

***Revised Study Plan***  
***Boundary Hydroelectric Project (FERC No. 2144)***

**Study No. 16**  
**Inventory of Riparian Trees and Shrubs**

**Seattle City Light**

**February 2007**



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# Study No. 16 – Inventory of Riparian Trees and Shrubs

## 1.0 INTRODUCTION

In general, information on the species composition, distribution, and extent of riparian trees and shrubs in the Boundary Project (Project) vicinity<sup>1</sup> is incomplete. Vegetation cover types, including riparian and wetland plant communities, were mapped in 2005–2006 and described in the Boundary Project relicensing Pre-Application Document (PAD) (SCL 2006a). However, detailed information on distribution, structure and composition of riparian tree and shrub stands was not collected. The inventory will provide information that is required for the relicensing analysis of Project effects on riparian tree and shrub habitats. A preliminary list of riparian tree and shrub species in the study area was developed based on reconnaissance surveys conducted in 2005; these species, listed below, will be the focus of the inventory:

- Black cottonwood      *Populus balsamifera* ssp. *trichocarpa*
- Sitka alder              *Alnus crispa* ssp. *sinuata*
- Red-osier dogwood      *Cornus sericeus*
- Shining willow          *Salix lucida* ssp. *lasiandra*
- Coyote willow          *Salix exigua*
- Sitka willow              *Salix sitchensis*
- Scouler’s willow        *Salix scouleriana*
- Black hawthorn         *Crataegus douglasii*

Western red-cedar (*Thuja plicata*) is not included because it is a common species in upland forests throughout northeastern Washington and in the Project vicinity.

## 2.0 STUDY PLAN ELEMENTS

### 2.1. Nexus Between Project Operations and Effects on Resources

Water level fluctuations and shoreline erosion associated with the Project potentially affect the establishment and maintenance of cottonwoods and other hydrophytic tree and shrub species in riparian areas along the reservoir. Other potential Project-related effects on these species include maintenance activities, such as mowing around Project facilities in riparian areas, and recreation. Cottonwood trees, snags, and logs are an important component of riparian areas, providing nesting and foraging habitat for a number of avian species. Willow and other riparian shrubs,

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<sup>1</sup> The study area for the botanical and wildlife resource studies varies by study, referring to both the “Project area” and “Project vicinity”. The area within the FERC-licensing Project boundary (which includes all Project structures, the reservoir, and the transmission line right-of-way from the powerhouse to the BPA interconnection) is considered the “Project area.” For the purposes of the botanical and wildlife resource studies, the “Project vicinity” encompasses the Project area as well as any adjacent areas that are included in the study.

which typically occur in thick stands, provide hiding cover for mammals such as deer, as well as food and breeding habitat for a variety of other mammals and birds.

Cottonwood logs also play a major role in aquatic habitat functioning, providing instream structure as large woody debris. Only a few relatively large cottonwood stands are known to occur adjacent to the Project reservoir, and the size and age distribution of these stands are unknown. Stands of riparian shrubs are also relatively rare. Further, there are no data on recruitment of cottonwood and other riparian tree and shrub species. The proposed Inventory of Riparian Trees and Shrubs described in this section will provide information that will be used to identify Project effects related to this type of riparian vegetation. The results of this study will be used in conjunction with data from the Erosion Survey (Attachment 2, Study No. 1 of this RSP), Mainstem Aquatic Habitat Modeling Study (hydraulic routing model study component) (Study No. 7), bathymetry survey of the reservoir, LIDAR (Light Detection And Ranging) elevation mapping (conducted by Seattle City Light [SCL] in 2005), and Recreation Resource Study (dispersed recreation use, access, and condition analysis component) ( Study No. 21) to evaluate the following:

- Are there areas where water level fluctuations are apparently affecting recruitment, establishment and maintenance of cottonwoods and other riparian trees and shrubs along the reservoir?
- Are a range of age classes represented by the riparian trees and shrubs in the Project vicinity?
- Where is shoreline erosion affecting the maintenance of riparian trees and shrubs?
- Are there locations where developed and/or dispersed recreation or other human uses (i.e., grazing, mining, and timber harvest) are impacting the establishment and maintenance of riparian trees and shrubs?

This evaluation and the full assessment of Project-related impacts will occur as part of the integrated resource analysis (see Attachment 1, section 2.4 of this RSP), which will be conducted during the development of the Preliminary Licensing Proposal. This evaluation will, as appropriate, include distinguishing Project-related impacts from the effects of other processes, either human-caused or natural. To the extent possible, the evaluation will attempt to isolate the effects of Project-related reservoir level fluctuations from those resulting from changes to inflow from upstream storage and hydroelectric developments, and the effects of Metaline Falls. This will be accomplished through use of the Hydrologic Routing Model (described in Attachment 2, Study No. 7) and Scenario Tool (Attachment 1, section 3.2), with the scenario selected in consultation with relicensing participants. However, the assessment of Project effects will not take the approach of attempting to differentiate fluctuations under current operations from “natural” fluctuations. First, it would be a highly speculative exercise to simulate pre-development conditions, particularly since the Boundary Project was the last dam to be constructed on the Pend Oreille River in the U.S. Moreover, the resulting information would not be relevant to the development of protection, mitigation, and enhancement measures because it would reflect not just the effects of Project operations but also the effects of many other actions on the river system.

## 2.2. Agency Resource Management Goals

In addition to providing information to characterize Project effects, the Riparian Tree and Shrub Inventory will provide information to help agencies with jurisdiction over these species in the Project vicinity identify appropriate conditions for the new Project license pursuant to their respective mandates. The following agencies are those with management responsibility in the context of FERC relicensing of the Boundary Project and management goals related to habitat for aquatic and riparian-dependent species:

### USFS and Bureau of Land Management (BLM)

The Interior Columbia Basin Ecosystem Management Project (ICBEMP) outlines management goals for aquatic/riparian/wetland resources on USFS- and BLM- administered land in eastern Washington and Oregon (U.S. Department of Agriculture-U.S. Department of Interior [USDA-USDI] 2000). The achievement of these goals is proposed through objectives and standards established for riparian conservation areas (RCAs), riparian influence areas, watershed condition indicators, and water quality. One of the primary ICBEMP goals for managing aquatic/riparian/wetland resources is to “maintain, conserve (protect), and/or restore aquatic and riparian-dependent terrestrial resources. Proper ecological function in RCAs is crucial to maintaining aquatic ecosystems and riparian-dependent resources.” Maintaining and restoring structure and function of riparian vegetation, particularly with respect to woody riparian species, is considered by ICBEMP to be a critical aspect of proper ecological function (USDA-USDI 2000).

Management of federal lands in the Project vicinity is also directed by the Inland Native Fish Strategy (INFISH). The purpose of INFISH is to provide interim direction, similar to the Pacific Anadromous Fish Strategy (PACFISH) for areas not covered by the Northwest Forest Plan or PACFISH, for native fish habitat management while the USFS and BLM develop long-term management strategies. This strategy is designed to implement measures to arrest the degradation, and begin the restoration of riparian and aquatic ecosystems in watersheds with inland native fish habitat (FR 61, 177, September 11, 1996).

### U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS)

The USFWS and NMFS are responsible for the recovery of species listed as threatened or endangered under the federal Endangered Species Act (ESA). This responsibility involves assessing potential Project effects on listed species, including those that occur in aquatic/riparian habitats. The bald eagle is the only ESA-listed species currently known to occur regularly in the Project vicinity; the bull trout occurred historically in the Pend Oreille River but is now rare in the reservoirs downstream of Albeni Falls. Although bald eagles often nest in large cottonwood trees in riparian areas, they also use other tree species and habitats. There is no federally designated critical habitat or essential fish habitat associated with the Boundary Project.

### Washington Department of Fish and Wildlife (WDFW)

Riparian habitats are considered a priority habitat type by the WDFW, which has an overall management goal to maintain or enhance the structural and functional integrity of riparian

habitat and associated aquatic systems needed to support fish and wildlife populations on both site and landscape scales (Knutsen and Naef 1997). WDFW management guidelines seek to promote riparian habitat characteristics beneficial to fish and wildlife and include the following:

- Connectivity of riparian vegetation corridors along and adjacent to rivers and streams.
- Vegetation with a diverse mix of growth forms and native species composition.
- Multi-layered, vertical vegetation structure to increase habitat diversity.
- Disturbance regimes associated with natural river processes.
- Snags and large woody debris to provide habitat, structural diversity and stabilization.
- Riparian dimensions (shape and width) needed to retain riparian function.
- Streambanks stabilized with native woody vegetation to promote near-channel habitat.
- Adjacent wetlands to provide transitional habitats between upland and riparian habitats, and generally increase habitat diversity.

### **2.3. Study Goals and Objectives**

The goal of the Riparian Tree and Shrub Inventory is to provide information needed to determine the extent, types, and structure of riparian tree and shrub species in the Project vicinity, and assess Project effects on these species. Specific objectives of this study are as follows:

- Identify the current location, extent, and distribution of riparian tree and shrub species.
- Characterize the species composition and structure of riparian tree and shrub stands.
- Document the age structure of cottonwood stands and the number and age class of snags.
- Estimate the distribution and extent of riparian tree and shrub habitat that could potentially occupy the fluctuation zone.
- Identify potential threats to existing riparian tree and shrub stands (e.g., infestations of exotic species, beaver, erosion, grazing, trampling, reservoir level fluctuations).

### **2.4. Need for Study**

#### Summary of Existing Information

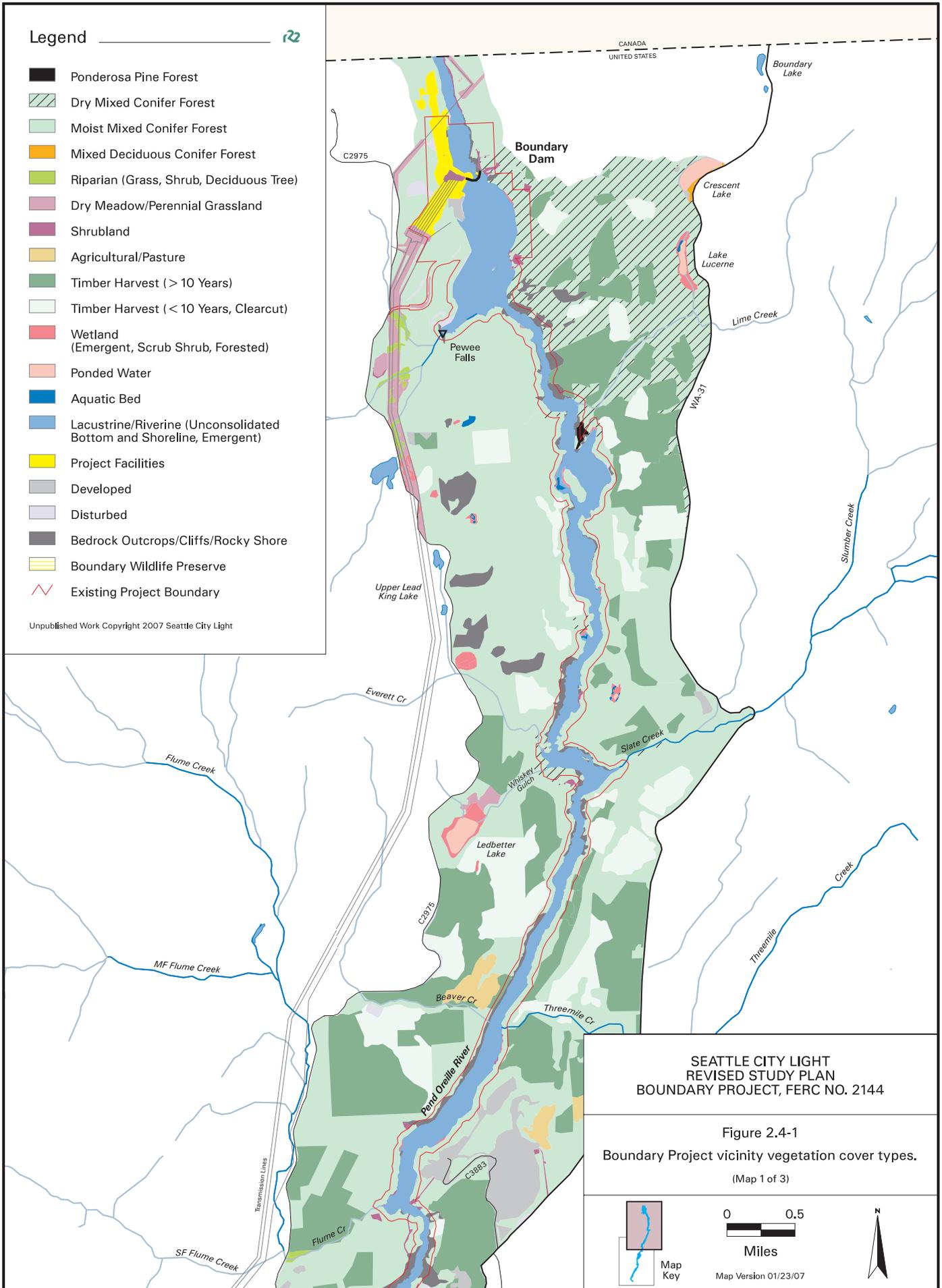
A total of 43 cover types were identified and mapped in the 13,666-acre Project vicinity in 2005; including 28 upland, 5 riparian, 5 wetland, and 5 littoral/deep water types (Figure 2.4-1).

Legend



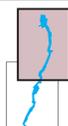
- Ponderosa Pine Forest
- Dry Mixed Conifer Forest
- Moist Mixed Conifer Forest
- Mixed Deciduous Conifer Forest
- Riparian (Grass, Shrub, Deciduous Tree)
- Dry Meadow/Perennial Grassland
- Shrubland
- Agricultural/Pasture
- Timber Harvest (> 10 Years)
- Timber Harvest (< 10 Years, Clearcut)
- Wetland (Emergent, Scrub Shrub, Forested)
- Ponded Water
- Aquatic Bed
- Lacustrine/Riverine (Unconsolidated Bottom and Shoreline, Emergent)
- Project Facilities
- Developed
- Disturbed
- Bedrock Outcrops/Cliffs/Rocky Shore
- Boundary Wildlife Preserve
- Existing Project Boundary

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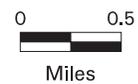


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Figure 2.4-1  
Boundary Project vicinity vegetation cover types.  
(Map 1 of 3)



Map Key



Map Version 01/23/07

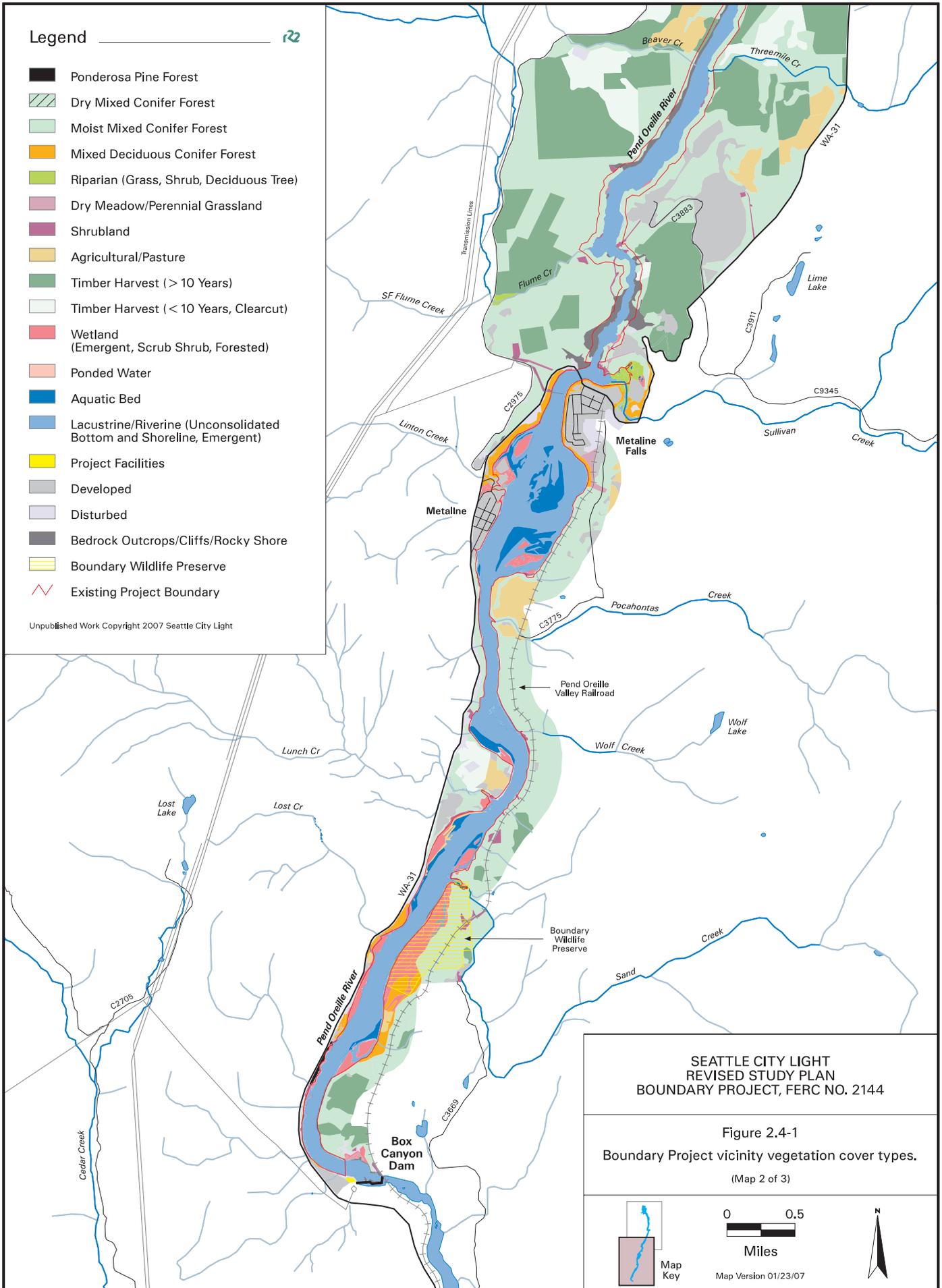


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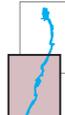
- Ponderosa Pine Forest
- Dry Mixed Conifer Forest
- Moist Mixed Conifer Forest
- Mixed Deciduous Conifer Forest
- Riparian (Grass, Shrub, Deciduous Tree)
- Dry Meadow/Perennial Grassland
- Shrubland
- Agricultural/Pasture
- Timber Harvest (> 10 Years)
- Timber Harvest (< 10 Years, Clearcut)
- Wetland (Emergent, Scrub Shrub, Forested)
- Ponded Water
- Aquatic Bed
- Lacustrine/Riverine (Unconsolidated Bottom and Shoreline, Emergent)
- Project Facilities
- Developed
- Disturbed
- Bedrock Outcrops/Cliffs/Rocky Shore
- Boundary Wildlife Preserve
- Existing Project Boundary

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Figure 2.4-1  
Boundary Project vicinity vegetation cover types.  
(Map 2 of 3)



Map Key



Miles  
Map Version 01/23/07



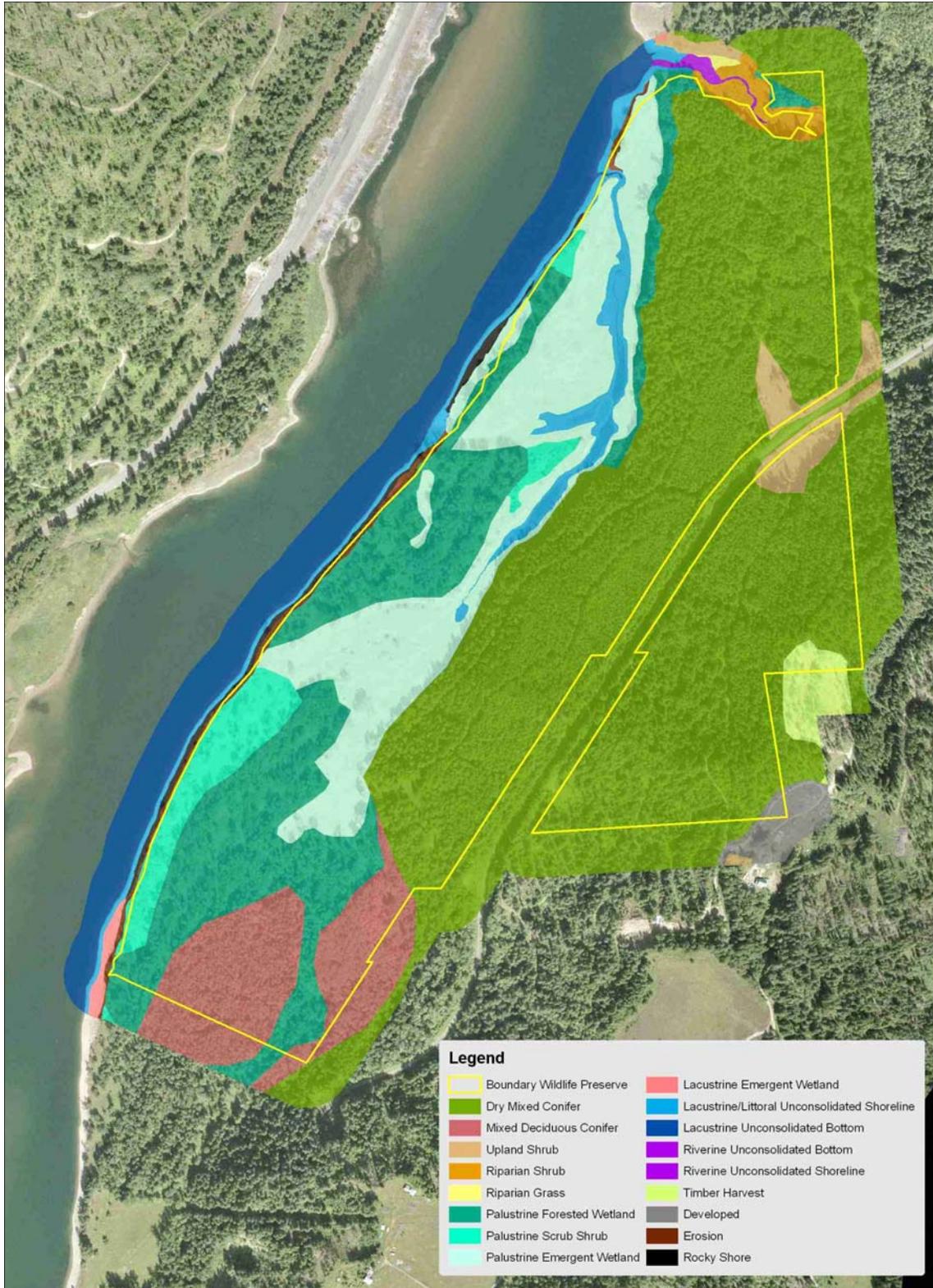


Figure 2.4-1. Boundary Project vicinity vegetation cover types (Map 3 of 3).

Approximately 2,691 acres, or 20 percent, of the total mapped acreage is within the FERC Project boundary (Project area). Of this area, 1,686 acres (62 percent) is represented by lacustrine, littoral, and riverine cover types, which include reservoir, river, shoreline, and aquatic bed habitats (Table 2.4-1). Riparian and wetland vegetation types dominated by trees and shrubs occupy just 23.8 acres, or slightly less than 1 percent of the Project area, and include 5.8 acres of riparian shrub and 1.7 acres of riparian deciduous tree types, and 12.8 acres of palustrine shrub scrub and 3.5 acres of palustrine forested wetlands (SCL 2006a).

**Table 2.4-1.** Aquatic, riparian and wetland cover types within the Boundary Project area.<sup>1</sup> (Note: Tree and shrub types are shaded.)

Cover Types	Acreage <sup>2</sup>	% of Project Area <sup>1,2</sup>
<b>Lacustrine/Littoral Types</b>		
Lacustrine Unconsolidated Bottom (LUB)	1,389.7	51.6%
Lacustrine Aquatic Bed (AB)	112.4	4.2%
Lacustrine/Littoral Unconsolidated Shoreline (LUS)	120.3	4.5%
Littoral Emergent Wetland (LEM)	12.8	0.5%
Rocky Shoreline (ROC)	5.6	0.2%
<b>Lacustrine/Littoral Total</b>	<b>1,640.7</b>	<b>61.0%</b>
<b>Riverine Types</b>		
Riverine Unconsolidated Bottom (RUB)	34.3	1.3%
Riverine Unconsolidated Shoreline (RUS)	10.8	0.4%
<b>Riverine Total</b>	<b>45.1</b>	<b>1.7%</b>
<b>Lacustrine/Littoral &amp; Riverine Total</b>	<b>1,685.8</b>	<b>62%</b>
<b>Wetland Types</b>		
Palustrine Unconsolidated Bottom (PUB)	0.0	0.0%
Palustrine Aquatic Bed (PAB)	0.3	0.0%
Palustrine Emergent Wetland (PEM)	70.9	2.6%
Palustrine Scrub-Shrub (PSS)	12.8	0.5%
Palustrine Forested Wetland (PFO)	3.5	0.1%
<b>Wetland Total</b>	<b>87.4</b>	<b>3.2%</b>
<b>Riparian Types</b>		
Riparian Grass (RG)	2.7	0.1%
Riparian Shrub (RS)	5.8	0.2%
Riparian Deciduous Tree (RDT)	1.7	0.1%
<b>Riparian Total</b>	<b>10.2</b>	<b>0.4%</b>
<b>Total Water Associated Habitat</b>	<b>1,783.5</b>	<b>66.3%</b>

1 Includes the Boundary Wildlife Preserve (BWP).

2 Project area is 2,691.4 acres and includes 907.9 acres of upland cover types.

Areas that support riparian trees and shrubs within the Project boundary appear to be under the influence of riverine processes, such as normal surface flows, degradation/ aggradation, and periodic flooding. In general, woody riparian vegetation in the vicinity is associated with tributary streams. Stands of riparian trees and shrubs along tributary streams are best developed

along Sullivan Creek, but also occur along Sand and Linton creeks. These tributary streams support Sitka alder, shining willow, coyote willow, and Sitka willow. Black cottonwood occurs as scattered individual trees or in small stands intermixed with conifers. Most of the tributary streams to Boundary Reservoir are small and narrow and are overtopped and shaded by adjacent upland forest. These streams support few, if any, riparian trees or shrubs; Sitka alder is the only riparian shrub species found along most of these heavily shaded stream channels.

Relatively few stands of riparian shrubs or trees grow in the reservoir fluctuation zone. In contrast to the species found along tributary streams, coyote willow was the only species observed growing within or in close proximity to this zone. This species occurs in sparse stands on a few gravel/cobble bars that are frequently inundated. Because of their small size, these stands were not mapped as distinct polygons on the vegetation cover type map (Figure 2.4-1).

Riparian trees and shrubs downstream of Boundary Dam were observed only as widely scattered individual plants; this is not unusual along rivers flowing through steep, confined valley bottoms. However, frequent high flows and confined valley bottom combine to create scouring conditions in areas along river banks, which are particularly detrimental when they occur during the growing season when riparian tree and shrub species are trying to establish. The lack of finer-textured sediment may also limit the establishment of riparian trees and shrubs in this reach.

Most of the mapped palustrine forest and scrub-shrub wetlands in the Project vicinity appear to be supported by seeps or springs or by shallow groundwater. A few shrub-dominated wetlands occur in the vicinity of tributaries where high pool levels and tributary inflows combine to contribute to shallow groundwater or inundation. Sitka alder is often the only dominant shrub layer species in these wetlands.

The SCL-owned Boundary Wildlife Preserve (BWP) includes the largest and best examples of forest and scrub-shrub wetlands in the Project vicinity. A large portion of the BWP occurs on a relict floodplain or terrace that is no longer influenced by overbank flows. However, when reservoir levels are high, portions of the old channel through the floodplain are inundated by backwater; other low points or depressions in the floodplain are inundated or saturated, presumably by shallow groundwater affected by the reservoir pool. Riparian tree and shrub species at the BWP include black cottonwood, red-osier dogwood, black hawthorn and various willow species. Large, old black cottonwood trees dominate the terrace forest. Few young cottonwoods were observed in the BWP during reconnaissance trips to this site in 2005, which may indicate that river processes required to facilitate establishment of this species are no longer occurring; foraging by beaver (*Castor canadensis*) and browsing by deer (*Odocoileus hemionus* and *O. virginianus*) may also limit establishment. Red-osier dogwood and willow form an abundant understory component in the cottonwood stands on the BWP. These species are more groundwater-dependent and may become dominant on the terrace as the cottonwood trees die. Black hawthorn is the dominant species in some shrub scrub wetland habitats and also occurs as an understory species in the cottonwood forest. Black hawthorn often colonizes old floodplains or terraces that are infrequently or no longer subjected to overbank flows that scour the landform.

A potential threat to the integrity of the forested and scrub-shrub wetlands on the BWP is reed canarygrass (*Phalaris arundinacea*), an aggressive invasive species with the potential to inhibit

reproduction of riparian trees and shrubs. Vegetation and wildlife monitoring conducted in the early 1990s at the BWP (Pacific Wetland Nursery 1992) indicated that reed canarygrass was expanding rapidly in the BWP compared to data from 1987 (Parametrix 1987). SCL planted woody riparian species in the reed canarygrass swards at the BWP but the plantings were unsuccessful.

### Need for Additional information

The existing cover type map provides a starting point for compiling comprehensive information on riparian tree and shrub species in the Project vicinity. However, previous surveys, including the reconnaissance level surveys conducted in 2005 and cover type mapping, did not provide detailed information on woody species distribution, composition, structure, and age class in riparian and wetland habitats within the Project boundary. Additional survey and documentation of riparian tree and shrub species are needed to provide the baseline information necessary to assess potential Project-related impacts.

## 2.5. Detailed Description of Study

### Study Area

The study area for the Riparian Tree and Shrub Inventory will extend approximately 18 miles along the Pend Oreille River from the Box Canyon tailrace downstream to the U.S.-Canada border (see Figure 1.3-2 of the Proposed Study Plan [PSP; SCL 2006b] for a location map of the Boundary Project) and will encompass the following:

- Downstream of Metaline Falls — The reservoir, fluctuation zone allowed under the current license (forebay elevation 1,950–1,990 feet NGVD 29 [1,954–1,994 feet NAVD 88]), and land within the FERC Project boundary (Project area), which includes most Project facilities, the area 200 horizontal feet (i.e., along the ground surface, perpendicular to the shoreline) beyond the high water level along both reservoir shorelines, and the transmission line right-of-way (ROW) from the powerhouse to the BPA interconnection.
- Upstream of Metaline Falls — The reservoir, fluctuation zone (elevation  $\approx$ 1,985–2,015 feet NGVD 29 [1,989–2,109 feet NAVD 88], as measured at the USGS gage below Box Canyon Dam), and the land within approximately 200 horizontal feet above the high water level (approximately 2,015 feet NGVD 29 [2,019 feet NAVD 88]) along both reservoir shorelines extending to the FERC project boundary for the Box Canyon Project.<sup>2 3</sup>

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<sup>2</sup> The estimated fluctuation range of approximately 1,985–2,015 feet upstream of Metaline Falls is based on the review of existing hydrology, as described in section 1.3.5 of the PSP (see Table 1.3-1; SCL 2006b). Following completion of the Hydrology Dataset and Statistics in March 2007 (see Attachment 1, section 3.1 of this RSP), SCL will review and refine, as necessary, this elevation range

<sup>3</sup> As indicated in this and other study plans in the PSP, SCL agrees it is appropriate to study the existing fluctuation range of the reservoir; however, for development of the Preliminary Licensing Proposal (PLP) and License Application, SCL will base its assessment of potential protection, mitigation, and enhancement measures on that portion of the fluctuation zone that is determined to be under the influence of Boundary Project operations, versus the effects of inflows and Metaline Falls that are beyond the control of the Project.

- The BWP (155 acres) and adjoining SCL-owned property (85 acres).
- 100 horizontal feet along both sides of the river from Boundary Dam to the U.S.-Canada border (approximately 0.9 mile).

The ability to conduct surveys on private land within the study area outside the FERC Project boundary (mainly upstream of Metaline Falls) may be limited due to access constraints on private lands in this area.

### Proposed Methodology

Determining the distribution, composition, and reproduction status of existing riparian tree and shrub species in the study area will require a thorough inventory of the Project reservoir shoreline, BWP, and Pend Oreille River downstream of the dam. This inventory will be conducted by boat along the reservoir shoreline and on foot in the BWP and downstream of Boundary Dam. Estimating the location and extent of riparian tree and shrub habitat that could potentially develop in the fluctuation zone will be primarily a mapping exercise. The four main tasks required to accomplish the Riparian Shrub and Tree inventory are described below.

#### *Task 1: Map Existing Riparian Tree and Shrub Stands*

The existing map (Figure 2.4-1) of tree- and shrub-dominated riparian and wetland habitats will serve as a starting point for the more comprehensive inventory and mapping of riparian trees and shrubs. Detailed mapping depicting the current distribution of tree- and shrub- dominated riparian and wetland habitats will be completed in the field. The field mapping will use the Project's orthophotographs, which were derived from true-color aerial photographs taken in 2005, as the base map. If additional resolution is required, mapping will be done on mylar overlays of the original true color aerial photographs (scales of 1 inch = 1,000 feet and 1 inch = 600 feet) or on enlarged versions of these photographs (1 inch = 100 feet). Individual riparian trees or shrubs and any additional stands observed during inventory will be delineated on the field maps or on aerial photographs. Some areas may be difficult to map because shadows on the aerial photographs or the orthophotographs obscure portions of the shoreline. GPS coordinates will be collected to document the occurrence of individual trees or shrubs or small patches of riparian species that are difficult to map. In addition, any errors in the 2005 classification and delineation of existing polygons will be corrected.

All spatial data will be digitized using ESRI's Geographical Information Systems (GIS) ArcMap software (Version 9.0/9.1 or more recent version). The spatial data will then be used to amend the existing shape files used to produce the 2005 cover type map (Figure 2.4-1), and to create an accurate and comprehensive map depicting the distribution of riparian trees and shrubs in the study area. The data in Table 2.4-1 will be updated to reflect the newly calculated acreages of riparian habitats.

Once the map of riparian trees and shrubs is complete, it will be overlaid with data from the Bathymetry Study and LIDAR elevation mapping. This step will be used to determine the range of elevations in the study area that currently support riparian trees and shrubs.

## *Task 2: Riparian Tree and Shrub Stand Characterization*

Data to characterize the stands (points and polygons) of riparian tree and shrub species in the study area will be collected concurrently with the mapping exercise and will include the following parameters:

- Species composition
- Area (sq feet or acres) estimation for each polygon
- Canopy cover by species in tree and shrub layers
- Average height(s) of shrub and/or tree layer(s)
- Age classes for each species
- Ecotones or transitions to other vegetation layers or habitat types
- Substrate (silt, sand, gravel, small cobble, large cobble, and boulder)
- Potential direct and/ indirect impacts, including Project- and non-Project- related impacts

Data sheets will be developed prior to field work to accommodate data collection and facilitate transfer to a database or spreadsheet format compatible with GIS attribute tables. A brief explanation and discussion of each parameter and its objective is provided below.

### Species Composition

Species identification will be fairly straightforward given the few riparian tree and shrub species known to occur within the study area. The identification of willow species may present some difficulties if fieldwork is conducted when no male or female catkins are present. However, willow species currently known to occur in the study area have diagnostic characteristics almost any time during the growing season. Although Sitka alder was the only alder species observed during reconnaissance surveys conducted in 2005, thinleaf alder (*Alnus incana* ssp. *tenuifolia*) has potential to occur in the study area. The presence of alder cones on the previous year's wood and unwinged seeds make this species easy to distinguish from Sitka alder.

### Polygon Area Estimation

The purpose of estimating polygon area is to provide an accurate accounting of the total area occupied by each riparian tree and shrub species. Although estimates of the mapped occurrences of riparian tree and shrub species will be calculated using GIS ArcMap software, the area of individual trees and very small stands should be estimated in the field since digitizing them may introduce considerable error.

### Canopy Cover

The purpose of assessing canopy cover is to determine the relative abundance of each riparian tree and shrub species within each mapped polygon. The percent canopy cover of each riparian tree and shrub species present will be visually assessed by shrub and/or tree layer(s). The number of shrub and/or tree layers will need to be determined by the sampling crew (for additional information on assessment of layers, see Sawyer and Keeler-Wolf 1995). Since the

majority of woody riparian and wetland habitats are small and dominated by one species, this parameter should be easy to assess. Large stands may be more difficult to assess due to structural variability in the tree and shrub layers. For example, the large black cottonwood forest stands in the BWP have a shrub layer in some areas and not in others. When possible, these stands will be stratified or subdivided on field maps into more homogenous units to aid in assessment of aerial cover. Variable stands that cannot be easily subdivided may require the use of transects and the line intercept method (Hayes et al. 1981) to obtain an estimate of canopy cover.

### Average Height(s) of Shrub and/or Tree Layer(s)

The purpose of assessing height is to document the vertical structure of stands of riparian trees and shrubs. The average height and aerial cover of each shrub and/or tree layer will be visually estimated for each polygon or stand.

### Age Classes

The purpose of assessing age classes is to determine whether riparian trees and shrubs are establishing and reproducing. The assessment will include estimating and recording the number of individual plants by age classes. For willows and other multi-stem species the following age classes will be used (adapted from Crowley et al. 2006 and Cagney 1993):

- 1) Seedlings — 1 stem at surface
- 2) Young — 2–10 stems at ground surface
- 3) Mature — >10 stems at ground surface and >50 percent live, and
- 4) Decedent/Dead — >10 stems at ground surface and <50 percent live

For cottonwoods the following age classes will be used (adapted from Crowley et al. 2006):

- 1) Seedling — Stem is <4.5 feet tall or < 1 inch diameter-at-breast height (dbh);
- 2) Young — Stems is > or < 4.5 feet and 1 to < 5 inches dbh;
- 3) Mature — Stem is  $\geq$  5 inches dbh;
- 4) Decedent/Dead — Stem is  $\geq$  5 inches dbh with <50 percent live canopy
- 5) Snag — Stem is > 5 inches dbh and with a completely dead canopy

Where possible, the reproductive status of riparian trees and shrubs will be noted along with age class. The term “reproductive” refers to whether or not flowers and fruit are present. In addition, approximately 10–20 percent of mature trees in each cottonwood stand will be selected for coring to determine actual age. The growing conditions associated with seedling establishment will also be noted. This assessment will be completed for each riparian tree and shrub species present in the stand.

### Ecotones

The purpose of assessing ecotones is to document the type and extent (linear distance) of habitats that adjoin the stands of riparian trees and shrubs (i.e., littoral zone, dry mixed conifer forest,

emergent wetland, open water, etc.). Completion of this task may include revising the existing cover type map (see Task 1) to more accurately delineate adjoining habitat types. The actual calculations of the linear distance of adjoining habitat types and riparian tree and shrub stands will be conducted using GIS ArcMap software.

### Substrate

The purpose of determining the substrate is to gain an understanding of the soil or rock that support riparian trees and shrubs in the study area. Evaluating substrate will involve determining the dominant material composing the site, as categorized below:

- Stones (>10 inches [ $>250$  mm])
- Cobble (3-10 inches [76–250 mm]),
- Gravel (<0.08–3 inches [2–76 mm]), and
- Fines (includes sand and silt)( $<0.08$  inches [2 mm])

### Assessment of Potential Direct and/or Indirect Impacts

Potential and observed impacts to riparian tree and shrub species will be noted in the field. A preliminary list of potential impacts is provided below:

- Water level fluctuations
- Invasive species infestations
- Human activities (developed recreation, dispersed recreation, timber harvest, etc.)
- Damage or trampling from cattle grazing
- Damage from beaver or other wildlife
- Erosion

Impacts to riparian shrubs and trees will be documented by taking photographs. Both Project-related and non-Project related effects will be included. The site will be revisited if an impact is suspected but cannot be confirmed in one visit.

### *Task 3: Mapping of Potential Riparian Tree and Shrub Habitat*

Developing a map of the area within the reservoir fluctuation zone that could potentially support riparian trees and shrubs will involve the following steps:

- 1) Hydrology and bathymetry data will be used to delineate the extent of reservoir fluctuation zone upstream and downstream of Metaline Falls in 5-foot (vertical) increments. The Hydraulic Routing Model, which will be developed as part of the Mainstem Aquatic Habitat Modeling Study (see Attachment 2, Study No. 7 of this RSP), will be used to translate the USGS gage data into corresponding water surface elevations along the length of the study area.
- 2) The bathymetry map and the map developed in Task 1 will be overlaid and used as a base for delineating locations in the fluctuation zone that could potentially support riparian trees and shrubs. This step will assume that areas that currently support

- riparian trees and shrubs would expand into the fluctuation zone if the reservoir was operated at the lower levels during the growing season and there were no significant changes in topography or substrate. Depending on topography, it may also be necessary to modify the riparian/upland boundary in some locations. In addition, some modifications to the expected habitat types in the fluctuation zone may need to be made to reflect the effects of periodic high flow events, which are outside the control of the Project, but which may affect the establishment and maintenance of riparian trees. Project hydrology data will be used to make this determination.
- 3) GIS will be used to develop a map of riparian tree and shrub habitat, and a table of associated acreage estimates, that could potentially be supported in the fluctuation zone in 5-foot (vertical) increments. This task will be coordinated with the Big Game Study (Study No. 19) and the Waterfowl/Waterbird Study (Study No. 15), which also require evaluating the development of potentially suitable habitat in the fluctuation zone.

#### *Task 4: Documentation and Effects Assessment*

All data collected in the field will be recorded on datasheets and/or maps or aerial photographs. Mapped data will be entered into the Project GIS database; other data will be entered into a database for analysis.

This task will also describe the effects of the Project and local land uses on the quantity and quality of riparian tree and shrub habitat in the study area. This will involve using information from the literature and data from Tasks 1 and 2 to identify locations where water level fluctuations and/or erosion are affecting the maintenance and/or age class distribution of existing stands of cottonwoods or other riparian shrubs. A similar assessment will be conducted for other local lands uses or threats (i.e. mining operations, logging, weeds). Determining the amount of riparian tree and shrub habitat that could potentially develop in the fluctuation zone at lower reservoir levels will be a quantitative assessment based on the results of Task 3.

## **2.6. Work Products**

Work products for the riparian tree and shrub inventory will include the following:

- A detailed riparian/wetland cover type map for the study area, which will be produced using GIS ArcView software and include elevation data. Each stand (polygon) and individual (point) containing riparian tree and shrub species will be assigned to one of four cover types — a riparian shrub (RS), riparian deciduous tree (RDT), palustrine shrub scrub (PSS) or palustrine forested wetland (PFO) — with an additional six-letter species acronym designed to indicate the dominant tree or shrub species. The cover type abbreviation and species acronym information will be clearly indicated in the legend on the cover type map.
- The shape file used to construct the updated cover type map, including an attributes table with the following information:
  - Cover type label
  - Cover type abbreviation plus species acronym for dominant species

- Acronym for dominant three tree species (3 columns max.)
- Cover for dominant three tree species (3 columns max.)
- Acronym for dominant three shrub species (3 columns max.)
- Cover for dominant three shrub species (3 columns max.)
- Tree layer cover (as many columns as layers)
- Tree layer height (as many columns as layers)
- Shrub layer cover (as many columns as layers)
- Shrub layer height (as many columns as layers)
- Comments column for impacts (i.e., type of disturbance, potential impact, link to photo)

Development of this product will entail adding columns to the existing attributes table for the 2005 cover type shape file. This product will provide a detailed summary of the data collected for each individual or stand of riparian trees and/or shrubs.

- A map and acreage estimates of potential riparian shrub and tree habitat in the fluctuation zone.
- A report in standard scientific format which summarizes the methods and results of the inventory of existing riparian tree and shrub stands. Results will be presented for three different segments within the study area:
  - Pend Oreille River downstream of Boundary Dam
  - Reservoir shoreline downstream of Metaline Falls to Boundary Dam, including tributaries, seeps and springs supporting riparian trees and shrubs
  - Reservoir shoreline upstream of Metaline Falls to south end of the Project boundary, including tributaries, seeps and springs supporting stands of riparian trees and shrubs, and the BWP
- A description of the extent and composition of riparian shrub and tree cover types, including information on stand size and structure, as well as the distribution, abundance and age classes for individual species.
- A discussion of potential Project effects and other threats to stands of riparian trees and shrubs will also be provided for each study segment, as determined from the results of this study. The full assessment of potential Project-related impacts, including the effects of the type and timing of Project operations and maintenance and Project-related recreation, will be part of the integrated resource analysis (see Attachment 1, section 2.4 of this RSP).
- A table that presents a comparison of the amount of riparian tree and shrub habitat currently available in each study area section, and the amount that could potentially occur in the fluctuation zone.
- A comprehensive list of all riparian trees and shrubs by cover type and study segment.

## 2.7. Consistency with Generally Accepted Scientific Practice

Although there are several standard approaches to monitoring riparian communities, most of these are designed to detect changes over time from restoration activities, particularly fencing or other methods to exclude cattle from these areas (National Riparian Service Team 2004). Techniques from one or more of these approaches may be suitable to monitor the development of riparian habitat in the fluctuation zone if operations are changed for the next license period. There is, however, no standardized approach to conducting inventories for riparian tree and shrub habitats. The methods described above are consistent with generally accepted practices in the scientific community for mapping and characterizing vegetation communities and incorporate some of the variables and techniques used in riparian monitoring programs.

## 2.8. Consultation with Agencies, Tribes, and Other Stakeholders

This study plan was prepared with input from the USFS, WDFW, and Pend Oreille County Noxious Weed Control Board, which was provided at a meeting of the Terrestrial Resources Workgroup on June 28, 2006. Additional comments were provided by the USFS at a Workgroup meeting on July 26, 2006. Comments provided at the workgroup meetings are summarized in PSP Attachment 5-1 (SCL 2006b) and can also be found in the workgroup meeting summaries, available on SCL's relicensing website (<http://www.seattle.gov/light/news/issues/bndryRelic/>). Additional comments were also provided by the WDFW in written comments (letter from D. Robison, WDFW, to M. Lynn, SCL, August 28, 2006) and a follow-up phone conversation (D. Robison, WDFW, personal communication, August 28, 2006) (included in PSP Attachment 5-1, SCL 2006b) and by the USFS in its PAD/Scoping comments and official study requests (USFS 2006). The proposed plan for the Riparian Tree and Shrub Inventory addressing these comments was included in the PSP that was filed with FERC on October 16, 2006.

Since filing the PSP, SCL has continued to work with relicensing participants on its proposed study plans. In response to comments made during the November 15 study plan meeting and comments filed with FERC by the USFS (2007) SCL has further modified the plan for the Riparian Tree and Shrub Inventory. (SCL's responses to comments are summarized in Attachment 3 and consultation documentation is included in Attachment 4 of this RSP.) Modifications included adding clarification, additional supporting rationale, and additional detail to address USFS comments. SCL believes that the USFS comments are adequately addressed in the plan for the Riparian Tree and Shrub Inventory.

## 2.9. Schedule

The Riparian Tree and Shrub Inventory will be conducted in 2007; the need for additional data will be evaluated after the first year of work. Assuming that mapping and data collection can be accomplished in one year, the expected schedule is as shown in Table 2.9-1.

**Table 2.9-1.** Schedule for Riparian Tree and Shrub Inventory.

<b>Activity</b>	<b>Timeframe</b>
Finalize study implementation details	April 2007
Field work to map and characterize existing riparian tree and shrub stands	June–July 2007
Map potential riparian tree and shrub habitat in the fluctuation zones	August–September 2007
Analyze data and mapping	September–October 2007
Prepare draft study report	November–December 2007
Distribute draft study report for relicensing participant review	January 2008
Meet with relicensing participants to review study efforts and results	February 2008
Include final study report in Initial Study Report (ISR) filed with FERC	March 2008
Hold ISR meeting and file meeting summary with FERC	March 2008

## 2.10. Progress Reports, Information Sharing, and Technical Review

In addition to preparing the study reports (as described in the above), there will be several opportunities for information sharing and technical review with relicensing participants. Interested agencies will be invited to participate in survey efforts and will be asked to provide input into the operating scenarios selected for analysis. Survey results will be presented at a workshop in early 2008, as described in Attachment 1, section 2.3 of this RSP.

## 2.11. Anticipated Level of Effort and Cost

The riparian tree and shrub inventory is expected to involve about 100 hours of field time (2 botanists for approximately 1 week each), as well as additional time for data summary, analysis, and reporting. The estimated cost for this study is \$32,000–\$42,000.

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