TR-09 BEAVER HABITAT ASSESSMENT INTERIM REPORT

SKAGIT RIVER HYDROELECTRIC PROJECT FERC NO. 553

Seattle City Light

Prepared by:
HDR Engineering, Inc.

March 2022
Initial Study Report

TABLE OF CONTENTS

List of Figures

List of Tables

List of Attachments

List of Acronyms and Abbreviations

BIP .....Beaver Intrinsic Potential
BDA .....beaver dam analog
City Light.....Seattle City Light
CMZ.....channel migration zone
dbh.....diameter at breast height
DEM.....digital elevation model
FCC .....Flow Coordinating Committee
FERC.....Federal Energy Regulatory Commission
GIS .....Geographic Information System
GPS .....Global Positioning System
HSI .....habitat suitability index
ISR .....Initial Study Report
LiDAR.....Light Detection and Ranging
LP.....licensing participant
LWM.....large woody material
NCC .....Non-Flow Coordinating Committee
NPS .....National Park Service
PME .....protection, mitigation, and enhancement
Project .....Skagit River Hydroelectric Project
ROW .....right-of-way
RSP .....Revised Study Plan
USFWS .....U.S. Fish and Wildlife Service
USR.....Updated Study Report
WDFW.....Washington Department of Fish and Wildlife

This page intentionally left blank.

1.0 INTRODUCTION

The TR-09 Beaver Habitat Assessment 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 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 Beaver Habitat Assessment as described in the RSP.

In its July 16, 2021 Study Plan Determination, FERC approved the Beaver Habitat Assessment without modification.

This interim report on the 2021 study efforts is being filed with FERC as part of City Light's Initial Study Report (ISR). City Light will perform additional work for this study in 2022 and include a report in the Updated Study Report (USR) in March 2023.

1.1 Background

In most of the temperate Northern Hemisphere, beavers (*Castor canadensis*) historically altered low-gradient, small stream ecosystems by constructing dams made primarily of wood. There has been widespread recognition that beaver dams play a vital role in maintaining and diversifying stream and riparian habitat (Pollock et al. 2018; Gurnell 1998; Collen and Gibson 2000; Rosell et al. 2005; Gibson and Olden 2014), and, in the past century, land managers throughout the Northern Hemisphere have attempted to reintroduce beavers in areas where they have been extirpated in an effort to restore stream and riparian habitats. Today, beaver populations are rebounding throughout North America; the population is estimated to be approximately 10 million and is reoccupying most of its former range (Naiman et al. 1988).

Beavers are a keystone species, meaning they have a disproportionately large effect on their environment relative to their abundance. Beavers play a critical role in the watersheds of North America by maintaining the structure of the surrounding ecological community. Their presence in watersheds affects not only the types and numbers of many terrestrial and aquatic plant and animal species, but also maintains the dynamic nature of channel form and watershed hydrology. Beaver dams provide many ecosystem services, including raising the groundwater levels and increasing riparian habitat, instream habitat, and retention of organic matter (Johnston and Naiman 1987; Naiman et al. 1988), and improving water quality (Pollock et al. 2018).

Water storage within stream reaches is particularly important for many aquatic species during low-flow periods when direct hydrologic inputs are limited. When beaver recolonize stream systems, their impoundments increase base flows, as well as recharge and elevate the water table (Pollock et al. 2004; Larsen et al. 2021). Given that climate change is expected to increase drought and

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

reduce snowpack, water storage from beaver impoundments may be an effective tool to help mitigate associated reductions in water resources (Dittbrenner 2019; Pollock et al. 2018).

Water is essential to the daily life of beavers, whether in the form of a stream, river, lake, or pond, as long as there is a year-round supply sufficient for access to food resources, protection of lodge and burrow entrances, and general safety from predators (Pollock et al. 2018). Beavers prefer to build dams on small- to medium-sized, low-gradient streams (<6 percent slope) that flow through unconfined valleys; beavers generally avoid constrained valleys with high-gradient streams (Pollock et al. 2018). Beavers tend to populate the lowest gradient (<1-2 percent slope) sites first but will colonize this high-gradient, less-preferred habitat if their population densities are high (Müller-Schwarze and Schulte 1999). In addition to these physical habitat attributes, beavers make use of streams with developed riparian areas that contain vegetation for food and potential construction materials to build dams and lodges. Although beavers use a wide variety of trees, shrubs, substrate, and herbaceous vegetation as construction material, they prefer species from the genera *Populus* and *Salix* (i.e., aspen, cottonwood, and willows) as a food source. These trees grow fast, sprout rapidly, and have soft wood that is easy to fell and peel (Müller-Schwarze and Sun 2003). Beavers also occupy large rivers but restrict their dam building to off-channel habitat fed by hyporheic flow, groundwater channels, and tributary channels that flow across the floodplains of the larger river channel (Gurnell 1998; Baker and Hill 2003; Pollock et al. 2004). They can also build seasonal dams across large rivers during low flow conditions (Pollock et al. 2018).

Beavers build dams to raise water levels to provide sufficiently deep water in their habitat to reduce risk of predation and to avoid expending more energy to collect food resources by moving overland. The sound of running water can stimulate beavers to initiate dam building or to perform dam maintenance (Pollock et al. 2018; Larsen et al. 2021). Sometimes, several dams are constructed and maintained by the same colony to control ponded water in relation to lodge or burrow entrances (Gurnell 1998). This series of dams, or beaver dam complex, consists of flat, ponded areas with abrupt gradient changes at each dam site (Pollock et al. 2004). Over long periods of time, beaver dams can accumulate significant sediment behind them, effectively changing the longitudinal profile of the valley slopes over long distances (Pollock et al. 2008; Westbrook et al. 2011; Polvi and Wohl 2013). Multiple dams in a series also help dissipate the energy of large flood events and may act as an insurance policy against dam failure—if one dam breaches, others may still be in place. Furthermore, having multiple dams increases the amount of retained water, which increases the foraging area of the colony and encourages the growth of woody vegetation and herbaceous species used for both food and construction materials.

According to MacFarlane et al. (2014), there are five primary habitat conditions necessary for beaver dam occurrence: (1) a perennial water source; (2) availability of forage and dam building materials (woody deciduous vegetation); (3) ability to build a dam at baseflow; (4) likelihood of dams to withstand a typical flood; and (5) likelihood that the stream gradient would not limit or eliminate dam building by beavers. As described in this study, several authors (e.g., Pollock et al. 2018; Dittbrenner et al. 2018; Tulalip Tribes 2015) have used geomorphic characteristics to map beaver intrinsic potential (BIP) and to use the mapping results to select beaver relocation sites. The BIP model is intended to identify stream sites where the hydrogeomorphic, or underlying intrinsic physical conditions, are suitable for beavers to occur. An intrinsic potential model predicts where beavers can likely exist within a watershed given the ability of beavers to modify variable habitat characteristics, such as vegetation density and type. Intrinsic variables used in the BIP model

include site features such as regional climate, precipitation regime, stream gradient, stream width, and valley width (Dittbrenner 2018, 2019).

2.0 STUDY GOALS AND OBJECTIVES

The goals of this study are to provide information that can be used to address the ongoing beaver conflicts at the Project's Chum salmon off-channel sites (spawning channels) and to characterize beaver habitat conditions in the study area to inform a Project effects assessment and development of protection, mitigation, and enhancement (PME) measures.

The objectives of the study are:

- Use existing information from the Indian Tribes and Flow/Non-Flow Coordinating Committee (FCC/NCC) to summarize beaver conflicts at the constructed spawning channels (e.g., Hall and Shanahan 2009; additional unpublished data, photos, and documents[2] provided by the Upper Skagit Indian Tribe and Skagit River System Cooperative).
- Summarize results of the GE-04 Skagit River Geomorphology Between Gorge Dam and the Sauk River Study (Geomorphology Study) and FA-02 Instream Flow Model Development Study that relate to beaver habitat and use in the spawning channels to assess hydrologic and geomorphologic conditions at the constructed spawning channels for use by LPs and City Light in assessing management options. (The current geomorphic and habitat conditions of the spawning channels, as well as hydrologic connectivity, water depth, velocity, and shear stress using the Instream Flow Model results for various flows will be assessed in relation to beaver habitat using data obtained from the GE-04 Geomorphology Study.)
- Identify beaver habitat and active beaver territories based on a combination of existing information from City Light and LPs as well as field observations by biologists during this and other relicensing studies throughout the study area.
- Assess beaver habitat in the study area using the BIP model in combination with morphological habitat, vegetation, and ownership/land use characteristics ultimately to assess ongoing Project effects from City Light's management of flow, vegetation, and roads, and to inform potential PME measures, which could include beaver relocation if deemed appropriate.

[2] Unpublished data, photos, and documents available upon request.

3.0 STUDY AREA

The study area for the beaver habitat assessment covers the entire Project Boundary, including the transmission line right-of-way (ROW) and fish and wildlife mitigation lands plus a two-mile buffer. The BIP model covers two miles on either side of the Project Boundary within the upper and lower Skagit, Nooksack, Stillaguamish, and Sauk watersheds (Figure 3.0-1). The Sammamish watershed in the Marysville to Bothell area was evaluated using WDFW BIP online data. A total of 10 field sites were selected from throughout the Project Boundary between Diablo and the City of Marysville, including the fish and wildlife mitigation lands, to qualitatively assess beaver habitat in stream reaches that were classified by the BIP model. These sites were selected to represent samples of all four BIP categories of 0 through 3 (no intrinsic potential to high potential of suitable beaver habitat). Sites were selected in areas that were safely accessible and located within the Project Boundary, including the transmission line ROW and the fish and wildlife mitigation lands. Identification of potential beaver habitat, known beaver territories, and incidental observations of beaver and beaver sign were obtained within the respective study areas for field work in other relicensing studies including the GE-02 Erosion and Geologic Hazards at Project Facilities and Transmission Line Right-Of-Way Study (Erosion and Geologic Hazards Study; City Light 2022b), TR-01 Vegetation Mapping Study (City Light 2022d), and TR-02 Wetland Assessment (City Light 2022e), among others.

This study also summarizes the beaver habitat in the general vicinity of the spawning channels funded by City Light as well as past beaver conflicts and management activities. These channels include the Newhalem and County Line Ponds, Park Slough, and the Taylor, Powerline Pond, and Illabot spawning channels (Figure 3.0-1).

To organize the results of the study, the study area is divided into eleven segments containing the BIP model results. These segments include Ross Lake, Diablo to County Line, Skagit Mainstem, Skagit Confluence, Skagit Downstream, Nooksack Wildlife Mitigation Lands, Savage Slough and Pressentin Mitigation Lands, Day Creek Slough Mitigation Lands, Sauk River, South Fork Stillaguamish, and North Fork Stillaguamish. These segments were delineated based on broad topographic character changes along the Skagit River valley and watershed and tributary drainage boundaries. The segment south of Stillaguamish was not modelled in the dataset provided by Dittbrenner (2019) but was evaluated using WDFW online beaver intrinsic potential data.

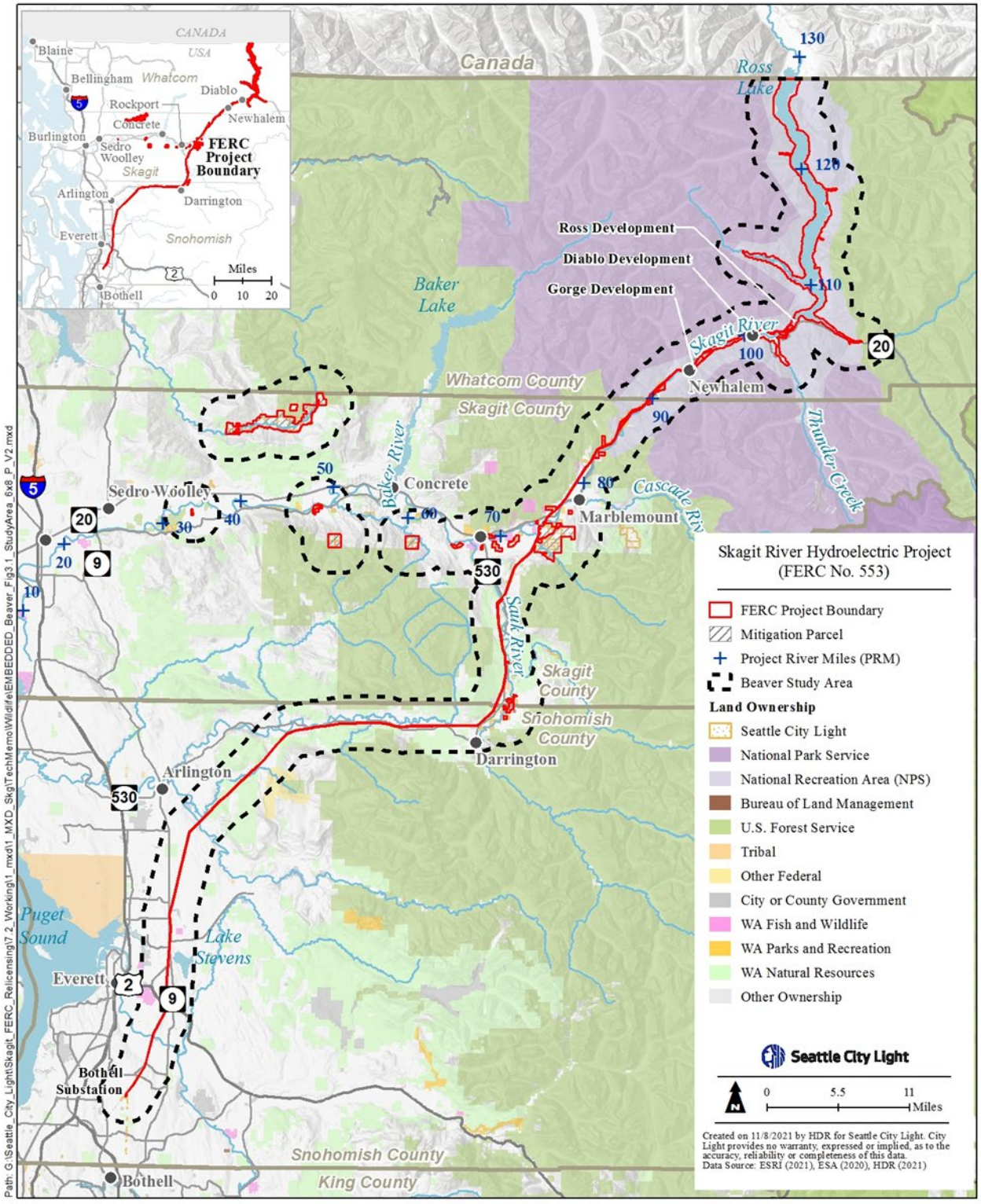


Figure 3.0-1. Beaver Habitat Assessment study area.

4.0 METHODS

4.1 Existing Conditions and Management Activities at Constructed Off-Channel Habitat Areas

Existing information on salmon use, beaver occurrence, and past management activities at each of the spawning channels was summarized using information from the NPS and the Upper Skagit Indian Tribe (which manages the spawning channels), as well as from a field visit conducted by biologists as part of this study.[3] This information includes past beaver dam locations described from the Upper Skagit Indian Tribe's and City Light's observations from management activities and monitoring of the channels over the past 14 years. Light Detection and Ranging (LiDAR) data along with wetland/riparian vegetation mapping and plant species occurrence data collected during the TR-01 Vegetation Mapping Study and TR-02 Wetland Assessment were also used to describe morphological and habitat conditions at each channel (City Light 2022d, 2022e). Additional information on the existing conditions of the channels was also obtained from the 2021 field results of the GE-04 Geomorphology Study (City Light 2022c).

4.2 Map Beaver Occurrence within the Project Boundary

To characterize the existing distribution of beavers in the study area, available information was obtained from Indian Tribes, NPS, WDFW, Beavers Northwest, and observations from concurrent relicensing studies conducting field work in 2020 and 2021. During these studies, incidental observations of inactive and active beaver dams, concentrated beaver sign, or individual beavers were reported by the field teams on data forms and mapped with Global Positioning System (GPS). This information was reviewed in a Geographic Information System (GIS) database displaying beaver occurrence in the study area from these sources. The beaver and beaver sign observational data were compared to the BIP model classifications of stream segments to assess the effectiveness of the model in classifying streams based on beaver habitat.

Potential beaver habitat, known beaver territories, and incidental observations of beaver and beaver sign were mapped within the study areas for concurrent relicensing studies, including GE-02 Erosion and Geologic Hazards Study (City Light 2022b), TR-01 Vegetation Mapping Study (City Light 2022d), TR-02 Wetland Assessment (City Light 2022e), TR-03 Rare, Threatened, and Endangered Plants Survey (City Light 2022f), TR-04 Invasive Plants Study (City Light 2022g), and TR-08 Special-Status Amphibian Study (City Light 2022h).

4.3 Beaver Habitat Assessment

GIS analysis of BIP mapping supplemented with field observations of beaver sign and habitat conditions and incidental observations of beaver and beaver sign from relicensing studies were combined with vegetation composition data from the TR-01 Vegetation Mapping Study and TR-02 Wetland Assessment and a review of LiDAR, aerial photography, and topography to qualitatively identify areas with high beaver habitat potential within the study area.

[3] The RSP states that spawning channels that are deemed important to be maintained are to be evaluated in this study. Management decisions by the FCC/NCC as to this determination have not yet been made, so all six channels were evaluated for this study.

The BIP model is intended to identify stream segments where the hydrogeomorphic, or underlying intrinsic physical conditions, are suitable for beaver dams. Unlike most habitat suitability models, the BIP model does not account for the current vegetation conditions, which can change or be modified, and does not classify sites as unsuitable if habitat restoration, management changes, or beaver modification could allow beaver to thrive there.

The BIP GIS data rates habitat potential based on a combination of hydrogeomorphic characteristics such as stream gradient, stream size, and size of the valley bottom (Dittbrenner et al. 2018). The model used hydrography data layers consisting of a combination of field-verified and digital elevation model (DEM)-derived stream segments from Whatcom, Skagit, and Snohomish counties, Washington. The stream slope, bankfull width, discharge, and stream segment breaks were derived using the methodology outlined by Davies et al. (2007). The valley width for each stream segment was then calculated using the methodology described in Beechie and Imaki (2014). Valley width was defined as the average width of the area adjacent to a stream segment that was within two meters vertical elevation of the channel elevation.

Based on the range of conditions present at potentially suitable sites, ranking values for each variable were based on a combination of expert opinion and analysis of habitat preference. Higher weight (value 4) was given to metrics with high intrinsic habitat potential (e.g., slope < 1 percent). A final BIP score was assigned for each segment by summing the ranked scores of stream slope, stream width, and valley width (Dittbrenner 2018). The model possesses four predictive categories of beaver intrinsic potential and assigns a BIP-score data ranking of 0-3 (BIP scores: 0 = "no" habitat value, 1 = "low", 2 = "moderate", and 3 = "high" value) to each stream segment. In general, sites with "no" habitat value have high gradient slopes in narrow valleys, while those with "high" value are low gradient to flat streams in wide floodplain valleys.

City Light reviewed GIS data of modeled BIP mapping of stream segments in the upper and lower Skagit, Nooksack, Stillaguamish, and Sauk watersheds provided by B. Dittbrenner, a beaver expert at Northeastern University, and Beavers Northwest (Dittbrenner 2019). The BIP model assessed streams mapped within the upper and lower Skagit, Nooksack, Sauk, and Stillaguamish watersheds. BIP data for the Snohomish watershed was not included, as this area is heavily developed within city and residential areas and would not be practicably considered for potential beaver relocation. This area in the southern extent of the Project Boundary (i.e., south of the Stillaguamish watershed) was qualitatively evaluated from similar BIP data viewed from WDFW online sources.

City Light used the BIP mapping classifications (Dittbrenner 2019) to characterize and assess stream segments in the analyzed watersheds within the study area. Online BIP data provided by WDFW was reviewed and qualitatively assessed to provide an overview of beaver habitat potential in the Snohomish watershed. Qualitative field verification was conducted at 10 accessible sites within the Project Boundary in July 2021 to assess the physical attributes of the stream channel including gradient, width, floodplain connectivity, riparian vegetation and characterization of the sites by the BIP model. Each field site consisted of an accessible reach of stream approximately 100 to 200 feet in length, and the riparian corridor within approximately 20 to 50 feet of the banks. Site selection considerations included habitat as well as other factors, such as safety, accessibility, and landowner permissions to facilitate efficient use of field time to cover sites across a wide portion of the study area.

The Beaver Habitat Assessment study area was divided into study area segments between major tributaries to assess sub-regions in the study area for beaver habitat potential. The BIP scores, documented beaver occurrences, and general vegetation cover were used to score each of these sub-regions based on habitat quality to indicate which would be most suitable for beaver habitat and have potential for future relocations if such management actions are undertaken in the future.

The TR-01 Vegetation Mapping Study developed a GIS database to describe the existing dominant vegetation conditions within and near the Project. Vegetation mapping was conducted in 2020 and 2021 within the vegetation assessment study area, which is the area within a 0.5-mile buffer of the Project Boundary and the channel migration zone (CMZ) between Newhalem and the Sauk River (refer to the TR-01 Vegetation Mapping Study for maps of vegetation mapping; City Light 2022d). Vegetation categories from this study were used that reflect the beaver habitat suitability index developed by the USFWS (Allen 1982) that indicate high index values for tree species and canopy closure. Sites dominated by species that include willows, alder (*Alnus* spp.), cottonwoods etc., were scored higher because they contain preferred beaver food sources.

The BIP data, habitat data from field visits, beaver activity locations, vegetation mapping, and landownership mapping were compiled in GIS to identify locations of high-quality beaver habitat that may provide suitable areas for potential beaver relocation in the future, if later deemed appropriate in coordination with LPs.

5.0 PRELIMINARY RESULTS

The results of the assessment of existing conditions and management activities, beaver occurrence, and beaver habitat assessment are described below. The results include information available at this time from the GE-04 Geomorphology Study that relate to the spawning channels to assess hydrologic and geomorphologic conditions (City Light 2022c).

5.1 Existing Conditions and Management Activities at Spawning Channels

A program to construct off channel habitat in the Skagit River floodplain was included as part of the 1991 Skagit Settlement Agreement to mitigate the impacts of the Project on Chum salmon. As part of this settlement, six spawning channels were constructed within upper Skagit River floodplains between the town of Newhalem and the confluence of the Skagit River and the Sauk River from 1991 to 2003. These sites vary in size and complexity and are each fed by groundwater percolation and include: Park Slough, Newhalem Ponds, County Line Ponds, Taylor Channel, Powerline Channel, and Illabot Channel (Figures 5.1-1, 5.1-2, 5.1-3). Although the original intent was to benefit Chum salmon spawning habitat, these types of groundwater-fed channels also provide spawning and rearing habitat for other anadromous fish such as Coho salmon.

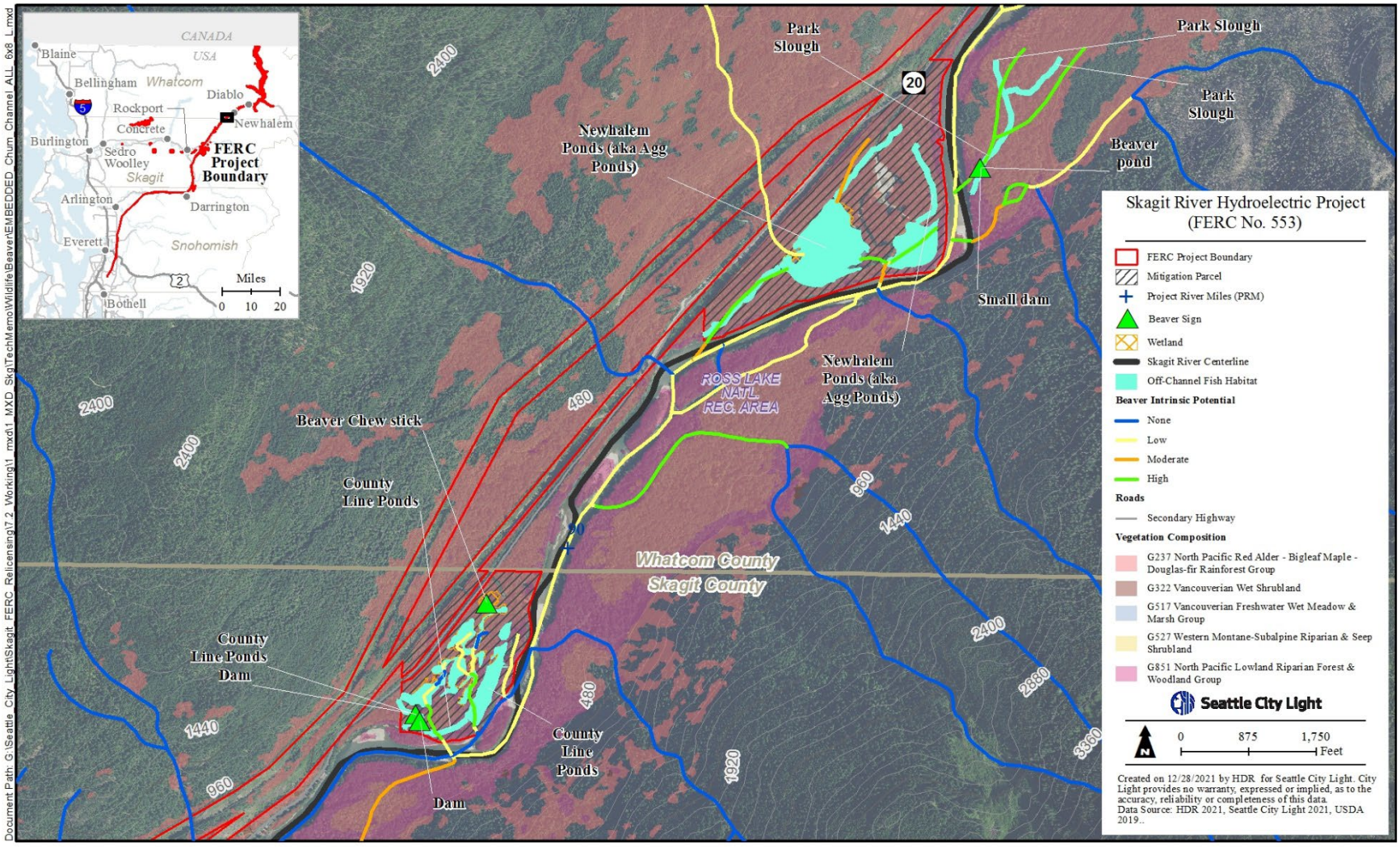


Figure 5.1-1. Park Slough, Newhalem Ponds, and County Line Ponds spawning channels.

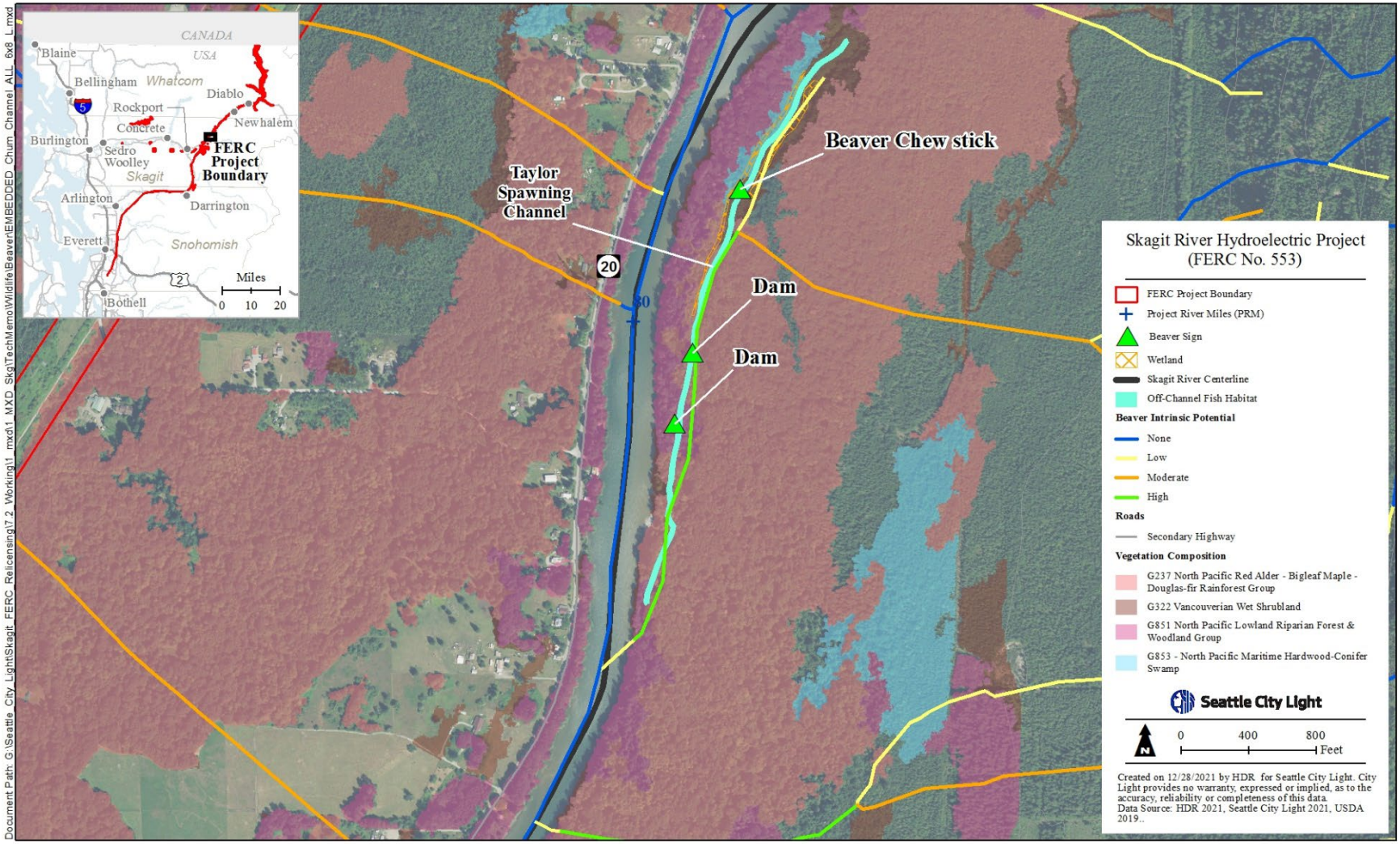


Figure 5.1-2. Taylor Spawning Channel.

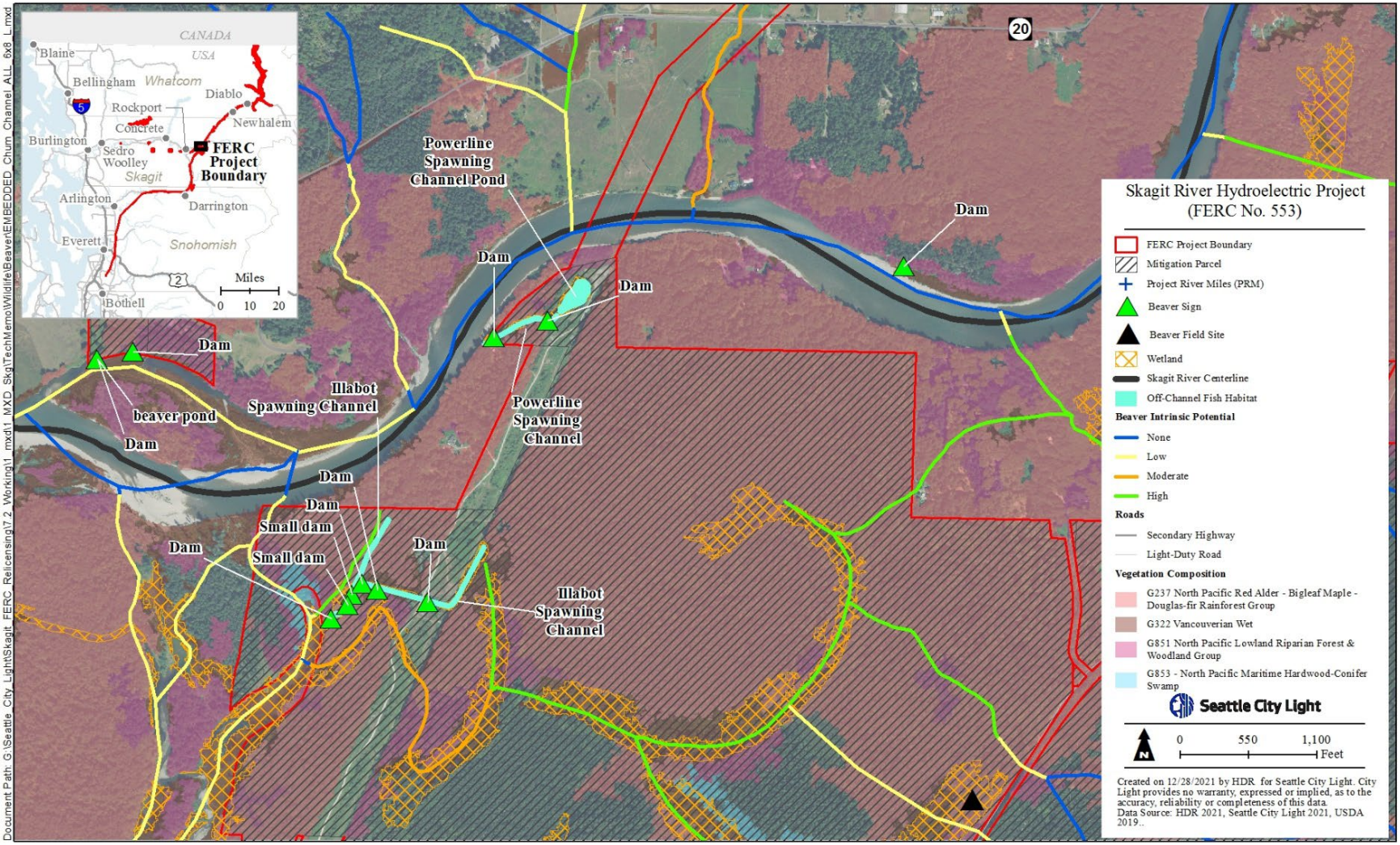


Figure 5.1-3. Powerline and Illabot spawning channels.

5.1.1 Past Management Actions

The Upper Skagit Indian Tribe conducts annual maintenance, as needed, of the Newhalem and County Line Ponds, and Taylor, Powerline, and Illabot spawning channels. A sixth spawning channel, Park Slough, is maintained by the NPS. These constructed channels and ponds have been regularly monitored for spawner abundance during fall Chum migrations. Upper Skagit Indian Tribe biologists have indicated that beaver dams constructed near the outlets and at other locations of several of the artificial channels and ponds are causing episodic but sometimes significant impediments to access by Chum salmon and other fish species. Based on observations during the field visit, as well as past studies (Upper Skagit Indian Tribe 2013), sedimentation in the channels seems to be one of the main issues in the reduction in spawning habitat quality and consequent use of the channels. In the years following channel construction, beavers have colonized and built dams within the constructed channels and road crossing culverts that blocked the upstream migration of adult Chum salmon, which has necessitated regular channel maintenance to remove beaver dams during the Chum spawning season. Spawner survey data from Park Slough did not contain records of beaver dam observations or removals, but, as part of the regular ongoing maintenance of the channels, beaver dams have been removed. The Upper Skagit Indian Tribe has employed annual labor-intensive beaver dam removal from several of the channels to facilitate Chum salmon access and egress. The Upper Skagit Indian Tribe has also completed other non-lethal habitat management and lethal beaver removal at sites in the watershed.

The deployment of personnel at frequent intervals during the spawning season to find and remove any beaver dams that have been constructed or repaired is time and labor intensive and is further complicated by the fact that beaver can repair or rebuild a dam overnight (e.g., Kingston 2003). Furthermore, breaching beaver dams during the fall may reduce valuable over-wintering habitat for juvenile Coho salmon within these constructed channels.

During fall spawning surveys in the channels, the Upper Skagit Indian Tribe has recorded observations of beaver sign and beaver dams over the past 15 years (Upper Skagit Indian Tribe unpublished data). Figure 5.1-4 below illustrates the numbers of beaver dams and woody debris material that have been observed and/or removed each year when Chum spawner monitoring has been conducted in October through December from 2006 to 2020 by the Upper Skagit Indian Tribe and WDFW. Park Slough is managed by the NPS and data on beaver dam observations and removal was not reported, so these data are not included in Figure 5.1-4.

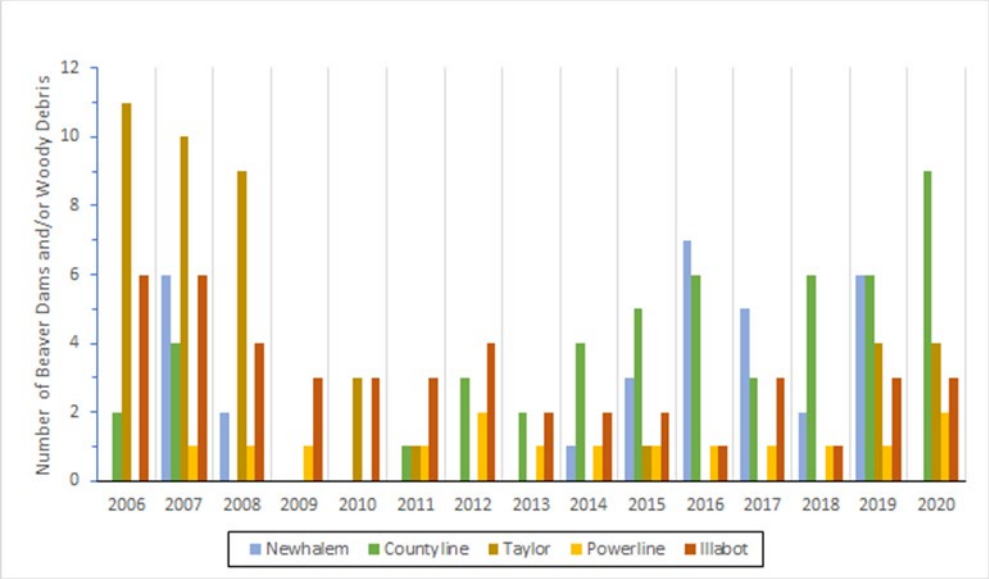


Figure 5.1-4. **The number of beaver dams and/or woody debris removal during fall (October – December) Chum channel spawning surveys by the Upper Skagit Indian Tribe. (Park Slough beaver dam removal data was not available.)**

The most beaver activity and dam removal over the monitoring period occurred at County Line Ponds. A total of 51 dams and/or woody debris jams were removed over 15 years at County Line Ponds, and removals occurred in 12 of 15 years. Illabot spawning channel had the second highest amount of beaver dam activity and had multiple locations where beaver dams occurred throughout the relatively uniform channel. Beaver dams were particularly common at the road culvert prior to installation of fencing in 2008. Beaver dam removal has been required every year at Illabot spawning channel, and 46 dams and/or woody debris material were removed in that time frame. Taylor channel also had beaver activity in multiple locations throughout the channel and had the next highest amount of activity with 43 dams and/or woody debris material were removed in total, with the highest activity from 2006 to 2008 (Figure 5.1-4). Newhalem Ponds had a total of 32 dams and/or woody debris material removed over the timeframe of the reporting. County Line and Newhalem Ponds had an increase in beaver activity in recent years; Newhalem Ponds fluctuated between some years with dams observed, and others with none. Powerline channel had the least amount of beaver activity with a total of 15 dams and/or woody debris material removed, likely due to the tendency for beavers to target the location near the confluence with the Skagit River where flowing water is present at the location of the fish ladder, and because beaver exclusion structures have been put in place.

Beaver exclusion devices have reduced beaver activity in some of these channels, such as the installation and operation of a pond leveler and fish ladder with a beaver exclusion device in 2006 at the Powerline channel (Hall and Shannahan 2009). This device was successfully installed through a collaborative effort between City Light and the Upper Skagit Indian Tribe and has been effective in maintaining fish access while impeding beaver activity (Hall and Shannahan 2009). At Illabot, installation of beaver exclusion fencing with 6-inch wide and 8-inch-tall openings, and complete coverage of the bottom and top of the exclusion cage, prevented beaver from damming or blocking flow within the fish ladder and the road crossing culvert. Prior to the installation of

exclusion cages, beavers regularly dammed the fish ladder at Powerline channel and the road crossing culvert at Illabot channel. Beaver exclusion fencing has also been installed at the road crossing culvert at Newhalem Ponds, and no fresh sign of beaver activity was observed at or near this culvert during the 2021 field visit. In the beaver exclusion device study, as well as subsequent annual spawning surveys at Powerline and Illabot, adult Chum and Coho did not appear to be negatively impacted by the beaver exclusion fencing given the fact that most adult Chum and Coho spawning within Illabot channel were observed upstream of the exclusion fencing installed at the culverted road crossing (Hall and Shannahan 2009). The study reported only a single large adult Chum that became entangled in the exclusion fencing. However, with any in-water structure, debris management is critical to maintaining the function of the structure. Ongoing debris management is required to maintain flows and fish passage; debris removal includes not only leaf litter and woody debris, but also post-spawned Chum carcasses that can drift downstream and become trapped on the fencing. If left uncleared, these carcasses can become a blockage to upstream migration (Hall and Shannahan 2009).

Between 1991 and 2002, the six spawning channels in total have provided spawning habitat for up to 2.8 percent (1.0 percent average) of the adult Chum escapement and up to 7.3 percent (3.2 percent average) of the adult Coho escapement for the Skagit River. Annual Chum spawner counts at Park Slough ranged from 2,000 to 4,000; several high-count years were interspersed among most years with low to very low counts. The counts ranged from as low as 71 in 2000 to a high of 7,461 in 2002. In the most recent survey data that was available, total numbers of alive and dead Chum spawning adults from 2006 numbered 1,761, and only 117 were reported in 2008 surveys (NPS unpublished data).

Data obtained from the Upper Skagit Indian Tribe provided the results of Chum spawner surveys from 2006 to 2020 conducted by the Tribe and WDFW. Counts of Chum spawners peaked at the beginning of the monitoring data period in 2006 and declined sharply in 2007 and stayed low in 2008. Fluctuations occurred at most channels throughout the monitoring period, including a common peak at all sites in 2014, but, in general, there has been a decline in Chum spawner abundance in recent years (Upper Skagit Indian Tribe unpublished data).

Although many factors could be contributing to the decline in spawning in these channels, these numbers may indicate the deterioration of spawning habitat, particularly over the last five years. Beaver dams have been a factor that has contributed to this decline by blocking passage and increasing sedimentation; however, at sites where fewer beaver dam conflicts have occurred, the salmon numbers have still declined. Beaver dam occurrence has also been generally declining in recent years due to the ongoing management efforts and, in particular, the addition of beaver exclusion fencing and the fish ladder exclusion device at Powerline.

The outlet channel at Newhalem Ponds has channel gradients that vary over its length. Instream habitat includes riffles and higher flow areas that help flush sediments and provides areas of clean spawning gravel intermixed with cut banks, small pools, and large woody material (LWM) providing habitat complexity for both spawning and rearing habitat. The channels at Taylor, Powerline, and Illabot are also located in the lower gradient floodplain area near the Skagit River confluence with the Sauk River, where the relatively flat topography and more mixed forest, wetlands, and sloughs provides high-quality beaver habitat. This is illustrated by the relatively high concentration of beaver sign and observations from field studies in this area. County Line and

Newhalem Ponds are located upstream where the Skagit River valley narrows and becomes surrounded by steep, conifer dominant hillslopes, which is less suitable habitat for beavers. However, the channels and ponds themselves do provide suitable beaver habitat, as evidenced by the beaver activity. The existing ponds at these sites may act as an attractant to beavers, possibly reducing the incentive for beaver to dam the connecting channels since ponded habitat already exists.

5.1.2 Existing Conditions and Habitat

Powerline, Illabot, Taylor, County Line Ponds, Newhalem Ponds, and Park Slough spawning channels all have mapped high suitability (BIP 3) beaver habitat (Figures 5.1-1 through 5.1-3). The following sections briefly describe existing habitat conditions at each of the constructed channels.

5.1.2.1 Powerline Channel

Within the Powerline spawning channel, beaver have repeatedly constructed a single large dam where the channel constricts near its confluence with the mainstem Skagit River. A pond leveler with a four-chambered fish ladder measuring approximately 7 feet wide, 7 feet long, and 4 feet tall was installed in September 2006 (Hall and Shannahan 2009), as well as beaver exclusion fencing (Figure 5.1-5). Beavers have made repeated attempts to dam the fish ladder and regular maintenance and debris removal has been required.

During the July 2021 field visit, limited beaver activity was observed at the Powerline channel. No recent signs of beaver chewing were observed on vegetation. There was only a partial dam observed at the channel outlet beside the fish ladder. The dam appeared to be unmaintained, as there was a significant amount of water flowing through the dam. Though no recent chew was observed, a few pieces of beaver scat were observed just upstream of the dam, indicating the site is currently or was recently occupied.

Little to no flow was observed throughout the channel during the July field visit. There were many pieces of medium size woody debris in the channel as well as some aquatic vegetation. On the upstream end of the Powerline Spawning Channel, there is a large pond. Due to the narrow, confined nature of the channel and surrounding deciduous shrubs and trees, this pond appears to be conducive to continued use by beavers. Encouraging beavers to build at the outlet of this pond using a beaver dam analog (BDA) may be a possible strategy for encouraging the beavers to build in a location that is less impactful to chum spawning habitat. However, it is possible that beavers would continue to build in other areas in the spawning channel.

Figure 5.1-5. Powerline spawning channel looking upstream from the fish ladder and beaver exclusion fencing near the confluence with the Skagit River.

5.1.2.2 Illabot Channel

The Illabot spawning channel was constructed in 1995 and extended in 2001 (Hall and Shannahan 2009). Within the Illabot channel, beaver have typically constructed multiple dams throughout the channel and consistently dammed the road crossing culvert. The Illabot channel is a relatively uniform channel and is mapped by the BIP model as having high intrinsic potential for beavers. The portion of the channel upstream of the road crossing has dense rows of willows lining both banks. Some beaver chew of indeterminate age was observed at several locations along the channel. There was also evidence of a dam that had been removed just downstream of the confluence of the channel extension (Figure 5.1-6). There were debris piles on either side of the channel where dam material had been removed, and some cobble remained loosely stacked, likely at the footprint of the dam.

Figure 5.1-6. Illabot spawning channel looking upstream showing area of gravel, mud, and woody debris where a beaver dam had previously been removed.

Similar to the Powerline spawning channel, there is limited opportunity for beavers to flood a large area by building here, but the narrow channel and the prevalence of willows is highly attractive to beavers.

There was little to no flow observed during the July site visit, and the substrate was heavily embedded with fine sediment.

5.1.2.3 Taylor Spawning Channel

The Taylor spawning channel was not visited during the July 2021 beaver habitat site visits due to field constraints. It is low gradient and fairly uniform and is mapped by the BIP model as having high intrinsic potential for beavers. The channel is perennial and groundwater-fed as evidenced by a subsurface inlet; it functions as cold water refugia for fish in the summer. Vegetation along the channel consists of mixed forest and contains forage species preferred by beavers. Previous field visits by the Upper Skagit Indian Tribe and City Light have recorded a high amount of beaver activity. During field visits to the Taylor spawning channel as part of the GE-04 Geomorphology Study, several beaver dams were observed in the downstream portion of the channel in August 2021 (Figure 5.1-7). The field team reported that the upper half of the channel was silted with fines covering the gravel substrate and had slow flow velocities. The lower portion downstream of the beaver dams had higher flow and areas of clean gravel; it also contained a large section of spawning sized gravels near the outlet (City Light 2022c).

Figure 5.1-7. Taylor spawning channel looking upstream showing one of the beaver dams observed during the GE-04 Geomorphology Study fieldwork in August 2021. (Photo credit: NSD, August 25, 2021).

5.1.2.4 County Line Ponds

The County Line Ponds are a series of side channels and old aggregate mining pits that have become ponds. The ponds and channels are located in the Skagit River riparian corridor with a dominant forest cover of deciduous species, including red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), and conifers including Douglas fir (*Pseudotsuga menziesii*). The TR-02 Wetland Assessment mapped 6 acres of forested wetlands in the relatively low gradient areas around the ponds (City Light 2022e). Within the County Line Ponds there are three side channels and two ponds that are perennially connected to the river, and a series of ponds that are less connected (City Light 2022c). During the July 2021 field visit at the County Line Ponds, some signs of beaver chew were observed as was a scent mound. Scent mounds mark beaver territory and are indicative of beaver presence in the area. No dams were observed. The channels connecting the ponds were observed from access roads, and no recent beaver activity was observed at or around the exclusion fencing at the culvert crossing (Figure 5.1-8).

Figure 5.1-8. Beaver scent mound observed at County Line Ponds between ponds and Skagit River.

5.1.2.5 Newhalem Ponds

The Newhalem Ponds are at a former aggregate mining site with excavated side channels and ponded off channel areas formed by old mining pits. The ponds and channel are located in the Skagit River floodplain and the area is dominated by deciduous forest, including red alder, bigleaf maple, and some Douglas fir. The TR-02 Wetland Assessment mapped 6 acres of forested wetlands within the fringes of the larger pond to the south of the mitigation land property. The channels and ponds are mapped as high intrinsic potential by the BIP model, and the combination of low gradient channels, pond areas, and deciduous vegetation provide high-quality beaver habitat. The areas surrounding the ponds on both sides of the CMZ, however, do not provide quality beaver habitat due to steep, coniferous forested streams, and narrow valleys.

A beaver exclusion fence was observed at both the inlet and outlet of a culvert under the access road along the east side of the ponds (Figure 5.1-9). The exclusion fence consisted of an exclosure around the culvert as well as a curved panel of fencing about six feet upstream of the exclosure and constructed of 6-inch x 8-inch mesh, which is recommended for fish passage. The curved panel upstream of the culvert exclosure had medium pieces of woody debris and leaves racked up against it. No obvious signs of recent beaver activity were observed. Maintenance of this fencing by removing accumulated debris on a regular basis is encouraged to ensure continued functionality.

Figure 5.1-9. Outlet channel at Newhalem Ponds looking upstream toward the ponds.

5.1.2.6 Park Slough

Park Slough is managed and maintained by the NPS and was not visited during the 2021 beaver study field visits due to field constraints. The site was visited in August 2021 during the GE-04 Geomorphology Study fieldwork (see Figure 5.1-10). This constructed channel is located off the left bank, on the south side of the Skagit River in mature mixed forest within the Skagit River valley floodplain and is mapped as having high intrinsic potential for beavers. The channel is groundwater-fed from a subsurface inlet in the floodplain. The flat gradient, relatively narrow channel width, and wide valley bottom with suitable woody vegetation provide an area of potentially suitable habitat for beavers, while the surrounding conifer-dominant hillslopes do not. Regular colonization attempts by beavers in this channel are therefore expected. A series of beaver dams were observed during the GE-04 Geomorphology Study fieldwork in August 2021 which caused sedimentation over the gravel streambed and slowed flow velocities, creating quality rearing habitat for juvenile salmon, but reducing suitable spawning habitat (City Light 2022c).

Figure 5.1-10. Park Slough spawning channel looking upstream during GE-04 Geomorphology Study field visit. (Photo credit: NSD, August 24, 2021).

5.1.2.7 Summary

In general, low gradient constructed channels planted with willows are highly attractive to beavers. However, since the channels are incised and relatively narrow, there is limited opportunity for beavers to flood a large area upstream. Beaver dams in these narrow channels likely cause fish passage barriers due to the confinement of the channel limiting alternate flow paths around the dams. Additionally, beaver ponded areas offer excellent salmon rearing habitat, particularly for Coho salmon that use beaver ponds for shelter, abundant food sources, and refuge from high flows during overwintering. Beaver dams also reduce viability of spawning habitat by slowing water and capturing sediment, resulting in embedded spawning substrate. In both the Powerline spawning channel and the Illabot spawning channel, little to no flow was observed during the site visit. A study by the Upper Skagit Indian Tribe in 2013 measured substrate embeddedness in the Taylor, Illabot, and Powerline channels as an indicator of the quantity and quality of spawning gravels. The study found Powerline had considerably higher embeddedness compared to Illabot and Taylor and, therefore, less suitable area for spawning (Upper Skagit Indian Tribe 2013). During the 2021 field visit, high embeddedness was observed where the gravels in the Powerline channel were nearly completely buried. High sediment accumulation and embeddedness were also observed in the Illabot channel during the 2021 field visit; however, it was less severe than at Powerline.

At culverts and the Powerline fish ladder, installation of beaver exclusion fencing (6-inch wide and 8-inch-tall openings) with complete coverage of the bottom and top of the exclusion cage was an effective means of preventing beaver damming within the exclusion while providing safe and effective adult Chum and Coho passage.

As demonstrated in a past study at Illabot spawning channel, the placement of a fish ladder and pond leveler structure did not appear to alter beaver behavior as it inadvertently became a targeted

area for dam construction (Hall and Shannahan 2009). Therefore, installation of a fish ladder and beaver exclusion structure may only be appropriate where beaver typically construct a single dam within a channel. For example, strategically placed BDAs may encourage beavers to build in locations that have a lower impact on fish passage. Ideally, a beaver control device would reduce the construction of additional dams within the Powerline channel upstream of the control site by maintaining water levels similar to those desired by beaver. The incorporation of a fish ladder that is passable to all life stages of salmonids but not accessible to beaver (similar to that constructed at the Powerline channel) would provide access upstream for spawning adults as well as juvenile access to valuable pool rearing habitat.

5.2 Beaver Occurrence within the Study Area

Information on the observed locations of beavers and beaver sign, including dams, lodges, food caches, scent mounds, and chewing activity, has been compiled into GIS and is shown in the mapbook in Attachment A. These sightings are largely derived from incidental observations from concurrent relicensing studies, including wetlands and vegetation, amphibians, and geomorphology studies. The distribution of these observations is therefore co-located within the respective study areas of these studies and does not represent the full extent of the study area considered for beaver habitat that extends two miles from either side of the Project Boundary (Attachment A).

The distribution of observed beaver locations is concentrated between the Sauk River confluence and County Line ponds. The Skagit Mainstem and Skagit Confluence study area segments had the majority of all reported beaver observations with 12 and 60, respectively. The Diablo to County Line segment had 7, and the South Fork Stillaguamish segment and the south end of the study area by Lake Stevens each had 3 observations. The study areas for the other terrestrial studies where these data were obtained included the Project corridor from upper Ross Lake to the south end of the transmission line ROW in Bothell. Therefore, the range of these observations is limited to less than the two miles mapped for the beaver study but extends the full length of the Project Boundary. This indicates that the distribution of beaver observations concentrated in the area between the Sauk River and County Line ponds is not simply an artifact of the area where observations were made.

This distribution is somewhat expected due to the general topography and landcover of the study area. The area around the Sauk River confluence is within a relatively wide floodplain of the Skagit River and contains many sloughs and low gradient tributaries. In areas upstream in the Gorge, Diablo, and Ross lakes, the Skagit River has a narrow floodplain within steep-sided ravines. Tributaries tend to be higher gradient, flowing down the hillslopes to the river, and the general landcover contains more conifer-dominant forests, less suited to beavers. Beaver and beaver sign sightings in these areas upstream tended to be along the Skagit River itself or within small side channels and tributaries along the valley bottom, including the constructed spawning channels.

5.3 Beaver Habitat Assessment

Suitable habitat for beavers must contain all of the following: (1) stable aquatic habitat providing adequate water; (2) channel gradient of less than 15 percent; and (3) quality food species present in sufficient quantity (Allen 1982). Stable water levels are of optimum value as beaver habitat, while major fluctuations in the water level or flow rate decrease the value of the site. Rivers or

streams that are dry during some parts of the year are assumed to be unsuitable beaver habitat (Allen 1982). Stream channel gradients of 6 percent or less have optimum value as beaver habitat. Beavers will most often colonize streams with gradients from 0 to 6 percent (Allen 1982), although those below 3 percent are preferred (Allen 1982; Müller-Schwarze and Schulte 1999). Several tree and shrub species (willow, aspen, cottonwood, and alder) have often been reported to be preferred foods; however, highly preferred species may vary in different geographic regions. In addition to low gradient streams, lacustrine habitat types less than 8 ha (20 acres) in surface area are assumed to provide suitable habitat if an adequate food source is present (Allen 1982).

The assessment of beaver habitat throughout the study area relied on data from the BIP model as well as data from vegetation, wetland, and geomorphology studies. Intrinsic potential models provide an alternative to habitat suitability index (HSI) models (which generally use both intrinsic and extrinsic predictors) by using geomorphic variables that are less prone to change through time. An intrinsic potential model predicts where beavers can likely exist within a watershed given the ability of beavers to modify variable habitat characteristics, such as vegetation density and type. Intrinsic variables used in the BIP model include site features, such as regional climate, precipitation regime, stream gradient, stream width, and valley width (Dittbrenner 2018, 2019).

Stream gradient is frequently correlated with beaver presence and is associated with a number of related site characteristics that make it an accurate predictor of suitable beaver habitat. Low-gradient reaches have slower moving water with finer substrates, which allows beavers to anchor dams to the streambed and provide mud for dam and lodge construction. Low-gradient reaches also allow constructed dams to spread water across a larger area, increasing the surface area-to-dam ratio and decreasing costs and risks of dam building (e.g., effort required for tree cutting and increased predation while on land) (Pollock et al. 2014).

Valley width is a measure of stream confinement commonly used in HSI models and is often correlated with stream order and gradient. Recent studies have found valley width to be a strong predictor of beaver habitat suitability, and potentially a predictor for intrinsic potential (Dittbrenner 2018). This metric may be more important in mountainous and topographically diverse areas where stream confinement more frequently occurs (Dittbrenner 2018).

The BIP model provided by B. Dittbrenner (2019) was used as the basis for analyzing beaver habitat throughout the study area. The BIP model was applied to streams in the upper and lower Skagit, Nooksack, Sauk, and Stillaguamish watersheds in this study. Areas in the southern segment of the study area (i.e., south of the Stillaguamish watershed) were qualitatively evaluated from similar BIP data viewed from WDFW online sources. This area has a large amount of mapped suitable beaver streams, but land ownership, vegetation, and conflicts with development make this area unsuitable for potential future beaver relocation efforts. For this reason, this portion of the study area is only qualitatively described.

5.3.1 Field Sites

The effectiveness of the model to map locations with suitable beaver habitat was evaluated by visiting a selection of 10 field sites that represent a range of BIP classifications. Each field site was an accessible reach of stream approximately 100 to 200 feet in length, and the riparian corridor within approximately 20 to 50 feet of the banks. Figure 5.3-1 below shows an overview of the locations of the field sites, and the mapbook in Attachment B shows the topography surrounding

each site using LiDAR data. Qualitative summaries of the habitat characteristics at each of the field sites is provided below.

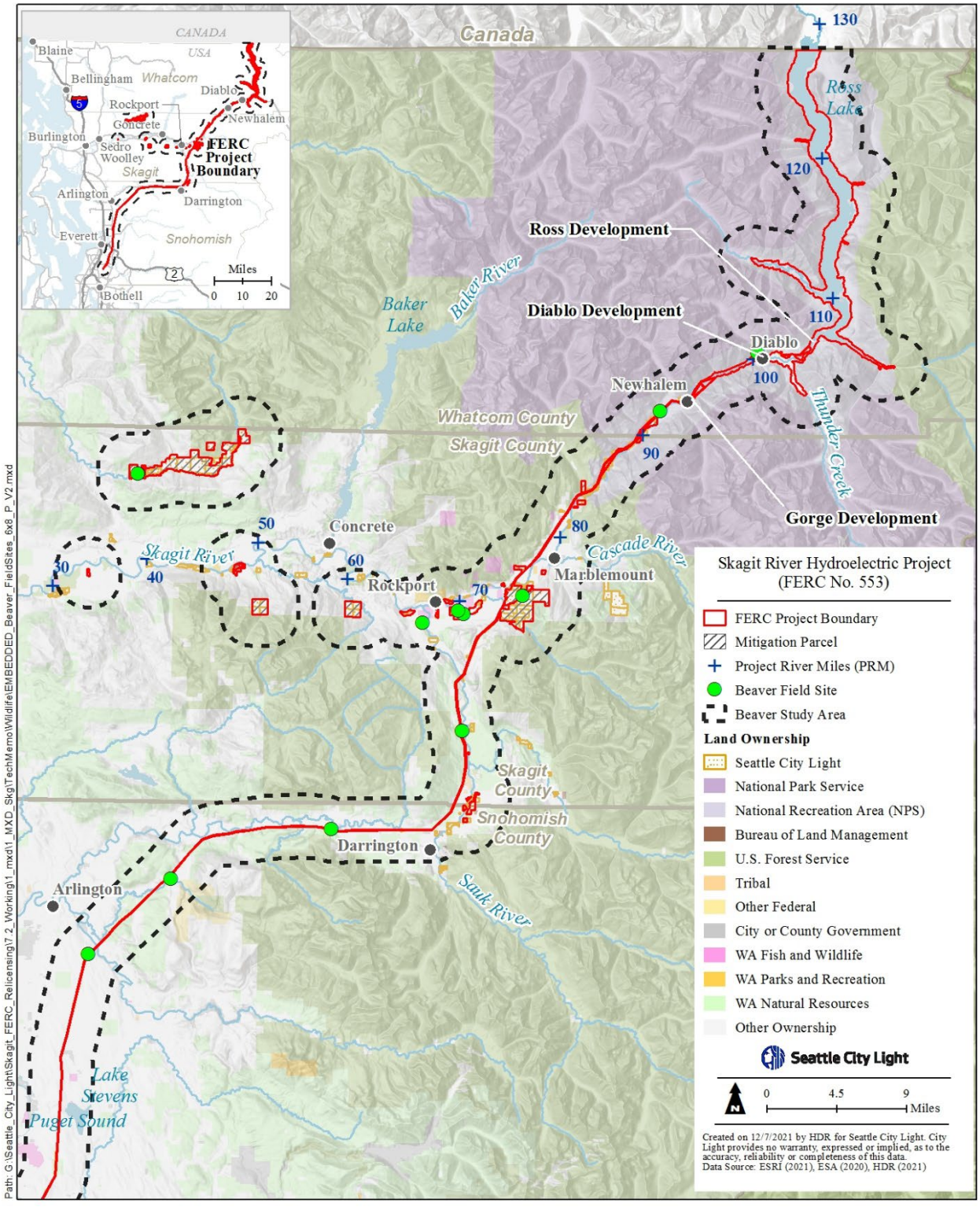


Figure 5.3-1. Field sites in the Beaver Habitat Assessment study area.

5.3.1.1 Nooksack Wildlife Mitigation Lands

The BIP model indicated that the majority of tributaries on the Nooksack Wildlife Mitigation Lands segment do not provide suitable beaver habitat (Attachment A). There were a few stream segments on the north side of the river that had modeled moderate and high BIP scores, and some beaver sign was noted in this area several years ago (Tressler 2021). The small tributaries to the South Fork Nooksack are high gradient and generally flow down hillslopes through narrow valleys (Attachment B, page 3). Several small tributaries that corresponded to BIP modeled stream segments were observed during the field site visit on July 11, 2021 and had these general characteristics. The stream at the selected field site was modeled with a BIP score of 0. The stream segment at the field site had a slope of approximately 8 to 10 percent and bankfull width of 12 feet (Figure 5.3-2). The tall banks were incised and steep, and, consequently, the floodplain is rarely inundated above bankfull, unless very high flows occur. Bank steepness was 30 degrees to vertical and generally about 3 feet in height throughout the sampled reach. The forest canopy was dominated by bigleaf maple, with red alder, and some large cedars, and hemlock (*Tsuga heterophylla*). The shrub layer along the banks was dominated by salmonberry (*Rubus spectabilis*), vine maple (*Acer circinatum*), and sword fern (*Polystichum munitum*). There are only a few maples and alders with diameter at breast height (dbh) <8 inches. No beaver sign was observed at the field site or in the vicinity. The steep gradient, limited floodplain, incised nature of the stream, and lack of suitable forage, such as willows or cottonwoods, corroborates the model's classification of no intrinsic potential habitat for beavers.

Figure 5.3-2. Nooksack wildlife mitigation lands tributary field site.

5.3.1.2 Diablo and Stetattle Creek

City Light staff have reported sightings of beavers around the Diablo town site and beaver chewings at a streambank willow planting restoration site at the reflector bar (Tressler 2021). Field investigations for this study did not observe suitable stream habitat for typical beaver colony

establishment with the creation of dams and surrounding areas of suitable forage. Stetattle Creek is a large, swift stream with tall, steep banks, particularly on the right bank, and does not provide suitable habitat for beavers (Figure 5.3-3). The riparian corridor contains mixed forest dominated by conifers, including Douglas fir and western red cedar (*Thuja plicata*). There are some alder present, but other preferred forage species are lacking. The stream is fast flowing and approximately 70 feet wide in the study area near the confluence with the Skagit River. The surrounding topography including Stetattle Creek upstream consists of high, steep hillslopes with narrow valleys (Attachment B, page 1). These characteristics, as well as the lack of forage species, make this area unsuitable for the establishment of beavers.

Beavers that inhabit this area would most likely inhabit the Skagit River mainstem and could potentially have a lodge in the bank. Transient beavers may also pass through this area during dispersal and may have temporarily remained to take advantage of the area of forage provided by the willow plantings. The BIP model ranked Stetattle Creek and nearby tributaries as having no intrinsic potential. This accurately reflects what was observed in the field in terms of tributary stream habitat for beavers.

Figure 5.3-3. Stetattle Creek field site by Diablo town site.

5.3.1.3 Babcock Creek

Babcock Creek is a small, overgrown channel where it crosses the transmission line ROW and access road. The canopy is open with no mature forest cover due to vegetation management in the transmission line ROW. There is some alder, red osier (*Cornus sericea*), and vine maple in the heavy shrub cover on both banks. The mouth of the creek, downstream of the access road, has a few trees, including one large Douglas fir and some alder and bigleaf maple. This reach is low gradient with floodplain wetland vegetation and provides a short reach of potential beaver habitat (Figure 5.3-4). No beaver sign was observed in this reach during the 2021 field visit. The reach that crosses the transmission line ROW had a bankfull width of 8 feet, with predominantly sand

and some small gravel substrate. The reach through the transmission line ROW crosses the relatively flat Skagit River floodplain (Attachment B, page 2), but was completely dry during the time of the July 2021 field visit. The BIP model classified this reach as having moderate intrinsic potential. This matches reasonably well with the qualitative physical conditions observed in the field, although lack of perennial flow makes this reach poorly suited for beavers to inhabit (Allen 1982).

Figure 5.3-4. Babcock Creek field site looking downstream from the transmission line ROW to the Skagit River.

5.3.1.4 Sauk River Left Bank Tributary

This stream flows through a small, forested ravine to the Sauk River south of its confluence with the Skagit. The stream does not cross City Light property but is located within the 2-mile buffer study area. The stream flows through a small, narrow valley with a mixed forest canopy of bigleaf maple, alder, Douglas fir, and western red cedar. There was very little preferred forage species, as no willows or cottonwoods were present (Figure 5.3-5). The bankfull width was approximately eight feet, and the slope upstream of the road crossing was approximately 2 percent, and downstream there was a series of small step pools, and the general slope was approximately 3 to 5 percent. This site was classified by the BIP model as having low intrinsic potential. Based on the geomorphology of the site (Attachment B, page 6), perennial flow, and small channel size, this seems an appropriate classification. The vegetation community lacks preferred species, and the limited floodplain in the narrow valley detracts from the quality of suitable beaver habitat.

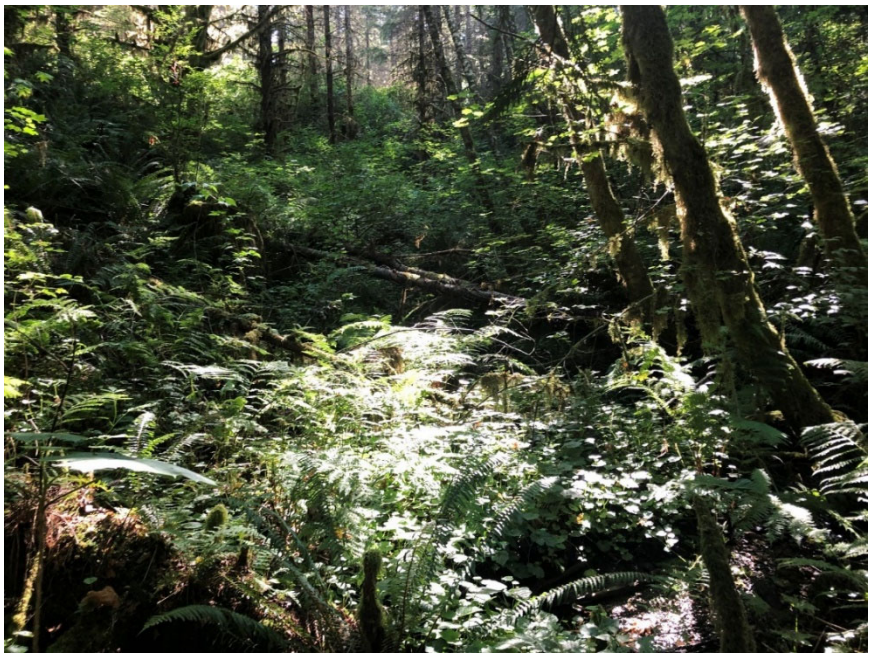


Figure 5.3-5. Sauk River left bank tributary field site in a small-forested ravine.

5.3.1.5 O'Brien Creek Tributary

This site was modeled as transitioning from a BIP score of 0 (no intrinsic potential) upstream to a score of 3 (high intrinsic potential) downstream towards O'Brien Creek. The stream reach does not cross City Light property but is located within the two-mile buffer study area. The field site was accessed from the road crossing where the tributary flows through a culvert under Rockport Cascade Road. Upstream of the road crossing, the stream is relatively high gradient and has small cascades and step pool morphology. The valley is narrow and forested with a mix of deciduous and conifer species, including cottonwood and alder. This portion of the stream was classified by the BIP model as having no intrinsic potential, which is corroborated by the high gradient and narrow valley characteristics of this reach.

Downstream of the road crossing, the stream flattens out and becomes braided with a wide, forested floodplain, with wetland areas (Attachment B, page 5). This site has some potential for beaver activity, although shallow flows and multiple braided channels downstream would detract from quality dam building sites (Figure 5.3-6). The forest in this reach is dominated by deciduous species including cottonwood, bigleaf maple, with Douglas fir and cedars as well.

This stream flows into O'Brien Creek, which provides high quality beaver habitat. Downstream of the wide braided section of the stream, near the confluence with O'Brien Creek, the tributary has high-quality habitat for beavers and was classified by the BIP model with a score of 3 as having high intrinsic potential.

Figure 5.3-6. Wide forested floodplain in downstream portion of the O'Brien Creek tributary field site.

5.3.1.6 False Lucas Slough Tributaries

Two tributary sites were visited in the field since they were in proximity and were ranked with different BIP scores. These sites are located on City Light False Lucas Slough mitigation lands. The area surrounding these sites is flat, with many sloughs and low-lying areas in the Skagit River floodplain (Attachment B, page 4). The forest cover at both sites is dominated by deciduous species, including alder, bigleaf maple, and some cottonwoods. The sites had bankfull widths of approximately 40 feet and 50 feet with steep sloped banks. These tributaries flow through flat terrain into False Lucas Slough and have channel slopes of nearly 0 percent. False Lucas Slough and the surrounding tributaries provide high-quality habitat for beavers; the BIP model classifies these sites as having high intrinsic potential (Attachment A, page 10). The reach furthest south from the slough had suitable topography and vegetation community, but the stream reach had a shallow stagnant flow with a thick layer of anoxic sediment (Figure 5.3-7). The reach closer to the slough was more riverine with forested banks and had little to no flow (Figure 5.3-8). These reaches were classified with BIP scores of 2 and 3 respectively, which is corroborated by the geomorphic and stream channel conditions observed.

Figure 5.3-7. **False Lucas Slough Tributary: South reach with stagnant flow and anoxic sediment. No beaver sign was observed.**

Figure 5.3-8. **False Lucas Slough Tributary: North reach closer to False Lucas Slough had little to no visible flow but suitable deciduous riparian habitat.**

5.3.1.7 Sauk River Tributary 2

The GIS mapping analysis prior to fieldwork indicated this stream crossed the transmission line ROW before flowing into the Sauk River. The field visit, however, revealed there is no channel that crosses the transmission line ROW at or near this location. The LiDAR for this site shows no signature of a stream channel in the transmission line ROW but corroborates the flat area with multiple channels observed immediately to the east (Attachment B, page 7). In this area on the east side of the transmission line ROW, some wetland areas and stream channels were observed that do flow into the Sauk River and are presumed to be this tributary (Figure 5.3-9). The observed main channel had a bankfull width of 12 feet, with very little flow. There were areas of shallow ponded water and wetlands. This area was heavily disturbed by recreational off-road vehicle traffic, as multiple ruts and tire tracks were observed throughout the floodplain and braided channels.

The site is mapped as having moderate to high intrinsic potential (BIP 2 to 3) (Attachment A, page 16). The conditions observed in the field, however, do not support this tributary as having moderate to high quality potential habitat for beaver under current conditions. The low flow, lack of defined channels, and the recreational disturbance all detract from this area being suitable for beavers. The stream slope and surrounding topography are the primary rationale for the model's high intrinsic potential classification. Downstream towards the Sauk River this site has some potential for beaver activity, although shallow flows and multiple braided channels downstream would detract from dam building sites.

Figure 5.3-9. Sauk River Tributary 2 field site adjacent to transmission line ROW. Poorly defined stream channel with multiple wet depressions.

5.3.1.8 Little French Creek

This small stream crosses the transmission line ROW just west of Darrington and flows into the North Fork Stillaguamish River to the north (Attachment A, page 19). Due to vegetation management in the transmission line ROW, there is no mature canopy cover along the stream segment in the ROW (Figure 5.3-10). Upstream of the transmission line ROW, the stream flows through a conifer-dominant forested area containing Douglas fir, hemlock, and cedar. The understory shrub layer is fairly open, and this reach offers very little suitable forage for beavers. The channel in this area has a relatively high gradient but flattens out to around 2 percent where it crosses the transmission line ROW (Attachment B, page 8). The stream channel is fairly uniform and has a bankfull width of approximately 10 feet. Although the stream has a low gradient through the transmission line ROW, the streambed substrate is dominated by cobbles and large gravel, indicating the stream has seasonally fast flows that carry away fine sediments. The stream channel was completely dry during the July field visit. The BIP model classified this stream segment as having low intrinsic potential (BIP 1). This matches reasonably well with the qualitative physical conditions observed in the field, although lack of perennial flow makes this reach poorly suited for beavers to inhabit (Allen 1982).

Figure 5.3-10. Little French Creek field site at transmission line ROW crossing.

5.3.1.9 Jim Creek Tributary

This is a small, forested stream channel that has good canopy cover with a mix of deciduous and conifer species. The bankfull width of approximately 20 feet, low stream gradient, and presence of suitable forage species, such as alder, make this stream segment moderately suitable for beaver (Figure 5.3-11). The stream flows through a shallow valley in a wide plateau, before crossing the Jim Creek floodplain (Attachment B, page 9). There is a small wetland with wood reed (*Cinna spp.*), skunk cabbage (*Lysichiton americanus*), and buttercup (*Ranunculus orthorhynchus*) along the left bank. The BIP model classified this stream reach as moderate intrinsic potential (BIP 2),

and this is corroborated by the field observations. The bankfull width was approximately 20 feet, and the streambed was dominated by gravel and some cobble. The stream and riparian corridor are in close proximity to Jim Creek Road, and the stream crosses through a culvert under the roadway and continues a short distance to where it joins Jim Creek. Although there are some habitat features suitable for beavers, the proximity to the roadway and some residential development detracts from suitability of this site.

Figure 5.3-11. Jim Creek tributary field site showing low gradient stream channel and suitable riparian habitat.

5.3.1.10 Powerline Road Tributary

This field site has two stream crossings in the transmission line ROW near Powerline Road in the southern portion of the BIP study area (Attachment A, page 24). There is a large pond on the east side of the transmission line ROW access road, and field observations indicated that the road had been flooded from this pond (Figure 5.3-12). Some excavation work was ongoing to build up the roadway at the time of the July 2021 field visit. The large pond provides some potential for beavers to occur, but the perimeter of the pond is comprised of a wide strip of reed canarygrass (*Phalaris arundinacea*) and offers little for forage or woody materials for beavers to access from the banks. This stream is mapped as having moderate intrinsic potential (BIP 2).

Figure 5.3-12. Pond and partially flooded access road in transmission line ROW at Powerline Road tributary field site.

The second tributary is a very small channel with a bankfull width of approximately five feet that was partially dry during the July field visit. This channel flows across the transmission line ROW in a strip of willows that cover both banks. There is a small culvert under the access road that conveys the stream, but the west side has been recently dug out, presumably to clear blockage and direct flows away from the road. These tributaries offer some potentially suitable habitat for beaver in that they are low gradient, and the ponded area and willows nearby provide some suitable habitat features. The lack of flow in the smaller tributary and lack of deciduous trees for dam and lodge building in close proximity to the pond detract from the habitat suitability at this site. The topography, low flow, and ponded channels with wide floodplain (Attachment B, page 10) account for the BIP score of 2, but conditions observed where the streams cross the transmission line ROW may be better suited to a slightly lower score.

5.3.1.11 Field Sites Summary

During the 2021 field visits for this study, the only beaver sign observed in the field was at the Powerline spawning channel, Illabot spawning channel (but not very recent), and a recent scent mound at Newhalem Ponds. Beaver sign was also incidentally observed during fieldwork for the TR-08 Special-Status Amphibian Study near the False Lucas Slough tributary field site. Despite the lack of beaver sign, the streams classified as having high and moderate intrinsic potential did have the geomorphological characteristics and some of the vegetation characteristics to provide potentially suitable habitat for beavers. Reviewing the LiDAR for the surrounding landform characteristics of each site also corroborates the occurrence of less suitable beaver habitat in the areas outside the main river valleys and floodplains that have steep hillslopes and narrow valleys. The former floodplain and channel migration areas around the Skagit River and Sauk River confluence have wide, flat areas with low gradient waterways highly suitable for beavers to colonize (Attachment B).

The field sites visited during this study represent only a small sample and do not constitute a complete or empirical evaluation of the BIP model based on field sites (as was completed during development of the model, Dittbrenner 2018). Field site stream and valley characteristics generally reflected BIP model rankings in areas observed but given the wide-ranging study area and large number of streams, the BIP model could potentially be inaccurate in some areas. The field investigation for this study was designed as a rapid general assessment for how well the BIP model matched conditions on the ground. Although qualitative, this data illustrates that the BIP model provides sufficient mapping of potentially suitable beaver habitat based on physical conditions that can be combined with land use, biological, and hydrological data to refine assessment of beaver habitat across broad areas.

5.3.2 Data from Concurrent Terrestrial Studies

To further corroborate the BIP model, the reported locations of beaver observations and beaver sign were mapped and compared to areas modeled as having moderate or high BIP. Most incidental and mapped beaver observations were located in the areas around the Sauk River confluence with the Skagit River (Attachment A). Mapped locations where beavers or beaver dams and sign were observed during the 2021 field season were overlaid on the BIP modeled streams. Streams where beavers were observed should be categorized as having some potential suitable beaver habitat (BIP scores 1-3). Results of this analysis showed a few stream segments rated with BIP scores of 0 did, in fact, have observations of beavers or beaver sign. Out of the 45 stream segments where beavers or beaver sign were reported, 82 percent were located on streams classified as having BIP scores of 1-3. It should be noted that the intent of the BIP model is to provide indicators of the suitability of physical stream characteristics independent of vegetation cover since this can change or be modified naturally or at targeted restoration sites. One of the biggest limitations of the BIP model in the study area was the stream data layer to which the model was applied. There were four sites where beavers or beaver sign was incidentally observed during relicensing studies and no stream segment in the BIP model was mapped; therefore, no BIP score was available to evaluate.

Further evaluation of the model used vegetation cover data from wetlands and vegetation studies to assess if streams identified by the BIP model as having potentially suitable habitat had vegetation characteristics that also were suitable to beavers. Vegetation cover data from the TR-01 Vegetation Mapping Study were used in GIS to show areas where vegetation groups generally suited to beavers occurred. The study area for TR-01 Vegetation Mapping was smaller (area within 0.5 mile of the Project Boundary and the CMZ) than the Beaver Habitat Assessment study area (area within 2 miles of the Project Boundary) but was still used to provide additional scoring information for the beaver study area. For mapping visualization clarity, only the vegetation categories that had species and cover at least partially suitable to beaver habitat are displayed in the mapbook (Attachment A). These are deciduous and mixed tree species forest cover, lowland, riparian, and shrub and marsh categories that include: G237 – North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest, 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, and G853 – North Pacific Maritime Hardwood-Conifer Swamp.

5.3.3 Beaver Habitat Distribution in the Study Area

Within the Project Boundary itself, there was a total of 143.2 miles of mapped stream segments by the BIP model. Of these, 8 percent were mapped as having high intrinsic potential, 5 percent had moderate intrinsic potential, 18 percent were low, and the remaining 69 percent had no intrinsic potential.

The data from incidental observations and vegetation cover were combined with the BIP model to qualitatively assess watersheds and sub-regions throughout the study area. Areas that contained higher amounts of potentially suitable beaver habitat were delineated from areas that did not provide quality potential habitat. To better assess specific areas with regard to the suitability of beaver habitat and land cover conditions, the study area was divided into eleven segments, using major tributaries and landforms as boundaries (see Sections 3.0 and 4.3 of this study report). Each of the study area segments was scored for overall potential beaver habitat based on: (1) the amount of mapped moderate or high beaver intrinsic potential stream habitat; (2) type and prevalence of vegetation cover; and (3) predominant land use. Vegetation cover scores were assigned high, moderate, or low to align with the other qualitative scoring parameters, based on the prevalence of suitable beaver habitat vegetation groups.

Land use was also considered a factor in determining general suitability for beaver occurrence, in particular for potential relocation efforts to areas with minimal risk of conflict with human interests and land use in the area. Segments that were predominantly public, state, or City Light land were scored highest, while areas that were predominantly private land and developed were scored lowest. Much of the upper Skagit watershed are lands administered by NPS and U.S. Forest Service lands, which would be feasible for potential relocation efforts; however, this area also has the lowest intrinsic habitat potential due to the steep streams and narrow, conifer forested valleys. There is a correlation between low gradient and wide valleys and areas that have been selected for human development.

Based on these factors, the study area segments were qualitatively assigned relative values for beaver habitat suitability and habitat potential for possible future relocation efforts. Table 5.3-1 below lists the scoring of each study area segment (which are also depicted in Figure 5.3-13). The percent of mapped stream length that was ranked moderate or high in the BIP model was the primary determinant of the study area segment ranking. Vegetation cover mapping was limited to the TR-01 Vegetation Mapping Study area and does not completely cover the extent of the Beaver Habitat Assessment study area but offers a general assessment within the area covered (City Light 2022d). The dominant land use is an important consideration but is fairly general at this scale and would need to be evaluated more closely and specifically at potential individual sites if and when future beaver relocation or restoration are considered.

Table 5.3-1. Summary of the percentage of BIP[1] and vegetation scores for study area segments.

Study Area Segment	Percent stream length classified as Moderate or High BIP	Vegetation Cover	Relative Potential for Beaver
Ross Lake	1	Low	Low
Diablo to County Line	3	Low	Low
Skagit Mainstem	4	Moderate	Low
Skagit Confluence	12	High	High
Skagit Downstream	3	Low	Low
Nooksack Wildlife Mitigation Lands	1	Low	Low
Savage Slough and Pressentin Mitigation Lands	5	Low	Low
Day Creek Slough Mitigation Lands	35	Moderate	High
Sauk River	14	High	High
South Fork Stillaguamish	19	Moderate	High
North Fork Stillaguamish	12	Moderate	Moderate

1 BIP scores are percentage of length of stream of each category within total mapped stream length in each study area segment.

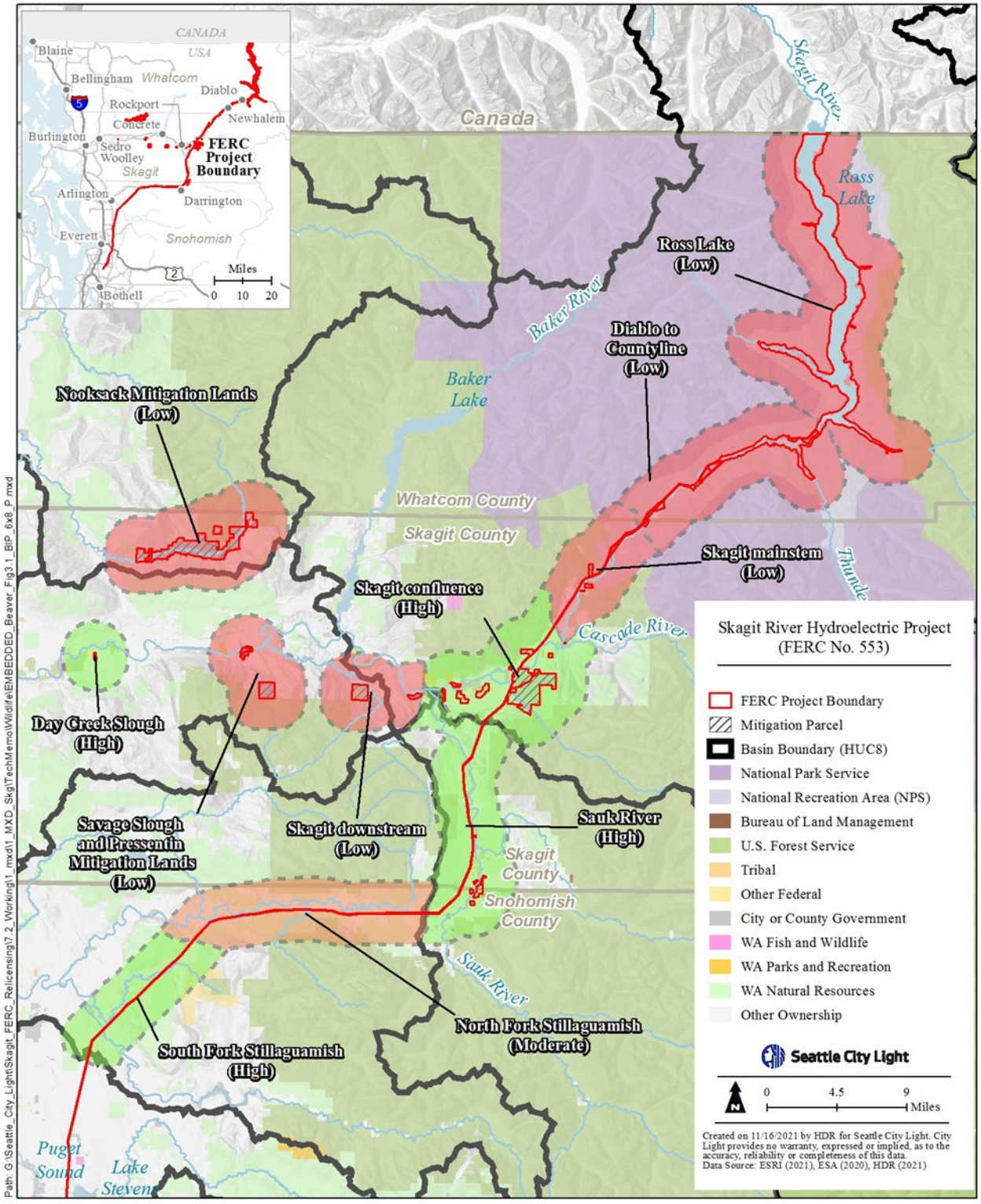


Figure 5.3-13. Beaver habitat potential in the study area segments.

5.3.3.1 Ross Lake Segment

The Ross Lake segment of the study area provides little suitable habitat for beavers in the majority of tributaries and the reservoir itself. The tributaries surrounding the reservoir are steep gradient streams that flow down from the hillsides through narrow valleys dominated by coniferous forest. In addition, water level fluctuations in the reservoir make the shoreline areas and tributary mouths unsuitable for beaver habitation. The exception to this is Big Beaver Creek and its tributaries. This large tributary to the reservoir flows through a relatively wide floodplain and offers some potentially suitable habitat for beavers. Beaver dam complexes have been observed in Big Beaver Valley beginning approximately 0.75 mile upstream from Ross Lake during wetland surveys conducted by the NPS (Tressler 2021).

5.3.3.2 Diablo to County Line Ponds Segment

The Diablo to County Line ponds segment of the study area likewise offers little suitable beaver habitat. The margins of Diablo Lake and Gorge Lake near the Diablo town site offer some limited habitat along the shoreline and side channel, but the surrounding steep hillslopes have high gradient, narrow drainages unsuitable for beaver. The flat area in the CMZ along the Skagit River at Newhalem and County Line ponds does contain some suitable beaver habitat, in particular at the constructed spawning channels created for Chum salmon as described in Section 5.1 of this study report.

5.3.3.3 Skagit Mainstem Segment

The Skagit mainstem segment of the study area has a few suitable tributaries, but the majority are similar to those around Diablo and Ross Lake and largely unsuitable due to gradient, topography, and lack of tracts of suitable vegetation. This segment has few streams modelled as having moderate or high intrinsic potential.

5.3.3.4 Skagit Confluence Segment

The Skagit confluence study area segment has a much wider corridor of floodplain and low-level lands along the Skagit River and confluence of the Sauk River. Within this area there are several slough and wetland complexes with predominantly deciduous forest cover. This segment has a high amount of mapped stream classified as BIP 2 or 3 (moderate to high) intrinsic potential (Table 5.3-1) and had the highest amount mapped as BIP 3 at 8 percent. This area also had the greatest concentration of incidental beaver observations.

5.3.3.5 Skagit Downstream Segment

Downstream of the Sauk River Confluence, the Skagit River corridor and floodplain narrows to the west, and the surrounding hillsides have some steep, narrow valley drainages similar to the Skagit mainstem segment. There is some low beaver intrinsic potential habitat on streams that cross the floodplain and CMZ along the Skagit River, but the majority of streams in this study area segment are classified as having no intrinsic potential (Table 5.3-1).

5.3.3.6 Wildlife Mitigation Lands Segments

The small tributaries to the South Fork Nooksack in the Nooksack Wildlife Mitigation Lands segment are high gradient and generally flow down hillslopes through narrow valleys. The BIP model indicated that the majority of tributaries on the Nooksack wildlife mitigation lands do not

provide suitable beaver habitat (Attachment A). As with the Skagit River, some side channels and the lower reaches of tributaries in the valley bottom along the South Fork Nooksack do have some potential beaver habitat; these reaches accounted for the 1 percent of moderate and high BIP scores for this segment (Table 5.3-1). The Savage Slough and Pressentin mitigation lands segment also contains predominantly high gradient, narrow valley streams, and a low percentage are classified as having moderate or high intrinsic potential (Table 5.3-1).

The 2-mile study area around the Day Creek Slough mitigation lands scored the highest for BIP out of all the segments with 35 percent of the stream segments classified as moderate or high intrinsic potential (Table 5.3-1). This study area segment is predominantly within the Skagit valley and floodplain and has flat topography throughout. The forested areas around the streams in this segment offer suitable habitat, but are limited due to the surrounding areas of agriculture and some residential development. This segment contains lands owned by City Light, which may indicate high potential for this area to support beavers. Within the Day Creek Slough mitigation property itself, there is only one mapped stream classified as having high intrinsic potential (BIP 3). It is approximately 795 feet in length within the mitigation land property boundary.

Within the boundaries of the mitigation land properties, there is a combined 93.8 miles of stream segments in total; 7 percent of these were classified as high BIP, 4 percent as moderate, and 10 percent as low BIP. The remaining stream segments were classified as having no intrinsic potential and this is mainly accounted for by the topography of narrow, steep valleys that are prevalent, particularly in the Nooksack wildlife mitigation lands.

5.3.3.7 Sauk River Segment

Similar to the Skagit Confluence segment, the Sauk River segment has moderate and high beaver habitat potential in the valley and low-lying areas and tributaries and also had the highest number of streams modeled as BIP 3 at 8 percent (Table 5.3-1). High intrinsic potential was most abundant at the north end of this segment near the wide floodplain and nearby sloughs. Moderate intrinsic potential was more prevalent in the southern part of the segment (Attachment A).

5.3.3.8 North Fork and South Fork Stillaguamish Segments

The North Fork Stillaguamish segment of the study area has numerous streams mapped across the three BIP categories of low, moderate, and high beaver intrinsic potential. This is largely due to the flatter topography in this portion of the study area, as well as the higher prevalence of deciduous tree cover. The South Fork Stillaguamish has similar characteristics but is ranked higher due to more streams being classified as moderate to high intrinsic potential (Table 5.3-1). This segment has the second highest percentage of mapped streams with moderate to high intrinsic potential, but covers a much broader area than the Day Creek Slough segment with the highest percentage.

5.3.3.9 South End of Study Area

The area within two miles of the Project Boundary located south of the Stillaguamish watershed was not modelled with the BIP analysis as described in Section 4.3 of this study report. Similar BIP data from WDFW was reviewed online and showed that this segment has a large proportion of stream segments classified as moderate to high intrinsic potential.

This segment of the study area contains approximately 231 miles of mapped streams. From the assessment of WDFW online data, approximately 36 percent of these can be considered as high intrinsic potential, 33 percent moderate, 18 percent low, and the remaining 23 percent as having no intrinsic potential. Many of the streams and rivers in this area are relatively low gradient with wide floodplain areas, and the vegetation is more deciduous. This area, however, has much more human development than areas upstream. This part of the study area includes the City of Lake Stevens, Marysville, and the City of Mill Creek. Consequently, beaver occurrence here would likely result in higher occurrence of conflicts from beaver colonization due to competing human interests than areas upstream in the Sauk, Skagit, and Stillaguamish watersheds.

5.3.3.10 Summary

Limitations of the BIP model are mainly from the accuracy of the stream layer data that is used as a base for the model. Field verification of a few sites indicated that streams mapped in the model at those locations were inaccurately represented on the map as streams were not present crossing the transmission line ROW.

Tributaries upstream of Marblemount were generally too steep and had ravine-like characteristics generally unsuitable for beaver habitat. This was also reflected in the BIP model. The area with highest quality beaver habitat in the Skagit watershed is between Marblemount and the Sauk River confluence. This area also contains some City Light mitigation lands. The mitigation lands near the Sauk confluence had more suitable habitat for beaver with lower gradient streams and wider floodplains. Sloughs provide quality beaver habitat, and this area is where the highest concentration of beaver observations was reported (Attachment A), so current occupation of many sites may limit some potential areas for relocations. The Day Creek Slough area had the highest percentage of moderate and high BIP scores, and contains City Light mitigation lands, making this area a candidate for potential future beaver relocation consideration.

The assessment of BIP scores, vegetation cover, and qualitative land use categorized the Skagit Confluence, Sauk River, and South Fork Stillaguamish study area segments as having high potential for beaver habitat, North Fork Stillaguamish and Skagit Downstream segments as moderate potential, and the Skagit Mainstem, Diablo to County Line, Ross Lake, and the Nooksack Wildlife Mitigation Lands segments as having low intrinsic potential for beaver habitat. Although areas within the segments categorized as having low potential could support a few beavers in some select locations, these areas are generally unsuitable for consideration for future beaver relocations. Segments with high potential for beaver habitat represent approximately 27 percent of the study area (Figure 5.3-12).

6.0 SUMMARY

The overall goal of this study is to provide information useful for addressing beaver conflicts at the spawning channels and to assess overall beaver habitat potential within a 2-mile buffer of the Project Boundary. One objective of this study was to summarize the results of the GE-04 Geomorphology Study and the FA-02 Instream Flow Model Development Study that relate to the spawning channels to assess hydrologic and geomorphologic conditions. Information from the GE-04 Geomorphology Study was summarized in this study report. The FA-02 Instream Flow Model Development Study is a two-year study that will develop a model to assess flow impacts to side channels and floodplains along the Skagit River between Gorge Dam and the Sauk River confluence; however, model calibration at this time is ongoing and hydraulic study results have not yet been completed. The model and flow-habitat maps are anticipated to be available in 2022. Upon completion, the results will be reviewed and summarized in the study report to be included in the USR.

Beaver habitat potential was assessed in the study area. Tributaries upstream of Marblemount were generally too steep and had ravine-like characteristics generally unsuitable for beaver habitat. The area with highest quality beaver habitat in the Skagit watershed is between Marblemount and the Sauk River confluence. The mainstem Skagit River and CMZ do not provide high quality habitat for beavers. Beavers can live in banks of large rivers as long as they have good access to forage. Beavers in large rivers can also occur as transients, such as dispersing juveniles in search of available suitable tributary habitat. The more channelized portions of the Skagit River have few connections to low gradient side channels and, therefore, offer less habitat for beavers. The establishment of beavers can help maintain water levels in side channels and tributaries by slowing flows and retaining groundwater, and creating habitat for many aquatic species, including juvenile salmon. However, these same habitat features created by beaver activity can be detrimental to suitable salmon spawning habitat in these low gradient tributaries.

The instream flow model being developed covers the Skagit River between the Gorge Powerhouse and the confluence with the Sauk River and, although focused on the in-channel mainstem Skagit River, it also includes hydraulically-connected side channels, including the spawning channels. Under future management considerations, applying the instream flow model to floodplain side channels that include the spawning channels may inform assessment of the function of these channels and impacts to flows and hydrology. The spawning channels have been constructed in areas where spring-fed, hyporheic flows, and groundwater sources provide perennial flow. Potential low water in the Skagit mainstem could reduce or temporarily cut off connectivity to these channels but would not be effective in dissuading beavers from inhabiting them. Even small ephemeral streams, springs, and seeps can be dammed by beavers to create perennial ponds (Pollock et al. 2018) and beaver dams can transform seasonal streams into perennial waterbodies. Beavers can help maintain water in river side channels by slowing flows and retaining groundwater; however, some connectivity with the mainstem must still occur at least seasonally to maintain water quality.

6.1 Potential Future Management Actions

City Light has a shared interest in working with LPs to collect information on beavers and their habitats in areas where flow management can influence riparian vegetation composition and

floodplain inundation patterns and where City Light vegetation and road management activities along the transmission line ROW alter riparian vegetation or contribute to erosion and sedimentation affecting aquatic habitats used by beavers. Ongoing conflicts with beavers at the spawning channels will need future management consideration, as beaver use and maintaining suitable Chum spawning habitat and access are largely incompatible. The multidisciplinary channel assessments slated to occur in 2022 will inform future management and potentially include beaver management tools that are consistent with fish habitat maintenance. Some possible remedies may include fish-passable exclusion devices, beaver deceivers, and pond levelers, as are in use at the mouth of Powerline Channel. Installation of similar structures or using BDAs may be a possible strategy for encouraging beavers to build in a location that has less of an effect on Chum spawning habitat. However, it is possible that beavers would continue to build in other areas in the spawning channel. A further option would be trapping and relocating beavers to new locations with suitable habitat, as well as willing recipients and land ownership that coincides with areas where beavers would be beneficial. Interest in reestablishing beaver populations to aid watershed restoration has led to recent publications that describe approaches to evaluating habitat and implementing beaver relocation projects (e.g., Pollock et al. 2018; Dittbrenner et al. 2018; Tulalip Tribes 2015).

This study provides a coarse overview of beaver habitat suitability over a large area and qualitatively assesses potential suitable habitat. If relocation becomes a feasible management option in the future, this information can serve as a first step in locating broad areas as candidates for relocation. Further analysis and on-the-ground assessments will be necessary to refine the information to locate suitable watersheds and particular relocation sites where beavers would be permitted to exist (Pollock et al. 2018; Dittbrenner et al. 2018; Tulalip Tribes 2015). This approach is supported by outcomes of successful beaver relocation efforts in the region (Kerr 2021).

The BIP model provides an excellent starting point for this process and has been shown to adequately assess streams for beaver habitat potential at a watershed or tributary scale. Although the model classifies mapped stream reaches, other variables and factors are also important to consider; using an individual BIP score of a stream segment for decision-making is unreliable on its own. Areas with multiple high scoring stream segments along with topography and land use need to be considered. This study has reviewed these factors and provides a coarse, qualitative overview of the study area, highlighting areas that warrant consideration for relocation while also showing areas that can be eliminated from consideration due to existing conflicts or lack of habitat.

The results from this beaver habitat assessment will also be used in a broader multidisciplinary assessment of the spawning channels to be completed in 2022. This assessment of conditions at the channels, of which data presented in this report is a part, will be used as part of future management planning and considerations for these channels.

7.0 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

The schedule in the RSP stated that reporting for this study would be completed by March 2022. The second study objective to "summarize results of the GE-04 Geomorphology Study and FA-02 Instream Flow Model Development Study" was not completed as described in the RSP and is a variance from the study plan. The GE-04 Geomorphology Study and FA-02 Instream Flow Model Development Study reports are still in development, but available applicable information was reviewed and summarized in this report to provide information on habitat conditions at the spawning channels. Field visit information from the GE-04 Geomorphology Study relevant to beaver habitat and use/occurrence in the spawning channels was reviewed and summarized in this report. Although the GE-04 Geomorphology Study report is not yet complete, the information from field visits was included to meet the intent of this objective to assess the current geomorphologic conditions at the constructed spawning channels.

The FA-02 Instream Flow Model Development Study is a two-year study and results are not available to assess and apply to the spawning channels at this time. The model and flow-habitat maps are anticipated to be available in 2022. Upon completion, the results will be reviewed and summarized in the Beaver Habitat Assessment study report to be included in the USR.

Additionally, incidental observations of beavers and beaver sign will continue to be collected during fieldwork for other relicensing studies that will be ongoing in 2022. These observations will be compiled and summarized in the study report to be included in the USR.

8.0 REFERENCES

Allen, A.W. 1982. Habitat suitability index models: Beaver. U.S. Department of the Interior. Fish Wild. Serv. FWS/OBS-82/10.30. 20pp.

Baker, B. and E. Hill. 2003. Beaver (Castor canadensis). Wild mammals of North America: biology, management, and conservation 2:288-310.

Beechie, T.J. and H. Imaki. Predicting natural channel patterns based on landscape and geomorphic controls in the Columbia River basin, USA. Water Resources Res. 2014; 50: 39±57. [Online] URL: https://doi.org/10.1002/2013WR013629. Accessed September 2021.

Collen, P. and R. J. Gibson. 2000. The general ecology of beavers (Castor spp.), as related to their influence on stream ecosystems and riparian habitats, and the subsequent effects on fish - a review. Reviews in Fish Biology and Fisheries 10:439-461.

Davies, J.R., K.M. Lagueux, B. Sanderson, T.J. Beechie. 2007. Modeling stream channel characteristics from drainage-enforced DEMs in Puget Sound, Washington, USA. J Am Water Resources Association; 43: 414±426. [Online] URL: https://doi.org/10.1111/j.1752-1688.2007.00032.x. Accessed September 2021.

Dittbrenner, B.J., M.M. Pollock, J.W. Schilling, J.D. Olden, J.J. Lawler, and C.E. Torgersen. 2018. Modeling intrinsic potential for beaver (Castor canadensis) habitat to inform restoration and climate change adaptation. PLoS ONE 13(2):e0192538.

Dittbrenner, B.J. 2019. Restoration potential of beaver for hydrological resilience in a changing climate. Ph.D. dissertation. University of Washington, Seattle.

Gibson, P.P., and J.D. Olden. 2014. Ecology, management, and conservation implications of North American beaver (Castor canadensis) in dryland streams. Aquatic Conservation: Marine and Freshwater Ecosystems, 24(3), 391-409.

Gurnell, A.M. 1998. The hydrogeomorphological effects of beaver dam-building activity. Progress in Physical Geography 22:167-189.

Hall, J. and J.P. Shannahan. 2009. Management of beaver in constructed off-channel spawning habitat for salmon on the upper Skagit River floodplain. Report prepared for Skagit River Non-Flow Plan Coordinating Committee. Prepared by Hall and Associates Consulting, Inc. and Upper Skagit Indian Tribe. 27pp.

Johnston, C.A. and R.J. Naiman. 1987. Boundary dynamics at the aquatic-terrestrial interface: the influence of beaver and geomorphology. Landscape Ecology 1:47-57.

Kerr, Elyssa. 2021. Personal communication between Elyssa Kerr, Beavers Northwest, and Ian Welch, HDR, Inc. August 2021

Kingston, D. 2003. The 2003 Upper Kitwanga beaver dam breaching program. Gitanyow Fisheries Authority, Kitwanga, BC. [Online] URL: http://www.skeenafisheries.ca/Beaver%20Dam%20Breaching%20Program%202004.pdf. Accessed October 2021.

Larsen, A., J.R. Larsen, S.N. Lane. 2021. Dam builders and their works: Beaver influences on the structure and function of river corridor hydrology, geomorphology, biochemistry, and

ecosystems. Earth Science Reviews. Volume 218, 2021, 103623. [Online] URL: https://doi.org/10.1016/j.earscirev.2021.103623. Accessed October 2021.

Macfarlane W.W., J.M. Wheaton, and M.L. Jensen. 2014. The Utah Beaver Restoration Assessment Tool: A decision support & planning tool. Ecogeomorphology and Topographic Analysis Lab, Utah State University, Prepared for Utah Division of Wildlife Resources, Logan, Utah, 142 pp. [Online] URL: http://etal.usu.edu/BRAT/. Accessed: January 9, 2020.

Müller-Schwarze, D. and B.A. Schulte. 1999. Behavioral and ecological characteristics of a "climax" population of beaver (Castor canadensis). Pp. 161-177. Beaver protection, management, and utilization in Europe and North America. Springer. [Online] URL: https://link.springer.com/chapter/10.1007/978-1-4615-4781-5_17. Accessed October 2021.

Naiman, R.J., C.A. Johnston, and J.C. Kelley. 1988. Alteration of North American streams by beaver. BioScience 38:753-761.

Pollock, M.M., G.R. Pess, T.J. Beechie, and R. Montgomery. 2004. The importance of beaver ponds to coho salmon production in the Stillaguamish River Basin, Washington, USA. North American Journal of Fisheries Management 24:749–760.

Pollock, M.M., T.J. Beechie, J.M. Wheaton, C.E. Jordan, N. Bouwes, N. Weber. 2014. Using beaver dams to restore incised stream ecosystems. Bioscience. 2014; 64: 279±290. [Online] URL: https://doi.org/10.1093/biosci/biu036. Accessed September 2021.

Pollock, M.M., G.M. Lewallen, K. Woodruff, C.E. Jordan and J.M. Castro (Editors). 2018. The beaver restoration guidebook: working with beaver to restore streams, wetlands, and floodplains. Version 2.01. United States Fish and Wildlife Service, Portland, Oregon. 189 pp. [Online] URL: http://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Beaver.asp. Accessed October 2021.

Polvi, L.E. and E. Wohl. 2013. Biotic drivers of stream planform implications for understanding the past and restoring the future. BioScience, 63(6), 439-452.

Rosell, F., O. Bozser, P. Collen, and H. Parker. 2005. Ecological impact of beavers Castor fiber and Castor canadensis and their ability to modify ecosystems. Mammal review, 35(3-4), 248-276.

Seattle City Light (City Light). 2021. Revised Study Plan (RSP) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2021.

_____. 2022a. FA-02 Instream Flow Model Development Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Northwest Hydraulic Consultants, Inc. and HDR Engineering, Inc. March 2022.

_____. 2022b. GE-02 Erosion and Geologic Hazards at Project Facilities and Transmission Line Right-Of-Way Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by American Forest Management, Inc., Shannon and Wilson, Inc., and Watershed GeoDynamics. March 2022.

_____. 2022c. GE-04 Skagit River Geomorphology between Gorge Dam and the Sauk River Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553.

Prepared by Natural Systems Design, Inc., Northwest Hydraulic Consultants, and Fain Environmental. March 2022.

_____. 2022d. TR-01 Vegetation Mapping Study, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022e. TR-02 Wetland Assessment, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022f. TR-03 Rare, Threatened and Endangered Plants Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022g. TR-04 Invasive Plants Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022h. TR-08 Special-Status Amphibian Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

Tressler, Ron. 2021. Personal communication between Ron Tressler, Seattle City Light, and Ian Welch, HDR, Inc. August 2021.

Tulalip Tribes. 2015. FY 2013 Noncompetitive Tribal projects for restoration and protection of Puget Sound. Evaluating the use of beaver relocation as an ecosystem tool in headwater steams of the Snohomish River Basin Project Deliverable: Beaver Relocation Strategy Report. [Online] URL: http://blogs.nwifc.org/psp/files/2017/12/Beaver-Relocation-Strategy-Report.pdf. Accessed December 13, 2019.

Upper Skagit Indian Tribe. 2013. An Assessment of Spawning and Rearing Conditions in Three Engineered Spawning Channels, Skagit River Watershed, WA.

Westbrook, C., D. Cooper, and B. Baker. 2011. Beaver assisted river valley formation. River Research and Applications 27:247-256.

This page intentionally left blank.

BEAVER HABITAT ASSESSMENT INTERIM REPORT

ATTACHMENT A

BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA MAPBOOK

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:55,000 SCALE)

FERC Project Boundary

Project River Miles (PRM)

Beaver Study Area

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G305 Central Rocky Mountain-North Pacific High Montane Mesic Shrubland
- 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

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

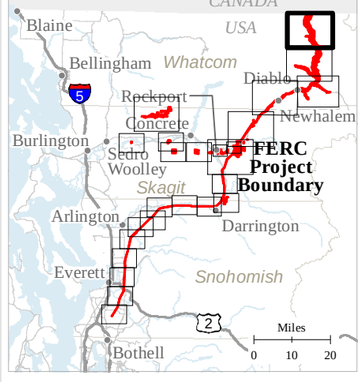
Land Ownership

- National Park Service
- National Recreation Area (NPS)
- U.S. Forest Service

N

0 2,500 5,000 Feet

Page 1 of 25



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: \\sac-svv01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\2_Working\1_mxd\1_MXD_Skg\TechMemoWildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:55,000 SCALE)

- FERC Project Boundary
- Project River Miles (PRM)
- Beaver Study Area

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G305 Central Rocky Mountain-North Pacific High Montane Mesic Shrubland
- 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

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

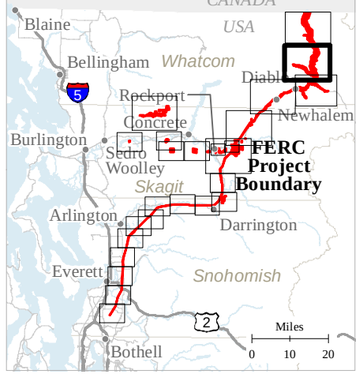
Land Ownership

- National Park Service
- National Recreation Area (NPS)
- U.S. Forest Service

N

0 2,500 5,000 Feet

Page 2 of 25



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: \\sac-csvr01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:55,000 SCALE)

- FERC Project Boundary
- Project River Miles (PRM)
- Seattle City Light
- Beaver Sign
- Beaver Field Site
- Beaver Study Area
- City
- Stream Gage (USGS)

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G305 Central Rocky Mountain-North Pacific High Montane Mesic Shrubland
- 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

Beaver Intrinsic Potential

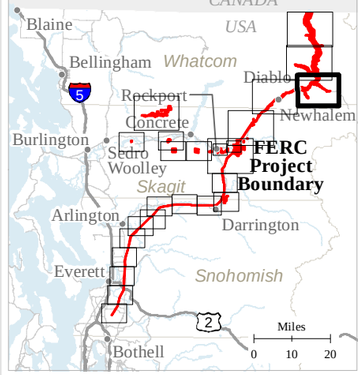
- None
- Low

Land Ownership

- National Park Service
- National Recreation Area (NPS)
- U.S. Forest Service

N

0 2,500 5,000 Feet

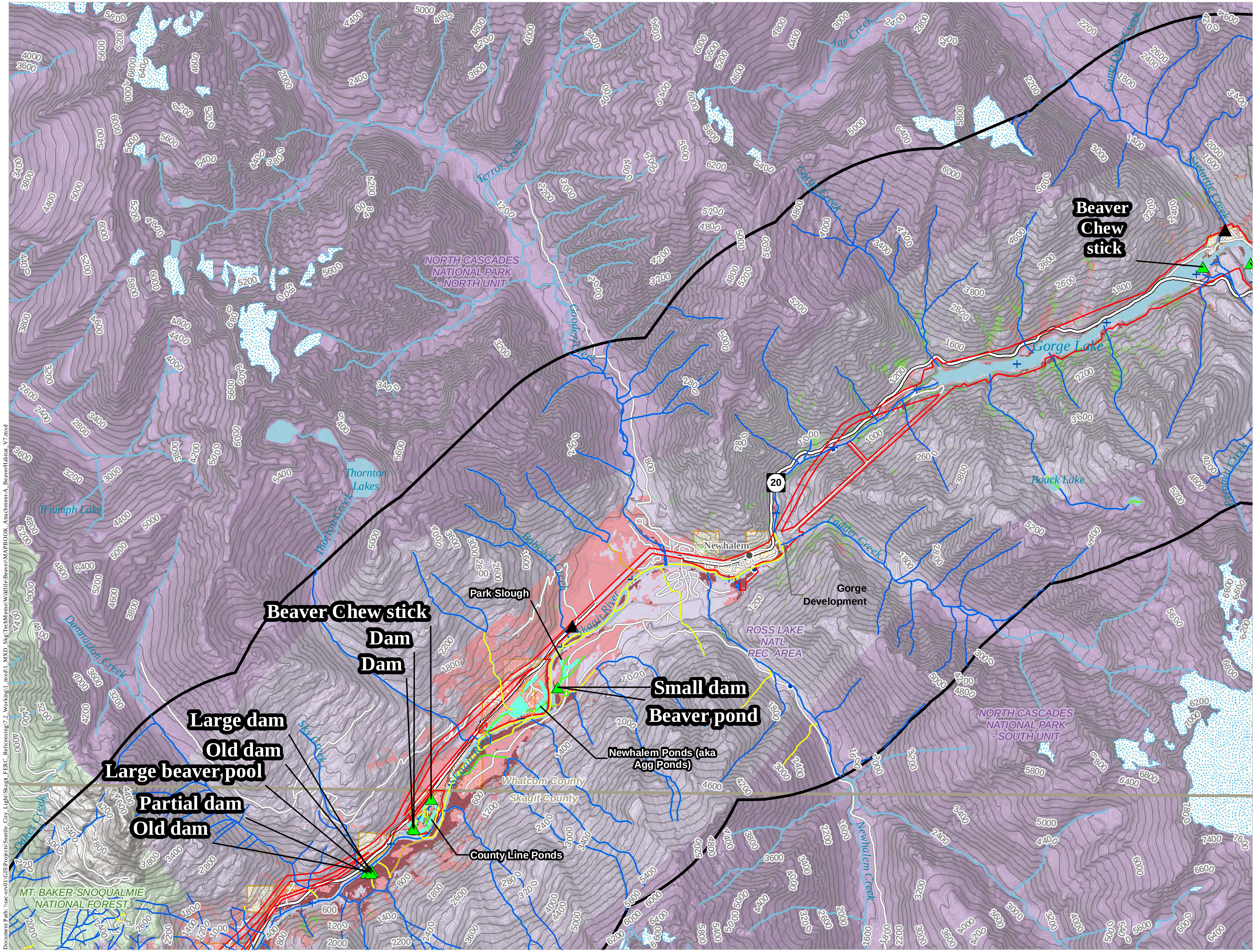


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: \\sac-csvf01\GIS\Projects\Seattle City Light\Skagit_FERC_Relicensing\T2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd



TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:55,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Sign
- Beaver Field Site
- Beaver Study Area
- City
- Stream Gage (USGS)
- Off-Channel Fish Habitat

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G305 Central Rocky Mountain-North Pacific High Montane Mesic Shrubland
- 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

Beaver Intrinsic Potential

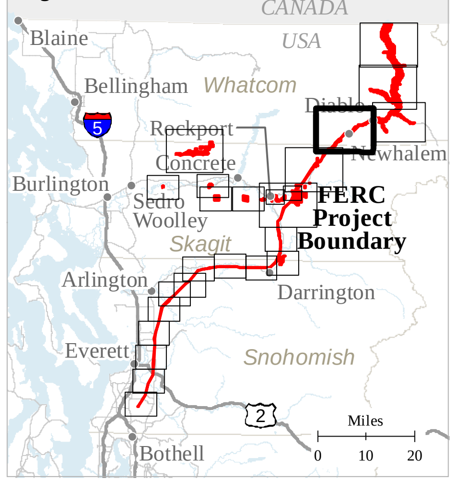
- None
- Low
- Moderate
- High

Land Ownership

- National Park Service
- National Recreation Area (NPS)
- U.S. Forest Service

N 0 2,500 5,000 Feet

Page 4 of 25



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:55,000 SCALE)

Beaver Pond

Beaver observation

Small dam

Large dam

Beaver Chew stick

Dam

Dam

Taylor Spawning Channel

Marblemount

MT. BAKER-SNOQUALMIE NATIONAL FOREST

ROSS LAKE NATL. REC. AREA

NORTH CASCADES NATIONAL PARK - SOUTH UNIT

Olson Lake

Monogram Lake

La Rush Lake

Baker River

Cascade River

Rocky Creek

Thunder Creek

Copper Creek

Lookout Creek

Monogram Creek

Dow Creek

Irene Creek

Taylor Creek

Arlington

Darrington

Everett

Bothell

Snohomish

Whatcom

Skagit

Diablo

Newhalem

Rockport

Concrete

Sedro Woolley

Burlington

Bellingham

Blaine

CANADA

USA

FERC Project Boundary

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Sign
- Beaver Study Area
- City
- Stream Gage (USGS)
- Off-Channel Fish Habitat

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- 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
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

Land Ownership

- National Park Service
- National Recreation Area (NPS)
- U.S. Forest Service

N

0 2,500 5,000 Feet

Miles 0 10 20

Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: \\sac-esvf01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:55,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Sign
- Beaver Field Site
- Beaver Study Area
- City
- Stream Gage (USGS)
- Off-Channel Fish Habitat

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

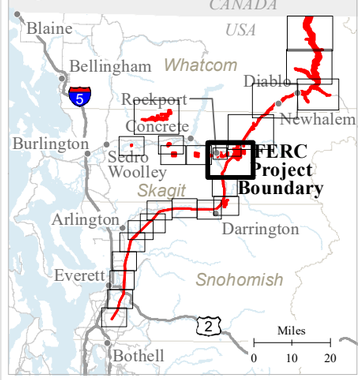
Land Ownership

- U.S. Forest Service

N

0 2,500 5,000 Feet

Page 6 of 25



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/7/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: \\sac-sv01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\72_Working\1_mxd\1_MXD_Skg\TechMemo\Wildlife\BeaverMAPLOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:17,300 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Sign
- Beaver Field Site
- Beaver Study Area
- Off-Channel Fish Habitat

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

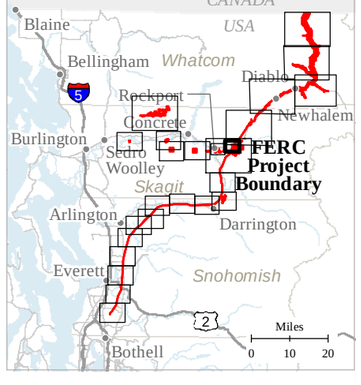
- None
- Low
- Moderate
- High

Land Ownership

- U.S. Forest Service

0 790 1,580 Feet

Page 7 of 25



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTrbMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:17,300 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Sign
- Beaver Field Site
- Beaver Study Area
- City
- Stream Gage (USGS)

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

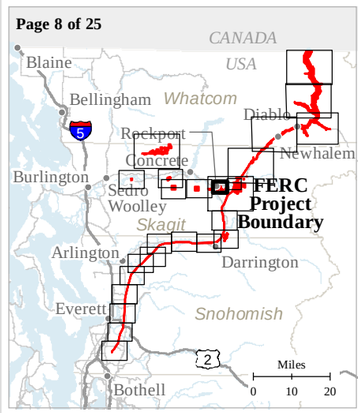
Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

Land Ownership

- U.S. Forest Service

0 790 1,580 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.

Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Study Area

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

Land Ownership

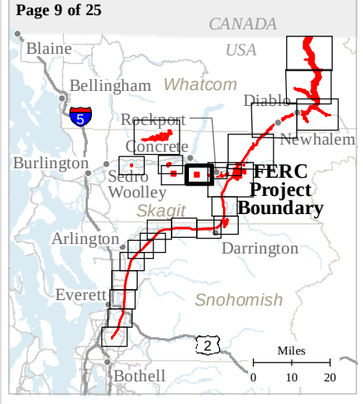
- U.S. Forest Service

Skagit River
Cummer Creek
MT. BAKER-SNOQUALMIE NATIONAL FOREST
Finney Creek
Aldon Creek
Big Fir Creek
Miller Creek
Sauk R
20

N

0 1,300 2,600 Feet

Page 9 of 25



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment\A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Study Area

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

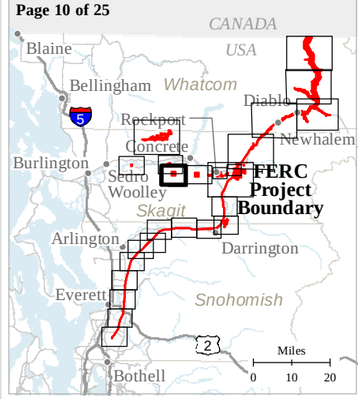
- None
- Low
- Moderate
- High

Land Ownership

- U.S. Forest Service

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Atachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Study Area

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

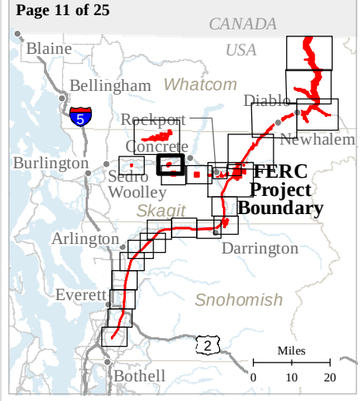
- None
- Low
- Moderate
- High

Land Ownership

- U.S. Forest Service

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_Skg_TechMemo\WildlifeBeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Seattle City Light
- Beaver Study Area
- City

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

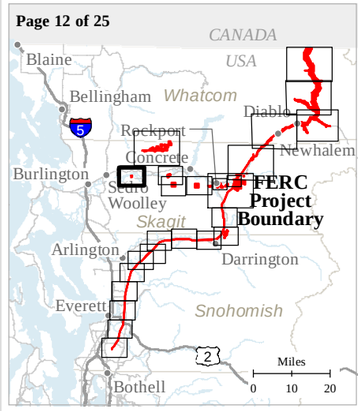
Land Ownership

- U.S. Forest Service

N

0 1,300 2,600 Feet

Page 12 of 25



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:55,000 SCALE)

FERC Project Boundary
Mitigation Parcel
Seattle City Light
Beaver Field Site
Beaver Study Area

Vegetation Composition

G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
G322 Vancouverian Wet Shrubland
G851 North Pacific Lowland Riparian Forest & Woodland Group
G853 North Pacific Maritime Hardwood-Conifer Swamp

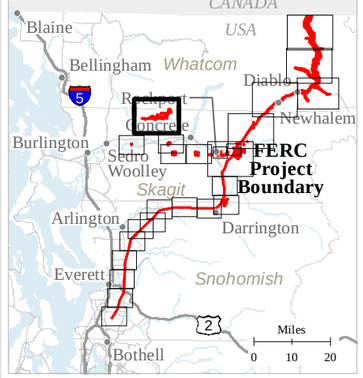
Beaver Intrinsic Potential

None
Low
Moderate
High

Land Ownership

U.S. Forest Service

N
0 2,500 5,000 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: \\sec-srv01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\2-Working\1_mxd\1_MXD_SkgTechMemoWildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Seattle City Light
- Beaver Field Site
- Beaver Study Area

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

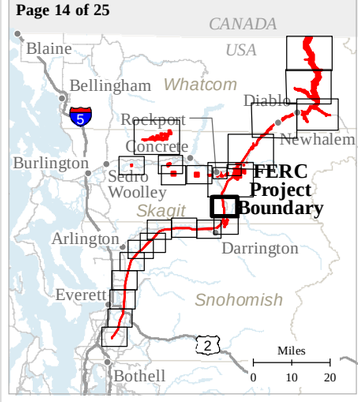
- None
- Low
- Moderate
- High

Land Ownership

- U.S. Forest Service

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.

Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\3_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Seattle City Light
- Beaver Study Area
- City

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

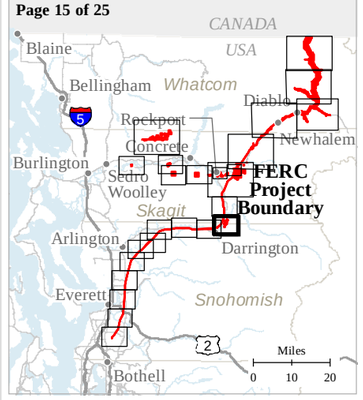
- None
- Low
- Moderate
- High

Land Ownership

- U.S. Forest Service

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_Sgt1TechMemo\Wildlife\BeaverMAPBOOK_Attachment\A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

FERC Project Boundary
Seattle City Light
Beaver Study Area
City

Vegetation Composition

G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
G322 Vancouverian Wet Shrubland
G851 North Pacific Lowland Riparian Forest & Woodland Group
G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

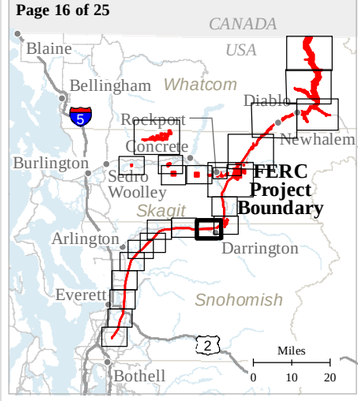
None
Low
Moderate
High

Land Ownership

U.S. Forest Service

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7-2_Working\1_mxd\1_MXD_SkgTrbMtgs\Wildlife\Beaver\MAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

FERC Project Boundary
Seattle City Light
Beaver Field Site
Beaver Study Area

Vegetation Composition

G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
G322 Vancouverian Wet Shrubland
G851 North Pacific Lowland Riparian Forest & Woodland Group
G853 North Pacific Maritime Hardwood-Conifer Swamp

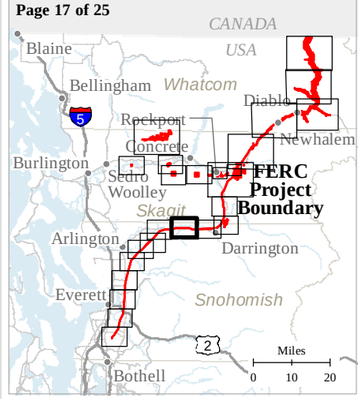
Beaver Intrinsic Potential

None
Low
Moderate
High

Land Ownership

U.S. Forest Service

N
0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment_A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Seattle City Light
- Beaver Sign
- Beaver Study Area
- City

Vegetation Composition

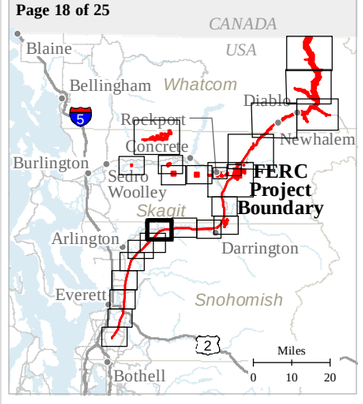
- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Seattle City Light
- Beaver Field Site
- Beaver Study Area

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

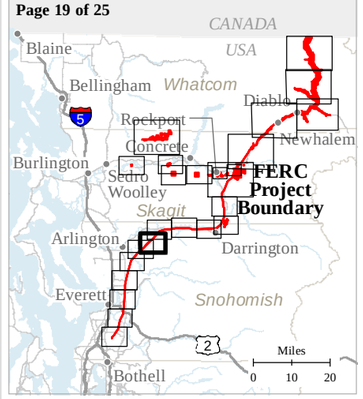
- None
- Low
- Moderate
- High

Land Ownership

- U.S. Forest Service

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTerrMemo\Wildlife\BeaverMAPBOOK_Attachment\A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

FERC Project Boundary
Seattle City Light
Beaver Sign
Beaver Field Site
Beaver Study Area

Vegetation Composition

G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
G322 Vancouverian Wet Shrubland
G851 North Pacific Lowland Riparian Forest & Woodland Group
G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

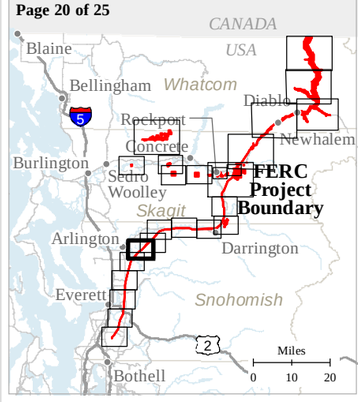
None
Low
Moderate
High

Dam
Dam
Dam

South Fork Stillaguamish River
Jim Creek
Porter Creek
Bear Creek
Siberia Creek

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Seattle City Light
- Beaver Sign
- Beaver Field Site
- Beaver Study Area

Vegetation Composition

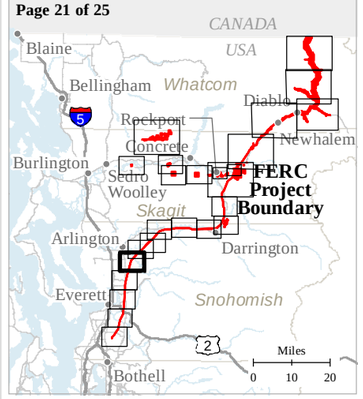
- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

Beaver Intrinsic Potential

- None
- Low
- Moderate
- High

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.

Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTceMemo\Wildlife\Beaver\MAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

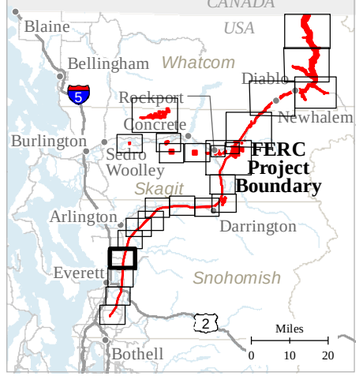
- FERC Project Boundary
- Seattle City Light
- Beaver Study Area
- City

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTerbMem\Wildlife\Beaver\MAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

Beaver Chew stick

Dam

Beaver lodge

Marysville Sewage Lagoon

Puget Sound

Union Slough

Lake Stevens

Catherine Creek

Burri Creek

Ebey Slough

Stitch Lake

Pilchuck River

Snohomish River

529

5

9

92

204

2

SP

400

200

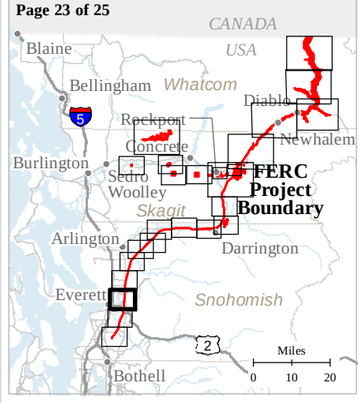
- FERC Project Boundary
- Seattle City Light
- Beaver Sign
- Beaver Study Area
- City

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_Skg7cethMemo\WildlifeBeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

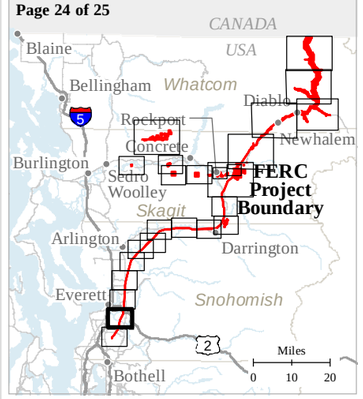
- FERC Project Boundary
- Seattle City Light
- Beaver Study Area
- City
- Stream Gage (USGS)

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group
- G853 North Pacific Maritime Hardwood-Conifer Swamp

N

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_Skg7TechMemo\Wildlife\BeaverMAPBOOK_Attachment\A_BeaverHabitat_V7.mxd

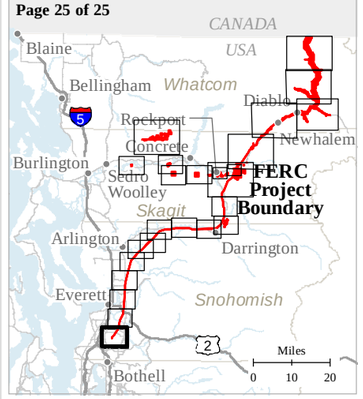
TR-09 BEAVER INTRINSIC POTENTIAL AND OCCURRENCE IN THE STUDY AREA (1:30,000 SCALE)

- FERC Project Boundary
- Seattle City Light
- Beaver Study Area
- City

Vegetation Composition

- G237 North Pacific Red Alder - Bigleaf Maple - Douglas-fir Forest Group
- G322 Vancouverian Wet Shrubland
- G851 North Pacific Lowland Riparian Forest & Woodland Group

0 1,300 2,600 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

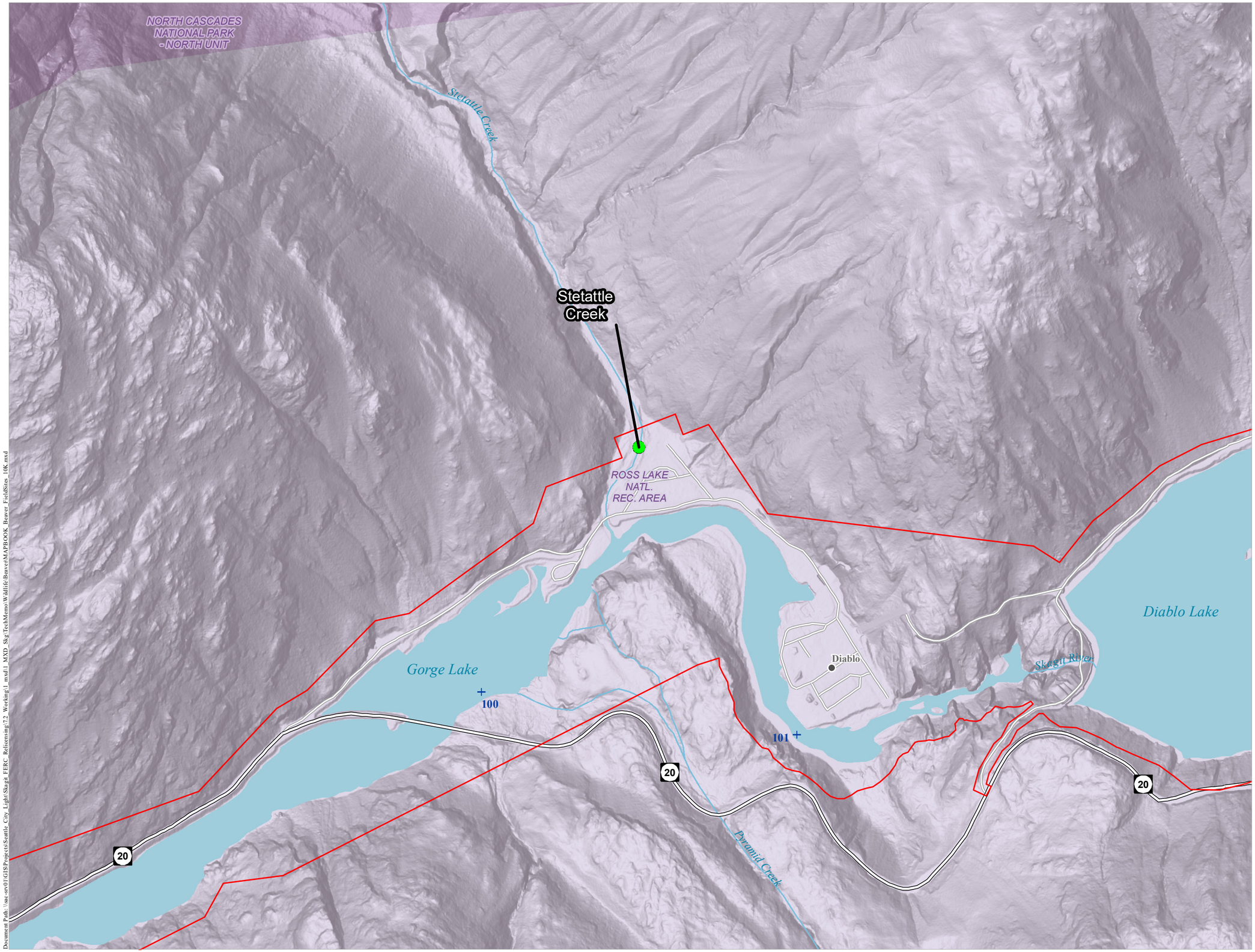
Created on 1/6/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, ESA 2021

Document Path: G:\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTrbMemo\Wildlife\BeaverMAPBOOK_Attachment-A_BeaverHabitat_V7.mxd

BEAVER HABITAT ASSESSMENT INTERIM REPORT

ATTACHMENT B

BEAVER FIELD SITES TOPOGRAPHY MAPBOOK

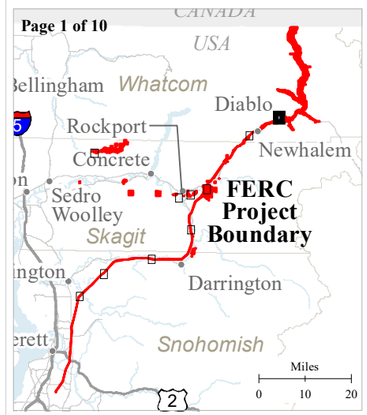


TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site
- National Park Service
- National Recreation Area (NPS)

N

0 450 900 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

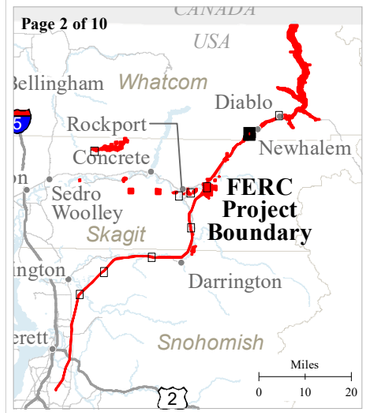
Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sea-srv01\GIS\Projects\Seattle City Light\Skagit FERC Relicensing\7.2 Working\1 mxd\1 MXD Skg\TechMemo\Wildlife\Beaver\MAPBOOK Beaver FieldSites 10K.mxd

TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site
- Off-Channel Fish Habitat
- National Recreation Area (NPS)

0 450 900 Feet

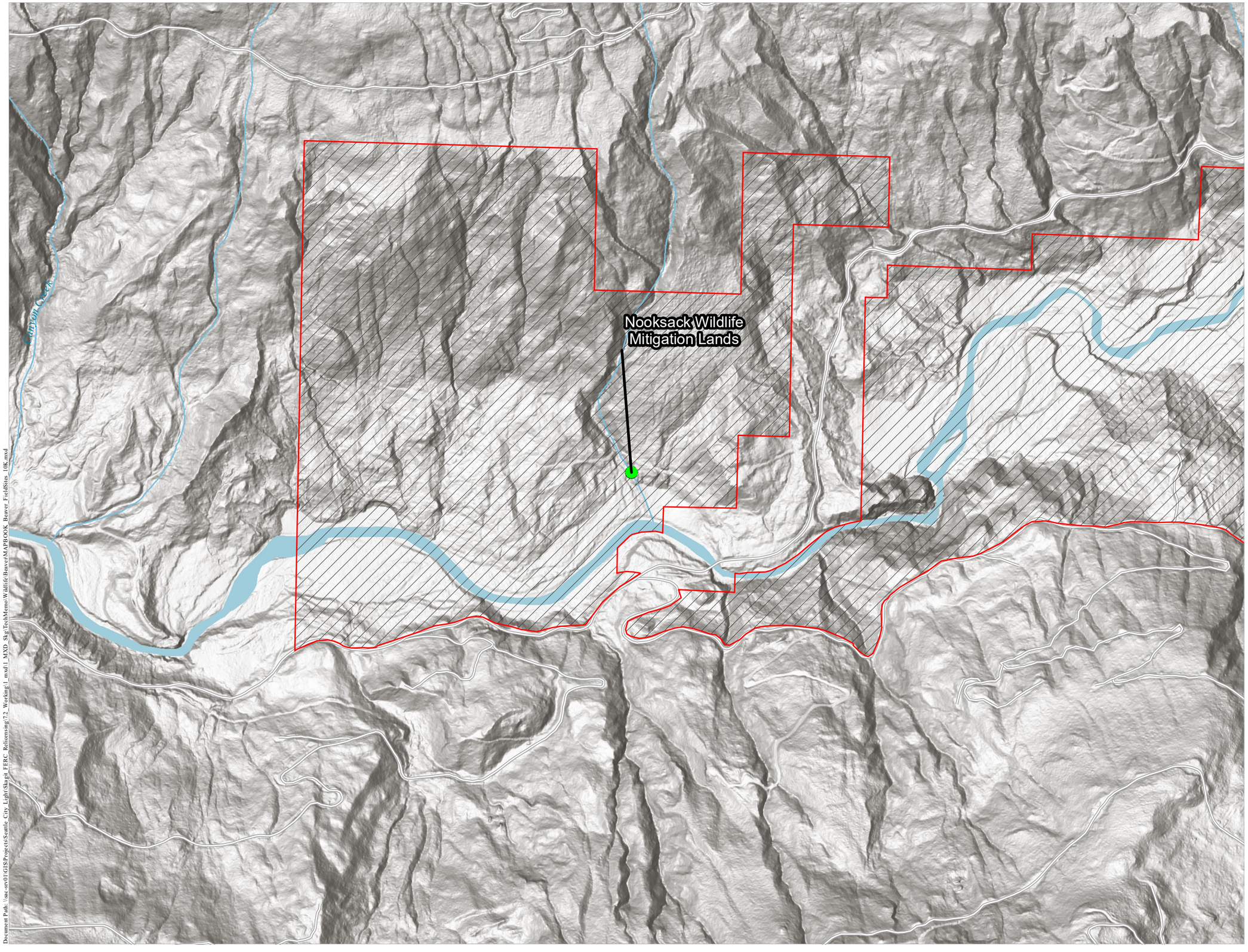


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sec-sre01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\2_Working\1_mxd\1_MXD_Skg\TechMemoWildlife\BeaverMAPBOOK_Beaver_FieldSites_10K.mxd

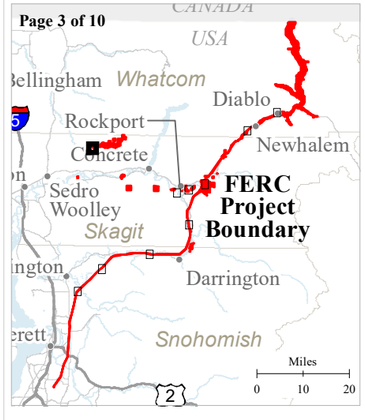


TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site

N

0 450 900 Feet



Seattle City Light

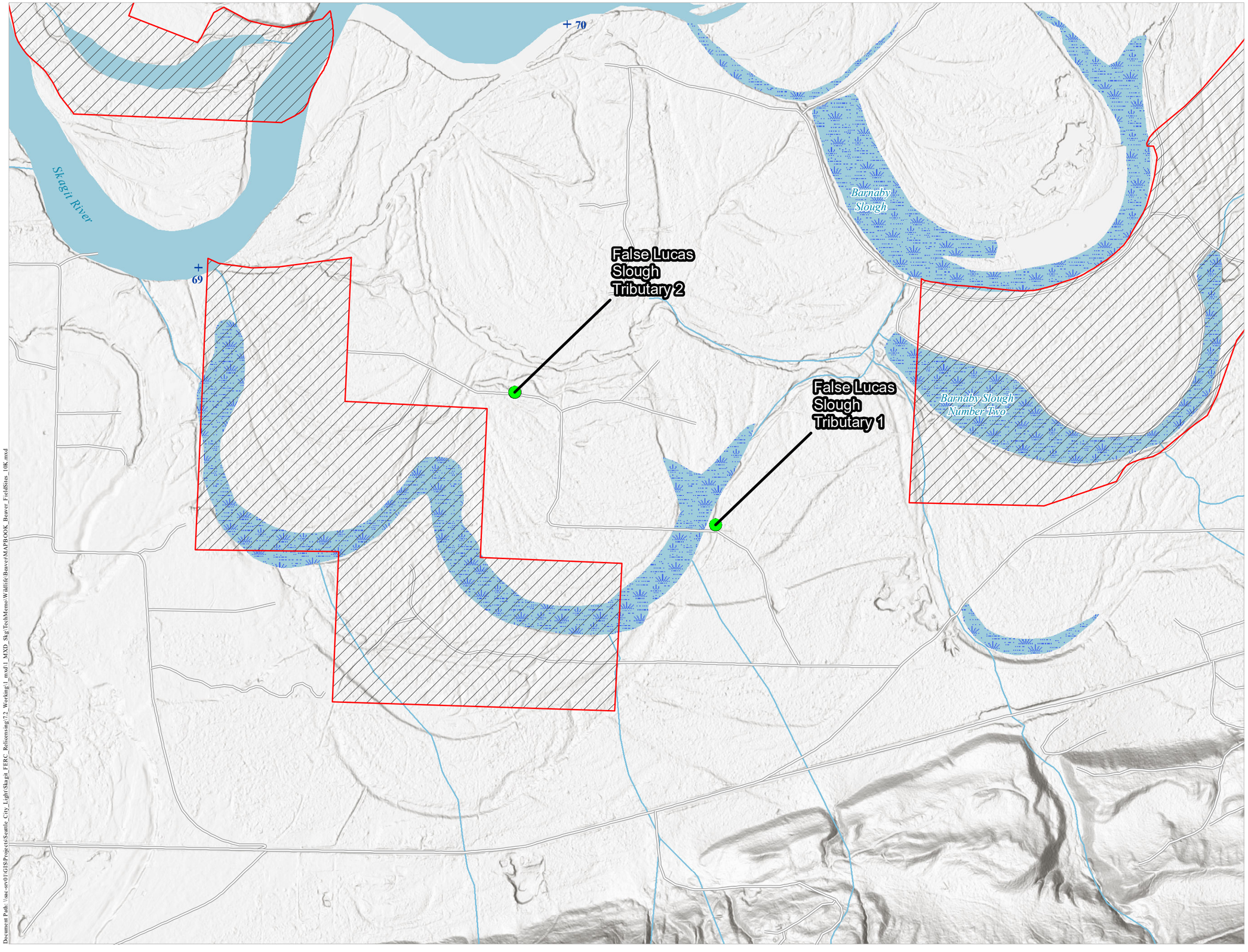
SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

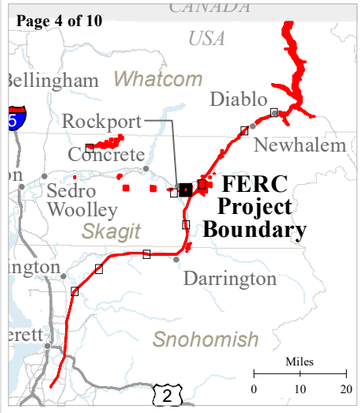
Document Path: \\sac-sev01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_Skg7TechMemoWildlife\BeaverMAPBOOK_Beaver_FieldSites_10K.mxd

TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site



0 450 900 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

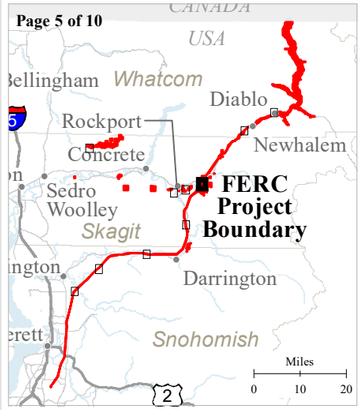
Document Path: \\sac-srv01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\72_Working\1_mxd\1_MXD_Skg\TechMemo\Wildlife\Beaver\MAPBOOK_Beaver_FieldSites_10K.mxd

TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site
- Off-Channel Fish Habitat
- U.S. Forest Service

N

0 450 900 Feet

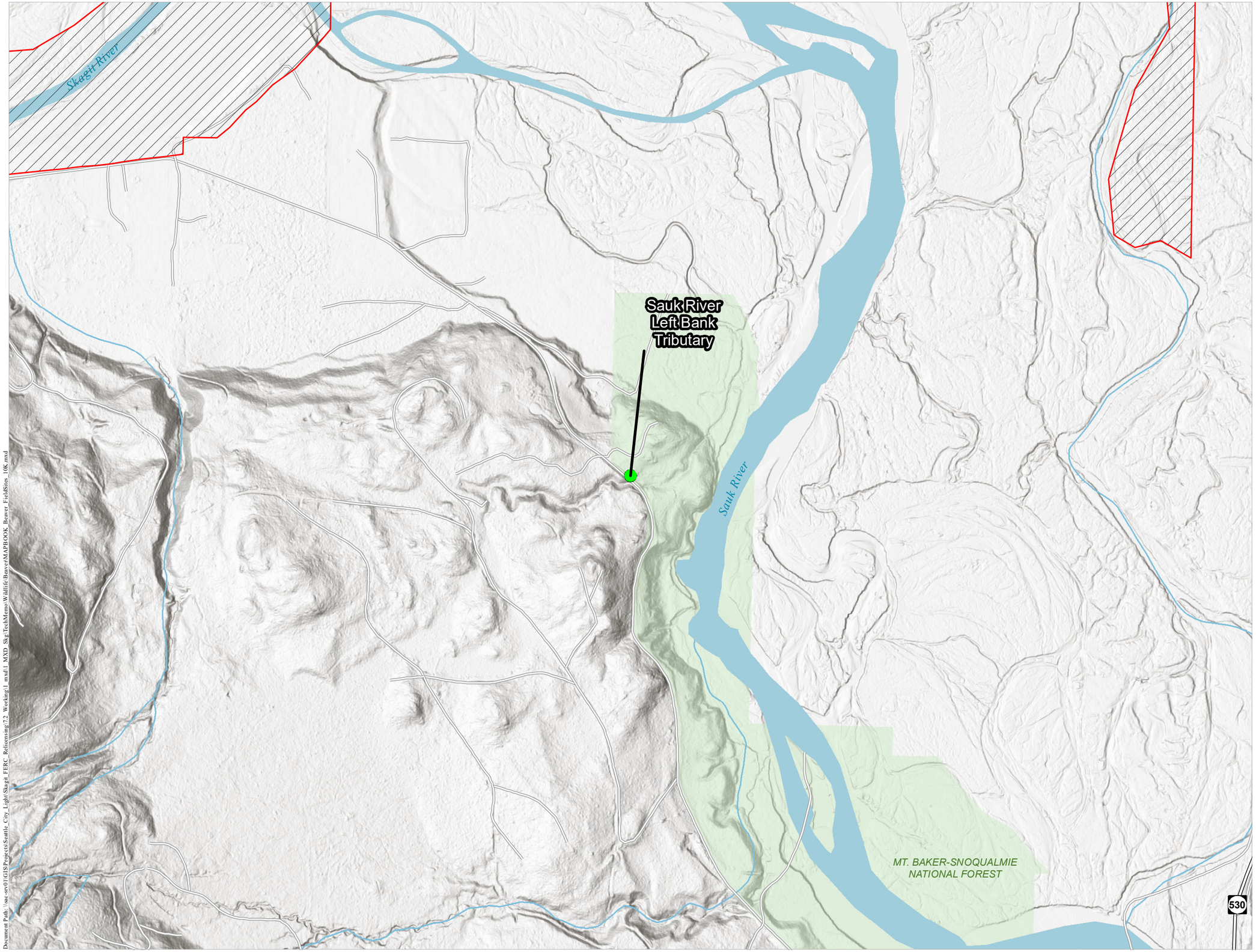


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sac-srv01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\7.2_Working\1_mxd\1_MXD_SkgTechMemo\Wildlife\Beaver\MAPBOOK_Beaver_FieldSites_10K.mxd

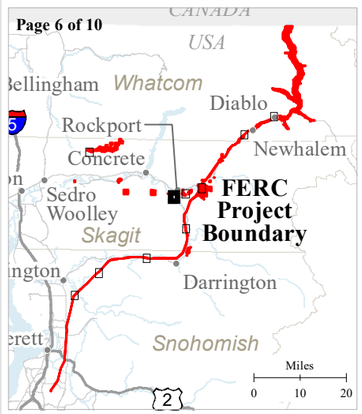


TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site
- U.S. Forest Service

N

0 450 900 Feet



Seattle City Light

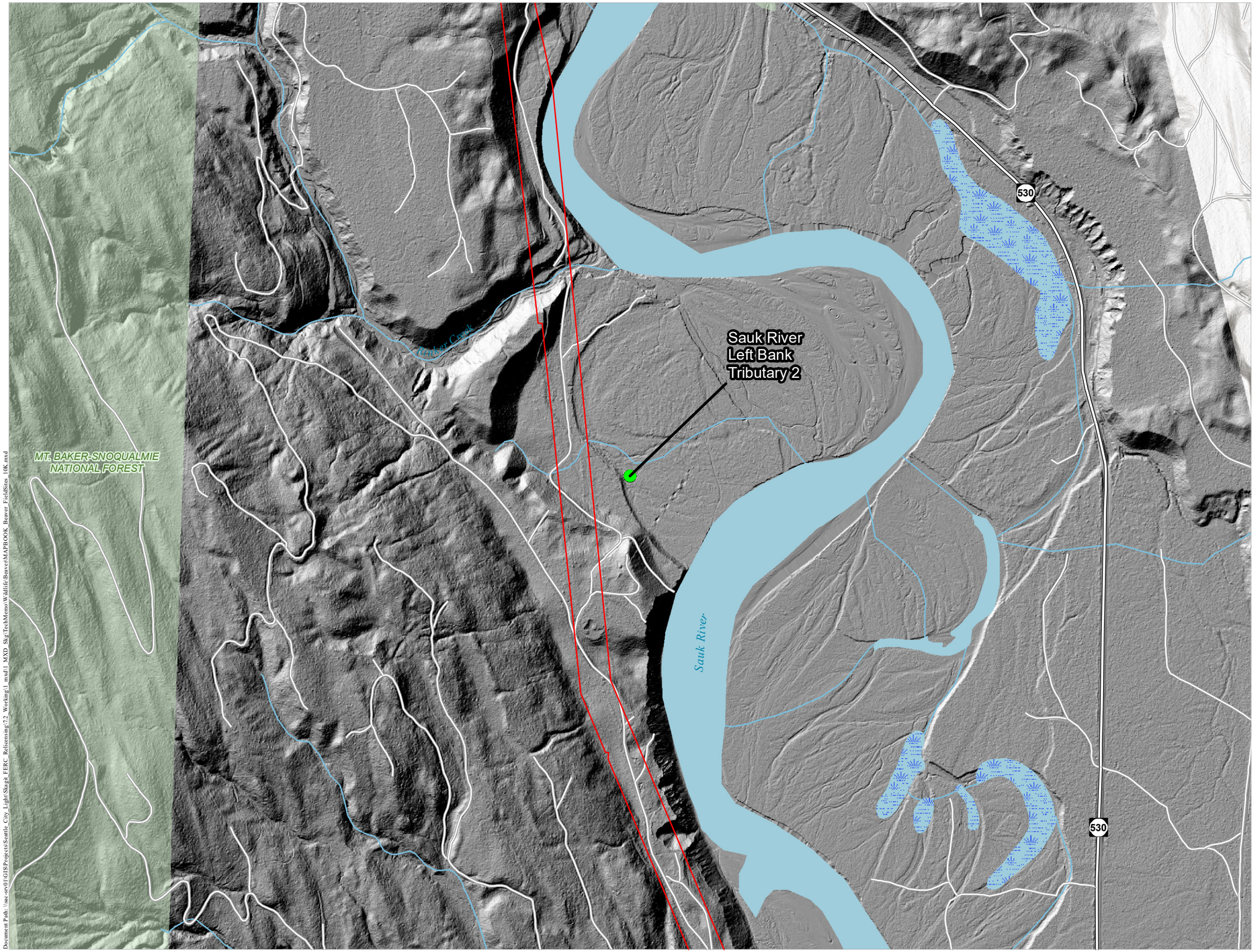
SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sac-sts01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\72_Working\1_mxd\1_MXD_Skgt\TechMemo\Wildlife\Beaver\MAPBOOK_Beaver_FieldSites_10K.mxd

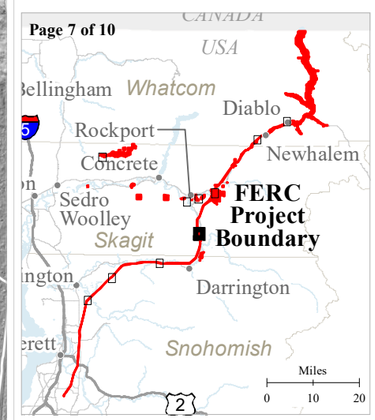
TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site
- U.S. Forest Service



N

0 450 900 Feet

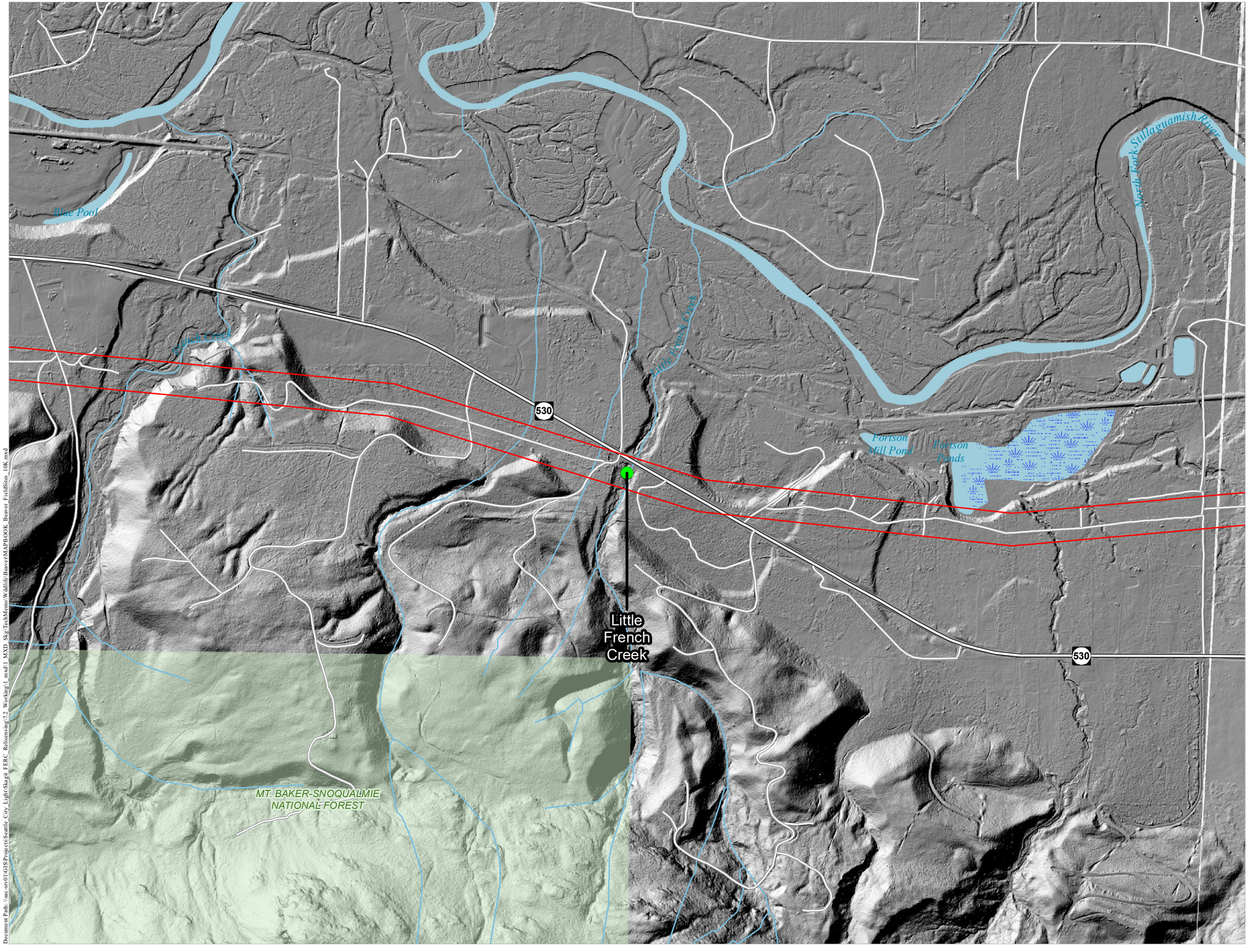


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sac-sv01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\72_Working\1_mxd\1_MXD_Skg\TechMemo\Wildlife\BeaverMAPBOOK_Beaver_FieldSites_10K.mxd

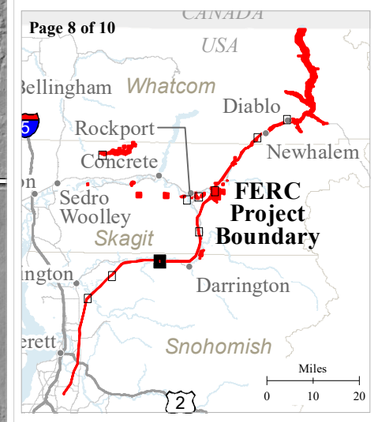


TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site
- U.S. Forest Service

N

0 450 900 Feet

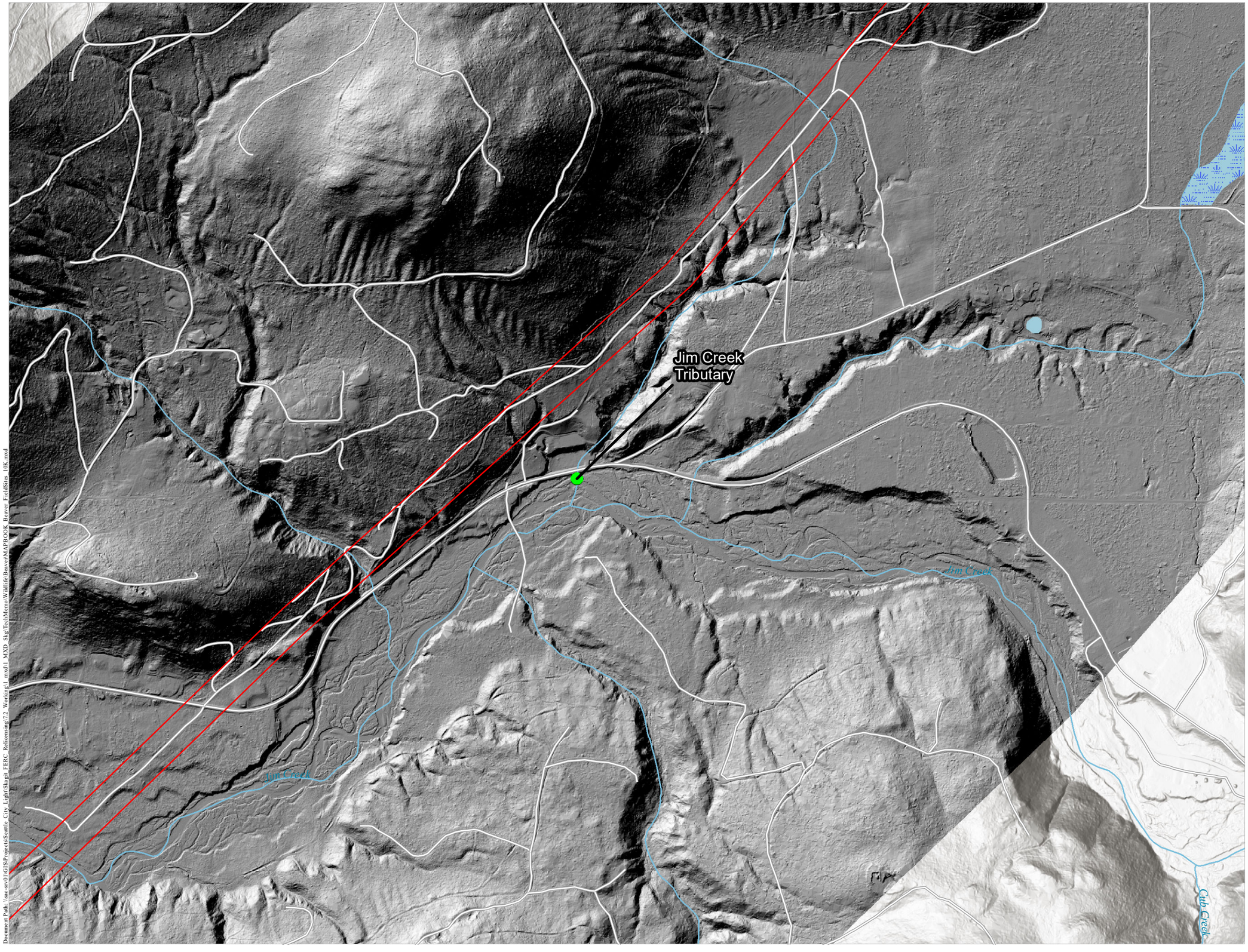


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sac-sv-01\GIS\Projects\Seattle City Light\Skagit FERC Relicensing\72 Working\1 mxd\1 MXD Skg\TechMemo\Wildlife\BeaverMAPBOOK Beaver FieldSites 10K.mxd

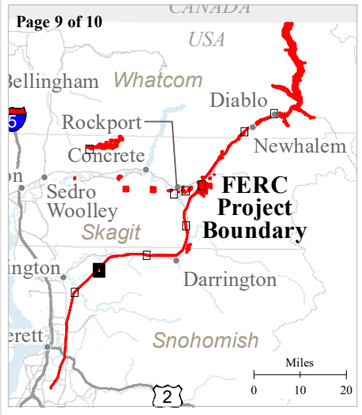


TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site

N

0 450 900 Feet

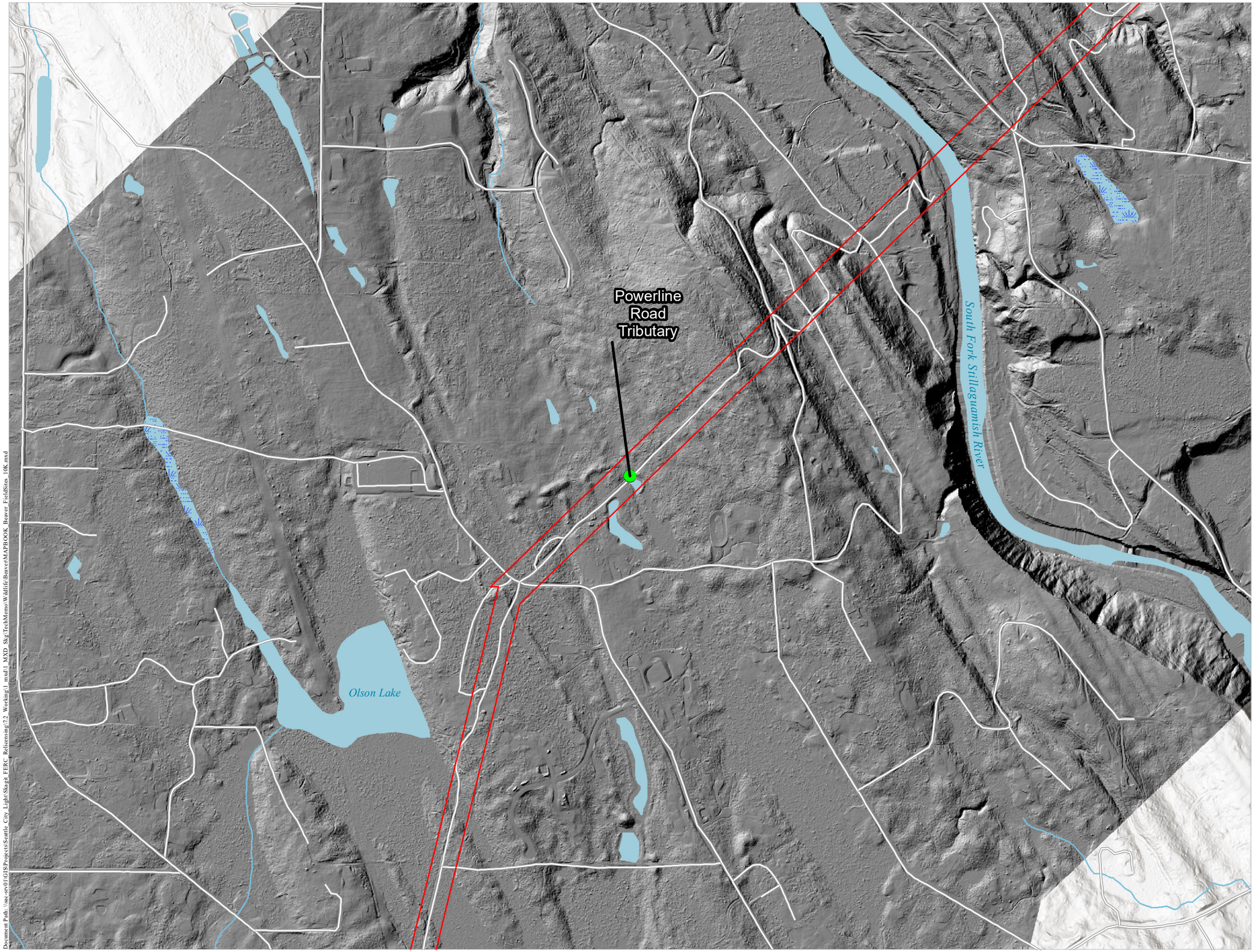


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sac-srv01\GIS\Projects\Seattle_City_Light\Skagit_FERC_Relicensing\72_Working\1_mxd\1_MXD_Skg\TechMemoWildlife\BeaverMAPBOOK_Beaver_FieldSites_10K.mxd

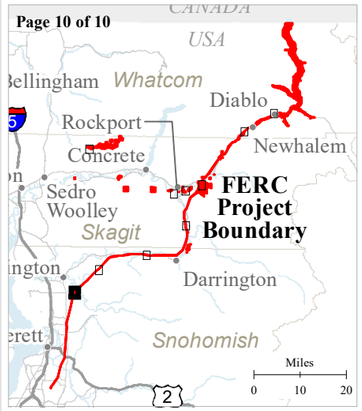


TR-09 BEAVER FIELD SITES TOPOGRAPHY (1:10,000 SCALE)

- FERC Project Boundary
- Mitigation Parcel
- Project River Miles (PRM)
- Beaver Study Field Site

N

0 450 900 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/5/2022 by HDR for Seattle City Light.
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: HDR 2021, Seattle City Light 2021, Airborne Imaging 2016, Eagle Mapping 2016, QuantumSpatial 2016,

Document Path: \\sea-serv01\GIS\Projects\Seattle City Light\Skagit_FERC_Relicensing\7.2 Working\1_mxd\1_MXD_Skg\TechMemo\Wildlife\Beaver\MAPBOOK_Beaver_FieldSites_10K.mxd