TR-01 VEGETATION MAPPING STUDY
DRAFT REPORT

SKAGIT RIVER HYDROELECTRIC PROJECT
FERC NO. 553

Seattle City Light

Prepared by:
Environmental Science Associates

March 2022
Initial Study Report

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List of Acronyms and Abbreviations

CHM .....Canopy Height Model
City Light.....Seattle City Light
CMZ.....channel migration zone
dbh.....diameter-at-breast-height
DEM.....digital elevation model
DNR .....Department of Natural Resources (Washington State)
ESA .....Environmental Science Associates
FERC.....Federal Energy Regulatory Commission
GIS .....Geographic Information System
ISR .....Initial Study Report
LiDAR.....Light Detection and Ranging
LP.....licensing participant
m^2 .....square meter
NAIP .....National Agriculture Imagery Program
NDVI.....Normalized Difference Vegetation Index
NPS .....National Park Service
NRCS .....Natural Resources Conservation Service
OBIA.....Object-based Image Analysis
PHS .....Priority Habitats and Species
PME .....protection, mitigation, and enhancement
PRM .....Project River Mile
Project .....Skagit River Hydroelectric Project
RLNRA.....Ross Lake National Recreation Area
ROW .....right-of-way
RSP .....Revised Study Plan
RTE.....rare, threatened, and endangered
SGCN.....Species of Greatest Conservation Need
SR.....State Route
SRSC.....Skagit River System Cooperative
SWAP .....State Wildlife Action Plan
TRREWG.....Terrestrial Resources and Reservoir Erosion Work Group

TWG .....Terrestrial Work Group
UGA.....urban growth area
USDA.....U.S. Department of Agriculture
USFWS .....U.S. Fish and Wildlife Service
USGS .....U.S. Geological Survey
USNVC.....U.S. National Vegetation Classification System
UW.....University of Washington
WDFW.....Washington Department of Fish and Wildlife

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1.0 INTRODUCTION

The TR-01 Vegetation Mapping Study is being conducted in support of the relicensing of the Skagit River Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 553, as identified in the Revised Study Plan (RSP) submitted by Seattle City Light (City Light) on April 7, 2021 (City Light 2021). On June 9, 2021, City Light filed a "Notice of Certain Agreements on Study Plans for the Skagit Relicensing" (June 9, 2021 Notice)[1] that detailed additional modifications to the RSP that were agreed to between City Light and supporting licensing participants (LP) (which include the Swinomish Indian Tribal Community, Upper Skagit Indian Tribe, National Marine Fisheries Service, National Park Service [NPS], U.S. Fish and Wildlife Service [USFWS], Washington State Department of Ecology, and Washington Department of Fish and Wildlife [WDFW]). The June 9, 2021 Notice proposed no changes to the Vegetation Mapping Study as described in the RSP.

In its July 16, 2021 Study Plan Determination, FERC approved the Vegetation Mapping Study without modification.

This study is complete and a draft report of the study efforts is being filed with FERC as part of City Light's Initial Study Report (ISR).

[1] Referred to by FERC in its July 16, 2021 Study Plan Determination as the "updated RSP."

2.0 STUDY GOALS AND OBJECTIVES

The goal of the Vegetation Mapping Study is to develop a complete and systematic vegetation mapping Geographic Information System (GIS) database to describe existing conditions, assess potential Project-related habitat effects, inform development of terrestrial resource management plans, and, as needed, protection, mitigation, and enhancement (PME) measures. Specific objectives of this study are as follows:

- Compile existing data and use remote sensing to describe and map vegetation to the "Group" level within the study area using the U.S. National Vegetation Classification (USNVC) Standard.[2] The Group level is defined as a combination of relatively narrow sets of diagnostic plant species (including dominants and co-dominants) with broadly similar composition and diagnostic growth forms reflecting biogeographic differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes. For highly modified areas such as the transmission line right-of-way (ROW), a custom set of cover types was used during mapping based on field observations and aerial photograph interpretation.
- Provide sufficient habitat information to prioritize field surveys, including model verification surveys, to accessible areas of transitional habitats (e.g., riparian areas and areas of Group transitions).
- Describe baseline vegetation resources and environmental conditions within the study area.
- Provide information on wetland communities within the study area (see TR-02 Wetland Assessment [City Light 2022e]).
- To the extent possible, provide information for assessing fish and wildlife habitat (e.g., salmonids, marbled murrelet [*Brachyramphus marmoratus*], golden eagle [*Aquila chrysaetos*], northern goshawk [*Accipiter gentilis*], beaver [*Castor canadensis*], and select Priority Habitats and Species [PHS] wildlife [https://wdfw.wa.gov/species-habitats/at-risk/phs/list] and WDFW Species of Greatest Conservation Needs [SGCN]) within the study area [https://wdfw.wa.gov/species-habitats/at-risk/swap]), as well as species of concern for the NPS.
- To the extent possible, provide information for assessing important tribal resources, including forage for important wildlife and culturally important plants. (Any information will be considered confidential and not included in materials distributed to the general public.)

[2] For more information on the USNVC Standard and categories including definitions for Group, Association, and Alliance levels, see: http://usnvc.org/data-standard/natural-vegetation-classification/.

3.0 STUDY AREA

The study area for the Vegetation Mapping Study is approximately 145,400 acres and consists of land within the Project Boundary, the area within 0.5 mile of the Project Boundary, and the channel migration zone (CMZ) from Gorge Powerhouse to the confluence of the Sauk and Skagit rivers.

To organize the results of the study, the study area was divided into the following six segments as described below and shown in Figures 3.0-1 through 3.0-3:

- **Ross Lake National Recreation Area (RLNRA):** This study area segment occurs within the upper Skagit River basin and includes all lands of the Project Boundary that lie within the RLNRA, including the transmission line ROW to the confluence of Bacon Creek and the Skagit River, excluding fish and wildlife mitigation lands (i.e., the Newhalem Ponds and County Line Ponds parcels). For reporting purposes, this segment is further divided into the following sub-segments:
  - Ross Lake exclusive of Big Beaver Valley;
  - Big Beaver Valley;
  - Diablo Lake, including the approximately 3.6 miles of transmission line ROW from the Ross Powerhouse to the Diablo Powerhouse;
  - Gorge Lake, including the approximately 3.5 miles of transmission line ROW from the Diablo Powerhouse to the southern end of Gorge Lake; and
  - The corridor between Gorge Lake and Bacon Creek that includes approximately 8.5 miles of transmission line ROW and the Skagit River.
- **Transmission Line ROW Segments**
  - **Bacon Creek to Sauk River Crossing:** This study area segment occurs primarily within the upper Skagit River basin and includes the 14.3 miles of transmission line ROW **(excluding fish and wildlife mitigation lands that fall within this segment)** from Bacon Creek to the Sauk River transmission line ROW crossing. This study area segment also includes the majority of the CMZ outside of the RLNRA, as well as the Taylor, Illabot, and Powerline spawning channels.[3] The lower approximately 2.5 miles of this study area segment occurs within the Sauk River basin.
  - **Sauk River Crossing to Oso:** This study area segment includes the 25.6 miles of transmission line ROW **(excluding fish and wildlife mitigation lands that fall within this segment)** from the Sauk River transmission line crossing to the community of Oso. The eastern part of this segment is located in the Sauk River basin from the Sauk River crossing to near Darrington. The western portion of this segment, from Darrington to Oso, is located in the Stillaguamish River basin.
  - **Oso to State Route (SR) 528:** This study area segment includes the 17.5 miles of transmission line ROW from Oso to SR 528. The northern portion of this segment is

[3] The Taylor, Illabot, and Powerline spawning channels were developed under the current license but are not considered to be part of the fish and wildlife mitigation parcels.

located within the Stillaguamish River basin, and the southern portion is located within the Snohomish River basin.

- **SR 528 to Bothell Substation:** This study area segment is located primarily within the Snohomish River basin and includes the 14.4 miles of transmission line ROW from SR 528 to the Bothell substation. The lower approximately 1.5 miles of this segment is located in the Lake Washington basin.

- **Fish and Wildlife Mitigation Lands:** This study area segment includes all fish and wildlife mitigation lands within the study area **(including fish and wildlife mitigation lands that geographically fall within a transmission line ROW segment above)**. For reporting purposes, they are separated by the watershed in which they occur in (i.e., the South Fork Nooksack, Sauk, and Skagit River basins.

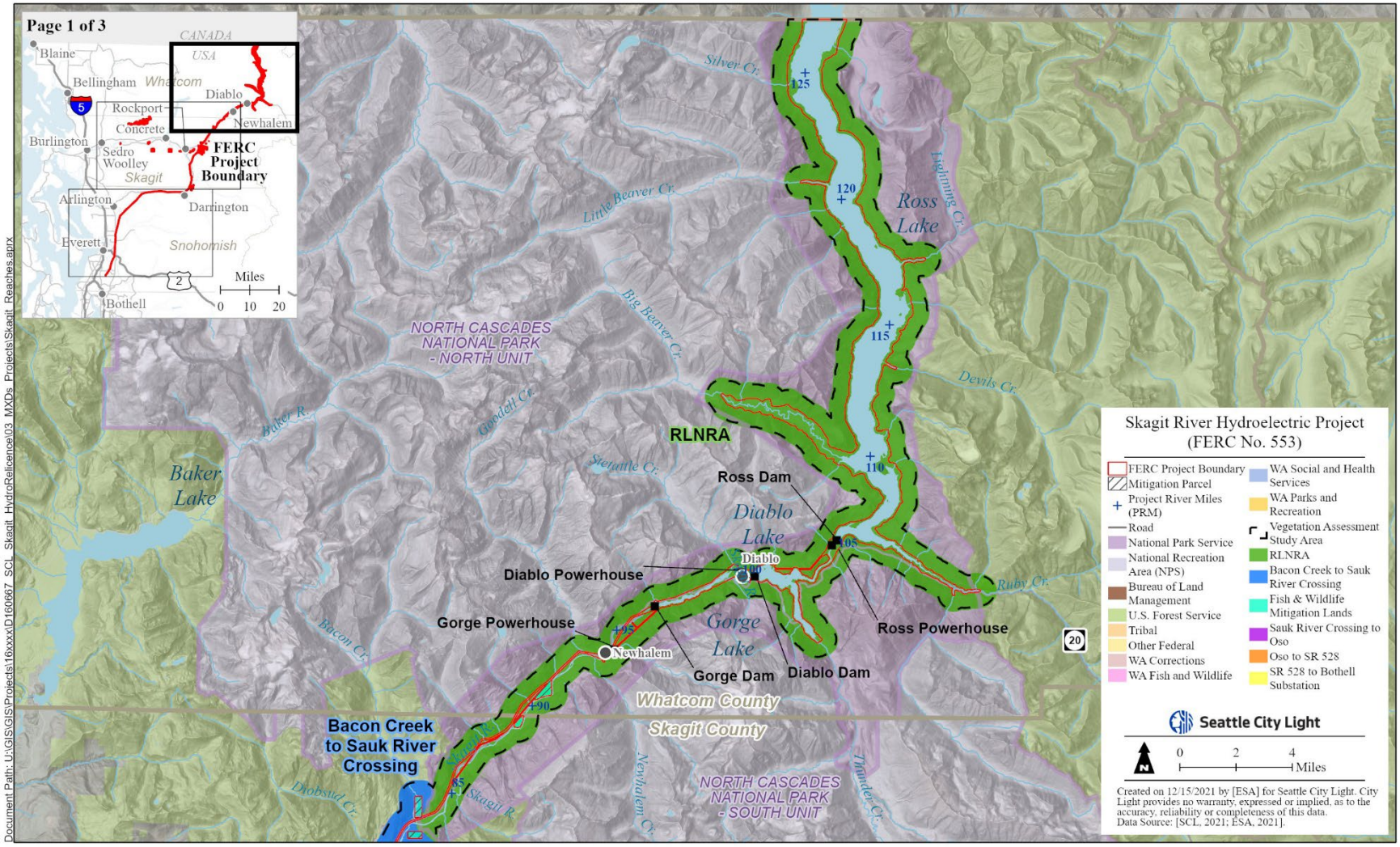


Figure 3.0-1. Study area segments for the Vegetation Mapping Study (north).

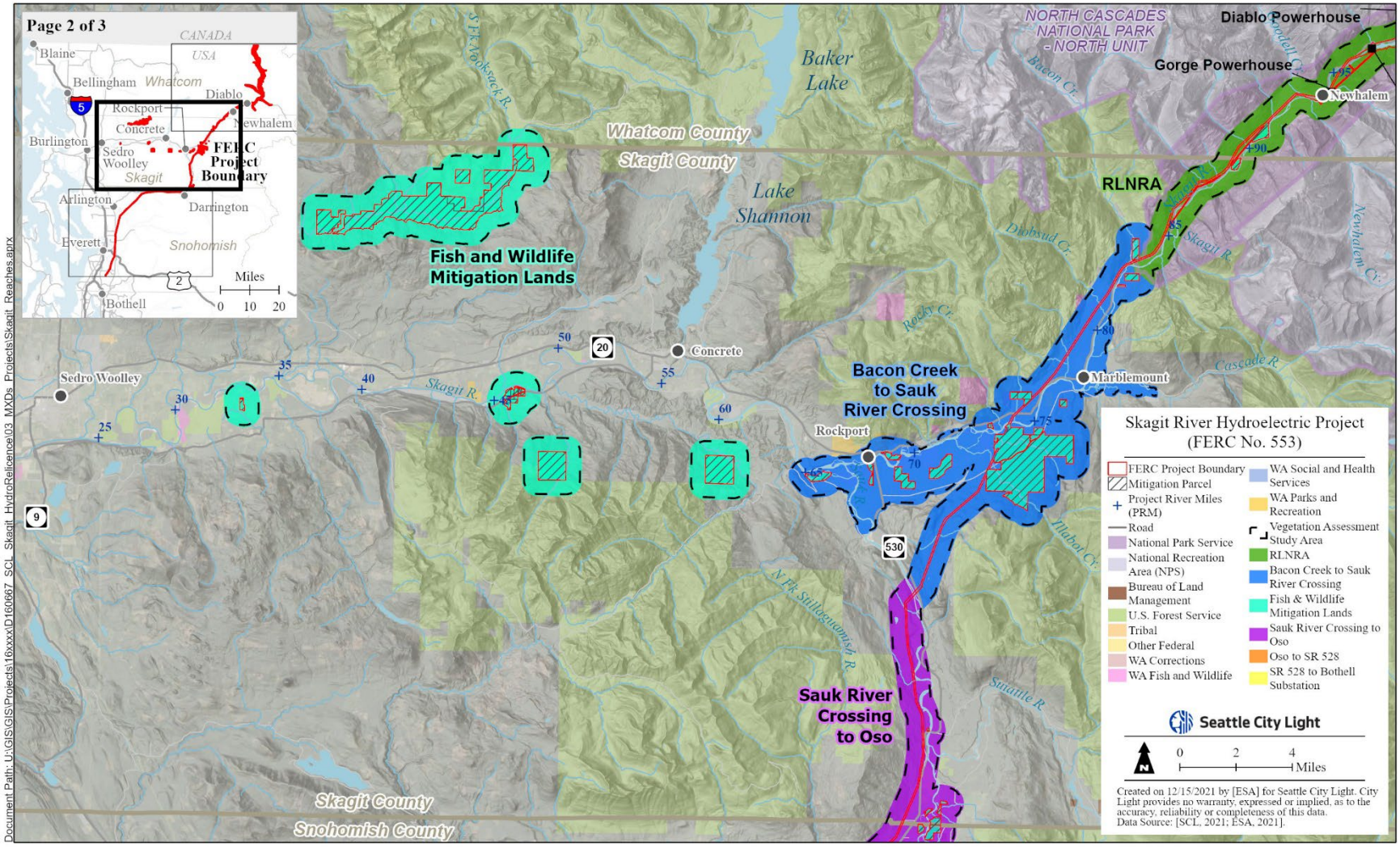


Figure 3.0-2. Study area segments for the Vegetation Mapping Study (central). Note: expanded canopy metrics modeling area is included.

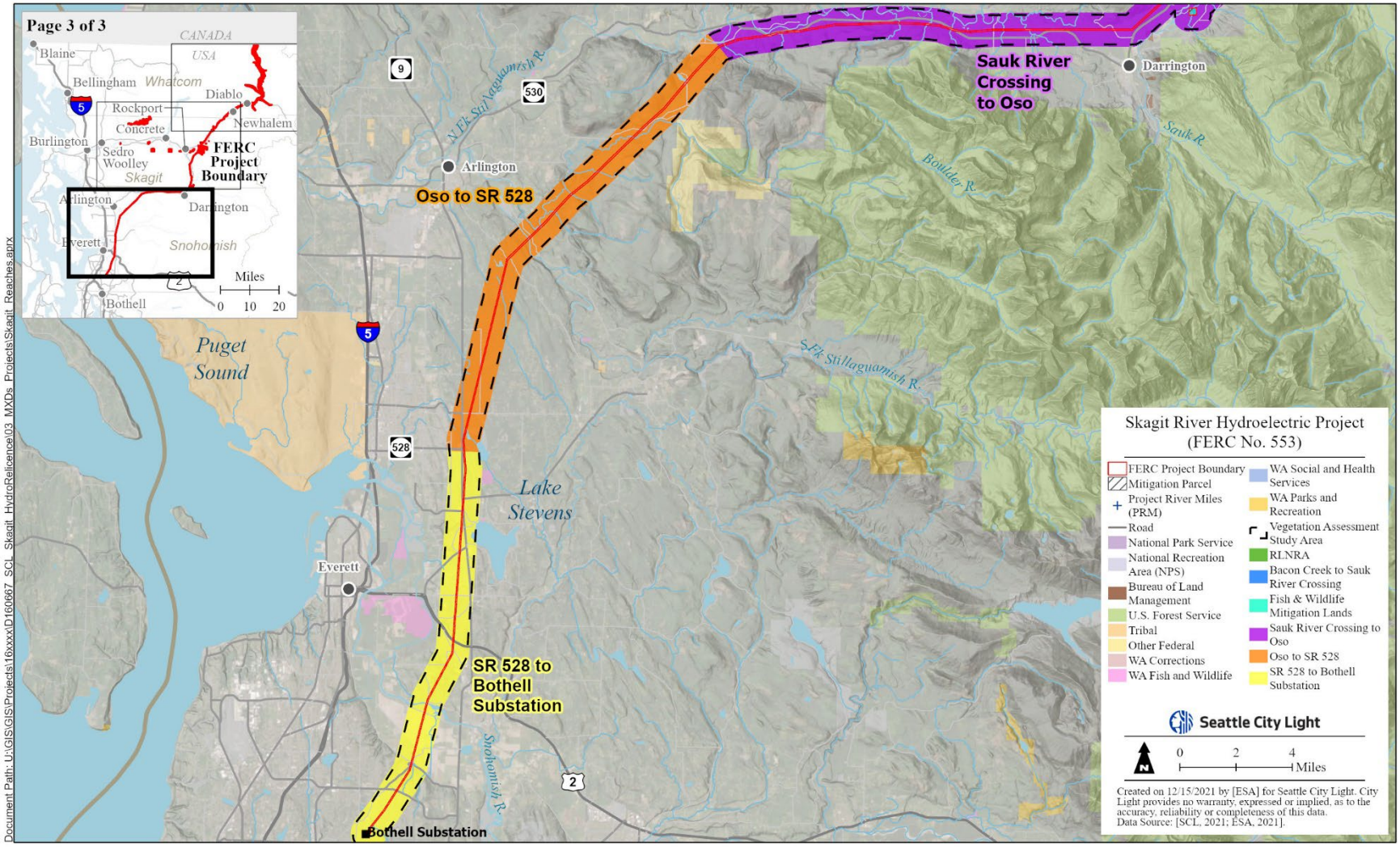


Figure 3.0-3. Study area segments for the Vegetation Mapping Study (south).

4.0 METHODS

The Vegetation Mapping Study used existing data, remote sensing methods, and models to identify and map vegetation composition and overstory structure within the study area. The study results will be used to inform the assessment and management of ROW vegetation and wildlife habitat, including habitats for amphibians and specific species, such as marbled murrelet, golden eagle, northern goshawk, northern spotted owl, and beaver. Additionally, the study provides data for the TR-02 Wetland Assessment (City Light 2022e); the TR-03 Rare, Threatened, and Endangered (RTE) Plants Study (City Light 2022f); and the TR-04 Invasive Plants Study (City Light 2022g), and will be used to inform other relicensing studies including, but not limited to, the large woody debris component of the GE-01 Reservoir Shoreline Erosion Study (City Light 2022b).

4.1 Vegetation Classification

As detailed in the RSP at Section 2.5.1, City Light compiled and reviewed existing data. These data sources were shared with the Terrestrial Work Group (TWG), formerly known as the Terrestrial Resources and Reservoir Erosion Work Group (TRREWG), at the October 15, 2019 meeting and include the following:

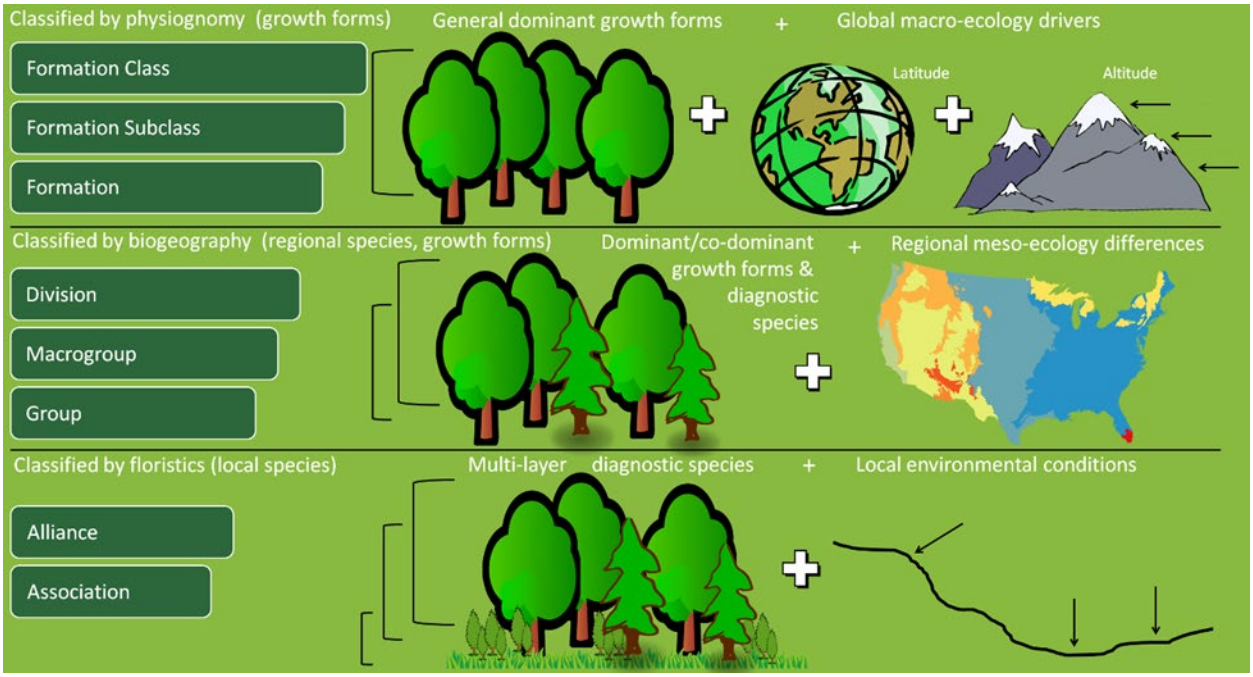
- Vegetation Classification of Mount Rainier, North Cascades, and Olympic National Parks (Ramm-Granberg et al. 2021).
- Mapping of vegetation cover types surrounding Project reservoirs for the 1995 FERC relicensing.
- The EcoVeg approach in the Americas: U.S., Canadian, and International Vegetation Classifications (Faber-Langendoen et al. 2017).
- Skagit Mitigation Lands Management Plan (City Light 2006).
- Skagit Watershed Council Riparian Assessment (Environmental Science Associates [ESA] 2017).
- Skagit Watershed Council Reach Level Analysis – Middle Skagit River (Skagit River System Cooperative [SRSC] 2011).
- Spectral/Temporal: Sentinel 2 – 12-bands (10m, 20m), coverage every 5 days (U.S. Geological Survey [USGS] 2018).
- High Resolution Land Cover Mapping (WDFW 2020a).
- Mapping Riparian Land Use within Agricultural Zones. A Case Study in Skagit County (Greenberg and Carson 2010).
- Washington Department of Natural Resources (DNR) Western Washington 3DEP Light Detection and Ranging (LiDAR) data (Washington DNR 2017).[4]
- High Spatial Res: 2018 4”/6” Pictometry, 1m 4band National Agriculture Imagery Program (NAIP) Normalized Difference Vegetation Index (NDVI) (U.S. Department of Agriculture [USDA] 2021).

[4] This was inadvertently referenced as a USGS data source in the RSP.

- Seattle City Light Skagit River LiDAR (2018).
- National Park Service – SRI Soil Survey Geographic Database for North Cascades National Park Complex (Natural Resources Conservation Service [NRCS] and NPS 2012).
- Conservation Biology Institute Late Seral Forest Classification Using ETM + Remote Sensing Imagery for the North Cascades (2004).[5]

The above references were reviewed to assess what information and data sources were readily available that would be useful for the development of the model. Information found to be pertinent to the study was assembled and used in the early stages of model development.

For consistency, City Light elected to apply the same methods and approach used by the NPS in its vegetation mapping efforts for the North Cascades National Park. The NPS incorporated multiple years of field plot data collection and extensive GIS modeling to produce a fine-scale vegetation map. NPS used the USNVC hierarchy, which defines eight levels of mapping resolution (Figure 4.1-1).



Source: USNVC 2021.

Figure 4.1-1. USNVC hierarchy.

NPS collected data at the Association level. Similar Associations were then combined by NPS into "map classes," which are comparable to Alliances (Nielsen et al. 2021). This study used the fine-scale NPS mapping to assess plant communities surrounding the reservoirs and the Skagit River from the U.S.-Canadian border to near Bacon Creek. The remainder of the study area was mapped to the Group level.

[5] This data source was reviewed but determined to be too coarse-scale for this mapping effort.

The Group level reflects combinations of relatively narrow sets of diagnostic plant species with broadly similar composition and growth forms, reflecting the biogeographic differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes. The Group level was selected because it provides the appropriate level of floristic detail and composition when combined with additional information on vegetation structure to assess wildlife habitat suitability and to inform vegetation management planning efforts. The Group level focuses on the dominant overstory species and does not include understory species. The study team field-verified the NPS classification results at the Group level by spot-checking specific areas during early field studies for TR-02 Wetland Assessment (City Light 2022e).

As noted in the RSP at Section 2.5.9, the townsites, transmission line ROW, and other heavily-altered habitats required a custom classification scheme because none of the USNVC classifications accurately captured the composition of these highly altered vegetation communities.

4.2 Model Development and Field Assessment

As a first step in the mapping process, a model was developed and assessed consistent with the methods described in Sections 2.5.2 through 2.5.8 of the RSP. The study group pre-processed data by re-projecting the various datasets summarized in Section 4.1 of this study report into a common geographic projection and clipping the combined data to the study area boundary. The study team presented an update on the processing of the LiDAR data to LPs at the March 17, 2020 TWG meeting. Next, the team prepared a preliminary map to classify vegetation at the Group level based on Object-based Image Analysis (OBIA) and the random forest model for areas not already mapped by the NPS. OBIA is a remote sensing technique used to identify patterns in raster imagery to create polygons, which were then used to aggregate statistics used to run the random forest model. The random forest model is a series of decision trees that are randomly built by subsets of data. The output, or cover class in this instance, is the class selected by the most trees. Inputs for the random forest model included multiple data sources, such as high-resolution aerial imagery, satellite imagery, LiDAR-derived data, digital terrain models, and geology and soils data. The random forest model was developed for the entire study area using data from the NPS classification that fell within the study extent. The model was developed and assessed consistent with the methods described in the RSP at Sections 2.5.3 through 2.5.8.

A preliminary model run helped to identify which remote sensing data inputs were the most significant in the vegetation classification and if additional datasets were needed. This yielded a distinct number of vegetation classes. For these classes, the study team used a stratified sampling approach that distributes or assigns random points evenly to each of the vegetation classes in the model. The preliminary model was also used to inform the field assessments. The points were assessed based on feasibility and accessibility (e.g., landowner permission, distance from access points, field safety, etc.) for collection of field-based data to support training and validation of the model. Preliminary model results were presented to LPs at the September 15, 2020 TWG meeting.

Field assessments focused on collecting additional vegetation information at representative sites not well covered by the NPS data to "train" the model and to refine the dataset. Field assessments to collect model training data also occurred where there is potential for Project effects (e.g., the

reservoir fluctuation zone and areas adjacent to Project facilities, buildings, and infrastructure) and in areas with apparent mapping errors or uncertainties, such as along the transmission line ROW.

Field assessment efforts coincided with the TR-02 Wetland Assessment (City Light 2022e) fieldwork. Site visits occurred in July through September 2020. Supplemental site visits occurred in December 2020 to collect vegetation information specific to the transmission line ROW. Field crews visited several areas along the transmission line ROW to identify vegetation patterns and to create a custom set of cover types (e.g., Invasive Shrub, Mixed Grass/Forb/Invasive Shrub, etc.). Additional data used to further refine these cover types were collected between June 2021 and August 2021 as part of the field efforts for the TR-03 RTE Plants Study (City Light 2022f) and the TR-04 Invasive Plants Study (City Light 2022g).

Field crews visited 255 sites and collected the following information to supplement the mapping:

- Cover estimates of co-dominant species of each stratum – tree, shrub, and groundcover. Plant species were documented using plant nomenclature from the University of Washington (UW) Burke Herbarium Image Collection (UW 2021).
- Sample measurements of diameter-at-breast-height (dbh) for co-dominant trees.
- Lists of common species in each stratum.
- Incidental observations of special features, such as areas of high snag density, beaver activity, wildlife sightings, and similar items.
- Observations of plant species that Indian Tribes and Canadian First Nations consider as culturally important. A list of these species was created based on feedback from the Stillaguamish Tribe of Indians, the Sauk-Suiattle Indian Tribe, the Swinomish Indian Tribal Community, the Upper Skagit Indian Tribe, and the Nlaka'pamux Nation Tribal Council.

Field crews visited 92 sites mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237); 62 sites mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237); 56 sites mapped as North Pacific Lowland Riparian Forest & Woodland Group (G851); 34 sites mapped as Vancouverian Wet Shrubland (G322); and 11 sites mapped as North Pacific Maritime Hardwood – Conifer Swamp (G853) (Figure 4.2-1).

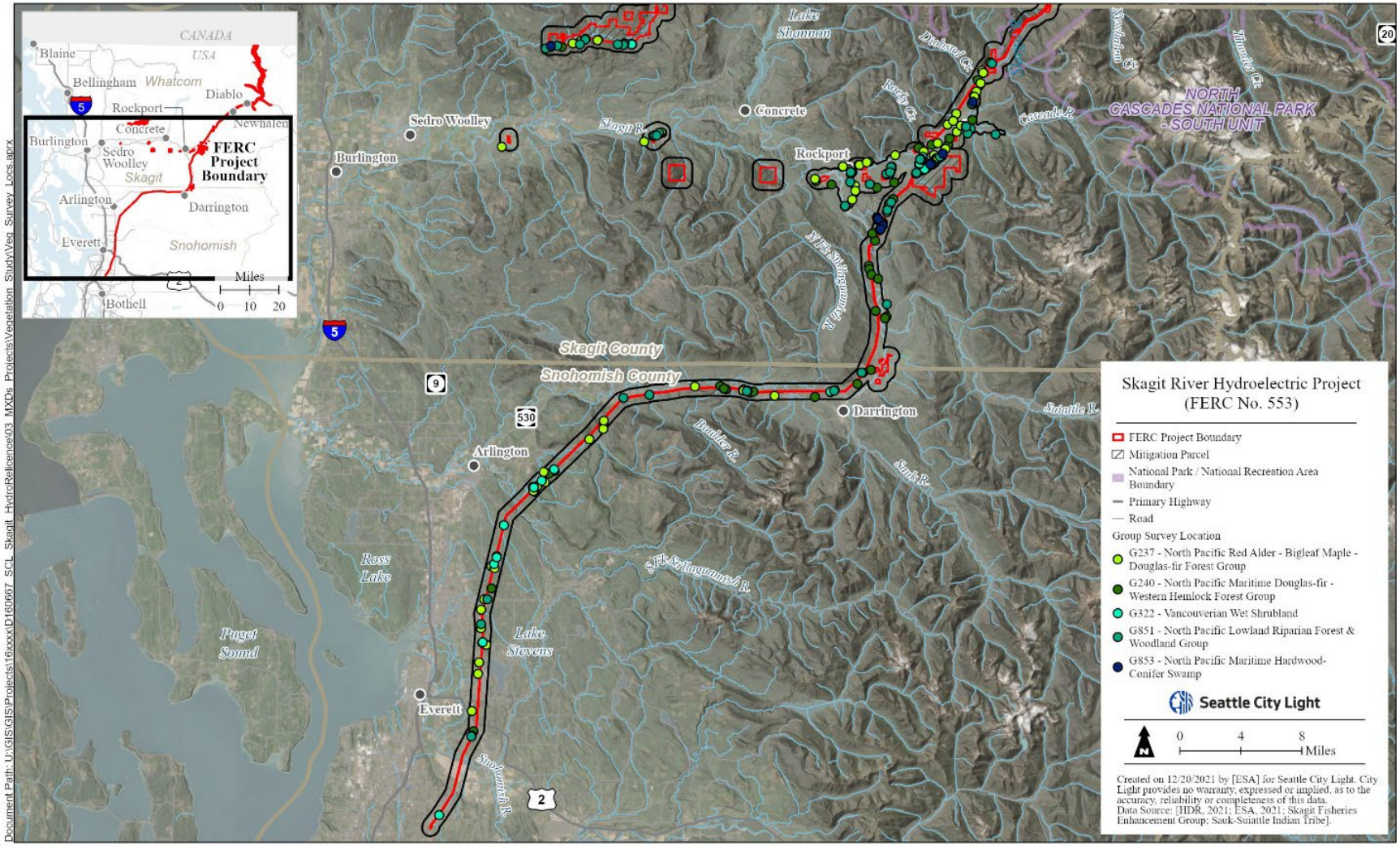


Figure 4.2-1. Locations of site visits.

The field assessments were used to refine the model results and to assess the accuracy of the initial classification. Accuracy of the model was assessed using standard accuracy assessment procedures. Consistent with the NPS vegetation mapping, greater than 80 percent overall accuracy was achieved, as described further in Section 4.7 of this study report. Updates on the field verification, transmission line ROW mapping, and accuracy assessment were shared with LPs at the November 17, 2020 TWG meeting.

4.3 Vegetation Map Products and Summary Statistics

As described in Section 2.5.9 of the RSP, vegetation composition in the study area was mapped and binned into one of the classification groups shown in Table A-1 in Attachment A of this study report. Table A-2 in Attachment A of this study report shows how the classes mapped by the NPS were assigned to the USNVC Group level. The minimum mapping unit size was set at 5 square meters (m^2). (This is commonly done to remove the "popcorn" effect that can make maps illegible.) The acreage of each vegetation group was summarized by geographic areas of the study area (e.g., within the RLNRA, along the transmission line ROW, within the fish and wildlife mitigation land parcels, etc.). Summary statistics were run at the polygon level using OBIA for attributes such as canopy height mean, standard deviation, slope, wetness, and digital elevation model (DEM). These statistics are part of the geodatabase as described in Section 4.6 of this study report and shown in Table G-1 of Attachment G of this study report. (Access to a web-based map that provides geospatial data on vegetation groups within the study area is available upon request to City Light.) A mapbook was produced to display vegetation cover in the study area according to the USNVC Group or modified cover type, and is included in Attachment B of this study report. These data products, as well as a draft technical memo describing results, were presented to LPs at the August 17, 2021 TWG meeting. Mapping results for multiple habitat types were also discussed with LPs during a site visit conducted on August 31, 2021. No comments on the maps or request for map revisions were received.

4.4 Structural Canopy Metrics

The study team evaluated the potential of LiDAR-derived vegetation metrics to be input variables demonstrating model significance. Based on that evaluation the study team used the LiDAR data to map vegetation structure in terms of canopy height using two different tools.

- **Canopy Height Model (CHM)** – The CHM provides a measure of the average canopy height in feet for each 1 m^2 grid cell of the study area. The canopy height model was run for the entire study area, and the mean canopy height and standard deviation were computed for each polygon in the vegetation study extent. Additionally, the dataset was used to support a visual assessment of the vegetation mapping output and is available as a web service in ArcGIS Online and mapbook (.pdf) formats.
- **p95** – The p95 data provide a measure of the tallest trees (the 95^{th} percentile of canopy height) in each 30 m^2 grid cell. This is a more accurate measure of height compared to the CHM. The

p95 analysis was completed for a limited area near the confluence of the Sauk and Skagit rivers.[6]

LiDAR data were also used to map canopy complexity. Canopy complexity using LiDAR data is based on a rumple analysis.

- **Rumple Index –** The rumple index is the ratio of canopy outer surface area to ground surface area, and it indicates the level of canopy vertical and horizontal complexity from low to high, measured for each 30 m^2 cell. This analysis was performed on the riparian areas near the confluence of the Sauk and Skagit rivers, the same area as the p95 analysis.[6] Generally, a higher rumple index value indicates a more complex canopy, including areas with tall trees, multiple canopy strata, and gaps in the canopy, which is typical of late seral stage forests. A low rumple index value, by contrast, indicates areas of high canopy homogeneity, which is more typical of even-aged forest stands at earlier successional stages.

To support the identification of taller tree areas with higher canopy complexity, generally indicative of older forests, the study team generated an additional output by taking the highest percentage (top 20 percent) of p95 and rumple index values to create a separate raster showing areas with tall trees and high canopy complexity. The lowest percentage (bottom 25 percent) of p95 and rumple index values were separated to show areas of shorter trees and low canopy complexity, which may indicate more recently disturbed areas.

The canopy height and rumple index maps are baseline data that can aid in future assessments of habitat suitability, management, and inform the assessment of riparian systems and habitats for target species within the Project Boundary.

Mapbooks displaying the results of the canopy height models and additional canopy metrics are included in Attachment C and Attachment D of this study report, respectively.

4.5 Correlation to Priority Habitats and Species (PHS) and State Wildlife Action Plan (SWAP)

Study products for the Vegetation Mapping Study include a cross-walk table of WDFW PHS data (WDFW 2020b) with the mapped vegetation classes throughout the study area. This was completed as a basic intersection of PHS data with the mapped vegetation polygons. Similarly, the WDFW State Wildlife Action Plan (SWAP) habitats (WDFW 2015) were overlaid on the vegetation classification polygons to show the intersection of mapped vegetation cover types with the documented and potential habitat ranges of the SGCN that occur within the study area. WDFW defines habitat range as the geographic area in which a species regularly occurs, including areas used for breeding, foraging, wintering, and/or migration. WDFW maps "documented habitat" and "potential habitat" ranges using USGS watershed boundaries. The "documented habitat" ranges are not based on inventories but are compiled using knowledge from field biologists. The

[6] The computational time to process these data across the entire study area would take approximately 3 months and could not be completed in time for this ISR; therefore, City Light elected to run the analysis for a more limited area. City Light is considering expanding this analysis over the entire study area in the future, based on input from the LPs.

"potential habitat" ranges have been modeled and are derived from the Ecological Systems[7] data developed by NatureServe, which provides a mid-scale ecological classification useful for conservation and planning (WDFW 2015). Based on a review of the data, documented and potential ranges may overlap. Additionally, areas of high snag density (a WDFW priority habitat feature) were mapped using Washington DNR Remote Sensing Forest Inventory System data (Washington DNR 2021). These data were analyzed to create a separate GIS layer of snag-rich areas. Areas were considered to be "snag-rich" if they contained at least four snags greater than 20 inches in diameter per acre based on the WDFW PHS definition of Old Growth – Mature Forest (WDFW 2008). The data were binned into separate density classes including greater than four snags per acre; 4-16 snags per acre; 17-30 snags per acre, 31-130 snags per acre; and greater than 130 snags per acre.[8] The results of the PHS and SWAP analyses are presented in Attachments E and F of this study report, respectively. The GIS layer of snag-rich areas is included in the geodatabase as described in Section 4.6 of this study report.

4.6 Geodatabase

Consistent with the study's goal, the study team also created a comprehensive list of GIS data sources containing all of the information collected as part of the study so far, along with a comprehensive vegetation type database, or geodatabase, of the primary data layers developed in the study. This information is included in Attachment G of this study report and has and will be used to inform assessments of wildlife habitat for marbled murrelet, golden eagle, northern goshawk, and beaver studies, and the large woody debris component of the GE-04 Geomorphology Study.

4.7 Accuracy Assessment

NPS completed an accuracy assessment for the NPS Vegetation Mapping Project in the North Cascades National Park, and the Vegetation Mapping study team conducted a separate accuracy assessment for the remaining areas in the vegetation study area. As described in the RSP at Section 2.5.10, standard accuracy assessment procedures as outlined in Congalton and Green (2009) were used which report overall classification accuracy and Kappa statistic along with a User's accuracy and Producer's accuracy for all vegetation types. In an accuracy assessment, "Producer's accuracy" represents how well reference polygons on the ground are classified. "User's accuracy" represents the probability that a polygon classified into a given category actually represents that category on the ground.

The North Cascades National Park classification received an overall accuracy of 78.8 percent based on 916 reference data points. The accuracy percentages for individual cover types (reported at the USNVC Association Level) are presented in Attachment H of this study report. The upland cover types consisting of western hemlock (*Tsuga heterophylla*) and Douglas-fir (*Pseudotsuga menziesii*), representing the largest area in the study extent, yielded individual accuracies of 63-89 percent User's accuracy and 73-95 percent Producer's accuracy. For riparian and wetland cover

[7] Additional information on the Ecological System Classification can be found on the Washington DNR website (https://www.dnr.wa.gov/NHPecologicalsys).

[8] The bins were based on the 'natural breaks' in the histogram using the Jenks natural break classification method, a data clustering method designed to determine the best arrangement of values into different classes. Class breaks are created to best group similar values while maximizing the differences between classes, so boundaries are set where there are relatively large differences in data values (ESRI 2022).

types (West-side Deciduous Floodplain & Swamp Forest, Bigleaf Maple Deciduous Apron Forest, Low Elevation Wet Meadow), recorded individual accuracies ranged from 60-88 percent User's to 62-100 percent Producer's accuracies.

The classification outside of the North Cascades National Park received an overall accuracy of 83 percent, with a Kappa statistic[9] of 0.81 based on 404 reference data points.[10] These results are also presented in Attachment H of this study report. Similar to the North Cascades National Park classification, the Upland USNVC Group that represented the largest area in the study extent, G240 – North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group, scored high for both User's (94 percent) and Producer's (91 percent) accuracies. Riparian & Wetland USNVC group types (G322 – Vancouverian Wet Shrubland, G851 – North Pacific Lowland Riparian Forest & Woodland Group, G853 – North Pacific Maritime Hardwood-Conifer Swamp) showed a larger range of variation in accuracies; particularly with confusion between G322 and G648 – Southern Vancouverian Lowland Ruderal Grassland & Shrubland, with a User's accuracy of 20 percent. Conversely, G851 and G853 yielded higher User's (73-100 percent) and Producer's (98-94 percent) accuracies. Other Cultural and Non-USNVC Group types in the study extent also received high accuracies.

As indicated above, a separate approach was used to map areas in the transmission line ROW and townsites, and was based on a combination of field-based surveys and aerial-photo interpretation using high-resolution aerial imagery. For these cover types, higher accuracies were recorded for the Invasive Shrub cover dominant cover type, which represented the largest extent in the transmission line ROW corridor cover. Mixed and native cover types ranged from 43-67 percent User's accuracies.

[9] Kappa (or Cohen's kappa) is a statistic that is considered to be a more robust measure of reliability over the overall percent accuracy in an error matrix as it takes into account the possibility of agreement occurring by random chance.

[10] For the classification outside of the North Cascades National Park, reference data points include a combination of field-based measurements and photo-interpreted points based on a stratified sampling approach that took into account accessibility. The classification within the North Cascades National Park includes all field-based measurements conducted over a 6-year period.

5.0 RESULTS

The results of this assessment provide a detailed and accurate overview of vegetation cover types within the study area. This baseline assessment, in combination with other relicensing studies, provides data to inform the environmental analyses to be presented in the license application and to inform potential PME measures.

5.1 Summary of Overall Vegetation Conditions

A total of 35 unique cover types were mapped in this study. North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) were the most abundant cover types within the study area. A preliminary description of each cover type is included in Attachment A of this study report and listed in Figure 5.1-1.

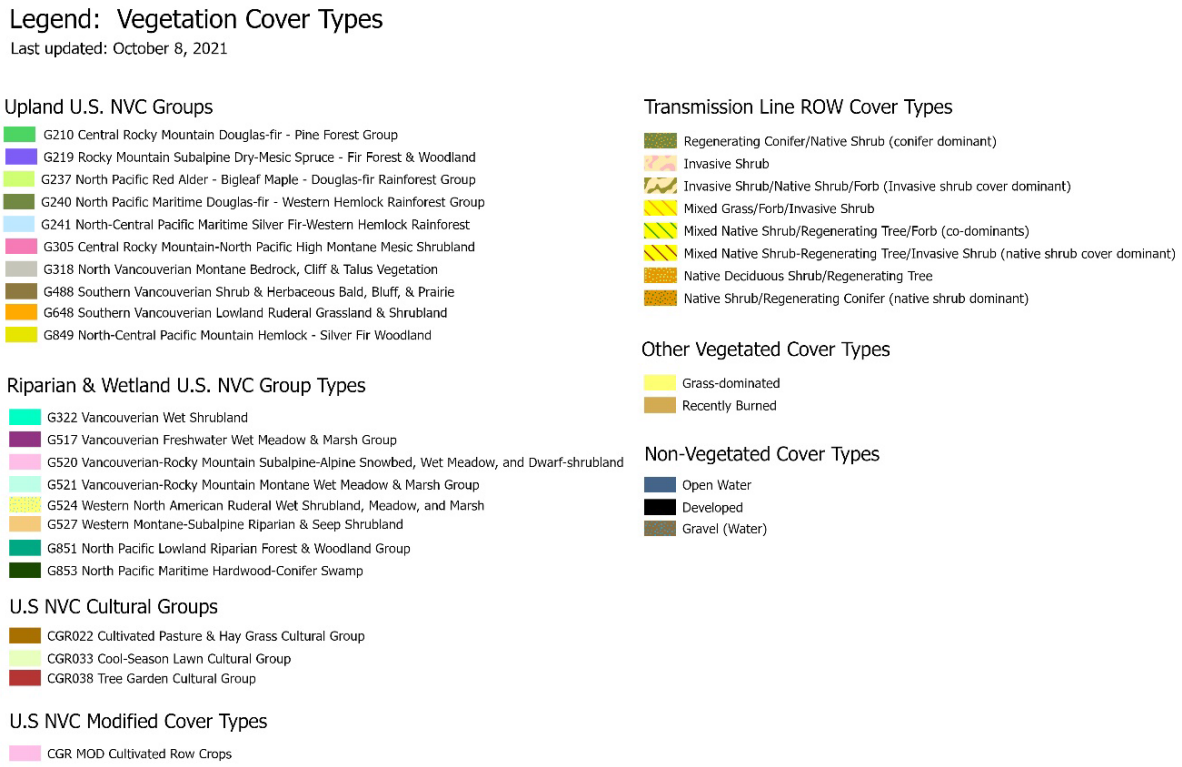


Figure 5.1-1. Cover types for the Vegetation Mapping Study.

The discussion below is organized into three main sections: (1) study area segments within the RLNRA; (2) study area segments outside of the RLNRA, exclusive of fish and wildlife mitigation lands; and (3) the fish and wildlife mitigation lands. For each study area segment, a summary table that shows the acreages of each vegetation cover type and the mean canopy height is included, along with a general discussion of each. The heights reported in the following sections are from the results of the CHM; the summaries report canopy heights separated into the following ranges:

- Less than or equal to 25 feet in height;
- 25.1-40.0 feet;
- 40.1-60.0 feet;
- 60.1-90.0 feet; and
- Taller than 90 feet.

It is important to note that the tables below summarize acreages of these canopy height ranges based on the mean canopy height of the mapped vegetation polygons. However, the draft canopy height mapbook included in Attachment C of this study report is based on highest hit LiDAR returns, thus portraying a more accurate visual representation of the diversity of an area.

5.2 Summary of Overall Vegetation Mapping Results by Study Area Segment Within the RLNRA

A discussion of vegetation cover types/composition mapped within the RLNRA study area segment is provided below and is divided into study area sub-segments (Table 5.2-1).

Table 5.2-1. Acreage of mapped cover types within the RLNRA study area segment.

Sub-segment	Acreage of Mapped Cover Types																	
	G210	**G219**	**G237**	**G240**	**G241**	**G305**	**G318**	**G322**	**G488**	**G517**	**G520**	**G521**	**G527**	**G849**	**G851**	**CGR 033**	**CGR 038**	**Grand Total**
Ross Lake (excl. Big Beaver Valley)	3,065	3	2,273	16,187	401	3	653	210	904	53	2	2	62	843	71	0	0	**24,732**
Big Beaver Valley	9	0	10	589	1	0	8	189	3	89	0	0	2	83	218	0	0	**1,201**
Diablo Lake	810	0	348	2,486	54	0	115	18	156	12	0	0	20	221	99	5	0	**4,344**
Gorge Lake	532	0	146	1,181	30	0	144	27	73	2	0	0	8	163	42	21	0	**2,369**
Gorge Lake to Bacon Creek	137	0	2,708	2,047	115	0	137	10	18	5	0	0	2	149	590	17	2	**5,937**
Total	**4,553**	**3**	**5,485**	**22,490**	**601**	**3**	**1,057**	**454**	**1,154**	**161**	**2**	**2**	**94**	**1,459**	**1,020**	**43**	**2**	**38,583**

5.2.1 Ross Lake (Excluding Big Beaver Valley)

5.2.1.1 Upland Vegetation

Upland vegetation surrounding Ross Lake is dominated by the North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240), interspersed with areas of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) (see Attachment B, pages 1-7). These pockets of G237 are concentrated on the east side of the lake. Other cover types mapped in this study area sub-segment include Central Rocky Mountain Douglas-fir – Pine Forest (G210) and Southern Vancouverian Shrub & Herbaceous Bald, Bluff, and Prairie (G488). These two cover types are found in the upper elevations of this sub-segment in high-gradient areas. Additionally, small areas of North-Central Pacific Mountain Hemlock – Silver Fir Woodland (G849) and North-Central Pacific Maritime Silver Fir – Western Hemlock Rainforest (G241) occur along the southern side of Ruby Arm and upslope of the south side of SR 20. A recently burned area is also mapped on the west side of the lake, north of Big Beaver Valley. This area was part of the 2015 Thursday Creek Fire. According to wildfire GIS data provided by NPS (2021), the fire was started by lightning and burned a total of 565 acres, 408 acres of which are in the study area. Another recently burned area is mapped to the north and is part of the 2015 Cat Island Fire. This fire was also started by lightning and burned a total of 147 acres, 113 acres of which is in the study area.

5.2.1.2 Riparian and Wetland Vegetation

Several streams flowing into Ross Lake contain narrow bands of Vancouverian Wet Shrubland (G322) cover. Larger areas of this cover type are also present in the riparian areas of larger streams, such as Lightning Creek and Devil's Creek.

5.2.1.3 Canopy Height

In general, this study area sub-segment exhibits mixtures of trees between 40.1-60 feet and 60.1-90 feet in height (Table 5.2-2). The largest concentration of trees taller than 90 feet is located on the east side of Ross Lake between May Creek and Hidden Hand Creek, and is associated with the G240 cover type. Additional concentrations of tall trees are within the Ruby Arm corridor, and at the northern extent of the study area along both the west and east sides of the lake near the Canadian border; all areas are dominated by G240 cover.

Table 5.2-2. Mean canopy height for the Ross Lake study area sub-segment (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G210	1,103	1,491	285	164	22	**3,065**
G219	2	0	0	0	0	**2**
G237	28	275	570	1,017	383	**2,273**
G240	1,275	1,975	5,221	6,219	1,496	**16,186**
G241	51	35	102	185	28	**401**
G305	3	0	0	0	0	**3**
G318	587	39	24	3	0	**653**
G322	100	46	42	18	5	**211**
G488	897	2	3	2	0	**904**
G517	20	7	23	2	0	**52**

Cover Type	Acreage of Mean Canopy Height Ranges (ft)					
	≤25.0	25.1-40.0	40.1-60.0	60.1-90.0	>90.0	Total
G520	1	0	0	0	0	**1**
G521	2	0	0	0	0	**2**
G527	37	16	7	1	0	**61**
G849	412	255	108	62	6	**843**
G851	14	12	24	15	6	**71**
Total	**4,532**	**4,153**	**6,409**	**7,688**	**1,946**	**24,728**

5.2.2 Big Beaver Valley

5.2.2.1 Upland Vegetation

Most of the land upslope of Big Beaver Valley is North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) (see Attachment B, page 6). Some areas of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) are present adjacent to drainages. Similar to areas along Ross Lake, Central Rocky Mountain Douglas-fir – Pine Forest (G210) and Southern Vancouverian Shrub & Herbaceous Bald, Bluff, and Prairies (G488) are at higher elevations within this study area sub-segment. A large burned area is also mapped on the south-facing slopes outside of the valley. According to wildfire GIS data provided by this area was part of the Big Beaver Fire, which NPS (2021)was caused by lightning in 2003 and burned approximately 2,300 acres, 790 acres of which are in the study area.

5.2.2.2 Riparian and Wetland Vegetation

The majority of Big Beaver Valley is a combination of several wetland and riparian cover types. These include Vancouverian Freshwater Wet Meadow & Marsh (G517), which coincides with open water and emergent wetlands; Vancouverian Wet Shrubland (G322), which covers shrub-dominated wetlands located along the outer boundaries of emergent wetlands in the valley, as well as the riparian areas of several contributing streams to Big Beaver Creek; and North Pacific Lowland Riparian Forest & Woodland Group (G851), which is within forested riparian areas of the mainstem.

5.2.2.3 Canopy Height

Trees taller than 90 feet within the Big Beaver Valley are associated with G240 cover and are concentrated along the edges of the valley as well as along the narrow channel near the confluence of Big Beaver Creek with Ross Lake (Table 5.2-3). In some areas, these tall trees continue up to higher elevations, but at higher elevations within this sub-segment, G240 cover consists of trees at heights of 40.1-60 feet and 60.1-90 feet. Trees at these higher elevations are mapped as G210 and are 25.1-40 feet. Trees near the burned area are less than or equal to 25 feet since they are currently in an early stage of re-growth.

Table 5.2-3. Mean canopy height for the Big Beaver Valley study area sub-segment (acres).

Cover Type	Acreage of Mean Canopy Height Ranges (ft)					
	≤25.0	25.1-40.0	40.1-60.0	60.1-90.0	>90.0	Total
G210	1	8	0	0	0	**9**
G237	0	0	1	7	2	**10**
G240	38	154	160	224	13	**589**
G318	8	0	0	0	0	**8**
G322	154	10	22	3	0	**189**
G488	3	0	0	0	0	**3**
G517	67	9	10	2	2	**90**
G527	1	1	0	0	0	**2**
G849	76	3	2	0	0	**81**
G851	23	63	68	63	0	**217**
Total	**371**	**248**	**263**	**299**	**17**	**1,198**

5.2.3 Diablo Lake

5.2.3.1 Upland Vegetation

Vegetation throughout the Diablo Lake sub-segment is a mixture of North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240), North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237), and Central Rocky Mountain Douglas-fir – Pine Forest (G210) cover types (see Attachment B, pages 8-10). G210 is more prevalent here than in the Ross Lake sub-segment and is located along Thunder Knob, north of the lake near the transmission line ROW, and at higher elevations near the Diablo townsite. G237 is concentrated along forested areas north of the lake where it is mixed with G240 cover.

5.2.3.2 Riparian and Wetland Vegetation

North Pacific Lowland Riparian Forest & Woodland Group (G851) occurs along drainages; the largest patch is at the outlet of Thunder Creek. Vancouverian Wet Shrubland (G322) is also present in riparian areas, primarily along the northeastern portion of the lake.

5.2.3.3 Canopy Height

Trees taller than 90 feet dominate the area north of the lake and have a mix of G237 and G240 cover (Table 5.2-4). Trees taller than 90 feet also occur in areas mapped as G240 near the outlet of Thunder Creek and along much of the areas upslope of SR 20. Smaller trees (less than 60 feet in height) that occur within this study area sub-segment correlate with areas mapped as G210 cover.

Table 5.2-4. Mean canopy height for the Diablo Lake study area sub-segment (acres).

Cover Type	Acreage of Mean Canopy Height Ranges (ft)					
	≤25.0	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G210	286	387	120	16	0	**809**
G237	33	34	127	130	24	**348**
G240	311	295	825	922	133	**2,486**
G241	4	7	17	23	3	**54**
G318	101	10	4	1	0	**116**
G322	6	2	8	2	0	**18**
G488	155	1	0	0	0	**156**
G517	4	3	4	1	0	**12**
G527	16	2	1	1	0	**20**
G849	124	52	33	10	2	**221**
G851	11	9	47	25	7	**99**
Total	**1,051**	**802**	**1,186**	**1,131**	**169**	**4,339**

5.2.3.4 Vegetation Within the Transmission Line ROW

Approximately 76 acres of vegetation occur within the transmission line ROW of this study area sub-segment. In northern portions of this sub-segment, vegetation within the transmission line ROW is a mix of native shrubs, trees, and forbs, where vegetation types are co-dominant. Common species include Douglas-fir, vine maple (*Acer circinatum*), and salal (*Gaultheria shallon*). The remainder of vegetation within the transmission line ROW in this sub-segment is a mixture of conifers and native shrubs where the conifers, primarily Douglas-fir, are dominant.

The majority of the vegetation within the transmission line ROW of this sub-segment (56 acres, 74 percent) is less than or equal to 25 feet tall. Six acres (8 percent) of this study area segment has trees 25.1-40 feet tall; 7 acres (9 percent) are trees 40.1 to 60 feet tall; and the remaining 7 acres (9 percent) are trees 60.1 to 90 feet tall. No trees taller than 90 feet occur within the transmission line ROW in this study are segment.

5.2.4 Gorge Lake

5.2.4.1 Upland Vegetation

This study area sub-segment is similar to the Diablo Lake sub-segment and contains a mixture of North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) and Central Rocky Mountain Douglas-fir – Pine Forest (G210) cover types. North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) is present in smaller patches, primarily located on the north side of the lake, upstream of Gorge Dam (see Attachment B, pages 10-11). The southern extent of this sub-segment was burned in the 2015 Goodell Fire.

5.2.4.2 Riparian and Wetland Vegetation

Vancouverian Wet Shrubland (G322) occurs within the riparian areas of tributaries, on the north and south sides of the lake. A few small pockets of North Pacific Lowland Riparian Forest &

Woodland Group (G851) are present along the lake shore, but this sub-segment lacks riparian and wetland cover types.

5.2.4.3 Canopy Height

Trees taller than 90 feet are limited in this sub-segment and correlate to areas mapped as G240 in the vicinity of Stetattle Creek to the north and Pyramid Creek to the south (Table 5.2-5). Areas of G237 cover, upstream of Gorge Dam, exhibit trees taller than 90 feet. However, they are mixed with trees of 40.1-60 feet in height. Similar to conditions observed within the Diablo Lake sub-segment, areas mapped as G210 cover are a mixture of trees with heights of less than or equal to 25 feet and 25.1-40 feet.

Table 5.2-5. Mean canopy height for the Gorge Lake study area sub-segment (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G210	284	219	23	4	1	**531**
G237	5	37	43	47	14	**146**
G240	28	78	371	633	71	**1,181**
G241	2	3	7	15	3	**30**
G318	105	32	5	1	0	**143**
G322	10	9	7	1	0	**27**
G488	72	1	0	0	0	**73**
G517	1	0	1	0	0	**2**
G527	4	2	2	1	0	**9**
G849	78	55	22	9	1	**165**
G851	4	4	14	17	3	**42**
Total	**593**	**440**	**495**	**728**	**93**	**2,349**

5.2.4.4 Vegetation Within the Transmission Line ROW

Approximately 202 acres of vegetation occur within the transmission line ROW of this study area sub-segment. The majority of vegetation within the transmission line ROW of this study area sub-segment is a mix of deciduous trees and shrubs, except for a portion of the northern transmission line ROW north of Gorge Creek that is a mix of conifers and native shrubs where conifers are dominant. Dominant species include bigleaf maple (*Acer macrophyllum*), Douglas-fir, and vine maple.

The majority of the vegetation within the transmission line ROW of this sub-segment (95 acres, 47 percent) is less than or equal to 25 feet tall. Fifty-four acres (27 percent) of this study area segment has trees 25.1-40 feet tall; 31 acres (15 percent) are trees 40.1-60 feet tall; 22 acres (11 percent) are trees 60.1-90 feet tall; and the remaining 1 acre (less than 1 percent) is taller than 90 feet.

5.2.5 Gorge Lake to Bacon Creek

5.2.5.1 Upland Vegetation

The northern extent of this study area sub-segment is largely unvegetated; significant portions of this area burned during the Goodell Fire (see Attachment B, pages 11-13). According to wildfire GIS data provided by NPS (2021), the Goodell Fire was caused by lightning in 2015 and burned approximately 7,100 acres, 3,360 acres of which are in the study area. South of the burned area, North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) is the dominant cover type continuing south to Bacon Creek. However, a stretch of North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover is present and located between Project River Mile (PRM) 88 and 91. Small pockets of North-Central Pacific Maritime Silver Fir – Western Hemlock Rainforest (G241) and Central Rocky Mountain Douglas-fir – Pine Forest (G210) are also interspersed throughout this area.

5.2.5.2 Riparian and Wetland Vegetation

Vegetated areas in the vicinity of this recently burned area are primarily Vancouverian Wet Shrubland (G322) cover types located along tributaries to the mainstem Skagit River. On the south side of the Skagit River within this study area sub-segment, vegetation is a mix of G237 and G240, with a narrow band of North Pacific Lowland Riparian Forest & Woodland Group (G851) in the riparian area adjacent to the river.

5.2.5.3 Canopy Height

The dominant canopy height in this study area sub-segment is 60.1-90.0 feet (Table 5.2-6). However, trees taller than 90 feet make up approximately 15 percent of the study area sub-segment and are prevalent throughout, except in the area affected by the Goodell Fire. This includes the riparian areas of the Skagit River. These tall trees are frequently mixed with trees 60.1-90 feet in height and are associated with both G237 and G240 cover types. A few small patches of trees 40.1-60 feet in height are present across from the Newhalem Ponds parcel near Babcock Creek, and mapped as G237 cover.

Table 5.2-6. Mean canopy height for the Gorge Lake to Bacon Creek study area sub-segment (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G210	52	41	13	31	2	**139**
G237	37	87	484	1,684	416	**2,708**
G240	80	713	421	502	334	**2,050**
G241	15	18	38	35	22	**128**
G318	100	26	10	2	0	**138**
G322	13	7	2	1	0	**23**
G488	17	1	0	0	0	**18**
G517	3	1	1	0	0	**5**
G527	1	1	0	0	0	**2**
G849	50	31	30	38	7	**156**
G851	57	36	242	138	117	**590**
Total	**425**	**962**	**1,241**	**2,431**	**898**	**5,957**

5.2.5.4 Vegetation Within the Transmission Line ROW

Approximately 840 acres of this study area sub-segment are located within the transmission line ROW. Vegetation is a mix of native deciduous and coniferous trees and shrubs, with some areas also containing native forbs. An exception is the approximately 1.5-mile-long section of the southern portion of the transmission line ROW from Thornton Creek (approximately PRM 90.5), south to just south of Damnation Creek (PRM 88), which is covered by a mix of native shrubs and conifers where conifers are dominant. Conifers are primarily Douglas-fir, and deciduous cover is primarily red alder (*Alnus rubra*). Shrubs include thimbleberry (*Rubus parviflorus*) and salal. Forbs are primarily bracken fern (*Pteridium aquilinum*) with some sword fern (*Polystichum munitum*) interspersed. Riparian vegetation within the transmission line ROW is limited to a narrow band on the south side of the Skagit River near PRM 87, which then transitions to a mix of upland native shrubs, trees, and forbs. The majority of the vegetation within the transmission line ROW (440 acres, 52 percent) is less than or equal to 25 feet tall. One hundred and fifty-three acres (18 percent) of this study are segment has trees 25.1-40 feet tall; 58 acres (7 percent) are trees 40.1-60 feet tall; 138 acres (16 percent) are trees 60.1-90 feet tall; and the remaining 55 acres (7 percent) are trees taller than 90 feet. Trees taller than 90 feet are located in steeper areas of the transmission line, such as across SR 20 near PRM 96, and where the northern transmission line crosses Damnation Creek.

5.3 Summary of Overall Vegetation Mapping Results by Study Area Segment Outside the RLNRA

A discussion of vegetation mapped within study area segments outside the RLNRA is provided below and is divided by study area segment (Table 5.3-1). The numbers below include the vegetation mapping results within the study area, exclusive of the transmission line ROW and the fish and wildlife mitigation lands. A summary of conditions along the transmission line ROW and within the 0.5 mile buffer is also included for each study area segment below. Vegetation mapped within the fish and wildlife mitigation lands is discussed in Section 5.4 of this draft report.

Table 5.3-1. Acreage of mapped vegetation cover types outside of the RLNRA study area segment.

Study Area Segment	G210	G237	G240	G241	G318	G322	G488	G517	G524	G648	G849	G851	G853	CGR 022	CGR 033	CGR 039	CGR MOD	Grand Total
Bacon Creek to Sauk River Crossing[1]	55	6,092	9,670	69	12	833	6	5	342	1	8	1,724	321	423	0	0	25	**19,586**
Sauk River Crossing to Oso	0	4,665	7,219	0	0	891	0	0	145	1,288	0	1,607	206	673	0	0	16	**16,710**
Oso to SR 528	0	3,168	3,227	0	0	828	0	0	0	1,242	0	1,327	187	333	0	0	22	**10,334**
SR 528 to Bothell Substation		707	1,227	0	0	195	0	0	22	1,607	0	982	3	354	0	0	898	**5,995**
Total	**55**	**14,632**	**21,343**	**69**	**12**	**2,747**	**6**	**5**	**509**	**4,138**	**8**	**5,640**	**717**	**1,783**	**0**	**0**	**961**	**52,625**

1 Portions of this study area segment were mapped as part of the NPS vegetation mapping effort.

5.3.1 Bacon Creek to Sauk River Crossing

5.3.1.1 Upland Vegetation

This study area segment exhibits a wide variety of cover types and has various biogeographic conditions and land uses. Forested areas at lower elevation within the CMZ, including those along the mainstem Skagit River, are predominately mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover type (see Attachment B, pages 13-17 and page 24). This is also where the largest concentrations of trees taller than 90 feet occur. On the outer edges of the valley and at higher elevations of the CMZ, the predominant forest cover transitions to North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover type, and canopy height is variable (largely a product of previous logging, based on aerial photos). Farmland and pastures are present in this study area segment, in addition to the town of Rockport. Additional land clearing adjacent to farmland or development are characterized as Southern Vancouverian Lowland Ruderal Grassland & Shrubland cover (G648), where non-native species are dominant. Adjacent to the transmission line ROW, areas of recent logging are apparent outside of the CMZ.

5.3.1.2 Riparian and Wetland Vegetation

Within the CMZ and lower valleys, there are several slough and wetland complexes that exhibit a combination of wetland and upland cover, primarily Vancouverian Wet Shrubland (G322) and North Pacific Lowland Riparian Forest & Woodland Group (G851), respectively. Additionally, several narrow bands of G322 shrubland are present within the channels of the Skagit and Sauk rivers. Finally, a large wet shrub and forested area is upslope from the Sauk River, with a mix of G322 and North Pacific Maritime Hardwood – Conifer Swamp (G853) cover.

5.3.1.3 Canopy Height

Approximately 10 percent of this study area segment, including the area within 0.5 mile of the Project Boundary, contains trees taller than 90 feet. Extensive areas of trees taller than 90 feet associated with G237 and G240 cover are present in large tracts within this segment (Table 5.3-2). Larger concentrations of these tall trees include riparian areas near the Skagit and Sauk River confluence, as well as the majority of the CMZ on the south side of the mainstem Skagit River. Coverage of these large trees is mostly continuous within this segment, excluding interruptions by several farm parcels and SR 530.

The structural canopy metrics p95 and rumple index analyses were performed in this entire study area segment. Areas where high p95 and high rumple index values intersect are indicative of tall tree stands with high structural complexity. Larger patches of these areas are located within the fish and wildlife mitigation land parcels that occur in this study area segment, including the Napoleon Slough parcel, east of the confluence with the Sauk River; near McLeod Slough and the McLeod Slough parcel west of the confluence with the Sauk River; and north of the Johnson parcel on the north side of the Skagit River. Additional information on these fish and wildlife mitigation land parcels is provided in Section 5.4 of this study report.

Conversely, areas where low p95 and low rumple values intersect can be indicative of areas with shorter trees and low structural diversity, often areas of disturbance. Within this study area segment, areas where this was evident include agricultural fields, areas of recent logging, and the transmission line ROW.

Table 5.3-2. Mean canopy height for the Bacon Creek to Sauk River Crossing study area segment (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G210	5	20	28	1	0	**54**
G237	363	460	1,464	2,864	942	**6,093**
G240	2,701	2,027	1,638	2,342	962	**9,670**
G241	0	1	42	13	13	**69**
G318	11	1	1	0	0	**13**
G322	624	153	43	12	0	**832**
G488	5	0	0	0	1	**6**
G517	3	1	1	1	0	**6**
G524	342	0	0	0	0	**342**
G648	1,006	1	1	0	0	**1,008**
G849	2	0	1	4	1	**8**
G851	124	0248	501	682	170	**1,725**
G853	23	142	73	72	11	**321**
Total	**5,209**	**3,054**	**3,793**	**5,991**	**2,100**	**20,147**

5.3.1.4 Vegetation Within the Transmission Line ROW

This study area segment is approximately 503 acres, all of which occur within the transmission line ROW portion of the Project Boundary. The majority of this segment (74 acres, 15 percent) is mapped as a mix of native shrubs, trees, and forbs. This portion of the transmission line ROW crosses several developed areas, such as farmland, rural residences, and access roads, and vegetation is affected by private landowner activities such as mowing and grazing. Invasive shrubs were also observed throughout the transmission line ROW north of the Skagit River crossing. Invasive species were primarily Scot's broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus bifrons*).[11] Native species included red alder, salal, and bracken fern. South of the Skagit River crossing, a mix of native trees, shrubs, and forbs was the dominant cover on the transmission line ROW, dominated by red alder, salal, and bracken fern, respectively. The riparian areas of Bacon, Diobsud, and O'Brien creeks are mapped as G851. The Skagit River crossing is mapped as Cultivated Pasture and Hay Grass Cultural Group (CGR022) on the northern bank, and a narrow riparian zone is mapped as G851 on the southern bank (north of the Powerline spawning channel). Illabot Creek riparian areas are a mix of native trees, shrubs, and forbs that transition to G851 outside of the transmission line ROW. G322 and G851 are mapped within a large wetland complex (Wetland #1564, detailed in the TR-02 Wetland Assessment [City Light 2022e]) that crosses the transmission line ROW near Hilt Creek as well as on the north bank of the Sauk River.

The majority of the vegetation within the transmission line ROW (394 acres, 78 percent) is less than or equal to 25 feet tall. Twenty-five acres (5 percent) of this study are segment has trees 25.1-40 feet tall; 32 acres (6 percent) are trees 40.1-60 feet tall; 40 acres (8 percent) are trees 60.1-90

[11] Additional information on invasive species within transmission line ROW in the various study area segments can be found in the TR-04 Invasive Plants Study (City Light 2022g).

feet tall; and the remaining 12 acres (3 percent) are trees taller than 90 feet. The small acreage of trees taller than 90 feet occur in riparian areas on the eastern bank of the Sauk River, as well as the forested hillside upslope of this area.

5.3.2 Sauk River Crossing to Oso

5.3.2.1 Upland Vegetation

From the Sauk River crossing south to Darrington, the study area contains forested slopes rising west of the transmission line ROW and the Sauk River and associated river valley east of the transmission line ROW (see Attachment B, pages 24-27). North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover dominates the area west of the transmission line ROW, some of which appears to be recently logged. Some areas at lower elevations contain a mix of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) and North Pacific Lowland Riparian Forest & Woodland Group (G851) cover. East of the transmission line ROW, some of the land has been recently logged.

From Darrington west to the community of Oso, the study area segment is located in the low elevation river valley of the North Fork Stillaguamish River (see Attachment B, pages 27-30). This area is dominated by G237 cover north of the transmission line ROW, and a mixture of G237 and G240 cover where the land slopes up to higher elevations.

5.3.2.2 Riparian and Wetland Vegetation

The majority of this portion of the study area segment is adjacent to the Sauk River and dominated by G237 and Vancouverian Wet Shrubland (G322) cover types. Surface water drainages that run down the slope from the west also contain a mixture of G237 and G851 cover. Near Spearhead (Caskey) Lake, there is a large wetland and riparian complex with a mix of G322 shrub-dominated wetland cover, G851 forested riparian cover, North Pacific Maritime Hardwood – Conifer Swamp (G853), and forested wetland cover. Several shrub-dominated riparian wetlands also occur within the channel of the Sauk River and are also mapped as G322 cover.

From Darrington west to the community of Oso, riparian areas represent a mix of G322 and G851 cover. These wetland and riparian cover types are along the mainstem of the North Fork Stillaguamish River, as well as several tributaries flowing from the south including Squire, Ashton, Furland, and Moose creeks and the Boulder River.

5.3.2.3 Canopy Height

Within the northern portion of this study area segment, riparian areas along the Sauk River primarily contain trees taller than 90 feet mixed with shorter trees with heights of 40.1-90 feet (Table 5.3-3). This analysis includes the area within 0.5 mile of the Project Boundary. This pattern is also apparent in upland forested areas mapped as either G237 or G240, with a higher concentration of taller trees upslope and away from the influence of the river. Along the North Fork Stillaguamish River, riparian areas are dominated by G237 cover with a mix of trees with heights between 40.1 and 60 feet and trees taller than 90 feet.

Upland forest height throughout this study area segment appears to reflect the history of logging activities. In the northern portion of this segment and west of the transmission line ROW, several areas contain continuous cover of trees taller than 90 feet (Table 5.3-3). However, within these

areas of tall tree cover there are several parcels with uniform cover of trees less than or equal to 25 feet tall representing parcels that were recently logged. This combination of parcels with uniform cover at several different heights (taller than 90 feet, 40.1-60 feet, and less than or equal to 25 feet) is also present in the recently logged areas in the southern portion of this study area segment south of the transmission line ROW between Darrington and Oso.

Table 5.3-3. Mean canopy height for the Sauk River Crossing to Oso study area segment (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	441	1,150	1,531	1,387	156	**4,665**
G240	1,230	1,558	1,740	1,443	1,248	**7,219**
G322	714	155	21	1	0	**891**
G524	145	0	0	0	0	**145**
G648	1,285	2	0	1	0	**1,288**
G851	173	199	586	570	80	**1,608**
G853	11	41	118	36	0	**206**
Total	**3,999**	**3,105**	**3,996**	**3,438**	**1,484**	**16,022**

5.3.2.4 Vegetation Within the Transmission Line ROW

This study area segment is approximately 950 acres, all of which occur within the transmission line ROW portion of the Project Boundary. The majority (236 acres, 25 percent) of this segment is mapped as invasive shrubs. From south of the Sauk River to where the transmission line ROW heads west near Darrington, the transmission line ROW is within industrial timber lands and is dominated by invasive shrubs, primarily Scot's broom. Flume Creek and Rinker Creek both cross the transmission line ROW in this portion of the study area, with riparian areas mapped as G851 and G322, respectively. West of Darrington, this study area segment is largely adjacent to developed areas, such as SR 530 and rural residences, where cover includes invasive shrubs, primarily Scot's broom. Farther west, where the transmission line ROW enters industrial timber lands again, the transmission line ROW is dominated by a mix of native salal and bracken fern. In the western extent of this study area segment, where the transmission line ROW runs adjacent to SR 530, cover is largely farmland and areas dominated by reed canarygrass (*Phalaris arundinacea*) and Himalayan blackberry, primarily in riparian areas near Montague Creek. Several streams cross the transmission line ROW between Darrington and Oso. French Creek has a narrow riparian area mapped as G322. The majority of other streams within this portion of the transmission line ROW have riparian areas dominated by native and non-native shrubs.

The majority of the vegetation within the transmission line ROW (864 acres, 92 percent) is less than or equal to 25 feet tall. Thirty-six acres (4 percent) of this study are segment has trees 25.1-40 feet tall; 26 acres (3 percent) are trees 40.1-60 feet tall; and the remaining 15 acres (1 percent) are trees 60.1-90 feet tall. No trees taller than 90 feet occur within the transmission line ROW in this study area segment.

5.3.3 Oso to SR 528

5.3.3.1 Upland Vegetation

North of the South Fork Stillaguamish River, the majority of this study area segment is North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover and represents logging areas (see Attachment B, pages 30-34). Lower elevations within this segment are North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover and are adjacent to riparian and wetland areas along Jim Creek.

South of the South Fork Stillaguamish River, this study area segment is dominated by rural residential land use. The dominant forest cover is G237 and is frequently interrupted by farmland, roads, and cleared land containing residences and Southern Vancouverian Lowland Ruderal Grassland & Shrubland (G648) cover.

5.3.3.2 Riparian and Wetland Vegetation

Riparian and wetland areas along Jim Creek are North Pacific Lowland Riparian Forest & Woodland Group (G851) and Vancouverian Wet Shrubland (G322), respectively. G851 and G322 riparian and wetland cover types are also mapped near Riley Lake in the northern portion of this segment. A large wetland area with G322 cover is near Olsen Lake, south of Jim Creek. This cover type, along with G851, is also located on wetland and stream complexes within this segment, including Star Creek and Quilceda Creek.

5.3.3.3 Canopy Height

North of the South Fork Stillaguamish River, the majority of this study area segment, including the area within 0.5 mile of the Project Boundary, appears to have been recently logged, as evidenced by the uniform cover of trees less than or equal to 25 feet in height (Table 5.3-4). It is assumed that parcels that exhibit a mix of canopy heights (40.1-90 feet) were recently logged. Some trees taller than 90 feet are apparent within the riparian areas of Jim Creek and associated tributaries, and they are a mix of G240 and G237 cover.

Some narrow bands of trees taller than 90 feet occur in the riparian areas along Star Creek and Quilceda Creek and in some areas south of the river that have not been impacted by development. However, the majority of this area is dominated by trees 25.1-60 feet in height, primarily located adjacent to cleared parcels containing residences.

Table 5.3-4. Mean canopy height for the Oso to SR 528 study area segment (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	559	968	1,295	428	6	**3,256**
G240	1,406	647	775	530	126	**3,484**
G322	586	225	21	2	0	**834**
G524	44	0	0	0	0	**44**
G648	1,245	3	0	0	0	**1,248**
G851	130	304	586	301	16	**1,337**
G853	7	88	82	11	0	**188**
Total	**3,977**	**2,235**	**2,759**	**1,272**	**148**	**10,391**

5.3.3.4 Vegetation Within the Transmission Line ROW

This study area segment is approximately 575 acres, all of which occur within the transmission line ROW portion of the Project Boundary. The majority of this segment (112 acres, 19 percent) is mapped as a mix of native shrubs, trees, and forbs. Upland vegetation in the transmission line ROW throughout this study area segment is a combination of mixed grasses and native shrubs with some invasive shrub cover, primarily Himalayan blackberry. North of Jim Creek, invasive shrubs (primarily Scot's broom) are dominant. South of Jim Creek, native vegetation is dominant or co-dominant, primarily salal and bracken fern. Areas of this segment near the South Fork Stillaguamish River also have a co-dominance of bigleaf maple. Several streams cross the transmission line ROW within this study area segment. Larger streams, including Jim, Bear, and Star creeks, have narrow riparian areas mapped as G322 within the transmission line ROW that transitions into a larger forested area outside of the transmission line ROW (mapped as a mix of G322 and G851). Additionally, portions of the larger wetland complexes in this segment, including those associated with Riley Lake (Wetland #1633) and Olsen Lake (Wetland #441), cross into the transmission line ROW and are mapped as G322 (Wetlands #1564 and #441, detailed in the TR-02 Wetland Assessment [City Light 2022e]). See Wetland Assessment for additional information on these wetlands (City Light 2022e).

The majority of the vegetation within the transmission line ROW (582 acres, 96 percent) is less than or equal to 25 feet tall. Eleven acres (2 percent) of this study are segment has trees 25.1-40 feet tall; 10 acres (2 percent) are trees 40.1-60 feet tall; and the remaining 7 acres (1 percent) are trees 60.1-90 feet tall. No trees taller than 90 feet occur within the transmission line ROW in this study are segment.

5.3.4 SR 528 to Bothell Substation

5.3.4.1 Upland Vegetation

This study area segment is in a highly developed and primarily residential environment. Vegetation throughout this segment is disturbed and limited to residential lawns and street trees (see Attachment B, pages 34-37). In the northern portion of this study area segment, some intact North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover occurs in natural areas near Martha Lake, Lake Cassidy, and Lake Stevens. Some tracts of intact North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover are also located adjacent to rural residential areas. Large parcels of farmland are also located within this segment and are concentrated within the river valley of the Snohomish River. South of the farmland, dense residential developments with little forest cover sit on a plateau. A steep forested corridor mapped as G240 and North Pacific Lowland Riparian Forest & Woodland Group (G851) cover connects the plateau with the Snohomish River valley. Forested corridors on the plateau near the residences include narrow bands of G240 cover and are frequently interrupted by streets and other developments.

5.3.4.2 Riparian and Wetland Vegetation

This study area segment also includes small areas of Vancouverian Wet Shrubland (G322) and North Pacific Lowland Riparian Forest & Woodland Group (G851) cover along wetland and riparian corridors that flow into Martha Lake, Lake Cassidy, and Lake Stevens to the east, and Ebey Slough to the west.

5.3.4.3 Canopy Height

Within this study area segment, including the area within 0.5 mile of the Project Boundary, trees taller than 90 feet are limited to the natural areas near Martha Lake and Lake Cassidy, and correlate to areas of G237 and G851 cover. Other forested areas near rural residences or narrow riparian corridors are associated with G240 cover, and are at heights of 60.1-90 feet with a few interspersed patches of trees taller than 90 feet. Trees in the denser neighborhoods within this study area segment are primarily landscaping and street trees with heights of less than or equal to 25 feet.

Table 5.3-5. Canopy height model results for the SR 528 to Bothell Substation study area segment (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	153	285	219	51	0	**708**
G240	257	332	404	227	9	**1,229**
G322	183	11	1	0	0	**195**
G524	23	0	0	0	0	**23**
G648	1,605	1	2	0	0	**1,608**
G851	302	292	301	93	4	**992**
G853	0	0	3	0	0	**3**
Total	**2,523**	**921**	**930**	**371**	**13**	**4,758**

5.3.4.4 Vegetation Within the Transmission Line ROW

This study area segment is approximately 400 acres, all of which occur within the transmission line ROW portion of the Project Boundary. The majority of this segment (101 acres, 25 percent) is mapped as invasive shrub cover. The transmission line ROW in the northern portion of this segment is predominantly adjacent to rural residences and is dominated by grass lawns and invasive shrubs, primarily Himalayan blackberry. In the southern portion of this segment, where denser residential development exists, the upland vegetation is dominated by Himalayan blackberry brambles. Riparian cover (a mix of G851 and G322) is mapped within the transmission line ROW along the stream that flows from Lake Stevens to Ebey Slough. Other riparian cover within the transmission line ROW is limited to the wetland areas that cross into the transmission line ROW. Riparian areas within the transmission line ROW near the Snohomish River crossing are invasive shrubs to the north, primarily Himalayan blackberry, and a narrow band of G851 cover on the south side of the river, north of Lowell Snohomish River Road. All vegetation within the transmission line ROW in this study area segment is less than or equal to 25 feet.

5.4 Fish and Wildlife Mitigation Lands

A discussion of vegetation mapped within the fish and wildlife mitigation lands within the study area is provided below and is separated into those within the RLNRA, and the South Fork Nooksack, Sauk, and Skagit river basins.

5.4.1 Fish and Wildlife Mitigation Lands – RLNRA

The mitigation lands within the RLNRA consist of the County Line Ponds and Newhalem Ponds

(see Attachment B, page 12).

5.4.1.1 Upland Vegetation

The County Line Ponds parcel has North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover inland and adjacent to the access road (Table 5.4-1). The Newhalem Ponds parcel is also dominated by G237 cover; a small portion of this parcel (approximately 4 acres) is used for storage for Project operations.

5.4.1.2 Riparian and Wetland Vegetation

The County Line Ponds parcel is predominantly North Pacific Lowland Riparian Forest & Woodland Group (G851) along the river and between the various ponds. Riparian vegetation on the Newhalem Ponds parcel is limited to only a narrow band of G851 cover along the Skagit River. Smaller pockets of Vancouverian Freshwater Wet Meadow & Marsh Group (G517) are within the larger pond to the south of the parcel.

Table 5.4-1. Acreage of mapped cover types on mitigation lands within the RLNRA and Project Boundary.

Parcel Name	G237	G240	G517	G851	Total
County Line Ponds	25	1	0	20	**46**
Newhalem Ponds	70	2	1	9	**82**
Total	**95**	**3**	**1**	**29**	**128**

5.4.1.3 Canopy Height

Trees 60.1-90 feet make up the majority of the County Line Ponds parcel and largely occur along the perimeter of the ponds (Table 5.4-2). Larger trees (> 90 feet) occur away from the ponds and along the access roads. This is also the case for trees within the Newhalem Ponds parcel (Table 5.4-3).

Table 5.4-2. Mean canopy height for the County Line Ponds parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	0	25	0	**25**
G240	0	0	1	1	0	**2**
G851	19	0	0	1	0	**20**
Total	**19**	**0**	**1**	**27**	**0**	**47**

Table 5.4-3. Mean canopy height for the Newhalem Ponds parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	0	41	29	**70**
G240	2	0	0	0	0	**2**
G517	1	0	0	0	0	**1**

Cover Type	Acreage of Mean Canopy Height Ranges (ft)					
	≤25.0	25.1-40.0	40.1-60.0	60.1-90.0	>90.0	Total
G851	0	0	3	6	0	**9**
Total	**3**	**0**	**3**	**47**	**29**	**82**

5.4.2 Fish and Wildlife Mitigation Lands – South Fork Nooksack River Basin

The fish and wildlife mitigation lands in the South Fork Nooksack River basin include the Bear Lake, Nooksack, and Nooksack West parcels (see Attachment B, pages 21-22).

5.4.2.1 Upland Vegetation

In the lower part of the river valley, upland areas along the South Fork Nooksack River are North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover. Upslope of the river valley, the vegetation cover is predominantly North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) within the fish and wildlife mitigation land parcels, as well as the surrounding one-half-mile. The Bear Lake parcel and surrounding area are also G240 cover.

5.4.2.2 Riparian and Wetland Vegetation

Riparian areas along the South Fork Nooksack River are North Pacific Lowland Riparian Forest & Woodland Group (G851) and North Pacific Maritime Hardwood – Conifer Swamp (G853), with some upland areas with G237 cover in the lower parts of the river valley (Table 5.4-4). Areas dominated by G237 cover have likely been impacted by logging practices that have removed large conifers and, in turn, have reduced potential for recruitment of large wood to the river (Tatum 2021). Vancouverian Wet Shrubland (G322) and G851 cover are mapped along Howard Creek, which drains into the South Fork Nooksack River from the north. Within the Bear Lake parcel, a shrub-dominated wetland adjacent to the lake and some narrow fringe wetland areas along a drainage to the South Fork Nooksack River to the south, are both mapped as G322.

Table 5.4-4. Acreage of mapped cover types on fish and wildlife mitigation lands within the South Fork Nooksack River basin and the Project Boundary.

Parcel Name	G237	G240	G322	G524	G648	G851	G853	Total
Bear Lake	0	133	4	0	10	0	0	**147**
Nooksack	448	2,622	58	1	27	417	176	**3,749**
Nooksack West	61	215	2	0	0	72	28	**378**
Outside Project Boundary[1]	64	7,676	19	1	117	143	16	**8,036**
Total	**573**	**10,646**	**83**	**2**	**154**	**632**	**220**	**12,310**

1 This includes the area outside the Project Boundary but within the 0.5-mile study area.

5.4.2.3 Canopy Height

Trees less than or equal to 25 feet in height are dominant within upland areas of the Bear Lake parcel mapped as G237 (Table 5.4-5). Along the South Fork Nooksack River, trees are 60.1-90 feet in height in riparian areas where G237 is dominant (Table 5.4-6 and Table 5.4-7). In the narrow steep areas of the South Fork Nooksack river valley, however, trees taller than 90 feet and mapped

as North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) are immediately adjacent to the river channel. Trees taller than 90 feet are also dominant in areas upslope to the north of the river and on steep ridges upslope to the south. Outside of the riparian areas, trees less than or equal to 25 feet in height are on the outer edges of the majority of the study area and appear to be the result of logging operations.

Table 5.4-5. Mean canopy height for the Bear Lake parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G240	83	47	4	0	0	**134**
G517	4	0	0	0	0	**4**
G851	10	0	0	0	0	**10**
Total	**97**	**47**	**4**	**0**	**0**	**148**

Table 5.4-6. Mean canopy height for the Nooksack parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	18	16	45	348	22	**449**
G240	510	377	388	968	379	**2,622**
G322	44	6	7	1	0	**58**
G524	1	0	0	0	0	**1**
G648	27	0	0	0	0	**27**
G851	12	33	101	246	26	**418**
G853	3	13	53	102	5	**176**
Total	**615**	**445**	**594**	**1,665**	**432**	**3,751**

Table 5.4-7. Mean canopy height for the Nooksack West parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	1	0	0	41	19	**61**
G240	0	3	13	161	38	**215**
G322	2	0	0	0	0	**2**
G851	0	2	11	36	22	**71**
G853	0	0	28	0	0	**28**
Total	**3**	**5**	**52**	**238**	**79**	**377**

5.4.3 Fish and Wildlife Mitigation Lands – Sauk River Basin

The fish and wildlife mitigation lands in the Sauk River basin include the Dan Creek, Everett Creek, North Everett Creek, North Sauk, and Sauk Island parcels (see Attachment B, pages 26-27).

5.4.3.1 Upland Vegetation

Canopy cover in all of the fish and wildlife mitigation land parcels within the Sauk River basin are dominated by the North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover type. Land use within one-half mile to the east of these parcels is primarily rural residences and farmland within the CMZ of the Sauk River. These surrounding areas are a mixture of North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) and Southern Vancouverian Lowland Ruderal Grassland & Shrubland (G648) in cleared fields used for farming.

5.4.3.2 Riparian and Wetland Vegetation

Small areas of Vancouverian Wet Shrubland (G322) and North Pacific Lowland Riparian Forest & Woodland Group (G851) are interspersed throughout the G237 cover outside of the Sauk Island parcel where G851 is the dominant cover type (Table 5.4-8). The G322 and G851 cover types are adjacent to the mainstem Sauk River, as well as off-channel habitat within the Dan Creek and North Everett Creek parcels. Some of the farm fields within this portion of the study area, outside of the fish and wildlife mitigation land parcels, are Western North American Ruderal Wet Shrubland, Meadow, and Marsh (G524).

Table 5.4-8. Acreage of mapped vegetated cover types on fish and wildlife mitigation lands within the Sauk River basin and Project Boundary.[1]

Parcel Name	G237	G240	G322	G648	G851	CGR022	Total
Dan Creek	32	0	0	0	10	0	**42**
Everett Creek	34	0	0	0	4	0	**38**
North Everett Creek	108	1	16	5	31	4	**165**
North Sauk	21	5	4	1	3	0	**34**
Sauk Island	6	0	0	0	9	0	**15**
Total	**201**	**6**	**20**	**6**	**57**	**4**	**294**

1 This table only represents acreage within the Project Boundary. Acreage mapped outside the Project Boundary, but within the 0.5-mile study area, is in the Sauk River Crossing to Oso study area segment in Table 5.3-1.

5.4.3.3 Canopy Height

The tallest trees in the Sauk River basin fish and wildlife mitigation lands are 60.1-90 feet and are located along the side channels that are within and in the vicinity of the Dan Creek (Table 5.4-9) and North Everett Creek parcels (Table 5.4-10). These trees are associated with the G237 cover type. Some of these taller trees are also along the riparian corridor of Gravel Creek, which flows into the North Sauk parcel and into the Sauk River from the southeast (Table 5.4-11). These trees are a mix of G237 and G851 cover. The majority of trees immediately adjacent to the Sauk River in this portion of the study area, including those in the Everett Creek (Table 5.4-12) and Sauk Island parcels (Table 5.4-13), are either riparian (G851) or upland (G237) cover, and are less than 40.1-60 feet in height.

Table 5.4-9. Canopy height model results for the Dan Creek parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	3	7	22	0	**32**
G851	0	2	2	5	0	**9**
Total	**0**	**5**	**9**	**27**	**0**	**41**

Table 5.4-10. Canopy height model results for the North Everett Creek parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	4	13	34	50	0	**101**
G322	11	5	0	0	0	**16**
G648	5	0	0	0	0	**5**
G851	6	4	16	5	0	**31**
Total	**26**	**22**	**50**	**55**	**0**	**153**

Table 5.4-11. Canopy height model results for the North Sauk parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	1	0	20	0	0	**21**
G240	5	0	0	0	0	**5**
G322	4	0	0	0	0	**4**
G851	1	0	0	2	0	**3**
Total	**11**	**0**	**20**	**2**	**0**	**33**

Table 5.4-12. Canopy height model results for the Everett Creek parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	8	14	11	1	**34**
G851	0	2	2	0	0	**4**
Total	**0**	**10**	**16**	**11**	**1**	**38**

Table 5.4-13. Canopy height model results for the Sauk Island parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	1	2	1	2	0	**6**
G851	0	1	6	2	0	**9**
Total	**1**	**3**	**7**	**4**	**0**	**15**

5.4.4 Fish and Wildlife Mitigation Lands – Skagit River Basin

A summary of the acreages and cover types mapped within the fish and wildlife mitigation lands in the Skagit River basin is presented in Table 5.4-14. A description of the vegetation composition and structure follows and is organized from north to south, then east to west within the study area. The fish and wildlife mitigation lands in the Skagit River basin include 18 parcels.

Table 5.4-14. Acreage of mapped vegetated cover types on fish and wildlife mitigation lands within the Skagit River basin and Project Boundary.[1]

Parcel Name	G210	G237	G240	G322	G524	G648	G851	G853	CGR022	Total
B&W Road 1[2]	2	36	38	0	0	0	0	0	0	**76**
B&W Road 2[2]	0	5	4	0	0	0	1	0	0	**10**
Bacon Creek[2]	3	61	8	0	0	0	12	0	0	**84**
Barnaby Slough	0	102	54	28	0	0	14	0	0	**198**
Bogert and Tam	0	10	0	0	0	1	5	0	0	**16**
Corkindale Creek	0	34	4	1	8	4	2	0	89	**142**
Day Creek Slough	0	2	0	1	1	1	0	0	31	**36**
Day Creek Slough Outside Project Boundary[3]	0	245	19	73	9	63	30	0	279	**718**
False Lucas Slough	0	131	1	55	0	0	16	0	0	**203**
Finney Creek	0	75	508	7	0	0	45	0	0	**635**
Finney Creek Outside Project Boundary[3]	0	220	1,423	22	0	8	76	5	0	**1,754**
Illabot North	0	390	206	51	0	2	39	12	0	**700**
Illabot South	0	209	2,188	7	0	6	98	5	0	**2,513**
Johnson Slough	0	14	0	8	2	4	26	0	0	**54**
McLeod Slough	0	51	1	4	1	1	15	0	49	**122**
Napoleon Slough	0	40	7	0	0	0	12	0	0	**59**
O'Brien Slough	0	32	0	5	0	0	9	1	0	**47**
Pressentin	0	3	632	0	0	0	1	0	0	**636**
Pressentin Outside Project Boundary[3]	0	52	1,679	4	0	11	27	0	0	**1,773**
Savage Slough	0	55	12	45	17	31	41	0	0	**201**
Savage Slough Outside Project Boundary[3]	0	300	391	128	62	53	117	5	68	**1,124**
South Marble 40	0	1	40	0	0	1	0	0	0	**42**
Total	**5**	**2,068**	**7,215**	**439**	**100**	**186**	**586**	**28**	**516**	**11,143**

1 Slight differences in the total acreage of each parcel between this table and summary Tables 5.4-15 through 5.4-32 are due to rounding.
2 The B&W Road 1 & 2 and Bacon Creek parcels were mapped as part of the NPS vegetation mapping effort.
3 This table only represents acreage within the Project Boundary unless otherwise noted. Acreage mapped outside the Project Boundary, but within the 0.5-mile study area, for the majority of these parcel is captured in the Bacon Creek to Sauk River Crossing study area segment in Table 5.3-1.

5.4.4.1 Bacon Creek Parcel

Upland Vegetation

The Bacon Creek parcel is located north of the Skagit River between PRM 83 and 84 (see Attachment B, page 13). Upland vegetation throughout the Bacon Creek parcel and surrounding areas is North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover to the west of the creek, and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) to the east. Small patches of Central Rocky Mountain Douglas-fir – Pine Forest (G210) and North Vancouverian Montane Bedrock, Cliff, & Talus Vegetation (G318) also occur throughout this portion of the study area.

Riparian and Wetland Vegetation

Riparian vegetation within the Bacon Creek parcel is limited to a narrow riparian corridor mapped as North Pacific Lowland Riparian Forest & Woodland Group (G851) in patches along both the east and west sides of Bacon Creek.

Canopy Height

Trees taller than 90 feet are mapped throughout this segment and are frequently mixed with trees 60.1-90 feet in height, except for the trees immediately adjacent to Bacon Creek, which are less than or equal to 25 feet tall (Table 5.4-15).

Table 5.4-15. Canopy height model results for the Bacon Creek parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G210	1	1	0	0	0	**2**
G237	0	2	4	51	5	**62**
G240	0	0	0	4	4	**8**
G318	3	0	0	0	0	**3**
G849	0	0	0	1	0	**1**
G851	4	0	1	4	3	**12**
Total	**8**	**3**	**5**	**60**	**12**	**88**

5.4.4.2 B&W Road 1 and 2 Parcels

Upland Vegetation

Both the B&W Road 1 and 2 parcels, between PRM 82 and 83, are a mix of North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover types (see Attachment B, page 13). Cover types are similar outside of the parcels, except at higher elevations to the east, where cover type is a mix of G240 and Rocky Mountain Subalpine Dry-Mesic Spruce – Fir Forest & Woodland (G219).

Riparian and Wetland Vegetation

Small pockets of North Pacific Lowland Riparian Forest & Woodland Group (G851) are mapped along several small streams within the B&W Road 1 parcel and along the mainstem of the Skagit River in the B&W Road 2 parcel.

Canopy Height

Except for a narrow patch of trees taller than 90 feet within the riparian area of the B&W Road 1 parcel, trees are 60.1-90 feet throughout these parcels (Table 5.4-16 and Table 5.4-17). B&W Road 1 also includes a large portion of trees less than or equal to 25 feet in height, as it was previously logged. Some taller trees (25.1-40 feet and 40.1-60 feet) are mixed in with the shorter trees on the outer edges of these parcels. Trees taller than 90 feet are continuously mapped along the riparian area of the Skagit River between the two parcels, as well as north of B&W Road 1. These are associated with the G237 cover type. Additionally, trees taller than 90 feet are mapped at high elevation to the south and southwest of the parcels, and are predominantly G240.

Table 5.4-16. Canopy height model results for the B&W Road 1 parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G210	0	0	2	0	0	**2**
G237	0	1	1	33	1	**36**
G240	32	0	0	2	3	**37**
Total	**32**	**1**	**3**	**35**	**4**	**75**

Table 5.4-17. Canopy height model results for the B&W Road 2 parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	2	0	3	0	**5**
G240	2	0	2	0	0	**4**
G851	0	0	0	1	0	**1**
Total	**2**	**2**	**2**	**4**	**0**	**10**

5.4.4.3 Corkindale Creek Parcel

Upland Vegetation

The Corkindale Creek parcel, near PRM 76, has been used for agriculture for many decades and is currently leased for grazing and haying until a management plan is developed (see Attachment B, page 15). This parcel is dominated by the Cultivated Pasture & Hay Grass Cultural cover (CGR022). In the northwest portion of the parcel, outside of the agricultural fields, forested areas at low elevation are North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) and transition to North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) at higher elevations.

Riparian and Wetland Vegetation

A narrow strip of riparian forest is North Pacific Lowland Riparian Forest & Woodland Group (G851) along the creek itself. Portions of the agricultural fields are Western North American Ruderal Wet Shrubland, Meadow, and Marsh (G524) cover.

Canopy Height

Within the Corkindale Creek parcel, the majority of trees are 60.1-90.0 feet (Table 5.4-18), and are located along the northern edge of the parcel and along the creek. The remainder of the parcel is CGR022, a cultivated agricultural field with very low vegetation which was not picked up by the CHM. Outside of the parcel, G237 and G240 cover types continue to the north and west, respectively, and are dominated by trees taller than 90 feet. Farmland continues to the south and east.

Table 5.4-18. Canopy height model results for the Corkindale Creek parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	2	0	2	17	0	**21**
G240	0	0	0	2	0	**2**
G322	1	0	0	0	0	**1**
G851	0	1	0	1	0	**2**
Total	**3**	**1**	**2**	**20**	**0**	**26**

5.4.4.4 South Marble 40 Parcel

Upland Vegetation

The South Marble 40 parcel located south of PRM 77, as well as the surrounding area, is predominantly North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover (see Attachment B, page 15). There is some cover of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) along steep drainages to the south and north.

Riparian and Wetland Vegetation

A large shrub-dominated wetland is present to the west of the parcel along Rockport-Cascade Road and mapped as Vancouverian Wet Shrubland (G322). Immediately adjacent, narrow patches of North Pacific Lowland Riparian Forest & Woodland Group (G851) are along the road.

Canopy Height

Average canopy height within the South Marble 40 parcel, as well as the surrounding area, is less than or equal to 25 feet, likely from apparent logging based on aerial photos (Table 5.4-19). Trees taller than 90 feet occur outside of the parcel to the north and west on the opposite side of the Rockport-Cascade River Road and are mapped as G237. Trees taller than 90 feet are also present outside the parcel along riparian areas adjacent to the Rockport-Cascade Road, and are mapped as G851. Trees are 40.1-60 feet in height on the G240 slope outside the parcel to the east.

Table 5.4-19. Canopy height model results for the South Marble 40 parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	1	0	0	**1**
G240	22	8	8	2	0	**40**
G648	1	0	0	0	0	**1**
Total	**23**	**8**	**9**	**2**	**0**	**42**

5.4.4.5 Bogert and Tam Parcel

Upland Vegetation

The Bogert and Tam parcel is located just upstream of PRM 73, and is predominantly North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover (see Attachment B, page 16). Outside of the parcel, farmland is to the west, and forested areas across SR 20 to the north are predominantly G237 in lower elevations and North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) in upper elevations.

Riparian and Wetland Vegetation

The Bogert and Tam parcel is upland, with North Pacific Lowland Riparian Forest & Woodland Group (G851) cover being limited to areas adjacent to the Skagit River.

Canopy Height

Within the parcel and surrounding area, trees are 60.1-90 feet in height (Table 5.4-20). Outside the parcel, some small clusters of trees taller than 90 feet occur adjacent to a side channel under G851 riparian forest cover. Larger tracts of trees taller than 90 feet occur across SR 20, outside of the parcel, and are associated with G240 cover.

Table 5.4-20. Canopy height model results for the Bogert and Tam parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	0	10	0	**10**
G648	1	0	0	0	0	**1**
G851	2	0	2	1	0	**5**
Total	**3**	**0**	**2**	**11**	**0**	**16**

5.4.4.6 O'Brien Slough, Illabot North, and Illabot South Parcels

Upland Vegetation

The O'Brien Slough, Illabot North, and Illabot South parcels are predominantly North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover in higher elevations located on the southeast side of Rockport-Cascade Road, and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover in the lower elevations located northwest of Rockport-Cascade Road (see Attachment B, page 16).

Riparian and Wetland Vegetation

Illabot Creek and O'Brien Creek flow into the study area from the southwest. Illabot Creek has a mix of G240, G237, and North Pacific Lowland Riparian Forest & Woodland Group (G851) cover through the majority of the study area, and dense concentration of trees taller than 90 feet are mapped across all cover types. Narrow riparian areas of O'Brien Creek also exhibit these cover types.

Both streams cross Rockport-Cascade Road into a complex slough system on the south side of the Skagit River between PRM 73 and 76, where the dominant cover is G237. However, the sloughs themselves are large wetland complexes with a mix of Vancouverian Wet Shrubland (G322), North Pacific Maritime Hardwood – Conifer Swamp (G853), and G851, and provide a forested connection to the Skagit River.

Canopy Height

Trees in the O'Brien Slough parcel are 60.1-90 feet tall with some trees greater than 90 feet in height occurring along the slough (Table 5.4-21). The Illabot North parcel is also dominated by trees 60.1-90 feet tall, and some trees taller than 90 feet occur in riparian areas of the Skagit River (Table 5.4-22). Upland areas near Illabot Slough, outside the Illabot North parcel to the west, also exhibit a dominance of trees taller than 90 feet. Dense concentrations of trees taller than 90 feet occur along Illabot Creek within the Illabot South parcel (Table 5.4-23). Trees taller than 90 feet are present in a narrow band along the O'Brien Creek corridor within the Illabot South parcel. Trees taller than 90 feet of the G240 cover type are dominant outside of the parcels in the areas between the two drainages. The remainder of the trees on the southeast side of Rockport-Cascade Road are 25.1-40 feet and 40.1-60 feet in height due to apparent recent logging based on aerial imagery. One tract of trees taller than 90 feet that were excluded from logging is in the southeast corner of the parcel.

Table 5.4-21. Canopy height model results for the O'Brien Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	7	22	3	**32**
G322	4	1	0	0	0	**5**
G851	0	2	0	7	0	**9**
G853	0	0	1	0	0	**1**
Total	**4**	**3**	**8**	**29**	**3**	**47**

Table 5.4-22. Canopy height model results for the Illabot North parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	2	2	85	293	8	**390**
G240	1	1	7	174	22	**205**
G322	27	15	0	8	1	**51**
G648	2	0	0	0	0	**2**

Cover Type	Acreage of Mean Canopy Height Ranges (ft)					
	≤25.0	25.1-40.0	40.1-60.0	60.1-90.0	>90.0	Total
G851	1	6	11	18	2	**38**
G853	0	0	2	10	0	**12**
Total	**33**	**24**	**105**	**503**	**33**	**698**

Table 5.4-23. Canopy height model results for the Illabot South parcel (acres).

Cover Type	Acreage of Mean Canopy Height Ranges (ft)					
	≤25.0	25.1-40.0	40.1-60.0	60.1-90.0	>90.0	Total
G237	3	11	94	75	26	**209**
G240	215	520	954	279	220	**2,188**
G322	3	5	0	0	0	**8**
G648	6	0	0	0	0	**6**
G851	3	11	21	45	18	**98**
G853	0	3	0	2	0	**5**
Total	**230**	**550**	**1,069**	**401**	**264**	**2,514**

5.4.4.7 Barnaby Slough and False Lucas Slough Parcels

Upland Vegetation

The Barnaby Slough and False Lucas Slough parcels are located west of Illabot and O'Brien Sloughs between PRM 70 and 72, and are part of the complex slough system on the north side of Rockport-Cascade Road described above (see Attachment B, pages 16-17). Upland areas within both of these parcels are dominated by North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover that continues north to the Skagit River. Forested areas to the south of these sloughs are dominated by North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover. Outside of the parcels, large agriculture parcels continue west of False Lucas Slough to SR 530 and are Southern Vancouverian Lowland Ruderal Grassland & Shrubland (G648), Cultivated Row Crops (CGR MOD), and grass-dominated pastures.

Riparian and Wetland Vegetation

Barnaby Slough has a large open water component with narrow fringes of Vancouverian Wet Shrubland (G322) and North Pacific Lowland Riparian Forest & Woodland Group (G851), primarily on its northern side. False Lucas Slough is vegetated with G322 cover, with narrow pockets of G851 occurring throughout. Some of the agricultural field to the west of the False Lucas Slough parcel have Western North American Ruderal Wet Shrubland, Meadow, and Marsh (G524) cover.

Canopy Height

Within the Barnaby Slough parcel, trees are largely 60.1-90 feet in height, with trees taller than 90 feet mixed in at areas along the river (Table 5.4-24). There is a high density of trees taller than 90 feet throughout the False Lucas Slough parcel, primarily in areas mapped as G237 (Table 5.4-25).

Upland areas to the north and south of these parcels with G237 cover are also dominated by trees taller than 90 feet.

Table 5.4-24. Canopy height model results for the Barnaby Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	3	0	77	22	**102**
G240	0	0	0	53	0	**53**
G322	27	1	0	0	0	**28**
G851	0	0	3	9	2	**14**
Total	**27**	**4**	**3**	**139**	**24**	**197**

Table 5.4-25. Canopy height model results for the False Lucas Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	7	21	103	**131**
G322	55	0	0	0	0	**55**
G851	0	0	1	13	2	**16**
Total	**55**	**0**	**8**	**34**	**105**	**202**

5.4.4.8 Johnson Slough Parcel

Upland Vegetation

Located on the north side of the Skagit River near PRM 69, the Johnson Slough parcel is a mix of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) and North Pacific Lowland Riparian Forest & Woodland Group (G851) cover types (see Attachment B, page 17). Across SR 20 to the north, G237 is at low elevation while North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) is dominant at higher elevations.

Riparian and Wetland Vegetation

Vancouverian Wet Shrubland (G322) shrub-dominated areas are south of the parcel within the Skagit River. North of the parcel is a mix of farmland and fields with Western North American Ruderal Wet Shrubland, Meadow, and Marsh (G524) cover, and riparian areas mapped as G851.

Canopy Height

Trees taller than 90 feet are associated with both G237 and G851 cover types and are located throughout the parcel (Table 5.4-26). Trees taller than 90 feet are also mapped across both G237 and G240, outside of the parcel, across SR 20 to the north.

Table 5.4-26. Canopy height model results for the Johnson Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	1	2	0	8	4	**15**
G322	8	0	0	0	0	**8**
G524	2	0	0	0	0	**2**
G648	4	0	0	0	0	**4**
G851	4	5	7	5	6	**27**
Total	**19**	**7**	**7**	**13**	**10**	**56**

5.4.4.9 Napoleon Slough Parcel

Upland Vegetation

Located immediately west of SR 530 near PRM 68, the Napoleon Slough parcel is predominantly North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover (see Attachment B, page 17). A small area in the northern portion of the parcel is North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover.

Riparian and Wetland Vegetation

Narrow bands of North Pacific Lowland Riparian Forest & Woodland Group (G851) occur along the riparian areas of the stream and slough channels.

Canopy Height

Trees associated with G237 cover are 60.1-90 feet or taller than 90 feet, while trees 40.1-60 feet height are located along the stream and slough channels mapped as G851 (Table 5.4-27). This upland/riparian vegetation pattern, and dominance of tall trees, continues to the Sauk River to the west and south, and north to the Skagit River. This parcel also contains areas with a high rumple index and a high p95 value, suggesting that older and more complex forests are present.

Table 5.4-27. Canopy height model results for the Napoleon Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	0	24	16	**40**
G240	0	0	0	7	0	**7**
G851	0	0	4	5	3	**12**
Total	**0**	**0**	**4**	**36**	**19**	**59**

5.4.4.10 McLeod Slough Parcel

Upland Vegetation

The McLeod Slough parcel, located west of the Skagit-Sauk confluence near PRM 66, contains a large grass-covered field that has been used as a hayfield for many years (see Attachment B, page 17). This field is Cultivated Pasture & Hay Grass Cultural (CGR022) cover. It is still used for hay

under a life estate agreement with the previous owner, and it also attracts large numbers of elk. Forested areas to the north and west of the field are North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) cover.

Riparian and Wetland Vegetation

North Pacific Lowland Riparian Forest & Woodland Group (G851) cover is present along two small channels that are connected to the Skagit River via McLeod Slough. Some small pockets of Vancouverian Wet Shrubland (G322) cover are immediately north of the field and along the channel connecting to the Skagit River to the west.

Canopy Height

Trees taller than 90 feet are dominant throughout the forested areas to the north and continue to the Skagit River (Table 5.4-28). Outside of the parcel to the east, trees taller than 90 feet with a G237 cover continue across the main channel of McLeod Slough and along the Skagit River. Similar to the Napoleon Slough parcel, this area also contains high rumple index and p95 values, consistent with older and complex forests. South of the parcel, across the Concrete-Sauk Valley Road, are parcels developed for farmland and rural residences. West of the parcel are timber harvest lands with North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover and an average canopy height of less than or equal to 25 feet.

Table 5.4-28. Canopy height model results for the McLeod Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	3	18	29	**50**
G240	0	0	1	0	0	**1**
G322	1	3	0	0	0	**4**
G524	1	0	0	0	0	**1**
G648	1	0	0	0	0	**1**
G851	0	1	9	2	4	**16**
Total	**3**	**4**	**13**	**20**	**33**	**73**

5.4.4.11 Finney Creek Parcel

Upland Vegetation

The Finney Creek parcel and surrounding area are predominantly North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover (see Attachment B, page 18). Upland vegetation at lower elevations is mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237), which transitions to G240 cover at higher elevations.

Riparian and Wetland Vegetation

The Finney Creek channel, which lies in a ravine to the northwest and downslope of the majority of the parcel, is a mix of G237 and North Pacific Lowland Riparian Forest & Woodland Group (G851). Shrub-dominated areas mapped as Vancouverian Wet Shrubland (G322) cover occur

along several areas of the river channel, as well as a small area of forested wetland with North Pacific Maritime Hardwood – Conifer Swamp (G853) cover.

Canopy Height

The largest trees are associated with the G240 cover type and are located along a slope in the west portion of the parcel (Table 5.4-29). The remainder of this portion of the study area, including adjacent to the stream channel, is dominated by trees 60.1-90 feet in height. Some small tracts of G240 cover with trees less than or equal to 25 feet in height occur outside the parcel, in timber harvest lands.

Table 5.4-29. Canopy height model results for the Finney Creek parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	7	12	56	0	**75**
G240	0	8	73	367	59	**507**
G322	3	4	0	0	0	**7**
G851	0	1	28	15	0	**44**
Total	**3**	**20**	**113**	**438**	**59**	**633**

5.4.4.12 Pressentin Parcel

Upland Vegetation

Similar to the Finney Creek parcel, the Pressentin parcel is predominantly North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover, outside the Pressentin Creek channel ravine (see Attachment B, page 19).

Riparian and Wetland Vegetation

Pressentin Creek flows southwest to northeast through the parcel through a steep canyon dominated by G240 cover. In areas of lower gradients, the forest cover transitions to a combination of G240 and Vancouverian Wet Shrubland (G322).

Canopy Height

The parcel is dominated by trees 60.1-90 feet tall and trees taller than 90 feet, including areas adjacent to the Pressentin Creek channel, and excluding areas that have previously been logged (Table 5.4-30).

Table 5.4-30. Canopy height model results for the Pressentin parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	0	3	0	0	**3**
G240	112	18	80	240	183	**633**
G851	1	0	0	0	0	**1**
Total	**113**	**18**	**83**	**240**	**183**	**637**

5.4.4.13 Savage Slough Parcel

Upland Vegetation

The Savage Slough parcel is located between PRM 46 and 47 of the Skagit River and includes land on both the north and south sides of the South Skagit Highway (see Attachment B, page 20). On the south side of the highway, forest cover at higher and lower elevations is primarily North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237), respectively. North of the South Skagit Highway, forest cover is G237.

Riparian and Wetland Vegetation

Mill Creek, which flows from upslope, north to south through a ravine, into the parcel and eventually into the Skagit River, has large patches of North Pacific Lowland Riparian Forest & Woodland Group (G851) forest cover and Vancouverian Wet Shrubland (G322) shrub-dominated cover. Several shrub-dominated side channels also exist here. In general, these channels are G322 cover with a G851 forest cover on their outer edges. A grass-covered field, mapped as Western North American Ruderal Wet Shrubland, Meadow, and Marsh (G524), is located on the north side of the highway, and was recently planted with coniferous tree species.

Canopy Height

Outside of the parcel, immediately to the south, there are a few areas adjacent to the Mill Creek channel where trees taller than 90 feet exist. However, the majority of forested areas within this portion of the study area are a mix of the various canopy heights (Table 5.4-31). Additional areas where these forests contain trees taller than 90 feet are apparent outside of the parcel on its northwest, north, and northeast edges, and adjacent to the Skagit River.

Table 5.4-31. Canopy height model results for the Savage Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	5	24	21	5	0	**55**
G240	0	10	1	0	0	**11**
G322	28	16	1	0	0	**45**
G524	17	0	0	0	0	**17**
G648	31	0	0	0	0	**31**
G851	8	2	21	11	0	**42**
Total	**89**	**52**	**44**	**16**	**0**	**201**

5.4.4.14 Day Creek Slough Parcel

Upland Vegetation

The Day Creek Slough parcel, located between PRM 33 and 35, is former farmland, mapped as Cultivated Pasture & Hay Grass Cultural (CGR022) (see Attachment B, page 23).

Riparian and Wetland Vegetation

Day Creek Slough flows through the northeast portion of the parcel and is a combination of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) and Vancouverian Wet Shrubland (G322) cover types. Outside the parcel, the slough is shrub-dominated and only represents the G322 cover type. Riparian areas north of the parcel are a mix of G237 and North Pacific Lowland Riparian Forest & Woodland Group (G851) with some shrub-dominated areas of G322 cover within the Skagit River. Adjacent to this parcel, the Skagit River exhibits high channel complexity with several large vegetated islands with a mix of G851, G237, and G322 cover.

Canopy Height

Since the majority of the parcel is CGR022, tall trees are limited (Table 5.4-32). Trees taller than 90 feet are present within the large vegetated islands to the north, outside of the parcel, in areas of G237 and G851 cover.

Table 5.4-32. Canopy height model results for the Day Creek Slough parcel (acres).

	Acreage of Mean Canopy Height Ranges (ft)					
Cover Type	**≤25.0**	**25.1-40.0**	**40.1-60.0**	**60.1-90.0**	**>90.0**	**Total**
G237	0	2	0	0	0	**2**
G524	1	0	0	0	0	**1**
G648	1	0	0	0	0	**1**
Total	**2**	**2**	**0**	**0**	**0**	**4**

5.5 Results of the PHS and SWAP Data Analysis

Based on WDFW PHS data, one priority habitat and 20 priority species are mapped within the study area. The majority of the occurrences are in North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) and North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover (see Table E-1 of Attachment E of this study report). Additionally, WDFW SWAP data map 23 SGCN species with documented and/or potential habitat ranges within the study area (see Table F-1 of Attachment F of this study report). All 23 species have documented and/or potential habitat ranges within G237, G240, and Vancouverian Wet Shrubland (G322) cover classes, with the exception of the western bluebird (*Sialia mexicana*) whose habitat range does not intersect with G322 cover.

Based on the definition of snag-rich areas (at least four snags greater than 20 inches in diameter per acre), the DNR data used for the analysis shows the majority of the study area is considered to be snag-rich, with the exception of the majority of the transmission line ROW, areas that have recently been logged, agricultural fields, and residential and commercial developments. The majority of snag-rich areas contain 5-16 snags per acre, including the areas affected by the Cat Island, Thursday Creek, Big Beaver, and Goodell fires. Areas of higher snag density coincide with areas that contain taller trees, including the east side of Ross Lake north of Ruby Arm, portions of the Illabot South parcel, and near the confluence of the Sauk and Skagit rivers.

6.0 DISCUSSION AND FINDINGS

This study has met the goals and objectives stated in the RSP and presented in Section 2.0 of this study report. The overall goal of the Vegetation Mapping Study is to provide baseline information about vegetation cover within the defined study area.

Data on culturally-important plants collected during field efforts will be provided confidentially to appropriate LPs as part of the geodatabase. Survey crews recorded 1,311 individual occurrences of 118 culturally-important plant species.

The results of this study will inform the development of vegetation and habitat management plans and as needed, PME measures. This baseline information also informed other studies being completed as part of this relicensing process, including:

- CR-02 Cultural Resources Survey (City Light 2022a);
- GE-01 Reservoir Shoreline Erosion Study (City Light 2022b);
- GE-02 Erosion and Geological Hazards at Project Facilities and Transmission Line Right-of-Way Study (City Light 2022c);
- GE-04 Skagit River Geomorphology Between Gorge Dam and the Sauk River Study (City Light 2022d);
- TR-02 Wetland Assessment (City Light 2022e);
- TR-03 Rare, Threatened, and Endangered Plants Study (City Light 2022f);
- TR-04 Invasive Plants Study (City Light 2022g);
- TR-05 Marbled Murrelet Study (City Light 2022h);
- TR-06 Golden Eagle Habitat Analysis (City Light 2022i);
- TR-07 Northern Goshawk Habitat Analysis (City Light 2022j);
- TR-08 Special-status Amphibian Study (City Light 2022k);
- TR-09 Beaver Habitat Assessment (City Light 2022l); and
- TR-10 Northern Spotted Owl Habitat Analysis (City Light 2022m).

7.0 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

There are no variances from or proposed modifications to the study plan for the Vegetation Mapping Study.

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VEGETATION MAPPING STUDY DRAFT REPORT

ATTACHMENT A

VEGETATION COVER INFORMATION

Table A-1. Mapped cover type descriptions.

Group Type	Source	Description
Upland USNVC Groups		
G210 – Central Rocky Mountain Douglas-fir – Pine Forest	USNVC	Montane coniferous forests found in the interior Pacific Northwest; most occurrences of this group are dominated by a mix of Douglas-fir (*Pseudotsuga menziesii)* and Ponderosa pine (*Pinus ponderosa)*, but Ponderosa pine can be absent. Other typically seral species, including lodgepole pine (*Pinus contorta* var. *latifolia),* western white pine *(Pinus monticola)*, western larch (*Larix occidentalis),* and grand fir (*Abies grandis)* (a fire-sensitive, shade-tolerant species), have increased on many sites once dominated by Douglas-fir and Ponderosa pine. Generally, floristic affinities are with areas of maritime-influenced climate of the interior Pacific Northwest.
G219 – Rocky Mountain Subalpine Dry-Mesic Spruce – Fir Forest & Woodland	USNVC	This group consists of matrix forests of the drier sites within the subalpine zone of the Cascades and Rocky Mountains with Engelmann spruce (*Picea engelmannii)* and subalpine fir (*Abies lasiocarpa)* dominating either mixed or alone. These forests often represent the highest elevation forests in an area, and the relatively xeric understory species are diagnostic.
G237 – North Pacific Red Alder –- Bigleaf Maple – Douglas-fir Rainforest Group	USNVC	Lowland hardwood or mixed-hardwood-conifer forest group dominated by red alder (*Alnus rubra*) or bigleaf maple (*Acer macrophyllum*). Common companion species observed through the study area include conifers such as Douglas-fir, western redcedar (*Thuja plicata*), and/or western hemlock (*Tsuga heterophylla*) and hardwood species including cascara (*Frangula purshiana*) and bitter cherry (*Prunus emarginata*).
G240 – North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group	USNVC	Mesic to dry lowland forests dominated by Douglas-fir. Other coniferous species may be present, primarily western redcedar and/or western hemlock. Deciduous species such as red alder and/or bigleaf maple are frequently observed in the understory, but never dominant species.
G241 – North-Central Pacific Maritime Silver Fir – Western Hemlock Rainforest	USNVC	Lower and montane regions of the central Pacific Northwest rainforest region, primarily west of the Cascade Crest. Western hemlock and/or Pacific silver fir (*Abies amabilis)* dominate the canopy of late seral stands, and yellow cyprus (*Callitropsis nootkatensis)* can be codominant, especially at higher elevations or moister sites. Western redcedar is also common. Major dominant understory species are Alaska blueberry (*Vaccinium alaskaense),* deer fern *(Blechnum spicant)*, and/or five-leaved bramble (*Rubus pedatus)*. In drier settings, Douglas-fir is usually also common.

Group Type	Source	Description
G305 – Central Rocky Mountain – North Pacific High Montane Mesic Shrubland	USNVC	This shrubland group is found within the zone of continuous forest in the upper montane and subalpine zones and is composed of a diverse mix of deciduous shrubs. Vegetation is mostly deciduous broadleaf shrubs, sometimes mixed with shrub-statured trees or sparse evergreen needleleaf trees and quaking aspen (*Populus tremuloides)*. Common species include Rocky Mountain maple (*Acer glabrum),* rhododendron *(Menziesia ferruginea),* prickly currant *(Ribes lacustre),* thimbleberry *(Rubus parviflorus),* white spirea *(Spiraea betulifolia),* mountain spirea *(Spiraea splendens),* and dwarf bilberry *(Vaccinium cespitosum)*. Stands are typically initiated by fires.
G318 – North Vancouverian Montane Bedrock, Cliff & Talus Vegetation	USNVC	This group consists of sparsely vegetated rock outcrops and cliff faces where fractures in the rock surface and colluvial slopes may be occupied by small patches of dense vegetation, typically scattered trees and/or shrubs. Scattered shrubs may be present, such as vine maple (*Acer circinatum),* green alder *(Alnus viridis)*, and *Ribes* spp. Soil development is limited as is herbaceous cover. Mosses or lichens may be very dense, well-developed and display cover well over 10 percent.
G488 – Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie	USNVC	The vegetation is grassland with some dwarf-shrubs that can occur as small patches but are usually in a matrix with the herbaceous vegetation. Bunchgrasses often dominate and include Pacific reedgrass (*Calamagrostis nutkaensis),* red fescue *(Festuca rubra),* Idaho fescue *(Festuca idahoensis)*, or California oatgrass (*Danthonia californica)*. Dwarf-shrub species imbedded in the herbaceous cover often include kinnikinnick (*Arctostaphylos uva-ursi),* hairy manzanita *(Arctostaphylos columbiana),* pinemat manzanita *(Arctostaphylos nevadensis),* salal *(Gaultheria shallon),* common juniper *(Juniperus communis),* salmonberry *(Rubus spectabilis)*, and evergreen huckleberry (*Vaccinium ovatum)*.
G648 – Southern Vancouverian Lowland Ruderal Grassland & Shrubland	USNVC	This group is dominated by non-native species, such as introduced and invasive shrubs Scot's broom (*Cytisus scoparius*)*,* Himalayan blackberry (*Rubus bifrons*)*,* common gorse (*Ulex europaeus*), and the introduced grasses colonial bent (*Agrostis capillaris*)*,* sweet vernalgrass (*Anthoxanthum odoratum*)*,* soft chess (*Bromus hordeaceus*)*,* common velvet grass (*Holcus lanatus*), and/or Kentucky bluegrass (*Poa pratensis*). It is abundant in waste areas and disturbed land throughout Pacific coastal areas either as abandoned pastures, roadside margins, or other weedy places, below approximately 1,500 m (5,000 feet) in elevation.
G849 – North-Central Pacific Mountain Hemlock – Silver Fir Woodland	USNVC	This forested group occurs throughout the mountains of the North Pacific and is dominated mostly by mountain hemlock (*Tsuga mertensiana*), but other species can be codominant, including Pacific silver fir*,* subalpine fir*,* yellow cyprus, and/or western hemlock.

Group Type	Source	Description
Riparian & Wetland USNVC Group Types		
G322 – Vancouverian Wet Shrubland	USNVC	This wetland group is dominated by shrub species that are adapted to seasonally wet to saturated soils. Common dominant species observed throughout the study area were willows (*Salix* spp.), hardhack (*Spirea douglasii*), and salmonberry.
G517 – Vancouverian Freshwater Wet Meadow & Marsh Group	USNVC	Freshwater herbaceous and shrubby wetlands dominated by a wide variety of graminoids and forbs, usually along freshwater ponds or wet meadows. Dominated by native sedges and rushes such as slough sedge (*Carex obnupta*) and soft rush (*Juncus effusus*). Shrub species are primarily willow.
G520 – Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow, and Dwarf-shrubland	USNVC	These are high-elevation communities dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from upper subalpine to alpine (1,500-3,600 m). These types occur as large meadows in subalpine valleys, as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are dominated by graminoids such as sheep sedge (*Carex illota),* twotipped sedge *(Carex lachenalii),* black alpine sedge *(Carex nigricans),* and Drummond's rush *(Juncus drummondii)*, or forbs such as white marsh marigold (*Caltha leptosepala),* ice grass *(Phippsia algida),* and alpine yellowcress *(Rorippa alpine).*
G521 – Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	USNVC	This group contains the wet meadows found in low and high montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (about 1,000-3,600 m). They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps dominated by graminoids such as bluejoint grass (*Calamagrostis canadensis),* water sedge *(Carex aquatilis),* common beaked sedge *(Carex utriculata)*, and spike rush (*Eleocharis palustris),* or forbs such as small camas (*Camassia quamash),* heartleaf bittercress *(Cardamine cordifolia),* alpine yellowcress*,* arrowleaf ragwort *(Senecio triangularis)*, and corn lily (*Veratrum californicum).*
G524 – Western North American Ruderal Wet Shrubland, Meadow, and Marsh	USNVC	This group contains disturbed wet meadows found in lowland, montane, and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (sea level to 3,600 m) throughout the western U.S. Vegetation is dominated by non-native species such as black bent (*Agrostis gigantean),* creeping bentgrass *(Agrostis stolonifera),* meadow foxtail *(Alopecurus pratensis),* smooth brome (*Bromus inermis),* Canadian fleabane (*Conyza canadensis*)*,* Canadian thistle *(Cirsium arvense),* prickly lettuce (*Lactuca serriola),* and reed canarygrass *(Phalaris arundinacea)*. Native species may be present but are low in abundance.

Group Type	Source	Description
G527 – Western Montane-Subalpine Riparian & Seep Shrubland	USNVC	These are montane to subalpine riparian shrublands ranging from short to tall (0.5-15 m) that occur in steep and narrow to wide, low-gradient valley bottoms and floodplains as well as steep, moist avalanche chutes, often associated with beaver activity. The shrub species that can be dominant reflect the large elevational gradient of this group and include gray alder (*Alnus incana),* green alder*,* red birch *(Betula occidentalis),* shrub birch *(Betula glandulosa),* red osier dogwood *(Cornus sericea),* and Bebb's willow *(Salix bebbiana).*
G851 – North Pacific Lowland Riparian Forest & Woodland Group	USNVC	Low-elevation linear forests found in riparian areas and alluvial floodplains dominated by red alder, black cottonwood (*Populus balsamifera*), and bigleaf maple. Some conifers are also observed, primarily western redcedar. It occurs at elevations ranging from 300 to 2,300 m (1,000-7,500 feet).
G853 – North Pacific Maritime Hardwood-Conifer Swamp	USNVC	Forested wetlands occurring in poorly drained areas dominated by tree species that are capable of growing on saturated or seasonally flooded soils. Cover can be conifer- or hardwood-dominated stands. Dominant species observed in the study area included western redcedar and red alder.
USNVC Cultural Groups		
CGR022 – Cultivated Pasture & Hay Grass Cultural	USNVC	Arable land specifically modified to grow pasture and hay.
CGR033 – Cool-Season Lawn	USNVC	Lawn and recreation grasslands dominated by cool-season grasses.
CGR038 – Tree Garden Cultural	USNVC	Horticultural garden vegetation dominated by trees.
USNVC Modified Cover Types		
CGR – MOD – Cultivated Row Crops	USNVC (modified)	Arable land specifically modified to grow crops for harvesting. Includes all agricultural areas outside of those used for pasture/hay.
Transmission Line ROW Cover Types		
Regenerating Conifer/Native Shrub (conifer dominant)	Shrub-Study	Mix of coniferous tree species and native shrub species where conifers make up >50 percent cover.
Invasive Shrub	Shrub-Study	Invasive shrubs make up >50 percent cover.
Invasive Shrub/Native Shrub/Forb (invasive shrub cover dominant)	Shrub-Study	Mix of invasive shrubs, native shrubs, and forbs combine to make up 60 percent of cover.
Mixed Grass/Forb/Invasive Shrub	Shrub-Study	Mix of grasses, native forbs, and invasive shrubs combine to make up 60 percent of cover.
Mixed Native Shrub/Tree/Forb (co-dominants)	Shrub-Study	Mix of native shrub, native coniferous and/or deciduous trees, and native forbs combine to make up 60 percent of cover.
Mixed Native Shrub-Regenerating Tree/Invasive Shrub (native shrub cover dominant)	Shrub-Study	Mix of native shrubs, trees, and invasive shrubs. Native shrubs and trees combine to make up 60 percent of cover.
Native Deciduous Shrub/Regenerating Tree	Shrub-Study	Mix of native deciduous shrubs and trees combine to make up 60 percent of cover.
Native Shrub/Regenerating Conifer (native shrub dominant)	Shrub-Study	Mix of native shrub and conifers combine to make up 60 percent of cover.

Group Type	Source	Description
Other Vegetated Cover Types		
Grass-dominated	WDFW	Natural or regrown areas of grass, lawn, or pasture.
Recently Burned	NPS Study	Forested areas recently burned by wildfire.
Non-Vegetated Cover Types		
Developed (built roads/structures)	WDFW	Impervious surfaces and compacted dirt and/or gravel.
Gravel (water)	WDFW	Unvegetated gravel bars below the ordinary high water mark of river and stream channels.
Open & Flowing Water	WDFW	Includes open water such as ponds and lakes as well as flowing water in streams channels.

Table A-2. Acreage of Group types in relation to NPS map class.

Group Type	NPS Map Class (Modified Association)	Acres
G210 – Central Rocky Mountain Douglas-fir – Pine Forest Group	C09 Ponderosa pine and Douglas-fir woodland	37
	C15 Lodgepole pine and Douglas-fir woodland	4,602
	Total	**4,639**
G219 – Rocky Mountain Subalpine Dry-Mesic Spruce – Fir Forest & Woodland	C26 Conifer krummholz and treed cliff	3
	Total	**3**
G237 – North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group	B33 Upland red alder, bigleaf maple and conifer forest	2,567
	B34 Bigleaf maple and Douglas-fir debris apron forest	35
	B35 Upland paper birch and conifer forest	4,175
	Total	**6,776**
G240 – North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group	C04 Moist western hemlock, Douglas-fir and foamflower forest	1,414
	C05 Western hemlock, Douglas-fir and sword fern forest	9,344
	C06 Western hemlock, Douglas-fir and salal forest	4,457
	C07 North Cascades dry Douglas-fir forest	7,934
	C16 North Cascades Douglas-fir and subalpine fir woodland	121
	M93 Timberland with uncertain vegetation	333
	Total	**23,603**
G241 – North-Central Pacific Maritime Silver Fir-Western Hemlock Rainforest	C10 Moist silver fir, western hemlock and foamflower forest	222
	C11 Mesic silver fir and western hemlock forest	390
	C12 Silver fir, hemlock and Alaska blueberry forest	60
	C14 Silver fir, big huckleberry and beargrass forest	1
	Total	**674**
G305 – Central Rocky Mountain-North Pacific High Montane Mesic Shrubland	S47 Successional huckleberry shrubland	3
	Total	**3**
G318 – North Vancouverian Montane Bedrock, Cliff & Talus	R71 Alluvial barren and debris-covered ice	199

Group Type	NPS Map Class (Modified Association)	Acres
Vegetation	R72 Colluvial barren	375
	R73 Bedrock barren	513
	Total	**1,087**
G322 – Vancouverian Wet Shrubland	S40W Low elevation shrub-dominated wetland	220
	S42 Sitka willow riparian shrubland	0
	S44 Thimbleberry shrubland, tall forbs and bracken fern	4
	S43 Sitka alder shrubland	232
	Total	**456**
G488 – Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie	H58 Bedrock balds and sparsely vegetated forest openings	1, 173
	Total	**1, 173**
G517 – Vancouverian Freshwater Wet Meadow & Marsh Group	H50W Lowland marsh and meadow	170
	Total	**170**
G520 – Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow, and Dwarf-shrubland	S48 Subalpine heather shrubland	2
	Total	**2**
G521 – Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh Group	H52 Cow parsnip meadow	2
	Total	**2**
G527 – Western Montane-Subalpine Riparian & Seep Shrubland	S46 Snowbrush and Scouler's willow shrubland	95
	Total	**95**
G849 – North-Central Pacific Mountain Hemlock – Silver Fir Woodland	C20 Subalpine fir and Sitka valerian forest and woodland	6
	C21 Mountain hemlock, subalpine fir and heather woodland	3
	S45 Vine maple shrubland	1,496
	Total	**241**
G851 – North Pacific Lowland Riparian Forest & Woodland Group	B30 Successional gravel bar shrubland	100
	B31 Broadleaf riparian and swamp forest	1,046
	Total	**1,146**

Group Type	NPS Map Class (Modified Association)	Acres
CGR033 – Cool-Season Lawn Cultural Group	N/A	
Recently Burned	M92 Burned with uncertain vegetation	3,449
	Total	**3,449**
Various transmission line ROW cover types	M96 Cleared corridors	407
	Total	**407**
Developed	M94 Development	310
	M95 Roads in park	610
	Total	**921**
Water	W81 Fresh water	13,133
	Total	**13,133**
	Grand Total	**59,232**

VEGETATION MAPPING STUDY DRAFT REPORT

ATTACHMENT B

DRAFT VEGETATION MAPPING RESULTS MAPBOOK

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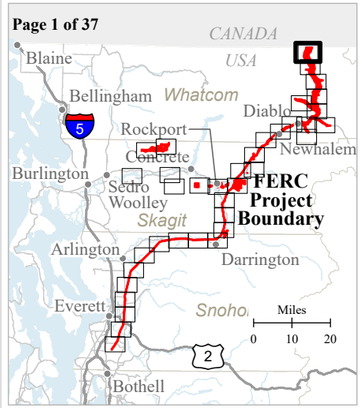

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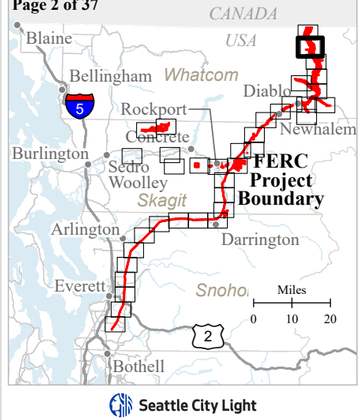

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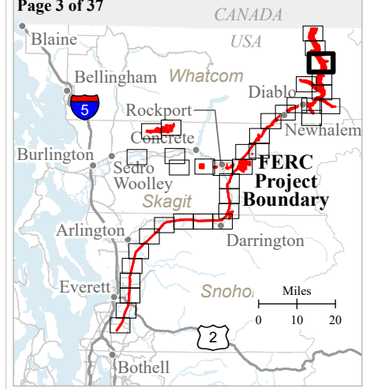

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T40N R13E
T39N R13E
T40N R14E
T39N R14E
Arctic Creek
Noname Creek
Lightning Creek
ROSS LAKE NATL. REC. AREA
120
119
118
117
116
115
Cat Island Fire
NORTH CASCADES NATIONAL PARK - NORTH UNIT
Skymo Creek
Ross Lake
Dry Creek
OKANOGAN-WENATCHEE NATIONAL FOREST
Skymo Lake

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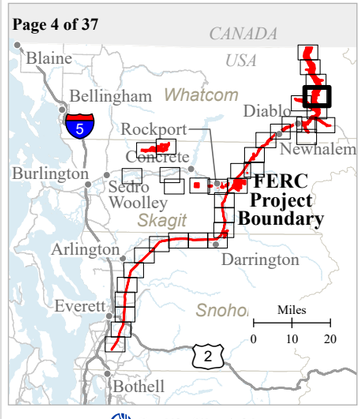

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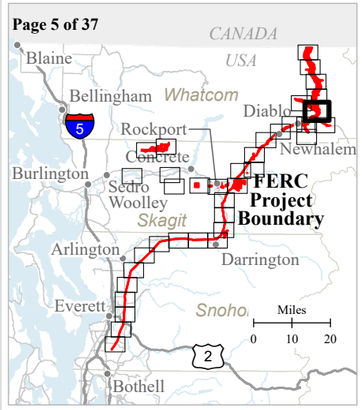

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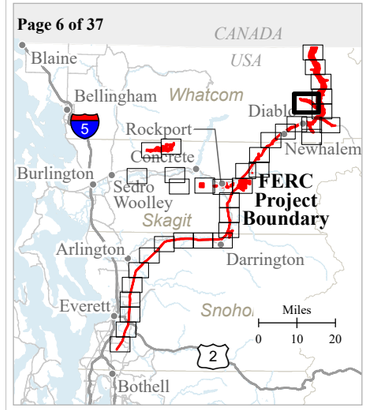

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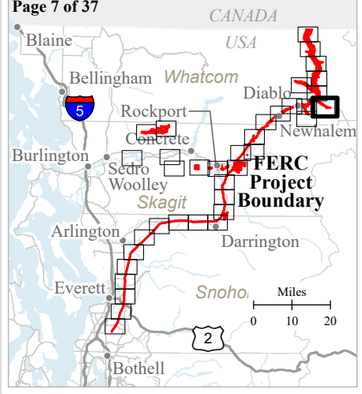

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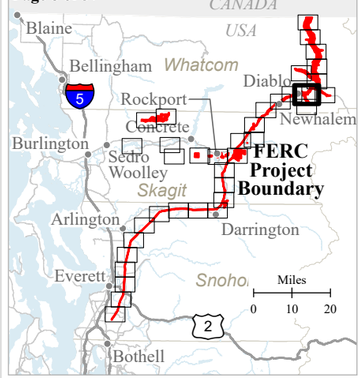

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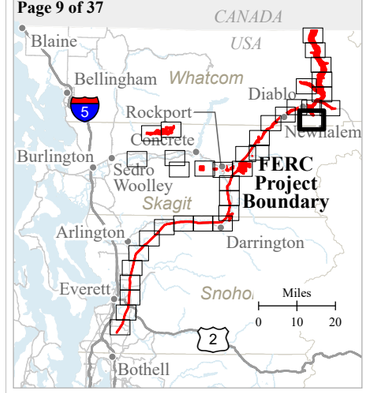

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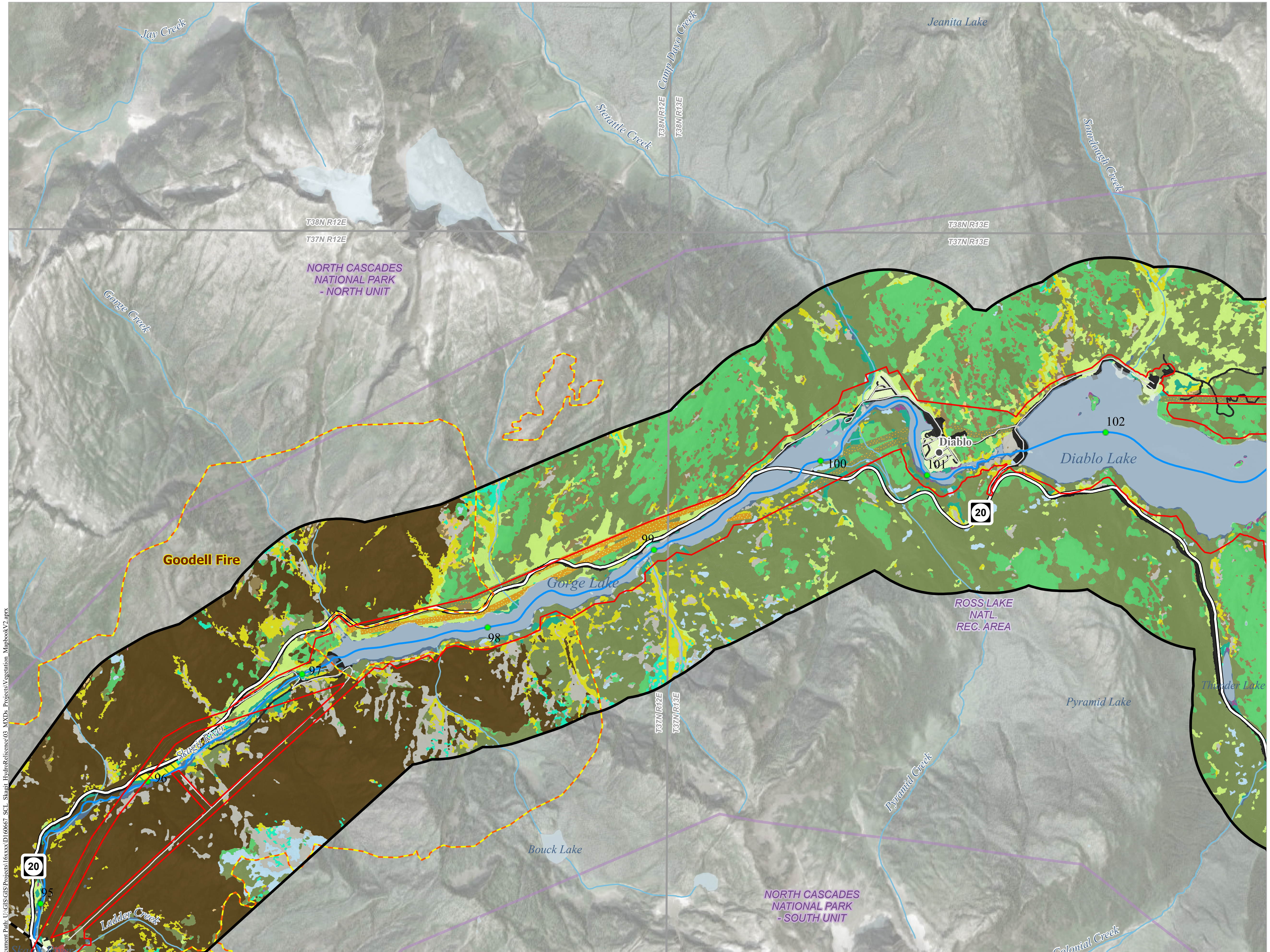

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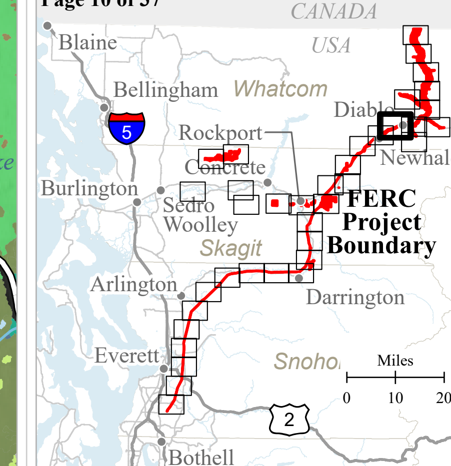
- CGR038 Tree Garden Cultural Group
- Recently Burned
- Mixed Native Shrub/Tree/Forb (co-dominants)
- Conifer/Native Shrub (conifer dominant)
- Native Deciduous Shrub/Tree
- Open Water
- Developed

0 1,000 2,000 Feet

N



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Data Source: [NAIP, 2015; NPS, 2020; SCL, 2020].

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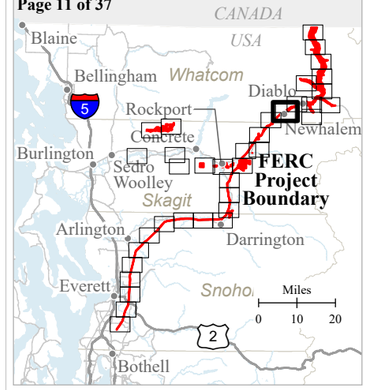
TR-01 VEGETATION STUDY DRAFT RESULTS MAPBOOK

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles
- Project River Centerline
- Streams
- Secondary Highway
- Other Road
- Fire Boundary
- Vegetation Study Area
- Canopy Metrics Modeling Area
- G210 - Central Rocky Mountain Douglas-fir - Pine Forest Group
- G219 - Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland
- G237 - North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G240 - North Pacific Maritime Douglas-fir - Western Hemlock Forest Group
- G241 - North-Central Pacific Maritime Silver Fir-Western Hemlock Rainforest
- G305 - Central Rocky Mountain-North Pacific High Montane Mesic Shrubland
- G318 - North Vancouverian Montane Bedrock, Cliff & Talus Vegetation
- G488 - Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie
- G849 - North-Central Pacific Mountain Hemlock - Silver Fir Woodland
- G322 - Vancouverian Wet Shrubland
- G517 - Vancouverian Freshwater Wet Meadow & Marsh Group
- G527 - Western Montane-Subalpine Riparian & Seep Shrubland
- G851 - North Pacific Lowland Riparian Forest & Woodland Group
- CGR033 Cool-Season Lawn Cultural Group
- CGR038 Tree Garden Cultural Group
- Recently Burned
- Mixed Native Shrub/Tree/Forb (co-dominants)
- Conifer/Native Shrub (conifer dominant)
- Native Deciduous Shrub/Tree
- Open Water
- Developed

0 1,000 2,000 Feet

N



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TR-01 VEGETATION STUDY DRAFT RESULTS MAPBOOK

- FERC Project Boundary
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- Secondary Highway
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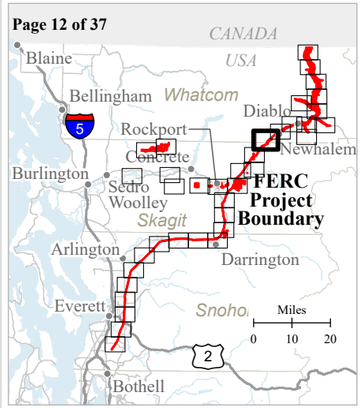
- Vegetation Study Area
- Canopy Metrics Modeling Area
- G210 - Central Rocky Mountain Douglas-fir - Pine Forest Group
- G237 - North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G240 - North Pacific Maritime Douglas-fir - Western Hemlock Forest Group
- G241 - North-Central Pacific Maritime Silver Fir-Western Hemlock Rainforest
- G318 - North Vancouverian Montane Bedrock, Cliff & Talus Vegetation
- G488 - Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie
- G849 - North-Central Pacific Mountain Hemlock - Silver Fir Woodland
- G517 - Vancouverian Freshwater Wet Meadow & Marsh Group
- G527 - Western Montane-Subalpine Riparian & Seep Shrubland
- G851 - North Pacific Lowland Riparian Forest & Woodland Group
- CGR033 Cool-Season Lawn Cultural Group
- Recently Burned
- Mixed Native Shrub/Tree/Forb (co-dominants)
- Conifer/Native Shrub (conifer dominant)
- Native Deciduous Shrub/Tree
- Open Water
- Developed

0 1,000 2,000 Feet



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TR-01 VEGETATION STUDY DRAFT RESULTS MAPBOOK

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- Mitigation Parcel
- Project River Miles
- Project River Centerline
- Streams
- Secondary Highway
- Other Road
- Vegetation Study Area
- Canopy Metrics Modeling Area
- G210 - Central Rocky Mountain Douglas-fir - Pine Forest Group
- G237 - North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G240 - North Pacific Maritime Douglas-fir - Western Hemlock Forest Group
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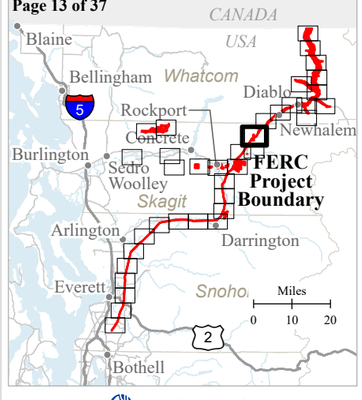
- G318 - North Vancouverian Montane Bedrock, Cliff & Talus Vegetation
- G488 - Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie
- G849 - North-Central Pacific Mountain Hemlock - Silver Fir Woodland
- G322 - Vancouverian Wet Shrubland
- G517 - Vancouverian Freshwater Wet Meadow & Marsh Group
- G521 - Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh Group
- G527 - Western Montane-Subalpine Riparian & Seep Shrubland
- G648 - Southern Vancouverian Lowland Ruderal Grassland & Shrubland
- G851 - North Pacific Lowland Riparian Forest & Woodland Group
- Mixed Native Shrub/Tree/Forb (co-dominants)
- Conifer/Native Shrub (conifer dominant)
- Native Deciduous Shrub/Tree
- Open Water
- Developed

0 1,000 2,000 Feet

N



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- FERC Project Boundary
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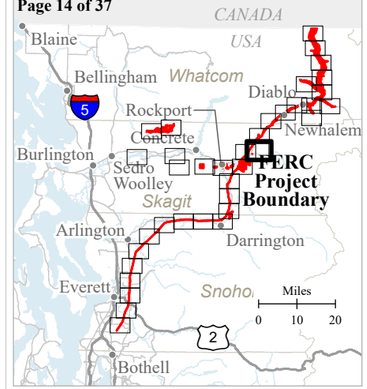
- Vegetation Study Area
- Canopy Metrics Modeling Area
- G237 - North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G240 - North Pacific Maritime Douglas-fir - Western Hemlock Forest Group
- G322 - Vancouverian Wet Shrubland
- G524 - Western North American Ruderal Wet Shrubland, Meadow, and Marsh
- G648 - Southern Vancouverian Lowland Ruderal Grassland & Shrubland
- G851 - North Pacific Lowland Riparian Forest & Woodland Group
- G853 - North Pacific Maritime Hardwood-Conifer Swamp
- Grass - Dominated
- CGR022 Cultivated Pasture & Hay Grass Cultural Group
- Invasive Shrub
- Invasive Shrub/Native Shrub/Forb (Invasive shrub cover dominant)
- Mixed Native Shrub-tree/Invasive Shrub (native shrub cover dominant)
- Gravel (Water)
- Developed
- Open Water

0 1,000 2,000 Feet



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- G648 - Southern Vancouverian Lowland Ruderal Grassland & Shrubland
- G851 - North Pacific Lowland Riparian Forest & Woodland Group
- G853 - North Pacific Maritime Hardwood-Conifer Swamp
- Grass - Dominated
- CGR MOD Cultivated Row Crops
- CGR022 Cultivated Pasture & Hay Grass Cultural Group
- Invasive Shrub
- Invasive Shrub/Native Shrub/Forb (Invasive shrub cover dominant)
- Mixed Native Shrub-tree/Invasive Shrub (native shrub cover dominant)
- Mixed Native Shrub/Tree/Forb (co-dominants)
- Gravel (Water)
- Developed
- Open Water

0 1,000 2,000 Feet

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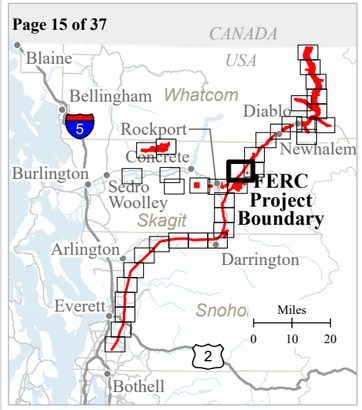

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