

**Draft**  
**Vegetation Cover Type Mapping Study**  
**Report for**  
**Energy Northwest's**  
**Packwood Lake Hydroelectric Project**  
**FERC No. 2244**  
**Lewis County, Washington**

Submitted to



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## TABLE OF CONTENTS

<b>Section</b>	<b>Title</b>	<b>Page</b>
<b>1.0</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	Project Area and Study Area.....	1
<b>2.0</b>	<b>STUDY GOALS AND OBJECTIVES.....</b>	<b>5</b>
<b>3.0</b>	<b>METHODS.....</b>	<b>5</b>
3.1	Base Maps and Cover Types.....	5
3.2	Conduct Photo-Interpretation and Map Vegetation.....	5
3.3	Selection and Sampling at Ground-Truthing Sites.....	6
3.4	Revise Map and Create GIS Vegetation Coverage.....	6
<b>4.0</b>	<b>RESULTS.....</b>	<b>7</b>
4.1	Upland Cover Types.....	7
4.2	Wetland and Riparian Cover Types.....	10
4.3	Developed and Non-vegetated Cover Types.....	12
4.4	Packwood Lake Drawdown Zone.....	12
<b>5.0</b>	<b>DISCUSSION AND RECOMMENDATIONS.....</b>	<b>13</b>
<b>6.0</b>	<b>LITERATURE CITED.....</b>	<b>13</b>

## LIST OF FIGURES

<b>Figure</b>	<b>Title</b>	<b>Page</b>
1-1	Location of the Packwood Lake Hydroelectric Project Near Packwood, WA.....	2
1-2	Vegetation Cover Type Mapping Study Area.....	3

## LIST OF TABLES

<b>Figure</b>	<b>Title</b>	<b>Page</b>
4-1	Summary of Mapped Cover Types in the Study Area.....	8

## APPENDICES

<b>Appendix</b>	<b>Title</b>	<b>Page</b>
<b>A</b>	<b>Packwood Lake Project Vegetation Cover Type Map.....</b>	<b>A-1</b>
<b>B</b>	<b>Representative Photographs of Cover Types.....</b>	<b>B-1</b>

## **1.0 INTRODUCTION**

Energy Northwest operates the Packwood Lake Hydroelectric Project (Project) near the town of Packwood in Lewis County, Washington. The source of water for the Project, Packwood Lake, is a lake that pre-existed the Project, situated at an elevation of approximately 2,857 feet above mean sea level (MSL), about 1,800 feet above the powerhouse. Packwood Lake receives water from Upper Lake Creek and other smaller creeks; regulated flows and spillage are released to Lake Creek, a tributary of the Cowlitz River. Water discharged from the Project is conveyed by penstock to the powerhouse and released to the Cowlitz River via a tailrace channel.

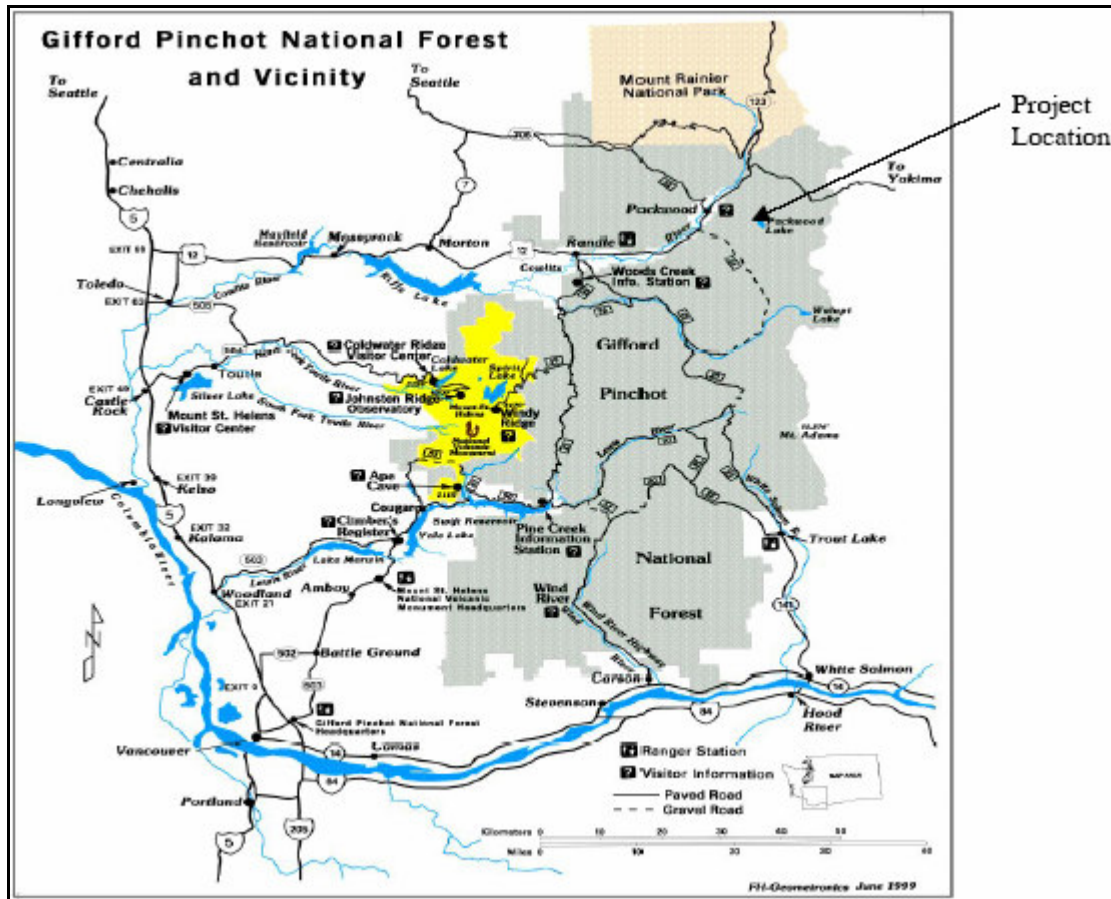
On November 12, 2004 Energy Northwest filed a Notice of Intent (NOI) to file an application for a new license to operate the Project. Energy Northwest also concurrently filed with the Federal Energy Regulatory Commission (FERC) and the resource agencies, a Pre-Application Document (PAD), containing existing, relevant, and reasonably available information describing the existing environment and the potential effects of Project facilities and operations. Additional studies were requested to supplement information contained in the PAD (WDFW 2005, USFS 2005).

Energy Northwest, in consultation with tribes and agencies, developed and implemented a study plan to identify and classify the vegetation cover types, and create a detailed GIS cover type map of the Project area showing the locations of these cover types, their distribution and total acreages (Devine Tarbell and Associates, Inc. 2005). This report provides results of the study.

### **1.1 Project Area and Study Area**

#### ***1.1.1 Project Area***

Packwood Lake lies within the Gifford Pinchot National Forest in the Cascade Mountains, east of the town of Packwood (Figure 1-1). The Project facilities at Packwood Lake include an intake canal, a concrete drop structure, and an intake building on Lake Creek located about 424 ft downstream from the outlet of Packwood Lake.



**Figure 1-1. Location of the Packwood Lake Hydroelectric Project near Packwood, WA (Source: Energy Northwest 2004).**

### **1.1.2 Study Area**

The study area included all lands within the Project Boundary, all lands within 100 meters of the Project Boundary, and all lands within 100 meters of the centerline of Project-affected roads, trails, and streams (Figure 1-2). The Project boundary encompasses Packwood Lake below elevation 2860 MSL, an intake building, drop structure, tailrace channel, powerhouse (and associated facilities), buried pipeline, penstock, tunnels, and transmission line. Project-affected roads and trails include Pipeline Road (FSR 1260-066), Latch Road (FSR 1262), and Trail #74. Project-affected streams include lower Lake Creek, and the tributaries of Packwood Lake: Upper Lake Creek, Crawford Creek, Osprey Creek, Trap Creek, Muller Creek, and Baker Creek. The study area also included a wetland complex associated with Hall Creek, although this wetland extends more than 100 meters beyond the Project boundary.

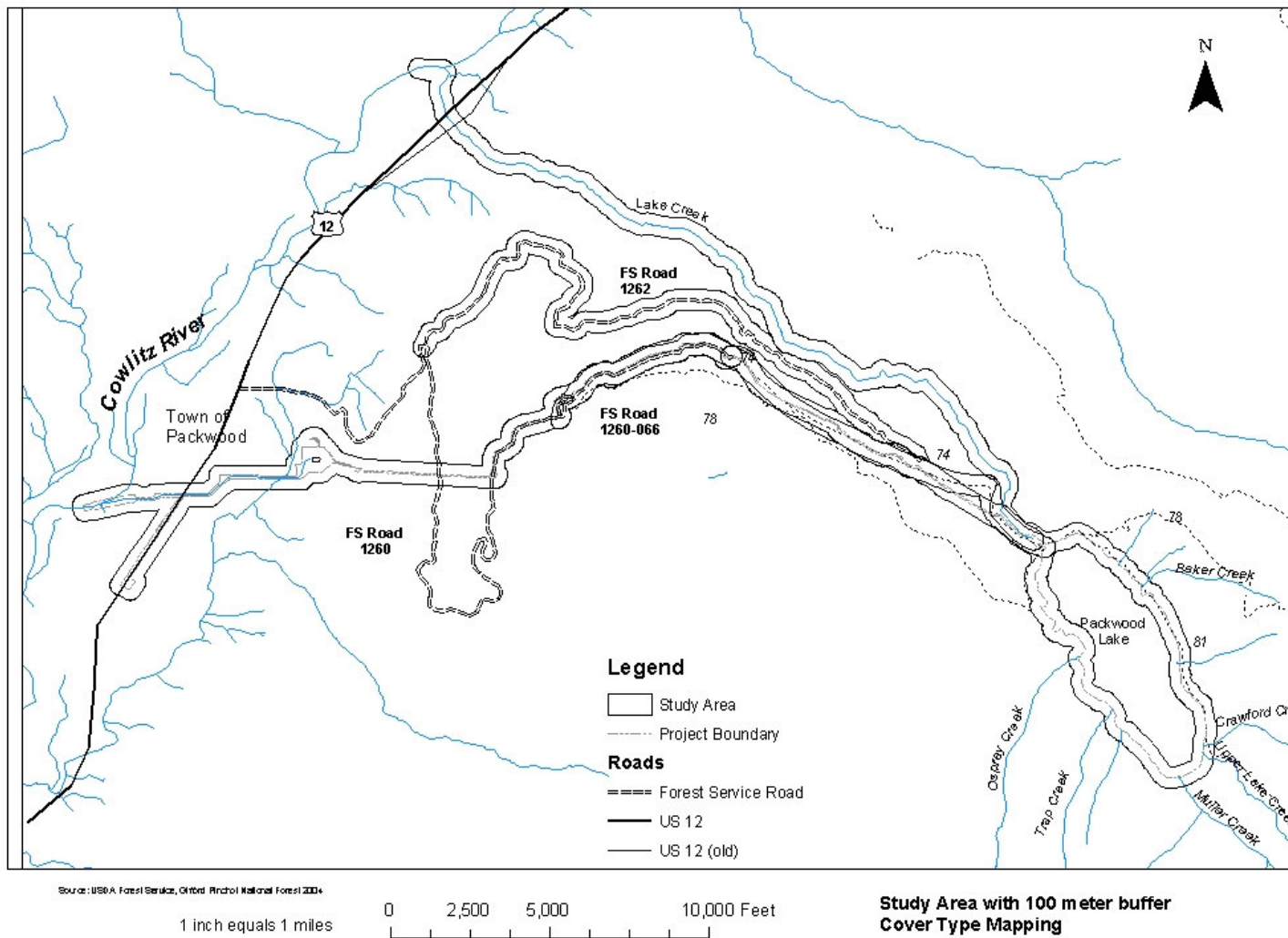


Figure 1-2. Packwood Lake Project Vegetation Cover Type Mapping Study Area.

## **2.0 STUDY GOALS AND OBJECTIVES**

The objectives of the Vegetation Cover Type Mapping study were: 1) to identify and classify the vegetation cover types in the Project area; 2) collect additional information on the species composition and structural attributes of each cover type; and 3) create a detailed GIS cover type map of the Project area describing the distribution and extent of each cover type. The study provides the baseline map for recording occurrences of rare plants, noxious weeds, and wildlife, including amphibians and also provides descriptions of existing habitat conditions in the Project area and in riparian areas along Lake Creek.

## **3.0 METHODS**

### **3.1 Base Maps and Cover Types**

Digital, black-and-white orthophotos were combined with existing Forest Service GIS vegetation data (available at <http://www.fs.fed.us/gpnf/forest-research/gis/>) to create base maps of the study area. Base maps were prepared at a resolution sufficient to show and map major vegetation types (1:6,500). Existing Forest Service vegetation data for the study area provide information on vegetation community or association types. In addition, upland forest types that may occur in the study area are defined and described in Forest Service Plant Association and Management Guides (Brockway et al. 1983, Topik et al. 1986). Plant associations represent reoccurring species assemblages, typically identified by the forest zone or series, or dominant tree species, and a characteristic shrub or herbaceous species (e.g., Western Hemlock/Salal). Riparian types are not depicted in the Forest Service GIS data, but descriptions to riparian associations known to occur on the Gifford Pinchot National Forest are presented in Diaz and Mellen (1996). Because the study area was not limited to Forest Service lands, development of the base map required additional mapping (described in Section 3.2).

The available orthophotography was collected during summer months, during which time the elevation of Packwood Lake is held relatively constant. As a result, the drawdown area was not exposed on the orthophotos; however, observations reported in the Packwood Lake Drawdown Study Report (EES Consulting 2006) indicate that virtually all of the drawdown zone can be characterized as “intermittent” (i.e., seasonally exposed areas within the drawdown zone, not supporting standing water during the drawdown period). Bathymetric maps and on-the ground photographs showing the drawdown area are included in the Packwood Lake Drawdown Study Report.

### **3.2 Conduct Photo-Interpretation and Map Vegetation**

Cover types currently used by the Forest Service and found in its `gpv_stand_view` database table were available electronically and provided coverage from Upper Lake Creek and around Packwood Lake to the USFS boundary along Lake Creek; along the Pipeline Road (FSR 1260-066) and penstock to immediately below the powerhouse; and along the Latch Road (FSR 1262) to the intersection with FS Road 1260. No existing cover type information was available for the remaining parts of the study area.

Existing Forest Service cover type polygons within the study area were revised and refined to reflect current forest conditions. Draft wetland boundaries were based on National Wetland Inventory (NWI) mapping for the study area. Polygon boundaries were adjusted based on the orthophotos and areas not included within the Forest Service maps were provisionally mapped on hard copy maps and digitized.

### **3.3 Selection and Sampling at Ground-Truthing Sites**

The base maps with USFS cover type polygons were reviewed and field sampling points were assigned to each major cover type. Sampling points were primarily placed in forest stands greater than 60 years of age, riparian zones, wetlands, and other specialized habitats where existing information was limited or appeared to be inaccurate.

At each sampling location, major vegetative and structural characteristics were documented using a plotless, rapid vegetation assessment method. The following data were collected at each point:

- Universal Transverse Mercator (UTM) coordinates;
- Representative photograph(s);
- Species and estimated cover for dominant and subdominant trees and shrubs;
- Estimated diameter at breast height (DBH) of dominant trees, or height of dominants in non-forested areas;
- Plant community type;
- Plant association, if defined for the habitat;
- Estimated local density of snags and coarse woody debris;
- Potential for or occurrence of special-status species;
- At wetland sites, observed source(s) of wetland hydrology;
- At wetland sites, hydrogeomorphic classification (Brinson 1993); and
- At wetland sites, classification of dominant wetland types (Cowardin et al. 1979).

Excepting photographs, this information is incorporated into the metadata associated with the GIS layers created during this study.

### **3.4 Revise Map and Create GIS Vegetation Coverage**

During field efforts, mapped cover type polygons were corrected on hard-copy base maps to represent current conditions. Wetland boundaries were mapped to reflect field observations of vegetation composition and hydrology, but should not be considered a formal wetland delineation. Existing Forest Service data did not accurately show any wetlands or riparian vegetation cover types; accordingly, special emphasis was placed on characterizing these vegetation types. Certain features (e.g., wetlands, seeps and tributaries along Lake Creek) were not discernible on orthophotos; these areas were mapped as points rather than polygons. Riparian vegetation was also generally not discernibly different from upland forest types on the orthophotos, requiring that the extent of riparian communities be inferred based on observations at sampling points.

Existing Forest Service terminology and mapping conventions were followed within the Forest Service property boundary, but these were not always applicable to vegetation types outside of Forest Service lands. Additional cover type categories were also assigned to non-forested cover types. Following on-site investigations of vegetation types, revisions to the draft map were digitized to create the final GIS vegetation coverage and to calculate the extent (acres) of each cover type.

The principal investigator for the study was Stephen Nyman, Ph.D., supported by Jeromy Waddell and Devin Malkin. Dr. Nyman has 25 years experience as a biologist, writer, and researcher of terrestrial resource issues, including Principal Investigator for Wildlife and Botanical studies on numerous FERC hydroelectric licensing projects. He has performed aerial photo interpretation, cover type mapping, and cover type ground-truthing on 10 other hydroelectric project relicensings, as well as for other studies. Mr. Waddell is a wildlife biologist who has conducted similar work on five relicensing projects. Mr. Malkin is a botanist with considerable experience in cover type classification and mapping, rare plant studies, and other botanical investigations.

## **4.0 RESULTS**

A total of nearly 2,181 acres were mapped in the study area, including 461 acres of water associated with Packwood Lake and the Cowlitz River within 100 meters of the mouth of Lake Creek and the tailrace. The majority of the study area consists of upland cover types (1,354 acres, or about 62% of the study area). Riparian and wetland types (including associated areas of water) comprised about 207 acres (approximately 9.4% of the study area) (Table 4.1). The remaining area (159 acres) represents developed and non-vegetated cover types. GIS maps depicting vegetation cover types and vegetation sampling sites are presented as Appendix A to this report. Plot data for each sample point are included as metadata associated with the GIS layers created for this study. Photographs showing representative conditions of the study area cover types are presented in Appendix B.

### **4.1 Upland Cover Types**

The predominant upland cover types in the study area are upland forests assigned to Forest Service forest zones or series, as defined by USFS Plant Association and Management Guides (Brockway et al. 1983, Topik et al. 1986). Three additional types were defined during this study to address upland cover types not included in these USFS efforts: Mixed Forest, Field, and Boulder/Talus.

#### **4.1.1 *Western Hemlock Types***

Most of the study area (1,019 acres, or nearly 47% of the study area) supports vegetation types within the Western Hemlock series. These habitats are defined by the Forest Service “as those lands where western hemlock (*Tsuga heterophylla*) is expected to be the dominant tree species given the opportunity to achieve a long-term stable state” (Topik et al. 1986). However, western hemlock may not currently be a dominant species in areas mapped as Western Hemlock, and

stands comprised of other species, including Douglas-fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*), are often very long lived.

**Table 4.1. Summary of Mapped Cover Types in the Study Area.**

COVER TYPE	TOTAL AREA <sup>1</sup>	DESCRIPTION
<b>Uplands</b>		
Western Hemlock <sup>2</sup>	1019	Upland forest type at lower elevations; site potential for western hemlock.
Pacific Silver Fir <sup>2</sup>	308	Upland forest type at higher elevation; site potential for Pacific silver fir.
Mixed Forest <sup>3</sup>	12	Upland forest type with a mixture of conifer and deciduous broad-leaved species. Occurring in small, fragmented or disturbed stands.
Field <sup>3</sup>	13	Upland, non-forested type dominated by grasses or low growing weedy species.
Boulder/Talus <sup>3</sup>	2	Talus slopes, sometimes with associated cliffs or bedrock outcrops.
<b>Wetland and Riparian</b>		
Palustrine Emergent Wetland <sup>3</sup>	92	Wetlands characterized by rooted herbs. Hydrologic characteristics and landscape setting variable.
Palustrine Scrub-Shrub Wetland <sup>3</sup>	1	Wetlands dominated by shrubs. Hydrologic characteristics and landscape setting variable.
Palustrine Forested Wetland <sup>3</sup>	61	Wetlands dominated by trees. Hydrologic characteristics and landscape setting variable.
Riparian Forest <sup>3</sup>	53	Forests associated with streams and rivers. Along high order streams may not be discernibly different from upland forests.
<b>Developed or Non-vegetated</b>		
Residential, Industrial, or Roads <sup>2</sup>	129	Developed areas including the Project facilities.
Non-vegetated <sup>2</sup>	23	Barren or sparsely vegetated areas.
Unconsolidated Shore <sup>3</sup>	7	Barren or sparsely vegetated alluvium (e.g. sand or gravel bars).
<b>Water</b>		
Lakes, rivers, etc. <sup>4</sup>	461	Bodies of water, notably Packwood Lake at summer operational level (approximately 2857 ft elevation), and Cowlitz River.

<sup>1</sup>Acres

<sup>2</sup>Cover type categories used in Forest Service GIS data.

<sup>3</sup>Descriptive cover type used for this study (not included in Forest Service data).

<sup>4</sup>Does not include small or narrow water bodies (such as Lake Creek) not easily discernible on orthophotos.

The Western Hemlock series is found throughout much of the study area from above Packwood Lake (approximately 2,900 ft) to the Cowlitz River valley (approximately 1,200 ft). A total of 21 sampling plots were situated within Western Hemlock types. Four Western Hemlock associations were mapped in the existing Forest Service data: Western Hemlock–Douglas-fir/Ocean-spray (*Holodiscus discolor*), Western Hemlock/Sword-fern (*Polystichum munitum*), Western Hemlock/Vanillaleaf (*Achlys triphylla*), and Western Hemlock/Dwarf Oregon-grape (*Mahonia nervosa*). Data collected at sampling plots located in Western Hemlock polygons documented four additional associations: Western Hemlock/Salal (*Gaultheria shallon*), Western Hemlock/Alaska huckleberry (*Vaccinium alaskaense*)/Bunchberry (*Cornus canadensis*), Western Hemlock/Alaska huckleberry/Salal, and Western Hemlock/Dwarf Oregon-grape/Salal.

Dominant tree species found within Western Hemlock mapped areas are Douglas-fir, western hemlock, and western red cedar. Subdominant species include Pacific yew (*Taxus brevifolia*), big-leaf maple (*Acer macrophyllum*), vine maple (*Acer circinatum*), and red alder (*Alnus rubra*). Salal and dwarf Oregon-grape were the most commonly occurring shrubs at sampling points; other shrubs included hazelnut (*Corylus cornuta*), twinflower (*Linnaea borealis*), serviceberry (*Amelanchier alnifolia*), little wild rose (*Rosa gymnocarpa*), Nootka rose (*R. nutkana*), and Pacific blackberry (*Rubus ursinus*). Shrub coverage at sample points ranged from 0-80%. Tree canopy cover ranged from 40 to 100% at some locations. Large woody debris was generally abundant, mostly comprised of smaller logs (8-12 inches in diameter) representing all decomposition classes. Similarly, snags occurred at all but two sites and ranged from 6-40 inches DBH and 15-100 feet in height.

#### **4.1.2 Pacific Silver Fir Types**

The Pacific Silver Fir zone “spans the [elevation] gradient between the warm, moist Western Hemlock Zone and the very cold, moist Mountain Hemlock Zone; the forests are dominated by Douglas-fir and noble fir (*Abies procera*) following large fires, but these species are eventually replaced by Pacific silver fir (*Abies amabilis*)” (Brockway et al. 1983). Within the study area, Pacific Silver Fir occurs at or above approximately 2,800 feet elevation.

About 308 acres (14% of the study area) support vegetation types within the Pacific Silver Fir series, including two associations that were included in existing Forest Service data: Pacific Silver Fir /Dwarf Oregon-grape and Pacific Silver Fir /Alaska huckleberry. Nine sampling plots were located within Pacific Silver Fir stands.

Dominant tree species at the Pacific Silver Fir sampling plots were Douglas-fir, western red cedar, and western hemlock. Pacific silver fir occurred at only three plots, and was co-dominant at only one of these. Shrub coverage at sample points ranged from 10-60 percent, mostly comprised of vine maple, Alaskan huckleberry, salal, and dwarf Oregon-grape. Tree canopy cover ranged from 70 percent to greater than 100 percent. Large woody debris varied considerably, absent from four sites, but abundant at the other four sites where logs were generally small (5-24 inches diameter) and represented all decomposition classes. These same four sites had snags, ranging from 6-30 inches DBH.

### **4.1.3 Mixed Forest**

An upland forest type supporting a mixture of conifers and deciduous hardwoods was categorized as Mixed Forest. Consisting mostly of small forested lots bordered by residential or industrial areas, or roads, Mixed Forest areas often included Douglas-fir, western red cedar, big-leaf maple, and black cottonwood (*Populus balsamifera* var. *trichocarpa*), with vine maple and Scot's broom (*Cytisus scoparius*) common in the shrub layer. Seven mixed forest stands were mapped within the study area totaling about 12 acres (0.6% of the study area). Stands of Mixed Forest were restricted to the lower elevations of the study area, outside the Forest boundary, and were often bordered by residential development or roads.

### **4.1.4 Field**

The Field cover type was defined as non-forested uplands dominated by grasses and weedy forbs, maintained by mowing or other regular disturbance. This type was confined to lower elevations of the study area beyond the Forest Service boundary. Fields occurred within four mapped polygons (including a large mowed area at the southern end of the Packwood airport) with a total area of about 13 acres (0.6% of the study area).

### **4.1.5 Boulder/Talus**

The Boulder/Talus cover type was used to designate slopes covered with boulders or large cobbles, and generally sparse vegetation. A total of about 2 acres (less than 0.1% of the study area) were mapped as Boulder/Talus, all within the Forest Service boundary. The largest areas mapped as this type occur at and immediately below Packwood Lake and below the surge tank along the penstock route. Descriptive data were collected at three sampling points within this cover type. Two of these sites were characterized by vine maple thickets, whereas the other included more sparsely vegetated areas of scattered Douglas-fir among bedrock outcrops.

## **4.2 Wetland and Riparian Cover Types**

Wetland cover types were classified according to dominance by herbaceous species (Palustrine Emergent Wetland), shrubs (Palustrine Scrub-shrub), or trees (Palustrine Forested). The two largest wetland complexes in the study area are associated with Hall Creek and upper Packwood Lake, respectively. Apparent sources of hydrology of the Hall Creek wetland are several small streams (Hall Creek, Snyder Creek, Hager Creek, and another unnamed creek); the outlet (Hall Creek) flows to the southwest. Based on geomorphic setting, hydrologic source, and flow characteristics, this wetland is classified as Riverine (Brinson 1993). The hydrology of the upper Packwood Lake wetland appears to be more complex, with a groundwater aspect, but is driven by stream discharge through an alluvial valley (Kent Doughty, EES Consulting, personal communication). Therefore, this wetland is also classified as Riverine.

The riparian cover type was also comprised of three different types of major communities in the study area. These types were Red Alder Dominated, Black Cottonwood Dominated, and Mixed Riparian.

#### **4.2.1 Palustrine Emergent Wetland**

Palustrine Emergent Wetland is defined as an herb-dominated wetland type and can be further differentiated by the persistence of surface flooding (e.g., temporarily or seasonally flooded). A total of 92 acres of Palustrine Emergent Wetland were mapped (4.2% of the study area) (Table 4-1). As a mapped cover type, Palustrine Emergent Wetland was exclusively associated with Hall Creek and the mouth of Osprey Creek. However, an area of Palustrine Emergent Wetland too small to be mapped was also noted at the head of Packwood Lake.

The wetland associated with Hall Creek included the largest area of Palustrine Emergent Wetland in the study area, although observations and aerial videography conducted by helicopter in 2006 suggest that this wetland is somewhat smaller than depicted on the current NWI map. Because this large wetland is situated on privately-owned lands some of which are posted, on-the-ground field investigation was limited to the proximity of the Project tailrace. The majority of the Hall Creek Palustrine Emergent Wetland was classified as seasonally flooded (about 36 acres); semi-permanently flooded Palustrine Emergent Wetland (13 acres) was mostly confined to channels and deeper depressions. Dominant species in this wetland included slough sedge (*Carex obnupta*), small-fruited bulrush (*Scirpus microcarpus*), manna grass (*Glyceria* sp.), and reed canary-grass (*Phalaris arundinacea*).

#### **4.2.2 Palustrine Scrub-Shrub Wetland**

Shrub dominated wetlands are uncommon in the study area, comprising about 1 acres (less than 0.01% of study area). This mapped type occurred within the wetland complex associated with Hall Creek, where hardhack (*Spiraea douglasii*) is dominant, and in a small willow (*Salix* spp.)-dominated area adjacent to Latch Road (FSR 1262). Palustrine Scrub-Shrub Wetland at Hall Creek was less extensive than depicted on the current NWI map.

#### **4.2.3 Palustrine Forested Wetland**

Forested wetlands occupy a total of 61 acres (2.8% of study area). Palustrine Forested Wetlands mapped areas were located southeast of the head of Packwood Lake, along Latch Road (FSR 1262), and along the periphery of the Hall Creek wetland. Current NWI maps of Palustrine Forested Wetlands indicate more palustrine forest area mapped at Hall Creek than what was observed by site visit. Palustrine Forested Wetlands southeast of Packwood Lake extend well beyond the study area boundary. Two categories of Palustrine Forested Wetland were differentiated: Palustrine Forested Wetland-Red Alder (36 acres) and Palustrine Forested Wetland-Mixed (26 acres). Palustrine Forested Wetland mixed wetlands were characterized by co-dominant species of red alder, black cottonwood, and western red cedar. Occasional Douglas-fir and western hemlock also occur on upland inclusions on slightly higher ground. Shrub cover ranged from about 10-30% and was dominated by red elderberry (*Sambucus racemosa*) and vine maple. Herbaceous cover at sampling points was 70-90%. Herbaceous species found at Palustrine Forested Wetland sites were diverse and included lady fern (*Athyrium filix-femina*), skunk cabbage (*Lysichitum americanum*), cow-parsnip (*Heracleum lanatum*), Cooley's hedge-nettle (*Stachys cooleyae*), mitrewort (*Mitella* sp.), piggy-back plant (*Tolmiea menziesii*), forget-me-not (*Myosotis laxa*), and monkey-flower (*Mimulus* sp.).

#### 4.2.4 Riparian Forests

Riparian vegetation types are defined as those associated with streams and rivers, occurring in the transition zone between aquatic and upland areas. The extent of the riparian zone is influenced by stream gradient, bank height, valley form, and other floodplain characteristics. In the study area, discernible riparian vegetation types are found along Lake Creek and the Cowlitz River. Upper Lake Creek is surrounded by Palustrine Forested Wetlands in the study area; as such, delineation of a separate riparian vegetation type was not feasible. The smaller tributaries of Packwood Lake are also surrounded by similar vegetation types, precluding riparian mapping. A total of 53 acres (2.4% of the study area) were mapped as Riparian Forests, differentiated as Red Alder Dominated, Black Cottonwood Dominated, or Mixed Riparian. These data are an approximation based on a continuous riparian zone along Lake Creek of uniform width (20 feet on either side of the creek). The actual width of the riparian zone varied by site and was interrupted in places by steep slopes and bedrock. Because no riparian vegetation types were differentiated in the Forest Service GIS base-map, no pre-existing data were available to describe the extent or composition of riparian communities within the study area.

Red Alder Dominated Riparian Forest was mapped from the mouth of Lake Creek to the drop structure near the outlet of Packwood Lake for a total of about 33 acres (1.5% of the study area). Mixed Riparian was mapped for a single 6.4 acre stand located on the right bank of the Cowlitz River, at the confluence with the tailrace. Black Cottonwood Dominated Riparian Forests occurred in two polygons at the confluence of the tailrace and the Cowlitz River. Total acreage for this stand type was 14.5 acres (0.7% of the study area).

Descriptive data were collected at a total of 19 sampling plots. In addition, numerous photographs of riparian areas along Lake Creek assembled during the Amphibian Survey Study, Large Woody Debris Study, and Lake Creek Physical Habitat Assessment Study were examined. In addition to red alder and black cottonwood, big-leaf maple, western red cedar, western hemlock, and Pacific silver fir sometimes occurred within riparian areas, but usually as sub-dominant species. Five previously described riparian associations were documented from sampling points: Red Alder/Vine Maple (7 sites), Red Alder/Cooley's Hedge-Nettle (5 sites), Red Alder/Coltsfoot (*Petasites frigidus* var. *palmatus*) (2 sites), Red Alder/Sword-fern (1 site), and Black Cottonwood. Other areas might best be classified as Red Alder/Herb Robert, based on an herb-layer dominated by a non-native species, *Geranium robertianum*. Shrubs found in Riparian Forests included vine maple, salmonberry (*Rubus spectabilis*), stink currant (*Ribes bracteosum*), Devil's club (*Oplopanax horridum*), willows, red elderberry, and Indian plum (*Oemleria cerasiformis*).

#### 4.3 Developed and Non-vegetated Cover Types

The Residential, Industrial, and Roads cover type (129 acres, or 6% of study area) encompasses all developed areas, including all of the facilities and structures associated with the Project. Non-vegetated cover types (23 acres) are areas of bare or very sparsely vegetated ground. Unconsolidated Shoreline (7 acres) describes exposed, barren areas within the active channel of the Cowlitz River.

#### **4.4 Packwood Lake Drawdown Zone**

At maximum seasonal drawdown, which begins September 15 or later each year, approximately 31.6 acres of Packwood Lake that is normally inundated may be exposed temporarily. Most of this drawdown zone does not support vegetation (emergent vegetation typically does not occur in water more than 4 feet deep). Emergent vegetation is concentrated in areas of lacustrine fringe emergent wetlands at the head of Packwood Lake and near the mouth of Osprey Creek. Water was generally shallow (less than 1-foot deep) in these areas when examined on July 18, 2006, but deeper depressions, 2 to 4-feet deep were present in this zone at the head of Packwood Lake. Slough sedge and small-fruited bulrush were predominant in both locations, with scattered skunk cabbage.

The entire drawdown zone appears to be dewatered during drawdown (i.e., no areas with surface water) (Kent Doughty, EES Consulting, personal communication). According to the terminology agreed to in the study plan, the area exposed during drawdown is classified as “intermittent.” Packwood Lake below the point that is temporarily exposed during drawdown is classified as “lower perennial” or permanently flooded.

#### **5.0 DISCUSSION AND RECOMMENDATIONS**

The results indicate that most of the study area is comprised of upland forest types. Wetland and riparian cover types are primarily associated with Lake Creek, upper Packwood Lake, the Cowlitz River, and Hall Creek. The wetlands at upper Packwood Lake and Hall Creek are large and extend much more than 100 meters from the Project boundary.

The Vegetation Cover Type Mapping Study was descriptive rather than analytical in nature. Therefore, no recommendations are advanced herein.

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