencies, tribes, and conservation groups on this issue during watershed studies. Instream habitat data collected by PacifiCorp on Yale Lake tributaries should contribute to this effort.

4.3.1.5 Expansion of Tributary Stream Habitat Survey

To improve understanding of land use impacts, WDFW requested that PacifiCorp extend the habitat surveys in Yale Lake tributaries farther upstream than what was surveyed during relicensing studies. The Yale Lake tributaries were surveyed during low flow conditions in the fall of 1997; the distance surveyed was between 0.5 and 1.0 mile upstream of Yale Lake. PacifiCorp will work with the resource agencies to determine the adequacy of existing habitat survey data during the Lewis River watershed studies.

4.3.1.6 Expansion of Bull Trout Surveys and Population Assessment

The WDFW and USFWS recommended that bull trout surveys occur in Yale tailrace, Swift No. 2 tailrace, and the Swift No. 2 bypass reach. PacifiCorp agrees that this is appropriate and within the scope of watershed studies of the North Fork Lewis River watershed.

4.3.1.7 Hydroacoustic Evaluation of Fish Entrainment at Yale Dam

Both the USFWS and WDFW commented on the adequacy of the methodology and timing of hydroacoustic surveys conducted by PacifiCorp as part of Yale relicensing (see Section 4.1.6.1). The entrainment study provided valuable information regarding spillway versus intake entrainment, and the relative size and number of fish entrained. However, PacifiCorp agrees that questions remain concerning the species composition and size/age of entrained fish, and the fate of these fish (i.e., mortality estimates). PacifiCorp will work closely with the resource agencies during the Lewis River watershed studies to define data gaps and additional study needs relative to the entrainment issue.

4.3.2 <u>Stage 2 Consultation - Comments on the Draft License Application</u>

Comments regarding aquatic resources were received from the USFWS, WDFW, American Rivers, WDOE, and NMFS. These comments are addressed by issue below.

4.3.2.1 Issue: ESA Listed Species

Numerous comments on the Yale draft Exhibit E centered on issues related to ESA listed species. These issues include concerns over PacifiCorp's approach to up and downstream passage and entrainment, water quality, tailrace attraction, bypass reaches, habitat conditions, hatchery practices, project operations, and others.

The USFWS indicated that the entrainment of bull trout in the Yale turbines may constitute a "take" under the ESA (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998). In addition, the NMFS contends that the presence of the Yale Project has contributed to the listing of several species as threatened or endangered, and consultation with NMFS will be required under Section 7 of the ESA. NMFS recommended a description of the impacts of the Lewis River projects on species listed under the ESA and on species that are proposed for listing and how those effects could be avoided, minimized, and mitigated (letter from S. Landino, Washington State Habitat Branch Chief, NMFS, Lacey, Washington, November 30, 1998).

PacifiCorp began ESA discussions with the USFWS and NMFS on February 18, 1999. The purpose of this first meeting was to discuss which approach will be taken for consultation (Section 7 or 10), who will be the participants, and the time frame. It was PacifiCorp's intent during these discussions to address all issues of concern with a multi-species approach. That is, bull trout and steelhead will be addressed concurrently, as will any potential candidate fish species. With the assessment of the biology of each species and the resulting biological opinion or habitat conservation plan, measures will be developed to mitigate for any potential take by the Yale and the other Lewis River projects. All participants in the Yale relicensing and APEA processes for the Lewis River watershed will be kept informed of ESA consultation progress.

4.3.2.2 Issue: Bull Trout Distribution and Population Studies

The USFWS requested more thorough documentation of suitable bull trout spawning habitat in tributaries to Yale Lake and indicated that the duration of time that Lewis River populations of bull trout spend in Cougar Creek is not well supported. USFWS also requested the results of the bull trout genetics study commissioned by PacifiCorp. USFWS recommended that the Cougar Creek juvenile bull trout study be redesigned and conducted again since the study was inconclusive (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998).

The WDFW asserted that bull trout population numbers and use patterns in the Yale tailrace and in the Swift No. 2 tailrace and bypass have not been adequately addressed. Measures that have been discussed between WDFW and PacifiCorp for the long-term management of bull trout passage are not reflected in the Exhibit E. Additionally, more information should be provided on spillway and turbine mortality, passage and tailrace injury. WDFW also believes that bull trout investigations in Cougar Creek were inconclusive and harmful (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998).

Section 4.1.1.2 of the final License Application was expanded to include a more thorough description of bull trout habitat suitability and availability in the Lewis River basin. Additional information describing the duration of time that Lewis River populations of bull trout spend in Cougar Creek was also provided. Spillway and turbine mortality, passage, and tailrace injury will be addressed as part of PacifiCorp's ESA consultation process (see Section 4.3.2.1).

PacifiCorp provided copies of the completed bull trout genetics study to the following agency/interest group representatives in December 1998:

Gene Stagner, USFWS
Curt Leigh, WDFW
Steve Fransen, NMFS
Steve Lanigon, USFS
Michael Pollack, American Rivers

The results of this study are also summarized in Section 4.1.1.2 of this document.

PacifiCorp agrees that only a limited amount of life history and adult abundance information was collected during bull trout sampling in Cougar Creek. However, further efforts to collect adult and/or juvenile bull trout in this system could result in a "take" of this threatened species. PacifiCorp recommends that no further bull trout sampling be conducted in Cougar Creek until consultation with the USFWS occurs.

A summary of existing bull trout snorkel survey information from Cougar Creek and the Swift No. 2 bypass, as well as the results of sampling in the Yale tailrace, are included in Section 4.1.1.2. PacifiCorp is proposing to expand its tailrace netting activities to include the Swift No. 2 tailrace. Results of all surveys will be made available to all interested parties.

4.3.2.3 Issue: Instream Flows at the Swift No. 2 Bypass Reach

The WDFW indicated that a study to evaluate flow augmentation in the Swift No. 2 bypass was requested but was not performed (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998).

American Rivers contends that instream flow studies are needed to determine fish habitat conditions. A study should be performed in reaches extending from Merwin Dam up to the head of Swift Reservoir (letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998).

While the Swift No. 2 bypass reach was shown to be part of the Yale Project study area, flow releases are a direct effect of the operating regimes of the Swift No. 1 and No. 2 projects. A flow study will be conducted in the Swift No. 2 bypass reach as a component of the watershed studies for all North Fork Lewis River projects. This will be initiated in 1999.

4.3.2.4 Issue: Restoration of Anadromous Fish Access to the Upper Lewis River Watershed

Restoration of anadromy is an issue of concern to several commenting organizations, including USFWS, WDFW, American Rivers, NMFS, and WDOE. The USFWS requested that the feasibility of re-introducing anadromous fish to the upper watershed be examined (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998). Similarly, WDFW reminded PacifiCorp that it requested these studies but that none were performed. WDFW contends that these studies are within the scope of the Yale relicensing, particularly an assessment of suitable habitat (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998). WDOE also disagrees with PacifiCorp's position that an evaluation of anadromous restoration is outside of the scope of this relicensing (letter from J. Marti, WDOE, Water Resources Program, Olympia Washington, November 30, 1998).

American Rivers indicated that passage around all 4 Lewis River projects should be studied to determine the feasibility of in-river migration for anadromous fish, bull trout, and other species. This step should precede any decision about modifications at the Yale Project. Pre-project and current aquatic habitat should be inventoried to enable the salmonid production potential to be estimated and to provide baseline information for monitoring habitat protection, mitigation, and enhancement measures. It is suggested that an aquatic Habitat Evaluation Procedure (HEP) be conducted (letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998).

NMFS indicated the need for a feasibly analysis, in collaboration with NMFS, of anadromous fish reintroduction into the Lewis River watershed upstream from the dams. This analysis should include an inventory of existing anadromous fish habitat upstream from the dams (letter from S. Landino, Washington State Habitat Branch Chief, NMFS, Lacey, Washington, November 30, 1998).

As stated in the draft License Application, reintroduction will be viewed in the context of the Lewis River basin, and PacifiCorp will address reintroduction as a component of basin-wide studies. This assessment will be conducted prior to any modification of the Yale Project. Alternatives regarding fish passage and reintroduction will be assessed in the APEA for all 4 Lewis River projects.

A number of habitat surveys were conducted in the Yale area to describe existing habitat conditions. These are described in Section 4.1.4 of this Exhibit E and in PacifiCorp (1998a). A key component of basin-wide aquatic studies will be an assessment of the adequacy of existing data in terms of estimating production potential and providing baseline information for developing enhancement measures. PacifiCorp will support additional data collection if critical uncertainties exist. This determination, as well as the approach taken to collect the needed data, will be made in consultation with the resource agencies and other interested parties.

Available information describing historical anadromous salmonid spawning habitat in the Lewis River above Yale Dam is provided in Section 4.1.2 of this document.

4.3.2.5 Issue: Entrainment and the Hydroacoustic Evaluation of Entrainment at Yale Dam

The USFWS asserts that Yale entrainment studies were inadequate and that no remedy has been offered. The USFWS also disagrees with PacifiCorp's conclusion that bull trout are not being entrained in the project turbines. Specific information requested includes species composition and the fate of entrained fish (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998). Similarly, American Rivers believes that the fish entrainment study at Yale did not adequately assess the effects on bull trout and other species. American Rivers recommended that further studies be conducted at each of the Lewis River projects to assess ongoing impacts on fish populations (letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998).

WDFW also disagrees with PacifiCorp's interpretation of the hydroacoustic study results (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998).

NMFS indicated that entrainment of resident fish, and potentially of anadromous fish, should be addressed at Yale and the other 3 projects in the basin (letter from S. Landino, Washington State Habitat Branch Chief, NMFS, Lacey, Washington, November 30, 1998).

PacifiCorp will conduct a fish passage feasibility study as part of the Lewis River watershed studies. Further entrainment studies will be developed by the Lewis River watershed team, as well as outcomes from ESA consultation with the appropriate agencies. Input from WDFW, USFWS, NMFS, USFS, and other interested parties will be incorporated into alternatives (management strategies) for fish passage to be analyzed in the APEA for all of the North Fork Lewis River projects.

Section 4.1.6 of the Exhibit E has been revised to clarify the hydroacoustic survey study results.

4.3.2.6 Issue: Fish Passage at Yale Dam

The USFWS intends to recommend downstream fish passage protection (turbine intake screens) at Yale Dam to protect bull trout. Until the federal recovery plan is drafted in late 1999, the USFWS encourages PacifiCorp to consider all options for fish protection. Furthermore, until measures are in place, the USFWS strongly recommends that PacifiCorp continue to transport bull trout in the Yale tailrace above Yale Dam. The USFWS also requested additional data on procedures used to net bull trout in the Yale tailrace to assess the effects of handling (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998).

NMFS indicated that both upstream and downstream fish passage options need to be assessed at each of the Lewis River projects, including screening options, and that it will reserve its Section 18 authority to prescribe upstream and downstream passage at Yale Dam (letter from S. Landino, Washington State Habitat Branch Chief, NMFS, Lacey, Washington, November 30, 1998).

American Rivers recommended that a study be performed to ascertain whether salmonids would benefit from fish passage at each of the dams on the Lewis River (letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998).

WDFW requested that additional information be included in Exhibit E on the fish passage programs that were implemented before and after the construction of Yale Dam (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998).

PacifiCorp is proposing to continue its bull trout netting activities in the Yale tailrace and to expand netting efforts to include the Swift No 2 tailrace. Methods used to capture, mark, and transport bull trout in the Yale tailrace are provided in Section 4.1.1.2 of this document.

Section 4.1.2 of this document has been expanded to include a detailed description of the historical (pre-project) anadromous fishery in the North Fork Lewis River, as well as a discussion of the fish passage programs that were implemented before and after the construction of Yale Dam.

NMFS's authority to prescribe fish passage is acknowledged in Section 4.1.7.1 of this document.

4.3.2.7 Issue: Yale Tailrace Configuration and Potential Damage to Fish

Because bull trout concentrate in the Yale tailrace, the USFWS recommends that the configuration be analyzed to determine if it is having an effect on bull trout (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998). WDFW also pointed out that the potential for fish to be injured in the Yale tailrace was not assessed (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998).

Information on the condition of bull trout captured in the Yale tailrace and the potential for bull trout injury is presented in Section 4.1.1.2 of this document. A schematic drawing of the tailrace area is provided in Exhibit F, Sheet 4. This issue will be addressed further as part of ESA consultation with the appropriate agencies. Please see Section 4.3.2.1.

4.3.2.8 Issue: Speelyai Creek Instream Flow

WDFW disagrees with the deferral of operational changes until further watershed investigations are performed (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998).

WDOE indicated that measures to address Speelyai Creek water temperature and flows were not presented. The position of WDFW on flow levels in Speelyai Creek should be explored further, as should the suitability of this water for hatchery uses. The WDOE also indicated that fish habitat and use in lower Speelyai Creek and Speelyai Canal has not been described. The potential habitat benefits of increased flow in the bypassed reach should be addressed, along with the potential for stranding of fish in the channel and canal (letter from J. Marti, WDOE, Water Resources Program, Olympia Washington, November 30, 1998).

A meeting between PacifiCorp, the WDOE, and the WDFW is planned for early 1999. The purpose of this meeting is to resolve flow issues cited by WDOE and WDFW. PacifiCorp provided water temperature data for Speelyai Creek in the FTR for Aquatic Resources (PacifiCorp 1998a).

PacifiCorp conducted a detailed fish habitat and fish population study, which included Speelyai Creek, in late August 1997. As part of this study, 3 reaches were surveyed in Speelyai Creek's channel, and a fourth reach was surveyed in the Speelyai Creek Canal. The results of the fish habitat and fish population study are summarized in Section 4.1.1 of this License Application. More detailed descriptions and photographs of aquatic habitat and fish populations found in the Speelyai Creek channel and canal are available in Section 3.3 of PacifiCorp's FTR for Aquatic Resources (PacifiCorp 1998a).

4.3.2.9 Issue: Kokanee Management

WDFW indicated that recently proposed changes in the kokanee management program should be added to the discussion in the document (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998). These changes are described in Section 4.1.1.1.

4.3.2.10 Issue: Sediment and Large Woody Debris Recruitment and Transport

American Rivers requested that the effects of Yale and the other Lewis River dams on sediment and large woody debris recruitment and transport in the basin be examined (letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998). These effects will be determined as a component of the watershed studies and documented in the PDEA for all 4 projects.

4.3.2.11 Issue: Anadromous Fish Resources

WDFW indicated that the final License Application should include a discussion of the fish passage programs that were implemented and conducted before and after the construction of Yale Dam.

NMFS states that the draft Exhibit E lacks adequately detailed descriptions of pre-project anadromous fish resources and their distribution, as well as pre-project and continuing impacts on anadromous fish. The incremental loss of anadromous fish and the continuing impact of this loss since construction of Yale and Merwin dams should be described. NMFS also indicated the need for a description of the relationship between funding of the hatcheries by PacifiCorp and Cowlitz County PUD and the absence of anadromous fish in the upper basin (letter from S. Landino, Washington State Habitat Branch Chief, NMFS, Lacey, Washington, November 30, 1998).

Section 4.1.2 of this document has been expanded to include more detailed information describing pre-project and existing anadromous fish resources. Special attention was given to an expanded discussion of historical anadromous salmonid production and habitat in the basin. PacifiCorp also plans to further expand the description of current and historical aquatic resources conditions (including current and historical habitat availability) as part the Lewis River watershed studies (See Sections 4.3.2.1 and 4.3.2.4). Hatchery funding is discussed in Section 4.1.2.

4.3.2.12 Issue Reservoir Drawdown

American Rivers indicated that the effects of lowering the 3 basin reservoirs to create a free-flowing river should be examined to determine if this would provide ecological benefits. The economic effects of such a change (loss of power revenue, replacement power costs, etc.) should be factored into this assessment (letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998).

This issue is not discussed in this License Application; however, if the collaborative relicensing participants view this operating scenario as an alternative of merit, it will be carried forward into the National Environmental Policy Act (NEPA) evaluation of basin alternatives under the APEA process.

4.3.2.13 Issue: Proposed Enhancement Measures

The USFWS, WDFW, NMFS, American Rivers, and WDOE indicated that the License Application cannot be considered complete or adequate without protection, mitigation, or enhancement measures to address aquatic resource issues. PacifiCorp needs to develop these measures as part of the APEA process (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998; letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998; letter from S. Landino, Washington State Habitat Branch Chief, NMFS, Lacey, Washington, November 30, 1998; letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998).

Specific aquatic resource mitigation measures for all the North Fork Lewis River projects will be developed in cooperation with agencies/interested parties as part of the collaborative relicensing process. Water temperature changes specific to the Yale project are addressed in Section 3.1.2.1 and 3.1.2.9.

4.3.2.14 Issue: Continuing Impacts

The USFWS requested that continuing impacts of the Yale Project on the following resource areas be described: loss of riverine and riparian habitat, loss of aquatic connectivity, water temperature changes, and nutrient cycle changes (letter from N. Gloman, Acting Supervisor, USFWS, North Pacific Coast Ecoregion, Lacey, Washington, November 12, 1998). The WDFW also concluded that the continuing impacts of the Yale Project on aquatic resources are inadequately described. In addition, specific mitigation and enhancement measures are needed (letter from C. Leigh, Fish and Wildlife Scientist, WDFW, Olympia, Washington, November 17, 1998).

American Rivers indicated that the current fish inventory should be expanded to determine what factors are limiting coldwater fish production and what role the dams play (letter from M. Delp and M. Pollock, American Rivers, Seattle, Washington, November 18, 1998).

The impacts of the Yale, Merwin and Swift projects on riverine and riparian habitat, aquatic habitat connectivity, water temperature, and nutrient cycling will be addressed as part of the North Fork Lewis River basin cumulative effects analysis.

4.4 CONTINUING IMPACTS

The present condition of the North Fork Lewis River basin is the result of the cumulative effects of all natural and human-induced activities. Until the Lewis River watershed studies process is complete and a new license is issued for the Yale Project, it will continue to operate under its existing license. Upon issuance of a new license, it is anticipated that enhancement measures will be implemented that will result in a net improvement in aquatic resources in the North Fork Lewis River compared to existing conditions.

4.5 IMPLEMENTATION, SCHEDULE, AND COST

The schedule and cost for implementation of aquatic resources enhancement measures will be developed as a component of the watershed studies for all North Fork Lewis River projects.