

## CONTENTS

|                                      |       |
|--------------------------------------|-------|
| 3.0 ENVIRONMENTAL CONSEQUENCES ..... | 3-1   |
| 3.1 GEOLOGY AND SOILS .....          | 3-1   |
| 3.1.1 Resource Issues.....           | 3-1   |
| 3.1.2 Affected Environment.....      | 3-1   |
| 3.1.3 Effects of Alternatives .....  | 3-2   |
| 3.1.4 Conclusion .....               | 3-3   |
| 3.2 WATER QUANTITY .....             | 3-3   |
| 3.2.1 Resource Issues.....           | 3-3   |
| 3.2.2 Affected Environment.....      | 3-4   |
| 3.2.3 Effects of Alternatives .....  | 3-10  |
| 3.2.4 Conclusion .....               | 3-21  |
| 3.3 WATER QUALITY .....              | 3-23  |
| 3.3.1 Resource Issues.....           | 3-23  |
| 3.3.2 Affected Environment.....      | 3-23  |
| 3.3.3 Effects of Alternatives .....  | 3-25  |
| 3.3.4 Conclusion .....               | 3-36  |
| 3.4 AQUATIC RESOURCES .....          | 3-37  |
| 3.4.1 Resource Issues.....           | 3-37  |
| 3.4.2 Affected Environment.....      | 3-37  |
| 3.4.3 Effects of Alternatives .....  | 3-65  |
| 3.4.4 Conclusion .....               | 3-87  |
| 3.5 BOTANICAL RESOURCES .....        | 3-90  |
| 3.5.1 Resource Issues.....           | 3-91  |
| 3.5.2 Affected Environment.....      | 3-91  |
| 3.5.3 Effects of Alternatives .....  | 3-100 |
| 3.5.4 Conclusion .....               | 3-109 |
| 3.6 WILDLIFE RESOURCES .....         | 3-110 |
| 3.6.1 Resource Issues.....           | 3-110 |
| 3.6.2 Affected Environment.....      | 3-110 |
| 3.6.3 Effects of Alternatives .....  | 3-119 |
| 3.6.4 Conclusion .....               | 3-129 |
| 3.7 CULTURAL RESOURCES.....          | 3-129 |
| 3.7.1 Resource Issues.....           | 3-129 |
| 3.7.2 Affected Environment.....      | 3-130 |
| 3.7.3 Effects of Alternatives .....  | 3-134 |
| 3.7.4 Conclusion .....               | 3-136 |
| 3.8 RECREATION.....                  | 3-137 |
| 3.8.1 Resource Issues.....           | 3-137 |
| 3.8.2 Affected Environment.....      | 3-138 |
| 3.8.3 Effects of Alternatives .....  | 3-143 |

|  |       |
|--|-------|
| 3.8.4 Conclusion .....   | 3-150 |
| 3.9 LAND MANAGEMENT AND USE.....   | 3-151 |
| 3.9.1 Resource Issues.....   | 3-151 |
| 3.9.2 Affected Environment.....  | 3-151 |
| 3.9.3 Effects of Alternatives .....                                      | 3-160 |
| 3.9.4 Conclusion .....   | 3-163 |
| 3.10 AESTHETIC/VISUAL RESOURCES .....                                    | 3-164 |
| 3.10.1 Resource Issues.....  | 3-164 |
| 3.10.2 Affected Environment.....   | 3-164 |
| 3.10.3 Effects of Alternatives .....                                     | 3-168 |
| 3.10.4 Conclusion .....  | 3-170 |
| 3.11 SOCIOECONOMICS.....   | 3-170 |
| 3.11.1 Resource Issues.....  | 3-170 |
| 3.11.2 Affected Environment.....   | 3-171 |
| 3.11.3 Effects of Alternatives .....                                     | 3-181 |
| 3.11.4 Conclusion .....  | 3-191 |
| 3.12 CUMULATIVELY AFFECTED RESOURCES .....                               | 3-191 |
| 3.12.1 Geographic Scope .....  | 3-192 |
| 3.12.2 Temporal Scope .....  | 3-192 |
| 3.12.3 Cumulative Effects of Alternatives.....                           | 3-192 |
| 3.13 UNAVOIDABLE ADVERSE IMPACTS .....                                   | 3-198 |
| 3.13.1 Geology and Soils.....  | 3-198 |
| 3.13.2 Water Quantity.....   | 3-199 |
| 3.13.3 Water Quality.....  | 3-199 |
| 3.13.4 Aquatic Resources .....   | 3-199 |
| 3.13.5 Botanical and Wildlife Resources.....                             | 3-200 |
| 3.13.6 Cultural Resources .....  | 3-200 |
| 3.13.7 Recreation .....  | 3-200 |
| 3.13.8 Socioeconomics .....  | 3-201 |
| 3.14 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF<br>RESOURCES.....      | 3-201 |
| 3.15 RELATIONSHIP BETWEEN SHORT-TERM AND LONG-TERM<br>PRODUCTIVITY ..... | 3-201 |

**LIST OF TABLES**

Table 3.1-1. Summary of reservoir shoreline bank heights. .... 3-2

Table 3.2-1. Summary of streamflow statistics for Lewis River stream gages. .... 3-4

Table 3.2-2. Magnitude and frequency of spill from Swift Creek Reservoir. .... 3-7

Table 3.2-3. Flood magnitude and frequency by alternative for Lewis River below Merwin Dam. .... 3-9

Table 3.2-4. Natural and regulated peak flows for Lewis River at Ariel (below Merwin Dam). .... 3-9

Table 3.2-5. Alternative A reservoir operations summary. .... 3-12

Table 3.2-6. Alternative B reservoir operations summary. .... 3-15

Table 3.2-7. Alternative C reservoir operations summary. .... 3-20

Table 3.2-8. Flow releases into the Lewis River bypass reach under Alternative C. ... 3-21

Table 3.3-1. Summary of WDOE surface water quality standards for Class A, Class AA, and Lake Class water bodies. .... 3-24

Table 3.3-2. Water quality monitoring sites. .... 3-25

Table 3.4-1. Resident and anadromous fish species present in the Lewis River basin. .... 3-38

Table 3.4-2. Preferred temperature ranges, and upper lethal water temperatures for various life stages of resident and anadromous salmonids found in the Lewis River basin. .... 3-39

Table 3.4-3. Current aquatic habitat metrics in measured stream reaches in the Lewis River watershed. .... 3-55

Table 3.4-4. Minimum flow provisions downstream of Merwin, as stipulated in Article 49 of the existing Merwin Project license. .... 3-58

Table 3.4-5. WDFW interim ramping rate criteria. .... 3-59

Table 3.4-6. Current WDFW fish production goals for the Lewis River basin in 2003. .... 3-62

Table 3.4-7. The average number of salmon and steelhead harvested in the Lewis River recreation fishery based on punch card returns to WDFW. .... 3-63

Table 3.4-8. Federally listed fish species in the Lewis River basin. .... 3-63

Table 3.4-9. Length of potentially accessible anadromous fish habitat and the percent of total accessible habitat in the three reaches of the Lewis River upstream of Merwin Dam. .... 3-71

Table 3.4-10. EDT estimates of adult abundance under current habitat conditions for spring Chinook, coho, and steelhead by geographic area. .... 3-72

Table 3.4-11. Lewis River fish passage model estimates of adult coho production for Alternatives B and C. .... 3-73

Table 3.4-12. Alternative C estimated adult fish passage survival rates by fish population. .... 3-84

Table 3.4-13. Model-derived survival estimates for juvenile anadromous fish migrating from Swift, Yale, and Merwin reservoirs for Alternative C. ... 3-85

Table 3.5-1. Summary of cover type acreages in the study area for the Lewis River Projects. .... 3-97

Table 3.5-2. Utility land ownership in the Lewis River basin. .... 3-100

Table 3.6-1. Special status species documented or potentially occurring in the study area for the Lewis River Projects..... 3-114

Table 3.6-2. Numbers of bald eagles recorded during PacifiCorp’s late-winter aerial surveys..... 3-118

Table 3.6-3. Bald eagle nest activity and productivity recorded during PacifiCorp’s summer aerial surveys..... 3-118

Table 3.9-1. Major land ownership within the Lewis River watershed..... 3-151

Table 3.10-1. Pool elevation photo documentation for Merwin, Swift, and Yale reservoirs. .... 3-166

Table 3.11-1. Recent growth rates in project vicinity..... 3-171

Table 3.11-2. Population estimates and forecasts for selected areas of Washington..... 3-172

Table 3.11-3. 2000 and 2002 labor force and employment estimates for Clark, Cowlitz, and Skamania counties. .... 3-173

Table 3.11-4. 2000 occupancy status by area. .... 3-175

Table 3.11-5. Comparison of Northwest utility electricity rates for 2002..... 3-177

Table 3.11-6. Cowlitz PUD and PacifiCorp customer base..... 3-178

Table 3.11-7. Combined Cowlitz PUD and PacifiCorp tax payment in 1999..... 3-179

**LIST OF FIGURES**

Figure 3.2-1. Swift Creek Reservoir average daily and seasonal water elevations, water years 1997 – 2001..... 3-5

Figure 3.2-2. Yale Lake average daily and seasonal water elevations, water years 1997 – 2001..... 3-6

Figure 3.2-3. Lake Merwin average daily and seasonal water elevations, water years 1997 – 2001..... 3-6

Figure 3.2-4. Daily flow exceedance curve for Lewis River at Ariel..... 3-8

Figure 3.2-5. Swift Creek Reservoir levels under Alternatives A, B, and C..... 3-13

Figure 3.2-6. Yale Lake levels under Alternatives A, B, and C. .... 3-13

Figure 3.2-7. Lake Merwin levels under Alternatives A, B, and C. .... 3-14

Figure 3.2-8. Daily average flow releases into the Lewis River bypass reach under Alternatives A, B, and C (50 percent exceedance values). .... 3-16

Figure 3.2-9. Monthly flow releases downstream of Merwin Dam under Alternatives A, B, and C. .... 3-17

Figure 3.3-1. Recorded water temperatures in the Swift No. 2, Yale, and Merwin powerhouse tailraces and corresponding releases, July 15 through July 28, 1996. .... 3-27

Figure 3.3-2. Monthly median temperatures at the Swift Creek Reservoir inflow, Swift No. 1 tailrace, Swift No. 2 tailrace, Yale tailrace, and Merwin tailrace; May 1999 through April 2000..... 3-28

Figure 3.3-3. Nitrogen to Phosphorus ratios for sites sampled monthly during May 1999 through April 2000..... 3-32

Figure 3.3-4. Observed Swift Dam release temperature and modeled water temperature at downstream end of Lewis River bypass reach for four release flows under average temperature conditions. .... 3-34

Figure 3.4-1. Adult spring Chinook and fall Chinook returns to the North Fork Lewis River (1980 to 2001). .... 3-40

Figure 3.4-2. Periodicity chart for various life stages of fish species in the Lewis River basin. .... 3-41

Figure 3.4-3. Adult coho returns to the North Fork Lewis River (1980 to 2001). .... 3-45

Figure 3.4-4. The number of winter and summer steelhead harvested in the Lewis River basin recreation fishery (1980 through 1998). .... 3-47

Figure 3.4-5. Annual peak counts of bull trout spawners observed in Cougar Creek 1979 through 2003. .... 3-51

Figure 3.4-6. Spawning population estimate of bull trout in Swift Creek Reservoir for the years 1994 through 2003. .... 3-51

Figure 3.4-7. Peak counts of kokanee spawning in Cougar Creek (1978 to 2002). .... 3-53

Figure 3.5-1. Generalized vegetation cover type map. .... 3-93

Figure 3.9-1. Project area land ownership. .... 3-156

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### 3.0 ENVIRONMENTAL CONSEQUENCES

#### 3.1 GEOLOGY AND SOILS

##### 3.1.1 Resource Issues

The primary project impact on geology and soils is erosion, which can affect water quality, aquatic habitat, and in some cases, terrestrial resources. No issues specific to geology and soil resources were raised during the NEPA scoping process.

##### 3.1.2 Affected Environment

The Lewis River watershed is underlain by primarily volcanic rocks that have been sculpted by subsequent glaciation, recent volcanic activity, and stream processes. Bedrock is comprised of Eocene-Oligocene basaltic-andesite lava flows, Oligocene volcanoclastic rocks, and Quaternary volcanoclastic deposits (Philips 1987a; Philips 1987b; Walsh et al. 1987). This is a geologically active watershed, shaped by several large-scale geomorphic processes active during the Holocene (past 10,000 years) (USFS 1995, 1996, 1997, 1998). The most obvious of these processes is the active volcanism from Mount St. Helens, Mount Adams, and the Indian Heaven volcanic field. There are three main types of volcanic activity that have had a major effect on the watershed: lava flows, debris avalanche/lahars, and tephra (ash) falls (Scott et al. 1995).

Lava flows are probably the least common of the three and have most often affected smaller, localized areas near the volcanic vents. Debris avalanches, mudflows, and lahars are more common on Mount St. Helens and Mount Adams. They are rapidly moving slurries of water, rock, soil, and debris. Mudflows swept down Swift Creek, Pine Creek, and the Muddy River during the May 18, 1980 eruption of Mount St. Helens, emptying nearly 18 million cubic yards of water, mud, and debris into Swift Creek Reservoir (Tilling et al. 1990). These types of features have the ability to alter the streambed and valley characteristics of affected drainages in a matter of hours, and result in long-term contributions of very high sediment load that alters channel characteristics. Streams affected by recent mudflows are continuing to process the sediment and woody debris and have changed from narrow channels into wide, braided, unstable channels with high sediment and wood loads. Riparian vegetation along these channels was wiped out and is slowly recovering as sediment loads decrease with time.

Tephra, ash, and/or pumice falls are the most common and widespread volcanic activity originating from Mount St. Helens and Mount Adams. Thick deposits of tephra can reduce infiltration rates and increase erosion rates. Seven to eight tephra deposits (including the 1980 eruption) from Mount St. Helens have occurred over the past 10,000 years.

Alpine glacial activity has sculpted the tributary and mainstem valleys of the Lewis River in the past, and is still active to a smaller extent on the tops of Mount Adams and Mount St. Helens. Streams with a large percent of flow from glacial melt carry heavy loads of

both fine-grained sediment and bedload, resulting in high summer turbidities and braided, shifting channels. Past alpine glacial activity has shaped the upper valleys of these same creeks into U-shaped troughs with steep sidewalls, creating areas where mass wasting is now very active.

Soils in the Lewis River watershed are generally deep and moderately well drained, and reflective of the volcanic rocks, glacial deposits, or alluvial terraces upon which they formed (USDA 1972, 1974, and 1989). Most soils have a moderate erosion potential, but soils on steeper slopes or those formed from unconsolidated ash or mudflow deposits have a high erosion potential.

Areas around most project facilities and reservoir shorelines are stable and not subject to erosion or landslides, with a few exceptions. Mapping of reservoir shorelines showed that 54-79 percent of the reservoir shorelines had only minor ongoing erosion, with bank heights of 0-5 feet (Table 3.1-1). An additional 4 percent of the Yale shoreline and 24-27 percent of the Merwin and Swift shorelines had bank heights of 5-10 feet. Approximately 11-18 percent of each reservoir had bank heights over 10 feet high. The majority of the high banks are located in areas of Quaternary volcanoclastic deposits, relatively young, unstable volcanic mudflow deposits. These deposits are subject to undercutting by wave erosion and form steep cliffs on faces exposed to wave action. There is relatively little landsliding along reservoir shorelines.

**Table 3.1-1. Summary of reservoir shoreline bank heights.**

| Bank Height in feet | Total Miles and Percent of Shoreline in Each Category |                |                |
|---------------------|---|----------------|----------------|
|                     | Merwin  | Yale           | Swift          |
| Developed shoreline | 1.3 mi. (5%)  | 0.0 mi. (0%)   | 0.0 mi. (0%)   |
| 0-5                 | 13.6 mi. (54%)  | 19.9 mi. (79%) | 20.0 mi. (59%) |
| 5-10                | 6.0 mi. (24%)   | 1.1 mi. (4%)   | 9.3 mi. (27%)  |
| 10-20               | 4.4 mi. (18%)   | 4.1 mi. (17%)  | 3.7 mi. (11%)  |
| 20-60               | 0.0 mi. (0%)  | 0.0 mi. (0%)   | 0.9 mi. (3%)   |

### 3.1.3 Effects of Alternatives

#### 3.1.3.1 Alternative A

Because the majority of areas around project facilities are stable and not subject to erosion, continued operation under Alternative A would very slowly erode reservoir shorelines, with the consequent loss of upland habitat and the addition of sediment to the reservoirs.

#### 3.1.3.2 Alternative B

Effects of Alternative B would be the same as those of Alternative A: continued slow erosion of reservoir shorelines, consequent loss of upland habitat, and the addition of sediment to the reservoirs.



Construction of new project facilities is proposed under Alternatives B. The majority of construction would be related to recreation facilities (25.4 acres). Erosion control plans would be developed for each facility prior to construction, and measures to minimize and contain eroded soil would be implemented during all construction. In addition, disturbed areas would be revegetated and/or stabilized following construction. It is anticipated that there would only be minor amounts of erosion during and following construction if adequate erosion control measures are implemented.

### 3.1.3.3 Alternative C

Effects of Alternative C would be the same as those of Alternatives A and B: continued slow erosion of reservoir shorelines, consequent loss of upland habitat, and the addition of sediment to the reservoirs.

Construction of new project facilities is proposed under Alternative C. The majority of construction would be related to either upstream and downstream fish passage facilities (2.75 acres) or recreation facilities (25.4 acres). Erosion control plans would be developed for each facility prior to construction, and measures to minimize and contain eroded soil would be implemented during all construction. In addition, disturbed areas would be revegetated and/or stabilized following construction. It is anticipated that there would only be minor amounts of erosion during and following construction if adequate erosion control measures are implemented.

### 3.1.4 Conclusion

Alternative A would have minor adverse effects on geology and soil resources through the continued slow erosion of reservoir shorelines. Under Alternatives B and C, additional erosion could occur during construction of new facilities, resulting in minor adverse effects. Properly implemented erosion control measures should be effective at minimizing the amount of erosion and soil loss during construction of these new facilities.

The slow erosion of reservoir shorelines under all alternatives would result in the slow loss of upland terrestrial habitat, addition of sediment to the reservoirs and possible very minor, localized, and short term increases in turbidity in the reservoirs. Erosion during construction of new facilities under Alternatives B and C could result in minor increases in turbidity in nearby waters if adequate erosion control measures are not implemented.

## **3.2 WATER QUANTITY**

### 3.2.1 Resource Issues

During the scoping process, three project-related water quantity issues were identified:

- Effects of managed water releases on aquatic and riparian habitat downstream of the projects, and on hatchery operations.
- Influence of the Speelyai diversion and hatchery on flow regimes in Speelyai Creek.

- Effects of project operation on downstream flood management.

This section discusses the effects of the alternatives on reservoir water level and flow regimes in river reaches affected by project facilities and operations. The effects of these changes on aquatic habitat, riparian habitat, hatcheries, and other resources are discussed in subsequent sections.

### 3.2.2 Affected Environment

Streams in the Lewis River watershed have flow patterns characteristic of a wet maritime climate: low flows in the late summer and early fall when little precipitation falls, and high flows during the wet winter and spring months. Streams in the upper portions of the watershed, with drainage basins at high elevations, show a marked snowmelt runoff peak in May and June that is even higher than the winter peak. The spring snowmelt peak becomes more and more muted in streams in the lower watershed. Lower elevation streams do not show a snowmelt peak but have high flows from November through April in response to winter rains, and very low summer flows. Flow characteristics of streams in the Lewis River watershed are shown in Table 3.2-1 and are based on historic flows measured at U.S Geological Survey stream gages in the basin. More details are available in the Streamflow Study (PacifiCorp and Cowlitz PUD 2003f and 2004: WTS 2).

**Table 3.2-1. Summary of streamflow statistics for Lewis River stream gages.**

| <b>Stream Gage</b>                    | <b>Drainage Area (sq mi)</b> | <b>Annual 50% Exceedance Flow</b> | <b>Average 1-day Baseflow</b> | <b>2-year Peak Flow</b> | <b>Baseflow: Annual Flow Ratio</b> | <b>Peak: Annual Flow Ratio</b> |
|---------------------------------------|------------------------------|-----------------------------------|-------------------------------|-------------------------|------------------------------------|--------------------------------|
| Lewis River near Trout Lake           | 127                          | 500                               | 113                           | 5,890                   | 0.23                               | 12                             |
| Lewis River above Muddy River         | 227                          | 917                               | 283                           | 9,240                   | 0.31                               | 10                             |
| Muddy River below Clear Creek         | 135                          | 620                               | 144                           | 6,720                   | 0.23                               | 11                             |
| Lewis River near Cougar (pre-project) | 481                          | 2,185                             | 687                           | 18,100                  | 0.31                               | 8                              |
| Lewis River near Amboy                | 665                          | 3,050                             | 949                           | 33,600                  | 0.31                               | 11                             |
| Speelyai Creek                        | 12.6                         | 56                                | 4                             | 1,680                   | 0.07                               | 30                             |
| Lewis River at Ariel (pre-project)    | 731                          | 3,370                             | 1,051                         | 42,000                  | 0.31                               | 12                             |
| Lewis River at Ariel (with-project)   |                              | 3,790                             | 767                           | 22,000                  | 0.20                               | 6                              |

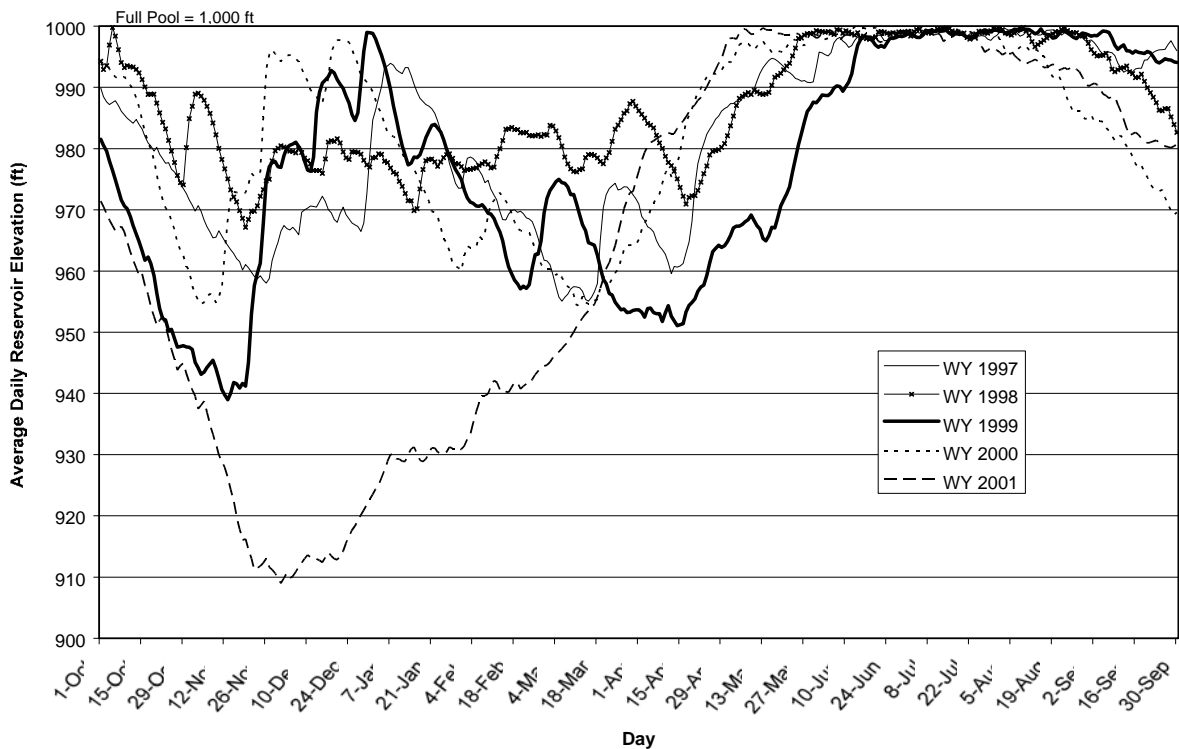
Baseflows for all streams studied occur during August, September, and October when little rain falls in the area. Baseflows vary with stream size, but are generally 1/3 to 1/4 of the average annual flow (Table 3.2-1). The exception to this is Speelyai Creek, a small tributary to Lake Merwin that has very low baseflows (about 14 times lower than average annual flow).

Peak flows in the watershed occur in response to winter rain and rain-on-snow events between November and April. In some years, the annual peak flow at upper watershed gages occurs during the spring snowmelt season, but these peaks are lower than the large rain-on-snow events. At most gages, the 2-year peak flow is 8-12 times higher than the mean annual flow. The exception is again Speelyai Creek, which has much higher peak flows, with the 2-year peak 30 times higher than the mean annual flow, indicating a very “flashy” hydrologic regime.

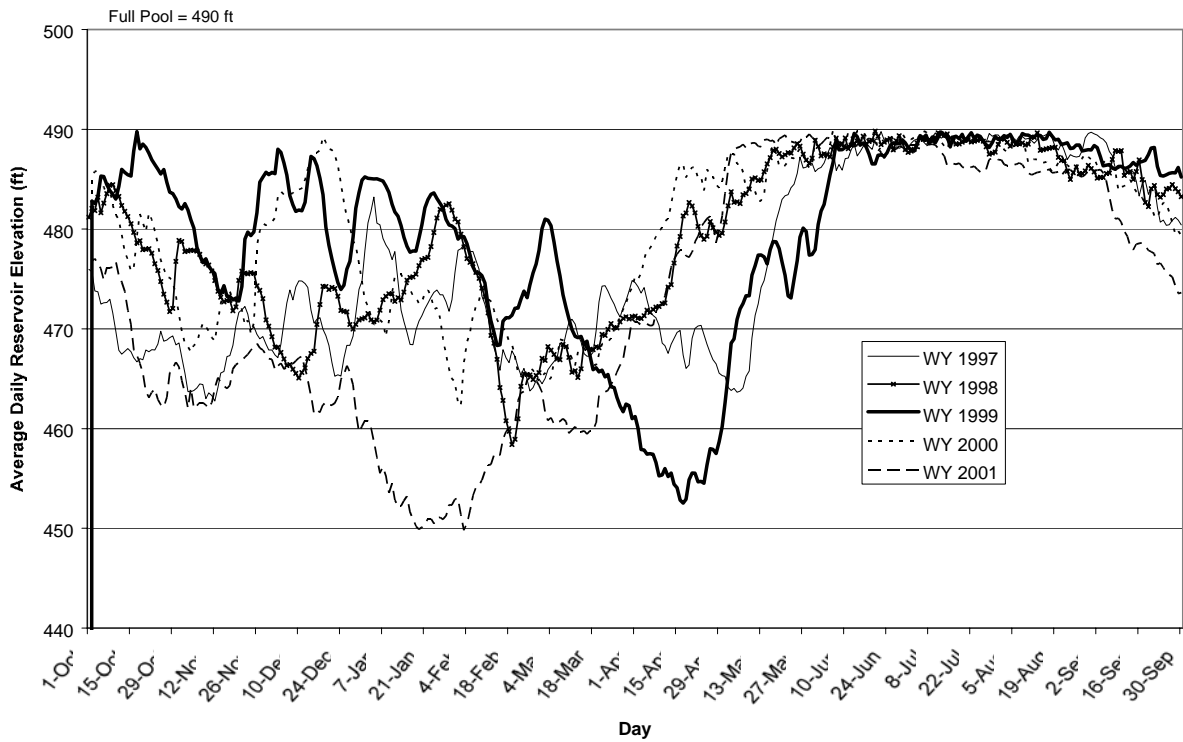
Project operations affect and cause variations in reservoir water levels and flows in two stream reaches: the Lewis River bypass reach and the Lewis River downstream of Merwin Dam. The effects of current project operations on reservoir water levels and daily average stream flows were determined through analysis of observed water level and flow data for representative recent years. The effects of current flood management operations on peak flows in the Lewis River downstream of Merwin Dam were analyzed using a computer model of the three-reservoir system as described in Section 3.2.3.1.

### 3.2.2.1 Reservoir Levels

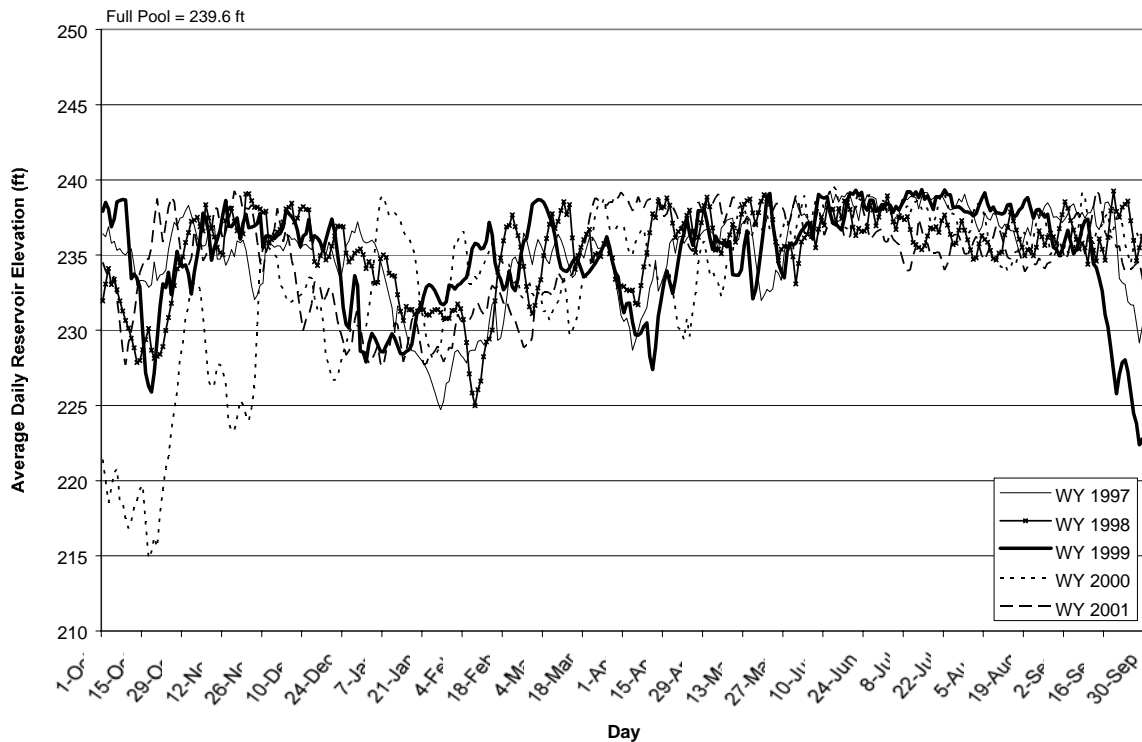
Plots of actual reservoir water surface elevation data from 1997 through 2001 are shown in Figures 3.2-1 through 3.2-3 for Swift, Yale and Merwin reservoirs respectively, and illustrate typical drawdown of water levels under current conditions due to flood management and power generation in the fall and winter months and relatively stable high water levels during the summer recreation season.



**Figure 3.2-1. Swift Creek Reservoir average daily and seasonal water elevations, water years 1997 – 2001.**



**Figure 3.2-2. Yale Lake average daily and seasonal water elevations, water years 1997 – 2001.**



**Figure 3.2-3. Lake Merwin average daily and seasonal water elevations, water years 1997 – 2001.**

### 3.2.2.2 Lewis River Bypass Reach

Under current conditions, flows from the Lewis River are diverted at Swift Dam into the Swift No. 2 canal and do not enter the 3.3-mile-long Lewis River bypass reach except during spill events (Figure 2.2-1, sheet 3). Flow in the bypass reach is a result of inflow from tributaries, groundwater, and canal seepage and spill. During high runoff conditions, when the projects are operating to manage floods in the basin or during operational emergencies, water is spilled into the reach from either the Swift Dam spillway or the Swift No. 2 canal spillway, located 1.25 miles downstream of Swift Dam. Flow in the Lewis River bypass reach is very low most of the time (approximately 5 to 10 cfs measured at the former USGS gage site upstream from the canal spillway; an estimated total of 21 cfs of accumulated groundwater and seepage at the downstream end of the reach). Flows below Ole Creek, near the downstream end of the reach, are higher as a result of inflows from the creek. Spill events occur sporadically, but in general, spills of several thousand cfs or greater occur every few years. The largest spill into the bypass reach from Swift Dam since the project was constructed was about 64,000 cfs in February 1996.

A flood frequency analysis was conducted on spill data from Swift Creek Reservoir to the Lewis River bypass reach for the period from 1976 through 2000, representative of existing conditions. Estimated maximum hourly spill rates by return period for current conditions and for the various alternatives are provided in Table 3.2-2. The lower spill rates under Alternatives B and C are the result of alternative flood management operations, as discussed in more detail in Sections 3.2.3.2 and 3.2.3.3.

**Table 3.2-2. Magnitude and frequency of spill from Swift Creek Reservoir.**

|                                       | Swift Spill Quantile (cfs) by Return Period (years) |       |        |        |        |
|---------------------------------------|---|-------|--------|--------|--------|
|                                       | 1.5   | 2     | 5      | 10     | 20     |
| Current Conditions<br>(Alternative A) | 0   | 5,000 | 28,000 | 43,000 | 55,000 |
| Alternative B                         | 0   | 5,000 | 28,000 | 40,000 | 50,000 |
| Alternative C                         | 0   | 5,000 | 28,000 | 40,000 | 50,000 |

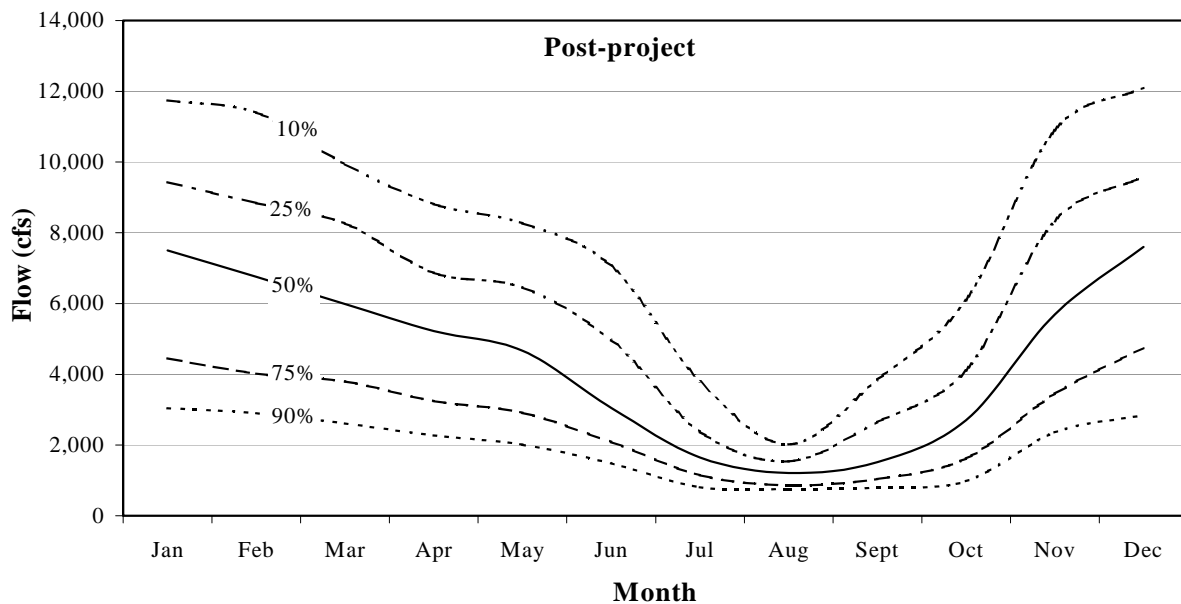
### 3.2.2.3 Flows in Speelyai Creek

Speelyai Creek is a tributary to Lake Merwin. A diversion structure 4.3 miles upstream of the mouth of the creek was installed to divert water from the upper watershed into a canal that carries flow into Yale Lake. This diversion has been non-functional since 1996 when floods altered the channel. The new channel directs flow into the canal regardless of the diversion structure. A second diversion structure, which supplies water to Speelyai Hatchery, is located 0.1 miles upstream of the mouth. The original purpose of the upper diversion structure was to divert all but 15 cfs of flow into the canal and Yale Lake with remaining flows supplying Speelyai Hatchery. The hatchery receives higher quality water when flows from the upper watershed are diverted to Yale Lake. Consequently, for the health of the fish in the hatchery and the desire for pathogen-free water, the upper diversion structure has remained closed, diverting all flow into the Speelyai Canal, since

1979 except for three occasions. The three occasions it was opened were during severe low flow conditions in October when additional water was needed at the hatchery. There are no plans to restore flows from the upper watershed to lower Speelyai Creek. Flows in lower Speelyai Creek are supplied by springs and small tributaries. At the hatchery intake, flow averages 17 cfs in the summer months (July-September), and 21-28 cfs during the spring and winter. The Speelyai Hatchery operators report considerable leakage at the hatchery diversion structure, so it is likely that total streamflow (intake plus leakage) is greater than the reported intake flows.

### 3.2.2.4 Lewis River Downstream of Merwin Dam

Flows in the Lewis River downstream of Merwin Dam are affected by the coordinated operation of the three upstream project reservoirs. Flows in this reach are highest during the winter, decrease gradually in the spring, and are lowest during summer months (Figure 3.2-4). Storage of water in project reservoirs and operation of the turbines result in a step-wise flow pattern as units are turned on and off for power generation.



**Figure 3.2-4. Daily flow exceedance curve for Lewis River at Ariel (below Merwin Dam, USGS Gage 14220500; 1932 through 1998).**

### 3.2.2.5 Flood Management

One of the current operational objectives of the Lewis River Projects is to provide flood management for the lower Lewis River between Merwin Dam and the confluence with the Columbia River. This objective is accomplished in accordance with procedures established under a 1983 contract between PacifiCorp and FEMA, the terms of which are a condition of PacifiCorp's FERC licenses. The current flood management procedures are fully documented in PacifiCorp's Standard Operating Procedures. Key aspects of these procedures are described in PacifiCorp and Cowlitz PUD (2003f and 2004: FLD 1).

Under current operations, PacifiCorp provides 70,000 acre-feet of dependable flood control storage space in the three-reservoir system of Swift, Yale, and Merwin between November 1 and April 1. Drawdown of the reservoirs to provide this storage starts by September 20. The reservoirs may be gradually refilled after April 1 such that the normal full pool is reached by April 30. The surface area of each of the three reservoirs at full pool is about 4,000 acres. The 70,000 acre-feet of mandated flood control storage thus requires a total cumulative drawdown among the three reservoirs of about 17 feet. Past and current operating experience demonstrates that actual drawdown during the flood management season is usually significantly greater than this required minimum as a result of snowpack conditions, climatological conditions, and normal operations for power generation. Plots of actual reservoir water surface elevations over five recent years are provided in Figures 3.2-1 through 3.2-3.

Estimates of the magnitude and frequency of floods for the Lewis River below Merwin Dam, based on analysis of flood control operations and historic flood data, are provided in Table 3.2-3 for current conditions and for the various flood management alternatives. The largest major flood in recent years, in February 1996, had a return period of approximately 50 years and caused considerable damage in the Lewis River valley below Merwin Dam. That event has been used as a benchmark in these studies for comparing the impact of current operations and alternative actions on flood hazard. The estimated peak flows under current flood control operations during the February 1996 flood and during a repeat of other significant historic floods are provided in Table 3.2-4. The socioeconomic impacts of the February 1996 flood are discussed in Section 3.11.2.6.

**Table 3.2-3. Flood magnitude and frequency by alternative for Lewis River below Merwin Dam.**

| Alternative                           | Location | Flow Quantile (cfs) by Return Period (yrs) |        |        |         |         |         |
|---------------------------------------|----------|--|--------|--------|---------|---------|---------|
|                                       |          | 1.5  | 2      | 10     | 50      | 100     | 500     |
| Current Conditions<br>(Alternative A) | Ariel    | 12,000                                     | 22,000 | 60,000 | 85,000  | 90,000  | 140,000 |
|                                       | Woodland | n/a  | n/a    | 65,600 | 92,600  | 98,400  | 150,500 |
|                                       | Mouth    | n/a  | n/a    | 85,400 | 119,400 | 128,200 | 187,600 |
| Alternative B                         | Ariel    | 15,000                                     | 25,000 | 50,000 | 60,000  | 90,000  | 140,000 |
| Alternative C                         | Ariel    | 15,000                                     | 25,000 | 50,000 | 60,000  | 90,000  | 140,000 |

Notes: Analyses based on the period of record 1912 - 2000.  
 Flows based on actual or expected storage available for flood management.

**Table 3.2-4. Natural and regulated peak flows for Lewis River at Ariel (below Merwin Dam).**

| Date of Peak     | Natural (Unregulated)<br>Peak Flow (cfs) | Current Conditions (Regulated)<br>Peak Flow (cfs) |
|------------------|--|---|
| 18 December 1917 | 92,000                                   | 85,000  |
| 22 December 1933 | 116,000                                  | 90,000  |
| 13 December 1946 | 67,300                                   | n/a   |
| 20 November 1962 | 79,200                                   | 60,000  |
| 20 January 1972  | 76,600                                   | 60,000  |
| 15 January 1974  | 76,200                                   | 60,000  |

**Table 3.2-4. Natural and regulated peak flows for Lewis River at Ariel (below Merwin Dam) (cont.).**

| <b>Date of Peak</b> | <b>Natural (Unregulated)<br/>Peak Flow (cfs)</b> | <b>Current Conditions (Regulated)<br/>Peak Flow (cfs)</b> |
|---------------------|--|---|
| 4 December 1975     | 80,700   | 60,000  |
| 2 December 1977     | 82,900   | 60,000  |
| 8 February 1996     | 111,400  | 85,000  |

Note: Data available from the December 1946 flood are insufficient to determine regulated peak flow under current conditions.

Further details of the flood management analyses undertaken for relicensing can be found in PacifiCorp and Cowlitz PUD (2003f and 2004: FLD 1).

### 3.2.3 Effects of Alternatives

#### 3.2.3.1 Alternative A

Under Alternative A, the projects would be operated as they are under current conditions. The resulting reservoir water levels and flow regimes in affected stream reaches would be as described under Section 3.2.2.

#### Operations Model for Comparison of Alternatives

A computer model was developed to facilitate comparison of the effects of alternative project operations on reservoir elevations and projects outflows. The model used inflow data together with project operating rules, other project data and operational constraints to simulate daily average reservoir elevations, reservoir outflows and power generation at Swift No. 1, Yale, and Merwin, plus outflows and power generation at Swift No. 2, during an average water year. Additional computations were made to estimate maximum and minimum reservoir elevations and outflows during representative wet and dry years. The computer model incorporates the significant features of each alternative that could affect reservoir operations, including, for example, minimum flows in the Lewis River bypass reach. The model seeks to optimize power generation while meeting streamflow and reservoir elevation requirements or targets. Modeling was done at a daily time step, using daily average data, and then summarized by month.

The results show, for each month, the range of reservoir water surface elevations and outflows that would have been experienced. The modeling results for Alternative A provide the baseline data against which results for Alternatives B and C may be compared. The effects of alternative project operations on power generation are discussed in more detail in Section 4.0.

The following are definitions of the column headings used in the tables showing model results for each alternative (Table 3.2-5 through 3.2-7):

#### **Reservoir Elevations:**

50% exceedance indicates, for each month, the reservoir water surface elevation that is exceeded 50 percent of the time over the simulation period.



Minimum Actual indicates, for each month, the minimum reservoir water surface elevation achieved over the simulation period.

Minimum Available indicates the minimum allowable reservoir water surface elevation.

Maximum Actual indicates, for each month, the maximum reservoir elevation achieved over the simulation period.

Maximum Available indicates the normal maximum reservoir water surface elevation at full pool.

**Outflow:**

50% exceedance indicates, for each month, the reservoir outflow that is exceeded 50 percent of the time over the simulation period.

Minimum Actual indicates, for each month, the minimum reservoir outflow achieved over the simulation period.

Minimum Available indicates, for each month, the prescribed minimum reservoir outflow.

Maximum Actual indicates, for each month, the maximum (daily) reservoir outflow achieved over the simulation period.

Turbine Capacity indicates the nominal maximum release through the turbines.

Alternative A Model Results

The modeling results for Alternative A (current conditions) are summarized in Table 3.2-5 and the seasonal variations in water levels are plotted in Figures 3.2-5 through 3.2-7. These data are provided as a baseline for comparison of the Alternatives B and C model results. Annual average power generation (see Section 4.3 in PacifiCorp's PDEA and Section 4.4 in Cowlitz PUD's PDEA) under Alternative A is estimated at 1,715,400 MWh for the combined Swift No. 1, Yale, and Merwin projects, and 217,300 MWh for Swift No. 2.

3.2.3.2 Alternative B

As discussed previously, a project operations model and a flood management simulation model were used to predict the effect of the different project operation alternatives on reservoir water levels and streamflows. The operations model was run using an average water year, with the assumption that streamflow and reservoir elevation requirements would be met under the different alternatives. As a result, the effects of the operational changes show up as lost generation.

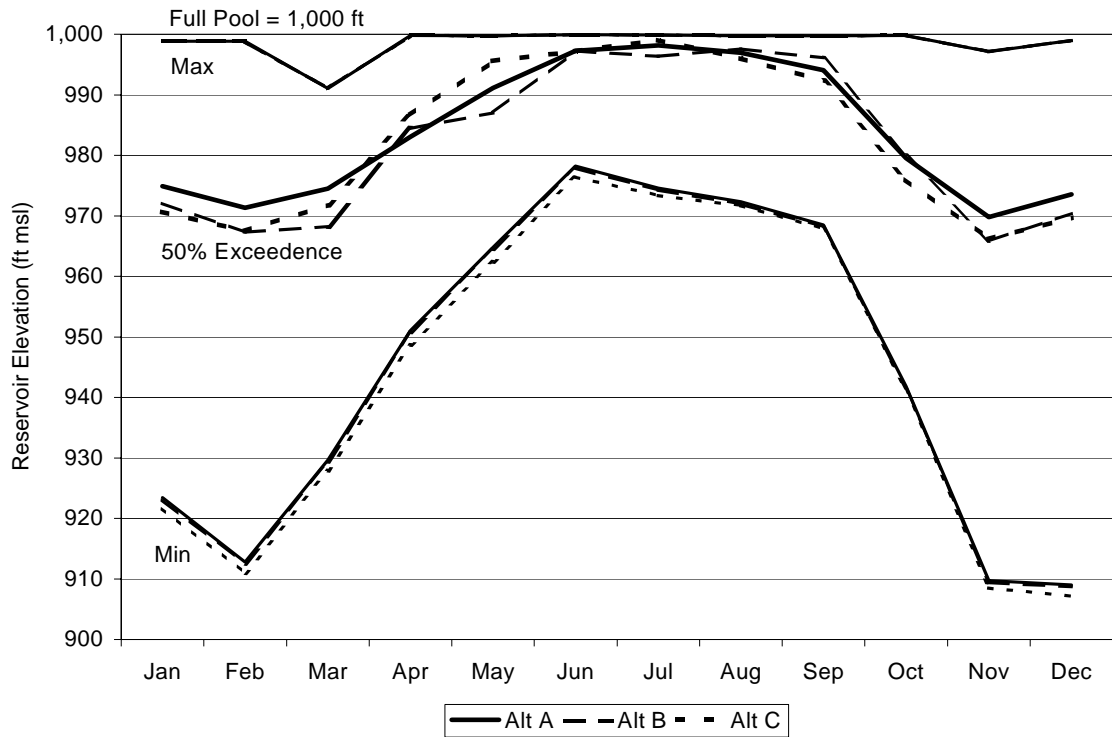
**Table 3.2-5. Alternative A reservoir operations summary.**

| Alternative: A<br>Reservoir: Swift |                | Reservoir Elevations - feet MSL |           |         |           |                | Outflow - cfs |           |         |                  |  |
|------------------------------------|----------------|---------------------------------|-----------|---------|-----------|----------------|---------------|-----------|---------|------------------|--|
| Month                              | 50% exceedance | Minimum                         |           | Maximum |           | 50% exceedance | Minimum       |           | Maximum | Turbine Capacity |  |
|                                    |                | Actual                          | Available | Actual  | Available |                | Actual        | Available |         |                  |  |
| Jan                                | 974.92         | 923.47                          | 878.00    | 998.83  | 1000.00   | 4,130          | -             | -         | 31,014  | 9,120            |  |
| Feb                                | 971.31         | 912.78                          | 878.00    | 998.83  | 1000.00   | 4,251          | -             | -         | 53,371  | 9,120            |  |
| Mar                                | 974.48         | 929.68                          | 878.00    | 991.08  | 1000.00   | 3,938          | -             | -         | 8,345   | 9,120            |  |
| Apr                                | 983.08         | 951.08                          | 878.00    | 999.79  | 1000.00   | 3,597          | -             | -         | 11,522  | 9,120            |  |
| May                                | 991.10         | 964.81                          | 878.00    | 999.74  | 1000.00   | 3,418          | -             | -         | 7,761   | 9,120            |  |
| Jun                                | 997.25         | 978.24                          | 878.00    | 999.94  | 1000.00   | 2,286          | -             | -         | 11,618  | 9,120            |  |
| Jul                                | 998.13         | 974.59                          | 878.00    | 999.89  | 1000.00   | 1,323          | -             | -         | 4,599   | 9,120            |  |
| Aug                                | 996.96         | 972.31                          | 878.00    | 999.77  | 1000.00   | 1,021          | -             | -         | 4,067   | 9,120            |  |
| Sep                                | 994.08         | 968.50                          | 878.00    | 999.73  | 1000.00   | 938            | -             | -         | 4,830   | 9,120            |  |
| Oct                                | 979.56         | 941.83                          | 878.00    | 999.80  | 1000.00   | 2,312          | -             | -         | 9,126   | 9,120            |  |
| Nov                                | 969.78         | 909.70                          | 878.00    | 997.15  | 1000.00   | 3,683          | -             | -         | 32,415  | 9,120            |  |
| Dec                                | 973.57         | 909.00                          | 878.00    | 998.99  | 1000.00   | 4,276          | -             | -         | 23,942  | 9,120            |  |

| Alternative: A<br>Reservoir: Yale |                | Reservoir Elevations - feet MSL |           |         |           |                | Outflow - cfs |           |         |                  |  |
|-----------------------------------|----------------|---------------------------------|-----------|---------|-----------|----------------|---------------|-----------|---------|------------------|--|
| Month                             | 50% exceedance | Minimum                         |           | Maximum |           | 50% exceedance | Minimum       |           | Maximum | Turbine Capacity |  |
|                                   |                | Actual                          | Available | Actual  | Available |                | Actual        | Available |         |                  |  |
| Jan                               | 473.81         | 449.89                          | 430.00    | 488.16  | 490.00    | 6,009          | -             | -         | 32,150  | 9,760            |  |
| Feb                               | 474.85         | 449.82                          | 430.00    | 489.35  | 490.00    | 6,051          | -             | -         | 47,474  | 9,760            |  |
| Mar                               | 475.45         | 457.79                          | 430.00    | 488.76  | 490.00    | 5,774          | -             | -         | 9,829   | 9,760            |  |
| Apr                               | 479.58         | 452.54                          | 430.00    | 489.79  | 490.00    | 4,497          | -             | -         | 14,658  | 9,760            |  |
| May                               | 487.53         | 463.65                          | 430.00    | 489.87  | 490.00    | 3,738          | -             | -         | 9,323   | 9,760            |  |
| Jun                               | 488.52         | 481.80                          | 430.00    | 489.96  | 490.00    | 2,568          | -             | -         | 12,772  | 9,760            |  |
| Jul                               | 488.33         | 484.42                          | 430.00    | 490.00  | 490.00    | 1,657          | -             | -         | 5,180   | 9,760            |  |
| Aug                               | 486.78         | 484.58                          | 430.00    | 489.87  | 490.00    | 1,328          | -             | -         | 4,615   | 9,760            |  |
| Sep                               | 483.06         | 465.90                          | 430.00    | 489.56  | 490.00    | 1,846          | -             | -         | 6,255   | 9,760            |  |
| Oct                               | 472.49         | 462.17                          | 430.00    | 489.77  | 490.00    | 2,708          | -             | -         | 8,153   | 9,760            |  |
| Nov                               | 475.26         | 462.02                          | 430.00    | 489.58  | 490.00    | 4,535          | -             | -         | 33,488  | 9,760            |  |
| Dec                               | 474.16         | 459.66                          | 430.00    | 489.24  | 490.00    | 6,512          | -             | -         | 33,031  | 9,760            |  |

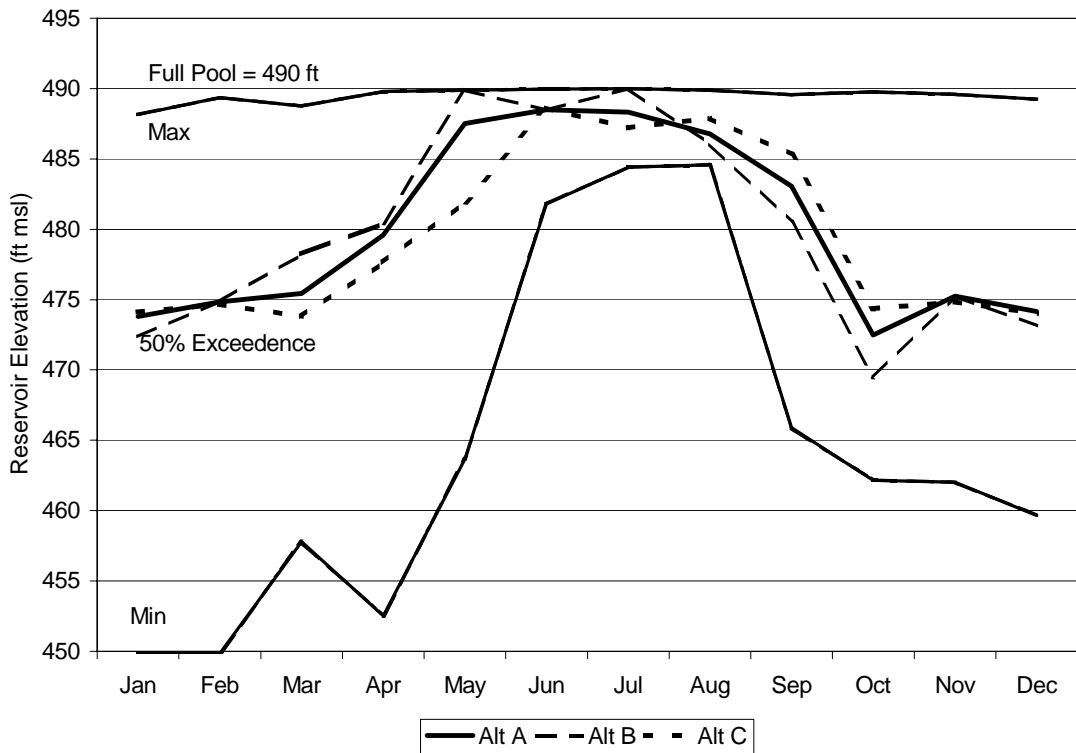
| Alternative: A<br>Reservoir: Merwin |                | Reservoir Elevations - feet MSL |           |         |           |                | Outflow - cfs |           |         |                  |  |
|-------------------------------------|----------------|---------------------------------|-----------|---------|-----------|----------------|---------------|-----------|---------|------------------|--|
| Month                               | 50% exceedance | Minimum                         |           | Maximum |           | 50% exceedance | Minimum       |           | Maximum | Turbine Capacity |  |
|                                     |                | Actual                          | Available | Actual  | Available |                | Actual        | Available |         |                  |  |
| Jan                                 | 234.46         | 224.72                          | 165.00    | 238.91  | 239.60    | 7,450          | 1,510         | 1,500     | 40,353  | 11,470           |  |
| Feb                                 | 234.53         | 224.15                          | 165.00    | 239.06  | 239.60    | 6,950          | 1,329         | 1,500     | 61,730  | 11,470           |  |
| Mar                                 | 234.70         | 221.46                          | 165.00    | 239.20  | 239.60    | 6,250          | 1,023         | 2,000     | 12,526  | 11,470           |  |
| Apr                                 | 235.81         | 224.69                          | 165.00    | 239.24  | 239.60    | 4,650          | 1,356         | 2,700     | 16,103  | 11,470           |  |
| May                                 | 236.80         | 227.02                          | 165.00    | 239.47  | 239.60    | 3,936          | 1,712         | 2,700     | 11,446  | 11,470           |  |
| Jun                                 | 238.00         | 233.63                          | 165.00    | 239.58  | 239.60    | 2,767          | 1,560         | 2,700     | 17,900  | 11,470           |  |
| Jul                                 | 237.40         | 233.95                          | 165.00    | 239.49  | 239.60    | 1,638          | 1,130         | 1,500     | 4,876   | 11,470           |  |
| Aug                                 | 236.39         | 233.90                          | 165.00    | 239.60  | 239.60    | 1,252          | 622           | 1,200     | 2,724   | 11,470           |  |
| Sep                                 | 235.70         | 201.45                          | 165.00    | 239.26  | 239.60    | 1,955          | 869           | 1,200     | 9,574   | 11,470           |  |
| Oct                                 | 235.35         | 201.16                          | 165.00    | 239.05  | 239.60    | 2,792          | 905           | 1,200     | 11,537  | 11,470           |  |
| Nov                                 | 235.03         | 202.20                          | 165.00    | 239.34  | 239.60    | 5,653          | 1,986         | 4,200     | 44,491  | 11,470           |  |
| Dec                                 | 234.80         | 226.66                          | 165.00    | 239.10  | 239.60    | 8,048          | 1,510         | 1,500     | 44,066  | 11,470           |  |

Notes: Column heading definitions are provided in Section 3.2.3.1.  
 All data (both reservoir elevations and outflows) are daily averages.



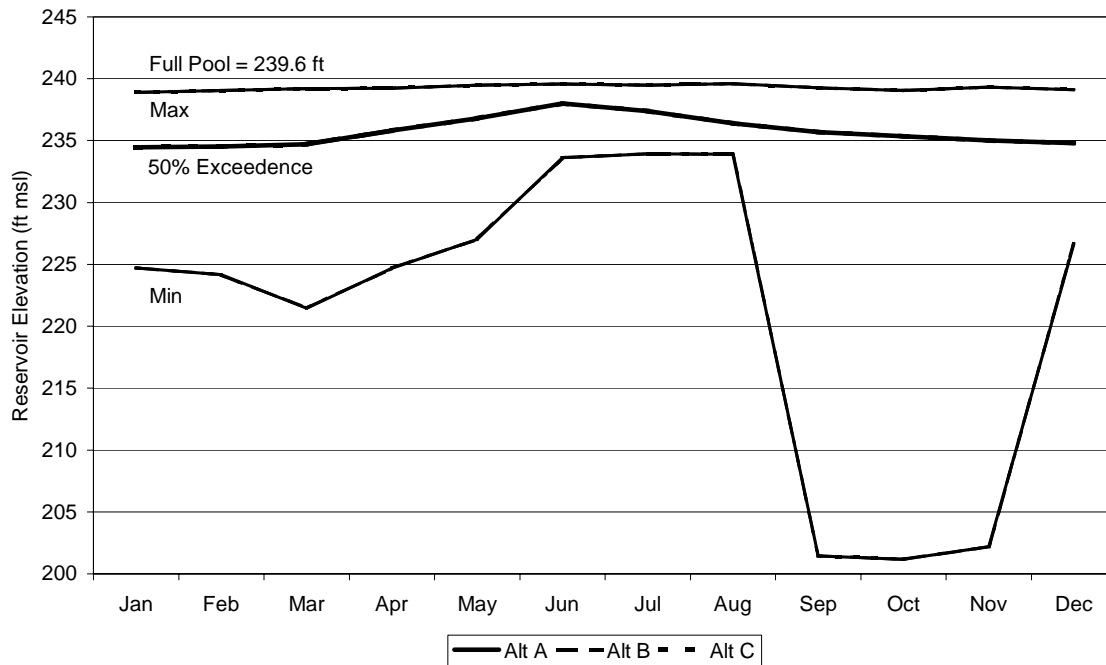
Note: Maximum water levels would be the same under all alternatives.

**Figure 3.2-5. Swift Creek Reservoir levels under Alternatives A, B, and C.**



Note: Maximum and minimum water levels would be the same under all alternatives.

**Figure 3.2-6. Yale Lake levels under Alternatives A, B, and C.**



Note: Lake Merwin water levels would be the same under all alternatives.

**Figure 3.2-7. Lake Merwin levels under Alternatives A, B, and C.**

The following sections describe the effects of Alternative B on reservoir levels, flows in the Lewis River bypass reach, flows in Speelyai Creek, flows downstream from Merwin dam, flood management, and power generation.

Reservoir Levels

The reservoir operations model provided information on water levels in Swift Creek Reservoir, Yale Lake, and Lake Merwin under the different alternatives considered for an average water year. Model output for Alternative B is provided in Table 3.2-6 and can be compared with other alternatives in Figures 3.2-5 through 3.2-7. Water levels in Swift Creek Reservoir under Alternative B would average about four feet lower than under Alternative A in the winter and early spring months, while average water levels in the summer would see little change. There would be minor changes in water levels in Yale Lake, with water levels in the fall and winter months averaging about two feet lower than under Alternative A, while summer levels would again see little change. Lake Merwin levels would be very similar under all three alternatives. These differences are due to a variety of factors including adoption of minimum releases to the bypass reach under Alternative B, and the effects of optimizing power generation while meeting the modified flow requirements. Compared with normal seasonal and year-to-year fluctuations under baseline conditions, the effect of Alternative B would be relatively small, as is illustrated in Figures 3.2-5 through 3.2-7, and is not expected to have any significant impact on recreational users or other resources.

**Table 3.2-6. Alternative B reservoir operations summary.**

| Alternative Reservoir: B Swift |                                 |                |           |                |           |                |                |           |                |                  |
|--------------------------------|---------------------------------|----------------|-----------|----------------|-----------|----------------|----------------|-----------|----------------|------------------|
| Month                          | Reservoir Elevations - feet MSL |                |           |                |           | Outflow - cfs  |                |           |                |                  |
|                                | 50% exceedance                  | Minimum Actual | Available | Maximum Actual | Available | 50% exceedance | Minimum Actual | Available | Maximum Actual | Turbine Capacity |
| Jan                            | 972.09                          | 923.14         | 878.00    | 998.83         | 1000.00   | 4,106          | 50             | 50        | 31,014         | 9,120            |
| Feb                            | 967.30                          | 912.45         | 878.00    | 998.83         | 1000.00   | 4,333          | 50             | 50        | 53,371         | 9,120            |
| Mar                            | 968.22                          | 929.35         | 878.00    | 991.08         | 1000.00   | 4,096          | 50             | 50        | 8,345          | 9,120            |
| Apr                            | 984.41                          | 950.75         | 878.00    | 999.79         | 1000.00   | 3,065          | 50             | 50        | 11,522         | 9,120            |
| May                            | 987.02                          | 964.48         | 878.00    | 999.74         | 1000.00   | 3,796          | 50             | 50        | 7,761          | 9,120            |
| Jun                            | 997.28                          | 977.91         | 878.00    | 999.94         | 1000.00   | 1,998          | 50             | 50        | 11,618         | 9,120            |
| Jul                            | 996.37                          | 974.26         | 878.00    | 999.89         | 1000.00   | 1,448          | 50             | 50        | 4,599          | 9,120            |
| Aug                            | 997.54                          | 971.98         | 878.00    | 999.77         | 1000.00   | 857            | 50             | 50        | 4,067          | 9,120            |
| Sep                            | 996.12                          | 968.17         | 878.00    | 999.73         | 1000.00   | 836            | 50             | 50        | 4,830          | 9,120            |
| Oct                            | 980.00                          | 941.50         | 878.00    | 999.80         | 1000.00   | 2,424          | 50             | 50        | 9,126          | 9,120            |
| Nov                            | 965.79                          | 909.37         | 878.00    | 997.15         | 1000.00   | 3,993          | 50             | 50        | 32,415         | 9,120            |
| Dec                            | 970.39                          | 908.67         | 878.00    | 998.99         | 1000.00   | 4,219          | 50             | 50        | 23,942         | 9,120            |

| Alternative Reservoir: B Yale |                                 |                |           |                |           |                |                |           |                |                  |
|-------------------------------|---------------------------------|----------------|-----------|----------------|-----------|----------------|----------------|-----------|----------------|------------------|
| Month                         | Reservoir Elevations - feet MSL |                |           |                |           | Outflow - cfs  |                |           |                |                  |
|                               | 50% exceedance                  | Minimum Actual | Available | Maximum Actual | Available | 50% exceedance | Minimum Actual | Available | Maximum Actual | Turbine Capacity |
| Jan                           | 472.36                          | 449.89         | 430.00    | 488.16         | 490.00    | 6,009          | -              | -         | 32,150         | 9,760            |
| Feb                           | 474.86                          | 449.82         | 430.00    | 489.35         | 490.00    | 6,051          | -              | -         | 47,474         | 9,760            |
| Mar                           | 478.25                          | 457.79         | 430.00    | 488.76         | 490.00    | 5,774          | -              | -         | 9,829          | 9,760            |
| Apr                           | 480.42                          | 452.54         | 430.00    | 489.79         | 490.00    | 4,076          | -              | -         | 14,658         | 9,760            |
| May                           | 489.97                          | 463.65         | 430.00    | 490.00         | 490.00    | 3,879          | -              | -         | 9,323          | 9,760            |
| Jun                           | 488.47                          | 481.80         | 430.00    | 489.96         | 490.00    | 2,568          | -              | -         | 12,772         | 9,760            |
| Jul                           | 490.00                          | 484.42         | 430.00    | 490.00         | 490.00    | 1,657          | -              | -         | 5,180          | 9,760            |
| Aug                           | 486.06                          | 484.58         | 430.00    | 489.87         | 490.00    | 1,328          | -              | -         | 4,615          | 9,760            |
| Sep                           | 480.53                          | 465.90         | 430.00    | 489.56         | 490.00    | 1,846          | -              | -         | 6,255          | 9,760            |
| Oct                           | 469.47                          | 462.17         | 430.00    | 489.77         | 490.00    | 2,848          | -              | -         | 8,153          | 9,760            |
| Nov                           | 475.24                          | 462.02         | 430.00    | 489.58         | 490.00    | 4,675          | -              | -         | 33,488         | 9,760            |
| Dec                           | 473.14                          | 459.66         | 430.00    | 489.24         | 490.00    | 6,512          | -              | -         | 33,031         | 9,760            |

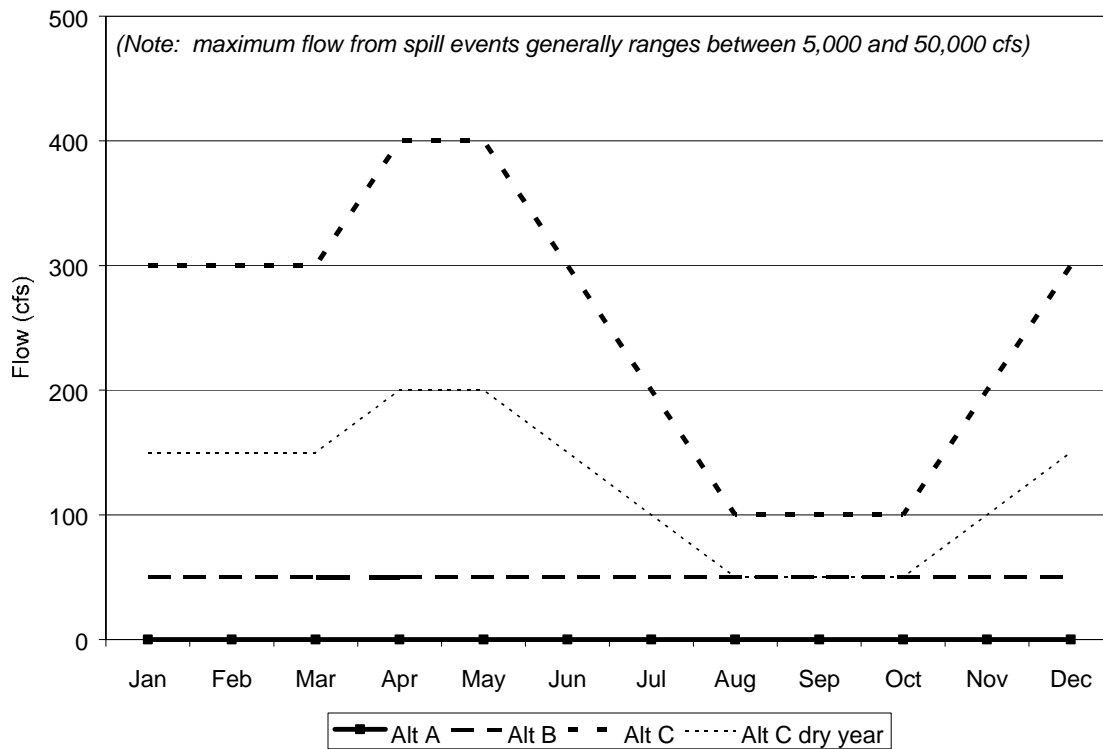
| Alternative Reservoir: B Merwin |                                 |                |           |                |           |                |                |           |                |                  |
|---------------------------------|---------------------------------|----------------|-----------|----------------|-----------|----------------|----------------|-----------|----------------|------------------|
| Month                           | Reservoir Elevations - feet MSL |                |           |                |           | Outflow - cfs  |                |           |                |                  |
|                                 | 50% exceedance                  | Minimum Actual | Available | Maximum Actual | Available | 50% exceedance | Minimum Actual | Available | Maximum Actual | Turbine Capacity |
| Jan                             | 234.46                          | 224.72         | 165.00    | 238.91         | 239.60    | 7,450          | 1,510          | 1,500     | 40,353         | 11,470           |
| Feb                             | 234.53                          | 224.15         | 165.00    | 239.06         | 239.60    | 6,950          | 1,329          | 1,500     | 61,730         | 11,470           |
| Mar                             | 234.70                          | 221.46         | 165.00    | 239.20         | 239.60    | 6,250          | 1,023          | 2,000     | 12,526         | 11,470           |
| Apr                             | 235.81                          | 224.69         | 165.00    | 239.24         | 239.60    | 4,229          | 1,356          | 2,700     | 16,103         | 11,470           |
| May                             | 236.80                          | 227.02         | 165.00    | 239.47         | 239.60    | 4,077          | 1,712          | 2,700     | 11,446         | 11,470           |
| Jun                             | 238.00                          | 233.63         | 165.00    | 239.58         | 239.60    | 2,767          | 1,560          | 2,700     | 17,900         | 11,470           |
| Jul                             | 237.40                          | 233.95         | 165.00    | 239.49         | 239.60    | 1,638          | 1,130          | 1,500     | 4,876          | 11,470           |
| Aug                             | 236.39                          | 233.90         | 165.00    | 239.60         | 239.60    | 1,252          | 622            | 1,200     | 2,724          | 11,470           |
| Sep                             | 235.70                          | 201.45         | 165.00    | 239.26         | 239.60    | 1,955          | 869            | 1,200     | 9,574          | 11,470           |
| Oct                             | 235.35                          | 201.16         | 165.00    | 239.05         | 239.60    | 2,932          | 905            | 1,200     | 11,537         | 11,470           |
| Nov                             | 235.03                          | 202.20         | 165.00    | 239.34         | 239.60    | 5,793          | 1,986          | 4,200     | 44,491         | 11,470           |
| Dec                             | 234.80                          | 226.66         | 165.00    | 239.10         | 239.60    | 8,048          | 1,510          | 1,500     | 44,066         | 11,470           |

Notes: Column heading definitions are provided in Section 3.2.3.1.  
 All data (both reservoir elevations and outflows) are daily averages.

Lewis River Bypass Reach

Under Alternative B, a constant flow of 50 cfs would be released into the upper end of the Lewis River bypass reach through a new outlet mechanism that would convey water from Swift No. 2 canal into the bypass reach approximately 2,000 feet downstream from Swift Dam. Flows would increase further down the bypass reach as a result of local inflows and canal seepage. As under Alternative A, during peak flows, releases from Swift No. 2 canal or the Swift Dam spillway would continue to pass through the reach.

A comparison of modeled daily average 50 percent exceedance flow releases into the Lewis River bypass reach is shown in Figure 3.2-8. This depicts conditions at the upper end of the reach; actual flows further downstream would be higher as a result of inflow and canal seepage.



**Figure 3.2-8. Daily average flow releases into the Lewis River bypass reach under Alternatives A, B, and C (50 percent exceedance values).**

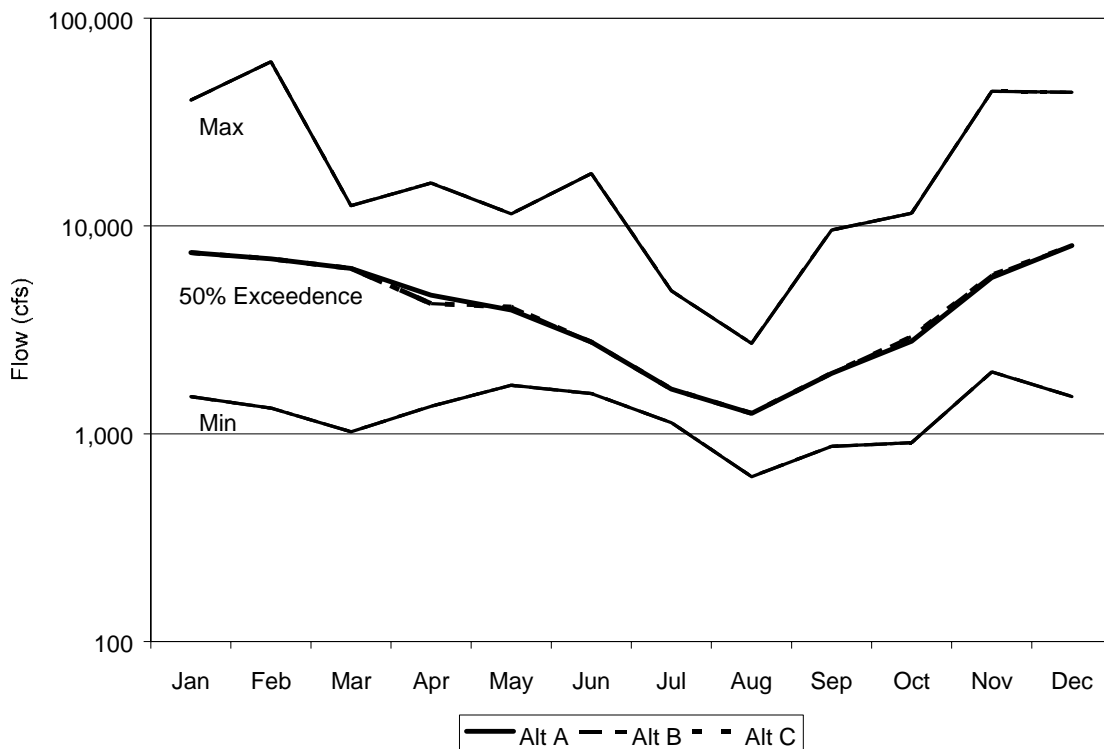
High runoff operating procedures under Alternative B would be modified to take advantage of improved flow forecasts. As is described below (Flood Management), pre-release operations would not affect spill into the bypass reach. Such spills are expected to be similar to Alternative A, except in large events where some shaving of peak flows would be expected. Table 3.2-2 presents estimates of the magnitude and frequency of such events.

Flows in Speelyai Creek

The effects of Alternative B on flows in Speelyai Creek would be the same as Alternative A because no new measures are proposed.

Lewis River Downstream of Merwin Dam

Flows downstream of Merwin Dam would be essentially the same under Alternative B as under Alternative A (Table 3.2-6 and Figure 3.2-9); however, in addition, a critical flow of 8,000 cfs would be provided.



Note: Maximum and minimum flows would be the same under all alternatives.

**Figure 3.2-9. Monthly flow releases downstream of Merwin Dam under Alternatives A, B, and C.**

Flood Management

Under Alternative B, the amount of dependable flood control storage would be maintained at 70,000 acre-feet (17 feet of project hole); however, that storage would be used more effectively through various operational changes based on weather and flow forecasts. The modified operations would include pre-releases from Merwin Dam, triggered by forecasts, and implementation of a policy to allow the projects to be operated at higher water levels on the falling limb of inflow hydrographs, thereby allowing for

additional reduction in peak releases from Merwin Dam. The amount of flood management storage would be maintained at the current level of 70,000 acre-feet (17 feet of project hole).

The pre-release operations under Alternative B would temporarily draw down Lake Merwin and Yale Lake to create additional flood management space. Pre-releases would not require additional drawdown of Swift Creek Reservoir.

The effects of these changes under Alternative B would be a moderate reduction in the magnitude of floods from about the five-year flood up to about the 50-year flood. The magnitude of severe floods (those which occur about once every 100 years on average and less frequently) would be unchanged (Table 3.2-3).

Pre-releases (turbine flows plus spill) from Merwin Dam under Alternative B, based on flow forecasts, would be made about once a year on average, ranging in magnitude from about 15,000 to 25,000 cfs. Pre-releases would be made up to about 48 hours in advance of forecasted high flow events and would temporarily lower pool elevations at Merwin and, to a lesser extent, at Yale Lake. It is anticipated that pre-releases would not affect pool elevations at Swift Creek Reservoir and would not result in change to the magnitude and frequency of spills to the Lewis River bypass reach. Pre-releases can be expected to result in a temporary additional increase of flood management storage of up to 60,000 acre-feet – this translates into a maximum temporary increase in combined drawdown at Merwin and Yale of about 15 feet of additional storage space. As a component of flood management operations, pre-releases would be exempt from ramping rate restrictions.

In years with below average March runoff forecasts, the flood management season would be shortened by two weeks, ending on March 15 instead of April 1. This measure would allow earlier project refill in dry years, slightly reducing the risk of failing to achieve refill due to low water conditions. Note from Figures 3.2-1 through 3.2-3 that drawdown in the winter months is dominated primarily by snowpack, climatological factors, and power generation operations, and that drawdown for flood management itself generally does not affect refill.

### Power Generation

Generation losses under Alternative B are primarily a result of the increased flows directed to the Lewis River bypass reach, as discussed above. Under Alternative B, there would be a reduction in annual generation (relative to Alternative A) from the Swift projects during an average water year of about 3,500 MWh. In addition to power generation losses, increased flows in the bypass reach reduce operational flexibility and other ancillary benefits. Further discussion of generation losses is provided in Section 4.1 of PacifiCorp's PDEA and Section 4.4 of Cowlitz PUD's PDEA.

#### 3.2.3.3 Alternative C

A project operations model and a flood management simulation model were used to predict the effect of the different project operation alternatives on reservoir levels and



streamflows. The operations model was run using an average water year, with the assumption that streamflow and reservoir elevation requirements would be met under the different alternatives. As a result, the effects of the operational changes show up as lost generation.

The following sections describe the effects of Alternative C on reservoir levels, flows in the Lewis River bypass reach, flows in Speelyai Creek, flows downstream of Merwin Dam, flood management and power generation.

### Reservoir Levels

Reservoir operations modeling for Alternative C is provided in Table 3.2-7 and can be compared with other alternatives in Figures 3.2-5 through 3.2-7. The operational model predicts that water levels in Swift Creek Reservoir under Alternative C would average about four feet lower than under Alternative A in the winter, four feet higher in the spring, while water levels in the summer would see little change. Water levels in Yale Lake would average about three feet lower in the spring, while water levels during the remainder of the year would see little consistent change. Lake Merwin levels would be the same under each alternative. Differences between reservoir levels for Alternatives A and C result from a variety of factors including adoption of minimum flows in the bypass reach, ramping rate restrictions, adoption of pulsed flows below Merwin Dam, modified flood management operations, and optimization of power generation under the modified flow requirements and reservoir water level constraints. Water level differences under Alternative C are relatively small compared with normal seasonal and year-to-year fluctuations illustrated in Figures 3.2-1 through 3.2-3 and are not expected to have any significant impact on recreational users or other resources.

### Lewis River Bypass Reach

Under Alternative C, variable flows would be released into the upper end of the Lewis River bypass reach via a pipe from a Swift No. 1 penstock. Flow releases would vary seasonally, fluctuating between 100 and 400 cfs during normal water years (Table 3.2-8). During low water years (as determined by the National Weather Service Northwest River Forecast Center's Water Supply Forecast for the Lewis River at Ariel, WA), flows would vary between 50 and 200 cfs. As under Alternative A, during peak flows, releases from the Swift No. 2 canal or Swift Dam spillway would continue to pass through the reach. Spills during flood conditions into the bypass reach from Swift Creek Reservoir under Alternative C are expected to be similar to those under Alternative B (Table 3.2-2).

### Flows in Speelyai Creek

The effects of Alternative C on flows in Speelyai Creek would be the same as Alternative A as no new measures are proposed.

**Table 3.2-7. Alternative C reservoir operations summary.**

| Alternative Reservoir: C Swift |                                 |                |           |                |           |                |                |           |                |                  |
|--------------------------------|---------------------------------|----------------|-----------|----------------|-----------|----------------|----------------|-----------|----------------|------------------|
| Month                          | Reservoir Elevations - feet MSL |                |           |                |           | Outflow - cfs  |                |           |                |                  |
|                                | 50% exceedance                  | Minimum Actual | Available | Maximum Actual | Available | 50% exceedance | Minimum Actual | Available | Maximum Actual | Turbine Capacity |
| Jan                            | 970.66                          | 921.63         | 878.00    | 998.83         | 1000.00   | 4,156          | 276            | 276       | 31,014         | 9,120            |
| Feb                            | 967.46                          | 910.94         | 878.00    | 998.83         | 1000.00   | 4,223          | 276            | 276       | 53,371         | 9,120            |
| Mar                            | 971.82                          | 927.84         | 878.00    | 991.08         | 1000.00   | 3,855          | 276            | 276       | 8,345          | 9,120            |
| Apr                            | 986.64                          | 948.63         | 878.00    | 999.79         | 1000.00   | 3,160          | 368            | 368       | 11,522         | 9,120            |
| May                            | 995.62                          | 962.36         | 878.00    | 999.74         | 1000.00   | 3,351          | 368            | 368       | 7,761          | 9,120            |
| Jun                            | 997.17                          | 976.40         | 878.00    | 999.94         | 1000.00   | 2,607          | 276            | 276       | 11,618         | 9,120            |
| Jul                            | 999.04                          | 973.37         | 878.00    | 999.89         | 1000.00   | 1,254          | 184            | 184       | 4,599          | 9,120            |
| Aug                            | 996.06                          | 971.69         | 878.00    | 999.77         | 1000.00   | 1,148          | 93             | 93        | 4,067          | 9,120            |
| Sep                            | 992.26                          | 967.88         | 878.00    | 999.73         | 1000.00   | 1,002          | 93             | 93        | 4,830          | 9,120            |
| Oct                            | 976.06                          | 941.21         | 878.00    | 999.80         | 1000.00   | 2,429          | 93             | 93        | 9,126          | 9,120            |
| Nov                            | 966.10                          | 908.48         | 878.00    | 997.15         | 1000.00   | 3,695          | 184            | 184       | 32,415         | 9,120            |
| Dec                            | 969.68                          | 907.16         | 878.00    | 998.99         | 1000.00   | 4,291          | 276            | 276       | 23,942         | 9,120            |

| Alternative Reservoir: C Yale |                                 |                |           |                |           |                |                |           |                |                  |
|-------------------------------|---------------------------------|----------------|-----------|----------------|-----------|----------------|----------------|-----------|----------------|------------------|
| Month                         | Reservoir Elevations - feet MSL |                |           |                |           | Outflow - cfs  |                |           |                |                  |
|                               | 50% exceedance                  | Minimum Actual | Available | Maximum Actual | Available | 50% exceedance | Minimum Actual | Available | Maximum Actual | Turbine Capacity |
| Jan                           | 474.13                          | 449.89         | 430.00    | 488.16         | 490.00    | 6,009          | -              | -         | 32,150         | 9,760            |
| Feb                           | 474.67                          | 449.82         | 430.00    | 489.35         | 490.00    | 6,051          | -              | -         | 47,474         | 9,760            |
| Mar                           | 473.79                          | 457.79         | 430.00    | 488.76         | 490.00    | 5,774          | -              | -         | 9,829          | 9,760            |
| Apr                           | 477.65                          | 452.54         | 430.00    | 489.79         | 490.00    | 4,076          | -              | -         | 14,658         | 9,760            |
| May                           | 481.93                          | 463.65         | 430.00    | 489.87         | 490.00    | 3,879          | -              | -         | 9,323          | 9,760            |
| Jun                           | 488.60                          | 481.80         | 430.00    | 489.96         | 490.00    | 2,568          | -              | -         | 12,772         | 9,760            |
| Jul                           | 487.20                          | 484.42         | 430.00    | 490.00         | 490.00    | 1,657          | -              | -         | 5,180          | 9,760            |
| Aug                           | 487.90                          | 484.58         | 430.00    | 489.87         | 490.00    | 1,328          | -              | -         | 4,615          | 9,760            |
| Sep                           | 485.32                          | 465.90         | 430.00    | 489.56         | 490.00    | 1,846          | -              | -         | 6,255          | 9,760            |
| Oct                           | 474.34                          | 462.17         | 430.00    | 489.77         | 490.00    | 2,848          | -              | -         | 8,153          | 9,760            |
| Nov                           | 474.85                          | 462.02         | 430.00    | 489.58         | 490.00    | 4,675          | -              | -         | 33,488         | 9,760            |
| Dec                           | 474.02                          | 459.66         | 430.00    | 489.24         | 490.00    | 6,512          | -              | -         | 33,031         | 9,760            |

| Alternative Reservoir: C Merwin |                                 |                |           |                |           |                |                |           |                |                  |
|---------------------------------|---------------------------------|----------------|-----------|----------------|-----------|----------------|----------------|-----------|----------------|------------------|
| Month                           | Reservoir Elevations - feet MSL |                |           |                |           | Outflow - cfs  |                |           |                |                  |
|                                 | 50% exceedance                  | Minimum Actual | Available | Maximum Actual | Available | 50% exceedance | Minimum Actual | Available | Maximum Actual | Turbine Capacity |
| Jan                             | 234.46                          | 224.72         | 165.00    | 238.91         | 239.60    | 7,450          | 1,510          | 1,500     | 40,353         | 11,470           |
| Feb                             | 234.53                          | 224.15         | 165.00    | 239.06         | 239.60    | 6,950          | 1,329          | 1,500     | 61,730         | 11,470           |
| Mar                             | 234.70                          | 221.46         | 165.00    | 239.20         | 239.60    | 6,250          | 1,023          | 2,000     | 12,526         | 11,470           |
| Apr                             | 235.81                          | 224.69         | 165.00    | 239.24         | 239.60    | 4,229          | 1,356          | 2,700     | 16,103         | 11,470           |
| May                             | 236.80                          | 227.02         | 165.00    | 239.47         | 239.60    | 4,077          | 1,712          | 2,700     | 11,446         | 11,470           |
| Jun                             | 238.00                          | 233.63         | 165.00    | 239.58         | 239.60    | 2,767          | 1,560          | 2,700     | 17,900         | 11,470           |
| Jul                             | 237.40                          | 233.95         | 165.00    | 239.49         | 239.60    | 1,638          | 1,130          | 1,500     | 4,876          | 11,470           |
| Aug                             | 236.39                          | 233.90         | 165.00    | 239.60         | 239.60    | 1,252          | 622            | 1,200     | 2,724          | 11,470           |
| Sep                             | 235.70                          | 201.45         | 165.00    | 239.26         | 239.60    | 1,955          | 869            | 1,200     | 9,574          | 11,470           |
| Oct                             | 235.35                          | 201.16         | 165.00    | 239.05         | 239.60    | 2,932          | 905            | 1,200     | 11,537         | 11,470           |
| Nov                             | 235.03                          | 202.20         | 165.00    | 239.34         | 239.60    | 5,793          | 1,986          | 4,200     | 44,491         | 11,470           |
| Dec                             | 234.80                          | 226.66         | 165.00    | 239.10         | 239.60    | 8,048          | 1,510          | 1,500     | 44,066         | 11,470           |

Notes: Column heading definitions are provided in Section 3.2.3.1.  
 All data (both reservoir elevations and outflows) are daily averages.

**Table 3.2-8. Flow releases into the Lewis River bypass reach under Alternative C.**

| <b>Month</b>   | <b>Flow Release during Average Flow Years (cfs)</b> | <b>Flow Release during Low Flow Years (cfs)</b> |
|----------------|---|---|
| January-March  | 300   | 150   |
| April – May    | 400   | 200   |
| June           | 300   | 150   |
| July           | 200   | 100   |
| August-October | 100   | 50  |
| November       | 200   | 100   |
| December       | 300   | 150   |

### Flows Downstream of Merwin Dam

Under Alternative C, flows downstream of Merwin Dam would be similar to Alternative A (Table 3.2-7 and Figure 3.2-9), but pulsed flows of 5,000 cfs (or 120 percent of the current flow release if flows are higher than 5,000 cfs) would be provided one day per week for 12 hours between March 1 and June 30 to assist outmigrating smolts. Down ramping rates under the different alternatives would also be slightly different, as described in Section 3.4.3.3.

### Flood Management

Flood management measures under Alternative C are the same as those under Alternative B, resulting in a similar magnitude and frequency of floods (Table 3.2-3).

### Power Generation

Generation losses under Alternative C are primarily a result of the increased flows directed to the Lewis River bypass reach. There would be a reduction in annual generation (relative to Alternative A) from the Swift projects during an average to high water year of about 84,400 MWh. In low water years, when releases to the bypass reach would be lower, the generation losses would amount to about 43,200 MWh. In addition to power generation losses, increased flows in the bypass reach also result in a loss of project operational flexibility and other ancillary benefits. Further discussion of generation losses is provided in Section 4.1 of PacifiCorp's PDEA and Section 4.4 of Cowlitz PUD's PDEA.

### 3.2.4 Conclusion

### Reservoir Levels

There would be relatively minor changes to reservoir levels under each of the proposed alternatives assuming the projects were operated to meet streamflow and reservoir level requirements.

### Lewis River Bypass Reach

Flow releases would increase to 50 cfs under Alternative B and between 100 and 400 cfs under Alternative C. Both alternatives would provide greater flow in the reach than under Alternatives A, and would beneficially affect water quantity, water quality, aquatic and terrestrial resources, aesthetics, and recreation. The increased flows under Alternatives B and C would result in decreased generation at Swift No. 2. During flood conditions, spill from Swift Creek Reservoir into the bypass reach would be similar to or slightly lower than spills under Alternative A.

### Speelyai Creek Flows

No changes to flows in lower Speelyai Creek are proposed under any alternative so there are no new effects.

### Flows Below Merwin Dam

There would be minimal changes to average daily flow releases in the Lewis River downstream of Merwin Dam under each of the alternatives, with minor differences in ramping rates and slightly different spring operations. Under Alternative C, pulsed flows of approximately 5,000 cfs would be provided once/week for 12 hours between March 1 and July 30 to assist outmigrating smolts. This would provide beneficial effects to fisheries resources and have minor effects on generation.

### Flood Management

Under Alternative A, PacifiCorp would operate the projects under the current flood notification and warning procedures and the current high runoff procedures. As a result, flood flows below Merwin Dam would be similar to those experienced in the past, but, with continuing residential and commercial development in the Lewis River floodplain downstream from the projects, flood damage and flood hazard can be expected to increase somewhat (see also Section 3.11). Under Alternatives B and C, notification efforts would be enhanced and high runoff operating procedures modified to incorporate improved flow forecasts. Alternatives B and C have an identical package of measures to facilitate improvements to flood notification and warning procedures that would reduce flood hazard to life and property in the Lewis River valley. Modified high runoff procedures would reduce the magnitude of floods ranging from about the 5-year to the 50-year flood, and hence would further reduce flood hazard and flood damage relative to Alternative A. Alternatives B and C would retain the existing 70,000 acre-feet of flood control storage. None of the alternatives would affect the magnitude of the 100-year flood. Flood management effects under Alternative A are expected to be neutral or slightly adverse, while effects associated with Alternatives B and C are likely to be moderately beneficial.

### **3.3 WATER QUALITY**

#### **3.3.1 Resource Issues**

The assessment of project alternatives on water quality has been driven by two key questions:

- What are the current conditions and trends in the basin with regard to water quality?
- Are state water quality standards being met?

In addition, several specific issues were raised during the NEPA scoping process that helped to focus study objectives. Water quality issues identified included:

- Effects of continued operations on water quality;
- Effects of boating and other recreation uses on reservoir water quality;
- Speelyai Creek diversion and hatchery effects on water quality and flow regimes;
- Effects of Merwin and Lewis River hatcheries on water quality in the Lewis River; and
- Effects on upper basin from lack of trace elements and nutrients.

#### **3.3.2 Affected Environment**

Documentation of whether the projects comply with water quality standards for surface waters in the State of Washington has been important in characterizing the environmental baseline, and has been an objective of all water quality-related studies completed by the Applicants. Washington Department of Ecology (WDOE) water quality standards are contained in Chapter 173-201A of the Washington Administrative Code (WAC). These standards recently were revised by WDOE, although approval has not been obtained from the EPA, thus the former standards are the applicable standards under the Clean Water Act as of early 2004.

The former water quality standards are class-based, and project waters are classified as either AA (extraordinary), A (Good), or Lake Class (for natural lakes and reservoirs with more than a 15-day retention time). Numeric water quality standards exist for each class of water body, although “no measurable change from natural conditions” is the criterion for most parameters in Lake Class. Mainstem Lewis River reaches within the project area (downstream of the boundary of the Gifford Pinchot National Forest) are designated Class A. Feeder streams to the project reservoirs are designated Class AA, and the reservoirs themselves Lake Class. Existing standards for these classes of water bodies are summarized below (Table 3.3-1).

**Table 3.3-1. Summary of WDOE surface water quality standards for Class A, Class AA, and Lake Class water bodies.**

| Parameter           | Class A Standard   | Class AA Standard   | Lake Class Standard   |
|---------------------|--|---|---|
| Fecal coliform      | Not to exceed geometric mean of 100 col./100 mL, less than 10% of all samples exceeding 200 col./100 mL. | Not to exceed geometric mean of 50 col./100 mL, less than 10% of all samples exceeding 100 col./100 mL. | Not to exceed geometric mean of 50 col./100 mL, less than 10% of all samples exceeding 100 col./100 mL. |
| Dissolved oxygen    | Must exceed 8.0 mg/L.  | Must exceed 9.5 mg/L.   | No measurable decrease from natural conditions.   |
| Total dissolved gas | Not to exceed 110% of saturation.  | Not to exceed 110% of saturation.   | Not to exceed 110% of saturation.   |
| Temperature         | Must not exceed 18°C <sup>1</sup> .  | Must not exceed 16°C.   | No measurable change from natural conditions.   |
| pH                  | Within 6.5 to 8.5 <sup>2</sup> .   | Within 6.5 to 8.5 <sup>2</sup> .  | No measurable change from natural conditions.   |
| Turbidity           | Not to exceed 5 NTU over background, or 10% over background of 50 NTU or more.                           | Not to exceed 5 NTU over background, or 10% over background of 50 NTU or more.                          | Not to exceed 5 NTU over background conditions.   |

1 When natural conditions exceed 18°C (Class A) or 16°C (Class AA), no temperature increase will be allowed which raises receiving water temperature by more than 0.3°C. Incremental increases from point source activities may not exceed  $t=28/(T+7)$  (Class A) or  $t=23/(T+7)$  (Class AA), where  $t$  = maximum possible increase at the mixing zone boundary, and  $T$  is background, unaffected upstream temperature. Incremental increases from non point sources may not exceed 2.8°C.

2 Human-caused variations must be within a range of 0.2 pH units.

On July 1, 2003, WDOE adopted revised standards for temperature, and restructured the water quality standards to a "use-based" format (i.e., numeric temperature criteria specific to salmonid spawning, rearing, etc.). Under the revised standards, former Class AA waters are designated core rearing waters, and former Class A waters are designated non-core rearing waters (WDOE 2003). The revised numeric temperature criteria are stated as 7-day averages of consecutive daily maximum temperatures (7DADMax). The criterion for non-core rearing waters (formerly Class A), is a 7DADMax of 17.5°C. The criterion for core rearing waters is a 7DADMax of 16°C. In addition to the revisions noted above, WDOE has adopted a 7DADMax 12°C temperature criterion to protect bull trout and dolly varden. Finally, if summer compliance with these temperature criteria would not result in protective spawning and incubation temperatures during the times of year when spawning and incubation occur (e.g., late summer and fall), the revised criteria apply a 7DADMax 9°C criterion to protect waters supporting char (bull trout and dolly varden) spawning and a 7DADMax 13°C criterion to waters supporting trout and salmon spawning.

For lakes and reservoirs, the new standards are very similar, requiring that natural conditions be maintained. In all waters, the revised standards include a 0.3°C cumulative allowance for anthropogenic warming.

The revised standards do not change the DO criteria, with the exception of the change from a class-based to a use-based designation system, as discussed above, and allowing

up to a cumulative 0.2 mg/l depression from all combined human activities when natural conditions cause DO concentrations to fall below the criterion. No changes were made to the pH, turbidity or total dissolved gas standards. A summary of all changes to the 1997 standards is provided on the WDOE web site (WDOE 2003).

### 3.3.3 Effects of Alternatives

This section relies on data and analyses presented in the Applicants' Technical Studies Report (PacifiCorp and Cowlitz PUD 2004), and in particular on the following studies: Water Quality Studies (WAQ) 1-4; the Swift Bypass Reach Synthesis Study (AQU 2), and the Speelyai Creek Connectivity and Hatchery Protection Study (AQU 9). Sites included in the Applicants' water quality studies are listed Table 3.3-2.

**Table 3.3-2. Water quality monitoring sites.**

| Site Location   | Code  | Site Location   | Code  |
|---|-------|---|-------|
| Canyon Creek near mouth                               | CANCM | Speelyai Hatchery effluent                                    | SPLYE |
| Cresap Bay boat launch                                | CREBL | Speelyai Creek lower site near Speelyai Hatchery              | SPLYL |
| Drift Creek near mouth                                | DRICM | Speelyai Creek upper site                                     | SPLYU |
| Lewis River near Eagle Island                         | LEWEA | Swift No. 1 tailrace at the canal                             | SW1TR |
| Lewis River Hatchery effluent                         | LEWHE | Lower Lewis River bypass reach                                | SW2BL |
| Merwin Hatchery effluent                              | MERHE | Swift No. 2 tailrace  | SW2TR |
| Lake Merwin near the dam                              | MERLD | Swift Reservoir boat launch at the upper end of the reservoir | SWIBL |
| Lake Merwin inflow to Lake Merwin at Hwy 503 crossing | MERLI | Swift Creek near mouth  | SWICM |
| Lewis River near Merwin powerhouse tailrace           | MERTR | Swift Reservoir near the dam                                  | SWRED |
| Northwoods boat launch and recreation area            | NWOOD | Lewis River inflow to Swift Reservoir                         | SWREI |
| Ole Creek near mouth                                  | OLECM | Lake Merwin at Woodland Park                                  | WOODP |
| Pine Creek near mouth                                 | PINCM | Yale Lake boat launch   | YALBL |
| Speelyai boat launch                                  | SPLBL | Lewis River near Yale powerhouse tailrace                     | YALTR |

#### 3.3.3.1 Alternative A

##### Water Temperature

Baseline stream temperatures and water quality in the Lewis River watershed are, in general, supportive of salmonids and other beneficial uses. Water temperatures in project-affected reaches measured during Study WAQ 1 were within the former WDOE criteria, with a single exception. The exception was at the downstream end of the Lewis River bypass reach, where a single daily maximum temperature of 18.2 °C was recorded

on August 4, 1999 (an exceedance of the former 18 °C criterion for Class A water bodies).

As a Class A water body, the Lewis River bypass reach is subject to the non-core salmonid rearing temperature criterion of 17.5 °C (measured as a 7DADMax) under the revised temperature standards. When the 7DADMax values were calculated at the downstream end of the Lewis River bypass reach, there were no exceedances of the revised standard. Stream temperatures in excess of former WDOE criteria have been recorded at other, non-project-affected sites in the vicinity, including Speelyai Creek upstream of the diversion, Canyon Creek, and Siouxon Creek.

Water temperatures at the Yale tailrace, and to a lesser extent at the Swift No. 2 tailrace, fluctuate in response to changing generation. While these plants are generating, tailrace temperatures are determined by water temperature at the turbine intake. During periods of reduced generation, the Yale tailrace is warmed by surface waters of Lake Merwin, and in mid-to late-summer there may be large daily temperature fluctuations as generation is changed to meet electricity demands. In contrast, little fluctuation is seen in temperatures or releases at the Merwin powerhouse tailrace (Figure 3.3-1). Temperatures at the Swift No. 1 tailrace are also relatively constant in response to changes in generation.

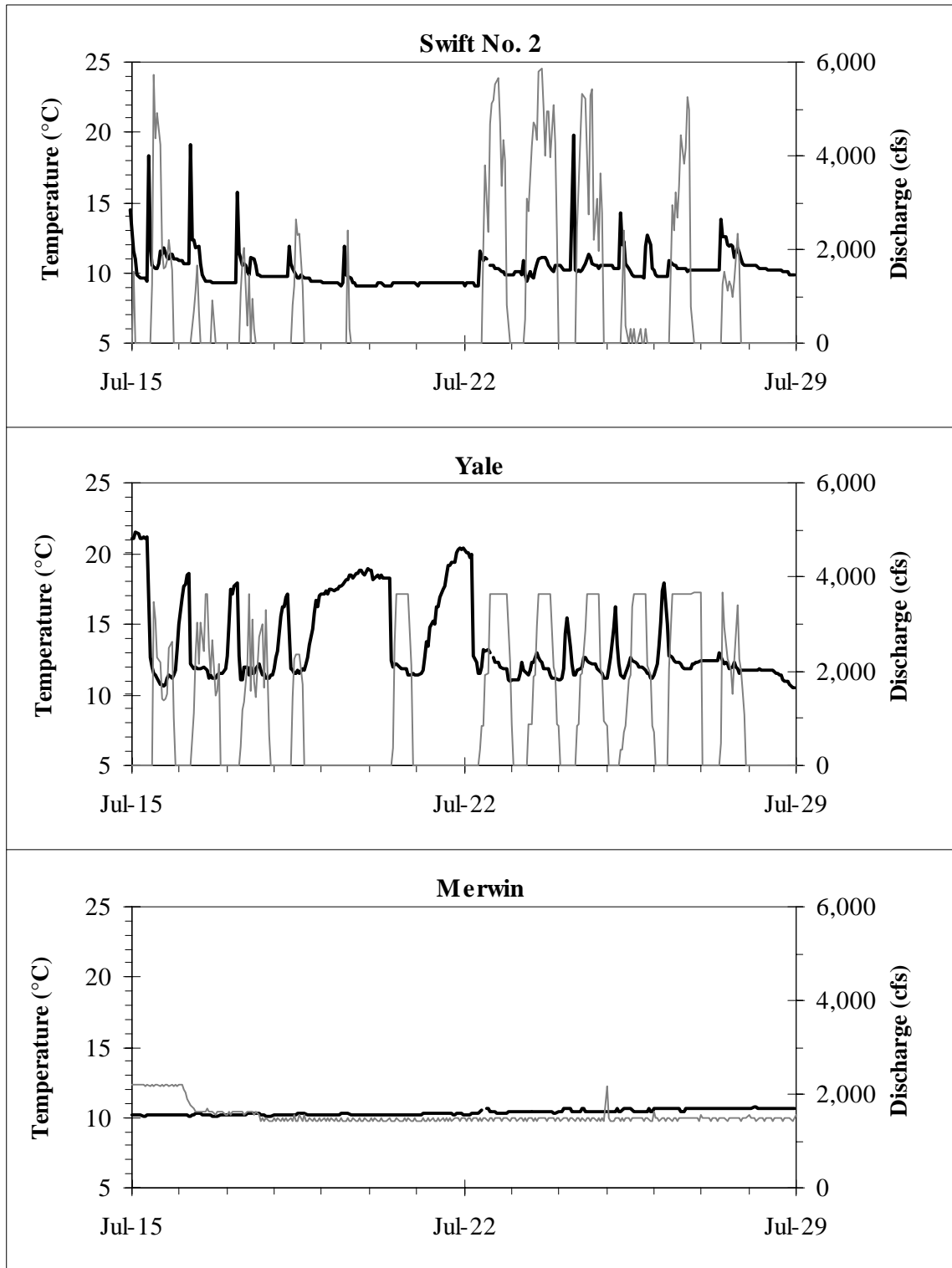
Thermal stratification in project reservoirs creates a thermal banking effect, whereby warmer temperatures extend later into the year at project tailraces than occur at the inflow to Swift Creek Reservoir. This pattern can be seen below for the 1999-2000 field season (Figure 3.3-2). The greatest differences among tailrace sites and the inflow to Swift Creek Reservoir occurred in October, when median monthly temperatures at the reservoir inflow were approximately 8°C, in contrast to 15°C at the Merwin tailrace. Annual maximum temperatures were seen in October at the Swift No. 1, Swift No. 2 and Merwin tailraces, and in September at Yale. In contrast, maximum temperatures at the Swift inflow were observed in August. Heat loss is delayed by reservoir storage, maintaining higher temperatures for 30 to 60 days. Temperatures throughout the projects converge throughout the winter months until April, when less than 2°C separates Swift Creek Reservoir inflow temperatures and all powerhouse tailraces.

### Total Dissolved Gas

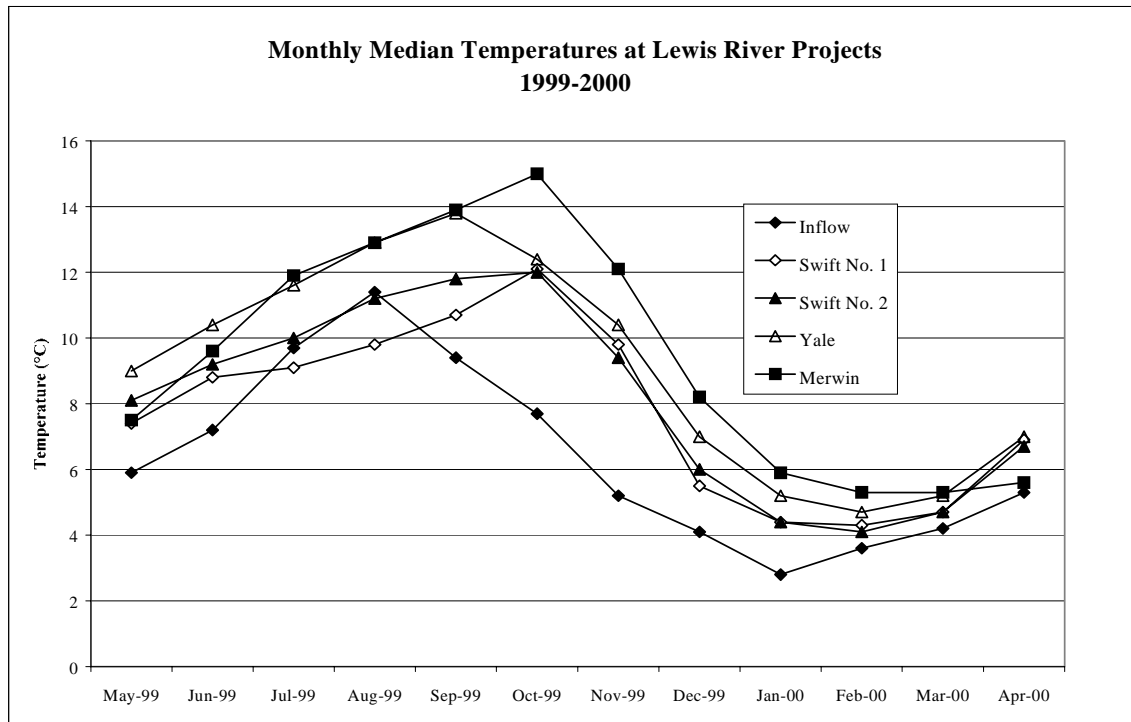
Water quality studies conducted by the Applicants have documented total dissolved gas (TDG) in excess of state standards at the Swift No. 1, Swift No. 2, and Yale powerhouse tailraces. While this is a concern from a regulatory standpoint, biological effects have not been investigated, and none have been established or documented. TDG studies have been undertaken by the Applicants to investigate the sources of elevated TDG and the spatial extent of the problem (i.e., whether exceedances occur within the reservoirs). Major findings of these studies include the following:

- Elevated TDG pressures resulting from power generation within the Lewis River hydropower complex were limited to the Swift No. 1 tailrace, Swift No. 2 canal, and to the tailrace area immediately below the Yale Project. No exceedances of TDG





**Figure 3.3-1. Recorded water temperatures (bold) in the Swift No. 2, Yale, and Merwin powerhouse tailraces and corresponding releases, July 15 through July 28, 1996.**



**Figure 3.3-2. Monthly median temperatures at the Swift Creek Reservoir inflow, Swift No. 1 tailrace, Swift No. 2 tailrace, Yale tailrace, and Merwin tailrace; May 1999 through April 2000.**

standards were documented in the forebays of Yale or Merwin dams. Sampling at sites in Lake Merwin was conducted over the course of six weeks and resulted in 10 values greater than 110 percent in over 5,000 observations of the Yale tailrace. No exceedances were observed at the Merwin tailrace.

- Approximately 60 percent of the exceedances in the Swift No. 1 tailrace and further downstream in the Swift No. 2 canal occurred during periods when neither Swift No. 1 nor Swift No. 2 was generating. This was most likely due to the relatively small volume of water within the canal and the cessation of flow during non-operating periods. Exceedances of the state TDG water quality standards in Swift No. 2 canal (resulting from operations at Swift No. 1) may lead to violations of the standard in the Swift No. 2 tailrace; however, no direct correlations between TDG saturation and Swift No. 2 operation were observed in these studies.
- Based on the relationship between TDG saturations measured in the Swift No. 2 tailrace and forebay, elevated pressures in upper Yale Lake likely resulted from generation at Swift No. 1.
- Elevated forebay levels of TDG were not observed during follow-up investigations at stations near Yale and Merwin dams. These data suggest that elevated TDG from upstream power generation does not extend to the reservoirs.

To address TDG at the Swift and Yale projects, PacifiCorp is avoiding operating in the inefficient range (between 20 and 50 MW) at these projects, and has installed an automatic air valve at Yale to reduce air entrainment. A similar air valve will be installed at Swift No. 1, and permanent monitoring equipment to test water temperature and TDG will be installed at each of these projects.

#### PAH/Metals

The effects of boating on reservoir water quality were identified as an issue during the NEPA scoping process. Discussion among the Aquatic Resource Group (ARG) focused this issue on the potential impacts of polycyclic aromatic hydrocarbons (PAH) in project reservoirs, where personal watercraft (PWC [e.g., jet skis]) use and associated fuel loss were identified concerns. The Applicants and the ARG designed and conducted a study to address this issue (PacifiCorp and Cowlitz PUD 2003f and 2004: WAQ3). This study, conducted at Yale Lake in August 2001, found measurable levels of PAH at three of four Yale Lake boat ramps: Yale Park, Cougar Creek, and Beaver Bay. Of the 19 component analytes measured in each sample, two were measurable at Cougar Creek and Beaver Bay (fluoranthene and pyrene), and three at Yale Park (fluoranthene, pyrene, and anthracene). All are phototoxic compounds (Oris et al. 1998). WDOE has no criteria for these compounds, although total PAH at Yale Park (7.28 nanograms per liter [ng/l]) exceeded toxicity thresholds for *Ceriodaphnia* survival (6.5 ng/l) and reproduction (3.4 ng/l) developed specifically for Lake Tahoe (Oris et al. 1998). However, applicability of these threshold values to Yale Lake is questionable given differences in water clarity, hydraulic residence time, and boat use, factors critical to the toxicity of these compounds.

Results of analyses for a number of metals, including mercury, as well as PCBs and other cations and anions are presented in PacifiCorp and Cowlitz PUD (2001). No exceedances of WDOE Freshwater Chronic Criteria presented in WAC 173-201A-040(3) (if available) were reported.

#### Dissolved Oxygen/Thermal Stratification

Dissolved oxygen (DO) levels met state standards (9.5 mg/l for Class AA/core salmonid rearing and 8 mg/l for Class A/non-core salmonid rearing reaches); however, exceedances were noted at several tributary sites (unaffected by project operations) at times of maximum air temperatures and/or low flow conditions (PacifiCorp and Cowlitz PUD 2003f).

The DO regimes at Swift and Merwin reservoirs are quite different, reflecting the different temperature regimes of these reservoirs. All three reservoirs thermally stratify during the summer months. Temperatures at the bottom of Swift Creek Reservoir varied little, and were approximately 5°C throughout the 1999 monitoring period. In contrast, temperatures near the bottom of Lake Merwin gradually increased from 6°C in May to nearly 14°C in October. Snowmelt from Mount St. Helens and Mount Adams, combined with a shallower intake at Swift (approximately 45 meters), creates a more stable and colder hypolimnion. The intake at Lake Merwin is deeper, well below the thermocline

(approximately 55 meters). This results in quicker turnover in the fall and a more pronounced depletion of colder water during the summer months.

Reservoir profiles at Yale Lake were more similar to Swift than to Lake Merwin; temperatures at depth remained near 4°C year-round during the 1996 and 1997 field seasons. Summer surface temperatures (July 1997) were 21°C, while temperatures near the bottom of Yale Lake (78 meters) were 4°C.

Dissolved oxygen near the bottom of Swift Creek Reservoir remained above 9 mg/l during late summer, while DO near the bottom of Lake Merwin decreased from approximately 11 mg/l in May to 4 mg/l in August and to 3 mg/l in September. However, DO in the majority of the Lake Merwin water column (above 40-45 meters in August and September) remained at or near 8 mg/l. Similarly, the water column was well oxygenated in Yale Lake throughout PacifiCorp's monitoring period (1996-1997). Summer dissolved oxygen levels (June through September) near Yale Dam ranged from 9 to 12 mg/l. The reservoir bottom did not approach anoxic conditions during either field season (1996 or 1997). Minimum DO at Yale Lake was observed in November and December 1996, when values were near 7 mg/l at a depth of 60-65 meters. Yale tailrace DO levels, however, typically were higher, ranging from 8.5 to 11.1 mg/l during a week of continuous hourly monitoring in August 1997.

### Trophic Status and Nutrients

Trophic status of the project reservoirs can be inferred from phytoplankton data collected during Yale relicensing studies (PacifiCorp 1999a), as well as from nutrient and dissolved oxygen data summarized above. Yale Lake phytoplankton data (1996 and 1997) documented short-term algal blooms during early summer, which temporarily increased trophic status from generally oligotrophic to more mesotrophic conditions. Blue green algae, often used as indicators of eutrophic conditions, were dominant at upper and lower Yale Lake during early summers of 1996 and 1997. The shift from diatoms to blue-greens was most dramatic in June 1996, when the blue-green algae *Anabaena flos-aquae* was dominant at both upstream and near-dam stations (85 percent of the biovolume at the upstream station, and 94 percent near the dam). Algal biovolume during most months was less than 100,000 cubic µM/ml; however, in June 1996 biovolume was approximately eight times higher than this at the upstream station, and approximately four times higher at the downstream station. Blue-green algae were also observed later in the summer at Yale during both field seasons.

Patterns in phytoplankton community composition observed at Yale are likely similar at Swift and Merwin. Carlson Trophic State Index (TSI) (Carlson 1977) values calculated for Swift and Merwin based on 1999 data show similar, short-term changes in trophic status indicative of algal blooms, although no phytoplankton data were collected. Summertime chlorophyll  $\alpha$  and secchi disk-based TSI values were in the mesotrophic range for both reservoirs; however, total phosphorus-based values increased to near 60 in July, well above the 40-50 level indicative of mesotrophic conditions. As discussed above, nutrient levels among upper watershed sites differed markedly from those in the lower watershed. The pattern observed at the inflow to Swift Creek Reservoir suggested

increasing total phosphorus (TP) concentrations correlated with snowmelt from Mount St. Helens, and, in general, higher TP values were recorded for upper watershed sites. These data suggest that soil geochemistry is not uniform throughout the project area. While this region of the Lewis River watershed historically may have had higher soil phosphorus levels, it is likely that the Mount St. Helens eruption continues to exert an influence on water quality. Exposure of previously subsurface ash as a result of the 1996 flood may also have caused higher phosphorus concentrations in Mount St. Helens runoff.

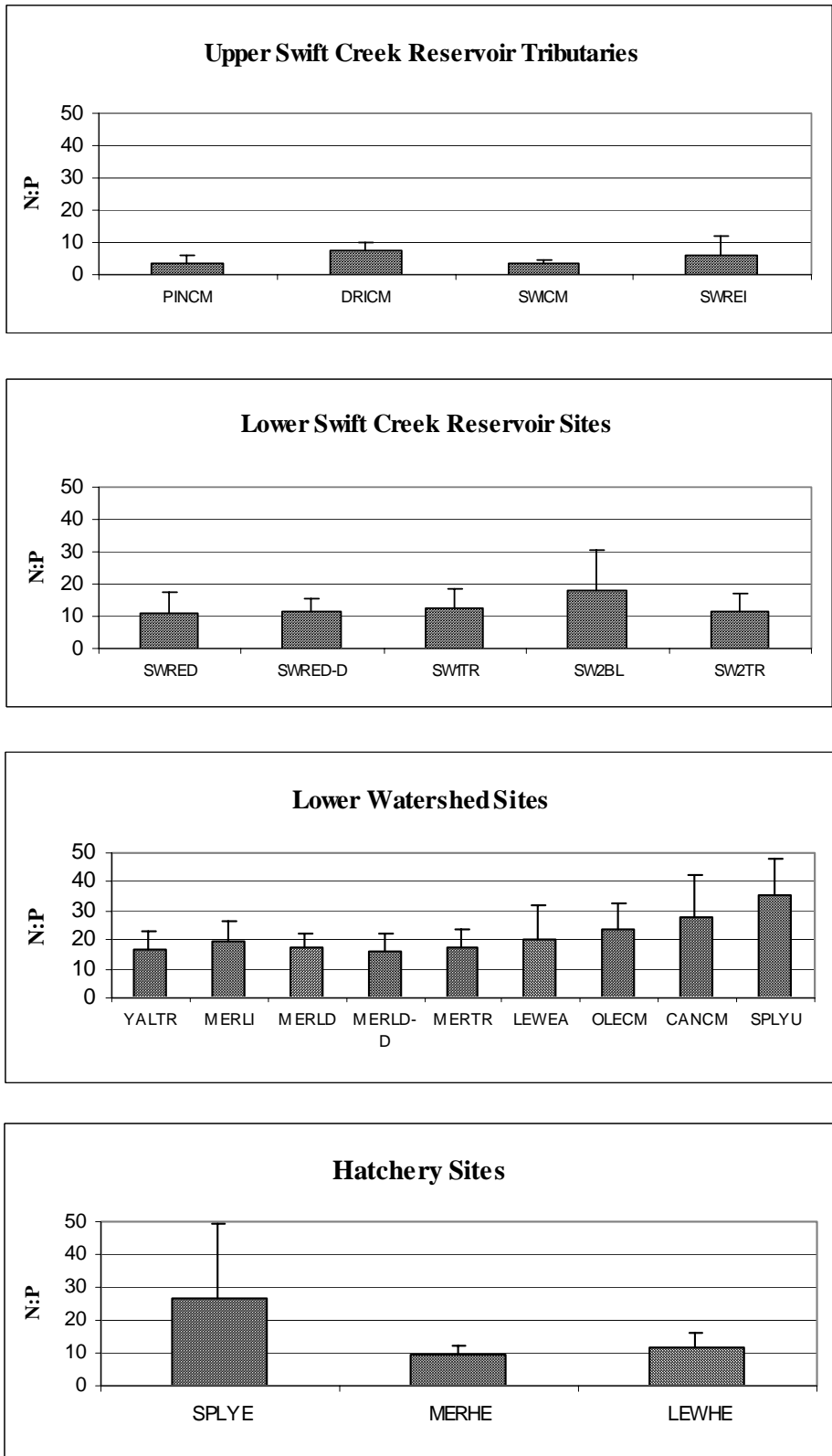
Nitrogen-to-phosphorous (N:P) ratios for all monitored sites strongly suggest nitrogen limitation for streams draining to Swift Creek Reservoir (Figure 3.3-3). Sites designated as “Lower Swift Creek Reservoir” are also likely nitrogen-limited, while “Lower Watershed” sites are more likely phosphorus limited. Lewis River and Merwin Trout hatchery effluents had N:P ratios similar to lower watershed sites, although Speelyai ratios were higher, indicative of greater nitrogen contribution from this hatchery. High ratios (greater than 10:1) suggest that phosphorous is the limiting nutrient, while ratios less than 5:1 are indicative of nitrogen limitation (Rast et al. 1989). Welch (1980) suggests that N:P ratios less than 16 are indicative of nitrogen limitation. Nitrogen limitation is not uncommon in Pacific Northwest streams (Lauer et al. 1979; Salminen and Beschta 1991). The nitrogen term in the ratio was total persulfate nitrogen (TPN), the sum of biologically available nitrogen forms (organic N, ammonia, and nitrate+ nitrite). Total phosphorous was used for the phosphorous term of the ratio. In general, nitrogen limitation in lakes and reservoirs creates a competitive advantage for nitrogen-fixing algae, such as the *Anabaena* sp. mentioned above (Levine and Shindler 1999).

The proportion of total nitrogen inputs contributed by annual algae blooms to project-affected reaches and associated nitrogen fixation is unknown. In light of the volcanic, nitrogen-poor soils that dominate the watershed, and the absence of marine derived nitrogen (MDN) to reaches upstream of Merwin Dam, the contribution from algae blooms could be significant.

All of the streams in the upper Swift watershed drain volcanic soils. Pine Creek, Swift Creek, and the mainstem Lewis River drain soils of the Cinnamon-Stabler-Chemawa group (USDA 1990). All of these soils were formed in pyroclastic flows of volcanic ash, with ash influences extending to 60 inches or more in the Chemawa series. The southeast side of Swift Creek Reservoir is comprised mainly of Zygore-Aschoff-Swift parent materials. These soils are more diverse, but the soil type in the Drift Creek subbasin is Swift cindery sandy loam, also derived from volcanic ash with a mantle of ash and pumice.

### 3.3.3.2 Alternative B

Measurable changes in reservoir water temperature would not be expected as a result of Alternative B. Depending on sources of water and time of year, actions that have potential to change water temperatures include fish passage attraction flows for adult passage, and flows required to facilitate downstream passage via floating surface collectors. Alterations in reservoir forebay levels associated with flood management



**Figure 3.3-3. Nitrogen to Phosphorus ratios for sites sampled monthly during May 1999 through April 2000. (Error bars are one standard deviation.)**

Note: Site location names are defined in Table 3.3-2.

pre-releases have the potential to influence reservoir water quality and temperature, although these flows would occur during periods of minimal variation in temperature between the reservoirs and the Lewis River downstream of Lake Merwin.

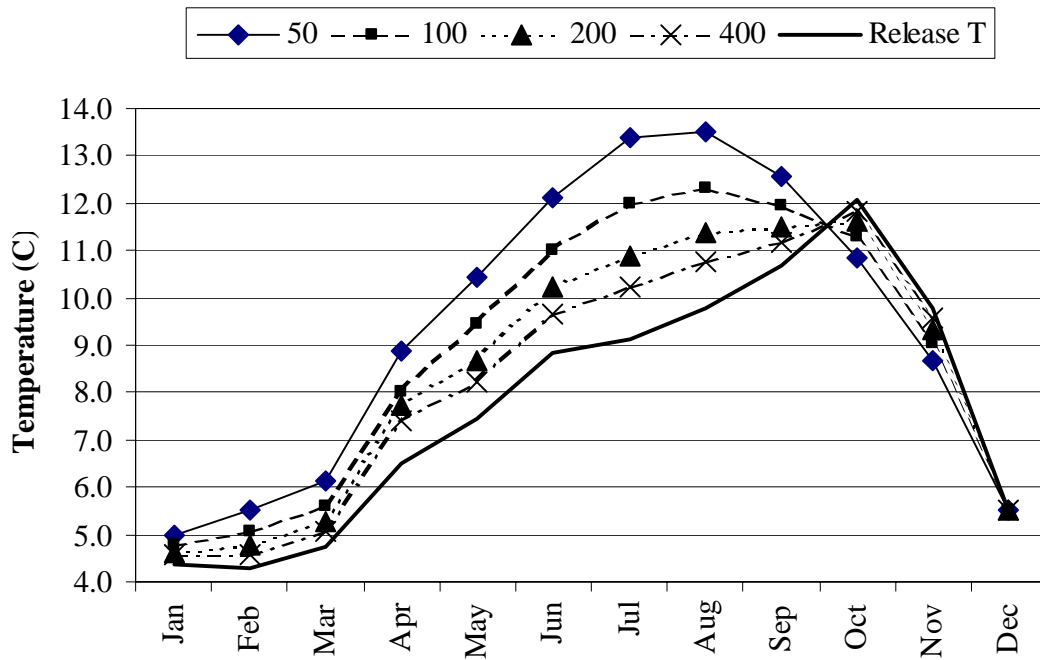
With respect to upstream fish passage, entrance weirs to the fish collection and sorting facility at Merwin would have attraction flows of approximately 100 cfs. Because this would be pumped from the tailrace, there would be no net change in temperatures within or downstream of the tailrace. Attraction flows of 600-1000 cfs for downstream passage under Alternative B would be drawn from near the surface of Swift Creek Reservoir, and released within surface waters near the dam. No thermal stratification or tailrace temperature modification is expected as a result of this discharge.

As discussed in Section 3.2.3.2, seasonal reservoir levels would be lower in Yale Lake (about two feet) and about four feet lower in Swift Creek Reservoir under Alternative B (Table 3.2-6). This is not expected to result in measurable changes in water quality or temperature.

Flows downstream of Merwin Dam would be the same under Alternative B as under Alternative A (Figure 3.2-9). However, pre-releases (turbine flows plus spill) would be made in advance of high flow events about once a year on average from Merwin Dam, based on flow forecasts (see Section 3.2.3.2). Assuming these releases would occur during periods of minimal thermal stratification, effects on water temperature would not be expected.

Water temperatures in the Lewis River bypass reach under licensed conditions reflect seepage from the Swift No. 2 canal and accretion from Rain and Ole creeks. Flows are approximately 5 to 10 cfs upstream of the canal spillway, and approximately 20 cfs near the downstream end of this reach. Increased flows under Alternative B would dampen diel temperature fluctuations; reducing the effect of nighttime cooling and afternoon heating, meaning minimum temperatures would increase and maximum temperatures would decrease. Predicted average monthly temperatures (modeled using the U.S. Fish and Wildlife Service's SSTEMP model) with flows of 50 cfs under Alternative B are between 4°C and 14°C, depending upon the month and the starting water temperature (Figure 3.3-4). These results suggest that flows of 50 cfs or more under all input temperature regimes would reduce water temperatures at the downstream end of the bypass reach to well under the former state Class A standard of 18°C (applicable to the Lewis River bypass reach), as well as the new non-core rearing standard of 17.5°C (measured as 7DADMax).

Under Alternative B, Upper Speelyai Creek would continue to be diverted into the Speelyai Canal and Yale Lake. Flows downstream of the upper diversion would come solely from groundwater and tributary inflow, thus temperatures would remain cooler than those upstream of the diversion during the summer months.



**Figure 3.3-4. Observed Swift Dam release temperature and modeled water temperature at downstream end of Lewis River bypass reach for four release flows under average temperature conditions.**

Assuming flows would originate at depth in Swift Creek Reservoir, turbidity levels in the Lewis River bypass reach would more closely mirror those at depth in the reservoir—increasing during the winter months to between 5 and 10 NTUs, and decreasing to 1-2 NTUs during the summer and fall. Other water quality parameters would not be expected to measurably change at flows of 50 cfs, although turbidity may increase during the winter months.

To the extent that proposed recreational enhancements bring greater numbers of visitors to the project area, and a corresponding increase in use of personal watercraft, there may be an increase in levels of PAH compounds in the reservoirs. Whether increased use occurs as a function of this alternative or of natural increases in demand for recreational resources is unknown.

Introduction of anadromous fish under Alternative B provides a mechanism by which marine-derived nutrients (MDN) would be transported to upper basin tributaries capable of supporting spawning fish, offsetting the absence of trace elements and nutrients to the upper basin in comparison to Alternative A. Introduction of anadromous fish to Swift Creek Reservoir tributaries may increase reservoir nutrient levels, possibly shifting phytoplankton species composition and trophic status. These changes may be ecologically positive, providing greater diversity and reduced dominance of nitrogen fixing blue-green algae during the summer months. Additionally, under Alternative B, hatcheries would not be modernized or expanded, thus no associated effects on water quality are anticipated.



Flood management pre-releases would be made in anticipation of forecast high flow events, and would consist of surface flows. Thus little, if any, increase in turbidity would be expected during these pre-release flows. Other constituents (e.g., dissolved oxygen, nutrients, pH) would be expected to be fairly uniform throughout the water column during late fall and winter; thus, effects of pre-releases on other indices of water quality also would be minimal. Similarly, pre-release flows are unlikely to increase TDG relative to levels that would naturally occur during spill events.

Pre-release flows could affect zooplankton populations in Lake Merwin, and to a lesser extent (depending on magnitude of spill) at Yale Lake. Zooplankton is a critical source of food for kokanee in the project reservoirs, and pre-release spills of this magnitude could reduce prey availability.

Additionally, PacifiCorp would develop a Water Quality Management Plan to address TDG and to define a monitoring program to ensure compliance with other WDOE water quality criteria at Merwin, Yale, and Swift No. 1. Cowlitz PUD would develop a Water Quality Management Plan to define a monitoring program to ensure compliance with state standards at Swift No. 2.

### 3.3.3.3 Alternative C

The most notable difference between Alternatives B and C with respect to water quality is the flow regime in the Lewis River bypass reach (Figure 3.2-8). Flow releases under Alternative C would vary seasonally in a manner that mimics the natural hydrograph at a reduced magnitude. During normal water years, flows would vary between 100 and 400 cfs (see Table 3.2-8). During low water years (as determined by the National Weather Service Northwest River Forecast Center's Water Supply Forecast for the Lewis River at Ariel, WA), flows would vary between 50 and 200 cfs. As under Alternative A, during peak flows, releases from the Swift No. 2 canal or Swift Dam spillway would continue to pass through the reach. Spills during flood conditions are expected to be similar in magnitude and frequency to those under Alternative B.

This flow regime in the Lewis River bypass reach would result in a seasonal range of water temperatures well within state standards. Assuming flows would originate at depth in Swift Creek Reservoir, turbidity levels in the bypass reach would closely mirror those in the reservoir—increasing during the winter months to between 5 and 10 NTUs, and decreasing to 1-2 NTUs during the summer and fall. Beyond changes in turbidity during the winter months, water quality in the bypass reach would not be expected to markedly differ from existing conditions under either Alternative B or C.

Effects of fish passage facilities on water temperature and thermal stratification in the reservoirs under Alternative C would be similar to Alternative B. Attraction flows for the trap-and-tram facilities for upstream passage at Yale and Swift No. 2 would be pumped from the tailraces, with no net change in tailrace temperatures. At Merwin, the 100 cfs attraction flow would come from the existing surface intake and hatchery effluent lines, with minimal if any effect on tailrace temperatures.

Changes in temperature as a result of downstream passage would also be expected to be negligible under Alternative C. Surface collectors at all three projects would draw attraction flows of 600-1000 cfs from near the surface and would release flows toward the existing intakes. These flows may slightly weaken thermal stratification near the intake. Tailrace temperatures may increase slightly as a result, although significant changes are not expected.

Introduction of anadromous fish to Swift Creek Reservoir as well as to tributaries that support spawning in Yale and Merwin would offset the absence of MDN. This may increase reservoir nutrient levels, particularly in Swift Creek Reservoir, possibly resulting in shifts in phytoplankton species composition and trophic status. These changes would be ecologically positive, providing greater diversity and reduce the dominance of nitrogen fixing blue-green algae during the summer months.

The operations model predicts that reservoir levels under Alternative C would differ from those under Alternative A by up to about four feet at Swift Creek Reservoir and about three feet at Yale Lake (Table 3.2-7). As noted previously, reservoir levels for Lake Merwin are the same under each alternative. Lower reservoir volume may reduce overall warming and the thermal banking effect of project reservoirs, although changes are expected to be negligible over existing conditions.

Under Alternative C, the upper Speelyai Creek diversion would continue to direct all water from the upper watershed into the Speelyai Canal and Yale Lake. Temperatures and water quality downstream of the upper diversion would continue to be dominated by groundwater, resulting in cooler temperatures at the hatchery intake during the summer than upstream of the diversion. No change over existing conditions is anticipated.

Downstream of Merwin, proposed pulse flows of 5,000 cfs (or 120 percent of the current flow release if flows are higher than 5,000 cfs) on a weekly basis between March 1 and June 30 may increase turbidity. These flows are expected to remove easily transported fines early in the spring, thus turbidity increases are likely be less evident later in this period. Depending on release timing, higher flows may reduce maximum water temperatures below Merwin, although this is not likely to cause large changes in temperature during this period of the year.

### 3.3.4 Conclusion

Water quality standards are being met and will continue to be met in all alternatives with the exception of TDG exceedances in the Swift No. 1, Swift No.2, and Yale tailraces. Measures are being undertaken to reduce these effects. Alternatives B and C are not expected to result in measurable changes to water quality or water temperature in project reservoirs relative to currently licensed conditions. Measurable changes in trophic status and nutrient levels are unlikely, although introduction of anadromous fish and associated inputs of MDN may positively influence the structure of reservoir phytoplankton populations. Changes in water quality or water temperature downstream of Merwin Dam are not expected, with the exception of minor increases in turbidity during pulsed and/or pre-release flows. Under both action alternatives, the Applicants would develop Water

Quality Management Plans to define a monitoring program to ensure compliance with WDOE water quality criteria.

### 3.4 AQUATIC RESOURCES

This section analyzes the aquatic resource issues associated with relicensing the Lewis River Projects; the distribution, abundance, status and life history of existing fish populations in the Lewis River basin; and the effects of each alternative on fish populations and watershed processes. The role of hatcheries and other fishery management practices are also described. The information included in this section was primarily derived from a series of technical reports completed during project relicensing (PacifiCorp and Cowlitz PUD 2004) provided as Appendix D to the PacifiCorp applications and as Volume 4 of the Cowlitz PUD application.

#### 3.4.1 Resource Issues

The continued operation of the Lewis River Projects has the potential to affect aquatic resources in the mainstem Lewis River and its tributaries. During the NEPA scoping process, federal, state, and local resource agencies; Indian Tribes; non-governmental organizations; and other interested parties identified 11 primary aquatic resource issues. These issues are grouped into the six categories listed below, and the effects of the alternatives on each of these categories are analyzed in Section 3.4.3.

- The effects of the projects on fish distribution, abundance, and movement through the project area.
- The effects of the projects on stream morphology, sediment transport, aquatic and riparian habitat, and large woody debris movement.
- The effects of the projects on instream flows and aquatic habitat connectivity.
- The effects of the projects on resident and anadromous fish distribution in the Lewis River basin above Merwin Dam.
- The effects of hatchery operations and management practices on native resident and anadromous species in the Lewis River.
- The effects of the projects on threatened and endangered fish species.

#### 3.4.2 Affected Environment

##### 3.4.2.1 Fish Distribution and Abundance

The Lewis River basin downstream of Merwin Dam supports a self-sustaining population of wild fall Chinook salmon (*Oncorhynchus tshawytscha*) and hatchery stocks of spring Chinook, early and late coho salmon (*O. kisutch*), and winter and summer steelhead (*O. mykiss*). Chum salmon (*O. keta*), Columbia River smelt (Eulachon) (*Thaleichthys pacificus*), Pacific lamprey (*Lampetra tridentata*), white sturgeon (*Acipenser*

*transmontanus*), and sea-run cutthroat trout (*O. clarki clarki*) also spawn and rear in the mainstem Lewis River and tributaries below Merwin Dam (Table 3.4-1). Except for occasional releases of excess hatchery fish to supplement the sport fishery, no anadromous fish populations are present above Merwin Dam.

**Table 3.4-1. Resident and anadromous fish species present in the Lewis River basin.**

| Species                          | Project Reach                              |                                   |                              |  |
|----------------------------------|--|-----------------------------------|------------------------------|--|
|                                  | Lewis River<br>Downstream of<br>Merwin Dam | Lake Merwin<br>and<br>Tributaries | Yale Lake and<br>Tributaries | Swift Creek<br>Reservoir and<br>Upper Lewis<br>River |
| Fall Chinook salmon <sup>1</sup> | X  |                                   |                              |  |
| Spring Chinook salmon            | X  | X <sup>3</sup>                    |                              | X <sup>4</sup>                                       |
| Coho salmon <sup>2</sup>         | X  | X <sup>3</sup>                    |                              | X <sup>4</sup>                                       |
| Winter steelhead <sup>1</sup>    | X  | X <sup>3</sup>                    |                              | X <sup>4</sup>                                       |
| Summer steelhead <sup>1</sup>    | X  | X <sup>3</sup>                    |                              |  |
| Chum salmon <sup>1</sup>         | X  |                                   |                              |  |
| Sea-run cutthroat trout          | X  |                                   |                              |  |
| White sturgeon                   | X  | X                                 |                              |  |
| Pacific lamprey                  | X  |                                   |                              |  |
| Eulachon (smelt)                 | X  |                                   |                              |  |
| Kokanee                          |  | X                                 | X                            |  |
| Bull trout <sup>1</sup>          | X  | X                                 | X                            | X  |
| Resident rainbow trout           | X  | X                                 | X                            | X  |
| Resident cutthroat trout         | X  | X                                 | X                            | X  |
| Northern pikeminnow              | X  | X                                 | X                            |  |
| Tiger musky                      | X  | X                                 |                              |  |
| Brook trout                      |  |                                   | X                            | X  |
| Mountain whitefish               | X  | X                                 | X                            | X  |
| Sculpin (spp.)                   | X  | X                                 | X                            | X  |
| Carp                             |  | X                                 |                              |  |
| Bluegill                         |  | X                                 |                              |  |
| Crappie                          |  | X                                 |                              |  |
| Threespine stickleback           | X  | X                                 | X                            | X  |
| Largescale sucker                | X  | X                                 | X                            | X  |
| Brown bullhead                   |  | X                                 |                              |  |

- 1 Species listed under the Endangered Species Act.
- 2 Candidate species under the Endangered Species Act.
- 3 Excess hatchery salmonids are planted into Lake Merwin to supplement the sport fishery.
- 4 Progeny of experimental releases in the upper watershed.

Resident fish species present in the Lewis River basin include bull trout (*Salvelinus confluentus*), kokanee (landlocked *O. nerka*), cutthroat trout, rainbow trout (*O. mykiss*), northern pikeminnow (*Ptychocheilus oregonensis*), tiger musky (*Esox lucius* x *Esox*

*masquinongy*), mountain whitefish (*Prosopium williamsoni*), sculpin (*Cottus* spp.), carp (*Cyprinus carpio*), bluegill (*Lepomis macrochirus*), crappie (*Pomoxis* sp.), threespine stickleback (*Gasterosteus aculeatus*), and largescale sucker (*Catostomus macrocheilus*) (Table 3.4-1). Each of these species, with the exception of kokanee, bluegill, tiger musky, and crappie, are native to the Lewis River basin. Non-native species were introduced following dam construction to enhance the recreational fishery.

### Chinook Salmon

Chinook salmon are anadromous and have a broad range of life history traits, including variation in age at seaward migration; variation in freshwater, estuarine, and ocean residence; variation in ocean distribution; and in age and season of spawning migration (Healey 1991, Myers et al. 1998). Most of this variation is exhibited in 2 distinct behavioral forms, commonly referred to as stream-type (spring Chinook) and ocean-type (fall Chinook). Spring Chinook reside in freshwater for a year or more before migrating to sea, and return to their natal river in spring or summer, several months prior to spawning. Fall Chinook migrate to sea in their first year of life, usually only a few months after emergence, and return to their natal river in the fall, a few days or weeks before spawning (Healey 1991).

Both spring and fall Chinook will spawn in tributaries as small as 6.5 feet wide and in the mainstem of larger rivers. Generally, spring Chinook prefer to spawn in middle and upper reaches of the mainstem areas, while fall Chinook prefer the middle and lower mainstem areas (WDFW 1994). Chinook fry inhabit river margins, particularly back eddies, behind fallen trees, undercut tree roots or other forms of bank cover. As the fish increase in size, they move to more mid-stream positions with higher water velocities. Chinook fry use the entire range of substrates found in the Lewis River but are concentrated along the shore. Preferred water temperature ranges and upper lethal water temperatures for Chinook are presented in Table 3.4-2.

**Table 3.4-2. Preferred temperature ranges, and upper lethal water temperatures for various life stages of resident and anadromous salmonids found in the Lewis River basin.**

| Species            | Preferred Temperature Range (°C) |          |            |                    | Upper Lethal Temperature (°C) |
|--------------------|----------------------------------|----------|------------|--------------------|-------------------------------|
|                    | Upstream Migration               | Spawning | Incubation | Freshwater Rearing |                               |
| Fall Chinook       | 10.6–19.4                        | 5.6-13.9 | 5.0-14.4   | 12-14              | 26.2                          |
| Spring Chinook     | 3.3–13.3                         | 5.6-13.9 | 5.0-14.4   | 12-14              | 26.2                          |
| Coho               | 7.2-15.6                         | 4.4-9.4  | 4.4-13.3   | 12-14              | 26.0                          |
| Chum               | 8.3-15.6                         | 7.2-12.8 | 4.4-13.3   | 12-14              | 25.4                          |
| Steelhead          | --                               | 3.9-9.4  | --         | 10-13              | 23.9                          |
| Bull Trout         | 10-12                            | 5-6      | 2-8        | 8-14               | --                            |
| Cutthroat Trout    | --                               | 6.1-17.2 | --         | 12.0-15.0          | 22.8                          |
| Rainbow Trout      | --                               | 2.2-20.0 | --         | 10-22.0            | 29.4                          |
| Mountain Whitefish | --                               | 0-10     | --         | 8.9-11.1           | --                            |

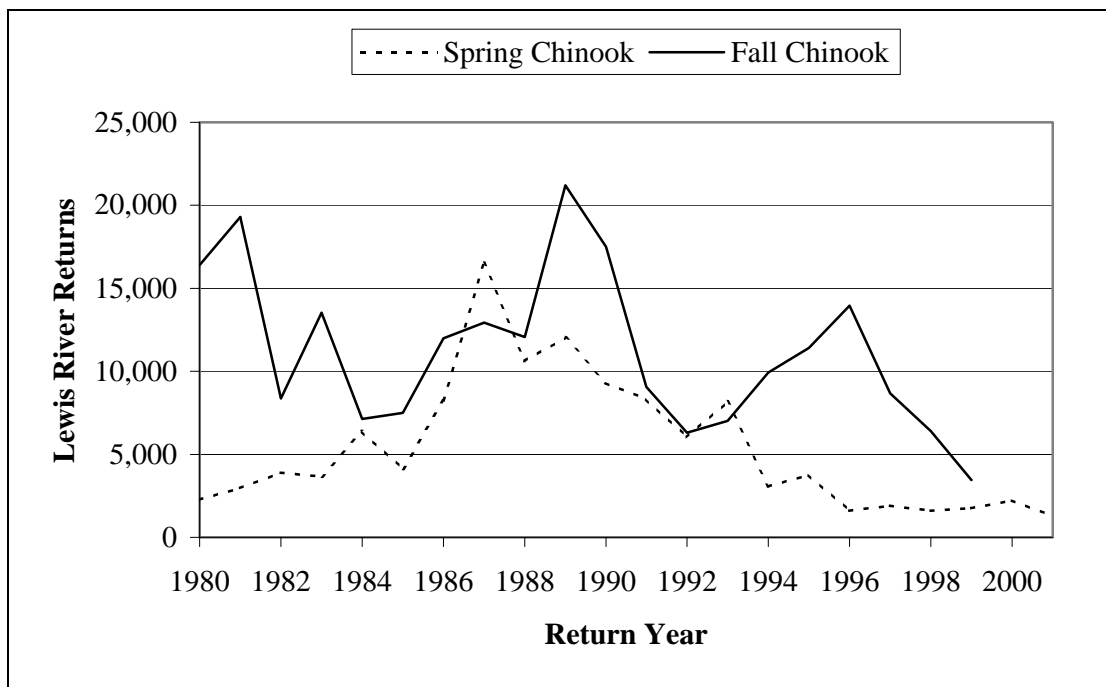
Source: Pratt 2003 (AQU 20), Bjornn and Reiser 1991, Goetz 1989, BioAnalysts, Inc. 1998, McPhail and Troffe 1998.

-- = not available

Three Chinook salmon stocks are found in the Lewis River basin. Spring Chinook have been supplemented with hatchery stocks for decades and current returns are thought to be primarily hatchery origin (pers. comm. R. Nicolay, WDFW, 1999). The other two stocks are fall Chinook components of the listed Lower Columbia River Chinook Evolutionarily Significant Unit (ESU). Both fall Chinook stocks are self-sustaining and their production is entirely natural. WDFW discontinued a Lewis River Hatchery fall Chinook program in 1986 to eliminate negative interactions with wild fall Chinook, and despite years of hatchery augmentation, the fall Chinook stock in the Lewis River system has “maintained a significant population with negligible hatchery influences” (Hymer et al. 1993). Lewis River fall Chinook represent about 80 to 85 percent of the wild fall Chinook returning to the lower Columbia River (NPPC 1990).

The current distribution of spring Chinook is limited to the mainstem Lewis River below Merwin Dam and to Cedar Creek. In the mainstem, most spring Chinook spawning and rearing occurs between Merwin Dam and the Lewis River Hatchery. In Cedar Creek, most spawning and rearing occurs between river mile (RM) 11.0 and RM 18.2 (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1).

In the last two decades, adult spring Chinook returns to the Lewis River basin have been highly variable. From 1980 through 2001, the total adult spring Chinook return (including hatchery returns, natural escapement, and sport harvest) has ranged from a low of 1,269 in 2001 to nearly 17,000 in 1987, with an average of approximately 5,400 fish (Figure 3.4-1) (Pettit 1997; pers. comm., R. Pettit, WDFW 2001; WDF, WDW, and WWTIT 1993). Life history periodicity for naturally spawning spring Chinook in the Lewis River is presented in Figure (Figure 3.4-2).

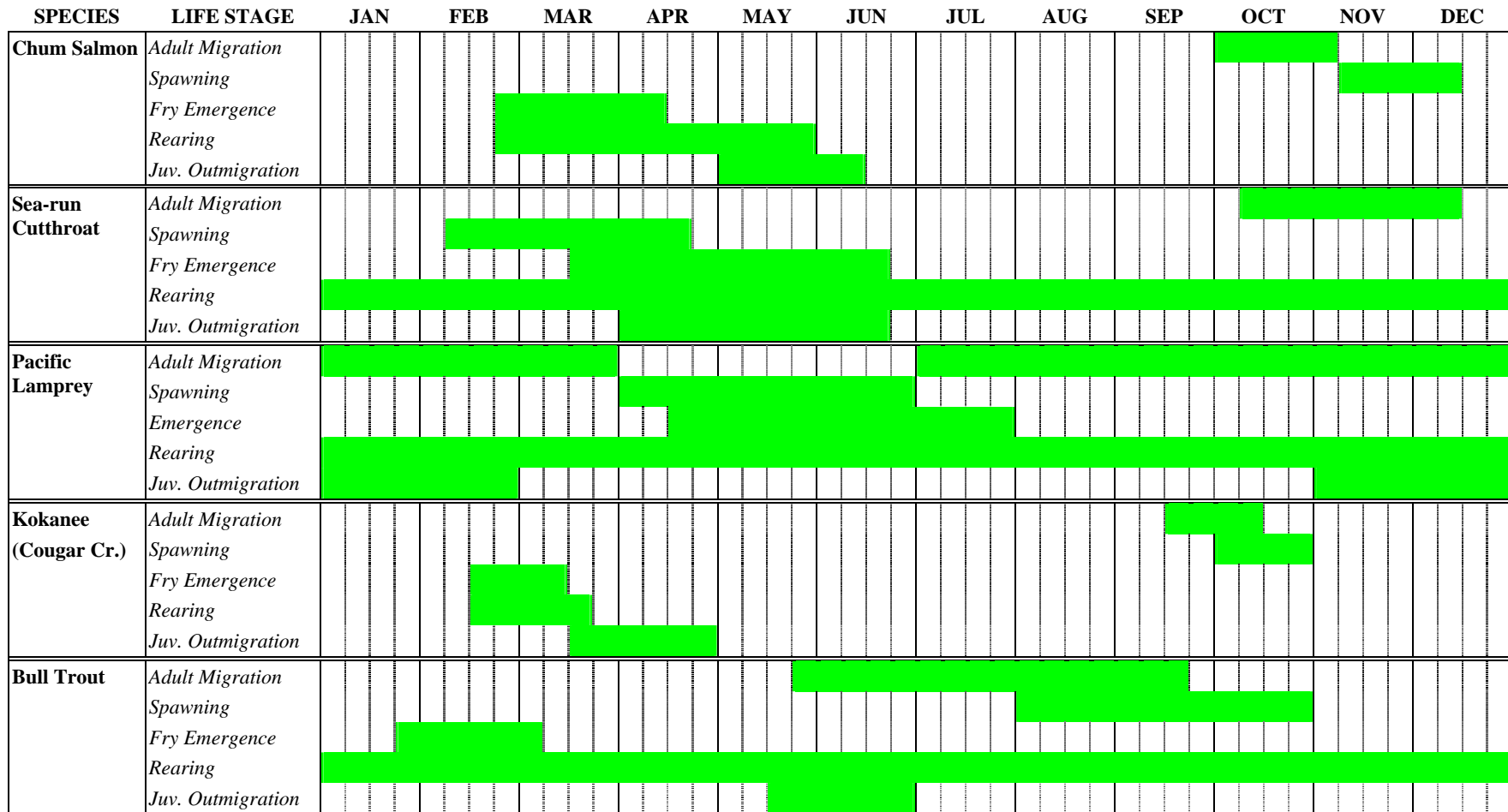


**Figure 3.4-1. Adult spring Chinook and fall Chinook returns to the North Fork Lewis River (1980 to 2001).**

| SPECIES                 | LIFE STAGE               | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG      | SEP | OCT      | NOV | DEC |  |  |
|-------------------------|--------------------------|-----|-----|-----|-----|-----|-----|-----|----------|-----|----------|-----|-----|--|--|
| <b>Spring Chinook</b>   | <i>Adult Migration</i>   |     |     |     | █   |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Spawning</i>          |     |     |     |     |     |     |     |          | █   |          |     |     |  |  |
|                         | <i>Fry Emergence</i>     |     | █   |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Rearing</i>           | █   |     |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Juv. Outmigration</i> |     |     |     |     | █   |     |     |          |     |          |     |     |  |  |
| <b>Fall Chinook</b>     | <i>Adult Migration</i>   |     |     |     |     |     |     |     |          | █   |          |     |     |  |  |
|                         | <i>Spawning</i>          |     |     |     |     |     |     |     |          |     |          | █   |     |  |  |
|                         | <i>Fry Emergence</i>     |     | █   |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Rearing</i>           |     | █   |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Juv. Outmigration</i> |     |     |     |     |     | █   |     |          |     |          |     |     |  |  |
| <b>Coho Salmon</b>      | <i>Adult Migration</i>   |     |     |     |     |     |     |     | Type S █ |     | Type N █ |     |     |  |  |
|                         | <i>Spawning</i>          |     |     |     |     |     |     |     |          |     | █        |     |     |  |  |
|                         | <i>Fry Emergence</i>     |     | █   |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Rearing</i>           | █   |     |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Juv. Outmigration</i> |     |     |     |     | █   |     |     |          |     |          |     |     |  |  |
| <b>Summer Steelhead</b> | <i>Adult Migration</i>   |     |     |     | █   |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Spawning</i>          |     |     | █   |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Fry Emergence</i>     |     |     |     |     |     | █   |     |          |     |          |     |     |  |  |
|                         | <i>Rearing</i>           | █   |     |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Juv. Outmigration</i> |     |     |     | █   |     |     |     |          |     |          |     |     |  |  |
| <b>Winter Steelhead</b> | <i>Adult Migration</i>   | █   |     |     |     |     |     |     |          |     |          |     | █   |  |  |
|                         | <i>Spawning</i>          |     |     | █   |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Fry Emergence</i>     |     |     |     |     |     | █   |     |          |     |          |     |     |  |  |
|                         | <i>Rearing</i>           | █   |     |     |     |     |     |     |          |     |          |     |     |  |  |
|                         | <i>Juv. Outmigration</i> |     |     |     | █   |     |     |     |          |     |          |     |     |  |  |

**Figure 3.4-2. Periodicity chart for various life stages of fish species (with known life history information) in the Lewis River basin.**

Note: Periodicity is based on peak times and fishes of wild or natural origin.



**Figure 3.4-2. Periodicity chart for various life stages of fish species (with known life history information) in the Lewis River basin (cont.).**

Note: Periodicity is based on peak times and fishes of wild or natural origin.



The distribution of fall Chinook is limited to the mainstem Lewis River from its mouth to Merwin Dam, in the East Fork Lewis River from its mouth to RM 20.6, and in Cedar Creek from its mouth to RM 8.2 (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1). In the mainstem Lewis River, most spawning and rearing occurs between Merwin Dam and the Lewis River Hatchery (RM 15.6 to RM 19.4).

Between 1980 and 1999, the number of fall Chinook returning to the Lewis River has ranged from a low of 6,200 in 1998 to approximately 21,200 in 1989 (Figure 3.4-1). The average over this period was 11,600 fish. Life history periodicity for fall Chinook in the Lewis River is presented in Figure 3.4-2. The National Marine Fisheries Service listed the Lower Columbia River Chinook salmon as a threatened species on March 25, 1999 (64 FR 14508).

### Coho Salmon

Like Chinook salmon, coho salmon are anadromous. Juvenile coho rear in freshwater, typically migrate to sea in the spring of their second year, spend 16-20 months rearing in the ocean, and then return to freshwater in the autumn as 3-year-old adults. A variable proportion of males return to freshwater to spawn after only 5 to 7 months in the ocean (Weitkamp et al. 1995, Sandercock 1991). Within this basic pattern, there are many variations that have evolved in response to opportunity and selective pressures. Stocks from British Columbia, Washington, and the Columbia River often have very early (entering rivers in July or August) or late (spawning into March) runs in addition to normally timed runs (Weitkamp et al. 1995). In general, earlier migrating fish spawn farther upstream within a basin than later migrating fish, which enter rivers in a more advanced state of sexual maturity (Sandercock 1991).

While in freshwater, coho salmon prefer streams with widths ranging from 3.3 to 16.4 feet in low flow periods, gradients less than 3 percent, pool to riffle ratios of 1:1, and an abundance of instream cover (WDFW 1994, McMahan 1983). Typically, coho spawn in gravelly transition areas between pool and riffle habitats. Spawning areas are often located close to cover that provides protection from predation on the spawning female (Schuett-Hames and Pleus 1996). Following emergence, coho fry form schools and move into shallow, low velocity areas typically found in backwater pools, dam pools, and beaver ponds (Reeves et al. 1989). Often fry are associated with cover such as overhanging or submerged logs, undercut banks, overhanging vegetation, or large substrate. These structures afford protection from predation and increase macroinvertebrate production, offering increased food sources for the young fry. As the fry become older, they begin to occupy areas near the open shoreline and progressively move into areas of higher velocity (Sandercock 1991, Reeves et al. 1989). Preferred temperature ranges and upper lethal water temperatures for coho salmon are presented in Table 3.4-2.

Preferred habitat for coho during the winter months includes side channels and backwater channels, especially those areas with heavy groundwater influence. These areas provide protection from extreme flows, freezing temperatures, and predation (Sandercock 1991).

In the early spring, the pre-smolts move back into the mainstem channels in preparation for their seaward migration.

Although they are indigenous to the Lewis River basin, coho salmon returning to this basin are currently managed for two hatchery stocks, a late run (Type-N) stock and an early run (Type-S) stock (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1). Since 1952, annual releases of hatchery coho have ranged from 457,000 in 1959 to over 12.2 million in 1989. Most (65 percent) were released as yearlings. The original Lewis River Hatchery coho stock was taken from native coho trapped at Merwin Dam (WDFW 2000a). Since then, coho have been supplemented using a variety of stock sources including late-run (Type-N) Cowlitz River stock and early-run (Type-S) Toutle River stock (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 8).

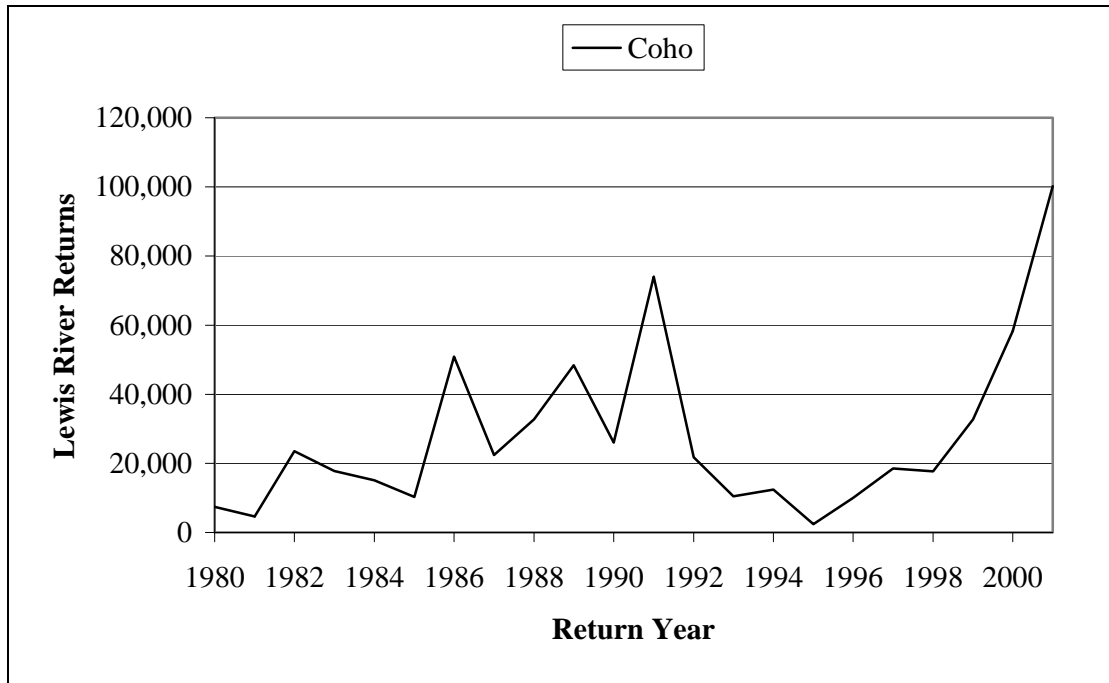
There is very little natural production of coho salmon in the Lewis River basin. The majority of returning coho are captured at the Merwin Hatchery, although an estimated 5 to 10 percent spawn naturally within the mainstem Lewis River below Merwin Dam and in several tributaries including the East Fork Lewis River, Ross, Cedar, Chelatchie, Johnson, and Colvin creeks, and numerous smaller tributaries (WDF, WDW, and WWTIT 1993, PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1).

From 1980 to 2001, returns of both Type S and Type N coho have ranged from approximately 2,400 to over 98,000 fish, with an average of around 28,000 fish (Figure 3.4-3). In recent years, coho abundance has increased dramatically. It should be noted that returns to the hatchery only account for a small portion of the adult coho produced at the Lewis River hatcheries since the bulk of the production (65 to 85 percent) is harvested in the mainstem Columbia River and Pacific Ocean (WDFW 1994). Life history periodicity for naturally spawning coho in the Lewis River is presented in Figure 3.4-2.

In 1993, National Marine Fisheries Service (NMFS) was petitioned to list west coast coho salmon, including Columbia River populations. After reviewing existing information, NMFS found that at least one ESU of coho salmon probably exists in the lower Columbia River Basin, although the agency was unable to identify any remaining natural populations to protect. NMFS concluded, however, that there was sufficient concern regarding the overall health of this ESU to add the lower Columbia River/southwest Washington coho salmon ESU to the candidate species list (Federal Register, Vol. 60, No. 142, July 25, 1995). Designation as a candidate species does not implement protection measures, but is a formal statement that existing information is not sufficient to comprehensively define the status of the species.

### Steelhead

Steelhead is considered by many to have the greatest diversity of life history patterns of any Pacific salmonid species, including varying degrees of anadromy, differences in reproductive biology, and plasticity of life history between generations. The species can be anadromous (steelhead) or freshwater resident (rainbow trout). It is believed that the



**Figure 3.4-3. Adult coho returns to the North Fork Lewis River (1980 to 2001).**

progeny from resident rainbow trout have the potential to become anadromous (steelhead) and that the progeny of steelhead have the potential to become resident rainbows (Peven 1990).

Biologically, the anadromous steelhead can be divided into two reproductive ecotypes based on their state of sexual maturity at the time of river entry and duration of their spawning migration. These two ecotypes are termed “stream maturing” (summer steelhead) and “ocean maturing” (winter steelhead). Summer steelhead enter freshwater during the summer months in a sexually immature state and require several months of maturation before they spawn. Winter steelhead enter freshwater ready to spawn in late winter or early spring (Busby et al. 1996). Steelhead are capable of spawning more than once before they die (Busby et al. 1996); however, the majority spawn only once. The amount of time steelhead spend in the marine environment is highly variable. North American steelhead most commonly spend two years in the ocean (2-ocean) before entering freshwater to spawn

Steelhead and rainbow trout prefer relatively small, fast flowing streams with a high proportion of riffles and pools (Barnhart 1991). As with most salmonids, spawning typically occurs in streams where the water is cool, clear, and well oxygenated. The most common steelhead spawning areas are located at the tail of a pool close to the point where the smooth surface water breaks into the riffle below.

After emergence, steelhead fry form small schools and inhabit the margins of the stream. As they grow larger and more active, they slowly begin to disperse downstream. Most steelhead in their first year of life live in riffles, but some larger fish also inhabit pools or

deep fast runs (Barnhart 1991). Instream cover such as large rocks, logs, root wads, and aquatic vegetation are very important for juvenile steelhead. This cover provides resting areas, visual isolation from competing salmonids, food, and protection from predators. Preferred temperature ranges and upper lethal water temperatures for steelhead are presented in Table 3.4-2.

Both summer and winter steelhead are indigenous to the Lewis River basin; however, hatchery summer and winter steelhead (Skamania and Beaver Creek stocks) have been planted in the system since the late 1940s (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 8). Annual releases in the past 20 years have averaged just under 500,000 fish (PSMFC 2001). The majority of the steelhead releases have been yearlings from the Merwin Hatchery (post 1993), as well as from the Skamania, Vancouver, and Beaver Creek hatcheries.

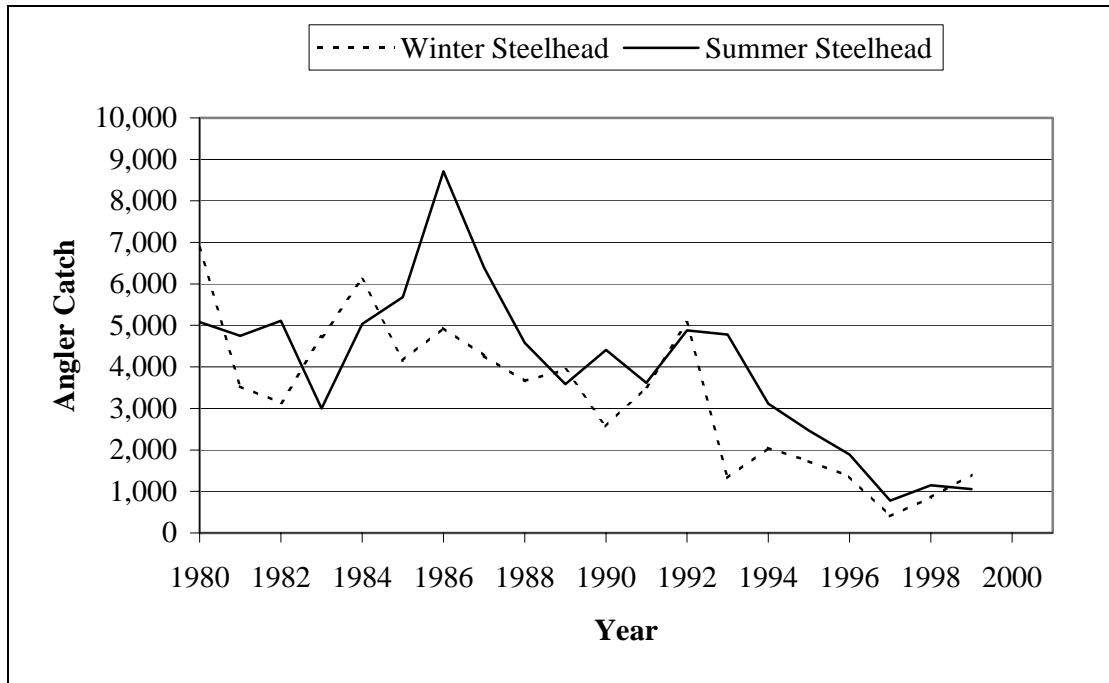
There is very little wild steelhead production in the Lewis River below Merwin Dam; wild steelhead returns account for approximately seven percent of the total run size (WDFW 1994). Steelhead distribution in the mainstem Lewis River occurs from the mouth to Merwin Dam. Steelhead also spawn and rear in the East Fork Lewis River and throughout most of Cedar Creek (Hymer et al. 1993). In addition to these reaches, winter and summer steelhead also utilize portions of Big, Rock, Chelatchie, Cold, Copper, Coyote, and Johnson creeks, and several smaller tributaries (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1).

Hatchery winter and summer steelhead support a popular recreational fishery in the lower Lewis River. From 1980 through 1998, annual angler catch of summer steelhead in the mainstem and North Fork Lewis River has averaged just over 4,150 fish. Catch of winter steelhead during this same period has averaged 3,380 fish (Figure 3.4-4) (PacifiCorp and Cowlitz PUD 2003f and 2004). Prior to 1994, all steelhead captured at the Lewis River Hatchery were returned to the river for harvest by anglers. Therefore, hatchery returns are not the best indicator of total run size. Selective harvest regulations allow only the harvest of adipose-fin clipped fish. There is no legal harvest for wild steelhead in the Lewis River basin; all wild steelhead caught must be released unharmed. Life history periodicity for naturally spawning winter and summer steelhead in the Lewis River is presented in Figure 3.4-2.

Steelhead in the lower Columbia River ESU, which includes naturally spawned populations and their progeny in the Lewis River below Merwin Dam, were listed as threatened by NMFS on March 19, 1998 (Federal Register, Vol. 63, No. 53, March 19, 1998).

### Chum Salmon

Chum salmon are anadromous and spend more of their life in marine waters than other Pacific salmonids (Johnson et al. 1997). Mature adults enter freshwater at an advanced stage of sexual development and spawn in the lower reaches of coastal streams (typically,



**Figure 3.4-4. The number of winter and summer steelhead harvested in the Lewis River basin recreation fishery (1980 through 1998).**

just above tidal influence). Rarely do chum salmon penetrate rivers more than 100 miles (Scott and Crossman 1973). Although very capable swimmers, they are not leapers and are usually reluctant to enter long-span fish ladders (Salo 1991, Powers and Orsborn 1985).

Chum salmon may enter their natal river from June to March (Johnson et al. 1997). In Washington, a variety of seasonal runs are recognized, including summer, fall, and winter populations; most enter freshwater from October to December (Wydoski and Whitney 1979). Preferred temperature ranges and upper lethal water temperatures for chum salmon are presented in Table 3.4-2.

Juvenile chum salmon outmigrate to saltwater almost immediately following emergence (Salo 1991). This means that their survival and growth depends less on freshwater conditions than on favorable estuarine conditions (Johnson et al. 1997). Freshwater residence can range from a few hours to a few months. In Washington, chum salmon may reside in freshwater for as long as a month, migrating from late January through May (Johnson et al. 1997). Because chum fry primarily emerge from gravels during darkness and promptly migrate, cover is not a significant factor in their freshwater environment.

Only a remnant population of chum salmon (of uncertain stocking history) exists in the Columbia River and its tributaries below Bonneville Dam. Most of these chum salmon spawn in the Grays River system near the mouth of the Columbia River and near Bonneville Dam in Hardy and Hamilton creeks (WDF, WDW, and WWTIT 1993). Very

small numbers have also been observed in the Washougal, Lewis, Kalama, and Cowlitz rivers (Johnson et al. 1997; Tacoma Power 1999).

In the lower Lewis River, spawning chum salmon were sighted occasionally during 1998 fall Chinook spawning surveys, and four adult carcasses were observed in Cedar Creek. In addition, about 45 juvenile chum salmon were captured during seining operations related to a smolt residual study in 1998. Annually, about three or four adult chum salmon have also been captured at the Merwin fish trap (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1). All of these fish were believed to be wild; hatchery supplementation has not occurred since 1940 (NPPC 1990). Life history periodicity for chum salmon in the Lewis River is presented in Figure 3.4-2.

The Columbia River chum salmon were listed as a threatened species on March 25, 1999 (64 FR 14508).

#### Sea-run Cutthroat Trout

Coastal cutthroat trout are found throughout the Lewis River watershed (WDFW 2000b; PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1). The anadromous form (sea-run cutthroat trout) is currently found in the Lewis River and its tributaries up to Merwin Dam (RM 19.4). Fluvial and resident coastal cutthroat trout are found throughout the upper and lower watershed (upstream and downstream of Merwin Dam), and adfluvial fish have been observed in Merwin, Yale, and Swift Creek reservoirs (WDFW 2000b). Although hatchery-origin anadromous cutthroat trout were released annually from 1993 through 1999 as smolts into the Lewis River (Cowlitz River and Skamania River stocks), the existing Lewis River coastal cutthroat trout stock is considered native. WDFW staff believes that few genetic interactions have occurred between wild and hatchery populations (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1).

Information describing the abundance of coastal cutthroat trout in the Lewis River basin is extremely limited. According to WDFW (2000b) there is no data available describing average run size distribution in the basin. In 1998, sea-run cutthroat trout creel survey results on the Lewis River showed a catch of only 20 fish (Hillson and Tipping 1999). Life history periodicity for sea-run coastal cutthroat trout in the Lewis River is presented in Figure 3.4-2.

Resident cutthroat trout was the most abundant salmonid species captured during PacifiCorp's 1996-1997 fish population surveys in Yale Lake tributaries. In September 1996, the Lewis River bypass reach contained an estimated 924 cutthroat trout greater than 65 mm (2.5 in) in length (254 cutthroat trout per mile) (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1). Cutthroat trout fry and adults were also captured in Ole, Dog, Speelyai, and Panamaker creeks in 1996 and 1997. 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).

### Pacific Lamprey

The distribution of Pacific lamprey is similar to that of Pacific salmon. In Washington, the species is found in most large coastal rivers including the Columbia, Snake, and Yakima river systems (Wydoski and Whitney 1979). No systematic survey of Pacific lamprey distribution or abundance has been conducted in the Lewis River basin, nor is their historic distribution known; however, current stocks in the Columbia and Snake river systems are in a steep decline (Close et al. 1995). Limited available data suggest that Pacific lamprey populations in the Columbia River basin have been declining since the construction of the network of dams on the mainstem Columbia River. Adult lamprey counts at each of these dams are markedly lower than counts during the mid-1900s, and growing evidence indicates that Pacific lamprey have great difficulty surviving downstream passage at dams and migrating upstream past dams.

Due to their role in the food web of North Pacific ecosystems as predator and prey, and their status as a food and cultural resource for the Pacific Northwest Indian Tribes, plans for restoration of the species are currently being developed. Life history periodicity for Pacific lamprey in the lower Columbia River is presented in Figure 3.4-2.

### Bull Trout

Bull trout exhibit two distinct life-history strategies: resident and migratory. Resident bull trout complete their entire life cycle in the tributary streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear for up to six years before migrating to either a lake (adfluvial), river (fluvial), or in certain coastal areas, to saltwater (anadromous). Maturity is reached in one of these three habitats (Fraley and Shepard 1989; Goetz 1989). Resident and migratory forms may be found together and it is suspected that bull trout give rise to offspring exhibiting both resident and migratory behavior (Federal Register, Vol. 63, No. 111, June 10, 1998; Rieman and McIntyre 1993).

Bull trout have more specific habitat requirements than other salmonids. Cold water temperature is likely the most important habitat component. Water temperature above 15°C is believed to limit bull trout distribution. Studies show that temperatures must drop below 9 or 10°C for spawning to occur. Egg survival is highest at 2 to 4°C. Complex cover including large woody debris, undercut banks, coarse substrates, and pools correspond to the distribution and abundance of bull trout. Preferred spawning habitat is low gradient streams with loose, clean gravels. Because bull trout eggs incubate about seven months in the gravel, they are especially vulnerable to fine sediments and water quality degradation, as are juveniles that live on or within the cobbles. Bull trout habitat requires stream channel and flow stability. Embryos and juveniles may be particularly vulnerable to flooding and channel scour.

The Columbia River basin supports a total of 141 subpopulations of bull trout. Two occur in the Lewis River basin (Federal Register, Vol. 63, No. 111, June 10, 1998). Genetic analysis by Neraas and Spruell (2004) of the Lewis River bull trout population indicated that there are statistically significant subpopulations, the Pine Creek

subpopulation and the Rush Creek subpopulation. Although both subpopulations can be found in Swift Creek Reservoir, the study indicates that there is not significant genetic exchange between the bull trout spawning in these two streams. Downstream from Swift Dam, genetic samples from Lake Merwin, Yale Lake, and Cougar Creek were indistinguishable and a mix of individuals from upstream sources. Furthermore, the ability of fish to move downstream through the dams but not upstream most likely explains the "mixed stock" genetics of the bull trout below Swift Dam.

No known spawning sites are accessible to bull trout in the tributaries to Lake Merwin or the mainstem below Merwin Dam. Bull trout found in Lake Merwin are believed to have moved downstream from Yale Lake. Adults and sub-adults have also been observed in the Swift No. 2 canal and Lewis River bypass reach (PacifiCorp 1999b). A very small number of unidentified adult char (bull trout or Dolly Varden) have also been captured in the ladder at the Lewis River hatchery downstream of Merwin Dam.

Bull trout spawning and rearing habitat in the Lewis River basin is limited. Most bull trout spawning and juvenile rearing occurs in Cougar, Rush, and Pine creeks (tributaries to Yale Lake and Swift Creek Reservoir) (Faler and Bair 1992; Lesko 2001). The primary limiting factor for bull trout production appears to be the availability of adequate spawning and rearing habitat. One and three-quarters miles of Cougar Creek are the only spawning and rearing habitat for the Yale Lake population.

From 1979 through 2003, the number of adult bull trout spawning in Cougar Creek (based on annual peak counts) has ranged from 0 in 1981 and 1982 to 40 in 1979 (Figure 3.4-5). The low number of spawners observed in the early 1980s may be related to impacts associated with the May 1980 eruption of Mount St. Helens. Because these surveys are not thought to have covered the entire spawning period, WDFW believes that bull trout spawners in Cougar Creek may be undercounted.

In addition to the survey work conducted in Cougar Creek, the USFS, WDFW, and PacifiCorp have been collecting distribution and abundance data about bull trout in Rush and Pine creeks (the primary spawning tributaries for the Swift bull trout population) (Faler and Bair 1992; Lesko 2002). In Swift Creek Reservoir, populations appear to have increased since the early 1990s. Between 1994 and 2003, the annual spawner population in Swift Creek Reservoir has ranged from 101 to 792 fish (Figure 3.4-6) (Lesko 2002; pers. comm.; D. Rawding and J. Weinheimer, WDFW, 2000). Life history periodicity for bull trout residing in Yale Lake and Swift Creek Reservoir is presented in Figure 3.4-2.

Each fall, bull trout adults enter the Yale Dam tailrace apparently attempting to migrate upstream. It is believed that they enter Lake Merwin from Yale Lake via spill over Yale Dam or as a result of turbine entrainment and are subsequently isolated from upstream habitat. Lake Merwin contains no appreciable bull trout spawning habitat, while Cougar Creek, a major tributary to Yale Lake, contains important bull trout spawning and early rearing habitat. Pine and Rush creeks, two tributaries to the Lewis River upstream of Swift Creek Reservoir, also provide important spawning and early rearing habitat for bull trout. According to USFWS and NMFS (2002), the gill netting program has reduced the number of adult bull trout that are isolated from Cougar Creek. Since the program began



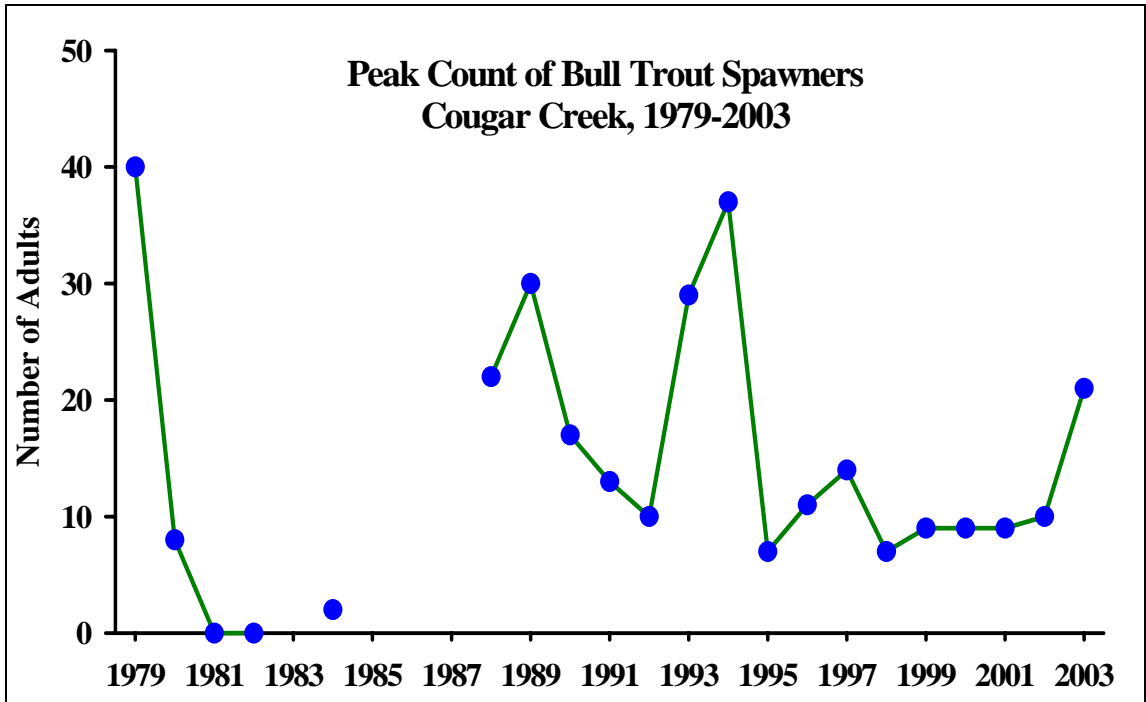


Figure 3.4-5. Annual peak counts of bull trout spawners observed in Cougar Creek 1979 through 2003.

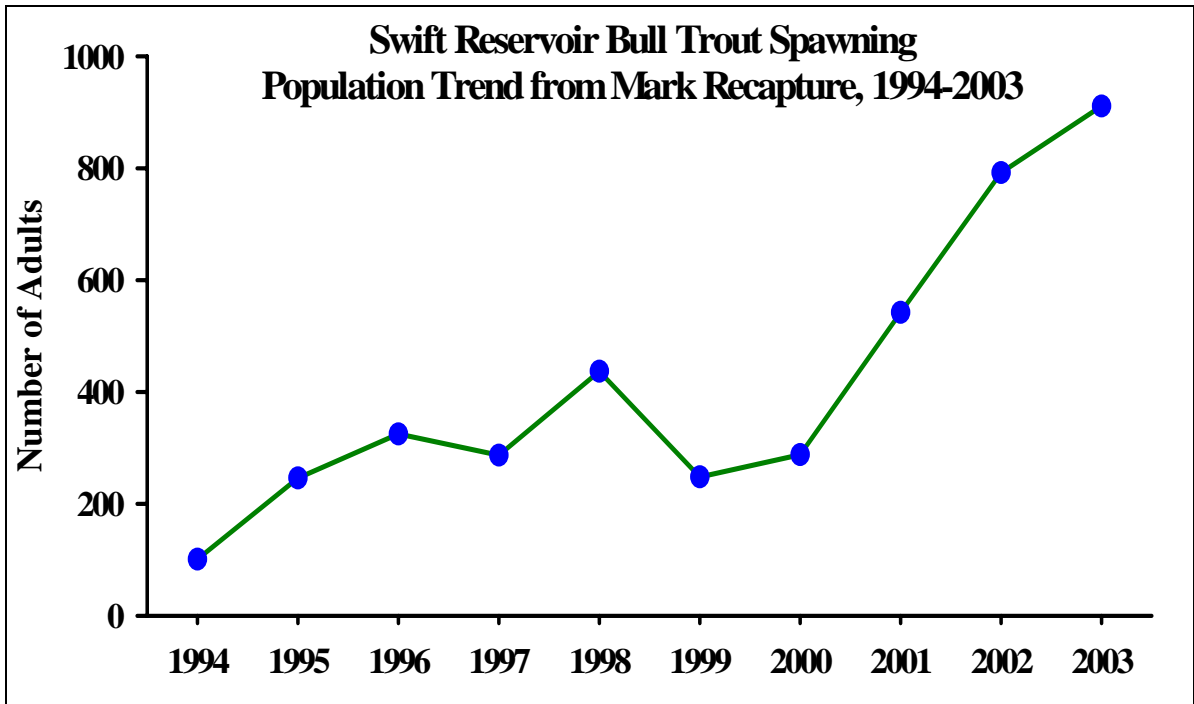


Figure 3.4-6. Spawning population estimate of bull trout in Swift Creek Reservoir for the years 1994 through 2003.

in 1995, an average of 21 percent of the annual Cougar Creek spawners were fish that had been trapped and transported from the Yale tailrace. In addition, Cowlitz PUD and PacifiCorp initiated a pilot net-and-haul program at the Swift No. 2 tailrace in 1999. No bull trout were captured or observed at the tailrace but two were netted in the Lewis River bypass reach directly upstream from the Swift No. 2 powerhouse (USFWS and NMFS 2002).

The USFWS listed the Columbia River Distinct Population Segment of bull trout as threatened on June 10, 1999 (63 FR 31647).

### Kokanee

*Oncorhynchus nerka* occur in two forms: the anadromous sockeye salmon, and the non-anadromous kokanee. Anadromous sockeye salmon typically spend their first year of life in a lake before migrating to the ocean to rear and mature, while kokanee complete their entire life cycle in freshwater (Meehan and Bjornn 1991). Kokanee usually mature at a smaller size than sockeye salmon because there is typically less food in lake environments than in the ocean (Meehan and Bjornn 1991). Throughout its range, the average life span of kokanee is 4 years (3 years in southern populations), although some as old as 8 years have been reported (Scott and Crossman 1973).

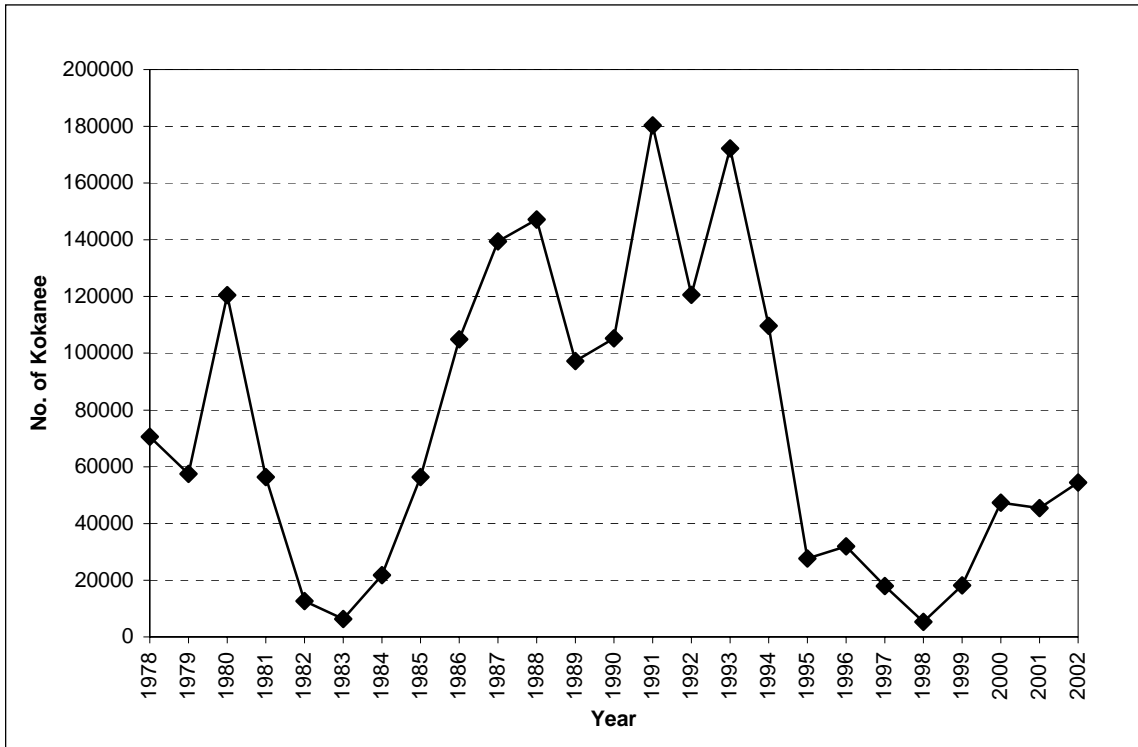
Kokanee are not native to the Lewis River basin. They were first introduced into Yale Lake and Lake Merwin in 1957, and into Swift Creek Reservoir in 1961 (PacifiCorp and Cowlitz PUD 2000a). To create a reservoir fishery, tributaries to all three reservoirs were stocked with kokanee from Kootenay Lake and Cultus Lake, both of which are located in British Columbia. Kokanee are currently found in Lake Merwin and Yale Lake, with Yale Lake supporting the only self-sustaining population in the basin.

Yale Lake kokanee spawn primarily in Cougar Creek, where PacifiCorp's annual surveys since 1978 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 about 180,000 (1991) to a low of 5,357 (1998) (Figure 3.4-7). Limited kokanee spawning has also been documented in the Lewis River bypass reach and Ole Creek (PacifiCorp 1999b). Kokanee outmigration is highly synchronized and occurs during the night, so that thousands of fry swim or drift en masse to the lake in an attempt to minimize predation (Burgner 1991). In the Lewis River basin, juvenile kokanee rear for an average two to three years before spawning. Life history periodicity for kokanee residing in Yale Lake and Lake Merwin is presented in Figure 3.4-2.

Kokanee in Lake Merwin spawn primarily in the lower 300 feet of Canyon Creek, because a natural barrier prohibits upstream passage beyond this point. Limited spawning also occurs in Speelyai Creek (downstream from the hatchery diversion), in lower Rock Creek, and in the Yale tailrace (Graves 1982).

Kokanee are the primary target species for anglers in Yale Lake and are the most popular target species in Lake Merwin (WDFW 1998). In 1996, WDFW decided to supplement

the kokanee population in Lake Merwin using kokanee spawned and reared at Speelyai Hatchery. In 1999, Yale Lake received its first planting of kokanee since 1957 (PacifiCorp and Cowlitz PUD 2000a), a practice that was discontinued in late 2001. The current kokanee production goal at Speelyai Hatchery is 45,000 fingerlings and 48,000 yearlings, all of which are planted in Lake Merwin.



**Figure 3.4-7. Peak counts of kokanee spawning in Cougar Creek (1978 to 2002).**

### Rainbow Trout

Although rainbow trout are native to the Lewis River basin, non-native stocks of rainbow trout have been planted in Swift Creek Reservoir since 1978 (PacifiCorp and Cowlitz PUD 2000a; PacifiCorp 1999b). The goal of this program is to support a popular sport fishery. Since 1978, approximately 800,000 to 1,000,000 rainbow trout fingerlings have been stocked annually.

In 1992, the Clark/Skamania Fly Fisheries Club funded a genetic analysis of rainbow trout collected in Canyon and Siouxon creeks to help determine the effects of past stocking on the native rainbow trout population (Phelps 1992). No evidence of hatchery rainbow trout gene flow was found in the population collected in upper Siouxon Creek (i.e., these fish are pure native) and only minor gene flow was found in the lower Siouxon Creek collection (i.e., there appears to be a low level of hatchery introgression into this population). The Canyon Creek population does not appear to be hybridized with hatchery-origin rainbow trout (Phelps 1992).

### Northern Pikeminnow

The northern pikeminnow is one of the largest native minnows (family Cyprinidae) in North America. It can weigh up to 13 kg (29 lbs) and reach a length of up to 64 cm (25 inches) (McPhail and Lindsey 1970). Juvenile northern pikeminnow feed on a variety of aquatic invertebrates, but fish are the favored prey of larger northern pikeminnow. In the Pacific Northwest, they are considered serious predators of anadromous salmonids and much effort has been expended in attempts to eradicate them.

Because of their preference for stillwater habitat, it is likely that very few northern pikeminnow occurred in the Lewis River basin prior to the construction of the Lewis River projects. Following the creation of substantial reservoir habitat, northern pikeminnow populations increased dramatically. In the last 40 years, large numbers have been observed in Lake Merwin, with smaller numbers observed in Yale Lake. In 1961, the population of northern pikeminnow > 20 cm in length (7.9 inches) in Lake Merwin was estimated to be about 350,000 fish (Hamilton et al. 1970).

### Tiger Musky

Tiger musky, a non-native sterile hybrid known to prey heavily on soft-rayed fishes (including salmonids), were introduced into Lake Merwin by WDFW in 1995. The goal of the program is to reduce the abundance of salmonid-eating northern pikeminnow and to provide a sport fishery for anglers. Northern pikeminnow are known to be one of the main predators on emigrating salmonids in the Columbia River basin. Annual tiger musky plants into Lake Merwin have ranged from 375 to just over 1,700. Funding for this program is provided by WDFW.

Recently, tiger muskies have been observed in the mainstem Lewis River below Merwin Dam; however, no studies have been conducted to determine how these fish moved there (i.e., over the spillway or through the turbines), nor have there been efforts to determine the number of tiger muskies that have migrated out of the reservoir.

### Other Resident Fish Species

Information on resident fish species present in the Lewis River basin that are not addressed in this document (Table 3.4-1) is available in PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1).

#### 3.4.2.2 Aquatic Habitat

The following sections describe the existing aquatic habitat conditions of project-affected reaches in the Lewis River watershed. Additional information is presented in several studies (WTS 1, WTS 3, WTS 4, AQU 9, and AQU 12) published in the Final Technical Study Reports (PacifiCorp and Cowlitz PUD 2004).

Lewis River Bypass Reach

The Lewis River bypass reach extends approximately 3.3 miles between Swift Dam and Yale Lake. Flow in the reach comes from seepage from Swift No. 2 canal, groundwater inflow, and tributary inflow, except when water is spilled into the reach from Swift Dam during high flow events. Input of wood and sediment to the Lewis River bypass reach currently comes from sources within the reach, which are very limited, except during very large flow events when Swift Dam spillgates are opened and some large woody debris is spilled. Ole Creek flows into the reach approximately 2.5 miles downstream of Swift Dam and provides a source of water, gravel, and large woody debris during the fall, winter, and spring.

The majority of this reach is characterized by riffles and glides with small boulder/cobble substrate (Table 3.4-3). In addition, there are several long side channels and an overall lack of gravel and smaller-sized particles. The substrate characteristics limit the availability of suitable fish spawning habitat except in the short section downstream of Ole Creek. There is very little large woody debris within the wetted or bankfull channel in the reach. Numerous large boulders provide cover and habitat complexity.

**Table 3.4-3. Current aquatic habitat metrics in measured stream reaches in the Lewis River watershed.**

| Stream Reach   | Riffle (percent by length) | Glide (percent by length) | Pool (percent by length) | Side Channel (percent by length) | Dominant/sub-dominant substrate | Total area of spawning gravel (sq yd) | Average percent fines (<1mm) in spawning gravel | LWD (pieces/mile) |
|--|----------------------------|---------------------------|--------------------------|----------------------------------|---------------------------------|---------------------------------------|---|-------------------|
| Lewis River bypass reach   | 12%                        | 11%                       | 15%                      | 62%                              | Small Boulder/Cobble            | Not measured                          | 1-5%  | 21                |
| Lower Speelyai Creek   | 18%                        | 42%                       | 40%                      | 0%                               | Cobble/Gravel                   | 730                                   | Not measured                                    | 108               |
| Lewis River: Merwin Dam to Lewis River Hatchery (confined channel) | 22%                        | 56%                       | 22%                      | 0%                               | Cobble/Gravel                   | 38,600                                | 0-4%  | 10                |
| Lewis River Hatchery to Eagle Island (unconfined channel)          | 17%                        | 60%                       | 0%                       | 23%                              | Cobble/Gravel                   | 40,600                                | 2-10%   | 20                |

Lower Speelyai Creek

Lower Speelyai Creek is a spring-fed system with stable flows increasing from 0 cfs below the upper diversion (RM 4.4) to 17 to 28 cfs at the Speelyai Hatchery intake through groundwater and tributary contributions. The local riparian zone along Speelyai Creek is dominated by mixed conifer/deciduous stands and provides large woody debris

that is reworked by numerous beavers in the reach. Since peak flows are extremely muted in the reach, the stream is very stable, with little transport of wood or sediment through the reach. As a result, there is abundant wood and gravel in the reach.

Aquatic habitat in lower Speelyai Creek is dominated by glides and pools, with some riffles (Table 3.4-3). Substrate is cobble/gravel, and there is an average of 108 pieces of large woody debris/mile in the reach.

Aquatic habitat is good quality, with diverse pool (resting habitat), riffle and run conditions, ample large woody debris, and spawning gravel resources. The lack of large peak flows is not a “natural” condition for the stream, but results in good quality aquatic and riparian habitat conditions capable of supporting both resident and anadromous salmonids.

#### Lewis River Downstream from Merwin Dam

The river channel below Merwin is fairly stable, with few areas of active bars, little channel migration, and little bedload transport. Riparian habitat is affected by development, agriculture, and recreation.

Swift, Yale, and Merwin dams trap the majority of sediment and large wood from the upper watershed, and reduce the magnitude of peak flows in the lower watershed (PacifiCorp and Cowlitz PUD 2003f and 2004: WTS-3). Sediment input to the Lewis River downstream of Merwin Dam is limited to contributions from tributaries and erosion/landslides from the valley walls. An average of 8,200 tons/yr of sediment (1,000 tons/yr of gravel and larger particles) is estimated to be delivered to the river between Merwin Dam and Eagle Island. Large woody debris is supplied by the local riparian habitat and infrequent spills over Merwin Dam. Peak flows, those that transport sediment and large wood and change channel conditions, are controlled by flood management procedures.

The Lewis River is confined to a narrow valley between Merwin Dam (RM 19.4) and the Lewis River Hatchery (RM 15.7). Aquatic habitat in the confined reach is characterized by glides, riffles, and pools. Bedrock outcrops are the dominant pool-forming mechanism. Substrate in this reach is cobble/gravel in the glides and riffles, and boulder/bedrock/cobble in the pools. Over 38,000 square yards of spawning-sized gravel was mapped and is distributed throughout the reach. Samples of the gravel show it has a low percent fines and a size distribution suitable for use by anadromous fish. The good quality of the gravel is substantiated by the high use of the reach for spawning. There is very little large woody debris (an average of 10 pieces per mile), the majority of which is located on bars within the bankfull channel, but above the wetted channel. The current flow regime, combined with the extremely low gradient of this reach, results in very low bedload transport rates. As a result, the gravel deposits appear to be relatively stable and provide good quality spawning habitat.

The unconfined reach of the Lewis River between the hatchery (RM 15.7) and the downstream end of Eagle Island (RM 10) is characterized by glides, side channels, and

riffles. The river has more room to migrate across the valley in this reach; however, the reduced peak flows and low gradient result in little channel migration. Several of the migrating meanders have been cut off, forming side channels that are connected to the river and provide good off-channel rearing and protection from high flows. The dominant substrate is cobble/gravel in the main channel and gravel/silt/sand in the side channels. Over 40,000 square yards of spawning-sized gravel was mapped in the reach. The gradient of the river decreases toward the downstream end of this reach, and the substrate is predominantly sand and gravel by the downstream end of Eagle Island. There is an average of 20 pieces of large woody debris/mile in the unconfined reach. Large wood is located on bars; submerged wood is also located in the channel near Eagle Island. The gradient of the river is very low in this section, and the influence of tides and backwater effects from the Columbia River extend upstream to this reach.

### 3.4.2.3 Flow

#### Lewis River Bypass Reach

Swift Dam releases flow from Swift Reservoir into Swift No. 2 canal. Flow in the Lewis River bypass reach is the result of inflow from tributaries, groundwater, leakage from the spill gates, and seepage from the earthen canal embankment, and infrequently, spills. During high runoff conditions, when the projects are operating to manage floods or during operational emergencies, water is spilled into the bypass reach from either the Swift Dam spillway or the Swift No. 2 canal spillway. Spill events occur sporadically, but in general, spills of several thousand cfs or greater occur every few years. Median summer water temperatures in the Lewis River bypass reach approach the upper end of preferred ranges for most salmonids (Table 3.4-2) (PacifiCorp and Cowlitz PUD 2003a). Maximum summer water temperatures exceed the preferred ranges for all salmonid species except rainbow trout.

Although the bypass reach supports populations of cutthroat trout, rainbow trout, mountain whitefish, largescale sucker, and other resident fish species (including an occasional bull trout), the quality and quantity of habitat in this reach is extremely limited by lack of flow.

#### Lewis River Below Merwin Dam

As discussed in Section 2.2.2, current FERC license articles and voluntary measures to protect aquatic resources control the flow of water in the Lewis River downstream of Merwin Dam (Table 3.4-4). Current flows are described in Section 3.2.

The existing flow regime provides stable wetted habitat area in the mainstem Lewis River in the summer and fall, benefiting resident and anadromous fish, especially native Lewis River fall Chinook. In fact, the flow regime stipulated in Article 49 of the existing Merwin license was purposefully developed by WDFW and PacifiCorp to maintain and enhance native fall Chinook in the mainstem Lewis River (WDF 1991). Fall Chinook rearing habitat studies and population estimates conducted between 1977 and 1990 (McIsaac 1980, 1990; NES 1984; Norman et al. 1987; and WDF 1991) found that

higher flows in the spring and early summer produce more wild fall Chinook smolts, and that flows in the 3,000 to 5,000 cfs range represent optimum rearing conditions for pre-smolt wild fall Chinook.

**Table 3.4-4. Minimum flow provisions downstream of Merwin, as stipulated in Article 49 of the existing Merwin Project license.**

| Time Period               | Minimum Flow Requirement   |
|---------------------------|--|
| December 8 to February 28 | 1,500 cfs  |
| March 1 to May 31         | During March, between 1,000 and 2,000 cfs, depending on runoff volume forecast on March 1.<br><br>During April, between 1,300 and 2,700 cfs, depending on runoff volume forecast on April 1.<br><br>During May, between 1,650 and 2,700 cfs, depending on runoff volume forecast on May 1.   |
| June 1 to July 31         | During June, 2,700 cfs, as long as natural flow at Merwin is equal to or greater than 2,000 cfs.<br><br>During July 1-15, 2,000 cfs, as long as natural flow at Merwin is equal to or greater than 1,600 cfs.<br><br>During the period July 15-31, 1,500 cfs, as long as natural flow at Merwin is greater to or equal to 1,200 cfs. |
| August 1 to October 15    | 1,200 cfs  |
| October 16 to December 7  | During the period Oct. 16 – 31, minimum flow of 2,700.<br><br>During the period Nov. 1 – 15, minimum flow is lesser of 4,200 cfs or natural flow at Merwin plus 2,000 cfs.<br><br>During the period Nov. 16 – Dec. 7, minimum flow is the lesser of 5,400 cfs or natural flow at Merwin plus 2,000 cfs.                              |

The controlled peak flows have created a stable channel condition with little scour of redds and infrequent gravel transport. Low flows during the spring may affect juvenile salmonid migration rates in the lower river, as their survival appears to increase with increasing river flows (Norman et al. 1987; Cada et al. 1993). The causal mechanisms for this increased survival is poorly understood but is likely related to water temperature, change in predation rates, and the timing of juvenile arrival in the Columbia River estuary. The effect of the existing Lewis River flow regime on water temperatures is discussed in Section 3.3.3.1.

Ramping Rates

Rapid changes in river flow due to hydroelectric project operations (i.e., changes in generation, shutdowns associated with maintenance, powerhouse failures, spill events, or other activities) have the potential to adversely affect aquatic resources. As water rapidly recedes in a project-affected reach, potential impacts can include the stranding of fish in shallow areas and off-channel habitat (resulting in immediate or delayed mortality);



temporary loss of habitat or loss of habitat access; and the dewatering of fish redds, amphibians, aquatic insects, and plant life (Hunter 1992). Rapid changes in river flow can also affect fish behavior that could reduce survival or growth. In most cases, the faster the reduction in water surface elevation or “stage,” the more likely fish and other aquatic organisms are to be stranded or adversely affected. Limits governing the rate and timing of project-induced stage changes (ramping rates) are often established to protect aquatic organisms from flow fluctuations.

In 1992, WDFW recommended ramping rates for hydroelectric projects on large rivers in Washington. These range from “no ramping” to two inches per hour, depending on season and time of day (Table 3.4-5) and are usually applied to flows less than a “critical flow” (Hunter 1992). Typically, this critical flow is the point at which low gradient gravel bars (stranding areas) become exposed.

**Table 3.4-5. WDFW interim ramping rate criteria.**

| Season                          | Daylight Rates <sup>3</sup> | Night Rates   |
|---------------------------------|-----------------------------|---------------|
| Feb. 16 to June 15 <sup>1</sup> | No Ramping <sup>4</sup>     | 2 inches/hour |
| June 16 to Oct. 31 <sup>2</sup> | 1 inch/hour                 | 1 inch/hour   |
| Nov. 1 to Feb. 15               | 2 inches/hour               | 2 inches/hour |

Source: Hunter 1992

<sup>1</sup> Salmon fry are present

<sup>2</sup> Steelhead fry are present

<sup>3</sup> Daylight is defined as one hour before sunrise to one hour after sunset

<sup>4</sup> No changes in river stage

Under Article 49 of the existing Merwin license, PacifiCorp is required to limit downramping below Merwin Dam to 1.5 feet (18 inches) per hour from August 1 through February 18. For the remainder of the year, required ramping rates range from 300 to 750 cfs per hour, depending on flow (as measured at Ariel gage). These ramping rates represent fairly rapid changes in river stage and consequently could strand large numbers of juvenile fish.

Since 1993, PacifiCorp has implemented a voluntary two-inch per hour down-ramping rate at all release levels to protect aquatic resources below Merwin Dam. The two-inch per hour down-ramping rate is designed to protect juvenile Chinook, coho, steelhead, and other aquatic resources, and to minimize fish stranding. In their Biological Opinion for the Interim Operation of the Lewis River Hydroelectric Projects (USFWS and NMFS 2002), the USFWS and NMFS recently required PacifiCorp to alter their Article 49 ramping rates to meet a limit of (1) 0.5 feet per three hour period; (2) 2 inches per hour for downramping; and (3) 1.5 feet per hour for up-ramping.

#### 3.4.2.4 Fish Passage

##### Upstream Passage Facilities

Of the four projects, only Merwin Dam is equipped with upstream fish passage facilities. The upstream facility at Merwin is a trap-and-haul system that is operated continuously throughout the year. The system consists of a fish entrance located on the left bank below the dam, a fish elevator, and truck transport loading facility. Collected fish are loaded into 1,000-gallon tanker trucks and transported to hatchery facilities, or released in the lower Lewis River to support sport harvest. This facility has not been used to transport anadromous fish upstream of Merwin Dam since 1957, because a lack of downstream fish passage facilities at all three dams has made this measure impractical.

##### Downstream Passage Facilities

No project structures are equipped with downstream fish passage facilities. Juvenile and adult migrants can, however, pass downstream of each facility through the project turbines and spillways. Both turbine and spillway entrainment have the potential to injure or kill fish, although survival rates are currently unknown.

#### 3.4.2.5 Hatcheries

The Lewis River Hatchery, constructed in 1932 and put into operation shortly after the Merwin Dam was completed, is the oldest of the three hatcheries in the Lewis River basin. Its construction and all operation costs are funded by PacifiCorp, although the facility is owned by WDFW. It is located at RM 15.7, approximately 8 miles east of Woodland. The facility uses up to 65 cfs of water pumped from the Lewis River. Over 400,000 cubic feet of outdoor rearing space is available, including four half-acre ponds, and twelve 10-by-100-foot raceways that are 4 feet deep. Indoors there are 50 incubator stacks, and seven shallow starter troughs. Support facilities include three on-site residences, four storage buildings, and two intakes and pump control buildings, and a domestic water well. A denil steep pass fish ladder at the hatchery attracts returning adults and allows them passage into an adult holding pond. Fish are sorted, some are spawned, and many are transported to Speelyai and Merwin for spawning (Tetra Tech/KCM, Inc. 2002). The Lewis River Hatchery currently produces spring Chinook and coho salmon. PacifiCorp provides all funding for the Lewis River Hatchery.

Speelyai Hatchery was completed in 1958 at the confluence of Speelyai Creek and Lake Merwin at RM 28. PacifiCorp owns the property upon which the hatchery was constructed; Cowlitz PUD and PacifiCorp jointly funded its construction and PacifiCorp has funded subsequent capital improvements. Hatchery operations are a joint responsibility of both utilities, with Cowlitz PUD providing 20 percent of annual funding and PacifiCorp providing 80 percent (Hamilton et al. 1970 and PacifiCorp and Cowlitz PUD 2000a). Initially, the facility consisted of two holding ponds and an incubation station. As part of the Speelyai Hatchery agreement with WDF, PacifiCorp and Cowlitz PUD funded a series of studies to determine if it was feasible to rear coho salmon in Lake Merwin (Hamilton et al. 1970). From 1958 through 1964, coho fry and fingerlings reared

at Speelyai Hatchery were released into Lake Merwin and Speelyai Creek. During the period of outmigration, smolt collectors were installed at the outlet of the lake and in the outlet of Speelyai Creek. Even with marked fish capture efficiencies as high as 70 percent, the number of migrant coho collected at the dam each year represented only small portion of the fish released into the lake. Low survival, 0.8 to 2.8 percent in Lake Merwin and 5.7 to 19.2 percent in Speelyai Creek, was found to be the major cause of low migration numbers. After six years of study, it was concluded that Lake Merwin could not be used “under present conditions” as a substitute for the in-river environment for coho salmon (Hamilton et al. 1970). As a result, rearing of coho in Lake Merwin was abandoned in favor of additional hatchery production.

Speelyai Hatchery was upgraded (expanded) in 1970 and is used for adult holding, spawning, incubation, and rearing of spring Chinook, coho, and kokanee (Montgomery Watson 1997). The hatchery uses almost the entire flow of lower Speelyai Creek, up to 20.5 cfs. Approximately 166,000 cubic feet of outdoor rearing space is available, including two quarter-acre rearing ponds, three 17-by-3-foot starter ponds, and twelve 20-by-80-foot concrete raceways. Support facilities include two residences, a storage building, domestic pump house, and the water supply intake. There is also a small adult return trap for kokanee (landlocked sockeye salmon) that are part of the production program at Speelyai. Due to its pathogen free water supply, which is often cooler than the water at Lewis River Hatchery, Speelyai Hatchery is used as a satellite facility to incubate and rear salmon collected from Lewis River Hatchery, and rear steelhead (net pen program) (Tetra Tech/KCM, Inc. 2002). The hatchery is owned and jointly funded by PacifiCorp and Cowlitz PUD, and operated by WDFW (Hamilton et al. 1970; PacifiCorp and Cowlitz PUD 2000a).

Merwin Hatchery became fully operational in 1993. PacifiCorp constructed, owns and funds operation of the Merwin Hatchery, which is operated by WDFW. Located at RM 19 on the Lewis River, the facility provides winter and summer steelhead and rainbow trout for harvest by sport anglers (Montgomery Watson 1997). The hatchery uses approximately 11 cfs of pumped water from Lake Merwin. About two-thirds of the flow is ozone-disinfected prior to use. The disinfected water is used in incubation and adult holding. The remaining water is routed to outdoor rearing ponds after passing through packed column degassing units. There are approximately 216,000 cubic feet of outdoor rearing space, consisting of four quarter-acre rearing ponds, ten 9.5-by-80-foot fingerling raceways that are 2.5 feet deep, and four 7.5-by-33-foot adult holding raceways that are 4 feet deep. Indoors are six 4.5-by-34-foot intermediate raceways that are 2 feet deep, four fry troughs and 30 vertical incubator stacks. Support facilities include an operations building with management offices, the ozone plant, a storage building, and three on-site residences (Tetra Tech/KCM, Inc. 2002).

Together the Lewis River Hatchery, Merwin Hatchery and Speelyai Hatchery (the Lewis River Hatchery Complex) produce spring Chinook, early coho, late coho, summer steelhead, winter steelhead, rainbow trout, and kokanee. Current juvenile production goals are summarized in Table 3.4-6. The overall goal of the anadromous fish program is to produce 92,000 pre-harvest adults.

While hatchery production is a successful strategy for maintaining fish runs, the release of millions of hatchery fish into a stream can negatively impact native fish populations through competition for food and space, predation, disease outbreaks, genetic alteration, and harvest. These interactions may result in the loss or reduction of wild native fish population abundance and diversity (NRC 1996, ISG 2000, Flagg et al. 2001). While the interactions between hatchery and wild fish do occur, the relative impact of hatchery operations and releases on the long-term fitness of wild stocks is unknown and continues to be a topic hotly debated within the fisheries scientific community (HSRG 2001).

**Table 3.4-6. Current WDFW fish production goals for the Lewis River basin in 2003.**

| Species             | Hatchery             | Release Site          | Production Goal                      |
|---------------------|----------------------|-----------------------|--------------------------------------|
| Spring Chinook      | Lewis River/Speelyai | Lewis River           | 1,050,000 (5-7/lb)                   |
| Early Coho (Type-S) | Lewis River/Speelyai | Lewis River           | 880,000 (13-15/lb)                   |
| Late Coho (Type-N)  | Lewis River          | Lewis River           | 815,000 (13-15/lb)                   |
| Summer Steelhead    | Merwin               | Lewis River           | 175,000 (5/lb)                       |
| Winter Steelhead    | Merwin               | Lewis River           | 100,000 (5/lb)                       |
| Kokanee             | Speelyai             | Lake Merwin           | 45,000 fingerlings, 48,000 yearlings |
| Rainbow Trout       | Merwin               | Swift Creek Reservoir | 800,000 (25/lb)                      |

### Commercial and Recreational Fisheries

Native and introduced salmonid stocks in the Lewis River basin are harvested in both commercial and recreational fisheries. Depending on species and stock, ocean commercial fisheries can intercept Lewis River fish off the coasts of Washington, Oregon, California, Canada, and southeast Alaska. Salmon can also be taken incidentally in the Bering Sea/Aleutian Islands (BSAI) and the Gulf of Alaska (GOA) groundfish fisheries. A restricted commercial fishery targeting lower Columbia River spring Chinook (including Lewis River spring Chinook) also occurs in the mainstem Columbia River below the Willamette River. Recreation fisheries target Lewis River salmon and steelhead stocks in the lower mainstem Columbia River, mainstem Lewis River and tributaries. The current tribal fishery in the Columbia River basin has little or no effect on Lewis River stocks, since this fishery occurs on the Columbia River above the Lower Columbia River Management Area (WDFW 2001). The mainstem Lewis River also supports a substantial Columbia River commercial smelt fishery.

Between 1980 and 1998, an average of approximately 4,300 spring Chinook, 1,400 fall Chinook, 3,500 coho, and 7,500 steelhead were harvested in the Lewis River recreation fishery annually (Table 3.4-7) (PacifiCorp and Cowlitz PUD 2003f: AQU 8). In addition, the Lewis River reservoirs support very popular rainbow trout, cutthroat trout, and kokanee fisheries.

**Table 3.4-7. The average number of salmon and steelhead harvested in the Lewis River recreation fishery based on punch card returns to WDFW.**

| Species/Stock    | Average Annual Recreation Harvest | Data Range        |
|------------------|-----------------------------------|-------------------|
| Spring Chinook   | 4,300                             | 1980 through 1998 |
| Fall Chinook     | 1,400                             | 1980 through 1998 |
| Coho             | 3,500                             | 1980 through 1998 |
| Winter steelhead | 3,400                             | 1962 through 1998 |
| Summer steelhead | 3,600                             | 1962 through 1998 |

### 3.4.2.6 Threatened and Endangered Species

Protected salmonid Evolutionarily Significant Units (ESUs) and Distinct Population Segments (DPSs) that occur in the basin include Lower Columbia River spring and fall Chinook salmon, Lower Columbia River winter steelhead, Columbia River chum salmon, and Columbia River bull trout (Table 3.4-8). These species are not present above the projects; however, project facilities and operations have the potential to affect these four listed salmonid species that are present downstream.

**Table 3.4-8. Federally listed fish species in the Lewis River basin.**

| Species        | Listing Unit             | Federal Status | Notes   | Critical Habitat   |
|----------------|--------------------------|----------------|---|--|
| Chinook salmon | Lower Columbia River ESU | Threatened     | ESU includes all naturally spawned fall- and spring-run Chinook salmon from the mouth of Columbia River to the crest of Cascade Range (including tributaries), excluding areas above Willamette Falls. Includes spring-run, tule, and late-fall bright populations. Lewis River spring Chinook, a hatchery stock, is considered a component of the lower Columbia ESU, but is not considered a listed species (USFWS and NMFS 2002).  | NMFS has withdrawn the designation of critical habitat [ <i>National Association of Home Builders v. Evans</i> , Civ. No. 00-2799 (D.D.C. April 30, 2002) (memorandum order)]. |
| Steelhead      | Lower Columbia River ESU | Threatened     | ESU includes all natural spawned winter- and summer-run steelhead in the Columbia River basin and tributaries between Cowlitz and Wind rivers in Washington, and Willamette and Hood rivers in Oregon, excluding upper Willamette River basin above Willamette Falls. Progeny of natural spawning steelhead in the Lewis River basin are treated as listed for the purposes of the ESA. Merwin Hatchery summer and winter steelhead are not considered part of the ESU and are not considered essential for recovery. |  |

**Table 3.4-8. Federally listed fish species in the Lewis River basin (cont.).**

| Species     | Listing Unit       | Federal Status | Notes   | Critical Habitat  |
|-------------|--------------------|----------------|---|---|
| Chum salmon | Columbia River ESU | Threatened     | The ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon.   |   |
| Bull trout  | Columbia River DPS | Threatened     | Columbia River DPS includes all populations occurring throughout entire Columbia River basin within U.S. and all tributaries, excluding bull trout found in Jarbridge River, NV. Subpopulations in the Lewis River basin are included in this listing (USFWS 2002). | On 11/29/02, the USFWS proposed critical habitat for bull trout which includes areas above Merwin Dam. Designation is under public review; therefore, no final rule has been established. |

NMFS also designated critical habitat for Lower Columbia River spring and fall Chinook salmon, Lower Columbia River winter steelhead, and Columbia River chum salmon; however, the designation was withdrawn by NMFS and the U.S. District Court for the District of Columbia on April 30, 2002. The lack of a formal critical habitat designation does not affect the “take” prohibitions for the species, nor the protection of much of their range under the essential fish habitat provisions of the Magnuson-Stevens Act.

On November 29, 2002, the USFWS proposed critical habitat for bull trout (67 FR 71235) including areas above Merwin Dam; however the proposed rule is currently under public review and a final rule has not been issued. A draft recovery plan for lower Columbia bull trout was completed by the USFWS in November 2002 (USFWS 2002). It is currently under review and has not yet been formally adopted by the USFWS.

A description of Chinook, steelhead, chum and bull trout distribution and abundance in the Lewis River basin is available in Section 3.4.1. Additional information describing the life histories and habitat of these species is available in PacifiCorp and Cowlitz PUD (2003f and 2004).

In 1999, PacifiCorp and Cowlitz PUD proposed operations modifications and conservation measures designed to conserve salmon, steelhead and bull trout. FERC consulted with NMFS and USFWS as required by the Endangered Species Act and issued a biological opinion and incidental take statement in June 2002 and incorporated actions into the Merwin license.

Pursuant to that incidental take statement and amended license, PacifiCorp and Cowlitz PUD purchased several parcels of land for protection as fish and wildlife habitat in perpetuity. These lands include Devil’s Backbone (87 acres), which is along the north shore of Swift Creek Reservoir; and the Cougar/Panamaker Creek parcel (213 acres), abutting Cougar and Panamaker creeks, west of the Yale Project. These areas include some of the highest quality bull trout habitat in the basin.

### 3.4.3 Effects of Alternatives

#### 3.4.3.1 Alternative A

This section addresses the effects of continuing current operations of the projects. Under FERC regulations, Alternative A is the environmental baseline against which effects of the action alternatives are measured. Therefore, the prior description of existing conditions and the effects of Alternative A discussed below, together form the baseline against which effects of Alternatives B and C are measured.

#### Fish Distribution and Abundance

Under Alternative A, fish distribution and abundance would be the same as that described in Section 3.4.2. Anadromous fish distribution would remain limited to the Lewis River and tributaries below Merwin Dam. Stocks of spring Chinook, steelhead, and coho salmon would continue to be maintained by hatchery production, and habitat fragmentation adversely affect bull trout and other resident species (i.e., the dams prevent genetic exchange between Yale and Swift populations) (USFWS 2002). The annual abundance of hatchery-produced anadromous species would depend on the size of the hatchery releases, the quality of fish produced, and on the habitat conditions in lower Lewis River, Columbia River estuary, and ocean. Natural production of spring Chinook, coho and steelhead, would remain relatively small (less than 10 percent of total adult production), and would be limited to the mainstem and tributaries below Merwin Dam (PacifiCorp and Cowlitz PUD 2003a).

#### Aquatic Habitat

Lewis River Bypass Reach - Continued operation under Alternative A would result in no changes to the 3.3-mile-long Lewis River bypass reach. Aquatic habitat would remain limited to seepage from the Swift No. 2 canal, leakage from the spill gates, groundwater, and tributary inflow. The channel is narrow, with encroaching vegetation, little gravel or finer particles, and little large woody debris. Occasional high flows (spills) through the reach wash away colonizing riparian vegetation, limiting the ability of riparian habitat to grow large enough to provide large woody debris to the channel. These conditions contribute to poor quality aquatic and riparian habitat in the reach and limit biological diversity.

Lower Speelyai Creek – Under Alternative A, there would be no change in aquatic habitat in lower Speelyai Creek. It would continue to have characteristics of a spring-fed system. Flows would be stable, sediment transport would occur infrequently, and the numerous beaver dam complexes and large woody debris accumulations would remain stable. The stream channel would shift little from its present location. Aquatic habitat would continue to be good quality, with diverse pool (resting habitat), riffle, run conditions, ample large woody debris, and spawning gravel resources. The lack of large peak flows would not be a “natural” condition for the stream, but results in good quality aquatic and riparian habitat conditions. The riparian habitat would be stable and dominated by mixed conifer/deciduous stands.

Lewis River Downstream from Merwin Dam – Under Alternative A, there would be no change in aquatic habitat in the Lewis River below Merwin Dam. Flows in the mainstem Lewis River would be the same as those stipulated in Article 49 of the Merwin Project license (Table 3.4-4). The river channel below Merwin would remain fairly stable, with few areas of active bars, little channel migration, and little bedload transport. Riparian habitat would be more affected by development, agriculture, and recreation than by the projects, although diminished active channel processes result in fewer opportunities for overbank deposits and log jams that affect riparian habitat dynamics. The low gradient of the Lewis River downstream of Merwin Dam, combined with the low flows, would result in infrequent bedload movement. As a result, good quality spawning gravel resources would continue to exist in this reach under all alternatives, and would be slowly transported downstream over time. There is some uncertainty of exact magnitudes of gravel transport rates, but sediment transport modeling estimated spawning-sized gravel movement in the reach below Merwin Dam to be equivalent to an average annual loss of less than half of one percent of the gravel resource at that site per year. Large woody debris levels would be low in this reach, as few new pieces of large wood would be added from riparian areas. The existing aquatic and riparian habitat values would be anticipated to change little as a result of project operations under Alternative A.

#### Flow

Lewis River Bypass Reach – Under Alternative A, Swift Dam would divert all of the flow from the Lewis River into the Swift No. 2 canal. Flow in the Lewis River bypass reach would be the result of inflow from tributaries, groundwater inflow, leakage from the spill gate, and seepage from the earthen canal embankment. During high runoff conditions when the projects are operating to manage floods or during operational emergencies, water would be spilled into the bypass reach from either the Swift Dam spillway or the Swift No. 2 canal spillway. These events occur sporadically, but in general, spills of several thousand cfs or greater would likely occur every few years. Median summer water temperatures in the Lewis River bypass reach would continue to approach the upper end of preferred ranges for most salmonids (Table 3.4-2) (PacifiCorp and Cowlitz PUD 2003a). Maximum summer water temperatures would likely exceed the preferred range for all bull trout and likely would exceed the preferred ranges for salmonid species except rainbow trout; however, salmonids could seek thermal refuge in deep pools and in areas with substantial groundwater inflow. Although the bypass reach currently supports populations of cutthroat trout, rainbow trout, mountain whitefish, largescale sucker, and other resident fish species (including an occasional bull trout), the quality and quantity of the habitat in this reach would be extremely limited by the lack of flow.

Lewis River Below Merwin Dam – Under Alternative A, flows in the mainstem Lewis River below Merwin Dam would be the same as those stipulated in Article 49 of the Merwin Project license. The effects of this flow regime on aquatic resources are described in Section 3.4.2.3.

Ramping Rates – Under Alternative A, PacifiCorp would continue to follow a two-inch per hour down-ramping rate below Merwin Dam (Section 3.4.2.3). To evaluate the



effectiveness of this existing measure, PacifiCorp and Cowlitz PUD conducted a flow attenuation and ramping rate study in November 2000 (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 3). This study showed that normal project operations produce down-ramping rates ranging from 1.0 to 1.6 inches per hour. Down-ramping rates were fastest near Merwin Dam (RM 19.4) and attenuated with distance downstream. Results of this study showed that PacifiCorp's voluntary two-inch per hour downramping rate appeared to minimize the potential for large-scale stranding of resident and anadromous salmonids.

Under Alternative A, operator error or emergency operations could still result in occasional severe flow reductions in the lower river with the potential to strand salmonids. In 2001, PacifiCorp implemented a new set of operating protocols to reduce the possibility of these violations.

### Fish Passage

Project facilities and operations would continue to limit fish migration and survival through the project area. These impacts occur from (1) the absence of upstream and downstream (all projects) fish passage facilities that would prevent fish entrainment through project spillways and turbines; (2) the presence of extensive reservoir-type habitat; and (3) flow limitations in specific stream reaches.

Upstream Fish Passage Facilities – Under Alternative A, the majority of upstream migrating anadromous fish arriving at Merwin Dam would be collected and either transported to the Lewis River Hatchery Complex or released back into the river for harvest by anglers. Adult resident fish collected at Merwin Dam in Alternative A would either be released into the lower Lewis River or transported into upstream stream reaches, based on management direction provided by the resource agencies.

Bull trout would be collected below Yale Dam using gill nets and transported and released into Cougar Creek to facilitate spawning. PacifiCorp and Cowlitz PUD would also net bull trout from Swift No. 2 tailrace as needed and transport them to a location specified by the fish management agencies. Genetic work conducted in 2004 (Nerass and Spruell 2004) found differences between bull trout in Rush and Pine creeks (tributaries to Swift Creek Reservoir), but considered all Lewis River bull trout to be a single population. The net-and-haul program therefore would help sustain the gene flow within this population.

As downstream passage facilities would not be provided, adult fish released into these reservoirs would only be able to migrate downstream by passing through project turbines or spillways.

Downstream Fish Passage Facilities – Under Alternative A, downstream migrating resident or anadromous juveniles or adults would pass the projects through the turbines and spillways. Data collected at the spillways at Merwin and Yale estimated juvenile survival at less than 60 percent (Schoeneman 1954). Survival data have not been collected on juvenile passage through project turbines; however, fisheries literature

indicates that juvenile survival through Francis turbines ranges from 65 to 97 percent (Eicher and Associates 1987). It should be noted that in Alternative A, only anadromous fish surplus to hatchery needs would likely be released into project reservoirs to provide marine derived nutrients. Because the establishment of self-sustaining populations of anadromous fish is not an objective of Alternative A, the effects of the projects on these fish likely would not be a major management concern.

Resident juvenile fish would pass downstream through turbines and spillways with survival rates similar to those presented for anadromous fish. The impacts of passage through multiple sets of turbines could be quite large. For example, for every 100 resident fish attempting to migrate from Swift Creek Reservoir to the river below Merwin Dam, survival rates may be as low as 24 fish. This assumes that all fish pass through turbines with no reservoir mortality (i.e., no fish pass via spill).

### Hatcheries

Under Alternative A, the Lewis River Hatchery Complex would continue to operate as it has in the past. The hatcheries would release approximately 4 million juvenile fish each year into stream reaches primarily located below Merwin Dam. These annual releases would include 1.7 million coho, 1.05 million spring Chinook, and 275,000 summer and winter steelhead.

Because most hatchery fish would be released at the smolt stage, they would likely prey on wild fall Chinook juveniles rearing in the lower river. The large numbers of coho released from the hatcheries may pose the greatest threat to the fall Chinook juveniles, as researchers have shown that coho smolts consume large numbers of juvenile fall Chinook (Hawkins and Tipping 1998). In addition to predation concerns, hatchery fish released as part of Alternative A would compete for food and space with native fish in the lower Lewis River basin, and adult returns from these releases may breed with wild fish, possibly reducing their genetic fitness. Salmon are subject to different selective pressures in the hatchery environment that may cause them to genetically diverge from their wild ancestors. When genetically different hatchery fish interbreed with wild fish, the resulting progeny may be less fit, and the genetic integrity of the local wild stock may be permanently affected (NRC 1996, NPPC 2000, and HSRG 2001). Hatchery operations would also pose risks to native wild stocks by acting as a reservoir for fish diseases, degrading water quality, and by capturing wild fish for use as hatchery broodstock (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 8).

The non-native kokanee program in Lake Merwin and the rainbow trout program in Swift Creek Reservoir would be supported using hatchery production. The programs are designed to provide sport harvest opportunities in these water bodies. Additionally, the kokanee and rainbow trout releases increase the food base for resident fish such as bull trout and northern pikeminnow. An increase in the northern pikeminnow population in Lake Merwin may increase predation on juvenile fish of all species.

As no changes in release numbers or hatchery operations are proposed in Alternative A, impacts to bull trout would remain the same (i.e., hatchery fish would provide food for

bull trout and potentially compete with bull trout for spawning and rearing habitat). Whether this has been a significant impact on the bull trout population is unknown, as hatchery plants in Lake Merwin and Swift Creek Reservoir may have helped compensate for the change.

### Threatened and Endangered Species

Under Alternative A, there would be no change in either project operations or facilities, except as needed for routine maintenance. Although anadromous species are not present above Merwin Dam, and no new effects on these threatened and endangered fish species are expected, operations under Alternative A would continue to affect fall Chinook, chum, steelhead, and steelhead downstream, as described below. Project effects on bull trout are also described below. As noted above, these existing conditions constitute the environmental baseline against which effects of the action alternatives are measured.

- Fall Chinook, chum, and steelhead distribution are limited to the mainstem Lewis River and tributaries below Merwin Dam.
- Unimpeded migration of bull trout into, out of, and between river reaches from Merwin Dam to Swift Creek Reservoir would not occur; however, the existing net-and-haul program allows genetic exchange within the upper basin.
- The absence of downstream fish passage facilities would subject downstream migrating fish such as bull trout to both spillway and intake entrainment.
- Bypass reach flows are limited to inflow from groundwater/seepage/leakage and tributaries except during spill events. The release of large quantities of water during high flow events limits the quality and quantity of aquatic habitat and precludes habitat connectivity in the bypass reach for bull trout and resident species.
- Project dams and reservoirs prevent the delivery of gravel and large wood needed to maintain good quality spawning and rearing habitat for Threatened or Endangered salmonids.
- Flows in the Lewis River downstream from Merwin Dam are affected by project operations to manage floods, produce power, and augment late summer and fall flows. These flow conditions likely benefit fall Chinook populations in the lower Lewis River, providing aquatic habitat in the summer months and reducing the frequency of scouring flows during the winter months. Reduced springtime flows may also have an impact on habitat structure and on out-migrating smolts.
- Project-related flow fluctuations have the potential to affect aquatic resources downstream of Merwin Dam. Fish losses can occur as a result of project-induced changes in river stage.
- Lentic habitat conditions in Lake Merwin support large numbers of northern pikeminnow, known to prey heavily upon juvenile salmonids.

- Operations of the Lewis River hatcheries, and other hatchery facilities in the region, could alter the genetic structure and life history diversity of native anadromous salmonids (Chinook, coho, and steelhead) and increase the risk of disease transmission between hatchery and wild stocks.
- WDFW's management of the recreation fishery in the Lewis River reservoirs has resulted in the introduction of several nonnative species including kokanee, tiger musky, and a nonnative stock of rainbow trout and, in some cases, has resulted in the accidental release of species into areas where release was not evaluated or planned.
- Recreational fishing associated with the project reservoirs increases fishing pressure on native stocks, including endangered species. The location of the Lewis River and Merwin hatcheries, and the resultant mixed sports fishery near these facilities, may also increase impacts on wild salmon and steelhead.
- Water temperatures in the Lewis River bypass reach exceed the preferred range for bull trout during the summer and fall. Water temperatures in the Lewis River below Merwin Dam would be consistently higher than those observed at the upstream end of Swift Creek Reservoir, affecting the life histories of naturally spawning Chinook, steelhead, and chum salmon.
- Changes in generation at the Yale powerhouse cause fluctuations in water temperature and pH in the upper portion of Lake Merwin (surface water temperature can fluctuate as much as 10°C), potentially affecting bull trout in Lake Merwin.
- TDG levels at the Swift No. 1, Swift No. 2, and Yale tailraces exceed the State standard when the Swift No. 1 and Yale projects are in the mid-range of turbine operation. TDG levels in excess of the State standard have the potential to adversely affect bull trout residing in Yale Lake and Lake Merwin.
- Concentrations of phototoxic polycyclic aromatic hydrocarbons (PAHs) in Yale Lake approach levels that are potentially toxic to zooplankton and fish (including bull trout), exceeding known no-effect levels.
- Productivity of the upper basin is limited by an absence of marine derived nutrients (potentially affecting bull trout), and hatchery operations would continue to affect nutrient levels downstream of the hatcheries (potentially affecting Chinook, steelhead, and chum salmon).

#### 3.4.3.2 Alternative B

Alternative B proposes upstream fish passage via a trap-and-haul system at the base of Merwin Dam and downstream fish passage via a floating surface collector in Swift Creek Reservoir. No anadromous fish are introduced to the intermediate reservoirs. In addition, a flow of 50 cfs would be provided to the Lewis River bypass reach.

Fish Distribution and Abundance

For migratory species of fish such as Chinook, coho, steelhead, and bull trout, the successful completion of their life cycle depends on access to habitat and safe, effective passage between these habitats. Connectivity between fish spawning, rearing, and overwintering habitats is critical to the survival and persistence of robust populations (Lichatowich 1999, ISG 2000, Bjornn and Reiser 1991); migration within river systems also ensures interchange of genetic material between local populations, thereby ensuring genetic variability (Rieman and McIntyre 1993).

A review of existing USFS habitat survey data, combined with supplementary field surveys<sup>1</sup> and GIS data determined that as much as 174 miles of potential anadromous fish habitat may exist in the Lewis River basin above Merwin Dam (PacifiCorp and Cowlitz PUD 2003f: AQU 4). According to this assessment, approximately 117 miles of potential habitat are located upstream of Swift Dam (the Swift Creek Reservoir reach) and would be made accessible under Alternative B. The remaining 59 miles of habitat are located between Merwin Dam and Swift No. 1 (Table 3.4-9). These estimates include mainstem and tributary habitat inundated by the project reservoirs.

Although the quality of this potentially accessible upper basin habitat has been affected by the eruption of Mount St. Helens, timber harvest, road construction, and other land management activities (PacifiCorp and Cowlitz PUD 2003a), the majority of it is believed to be capable of supporting anadromous fish (USFS 2002a). Whether or not the available habitat is capable of supporting self-sustaining life histories without periodic hatchery supplementation is not known.

**Table 3.4-9. Length of potentially accessible anadromous fish habitat and the percent of total accessible habitat in the three reaches of the Lewis River upstream of Merwin Dam.**

| Reach Name*           | Length of Potentially Accessible Habitat (miles) | Percent of Total Accessible Habitat (by length) |
|-----------------------|--|---|
| Lake Merwin           | 29.4   | 17%   |
| Yale Lake             | 27.4   | 15.5%   |
| Swift Creek Reservoir | 117.1  | 67%   |
| Grand Total           | 173.9  | 100%  |

\* The Lake Merwin reach extends from Merwin Dam to the base of Yale Dam; the Yale Lake reach extends from Yale Dam to the base of Swift Dam; and the Swift Creek Reservoir reach extends from Swift Dam to the lower falls on the North Fork Lewis River. Source: Based on estimates developed for the EDT analysis (Mobrand Biometrics, Inc. 2003).

Under Alternative B, spring Chinook, coho, and late-winter steelhead would be introduced into the upper Lewis River basin above Swift Dam. No anadromous fish would be released into Lake Merwin or Yale Lake. Upstream passage would be provided via an improved trap-and-haul facility at Merwin Dam, and downstream passage would be provided via a floating surface collector in Swift Creek Reservoir adjacent to the dam.

<sup>1</sup> Surveys were conducted during summer low flow conditions.

Kokanee would be planted in Lake Merwin, rainbow trout would be planted in Swift Creek Reservoir; and PacifiCorp would gill net bull trout adults below Yale Dam and transport them to Cougar Creek. The corresponding beneficial effects discussed in Section 3.4.2 would continue. Cowlitz PUD and PacifiCorp would also net-and-haul bull trout at the Swift No. 2 tailrace if it is determined to be necessary by the USFWS.

In order to estimate the size of potential fish runs from the Swift Creek Reservoir reach, Ecosystem Diagnosis and Treatment (EDT) modeling was performed. Results of the EDT modeling (Mobrand Biometrics, Inc. 2003) indicate that the Swift Creek Reservoir reach is currently capable of producing 1,893 adult spring Chinook, 8,866 adult coho, and 1,680 adult late-winter steelhead (assuming 100 percent survival past the dams and no harvest) (Table 3.4-10). This represents 76 percent of the total estimated adult anadromous fish production potential upstream from Merwin Dam.

**Table 3.4-10. EDT estimates of adult abundance under current habitat conditions for spring Chinook, coho, and steelhead by geographic area (introduction reach).<sup>1</sup>**

| Species/Stock  | Adult Abundance by Introduction Reach |            |           | Total Abundance |
|--|---------------------------------------|------------|-----------|-----------------|
|  | Swift                                 | Yale       | Merwin    |                 |
| Spring Chinook   | 1,893                                 | 121        | 0         | 2,014           |
| Coho   | 8,866                                 | 2,500      | 887       | 12,253          |
| Steelhead  | 1,680                                 | 154        | 171       | 2,005           |
| Percent of Total Adult Abundance by Introduction Reach | 76 percent                            | 17 percent | 7 percent |                 |

<sup>1</sup> Adult abundance is the number of adults entering the mouth of the Lewis River.

Although Alternative B only allows anadromous fish access to stream habitat above Swift Dam, it still produces (on average) as many or more fish than Alternative C; an alternative that allows fish access to all stream habitat within the Project area (Table 3.4-11). The reason for similar production levels between the alternatives is due to increased juvenile and adult fish passage losses under Alternative C. In Alternative C, Swift origin fish must pass two additional projects as they migrate to and from the spawning grounds. As coho production from the Swift Creek Reservoir tributaries accounts for 76 percent of the total production from the upper basin, any increase in mortality to the population can have a dramatic effect on overall fish production. This is evidenced by the Swift coho adult numbers presented for the two alternatives in Table 3.4-11. Note that in Alternative B, Swift coho production is 6,169, while in Alternative C it is only 3,061.

It should be noted that the above outcome would be even more evident for spring Chinook and steelhead, as the Swift components make up 94 percent and 84 percent of the total production of these species, respectively. The highest odds of program success are linked to an anadromous fish introduction effort prioritized to above Swift Dam where the majority of habitat is available for all fish (Norman et al. 2004).

**Table 3.4-11. Lewis River fish passage model estimates of adult coho production for Alternatives B and C.**<sup>1,2</sup>

| Spawners (on spawning grounds) |                                    | Number of Coho |               |
|--------------------------------|------------------------------------|----------------|---------------|
|                                |                                    | Alternative B  | Alternative C |
| <b>Total</b>                   | <b>Average</b>                     | <b>6,169</b>   | <b>6,160</b>  |
|                                | <b>Max</b>                         | <b>15,723</b>  | <b>17,079</b> |
|                                | <b>Min</b>                         | <b>1,772</b>   | <b>1,709</b>  |
|                                | <b>No. &lt;50 fish<sup>3</sup></b> | <b>0</b>       | <b>0</b>      |
| Swift                          | Average                            | 6,169          | 3,061         |
|                                | Max                                | 15,723         | 9,001         |
|                                | Min                                | 1,772          | 827           |
|                                | No. <50 fish <sup>3</sup>          | 0              | 0             |
| Yale                           | Average                            |                | 1,669         |
|                                | Max                                |                | 4,480         |
|                                | Min                                |                | 468           |
|                                | No. <50 fish <sup>3</sup>          |                | 0             |
| Merwin                         | Average                            |                | 1,430         |
|                                | Max                                |                | 3,598         |
|                                | Min                                |                | 413           |
|                                | No. <50 fish <sup>3</sup>          |                | 0             |

Summary results for Inter-Annual Variation Analysis, summary of spawner and smolt abundance over 100 generations. Smolt to adult survival (SAR) – Variable; Smolts/Female – Fixed

<sup>1</sup> The coho data was generated using the Lewis River fish passage model. Model settings were selected based on ARG agreed upon inputs for factors such as transport, reservoir and bypass survival. This run assumes that the proposed juvenile collection facilities under each alternative have an fish collection efficiency of 95 percent.

<sup>2</sup> Values presented in this figure are lower than EDT estimates as they were produced in a model that varies SAR from 1 percent to 13 percent. In contrast, EDT uses a static SAR of 5 percent.

<sup>3</sup> Number of generations when spawner abundance is less than 50 fish.

Introduction of anadromous fish above Swift Dam may displace resident rainbow and cutthroat trout from preferred habitats that have been colonized in the absence of anadromous species; however, these impacts are expected to be minimal (PacifiCorp and Cowlitz PUD 2004: AQU 16). Both coho and bull trout have similar run timing, spawning habitat requirements, and general egg burial depth characteristics. It is uncertain how the overlapping spawning of these two species would affect either species. If bull trout have expanded their distribution due to the absence of coho and are now spawning in areas historically used by coho, then spawning interactions could adversely affect bull trout. The potential adverse effects of bull trout predation on introduction efforts is highly uncertain, as are the possible benefits of increased food sources to bull trout in the Lewis River.

Non-native kokanee (45,000 fingerlings and 48,000 yearlings) would continue to be planted into Lake Merwin to provide a resident sport fishery. The number of juvenile kokanee stocked each year would depend on annual hatchery production, angler success, and on yearly WDFW management goals. Because the kokanee population in Lake

Merwin is land-locked, the effect of the kokanee stocking program on native fish species above and below Lake Merwin is expected to be minimal. Because anadromous fish would not be introduced to Lake Merwin under this alternative, there would be no effect on anadromous species.

Large numbers of rainbow trout (approximately 800,000 fingerlings) would be planted in Swift Creek Reservoir to support the recreational fishery. This action would adversely affect salmonids through competition and predation. Juvenile steelhead would also be affected by inadvertent recreational harvest and hook and release mortality. As a result, this action could decrease the survival of juvenile salmon and steelhead rearing in the upper basin tributaries and reservoirs, and ultimately decrease the total production of adult anadromous fish. Because the fish planted would be selected from a stock with poor spawning success in the wild, it is unlikely that these fish would successfully breed with native rainbow trout. Thus, genetic introgression between the hatchery and wild/native population should not be a concern.

Under Alternative B, WDFW may restrict sport harvest of anadromous salmonids in river reaches above Merwin Dam until adult escapement goals are exceeded for a number of brood years. If implemented by WDFW, this fishing regulation would prevent the overharvest of adults, and help ensure the success of the introduction effort. WDFW may also restrict fishing in Swift Creek Reservoir, Yale Lake, and Lake Merwin to months outside of the primary juvenile migration period (April 15 to October 1), and may alter resident fish harvest in the upper basin tributaries to better protect anadromous smolts, especially the large age-two late winter steelhead. This reduction in harvest would be expected to increase juvenile production and eventually adult returns to the basin. If angler restrictions are not implemented, harvest of adult and juvenile salmonids could potentially impact the success of the introduction program.

### Aquatic Habitat

Lewis River Bypass Reach – Under Alternative B, 50 cfs would be continuously provided to the Lewis River bypass reach, increasing the amount of available habitat for cutthroat trout, rainbow trout, kokanee, brook trout, and mountain whitefish. The 50 cfs flow release would also create additional foraging habitat for bull trout during the winter and spring; however, warm summer and fall water temperatures would preclude successful bull trout spawning in this reach (Pratt 2003, published as AQU 20 in PacifiCorp and Cowlitz PUD 2004). It should be noted that this temperature limitation for bull trout would exist at all proposed flow releases due to the relatively warm water released from Swift Creek Reservoir during the fall spawning season (see analysis below under *Flow*).

While instream habitat would increase substantially compared to Alternative A, periodic spill events would continue to transport wood and gravel particles from the reach, limiting the amount of spawning gravel and instream cover. The same very large spills would scour redds and wash out encroaching riparian brush and shrubs from within the high water channel. The magnitude and frequency of spills would be slightly different under the proposed flood management scenario. Under Alternative B, a high flow pre-



release policy would be implemented as part of the forecast-based high runoff procedure, decreasing the magnitude of moderate spill events (between 10 and 20 year recurrence interval). Fewer and lower magnitude spill events under the flood management measures of Alternative B would reduce the frequency of events that wash out the gravel, wood, and riparian vegetation, improving the quality of aquatic habitat compared to Alternative A, and would result in somewhat improved riparian conditions. However, the bypass reach would continue to have little gravel or large woody debris.

Lower Speelyai Creek – Conditions in lower Speelyai Creek would be the same under Alternative B as under Alternative A (existing conditions).

Lewis River Downstream from Merwin Dam – Under Alternative B, a forecast-based high runoff procedure would be implemented that would include pre-releases from Merwin Dam of up to 25,000 cfs to reduce peak flood magnitudes. The net result downstream from Merwin Dam would be more frequent small to moderate peak flows and lower magnitude larger peak flow events. Flows up to 25,000 cfs are not anticipated to result in much change in gravel transport, channel morphology, or riparian habitat quality compared to existing conditions. Therefore, the aquatic and riparian habitat conditions downstream from Merwin Dam under Alternative B are anticipated to be similar to those described under Alternative A.

### Flow

Lewis River Bypass Reach – As discussed under *Aquatic Habitat*, the addition of 50 cfs to the bypass reach would improve aquatic habitat connectivity and increase the amount of available habitat in the bypass reach for cutthroat trout, rainbow trout, kokanee, and brook trout (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 2). However, resident salmonid spawning and rearing habitat would be limited by a lack of gravel and instream cover (i.e., habitat quality would be limited by physical factors in addition to instream flow).

The 50 cfs flow release would also create additional foraging habitat for bull trout during the winter and spring; however, relatively warm summer and fall water temperature would likely preclude bull trout spawning in this reach. As discussed previously, the Applicants conducted water temperature studies to help determine the effects of temperature on the usability of trout habitat under varying flows in the bypass reach. Water temperatures were recorded under existing conditions and were also simulated for four flow releases (50, 100, 200, and 400 cfs) using the USGS Stream Segment Temperature model (SSTEMP) (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 2) (Figure 3.3-4). At a 50 cfs flow release, water temperatures in the bypass reach would range from approximately 5°C in January to 13.5°C in July and August.

In reviewing this information, Pratt (2003, published as AQU 20 in PacifiCorp and Cowlitz PUD 2004) noted that predicted fall water temperatures in excess of 11°C might delay or abort bull trout spawning, as appropriate spawning temperatures (<9°C) would not occur until November or December. In September, the median water temperature in Cougar Creek (a known bull trout spawning site) is 6.7°C, approximately 5 to 6°C cooler

than the water temperature predicted in the bypass reach during that same period (with a 50 cfs flow release). Currently, bull trout residing in Yale Lake spawn from early August through late October (PacifiCorp and Cowlitz PUD 2003a). If bull trout spawning is not delayed until at least November, eggs in the redds would be exposed to bypass reach temperatures in excess of 10°C and egg mortality would likely be complete (Pratt 2003). As a result, augmenting the flows in the bypass reach may not provide additional spawning habitat for bull trout residing in Yale Lake.

Under Alternative B, spring and fall water temperatures would likely be within the preferred range for spawning cutthroat trout, rainbow trout and mountain whitefish (Table 3.4-2 and Figure 3.3-4) (PacifiCorp and Cowlitz PUD 2003a). These water temperatures would also be ideal for brook trout, a species that is known to hybridize and compete with bull trout (USFWS 2002). Hybridization with brook trout is one of the major factors contributing to the decline and lack of recovery of bull trout throughout its range (USFWS 2002).

Large-scale sucker, northern pikeminnow, threespine stickleback, and sculpin are native to the Lewis River basin and these species would also benefit from the increase in flow.

While a 50 cfs release would improve aquatic habitat conditions for resident fish species, occasional spill would severely impact the quality of aquatic and riparian habitat located adjacent to, and downstream from the bypass reach.

Lewis River Below Merwin Dam – Flow conditions in the Lewis River below Merwin Dam would be the same under Alternative B as under Alternative A (existing conditions).

Ramping Rates – Ramping rates in the Lewis River below Merwin Dam would be the same under Alternative B as under Alternative A (existing conditions) with the addition of establishment of an 8,000 cfs critical flow to reduce stranding, protect redds and enhance fry emergence.

### Fish Passage

Under Alternative B, the existing adult trap-and-haul system at Merwin Dam would be updated by adding additional entrance weirs to enhance adult collection efficiency over a wider range of river flows. Juvenile collection and bypass facilities would be constructed at Swift Dam. The facility would consist of a floating surface collector, sorting facility and truck transport system.

Upstream Fish Passage – Under Alternative B, all upstream migrants arriving at Merwin Dam would be collected, sorted, and directed to one of three locations in the basin: Lewis River Hatchery Complex, Lewis River below Merwin Dam, or Swift Creek Reservoir.

The adult handling protocols by species would depend on the fish management objectives of the resource agencies. In general, anadromous hatchery fish identified by fin clips would be transported to the hatchery to meet broodstock needs or released back to the river for harvest. Naturally produced anadromous fish would be transported and released

into the upper end of Swift Creek Reservoir. Adult resident fish (i.e., bull trout) would either be returned to the lower river or transported and released above Merwin, Yale or Swift Dams, depending on the fish management policy of the agencies. It is expected that at least 94 percent of the adult fish collected at Merwin Dam would survive the transport process<sup>2</sup>.

The risk associated with reservoir loss is reduced in Alternative B as anadromous adults would be released at the head of the Swift Creek Reservoir. Thus, overall survival of transported adults would likely be higher than the 94 percent value assumed, and may equal the NMFS target of 99.5 percent upstream passage survival.

Downstream Fish Passage – Fish migration through the Project area would be enhanced in Alternative B with the construction of downstream collection facilities at Swift Dam. A floating surface collector would collect both adult and juvenile fish attempting to migrate downstream past this project. Although the collection efficiency of this facility would not be known until constructed, the efficiency of the Baker River gulper system, upon which the proposed Swift system is based, has been estimated at between 53 and 70 percent (pers. comm. Cary Feldman, Puget Sound Energy, 2003). Because the Swift floating surface collector would be significantly larger (more attraction flow) than the existing Baker system, it is anticipated that its collection efficiency would exceed the high end of the Baker gulper efficiency range. Baker River data show that approximately 98 percent of the juveniles survive the collection and transport process (pers. comm. Cary Feldman, Puget Sound Energy, 2003). Given these efficiency and survival estimates, the presence of a floating surface collector at Swift Dam would reduce project entrainment through turbines and spillways, increase passage survival, and thus better facilitate fish movement through the project area. Overall estimated survival rates of juveniles arriving at Swift Dam and trucked below Merwin Dam would be approximately 93 percent. This level of survival assumes that the fish collection efficiency of the gulper would be approximately 95 percent. It is further assumed that an additional 2-3 percent of those fish not collected at Swift Dam would survive the downstream journey to the river. Juvenile survival would decrease to approximately 67 percent if gulper fish collection efficiency assumptions were reduced to 70 percent. This lower survival estimate is presented to describe the possible impacts to fish production if the target fish collection efficiency of 95 percent is not achieved. The floating surface collector would be operational from March 15 through October 15, coinciding with the peak downstream migration period of juvenile spring Chinook, coho, summer and winter steelhead, sea-run cutthroat trout, and bull trout (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 1).

There is considerable debate in the fisheries literature as to whether or not fish transported as juveniles survive to adulthood at the same rates as fish migrating in-river (NMFS 2000). However, as no data currently exists to confirm or refute this assumption, it is simply noted as a risk.

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<sup>2</sup> Adult survival value was taken from the Lewis River Fish Passage Assessment Model (Mobrand Biometrics 2003).

Studies performed by the Applicants indicate that survival of anadromous fish migrating downstream through Swift Creek Reservoir was approximately 90 percent (PacifiCorp and Cowlitz PUD 2004: AQU 14A and AQU 14B). Although fish survival data were not collected in the other two reservoirs, it is assumed that survival rates through Yale and Merwin would be similar. All bull trout and resident fish collected at the Swift juvenile collector would likely be sorted and released back into Swift Creek Reservoir or transported to a location specified by the resource agencies. This action would reduce project-related mortality by decreasing entrainment. To separate bull trout and other resident species from anadromous fish arriving at the Swift sorting facility would require that all fish be handled and anesthetized. Fish sorting activities would result in some mortality; however, overall mortality from handling and sorting is expected to be minor (two percent or less).

### Hatcheries

Under Alternative B, hatchery production of anadromous species would be reduced on a 1:1 basis, as introduced runs become established. The initial production goal at the Lewis River Hatchery Complex would be 621,514 spring Chinook smolts, 1,126,286 coho smolts, and 82,082 steelhead smolts to achieve a target of 38,626 pre-harvest ocean recruits (9,855 spring Chinook, 21,753 coho, and 7,018 winter steelhead)<sup>3</sup>. A reduction in hatchery production would be gradual and would be in response to a successful introduction program that establishes a trend of significant and stable natural production. Annual monitoring of wild production would be used to adjust juvenile hatchery fish production levels to achieve the pre-harvest ocean recruitment goal. The hatcheries would not be expanded or modernized, with the exception of improvements to the sorting facilities at the Lewis River Hatchery. As natural production increases and the need for the hatcheries for mitigation decreases (i.e., rearing space needs diminish), the hatcheries would be retired from anadromous fish production in the following order: (1) Lewis River Hatchery; (2) Speelyai Hatchery; and (3) Merwin Hatchery. State or federal agencies may choose to continue to operate these facilities without financial support by the Applicants. It is expected that the Swift Creek Reservoir rainbow trout program and Lake Merwin kokanee program would continue at the same levels as those described in Alternative A.

Because hatchery production would be phased-out as natural fish populations are restored in the upper basin, adverse hatchery effects such as increased predation, disease, and competition would be a concern only in the short term, and would be eliminated after an estimated 10-20 years. Eventually ceasing hatchery production would eliminate the genetic risks associated with hatchery fish spawning in the wild, or interbreeding with wild fish. Predation and competition associated with large-scale hatchery fish releases would no longer adversely affect wild fish in the lower river and hatchery effluent would

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<sup>3</sup> The Alternative B production goal was developed using EDT estimates of anadromous fish production potential for the Lewis River basin (Norman et al. 2004; Mobrاند Biometrics, Inc. 2003). EDT estimates assume current habitat below Merwin Dam, historical habitat under the reservoirs, properly functioning habitat conditions (PFC) in tributaries above Merwin Dam, and average ocean survival.

no longer impact downstream water quality. The risk of hatchery operations transmitting diseases to wild fish would also be eliminated.

It is also assumed that the wider geographic distribution of anadromous fish would increase life history diversity, gene flow, and genetic fitness of introduced stocks. These naturally produced fish would be better adapted to the Lewis River and its tributaries and theoretically, exhibit higher smolt to adult survival rates than their hatchery counterparts. This action would also increase system productivity and the available prey base for bull trout in all three reaches. It is assumed that this action would help increase bull trout abundance, especially in stream reaches where resident hatchery fish are not planted.

Reducing the reliance on hatchery production may cause a severe decline in the abundance of summer steelhead in the Lewis River basin. Historically, few summer steelhead were produced in the upper Lewis River. EDT estimates of historical summer steelhead production range from 344 to 656 adults (PacifiCorp and Cowlitz PUD 2004: AQU 16). Reducing hatchery production of this stock may decrease summer steelhead runs from their current level (approximately 4,000 fish) to levels approximating the EDT estimates.

The effects associated with the current resident fish hatchery programs would be the same as those discussed under Alternative A.

#### Threatened or Endangered Species

Alternative B includes a number of measures designed to minimize project effects and to enhance aquatic habitat in the project area. These measures and their effects on threatened or endangered fish are identified below. Effects not addressed by these measures would be the same as those described under Alternative A.

- Anadromous fish would be introduced into the upper Lewis River basin above Swift Dam. This action would allow access an estimated 117 miles of potential habitat. Species/stocks to be introduced are currently being evaluated in consultation with the resource agencies and may include ESA-listed stocks.
- Upstream fish passage facilities at Merwin Dam (trap-and-haul) and downstream passage facilities at Swift Dam (floating surface collector) would allow anadromous salmonids to be transported to and from additional habitat upstream of Swift Dam. This action would also minimize the potential for entrainment at Swift Dam and allow bull trout to be transported from Swift Creek Reservoir to Yale Lake and from the lower river to either Swift Creek Reservoir or Yale Lake.
- Reducing hatchery production on a 1:1 basis as natural anadromous fish runs become established in the upper basin would reduce the potential for hatchery-related impacts on naturally spawning anadromous species (i.e., competition, predation, hatchery operations, and disease). Eventually ceasing the production of anadromous fish would eliminate potential hatchery impacts on ESA-listed species.

- Implementing a two-inch per hour downramping rate below Merwin Dam would protect salmonids in the lower river.
- Releasing 50 cfs to the bypass reach would increase the amount of riverine rearing habitat for bull trout residing in Yale Lake; although it is highly unlikely that successful bull trout spawning would occur in this reach (due to warm summer and fall water temperatures).
- Monitoring plans that address TDG and other state water quality standards would help ensure adequate water quality conditions for bull trout in the project reservoirs.

Improvements to recreation facilities planned for Alternative B may increase fishing pressure on native stocks. These impacts would be addressed by WDFW in consultation with NMFS and USFWS.

### 3.4.3.3 Alternative C

#### Fish Distribution and Abundance

Under Alternative C, anadromous fish would have access to all three project reaches above Merwin Dam (i.e., Swift, Yale, and Merwin) allowing entry to an estimated 174 miles of potential anadromous fish habitat, or 100 percent of the accessible habitat above Merwin Dam. Upstream passage would be provided via trap-and-tram systems at Merwin and Yale dams and at Swift No. 2 (Section 2.4.1.9). Each facility would collect and release fish into the next upstream reservoir. Downstream passage facilities would be provided at all three dams. Results of EDT modeling (Mobrand Biometrics, Inc. 2003) indicate that together, all three reaches are currently capable of producing 2,014 adult spring Chinook, 12,253 adult coho, and 2,005 adult steelhead (assuming 100 percent survival past the dams and no harvest) (Table 3.4-10). The majority of adult production (76 percent) would result from tributaries located upstream from Swift Dam, 7 percent would result from tributaries to Lake Merwin, and 17 percent would result from tributaries to Yale Lake. Total spring Chinook, coho and steelhead production is expected to be lower under Alternative C in comparison to B (Table 3.4-11). This is because 76 percent of the available habitat is located above Swift Dam), and because fish survival is reduced as outmigrants pass through each of the Project reservoirs and dams (See *Fish Passage* below).

Under Alternative C, bull trout would have access into the same reaches as introduced anadromous species. Guidance on bull trout placement between the three reservoirs would be provided by the USFWS.

It should be noted that the survival of anadromous fish migrating through Lake Merwin might be severely reduced due to the presence of tiger musky and large numbers of northern pikeminnow. As discussed in Section 3.4.2.1, northern pikeminnow and tiger musky are known to prey heavily upon resident and anadromous salmonids. Northern pikeminnow and rainbow trout predation was believed to be the major cause of very low

coho salmon survival in Lake Merwin the late 1950s and early 1960s (Hamilton et al. 1970).

Anadromous fish introduced into Lake Merwin, Yale Lake, and Swift Creek Reservoir may displace resident rainbow and cutthroat trout from preferred habitats that have been colonized in the absence of anadromous species; however, these impacts are expected to be minimal (PacifiCorp and Cowlitz PUD 2004: AQU 16). Because coho salmon and bull trout have similar run timing, spawning habitat requirements, and general egg burial depth characteristics (Section 3.4.2.1), competitive interactions may occur between these two species. In Alternative C, these interactions could occur in Cougar, Rush, and Pine creeks. If bull trout have been ecologically released (expanded their distribution) due to the absence of coho and are now spawning in areas historically used by the coho, then spawning interactions could adversely affect bull trout. Competition for limited rearing habitat in these tributaries may also decrease the survival of bull trout juveniles. Impacts on a population level would likely be greatest in Cougar Creek, as this relatively small stream represents the only spawning and early rearing habitat available to bull trout residing in Yale Lake.

The potential adverse effects of bull trout predation on introduction efforts is highly uncertain, as are the possible benefits of increased food sources to bull trout in the Lewis River. The elimination of the existing Lake Merwin kokanee program and Swift Creek Reservoir rainbow trout program under Alternative C would ensure that no adverse competitive interactions would occur with introduced anadromous species. This action would likely increase the survival of juvenile salmon and steelhead rearing in the upper basin tributaries and reservoirs, and ultimately increase the total production of adult anadromous fish. This increased production would ultimately contribute to the establishment of anadromous fish runs in the upper basin.

#### Aquatic Habitat

Lewis River Bypass Reach – Under Alternative C, flows ranging between 100 and 400 cfs would be added to the bypass reach during average and high water years. In low water years, releases would be reduced to between 50 and 200 cfs. Like Alternative B, this variable flow regime would increase the amount of available habitat for cutthroat trout, rainbow trout, kokanee, and brook trout. The amount of habitat area (surface area of stream) created under Alternative C would be greater than that realized under Alternative B (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 2); however, periodic spill events would continue to transport wood and gravel from the reach, limiting the amount of spawning habitat and instream cover. Suboptimal summer and fall water temperatures (at all flow releases) would likely limit the production of bull trout, steelhead, Chinook, and coho (see our analysis under *Flow*).

Hydraulic modeling indicates that spawning-sized gravel in riffles becomes mobile at flows of approximately 400 to 500 cfs; however, there is very little gravel in the reach, so it is likely that the 400 cfs releases would have little effect on sediment movement. There would be little change to stream morphology since the added flows would not be large enough to change channel form, but the wetted channel would be wider and deeper.

The magnitude and frequency of spills would be the same as Alternative B. Spills through the bypass reach would wash away colonizing riparian vegetation, eliminating this as a potential source of large woody debris. The lack of gravel and fine particles would limit suitable spawning habitat. These conditions result in poor quality aquatic and riparian habitat in the reach and limit biological diversity.

Lower Speelyai Creek – Conditions in lower Speelyai Creek would be the same under Alternative C as under Alternative A (existing conditions).

Lewis River Downstream from Merwin Dam – Conditions in this reach are expected to be the same as described under Alternative B.

### Flow

Lewis River Bypass Reach – As discussed above, PacifiCorp and Cowlitz PUD would release flows into the bypass. In average water years, these flows would range from 100 to 400 cfs depending on the season (Table 3.2-8). In low water years (as determined by forecasts), released flows would range from 50 to 200 cfs. Groundwater and seepage from the Swift No. 2 canal would also contribute approximately 21 cfs.

Like Alternative B, the variable flow regime in Alternative C would increase the amount of available habitat for resident cutthroat trout, rainbow trout, kokanee, and brook trout (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 2). Benefits would be substantial compared to Alternatives A and B; however, periodic spill events and a lack of LWD would continue to limit the amount of spawning gravel and instream cover respectively in the reach (i.e., habitat quality would continue to be limited by physical factors other than instream flow).

The variable flow regime would also create additional foraging habitat for bull trout during the winter and spring; however, warm summer and fall water temperatures approaching 12°C would likely preclude bull trout spawning in this reach. These warm temperatures would occur at all flow releases (Figure 3.3-4). According to Pratt (2003, published as AQU 20 in PacifiCorp and Cowlitz PUD 2004), water temperatures above 9°C would delay or abort bull trout spawning, as appropriate spawning temperatures (<9°C) would not occur until late November or December (Figure 3.3-4). Pratt also concludes that if bull trout spawning were not delayed until at least mid-November, which is highly unlikely, egg mortality would be complete. As a result, augmenting the flows in the bypass reach would not provide additional spawning habitat for bull trout residing in Yale Lake.

While the variable flow regime would also increase the amount of habitat area for anadromous species, late spring and fall water temperatures in the bypass reach would be higher than those preferred by spawning steelhead and coho (Table 3.4-2 and Figure 3.3-4). They would also approach the upper end of the preferred range for Chinook. As a result, it is likely that high water temperatures would limit the production of anadromous species in this reach.



Increased flows in the bypass reach would also have the potential to attract migrating anadromous fish that are bound for higher quality habitat located above Swift Dam. Any such delay in reaching the trap-and-tram entrance at Swift No. 2 could decrease the survival of these upstream migrants.

Lewis River Below Merwin Dam – Under Alternative C, flows below Merwin Dam would be similar to those presented in Table 3.4-4. PacifiCorp would also release pulsed flows one day a week for 12 hours from March 1 through June 30 (5,000 cfs or 120 percent of current flow, whichever is higher). This reduced minimum flow would provide stable flow conditions during drought years to eliminate the potential for redd dewatering below Merwin Dam, where spring and fall Chinook, coho and chum salmon spawn. This would increase egg and alevin survival, contributing to an increase in natural production. The pulsed flows may both stimulate and increase juvenile migration rates in the lower river. Faster juvenile salmonid migration also would likely reduce exposure time to predators and possibly increase survival (Norman et al. 1987; Cada et al. 1993).

Ramping Rates – Under Alternative C, PacifiCorp would implement a two-inch per hour down-ramping rate below Merwin Dam from February 16 through October 31, and implement a less restrictive six-inch per hour rate from November 1 through February 15. Ramping rates would be unrestricted above a critical flow of 8,000 cfs (the flow at which gravel bars in the lower Lewis River become inundated). Like Alternative A, the two-inch per hour down-ramping rate in the spring summer and fall would minimize fish stranding. Adopting a six-inch per hour down-ramping rate from November 1 through February 15 would represent a decrease in the level of protection compared to Alternative A, and as a result, fish and other aquatic organisms more likely would be stranded. Effects would be greatest on those juvenile salmonids overwintering in the lower river (i.e., wild spring Chinook, coho, steelhead, and cutthroat trout). Large numbers of juvenile fall Chinook and chum salmon would not be present in the river during this period, as the vast majority migrate to the sea as sub-yearlings during the spring and summer. However, Phinney et al. (1973) determined that significant fish stranding occurred in the mainstem Lewis River when Merwin Project operations resulted in downramping rates ranging from 5 to 11 inches per hour. The less restrictive ramping rates from February through October 31 could adversely affect coho, steelhead and other species rearing in the Lewis River below Merwin Dam.

### Fish Passage

Under Alternative C, both upstream and downstream passage facilities would be constructed at Merwin, Yale and Swift dams. Upstream passage facilities would consist of trap-and-tram systems that rely primarily on tramways to move fish from below to above each dam<sup>4</sup>. Upstream trams would originate at the base of Merwin and Yale dams, and adjacent to the Swift No. 2 powerhouse. Downstream fish passage facilities would

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<sup>4</sup> Back-up truck trap-and-haul capability would still be maintained in case of system failure and during maintenance periods.

also be provided at each mainstem dam and would consist of floating surface collectors, similar to that proposed in Alternative B, with bypass pipelines that would release fish to the tail water below each dam in lieu of sorting, sampling, holding, and trucking facilities.

Upstream Fish Passage – It is assumed that adult trap-and-tram survival per system would be 94 percent. This value includes mortality associated with trapping, sorting, handling (tramway) and passage through each reservoir. Estimates of adult passage survival for each population are presented in Table 3.4-12. The data in this table indicate that adult passage survival would range from a low of 83.1 percent for fish migrating to habitat located above Swift to a high of 94 percent for fish entering Merwin. The numbers apply to both resident and anadromous fish species. Survival of upstream migrants reaching Swift Creek Reservoir is lowest because fish must pass over three dams to reach spawning habitat above Swift Dam.

**Table 3.4-12. Alternative C estimated adult fish passage survival rates by fish population.**

| Alternative | Merwin     | Yale         | Swift        |
|-------------|------------|--------------|--------------|
| C           | 94 percent | 88.4 percent | 83.1 percent |

Introduction of anadromous fish to all three reservoirs may displace resident rainbow and cutthroat trout from preferred habitats that have been colonized in the absence of anadromous species; however, these impacts are expected to be minimal (PacifiCorp and Cowlitz PUD 2004: AQU 16). Because coho and bull trout have similar run timing, spawning habitat requirements, and general egg burial depth characteristics, this action may also adversely affect the existing bull trout populations in Yale Lake and Swift Creek Reservoir (if bull trout have been ecologically released due to the absence of coho and are now spawning in areas historically used by the species).

In Alternative C, migrating resident fish would have access to all reservoirs and associated stream habitat within, below and above the Project area (except Speelyai Creek); resulting in the possibility of increased gene flow between populations. Adult bull trout passage survival and effectiveness are expected to be higher at Yale for this alternative in comparison to Alternatives A and B as fish would no longer be captured using gill-nets.

Downstream Fish Passage – The floating surface collectors proposed in Alternative C would be similar to, and have the same impacts as, those described for the Swift Dam system under Alternative B. In short, it is assumed that each of the three systems would be able to collect and safely bypass approximately 95 percent of the migrants arriving at each dam. Because the spillways at Merwin and Yale are located away from the turbine units, the floating surface collectors would remain in place and operational year-round, thereby reducing impacts to downstream migrating juvenile and adults throughout the year.

Fish arriving at each collection point would be passed via flume to the next body of water downstream of the collection point (Section 2.4.1.10). Anadromous fish arriving at Swift Dam would need to pass through two more reservoirs and bypass systems, while Yale

fish would pass through one additional reservoir and bypass system. The data in Table 3.4-13 show the resulting fish loss estimated by the Lewis River Fish Passage Assessment Model under this alternative for two scenarios (70 percent and 95 percent fish collection efficiency [FCE])<sup>5</sup>. It should be noted that the survival data presented in this table assume that fish not collected would pass each project either through turbines or spill.

**Table 3.4-13. Model-derived survival estimates for juvenile anadromous fish migrating from Swift, Yale, and Merwin reservoirs for Alternative C.**

| Fish Population       | Percent Survival (70% FCE) <sup>1</sup> | Percent Survival (95% FCE) <sup>2</sup> |
|-----------------------|---|---|
| Swift Creek Reservoir | 47%                                     | 61%                                     |
| Yale Lake             | 63%                                     | 73%                                     |
| Lake Merwin           | 79%                                     | 85%                                     |

<sup>1</sup> Assumes collection efficiency of 70 percent, reservoir survival 90 percent, turbine survival 70 percent, bypass survival 98 percent, outfall (flume) survival 98 percent.

<sup>2</sup> Assumes collection efficiency of 95 percent, reservoir survival 90 percent, turbine survival 70 percent, bypass survival 98 percent, outfall (flume) survival 98 percent.

The data in Table 3.4-13 show a decrease in FCE has a larger impact on outmigrants from Swift than from Yale and Merwin. The need to pass through two additional Projects is a major reason that total fish production under Alternative C is expected to be lower in comparison to Alternative B. Note that even with 95 percent FCE, only 61 percent and 83.1 percent of the Swift juveniles and adults survive passage through the hydropower system, respectively.

Data collected on the Columbia River indicate juveniles that migrate through multiple bypass systems may have lower adult return rates than fish exposed to a single facility, or no facility at all (Fish Passage Center 2003). As data to support or refute this assumption are not available for the Lewis River, it is simply noted as risk that may alter the resulting fish benefits.

It is assumed that survival rates for resident fish encountering downstream collection facilities would be similar to anadromous fish.

### Hatcheries

Under Alternative C, the Lewis River Hatchery Complex would be programmed to produce 1,462,857 spring Chinook smolts and 154,386 steelhead smolts to achieve a target of 12,800 adult spring Chinook and 13,200 adult steelhead. Hatchery production of coho would be increased from 1,800,000 to 2,285,715 smolts to produce an additional 14,000 adults for a total production target of 106,000 pre-harvest adult anadromous fish. The existing Swift Creek Reservoir rainbow trout program and the Lake Merwin kokanee program would be eliminated, favoring natural kokanee production in Yale Lake. No expansion or modernization of the hatchery program is planned; additional coho rearing

<sup>5</sup> Adult survival value was taken from the Lewis River Fish Passage Assessment Model (Mobrand Biometrics 2003).

capacity would be obtained by using the existing resident species' rearing space. To reduce the impacts of this increase in coho production on wild fish, WDFW's hatchery management would have to be modified. For example, hatchery fish would be released at a size and time that better mimic their wild counterparts. Fish would be allowed to leave hatchery rearing facilities voluntarily to ensure proper smoltification. It is assumed that a true smolt would spend less time in the river and would therefore have less chance to prey on wild fall Chinook juveniles.

Under Alternative C, it is assumed that the hatcheries would continue as a tool to support sport harvest in the basin. In contrast, it is assumed in Alternative B that hatchery production would be phased-out as natural fish populations are restored in the upper basin. Therefore, hatchery effects such as increased predation, disease, and competition would continue to be a concern in Alternative C, but would be reduced or eliminated in Alternative B after an estimated 10-20 years. Although hatchery management would need to be changed to minimize impacts on naturally-producing runs, an increase in the production of coho salmon may negate these benefits. As in Alternative A, hatchery fish released from the complex would continue to compete for food and space with native fish, and adult returns from these releases would have the potential to breed with wild fish, possibly reducing their genetic fitness. Hatchery operations would also pose risks to native wild stocks by transporting fish pathogens out of the hatchery, degrading water quality, and by capturing wild fish for use as hatchery broodstock.

The elimination of the existing Lake Merwin kokanee program and Swift Creek Reservoir rainbow trout program would ensure that no adverse competitive interactions would occur with introduced anadromous species; however, it would also reduce angling opportunities.

### Threatened or Endangered Species

Although anadromous fish are not present above Merwin Dam, the effect of measures designed to protect and enhance threatened or endangered fish species under Alternative C are described below. Effects not specifically addressed in this section would be similar to those described under Alternative A.

- Anadromous fish, would be introduced into all three reservoir reaches, allowing access to an estimated 176 miles of potential habitat above Merwin Dam.
- Trap-and-tram facilities at Merwin and Yale dams, and Swift No. 2 would allow adult salmonids to be collected and transported to habitat upstream of each reservoir.
- Juvenile fish passage facilities at Swift, Yale, and Merwin dams would allow anadromous fish to be collected and passed downstream; however, overall survival rates would be lower than in Alternative B. These facilities would also minimize the potential for entrainment at each dam.
- While improved hatchery operations and management would minimize impacts on ESA-listed fall Chinook, steelhead, chum, and bull trout (i.e., competition, predation, and disease), an increase in the production of coho salmon may negate these benefits.

- Providing a variable flow release into the bypass reach would create additional spawning and rearing habitat for both resident and anadromous species. Benefits to bull trout would be limited to an increase in winter rearing habitat. Additional fish production in this reach may increase the forage base for bull trout in Yale Lake.
- Maintaining the existing flow releases from Merwin Dam and providing pulsed flows one day a week for 12 hours from March 1 through June 30 would eliminate the potential for redd dewatering and may both stimulate and increase juvenile migration rates in the lower river (Normal et al. 1987; Cada et al. 1993). Both flow measures would likely increase the survival of ESA-listed species in the lower Lewis River.
- Implementing a two-inch per hour downramping rate below Merwin Dam from February 16 through October 31 and a six-inch per hour downramping rate from November 1 through February 15 would help protect ESA-listed salmonids in the lower river. However, benefits would not be a great as those realized under Alternatives A and B.
- Monitoring plans that address TDG and other State water quality standards would help ensure adequate water quality conditions for anadromous species and bull trout in the project reservoirs and lower Lewis River.

#### 3.4.4 Conclusion

Under Alternative A, project operations and fishery management in the Lewis River basin would remain unchanged from existing conditions and there would be no new effects on aquatic resources. The distribution of anadromous fish would be limited to the mainstem Lewis River and tributaries below Merwin Dam. Most upstream migrating anadromous fish would be collected at Merwin Dam and transported to the Lewis River Hatchery Complex or released back into the river for harvest by anglers. Smolts released from the hatcheries would prey on wild fall Chinook juveniles rearing in the lower river. In addition to predation concerns, hatchery fish would compete for food and space with native fish and returning adult hatchery fish may breed with wild fish, possibly reducing their genetic fitness.

The reasonably expected effects to aquatic resources under Alternative B are significantly beneficial when compared to Alternative A and moderately better than Alternative C. Under Alternative B, upstream migrating anadromous fish arriving at Merwin Dam would be collected and transported to Swift Creek Reservoir, allowing access to an estimated 117 miles of potential habitat which represents about 67 percent of the available habitat upstream of Merwin Dam. Aquatic habitat above Swift Dam has more miles of functional habitat than anywhere else in the upper basin. This would result in more robust anadromous fish production and a more successful introduction program than in Alternative C.

In Alternative B, hatchery production of anadromous species would be reduced on a fish-for-fish exchange (1:1 basis), as natural runs become established above Swift Dam. Ceasing hatchery production of anadromous fish would eliminate adverse hatchery effects on wild fish such as increased predation, disease, and competition. The existing

Swift Creek Reservoir rainbow trout program and Lake Merwin kokanee program would continue at the same levels as in Alternative A. The effects of resident hatchery fish on introduced salmonids would be similar to Alternative A because the predominant rainbow trout strain (Goldendale stock) is a fall spawner and will not interact with returning steelhead. Additionally, rainbow trout likely would remain in Swift Creek Reservoir and therefore not compete with steelhead in the tributaries. Kokanee planted in Lake Merwin under Alternative B would have no effect on anadromous fish introduced above Swift Dam.

It is expected that at least 94 percent of the fish collected at Merwin Dam would survive transport to the upper Lewis River basin. For downstream migrants, NMFS and the USFWS have established an overall juvenile survival standard (target) that is equal to or greater than 75 percent around all projects, which Alternative B is expected to meet.

Although the quality of aquatic habitat upstream of Swift Dam is highly variable, results of EDT modeling (Mobrand Biometrics, Inc. 2003) indicate that it is currently capable of producing an estimated 1,893 adult spring Chinook, 8,866 adult coho, and 1,680 adult late-winter steelhead. This represents 76 percent of the total estimated adult anadromous fish production potential above Merwin Dam. Although Alternative B only allows anadromous fish access to stream habitat above Swift Dam, it still produces (on average) as many or more fish than Alternative C; an alternative that allows fish access to all stream habitat within the Project area. This is because juvenile fish produced above Swift Dam (the vast majority of the total production) would have to pass three project reservoirs and dams, subjecting them to increased mortality.

Alternative B includes a continuous release of 50 cfs into the Lewis River bypass reach that would increase the amount of available spawning and rearing habitat for resident fish species (cutthroat trout, rainbow trout and mountain whitefish). This represents an improvement in habitat availability over existing conditions; however, overall aquatic habitat quality would continue to be poor in the reach. It is likely that benefits to bull trout would be minimal, as predicted fall water temperatures in the bypass reach (in excess of 9°C) may delay or abort bull trout spawning in the reach. Pratt (2003, published as AQU 20 in PacifiCorp and Cowlitz PUD 2004) determined that recovery of bull trout in Yale Lake was not dependant on the Lewis River bypass reach and believed that any attempts to provide habitat there could result in a detriment to the small, critical population residing in Yale Lake. Under Alternative B, flows below Merwin Dam would be similar to those in Alternative A; however, flood management operations would incorporate high flow pre-releases from Merwin, which might introduce minor differences in gravel transport below the dam. A downramping rate of 2 inches/hour and the proposed 8,000 cfs critical flow level below Merwin Dam would minimize the potential for stranding, thereby enhancing the survival potential of resident and anadromous fish below that project. The increased flows in the Lewis River bypass reach would have a negative effect on generation and would reduce operational flexibility and ancillary benefits when compared to Alternative A.

PacifiCorp and Cowlitz PUD would continue to investigate alternative methods for capturing adult bull trout in an effort to minimize handling and transport affects. An

improved spillway at Yale Dam would provide greater protection for any bull trout that attempt to migrate downstream during the spill season.

Alternative C would also have a some beneficial effects on aquatic resources in the Lewis River basin over Alternative A but with significantly greater cost to the Applicants. Anadromous fish would have access to Swift, Yale and Merwin reservoirs via a trap-and-tram passage system, representing 176 miles of potential habitat. This results in an incremental gain of 59 miles of habitat, which may or may not prove productive. Hatchery production would be increased 15 percent to support harvest and anadromous fish introduction. While hatchery practices would likely be made consistent with ESA species management, an increase in the production of coho salmon may negate these benefits. As in Alternative A, large numbers of hatchery fish would continue to compete for food and space with native wild fish, and adult returns from these releases would have the potential to breed with wild fish, possibly reducing their genetic fitness. Hatchery operations would also pose risks to native wild fish by transporting fish pathogens out of the hatchery, degrading water quality, and by capturing wild fish for use as hatchery broodstock. The potential impacts from resident fish stocking would be eliminated with this alternative.

In Alternative C, a 94 percent survival rate has been assumed for each adult trap-and-tram facility (totaling an 83 percent survival rate past all three dams). Juvenile survival would be 73 percent at Swift, 74 percent at Yale, and 78 percent at Merwin (assuming no delayed mortality from transport). Results of EDT modeling (Mobrand Biometrics, Inc. 2003) indicate that together, all three reaches are currently capable of producing 2,014 adult spring Chinook, 12,253 adult coho, and 2,005 adult steelhead (assuming 100 percent survival past the dams and no harvest) (Table 3.4-10). The majority of adult production (76 percent) would result from tributaries located upstream from Swift Dam, 7 percent would result from tributaries to Lake Merwin, and 17 percent would result from tributaries to Yale Lake. Coho presence in Yale Lake represents a significant threat to bull trout if they were to spawn in Cougar Creek. While access to more potential habitat is provided in Alternative C, total spring Chinook, coho and steelhead production is expected to be lower under Alternative C in comparison to B. This primarily results from the location of stream habitat in the basin (76 percent above Swift), and resulting fish mortality through Project reservoirs and dams. There would likely be some negative interaction between kokanee and coho in Lake Merwin and Yale Lake because the two species would occupy similar feeding spaces in the reservoirs.

The variable flow regime in the bypass reach would provide more resident and anadromous rearing habitat in the 3.3-mile-long Lewis River bypass reach than Alternative A. However, spawning and rearing habitat quality would be limited by a lack of gravel and large wood. Spring and fall water temperatures in the bypass reach would also be higher than those preferred by spawning steelhead and coho, and would also approach the upper end of the preferred range for Chinook. As a result, it is likely that high water temperatures would limit the production of anadromous species in this reach. Increased flows in the bypass would also have the potential to attract migrating anadromous fish that are bound for higher quality habitat located above Swift Dam. Any

delay in migration (entry into the Swift No. 2 trap-and-haul facility) could decrease the survival of these upstream migrants.

Flows and their effects on the mainstem Lewis River below Merwin Dam would be the same as under the current FERC license; however, pulsed flow releases from Merwin included in Alternative C may both stimulate and increase juvenile migration rates in the lower river. PacifiCorp would implement a two-inch per hour down-ramping rate below Merwin Dam from February 16 through October 31, and a six-inch per hour rate from November 1 through February 15, providing less stranding protection than Alternatives A or B. Effects would be greatest on those juvenile salmonids over-wintering in the lower river (i.e., wild spring Chinook, coho, steelhead, and cutthroat trout). The increased flows in the Lewis River bypass reach, pulse flows, and ramping rates would have an effect on generation.

Overall, the measures under Alternative B provide more beneficial effects on aquatic resources than Alternatives A and C.

### 3.5 BOTANICAL RESOURCES

The Lewis River Projects straddle the boundary between the Puget Trough and Southern Washington Cascades physiographic provinces. The Puget Trough area consists primarily of rolling hills and terraces. Ridges separated by steep, dissecting valleys characterize the Southern Washington Cascades (Franklin and Dyrness 1988). Area vegetation is supported by a temperate maritime climate, as described in Section 2.1.1. The 54,608-acre study area, with elevations ranging from about 200 feet near Eagle Island to over 1,000 feet upstream of Swift Creek Reservoir, is entirely within the western hemlock (*Tsuga heterophylla*) vegetation zone, which is characterized by coniferous forest dominated by Douglas-fir (*Pseudotsuga menziesii*), western hemlock, and western red cedar (*Thuja plicata*).

As part of relicensing, botanical resources for the Lewis River Projects were evaluated in a study area that included the following:

- All areas within 0.5 mile of project facilities and reservoirs;
- All project-related lands owned by PacifiCorp and Cowlitz PUD in the Lewis River basin;
- Selected lands identified by the Terrestrial Resource Group (TRG) as potential wildlife habitat enhancement locations;
- The Swift to Merwin and Yale to Merwin transmission line ROWs;
- Eagle Island downstream of Merwin Dam;
- Riparian habitat from Merwin Dam to the downstream end of Eagle Island, bounded by the 240-foot contour line defining the majority of the surrounding floodplain; and
- Riparian habitat along Speelyai Creek downstream of the upper diversion structure.



Detailed results of botanical resource studies conducted for relicensing can be found in PacifiCorp and Cowlitz PUD (2003c and 2004) and PacifiCorp (1999d).

### 3.5.1 Resource Issues

Botanical resource issues identified during the NEPA scoping process included the following concerns:

- Effects of the projects on botanical resources
- Establishment and control of noxious weeds
- Effects of projects on state and federally listed or rare plants.

### 3.5.2 Affected Environment

Existing botanical resources in the study area for the Lewis River Hydroelectric Projects include the following: (1) vegetation communities; (2) rare plant species; and (3) exotic and invasive plant species. Each of these resources and the effects from current project operations, land management practices, and recreation are described below.

#### 3.5.2.1 Vegetation Communities

Land use practices significantly influence vegetation associated with the Lewis River projects. Lands around Swift Creek Reservoir are relatively unaffected by development, and include a patchwork of managed timberlands consisting of various age classes of coniferous forest typical of the western hemlock vegetation zone. Around Yale Lake and Lake Merwin, pastures, farmlands, and small residential and recreational developments are interspersed with large areas of managed timberlands and deciduous forest stands. Along the lower river, the effects of development are most pronounced; the area is dominated by a riparian deciduous and mixed deciduous-coniferous forest surrounded by residential and recreation developments and agricultural lands.

As part of relicensing, a comprehensive map of cover types in the 54,608-acre study area was developed (PacifiCorp and Cowlitz PUD 2003f and 2004). Cover types are broad categories that represent combinations of vegetation community types, which are typically defined by plant species, as well as land uses (i.e. disturbed/developed) and water types (i.e., riverine, lacustrine). In total, 44 distinct cover types were identified in the study area; these were consolidated into nine generalized types, as shown in Figure 3.5-1.

Nearly 21,420 acres, or about 40 percent of the study area, is covered by upland coniferous forest, which includes seven individual cover types distinguished by species or age class (Figure 3.5-1; Table 3.5-1). Upland conifer forests are dominated by stands of Douglas-fir and western hemlock, and range in age from recent clearcuts <1 year old to old-growth with trees >150 years old. Over 51 percent of the old-growth and mature conifer forest and nearly 56 percent of the seedling/sapling stands in the study area are located around Swift Creek Reservoir. Most of the old-growth occurs along the south side of the reservoir, while the seedling/sapling stands are concentrated on the north side

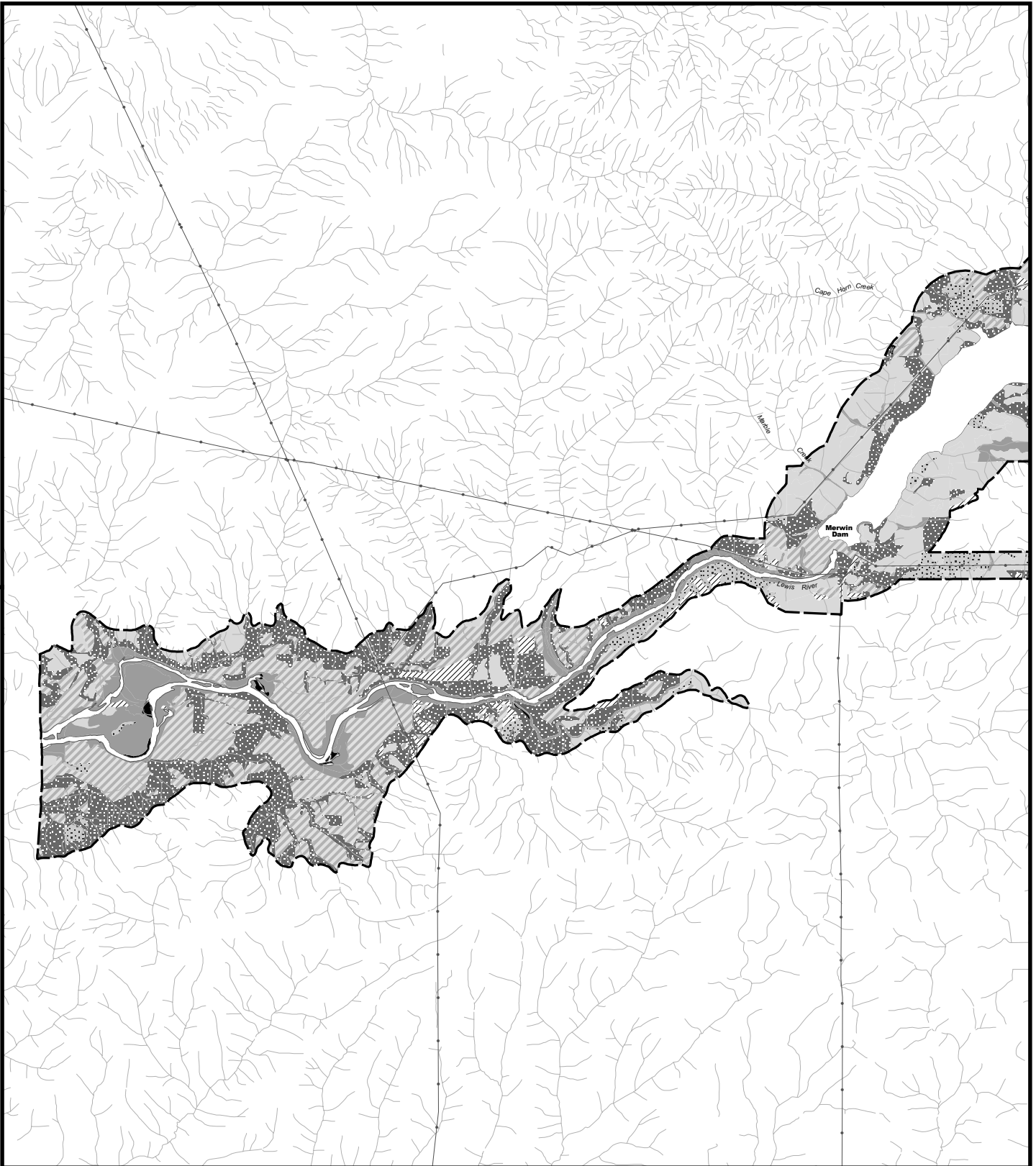
where lands are actively managed for timber production. An unusual community of lodgepole pine (*Pinus contorta*) and Douglas-fir occurs on the lava flow north and south of portions of the Swift No. 2 canal.

Approximately 23 percent of the study area, or 12,771 acres, is represented by upland deciduous forest and mixed conifer-deciduous forest (Table 3.5-1). In general, the deciduous forests are more common in the lower elevation areas of the projects where disturbance and residential development are comparatively more extensive (Figure 3.5-1). Over 58 percent of the mixed conifer-deciduous and upland deciduous forests occur along Yale Lake, Lake Merwin, and the lower Lewis River. The deciduous overstory component of these forests is largely limited to big-leaf maple (*Acer macrophyllum*) and alder (*Alnus rubra*), except at the south end of Lake Merwin where there are a few small stands of Oregon white oak (*Quercus garryana*).

Riparian cover types in the study area include grass/forbs, deciduous shrubs, deciduous forests, and young and mature mixed conifer-deciduous forests. Combined, these riparian types total approximately 1,958 acres (3.6 percent) (Table 3.5-1). Most of the riparian habitat occurs in the Lewis River bypass reach and along the Lewis River below Merwin Dam, including Eagle Island. Wetlands occupy only 279 acres, or 0.5 percent of the total study area. Most of the wetlands are small, and some are created; forested, scrub-shrub, emergent, and aquatic bed wetland types are all represented in the study area. The greatest number of individual wetlands and the largest amount of wetland acreage are associated with the Yale Project. Relatively few wetlands in the study area show evidence of a direct hydrological connection to project reservoirs. Wetlands that are influenced by reservoir water levels include the Beaver Bay, IP, and Yale Park wetlands at Yale Lake; the Speelyai Point, Riparian Bridge, and Buncombe Hollow wetlands at Lake Merwin; and the Drift Creek mouth wetland at Swift Creek Reservoir. Of these, Beaver Bay and IP have other water sources and do not appear to be greatly affected by reservoir fluctuation.

Aquatic habitat, which includes the project reservoirs, tributaries, and the Lewis River, accounts for the remainder of the study area. Approximately 22 percent of the study area, or 12,242 acres, consists of lacustrine habitat; riverine areas account for an additional 521 acres (Table 3.5-1; Figure 3.5-1). Riverine habitat is found in the Lewis River bypass reach, the Lewis River between Lake Merwin and Eagle Island, and in several major tributaries.

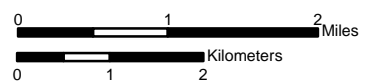
The Washington Department of Fish and Wildlife (WDFW) has designated a number of cover types in the vicinity of the Lewis River Projects as priority habitats. A priority habitat is defined as an area that meets one of the following criteria: comparatively high fish or wildlife density and/or diversity; important fish or wildlife breeding habitat, seasonal range, and/or movement corridors; limited availability; high vulnerability to alteration; or supports unique or dependent species (WDFW 2002). Priority habitats in the study area include caves, freshwater wetlands, fresh deepwater, streams, old-growth and mature forest stands, Oregon white oak woodlands, riparian areas, rural open space, areas with abundant snags and logs, and talus.

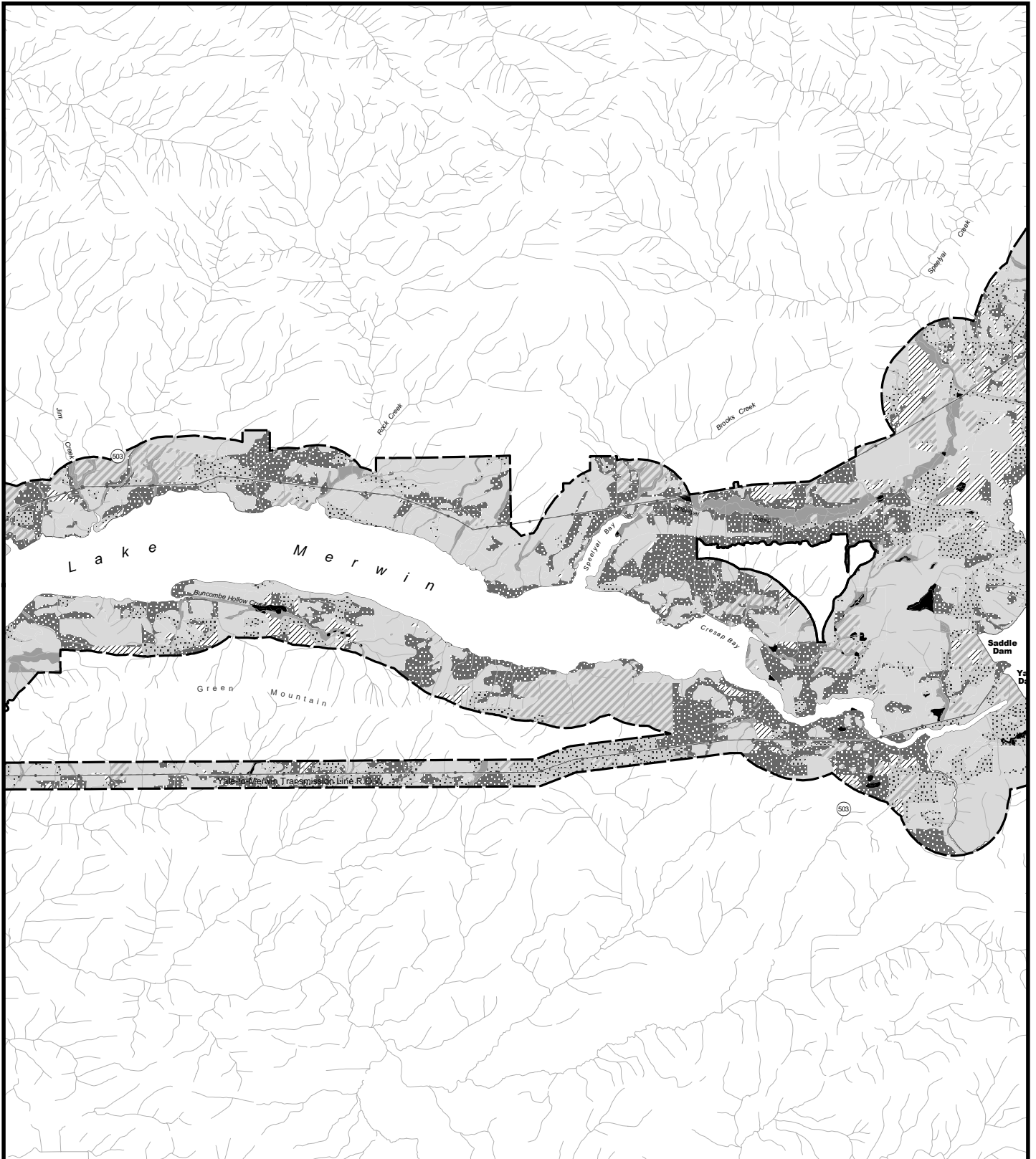


Public Utility District No. 1  
of Cowlitz County

- Lacustrine and Riverine
- Wetland
- Riparian
- Conifer Forest
- Mixed Conifer/Deciduous Forest
- Upland Deciduous Forest
- Non-forested
- Developed and Disturbed
- Study Area
- Transmission Line

**Lewis River Hydroelectric Projects**  
Vegetation Communities in the Lewis  
River Study Area  
FERC No. 935, 2071, 2111, 2213  
Sheet 1 of 4  
Figure 3.5-1

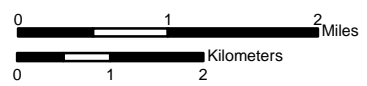


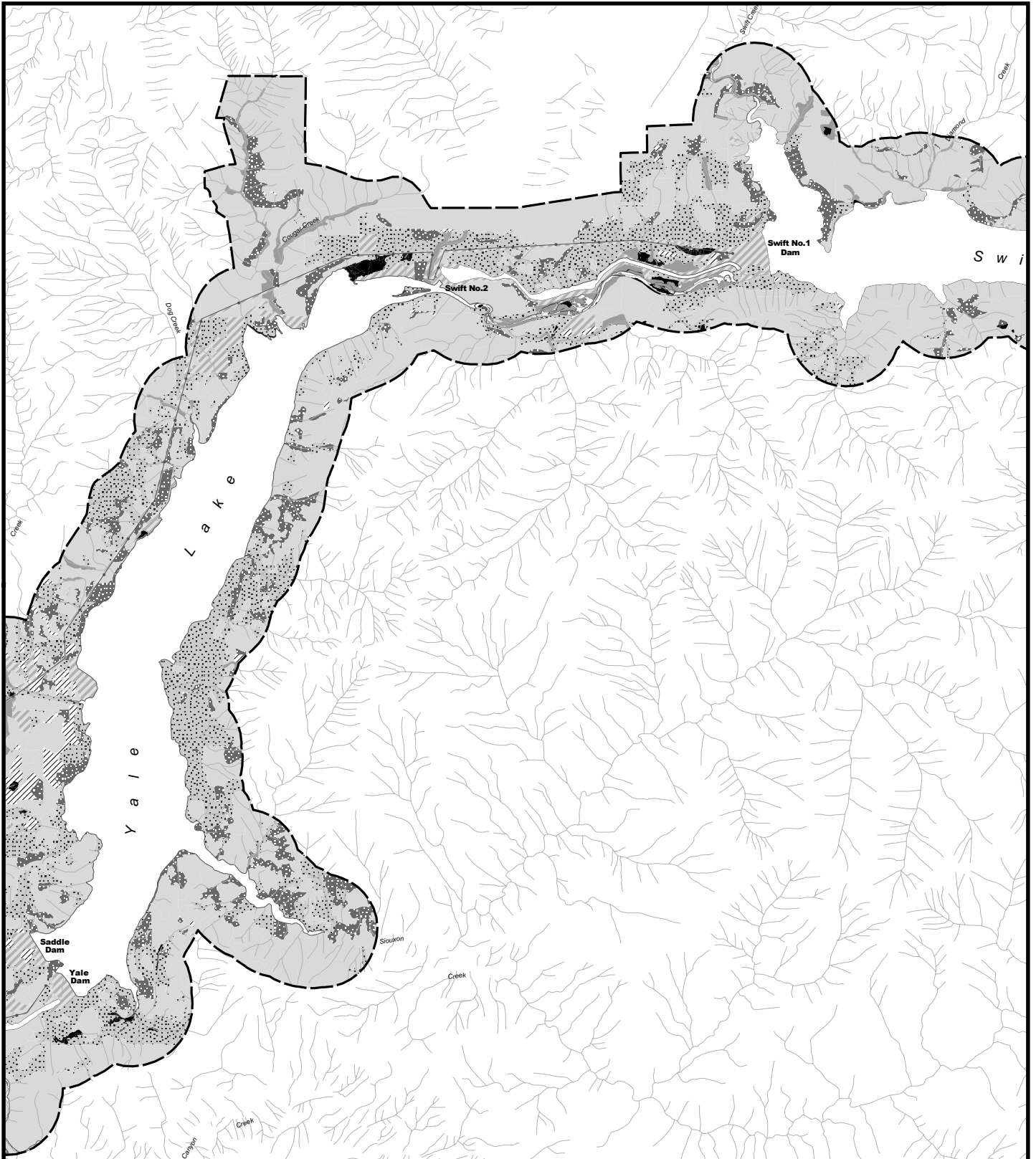


**PACIFICORP**  
 Public Utility District No. 1  
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**Lewis River Hydroelectric Projects**  
 Vegetation Communities in the Lewis  
 River Study Area  
 FERC No. 935, 2071, 2111, 2213  
 Sheet 2 of 4  
 Figure 3.5-1

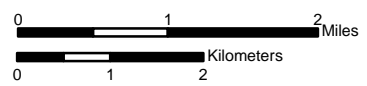


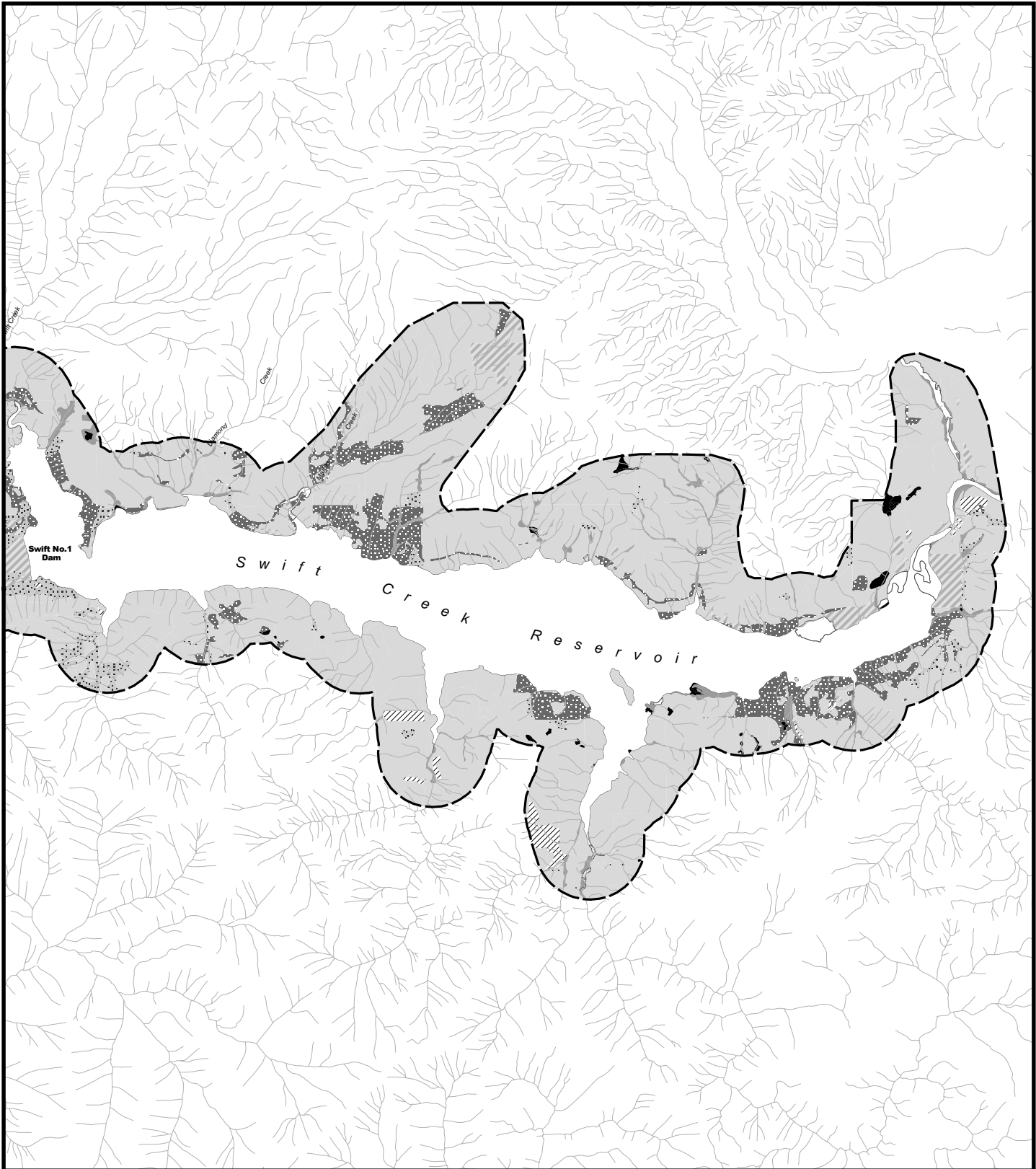


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**Lewis River Hydroelectric Projects**  
 Vegetation Communities in the Lewis  
 River Study Area  
 FERC No. 935, 2071, 2111, 2213  
 Sheet 3 of 4  
 Figure 3.5-1





Public Utility District No. 1  
of Cowlitz County

- Lacustrine and Riverine
- Wetland
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**Lewis River Hydroelectric Projects**  
Vegetation Communities in the Lewis  
River Study Area  
FERC No. 935, 2071, 2111, 2213  
Sheet 4 of 4  
Figure 3.5-1



**Table 3.5-1. Summary of cover type acreages in the study area for the Lewis River Projects.**

| COVER TYPES                             | Segment <sup>1</sup> |                |                |                |                    |                   |              |                | Grand Total     | Percent of Total |
|---|----------------------|----------------|----------------|----------------|--------------------|-------------------|--------------|----------------|-----------------|------------------|
|   | Eagle Island         | Lower River    | Merwin         | Swift No. 1    | Lewis River Bypass | Swift No. 2 Canal | T-line       | Yale           |                 |                  |
| <b>Conifer Forests</b>                  |                      |                |                |                |                    |                   |              |                |                 | 0.0              |
| Seedling/Sapling-new (SS1)              | 0                    | 0              | 172.4          | 343.4          | 0                  | 0                 | 0            | 0              | 515.9           | 0.9              |
| Seedling/Sapling (SS)                   | 17.4                 | 43.3           | 1,331.6        | 3,838.7        | 227.3              | 0                 | 87.5         | 1,349.7        | 6,895.7         | 12.6             |
| Pole Conifer (P)                        | 62.8                 | 80.2           | 839.1          | 2,856.7        | 57.0               | 5.0               | 36.6         | 1,205.9        | 5,143.3         | 9.4              |
| Pole Conifer-thinned (P-t)              | 0                    | 0              | 49.9           | 0              | 0                  | 0                 | 0            | 27.1           | 77.0            | 0.1              |
| Mid-Successional Conifer (MS)           | 13.1                 | 0              | 1,518.0        | 926.7          | 18.9               | 56.6              | 102.9        | 1,917.2        | 45,553.5        | 83.4             |
| Mid-Successional Conifer-thinned (MS-t) | 0                    | 0              | 226.5          | 0              | 0                  | 0                 | 0            | 0              | 226.5           | 0.4              |
| Mature Conifer (M)                      | 0                    | 76.5           | 567.8          | 209.0          | 54.1               | 0                 | 124.7        | 502.0          | 1,534.0         | 2.8              |
| Old-Growth (OG)                         | 0                    | 0              | 86.5           | 1,622.6        | 6.3                | 0                 | 10.2         | 284.4          | 2,010.0         | 3.7              |
| Lodgepole Pine (LP)                     | 0                    | 0              | 0              | 10.2           | 70.6               | 300.5             | 0            | 80.9           | 462.3           | 0.8              |
| <b>Conifer Forest Total</b>             | <b>93.3</b>          | <b>200.0</b>   | <b>4,791.7</b> | <b>9,807.4</b> | <b>434.2</b>       | <b>362.2</b>      | <b>362.0</b> | <b>5,365.7</b> | <b>21,418.2</b> | <b>39.2</b>      |
| <b>Upland Deciduous Forests</b>         |                      |                |                |                |                    |                   |              |                |                 | 0.0              |
| Young Upland Deciduous (YUD)            | 20.5                 | 17.6           | 32.1           | 14.2           | 0                  | 0                 | 0            | 3.2            | 87.6            | 0.2              |
| Upland Deciduous (UD)                   | 15.0                 | 37.4           | 832.1          | 662.8          | 160.0              | 349.0             | 410.4        | 2408.6         | 487.2           | 0.9              |
| <b>Upland Deciduous Forest Total</b>    | <b>35.5</b>          | <b>55.0</b>    | <b>864.2</b>   | <b>677.0</b>   | <b>160.0</b>       | <b>349.0</b>      | <b>410.4</b> | <b>2,411.8</b> | <b>4,962.8</b>  | <b>9.1</b>       |
| <b>Upland Mixed Forests</b>             |                      |                |                |                |                    |                   |              |                |                 | 0.0              |
| Young Upland Mixed (YUM)                | 155.5                | 53.5           | 245.7          | 0              | 0                  | 0                 |              | 97.6           | 552.3           | 1.0              |
| Upland Mixed (UM)                       | 293.9                | 1,740.2        | 2,567.3        | 1,160.9        | 21.0               | 40.3              | 226.5        | 1,198.5        | 7,248.5         | 13.3             |
| Upland Mixed-thinned (UM-t)             | 3.5                  | 0              | 3.7            | 0              | 0                  | 0                 |              | 0              | 7.2             | 0.0              |
| <b>Upland Mixed Forest Total</b>        | <b>452.9</b>         | <b>1,793.7</b> | <b>2,816.6</b> | <b>1,160.9</b> | <b>21.0</b>        | <b>40.3</b>       | <b>226.5</b> | <b>1,296.1</b> | <b>7,808.0</b>  | <b>14.3</b>      |
| <b>Riparian</b>                         |                      |                |                |                |                    |                   |              |                |                 | 0.0              |
| Riparian Shrub (RS)                     | 136.2                | 43.0           | 3.2            | 0.7            | 20.7               | 0                 | 0            | 3.7            | 207.6           | 0.4              |
| Riparian Deciduous (RD)                 | 64.6                 | 211.4          | 197.5          | 235.2          | 71.0               | 35.1              | 15.5         | 188.8          | 1,019.1         | 1.9              |
| Young Riparian Mixed (YRM)              | 0                    | 0              | 0              | 5.2            | 0                  | 0                 | 0            | 0              | 5.2             | 0.0              |
| Riparian Mixed (RM)                     | 116.3                | 142.4          | 206.2          | 76.3           | 14.6               | 0                 | 1.7          | 157.2          | 714.8           | 1.3              |
| Riparian Grassland (RG)                 | 0.2                  | 10.3           | 0.8            | 0              | 0                  | 0                 | 0            | 0              | 11.3            | 0.0              |
| <b>Riparian Total</b>                   | <b>317.3</b>         | <b>407.1</b>   | <b>407.8</b>   | <b>317.4</b>   | <b>106.4</b>       | <b>35.1</b>       | <b>17.2</b>  | <b>349.7</b>   | <b>1,958.0</b>  | <b>3.6</b>       |
| <b>Oak Woodland (OW)</b>                | 0                    | 0              | 13.8           | 0              | 0                  | 0                 | 0            | 0              | 13.8            | 0.0              |
| <b>Wetland</b>                          |                      |                |                |                |                    |                   |              |                |                 | <b>0.0</b>       |
| Palustrine Aquatic Bed (PAB)            | 0                    | 0              | 0              | 1.6            | 0                  | 0                 | 0            | 0              | 1.6             | 0.0              |
| Palustrine Unconsolidated Bottom (PUB)  | 0                    | 0              | 10.9           | 7.0            | 0.5                | 8.0               | 0            | 23.9           | 50.2            | 0.1              |
| Palustrine Emergent Wetland (PEM)       | 0.0                  | 7.1            | 19.9           | 27.1           | 2.5                | 5.9               | 0            | 19.6           | 82.1            | 0.2              |
| Palustrine Scrub-shrub Wetland (PSS)    | 6.1                  | 3.4            | 4.3            | 9.2            | 9.4                | 3.9               | 3.0          | 13.8           | 53.1            | 0.1              |
| Scrub-shrub/emergent wetland (PSS/PEM)  | 0                    | 1.2            | 0              | 0              | 0                  | 0                 | 0            | 0              | 1.2             | 0.0              |
| Palustrine Forested Wetland (PFO)       | 6.0                  | 2.7            | 18.6           | 24.0           | 6.4                | 2.7               | 0            | 30.4           | 90.8            | 0.2              |
| <b>Wetland Total</b>                    | <b>12.1</b>          | <b>14.4</b>    | <b>53.7</b>    | <b>68.9</b>    | <b>18.8</b>        | <b>20.5</b>       | <b>3.0</b>   | <b>87.7</b>    | <b>279.0</b>    | <b>0.5</b>       |

**Table 3.5-1. Summary of cover type acreages in the study area for the Lewis River Projects (cont.).**

| COVER TYPES                            | Segment <sup>1</sup> |                |                 |                 |                    |                   |                |                 | Grand Total     | Percent of Total |
|--|----------------------|----------------|-----------------|-----------------|--------------------|-------------------|----------------|-----------------|-----------------|------------------|
|  | Eagle Island         | Lower River    | Merwin          | Swift No. 1     | Lewis River Bypass | Swift No. 2 Canal | T-line         | Yale            |                 |                  |
| <b>Other Upland Cover Types</b>        |                      |                |                 |                 |                    |                   |                |                 |                 | 0.0              |
| Rock Talus (RT)                        | 0                    | 0              | 0.4             | 2.5             | 0                  | 1.7               | 0              | 1.5             | 6.2             | 0.0              |
| Exposed Rock (ER)                      | 0                    | 0              | 1.7             | 16.2            | 0                  | 0.7               | 0              | 12.0            | 30.6            | 0.1              |
| Sparsely Vegetated (SV)                | 0                    | 0              | 28.1            | 81.1            | 2.2                | 0                 | 0              | 2.8             | 114.0           | 0.2              |
| Shrub (SH)                             | 19.8                 | 0              | 166.8           | 103.5           | 7.7                | 0                 | 4.0            | 123.3           | 425.0           | 0.8              |
| Pasture (PA)                           | 111.4                | 277.2          | 173.5           | 0               | 0                  | 0                 | 13.6           | 101.6           | 677.3           | 1.2              |
| Meadow (MD)                            | 0                    | 148.0          | 84.3            | 5.0             | 0                  | 7.8               | 9.7            | 200.1           | 454.9           | 0.8              |
| Orchard (OR)                           | 0                    | 0              | 2.7             | 0               | 0                  | 0                 | 0              | 4.3             | 7.0             | 0.0              |
| <b>Other Upland Cover Types Total</b>  | <b>131.2</b>         | <b>425.2</b>   | <b>457.4</b>    | <b>208.3</b>    | <b>9.9</b>         | <b>10.2</b>       | <b>27.3</b>    | <b>445.5</b>    | <b>1,715.0</b>  | <b>3.1</b>       |
| <b>Lake and Riverine</b>               |                      |                |                 |                 |                    |                   |                |                 |                 | 0.0              |
| Riverine Unconsolidated Bottom (RUB)   | 100.9                | 216.1          | 34.2            | 79.8            | 19.3               | 0                 | 0              | 0               | 450.3           | 0.8              |
| Riverine Unconsolidated Shore (RUS)    | 1.1                  | 3.4            | 0               | 8.5             | 57.9               | 0                 | 0              | 0               | 70.9            | 0.1              |
| Lacustrine Unconsolidated Bottom (LUB) | 0                    | 1.0            | 3,886.5         | 4,487.4         | 0                  | 99.9              | 0              | 3,673.9         | 12,148.7        | 22.2             |
| Lacustrine Unconsolidated Shore (LUS)  | 0                    | 0              | 1.2             | 88.8            | 0                  | 0                 | 0              | 1.0             | 91.0            | 0.2              |
| <b>Lake and Riverine Total</b>         | <b>102.0</b>         | <b>220.5</b>   | <b>3,921.9</b>  | <b>4,664.6</b>  | <b>77.2</b>        | <b>99.9</b>       | <b>0.0</b>     | <b>3,674.9</b>  | <b>12,760.9</b> | <b>23.4</b>      |
| <b>Developed and Disturbed</b>         |                      |                |                 |                 |                    |                   |                |                 |                 | 0.0              |
| Developed (DV)                         | 0                    | 11.9           | 132.1           | 77.8            | 0                  | 104.7             | 1.2            | 49.0            | 376.8           | 0.7              |
| Recreation (REC)                       | 0                    | 230.5          | 25.9            | 47.9            | 0                  | 0                 | 0              | 69.4            | 373.8           | 0.7              |
| Disturbed (DI)                         | 0.4                  | 2.1            | 23.5            | 25.0            | 22.9               | 0                 | 0              | 76.3            | 150.3           | 0.3              |
| Residential (RES)                      | 8.9                  | 92.2           | 673.6           | 175.7           | 0                  | 0                 | 16.7           | 232.0           | 1,199.1         | 2.2              |
| Agriculture/Residential                | 254.3                | 966.7          | 0               | 0               | 0                  | 0                 | 0              | 0               | 1,221.0         | 2.2              |
| Transmission line Right-of-Way (ROW)   | 0                    | 9.9            | 148.9           | 0               | 0                  | 35.1              | 60.8           | 116.5           | 371.2           | 0.7              |
| <b>Developed and Disturbed Total</b>   | <b>263.6</b>         | <b>1,313.3</b> | <b>1,003.9</b>  | <b>326.5</b>    | <b>22.9</b>        | <b>139.8</b>      | <b>78.7</b>    | <b>543.3</b>    | <b>3,692.2</b>  | <b>6.8</b>       |
| <b>Grand Total</b>                     | <b>1,407.9</b>       | <b>4,429.2</b> | <b>14,331.0</b> | <b>17,231.0</b> | <b>850.4</b>       | <b>1,057.0</b>    | <b>1,125.1</b> | <b>14,176.0</b> | <b>54,607.9</b> |                  |

<sup>1</sup> Study area segments are based on geography, not ownership (see Figure 3.5-1 and PacifiCorp and Cowlitz PUD 2003f and 2004):

Eagle Island = Eagle Island + the Lewis River + land within the 240-foot contour line on both sides of the river north/south of the island;

Lower Lewis River = Lewis River + land within the 240-foot contour line on both sides of the river from 0.5-mile downstream of Merwin Dam to the upstream end of Eagle Island;

Merwin = Lake Merwin and lands within 0.5-mile of the reservoir to the base of Yale Dam + the Lewis River and lands on both sides within 0.5-mile downstream of Merwin Dam;

Yale = Yale Lake and lands within 0.5-mile of the reservoir to 0.25-mile upstream of the Swift No. 2 tailrace + PacifiCorp-owned lands contiguous with the Yale Project but over 0.5-mile from the reservoir;

Lewis River Bypass = Lewis River bypass reach and land 0.5-mile to the south;

Swift No. 2 = Swift No. 2 canal and most land within 0.5-mile to the north side of the canal;

Swift No. 1 = Swift Creek Reservoir and lands within 0.5 mile of the reservoir to about 0.25-mile upstream of the reservoir;

T-line = The Yale to Merwin transmission line corridor and land within 0.125 mile of each side.



### 3.5.2.2 Rare Plant Species

There are no known occurrences of ESA-listed plant species in the study area for the Lewis River Projects (letter from K. Berg, Manager, Western Washington Field Office, USFWS, June 24, 2003; letter from S. Swope Moody, Environmental Coordinator, WNHP, Department of Natural Resources, Olympia, WA, July 1, 2003). There are, however, a number of plant species that are state-listed, or considered by the USFWS, the Washington Natural Heritage Program (WNHP), or USFS to be at risk of decline or in need of monitoring or protection. These species are collectively referred to as rare plants.

The WNHP, USFWS, and USFS provided lists of rare plant species potentially occurring in the study area. Of the 49 vascular plant species on these lists, only one—cold-water corydalis (*Corydalis aquae-gelidae*)—had been documented within the general vicinity of the Lewis River Projects (PacifiCorp 1999d; PacifiCorp and Cowlitz PUD 2003f and 2004: TER 4). Surveys for rare plants in the study area were conducted in 1997, 2000, and 2001, and located only one rare taxa, the green-fruited sedge (*Carex interrupta*). It was found during the 1997 surveys in a wetland along the south shore of the Lewis River between Lake Merwin and Yale Dam upstream of Highway 503, in a wetland at the base of the Swift No. 2 canal berm, and in several wetlands associated with the Yale Project (PacifiCorp and Cowlitz PUD 2003f and 2004; PacifiCorp 1999d). The green-fruited sedge was a WNHP List 4 species through 1998, when it was de-listed because of mounting evidence that it was more common than previously thought (WNHP 2002).

### 3.5.2.3 Exotic and Invasive Plant Species

Noxious weeds potentially occurring in the study area were identified from the Washington State Weed Control Board (WSWCB) list of weeds for Clark, Cowlitz, and Skamania counties, the Pacific Northwest Exotic Pest Plant Council list of invasive plants (WSWCB 2002), and consultation with the USFS. This process resulted in a target list of 27 species, which was used to guide field surveys for noxious weeds. Several invasive species, such as reed canarygrass (*Phalaris arundinacea*), were not included on the target weed list because they are ubiquitous throughout western Washington and the Lewis River area. Conversely, the target weed list included some native species, such as trailing blackberry (*Rubus ursinus*), that are not considered weeds in Washington but can be invasive and are of interest to the USFS. The complete target list of exotic and invasive plant species, as well as additional information on the species selection process, is provided in PacifiCorp and Cowlitz PUD (2003f and 2004: TER 4).

Nine of the 27 target weed species were found in the study area, with most infestations concentrated around project facilities, roads, ROWs, and other disturbed sites (PacifiCorp and Cowlitz PUD 2003f and 2004). Weed species identified in the study area include the following:

- Bull thistle (*Cirsium vulgare*)
- Canada thistle (*Cirsium arvense*)
- Himalayan blackberry (*Rubus discolor*)
- Japanese knotweed (*Polygonum cuspidatum*)

- Policeman’s helmet (*Impatiens glandulifera*)
- Scot’s broom (*Cytisus scoparius*)
- St. John’s wort (*Hypericum perforatum*)
- Tansy ragwort (*Senecio jacobaea*),
- Trailing blackberry (*Rubus ursinus*)

Overall, weed infestations occupy a relatively small portion of the study area. Himalayan blackberry is perhaps the most pervasive, particularly in riparian areas and wetlands. Scot’s broom is common along roadways and the transmission line ROWs. Japanese knotweed and policeman’s helmet are confined to a few locations along the lower river. Many weed taxa thrive in full sun, and the second-growth Douglas-fir stands that dominate the study area eventually shade out most invasive species.

### 3.5.3 Effects of Alternatives

Continued operation of the four Lewis River Projects would affect botanical resources in slightly different ways under the alternatives being considered. The effects of each are summarized below.

#### 3.5.3.1 Alternative A

A number of ongoing project operations, land management practices, and project-related recreational activities affect botanical resources in the Lewis River basin. In addition, Alternative A includes several specific terrestrial resource measures that PacifiCorp currently conducts, or plans to implement over the next license period, that are designed to reduce the effects of some project-related activities on botanical and wildlife resources.

#### Land Management Practices

The utilities own over 11,000 acres of land in the Lewis River basin (Table 3.5-2), and conduct a variety of land management activities to allow for effective and safe project operations, provide access, and improve fish and wildlife habitat.

**Table 3.5-2. Utility land ownership in the Lewis River basin.**

| <b>Project/Area<sup>1</sup></b>     | <b>PacifiCorp<br/>(acres)</b> | <b>Cowlitz PUD<br/>(acres)</b> | <b>Combined<br/>(acres)</b> |
|-------------------------------------|-------------------------------|--------------------------------|-----------------------------|
| Merwin                              | 5,100                         |                                | 5,100                       |
| Yale (includes<br>Cougar/Panamaker) | 3,710                         |                                | 3,710                       |
| Swift No. 1                         | 1,647                         | 284 <sup>2</sup>               | 1,931                       |
| Swift No. 2                         |                               | 291                            | 291                         |
| <b>Totals</b>                       | <b>10,457</b>                 | <b>575</b>                     | <b>11,032</b>               |

<sup>1</sup> PacifiCorp also provided funding for Clark County to purchase Eagle Island for the protection of fish and wildlife habitat.

<sup>2</sup> Devil’s Backbone (284 acres).

Wildlife Habitat Management – PacifiCorp currently protects and enhances wildlife habitat on 5,600 acres of land around Lake Merwin, as well as Saddle Dam Farm near Yale Lake, an area known as the Merwin Wildlife Habitat Management Area (MWHMA). Under the guidance of the Merwin Wildlife Habitat Management Plan (MWHMP), timber harvest is used as a tool to improve wildlife habitat quality on some of these lands. Timber harvests alter the successional stage and/or species composition of forest communities and can also result in disturbed areas that are at risk for establishment of noxious weeds. However, timber harvests in the MWHMA are focused on enhancing wildlife habitat, as stipulated by the MWHMP, and include a number of measures designed to improve forest stand conditions at various seral stages, such as: (1) retention of reserve trees and green recruitment trees in a distribution that provides for seed dispersal across the stand; (2) pruning and thinning of young stands to increase shrub and herb layers; and (3) seeding with a grass-legume seed mix to reduce the potential for erosion and to control the establishment of weeds and other undesirable species. Old growth and mature conifer stands are not harvested.

Under Alternative A, PacifiCorp would continue timber harvests on the MWHMA, as guided by the MWHMP. Approximately 300 acres of land, including 213 acres adjacent to Cougar and Panamaker creeks (owned by PacifiCorp) and 87 acres along the Swift Creek Reservoir known as Devil's Backbone (owned by Cowlitz PUD), were acquired as conservation measures for the 2002 biological opinion and incidental take statement for interim operation of the projects. These conservation lands would be protected from timber harvest and development in perpetuity under a conservation easement and managed for fish and wildlife habitat. The 488 acres of land owned by Cowlitz PUD would be managed for natural succession under Alternative A and would not be harvested.

Overall, the habitat management and protection measures included in Alternative A are expected to: (1) gradually increase the amount of old growth and mature conifer forest, particularly on conservation lands; (2) continue to maintain a mixture of early, mid-successional, and mature conifer forest stands on the MWHMA; and (3) decrease the amount of upland deciduous and mixed deciduous-conifer forest vegetation, especially on the MWHMA.

Timber Management – PacifiCorp currently harvests very little timber from the nearly 5,000 acres of its lands associated with the Yale and Swift No. 1 projects, although there is nothing to prohibit this activity. Under Alternative A, all PacifiCorp-owned forest lands other than the MWHMA and ESA-compliance parcels would be managed for timber production. Harvest activities on lands associated with the Swift No. 1 and Yale projects would be managed under the provisions of the Washington State Department of Natural Resources (WDNR) forest practice rules, which describe the minimum acceptable level of resource protection, and guide how silvicultural treatments are applied to the landscape. Wetland and riparian areas along tributary streams and the mainstem Lewis River would be protected by establishing buffers consistent with state forest practice rules (WDNR 2001). No timber would be harvested within 50 feet of a fish-bearing stream; beyond the 50-foot exclusionary zone there would be two variable width buffers defined by channel width, site productivity, and basal area targets. For non-fish

bearing streams, the buffer width would be 30 feet. Wetland buffers range from 25 to 50 feet (WDNR 2001).

Although timber harvest on lands associated with the Yale and Swift No. 1 projects would be managed according to WDNR rules under Alternative A, the forest practices applied to these areas by PacifiCorp would be similar to the those in the MWHMP. Timber management would be used primarily as a tool to improve wildlife habitat and would focus on the conversion of deciduous stands dominated by red alder to conifer forest. Old-growth and mature forest at these two projects would not be harvested, and forest practices would be designed to provide for a diversity of forest types, stand ages, and species. Best practices to control the establishment of weeds would also be applied.

The overall effect of timber management at the Swift No. 1 and Yale projects under Alternative A would be: (1) a reduction in the proportion of deciduous forest stands on project lands; (2) an increase in the amount of conifer forest; and (3) an increase in the amount of early successional vegetation, at least in the short term.

Project Access Roads – The utilities currently maintain a number of access roads to project facilities. Roads are also required for timber management and recreational access. The utilities generally follow the WDNR’s forest practice standards for managing roads, which include measures to reduce surface runoff and sediment delivery to streams, prevent mass-wasting, remove fish blockages, and maintain hydrologic connectivity. Several of these measures provide some level of protection to riparian vegetation from erosion associated with roads.

PacifiCorp has installed gates and closed a number of roads to vehicle access to reduce disturbance to sensitive habitats on Merwin Project lands. Access to ESA-compliance lands at Cougar-Panamaker creeks, and a few wetlands and elk wintering areas near the Yale Project is also restricted. Under Alternative A, PacifiCorp would maintain existing closures and close some additional roads, thus reducing disturbance and degradation to vegetation in sensitive areas such as wetlands and riparian areas. In addition, small or blocked culverts would be replaced, which would reduce damage to riparian vegetation from the erosion and inundation that can result from culvert problems.

Vegetation Maintenance – The utilities routinely remove and dispose of vegetation that potentially interferes with safe and effective project operations. Vegetation maintenance activities are typically focused along transmission line corridors and around project facilities. The ROW clearance area, or corridor associated with transmission lines typically averages 100 feet and is cleared of trees that could contact the lines. The Swift No. 2 canal and the faces of Swift and Yale dams are also cleared of trees and shrubs with roots that could compromise the integrity of these structures. Under Alternative A, these activities would continue to affect the vegetation communities in these areas.

Vegetation maintenance practices that result in ground disturbance can introduce noxious weeds into native vegetation communities. PacifiCorp and Cowlitz PUD currently control noxious weeds along their ROWs and around project facilities and would

continue this practice over the next license period under Alternative A. Control of some noxious weed species is required by law in the counties with jurisdiction in the area.

### Flow Management

The amount and timing of project-related flows under Alternative A influences the extent, distribution, composition, and function of riparian vegetation in the Lewis River bypass reach, lower Speelyai Creek, and the Lewis River below Merwin Dam (PacifiCorp and Cowlitz PUD 2003f and 2004). These effects are summarized below for each area.

Lewis River Bypass Reach – Normal flows in the bypass reach are currently 10 to 21 cfs upstream of Ole Creek, and would remain unchanged under Alternative A. These low flows allow riparian vegetation, primarily of willow (*Salix* spp.) and red alder, to encroach into the active channel between periodic high flows. Extreme high flow events through the bypass reach periodically remove areas of riparian vegetation, creating disturbed sites that may be subject to erosion over the following several years. Although scoured/disturbed sites are typically colonized quickly by willow and alder, seedlings and small shrubs do not provide much erosion control. While fast growing, these species need to reach a certain size and/or density to provide adequate bank stabilization. By removing trees and shrubs, high flow events increase the amount of time that the active channel through the bypass reach is bordered by early successional vegetation, and thus periodically reduce the ability of riparian habitat to stabilize stream banks. In addition, scouring from the periodic high flows appears to reduce the shrub layer in some of the forest stands in the bypass reach, and increases the cover of invasive species such as Himalayan blackberry and Scot's broom in these areas (PacifiCorp and Cowlitz PUD 2003f and 2004).

Under Alternative A, the area along the bypass reach would be dominated by relatively young red alder and willow. This type of community provides a number of important riparian functions, such as wildlife habitat, nutrient exchange, and input to the aquatic food web. It is, however, unable to contribute large wood to the adjacent channel for fish habitat, floodplain development, and aquatic structural diversity (PacifiCorp and Cowlitz PUD 2003f and 2004).

Lower Speelyai Creek – Lower Speelyai Creek is currently characterized by low base flows and a low incidence of scouring flows. As a result, this area supports a mature, stable riparian community that consists of a mix of wetlands and dense stands of deciduous trees, primarily red alder (PacifiCorp and Cowlitz PUD 2003f and 2004). Alternative A would maintain existing flows and existing riparian conditions along the lower creek.

Lower Lewis River – The Lewis River downstream of Merwin Dam is a large river. As stream size increases, the aquatic system influences a progressively larger amount of adjacent riparian habitat (Bilby 1988; Knutson and Naef 1997), particularly in areas of low relief. However, the lower base flows and reduced flood flows from the project, as well as the existing levees, limit the influence of the lower Lewis River on the adjacent

riparian area (PacifiCorp and Cowlitz PUD 2003f and 2004). As a result, the lower Lewis River supports relatively stable riparian communities, consisting primarily of deciduous and mixed conifer-deciduous forests. There are very few wetlands, shrub-scrub communities, or exposed gravel bars. Under Alternative A, the existing riparian communities along the lower river are likely to remain and mature, although they may be affected by residential, agricultural, and recreational developments unrelated to the project. The lack of exposed bars combined with lower flood flows under Alternative A is likely to decrease the ability of cottonwood to establish in this area over the long term (PacifiCorp and Cowlitz PUD 2003f and 2004).

### Reservoir Water Level Management

The Lewis River Projects are operated for flood management and power generation, which results in daily and seasonal reservoir water level fluctuations. In general, the three project reservoirs are maintained at or near full pool from Memorial Day through Labor Day, although there is some daily fluctuation. Fall-winter drawdowns are greatest at Swift Creek Reservoir, ranging from 60-90 feet below full pool. Yale Lake and Lake Merwin are typically 20 to 30 feet and 8 to 13 feet, respectively, below full pool in the fall and winter. These fluctuations limit the development of vegetated littoral zones, and affect the size and composition of shoreline riparian communities (PacifiCorp and Cowlitz PUD 2003d). The timing of seasonal drawdowns, combined with reservoir substrate and slope, results in relatively xeric conditions in the upper portion of the drawdown zone. This situation inhibits the establishment of hydrophytic plant species and the development of typical littoral and riparian communities along project reservoir shorelines (Hill et al. 1998).

Under Alternative A, water level fluctuation also affects wetlands that have a hydrological connection to the reservoirs. Of the 279 acres of wetlands in the project vicinity, about 59 acres (21 percent) in seven different areas are hydrologically connected to project reservoirs. Two of these wetlands, representing 44 acres, have other water sources and show no apparent effect of reservoir water level fluctuations. The other 15 acres (5 percent) in five areas show altered plant composition and structure (PacifiCorp and Cowlitz PUD 2003f and 2004).

### Project-related Recreation

Currently, public access to all project lands for recreational purposes is allowed except where unsafe conditions exist. As a result, there are at least 96 identified dispersed recreation sites, most of which are primarily accessible by boat. Vegetation at these sites is often removed or trampled, making them susceptible to increased erosion and/or colonization by noxious weeds. Horses, hikers, boats, and motorized vehicles can all introduce exotic/invasive plant species to an area (Douglass et al. 1999). One developed campground, Beaver Bay, is located near one of the largest and most diverse wetland complexes associated with the projects.

Although there are no new recreational facilities included in Alternative A, use of existing campsites, day use areas, and boat launches is likely to increase as the population

in the Portland-Vancouver area grows over the next 30-50 years. As a result, disturbance to shoreline vegetation is likely to increase under Alternative A. New dispersed sites may be developed and existing ones are likely to expand, degrading nearby shoreline vegetation and introducing noxious weeds. Greater equestrian use would also increase the potential for localized weed problems. The continued use of Beaver Bay Campground may result in some negative effects to the associated large wetland complex. Water levels that threaten the campground may need to be controlled by berms or other means, disrupting hydrology and vegetation. Unplanned trails that develop over time through the wetland could also trample and disturb vegetation.

### 3.5.3.2 Alternative B

Under Alternative B, land management practices and reservoir water level management would remain unchanged from Alternative A. However, Alternative B introduces anadromous fish above Swift Dam, proposes changes to flow and flood management, and includes a number of enhancements to recreation facilities and management. Effects of Alternative B on botanical resources are described below.

#### Fish Passage

Upstream fish collection facilities proposed under Alternative B would be located just downstream of Merwin Dam in an area that is already disturbed. The docking station and sorting/transport facility associated with the surface collection facility at Swift Creek Reservoir for downstream anadromous fish passage would also be sited in an area that is disturbed and does not currently support native plant communities or sensitive plant species. Thus, the effects of new fish passage facilities on botanical resources are expected to be negligible.

The goal of the fish passage facilities proposed for Alternative B is to introduce anadromous fish to the Lewis River basin above Swift Dam. Salmon carcasses are an important source of nitrogen for some riparian forests, particularly those not dominated by red alder, which is a nitrogen-fixer (Helfield and Naiman 2001). Alternative B would introduce marine nutrients from salmon carcasses, and consequently, may increase the productivity of riparian conifer forests along the upper river and its tributaries.

#### Land Management Practices

Land management practices under Alternative B would be similar to Alternative A. The primary difference is that a plan and schedule would be developed to replace additional culverts on PacifiCorp roads under Alternative B, with the objective of improving aquatic and riparian habitat connectivity. New culverts would be larger and configured to carry higher flows; in some areas, pipe arch culverts would be installed. The new culverts would benefit riparian vegetation, and possibly some wetland communities.

### Flow Management

Alternative B includes a proposal to continuously release flows of 50 cfs in the Lewis River bypass reach via a new outlet structure in the Swift No. 2 canal. Flows of 50 cfs would inundate about 5 acres of riparian habitat in the bypass reach, resulting in a wider active channel through this area. Assuming that the majority of the inundated area now supports riparian vegetation and that none of this type would develop in other areas, six percent of the riparian vegetation in the bypass reach would be lost (PacifiCorp and Cowlitz PUD 2003f and 2004). However, it is very likely that some adjacent uplands would be affected by higher surface or groundwater levels, resulting in changes that make these areas conducive to species tolerant of wetter conditions. Consequently, the net effect on the acreage of riparian vegetation in the bypass reach is probably relatively low. Higher flows would be expected to increase the extent of the wetted channel and floodplain hyporheic zone and raise associated soil moisture. Thus, floodplain terraces that currently support primarily upland species may provide habitat for facultative species, which are generally more tolerant of higher soil moisture. The result may be an overall increase in plant species diversity in some areas, provided that Himalayan blackberry and other invasive non-native species do not dominate. Higher flows would also be expected to increase the annual exchange of nutrients and organic matter between aquatic and terrestrial habitats.

### Reservoir Water Level Management

Despite proposed changes in project flood storage that would moderately influence Swift Creek and Yale reservoir levels, Alternative B would not reduce daily or seasonal water fluctuations; therefore, effects to botanical resources would remain the same as Alternative A.

### Flood Management

High runoff procedures under Alternative B would include pre-releases from Merwin Dam. Pre-releases (turbine flows plus spill) based on flow forecasts would be made about once a year on average, ranging in magnitude from about 15,000 to 25,000 cfs. The result would be a moderate reduction in the magnitude of floods from about the five-year flood up to about the 50-year flood. The magnitude of severe floods (those which occur about once every 100 years on average and less frequently) would be unchanged under Alternative B. Reducing the magnitude of floods with a 5-50 year return interval would have an unknown effect on riparian vegetation along the lower Lewis River. It is likely that vegetation growing along the margins of the active channel would be inundated and/or scoured less frequently by higher flows. Lower magnitude flood flows may decrease some riparian habitat functions, such as nutrient exchange (PacifiCorp and Cowlitz PUD 2003f and 2004).

Pre-releases for flood management under Alternative B would not require additional drawdown of Swift Creek Reservoir and therefore would not affect spill into the bypass reach. The frequency of spill to the bypass reach is therefore expected to be similar to Alternative A, except in large events where some shaving of peak flows would be



expected. Consequently, riparian vegetation in the bypass reach would be subjected to periodic scouring under Alternative B.

### Project-related Recreation

Alternative B proposes substantial increases in recreational facilities and amenities and includes partially funding of a Visitor Information Center, which would also be used to provide centralized curation space for cultural artifacts. Planned upgrades and expansions, as well as provisions to increase the diversity of recreation opportunities at the projects would affect about 24.5 acres of project lands and 0.2 acres of land in the Town of Cougar. The majority of the affected acreage is associated with Cougar Park at Yale, which would be expanded by 14.5 acres; Swift Camp would also be expanded by about 1.5 acres. Of these two projects, the Cougar Park expansion is likely to have the greatest affect on botanical resources. Although many overstory trees in the existing upland mixed and mid-successional conifer stands would remain in the new area, sub-dominant trees and much of the understory shrub layer would be removed. In addition, it is likely that campers in this area would want to access nearby Cougar Creek, cutting trails through the riparian vegetation. Uncontrolled access could be reduced by providing one or two developed trails, but these measures also would affect vegetation. Effects from the expansion of Swift Camp are expected to be less because the new area would be relatively small and in an area already influenced by day use/boat launch activities.

Six new trails are included in Alternative B—four associated with Yale Lake and one each at Merwin and Swift Creek Reservoir. Together, these new trails would directly affect about 6.5 acres of vegetation, with the 4.2 acres associated with two new two-mile trails—one between Beaver Bay and Cougar Campground and one between Eagle Cliff Park and the USFS boundary. The longest proposed new trail is planned along the east side of Yale Lake on the existing IP Road; improvements to this trail would affect about 1.9 acres. This area is already bisected by the existing road and receives a great deal of dispersed use; wetlands and other vegetation communities have been damaged by off-road vehicles (ORVs) that access the IP Road from adjacent WDNR lands. To the extent that vehicle access and dispersed camping can be controlled, use of the IP Road as a trail would represent an improvement over the status quo, as proposed in Alternative A. The remaining three trails are quite short, affecting a total of about 0.4 acre, and would be located in areas that are already developed or disturbed, with minor effects on botanical resources.

In addition to trails, Alternative B includes an expanded area for horse trailer parking near Saddle Dam Park, potentially increasing equestrian use of trails in the vicinity of the Yale Project. Although hikers can inadvertently introduce noxious weeds along trails and in associated disturbed areas, horses and their feed represent a greater risk.

Several changes to recreational use and developments proposed under Alternative B would actually benefit botanical resources. Under this alternative, dispersed shoreline camping would be prohibited along Lake Merwin and limited along Swift Creek Reservoir and Yale Lake. Some of the existing sites would be converted to day use sites, others would be closed, thus reducing disturbance and trampling effects on shoreline

vegetation. Sites closed to recreation use would be rehabilitated and would be expected to be less susceptible to erosion and invasion by noxious weeds. In addition, PacifiCorp would provide the USFS with funds (\$6,000 annually) to manage dispersed camping on their lands around Swift Creek Reservoir, which may decrease disturbance to shoreline vegetation in this area.

### 3.5.3.3 Alternative C

Alternative C includes the same measures for flood management and project related recreation as does Alternative B. The facilities proposed for fish passage, however, are substantially different under Alternative C. Alternative C also differs from Alternative B by introducing a variable flow regime in the Lewis River bypass reach and an Integrated Wildlife Habitat Management Plan (IWHMP) for PacifiCorp's land. Effects of these proposals on botanical resources are described below.

#### Fish Passage

Alternative C introduces anadromous fish to all three reservoirs with trap-and-tram facilities constructed at the base of Merwin and Yale dams and adjacent to the Swift No. 2 tailrace. Trap-and-tram facilities are expected to occupy a total of about 2.75 acres. Adult collection facilities for Merwin would be located in an area that is already disturbed/developed and there would be no effects on botanical resources. Small areas of vegetation may need to be cleared for collection facilities downstream of the Yale powerhouse and near the Swift No. 2 powerhouse. Installation of the poles needed to carry the 3.2-miles of cable for the tram between the Swift No. 2 powerhouse and Swift Dam would also require some vegetation clearing. However, the alignment generally would follow the Swift No. 2 canal, which is within a ROW already cleared of most trees, so impacts on botanical resources are expected to be minor.

The benefits to riparian vegetation from the introduction of anadromous fish would be greater under Alternative C than Alternative B. Under Alternative C the availability of marine nutrients from salmon carcasses would potentially increase the productivity of riparian conifer forests along tributaries to Lake Merwin and Yale Lake, as well as to the upper Lewis River and its tributaries.

#### Land Management Practices

Alternative C includes development and implementation of an IWHMP, to guide wildlife habitat protection and improvement efforts on PacifiCorp lands over the next license period. The IWHMP would include measures to protect and enhance wetland and riparian habitats, and would be expected to benefit associated botanical resource. The IWHMP probably would not eliminate timber harvest on PacifiCorp lands, and this activity would continue to result in changes to the successional stage and/or species composition of some communities, and may create disturbed areas that are at risk for establishment of noxious weeds. However, the IWHMP is likely to be similar to the MWHMP, and timber harvests on project lands would continue to emphasize forest practices that benefit wildlife and improve stand condition at various seral stages. The

IWHMP would also include provisions to control the establishment and spread of noxious weeds to protect the integrity of plant communities on PacifiCorp lands. Like Alternative B, Alternative C would also include a plan and schedule to replace additional culverts on PacifiCorp roads, with the objective of improving aquatic and riparian habitat connectivity, with some additional benefits to riparian and wetland vegetation.

#### Flow Management

Proposed changes to flow under Alternative C potentially benefit riparian communities in the Lewis River bypass reach. The variable flow regime would improve the exchange of nutrients and organic matter between aquatic and terrestrial habitats in this area. Higher and variable flows and the reduced magnitude of moderate spill events may increase the diversity of plant species composition and structure within and along the active channel. Flows of 100 cfs would be expected to permanently inundate about eight acres of riparian vegetation, but it is very likely that some adjacent uplands would be affected by higher surface or groundwater levels, resulting in changes that make these areas conducive to species tolerant of wetter conditions. Higher flows would be expected to increase the extent of the wetted channel and floodplain hyporheic zone and raise associated soil moisture. Flows of 400 cfs in April-May would temporarily inundate another eight acres; riparian plants are generally adapted to flooding at this time of year.

#### Reservoir Water Level Management

Proposed changes in reservoir flood storage in Swift Creek and Yale reservoirs under Alternative C would not reduce daily or seasonal water fluctuations; thus, effects to botanical resources would remain the same as Alternative A.

#### Flood Management

Flood management under Alternative C would be the same as under Alternative B, with similar effects on botanical resources along the lower Lewis River.

#### Project-related Recreation

Proposed changes to recreational facilities are the same under Alternatives B and C, with identical effects on botanical resources.

#### 3.5.4 Conclusion

Both Alternatives B and C would benefit botanical resources more than Alternative A. Continued growth of unmanaged recreation, which would occur under Alternative A, represents a moderate threat to botanical resources by creating more disturbed areas that are susceptible to erosion and invasion by noxious weeds. Alternative B has minor beneficial effects on botanical resources over baseline conditions, primarily through the introduction of anadromous fish above Swift Dam, additional management of recreation, and restrictions on shoreline dispersed camping. Alternative C has moderately beneficial effects on vegetation compared to baseline through (1) introduction of anadromous fish to all three project reservoirs, (2) implementation of the IWHMP; (3) additional

management of recreation; (4) restrictions on shoreline dispersed camping; and (5) implementation of a variable flow regime in the Lewis River bypass reach that would improve the exchange of nutrients and organic matter, increase the extent of the wetted channel and floodplain hyporheic zone, raise associated soil moisture, and potentially increase the diversity of riparian plant species composition and structure. Overall, Alternative C provides more opportunities to protect and improve botanical resources compared to baseline conditions than Alternative B.

### **3.6 WILDLIFE RESOURCES**

Located in the Cascade Mountains and foothills of western Washington, the Lewis River basin supports a diverse assemblage of wildlife. Wildlife surveys and studies for relicensing the Lewis River Projects were conducted in the same 5,608-acre study area described for botanical resources (see Section 3.5). These studies documented 16 amphibians, 4 reptiles, 114 birds, and 13 mammals (PacifiCorp and Cowlitz PUD 2003c). Most wildlife species inhabit the coniferous forest stands that dominate the area. The local distribution of these populations is continually affected by the harvest cycle and age of managed forest stands. There are also a number of species dependent on the wetland and riparian habitats provided by the study area. Wildlife species composition and distribution has also been influenced by the project reservoirs and associated facilities, as well as by residential and recreational developments in the Lewis River valley. Detailed results of wildlife resource studies and surveys conducted for relicensing can be found in PacifiCorp (1999d) and PacifiCorp and Cowlitz PUD (2003c, 2003f, and 2004).

#### 3.6.1 Resource Issues

The NEPA scoping process for the Lewis River projects identified four primary issues related to wildlife resources:

- Effects of project operations and maintenance activities on wildlife and wildlife habitat, including: (1) big game winter range, reproductive habitat, and forage availability; (2) riparian, shoreline, and wetland habitat structure, function, and composition; (3) available snags/dead wood habitat for cavity-nesting species; and (4) habitat connectivity.
- Effects of project-related recreation use and facilities on wildlife and wildlife habitat.
- Impacts to wildlife from an absence of anadromous fish in the upper basin.

#### 3.6.2 Affected Environment

Wildlife resources in the study area for the Lewis River Hydroelectric Projects include the following: (1) amphibians; (2) reptiles; (3) birds; (4) mammals; (5) special status wildlife species; and (6) ESA-listed wildlife species. Each of these resources and the effects from current project operations, land management practices, and recreation are described below.

### 3.6.2.1 Amphibians

The Lewis River basin is extremely rich in amphibian abundance and diversity; all 16 amphibian species known to occur in the western Cascades of Washington were documented in the study area. A large population of Larch Mountain salamanders (*Plethodon larselli*), a species with very restrictive habitat requirements, was documented on Yale Dam, apparently colonizing the area from adjacent moist cliff/talus habitat. Van Dyke's salamander (*P. vandykei*), another rare species, was found in a seep near the Yale Project. The Cascade torrent salamander (*Rhyacotriton cascadae*), a species restricted to the Cascades between central Washington and Oregon, was common in tributary streams, particularly in the vicinity of Lake Merwin and Yale Lake. Cope's giant salamander (*Dicamptodon copei*), another species with a relatively limited range, was also documented in a few tributaries to Yale Lake. The northern red-legged frog (*Rana aurora*), a species thought to be in decline in other areas of the Pacific Northwest, was a common breeder in study area wetlands; numerous adults were observed along the Lewis River and tributary streams during the summer. The western toad (*Bufo bufo*), another species thought to be declining, was observed breeding in an aquatic bed wetland along Swift Creek Reservoir near the mouth of Drift Creek. Relatively ubiquitous species included the Pacific treefrog (*Hyla regilla*), ensatina (*Ensatina eschscholtzii*), and rough-skinned newt (*Taricha granulosa*). The non-native bullfrog (*Rana catesbeiana*) was also present in a number of wetlands associated with the Yale Project, including the Frazier Creek, IP, and the Saddle Dam Farm wetlands.

### 3.6.2.2 Reptiles

In general, reptiles are poorly represented in the Pacific Northwest (Brown et al. 1995), with only two turtle, one lizard, and four snake taxa native to the western Washington Cascades. Four of these seven species—the painted turtle (*Chrysemys picta*), northern alligator lizard (*Elgaiia coerulea*), rubber boa (*Charina bottae*), and northwestern garter snake (*Thamnophis ordinoides*)—were documented in the project vicinity. The painted turtle was observed in several wetlands, such as Frazier Creek wetland, with large areas of open water. The alligator lizard and rubber boa were both noted on the rocky face of Yale Dam. The alligator lizard was also common in other open habitats such as shrublands, ROWs, and clearcuts. The northwestern garter snake was common in riparian and wetland areas.

### 3.6.2.3 Birds

Of the 120 bird species known to be associated with low elevation conifer forests in western Washington (Johnson and O'Neil 2001), 103 were recorded in the study area. Woodpeckers were well represented and probably breed in the vicinity of the projects, with hairy, downy, and pileated woodpeckers (*Picoides villosus*, *P. pubescens*, and *Dryocopus pileatus*) observed, as well as the red-breasted sapsucker (*Sphyrapicus ruber*) and northern flicker (*Colaptes auratus*). Other bird species common to coniferous and mixed conifer/deciduous forest habitats and likely breeding in the study area include the black-throated gray warbler (*Dendroica negrescens*), Steller's jay (*Cyanocitta stelleri*),

dark-eyed junco (*Junco hyemalis*), Swainson's thrush (*Catharus ustulatus*), spotted towhee (*Pipilo maculatus*), and chickadee (*Poecile* sp.).

Many of the less-represented habitat types in the study area support a higher density and diversity of wildlife species than the predominant coniferous forest. Although wetland and riparian habitat combined account for only about four percent of the study area, a disproportionately large number of common and special status avian species occur in these communities. Riparian, wetland, and shoreline areas provide habitat for a number of swallow species, as well as cedar waxwings (*Bombycilla cedrorum*), Wilson's warblers (*Wilsonia pusilla*), song sparrows (*Meospiza melodia*), and warbling vireos (*Vireo gilvus*). There were 79 avian species observed in wetlands, far more than in any other habitat type in the study area. Observations of the common yellowthroat (*Geothlypis trichas*), green heron (*Butorides virescens*), red-winged blackbird (*Agelaius phoeniceus*), wood duck (*Aix sponsa*), blue-winged teal (*Anas discors*), and Bullock's oriole (*Icterus bullockii*) were confined primarily to wetland habitats. All of these species are known or suspected to breed in the study area.

The project reservoirs, particularly Yale and Merwin, provide habitat for waterfowl and waterbirds, especially in the winter. Summer use is quite low, probably because some wintering species migrate north to breed and nesting habitat for resident species is very limited. Mallards (*Anas platyrhynchos*), common mergansers (*Mergus merganser*), American wigeon (*Anas americana*), and glaucous-winged gull (*Larus glaucescens*) were some of the more common species. The reservoirs also provide foraging habitat for ospreys (*Pandion haliaetus*) and bald eagles (*Haliaeetus leucocephalus*), as well as great blue herons (*Ardea herodias*).

Two non-native avian species that thrive in disturbed and developed sites—the house sparrow (*Passer domesticus*) and European starling (*Sturnus vulgaris*)—were noted around project facilities. The brown-headed cowbird (*Molothrus ater*), an avian parasite and another non-native species in the Pacific Northwest, was present in a number of habitats, but not commonly observed.

#### 3.6.2.4 Mammals

Relicensing studies did not include specific surveys for mammals; however, observations were recorded. Of the 72 mammals associated with low elevation conifer forests in western Washington (Johnson and O'Neil 2001), only 13 were recorded in the study area. However, most small mammal and bat species are nocturnal and/or cryptic, and are therefore difficult to observe without specific surveys. Many of these species are common and likely occur in the study area.

Perhaps the most visible wildlife in the Lewis River valley are elk (*Cervus elaphus*) and black-tailed deer (*Odocoileus hemionus hemionus*). In addition to game mammals, the Townsend's chipmunk (*Eutamias merriami*) and Douglas' squirrel (*Tamiasciurus douglasii*) were frequently observed in conifer forests. Evidence of beaver (*Castor canadensis*) was noted in most wetlands, and mink (*Mustela vison*) were observed in several wetland and riparian areas. Although not common, the black bear (*Ursus*

*americanus*), bobcat (*Lynx rufus*), river otter (*Lutra canadensis*) and coyote (*Canis latrans*) were also recorded.

### 3.6.2.5 Special Status Wildlife Species

Taxa not protected under the ESA, but listed by the state or designated as priority species, or considered by the USFWS to be at risk of decline or in need of monitoring or protection, are collectively referred to as special status species. These include the following:

- USFWS species of special concern (formerly Category 2 candidates), which may be proposed for listing in the future, but are not protected by the ESA;
- State-listed species, which are protected by the WDFW under the State Endangered Species Act;
- State candidate and monitor species, which are being considered for protection and/or are monitored by the WDFW;
- WDFW priority species, which are those requiring protective measures and/or management guidelines to ensure their perpetuation;
- Species on the Sensitive Animal List in 2000 for the USFS, Region 6; and
- Species designated as Survey and Manage (S/M) by the USFS and the Bureau of Land Management (BLM) under the Northwest Forest Plan, as amended (USFS and Bureau of Land Management [BLM] 2001).

Thirty-two special status species potentially occur in the vicinity of the Lewis River Projects (Table 3.6-1), 24 of which were documented during relicensing studies. Additional data on special status species can be found in PacifiCorp (1999d) and PacifiCorp and Cowlitz PUD (2003c, 2003f and 2004).

### 3.6.2.6 ESA-Listed Species

The USFWS, WDFW, and WNHP list two wildlife species potentially occurring in vicinity of the Lewis River Projects that are federally designated as threatened and therefore protected under the ESA (letter from K. Berg, Manager, Western Washington Field Office, USFWS, June 24, 2003; letter from S. Swope Moody, Environmental Coordinator, WNHP, Department of Natural Resources, Olympia, WA, July 1, 2003; letter from L. Guggenmos, WDFW, PHS Program, Olympia, WA, June 27, 2003). These species include the bald eagle (*Haliaeetus leucocephalus*) and the northern spotted owl (*Strix occidentalis*). There are no federally listed endangered wildlife species known to occur or potentially occurring in the project vicinity.

**Table 3.6-1. Special status species documented or potentially occurring in the study area for the Lewis River Projects.<sup>1</sup>**

| Species <sup>2</sup>  | Status             |                   |                     | Habitat  | Location in Study Area   |
|---|--------------------|-------------------|---------------------|--|--|
|   | USFWS <sup>3</sup> | USFS <sup>4</sup> | WDFW <sup>5,6</sup> |  |  |
| <b>Amphibians and Reptiles</b>  |                    |                   |                     |  |  |
| <b>Cope's giant salamander</b><br>( <i>Dicamptodon copei</i> )        | --                 | S                 | SM                  | Small rocky creeks & seeps   | Documented in six tributary streams along the east side of Yale Lake   |
| <b>Larch Mountain salamander</b><br>( <i>Plethodon larselli</i> )     | SoC                | S<br>S/M          | SS<br>P1            | Associated with steep, shaded talus slopes & old-growth              | A large population occurs on the face of Yale Dam & at the base of an adjacent cliff; WDFW also has records for Moss Cave  |
| <b>Van Dyke's salamander</b><br>( <i>Plethodon vandykei</i> )         | SoC                | S<br>S/M          | SS<br>P1            | Splash zones of creeks or waterfalls; seeps over talus or rock faces | Recorded on a south-facing slope at the edge of an old lava flow just north of Swift No. 2 Canal.  |
| <b>Cascade torrent salamander</b><br>( <i>Rhyacotriton cascadae</i> ) | --                 | S                 | SC<br>P1            | Associated with headwater streams & cold water                       | Found in 37, 16, & 7 tributary streams/seeps to Lake Merwin, Yale Lake, & Swift Creek Reservoir, respectively  |
| <b>Tailed frog</b><br>( <i>Ascaphus truei</i> )                       | SoC                | --                | SM                  | Clean, cold mountain streams   | Found in one tributary stream to the upper end of Lake Merwin; Ole Creek; the Lewis River bypassed reach; one & three tributary streams to Yale Lake & Swift Creek Reservoir, respectively |
| <b>Oregon spotted frog</b><br>( <i>Rana pretiosa</i> )                | FC                 | S                 | SE<br>P1            | Found in wetlands & ponds; breeds in very shallow water              | Not found – thought to be nearly extirpated from western WA  |
| <b>Northern red-legged frog</b><br>( <i>Rana aurora</i> )             | SoC                | --                | --                  | Breeds in wetlands & still water habitats                            | Egg masses found in at least 27 separate wetlands or ponds throughout the area; adults common in riparian areas  |
| <b>Cascades frog</b><br>( <i>Rana cascadae</i> )                      | SoC                | --                | --                  | Breeds in wetlands & still water habitats                            | One adult found in a beaver pond north of Swift Creek Reservoir  |
| <b>Western Toad</b><br>( <i>Bufo boreas</i> )                         | SoC                |                   | SC<br>P1            | Breeds in shallow wetlands & still water habitats                    | Numerous juvenile toads observed in an aquatic bed wetland along Swift Creek Reservoir near the mouth of Drift Creek   |



**Table 3.6-1. Special status species documented or potentially occurring in the study area for the Lewis River Projects<sup>1</sup> (cont.).**

| Species <sup>2</sup>   | Status             |                   |                     | Habitat   | Location in Study Area   |
|--|--------------------|-------------------|---------------------|---|--|
|  | USFWS <sup>3</sup> | USFS <sup>4</sup> | WDFW <sup>5,6</sup> |   |  |
| Northwestern pond turtle<br>( <i>Clemmys marmorata marmorata</i> ) | SoC                | S                 | SE<br>P1            | Uses ponds & wetlands that warm up in the summer, typically at lower elevations | Not found; the project is on the border of the currently known distribution; WDFW has no records for the area                                  |
| <b>Birds</b>   |                    |                   |                     |   |  |
| <b>Great blue heron</b> ( <i>Ardea herodias</i> )                  | --                 | --                | SM<br>P2            | Forages in shallow water; nests in large trees                                  | Commonly observed along Yale Lake & Lake Merwin and in several wetlands. No known breeding sites   |
| <b>Common loon</b> ( <i>Gavia immer</i> )                          | --                 | S                 | SS<br>P2            | Breeds on mats of aquatic vegetation in shallow water                           | Several individuals observed on Yale Lake; breeding unlikely due to lack of suitable habitat   |
| Harlequin duck<br>( <i>Histrionicus histrionicus</i> )             | SoC                | --                | P2&3                | Breeds near cold, fast-moving streams; winters in coastal waters                | Not found; WDFW has historic records on USFS lands upstream of the Yale Project  |
| <b>Wood duck</b> ( <i>Aix sponsa</i> )                             | --                 | --                | P3                  | Breeds in cavities in large snags near still water & wetland habitat            | Observed breeding in several wetlands, including Frazier Creek, IP, & Yale Pond  |
| <b>Hooded merganser</b> ( <i>Lophodytes cucullatus</i> )           | --                 | --                | P3                  | Breeds in cavities in large snags near still water & wetland habitat            | Observed breeding in several wetlands, including Frazier Creek, IP, & Yale Pond  |
| <b>Bufflehead</b> ( <i>Bucephala albeola</i> )                     | --                 | S                 | P2&3                | Nests in woodlands near ponds & lakes; winters in aquatic habitat throughout WA | Observed on several project reservoirs & wetlands in the winter; no known nesting  |
| Northern goshawk<br>( <i>Accipter gentilis</i> )                   | SoC                | --                | SC<br>P1            | Typically associated with mature & old-growth forests                           | Not found, but likely occurs in suitable habitat. WDFW has one record west of Cougar Creek   |
| <b>Osprey</b> ( <i>Pandion haliaetus</i> )                         | --                 | --                | SM                  | Nests in large trees near water; forages along rivers & lakes                   | Active nest sites in forested areas adjacent to all three project reservoirs   |
| <b>Peregrine falcon</b> ( <i>Falco peregrinus</i> )                | SoC                | S                 | SS                  | Nests on cliffs near water; forages on birds                                    | Observed only one time in the project vicinity; no known nest sites; Eagle Cliff near Swift Creek Reservoir is the only potential nest habitat |
| <b>Blue grouse</b> ( <i>Dendragapus obscurus</i> )                 | --                 | --                | P3                  | Uses conifer forest habitat throughout western WA                               | Observed in the Yale Project vicinity  |

**Table 3.6-1. Special status species documented or potentially occurring in the study area for the Lewis River Projects<sup>1</sup> (cont.).**

| Species <sup>2</sup>  | Status             |                   |                     | Habitat   | Location in Study Area  |
|---|--------------------|-------------------|---------------------|---|---|
|   | USFWS <sup>3</sup> | USFS <sup>4</sup> | WDFW <sup>5,6</sup> |   |   |
| <b>Band-tailed pigeon</b><br>( <i>Columba fasciata</i> )                      | --                 | --                | P3                  | Uses low & mid-elevation conifer & mixed conifer stands throughout western WA | Observed in several locations west of Swift Dam; one roost site documented north of Lake Merwin                       |
| <b>Pileated woodpecker</b><br>( <i>Dryocopus pileatus</i> )                   | --                 | --                | SC<br>P1            | Cavity-nesting species requiring large snags & down wood in conifer forests   | Observed in forested habitats associated with all four Lewis River projects; probable breeding                        |
| <b>Olive-sided flycatcher</b><br>( <i>Contopus borealis</i> )                 | SoC                | --                | --                  | Uses most conifer forest types in western WA                                  | Observed during bird surveys on lands near the Yale Project   |
| <b>Vaux's swift</b><br>( <i>Chaetura vauxi</i> )                              | --                 | --                | SC                  | Associated with grassland habitat & dry meadows                               | Observed during bird surveys on lands near the Yale Project   |
| <b>Mammals</b>  |                    |                   |                     |   |   |
| <b>Pacific Townsend's big-eared bat</b><br>( <i>Corynorhinus townsendii</i> ) | SoC                | S                 | SC<br>P1&2          | Dependent on caves & mines for roosting; highly sensitive to disturbance      | Uses Moss Cave along the Swift-Yale transmission line ROW as a nursery colony, hibernacula, & communal roost site     |
| Long-eared myotis<br>( <i>Myotis evotis</i> )                                 | SoC                | --                | SM<br>P2            | Occurs in forests throughout WA   | WDFW has records from Clark Co., south of Yale Lake; likely occurs in the project vicinity                            |
| Long-legged myotis<br>( <i>Myotis volans</i> )                                | SoC                | --                | SM<br>P2            | Common in montane conifer forest  | WDFW has records from Clark Co., south of Yale Lake; likely occurs in the project vicinity                            |
| <b>Mink</b><br>( <i>Mustela vison</i> )                                       | --                 | --                | P3                  | Wetlands & riparian habitat   | Documented in several wetlands associated with the Yale Project   |
| Wolverine<br>( <i>Gulo gulo</i> )   | SoC                | S                 | SC<br>P1            | High elevations-subalpine & alpine habitats                                   | Not found; WDFW has no records for the project vicinity; unlikely to occur due to lack of suitable habitat            |
| Fisher<br>( <i>Martes pennanti</i> )  | SoC                | S                 | SE<br>P1            | Old-growth & mature conifer forest  | Not found; thought to be nearly extirpated from WA  |
| <b>Black-tailed deer</b><br>( <i>Odocoileus hemionus</i> )                    | --                 | --                | P3                  | Uses a variety of forest habitats for cover & more open habitat for forage    | Commonly observed in the project vicinity; density in WDFW Region 5, which includes the Lewis River, is ~ 10.45/sq mi |

**Table 3.6-1. Special status species documented or potentially occurring in the study area for the Lewis River Projects<sup>1</sup> (cont.).**

| Species <sup>2</sup>                    | Status             |                   |                     | Habitat   | Location in Study Area  |
|---|--------------------|-------------------|---------------------|---|---|
|   | USFWS <sup>3</sup> | USFS <sup>4</sup> | WDFW <sup>5,6</sup> |   |   |
| <b>Elk</b><br>( <i>Cervus elaphus</i> ) | --                 | --                | P3                  | Dependent on low-elevation winter range & interconnected movement corridors | Observed throughout the project vicinity, especially in the winter. Lewis River-Kalama herd is ≈ 14,000 elk |

<sup>1</sup> Sources: Letter from WDFW, Priority Habitats and Species (PHS) Program, June 27, 2003. Data sources: PacifiCorp (1999d); PacifiCorp and Cowlitz PUD (2002a, 2003f and 2004).

<sup>2</sup> Species in **bold** font are those observed in the project vicinity during relicensing studies.

<sup>3</sup> USFWS Status:

FC = Federal Candidate: Candidate for federal listing as threatened or endangered. Species for which the USFWS has sufficient information to support a proposal to list under ESA.  
 SoC = Species of Concern: Former Category 2 candidate species for listing – species needs additional information to support a proposal to list as threatened or endangered; not protected under ESA.

<sup>4</sup> USFS Status:

S = On the Region 6 Forester's Sensitive Animal Species List (USFS 2002b).  
 S/M = Survey and Manage Species, as designated by the Northwest Forest Plan (USFS and BLM 1994 and 2001).

<sup>5</sup> WDFW Listing Status:

SE = State Endangered: Any wildlife species native to Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

SS = State Sensitive: Any wildlife species native to Washington that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range within the state without cooperative management or removal of threats.

SC = State Candidate: Species that WDFW will review for possible listing as State Endangered, Threatened, or Sensitive; species have sufficient evidence to suggest that its status may meet the listing criteria.

SM = State Monitor.

<sup>6</sup> WDFW Priority Species Status: Priority species = Species that requires protective measures for their perpetuation due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Priority species include State Endangered, Threatened, Sensitive, and Candidate species (P1); animal aggregations considered vulnerable (P2); and those species of recreational, commercial, or tribal importance that are vulnerable (P3).

### Bald Eagle

Bald eagles use the project vicinity for both wintering and breeding. Late winter surveys conducted by PacifiCorp since 1996 have documented from 5 to 80 bald eagles between Woodland and the upper end of Swift Creek Reservoir (Table 3.6-2). Winter use is likely related to forage availability, particularly fish, along the Lewis River and other nearby drainages. The WDFW has records of 7, 6, and 4 bald eagle communal roost sites along Yale, Swift, and Merwin reservoirs, respectively.

**Table 3.6-2. Numbers of bald eagles recorded during PacifiCorp's late-winter aerial surveys.**<sup>1,2</sup>

| Location                  | 1996         | 1997         | 1998        | 1999         | 2000         | 2001       | 2002        |
|---------------------------|--------------|--------------|-------------|--------------|--------------|------------|-------------|
| Swift Creek Reservoir     | 5/1          | 4/1          | 5/1         | 10/10        | 3/5          | 0/0        | 2/0         |
| Swift Dam to Yale Lake    | 5/3          | 2/5          | 1/0         | 2/0          | 3/0          | 0/0        | 0/0         |
| Yale Lake                 | 19/8         | 1/0          | 0/3         | 5/7          | 2/0          | 2/0        | 1/1         |
| Yale Dam to SR 503 Bridge | 5/5          | 4/3          | 1/1         | 3/1          | ½            | 0/0        | 2/0         |
| Lake Merwin               | 4/1          | 3/1          | 1/0         | 3/1          | 3/7          | 0/0        | 3/0         |
| Merwin Dam to Woodland    | 19/5         | 10/4         | 4/1         | 18/5         | 8/1          | 2/1        | 3/1         |
| <b>Totals</b>             | <b>57/23</b> | <b>24/14</b> | <b>12/6</b> | <b>41/24</b> | <b>20/15</b> | <b>4/1</b> | <b>11/2</b> |

<sup>1</sup> Surveys are typically conducted in mid-late February by helicopter; the 2002 survey was conducted in late March.

<sup>2</sup> Adult/subadults.

There are five known bald eagle nest sites associated with the hydroelectric projects – one each on the north and south sides of Lake Merwin, one on the east side of Yale Lake, and two along Swift Creek Reservoir (one near Swift Dam and one in the Drift Creek drainage). There is also a nest site downstream of Merwin Dam near Woodland, first observed in 1997. Activity and productivity at these nest sites vary from year to year, with at least two active nests in any given year (Table 3.6-3). Overall bald eagle productivity along the Lewis River has ranged from two to six young per year since 1996, with an average nesting success rate of 0.75, and a mean productivity of 1.05 young/occupied territory. Average productivity along the Lewis River slightly exceeds the standard of 1.0 young/occupied territory in the Pacific Bald Eagle Recovery Plan (USFWS 1986).

**Table 3.6-3. Bald eagle nest activity and productivity recorded during PacifiCorp's summer aerial surveys**<sup>1</sup>.

| Location                                 | Activity <sup>2</sup> /Productivity (No. of Live Young) |             |             |             |             |             |             |                   |
|--|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------------|
|  | 1996  | 1997        | 1998        | 1999        | 2000        | 2001        | 2002        | 2003 <sup>3</sup> |
| Swift Creek Reservoir – Drift Creek site | A/2   | F           | A/2         | UO          | O           | A/2         | O           | A                 |
| Swift Creek Reservoir – Swift Dam site   | A/1   | A/2         | O           | UO          | A/2         | O           | UNK         | UNK               |
| Yale Lake – Siouxon Ridge site           | A/1   | A/1         | UO          | A/1         | UO          | O           | A/2         | A                 |
| South Lake Merwin site                   | UO  | UNK         | A/2         | A/1         | UO          | A/1         | F           | A                 |
| North Lake Merwin site                   | --  | --          | --          | --          | --          | --          | --          | A                 |
| Woodland site                            | --  | A/1         | A/2         | A/0         | A/2         | A/1         | A/1         | A                 |
| <b>Totals</b>                            | <b>4</b>  | <b>4</b>    | <b>6</b>    | <b>2</b>    | <b>4</b>    | <b>4</b>    | <b>3</b>    | <b>--</b>         |
| <b>Successful/Occupied Territories</b>   | <b>1.0</b>  | <b>0.75</b> | <b>0.75</b> | <b>1.0</b>  | <b>0.66</b> | <b>0.60</b> | <b>0.50</b> | <b>--</b>         |
| <b>No. Young/Occupied Territory</b>      | <b>1.30</b>   | <b>1.0</b>  | <b>1.50</b> | <b>0.67</b> | <b>1.30</b> | <b>0.80</b> | <b>0.75</b> | <b>--</b>         |

<sup>1</sup> Surveys to determine activity are conducted in March/April; surveys to determine productivity are conducted in late June.

<sup>2</sup> A=Active (incubation observed); O=Occupied only (adults present but no incubation observed); UO=Unoccupied; UNK=Unknown; F=Active, failure (incubation observed but no young produced).

<sup>3</sup> Productivity unknown at the time this document was prepared.

### Northern Spotted Owl

The WDFW has documented more than 20 breeding pairs of spotted owls in the general project vicinity, approximately 15 with territories contiguous with the project area. These territories are at Swift Creek Reservoir along Range and Drift creeks and along the south side of the Lewis River bypass reach; along the east and west shores of Yale Lake; and along the north shore of Lake Merwin. The highest density of breeding territories in the project vicinity is south of Swift Creek Reservoir and east of Yale Lake. The density in this area is sufficient to create a large, coterminous region of documented spotted owl habitat.

Spotted owls were observed only once during relicensing studies – in a parcel of mature conifers on USFS land north of Swift No. 2 canal. Given the known density of spotted owl breeding territories in the vicinity, the species may occur incidentally in a variety of habitat types in the project area. However, spotted owls are typically associated with old-growth, late-successional Douglas-fir, or other conifer-dominated forests (Csuti et al. 1997), and the probability of occurrence for this species is highest in these habitat types. The most extensive stands of old-growth and late-successional conifer forest exist along the south shore of Swift Creek Reservoir, especially in the vicinity of Drift Creek (see Figure 3.5-1).

### 3.6.3 Effects of Alternatives

Continued operation of the four Lewis River Projects would affect wildlife resources in slightly different ways under the alternatives being considered. The effects of each are summarized below.

#### 3.6.3.1 Alternative A

A number of current project operations, land management practices, and project-related recreational activities affect wildlife and habitat in the Lewis River basin. These would continue over the next license period under Alternative A. In addition, Alternative A includes several specific measures that PacifiCorp currently conducts, or plans to implement over the next license period, that are designed to reduce the effects of some project-related activities on botanical and wildlife resources.

#### Land Management Practices

PacifiCorp owns over 10,000 acres of land in the Lewis River basin and Cowlitz PUD owns 575 acres. The utilities conduct a variety of land management activities to allow for effective and safe project operations, provide access, and improve fish and wildlife habitat. These activities, which would continue under Alternative A, affect wildlife resources in the vicinity of the projects, as described below.

Wildlife Habitat Management – As a condition of relicensing its Merwin Project in 1976, PacifiCorp agreed to manage approximately 5,600 acres of their lands between Merwin and Yale dams for wildlife. These lands are known as the Merwin Wildlife Habitat

Management Area (MWHMA), and are managed under the Merwin Wildlife Habitat Management Plan (MWHMP) (PacifiCorp 1998), which was developed in cooperation with the WDFW. This plan involves: (1) managing forests to improve habitat for big game and other native species; (2) maintaining existing water control structures to protect the hydrology of wetlands in Saddle Dam Farm; (3) planting shrubs along roads, ROWs, and open areas to provide wildlife cover; (4) managing existing grasslands and pastures, as appropriate, to meet specific objectives to enhance wildlife habitat; (5) creating/protecting habitat for species that use cavities and snags for reproduction and foraging; (6) maintaining and/or increasing areas of late-successional forest (large trees); and (7) controlling noxious weeds.

Although the MWHMP was developed to enhance conditions for wildlife in general, the overriding objective of the plan is to maintain a 50:50 cover:forage ratio to benefit elk populations. Both Roosevelt (*C. e. roosevelti*) and Rocky Mountain elk (*C. e. nelsoni*) from the Lewis-Kalama River watershed herd, estimated at about 14,000 individuals (Michaelis et al. 1995), overwinter in the study area. Although elk are considered to be non-migratory in the lower foothill regions of the Cascade Mountains (Michaelis et al. 1995), the Lewis-Kalama River population exhibits local seasonal movements from higher elevation summer grounds to the lower slopes and adjacent valley floors where they winter. On adjacent USFS lands, elk winter range is generally defined as areas below 2,200 feet. Suitable lands in the watershed below 1,000 feet – including the majority of the MWHMA – are viewed as critical to the continued viability of the Lewis-Kalama River elk population (Michaelis et al. 1995).

The 50:50 cover:forage mandate in the MWHMP requires that 50 percent of the area remain suitable for elk cover and 50 percent exists as elk foraging habitat. Cover habitat is defined as forest with trees  $\geq 12$  inches dbh and a canopy closure of  $\geq 70$  percent; forage habitat is defined by a canopy closure of  $< 70$  percent. The management area is divided into 16 smaller units, and a strategic timber harvest rotation is used to maintain the 50:50 cover:forage ratio.

Innovative forest management techniques beyond those mandated by the Washington State Forest Practices Act (RCW 76.09) are used to maintain the 50:50 cover:forage ratio for big game and to enhance wildlife habitat quality within the MWHMA. Specific forest practices designed to improve wildlife habitat conditions on manageable lands include: (1) restricting timber harvests to less than 30 acres; (2) retaining five trees per acre at harvest with two trees developed as wildlife snags; (3) reseeding clearcuts and all bare ground with a grass-legume mix; (4) girdling and pruning trees during thinning to increase wildlife access; (5) maintaining permanent big game concealment zone buffers extending 200 feet from all roads; and (6) no-harvest restrictions on all cedar and cottonwood (*Populus trichocarpa*) (Merker and Hale 1982; PacifiCorp 1998). There are 1,500 acres of land in the MWHMA that are not used for timber production, but are used to protect certain habitats and further enhance conditions for area wildlife. These areas are designated as permanent, specialized management sites for old-growth, shrublands, riparian buffers, and wetlands. In addition, all areas identified for timber harvest are surveyed for the presence of raptor nests. Raptor nests and a surrounding buffer are

protected from harvest, and nearby habitat management activities are scheduled to avoid disturbance.

Under Alternative A, the 5,600-acre MWHMA would continue to be managed for wildlife over the term of the new licenses, with updates to the MWHMP as needed. In addition, approximately 300 acres of land, including 213 acres adjacent to Cougar and Panamaker creeks (owned by PacifiCorp) and 87 acres along Swift Creek Reservoir (owned by Cowlitz PUD), were acquired for conservation. These lands would be protected from timber harvest and development in perpetuity under a conservation easement and managed for fish and wildlife habitat. The other 488 acres of land owned by Cowlitz PUD would be managed for natural succession under Alternative A and would continue to provide wildlife habitat. Overall, the habitat management and protection measures included under Alternative A are expected to: (1) gradually increase the amount of old growth and mature conifer forest habitat, particularly on ESA compliance lands; (2) continue to benefit big game on the MWHMA by maintaining a 50:50 forage cover ratio; and (3) decrease the amount of upland deciduous and mixed deciduous-conifer forest habitat, especially on the MWHMA.

Timber Management – PacifiCorp currently harvests very little timber from its nearly 5,000 acres of land around the Yale and Swift No. 1 projects. Under Alternative A, all PacifiCorp-owned forest lands other than the MWHMA and ESA-compliance parcels would be managed for timber production. Harvest activities on lands associated with the Swift No. 1 and Yale projects would be managed under the provisions of the Washington State Department of Natural Resources (WDNR) forest practice rules, as described in Section 3.5.3.1. However, specific forest practices applied to these areas by PacifiCorp would be similar to those in the MWHMP. Timber management would be used primarily as a tool to improve wildlife habitat and would focus on the conversion of deciduous stands dominated by red alder to conifer forest. Existing old-growth and mature forest habitat at these two projects would be protected, and forest practices would be designed to provide for a diversity of habitat types, stand ages, and species. Surveys for raptor nests would be conducted prior to any timber harvests. Nest sites and associated buffers would be protected from harvest, and nearby habitat management activities would be scheduled outside the nesting season.

The overall effect of Alternative A on wildlife would be a reduction in the proportion of deciduous forest habitat on land near the Yale and Swift No. 1 projects and increase the amount of conifer forest habitat. In the short term, additional timber harvest at the Yale and Swift No. 1 projects would benefit species that use early successional habitats and may increase the amount of big game forage.

Project Access Roads – The utilities currently maintain a limited network of roads for access to project facilities, harvest units, and recreational access. Roads have a number of documented effects on wildlife (Forman et al. 2002). Although car-wildlife collisions are uncommon along project access roads, which do not receive a lot of traffic, big game are known to avoid habitats near roads, even those that receive only occasional use (Witmer et al. 1985). Sediment delivery to streams and wetlands from roads can reduce

habitat quality for aquatic amphibians, and blocked or under-sized culverts can restrict the movement of species that travel along stream margins.

Timber harvest at the Yale and Swift No. 1 projects is likely to increase road density, potentially reducing habitat quality for big game and other mammals in these areas. The edge habitat associated with roads and clearings can also result in increased predation and nest parasitism for breeding songbirds (Hamann et al. 1999). As described in Section 3.5.3.1, the utilities generally follow the WDNR's forest practice standards for managing roads, which include measures to reduce surface runoff and sediment delivery to streams, prevent mass-wasting, remove fish blockages, and maintain hydrologic connectivity. These measures provide some level of protection to riparian habitats from road-related erosion, and help maintain fish and wildlife habitat connectivity.

PacifiCorp has installed gates and closed a number of roads to vehicle access to reduce disturbance to wildlife and sensitive habitats on Merwin Project lands. Permanent big game concealment zone buffers (200 feet) are also maintained along all roads through the MWHMA. Access to ESA-compliance lands at Cougar-Panamaker creeks, and a few wetlands and elk wintering areas near the Yale Project is also restricted. Under Alternative A, PacifiCorp would maintain existing closures and close some additional roads, thus reducing disturbance to wildlife and habitat degradation in sensitive areas such as wetlands and riparian areas. In addition, small or blocked road culverts would be replaced, which would improve aquatic and riparian habitat connectivity.

Vegetation Maintenance – The utilities routinely remove and dispose of vegetation that potentially interferes with safe and effective project operations, which affects habitat along transmission line rights-of-way (ROWs) and around project facilities. However, on the MWHMA, PacifiCorp routinely plants shrubs along ROWs and in open areas near project facilities to provide wildlife cover, an activity that would continue under Alternative A.

#### Flow Management

Under Alternative A, there would be no changes to project operations or flows in the Lewis River bypass reach or lower Speelyai Creek, and the Lewis River below Merwin would remain unchanged. All of these areas currently support a variety of wildlife species and habitat types. Riparian habitat in the bypass reach would be affected by periodic high flows, which alter the types and extent of habitats available for wildlife in this area (PacifiCorp and Cowlitz PUD 2003f and 2004). Riparian habitat along the Lewis River below Merwin is and probably would continue to be more affected by development, agriculture, and recreation than by the projects. Riparian habitat along Speelyai Creek is very stable under the current operating regime and would continue to be affected primarily by development and timber operations unrelated to the projects.

#### Reservoir Water Level Management

Alternative A would maintain current reservoir water level management practices, which result in fall-winter drawdowns at all three project reservoirs. These drawdowns are



greatest at Swift Creek Reservoir and Yale Lake and expose large, steep barren areas between the shoreline and the water, which can limit the ability of some wildlife to access the water. Water level fluctuations of more than a few feet also preclude reservoir use by beavers and some other aquatic furbearers.

Since reservoir operations would be unchanged under Alternative A, the five wetlands that are hydrologically dependent on the reservoirs would continue to be affected by water level fluctuations (see Section 3.5.3.1), with relatively low use of most of these areas by wildlife. Reservoir shoreline habitats would also continue to be more upland in character, without suitable habitat for species that require hydrophytic vegetation (see Section 3.5.3.1).

### Project-related Recreation

The Lewis River Projects provide a variety of recreational opportunities, including camping, boating, picnicking, hiking, fishing, bicycling, horseback riding, and hunting. PacifiCorp operates and maintains 14 day use areas, including four developed campgrounds and seven boat launches associated with the project reservoirs and the Lewis River. One campground, Beaver Bay, is located near one of the largest and most diverse wetland complexes associated with the projects. In addition, there are at least 96 identified dispersed recreation sites, most of which are primarily accessible by boat.

Depending on the activity, location, and timing, recreation can disturb wildlife and degrade wildlife habitat. Recreational facilities, such as developed campsites, can reduce wildlife habitat quantity and quality by fragmenting habitat and reducing the cover of understory shrubs and herbaceous species (Hamann et al. 1999). Campers collect down wood for fires, reducing the availability of this habitat feature for wildlife (Hall and Farrell 2001; Bratton et al. 1978). Snags are often removed from developed recreation areas for safety reasons, reducing habitat for cavity-nesting birds (Hamann et al. 1999). Wild predators, such as crows and raccoons, are often supported at artificially high numbers by the food and refuse associated with recreational facilities; these species can reduce the number of native amphibians, mammals, and songbirds (Hickman et al. 1999; Hamann et al. 1999). The creation of edge habitat can also increase predation and parasitism on songbirds, particularly in riparian areas (Hamann et al. 1999). Some research suggests that corridors as narrow as 25 feet can attract cowbirds and nest predators (Hamann et al. 1999). Recreation-related disturbance is often greatest in the summer, corresponding with the breeding and rearing periods for many species.

Recreational use in the project vicinity is likely to increase under Alternative A. Although there are no new facilities planned, use of existing campsites, day use areas, and boat launches would increase as the population in the Portland-Vancouver area grows over the next 30-50 years. As a result, disturbance to wildlife and habitat is likely to increase. New dispersed sites may be developed and existing ones are likely to expand, degrading nearby shorelines and habitat. In addition, down wood in and around developed and dispersed campsites would be collected by campers, reducing the availability of this habitat feature for wildlife. Snags near developed recreational facilities would be removed for safety reasons, limiting cavity-nesting species.

The continued use of Beaver Bay Campground under Alternative A may result in some negative effects to the associated large wetland complex. Water levels that threaten the campground may need to be controlled by berms or other means, disrupting hydrology. Unplanned trails that develop over time through the wetland could also disturb habitat and breeding species.

Greater recreational use could potentially affect existing bald eagle nest success and productivity. The greatest recreation use of project lands occurs between June and August, after the courtship, incubation, and hatching periods in bald eagle nesting chronology (Isaac et al. 1983). Thus, it is impossible to predict any changes to the bald eagle use or success of the project area under Alternative A. In general, it is thought that bald eagles are less likely to abandon a nest site in response to disturbance later in the season when they have young. However, response to disturbance varies greatly with the type, magnitude, and location, as well the individual bald eagle involved.

### 3.6.3.2 Alternative B

Under Alternative B, land management practices would remain unchanged from Alternative A. Fish would be introduced above Swift Dam, changes made to flow and flood management, and upgrades and enhancements made to recreation facilities and management. These effects of Alternative B on wildlife and habitat are described below.

#### Fish Passage

Upstream fish collection facilities at Merwin Dam and the docking station and sorting/transport facility associated with the surface collection facility at Swift Creek Reservoir would be located in an area that is already disturbed and does not currently provide wildlife habitat. However, the increased traffic associated with trucking fish between Merwin and Swift dams would increase the risk of road-related mortality. However, the overall the effects of fish passage activities under Alternative B on wildlife resources are expected to be negligible.

The goal of the fish passage facilities proposed for Alternative B is to introduce anadromous fish to the Lewis River basin above Swift Dam. The role of anadromous fish in Pacific Northwest ecosystems has been well documented. Salmon play a role in the distribution, viability abundance, and/or population status of at least 137 terrestrial and marine wildlife species (Cederholm et al. 2001). All salmon life stages provide food for some wildlife. Several species consume salmon eggs and freshwater fry, and fingerlings are eaten by a wide variety of taxa, birds in particular. However, salmon carcasses provide food for by far the greatest number of wildlife species (82) (Cederholm et al. 2001). Introduction of anadromous fish into the upper basin is expected to increase the carrying capacity of this area for a number of wildlife species, such as black bears, osprey, and common mergansers, which show a strong and consistent link to salmon. Bald eagles, federally listed as threatened, would also benefit from the introduction of anadromous fish to the upper basin.

### Land Management Practices

Land management practices under Alternative B would be similar to Alternative A. The primary difference is that a plan and schedule would be developed to replace additional culverts on PacifiCorp roads under Alternative B, with the objective of improving aquatic and riparian habitat connectivity for wildlife as well as fish. New culverts would be larger and configured to carry high flows and provide passage for wildlife. In some areas, pipe arch culverts would be installed. Additionally, some dispersed campsites would be closed to enhance terrestrial habitat.

### Flow Management

Alternative B includes a proposal to continuously release flows of 50 cfs in the Lewis River bypass reach via a new outlet mechanism from the Swift No. 2 canal. Flows of 50 cfs would inundate about 5 acres of riparian habitat in the bypass reach, resulting in a wider active channel through this area. Although the proposed flow changes would benefit some ecological functions of riparian habitats, effects on wildlife use in this area is expected to be small. Additional flow releases in the Lewis River bypass reach that improve fish populations may increase forage availability for bald eagles.

Water from the new Swift No. 2 canal outlet mechanism would be routed to a large existing pond in the bypass reach. This pond is located about 2,000 feet downstream of Swift Dam, is about 30 feet deep, and currently supports fish. The water level in this pond would rise, connecting it to the main channel in the bypass reach, and ultimately to Yale Lake, potentially increasing use by fish. Some of the smaller ponds and wetlands in the reach currently support populations of still water-breeding amphibians. The larger ponds, however, do not have suitable substrate or water depths for breeding amphibians, and surveys of these areas showed no or low use. Thus flow changes under Alternative B would not be expected to affect still water breeding amphibians in ponds in the bypass reach.

### Reservoir Water Level Management

Despite proposed changes in project flood storage that would influence reservoir levels, Alternative B would not reduce daily or seasonal water fluctuations. Effects to wildlife resources would remain the same as Alternative A.

High runoff procedures under Alternative B would include pre-releases from Merwin Dam. These pre-releases (turbine flows plus spill) would occasionally inundate some shoreline habitat downstream of the dam, although effects on wildlife would be minor since the species that use riparian habitats are generally adapted to periodic disturbance from high flows.

Flood management pre-releases would not affect spill into the bypass reach except in large events where some shaving of peak flows would be expected. Consequently, riparian habitat in the bypass reach would continue to be affected by periodic high flows,

which alter the types and extent of habitats available for wildlife in this area (PacifiCorp and Cowlitz PUD 2003f and 2004).

### Project-related Recreation

Alternative B proposes substantial increases in recreational facilities and amenities such as a Visitor Information Center. Planned upgrades and expansions, as well as provisions to increase the diversity of recreation opportunities at the projects would affect about 24.5 acres of project lands and 0.2 acres of land in the Town of Cougar. The majority of the affected acreage is associated with Cougar Park at Yale, which would be expanded by 14.5 acres; Swift Camp would also be expanded by about 1.5 acres. Of these two projects, the Cougar Park expansion is likely to have the greatest effect on wildlife habitat. Although many overstory trees in the existing upland mixed and mid-successional conifer stands would remain in the new area, sub-dominant trees and much of the understory shrub layer would be removed. These changes probably would influence wildlife use of this area, even when campers are not present. In addition, it is likely that campers in this area would want to access nearby Cougar Creek, potentially cutting trails through riparian habitat. Uncontrolled access could be reduced by providing one or two developed trails, but these also would affect habitat. Effects from the expansion of Swift Camp are likely to be less because the new area would be relatively small and in an area already influenced by existing day use/boat launch activities.

The six new trails included in Alternative B would directly affect about 6.5 acres of habitat, 4.2 of which are associated with two new two-mile trails—one between Beaver Bay and Cougar Campground and one between Eagle Cliff Park and the USFS boundary. The longest proposed new trail is planned along the east side of Yale Lake on the existing IP Road; improvements to this trail would affect about 1.9 acres. This area is already bisected by the existing road and receives a great deal of dispersed use; wetlands and other vegetation communities have been damaged by off-road vehicles (ORVs) that access the IP Road from adjacent WDNR lands. To the extent that vehicle access can be prohibited and dispersed camping controlled, use of the IP Road as a trail would represent an improvement over the status quo, as described in Alternative A. The remaining three trails are quite short, affecting a total of about 0.4 acre, and would be located in areas that are already developed or disturbed, with minor effects on wildlife habitat.

Effects of the new recreational facilities on threatened and endangered species are uncertain but are likely to be minor. None of the new trails and expanded campgrounds included in Alternative B are planned for areas that are known to be used by spotted owls. The proposed trail along the IP Road probably represents the greatest potential source of disturbance to bald eagles. The trail would be within 0.25 mile of a known bald eagle nesting territory, but would not be in the line of sight. The trail would also be close to several areas along the east side of Yale Lake used by bald eagles for roosting and perching. It is impossible to predict the effects of the trail on bald eagles. There is some evidence to suggest that pedestrian activities are more disturbing to bald eagles than boats or vehicles (Stalmaster and Kaiser 1998; Watson and Roderick 2001). However, eagle

responses to human activity are extremely variable, difficult to quantify, and often site specific. Variables include the type, intensity, duration, timing, predictability, and location of the activity, as well as the season, weather, geographic area, and topography. The age, gender, sensitivity, physiological condition, and mated status of the eagle also play roles (Hamann et al. 1999). Bald eagles in the Lewis River basin may be most susceptible to disturbance during the winter, particularly if available prey is limited, and early in the breeding season when birds are more likely to abandon a nest site in response to disturbance. Recreational uses of the reservoir and trails are lowest during winter months, so the potential for disturbance during this time is relatively low.

In addition to trails, Alternative B would potentially increase equestrian use of trails in the vicinity of the Yale Project, particularly near Saddle Dam Farm. Assuming that use is likely to be concentrated during the summer months, increased equestrian use is unlikely to disturb big game that use the Saddle Dam Farm area during the winter.

Several changes to recreational use and developments proposed under Alternative B would actually benefit wildlife. Under this alternative, dispersed shoreline camping would be prohibited along Lake Merwin and limited along Swift Creek Reservoir and Yale Lake. Some of the existing campsites would be converted to day use sites; others would be closed, thus reducing disturbance to shoreline habitat. In addition, PacifiCorp would provide the USFS with funds (\$6,000 annually) to manage dispersed camping on their lands around Swift Creek Reservoir, which may decrease disturbance to shoreline habitats in this area. Although recreational use of project reservoirs may increase under Alternative B, an overall reduction in dispersed shoreline camping and better management of this activity at Drift Creek would reduce the disturbance to nesting bald eagles along Swift Creek Reservoir.

### 3.6.3.3 Alternative C

Alternative C includes the same measures for flood management and project-related recreation as does Alternative B. The facilities proposed for fish passage, however, are substantially different under Alternative C. Alternative C also differs from Alternative B by introducing a variable flow regime in the Lewis River bypass reach and an Integrated Wildlife Habitat Management Plan (IWHMP) for PacifiCorp's lands. Effects of these proposals on wildlife resources are described below.

#### Fish Passage

Alternative C introduces anadromous fish to all three reservoirs with trap-and-tram facilities constructed at the base of Merwin and Yale dams and adjacent to the Swift No. 2 tailrace. Trap-and-tram facilities are expected to occupy a total of about 2.75 acres. Adult collection facilities for Merwin would be located in an area that is already disturbed/developed and there would be no effects on wildlife habitat. Small areas of habitat may be removed for collection facilities downstream of the Yale powerhouse and near the Swift No. 2 powerhouse. Installation of the poles needed to carry the 3.2-miles of cable for the tram between the Swift No. 2 powerhouse and Swift No. 1 Dam would also remove some habitat. However, the alignment would generally follow the Swift No.

2 Canal, which is within a ROW already cleared of most trees, so impacts on wildlife are expected to be minor.

Under Alternative C, the availability of salmon carcasses would potentially increase wildlife use of riparian habitats along tributaries to Lake Merwin and Yale Lake, as well as to the upper Lewis River and its tributaries. Populations of species that show a strong and consistent link to salmon, such as the black bear, bald eagle, and common merganser, would be expected to increase.

### Land Management Practices

Alternative C includes development and implementation of an IWHMP, which would guide wildlife habitat protection and improvement efforts on PacifiCorp lands over the next license period. The results of the HEP study that was conducted as part of relicensing (PacifiCorp and Cowlitz County PUD 2004: TER 2) would be used to guide the development of the IWHMP and provide the basis for the monitoring program. Management activities, including timber harvests, would be directed at improving wildlife habitat for a diverse array of species. While the proposed IWHMP may not be as focused on big game habitat as is the MWHMP, some of the goals and objectives would address improvements to winter range, reproductive habitat, and forage availability. The plan would also protect and enhance wetland and riparian areas and snags and down wood resources on project lands outside the MWHMA.

The IWHMP would increase the protection of sensitive resources on PacifiCorp lands by establishing larger temporal and spatial buffers around wetlands, streams, and raptor nests than are required by current state forest practice rules, and by closing roads to select sensitive habitats. Wetland and stream buffers would range from 50 to 300 feet, depending on the type and location of activity requiring the buffer, as well as resource sensitivity. Raptor nest and roost buffers are likely to range from 0.25 to 0.5 mile. Sensitive habitat targeted for road closures would include elk calving areas, wetlands, riparian areas, and raptor nest and roost sites. Like Alternative B, Alternative C would include a plan and schedule to replace additional culverts on PacifiCorp roads, with the objective of improving habitat connectivity for fish and wildlife along selected streams.

### Flow Management

The increased amount of water in the Lewis River bypass reach under Alternative C would widen the wetted channel and may improve side channel habitat, thus benefiting wildlife in this area and potentially increasing species diversity and use. Bald eagles would also potentially benefit from the variable flow proposed for the Lewis River bypass reach; if fish populations increase, forage availability increases.

### Reservoir Water Level Management

Proposed changes in reservoir flood storage under Alternative C would not reduce daily or seasonal water fluctuations; thus, effects to wildlife would be the same as those described for Alternative A.

### Project-related Recreation

Proposed changes to recreational facilities are the same under Alternatives B and C, with identical effects on wildlife resources.

#### 3.6.4 Conclusion

Both Alternatives B and C would benefit wildlife resources more than Alternative A. Continued growth of unmanaged recreation, which would occur under Alternative A, represents a moderate threat to wildlife by reducing habitat structure, increasing disturbance, and creating more areas susceptible to habitat degradation from erosion and invasion by noxious weeds. Alternative B has minor beneficial effects on wildlife over baseline conditions primarily through the introduction of anadromous fish above Swift Dam, additional management of recreation, and restrictions on shoreline dispersed camping. Alternative C has moderate to significant beneficial effects on wildlife compared to baseline through (1) introduction of anadromous fish to all three project reservoirs; (2) implementation of the IWHMP; (3) additional management of recreation; and (4) restrictions on shoreline dispersed camping.

### **3.7 CULTURAL RESOURCES**

#### 3.7.1 Resource Issues

Cultural resources include prehistoric and historic-period archaeological sites, historical buildings and structures, and traditional cultural properties (TCPs). The latter are places that may or may not have human alterations but are important to maintaining the cultural identity of a community such as an Indian tribe. FERC regulations follow the National Historic Preservation Act of 1966 (NHPA), as amended, in requiring that these resources be inventoried and evaluated for their eligibility for listing in the National Register of Historic Places (National Register); that project effects be determined; and that consultation take place about mitigation and management measures. This work is accomplished in consultation with interested parties, including the Gifford Pinchot National Forest, the State Office of Archaeology and Historic Preservation (OAHP), the Cowlitz Indian Tribe, and Yakama Nation. Representatives of these groups, the Applicants, and their cultural resource contractors formed the Project's Cultural Resource Group, which guided and reviewed the studies.

Resources are National Register-eligible if they have integrity and meet one of four criteria for listing, which relate to important past events or persons (criteria [a] and [b]), outstanding design or construction (criterion c), or the capability of providing information important to prehistory or history (criterion d) (36 CFR 60.4). The resources that are listed in or eligible for the National Register are called "historic properties."

Three related cultural resource issues were identified during NEPA scoping.

- Effects of the Lewis River Projects on traditional cultural properties and resources

- Effects on historic buildings and structures
- Effects on archaeological sites.

During relicensing studies, the Applicants conducted professional evaluations of cultural resources to assess the effects of potential project changes on these resources.

Archaeological sites that have been determined eligible for the National Register may be affected by continued project operations. During Cultural Resource Group meetings for relicensing, representatives of the Yakama Nation and Cowlitz Indian Tribe (collectively referred to as “the tribes”) expressed their views that all prehistoric archaeological sites within the APE hold cultural heritage value to them (criterion a). Therefore, all the prehistoric sites will be treated as historic properties unless or until project effects on them make it necessary for a formal determination of eligibility for the resolution of adverse effects.

Several proposed enhancement measures for other resource areas could affect two historic districts that consist of historic buildings and structures related to the Swift No. 1 and Merwin projects. New construction or upgrades of current facilities within these districts could have an adverse effect on them.

Traditional cultural properties (TCPs) may be present in the project area, although the tribes did not identify any during the relicensing studies. The tribes prefer to be consulted about individual enhancement actions, giving them an opportunity to voice concern about potential TCP impacts. Traditional cultural resources (TCRs), which consist of the native animals and plants used by the tribes, are generally present throughout the project area and potentially would be affected by continued operation of the projects. The major TCR consists of native fish runs. Terrestrial animals and certain species of vegetation are still used by the tribes, and in general, the tribes prefer to see these resources managed to allow them to exist in as natural a state as feasible.

Measures proposed to enhance other resource values under the action alternatives could also impact the TCPs and TCRs, both directly and indirectly. An increase in the number of recreational visitors can negatively affect TCPs and TCRs through an increase in human traffic, with the accompanying destruction and encroachment upon native habitat.

### 3.7.2 Affected Environment

The information gathered during many cultural resource studies is considered confidential. It is exempt from the Freedom of Information Act regulations because details about the nature and location of cultural resources could lead to vandalism, such as unauthorized artifact collection. In addition, Indian tribes consider information on traditional places and activities to be private and confidential. Fearing the disturbance of archaeological sites, burials, and resources such as native plants, tribal representatives are uncomfortable about documenting this information in detail and sharing it with others.



The Area of Potential Effects (APE) is the area in which National Register-listed or eligible resources, if they occur, could be affected by a project (36 CFR 800.16(d)). A primary APE for archaeological sites and historical structures has been defined close to the reservoir shorelines. It encompasses the hydroelectric, recreation, and fishery facilities (Historical Research Associates 2003). A secondary APE includes the wildlife enhancement and other mitigation lands. Detailed inventories were conducted for the primary APE, with inventories to be conducted as needed for specific project activities in the secondary APE.

Studies for TCPs also adopted primary and secondary APEs, which differ from those mentioned above. The primary APE for TCPs encompasses the North Fork of the Lewis River from its mouth to the headwaters, its tributaries, and lands lying within one mile of the river channels. Within the primary APE, the investigation placed emphasis on the locations of the four hydroelectric projects. Stretching from the Cowlitz River on the north, to Mount Adams on the east, and to the Columbia River on south and west, the secondary APE provided a regional context for the TCP study.

Limited archaeological studies accompanied original development of the Yale and Swift reservoirs, locating a few sites, one of which contained a human burial (Bryan 1955; Denman 1957a, 1957b, 1957c, 1957d; Hamilton 1957; Osborne 1957a, 1957b, 1957c). Cultural resources inventory and evaluation work for the relicensing started in 1996 with several studies at the Yale Project (PacifiCorp 1999a). In 1998 and 1999, archaeological inventory took place at Swift Creek Reservoir (Goetz et al. 2003). In 1999, studies included archaeological survey and testing at the Merwin Project (Historical Research Associates, Inc. 2003); historical inventory and evaluation for the Swift No. 1, Swift No. 2, and Merwin projects (Historical Research Associates, Inc. 2002a); and traditional cultural property work for the project area (Historical Research Associates, Inc. 2002b). Reports containing detailed information on the studies are on file at the OAHF.

#### 3.7.2.1 Archaeological Sites

The Swift No. 1 project boundary includes approximately 1,200 acres within the exposed drawdown zone, areas downstream of the dam, and dispersed campsites above the full pool level. Although the normal full pool level for Swift Creek Reservoir is 1,000 feet msl, the level was down to about 950 feet msl at the time of the archaeological resources inventory.

The archaeological work surveyed approximately 900 of the 1,200 acres in the APE, recording two archaeological sites and ten isolated finds. Subsurface testing was performed at one of the sites, 45SA449, but the limited number and diversity of cultural materials at the site, along with the apparent lack of an extensive subsurface component, led the archaeologists to recommend the site as not eligible for listing in the National Register on the basis of archaeological information value (criterion d). At 45SA448, field personnel noted debitage, bifaces, a uniface, and a leaf-shaped projectile point on the surface. However, no subsurface testing was performed as the site was too difficult to access with the necessary field equipment. Although the site remains unevaluated for the National Register, it will be treated as eligible until some threat makes it important to

define the site's eligibility (Goetz et al. 2003). The work also included a study of the distribution in the Swift Reservoir of the sediments resulting from the 1980 eruption of Mount St. Helens that likely have buried some archaeological sites.

Gifford Pinchot National Forest archaeologists have recorded five archaeological sites within or near the Swift Creek Reservoir drawdown zone. Two historic-period sites are located under water near the former mouth of Range Creek. Site 7N6E-30/01 is a circa-1935 trail shelter, and 7N6E-31/01 is the location of the 1910s basket ferry across the river along the Overland Trail (Marden 1988a, 1988b). A third historical site, 7N6E-34/01, also a basket ferry crossing now covered by the impoundment, is located south of the present boat ramp (Marden 1988c). The fourth site, the Pine Creek Guard Station (7N6E-26/01), was built in 1946 between FR 9030 and 9031, outside the current survey area. A USFS survey in 1977 noted that the guard station buildings had been removed (Nieland 1977). The fifth site, lithic scatter 6N6E-05/01, is situated near Drift Creek. Archaeologists recorded a basalt biface and two unidentified lithics from the site, but shovel probes did not yield additional cultural materials. The USFS Archaeologist and the Washington State Archaeologist determined that the site was ineligible for listing in the National Register (Marden and Brackett 1989).

The Yale Project archaeological APE comprises approximately 2,280 acres, including the area below the high water line, the area between the reservoir margin and the main access roads, the area bordering Lewis River bypass reach, and the area associated with the Merwin-Yale 115 kV transmission line. The normal full pool level for Yale Lake is 490 feet msl, although the reservoir pool was drawn down on average to 464 feet msl during the archaeological survey (PacifiCorp 1999c). The archaeological survey included 1,100 acres, with 700 located in the drawdown zone.

The archaeological inventory located eight prehistoric sites (45CW101, 45CW102, 45CW103, 45CW104, 45CW105, 45CW106, 45CW468, 45CW469); five historic-period sites (H-1, H-2, H-3, H-4, H-5); and nine isolated finds (ISO-1, ISO-2, ISO-3, ISO-4, ISO-P4/1, ISO-P4/2, ISO-P4/3, TL-1, TL-2). The prehistoric sites and isolates consisted mostly of lithic debitage and formed tools. Five of the sites contained ground stone tools, and one of the sites (45CW102) contained a feature that may have been a pit house. Historic-period features included a ditch, trash scatter, road grades, and a house/cellar site. Five of the prehistoric sites (45CW101, 45CW102, 45CW103, 45CW105, 45CW106) were considered eligible for inclusion in the National Register. The other three prehistoric sites, the five historic sites, and the nine isolated finds were all deemed not eligible (PacifiCorp 1999c).

The Merwin Project primary APE totals about 721 acres, while the secondary APE includes about 5,000 acres of PacifiCorp land around the reservoir. The normal operating elevation of Lake Merwin is between 235.0 and 239.6 feet msl. Typically the reservoir fluctuates between 5 and 10 feet throughout the year, although drawdowns of over 60 feet have occurred during the reservoir's 70 years of operation. The level at the time of cultural resource surveys was 219 feet msl. The archaeological survey covered 537 acres.

During the Lake Merwin inventory, archaeologists recorded 20 sites (7 historic-period and 13 prehistoric), and recommended six of them as eligible for the National Register. One of these sites, 45CW108, is an historic cemetery and was considered to be eligible as a heritage site (criterion a). The other five sites (45CW100, 45CW111, 45CW116, 45CW118, 45CL519) were prehistoric and considered to be important as sites likely to provide information about one or more of several regional research themes (criterion d).

During consultation, the Yakama Nation and Cowlitz Indian Tribe representatives expressed their views that all of the prehistoric archaeological sites hold cultural heritage value (National Register criterion a). Therefore, the prehistoric sites will be treated as National Register-eligible unless or until project effects on them make it necessary for a formal determination of eligibility for the resolution of adverse effects.

### 3.7.2.2 Historic Structures and Buildings

The historic resources work inventoried and evaluated the buildings and structures of the four projects in accordance with National Register criteria. The historians recommended that resources of the Swift No. 1 Project be considered eligible for the National Register based on their importance in the region's history (criterion a) and as the highest earthfill dam of its time (criterion c). The Swift No. 1 Historic District boundaries include Swift Dam, the Swift No. 1 powerhouse, and penstocks. Following the canal failure of April 2002, the resources associated with the Swift No. 2 Project no longer retain the physical integrity necessary for National Register listing (Historical Research Associates 2002a).

The buildings and structures associated with the Yale Project were determined to be ineligible for listing in the National Register due to the Project's lack of association with significant themes in local and state history (PacifiCorp 1999c).

Work at the Merwin Project (historically called "Ariel Dam") recommended several resources as eligible for the National Register based on the Project's importance to regional history (criterion a) and its distinctive construction (criterion c). The Ariel Dam Historic District boundaries include resources built in association with the dam that have retained their integrity. These consist of the dam and water conveyance system, the powerhouse, and the control house. Ariel Village, the employee-housing compound, no longer retains integrity and is not considered to contribute to the historic district (Historical Research Associates 2002b).

Project operations and maintenance activities, future construction, and proposed enhancement measures could affect the two historic districts.

### 3.7.2.3 Traditional Cultural Properties and Resources

Studies of traditional cultural properties have been conducted of the Lewis River area, both for the hydroelectric projects and for other purposes such as management of the Gifford Pinchot National Forest. Project-related studies were guided by the Cultural Resource Group, whose members included the Yakama Nation and Cowlitz Indian Tribe, and who met 14 times. Project work and communications from 1996 to 2002 have

revealed some general place names or TCPs, but the information is not specific enough to prepare inventory forms or to warrant particular treatment or management for relicensing the hydroelectric projects. It is possible that the lack of data reflects the loss of this type of information since the time when early Euroamerican contact in the lower Columbia River region brought deadly diseases and disrupted traditional Indian activities in the area. Regardless of the reason, the tribes consider information on traditional places and activities to be private and confidential. Fearing the disturbance of archaeological sites, burials, and resources such as native vegetation, tribal representatives are uncomfortable about documenting this information in detail and sharing it.

### 3.7.3 Effects of Alternatives

#### 3.7.3.1 Alternative A

Alternative A would have no new affect on archaeological sites, historical buildings and structures, or traditional cultural properties. Under this alternative, project operations would continue without the benefit of an Historic Properties Management Plan (HPMP). Most of the known archaeological sites are within the drawdown zones of PacifiCorp's reservoirs, where they can be affected by the rise and fall of pool levels as well as by the erosive effects of waves. Archaeological sites near campgrounds, fishing access spots, and other areas that experience human contact are vulnerable to erosive effects of human traffic as well as the impact of unauthorized artifact collectors. Project operations also could have several effects on the buildings and structures. Ongoing maintenance activities and upgrades to the structures could degrade the character-defining elements that make these districts National Register eligible. Ongoing project operations could impact the TCPs and TCRs in several ways. Alternative A would block fish passage into the upper basin. The presence of campgrounds, particularly many of the dispersed sites, as well as logging and other forest management activities, would continue to affect the native plants and animals, and the ability of Indian people to use these resources.

#### 3.7.3.2 Alternative B

##### Archaeological Sites

Project operations under Alternative B could affect archaeological sites in the project area in the same manner as described under Alternative A. Measures are proposed that would increase protection for archaeological sites in the project area. The alternative would help fund construction of a Visitor Information Center that would store the collected archaeological artifacts and documents, as well as provide space for the exhibition and interpretation of the artifacts. This Visitor Information Center could be constructed in the Town of Cougar, in a location readily accessible to travelers along the state highway. PacifiCorp would develop an HPMP that would provide specific guidance for reducing the impacts of project actions on archaeological sites. Management measures would include consultation with a professional archaeologist to avoid affecting sites, prevention of vehicle access to reservoir drawdown areas, public education about resource values, patrols to reduce unauthorized artifact collection, engineered erosion protection as feasible, and data recovery as needed.

Several archaeological sites occur in areas likely to be affected by construction activities, facility upgrades, or recreation activities under Alternative B. Specifically, site 45CW121 along Lake Merwin near the dam could be affected by future modifications or construction. Also along Lake Merwin, sites 45CW114 and 45CW100 lie close to Speelyai Bay Park, and could be affected through increased human traffic associated with site improvements such as the restroom or the boat ramp modifications. Sites 45CW110, 45CW118, and 45CW119 are located near the Cresap Bay Campground, which could be affected by increased recreation use. Around Yale Lake, site 45CW103 is located between the Town of Cougar and Cougar Park, and potentially could be impacted by trail development. The management measures discussed in the previous paragraph would avoid or reduce impacts on the sites.

### Historic Structures and Buildings

The cultural resource management measures for Alternative B would be provided for the two historic districts within the project area. Changes to the buildings and structures within these districts would be limited and carefully designed to retain the historic value. The implementation of an HPMP would help guide changes within the districts, ensuring the retention of historic value while sustaining the industrial use for which the facilities were intended.

This includes the construction of a floating surface collector, trap-and-haul systems, or other construction within the districts. Alternative B would likely have little direct effect on the historic structures. Upkeep of the roads used to transport fish between Merwin and Swift dams would not likely affect the historic districts, although an increase in truck traffic may affect their setting.

### Traditional Cultural Properties and Resources

Cultural resource protection measures proposed under Alternative B treat TCPs and TCRs in a similar manner. This alternative allows tribal access to project lands to continue traditional practices. The development and implementation of an HPMP by PacifiCorp should also aid the preservation of any TCPs that may be identified on their project lands in the future.

The introduction of native runs of fish is an important goal to the tribes; the hatchery programs proposed in Alternative B that emphasize a transition to more natural fish runs would help address tribal concerns.

Alternative B provides funding for terrestrial habitat enhancement, along with continued implementation of the MWHMP and protection of sensitive habitats from timber operations and construction disturbances. These measures would help sustain traditional cultural values by protecting a variety of native plant and animal resources.

Proposed measures such as increasing and/or upgrading camping facilities, and the addition of new or improved fishing and boating access spots, could negatively affect TCPs and TCRs. Alternative B expands and/or enhances recreational facilities and

increases the diversity of recreational opportunities, which would reduce the habitat for native plants and animals. Preparation of an interpretation and education program could educate recreation users to help protect these habitat values.

### 3.7.3.3 Alternative C

#### Archaeological Sites

The effects of the proposed cultural resource protection measures in Alternative C on archaeological sites in the project area would be the same as described for Alternative B. Recreation measures also would be the same as assessed for Alternative B. More extensive construction would be associated with fish passage facilities, however. Several archaeological sites occur in areas likely to be affected by construction activities or facility upgrades. Specifically, site 45CW121 along Lake Merwin near the dam could be affected by modifications such as those associated with an overhead cable tram proposed in Alternative C.

#### Historic Structures and Buildings

Cultural resource management measures for Alternative C would provide similar protection for the two historic districts within the project area as described for Alternative B. Changes to the buildings and structures within these districts would be carefully designed to retain their historic value. The implementation of an HPMP would help guide changes within the districts, ensuring the retention of historic value while sustaining the industrial use for which the facilities were intended.

This includes the construction of floating surface collectors, trap-and-tram systems, or other construction within the districts. The construction of overhead cable tram at the Swift and Merwin dams for Alternative C would probably affect the setting of the Ariel (Merwin) or Swift No. 1 Historic Districts.

#### Traditional Cultural Properties and Resources

Cultural resource protection measures proposed under Alternative C treat TCPs and TCRs in a similar manner, as described in Alternative B. The effects of measures proposed for other resources on cultural values would be the same as assessed for Alternative B, with the exception of fish passage. Trap-and-tram facilities would introduce fish to Lake Merwin and Yale Lake, as well as to the watershed above Swift Dam. This addresses a goal of the tribes. In addition, expanded hatchery production is proposed in Alternative C.

### 3.7.4 Conclusion

Alternatives B and C would enhance the production of native fish runs, a goal important to tribal groups. Terrestrial habitat protection would be supported by Alternative C, benefiting a variety of native plant and animal populations important to traditional cultural practices. National Register eligible historic districts would be least affected by Alternatives B and C, because PacifiCorp's HPMP developed under these alternatives

would provide greater protection to facilities than the existing conditions. Alternative B and C would specifically include archaeological site protection in PacifiCorp's HPMP. For the Swift No. 2 Project, no archaeological sites were recorded during surveys, no traditional cultural properties have been identified, and there are no buildings or structures eligible for listing on the National Register of Historic Places. Nonetheless, Cowlitz PUD has prepared an Unanticipated Discovery Plan for archaeological resources in the event they may be encountered. The plan describes how Cowlitz PUD proposes to identify and treat archaeological resources and human remains that may be found during ground-disturbing activities and specifies communication with the Tribes and OAHF.

Alternatives B and C include partial funding for the construction of a curation and interpretation center for artifacts found in the project area. The interpretive aspect of the facility as well as the development of an interpretation and education program could aid in the conservation of archaeological sites, because educating the public has the potential to decrease archaeological site looting. Both Alternatives B and C represent moderate beneficial improvements over Alternative A.

### **3.8 RECREATION**

#### **3.8.1 Resource Issues**

The Merwin, Yale, and Swift developments create scenic reservoirs that offer recreational opportunities in a natural environment close to large urban populations. PacifiCorp's developed recreation facilities at the projects provide public access to project lands and waters, offering opportunities for power boating, water-skiing, RV and tent camping, picnicking and swimming, and boat and bank fishing, among other outdoor activities. A variety of federal, state, local, and private recreation facilities and use areas are located within a 50-mile radius of the projects.

Potential recreation needs in the project area were examined through the anticipated terms of the new licenses (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 6) by comparing the supply of existing and potential recreation facilities and use areas to current and anticipated demand for outdoor activities. The local economic conditions, specifically as they relate to recreation use, are discussed in detail in Section 3.11 (Socioeconomics).

In addition to the project area, the nearby Mount St. Helens National Volcanic Monument (Monument) and the Gifford Pinchot National Forest (GPNF) are also recreation destinations. An estimated three million visitors traveled to the Monument in 1999 and interest in the overall area is increasing (pers. Comm., D. Siegel, the Monument, Amboy, WA. June 13, 2000). Many of these visitors stop at project recreation facilities, especially those at Yale Lake. Due to the proximity of the project area to the Monument/GPNF, visitation to one area affects visitation at the other area.

Project operations, facilities, and land management practices affect recreation opportunities and management in the Lewis River basin. The presence and use of these developments sometimes affects terrestrial, aquatic, water quality, and cultural resources,

among other values. Additionally, the project area is an important regional recreation destination and public use of project recreation facilities and sites in the area affects local communities in a variety of ways. During the scoping process, the Recreation Resource Group identified four primary issues related to recreation and public use.

- Adequacy of the supply and quality of project recreation facilities, use areas, and services to accommodate existing and future user demand in the project area
- Effect of project area recreation visitation on the local economy, resources, and residents
- Compatibility of existing and potential increased recreational use on project area and basin ecosystems
- Effects of Monument and GPNF-induced recreation on project lands and facilities

Section 3.8.2 describes the existing recreation opportunities and use levels and Section 3.8.3 describes the potential effects of the three alternatives on recreation resources in the project area as they relate to the scoping issues listed above.

### 3.8.2 Affected Environment

#### 3.8.2.1 Recreation in the Project Area

Recreational use at the project reservoirs, in the river reach below Merwin Dam, and in the Lewis River bypass reach varies by location, activity type, and season. During the peak summer months, reservoir recreation activities include power boating, boat fishing, water-skiing, RV and tent camping, and personal watercraft (PWC) use; in other areas, recreation activities, such as shoreline fishing, relaxing, hunting, wildlife observation, and non-motorized boating, occur during much of the year.

Five different project recreation areas include Swift Creek Reservoir, the Swift No. 2 canal area, Yale Lake, Lake Merwin, and the Lewis River reach below Merwin Dam. These different recreation areas have unique characteristics that are defined by the presence or absence of private shoreline residences, overnight camping versus a day use orientation, roads and highway access, topography, elevation, and level of use.

Access to all developed recreation facilities in the project area is provided via SR 503, SR 503 Spur, and FR 90. These highways or roads connect the Interstate 5 (I-5) corridor with the southern and eastern portions of Mount St. Helens and also provide access to Mount Adams and the Columbia River Gorge.

In general, the shorelines of the three reservoirs may be accessed by boat and/or foot trails. Due to the steep terrain, dispersed shoreline sites are generally small and limited in number, particularly around Swift Creek Reservoir and Lake Merwin. One exception is on Yale Lake along the private IP Road (also called Yale Road) corridor, which receives extensive dispersed use and some unauthorized motorized use.



At the highest elevation and farthest from I-5, Swift Creek Reservoir receives the fewest visitors and has the shortest recreation season. Swift Creek Reservoir is 11.5 miles long with a water surface area of 4,600 acres at full pool elevation (1,000 feet msl). Shoreline length at full pool is approximately 35 miles, although steep terrain limits access to much of it. The reservoir and adjacent project lands offer publicly accessible developed recreation facilities and undeveloped use areas, with a focus on more primitive camping and day use activities such as picnicking, swimming, fishing, and boating. Private residential shoreline development is located at the eastern end of the reservoir. This reservoir is drafted more than others in the basin, with drawdown typically beginning in late August and September to accommodate winter runoff and to maintain pool levels in the other reservoirs. The pool level is raised again between April and Memorial Day weekend in May. This drawdown, combined with the harsher weather conditions and more distant access, reduces recreation use at Swift Creek Reservoir. Project supported facilities at Swift Creek Reservoir and their percent contribution to the total number of facilities in the basin include:

- 1 day use area (Eagle Cliff) with 15 picnic sites (6 percent of total picnic sites);
- 1 campground (Swift Campground) with 93 sites (36 percent of total campsites);
- 1 boat launch at Swift Campground (14 percent of total boat launches); and
- 24 dispersed, undeveloped recreation sites (26 percent of total dispersed recreation sites). All are accessible by boat and most are used for camping as well as day use. Dispersed sites are not project-supported amenities.

The three-mile-long Swift No. 2 canal has no developed recreation facilities, but it is a popular area for bank fishing. Angler access is primarily restricted to two small roadside pullouts where the FR 90 highway bridge crosses the canal. Visitors frequently park their vehicles and proceed on foot along a gravel maintenance road that runs alongside the canal. South of the canal is the 3.3-mile-long Lewis River bypass reach. Since this reach is the emergency spill channel for Swift Dam, public use, particularly camping, is not encouraged.

Of all the project developments, Yale Lake and adjacent project lands support the greatest amount of boating, day use, and camping activity. It also has very little private shoreline development. The western shoreline is accessible via SR 503 Spur, while access to the eastern shore is limited by the private, gated IP Road. This road parallels the shoreline, so it is an attractive area for unauthorized use despite several gates and barriers.

At 10 miles long, Yale Lake covers 3,800 surface acres, and has 27 miles of shoreline at a full pool elevation of 490 feet msl. Popular recreation activities include picnicking, boat and bank fishing, power boating, small boat sailing, windsurfing/sail boarding, canoeing/kayaking, swimming, water-skiing, PWC, hiking and walking, horseback riding, bicycling, and camping. Hiking and mountain biking is generally limited to existing roads, such as the IP Road and SR 503 Spur, and a trail south of Speelyai Canal that extends to Saddle Dam Park. Horseback riding occurs primarily along the Speelyai Canal trail. Dispersed camping typically occurs along the eastern lake shoreline and Siouxon Creek. Sightseeing, nature observation, and outdoor photography are also

popular activities. In addition, cave exploration and rock climbing are popular because of nearby lava flows and caves in both the eastern part of the basin and at Ape Cave. Project supported facilities at Yale Lake and their percent contribution to the total number of facilities in the basin are:

- 4 day use areas (Beaver Bay, Cougar Camp, Yale Park, and Saddle Dam Park) with 75 picnic sites (28 percent of total project area picnic sites);
- 2 campgrounds (Beaver Bay Campground and Cougar Camp) with 108 campsites (42 percent of total campsites);
- 4 boat launches (Beaver Bay, Cougar Camp, Yale Park and Saddle Dam Park) (57 percent of total boat launches); and
- 48 dispersed undeveloped recreation sites (48 percent of total dispersed recreation sites). Dispersed sites are not project-supported amenities.

Lake Merwin is the closest project facility to the I-5 corridor and therefore is most accessible to the nearby metropolitan areas of Portland, Vancouver, and Kelso/Longview. Recreation facilities associated with this project focus on day use activities such as picnicking, swimming, and boating. PacifiCorp's newest and only campground on Lake Merwin, Cresap Bay Campground, is very popular. Lake Merwin is 14.5 miles long and covers 4,000 surface acres at a full pool elevation of 239.6 feet msl. Of the three reservoirs, it has the most stable water surface level, typically fluctuating not more than five to ten feet throughout the year around the approximately 32 miles of shoreline. Like Swift Creek Reservoir, the surrounding terrain is generally steep and heavily wooded. Recreation development is limited because of the steep topography and the large amount of privately owned shoreline. Lake Merwin has more private shoreline residences than the other project reservoirs. Project supported facilities at Lake Merwin and their percent contribution to the total number of facilities in the basin include:

- 2 day use areas (Speelyai Bay Park and Merwin Park) with 180 picnic sites (67 percent of total project area picnic sites);
- 1 campground (Cresap Bay) with 58 campsites (22 percent of total campsites);
- 2 boat launches (Cresap Bay Campground and Speelyai Bay Park) (29 percent of the total boat launches) (does not include launches below the dam); and
- 24 dispersed undeveloped recreation sites (26 percent of total dispersed recreation sites), 21 of which can be accessed by boat. Most are primarily day use sites, although some camping does occur. Dispersed sites are not project-supported amenities.

The reach of the Lewis River below Merwin Dam and east of Woodland contains five river access sites that are operated by PacifiCorp and one operated by Vancouver-Clark Parks and Recreation Division (VCPRD). These sites provide access for bank fishing and/or boat launching. Fishing (boat and bank) is the main activity in this river reach. Many private shoreline residences line the banks of the river below the Merwin Dam, as do two fish hatcheries, numerous roadways, and some undeveloped natural areas.

Private entities also provide recreation opportunities in the immediate project area. Private sector development along SR 503 and 503 Spur has increased steadily over the years. There are a few RV campgrounds/resorts in the vicinity of the projects, the majority of which cater to RV campers by providing hookups. The Lewis River RV Park offers 70 campsites and there are several RV campsites near of the Town of Cougar. A few smaller motels and bed and breakfasts operate in Woodland, Ariel, and Cougar. A variety of other private businesses support visitor activity in the corridor.

There are a number of private year-round residential and vacation developments along the project reservoirs. Many of these provide day use facilities such as boat moorage, swim areas, and picnic facilities for their members. On Swift Creek Reservoir, three private shoreline developments (Northwoods, Swift Creek Estates, and Swift View) with approximately 253 home sites provide a range of private recreation facilities. At Yale Lake, in the vicinity of Speelyai Canal, the Yale Estates Homeowner's Association includes about ten residential lots. At Lake Merwin, three private developments (King's Lakeside Landing, Woodland Park, and Camper's Hideaway) provide approximately 1,550 home/trailer sites and a range of recreation opportunities for area residents

### 3.8.2.2 Recreation in the Lewis River Basin

Multiple recreation facilities and opportunities are available within the project region. Most of these regional recreation areas are managed by state and federal agencies, including the WDNR and USFS. In addition, some of the extensive private timberlands in the project area are open to the public for dispersed recreation use. The majority of these 98,000 acres are owned by Weyerhaeuser, Longview Fibre, and Olympic Resource Management.

Merrill Lake, managed by the WDNR, is a popular area for anglers. It is located about six miles north of Yale Lake and provides a campground with 7 tent sites; a day use area with 3 picnic tables; and a two-lane boat launch.

The 32,000-acre WDNR-managed Siouxon Landscape Area is a popular dispersed recreation area. It is bordered by Swift Creek Reservoir on the north and Yale Lake on the west. Although there are no facilities in this area except for trails and logging roads, common activities include hunting, fishing, hiking, horseback riding, and mountain biking. Access to the area is by trail, boat, or logging road.

Owned by Clark County, the undeveloped Siouxon park site on the eastern shoreline of Yale Lake is currently used by boaters for boat-in camping and day use, and is being considered for future development by PacifiCorp and VCDPR.

Several recreation sites and facilities are present on the GPNF. These sites are located to the north and east of the project reservoirs including:

- Lower Falls Recreation Area – a popular recreation area located east of Swift Creek Reservoir with facilities that include:
  - 1 campground with 46 sites

- 1 day use area with a picnic area and short trails leading to several waterfalls
- Pine Creek Information Center – a small facility that provides basic information to visitors traveling through the area. The facility is located east of Swift Creek Reservoir near the junction of FR 25 and FR 90.
- Kalama Horse Camp – a base camp for equestrian riders in the area that is north of the project reservoirs. Facilities include:
  - 1 campground with 23 campsites, each with a corral
  - 1 day use area with a picnic area, horseshoe pit, loading/unloading ramp, and parking

Additional recreation sites and facilities managed by the USFS are located on the Monument, just north of the project reservoirs, including:

- Ape Cave – two-mile trail (round trip) to a lava tube and other unique geological features
- Lava Canyon – six-mile trail (round trip) through the Muddy River canyon
- Blue Lake Trailhead – parking and trailhead information for various trails
- Several other trails and snow play areas that are popular with visitors during all seasons

Several private timber companies also own and manage land in the vicinity of the project reservoirs. Weyerhaeuser owns large tracts of land south of the Siouxon landscape area near Yacolt and north of the project area in the Kalama Basin. In general, many of the roads into these lands are gated; however, non-motorized recreation use, such as hiking, is permitted behind private locked gates. Although gated much of the year, many roads are open during the big game (deer, elk) hunting season, roughly from mid-October until December 15. During this period, dispersed camping is permitted, although not encouraged.

Olympic Resource Management owns a large block of land on Swift Creek Reservoir in addition to smaller parcels near Lake Merwin and Yale Lake. In general, it is understood that the company endorses an open lands policy that allows public use on its approximately 28,000 acres in the basin. However, roads may be closed at any time, especially during periods of increased fire danger. Many of the roads into these areas are open during hunting season. Off-highway vehicle (OHV) use also occurs and is not an issue when confined to existing roads. Other recreation uses include cross-country skiing and snowmobiling.

Longview Fibre owns over 11,000 acres in the basin, including several parcels just north of Lake Merwin and in the area between Lake Merwin and Yale Lake. The company endorses an open lands policy that allows for public uses such as hunting, hiking, horseback riding, and berry picking. In general, most areas are restricted by gated roads that are open during the hunting season. Camping is not permitted and is occasionally a

management issue during hunting season (pers. comm., B. Roth, Longview Fibre, July 28, 2000).

### 3.8.3 Effects of Alternatives

#### 3.8.3.1 Alternative A

Under Alternative A, PacifiCorp would continue to voluntarily operate 18 developed public recreation facilities in the project area. Facilities would be improved or expanded at PacifiCorp's voluntary discretion, as needed, but no significant increase in the number or quality of recreation sites is anticipated, except at several project area boat launches. The Speelyai Bay, Yale Park, and Beaver Bay boat launches would be extended to improve reasonable year-round boater access. Additionally, ADA-accessibility enhancements would be completed only when recreation facilities are improved or expanded.

PacifiCorp agreed to implement a number of recreation measures at Yale Lake following submittal of the Yale License Application in 1999. These interim measures will improve the quality of recreation at developed sites, at least in the short-term, and may delay reaching the anticipated capacity at some sites. Interim measures that affect current and future recreational use of Yale Lake include: (1) installing playground equipment and repairing picnic tables at Beaver Bay Campground; (2) re-graveling group campsites and roads at Beaver Bay Campground and Cougar Camp; (3) lengthening and realigning the existing boat ramp at Saddle Dam, including replacing the dock and repairing the existing entry road (completed); and (4) removing camping facilities at Saddle Dam (completed) and providing improved facilities including universal access. In addition, regular operations and maintenance would continue at the five existing developed recreation facilities at Yale Lake.

Under the Alternative A, ecological concerns resulting from ongoing recreational use are likely to increase as the number of visitors to the project area increases over the term of the new licenses. Currently, ecological capacity is a concern in some locations where facilities are older or sites are not hardened. Typically such concerns are focused at undeveloped dispersed recreation sites; however, several developed sites at each reservoir exhibit ecological impacts. These include soil compaction, vegetation damage and loss, shoreline erosion, litter accumulation, and sanitation concerns. Such impacts would likely increase with increased visitation, especially at dispersed recreation sites.

The Merwin Wildlife Habitat Management Plan (MWHMP) currently places use restrictions on sensitive areas of the reservoir to protect elk habitat and raptor nest sites. Restrictions would continue under Alternative A, and recreation would be limited during restricted times in wetlands areas.

#### Visitor Management

Approximately 594,000 visitors use the project area when recreation sites are open (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 2). This use level equates to an

overall capacity utilization at all public recreation sites (campgrounds, day use areas, and dispersed sites) of about 36 percent.

During the entire recreation season, campground utilization was approximately 50 percent. Day use sites are generally occupied for shorter periods of time (a few hours or less) than campgrounds and typically during good weather conditions. As a result, utilization of day use sites and boat launches is much lower than campgrounds. Based on parking capacity, day use sites are being used at only 35 percent of their seasonal capacity (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 5). Because most undeveloped dispersed sites are accessed by boat, utilization of these sites was based on the number of days a boat launch on the reservoir was usable. Dispersed camping use was approximately 39 percent, while dispersed day use was 40 percent.

Under Alternative A, local residents would experience a greater sense of crowding (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 2 and REC 6). On a 9-point crowding scale (Shelby and Heberlein 1986), area residents indicated an average perceived crowding score equivalent to “slightly crowded” and “moderately crowded” (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 3). Additionally, over half of area residents (52 percent) indicated that the level of use had detracted “a little” or “a lot” from their overall enjoyment of the project area. Nearly two-thirds (63 percent) indicated that they have changed their visitation to the project reservoirs as a result of perceived crowding. Expected increases in recreational use of the project area by non-residents over the new license terms likely would exacerbate perceived crowding levels and displacement by residents, especially at Lake Merwin and Swift Creek Reservoir, areas favored by local residents.

Project recreation sites are affected by adjacent recreation areas, including the Monument and GPNF. Although the reservoirs are the primary destination for many visitors, they commonly visit other adjacent recreation areas while on their trip. Approximately half of the visitors surveyed in 1998 who visited another recreation site while on their trip indicated they had visited the Monument. This indicates that both the project area and the nearby Monument are important regional recreation destinations, and that an increase in visitor use at one area likely would increase use at the other. The USFS has no current plans to provide additional camping facilities within the Monument or GPNF near the projects. Under Alternative A, increased visitation to the project area by Monument and GPNF visitors, and the lack of new overnight camping facilities provided by both the USFS and PacifiCorp, would exacerbate overnight capacity anticipated for project area campgrounds during the term of the new licenses (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 2, REC 5, and REC 6).

Visitors to the project area could affect or be affected by adjacent recreation areas through visitor displacement. When recreation facilities are at or near capacity, additional visitors may be displaced into adjacent recreational use areas. This is most likely on summer holiday weekends and on some weekends during the peak summer months of July and August. Most project area visitors participate in water-related activities that are very limited at adjacent recreation areas, and thus displacement is currently not a major concern. Additionally, overnight visitors to the Monument and

GPNF generally seek a recreation experience that is different from the experience available in the project area (i.e., opportunities for solitude, quiet, and getting away from other people/restrictions). However, under Alternative A, all project campgrounds are anticipated to exceed their annual capacity over the new license terms (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 5). Some visitors would be displaced to adjacent recreation areas, potentially including the Monument and GPNF. Conversely, as visitation increases at the Monument and GPNF, some visitors may be displaced to project recreation facilities. Additionally, undeveloped dispersed recreation sites at the Monument and GPNF or other regional public lands may be affected by this potential displacement. As recreation sites reach capacity, visitors may begin to bypass the project area entirely.

### Campgrounds

Under Alternative A, no significant capacity improvements or enhancements would be completed at project area campgrounds. As a result, anticipated increases in demand would likely cause the use of all developed campgrounds to exceed their annual capacity (60 percent utilization over the summer season) by or before the year 2030 (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 2 and REC 5). Peak season (July and August) use would likely exceed capacity (90 percent utilization) at all project campgrounds by or before 2015.

### Day Use Areas

No significant capacity improvements or enhancements would be completed at project day use areas. Anticipated increases in demand would likely cause three developed day use areas to exceed their peak season weekend capacity (75 percent) by or before 2030 (two day use areas currently exceed this peak season weekend capacity criteria) (PacifiCorp and Cowlitz PUD 2003f and 2004: REC 2 and REC 5).

### Trails

There are several non-motorized trails in the project area; however, most are undesignated or user-defined. Under Alternative A, no improvements would be made to these trails. A new trail at Beaver Bay Campground, however, would be implemented per the Yale Interim Measures previously described.

### Recreation Access

Under Alternative A, pedestrian and boater access improvements would be implemented at existing recreation facilities as part of the Yale Interim Measures. These improvements would enhance existing access to the project reservoirs.

### 3.8.3.2 Alternative B

#### Visitor Management

Similar to Alternative A, PacifiCorp would continue to allow appropriate non-motorized access to all existing and future PacifiCorp-owned lands under Alternative B except where unsafe. When possible, conservation easements for recreational purposes would be provided, including hunting access. PacifiCorp would also implement additional visitor management controls where needed, such as signs, barriers, and enforcement, to ensure a high quality recreation experience and to enhance public health and safety. Additionally, under this alternative, PacifiCorp would discourage dispersed upland (non-shoreline) camping and motorized use by keeping project roads gated and maintained as necessary (see Recreation Access below).

A Recreation Resource Management Plan (RRMP) has been developed to guide operations and maintenance at PacifiCorp's developed and dispersed recreation sites under Alternative B, including enhancing visitor management controls (see Appendix B to the Swift No. 1 and Merwin license applications). This plan would guide improvements in the general condition of project recreation facilities and the quality of recreation opportunities in the project area. An operations and maintenance program, a component of the RRMP, details how public use and associated impacts in the project area would be managed and facilities maintained. An interpretation and education (I&E) program is included, focusing on interpreting recreation resources, history in the basin, hydropower generation, natural resources, and cultural resources. The I&E Program would educate visitors about minimizing recreation-caused impacts to shoreline and riparian areas, as well as implement an early notice system to announce when project campgrounds and day use areas are full or approaching capacity.

Under Alternative B, visitors to the project area would continue to affect or be affected by adjacent recreation areas such as the Monument and GPNF. It is anticipated that the Monument and GPNF would remain significant regional attractions and visitation would continue to increase over time. Visitation to the project area is also anticipated to increase during the term of the new licenses, and as use levels at project facilities reach capacity, some facility capacity expansion would be provided by PacifiCorp. These campground improvements and expansions would attract additional visitors from the Monument and GPNF to the project area, and vice versa. Additionally, enhanced and expanded recreation facilities would reduce perceived crowding and displacement of area residents by providing a larger supply of facilities in the areas most used by local residents.

Under Alternative B, several specific actions could have a greater effect on recreation use at the Monument and GPNF than Alternative A. All dispersed shoreline camping would be prohibited at Lake Merwin. PacifiCorp would provide funding to the USFS to better manage dispersed camping on USFS-managed land, primarily north of Yale Lake where some project-related dispersed camping is occurring. Neither of these actions would significantly increase or decrease total visitation to the Monument and GPNF, or to the



project area; rather, the funding provided by PacifiCorp would be used by the USFS to mitigate for project visitor impacts.

### Campgrounds

Existing and projected overnight use in the project area is anticipated to exceed annual capacity (60 percent utilization seasonally) by or before the year 2030. Peak season (July and August) use is projected to exceed capacity (90 percent utilization) at all project-developed campgrounds by or before 2015. Multiple new and/or improved camping facilities would be provided under Alternative B to help meet some of the anticipated overnight needs during the term of the new licenses, but not all demand. Campground improvements and/or expansions would include expanding camping facilities at Yale and Swift Creek reservoirs when needed based on monitoring, renovating the existing Cougar Camp, extending the campground season at Swift Camp and Cresap Bay Campground, and allowing public use of existing RV dump stations (for a fee). Additionally, dispersed overnight sites along the Yale Lake and Swift Creek Reservoir shorelines would be hardened while the use of dispersed overnight camping sites along the Lake Merwin shoreline would be prohibited. PacifiCorp would also provide funding to the USFS to help it manage dispersed camping on its land. These measures would generally help accommodate existing and projected overnight use in the project area through the term of the new licenses. However, some primitive camping opportunities would be lost as dispersed shoreline sites along the Lake Merwin shoreline would be closed. This action may potentially displace some overnight use to developed shoreline campgrounds in the project area or to other boat-in dispersed sites in the region.

Several camping-related actions under Alternative B may affect terrestrial and cultural resources. Cresap Bay Campground would remain open through September (four additional weeks), potentially affecting a few elk (this site is currently closed in September to protect elk). All dispersed shoreline sites at Lake Merwin would be closed to overnight use, while those in sensitive areas would be closed to all use. In the long term, closing dispersed shoreline sites to overnight camping would limit the extent of potential impacts on vegetation and wildlife. Additionally, some roads would be closed and gates installed to reduce disturbance to identified sensitive habitat and cultural resource sites.

Recreation facility improvements and expansion would disturb approximately 25.4 acres in the project area. Much of this disturbance would occur in previously altered areas or in areas adjacent to existing facilities. However, the remainder of the new disturbance would result in a slight loss of habitat and open space. Potential ecological impacts would be more pronounced in the second or third ten-year period of the new licenses when campground expansions are anticipated. At the same time, new and improved facilities would be able to limit and absorb potential ecological impacts through site hardening and facility modernization.

## Day Use Areas

Improvements to day use facilities under Alternative B would increase capacity at day use sites. During consultation with agencies and stakeholders, it was agreed that the project area should absorb only a limited amount of additional day use. As a result, not all of the projected recreation demand for the project area would be met during the term of the new licenses. Several existing sites would be significantly improved, including redesigning and renovating Eagle Cliff Park; providing additional day use site facilities at Merwin Park; providing several new group picnic shelters in the project area (one each at Swift Creek Reservoir and Yale Lake and two at Lake Merwin); and upgrading and/or renovating restroom buildings at day use sites at Speelyai Bay Park and Cougar Camp. Additionally, PacifiCorp would partially fund a visitor center in Cougar.

Under Alternative B, several improvements to the five lower river access sites would also be completed, including new vault toilets and picnic tables. A new river access site would be provided on the southern shoreline of the Lewis River below Merwin Dam (Switchback Property) if/and when use levels at the other river access sites reach capacity. The site would be similar to the existing Johnson Creek River Access Site and would include a small parking area and trail.

Demand for many boating-related activities is projected to increase by at least 100 percent during the term of the new licenses. To better accommodate this anticipated increase in demand and to provide boat ramps at usable lower reservoir levels, Alternative B includes several improvements and enhancements to boating-related facilities. During the new licenses, boat ramp lanes would be extended at Speelyai Bay, Yale Park, and Beaver Bay, ranging from 6 to 45 feet (horizontal). At the Beaver Bay Campground boat launch, a new earthen berm and fence would be constructed between the boat launch parking area and the adjacent wetland complex to limit ongoing impacts to the wetland area. An improved river access site would also be provided at Yale Bridge to provide a take-out area for non-motorized car-top boats on the upper arm of Lake Merwin near Cedar Creek. These new and improved boating facilities would accommodate most existing and projected boating use over several seasons in the project area.

Proposed fish passage facilities under Alternative B would not significantly affect recreation in the project area (i.e., existing and/or potential recreation sites are not eliminated due to new fish passage facilities). The floating surface collector at Swift Creek Reservoir would not limit surface water boating, as its location would be within a restricted surface water area near the dam. Additionally, fish collection operations would not affect boat launching and boating use during the peak months of July and August.

Swift Creek Reservoir levels during the summer recreation season would not be affected by flood management measures or the continuous release of 50 cfs to the Lewis River bypass reach. These releases may attract visitors; however, increased enforcement and gating would limit access within this unauthorized use area. Flow modeling that assumed these releases would maintain Swift Creek Reservoir levels indicates very slight fluctuations from current reservoir conditions (up to four feet lower in winter). Reservoir

elevations at Lake Merwin would not change under Alternative B, while elevations at Yale Lake would change only slightly (up to two feet lower in winter).

### Trails

Demand for trail-related activities including day hiking and backpacking are projected to increase significantly over the next 30 years (157 and 114 percent, respectively). Under Alternative B, multiple new and/or improved trails would be provided to accommodate existing and future demand for trails. Actions would include improving the existing Marble Creek Trail to ADA-accessibility standards, formalizing the trail link between Saddle Dam Park and Saddle Dam Trail including parking for vehicles with horse trailers (provisions would be made to limit and/or restrict potential equestrian-related impacts to wintering elk), developing a non-motorized trail from Eagle Cliff Park to the USFS boundary, developing a shoreline trail between Cougar Camp and Beaver Bay Campground, and securing recreational access and improving the IP Road for non-motorized use at Yale Lake. Following additional analysis, PacifiCorp would provide an easement across PacifiCorp-owned land for pedestrian access between a proposed new VCPRD-managed regional park south of Lake Merwin and the reservoir shoreline.

### Recreation Access

Under Alternative B, recreational access in the project area would generally improve compared to Alternative A. In addition to improving and enhancing many of the existing developed recreation sites, several new recreation sites would be developed that would provide additional public access. Potential new sites include a developed trail along the existing IP Road, a river access site at the Yale Bridge for non-motorized watercraft, a river access site below the Merwin Dam when and if needed (Switchback property), and a visitor center in the Town of Cougar. These new sites would increase the level of public use and recreation access in the project area.

Many existing PacifiCorp-maintained recreation facilities would be modified to comply with new ADA-accessibility requirements (ADAAG, as amended) under Alternative B. This would include upgrading or replacing worn facilities and improving accessibility to recreation facilities (boat ramps, picnic sites, campsites, parking, restrooms, trails, etc.). New ADA-accessible facilities would be provided under this alternative, including at least one ADA-accessible bank fishing site (likely at or near an existing recreation site) and several ADA-accessible restrooms or vault toilet buildings at existing recreation sites.

#### 3.8.3.3 Alternative C

All of the recreation actions previously described under Alternative B also would be implemented under Alternative C. All project-related effects would be the same, with the exception of fish passage, and these effects on recreation would be minimal.

Fish passage facilities proposed under Alternative C would be extensive; however, generally they would not affect existing or potential new recreation facilities.

Downstream fish collection facilities at each reservoir are not anticipated to limit surface water boating because they would be located within restricted surface water areas near the dams. Surface collector operations also would not likely result in significant pool elevation changes in July and August at Lake Merwin and Yale Lake, and would therefore not significantly affect reservoir recreation use.

Swift Creek Reservoir levels may be affected by flood management measures and variable releases of between 50 and 400 cfs to the Lewis River bypass reach. The additional flows in this reach may attract some dispersed use; however, increased enforcement and gating would help limit access within this unauthorized use area. Flow modeling that assumed these releases would maintain Swift Creek Reservoir levels indicates only slight fluctuations from current conditions (four feet lower than existing winter conditions), so the Swift Campground boat ramp would continue to be accessible.

#### 3.8.4 Conclusion

The reasonably expected impacts to recreational resources associated with actions under Alternative A are likely to be moderately adverse, while the impacts associated with Alternatives B and C are likely to be moderately beneficial. Under Alternative A, PacifiCorp would continue to voluntarily operate developed recreation sites and five river access points. No major improvements or enhancements to these sites would be provided, with the exception of improvements to some boat launches and ADA-accessibility enhancements when planned upgrades occur over time. The lack of significant facility expansion coupled with anticipated increases in visitation would likely exacerbate overnight and day use capacity concerns and visitor displacement in the project area. The lack of camping facility expansion may shift more use to surrounding undeveloped dispersed sites, contributing to terrestrial impacts. Additionally, Alternative A would not address existing perceived crowding concerns in the project area. In the short term, the actions under Alternative A would likely have no immediate impact on recreation resources; however, in the long term, potential crowding, capacity, displacement, and terrestrial impacts would worsen.

Alternatives B and C would generally improve and enhance recreation opportunities in the project area through the term of the new licenses. Both alternatives would help reduce existing and future capacity and displacement concerns, although with slight impacts to terrestrial resources due to the increased area of disturbance. As a result of improved recreation facilities, these alternatives likely would require some expanded law enforcement, and other emergency services, along with more operations and maintenance staff during the peak summer season. Swift Creek Reservoir recreational facilities would be retained in a less developed condition than the other reservoirs but some recreation facilities would be provided to partially meet anticipated needs during the license term. The proposed recreation measures under Alternatives B and C would have no impact on generation capacity of the projects. Overall, compared to the baseline (Alternative A), the improvements and enhancements under both Alternatives B and C would likely result in moderately beneficial impacts on recreation resources in the project area.

### 3.9 LAND MANAGEMENT AND USE

#### 3.9.1 Resource Issues

Continued operation of the four Lewis River Projects would influence land uses throughout the basin in slightly different ways under the alternatives being considered. The consistency of these alternatives with federal, state, and local comprehensive plans was targeted for evaluation during the NEPA scoping process. Consistency is addressed by alternative in this section. We also describe the implications of proposed resource measures on land use.

#### 3.9.2 Affected Environment

Major land owners in the vicinity of the projects include the USFS, WDNR, and private timber companies, while the combined ownership of the Applicants totals one percent of the basin. Table 3.9-1 displays the acreage held by each major owner.

**Table 3.9-1. Major land ownership within the Lewis River watershed.**

| <b>Ownership Classification</b> | <b>Landowner</b>                            | <b>Acres in Ownership Classification</b> | <b>Landowner Acres</b> | <b>Percent of Total Watershed</b> |
|---------------------------------|---|--|------------------------|-----------------------------------|
| Federal Lands                   | Gifford Pinchot National Forest             |  | 353,660                |                                   |
|                                 | Mount St. Helens National Volcanic Monument |  | 32,712                 |                                   |
|                                 | Wilderness Areas                            |  | 17,146                 |                                   |
|                                 | Other federal lands (BLM and USFWS)         |  | 924                    |                                   |
|                                 | <b>Total</b>                                | 404,442                                  |                        | 54%                               |
| State Lands                     | WDNR and other state lands                  |  | 87,747                 |                                   |
|                                 | <b>Total</b>                                | 87,747                                   |                        | 12%                               |
| County Lands                    | <b>Total</b>                                | 1,670                                    |                        | < 1%                              |
| Private Industrial Forest Lands | ANE   |  | 4,881                  |                                   |
|                                 | Hampton Tree Farms                          |  | 739                    |                                   |
|                                 | International Paper                         |  | 61                     |                                   |
|                                 | Longview Fibre                              |  | 11,668                 |                                   |
|                                 | Mid-Valley Resources                        |  | 1,532                  |                                   |
|                                 | Olympic Resources Management                |  | 28,570                 |                                   |
|                                 | Stimson Lumber                              |  | 1,829                  |                                   |
|                                 | Weyerhaeuser                                |  | 48,761                 |                                   |
| <b>Total</b>                    | 98,041                                      |  | 13%                    |                                   |
| Utility Lands                   | PacifiCorp                                  |  | 10,457                 |                                   |
|                                 | Cowlitz PUD <sup>1</sup>                    |  | 577                    |                                   |
|                                 | <b>Total</b>                                | 11,034                                   |                        | 1%                                |
| Private Lands                   | Non-Industrial Private Lands                |  | 73,956                 |                                   |
|                                 | Other Private Lands not Identified          |  | 50,216                 |                                   |
|                                 | <b>Total</b>                                | 124,172                                  |                        | 17%                               |

**Table 3.9-1. Major land ownership within the Lewis River watershed (cont.).**

| <b>Ownership Classification</b> | <b>Landowner</b> | <b>Acres in Ownership Classification</b> | <b>Landowner Acres</b> | <b>Percent of Total Watershed</b> |
|---------------------------------|------------------|--|------------------------|-----------------------------------|
| Project Reservoirs              | <b>Total</b>     | 12,366                                   |                        | 2%                                |
| Lakes/Rivers                    | <b>Total</b>     | 9,607                                    |                        | 1%                                |
| <b>Total Watershed</b>          |                  | <b>749,079</b>                           |                        | <b>100%</b>                       |

Source: PacifiCorp GIS 2001.

<sup>1</sup> Includes only acres associated with Swift No. 2; Cowlitz PUD also owns other lands in the watershed.

Predominant land uses include industrial activities associated with the hydroelectric projects, recreation, lands managed for fish and wildlife habitat values, forestry, agriculture, and private residential areas.

### 3.9.2.1 Project Operations / Industrial Uses

Industrial uses within the project area are predominantly related to the PacifiCorp and Cowlitz PUD hydropower operations. These facilities include the primary generation features described in Section 2.2.1, three reservoirs, transmission lines, canals (Swift No. 2 and Speelyai), and support facilities. Fish production facilities associated with the projects are the Lewis River Hatchery, Speelyai Hatchery, and the Merwin Trout Hatchery. All were constructed by the Applicants and are operated by WDFW. These are described in Section 2.2.1.5.

### 3.9.2.2 Recreation Facilities and Use Areas

Recreational facilities and shoreline access areas are located at all three project reservoirs. Swift Creek Reservoir, with two developed sites, has the fewest public facilities, both operated by PacifiCorp. These are 40-acre Swift Camp and the one-acre Eagle Cliff Park day use area. There are numerous undeveloped, dispersed recreation sites around Swift Creek Reservoir, the most popular of which is around Drift Creek Cove on USFS-managed lands.

Yale Lake offers a variety of heavily used water- and land-based recreation opportunities. There are four PacifiCorp-owned recreation facilities along the north and west sides of Yale Lake, each with boat launches. Seasonally operated campgrounds are provided at the 30-acre Cougar Camp and at Beaver Bay, a 40-acre site. Day use facilities are associated with each campground, comprising 40 acres adjacent to Cougar Camp and 27 acres at Beaver Bay. In addition, shoreline day use areas have been developed at Saddle Dam Park and at the ten-acre Yale Park.

Dispersed recreation uses around Yale Lake include water-based activities, picnicking, camping, horseback riding, hiking, hunting, and fishing. The Siouxon Creek area is used for boat-in day use and dispersed camping. Most of the shoreline sites are accessed by

boat, although there is limited and generally unauthorized vehicle access available via the Yale/IP Road along the southern/eastern shore.

PacifiCorp operates three developed recreational facilities at Lake Merwin: Cresap Bay Campground and two day use areas, Speelyai Bay Park and Merwin Park. Cresap Bay is a 120-acre campground and day use area / boat launch, while Speelyai Bay Park occupies four acres and Merwin Park covers 16 acres near the dam. Additional developed recreation sites in the Lake Merwin area, managed by public and private entities, are described in Section 3.8.2.1. Approximately 24 separate dispersed shoreline sites have been documented. These appear to be used primarily for picnicking, although some camping may occur.

Below Merwin Dam are six river access sites. One facility (Haapa) is operated by Vancouver-Clark Parks and Recreation Department. The remaining five sites are operated by WDFW and/or PacifiCorp.

### 3.9.2.3 Fish and Wildlife Habitat Uses

Lands in the project area support an array of terrestrial and wetland-dependant wildlife species. Many wildlife species inhabit the coniferous forest stands that dominate the area, and their local distribution is continually affected by the harvest cycle and age of managed stands. Wetland and riparian-dependant species distribution is influenced by the project reservoirs, as well as by residential and recreational developments in the Lewis River valley. Since the early 1980s, PacifiCorp has managed its land between the Merwin and Yale projects specifically for wildlife. The 5,600-acre Merwin Wildlife Habitat Management Area was established to mitigate the effects of habitat loss from the original construction and operation of the Merwin Project. As described in Section 3.6.3.1, the primary management objective for this area is to benefit elk populations that winter in these low elevations of the valley. Management of the area targets harvest actions to sustain a specific cover:forage ratio. Some cover types are designated as permanent, specialized management areas for old-growth, shrublands, riparian buffers, and wetlands.

In addition, the Applicants purchased several biologically significant parcels as a conservation measure under the biological opinion and incidental take statement for interim operations issued in 2002. These include 779 acres along Cougar Creek to preserve bull trout habitat; 284 acres on Swift Creek Reservoir known as Devil's Backbone (purchased by Cowlitz PUD), to protect bull trout sub-adult rearing habitat; and 129 acres in the vicinity of Speelyai Creek to preclude development of this lower elevation habitat. In addition, PacifiCorp provided funding to Clark County to assist its acquisition of Eagle Island, in order to protect anadromous fish habitat.

### 3.9.2.4 Agriculture Uses

Like many other rural areas in western Washington, the amount of agricultural land has decreased along the Lewis River. In 2001, only 22 percent of the area within the 240-foot contour along both sides of the river was classified as agriculture, with another nine

percent in pasture. Much of the previously farmed agricultural land has reconverted to forest and now supports deciduous and mixed conifer stands. Within the project boundary, approximately 30 acres near Saddle Dam are farmed as part of the Merwin Wildlife Habitat Management Program (MWHMP). Agriculture also occurs along the SR 503 corridor, particularly in the lower basin.

### 3.9.2.5 Forestry Uses

PacifiCorp owns the greatest amount of forestland along the project shorelines. Their primary management consideration is not timber production, but the protection of the terrestrial and aquatic resources. Management guidelines have been implemented for their forest lands around Lake Merwin and up to Yale Dam through the MWHMP. Emphasis is placed on forest health and wildlife habitat, old-growth retention, shrubland management, wetland management, orchard management at old homestead sites, and farmland management to provide winter forage for big game. Cowlitz PUD owns 577 acres, most of which is forested.

Forest lands adjacent to but outside of the boundaries of the projects are owned by the WDNR, USFS, and numerous private timber companies. The WDNR manages 87,747 acres in the Lewis River watershed to provide income for schools and other state trusts. This includes the 32,000-acre Siouxon drainage bounded on the north by Swift Creek Reservoir and the west by Yale Lake. It is managed for annual timber harvests, aquatic habitat protection, wildlife habitat, and other resource values.

The USFS manages 403,518 acres classified as non-wilderness, wilderness, and national monument within the watershed. This includes 353,660 acres of non-wilderness forest lands under multiple use management to provide a sustained yield of wood, water, forage, wildlife, and recreation. Wilderness and national monument lands include the Mount St. Helens National Volcanic Monument (Monument), the Mount Adams Wilderness Area, and the Indian Heaven Wilderness Area. The Monument occupies 32,712 acres while 17,146 acres are within the two Wilderness Areas. These areas include forested and non-forested lands that are managed for the protection of natural resources and unique resource values. Commercial harvest is prohibited and wildlife habitat management activities are restricted.

Approximately 98,000 acres of forestland are managed by private industrial timber companies in the Lewis River watershed. The private timberlands closest to the project belong primarily to Olympic Resources Management, with Weyerhaeuser and ANE Forestry having additional large holdings (PacifiCorp and Cowlitz PUD 2003f and 2004). Swift Creek Reservoir is close to these units. Private timberlands decrease as one travels west down the basin. While specific harvest practices are determined by each company, minimum requirements are established by the State of Washington Forest Practices Regulations to protect public resources.

Non-industrial private forest lands are owned by a variety of individuals not associated with commercial timber companies. There are approximately 74,000 acres of forest land



within this ownership classification, occurring predominately in the lower third of the watershed.

### 3.9.2.6 Residential Uses

Three private shoreline developments with approximately 253 home sites are located around Swift Creek Reservoir. The Yale Lake area has multiple small groupings of residences near Beaver Bay, in and around Cougar, and near Speelyai Creek where low-density rural residences have been built along the highway. There are several farms in the vicinity also. Yale Lake currently has only one private residential development of ten home sites that share shoreline access. Several privately developed communities on Lake Merwin support approximately 1,550 total home/trailer sites. All are on private land controlled by the homeowners associations that make use of shoreline areas leased from PacifiCorp. Residential use becomes denser along the SR 503 corridor from the western end of Lake Merwin to the City of Woodland.

### 3.9.2.7 Land Use Management and Jurisdiction

#### Federal Lands

The Gifford Pinchot National Forest is a major land manager in the basin surrounding Swift Creek Reservoir, with holdings concentrated in areas north and south of the reservoir and within Skamania County (Figure 3.9-1). USFS land within the Swift No. 2 Project boundary totals 3.79 acres in the Swift No. 2 Canal. The Gifford Pinchot Land and Resource Management Plan (USFS 1990) and the Northwest Forest Plan (USFS and BLM 1994) provide management direction for some of these lands, with the principles of multiple use guiding decisions regarding timber yield, water, forage, wildlife, and recreation. Opportunities to harvest timber are limited to areas specifically designated in the Forest Plan (USFS 1990). Further constraints have been placed on harvest to protect fish habitat, wildlife habitat, and soils (USFS 1996). The primary access road to the upper basin, FR 90, is constructed on land for which the USFS holds an easement, conveying authority to construct and maintain the road, but without a real property interest.

Monument lands extend north of Yale Lake and the Swift No. 2 Project, and have incorporated approximately 300 acres of former PacifiCorp land north of Beaver Bay Campground. Monument lands are managed to protect geological, ecological, and cultural resources for scientific study and research, while providing compatible recreation and interpretation opportunities.

BLM retains 84 acres within the Yale project boundary, including the land on which Yale Dam was constructed. The BLM relies on PacifiCorp to manage these lands for maintenance of the hydropower facilities. PacifiCorp's right to occupy these lands is authorized under a long-term FPA withdrawal. BLM lands within the Merwin Project boundary total 121 acres, and an additional 67 acres are retained by BLM at the Swift No. 1 Project. PacifiCorp pays an annual fee for its right to occupy and use these parcels. No BLM lands are within the Swift No. 2 project boundary.

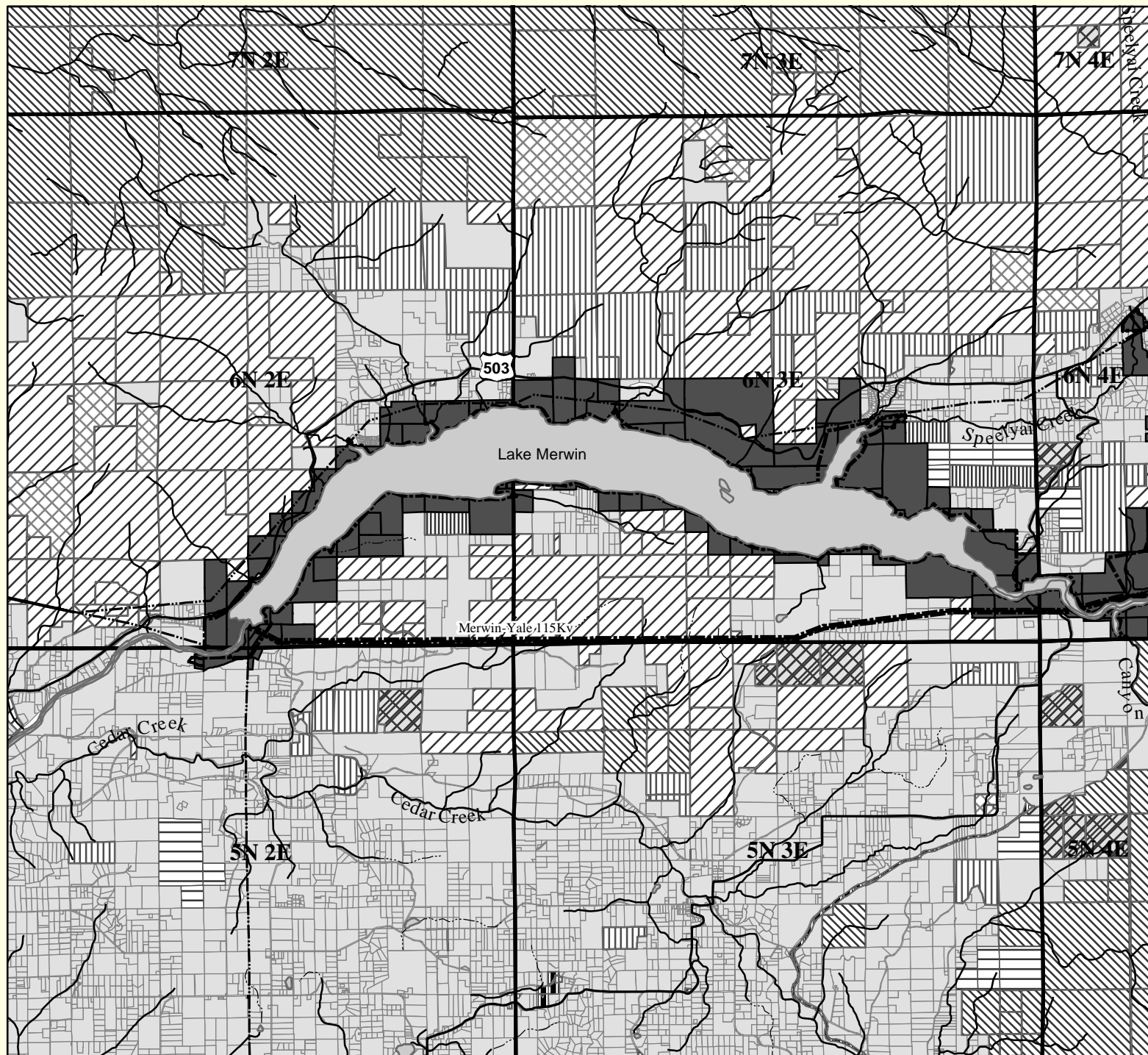
# Lewis River Hydroelectric Projects

FERC No. 935, 2071, 2111, 2213

## Major Property Owners

Sheet 1  
Lake Merwin

Figure 3.9-1



- Transmission Lines
- ▭ PLSS-Township/Range
- ▭ FERC License Boundary

### OWNER CATEGORY

- ▨ USDA Lands (USFS)
- ▨ BLM
- ▨ State
- ▨ County
- ▨ Cowlitz County PUD
- ▨ ANE Forests
- ▨ Fruit Growers
- ▨ KLL Corp
- ▨ Longview Fibre
- ▨ Pacific Timber Acq
- ▨ PacifiCorp
- ▨ Private
- ▨ Olympic Resource Mgt
- ▨ Weyerhaeuser



0 1 2 Miles



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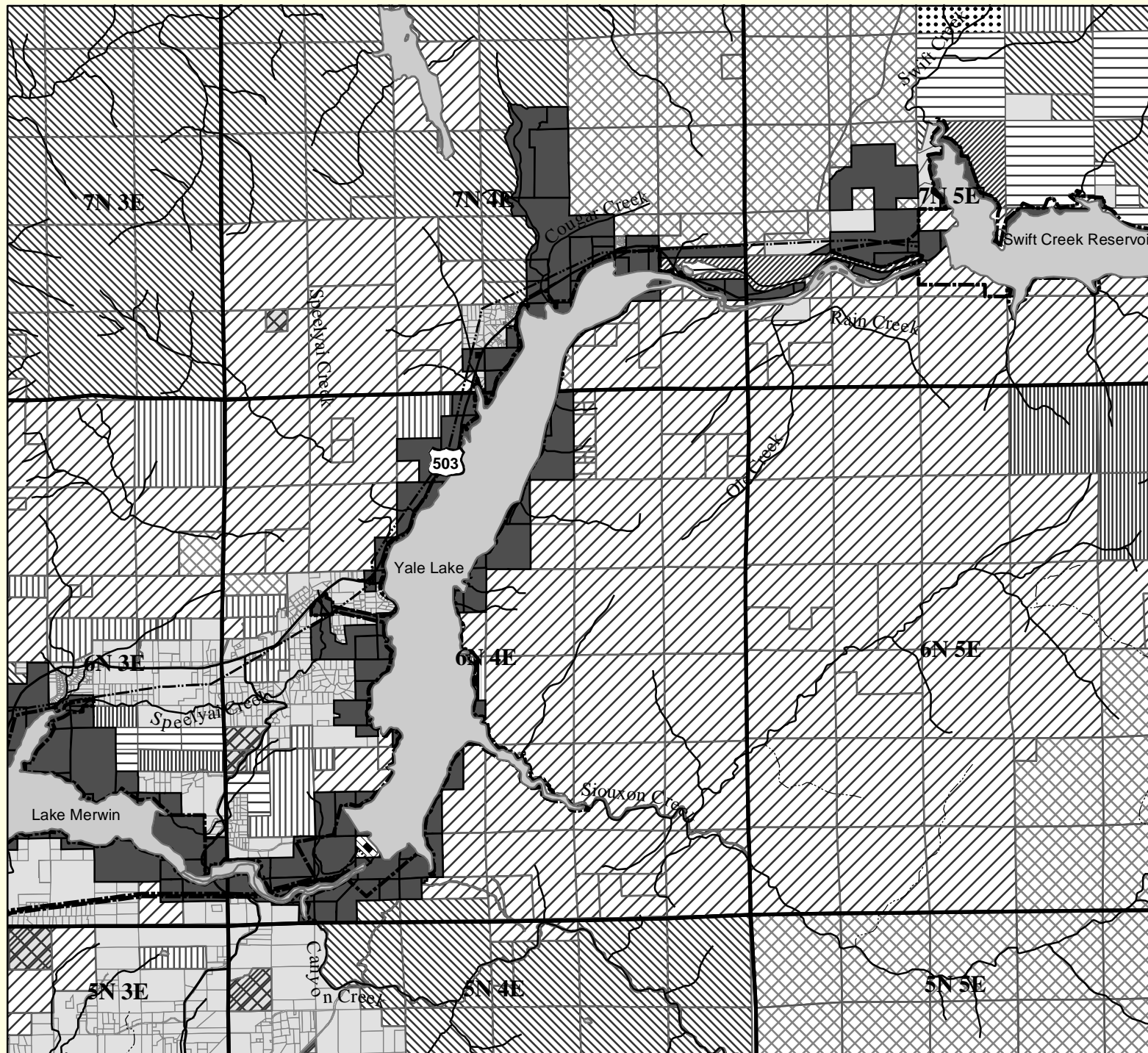
# Lewis River Hydroelectric Projects

FERC No. 935, 2071, 2111, 2213

## Major Property Owners

Sheet 2  
Yale Lake  
and Swift No. 2

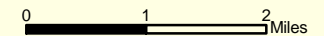
Figure 3.9-1



- Transmission Lines
- ▭ PLSS-Township/Range
- ▭ FERC License Boundary

### OWNER CATEGORY

- ▨ USDA Lands (USFS)
- ▨ BLM
- ▨ State
- ▨ County
- ▨ Cowlitz County PUD
- ▨ ANE Forests
- ▨ Fruit Growers
- ▨ KLL Corp
- ▨ Longview Fibre
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- ▨ PacifiCorp
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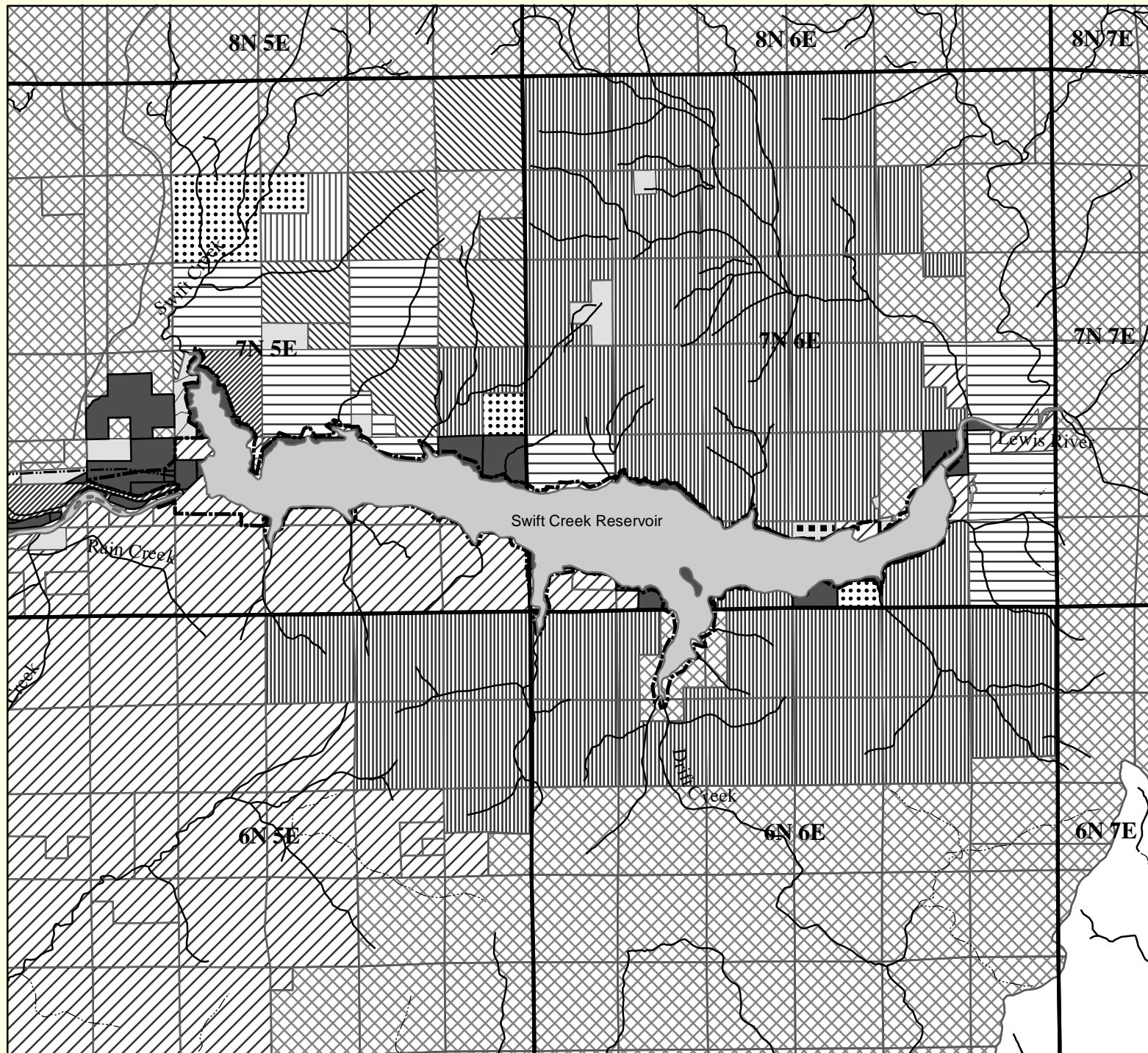
# Lewis River Hydroelectric Projects

FERC No. 935, 2071, 2111, 2213

## Major Property Owners

Sheet 3  
Swift Creek Reservoir  
and Swift No. 2

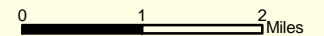
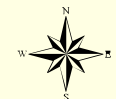
Figure 3.9-1



- Transmission Lines
- ▭ PLSS-Township/Range
- ▭ FERC License Boundary

### OWNER CATEGORY

- ▨ USDA Lands (USFS)
- ▨ BLM
- ▨ State
- ▨ County
- ▨ Cowlitz County PUD
- ▨ ANE Forests
- ▨ Fruit Growers
- ▨ KLL Corp
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July 17, 2003

### State Lands

The WDNR manages 12 percent of the lands in the basin (87,747 acres), including several small parcels on the eastern side of Swift Creek Reservoir. Swift Camp occupies 20 acres that WDNR leases to PacifiCorp. Another parcel is located along the eastern shore of Swift Creek Reservoir and includes a segment of FR 90. Additional WDNR holdings are scattered north of the project area, extending from Swift Creek Reservoir west to Woodland and include a small parcel on the south shore of Lake Merwin. A majority of these holdings are located outside the FERC project boundaries and are managed by the Forest Resources Plan (WDNR 1992) and WDNR's Habitat Conservation Plan, developed to conserve threatened and endangered species on its lands within the range of the northern spotted owl (WDNR 1997). The most extensive WDNR holdings in the basin are the approximately 32,000 acres east of Yale Lake and south of Swift Creek Reservoir that make up the Siouxon Landscape Area, managed under the Siouxon Landscape Plan (WDNR 1996).

The Washington State Department of Transportation is responsible for SR 503. This corridor bisects the project area on the northern side of the reservoirs from I-5 to approximately 1.5 miles west of Swift Dam, at which point it becomes FR 90. Also known as the Lewis River Road, it is the main east-west transportation corridor through the basin. Use of SR 503 has increased substantially since the eruption of Mount St. Helens, and as residents of the Portland/Vancouver areas have discovered the recreational opportunities available in the upper basin.

### County Land Management

Skamania County encompasses all of the project area associated with Swift No. 1 and extends westward along about two miles of the Swift No. 2 Canal. The comprehensive plan for this county (Skamania County 1977) depicts the project area as unzoned. As such, Skamania County does not identify any land use designations in the project area, so continued operation would not be subject to this comprehensive plan.

Clark County covers an area from just upstream of the Swift No. 2 powerhouse downstream to the Columbia River, following the southern and eastern edges of the Yale and Merwin reservoirs. The southern half of Yale and Merwin dams and reservoirs, both powerhouses, and switchyards are within Clark County. These County lands are relatively remote and are predominantly designated Forest Tier I under the Clark County Comprehensive Growth Management Plan (Clark County 1994). Land management objectives focus on the long-term production of commercial forest products and other natural resources. Some lands along the south shore of Lake Merwin are zoned for denser development (one principal dwelling per 40 acres). Project features are within the Shoreline Conservancy environment of both Clark and Cowlitz counties (Clark County 1974 and Cowlitz County 1977). As such, power-generating facilities are allowable uses where they create minimal visual impact and when shoreline restoration is performed.

Clark County owns an 80-acre site along the east side of Yale Lake. This parcel is designated as Parks / Open Space under its comprehensive plan (Clark County 1994).

Absent a recreation easement along the only access road (the IP Road), the site has remained undeveloped.

Cowlitz County boundaries include lands west and north of Yale Lake, extending along the west and north edges of the Yale and Merwin reservoirs from the Skamania County line near the Swift No. 2 powerhouse to the Columbia River. Swift No. 2 and the northern half of Yale and Merwin dams and reservoirs are within Cowlitz County, as is the Hydro North Headquarters facilities, where operation of the Lewis River Projects and other smaller PacifiCorp hydro projects are coordinated. Project features occupy lands designated as Rural Residential-2 and Forestry-Open Space (Cowlitz County 1977). The Swift No. 2 powerhouse, Saddle Dam, and portions of Yale Dam, located within the boundaries of the Cowlitz County Shoreline Management Master Program (Cowlitz County 1981), are consistent with the Economic Development component of this program. Within the designated Shoreline Conservancy environment, power generating facilities are permitted where they create minimal visual impact and when shoreline restoration is performed. Transmission lines associated with the Swift No. 1 and Swift No. 2 projects span a number of management designations, but generally, utility systems are permitted uses. Project recreation facilities in Cowlitz County occupy areas designated as Parks/ Open Space or Rural Residential-2 by the County Comprehensive Plan and as Rural District shorelines by the Shorelines Management Master Program. Recreation uses are consistent with these designations.

### Private Lands

Private ownership adjacent to the FERC project boundaries is predominantly that of PacifiCorp, with several parcels held by various timber companies and residential/recreational communities. The majority of the non-PacifiCorp private land is located around Swift Creek Reservoir, in the ownership of Olympic Resources Management and some smaller timber companies. Non-timber company private ownership is scattered around the three project reservoirs, including the private residential communities described above. Residential ownership is more common around Lake Merwin than around Yale or Swift Creek reservoirs. On privately owned reservoir frontage, PacifiCorp retains flowage easements.

### 3.9.3 Effects of Alternatives

#### 3.9.3.1 Alternative A

Under Alternative A, the current FERC license requirements would remain in effect over the next license terms and the projects would continue to operate as they currently do. While beyond the control of the Applicants, it is assumed that current land management direction would remain constant and that the existing conditions described in Section 3.9.2 would be indicative of conditions over the new license terms.

### Compatibility with Ongoing Resource Measures

Numerous resource protection and enhancement measures would continue under Alternative A. Recreation facilities would be operated and maintained by PacifiCorp, but would not be expanded. As demand exceeds capacity, dispersed use on other project and non-project lands would be expected to increase. Unmanaged use would degrade wildlife habitat and could affect adjacent privately owned land.

Residential development would continue to be precluded within the FERC boundaries. Easements for access would be evaluated by the Applicants based on their current shoreline and land management objectives. Residential development on adjacent lands could be expected to intensify. Development on surrounding lands would be expected to gradually become denser as the population of Cowlitz and Clark counties increases, placing greater pressure on the existing recreation facilities and on project lands to preserve wildlife habitat. Such development would be regulated by the county in which it is proposed.

Timber management would continue under the Alternative A, with harvest cycles the same as those implemented under PacifiCorp's current management plans. On adjacent non-federal land, harvest cycles would be guided by WDNR forest practice criteria that will evolve over the license term.

Flood management operations would continue to follow existing high runoff procedures, as described in Section 3.2.2.5, and damaging floods would be expected to occur about once every 25 years on average. Flood warning procedures and regulatory restrictions on land use within flood-prone areas would continue to follow existing practices, as described in Section 3.11.2.6. If permitted by the counties, new development would continue to occur in flood-prone areas of the Lewis River valley within the 100-year floodplain. While such development would meet the minimum requirements established under the National Flood Insurance Program, new development would expose property to potential flood hazards.

### Consistency with Comprehensive Plans

Adoption of Alternative A could be considered compliant with the consultation objectives of the comprehensive plans described in Section 5.5, although no additional measures would be implemented to protect fish, wildlife, cultural, recreation resources specifically encouraged by the comprehensive plans.

#### 3.9.3.2 Alternative B

### Consistency with Comprehensive Plans

As described in Section 5.1, ten comprehensive plans recognized by the FERC are relevant to the Lewis River Projects. Most provide general resource management guidance, which the Applicants followed in conducting relicensing studies and in the

development of measures evaluated in this PDEA. Therefore, Alternative B is consistent with the general recommendations of these ten plans.

The major facility modifications proposed under Alternative B are the recreation and fish facility expansion and improvements. These actions would occur primarily in areas already used for these purposes and, therefore, would be consistent with the Cowlitz County Comprehensive Plan (Cowlitz County 1981) and the Clark County Comprehensive Plan (Clark County 1994). Modifications to facilities within 200 feet of a waterway may require a Shoreline Substantial Development Permit from the respective county.

### Compatibility with Proposed Measures

Several measures proposed in Alternative B have the potential to affect land uses in the basin. Specific measures proposed to enhance wildlife habitat, fish passage, and recreation could alter current land uses, as summarized below.

Measures proposed as part of Alternative B to protect and enhance wildlife habitat on project lands include replacing some damaged or undersized culverts on PacifiCorp lands, restricting dispersed camping in some shoreline and riparian areas, and closing some roads to vehicles. In addition to benefiting amphibians and aquatic species, culvert replacement would reduce potential land use impacts associated with erosion and overflow that can occur with undersized or damaged culverts. Dispersed camping would be precluded in some currently used areas, a measure that would benefit wildlife and vegetation while forcing the relocation of some campers. Road closures on project lands to benefit wildlife would not be expected to significantly change current uses, as these are private roads. None of these measures would have a significant effect on land uses.

Recreation development proposed as part of Alternative B would be consistent with current patterns of use. Use would increase in the Town of Cougar if full funding is obtained for construction of a Visitor Information Center. This facility would focus traffic in an already developed area, which could over time attract commercial development.

Several trail segments would be developed or improved in the vicinity of Yale Lake, meeting a demand for safer, off-road pedestrian and bicycle corridors. Measures would include the conversion of the Yale/IP Road to a non-motorized public corridor. Unauthorized use of this road along the shoreline of Yale Lake currently occurs, so while this measure would be a formal use change, it would provide a more managed approach to current, although somewhat limited use patterns.

Development of new fish passage facilities in Swift Reservoir and at Merwin Dam would complement current land uses at the project sites and would occur entirely within the existing FERC boundaries. Construction would introduce short-term increases in traffic in the vicinity of Swift Dam and just below Merwin Dam. Work in the Merwin area would be spatially contained and conducted within an area generally not accessible to the public. Conversely, construction activities just upstream of Swift Dam would affect



visitors to this more remote area. Temporary land use modifications would occur in this vicinity as heavy equipment and supplies are present. When these facilities become operational, truck traffic on area roads between Merwin Dam and Swift Creek Reservoir would increase somewhat as fish are hauled into and out of the upper basin.

During the terms of the licenses, as anadromous fish become established in the upper basin and hatchery production is reduced, the Applicants would discontinue their support of anadromous fish programs at the hatcheries.

### 3.9.3.3 Alternative C

#### Compatibility with Proposed Measures

Measures proposed under Alternative C would have similar land use effects to those described for Alternative B; however, modifications associated with fish passage facilities would be much more extensive. New trap-and-tram amenities at Merwin, Yale and Swift No. 2 would add or modify upstream collection facilities and add overhead tramways to the landscape. Surface collectors to pass outmigrating fish would introduce new elements to Swift, Yale and Merwin dams. The presence of these facilities would not alter land uses, as they would be located entirely within the existing project boundaries. The approximately three-mile-long overhead tramway associated with Swift No. 1 and Swift No. 2 would be an obvious new element in the landscape, but would partially parallel the existing Swift No. 2 Canal so would not introduce a new land use. The effects of these new facilities would be greatest during their construction, a process that would increase traffic and the sense of industrialization in the immediate vicinity over an estimated six- to seven-year period.

#### Consistency with Comprehensive Plans

Consistency with comprehensive plans and local ordinances would be the same under Alternative C as described for Alternative B.

### 3.9.4 Conclusion

Land uses would not be altered by the continuing measures under Alternative A nor would significant alterations occur under Alternatives B or C. Some uses would intensify, with associated land use effects. Development and visitor pressure on the Lewis River basin can be expected to increase over the term of the new FERC licenses because of its proximity to major metropolitan areas, the regional attractions of the Mount St. Helens National Volcanic Monument and the project reservoirs, and a good transportation network. Under Alternative A, these pressures are expected to have a moderate adverse impact on project lands over the terms of the new licenses because demand for the recreation facilities would exceed capacity and no new management controls would be implemented. This effect also would be experienced on USFS lands in the basin and on private land adjacent to the projects.

Expansion of PacifiCorp's recreation facilities under Alternatives B and C would reduce encroachment on adjacent federal, state, and private lands by meeting a portion of the expected demand for water-based recreation. This represents a moderate land management improvement over existing conditions.

Although construction of trap-and-tram facilities for upstream fish passage under Alternative C would not introduce new land uses, it would increase construction-related traffic over a six- to seven-year period. Depending on the facility development schedules, this effect could have from moderate to major short-term effects on transportation networks adjacent to the construction activity. Construction of downstream passage facilities under Alternative B would have a major short-term effect on FR 90 in the vicinity of Swift Dam and a moderate effect on road use in the Merwin Dam vicinity. Identical effects would occur under Alternative C, but would include construction of a downstream passage facility at Yale Dam, contributing heavy vehicle traffic for a short duration to area roads.

### **3.10 AESTHETIC/VISUAL RESOURCES**

#### **3.10.1 Resource Issues**

Project operations, facilities, and land management practices, among other factors, currently affect the aesthetic quality of the project area. During the scoping process, one aesthetics-related issue was identified. Some stakeholders expressed concern about the effect of the Swift No. 2 canal and powerhouse on the aesthetic experience of visitors traveling on FR 90. The powerhouse and canal are adjacent to SR 503 Spur and FR 90. Some stakeholders suggested that the proximity of these structures to the road and the contrasting grey color of the powerhouse made them highly visible and generally unpleasing to motorists. Both were extensively damaged in 2002 and will be reconstructed by mid-2005. The canal and powerhouse will be reconstructed within the existing footprint. The powerhouse has been re-sided in a two-tone color scheme approved by the USFS.

#### **3.10.2 Affected Environment**

The Lewis River basin is mountainous, with sweeping vistas of forested hillsides and mountain reservoirs. Mount St. Helens and Mount Adams are visible in the distance on a clear day. The majority of the Lewis River basin is forested, except for a 30-square-mile area located in the upper basin that was denuded by the eruption of Mount St. Helens in 1980, as well as the three large project reservoirs. The remainder of the valley landscape is managed for commercial timber production and consists of second-growth Douglas-fir and mixed conifer-hardwood forests. Logging roads and cut/fill slopes are visible as tan scars against the green of the forest. Areas of the valley not in timber production support small farms, tree farms, single-family homes, and small rural or suburban developments. Detailed descriptions and photos of project features and surrounding landscapes are presented in PacifiCorp and Cowlitz PUD (2003f and 2004).

### 3.10.2.1 Aesthetic/Visual Assessment of Project Features

Operations facilities associated with the Merwin Project include an arched concrete dam, a powerhouse at its base, and a 115 kV transmission line, all of which are largely out of sight to recreation visitors. The Merwin development also includes the well-maintained Hydro North Headquarters facilities, as well as the extensive, highly manicured Merwin Park day use recreation area. Adjacent to these features is the Merwin Trout Hatchery, where structures and the open ponds appear neat and orderly. The dam impounds the 14.5-mile-long Lake Merwin, which is surrounded by forested slopes and broad river plateaus. Other recreation facilities include Speelyai Bay Park and Cresap Bay Campground.

Yale Dam, an earthfill embankment structure, is faced with rock and grass, blending well with the surrounding forest. It forms the 10.5-mile-long Yale Lake, the primary viewpoint from which the dam is visible. The powerhouse at the base of Yale Dam is visually inconspicuous. Nearby, Saddle Dam is visible primarily from the adjacent day use park and boat launch and from the reservoir surface. Other facilities associated with the Yale Project include 10.5 miles of 115 kV overhead transmission line (the Merwin-Yale line), a cluster of project operator housing, and a number of recreation facilities (Saddle Dam Park, Yale Park, Cougar Camp, and Beaver Bay Campground).

Swift No. 1 is the farthest upstream hydroelectric facility on the Lewis River. Swift Dam, a massive stone-faced embankment, is visible from two viewpoints on FR 90, one along Swift No. 2 canal, and the other from an overlook at the west end of Swift Creek Reservoir. The Swift No. 1 powerhouse is located directly below the dam and is visually subordinate to it. From a nearby switchyard, a 230 kV overhead transmission line extends from Swift No. 1 to the Swift No. 2 substation. The dam creates the 11.5-mile-long Swift Creek Reservoir that is surrounded by rugged, forested slopes with background views of Mount St. Helens. Recreation facilities associated with Swift No. 1 include Swift Camp and Eagle Cliff Park. This is the most undeveloped setting in the project area.

The Swift No. 2 powerhouse, adjacent substation, and embankment canal located on SR 503 Spur and FR 90 were heavily damaged by the failure of the canal embankment in April 2002. Cowlitz PUD is proceeding with reconstruction of these facilities. Other than the three large reservoirs, the Swift No. 2 facilities are the most visually apparent hydroelectric features in the basin, due to their proximity to SR 503 Spur and FR 90.

#### Visibility of Project Facilities

Local residents, motorists, and recreation visitors have been identified as the three viewer groups in the Merwin, Yale, and Swift project areas.

Local Residents – None of the hydropower facilities are visible from local residential areas; however, local shoreline communities have views of the reservoirs and are themselves visible from the reservoirs.

Motorists – One major state highway, SR 503 and SR 503 Spur, extends eastward up the Lewis River basin from Woodland. At the Swift No. 2 canal, this road becomes FR 90, a well-maintained major access road to USFS-managed lands on the flanks of Mount St. Helens. Typically, motorists have intermittent views of the project reservoirs, campgrounds and parks, and the Merwin-Yale transmission line. From FR 90, the length of Swift No. 2 canal and Swift Dam are visible in the distance. Swift Dam, the Swift No. 2 canal, Swift No. 1 powerhouse, surge tank, and spillway are visible in the middle-ground to the south from an overlook on FR 90. Looking east from this overlook, there is a scenic view of steep forested hillsides and Swift Creek Reservoir. From Jack’s Restaurant, where SR 503 turns south and the SR 503 Spur heads east, south to the Yale Bridge, the only view of the projects is from the Yale Bridge area across Lake Merwin.

Recreation Visitors – Visitors to PacifiCorp recreation sites are the primary viewers of project facilities. Approximately 594,000 people visited the Lewis River recreation facilities during 2000 (PacifiCorp and Cowlitz PUD 2003f and 2004). Most Yale generating facilities are not visible from developed recreation areas, except Saddle Dam is visible from the adjacent Saddle Dam Park. Yale Dam is visible in the background from Yale Park (more than four miles away) and from Cougar Park and Camp (more than six miles away). Saddle Dam and Yale Dam are also visible from the reservoir. The 115-kV Merwin-Yale transmission line is supported on steel towers that are visible from Merwin Park across the reservoir. The Swift No. 2 powerhouse, transmission line, and canal are visible foreground elements at the entrance road to the Beaver Bay Campground. The substation and powerhouse are visible in the foreground from Yale Lake, upstream from Beaver Bay Campground.

### 3.10.2.2 Visual Assessment of Reservoir Pool Level Fluctuations

Project operations currently involve reservoir level fluctuations that alter the visual quality of the reservoir viewsheds. To evaluate the visual effect of existing reservoir fluctuations, three pool levels were identified to represent the ranges that occur in the Merwin, Yale, and Swift Creek reservoirs (Table 3.10-1). PacifiCorp voluntarily maintains reservoir surface levels at or near full pool in these reservoirs throughout the summer unless inflow is inadequate, generally late in the recreation season (Tables 3.2-5 through 3.2-7).

**Table 3.10-1. Pool elevation photo documentation for Merwin, Swift, and Yale reservoirs.**

| <b>Representative Reservoir Pool Conditions</b> | <b>Swift Creek Reservoir Elevation (msl)</b> | <b>Yale Lake Elevation (msl)</b> | <b>Lake Merwin Elevation (msl)</b> |
|---|--|----------------------------------|------------------------------------|
| Summer High Pool                                | 999  | 490                              | 238                                |
| Summer Low Pool                                 | 991  | 480                              | 236                                |
| Low Pool  | 964  | 470                              | 234                                |

Source: PacifiCorp.

Lake Merwin is operated as a re-regulating reservoir and fluctuates only minimally (Table 3.2-5). As a result of the limited amount of exposed shoreline at low pool levels,

Lake Merwin has a high level of scenic attractiveness throughout the year (PacifiCorp and Cowlitz PUD 2003f and 2004).

Key observation points (KOPs) at Saddle Dam Park, along the SR 503 Spur, and Cougar Camp and Park, were identified for assessing visual resources and views at Yale Lake. The most extensive areas of exposed shoreline due to pool level fluctuations are visible from Cougar Park and Camp during the off-season closure. Trees and brush limit views of Yale Lake from SR 503 Spur; however, where there are breaks in the trees, areas of exposed lake bottom can be seen during low pool conditions. Due to the extent and character of exposed lake shoreline, the visual quality of the reservoir is lowest when its surface is at minimum pool level and is highest when the reservoir is at full or near-full pool. Minimum pool conditions typically occur during the time when the fewest number of people visit the lake, reside in the area, or travel along SR 503 Spur (PacifiCorp and Cowlitz PUD 2003f and 2004) (Figure 3.2-6).

Operation of Swift Creek Reservoir results in greater pool elevation fluctuations than Merwin or Yale reservoirs (Table 3.10-1 and Figure 3.2-5). KOPs on FR 90, at pullouts along FR 90, the Northwoods Village Marina, and the Swift Camp boat launch were used to assess the visual resources at Swift Creek Reservoir. Views of the reservoir from FR 90 are distant, and reservoir pool level fluctuations do not dominate the overall visual quality of the reservoir viewshed. From the Swift Camp boat launch and the Northwoods Village Marina, the reservoir shoreline is visible in the foreground; therefore, reservoir level fluctuations dominate the views (PacifiCorp and Cowlitz PUD 2003f and 2004). Minimum pool conditions typically occur during the time when the fewest number of people visit the lake or reside in the area.

### 3.10.2.3 Visual Assessment of River Flow Fluctuations

Operation of the Merwin, Swift No.1 and Swift No. 2 projects affect river flow in the Lewis River below their respective powerhouses. River flow in the Lewis River between Merwin Dam and the City of Woodland is primarily affected by natural runoff conditions, although the timing of releases can vary somewhat from natural inflow. Flow in the Lewis River bypass reach is strongly influenced by project operations. The Yale Project is not included in this assessment because Lake Merwin extends to the tailrace of the Yale powerhouse; therefore, there is no natural riverine section.

River flows selected for the visual analysis represent the range that typically occurs during periods of peak recreation use on the Lewis River (PacifiCorp and Cowlitz PUD 2003f and 2004) (Figure 3.2-9). Fishing is the primary river recreation activity, and during the peak fishing months of April through September, flows typically range from 1,400 to 5,000 cfs. Generally, the visual difference between the ranges of flows on the Lewis River is not significant (PacifiCorp and Cowlitz PUD 2003f and 2004).

A visual assessment was performed based on photo documentation collected during an instream flow study (PacifiCorp and Cowlitz PUD 2003f and 2004: AQU 2). KOPs on the IP Road bridge looking upstream and downstream and on FR 90 near the Swift No. 2 canal were used to assess visual resources at four flow levels in the bypass reach. The

visual quality of the reach was not significantly altered by the four flow levels, even though the highest flow (290 cfs) was more than five times the lowest flow (68 cfs). From the KOPs, there was little change in the visual appearance of the reach as flows increased. Changes were apparent from the IP Road bridge looking upstream; the general visual appearance somewhat improved with flows between 200 and 290 cfs, mostly due to increased water depth and increased reflection of the sky colors. However, the existing conditions are also visually pleasing, appearing as a natural creek.

#### 3.10.2.4 Compliance with Visual Resource Objectives, Policies, and Guidelines

Adopted agency plans and policies were reviewed for Cowlitz, Clark, and Skamania counties, as well as WDNR and the USFS. Policies and plans that include language regarding aesthetic/visual resources were reviewed, and any issues or conflicts were noted and analyzed.

The Parks and Recreation Section of the Cowlitz County Comprehensive Plan (Cowlitz County 1976) identified two scenic resource goals for project lands. The first goal is to develop scenic vistas of Lake Merwin and Yale Lake from SR 503 and SR 503 Spur. There are no current proposals to develop view corridors, but several natural viewpoints exist. The second goal is to maintain scenic values at Marble Creek Falls on Lake Merwin. Vegetation removal to improve views of the falls may be possible; however, a sharp bend in the highway at this location would make viewing or stopping potentially dangerous to drivers. A trail already exists in the Marble Creek area near Merwin Park.

The WDNR, which manages extensive lands on the south shore of Yale Lake, integrates aesthetics/visual resource management as part of their ongoing landscape planning efforts (WDNR 1996). No specific guidance is provided relative to the hydropower projects.

The GPNF Land and Resource Management Plan (USFS 1990) covers federally managed lands in the GPNF and in the Monument. It contains Visual Quality Objectives (VQO) for USFS-managed lands under its Visual Management System. These VQOs apply to two isolated parcels of USFS-managed land at or near the projects—the Pine Creek Ranger Station property, and lands at Drift Creek Cove on the southern shoreline of Swift Creek Reservoir. Continued project operations would not affect the ability of the USFS to maintain VQOs at either location.

### 3.10.3 Effects of Alternatives

#### 3.10.3.1 Alternative A

Under Alternative A, there are no aesthetic-related actions. Aesthetic/visual resource conditions would likely remain similar to the existing conditions in the project areas.

#### 3.10.3.2 Alternative B

There are no aesthetic/visual resource actions associated with Alternative B; however, several other resource actions may potentially affect the aesthetic quality of the project area. Specifically, new fish passage facilities would be constructed at Merwin and Swift

dams. Below Merwin Dam, the existing fish collection facilities would be improved and reconfigured. The improved facilities would be largely out of sight of recreation visitors and would likely not result in an overall adverse effect on the aesthetic quality of the area.

At Swift Dam, new fish collection facilities would be constructed, including a new 400-foot guide wall paralleling the southern shoreline and a fish sorting/sampling facility below the dam. These new facilities would be visible to motorists traveling FR 90, adjacent to the Swift No. 2 powerhouse and canal and at viewpoints along the northern shoreline of Swift Creek Reservoir. The new guide wall also may be visible to boaters on Swift Creek Reservoir during low water conditions. The area around Swift Dam is already highly modified by the presence of the canal, dam, and powerhouse; however, the extent of the new features would have an overall adverse effect on the aesthetics of this area.

### 3.10.3.3 Alternative C

No aesthetic/visual resource actions are proposed under Alternative C. New fish passage facilities would be constructed that would affect the aesthetic/visual quality of the project area.

Fish trap-and-tram facilities would be built at Merwin Dam, Yale Dam, and at Swift No. 2. Each trap-and-tram system would consist of a cableway tram and associated fish collection and release facilities. The length of the overhead tram at Merwin Dam would be approximately 500 feet with a 150-foot vertical rise, while the length of the tram at Yale Dam would be approximately 1,500 feet with a 260-foot vertical rise. These facilities and their associated construction activities would alter the existing aesthetic/visual condition in these areas. The tram support poles would be painted to match the surrounding natural setting to minimize their potential aesthetic/visual effect at both locations (unless FAA high structure safety regulations require providing high visual contrast for aviation warnings). Regardless of the tram pole color, the trap-and-tram facilities at Merwin and Yale dams would largely be out of sight to most recreation visitors and generally would not result in an overall adverse effect on aesthetic/visual resources.

Fish passage facilities at Swift No. 1 and Swift No. 2 would be highly visible to recreation visitors. Collection facilities would be constructed adjacent to the Swift No. 2 powerhouse, an overhead cableway tram would be installed along the Swift No. 2 canal, and a fish unloading station would be constructed at the north side of the Swift Dam. The length of the tram along the canal would be approximately 3.2 miles with a 520-foot vertical rise. Regardless of tram pole color, these new fish passage facilities and the associated construction activities would highly alter the existing aesthetic condition in this area. The new facilities would be very visible to motorists traveling FR 90 adjacent to the Swift No. 2 powerhouse and canal. They would also be visible from viewpoints along the northern shoreline of Swift Creek Reservoir, including the existing overlook site along FR 90. While this area is already highly modified by the presence of the canal,

dam, and powerhouse, the extent of the new fish passage facilities would have an overall adverse effect on aesthetic/visual resources in this area.

#### 3.10.4 Conclusion

There are no specific aesthetic-related actions proposed under any of the alternatives. Fish passage facilities under Alternatives B and C would have an effect on the aesthetic/visual quality of the project area. The actions proposed under Alternative A would have no new aesthetic/visual impacts. New fish passage facilities proposed under Alternative B would have moderate impacts on aesthetic quality. Under Alternative C, the new fish trap-and-tram facilities would have a moderately high impact on the aesthetic/visual quality of the area, especially on the aesthetic/visual experience of motorists and bikers traveling along FR 90.

### **3.11 SOCIOECONOMICS**

#### 3.11.1 Resource Issues

Five socioeconomic issues were identified by relicensing participants and are analyzed in this section under each of the three alternatives:

- Effects of potential enhancement measures on project economics, utility rates and local economic conditions – The protection, mitigation and enhancement measures addressing other resources included in each alternative would also affect the economic viability of the projects, and the utility rates that would be charged to customers.
- Impacts on local economic conditions – Employment opportunities during construction and operation of the protection, mitigation and enhancement measures, as well as the secondary effects of increased employment on housing and retail sales will affect the local economy.
- Effects of project-generated recreation on local government infrastructure, tax assessments, emergency services, and local residents – The availability of increased recreational opportunities and the duration of the recreation season affect the number of recreation visitors served by the project area. These visitors require law enforcement, fire/rescue, and emergency services. The Applicants also pay additional taxes on their projects, some of which is returned to local service districts. There is a relationship between the recreation use levels, the services required, and tax revenues that would accrue to these services.
- Effects of projects on the local residents' quality of life – Local residents enjoy the recreational benefits that the projects provide, but also feel the effects of recreational visitors in their neighborhoods. Issues such as trash, overflow parking, security, privacy, and vandalism are addressed.



- Effects of project operations on downstream flood management – Life and property in the Lewis River valley below Merwin Dam are periodically threatened by flooding, which affects property values.

### 3.11.2 Affected Environment

The primary areas that experience socioeconomic impacts from the Lewis River Projects are the small rural communities of Ariel, Cougar, Woodland, Yale, Northwoods, Yacolt, and Amboy. The first four (Ariel, Cougar, Woodland, Yale) are in Cowlitz County; Northwoods is in Skamania County; and Yacolt and Amboy are in Clark County. All of Cowlitz County is also considered a primary affected area due to the importance of the projects to Cowlitz PUD and the role that Cowlitz PUD plays as the electrical utility for residences and businesses in the county. The affected communities identified above are small towns located in or near the rural Lewis River valley for which detailed statistical data are not readily available. Therefore, a focused study area defined by four census tracts is used for presentation of demographic statistics.

#### 3.11.2.1 Population and Demographics

As shown in Table 3.11-1, the 2000 census placed the 2000 population of Clark County at 345,238, a 45 percent increase in population since the 1990 census (Census Bureau 1991, 2001). Clark County has been one of the fastest-growing counties in the state for the past two decades and has gained attention as one of the faster growing areas on the national level. Current growth in Clark County is occurring principally along the urban fringe of Vancouver, located at the opposite end of the county from the Lewis River valley, but rural areas of the county are experiencing high growth levels as well. Vancouver is the largest city in Clark County.

**Table 3.11-1. Recent growth rates in project vicinity.**

| Jurisdiction       | 1990 Population | 2000 Population | Percent Growth |
|--------------------|-----------------|-----------------|----------------|
| Clark County       | 238,053         | 345,238         | 45.0%          |
| Cowlitz County     | 81,119          | 92,948          | 14.6%          |
| Skamania County    | 8,289           | 9,872           | 19.1%          |
| Lewis River Valley | 18,126          | 27,231          | 50.2%          |

Source: Census Bureau 2001

For Cowlitz County, the 2000 population was 92,948 persons, an increase of 13 percent from 1990 (Census Bureau 1991, 2001). The restructuring of the timber industry caused the population to decline and stagnate during the 1980s. While population growth was positive during the 1990s, it was less than the overall statewide growth rate. Woodland, the largest community in the study area, is the third largest city in Cowlitz County, behind the cities of Kelso and Longview.

In Skamania County, most of the population is located in the Columbia River Gorge area, far from the Lewis River. The Lewis River valley is separated from the rest of Skamania County by large areas of forest lands, consisting predominantly of National Forest.

Skamania County experienced moderate growth during the decade of the 1990s, with a countywide population increase of 19 percent (Census Bureau 1991, 2001).

The four census tracts in the Lewis River valley had a 2000 population of 27,231. This represents an increase of 50 percent over 1990 population levels, for an annual growth rate of almost five percent, very high for a rural area with no major employers in the vicinity (Table 3.11-1). Of this total, 70 percent reside in Clark County and 30 percent reside in Cowlitz County. Less than one-half of one percent reside in Skamania County. The Clark County portion of the Lewis River valley has a population of 19,092, an increase of 52 percent since the 1990 census, accounting for 5.5 percent of the total Clark County population in 2000. That portion of the Lewis River valley in Cowlitz County had a population of 8,056 (48 percent growth since 1990), accounting for 8.7 percent of the total Cowlitz County population in 2000. The study area includes only 83 persons in Skamania County, accounting for just 0.3 percent of the study area population and less than one percent of the total Skamania County population in 2000.

Table 3.11-2 details population projections for each of the three counties in the study area, as well as the state as a whole. This table indicates that the steady growth occurring in this region is projected to continue until at least the year 2020. Since these three counties are also the place of residence for the majority of visitors (70 percent) to the study area (EDAW 2000), their population trends will influence potential growth in demand for recreation activities provided at the projects. Additionally, a significant proportion (23 percent) of the visitors are residents from the Portland, Oregon metropolitan area (EDAW 2000), which is expected to experience increases in population similar to those in Clark, Cowlitz, and Skamania counties.

**Table 3.11-2. Population estimates and forecasts for selected areas of Washington.**

| Area             | 1999 Population | Estimated 2020 Population | 1999-2020 Population Change (percent) |
|------------------|-----------------|---------------------------|---------------------------------------|
| Washington State | 5,757,400       | 7,610,089                 | +32.2                                 |
| Cowlitz County   | 94,100          | 134,122                   | +42.5                                 |
| Clark County     | 337,000         | 425,502                   | +26.3                                 |
| Skamania County  | 9,900           | 12,809                    | +29.4                                 |

Source: OFM 1999.

### 3.11.2.2 Labor Force and Employment

Unemployment rates in Clark County have consistently hovered around four to seven percent over the past decade (see Table 3.11-3) but have risen sharply in recent years partly due to volatile and rising energy prices, which has affected such basic manufacturing sectors as the aluminum industry. Historically, the county depended on wood products as the key industry; however, since the decline of the timber industry in the early 1980s, the economy has rebounded with new industries locating in the county. Clark County was chosen as the site for a number of high technology operations. Many of these operations are currently feeling the impacts of the general slump in the high technology sector and low demand for their products.

**Table 3.11-3. 2000 and 2002 labor force and employment estimates for Clark, Cowlitz, and Skamania counties.**

|                           | 2000         |                |                 | 2002         |                |                 |
|---------------------------|--------------|----------------|-----------------|--------------|----------------|-----------------|
|                           | Clark County | Cowlitz County | Skamania County | Clark County | Cowlitz County | Skamania County |
| Total Labor Force         | 179,700      | 41,060         | 4,020           | 181,900      | 39,490         | 3,850           |
| Total Employment          | 170,900      | 37,890         | 3,660           | 166,800      | 35,410         | 3,520           |
| Total Unemployment        | 8,800        | 3,170          | 360             | 15,100       | 4,080          | 330             |
| Average Unemployment Rate | 4.9%         | 7.7%           | 8.9%            | 8.3%         | 10.5%          | 8.5%            |

Source: State of Washington 2000, 2002.

Unemployment in Cowlitz County has largely followed trends similar to those in Clark County. Traditional manufacturing, however, has maintained a larger employment base in Cowlitz County. The restructuring and modernization of the timber industry eliminated a large number of jobs, resulting in a jobless rate that hovers just above the statewide average. Since the early 1990s, there has been significant expansion in the labor force due to population growth, the stabilization of timber jobs, and the attraction of new industries, all contributing to the relative health of the Cowlitz County economy through the 1990s. However, with the economic downturn over the past several years, county unemployment rates are up sharply.

None of these manufacturing operations are present in the Lewis River valley, however. Basic manufacturing and other employment centers in Clark and Cowlitz counties tend to be based close to the Columbia River, in or near cities such as Kelso, Longview, Vancouver, and Camas. The Lewis River area remains remote and rural. Employment is principally related to exploitation of rural resources, including the wood products industry, and recreation and tourism.

#### Lewis River Projects Employment

PacifiCorp has 25 employees at the projects, with an additional four seasonal employees. Lewis River recreation operations provide seasonal jobs for approximately 42 campground hosts and maintenance personnel under contract with Thousand Trails, up from 33 seasonal employees as recently as 2000. Cowlitz PUD employs 143 people at its offices in Longview, including one full-time equivalent for relicensing/license compliance, and up to two full-time equivalents for other activities related to the Swift No. 2 Project.

Three fish hatcheries operate along the Lewis River. These hatcheries are operated by WDFW with funding by PacifiCorp and Cowlitz PUD. Operation of the fish hatcheries currently provides employment for 20 to 25 people.

Existing recreation within the project boundary includes campgrounds at Swift, Beaver Bay, Cougar, and Cresap Bay (totaling 259 campsites); day use recreation at Merwin Park, Speelyai Park, Cougar Park, Eagle Cliff Park, Saddle Dam, and Yale Park (totaling 270 picnic sites); seven boat ramps on the reservoirs and five boat launch sites on the

river operated by PacifiCorp; and numerous dispersed sites in the basin. Annual recreation use is estimated at 594,000 visitors per season for all recreation sites. These facilities provide seasonal jobs for approximately 42 campground hosts and maintenance personnel under contract with Thousand Trails.

### Local Retail Trends

To support the increasing demand of visitors traveling to the Mount St. Helens National Monument, the GPNF, and project-related recreation facilities and reservoirs, private sector development along Lewis River Road (SR 503) has increased steadily over the years. In addition to the PacifiCorp-owned and operated campgrounds and day use areas on the project reservoirs and lower Lewis River, there are a few private campground facilities in the vicinity, the majority catering to RV campers desiring hookups. The Lewis River RV Park offers 70 campsites adjacent to Lewis River Road. Several campsites are offered in the immediate vicinity of the town of Cougar as well, including the Cougar RV Park (18 campsites) and the Lone Fir Resort and Trailer Park (32 campsites). A few smaller motels and bed and breakfast establishments, such as the Lone Fir Resort (17 motel rooms), operate along Lewis River Road, in Woodland, Ariel, and Cougar.

A variety of other private businesses support visitor activity in the Lewis River basin as well. Several restaurants and services are dependant on recreation-related traffic in the vicinity of the projects, with the majority of their revenues occurring during the peak summer recreation season. General stores selling food, gas, recreation equipment, souvenirs, guidebooks and maps, and local crafts are concentrated in the town of Cougar. Jack's Restaurant and Store, at the intersection of SR 503 and the SR 503 Spur, is the location of the USFS Climber Registration for ascents of Mount St. Helens. Farther west, developed facilities such as hotels, motels, and larger stores are concentrated in the Woodland area. The Merwin Project is approximately a 20- to 30-minute drive from Woodland, while the Swift Project is approximately one hour from Woodland. Although somewhat distant from the projects, Woodland is important as a major gateway into the Lewis River valley from I-5, and project visitors are an important source of revenue for Woodland businesses. Based on sales patterns and discussions with management, it is clear that much of the strategy of these businesses is recreation-driven. Various factors including weather patterns, conditions in the Monument and GPNF, and operations of the projects that affect visitors' recreation experience can have a substantial effect on their revenues.

#### 3.11.2.3 Housing

As of the 2000 census, the Lewis River valley had 9,126 occupied housing units, a 49 percent increase in occupied housing units since the 1990 census. Of these, approximately 75 percent are located in Clark County, and most of the remainder are located in Cowlitz County. Approximately 367 units of private housing are located in Skamania County, in the Northwoods/Swift Creek Reservoir area. Nearly all of these (339 units) have been constructed since 1990. Most are second family units, with very few being rented or owner-occupied, according to census records. Approximately 83

percent of the occupied housing units in the Lewis River valley were owner-occupied, with the remaining 17 percent renter-occupied (Table 3.11-4).

**Table 3.11-4. 2000 occupancy status by area.**

|                         | Renter Occupied |         | Owner-Occupied |         | Vacant | Total Units |
|-------------------------|-----------------|---------|----------------|---------|--------|-------------|
|                         | Total Units     | Percent | Total Units    | Percent |        |             |
| Clark County            | 42,454          | 33%     | 87,609         | 67%     | 3%     | 134,032     |
| Cowlitz County          | 11,598          | 32%     | 24,252         | 68%     | 7.1%   | 38,594      |
| Skamania County         | 980             | 26%     | 2,775          | 74%     | 17.9%  | 4,576       |
| Lewis River Valley Area | 1,529           | 17%     | 7,595          | 83%     | 9.5%   | 10,081      |

Source: Census Bureau 2001.

### 3.11.2.4 Public Services

#### Public Safety

PacifiCorp contracts with private security personnel for the projects, who assist with security issues and crowd control. PacifiCorp also contracts with the Cowlitz County Sheriff's Office, which provides one to two land-based officers on weekends and holidays to patrol Cowlitz County land bordering Lake Merwin and Yale Lake. At Swift Creek Reservoir, PacifiCorp employs private security personnel only; there are no additional land-based patrols by county law enforcement personnel. Current use levels at Swift Creek Reservoir are comparatively low and do not warrant additional service at this time. Private security personnel hired and administered by PacifiCorp are staffed at variable levels of two employees for three days in the middle of the week, and three employees for the other four days a week through the summer months.

There are no permanent law enforcement facilities in the Lewis River valley. The Cowlitz County Sheriff's Office deputies work from their vehicles, using the Kelso Station as their base of operations. Recreational facilities associated with the projects generate demand for law enforcement services. Seasonal operations from approximately Memorial Day to Labor Day, defines the peak operations period for the Cowlitz County Sheriff's Office during the summer months. The Clark and Cowlitz County Sheriff's Office rely on a combination of an extensive use of overtime and the assistance of private security forces to meet the additional summer demand. PacifiCorp pays the Cowlitz County Sheriff's Office for overtime salaries and hires private security personnel during the peak recreation season to supplement law enforcement. The Washington State Patrol has jurisdiction for patrolling SR 503 and SR 503 Spur, the main travel routes through the project area.

Additional law enforcement is provided on the reservoirs by Marine Patrol Deputies in patrol boats. The Clark County Sheriff's Office maintains a patrol boat on the water on variable weekends and weekdays. In 1999, they issued 61 citations to Lake Merwin visitors and 105 citations to Yale Lake visitors. These citations were issued for violations related to boat speed, personal floatation device usage, illegal fires, fishing regulations, water-skiing/PWC use, and intoxication. The Cowlitz County Sheriff's Office also

conducts boat patrols of the reservoirs through the summer, although these are not regularly scheduled. Patrols typically coincide with good weather patterns when recreational boat traffic is highest. Swift Creek Reservoir does not have similar Marine Patrol enforcement at this time due to its lower use levels.

### Fire Protection

There are four Fire Protection Districts within the vicinity of the projects, principally staffed by volunteers. These include Cowlitz Fire Protection District (FPD) No. 1, Cowlitz-Skamania FPD No. 7, Clark County FPD No. 10, and Skamania County FPD No. 6. The majority of the Lewis River valley is protected by Cowlitz-Skamania FPD No. 7, an all-volunteer force of approximately 40 individuals, which covers the north side of Yale Lake and Swift Creek Reservoir. Cowlitz District No. 1 provides fire protection coverage to the area around Merwin Dam and along the north side of Lake Merwin, while Clark County Fire District No. 10 provides protection along the south side of the reservoirs and the Lewis River. Although Clark County Fire District No. 10 is technically responsible for the south side of Merwin Dam and the powerhouse, there is no access to these facilities from Clark County. Cowlitz District No. 1 would respond to a call to this facility. Skamania County Fire Protection District No. 6 covers some of the eastern project area.

A gap in fire protection districts exists in Skamania County. An area approximately eight miles along FR 90 is outside the district boundaries of both Cowlitz-Skamania FPD No. 7 and Skamania No. 6. In addition, the Marble Mountain neighborhood along FR 9015 is outside of any fire protection district. For the moment, Cowlitz-Skamania FPD No. 7 responds to calls in those areas but receives no property tax monies to cover those services. Funding for fire protection services comes from property taxes and, in the case of the public utility districts, privilege taxes in lieu of property taxes.

A substantial portion of the fire district responses are directly or indirectly related to the projects. Emergency service calls typically comprise 85 percent of call response activity during the course of the year for Fire District No. 7, which estimates that 54 percent assist recreation visitors in the project area, although not all recreation activities are project-related. About 33 calls per year are made to the recreation facilities on the reservoirs or river (pers. comm., D. Stuart, 2/16/01). These services cannot be funded by user fees as state law prevents fire districts from imposing direct charges for services rendered.

### Emergency Services

Emergency services in the area are provided by North Country Emergency Medical Services (NCEMS), based in the Yacolt Fire Station, and the various regional fire departments. NCEMS is the only organization that provides hospital transport and advanced life support in the study area (pers. comm., D. O'Brien, 2/15/02). The four fire departments provide basic life support and first-responder capability to support NCEMS. An auxiliary station adjacent to the Cresap Bay Campground entrance is staffed on weekends in the summer, from Memorial Day until Labor Day. The facilities at the Cresap Bay Station were donated by PacifiCorp to NCEMS and house an ambulance

(NCEMS), a fire engine (Fire District No. 7), and a patrol boat (Clark County Sheriff's Marine Patrol).

Schools

There are no school properties affected by the projects, nor are there any direct payments made to local school districts (pers. comm., K. Griffin, 3/1/01). School districts throughout the project area benefit indirectly from property taxes and/or utility taxes paid by PacifiCorp and Cowlitz PUD.

Electrical Utilities

Cowlitz PUD is the electric service provider for Cowlitz County. All ratepayers in Cowlitz County purchase electric power from Cowlitz PUD, with a few exceptions for some residential customers nearer to adjoining utility service areas and a few large industrial users. Cowlitz PUD currently offers favorable electric rates to its customers, with a rate structure less than the average of the state's 18 utilities. Table 3.11-5 compares 2002 residential rates of a number of northwest utilities.

**Table 3.11-5. Comparison of Northwest utility electricity rates for 2002.**

| <b>Electric Utility</b>        | <b>Cost for 1,500 kWh</b> | <b>Average Cost per kWh</b> |
|--------------------------------|---------------------------|-----------------------------|
| Douglas PUD                    | \$35.64                   | 2.38¢                       |
| Chelan PUD                     | \$42.15                   | 2.81¢                       |
| Pend Oreille PUD               | \$58.50                   | 3.9¢                        |
| Clatskanie PUD (Clatskanie)    | \$59.25                   | 3.95¢                       |
| Grant PUD                      | \$63.23                   | 4.21¢                       |
| <b>PacifiCorp - Washington</b> | <b>\$66.90</b>            | <b>4.46</b>                 |
| Lewis PUD                      | \$72.75                   | 4.85¢                       |
| Clatskanie PUD (Rainier)       | \$74.25                   | 4.95¢                       |
| Okanogan PUD                   | \$76.00                   | 5.07¢                       |
| <b>Cowlitz PUD</b>             | <b>\$76.80</b>            | <b>5.12¢</b>                |
| City of Richland               | \$81.00                   | 5.4¢                        |
| Puget Sound Energy             | \$90.53                   | 6.04¢                       |
| Mason PUD (No. 3)              | \$91.20                   | 6.08¢                       |
| Tacoma Power                   | \$91.85                   | 6.12¢                       |
| All Washington PUD customers * | \$99.00                   | 6.6¢                        |
| Clallam PUD                    | \$102.36                  | 6.82¢                       |
| Eugene Water & Electric Board  | \$104.30                  | 6.95¢                       |
| Seattle City Light             | \$112.03                  | 7.47¢                       |
| Portland General Electric      | \$113.15                  | 7.54¢                       |
| Klickitat PUD                  | \$114.01                  | 7.6¢                        |
| Benton PUD                     | \$113.70                  | 7.58¢                       |
| Grays Harbor PUD               | \$114.85                  | 7.66¢                       |
| Clark Public Utilities         | \$116.80                  | 7.79¢                       |
| Snohomish PUD                  | \$117.85                  | 7.86¢                       |
| Franklin PUD                   | \$117.85                  | 7.86¢                       |

\* Based on reported average residential electric sales in 2002 and Energy Information Administration form 861, Final 2002.

As a public utility, Cowlitz PUD is a BPA preference customer. Excluding unusual load growth, BPA is required by law to meet Cowlitz PUD's needs in excess of the assured

capability from Swift No. 2, the PUD's only generation resource. Cowlitz PUD currently obtains approximately 90 percent of its power for its residential, commercial, and small industrial customers from the BPA. Another 5 percent of its power mix for these customers comes from Grant County PUD's Priest Rapids/Wanapum Project, and the final 5 percent is from the Swift No. 2 Project. Swift No. 2 is used as a load following plant in times of maximum power demand, and can therefore provide up to 30 percent of the load peaking needs of the residential, commercial, and smaller industrial customers in Cowlitz County (pers. comm., D. MacDonald, Cowlitz County PUD, 3/2/01). No power from the Swift No. 2 Project is allocated to the PUD's largest industrial customers, such as Weyerhaeuser. Pursuant to Cowlitz PUD's Partial Requirements contract, the Swift No. 2 power may not be sold into the open market.

As shown in Table 3.11-6, Cowlitz PUD had eight major customer groups and 44,361 accounts as of the end of 2000. The single largest account is Weyerhaeuser Company, which contracts for more than half of Cowlitz PUD's load. Weyerhaeuser is also the largest employer in Cowlitz County, with 2,400 employees (River Cities Chamber of Commerce 2001).

**Table 3.11-6. Cowlitz PUD and PacifiCorp customer base.**

| Type                              | Number of Customers |                  |
|-----------------------------------|---------------------|------------------|
|                                   | Cowlitz PUD         | PacifiCorp       |
| Residential                       | 39,188              | 1,262,293        |
| Commercial lighting and power     | 5,047               | -                |
| Small commercial or industrial    | -                   | 175,420          |
| Small industrial                  | 58                  | -                |
| Large industrial                  | 24                  | 35,004           |
| Public streets and highways       | 12                  | 4,218            |
| Other sales to public authorities | 20                  | 28               |
| Sales to other electric utilities | 2                   | -                |
| Inter-departmental sales          | 10                  | -                |
| <b>TOTALS</b>                     | <b>44,361</b>       | <b>1,476,963</b> |

Source: pers. comm., D. MacDonald, 3/2/01; PacifiCorp 2000.

PacifiCorp has a much larger customer base than the PUD, with approximately 1.5 million customers throughout six western states (Table 3.11-6). The majority of these are residential customers. The power generated by PacifiCorp on the Lewis River goes into their overall power mix, which in turn is distributed throughout the west. The Lewis River Projects are only a portion of PacifiCorp's overall generating capacity within their service area but provide a significant portion of load following and auxiliary benefits as described in Section 1.2.1. For 2002, PacifiCorp's electricity rates were lower than the average rate (\$66.90 for 1,500 kWh) of the 24 Northwest utilities, most of which are public utility districts, as seen in Table 3.11-5.

### 3.11.2.5 Tax Revenues

#### Property/Utility Tax Revenues

The projects generate tax revenues that help support public services in the Lewis River valley. A primary purpose of property taxes is to provide local governments with the



necessary funds to provide public services, including fire and police protection, education, and infrastructure development and maintenance, as well as other basic human services. The majority of the human service demand generated by the projects, consisting of law enforcement and emergency response services, is driven by recreation-oriented visitation during the period from Memorial Day to Labor Day.

As a private corporation, PacifiCorp pays a state property tax on its lands and facilities. Revenues are distributed to the counties based on project valuation. Total 1999 property tax payments by PacifiCorp on the Lewis River facilities were \$1.38 million, distributed as follows: Clark County received \$680,956; Cowlitz County received \$388,467; and Skamania County received \$316,626.

As a Public Utility District, under state law Cowlitz PUD pays a Generation Privilege Tax directly to the State of Washington on power generated, rather than paying property taxes on its lands and facilities. A portion of this tax is then rebated to those counties where the power facilities are located. For the 1999 tax year, the PUD paid a total of \$1.39 million in privilege taxes, of which \$0.78 million was rebated to Cowlitz County. Payments to Clark and Skamania counties were negligible. Table 3.11-7 presents combined tax payments from Cowlitz PUD and PacifiCorp to Washington State and the three counties affected by the projects.

**Table 3.11-7. Combined Cowlitz PUD and PacifiCorp tax payment in 1999<sup>1</sup>.**

| County                                     | Tax Revenue            | % of Total Taxes Paid |
|--|------------------------|-----------------------|
| State of Washington                        |                        |                       |
| ▪ Cowlitz PUD Privilege Tax                | \$613,428 <sup>4</sup> | 22.1%                 |
| Cowlitz County (incl. cities)              |                        |                       |
| ▪ Cowlitz PUD Privilege Tax                | \$779,919 <sup>2</sup> |                       |
| ▪ PacifiCorp                               | \$388,467 <sup>3</sup> |                       |
| Subtotal                                   | \$1,168,386            | 42.0%                 |
| Clark                                      |                        |                       |
| ▪ Cowlitz PUD Privilege Tax                | \$513 <sup>4</sup>     |                       |
| ▪ PacifiCorp                               | \$680,956 <sup>3</sup> |                       |
| Subtotal                                   | \$681,469              | 24.5%                 |
| Skamania                                   |                        |                       |
| ▪ Cowlitz PUD Privilege Tax                | \$131 <sup>4</sup>     |                       |
| ▪ PacifiCorp                               | \$316,626 <sup>3</sup> |                       |
| Subtotal                                   | \$316,757              | 11.4%                 |
| <b>Total Combined Project Taxes – 1999</b> | <b>\$2,780,084</b>     | <b>100%</b>           |

<sup>1</sup> The PUD tax payments to the State are reflective of the entire revenue of the PUD, of which the Swift No. 2 Project is only a small part.

<sup>2</sup> Source: Cowlitz County Treasurer

<sup>3</sup> Source: Provided by PacifiCorp

<sup>4</sup> Source: Washington State Department of Revenue

### Sales Tax Revenues from Recreation-related Spending

Spending associated with recreation-related activities generates a substantial amount of economic activity across the U.S. (USFWS and Bureau of the Census 1996). Participants spend money on a variety of trip-related goods and services such as food, lodging, and transportation. Because this spending directly benefits towns and communities where these purchases are made, recreation can have a significant impact on local economies, especially in small towns and rural areas such as the project area (USFWS and Bureau of the Census 1996). To identify an approximate value of this benefit, estimates for the total annual sales associated with the projects' recreation activity and the resultant sales tax revenue for Cowlitz County were made (EDAW 2001), indicating annual expenditures in the study area to be \$1.09 million. It was estimated that local sales tax distributed to Cowlitz County as a result of recreation-related expenditures in the project area is approximately \$109,000, based on a conservative estimate of daily expenditure rates by visitors when estimating actual expenditures. In actual practice, annual revenue probably fluctuates widely, as visitation can vary widely from year to year.

#### 3.11.2.6 Flood Management

Life and property values in the Lewis River valley below Merwin Dam are periodically threatened by flooding. Floods causing significant damage are expected to occur about once every 25 years on average. Flood hazard is currently managed through flood management operation of the Lewis River Projects, issuance of flood notifications and warnings, and regulatory restrictions on development and land use in areas affected by flooding.

Assessment of the socioeconomic impact of current flood management practices was based on the flood damage experienced during the severe flood of February 1996. No estimates are available of the dollar value of flood damages experienced in this event; however, information is available on the area inundated by flood waters and the number of dwellings or businesses affected. Under existing flood management operations at the Lewis River Projects, it is estimated that some 250 homes and businesses on the mainstem Lewis River below Merwin Dam were flooded to levels above their finished floor levels. An unknown number of additional outbuildings, barns, sheds, and other structures also suffered some degree of flood damage.

During flood events, considerable coordination takes place among PacifiCorp, the National Weather Service, Clark County and Cowlitz County emergency services, the City of Woodland, and, in very severe events, the U.S. Army Corps of Engineers. The National Weather Service provides PacifiCorp with forecasts of project inflows on a regular basis during flood conditions. PacifiCorp uses this information as guidance for project operations and notifies the National Weather Service and county and local government agencies of actual or expected large releases from Merwin Dam. The National Weather Service then forecasts flood conditions in the lower Lewis River valley. The National Weather Service and the relevant county and local government agencies are responsible for issuing notifications and flood warnings to the public. If the

situation warrants, the county emergency services and local government agencies may initiate evacuations.

A number of significant improvements have been made to notification and warning procedures since the February 1996 flood. These include improved flow forecast procedures and improved public access to real-time streamflow and reservoir conditions. PacifiCorp provided funding to the National Weather Service to install a radio transmitter for broadcasts to Lewis River valley residents that previously were in a reception shadow.

New development in areas prone to flooding is regulated by Clark County, Cowlitz County, and the City of Woodland to meet the minimum requirements established by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program. These requirements essentially prohibit new development within the regulatory floodway and require that new structures built within the 100-year floodplain outside the floodway have finished floor elevations one foot above the 100-year water surface elevation.

### 3.11.3 Effects of Alternatives

#### 3.11.3.1 Alternative A

#### Project Economics and Utility Rates

Under this alternative (existing conditions), both PacifiCorp and Cowlitz PUD would continue to operate the projects as they do under their current licenses. No new environmental protection, mitigation, or enhancement measures would be implemented, although existing environmental measures (such as funding for the Speelyai Hatchery) would continue. Thus, utility rates would be unaffected by new protection, mitigation, or enhancement measures. For this alternative, the Levelized Annual Net Benefit of the projects is approximately \$36.6 million for PacifiCorp. For Cowlitz PUD, the Levelized Annual Net Benefit averaged over 50 years is \$8.0 million in average water years and \$5.5 million in low water years. When evaluated over 30 years, the Cowlitz PUD Levelized Annual Net Benefit is \$4.1 million in average water years and \$2.3 million in low water years. First year annual net benefits of Swift No. 2 under average water conditions would be \$1,545,440 and \$297,720 under low water conditions.

#### Local Economic Conditions

Three fish hatcheries along the Lewis River are operated by WDFW with funding by PacifiCorp and Cowlitz PUD and currently employ 20 to 25 people. Since no new hatchery construction would occur under Alternative A, no new employment would be expected. This level of employment would be expected to continue through the license period. This alternative would not alter socioeconomic conditions.

Existing recreation within the project boundary provides seasonal jobs for approximately 42 campground hosts and maintenance personnel under contract with Thousand Trails. Since no significant changes to recreation facilities are proposed under this alternative, no

major changes to employment are anticipated. Employment is expected to gradually increase as general visitation levels increase.

Private sector recreation development in the vicinity of the projects has increased over recent years. Without new project recreation facilities, gradual increases in visitor levels over time would allow local businesses to provide additional campsites, RV sites, and other visitor services; however, the increase in demand for local services is likely to be less in Alternative A than the other alternatives, since no new project-sponsored recreation opportunities are being provided in Alternative A.

### Emergency Services

Annual recreation use, estimated at 594,000 visitors per season for all recreation sites, is expected to increase over time as populations increase. This visitation level requires public services for law enforcement, fire protection, and emergency services, which are provided by the Cowlitz County Sheriff's Office, four FPDs, and the NCEMS. PacifiCorp also pays the Sheriff's Office for overtime salaries and hires private security personnel through the peak recreation season to supplement the publicly funded efforts. Public services are funded through property and utility tax revenues that accrue to the state, a portion of which is returned to the counties and then to their service providers. Revenues are distributed to the counties on the basis of project valuation, not on the actual services provided.

As a practical matter, access to the project is not available from Clark County for service from Clark County Fire District No. 10 so Cowlitz Skamania FPD No. 7 provides all fire response services. As a result, there is a concern by Cowlitz Skamania FPD No. 7 and NCEMS that the increasing need for services due to recreation is outstripping tax revenue growth to these agencies (pers. comm. D. O'Brien, 2/15/01). Since no changes to recreation facilities are proposed under this alternative, the only change to service demand would result from a gradual minor increase in visitation levels at the existing facilities. However, revenues generated by the projects would likely decrease gradually under this alternative as the projects' valuation decreases. The long-term effect would be further strain on local fire and emergency services.

### Local Residents' Quality of Life

The quality of life of local residents in the project area is both enhanced and adversely affected by the existence of the project facilities, their operation, and their recreation facilities. On the positive side, the project facilities provide scenic reservoirs and flood management to the area, reducing the frequency of damaging floods from once in five years to once in 25 years. Together, the enhanced scenery and reduction of flooding increase property values and support the development of surrounding residential areas. Operation of the projects also provides 25 local full-time jobs for employees who support the local economy through their purchases. Project recreation facilities, as well as project lands and the reservoirs themselves, provide a range of recreational opportunities for local residents in a rural area with very few public parks.

On the negative side, recreation visitors cause problems for local residents in the manner that they use the sites. Residents whose homes are located near entry points often feel the effects of careless visitors' illegal parking, dumping, and trash. Also, in an effort to control vandalism and inappropriate use of the recreation facilities, PacifiCorp has instituted a parking fee for day use areas that impacts local residents by imposing a charge for parking at areas that they view as part of their neighborhood.

Under Alternative A, no change to project facilities, operations, or recreation development is proposed. The projects would continue to provide the benefits and the adverse effects noted above. As visitor use increases over time, many of the existing problems would be expected to increase.

### Flood Management

Under Alternative A, flood management operations at the projects would continue to follow existing high runoff procedures, as described in Section 2.2.1.6, and floods that result in significant damage would be expected to continue to occur about once every 25 years on average. Flood notification procedures and regulatory restrictions on land use within flood-prone areas would continue to follow existing practices. Under this alternative, no change to flood management procedures or flood warning systems would occur. Residents and property in the Lewis River valley would be affected by flooding events over the next 30 years at a frequency similar to that which has occurred over the last 30 years.

New development is likely to occur in flood-prone areas of the Lewis River valley within the 100-year floodplain. County and city regulations currently require such development to meet the minimum standards established under the National Flood Insurance Program (e.g., finished floor levels one foot above the 100-year floodplain level). Unless the County establishes more stringent floodplain regulations, new development would continue to expose additional lives and property to potential flood hazards.

#### 3.11.3.2 Alternative B

### Project Economics

Enhancement measures are proposed to address many of the environmental issues in the alternatives, as described in Section 2. These measures not only incur direct costs for PacifiCorp and Cowlitz PUD, but also they affect the costs of operation and maintenance activities and, in some cases, the amount of power that can be produced. This analysis considers these costs in terms of the economic viability of the project, based on the Developmental Analysis presented in Section 4.

Under Alternative B, the most significant costs are for fish, recreation, and terrestrial resources. Fish passage improvements and costs for continued operation of the hatcheries are estimated at \$66.8 million in capital costs and about \$1.8 million in operation and maintenance (O&M) costs. Costs for recreation improvements totaled over 30 years are estimated at \$15 million with \$598,500 in annual O&M. Enhancements for

terrestrial resources are estimated at \$1.3 million in capital costs and \$356,000 in O&M costs. Annual generation would be reduced slightly by changes in operations and flow regimes. The net result of the increased costs and reduced generation is a Levelized Annual Net Benefit of the projects of \$29.9 million for PacifiCorp, a reduction of 18 percent. For Cowlitz PUD, when evaluated over 50 years, the Levelized Annual Net Benefit would be \$6.9 million for average water years (a 13 percent reduction) and \$4.5 million (a 19 percent reduction) for low water years. When levelized over 30 years, this amount is reduced to \$3.0 million for average water years (a 25 percent reduction) and \$1.3 million for low water years (a 45 percent reduction). Based on first year costs, the annual net benefit of Swift No. 2 under Alternative B in average water year conditions would be \$657,000 and in a low water year would be a negative \$590,000.

### Utility Rates

For PacifiCorp customers, the increased costs of operating the projects and providing environmental measures may substantially increase the costs of getting power out of the Lewis River Projects. However, these costs are only one of many factors in determining consumer utility rates. Costs to PacifiCorp customers over their six-state service area are likely to increase as a result of relicensing under Alternative B. However, since these costs are distributed over such a large customer base, the level of impact is expected to be minor and would be substantially lower than alternative sources of power. The effect on the local or regional economy would not be significant.

For Cowlitz PUD customers, the increased costs of operating Swift No. 2 and providing environmental measures may effectively double or triple the costs of getting power from Swift No. 2. Further, the Swift No. 2 project represents about 20 to 30 percent of the power needed for their residential, commercial, and light industrial customers. As a public utility district, any increases in costs are passed to the consumer. Costs to Cowlitz PUD customers are likely to increase as a result of relicensing under Alternative B. It is difficult to predict the increase in Cowlitz PUD's rates because many factors affecting rates are undecided or unknown at this time. The effect on the general local economy cannot be predicted without further data on increases in customer rates. However, any future utility rate increase will have a negative impact on Cowlitz County, given the county's weak economy combined with Cowlitz PUD's 97 percent rate increase over the last three years in response to market conditions.

### Local Economic Conditions

Alternative B would involve the construction of a sorting facility and an improved entrance to the existing trap at Merwin Dam for upstream passage of adult fish and a floating surface collector at Swift Dam for downstream passage of juvenile fish, along with facilities for holding and trucking the fish. The estimated costs of these facilities are approximately \$6.0 million for the Merwin improvements and \$60.3 million for the facility at Swift. The equipment to be installed would require custom steel fabrication that most likely would be completed outside of the immediate area, possibly in Longview or, more likely, the Portland area. Thus, the labor related to fabrication would not support the Lewis River valley, but would support either Cowlitz County or the broader

regional economy. On-site construction labor is estimated to average approximately 112 construction workers per month for an 18- to 24-month period for these facilities. Since the construction work force would involve a number of different trades, an individual laborer is unlikely to be employed for the entire duration of construction. Given the limited duration of the construction period and the availability of construction workers within the adjacent three-county area, many of these workers are likely to commute to the site and/or stay in temporary housing such as campsites or RV parks for all or portions of their on-site work. Thus, the economic benefit of the additional employment and demand for housing, goods, and services would be dispersed among the three-county region.

Over the life of the new licenses, the trap-and-haul facilities would require crews to handle both upstream and downstream operations. A typical crew for the trap-and-haul facility would be two operators and one truck driver working a full-time 40-hour week for the full year. A typical crew for the surface collection facility would be two full-time workers. When the salmon are running at their peak returns (approximately three months of the year), temporary employees may be added. The regular workers are likely to be PacifiCorp employees, while the temporary employees may be hired locally. This would add a total of six PacifiCorp employees (five full-time and one seasonal) and a variable number of temporary employees to the local economy. This would represent an increase from 25 to 30 locally based full time PacifiCorp employees and from 42 to 43 project-related seasonal employees.

Under Alternative B, recreation facilities would be expanded by renovating and improving existing facilities, including picnic shelters, restrooms, and parking. New campsites would be added at Swift Forest Camp, Beaver Bay Campground, and Cougar Campground. Other new facilities would focus on trails, boat launches, day use facilities, and partial funding of a new Visitor Information Center at Cougar. This overall facility upgrade and construction program is estimated to cost approximately \$13.5 million in current dollars and would be implemented over a 30-year period, for an average of \$567,000 per year beginning shortly after the license orders are accepted. In actual practice, construction budgets would vary from year-to-year. Most campground expansion would occur during the second and third ten-year periods of the new license, based on increased demand. This limited level of construction would likely require only two to six laborers per season, on limited projects, over the 30-year construction period. Given the limited number of construction workers needed and the availability of construction workers within the adjacent three-county area, these workers are likely to commute to the site and/or stay in temporary housing such as campsites or RV parks for all or portions of the duration of the construction period. Thus, the economic benefit of the additional employment and demand for housing, goods and services would be limited and would be dispersed among the three-county region.

This alternative would provide many new facilities, including trails, boat launches, day use facilities, campgrounds, and the Visitor Information Center at Cougar (partial funding). The various new facilities would encourage higher use levels within the project – estimated at a 20 to 25 percent increase over current levels, or approximately 120,000 to 150,000 additional recreation days (over the anticipated term of the new license). This increase would support the economic development of the Lewis River valley, particularly

in Cougar, where the Visitor Information Center would induce travelers to stop. The center could orient visitors to events and commercial establishments throughout the valley. New operational employment associated with this alternative is estimated at approximately 9 seasonal employees for staffing the visitor center and for general maintenance. This represents an increase of 21 percent over the current level of 42 seasonal employees, if seasonal employees are hired. Alternatively, the visitor center could be staffed by volunteers.

### Emergency Services

Under Alternative B, recreation facilities would be expanded by renovating and improving existing facilities at existing parks and new campsites would be added, including picnic shelters, restrooms, and parking. These new facilities are estimated to cost approximately \$15 million and would be constructed over a 30-year period, with most campground expansion projects occurring during the second and third ten-year periods of the new license, based on monitoring.

The various new facilities would encourage higher use levels within the project – estimated at an approximately 20 to 25 percent increase over current levels, or approximately 120,000 to 150,000 additional recreation days. This increase would support the economic development of the Lewis River valley, increasing sales tax revenues and, if new development occurs, property tax revenues.

The increase in number of visitors could likely increase the need for public services, including law enforcement, fire protection, and emergency services, which are provided by the Cowlitz County Sheriff's Office, four FPDs, and the NCEMS. This alternative also expands existing marine patrols and land-based law enforcement as needed. The increased valuation of the project due to recreation and fish passage facilities, as well as other improvements, would increase property tax revenues. The increased revenues may offset the increased costs of service providers. This alternative is not expected to have a significant impact on public services and emergency services.

### Local Residents' Quality of Life

Under Alternative B, recreation facilities would be expanded by renovating and improving existing facilities at existing parks; new trails and campsites would be added at three locations; and a new Visitor Information Center at Cougar would be partially funded. The visitor center would encourage an estimated 20 to 25 percent increase in project area use over current levels, or approximately 120,000 to 150,000 additional recreation days (over the term of the new license). The adverse effects of additional visitors could be regulated by additional marine patrols and additional land-based law enforcement. Overall, Alternative B is expected to enhance local resident's quality of life.



## Flood Management

A package of measures to provide financial support to or otherwise facilitate improvements in flood notification systems and procedures would be provided under Alternative B. The proposed improvements could reduce flood risk (although amounts cannot be quantified) by allowing valley residents to keep themselves better informed of developing flood conditions and by improving lead times for flood warnings and evacuation notices. These measures include:

- Emergency Telephone Notification System – PacifiCorp would provide financial support to Clark County Regional Emergency Services Agency and Cowlitz County Department of Emergency Management for the acquisition and maintenance of a new emergency telephone notification service. This measure would facilitate dissemination of flood warnings and evacuation notices throughout the Lewis River valley, increasing warning and evacuation lead times and allowing residents additional time to protect property and livestock.
- Real-time Data – PacifiCorp would contribute to the cost of providing public access to real-time flow and reservoir storage data. Valley residents would be able to make better decisions about both evacuation and protection of property from flooding.
- Improved Coordination – PacifiCorp would take measures to improve coordination with emergency management officials and personnel. This would include organization of an annual agency meeting to discuss flood management operations for the preceding flood season, results of dam safety inspections, coordination of flood emergency action plans, and public outreach regarding flood management. Information would then be shared with the public. Improved coordination would enhance the efficiency of notification and emergency procedures and result in increased notification lead times.

Under Alternative B, the amount of dependable flood control storage would be maintained at the existing level of 70,000 acre-feet (17 feet of hole). However, project operations and high runoff procedures would be modified to take advantage of flow forecasts. This would include implementation of pre-release policies in anticipation of forecast high flow events. As a result of adopting pre-release procedures and other forecast-based operating policies, the magnitude of floods from about the five-year flood up to about the 50-year flood would be reduced, as summarized in Table 3.2-3. Under Alternative B, releases from Merwin Dam during an event similar to the February 1996 flood would be held to a peak flow of 60,000 cfs. (The actual peak discharge from Merwin Dam during this event was about 85,000 cfs.) This would significantly reduce flooding above finished floor levels for an event the magnitude of the 1996 flood. The increase in flood magnitude for two-year floods and smaller (Table 3.2-3) would have minimal adverse effect since flows at that level produce no known property damage to structures and would have little impact on access to residential property. The magnitude of very severe floods (those which occur about once every 100 years on average and less frequently) would be unchanged. The flood management season would be reduced by two weeks in years with below average March runoff forecasts (ending March 15 rather

than April 1) to facilitate refilling the reservoirs. Overall, Alternative B would reduce flood damages and inconvenience in the Lewis River valley below Merwin Dam for most flood events, and improve notification over existing conditions, thereby reducing impacts to life and property.

### 3.11.3.3 Alternative C

#### Project Economics

Under Alternative C, the most significant costs are for fish, recreation, and terrestrial resources. Costs for fish habitat, fish passage and improvements to the fish hatchery are estimated at \$130 million in capital costs and about \$3.5 million in O&M and lost generation costs. Costs for recreation improvements are the same as Alternative B and are estimated at \$15 million with \$598,500 in annual O&M. Enhancements for terrestrial resources are estimated at \$1.8 million in capital costs and \$556,000 in O&M costs. Annual generation would be reduced by changes in operations and flow regimes. The net result of the increased costs and reduced generation is a Levelized Annual Net Benefit of the projects of \$20 million for PacifiCorp, a reduction from existing levels of 45 percent. When calculated over 50 years, the Levelized Annual Net Benefit for Cowlitz PUD is \$3.5 million for an average water year (a 56 percent reduction) and \$2.4 million for a low water year (a 70 percent reduction). Over a 30-year period, Cowlitz PUD's Levelized Annual Net Benefit would be \$319,300 for an average water year (a 92 percent reduction) and a negative \$463,900 for a low water year (a 111 percent reduction). Based on first year costs, the annual net benefit of Swift No. 2 under Alternative C in average water year conditions would be a negative \$1,482,000 and in low water conditions would be a negative \$2,013,000.

#### Utility Rates

The enhancement measures under Alternative C not only incur direct costs for PacifiCorp and Cowlitz PUD, but they also affect the costs of operation and maintenance activities as summarized above and detailed in Section 4. This analysis considers these costs in terms of potential changes in utility rates to the consumer, based on the Developmental Analysis presented in Section 4.

Alternative C involves higher costs for enhancement measures, particularly fish passage and terrestrial resources, than Alternatives A and B. While the precise effects of these costs on utility rates are not available at this time, rate increases are likely to be substantially greater in Alternative C than Alternatives A and B.

For PacifiCorp customers, the increased costs of operating the projects and providing environmental measures may effectively double or triple the costs of getting power from the Lewis River Projects. However, these costs are only one of many factors in determining customer utility rates. Costs to PacifiCorp customers over their six-state service area are likely to increase as a result of relicensing under Alternative C. However, since these costs are distributed over such a large customer base, the level of

impact is expected to be minor and would be lower than alternative sources of power. The effect on the local or regional economy would not be significant.

For Cowlitz PUD customers, the increases costs of operating Swift No. 2 and providing environmental enhancement measures may effectively double or triple the costs of getting power from Swift No. 2. Further, the Swift No. 2 Project represents about 20 to 30 percent of the power needed for their residential, commercial, and light industrial customers. As a public utility district, any increases in costs are passed to the customer. Costs to Cowlitz PUD customers are likely to increase as a result of relicensing under Alternative C. It is difficult to predict the increase in the PUD's rates because many factors affecting rates are undecided or unknown at this time. The effect on the general local economy cannot be predicted without further data on increases in customer rates. However, any future utility rate increase will have a negative impact on the Cowlitz County economy, given the economy's weak condition, combined with Cowlitz PUD's 97 percent rate increase over the last three years in response to market conditions.

#### Local Economic Conditions

Under Alternative C, the Applicants propose to provide upstream passage by trapping fish below Merwin, Yale, and Swift No. 2 facilities and transporting them via a tram system for release in the next reservoir. For downstream passage, each dam would have a surface collector and sorting facility from which collected juveniles would be released below each dam. The new facilities proposed under this alternative are more numerous and more extensive than those proposed in Alternative B. The total cost for this system of fish passage facilities is estimated at nearly two times those of Alternative B, or a total of approximately \$129.7 million. This total includes \$43.1 million for three trap-and-tram facilities and \$86.6 million for the three surface collection facilities. As in Alternative B, the facilities would be fabricated off site, benefiting the larger region but not the immediate project area. Facilities initially would be constructed at Merwin and Swift, and then the additional facilities thereafter. Because various portions of the facilities could be constructed concurrently, the construction period is similar to that of Alternative B, and is estimated to total 36 to 48 months. The number of construction workers is estimated to be an average of 118 workers per day. This labor force would include a variety of different skills such that most workers would be needed for only a limited portion of this time. Given the limited duration of the construction period for individual skills and the availability of construction workers within the adjacent three-county area, these workers are likely to commute to the site and/or stay in temporary housing such as campsites or RV parks.

The total number of such workers over the three- to four-year construction period is sufficient to have an economic effect on the local area – both positive and negative. The positive economic benefit would be the additional employment opportunities in the area and the associated demand for housing, goods, and services. This estimated labor force would require an average monthly payroll of approximately \$1.2 million for the construction period. This payroll has a multiplier effect in terms of benefiting the local and regional economy through expenditures on housing, goods, and services. The potential negative effect of this economic boost is two-fold: (1) if local RV parks and

campgrounds that typically cater to tourists are full with construction workers for two to three recreation seasons, the tourists may develop interest in other locations and not return to the Lewis River basin; and (2) at the end of the construction period, the loss of construction workers may cause new or expanded businesses serving that labor force to layoff staff or to close.

Operationally, the expanded system of fish passage facilities would require more new employees than Alternative B. Each upstream facility would require a crew of two workers and one truck driver, and each downstream facility would require two workers. Thus, a total of 15 employees would be needed, for the three upstream and three downstream facilities. Additional temporary workers would be needed at peak times, assumed to be one per upstream facility, or 3 temporary workers. This would increase PacifiCorp's on-site full time employees from 25 to 40 and the seasonal employees from 42 to 45. Given the fairly high rates of unemployment in the area and the need for opportunities for unskilled labor, this would be a positive impact on the local economy. Additionally, locally based regular employment would increase the demand for local housing, goods, and services. The estimated payroll of \$780,000 for the 15 full-time staff and \$90,000 for the 3 seasonal workers would have a multiplier effect on the local economy through expenditures on housing, goods, and services.

Under Alternative C, recreation measures would be the same as described for Alternative B. Effects on the local economy would also be the same.

### Emergency Services

Under Alternative C, new recreation facilities would be developed and existing facilities expanded, as described for Alternative B. Costs and projected revenues also would be the same, as would the effects on the local economy.

The increase in number of visitors could likely increase the need for public services, including law enforcement, fire protection, and emergency services, which are provided by the Cowlitz County Sheriff's Office, four FPDs, and the NCEMS. This alternative also expands existing marine patrols and land-based law enforcement as needed. The increased valuation of the project due to recreation and fish passage facilities, as well as other improvements, would increase property tax revenues. The increased revenues may offset the increased costs of service providers. This alternative is not expected to have a significant impact on public services and emergency services.

### Local Residents' Quality of Life

Under Alternative C, recreation facility expansion and associated use levels would be the same as in Alternative B. The adverse effects of additional visitors would be regulated by additional marine patrols and additional land-based law enforcement. Overall, this alternative is expected to enhance local resident's quality of life.

### Flood Management

Under Alternative C, PacifiCorp would contribute to the same package of measures to improve flood notification systems and procedures as described for Alternative B. Project operations and high runoff procedures would also be identical to Alternative B, with the amount of dependable flood control storage maintained at the existing 70,000 acre-feet (17 feet of hole) and with project operations and high runoff procedures modified to take advantage of flow forecasts.

#### 3.11.4 Conclusion

Alternative A would not have the beneficial effects of new employment and added recreation visitors as shown in Alternatives B and C. Alternative A would adversely affect local service providers over the length of the license as gradually increasing needs for fire and emergency services for recreation visitors are not covered by the gradually decreasing revenues distributed by the state, due to the declining valuation of the PacifiCorp projects.

Neither Alternative B nor C have significant adverse effects on overall social and economic conditions, although rate increases in Cowlitz County would adversely affect local residential, commercial, and light industrial customers. Alternatives B and C both include measures to enhance the local economy by expanding recreation opportunities that would attract visitors and by constructing fish passage and recreation facilities that would provide additional construction and operations employment to the area. Local fire and emergency services would be supported through increased tax revenues related to project improvements. Alternative C would provide the most long-term employment of operations personnel at the three fish passage facilities.

### **3.12 CUMULATIVELY AFFECTED RESOURCES**

According to the Council on Environmental Quality's regulations for implementing NEPA (50CFR§1508.7), an action may cause cumulative impacts on the environment if its effects overlap in space or time with the effects of other past, present, or reasonably foreseeable future actions, regardless of the agency, company, or person undertaking the action. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. For the purposes of this analysis, an effect was considered cumulative if it occurred as a result of an interaction of a project and a non-project action. Two or more project actions that result in a cumulative effect are addressed as a direct or indirect project effect, and are described in the Environmental Consequences sections for each particular resource. The following non-project effects were considered in the cumulative effects analyses:

- Timber harvest on non-project lands
- Recreation activities on non-project lands
- Land development in Woodland
- Land development in rural areas
- Proposed Mount St. Helens loop road

- Ocean and river harvest of fish
- Hunting
- Management of ESA-listed species (e.g., northern spotted owl and various fish species)
- Collection of botanical resources important to Native Americans
- Anticipated population growth in the region

To present the cumulative effects analyses in a clear manner that promotes understanding of the complex issues, the descriptions in each resource section have been organized along the following format. Each cumulative effect description includes a statement identifying the non-project action and its associated effect; a statement identifying the related project action and its associated effect; and a description of the resulting incremental effect. Since the location, magnitude, and timing of many of the non-project actions are known with only a limited degree of certainty, the cumulative effects statements provide a general indication of the direction of the potential cumulative effect.

### 3.12.1 Geographic Scope

The spatial scope of analysis for cumulatively affected resources is defined by the physical limits or boundaries of: (1) the Lewis River Projects' effects on the resources; and (2) the contributing effects from other activities within the Lewis River watershed or the surrounding socioeconomic area. Because a proposed action may affect some resources differently, the spatial scope of analysis may vary slightly as noted within each resource area, but is generally considered to be the Lewis River watershed upstream from the confluence with the Columbia River.

### 3.12.2 Temporal Scope

The temporal scope of analyses for cumulative effects includes past, present, and future actions and their effects on each resource. For the purpose of this analysis, the temporal scope is 50 years into the future. The assessment of future actions is limited to actions that are reasonably foreseeable. Existing conditions, not historical conditions, are the baseline for comparison of alternatives. The inclusion of past actions is limited to available information, and provides an historical context from which the existing conditions have developed.

### 3.12.3 Cumulative Effects of Alternatives

#### 3.12.3.1 Geology and Soils

Erosion associated with past and continued timber harvest and development in the Lewis River basin delivers sediment to streams in the watershed. Ongoing erosion of reservoir shorelines and erosion associated with potential new project facilities could also be contributed to streams and reservoirs. The combined effects of project and non-project erosion, as well as sediment input from the 1980 eruption of Mount St. Helens (a natural condition), result in sediment accumulation in project reservoirs, a minor loss of reservoir capacity, minor loss of upland habitat, and moderately adverse effects to turbidity and

sediment supply. It is expected that changes to timber harvest practices, natural stabilization of Mount St. Helens deposits, and erosion control practices at any potential new project facilities (Alternatives B and C) would decrease quantities of sediment contributed to project streams over time, resulting in less cumulative future impacts to geology and soil resources.

### 3.12.3.2 Water Quality

Prevention of the transfer of marine-derived nutrients (MDN) by project dams combined with the natural geochemistry of the Lewis River watershed is a potential moderate cumulative effect of the Lewis River Projects under Alternative A. Introduction of anadromous fish under Alternatives B and C would offset project effects on MDN, decreasing the cumulative effect of the projects on water quality. MDN has been shown to create significantly higher growth rates in trees near spawning streams, thus improving spawning and rearing habitat for subsequent generations (Helfield and Naiman 2001). Similar to riparian vegetation, increased productivity has been observed in stream macroinvertebrates and in terrestrial invertebrates in carcass-enriched streams vs. sites upstream of spawning salmon (Wipfli et al. 1998; Hocking and Reimchen 2002). Thus, Alternatives B and C would have a positive effect on water quality.

### 3.12.3.3 Aquatic Resources

Under Alternative A, anadromous fish would be limited to the Lewis River basin downstream of Merwin Dam. Sediment and large woody debris would be limited in the Lewis River bypass reach and downstream of Merwin Dam; development and timber harvest on non-project lands would occur; ocean and river harvest of fish would occur; and hatchery operations would limit genetic diversity. The cumulative effect of all these practices would severely limit populations of natural fish in the Lewis River watershed.

Under Alternatives B and C, the introduction of anadromous salmonids into the upper Lewis River basin and the development of fish passage facilities would likely increase the distribution and abundance of resident and anadromous salmonids. These actions, combined with improved timber harvest regulations (USFS 1990, USFS and BLM 1994; WAC 222-08 through WAC 222-50), improved hatchery management, ongoing habitat restoration measures (USFS 1999; Wade 2000), and increased enforcement (WDFW 2001) would likely increase the chances that fish restoration goals could be achieved. Existing and future ESA recovery efforts in the Columbia River basin, including those being developed and recommended by the lower Columbia River Fish Recovery Board and Bull Trout Draft Recovery Plan (USFWS 2002), would also work in conjunction with project-related enhancement measures to improve conditions for ESA-listed stocks. While these actions would likely benefit resident and anadromous salmonids, ongoing impacts associated with trapping of sediment and large woody debris in project reservoirs, urban and rural development, increased recreation, future road construction, population growth, and past timber harvest practices would alter aquatic habitat in the watershed.

Alternatives B and C provide moderate beneficial effects that offsets some of the cumulative effects on aquatic resources in the Lewis River basin compared to Alternative A.

#### 3.12.3.4 Wildlife Resources

There are four potential sources of cumulative effects on wildlife resources over the next license periods: timber harvest, rural land development, recreation on non-project lands, and the proposed Mount St. Helens loop road. Each of these is briefly described below:

- Timber harvest – A number of wildlife species, including the northern spotted owl, are dependent on large tracts of old-growth forest (Meyer et al. 1998 and Mills et al. 1993). Thus, project lands, in combination with adjacent USFS and WDNR forests, may provide habitat for these species in the Lewis River basin. Timber harvest on project lands under all alternatives would be focused on improving wildlife habitat and would not occur in existing old-growth and mature stands. Thus, it is unlikely that harvest from project lands would reduce the amount of habitat for old-growth dependent species. However, if harvest activities increase on industrial forests, WDNR, USFS, and private lands near the projects, then project lands being managed for wildlife may provide important refugia for these species, although the amount of habitat protected may be insufficient to support breeding spotted owls and other species requiring large tracts of old growth.
- Rural Land Development – Increased rural land development would decrease the amount of available wildlife habitat and often results in increased populations of nuisance species, such as pigeons, starlings, and raccoons. Project lands may become increasingly important as wildlife habitat under all alternatives. Higher populations of nuisance wildlife may cause these species to encroach on wildlife habitat provided by project lands and compete with native species for food and cover. Nuisance wildlife, as well as the domestic cats and dogs that accompany rural development can also decrease the breeding success of native species by increasing predation and disease rates.
- Recreation on Non-project Lands – Increased recreation on non-project lands may reduce available wildlife habitat and create additional disturbance. Project lands may become increasingly important as wildlife habitat under all alternatives.
- Proposed Mount St. Helens Loop Road – Should a proposed route linking Highway 503 to the existing highway on the north side of Mount St. Helens be constructed, a substantial amount of additional traffic would use Highway 503. This route through the project area would be expected to increase the potential for wildlife mortality from vehicle collisions.

All three alternatives provide some moderate beneficial effects that offset otherwise adverse cumulative impacts on wildlife resources from timber harvest, rural land development, recreation, and proposed new roads. Benefits from Alternative C are likely



to be greatest since this alternative provides the most protection to wildlife habitat on project lands. The benefits of Alternatives A and B are similar.

#### 3.12.3.5 Botanical Resources

There are two potential sources of cumulative effects related to botanical resources: timber harvest and floodplain habitat modification. Timber harvest on and off project lands affects vegetation community structure in the Lewis River basin. These practices reduce the amount of mid-successional, mature, and old-growth timber on forest lands outside the project boundaries. The amount of harvest activity on non-project lands is likely to influence the extent to which timber harvest is used as a habitat management tool on project lands under all alternatives. If harvest activities increase on industrial forest, WDNR, USFS, and private lands near the project, then timber harvest may be used only sparingly on project lands, with the goal of protecting as much mid- and later-successional forest as possible. Conversely, if harvest activities decrease on non-project lands, then it may be desirable to increase timber harvest to maintain areas as forage habitat for big game. All three alternatives provide some moderate beneficial effects that offset otherwise adverse cumulative impacts on botanical resources from timber harvest. Benefits from Alternative C are likely to be greatest since this alternative provides the most protection to habitat on project lands. The benefits of Alternatives A and B are similar.

Floodplain habitat along the lower Lewis River is and continues to be affected by dikes and development. Rural and agricultural development will continue over the next license period, resulting in the loss of riparian vegetation. The dikes that were built to protect property from flooding will also continue to affect the amount, type, and quality of riparian vegetation along the river. In addition, the project reservoirs block the downstream movement of large woody debris (LWD). Trapping of LWD in project reservoirs, combined with continued timber harvest and development along the river shoreline downstream of Merwin Dam, result in little LWD in the channel downstream of the dam. One consequence of these factors is the inability of large log jams to form and trap sediment, thus reducing the creation and maintenance of riparian and floodplain habitat (PacifiCorp and Cowlitz PUD 2003f; Collins et al. 2002). None of the alternatives would increase the amount of LWD in the river, remove dikes, or decrease development in the floodplain. Thus, all three alternatives would contribute similarly to the adverse cumulative effects on floodplain habitat.

#### 3.12.3.6 Cultural Resources

Natural fish runs are culturally important to Indian tribal members. Timber harvest, development, and ocean and river harvest of fish have all contributed to a reduction in natural fish populations in the Lewis River basin. In addition, the projects have reduced natural fish populations by blocking access to upstream habitat. Fish recovery efforts associated with project and non-project actions would help to increase the populations of natural fish in the watershed. Increases in natural fish runs are expected under Alternatives B and C, and would provide moderate beneficial effects that would offset some of the cumulative effects on natural fish runs.

Native vegetation and wildlife are culturally important to Indian tribal members. Timber harvest and development in the Lewis River watershed can affect the amount of native vegetation and wildlife species. Disturbances associated with continued existence of project facilities and potential new facilities also reduce the amount of native vegetation and wildlife habitat. Management of project lands in the future under all alternatives is expected to improve conditions for wildlife. Management under Alternatives B and C would provide the greatest beneficial effects to vegetation and wildlife resources to offset the cumulative effects on these resources.

Timber harvest and site disturbance on non-project lands, as well as artifact removal, contribute to the attrition of archaeological sites. Erosion of archaeological sites in project reservoirs also results in disturbance of artifacts. The cumulative effect of all these actions is the reduction in archaeological resources. Additional disturbance during the construction of new facilities under Alternatives B and C could result in a minor additional adverse cumulative effect to artifacts if they are located in disturbed areas.

### 3.12.3.7 Recreation Resources

Project-related recreation resources are cumulatively affected by past, present and future actions on non-project lands in the vicinity. In addition, these resources are cumulatively affected by changes in regional population growth and changes in recreational demand over time. These non-project effects include:

- Timber harvesting, new residential development and other private land management actions on surrounding private land that restricts the public's use of these lands for recreational activities.
- Management of recreation, natural and cultural resources on surrounding USFS-, WDFW- and WDNR-managed lands that increasingly restricts the use of public lands for recreational purposes due to resource protection requirements.
- Proposed Mount St. Helens highway loop that potentially would funnel more visitors through the project area. Some of these visitors likely would use project recreation facilities, such as campgrounds and day use area, as well as the project reservoirs.
- Hunting activity in the vicinity of the projects is occurring within an area that is shrinking in size and is more fragmented due to increasing new development and other land use restrictions.
- Management of ESA-listed species increasingly restricts the use of certain areas for fishing or other recreational activities.
- Adjoining Monument-, GPNF-, and WDNR-managed lands attract visitors to the project vicinity. Visitors to the project area often engage in multi-destination visits within the region. Increased visitation at one regional recreation area would likely increase visitation at the adjoining recreation areas. A lack of USFS campgrounds

south of Mount St. Helens may also cause some Monument and GPNF visitors to seek out nearby campsites within the project area.

- Increasing population growth in the Portland-Vancouver metropolitan area, as well as the Kelso-Longview area, increases the regional demand for recreation in the project area. Some changes in regional use patterns may occur as recreation sites and facilities are improved, as different population centers grow, and desired activities and technologies change. However, water-related recreation facilities, such as those provided in the project area, are in demand now, particularly during the summer months, and should continue to be in demand in the future. As a result, the Lewis River basin, Monument, GPNF, and WDNR Siouxon Landscape areas will experience increased visitation over the term of the new licenses. This increased visitation would cause higher occupancy rates at recreation facilities and increased boater density on project reservoirs over time.

In summary, there are numerous non-project pressures and actions that tend to restrict the public's general use of natural open space areas in the vicinity of the projects, while at the same time focusing additional recreational activity and attention within the area. This evolving condition, coupled with increasing regional population and resulting increased demand, results in direct and indirect adverse effects on project recreation resources.

The measures analyzed under Alternative A would generally retain the existing recreation resources in the project area with some facility replacement or refurbishment occurring over time. However, since there is no expansion of recreation capacity at the campgrounds and day use areas, crowding and capacity concerns and potential resource damage would likely occur. As a result, the positive recreation measures in Alternative A, such as the Yale interim measures, would not be able to beneficially offset the cumulative adverse effects of the various actions occurring in the region.

In contrast, the measures analyzed in Alternatives B and C would improve recreation resources in the project area over the term of the new license. These two alternatives would expand recreation facility capacity to help accommodate the increasing demand over the term of the new licenses. However, while facility expansion would accommodate much of the projected demand, Alternatives B and C likely would not meet all of the projected demand. This condition may result in future crowding at project recreation facilities and potential resource damage. Compared to Alternative A, anticipated facility crowding in Alternatives B and C would be less and would likely be delayed for several more years. As a result, recreation measures in Alternative B and C, such as recreation facility expansion, generally would offset the cumulative adverse effects of the various actions occurring in the region and in the project vicinity.

#### 3.12.3.8 Aesthetic/Visual Resources

Project-related aesthetic/visual resources are cumulatively affected by past, present and future actions on non-project lands in the vicinity of the project. Many non-project facilities and activities adversely affect the visual quality of the project area. These effects include timber harvesting on steep mountain slopes of private and WDNR-

managed timber lands, and new highways, roads, and private buildings occurring throughout the forested Lewis River valley. While forestry practices may change in the future, the harvesting of trees for timber would likely continue to reduce the natural visual quality of the basin. Additionally, future private land development and proposed highway improvements are probable in the project vicinity. In summary, there are numerous non-project-related activities that tend to have both direct and indirect adverse effects on aesthetic/visual resources in the project vicinity.

Some of the project hydropower dams, transmission lines, canals, switching stations, and powerhouses are visually dominant and generally inconsistent with the natural forested surroundings. Project transmission line ROWs are typically cleared of vegetation. Each of these industrial facilities also cumulatively affects the aesthetic quality of the project area as seen from sensitive visitor viewpoints, such as along SR 503 and SR 503 Spur.

Alternatives A, B and C do not contain measures to enhance aesthetics/visual resources in the project area; however, numerous recreation measures would enhance aesthetic/visual conditions. These measures would not, however, offset the cumulative adverse effects of non-project actions, such as continued timber clear-cutting adjacent to the project and new private residential development expected over the term of the new licenses.

#### 3.12.3.9 Socioeconomics

Regional population growth and the proposed loop road to Mount St. Helens, combined with improved recreation facilities would likely increase the level of recreation activity in the Lewis River valley. Much of the local economy is dependent on recreation visitors, so these changes would have a positive cumulative effect on the local economy over the long term. Improvements to recreational facilities under Alternatives B and C would have more beneficial effects to socioeconomics than Alternative A.

Population growth and associated development of land in the Lewis River watershed likely would increase in the future. Improved flood notification under all alternatives would reduce the impacts of flooding, encouraging development to occur within the regulatory 100-year floodplain of the Lewis River downstream from Merwin Dam. These combined effects would increase the number of people and the amount of property at risk during severe flood conditions. Flood control measures under Alternatives B and C would provide beneficial effects to the increased residents living in the flood plain under moderate peak flows, but would not be able to protect these residents under extreme high flow events.

### 3.13 UNAVOIDABLE ADVERSE IMPACTS

#### 3.13.1 Geology and Soils

Under all alternatives, there would be continued slow erosion of parts of the reservoir shorelines. Under Alternatives B and C there would be minor erosion during construction of new project facilities, but these effects could be minimized by the implementation of erosion control measures.

### 3.13.2 Water Quantity

The Lewis River Projects would continue to control flows in the Lewis River downstream of project facilities under all alternatives considered in this assessment. Thus, to varying degrees, operational and flow related impacts to sediment transport and aquatic habitat would continue in the project reservoirs, the Lewis River bypass reach, and in Speelyai Creek.

### 3.13.3 Water Quality

Operational impacts to TDG in the Swift No. 1 and Yale tailraces, flow related impacts to water temperature in the Lewis River bypass reach and Speelyai Creek, and loss of marine-derived nutrients would continue under Alternative A. Effects on MDN would be offset by introduction of anadromous fish under Alternatives B and C. Monitoring of these and other parameters under the Water Quality Management Plans would document compliance with State standards under Alternatives B and C.

### 3.13.4 Aquatic Resources

Operation of the Lewis River Projects under all alternatives would trap most sediment and woody debris in the three project reservoirs and alter flow regimes in the Lewis River bypass reach, lower Speelyai Creek, and the Lewis River downstream from Merwin Dam. As a result, aquatic and riparian habitat in the Lewis River bypass reach would be limited under all alternatives. Aquatic and riparian conditions in lower Speelyai Creek would be stable under all alternatives. In the Lewis River downstream from Merwin Dam, aquatic and riparian habitat conditions would be stable, with little channel shifting or active aquatic or riparian conditions under all alternatives.

Under Alternative A, anadromous fish would not have access to an estimated 174 miles of potential habitat above Merwin Dam. The relatively slow moving reservoir habitat in Lake Merwin would sustain northern pikeminnow, known to prey heavily upon juvenile salmonids. Project operations would provide limited flows in portions of the Lewis River bypass reach and lower Speelyai Creek. Gill netting bull trout below Yale Dam and Swift No. 2 and transporting them to the mouth of Cougar Creek would have the potential to injure or kill individual bull trout although these actions would be beneficial to the species as a whole. Large hatchery releases may impact wild salmonid populations through predation, competition, and disease in the lower Lewis River, Lake Merwin, and Swift Creek Reservoir. Finally, recreational fishing associated with the project reservoirs and hatcheries would result in fishing pressure on native stocks, including endangered species.

The upstream and downstream fish passage facilities associated with Alternative B could delay, injure, or kill fish migrating past the project dams. These impacts would likely be more severe under Alternative C. Gill netting bull trout below Yale Dam and transporting them to the mouth of Cougar Creek would have the potential to injure or kill individual bull trout although these actions would be beneficial to the species as a whole. The relatively slow-moving reservoir habitat in Lake Merwin would continue to support

northern pikeminnow. While they remain in operation, the Lewis River hatcheries may convey fish disease in the basin, and competition between hatchery and wild fish. Both effects may alter the abundance and fitness of wild fish populations. Recreational fishing associated with the project reservoirs and hatcheries would result in fishing pressure on native stocks, including endangered species.

The trap-and-tram facilities and surface collectors included in Alternative C would have the potential to delay, injure, or kill fish migrating past the project dams. The hatchery fish releases included in Alternative C may impact wild salmonid populations through predation, competition, and disease. Under Alternative C, project operations would alter the amount of flow entering the Lewis River bypass reach and result in moderate fish habitat. The upper Speelyai Creek diversion would continue to divert all water from upper Speelyai Creek into Yale Lake. As in each alternative, recreational fishing would result in fishing pressure on native stocks, including endangered species.

### 3.13.5 Botanical and Wildlife Resources

To protect botanical and wildlife resources, Alternatives B and C close additional roads and install gates, actions that would reduce vehicle access to some utility-owned lands and may curtail some current recreation use. In addition, the alternatives would permanently reduce the number of sites available for dispersed camping along the reservoirs. Construction associated with installation of new culverts and gates under Alternatives B and C would disturb wildlife over a few days. Timber harvest activities under all alternatives would alter wildlife habitat and vegetation communities, and may affect nearby recreation use, as well as aesthetics.

### 3.13.6 Cultural Resources

Regardless of the alternative selected and the mitigation measures undertaken, continued operation of the projects would affect traditional cultural resources. For example, fish runs would not be completely natural under any of the alternatives. Facility modifications and new construction would alter some historic structures. Some archaeological sites would be affected by reservoir erosion and possibly by fish passage facilities that cannot be re-sited. These effects would add to the cumulative loss of traditional cultural resources, historic structures, and archaeological sites over time in the upper Lewis River valley.

### 3.13.7 Recreation

Some of PacifiCorp's proposed recreation resource enhancements would entail ground-disturbing activities, including construction of new and improved recreation sites. These activities could result in short-term temporary displacement of wildlife and recreationists during construction. Additionally, some vegetation removal would also occur, which could result in longer-term loss of habitat. The potential effects of recreation facility construction activities would be most extensive under Alternatives B and C (which are the same), and least extensive under Alternative A (No Action). The proposed recreation enhancements would attract new visitors to the project area (in addition to previously

projected increases). In the long-term, these additional visitors would have minor effects on wildlife and vegetation.

### 3.13.8 Socioeconomics

The projects provide a recreation benefit that supports the local economy and attracts new residents. While the various alternatives differ in the period of time and the extent to which they support additional benefits, none have unavoidable adverse effects on the local economy. The current operations (Alternative A) have adverse effects on the demand for fire and emergency services that are not fully covered by tax revenues, due to two factors: 1) the existing tax distribution system does not reflect the realities of access to the project; and 2) the expectation that future recreational use will not be matched by growth in revenues as the projects age. In Alternatives B and C, these effects would be addressed by increased project value, resulting in increased revenues.

## **3.14 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES**

Continued operation of the projects under each alternative analyzed would continue to commit the lands and water that have been developed for energy production to this purpose. This commitment of resources would not necessarily be irreversible or irretrievable because removal of project facilities and restoration of disturbed areas could ultimately return the area to a condition approximating pre-project. Given the substantial costs and loss of energy, recreation, and socioeconomic benefits, however, removal of the projects is unlikely in the reasonably foreseeable future.

The electrical generation lost as a result of the proposed minimum flow releases to the Lewis River bypass reach under Alternatives B and C would be irretrievable.

## **3.15 RELATIONSHIP BETWEEN SHORT-TERM AND LONG-TERM PRODUCTIVITY**

Under all three alternatives, the projects would continue to generate power for the customers of Cowlitz PUD and PacifiCorp and provide recreation and socioeconomic benefits for the duration of the new licenses (30 to 50 years). Each action alternative (B and C) would provide significant long-term protection and enhancement of biological, cultural, and recreational resources, while decreasing the ability of the projects to meet energy and economic needs.

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