PRE-APPLICATION DOCUMENT

APPENDICES

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APPENDIX A

CONVERSION TABLE OF CITY OF SEATTLE DATUM TO NAVD 88 DATUM

Skagit Project Elevation Transformation Table

City Light As-Built to NAVD 88 Datum
Last Revised 12/2/2019

SPU was tasked to densify the elevations on the Skagit River Hydroelectric Project from the established NAVD 88 benchmarks that was done in 2015 for the Height Modernization. These benchmarks were published by the NGS (National Geodic Survey). SPU used these published benchmarks to establish NAVD 88 elevations on a number of existing City Light benchmarks, staff gages, and elevations of powerhouses and top of dam elevations to obtain a comparison between the existing City Light datum elevations of this items and the NAVD 88 datum. Below are the compiled elevations of these items at each site on the Skagit River Hydroelectric Project.

Notes:

(1) All elevations are in US Survey Feet.

(2) Refer to Geodetic Control Tables for each of the above networks.

(3) No guarantees are made for adjustment of feature elevations not listed in this table and additional survey may be required to determine current elevation of the feature in question.

(4) Above features are not to be used for survey control. All surveys shall use NGS benchmarks shown on Drawings D-44743 through D-44746.

Control Network and Feature	Reference	As-Built City Light Elevation (feet)	Surveyed Elevation in NAVD 88 (feet)	Delta (feet) (City Light Datum above NAVD 88)	Notes
Newhalem					
Gorge Powerhouse Finish Floor	D-44944	515.75	521.97	+6.22	
Gorge Dam					
Top of Gorge Dam	D-49941	880.67	886.97	+6.30	City Light brass disc in concrete 2.5' east of D/S parapet wall
Diablo (Powerhouse / Hollywood Townsite)					
Diablo Powerhouse	RR Map El., FB 49A, PG10	892.39	898.77	+6.38	Finish floor elevation surveyed 897.42 (+6.42 feet). 6.38 feet selected based on brass cap.
Stetattle Creek Bridge	RR Map	890.78	897.16	+6.38	Based off of City Light Survey Field Book 49A, Page 9 using the Railroad (RR) Map Elevation.
Diablo Dam					
Top of Dam (0+00 level pegging station)	D-44947	1,218.00	1,224.72	+6.72	Use +6.65 for Diablo Dam
Top of Dam (2+00 level pegging station)	D-44947	1,218.00	1,224.59	+6.59	Use +6.65 for Diablo Dam

Control Network and Feature	Reference	As-Built City Light Elevation (feet)	Surveyed Elevation in NAVD 88 (feet)	Delta (feet) (City Light Datum above NAVD 88)	Notes
City Light Benchmark NE end of bathrooms	Benchmark	1,219.69	1,226.01	+6.32	
Ross Dam (and Powerhouse)					
Top of Dam at toe of D/S parapet wall	D-44952	1,615.25	1,621.45	+6.20	Upstream wall also had delta of +6.20'.
Ross Powerhouse Finish Floor	D-44954	1,236.50	1,242.65	+6.15	

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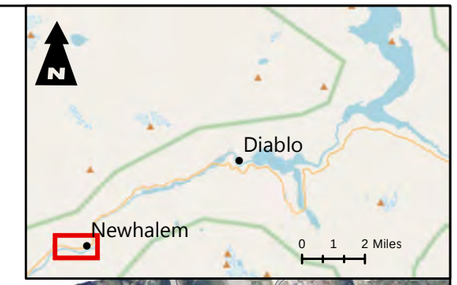

Seattle City Light

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NAVD-88 Survey Elevations

Newhalem and vicinity

1:5,500

500 250 0 500 1,000 Feet

All elevations in this map are current as of January 28, 2020.

N

Horizontal Datum: NAD 83, 2011 (2010.00)*
Vertical Datum: NAVD-88 (Geoid12)
Units: US Survey Feet
*Note: Non NGS Bench Marks have not been horizontally surveyed.

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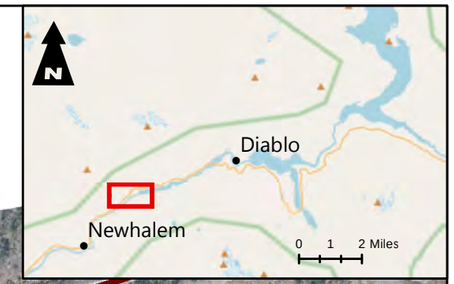

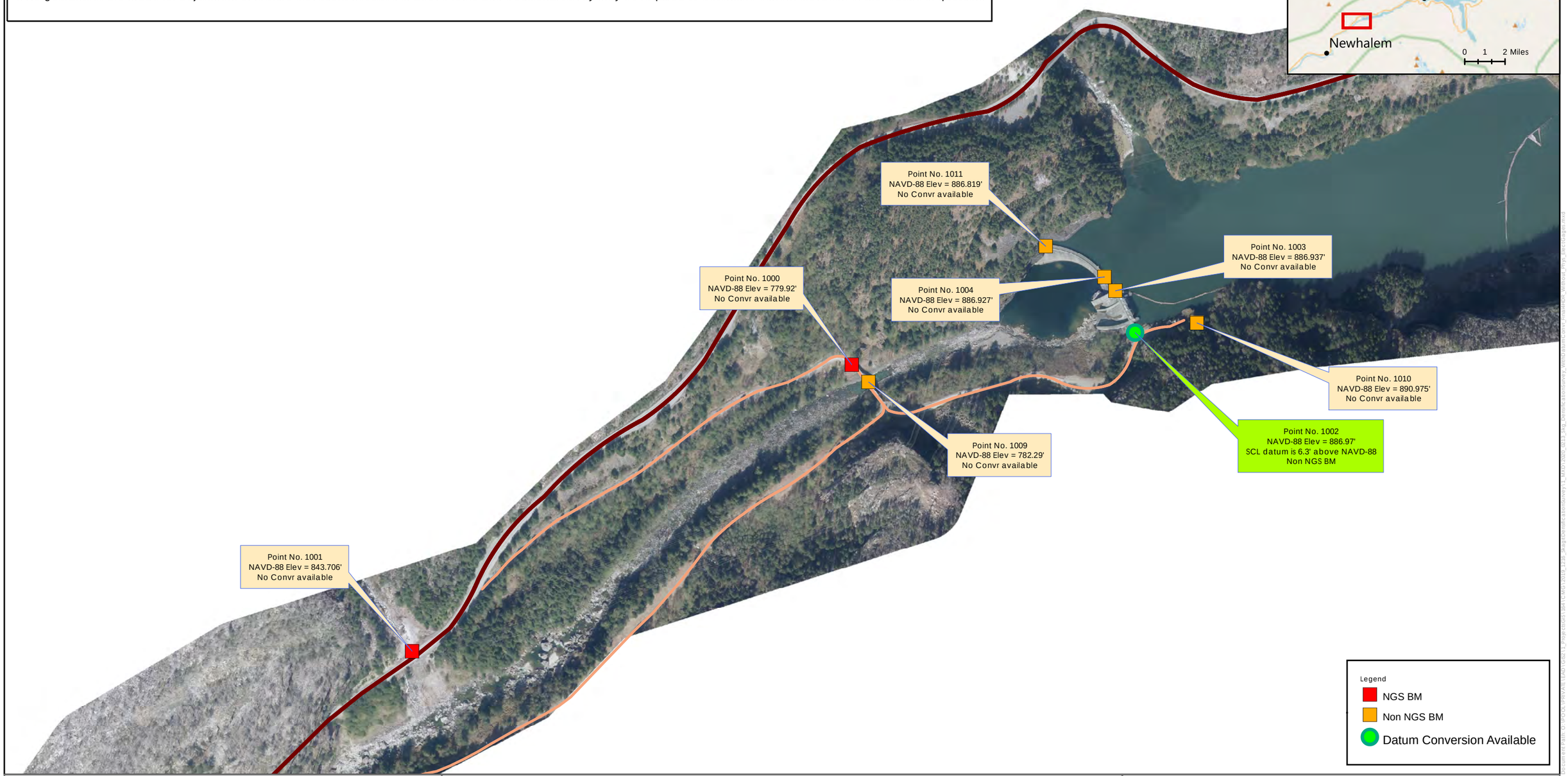

Seattle City Light

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NAVD-88 Survey Elevations

Gorge Dam and vicinity

1:5,500

500 250 0 500 1,000 Feet

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N

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Point No. 2027
NAVD-88 Elev = 897.16'
SCL datum is 6.38' above NAVD-88
Non NGS BM

Point No. 2102
NAVD-88 Elev = 894.409'
No Convr available

Point No. 2011
NAVD-88 Elev = 899.641'
No Convr available

Point No. 2007
NAVD-88 Elev = 895.479'
No Convr available

Point No. 2012
NAVD-88 Elev = 898.987'
No Convr available

Point No. 2005
NAVD-88 Elev = 895.799'
No Convr available

Point No. 2101
NAVD-88 Elev = 894.729'
No Convr available

Point No. 2029
NAVD-88 Elev = 888.918'
No Convr available

Point No. 2013
NAVD-88 Elev = 900.413'
No Convr available

Point No. 2030
NAVD-88 Elev = 898.77'
SCL datum is 6.38' above NAVD-88
Non NGS BM

Gorge

Point No. 2014
NAVD-88 Elev = 899.034'
No Convr available

Point No. 2001
NAVD-88 Elev = 1227.379'
No Convr available

Point No. 2015
NAVD-88 Elev = 896.982'
No Convr available

Point No. 2023
NAVD-88 Elev = 890.977'
No Convr available

Point No. 2016
NAVD-88 Elev = 896.801'
No Convr available

Point No. 2022
NAVD-88 Elev = 894.168'
No Convr available

Diablo

Point No. 2000
NAVD-88 Elev = 895.238'
No Convr available

Point No. 2002
NAVD-88 Elev = 897.385'
No Convr available

Point No. 2003
NAVD-88 Elev = 894.057'
No Convr available

Point No. 2031
NAVD-88 Elev = 901.421'
No Convr available

Legend
- NGS BM
- Non NGS BM
- Datum Conversion Available

Seattle City Light

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NAVD-88 Survey Elevations

Diablo Townsite and vicinity

1:5,500

500 250 0 500 1,000 Feet

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N

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Point No. 3001
NAVD-88 Elev = 1213.912'
No Convr available

Point No. 3007
NAVD-88 Elev = 1226.01'
SCL datum is 6.32' above NAVD-88
Non NGS BM

Point No. 3000
NAVD-88 Elev = 1226.674'
No Convr available

Point No. 3005
NAVD-88 Elev = 1228.088'
No Convr available

Point No. 3006
NAVD-88 Elev = 1224.699'
No Convr available

Point No. 3009
NAVD-88 Elev = 1224.59'
SCL datum is 6.59' above NAVD-88
Non NGS BM

Point No. 3008
NAVD-88 Elev = 1224.72'
SCL datum is 6.72' above NAVD-88
Non NGS BM

Point No. 3010
NAVD-88 Elev = 1224.841'
No Convr available

Legend
- NGS BM
- Non NGS BM
- Datum Conversion Available

Seattle City Light

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NAVD-88 Survey Elevations

Diablo Dam and vicinity

1:5,500

500 250 0 500 1,000 Feet

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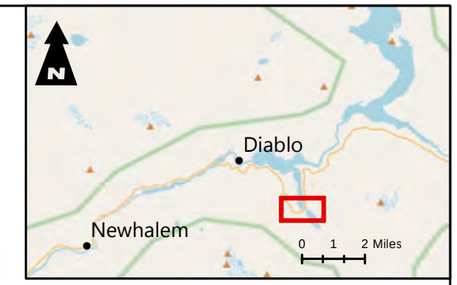

Colonial Creek N

Point No. 3004
NAVD-88 Elev = 1223.8'
No Convr available

Colonial Creek S

Legend
NGS BM
Non NGS BM
Datum Conversion Available

Seattle City Light

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NAVD-88 Survey Elevations

Thunder Arm

1:5,500

500 250 0 500 1,000 Feet

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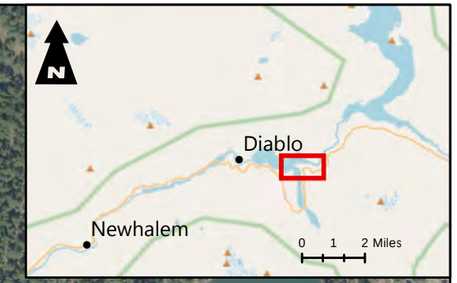

Hidden Cove

Point No. 3003
NAVD-88 Elev = 1695.315'
No Convr available

Thunder Point

Legend
NGS BM
Non NGS BM
Datum Conversion Available

Seattle City Light

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1:5,500

NAVD-88 Survey Elevations

Diablo Overlook

500 250 0 500 1,000 Feet

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N

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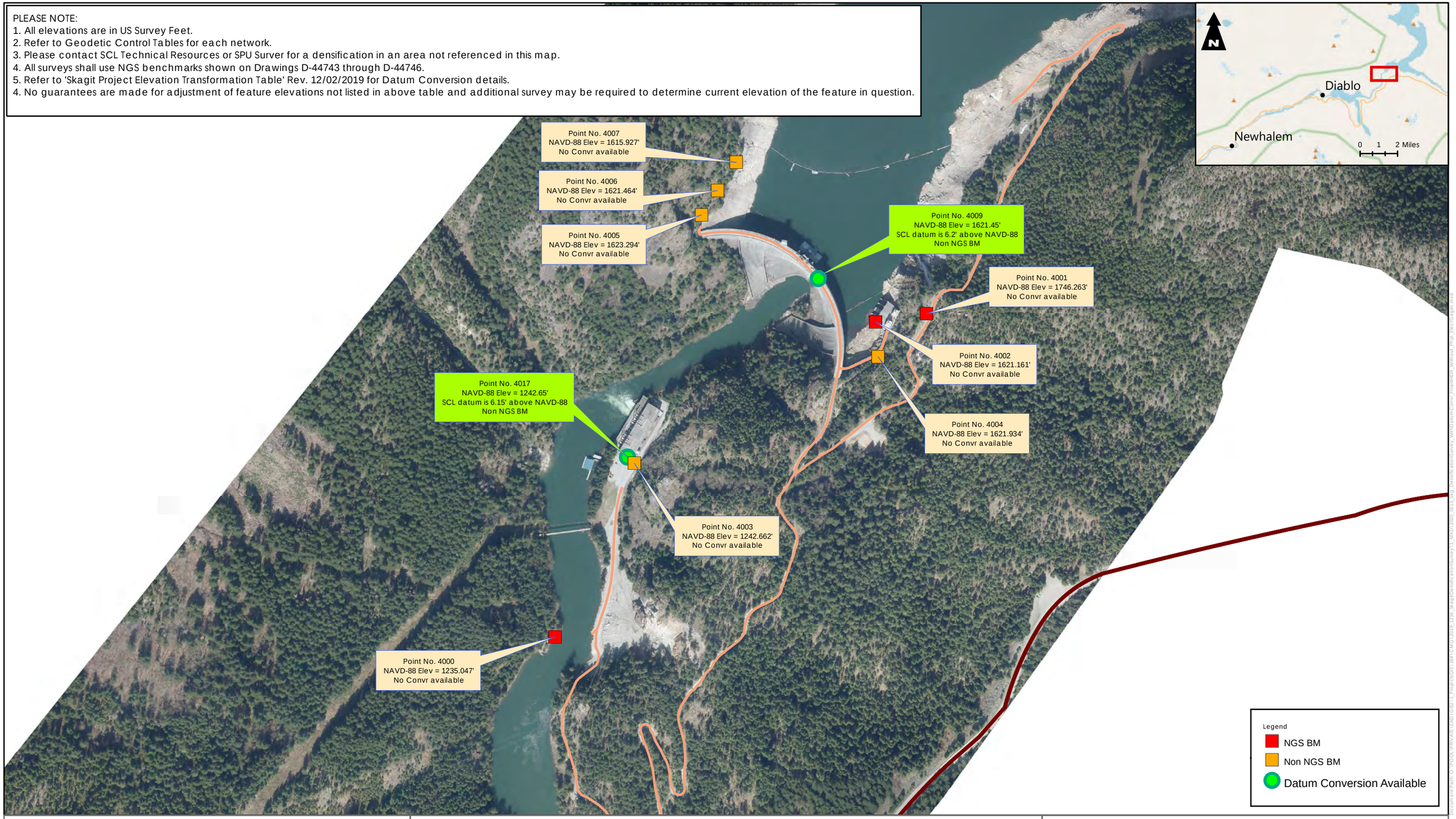

Seattle City Light

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NAVD-88 Survey Elevations

Ross Dam and vicinity

1:5,500

500 250 0 500 1,000 Feet

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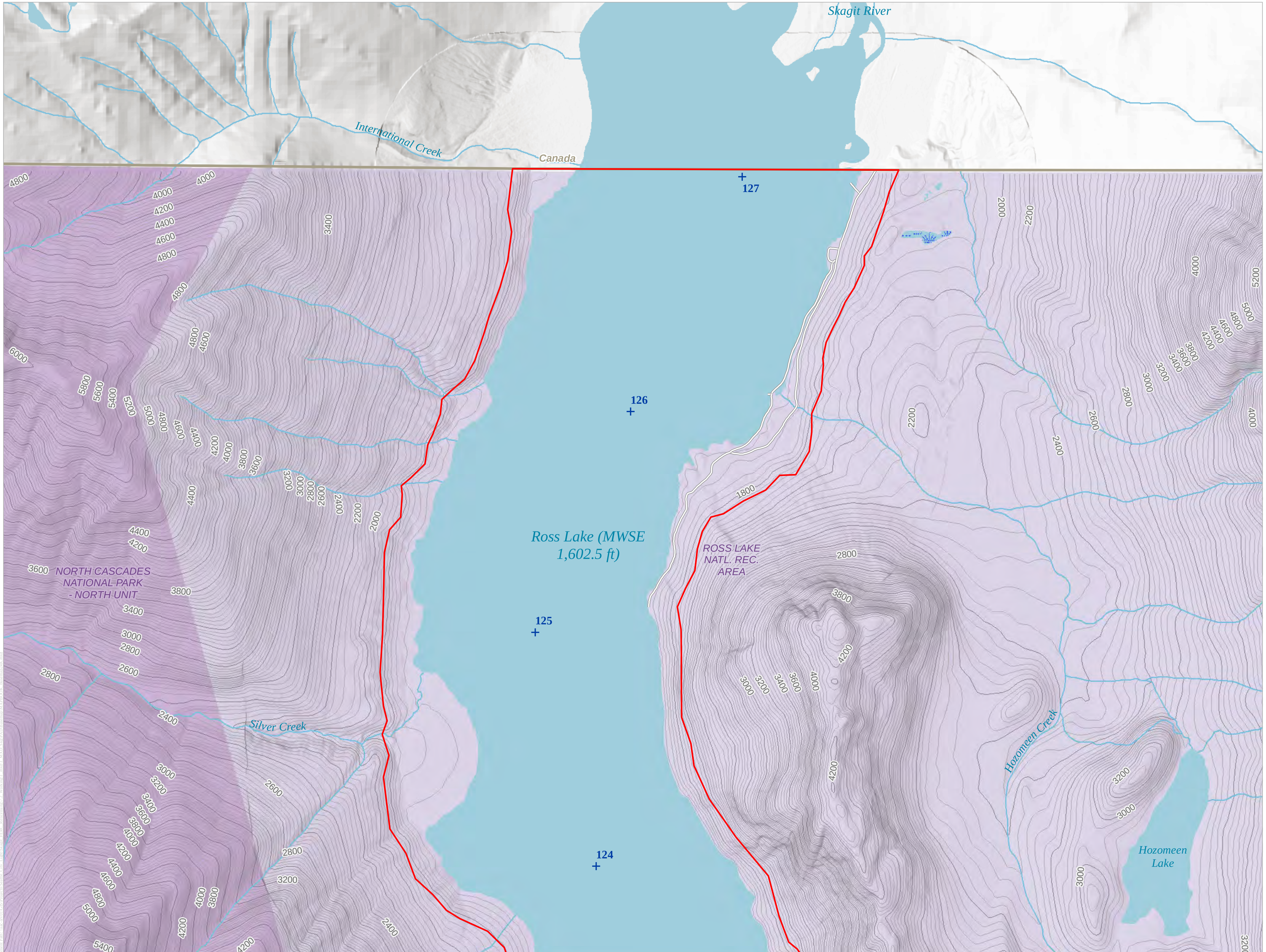
APPENDIX B

MAPBOOK OF PROJECT BOUNDARY AND MITIGATION LANDS



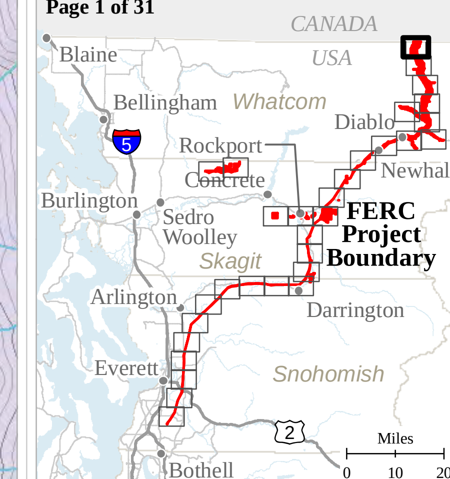
GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- National Park Service
- National Recreation Area (NPS)

NOTE: Maximum water surface elevations (MWSE) are in City of Seattle vertical datum.

0 1,000 2,000 Feet

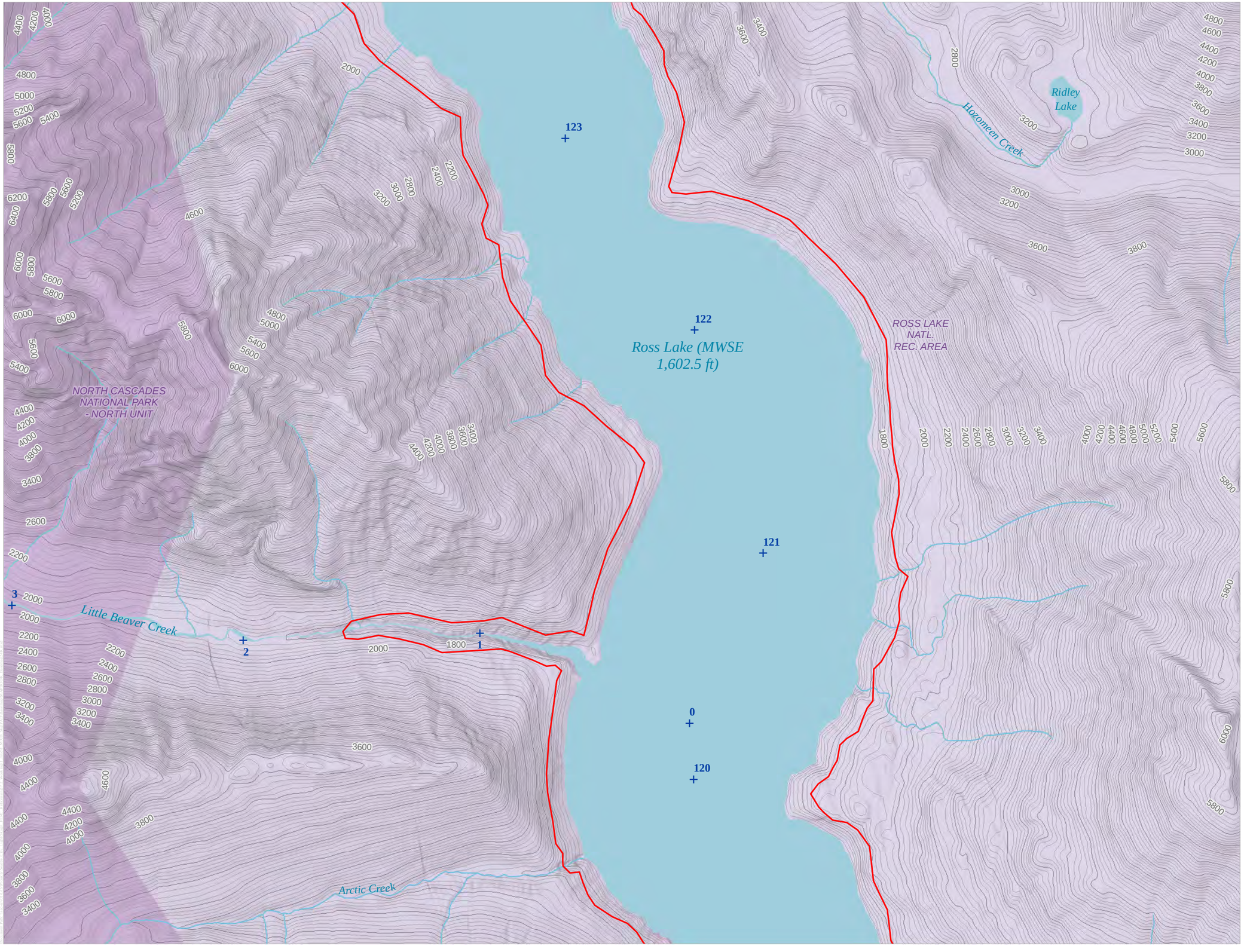
Page 1 of 31



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Data Source: Hydrography - USGS (2019); NPS/USFS land ownership - BLM (2019); Roads - Washington DNR (2019).



GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

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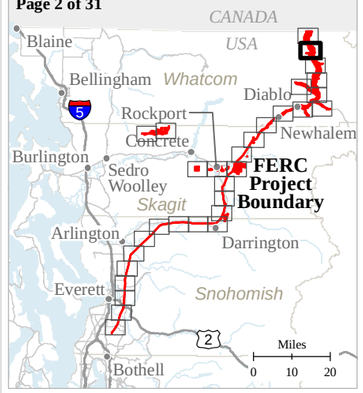
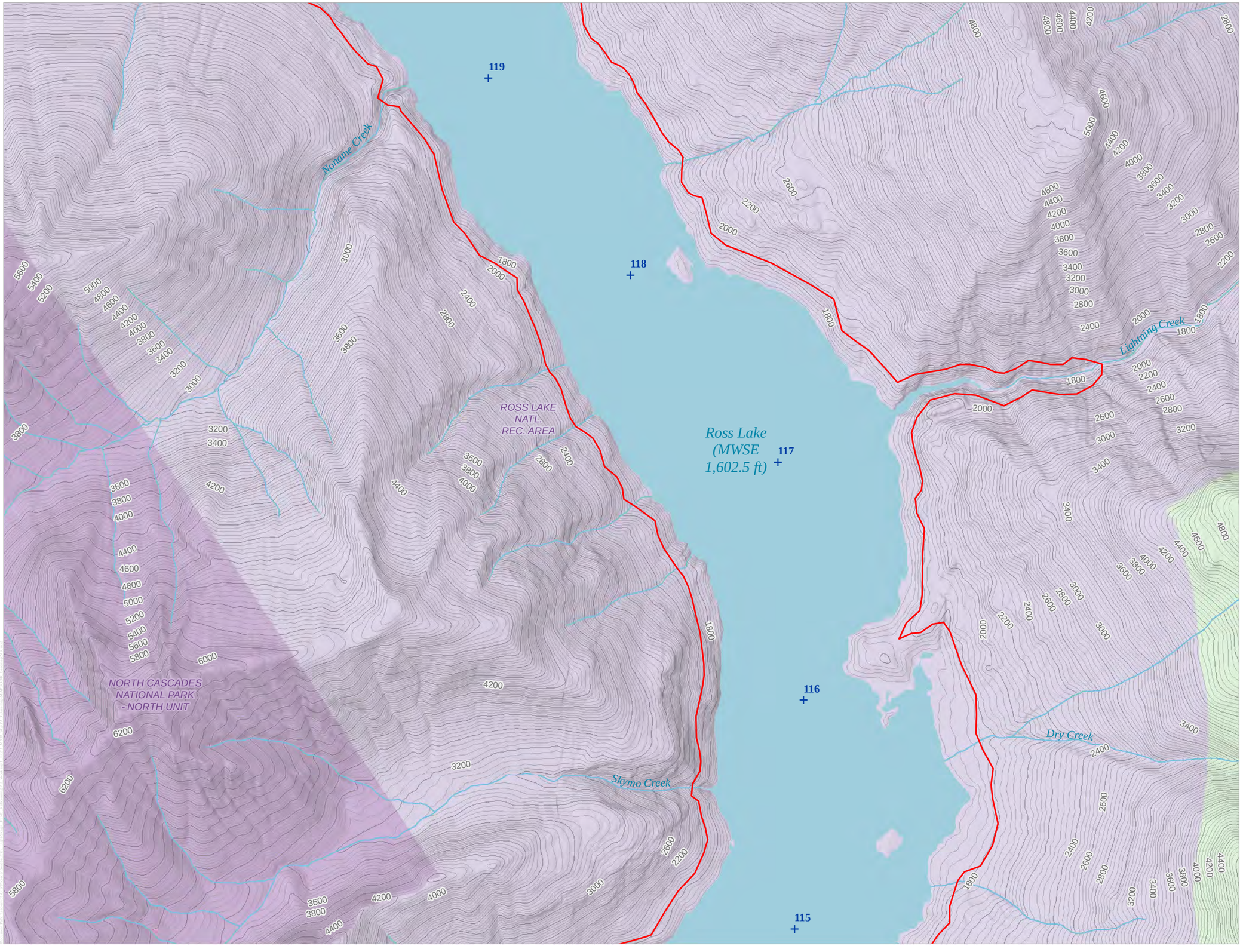
N

0 1,000 2,000 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)



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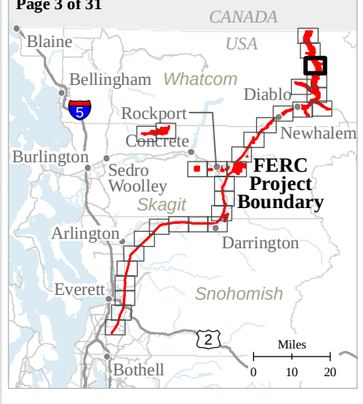
0 1,000 2,000 Feet



Seattle City Light

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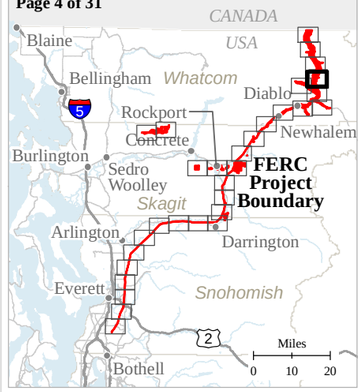
0 1,000 2,000 Feet



Seattle City Light

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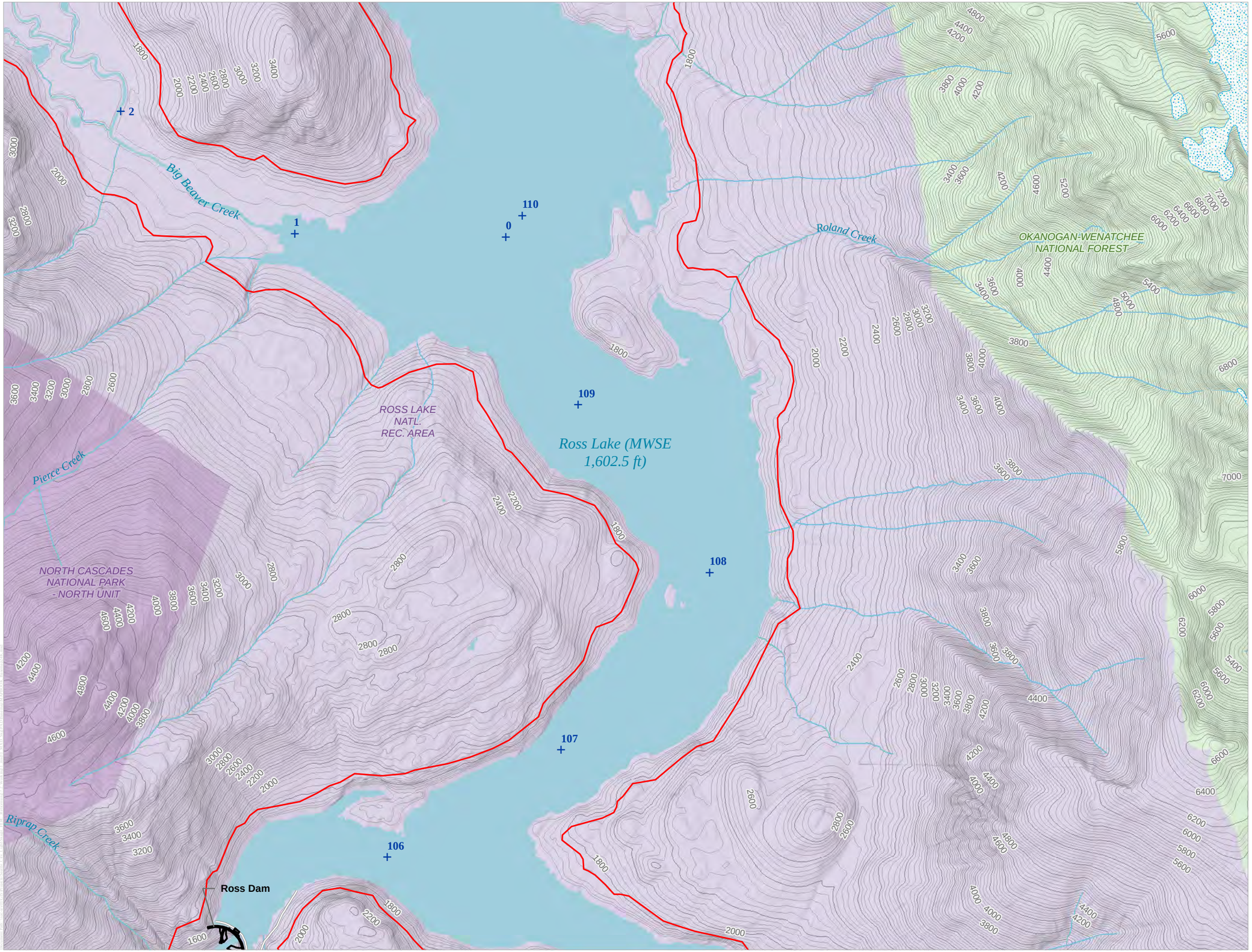

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

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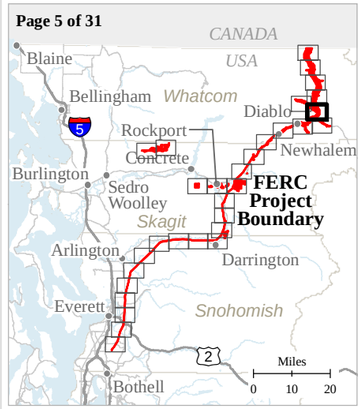

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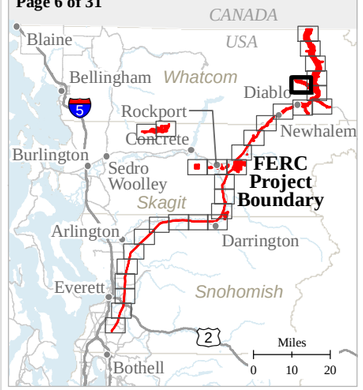
0 1,000 2,000 Feet



Seattle City Light

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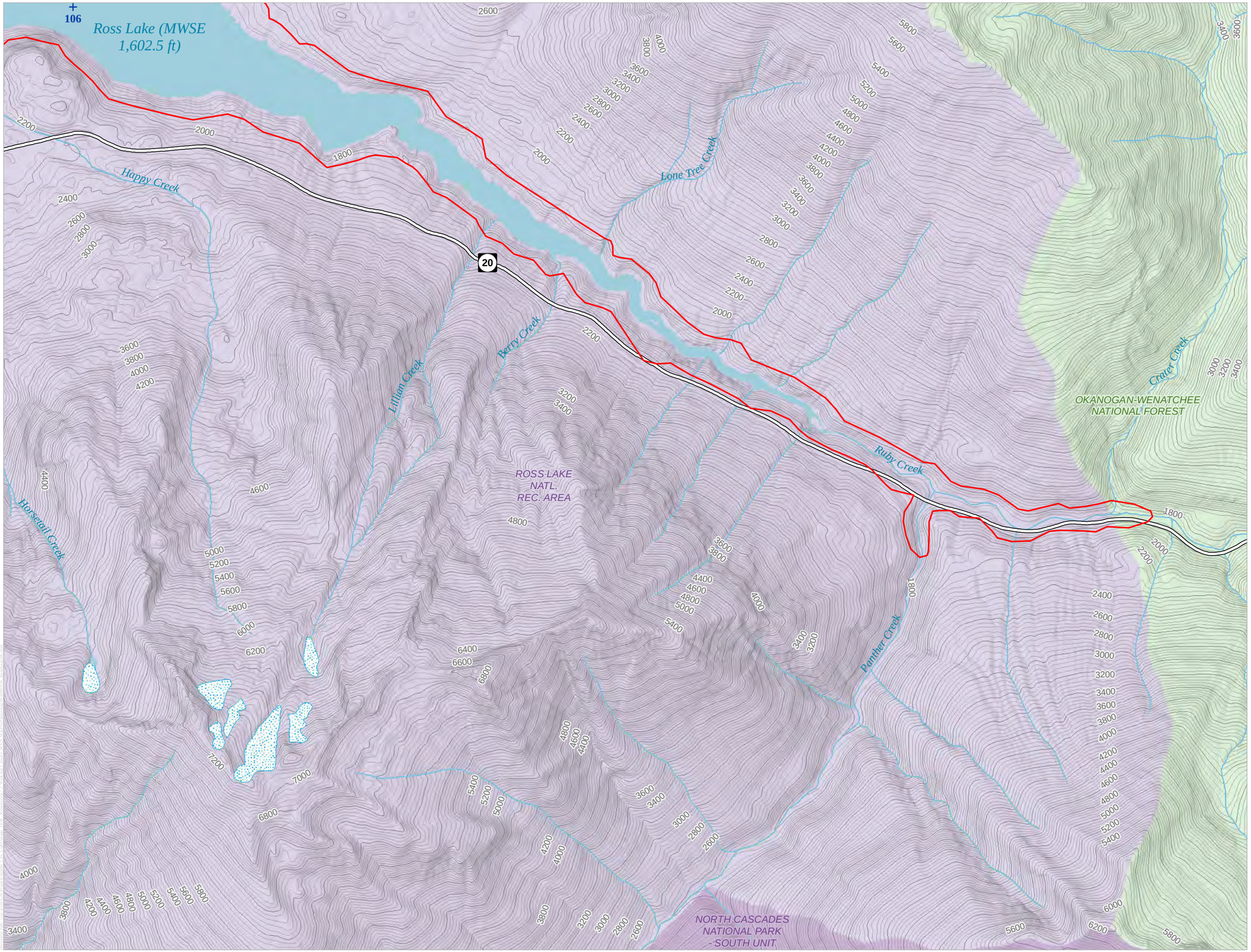

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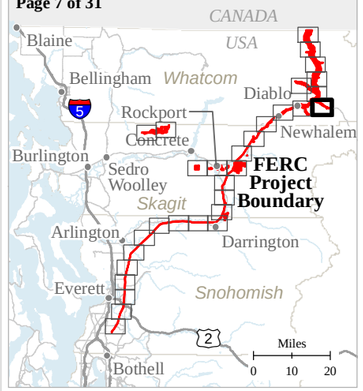
N

0 1,000 2,000 Feet



Seattle City Light

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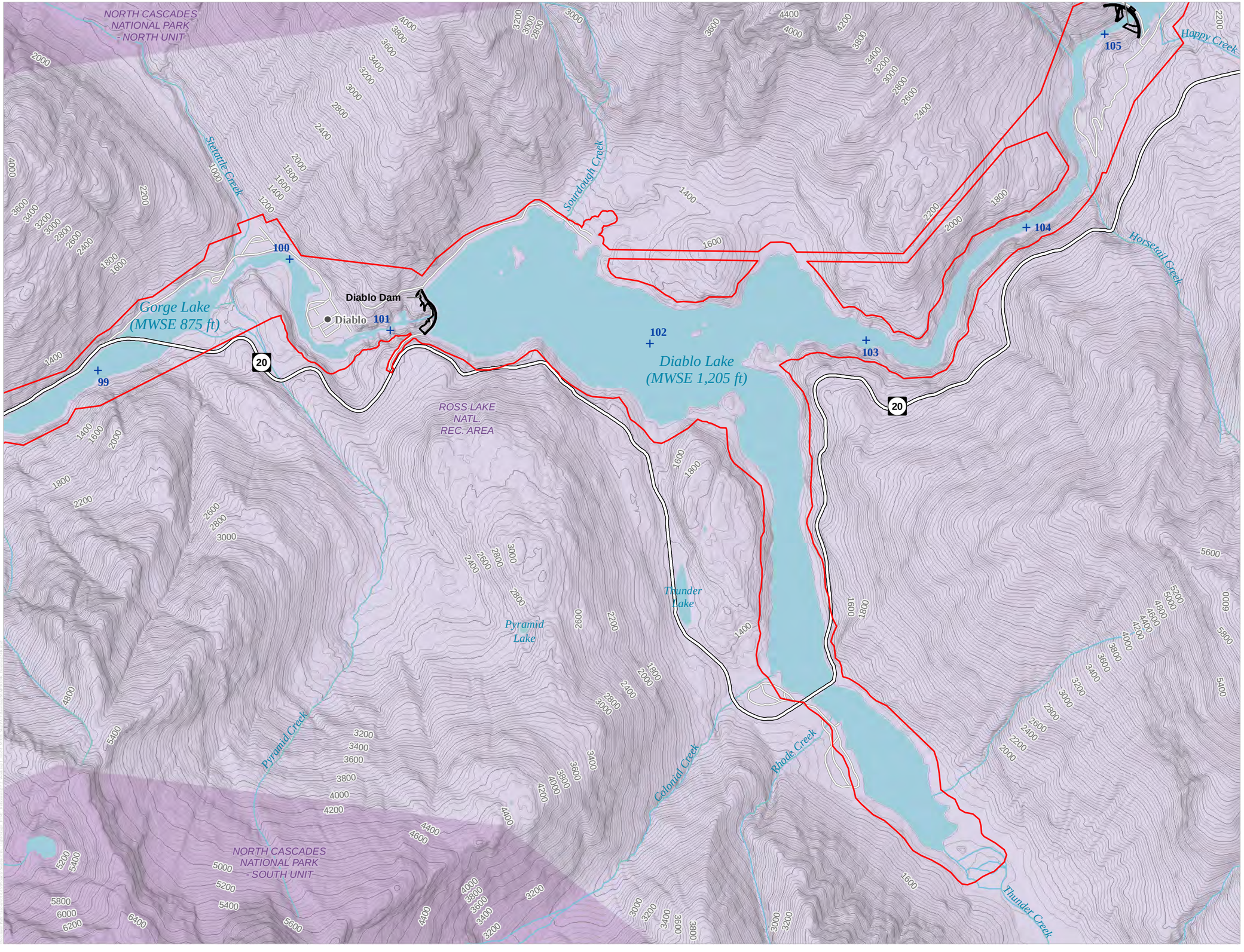

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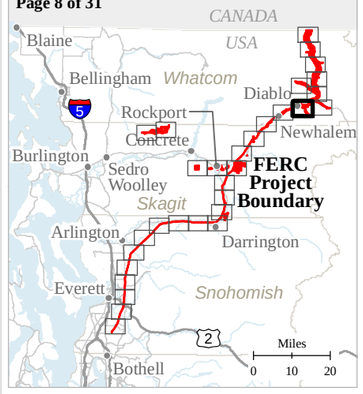
0 1,000 2,000 Feet



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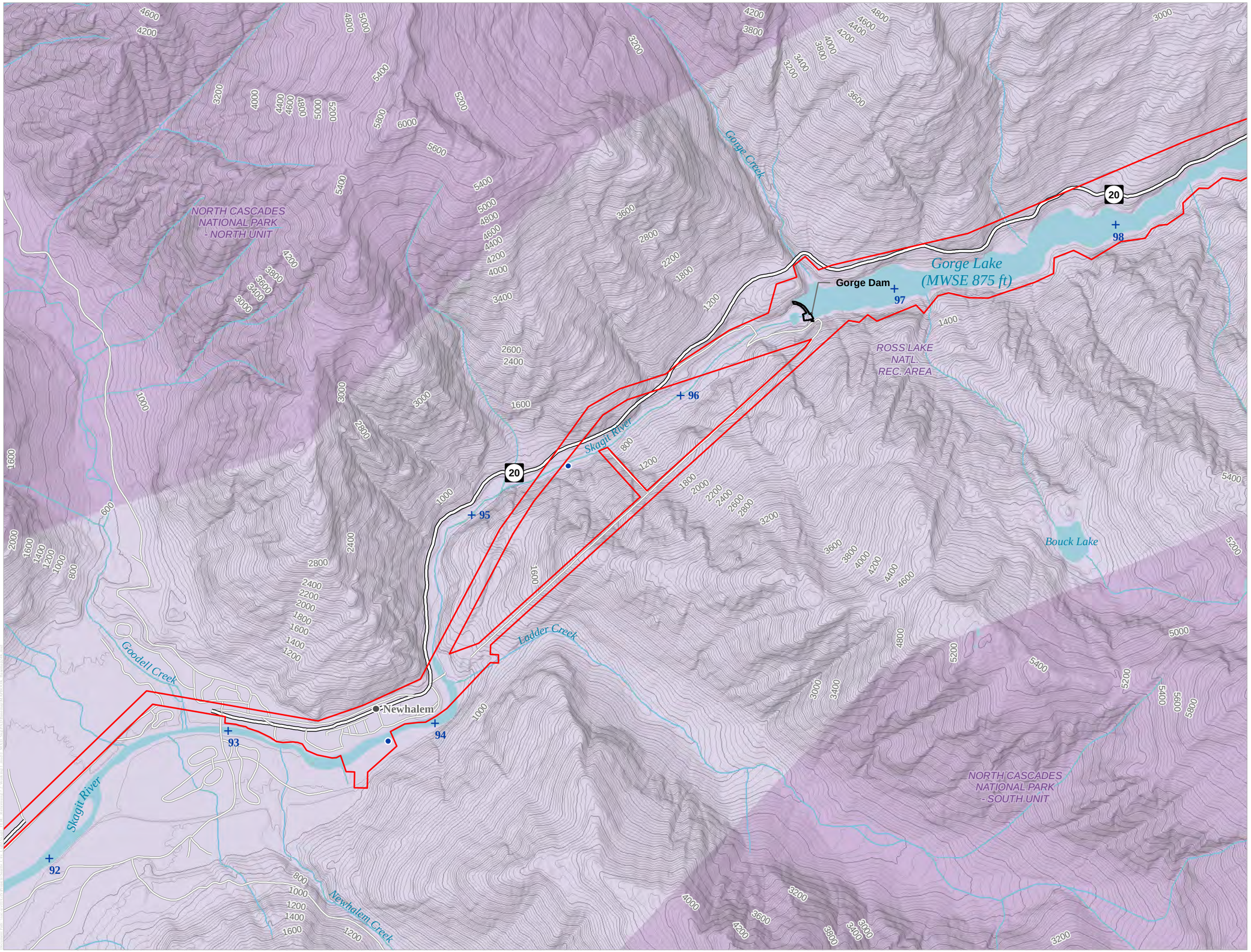


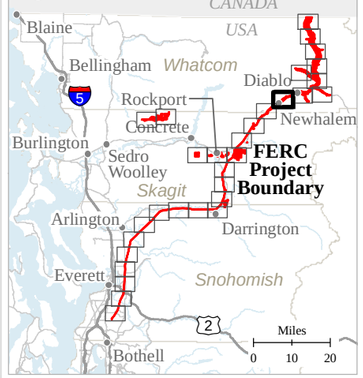
GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- Stream Gage (USGS)
- National Park Service
- National Recreation Area (NPS)

NOTE: Maximum water surface elevations (MWSE) are in City of Seattle vertical datum.

N

0 1,000 2,000 Feet



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SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

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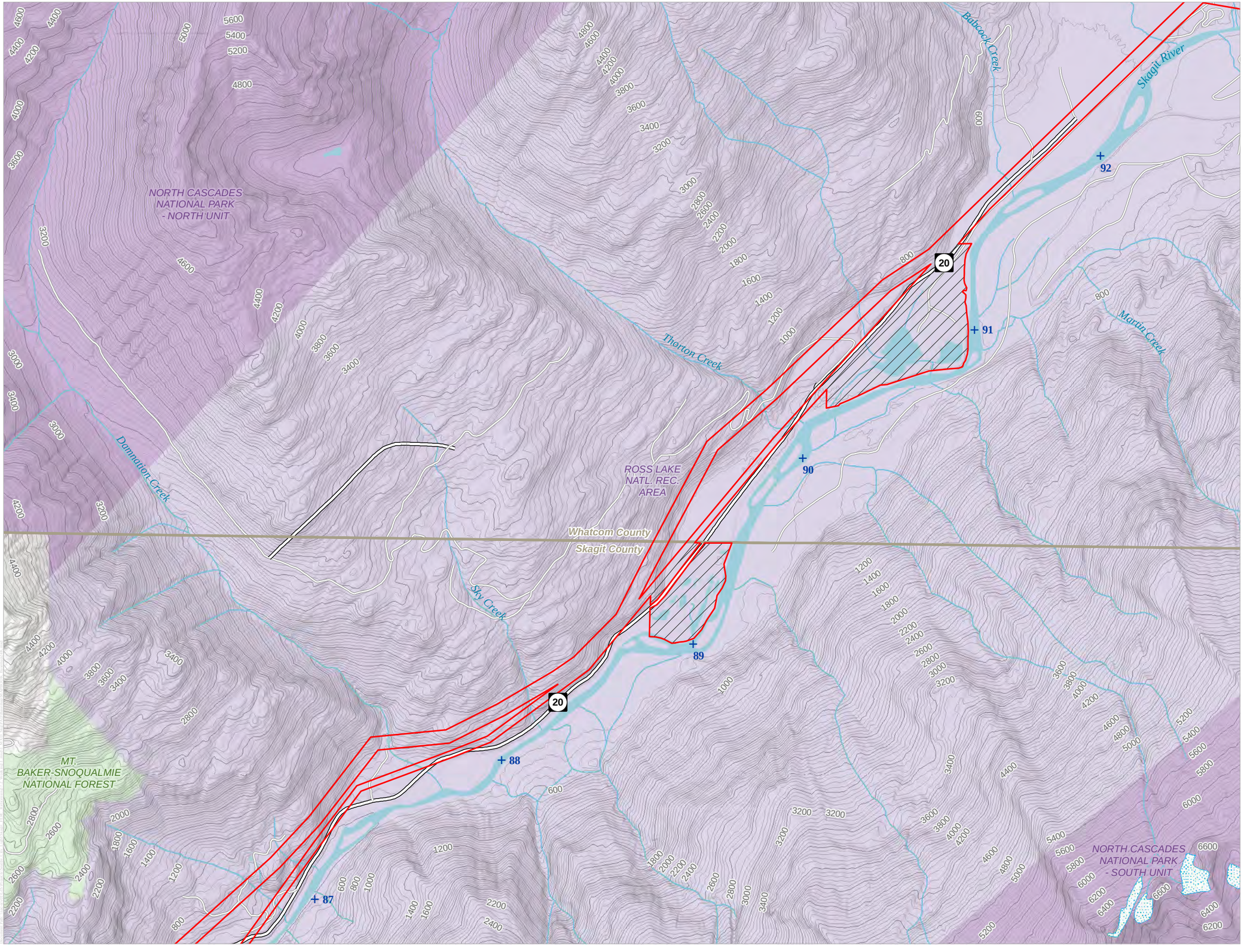

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- National Park Service
- National Recreation Area (NPS)
- U.S. Forest Service

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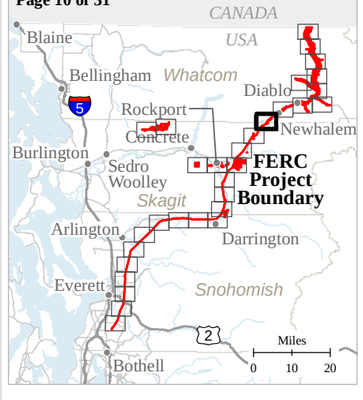
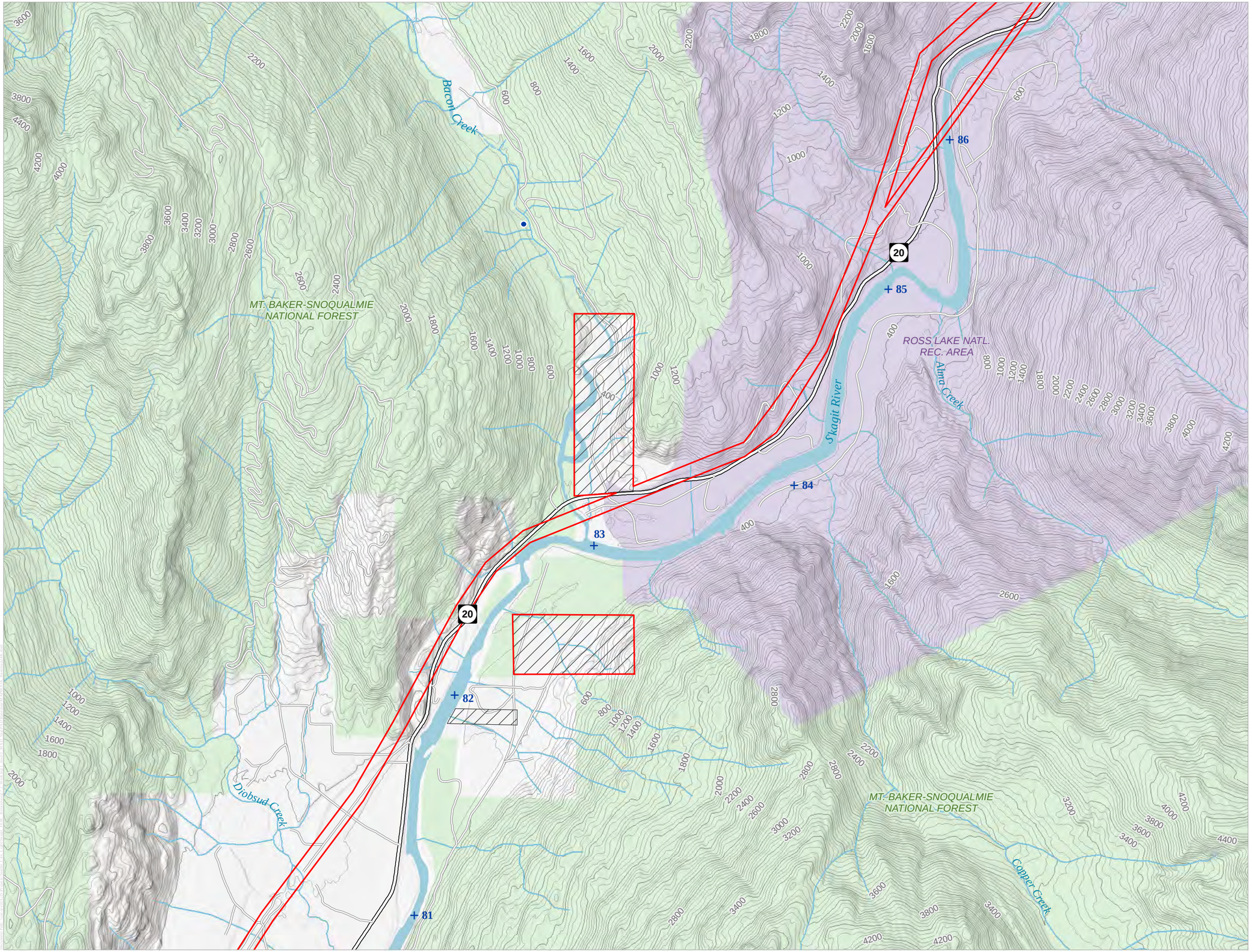


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)



GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
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- National Recreation Area (NPS)
- U.S. Forest Service

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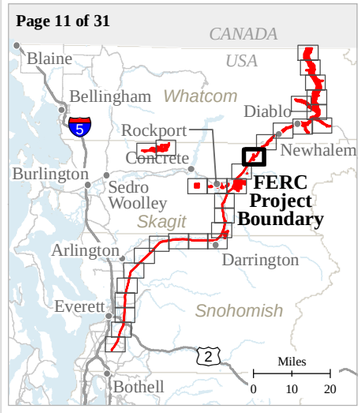

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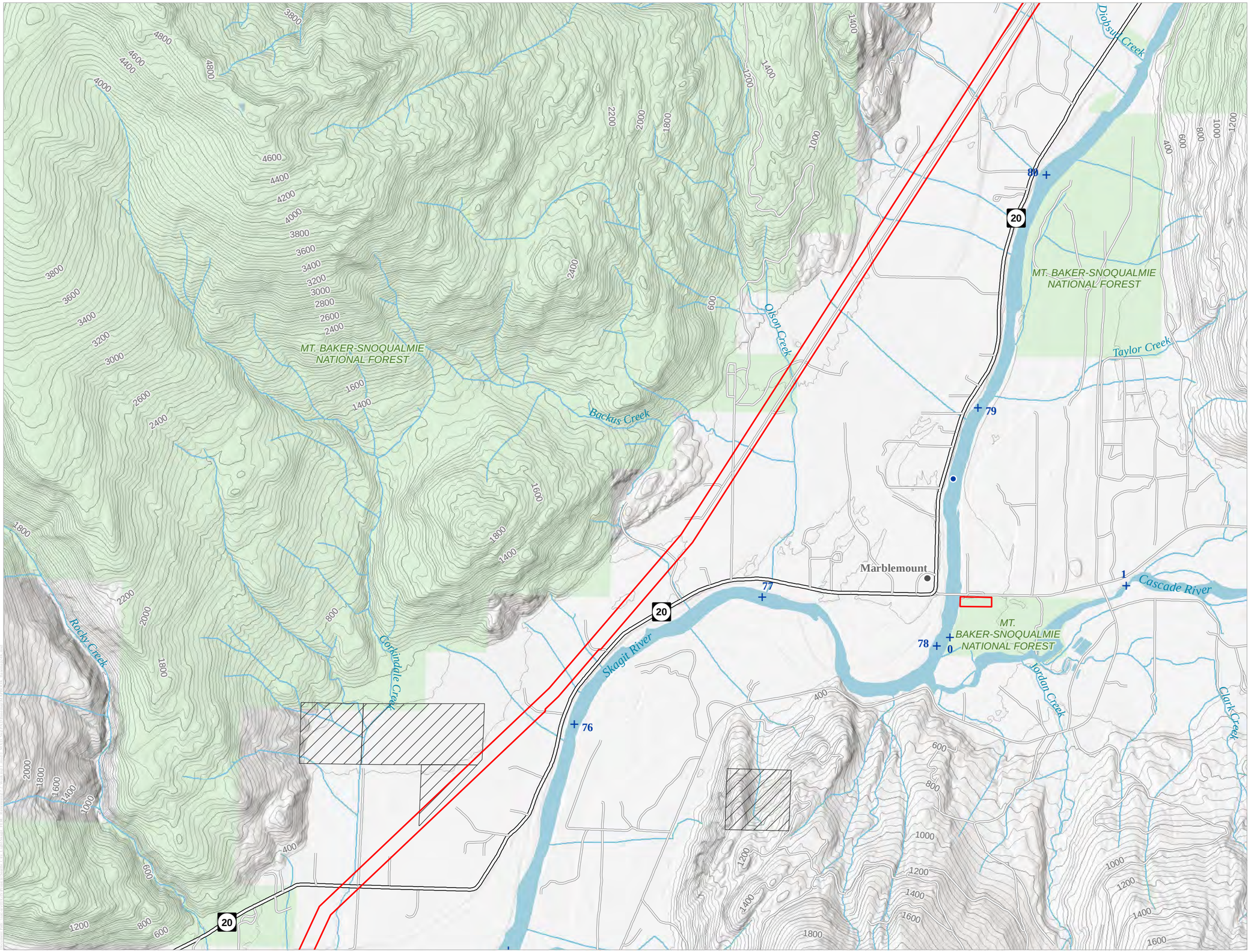

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

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- River Mile (USGS)
- Stream Gage (USGS)
- U.S. Forest Service

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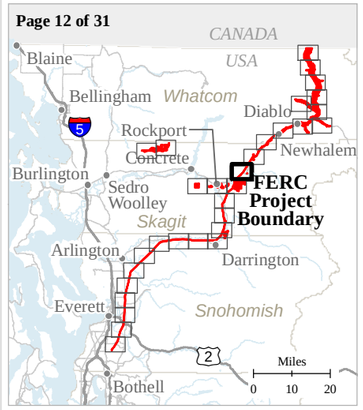

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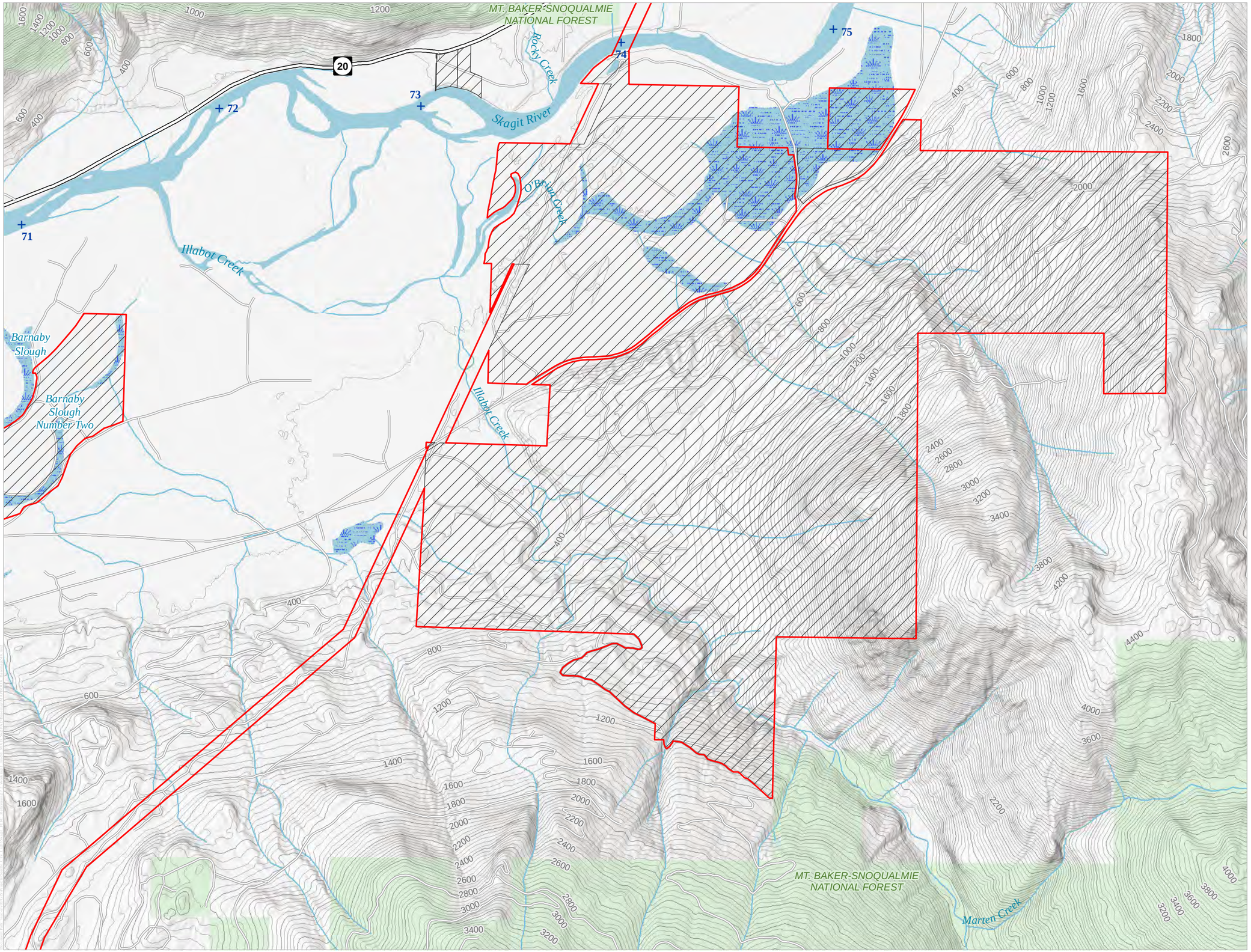

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- U.S. Forest Service

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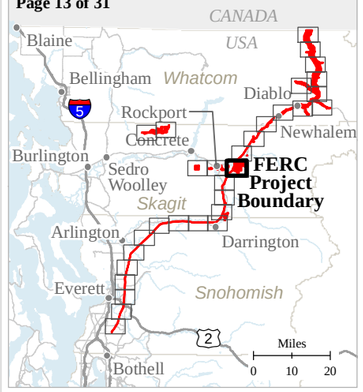

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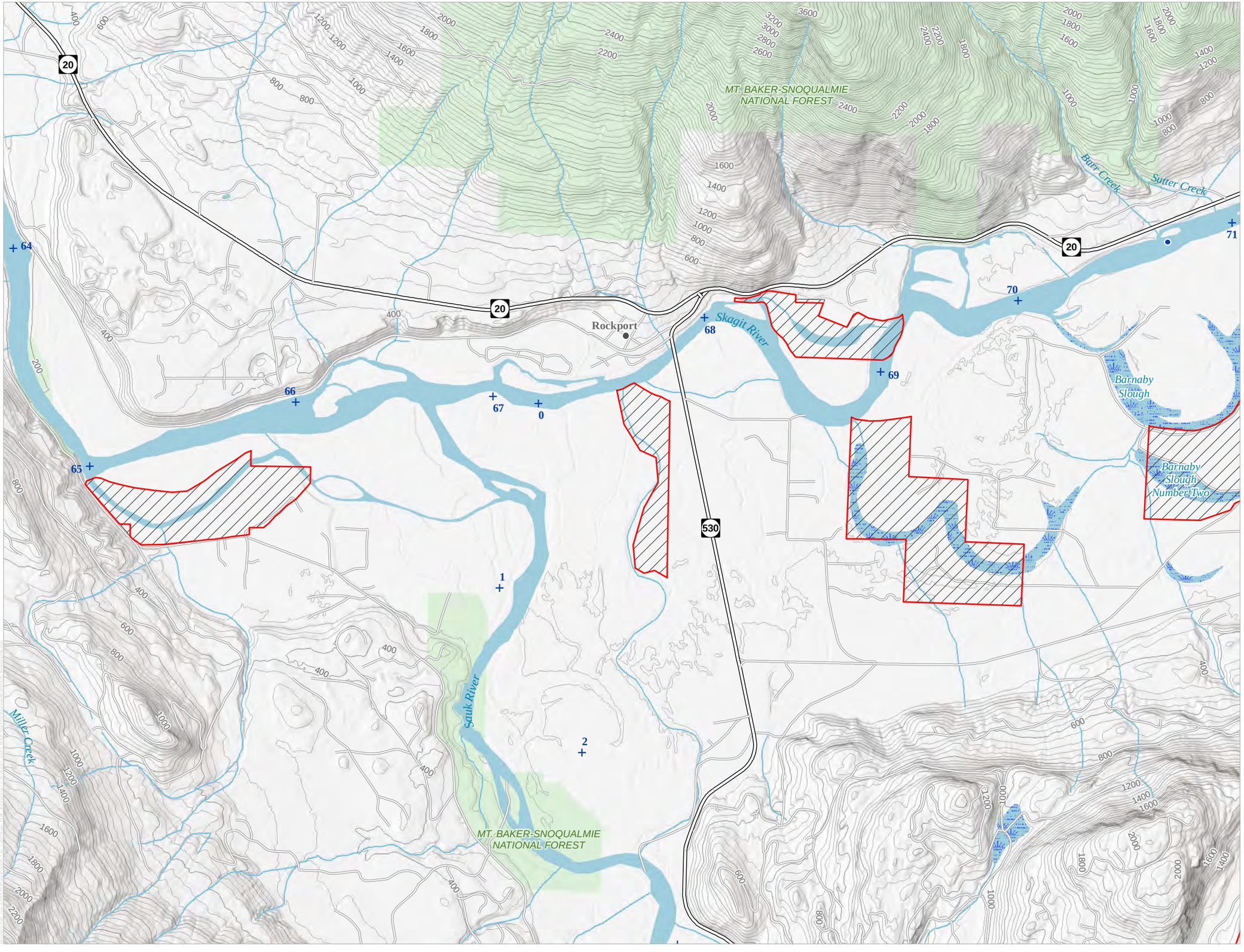

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- Stream Gage (USGS)
- U.S. Forest Service

N

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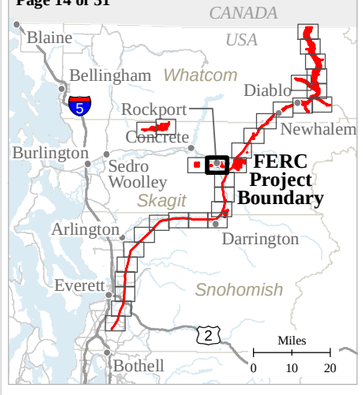
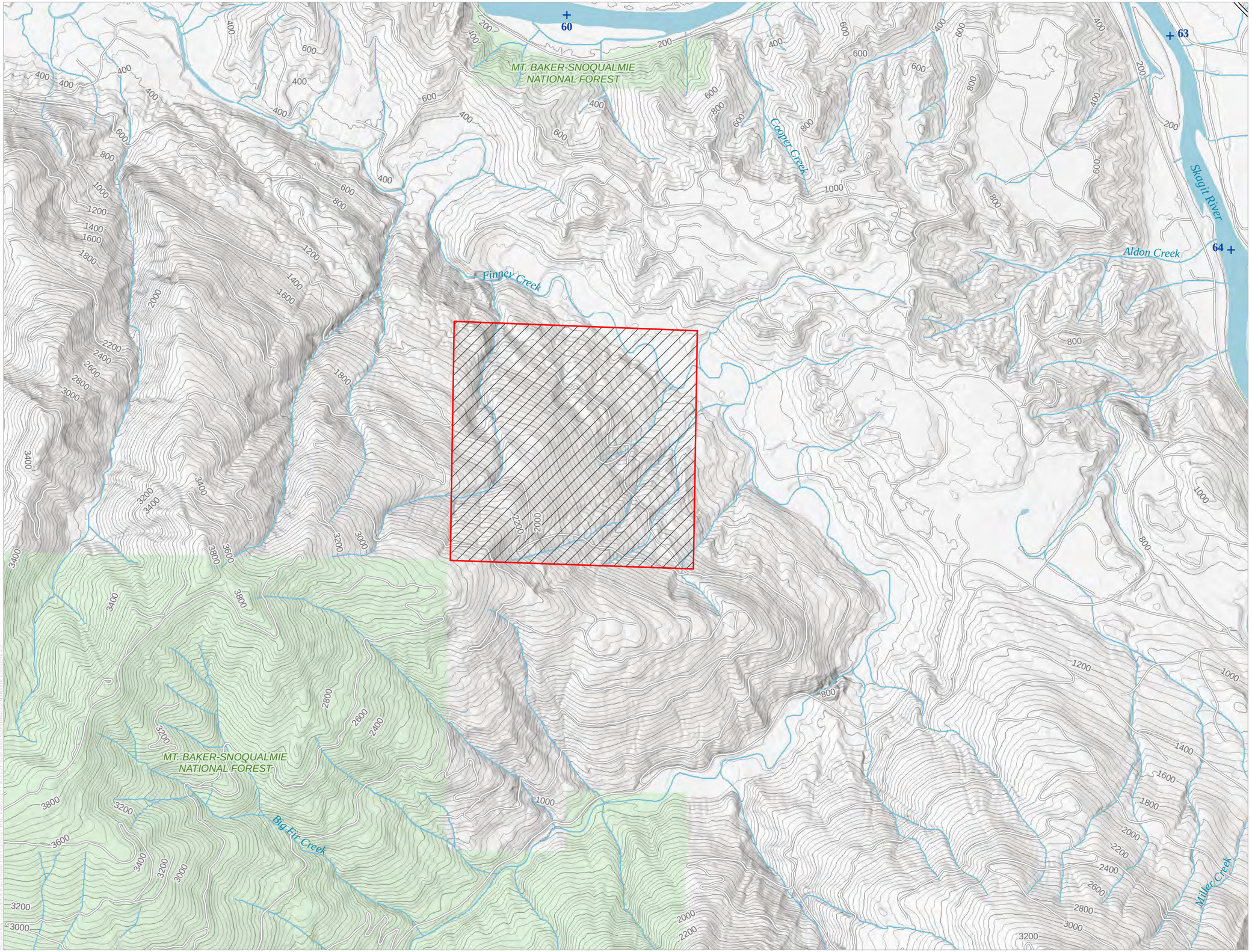


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)



GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

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- River Mile (USGS)
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N

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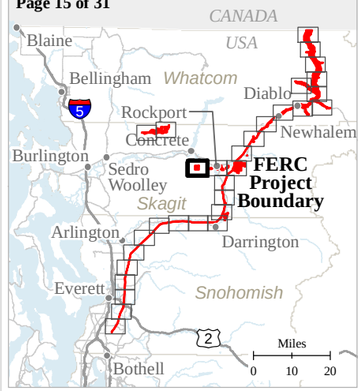

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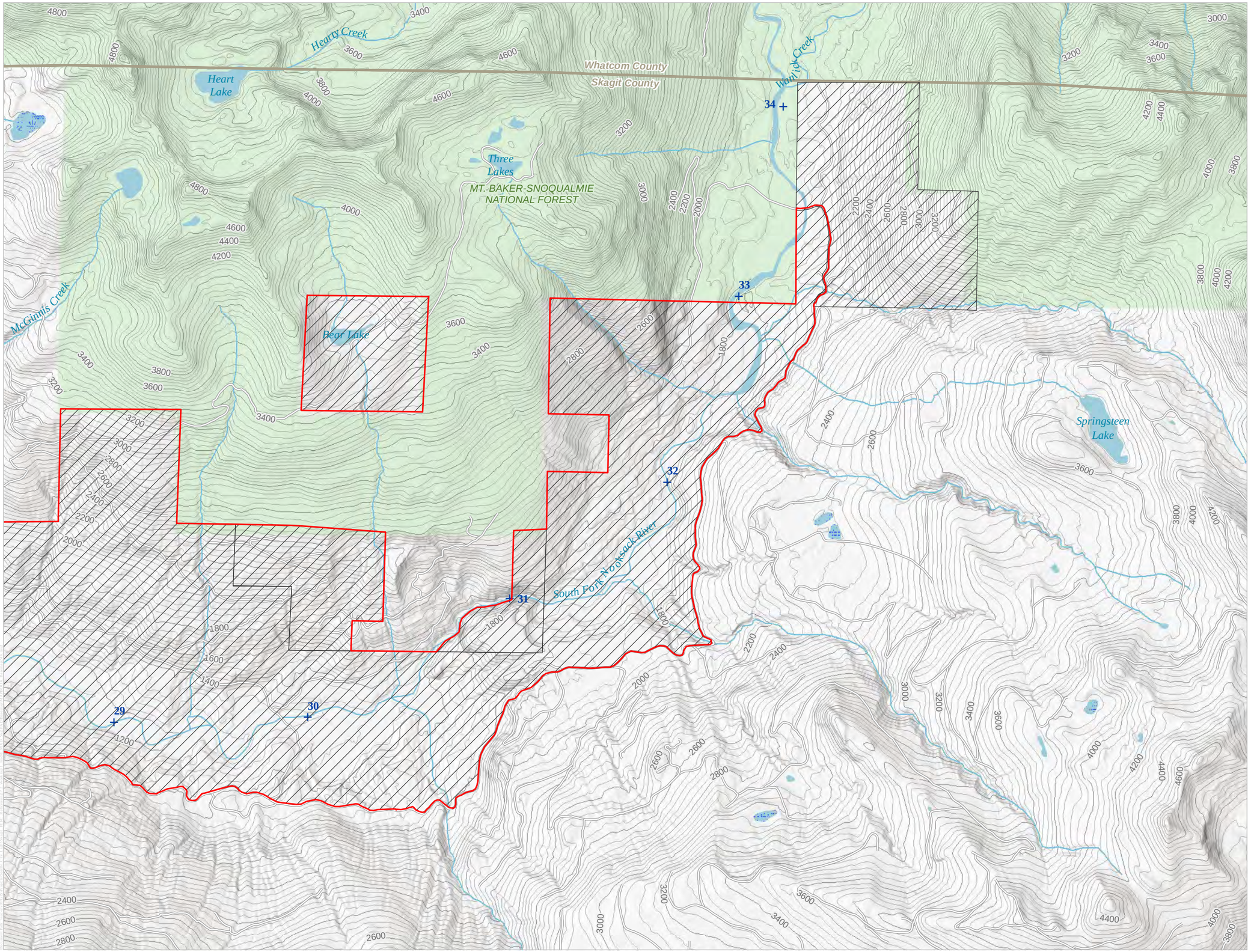

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- U.S. Forest Service

N

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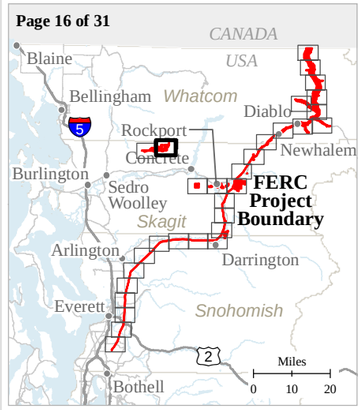

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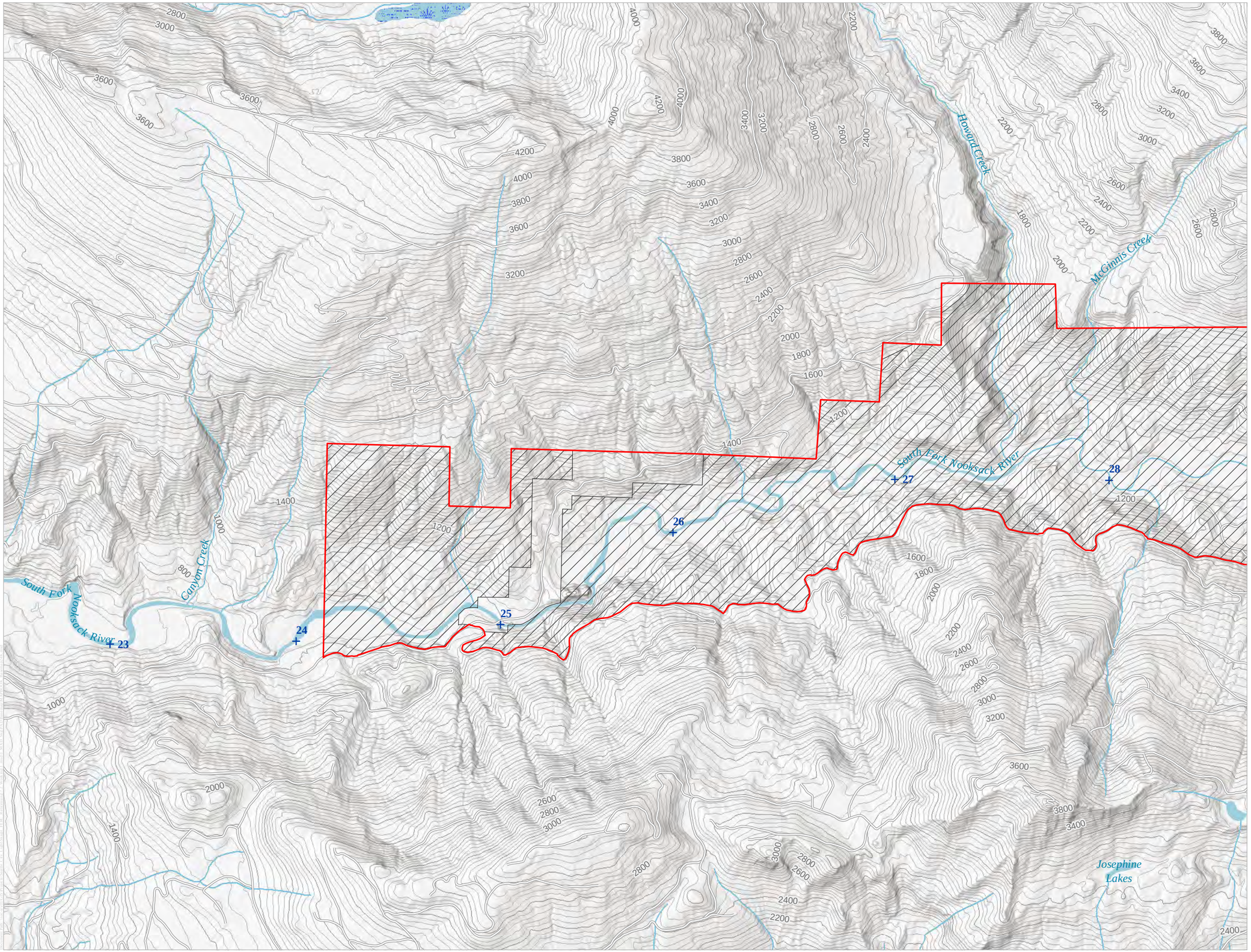

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)

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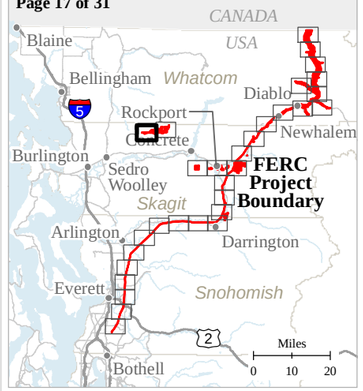

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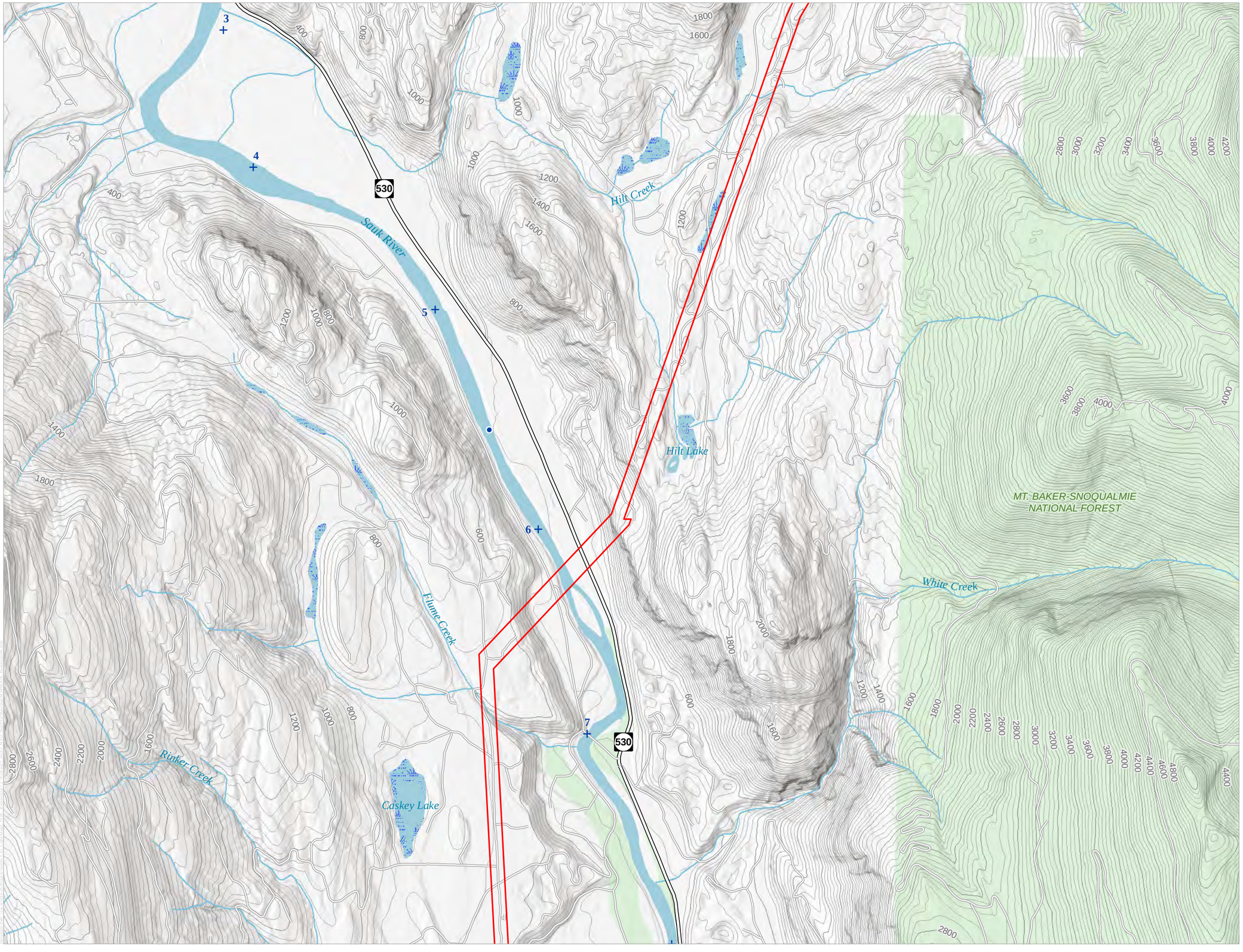

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
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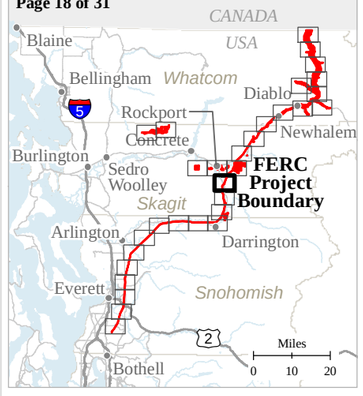

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SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- U.S. Forest Service

N

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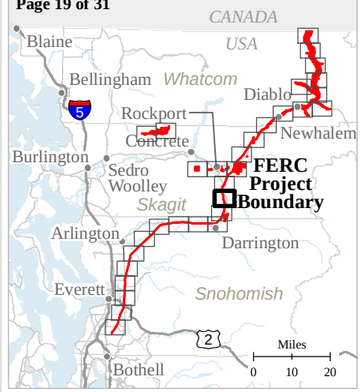

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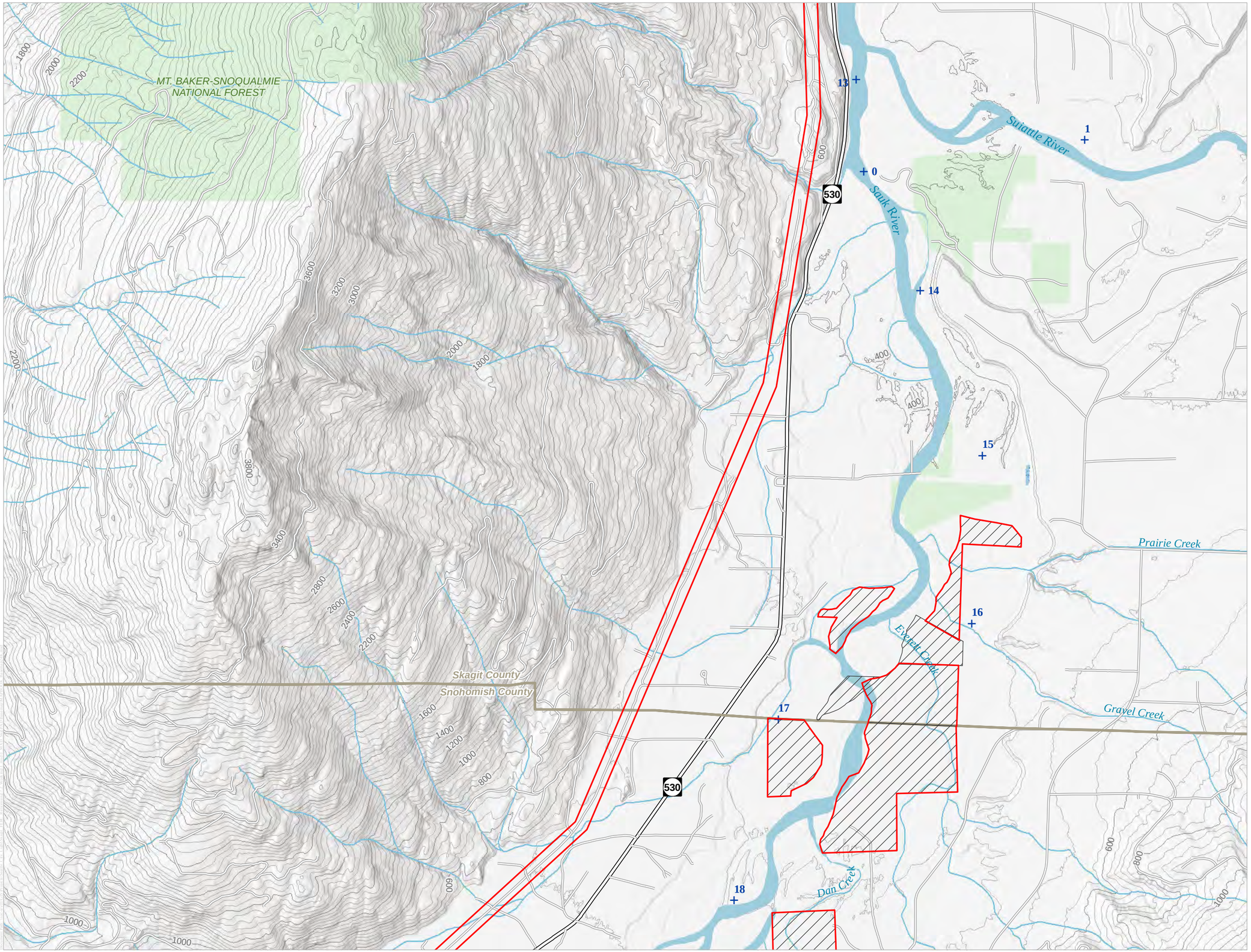

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- U.S. Forest Service

N

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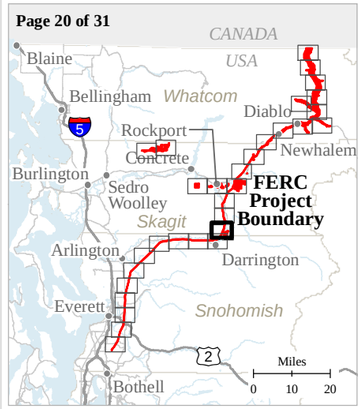

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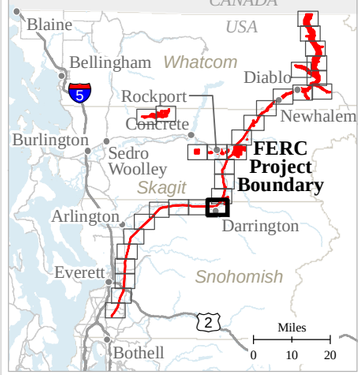
SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- U.S. Forest Service

N

0 1,000 2,000 Feet



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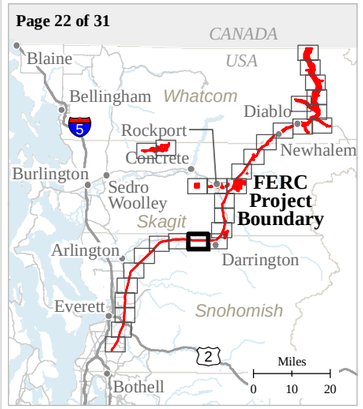
SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- U.S. Forest Service

N

0 1,000 2,000 Feet



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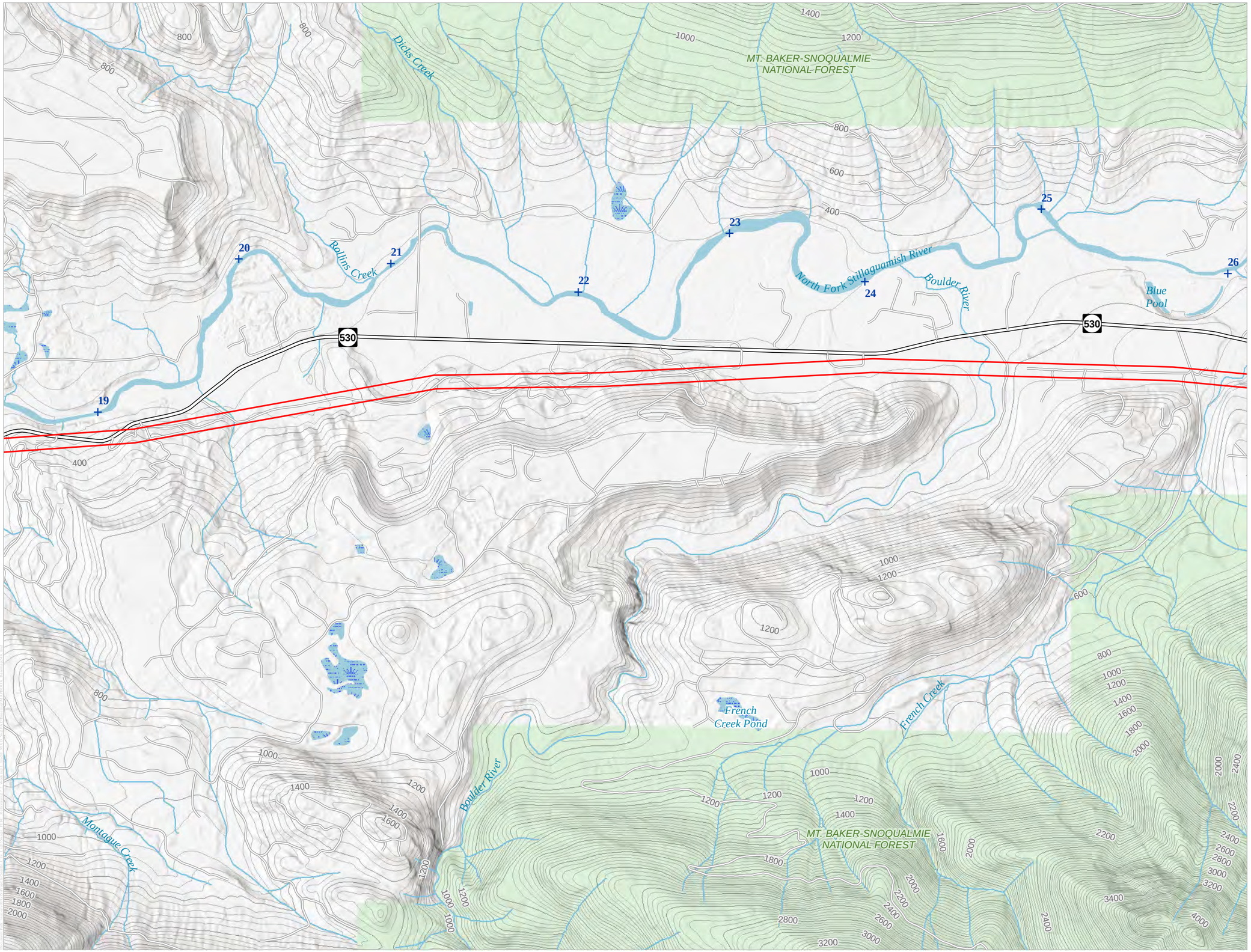
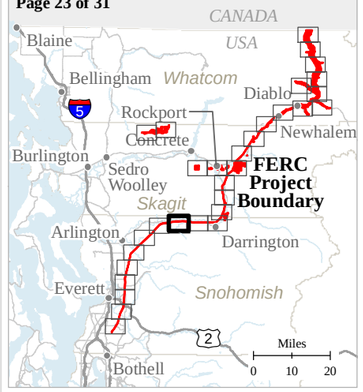


GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- U.S. Forest Service

N

0 1,000 2,000 Feet



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SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

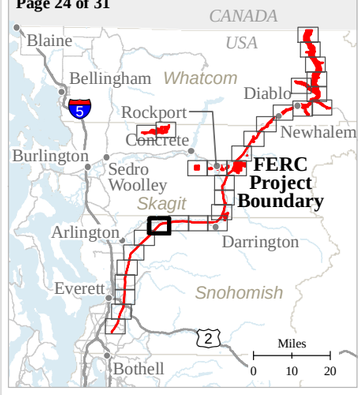
GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

FERC Project Boundary

Mitigation Parcel

River Mile (USGS)

0 1,000 2,000 Feet



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GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

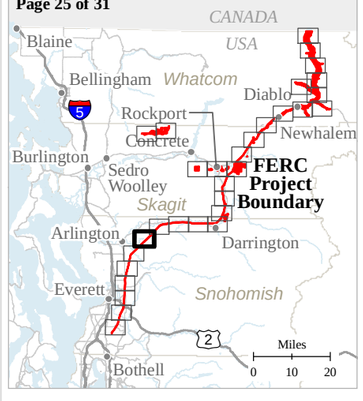
FERC Project Boundary

Mitigation Parcel

\+ River Mile (USGS)

N

0 1,000 2,000 Feet



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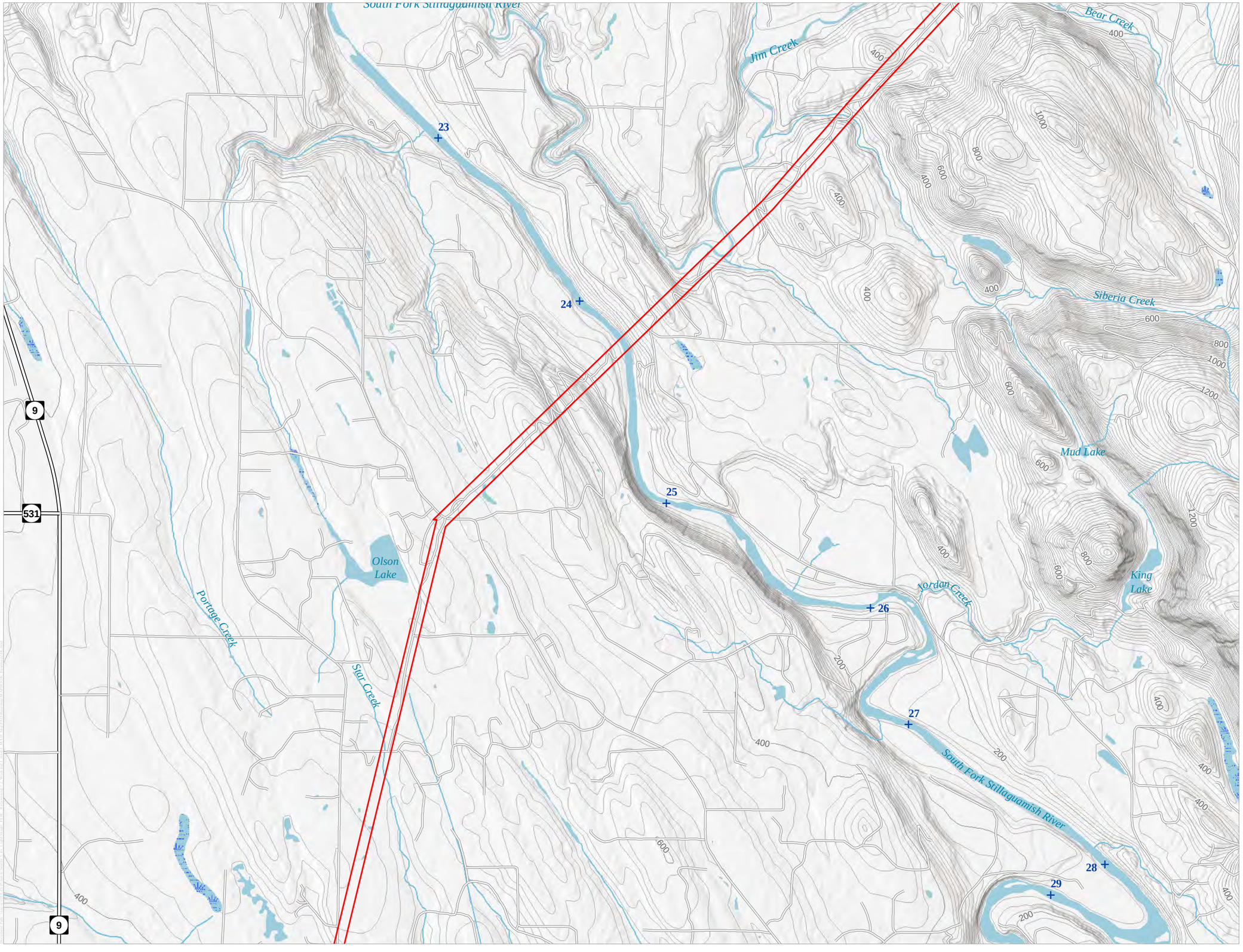
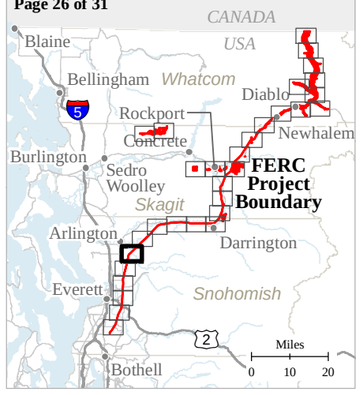


GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)

N

0 1,000 2,000 Feet



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GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

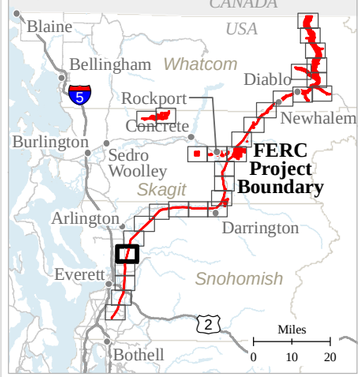
FERC Project Boundary

Mitigation Parcel

\+ River Mile (USGS)

N

0 1,000 2,000 Feet



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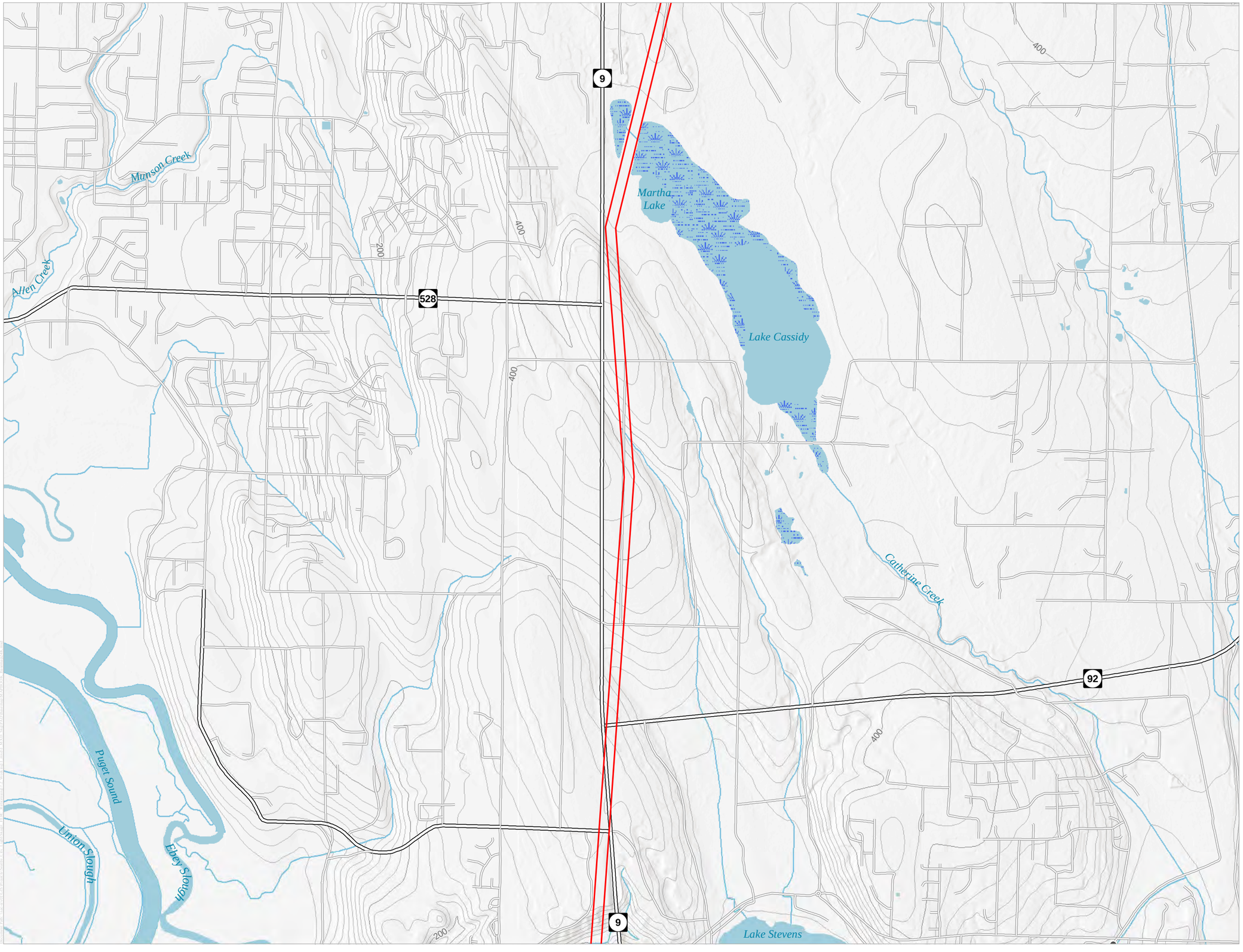
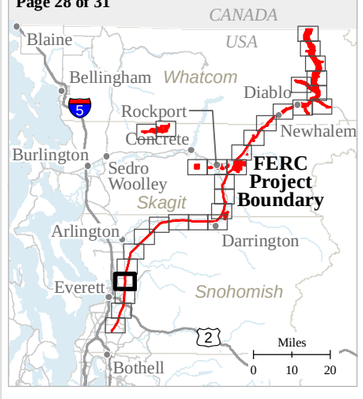


GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)

N

0 1,000 2,000 Feet



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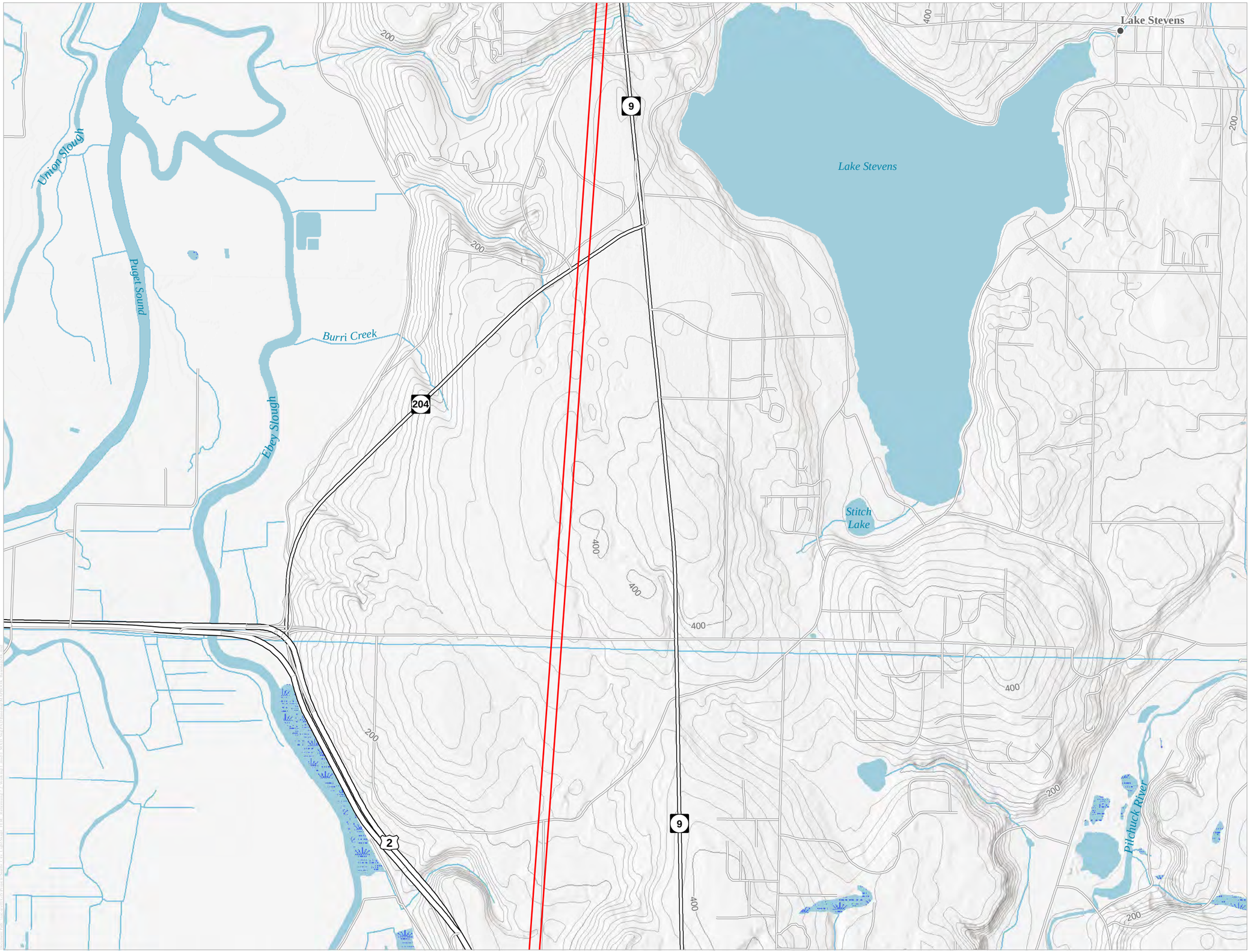
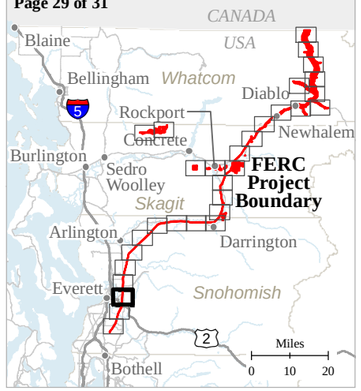


GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)

N

0 1,000 2,000 Feet



Seattle City Light

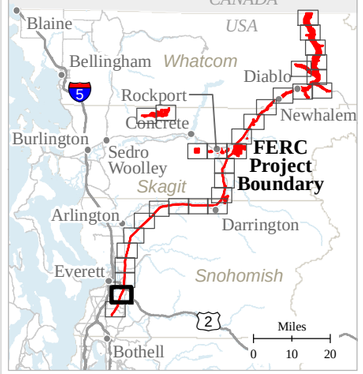
SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- Stream Gage (USGS)

N

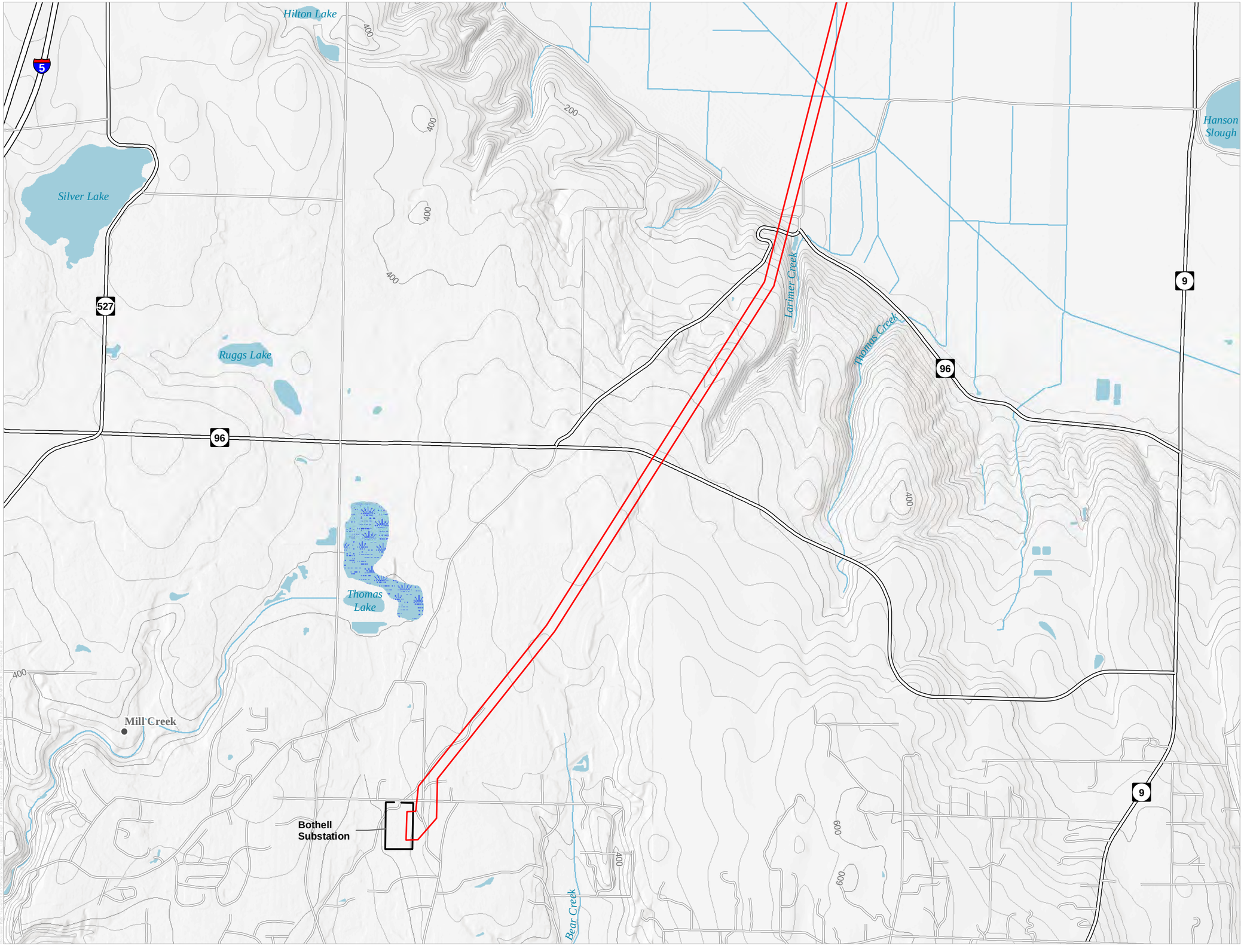
0 1,000 2,000 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Ebey Slough
Swan Trail Slough
Snohomish River
Thomas Creek
Blackmans Lake
Pilchuck River
Snohomish
8
9
10
11
12
13
2
9
200
400

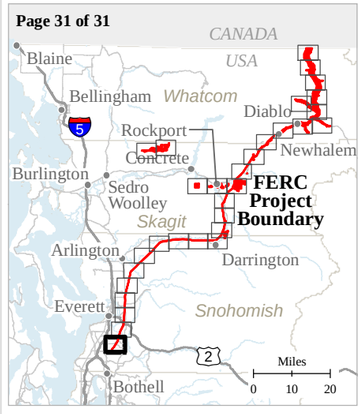


GENERAL PROJECT BOUNDARY AND MITIGATION LANDS

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)

N

0 1,000 2,000 Feet



Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

PRE-APPLICATION DOCUMENT

APPENDIX C
MONTHLY FLOW DURATION CURVES FOR ROSS LAKE, DIABLO LAKE, AND GORGE LAKE

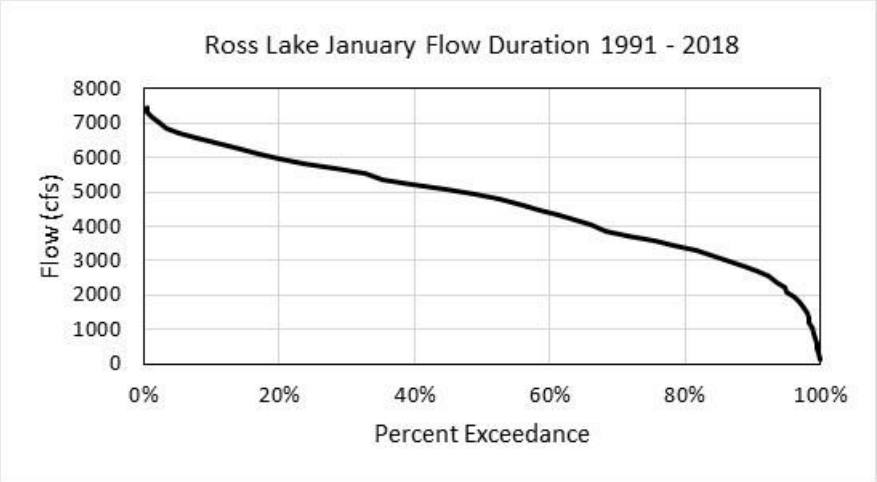


Figure 1. January flow duration curve for Ross Lake outflow (1991-2018).

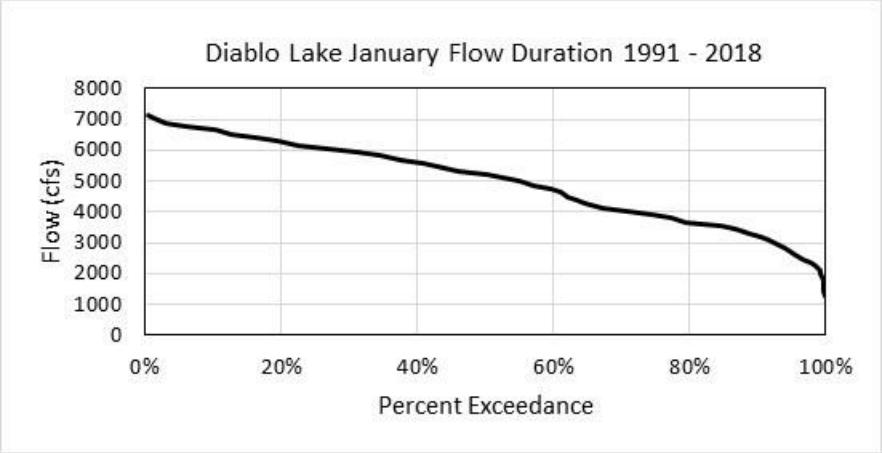


Figure 2. January flow duration curve for Diablo Lake outflow (1991-2018).

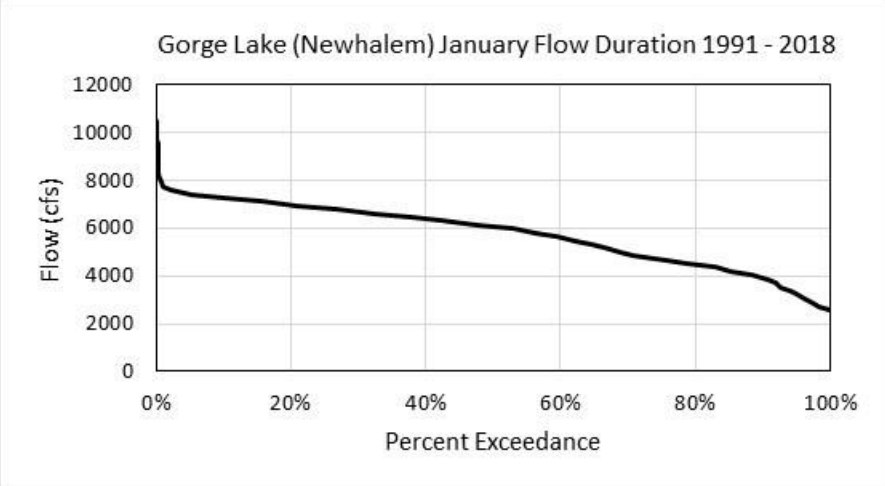


Figure 3. January flow duration curve for Gorge Lake outflow (1991-2018).

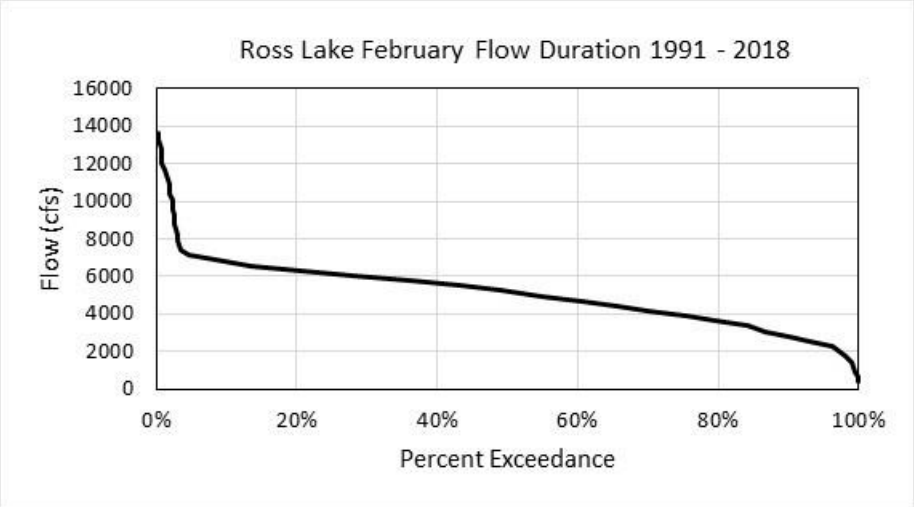


Figure 4. February flow duration curve for Ross Lake outflow (1991-2018).

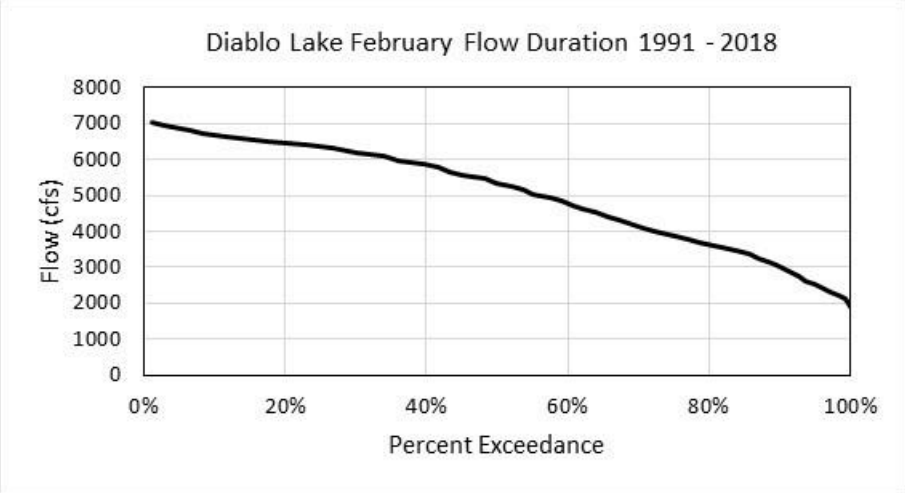


Figure 5. February flow duration curve for Diablo Lake outflow (1991-2018).

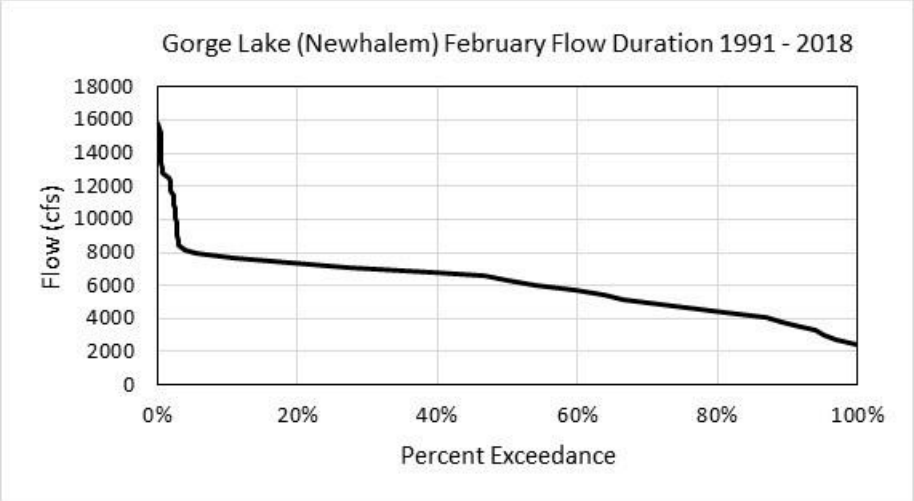


Figure 6. February flow duration curve for Gorge Lake outflow (1991-2018).

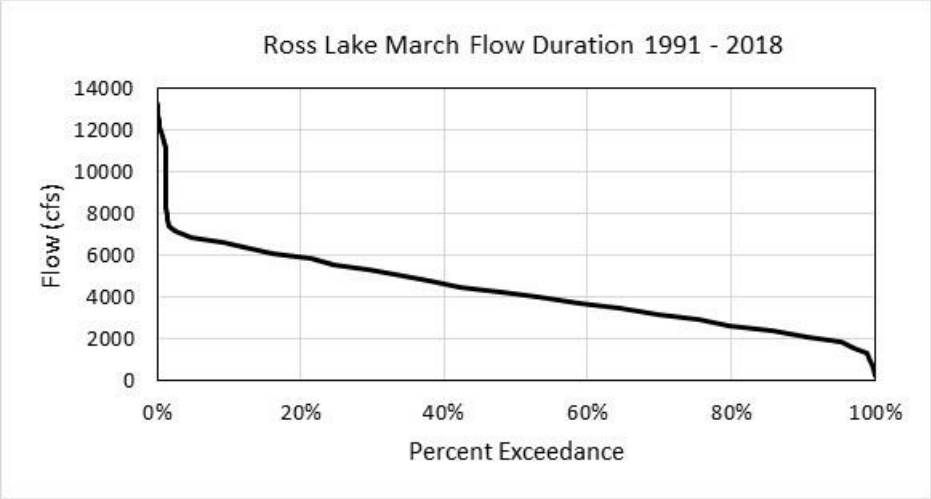


Figure 7. March flow duration curve for Ross Lake outflow (1991-2018).

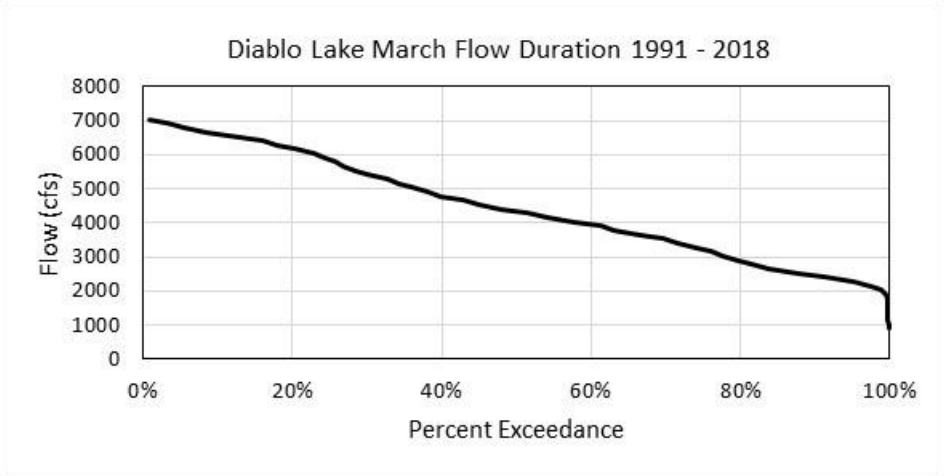


Figure 8. March flow duration curve for Diablo Lake outflow (1991-2018).

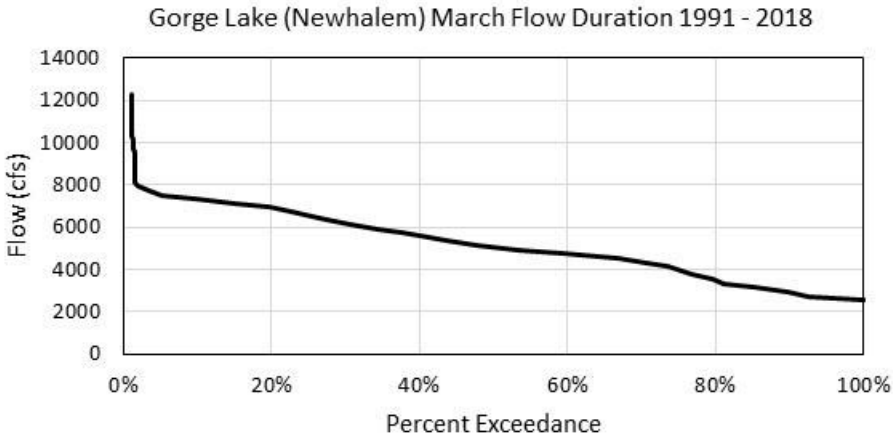


Figure 9. March flow duration curve for Gorge Lake outflow (1991-2018).

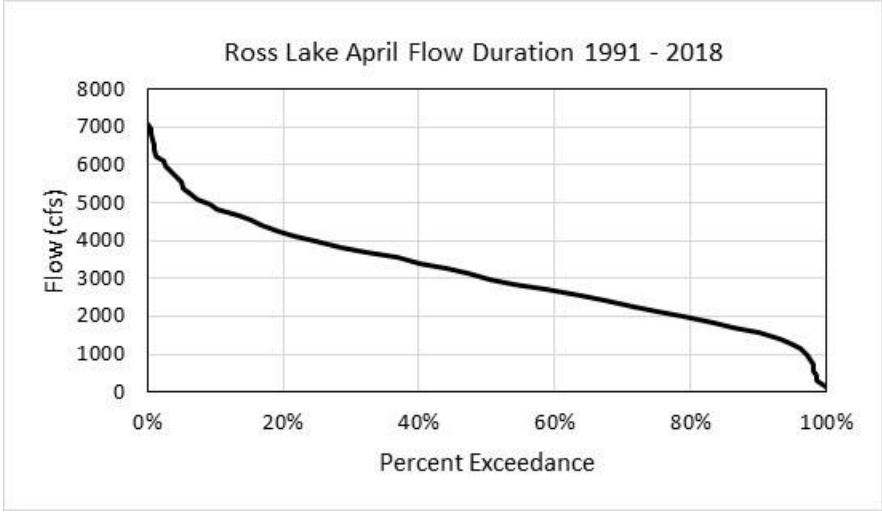


Figure 10. April flow duration curve for Ross Lake outflow (1991-2018).

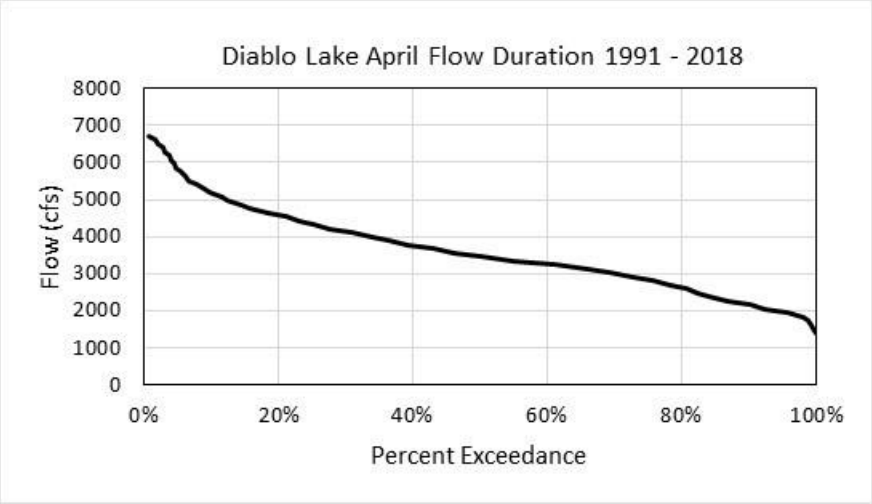


Figure 11. April flow duration curve for Diablo Lake outflow (1991-2018).

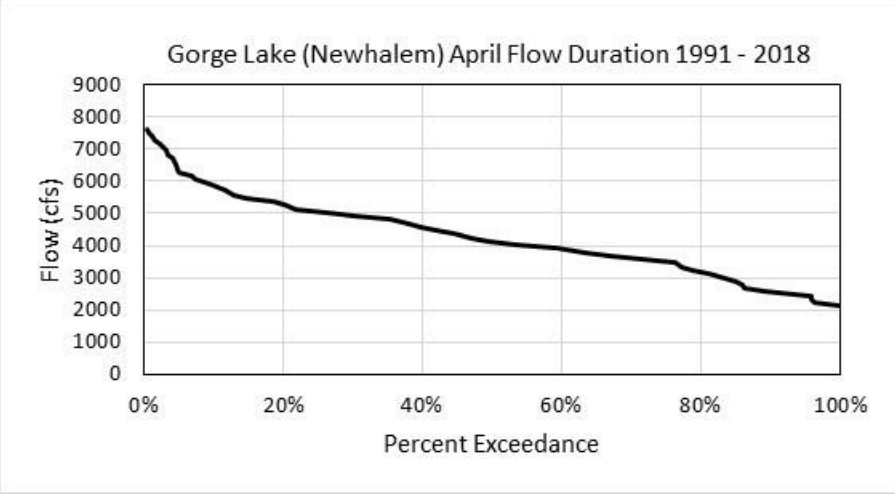


Figure 12. April flow duration curve for Gorge Lake outflow (1991-2018).

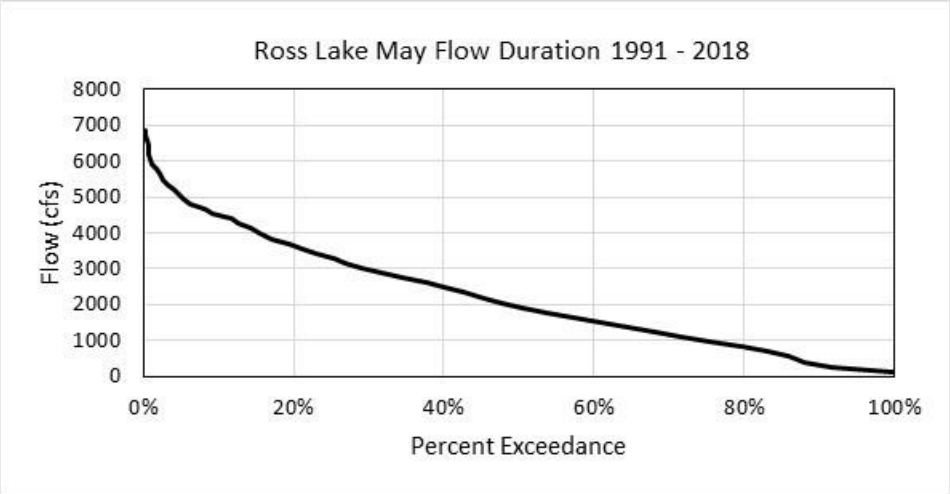


Figure 13. May flow duration curve for Ross Lake outflow (1991-2018).

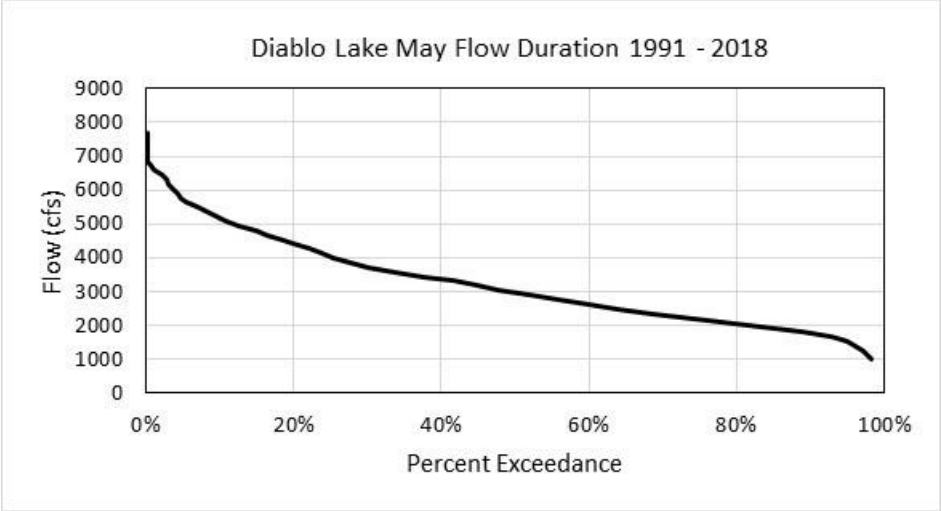


Figure 14. May flow duration curve for Diablo Lake outflow (1991-2018).

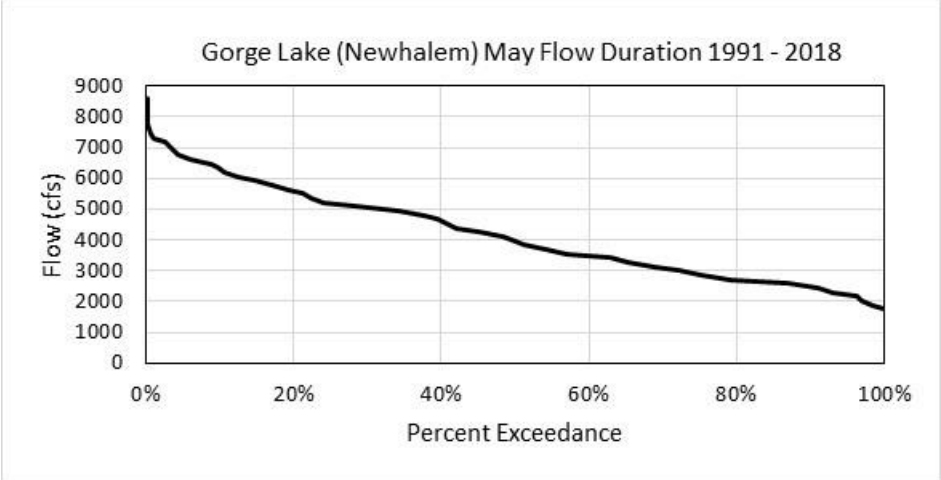


Figure 15. May flow duration curve for Gorge Lake outflow (1991-2018).

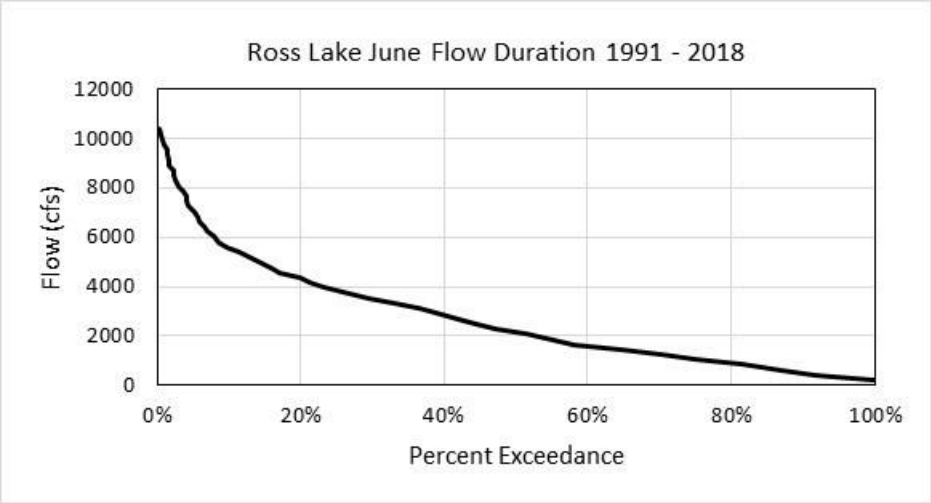


Figure 16. June flow duration curve for Ross Lake outflow (1991-2018).

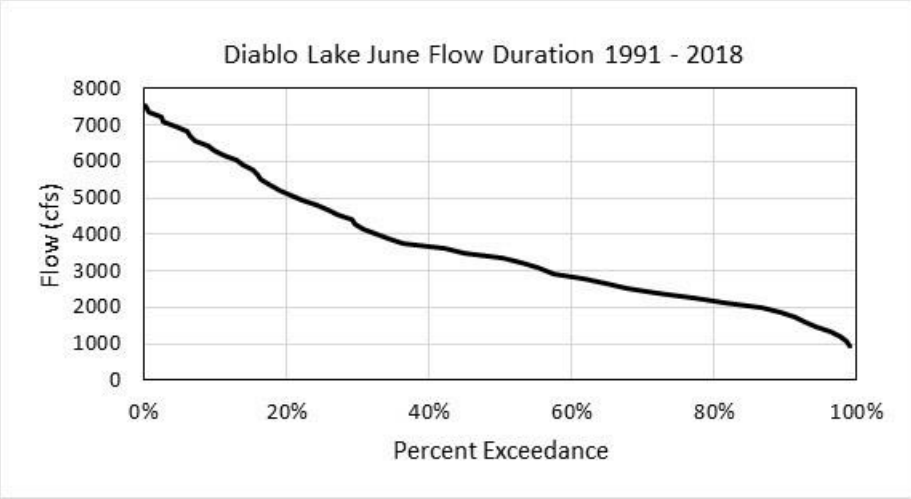


Figure 17. June flow duration curve for Diablo Lake outflow (1991-2018).

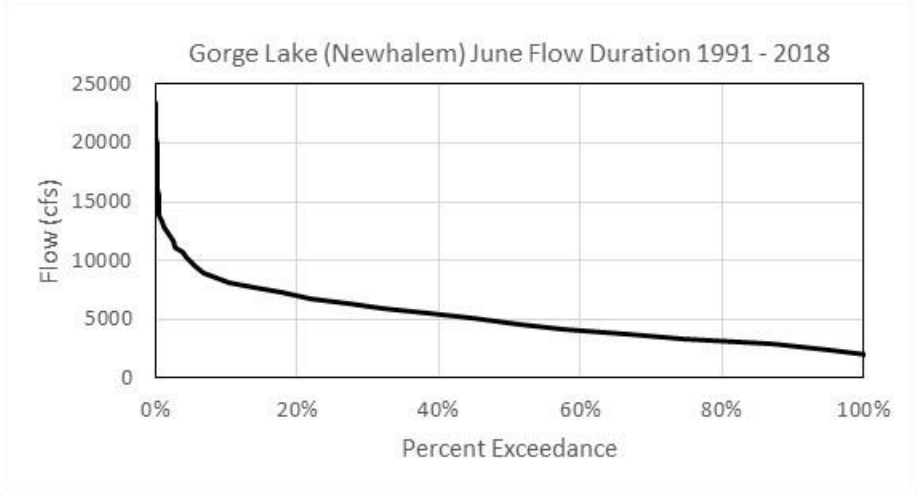


Figure 18. June flow duration curve for Gorge Lake outflow (1991-2018).

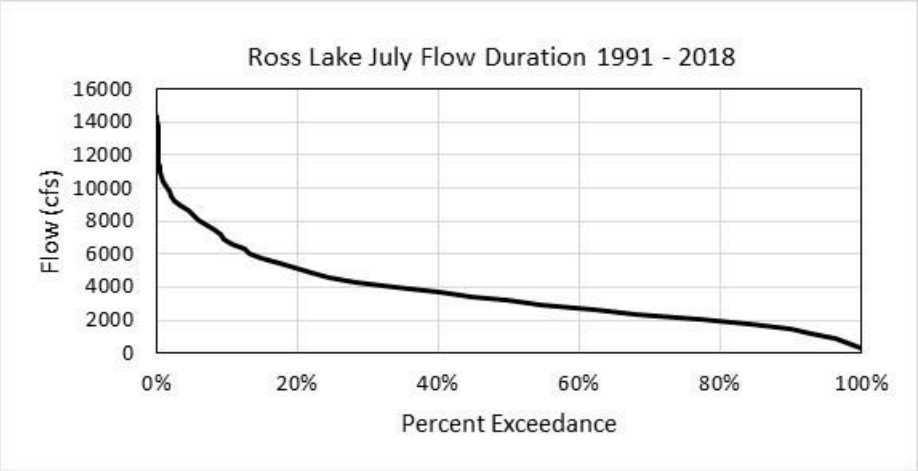


Figure 19. July flow duration curve for Ross Lake outflow (1991-2018).

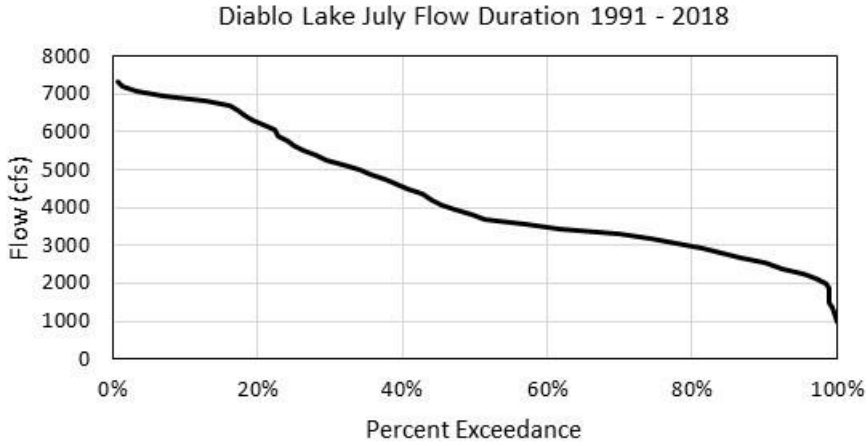


Figure 20. July flow duration curve for Diablo Lake outflow (1991-2018).

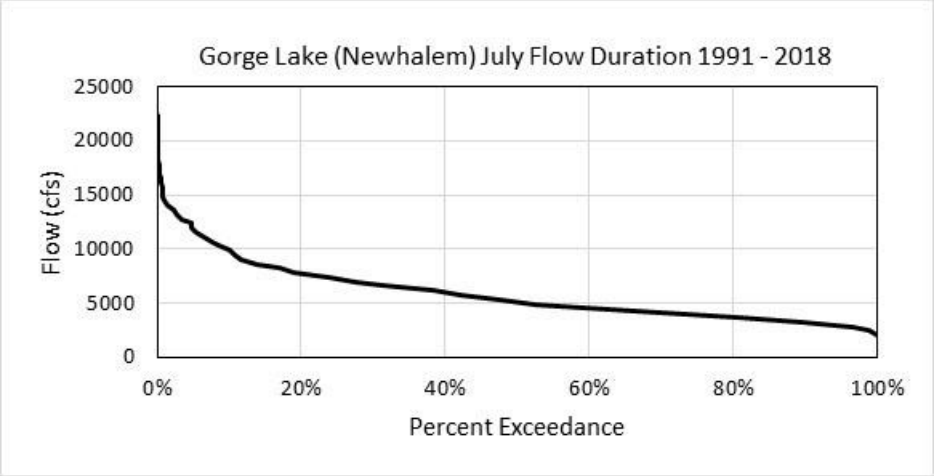


Figure 21. July flow duration curve for Gorge Lake outflow (1991-2018).

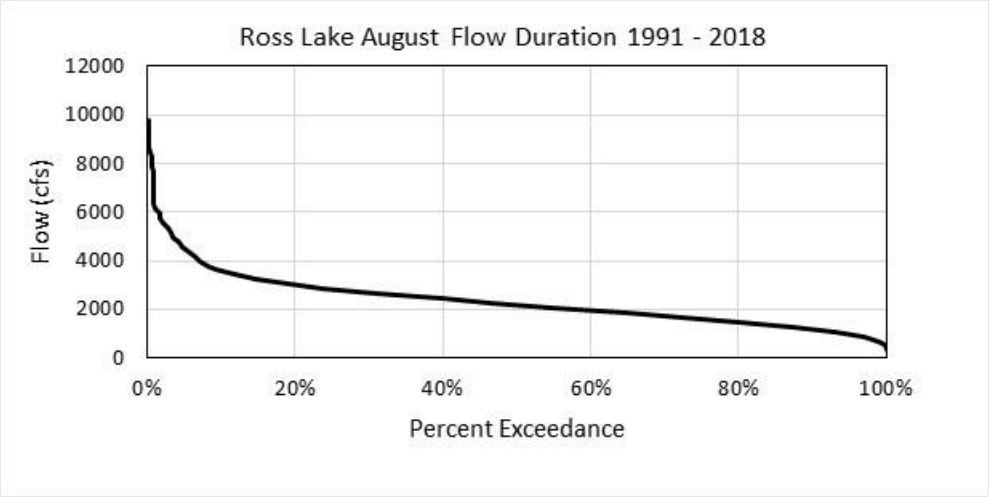


Figure 22. August flow duration curve for Ross Lake outflow (1991-2018).

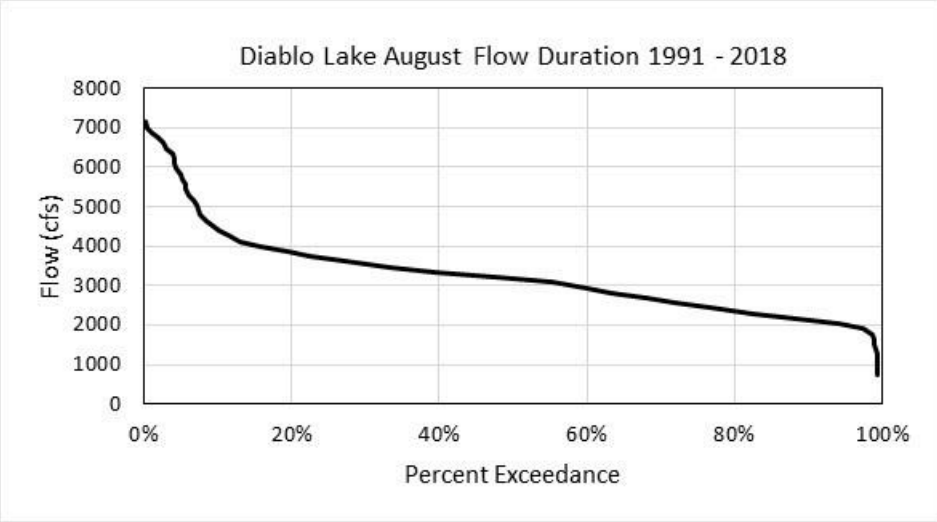


Figure 23. August flow duration curve for Diablo Lake outflow (1991-2018).

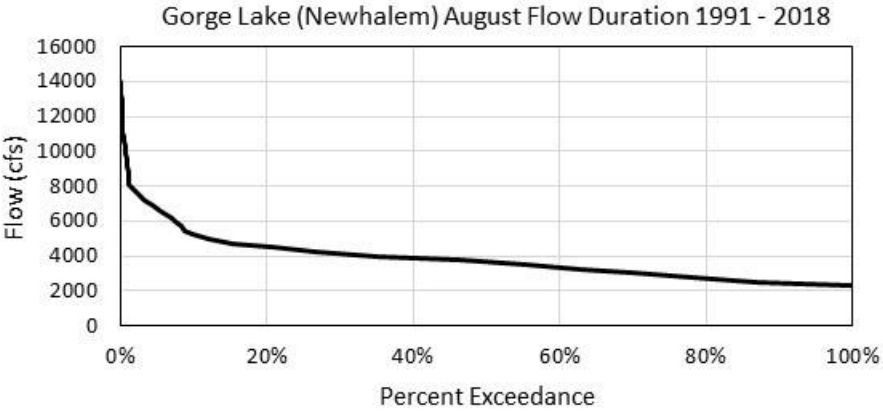


Figure 24. August flow duration curve for Gorge Lake outflow (1991-2018).

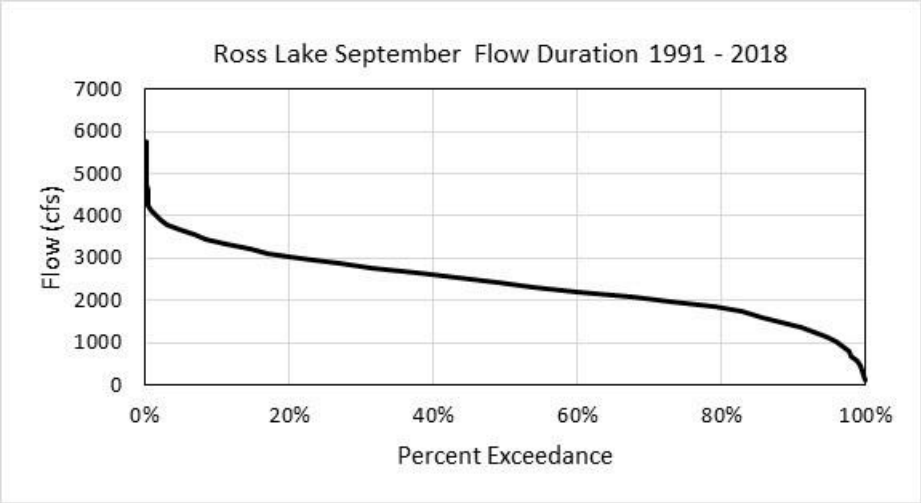


Figure 25. September flow duration curve for Ross Lake outflow (1991-2018).

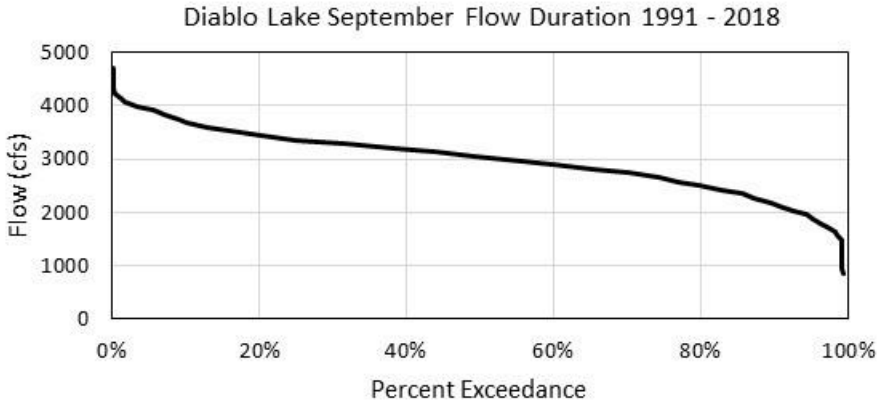


Figure 26. September flow duration curve for Diablo Lake outflow (1991-2018).

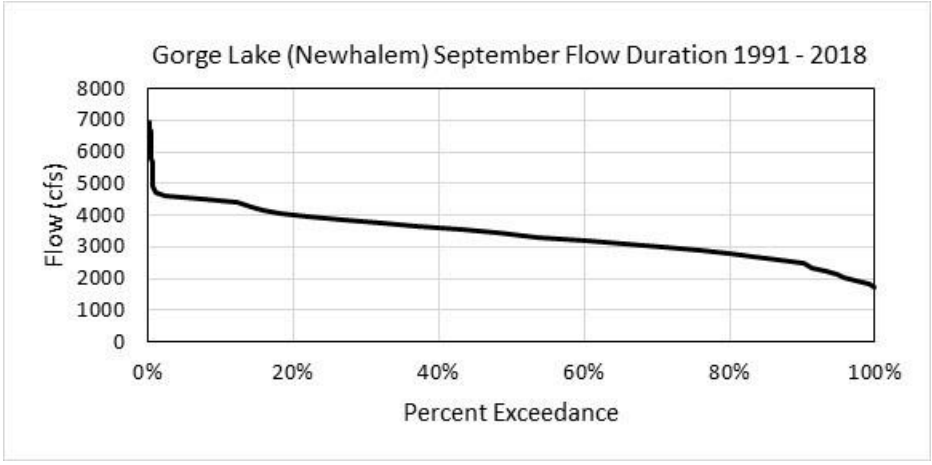


Figure 27. September flow duration curve for Gorge Lake outflow (1991-2018).

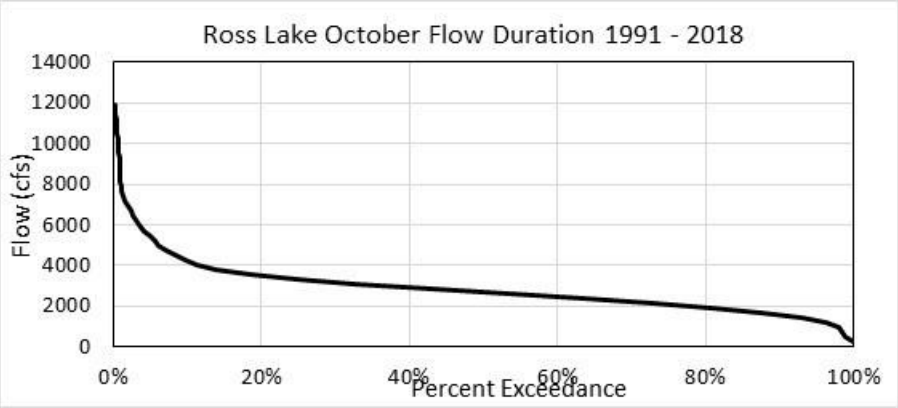


Figure 28. October flow duration curve for Ross Lake outflow (1991-2018).

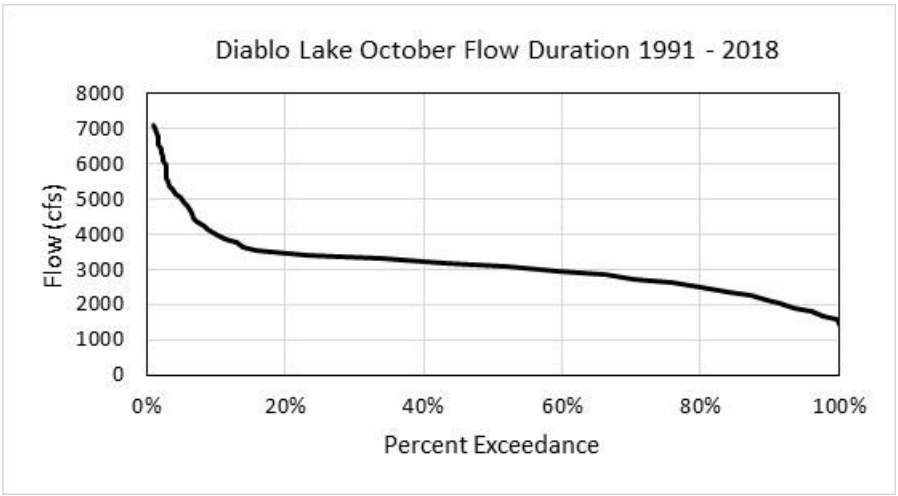


Figure 29. October flow duration curve for Diablo Lake outflow (1991-2018).

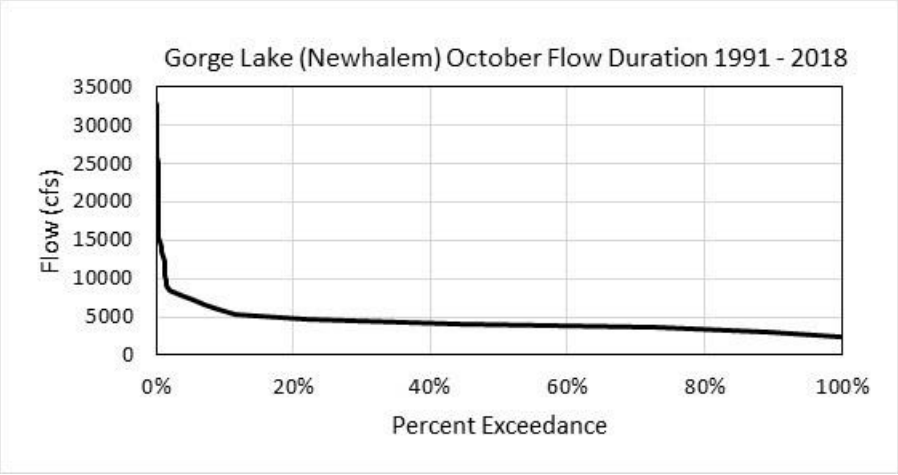


Figure 30. October flow duration curve for Gorge Lake outflow (1991-2018).

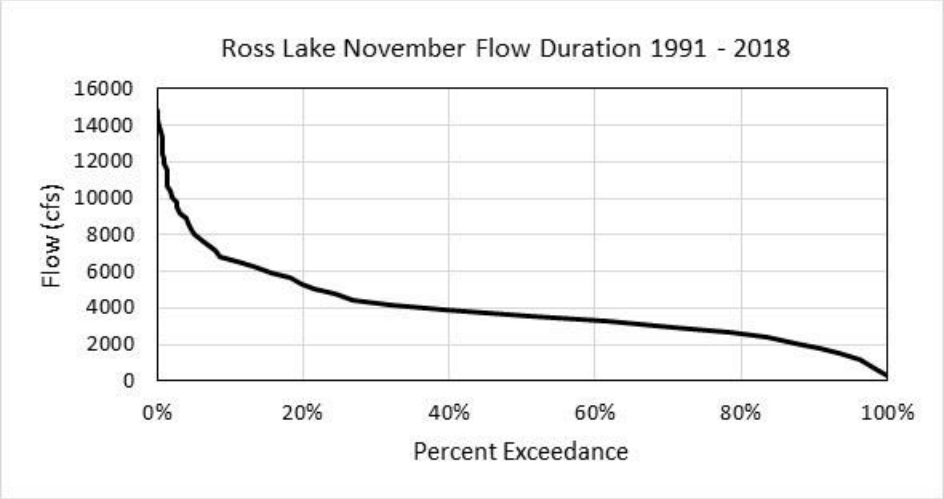


Figure 31. November flow duration curve for Ross Lake outflow (1991-2018).

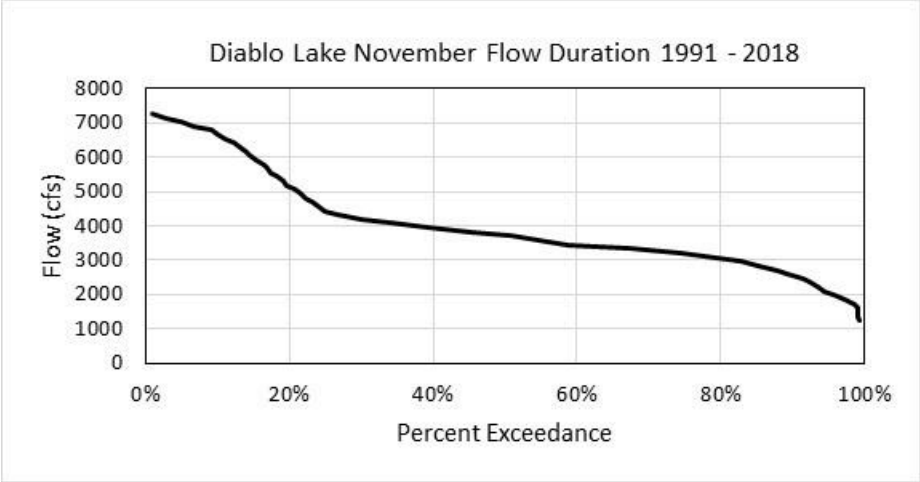


Figure 32. November flow duration curve for Diablo Lake outflow (1991-2018).

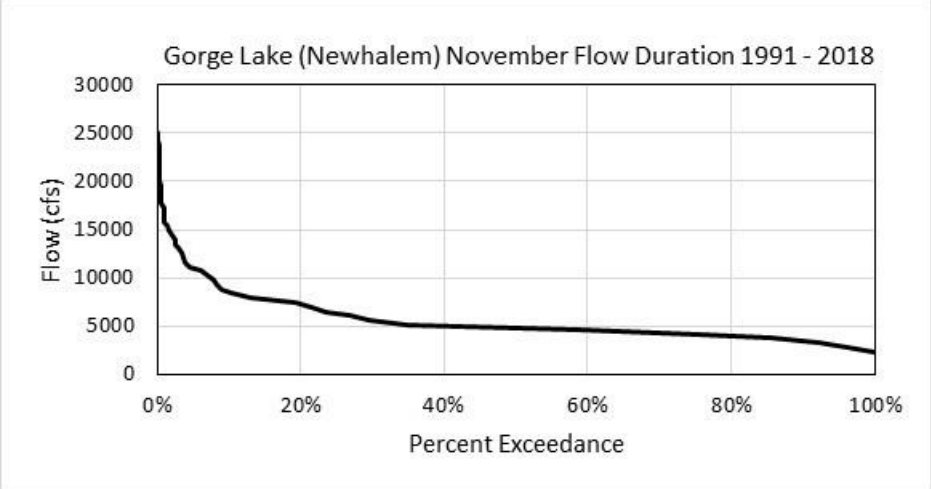


Figure 33. November flow duration curve for Gorge Lake outflow (1991-2018).

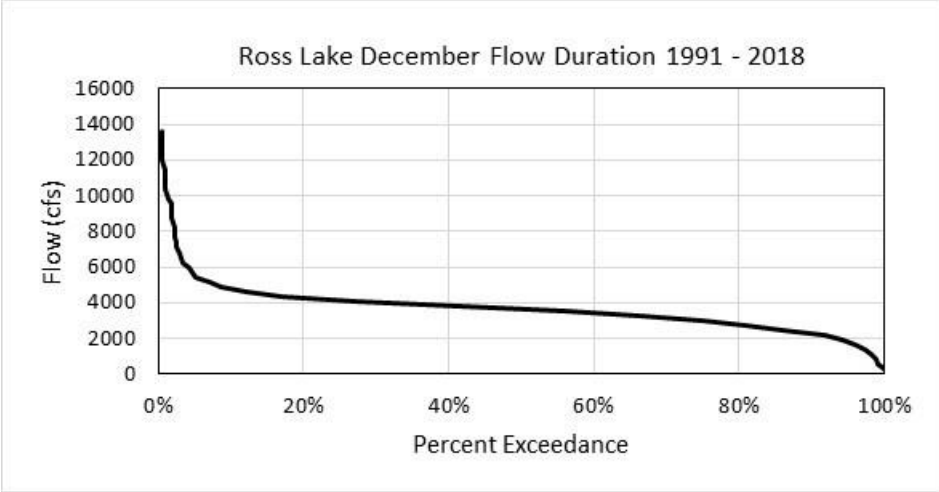


Figure 34. December flow duration curve for Ross Lake outflow (1991-2018).

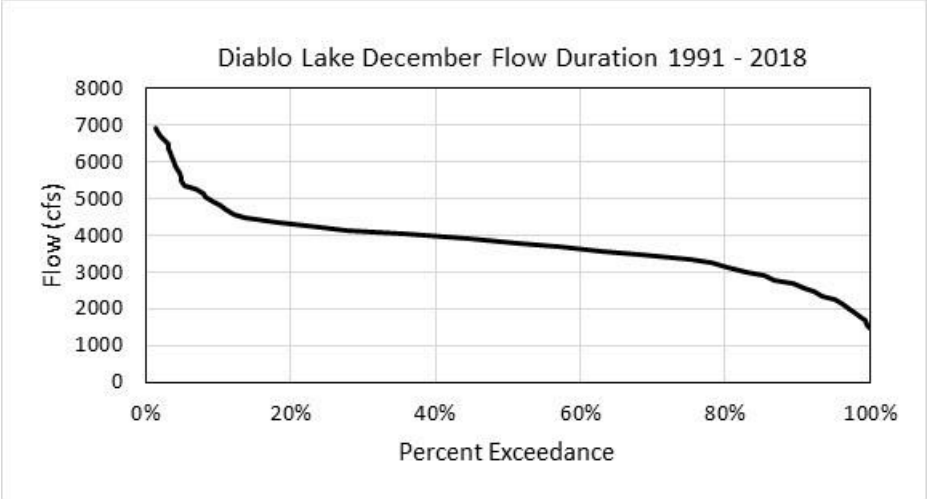


Figure 35. December flow duration curve for Diablo Lake outflow (1991-2018).

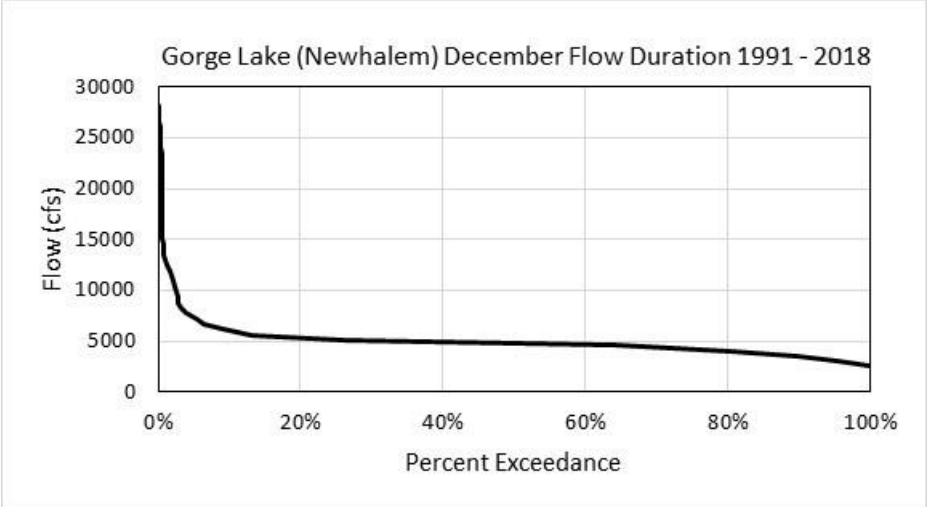


Figure 36. December flow duration curve for Gorge Lake outflow (1991-2018).

PRE-APPLICATION DOCUMENT

APPENDIX D

VEGETATION ALLIANCE DESCRIPTIONS

Vegetation Alliance Descriptions

Class	Code	Map Class Name	Photo	Overview Sentence	Setting Description	Floristic Description	Similar Classes	MORA plots	OLYM plots	NOCA plots
Hardwood Forest	M01	Deciduous Floodplain and Swamp Forest		Deciduous floodplain forests.	These lower elevation (30 – 850 m asl) forests are found on floodplains in riparian and swamp settings, including as vegetated islands within the active channel. They are often initiated by riverine disturbance and can experience overbank flooding during high flow events. Slopes are gentle, the water table is close to the surface and soils can be saturated. This map class also includes deciduous swamp forests around oxbow lakes, swales and other backwaters removed from an active channel. Gravel bars recently colonized by Alnrub, Popbal, and/or Salix spp. are included in M01Y.	Upper canopies are > 5m tall and typically composed of a single cohort of Alnrub; or dominated or co-dominated by Acemac, and/or Popbal. Conifers such as Thupli, Picsit, and Tsuhet can be present to co-dominant, especially in the understory. Acecir is occasionally forms the upper canopy. The shrub and herbaceous layers are often lush and vary depending on park, substrate, and disturbance (e.g. inundation, browsing). Common understory species are Rubspe, Corser, Polmun, Tolmen, Ciralp, Athfil, Viogla, and Oxaore.	M01Y, M20I, M44, M20C	26	97	52
Hardwood Forest	M01Y	Gravel Bar Shrubland		Deciduous shrublands on gravel bars in active floodplains.	These vegetated gravel bars are found as islands within river channels or along river banks. Vegetation density varies depending on recent disturbance history and substrate. In absence of continued disturbance, these shrublands mature into M01.	Vegetation is dominated by Salsit, shrub-form Alnrub and/or shrub-form Popbal, with a diverse assortment of herbaceous colonizers, such as Hyprad, Rumace, Claytonia_sp, Plalan, Phahas, Agrostis_sp, Fravir, and Erilan.	M01, M39S	0	6	4
	M07	Warm Silver Fir Western Hemlock Forest	Information currently not available.							

Class	Code	Map Class Name	Photo	Overview Sentence	Setting Description	Floristic Description	Similar Classes	MORA plots	OLYM plots	NOCA plots
Tall Shrub	M18	Vine Maple Shrubland		Deciduous shrublands dominated by Acecir.	These dense shrublands occur on all aspects at low to middle elevations (525 – 1250 m asl) on both sides of the Cascade crest. Low conifer cover is maintained by mechanical disturbance, these shrublands generally occur on talus, at the lower ends of avalanche chutes, or on rock slides, and are usually not associated with riparian areas. Sites are typically moderate to steep and exposed rock has low (less than 25%) cover.	While Acecir is typically the dominant species in the dense tall shrub layer (average 75 percent cover), other shrubs such as Samrac, Rubspe, shrub-form Acemac, Oplhor, Acegla, and Alnvir can be present to co-dominant. The understory is variable, from dry to moist and sparse to dense. Many different species can be present, most commonly Paxmyr, Galtriflo, Mairac, Polmun, and Athfil.	M19, M21, M51, M50	38	18	49
Hardwood Forest	M19	Big Leaf Maple Debris Apron Forest		Acemac debris apron forests.	These forests occur at low elevations (350 – 900 m asl), primarily east of Cascade crest. They occur on partially stabilized debris aprons, at least slightly above the floodplain below (median slope is 13 degrees). Pistol butt trunks and other evidence of ongoing mechanical disturbance are usually present.	Acemac dominates the closed to patchy canopy, occasionally with Psemen and/or Cornut. The understory has a diverse assortment of both shrubs and herbs with Disporum_sp, Pteaqu, Rubpar, Paxmyr, Rosa_sp, Osmorhiza_sp, Galium_sp, Mairac, Symalb, Adebic, Amealn, and Triova most common.	M20I, M18, M36, M43N	0	0	20
Hardwood Forest	M20I	Upland Deciduous Forest		Upland successional deciduous forests.	These forests occur on floodplain terraces and lower valley walls between 130 and 570 m asl on all aspects. These are successional forests, where the deciduous component has come in due to natural (e.g. wildfires, landslides) or human-caused disturbance (such as logging, clearing, or road building/widening) and is often facilitated by summer water availability.	Acemac or Alnrub are dominant or at least prominent in the canopy, and usually both species are present. If present, Popbal can also co-dominate. Conifers such as Tsuhet, Thupli, and Psemen are often present as canopy trees or saplings. Species composition usually reflects the upland setting, but some mesic indicators are often present. The understory can be dense and usually has Polmun, Tolmen, Ciralp, Clasib, Galium_sp, and/or Mycmur. Athfil, Viogla, Tiatri, and Dryexp are also commonly present. A well-developed shrub layer of Acecir or Rubspe can be present.	M01, M19, M43N, M43O, M20C	0	59	24

Class	Code	Map Class Name	Photo	Overview Sentence	Setting Description	Floristic Description	Similar Classes	MORA plots	OLYM plots	NOCA plots
Tall Shrub	M21	Sitka Alder Shrubland		Tall shrublands dominated by Alnvir.	These shrublands occur at middle to high elevations (800 – 1525 m asl), on gentle to steep slopes. They are maintained by mechanical disturbance, generally occurring on talus and toe slopes or along avalanche chutes and steep stream channels. Soils are typically rocky and well drained, but can be moist year round. Adjacent vegetation is usually montane or subalpine conifer forest, but can also be herbaceous meadows.	The dense, tall shrub layer in these moist shrublands is dominated by Alnvir (average cover of 65 percent). Shrub-form Cupnoo can be codominant, especially on talus that forms below high cliffs. The understory ranges from sparse to dense with many different species possible. Rubpar, Samrac are common associates. On wetter sites, Rubspe forms a dense lower shrub layer above a lush herbaceous layer that includes Athfil and forbs such as Viogla, Vervir, Galium_sp, and Clasib.	M18, M51, M50, M85, M73, M39S	27	50	50
Conifer – Medium	M33	Douglas-fir – Subalpine Fir Woodland		Mid-elevation dry conifer forests and woodlands.	These forests and woodlands are generally found east of the cascade crest on moderate to steep midslopes between 700–1600m als. They can occur on dry sites of all aspects, but are most common on west-facing slopes.	The open (average cover 35%), short canopy is dominated by Psemen, often with Abilas prominent to co-dominant. Trees are generally well-spaced rather than clumped. Pinmon, Abiama, and Piceng can also occur, usually at low cover. Paxmyr is always present in a well-developed shrub layer typically dominated by Vacmem with scattered Sorsco, Salsco, and/or Amealn. The herb layer is variable, featuring a diverse assortment of perennial forbs and grasses. Calrub is typically prominent. Gooobl, Hiealb, and Moemac are commonly present at low cover. Understory diversity is high, with an average of 27 species recorded in training plots.	M43N, M17N, M36, M35, M66, M51	0	0	72
Conifer – Medium	M35	Lodgepole Pine – Douglas-fir Forest		Pincon woodlands.	These forests are found at middle elevations (475 – 1350 m asl) in climatic transitions zones, along and east of the cascade crest at NOCA and within the rain-shadow at OLYM. At MORA, these forests are found in floodplains on well-drained glacial outwash. At NOCA and OLYM, these forests are found on midslopes, bedrock benches or along dry ridgelines, usually with shallow to moderate slopes.	These stands tend to have short, open (average 34% cover) canopies of evenly spaced, even-sized Pincon and Psemen. Occasionally one or the other is absent. Pinmon or Tsuhet are common, but rarely prominent. Jackstraw Pincon can obstruct travel, a result of recent mortality. Gausha dominates a patchy to dense shrub layer, but can be entirely absent in drier stands. Arcuva+ and Paxmyr are also common understory components, and at NOCA, so are Vacmem, Spibet, Amealn, and Salsco. The herb layer is sparse, with Hiealb, Chiumb and scattered graminoids the most common associates. Exposed bedrock and lichens are common.	M42G, M36, M43N, M43O, M66	3	18	66

Class	Code	Map Class Name	Photo	Overview Sentence	Setting Description	Floristic Description	Similar Classes	MORA plots	OLYM plots	NOCA plots
Conifer – Low	M36	Ponderosa Pine – Douglas-fir Forest		Pinpon and Psemen Woodlands.	These forests are found on lower slopes and terraces in the hottest and driest parts of North Cascades National Park (370 – 1250m als).	The open canopy is dominated by open-grown Psemen, usually with prominent Pinpon. Acemac can be prominent, but is never co-dominant. The understory is either open and dominated by graminoids (Calrub or Psespi), or covered with a dense shrub and herb layer that includes Holdis, Symalb, and Mahaqu. Across the map class, the most common understory plants are Paxmyr, Amealn, Ceavel, Rosgym, Spibet, and Arcuva+.	M42G, M35, M43N, M19, M66, M51	0	0	58
Wetland – Low	M39H	Lowland Wet Meadow		Wet meadows or marshes at low to mid elevations.	The wetlands are found on pond or lake margins, in backwaters along rivers, upstream of beaver dams, and in occasional midslope depressions up to 1200 m als. Soils are saturated, with standing water much of the year.	Wetland sedges such as Caraqu, Carlen, or Carutr are always present, averaging 55% cover. Other common species tend to be associated with standing water such as Scimic, Mentri, Equarv+, and Nuplut. Spidou and Salsit+ are common in adjacent slightly drier areas and can be scattered at low cover within these wetlands. In large river valleys, these wetlands form a complex with shrub swamps or swampy floodplain forests.	M39S, M58, M81	1	15	18
Wetland – Low	M39S	Lowland Wet Shrubland		Riverine tall shrublands and shrub swamps at low to mid elevations.	These wetlands are found ringing herbaceous marshes, in narrow patches along major river channels, upstream of beaver dams, on irrigated toeslopes, and in rare midslope depressions below 1100 m asl. In large river valleys, these wetlands form a complex with open herbaceous wetlands and swampy floodplain forests. Soils are poorly drained and saturated or well drained but frequently flooded.	Spidou, Salsit+ and/or Corser (most common at North Cascades National Park) dominate a dense tall shrub layer (average cover of 75%). Wetland sedges such as Caraqu, Carlen, or Carutr can form a dense lower stratum, averaging 30% cover. Athfil, Rubspe, and Lysame are common associates. Trees such as Alnrub and Thupli are often found nearby.	M39H, M58, M81, M01Y, M01	3	4	30

Class	Code	Map Class Name	Photo	Overview Sentence	Setting Description	Floristic Description	Similar Classes	MORA plots	OLYM plots	NOCA plots
	M42	Mesic Western Hemlock Douglas-fir Forest	Information currently not available.							
	M43E	Dry Western Hemlock Douglas-fir Forest	Information currently not available.							
Conifer – Low	M44	Wet Western Hemlock – Douglas-fir Forest		Mesic coniferous forests.	Generally occurs on valley bottoms or in moist water-receiving areas on north-facing slopes, flats or otherwise protected sites below 1000 m. Soils remain moist year-round but are not saturated.	The coniferous canopy is dominated by any combination of Tsuhet, Psemen, and Thupli. Abigra is occasionally co-dominant. Alnrub and Acemac (often spilling over from adjacent riparian forests) can be prominent. Abiama can be present at low cover, but is never prominent or contiguous with midslope Abiama on adjacent valley walls. The tree canopy is usually complex with prominent conifer regeneration and several cohorts of trees. Vacala, Oplhor, and/or Rubspe make up a prominent lush shrub layer in about half of the stands in the map class. Acecir and Vacpar are often present. The herbaceous layer is characterized by a variety of drought-intolerant ferns and forbs: Tiatri, Polmun, Cliuni, Athfil, Gymdry, Galium_spp, Gooobl, Triova, Maiste, Achtri, Blespi, Disporum_spp, Dryopteris_spp, Viogla+, and Coruna. Mosses are abundant on trees, snags, down logs, and the ground surface.	M07W, M42P, M01, M42G, M27I	74	64	76
	M46A	Silver Fir Mountain Hemlock Forest A	Information currently not available.							
Tall Shrub	M50	Sparse Shrubland and Woodland on Talus		Middle elevation (350-1300m als) talus slopes with scattered woody vegetation.	The sizeable (usually > 20cm diameter and often much greater) angular rocks that tend to make up these slopes tend to be deep (precluding soil development) and relatively stable, hosting lichens and mosses. Slopes range from moderate to steep and cover all aspects.	The dominant woody plants vary, but usually Psemen, Abilas and/or Acecir is at least prominent. Other possible dominants include Poptre, Piceng, Cupnoo, Acegla, Holdis, and/or Amealn. Patches of woody plants often matrix with open talus slopes that feature scattered Paxmyr, Cryacr, Rubleu, Amealn and/ or Riblac.	M18, M51, M43N, M43O, M42P, M21, M19	0	5	37

Class	Code	Map Class Name	Photo	Overview Sentence	Setting Description	Floristic Description	Similar Classes	MORA plots	OLYM plots	NOCA plots
Tall Shrub	M51	Dry Tall Shrubland		Dry tall shrublands.	These mixed shrublands occur along and east of the Cascade crest at middle elevations (550 – 1500 m asl). They occur on south and southwest facing slopes, often in openings within Psemen woodlands. Lack of tree cover is sometimes maintained by mechanical disturbance, but more often the result of a dry setting and a recent fire or other tree-killing disturbance.	These shrublands are composed of a diverse mix of tall shrubs and herbs, including Ceavel, Amealn, Salsco, Acegla, Sorsco, and Prunus_spp. A few Psemen are often scattered and sometimes standing dead, but live trees never form a full canopy. Rubpar, Vacmem, or Symalb sometimes form a prominent mid-layer of shrubs. Herbs tend to be diverse as well and concentrated in patched with fewer shrubs. Paxmyr, Chaang, Spibet, Calrub, Mairac, Eucled+, and Thalictrum_spp are common.	M18, M19, M21, M85, M43N, M36, M35, M33, M66	0	0	66
	M61	Mesic Tall Forb and Thimbleberry Meadow	Information currently not available. Email sent to NPS 12/17/2019							
Meadow – Low	M66	Vegetated Bald		Balds and other open upland sites within a closed conifer forests.	These openings occur below closed treeline at low to middle elevations (500 – 1700 m asl) on both sides of the Cascade crest. These forest openings are typically grouped in an areas of favorable geology, with individual patches varying in size. The substrate is mostly bedrock and what soil exists is shallow, which limits tree growth. They are most common on south-facing bedrock outcrops and occasionally found in erosional areas.	Associated vegetation is sparse to moderately dense and dominated by woody shrubs, forbs, or grasses. Scattered Psemen and assorted graminoids are usually present. Different plants are likely to dominate depending on setting and park. Prominent mosses and lichens include Racomitrium_spp. and Cladonia spp. At North Cascades National Park, these balds are most common on the east side and often have prominent Arcuva+, Psespi, Achmil, Danint, Paxmyr, Amealn, and Cryacr. At Olympic National Park, they are most common on slopes near the Elwha River and Achmil, Fesroe, Lommar, Arccol, Cerarv, Fravir, Frilan, Lomnud+, Mahaqu, and Zigadenus_spp are most common. At Mount Rainier, they are most common around the Muddy Fork Cowlitz River and Box Canyon.	M50, M67E, M67W, M61H, M61S, M36, M35, M33	6	7	55

Class	Code	Map Class Name	Photo	Overview Sentence	Setting Description	Floristic Description	Similar Classes	MORA plots	OLYM plots	NOCA plots
Abiotic - Rock	M90	Alluvial Barren		Alluvial Barren	Alluvium deposited by water, usually with evidence of sorting.	Less than 10% cover of live vascular plants		25	27	43
Abiotic - Rock	M91	Colluvial Barren		Colluvial Barren	Scree, talus, or colluvium deposited by gravity.	Less than 10% cover of live vascular plants		52	38	139
Abiotic - Rock	M93	Bedrock Barren		Bedrock Barren	Bedrock	Less than 10% cover of live vascular plants		28	32	69

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PRE-APPLICATION DOCUMENT

APPENDIX E

LIST OF THREATENED AND ENDANGERED SPECIES THAT MAY OCCUR IN THE PROPOSED PROJECT LOCATION, AND/OR MAY BE AFFECTED BY THE PROPOSED PROJECT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington Fish And Wildlife Office
510 Desmond Drive Se, Suite 102
Lacey, WA 98503-1263
Phone: (360) 753-9440 Fax: (360) 753-9405
http://www.fws.gov/wafwo/

In Reply Refer To:
Consultation Code: 01EWFW00-2019-SLI-1187
Event Code: 01EWFW00-2019-E-02419
Project Name: City Light Skagit FERC Relicensing

June 19, 2019

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, and proposed species, designated and proposed critical habitat, and candidate species that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. The species list is currently compiled at the county level. Additional information is available from the Washington Department of Fish and Wildlife, Priority Habitats and Species website: http://wdfw.wa.gov/mapping/phs/ or at our office website: http://www.fws.gov/wafwo/species_new.html. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether or not the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species, and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:
http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.). You may visit our website at http://www.fws.gov/pacific/eagle/for information on disturbance or take of the species and information on how to get a permit and what current guidelines and regulations are. Some projects affecting these species may require development of an eagle conservation plan: (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Also be aware that all marine mammals are protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas. The importation of marine mammals and marine mammal products into the U.S. is also prohibited. More information can be found on the MMPA website: http://www.nmfs.noaa.gov/pr/laws/mmpa/.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Related website:
National Marine Fisheries Service: http://www.nwr.noaa.gov/protected_species/species_list/species_lists.html

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Washington Fish And Wildlife Office
510 Desmond Drive Se, Suite 102
Lacey, WA 98503-1263
(360) 753-9440

Project Summary

Consultation Code: 01EWFW00-2019-SLI-1187

Event Code: 01EWFW00-2019-E-02419

Project Name: City Light Skagit FERC Relicensing

Project Type: ** OTHER **

Project Description: RTE species in Project Boundary for Botanical Section of Pre-Application Document

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/48.47841057629254N121.7127768481529W

Counties: Skagit, WA | Snohomish, WA | Whatcom, WA

Endangered Species Act Species

There is a total of 13 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Wherever Found in Contiguous U.S. There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened
Gray Wolf *Canis lupus* Population: Western Distinct Population Segment No critical habitat has been designated for this species.	Proposed Endangered
Gray Wolf *Canis lupus* Population: U.S.A.: All of AL, AR, CA, CO, CT, DE, FL, GA, IA, IN, IL, KS, KY, LA, MA, MD, ME, MI, MO, MS, NC, ND, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, and WV; and portions of AZ, NM, OR, UT, and WA. Mexico. There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/4488	Endangered
Grizzly Bear *Ursus arctos horribilis* Population: U.S.A., conterminous (lower 48) States, except where listed as an experimental population There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/7642	Threatened
North American Wolverine *Gulo gulo luscus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5123	Proposed Threatened

Birds

NAME	STATUS
Marbled Murrelet *Brachyramphus marmoratus* Population: U.S.A. (CA, OR, WA) There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/4467	Threatened
Northern Spotted Owl *Strix occidentalis caurina* There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1123	Threatened
Streaked Horned Lark *Eremophila alpestris strigata* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7268	Threatened
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **proposed** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Amphibians

NAME	STATUS
Oregon Spotted Frog *Rana pretiosa* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6633	Threatened

Fishes

NAME	STATUS
Bull Trout *Salvelinus confluentus* Population: U.S.A., conterminous, lower 48 states There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8212	Threatened
Dolly Varden *Salvelinus malma* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1008	Proposed Similarity of Appearance (Threatened)

Conifers and Cycads

NAME	STATUS
Whitebark Pine *Pinus albicaulis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1748	Candidate

Critical habitats

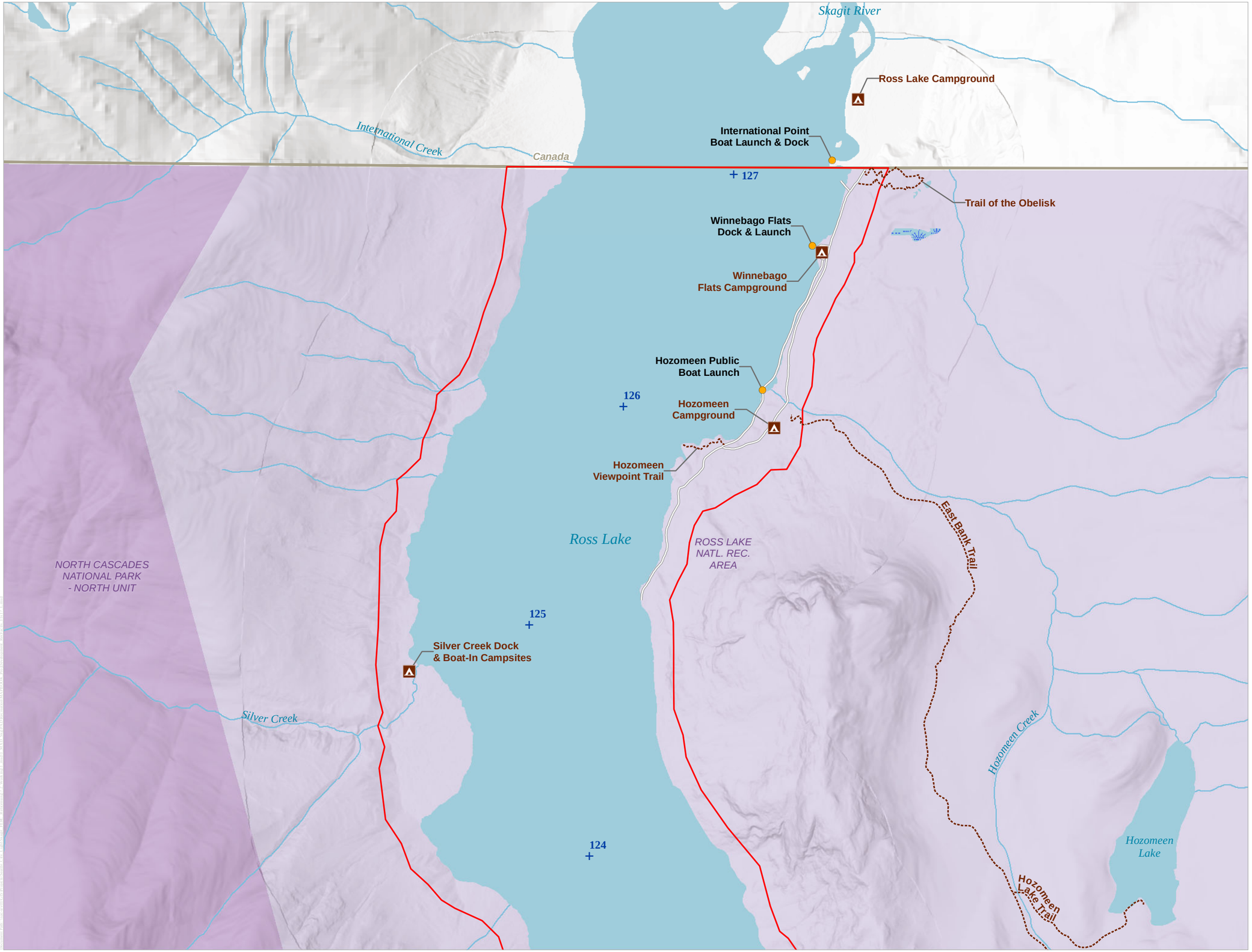
There are 3 critical habitats wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Bull Trout *Salvelinus confluentus* https://ecos.fws.gov/ecp/species/8212#crithab	Final
Marbled Murrelet *Brachyramphus marmoratus* https://ecos.fws.gov/ecp/species/4467#crithab	Final
Northern Spotted Owl *Strix occidentalis caurina* https://ecos.fws.gov/ecp/species/1123#crithab	Final

PRE-APPLICATION DOCUMENT

APPENDIX F

MAPBOOK OF RECREATION SITES AND FACILITIES IN THE PROJECT VICINITY



RECREATION SITES IN PROJECT VICINITY

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- National Park Service
- National Recreation Area (NPS)
- Recreation Site (other)
- Campsite
- Trail (NPS)

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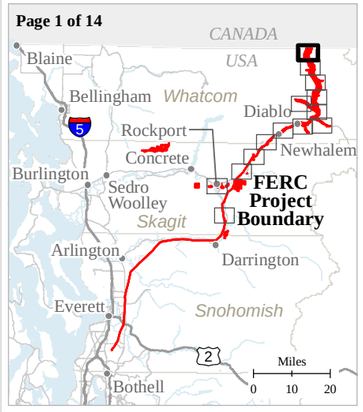
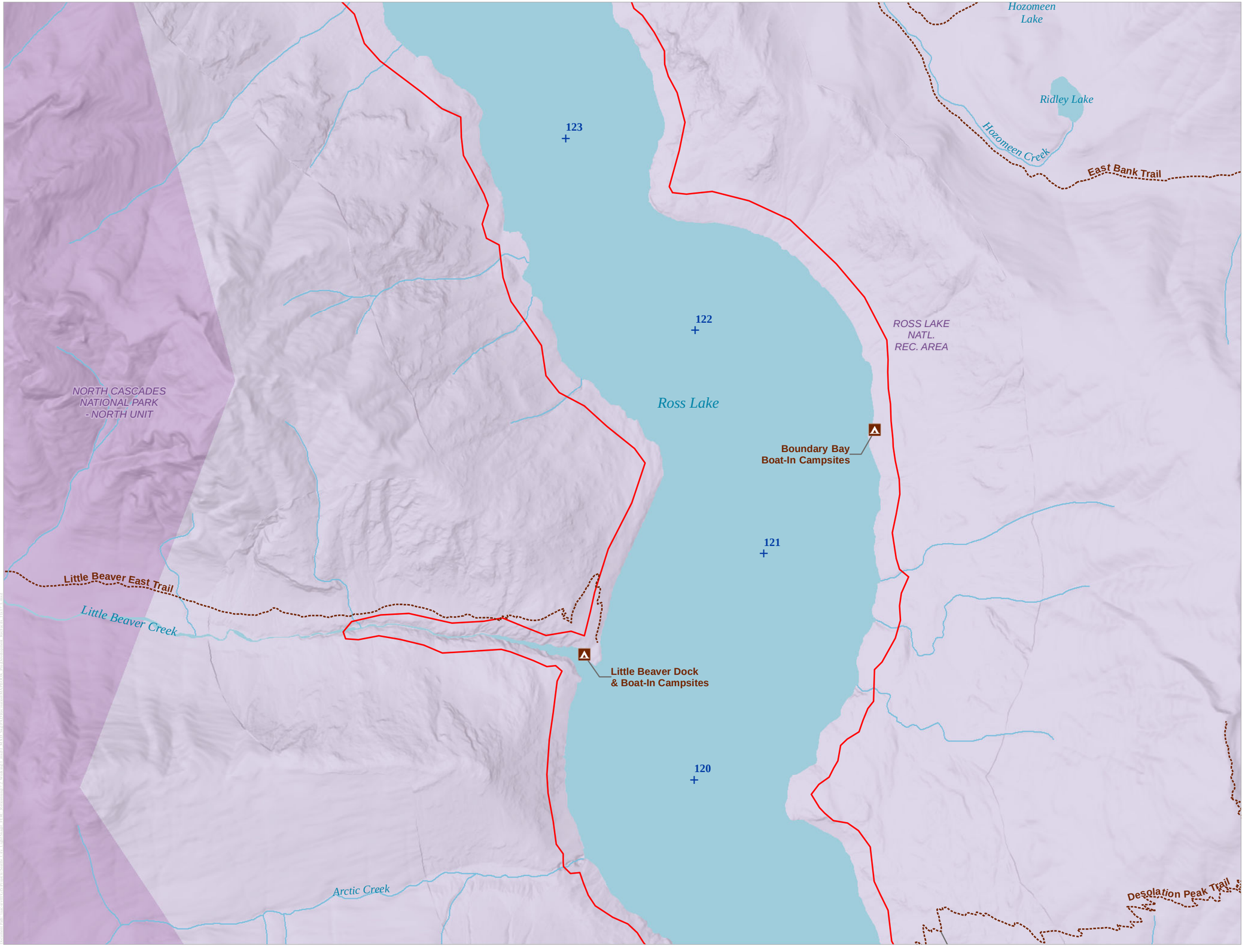


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

Created on 1/2/2020 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: Recreation Sites, Campsites - Seattle City Light. Campsites, Trails - NPS.



RECREATION SITES IN PROJECT VICINITY

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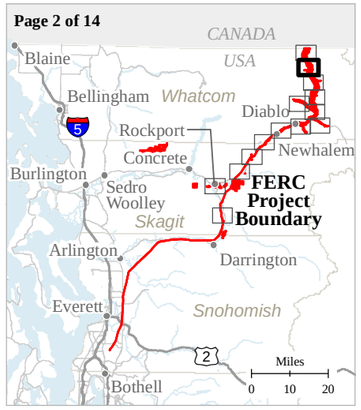

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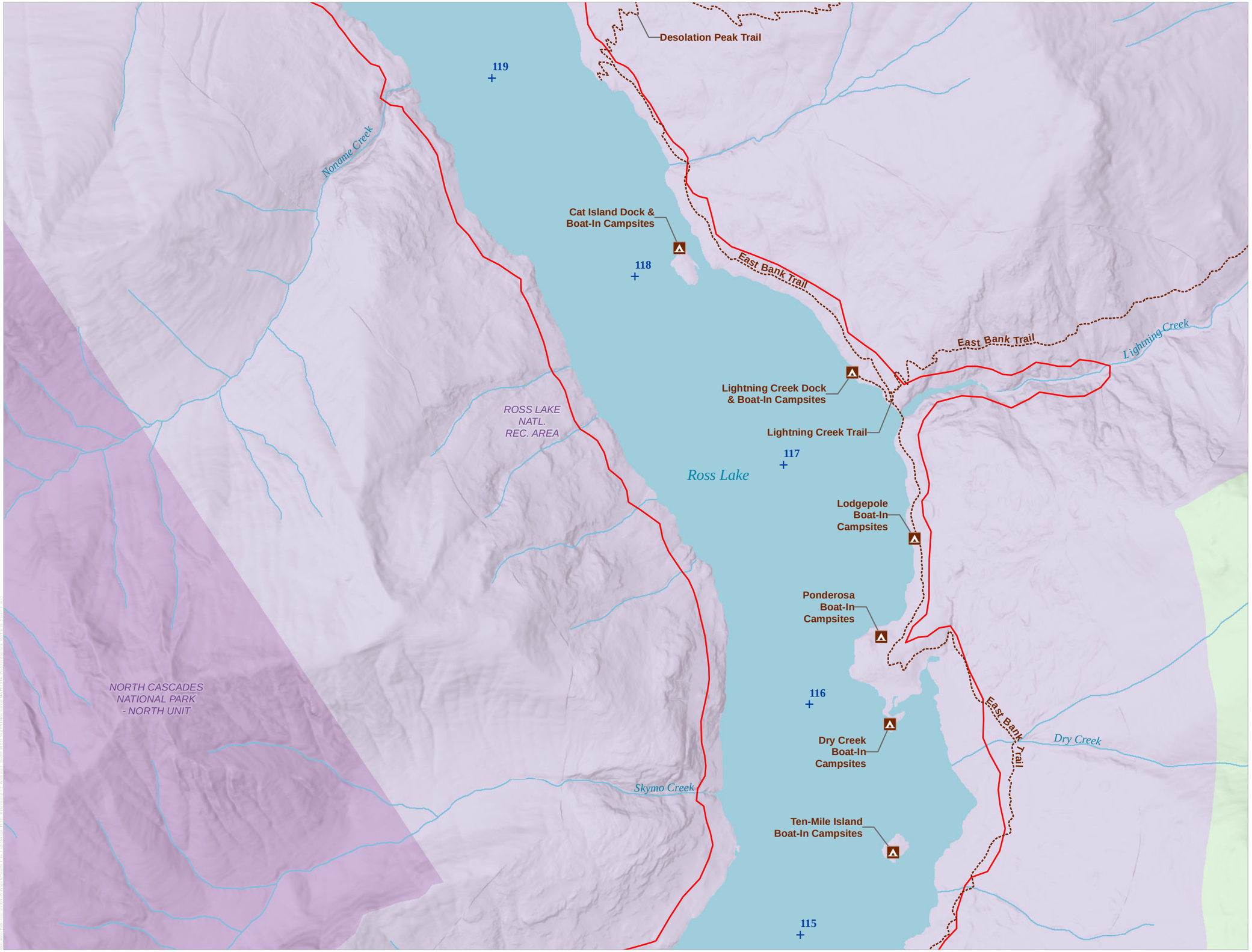

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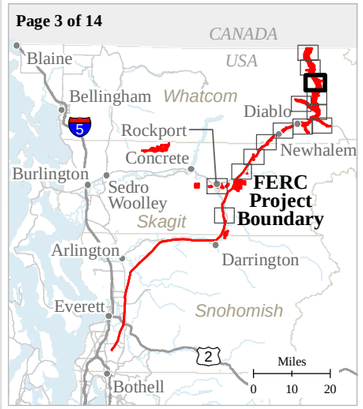

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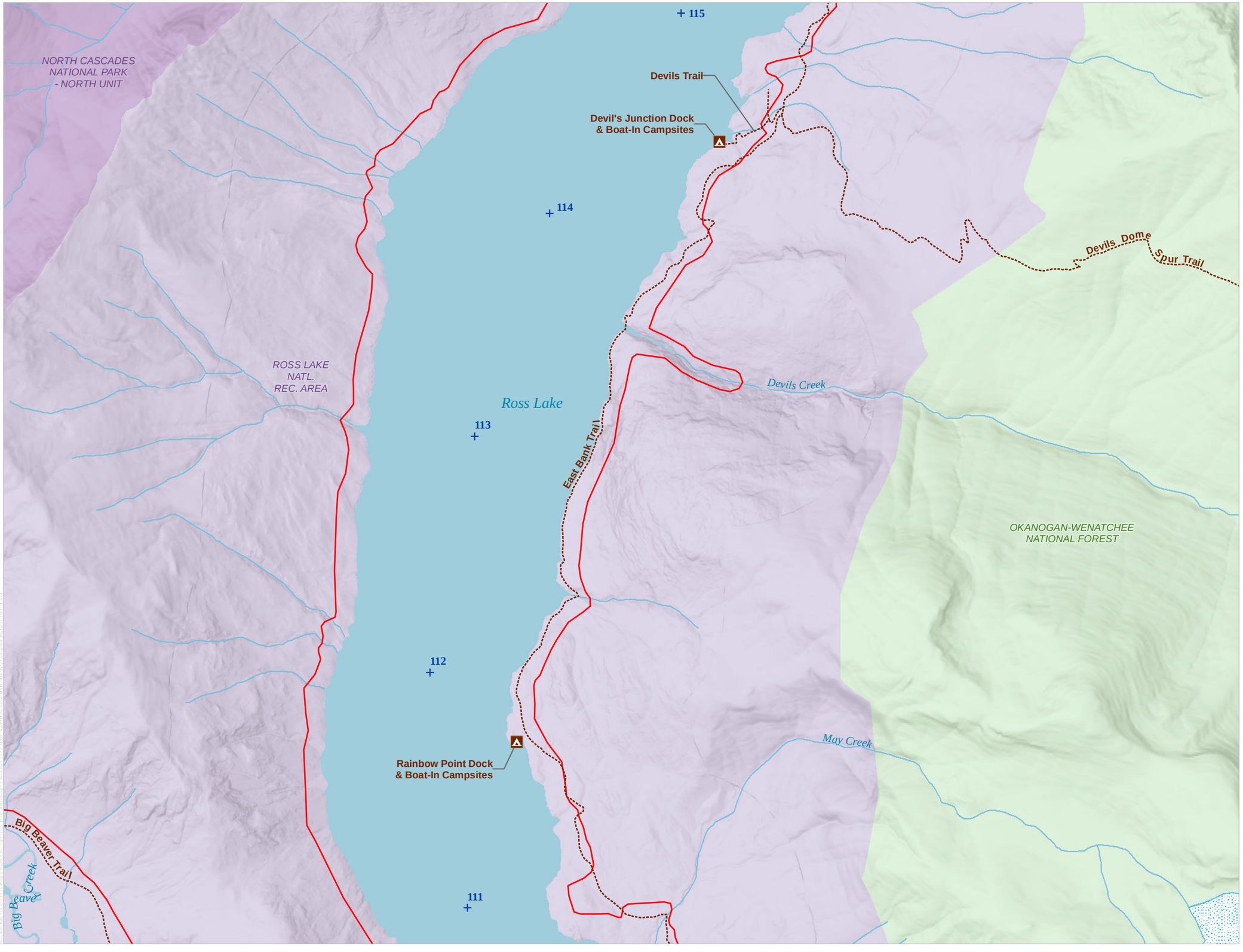

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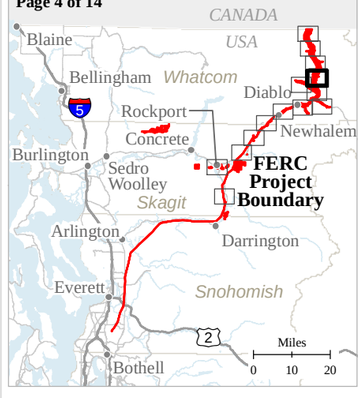

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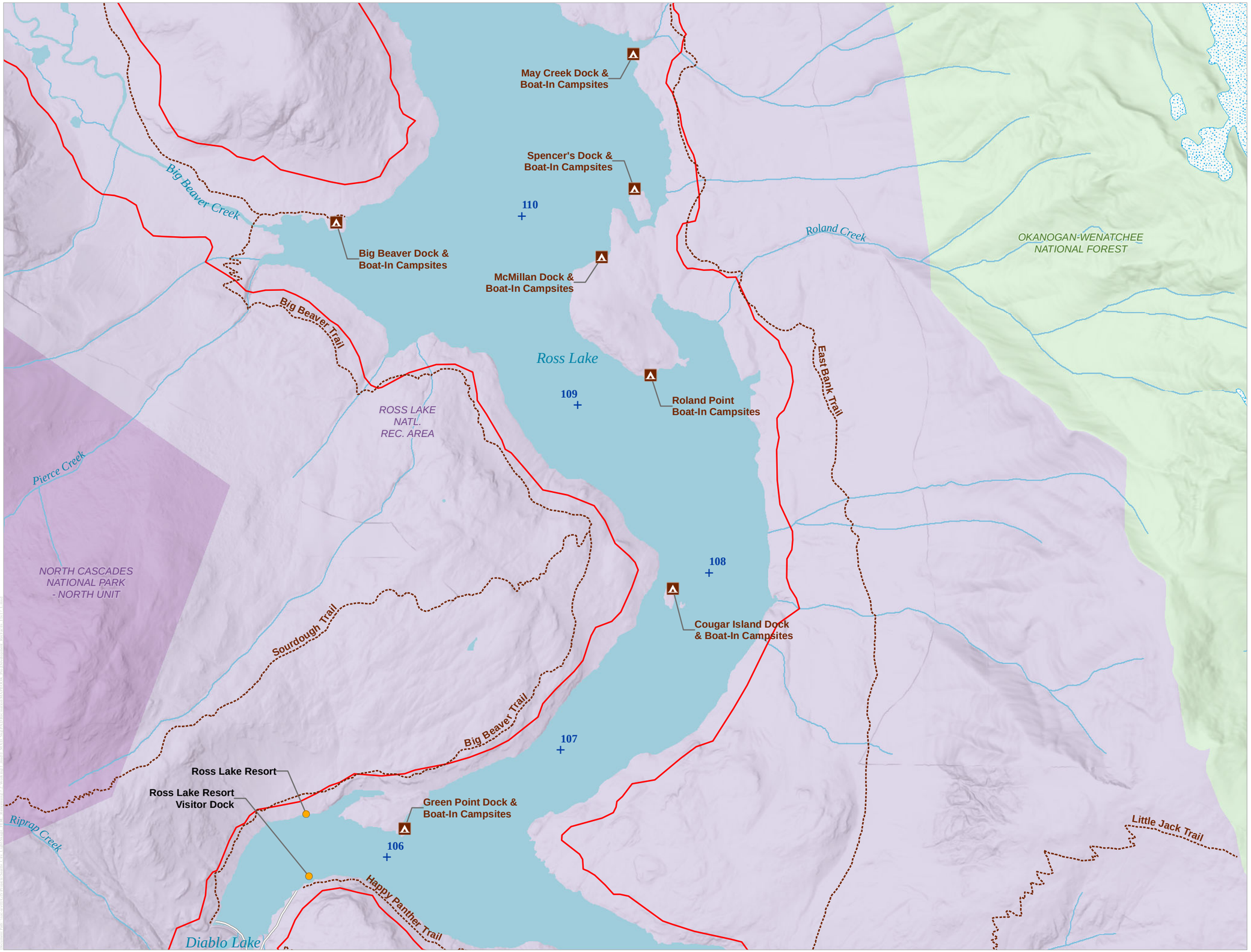

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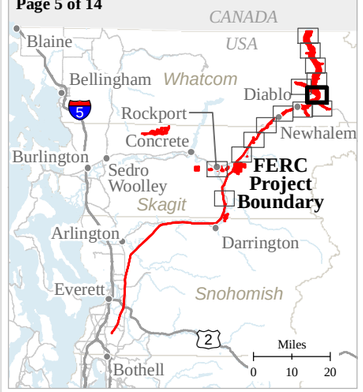
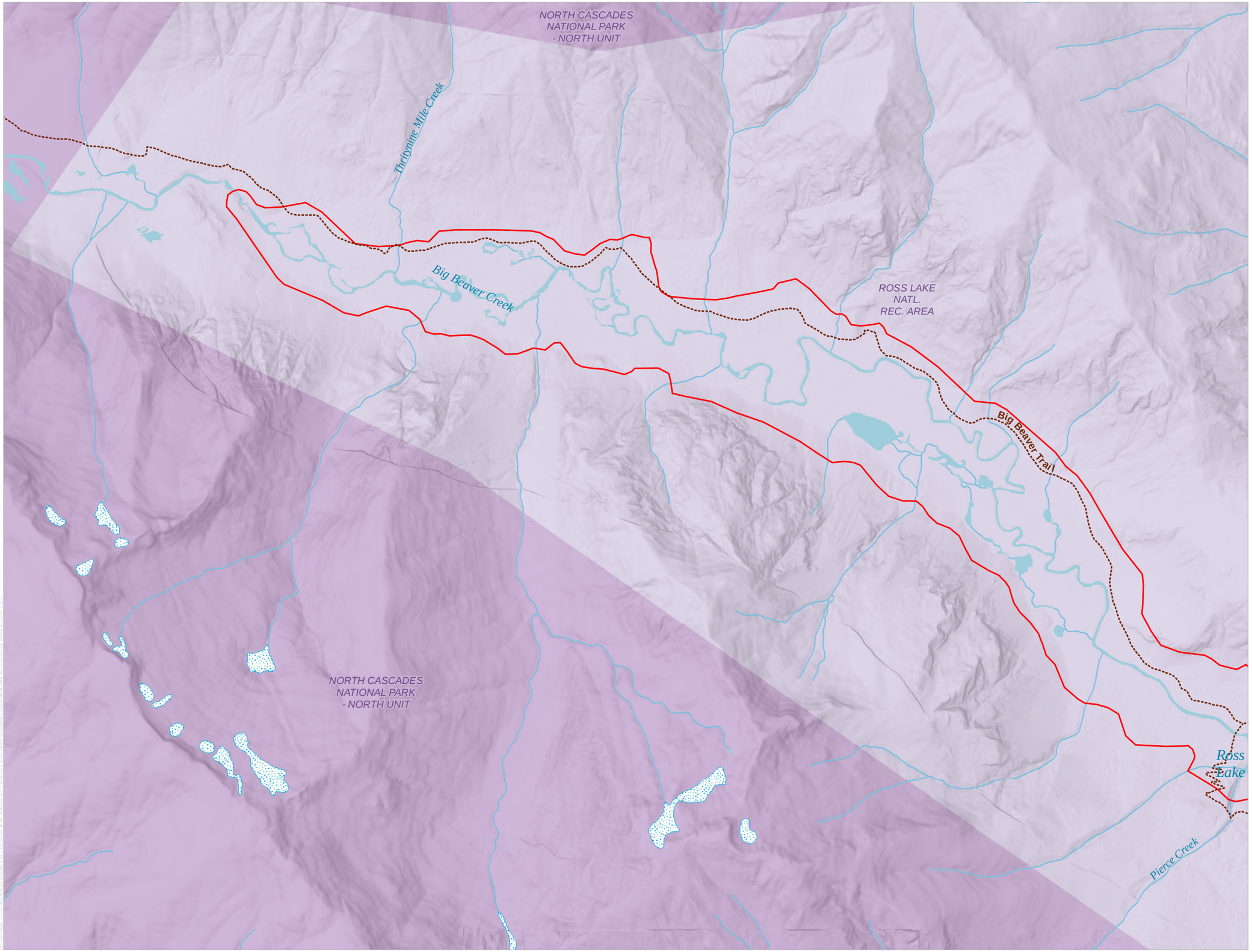


Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)



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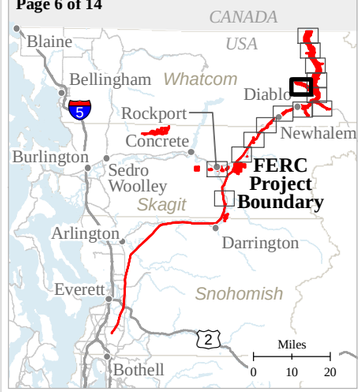

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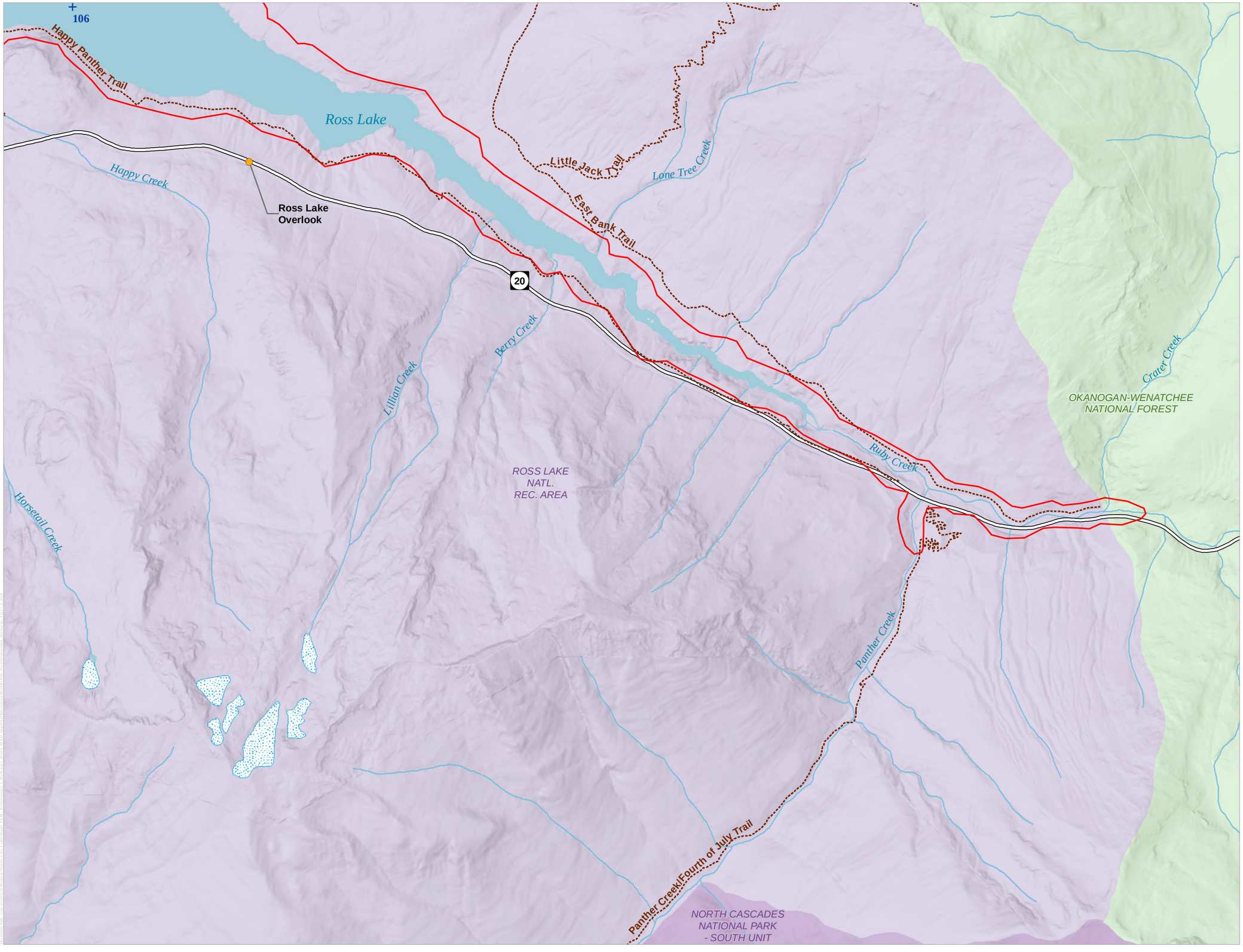

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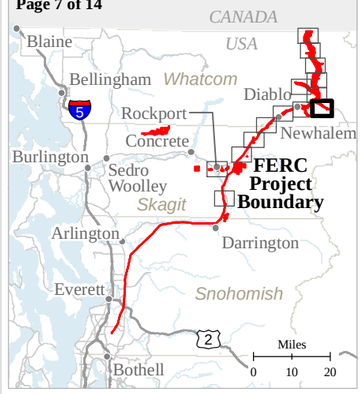

Seattle City Light

SKAGIT RIVER HYDROELECTRIC PROJECT (FERC NO. 553)

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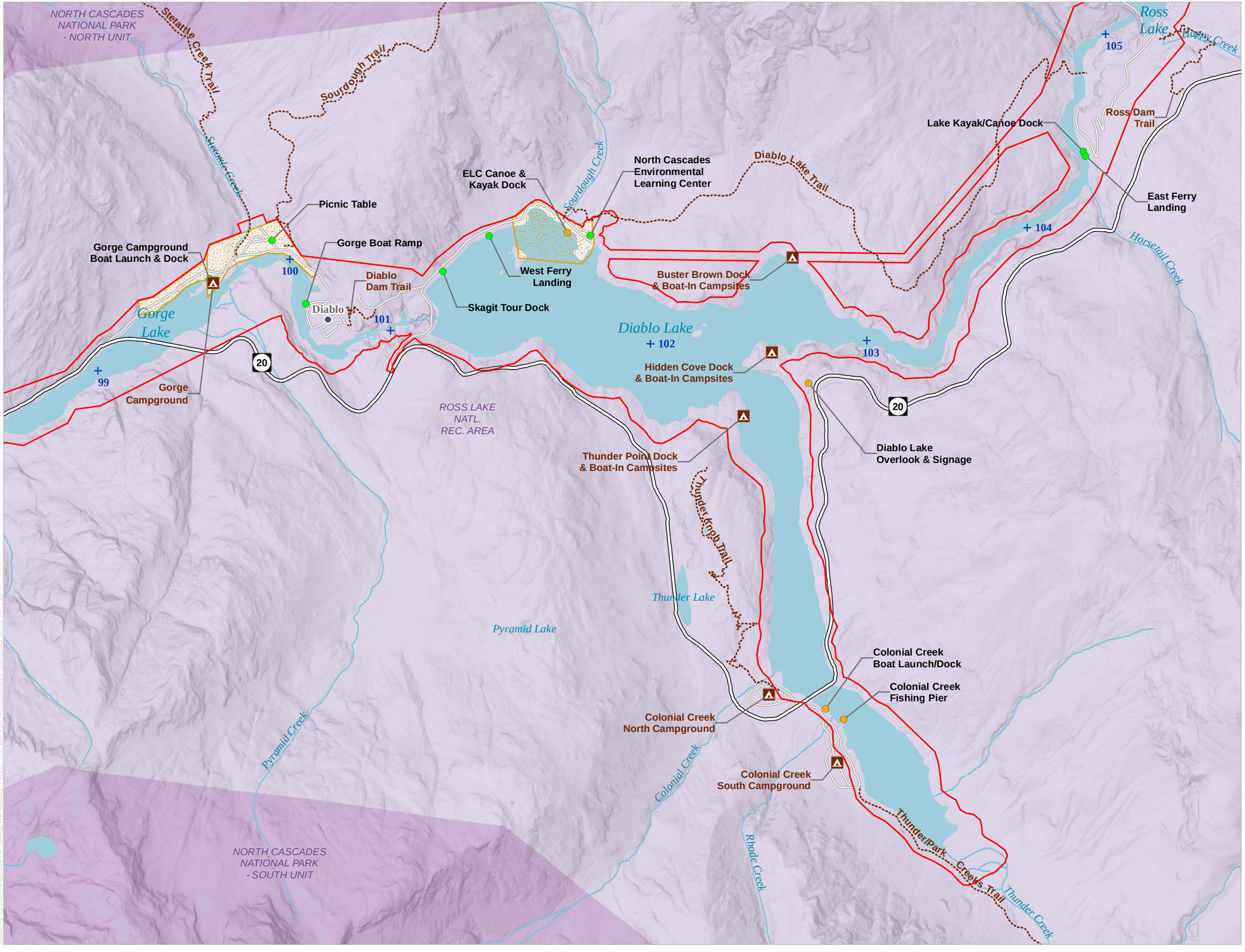
City Light provides no warranty, expressed or implied, as to the accuracy, reliability or completeness of this data.
Data Source: Recreation Sites, Campsites - Seattle City Light. Campsites, Trails - NPS.



RECREATION SITES IN PROJECT VICINITY

- FERC Project Boundary
- Mitigation Parcel
- River Mile (USGS)
- National Park Service
- National Recreation Area (NPS)
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- Recreation Site (City Light)
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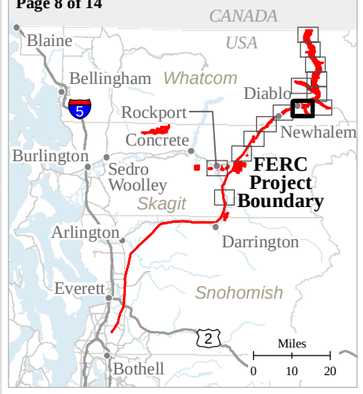

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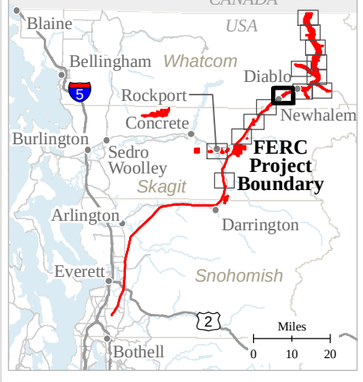

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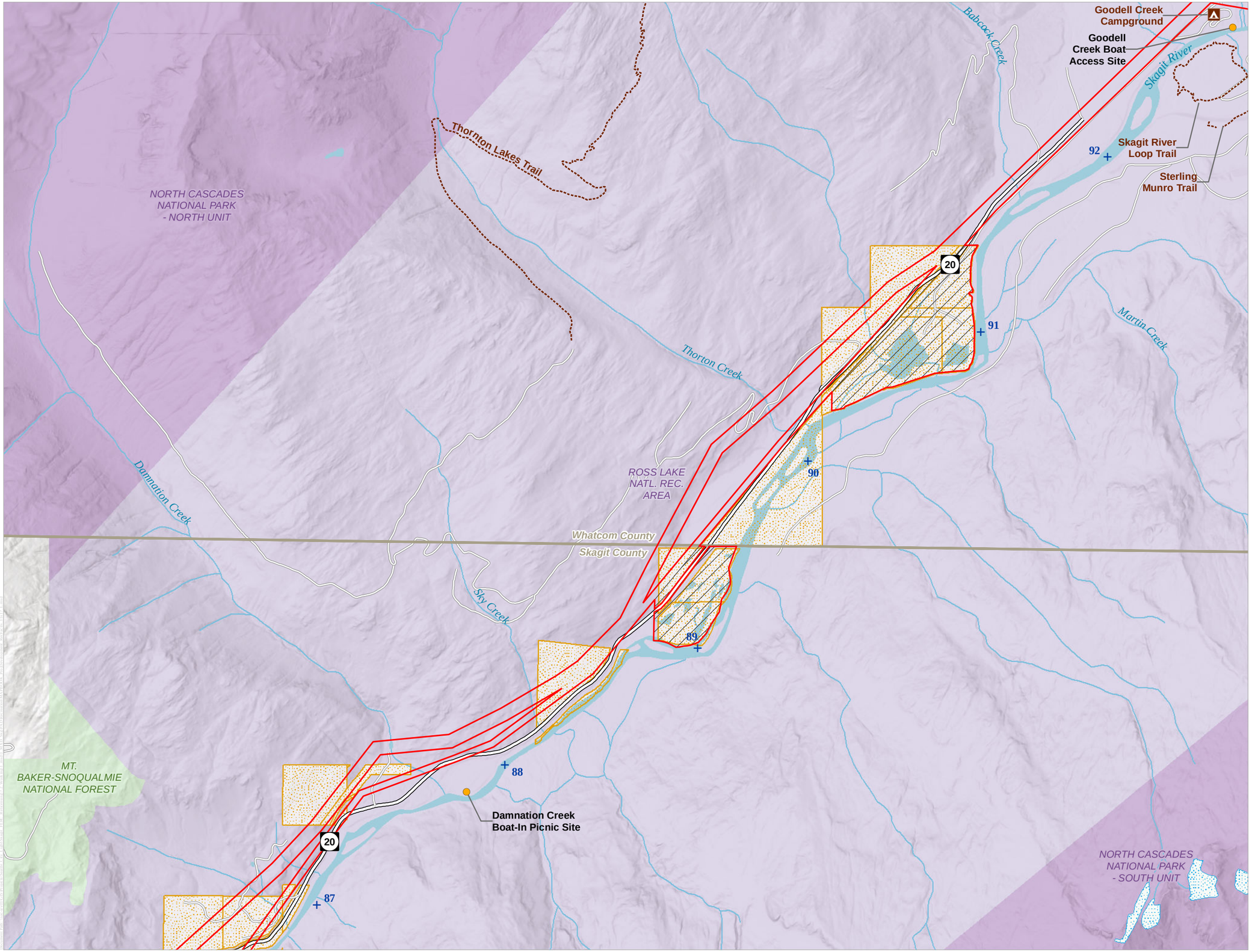

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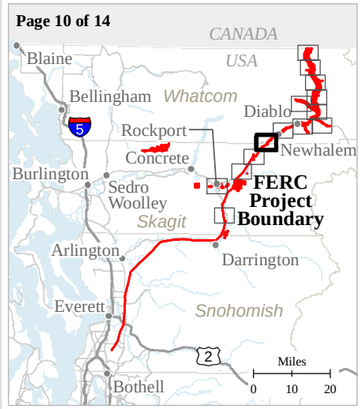

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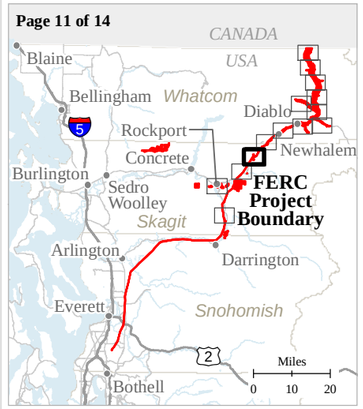

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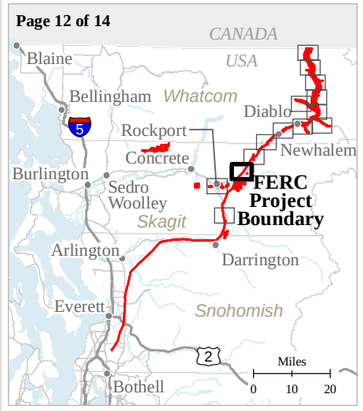

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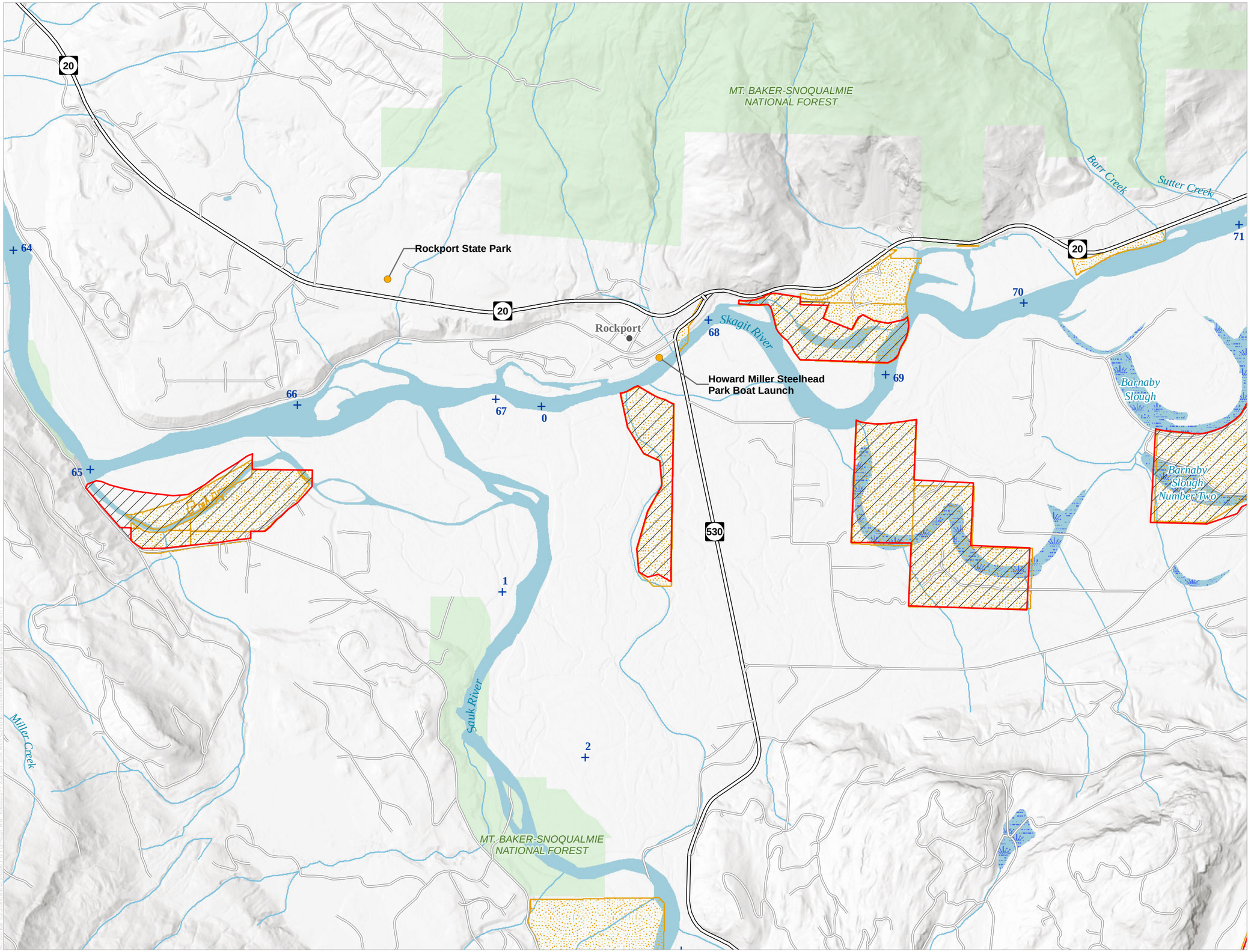

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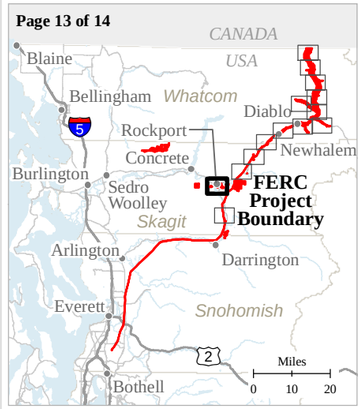

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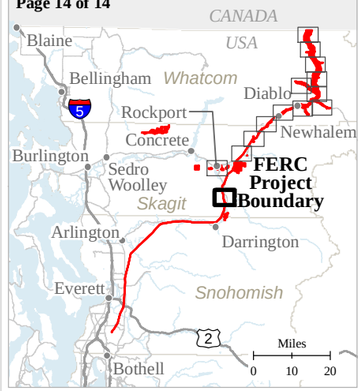

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MT. BAKER-SNOQUALMIE NATIONAL FOREST

MT. BAKER-SNOQUALMIE NATIONAL FOREST

Texas Pond

Rinker Creek

Sauk River

Suiattle River

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9

10

11

12

4

3

530

530

Sauk Boat Launch

PRE-APPLICATION DOCUMENT

APPENDIX G

OVERVIEW OF THE ETHNOHISTORIC, ARCHAEOLOGICAL, AND HISTORICAL BACKGROUND OF THE PROJECT REGION

NOTE: Because of the potentially sensitive nature of information regarding archaeological and historic sites containing cultural resources, the information contained in Appendix G is not being distributed to the general public. This information has been filed with the Federal Energy Regulatory Commission (FERC) separate from the Pre-Application Document (PAD) with a Privileged designation. It may be obtained by request to Seattle City Light or FERC, subject to confidentiality provisions.

PRE-APPLICATION DOCUMENT

APPENDIX H

PROPOSED STUDY PLANS

VEGETATION MAPPING
DRAFT STUDY PLAN

SKAGIT RIVER HYDROELECTRIC PROJECT
FERC NO. 553

Prepared for:
Seattle City Light

Prepared by:
ESA

March 2020

TABLE OF CONTENTS

List of Figures

List of Attachments

List of Acronyms and Abbreviations

City Light .....Seattle City Light
FERC.....Federal Energy Regulatory Commission
GIS .....geographic information system
LP .....licensing participant
NCNP .....North Cascades National Park
NPS .....National Park Service
NVC .....National Vegetation Classification Standard
OBIA.....Object-based Image Analysis
PAD.....Pre-Application Document
PHS .....Priority Habitat and Species
PME .....protection, mitigation and enhancement
Project .....Skagit River Hydroelectric Project
RLNRA .....Ross Lake National Recreation Area
RM .....river mile
RWG .....Resource Work Group
SGCN .....Species of Greatest Conservation Needs
TRREWG.....Terrestrial Resources and Reservoir Erosion Work Group
USFWS .....U.S. Fish and Wildlife Service
WDFW .....Washington Department of Fish and Wildlife

1.0 INTRODUCTION

1.1 General Description of the Project

The Seattle City Light (City Light) Skagit River Hydroelectric Project (Project) is located in northern Washington State and consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities. The Project generating facilities are in the Cascade Mountains of the upper Skagit River watershed, between river miles (RM) 94 and 127. Power from the Project is transmitted via two 230-kilovolt powerlines that span over 100 miles and end just north of Seattle at the Bothell Substation. The Project also includes two City Light-owned towns, an Environmental Learning Center, several recreation sites, and several parcels of fish and wildlife mitigation lands.

Project generating facilities are all located in Whatcom County, although Ross Lake, the most upstream reservoir, crosses the U.S.-Canada border and extends for about one mile into British Columbia at normal maximum water surface elevation. Gorge Powerhouse, the most downstream facility, is approximately 120 miles northeast of Seattle and 60 miles east of Sedro-Woolley, the nearest large town. The closest town is Newhalem, which is part of the Project and just downstream of Gorge Powerhouse. The primary transmission lines cross Whatcom, Skagit, and Snohomish counties; the fish and wildlife mitigation lands are in the same counties.

The Project Boundary is extensive, spanning over 133 miles from the Canadian border to the Bothell Substation just north of Seattle, Washington. In addition, there are "islands" of fish and wildlife mitigation lands and recreation sites within the Skagit, Sauk, and South Fork Nooksack watersheds that are also within the Project Boundary. Project generating facilities are entirely within the Ross Lake National Recreation Area (RLNRA), which is administered by the National Park Service (NPS) as part of the North Cascades National Park (NCNP) Complex. The RLNRA was established in 1968 in the enabling legislation for North Cascades National Park to provide for the "public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge lakes." The Federal Energy Regulatory Commission (FERC; formerly the Federal Power Commission) maintains jurisdiction over the lands and waters within the Skagit River Hydroelectric Project, FERC No. 553, and the Newhalem Project, FERC No. 2705, within the RLNRA and existing hydrologic monitoring stations necessary for the proper operation of the hydroelectric projects listed herein (Public Law 90-544. Sec. 505 dated October 2, 1968, as amended by Public Law 100-668. Sec. 202 dated November 16, 1988).

1.2 Relicensing Process

The current FERC license for the Project expires on April 30, 2025, and City Light will apply for a new license no later than April 30, 2023. City Light will begin the relicensing process by filing a Notice of Intent and Pre-Application Document (PAD) with FERC on April 30, 2020. The PAD included descriptions of the Project facilities, operations, license requirements, and Project lands as well as a summary of the extensive existing information available on Project area resources and early consultation on potential resource issues to be addressed during the relicensing. The PAD included a draft of this study plan. City Light has convened a series of Resource Work Group

(RWG) to engage agencies and other licensing participants (LPs) in the study plan development process

1.3 Study Plan Development

A baseline characterization of vegetation resources within the Project Boundary and vicinity was identified as an early study need during 2019 discussions with the Terrestrial Resources and Reservoir Erosion Resources Work Group (TRREWG). On October 10, 2019, a draft of the Vegetation Mapping Study Plan was distributed to the TRREWG for review and comments were requested by November 4, 2019. The draft study plan was then discussed at the TRREWG meeting held on October 15, 2019. Following the meeting, written comments were received from the Washington Department of Fish and Wildlife (WDFW) and the NPS (see Attachment A to this study plan). In March 2020, a revised draft of the study plan was provided with the PAD for LP review and for discussions in 2020 TRREWG meetings.

2.0 STUDY PLAN ELEMENTS

2.1 Study Goals and Objectives

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

- Compile existing data and use remote sensing to describe and map vegetation to the "Group" level within the study area using the National Vegetation Classification (NVC) Standard.[1] The Group level is defined as a combination of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), with broadly similar composition and diagnostic growth forms reflecting biogeographic differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes. For highly modified areas such as the transmission line, a custom set of cover types will be used during mapping.
- Develop an overlay of potential Project-related disturbances to prioritize field surveys.
- Describe baseline vegetation resources and environmental conditions within the study area.
- Provide information on wetland communities within the study area (see Wetland Assessment Study).
- Provide information for assessing wildlife habitat (e.g., Marbled Murrelet, Golden Eagle, Northern Goshawk, beaver, and select Priority Habitat and Species (PHS) wildlife and WDFW Species of Greatest Conservation Needs (SGCN)) within the study area.

2.2 Resource Management Goals

City Light's goal is to compile and update existing information to provide a comprehensive vegetation type database to describe existing conditions, inform analysis of potential effects of Project operations and maintenance on vegetation and wildlife, and to inform natural resource management actions in the study area.

The study will also provide information to help resource agencies with jurisdiction in the Project vicinity identify appropriate conditions for the new Project license pursuant to their respective mandates. Management goals related to vegetation are described below.

- Ross Lake National Recreation Area General Management Plan and Environmental Impact Statement – Published by the NPS in 2012. The General Management Plan states that a Vegetation Management Plan will be developed to guide the vegetation management program. The Vegetation Management Plan will have priorities for restoration based on threats to high-quality habitats.

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

- U.S. Forest Service Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan – Published by the U.S. Forest Service in June 1990. The Land and Resource Management Plan was developed to guide resource management and establish standards for the management of resources, including vegetation, throughout the Mt. Baker-Snoqualmie National Forest.

City Light will confer with Resource Agencies that are interested in participating in development of this study plan and request that they provide language identifying specific management goals relevant to this study proposal.

2.3 Background and Existing Information

NPS, in partnership with the Washington Natural Heritage Program and the Institute for Natural Resources (based at Portland State University), is in the final stage of developing a vegetation map at the Association level for the NCNP using the NVC Standards. The Association level is a more refined unit below the Group level that classifies vegetation based on a characteristic range of species composition, with diagnostic species occurrence, habitat conditions, and physiognomy reflecting topo-edaphic conditions, climate, substrates, hydrology, and disturbance regimes. This is part of an eight-year-long effort to map the three National Parks in Washington State – NCNP, Mt. Rainier National Park, and Olympic National Park. City Light will use mapping provided by NPS by the end of 2019 to cover the NPS portion of the study area. With this vegetation mapping effort, the target is an overall accuracy of 80 percent.

City Light owns over 10,700 acres of land in scattered tracts within the Sauk, Skagit, and South Fork Nooksack basins that have been acquired for wildlife and fish mitigation under the current Project license. These lands, known as the fish and wildlife mitigation lands, were purchased in accordance with the Wildlife Settlement Agreement and Fisheries Settlement Agreement. City Light has mapped vegetation cover types of most of these lands, but has used a different vegetation classification scheme than the NPS. The transmission line corridor within the Project Boundary has not been mapped, except for the portion that is within the RLNRA or that cross fish and wildlife mitigation lands.

In this study, the NPS vegetation mapping (Group level) results for the NPS areas will be adopted within the study area. The NPS detailed field vegetation plots database will be leveraged along with a limited number of additional training plots and remote sensing methods to map vegetation at the Group level for all other vegetated areas in the study area. Vegetation mapping at the Group level was chosen because it provides the appropriate level of floristic detail and composition when combined with structural data from LiDAR to assess wildlife issues and inform vegetation management planning efforts. The Group level focuses on the dominant overstory species and does not include understory species. As needed for impact assessment and management planning, specific sites may be further refined to Alliance or finer levels. Along the transmission line and other highly altered vegetation types, traditional air-photo interpretation techniques will be used to map disturbed areas using custom cover types.

Existing resources include the following:

- Vegetation Classification of Mount Rainier, North Cascades, and Olympic National Parks. NRTR – NPS/NCCN/NRTR – 2009/211.

- Mapping of vegetation cover types surrounding Project reservoirs for the 1995 FERC relicensing.
- The EcoVeg approach in the Americas: U.S., Canadian, and International Vegetation Classifications. Faber-Langendoen, et al. Phytocoenologia. December 2017.
- Skagit Mitigation Lands Management Plan. Seattle City Light. 2006.
- Skagit Watershed Council Riparian Assessment. ESA. 2017.
- Skagit Watershed Council Reach Level Analysis – Middle Skagit River. Skagit River System Cooperative. 2011.
- Washington Department of Fish and Wildlife High Resolution Land Cover Mapping. https://wdfw.wa.gov/conservation/research/projects/aerial_imagery/.
- Mapping Riparian Land Use within Agricultural Zones. A case study in Skagit County. Whitefield, E. 2010. https://www.skagitcounty.net/SalmonStrategy/Documents/White%20Paper%20v23%20booklet-style.pdf.
- Seattle City Light Skagit River LiDAR – 2018.
- USGS Western Washington 3DEP LiDAR. 2016/2017. http://lidarportal.dnr.wa.gov/.
- High Spatial Res: 2018 4”/6” Pictometry, 1m 4band NAIP (normalized difference vegetation index).
- Spectral/Temporal: Sentinel 2 – 12-bands (10m, 20m), coverage every 5 days.
- National Park Service – SRI Soil Survey (SSURGO) for North Cascades National Park Complex. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/washington/NorthCascadesWA2012/NOCA_WA.pdf.

2.4 Study Area

The study area will consist of land within the Project Boundary, the area within 0.5 mile of the Project Boundary, and the channel migration zone from Gorge Powerhouse to the confluence of the Sauk and Skagit Rivers. A location map of the Project Boundary and fish and wildlife mitigation lands is shown in Figure 2.4-1.

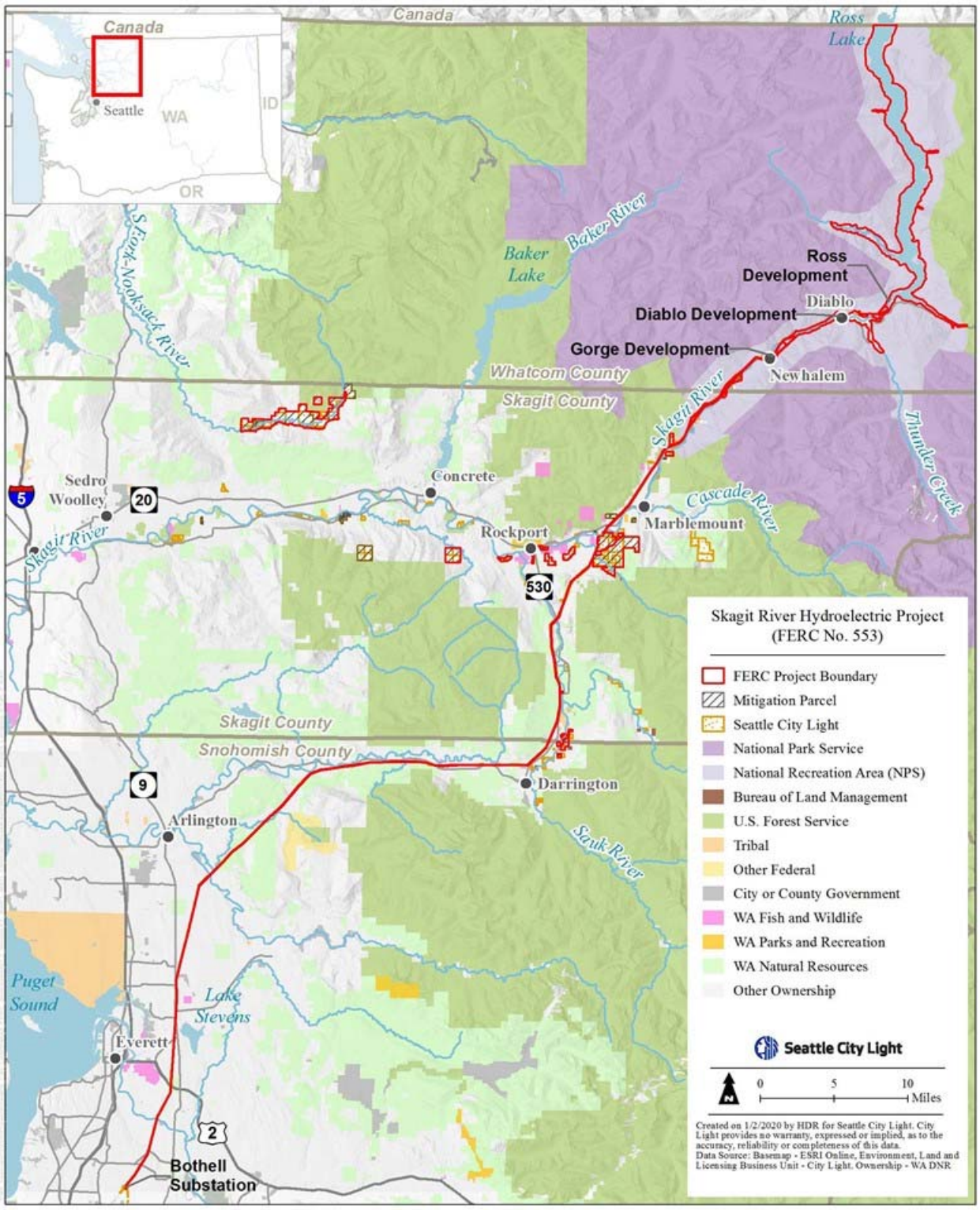

Figure 2.4-1. Location map of the Skagit River Project.

2.5 Methodology

2.5.1 Compile and Review Existing Information

City Light will work with the TRREWG to compile and summarize existing information including reports, documents, existing geospatial data, and similar studies relevant to the study area (see above existing resources list).

2.5.2 Validate Field and Remote Sensing Methods

The NPS has developed and applied a set of methods for their vegetation mapping inventory for NCNP based on a hierarchical classification of vegetation using the NVC Standard system. This approach uses a combination of random forest modeling and Object-based Image Analysis (OBIA) techniques. Random forest modeling is the most commonly used non-parametric classification method, which allows for the use of multiple, correlated input variables that are not normally distributed. Random forest is an ensemble, decision tree method, which uses a different random subset of training data (bootstrap) to build a multitude of decision trees and uses the mode of all decision trees to classify objects (Breiman 2001).

OBIA is a remote sensing technique used to identify patterns in raster imagery. For high-resolution mapping (<1 meter), OBIA improves classification accuracy, especially when the objects being resolved are larger than the pixel resolution of the imagery used (Blaschke et al. 2014). For efficiency purposes, the completed field and map products from NPS will be used as a basis, and the NPS field and remote sensing (random forest modeling and OBIA) framework will be applied to complete mapping vegetation in the study area outside of NCNP. The TRREWG will be informed of this approach, and intermediate products (maps, data summaries) will be shared as the study progresses.

2.5.3 Pre-process Geospatial Resources (Imagery, LiDAR, etc.)

Input and ancillary datasets will be compiled and pre-processed for incorporation into the analysis. Pre-processing includes re-projecting datasets into a common geographic projection and clipping data to the study extent.

2.5.4 Assess NPS Vegetation Mapping and Classification

The NPS vegetation mapping and classification output will be integrated into the final mapping product. In order to align results with the NPS classification, the NPS results will first be clipped to the study extent. Secondly, the NPS classification results mapped at the Group level will be spot checked based on limited field verifications and focus on areas where there is the greatest potential for Project effects.

2.5.5 Apply Field and Remote Sensing Methodology

A Group level vegetation map will be created based on a random forest model using multiple sources of remotely sensed (i.e., imagery, LiDAR-derived datasets) and ancillary (e.g., soils data) input variables identified as a first step in this analysis. A preliminary classification map will be produced for the portion of the study area not covered by NPS to interpret the initial model results,

help identify areas to review in the field to inform the model, and to assist with field data collection efforts. The classification will be refined and the classification accuracy will be validated using the collected field data.

2.5.6 Input Datasets

As stated above, any existing datasets that could be used in the random forest model will first be compiled and reviewed. The following input datasets will be tested for the preliminary model:

- Imagery
  - High-resolution aerial imagery
  - Sentinel-2 satellite imagery
  - Landsat satellite imagery
- LiDAR-derived datasets
  - Digital terrain model
  - Canopy height model
  - Slope index
  - Topographic wetness index
  - Topographic indices (plan curvature, grad curvature, profile curvature)
- Ancillary datasets
  - Geology
  - Soils

In addition, the potential of other LiDAR-derived vegetation metrics will be evaluated such as canopy bulk density, sub-canopy metrics (i.e., number of LiDAR points at different height stratifications), and rumple (i.e., canopy complexity). Only input variables that show model significance will be used for the preliminary random forest model that is run over the part of the study area not covered by NPS.

2.5.7 Preliminary Model

As a first step, a preliminary random forest model will be developed using training data taken from the NPS classification that falls within the study extent and run the model across the study area. The training data will be maximized by identifying as many of the NPS data plots within proximity of the study area as possible.

This preliminary modeling effort will serve two purposes. First, it will provide an early look at the random forest model, which will help to identify which remote sensing data inputs are the most significant in the vegetation classification and if additional datasets are needed. Second, the preliminary classification can be used to stratify sampling for the limited field data collection effort. Preliminary maps will be output in raster format with each pixel containing information on

probability of vegetation group class membership. The pixel will be classified by the class with the highest probability of class membership. The prediction error output and input variable performance will be used, and two metrics will be provided through the randomForest package in R (Liaw and Wiener2002), to assess overall model performance and the significance of each of the input variables. In addition, the accuracy of the preliminary classification will be assessed using field data points collected by the NPS in NCNP.

2.5.8 Collection of Model Training and Verification Data

A stratified sampling approach will be used to collect vegetation information at representative sites not well covered by NPS data. These data will be used to develop an initial training and validation dataset to verify areas within the potential effects overlay and where model interpretation is less certain. Stratification will be based on a combination of vegetation mapping units and a combination of topography, soils, and other key components.

In order to increase efficiency in field data collection, the training and validation dataset will be refined by constraining the sampling sites to areas that are both safe and easily accessible to field ecologists. Areas with a steep gradient, non-easement private property, and areas over a half-mile from a road will be masked out of the sampling frame. The training dataset will be supplemented with opportunistic sampling by collecting additional data points for every group class encountered during travel to a sample point. These points can help boost the number of training data points needed for the random forest model. A proportion of sample points will be reserved for validation of the model to assess the accuracy of the classification. Accuracy assessment methods are described below. Validation data points will not include opportunistic collection of data.

2.5.9 Develop Draft and Final Vegetation Map

An OBIA approach will be used for a draft and final model instead of a pixel-based approach as was used in the preliminary modeling effort. While OBIA can produce more accurate results than pixel-based approaches, it is more computationally intensive. Therefore, only OBIA will be run for the final modeling effort. Object statistics (e.g., mean, min, max elevation) will be calculated, which is unique to OBIA, and will be integrated into the final random forest model.

The preliminary random forest model will be refined by using the training data collected within the study area and selecting the input variables that have the highest overall model importance. While random forest models can handle highly correlated input datasets, reducing the number of input variables will improve computing performance. Input variables will be checked for multi-collinearity and any datasets with a correlation greater than 0.8 will be removed.

Running filters will be evaluated on the final habitat classification to remove patches below a minimum mapping unit of 5 square meters. This is commonly done to remove the “popcorn” effect that can make maps illegible. In addition, manual refinements will be applied using very high spatial resolution imagery to address clear visual errors.

OBIA segmentation and calculation of object statistics will occur using Orpheo toolbox as part of QGIS. Random forest modeling will occur in R using the statistical package randomForest (Liaw

and Wiener 2002). Post-processing, clean-up, and final map products including FGDC-compliant metadata will be done using ESRI ArcGIS desktop software.

The townsites and transmission line right-of-way are heavily altered habitats that require a modified mapping approach. Similarly, vegetation types likely modified through modern agriculture and traditional ecological management practices may not fit into natural vegetation categories. As such, separate cultural classifications will be developed for these areas because these vegetation communities are not included in typical vegetation classifications. Aerial photography will aid in determining the classifications of these sites and LiDAR will inform vegetation height determination on the transmission line corridor. Field verification will be conducted in the townsites and along the transmission line at representative sites where vegetation management occurs.

Specific study products include:

- GIS-based map of vegetation at group or cultural group level within the study area. The database will include information on dominant plant species composition and field- and LiDAR-derived structural data (e.g. tree size and canopy closure, riparian/wetland deciduous tree and shrub cover, etc.) that will inform assessment of wildlife habitat for Marbled Murrelet, Golden Eagle, Northern Goshawk, and beaver studies.
- Overlay of potential Project-related disturbances.
- A description of vegetation resources and environmental conditions within the study area.
- Initial data on wetland communities to inform the Wetland Assessment Study.

Draft and final maps will be reviewed by the TRREWG and manual refinements to the vegetation map will be made based on expert input.

2.5.10 Accuracy Assessment

Accuracy of the final habitat classification will be assessed using standard accuracy assessment procedures as outlined in Congalton and Green (2010). The overall accuracy will be calculated as well as the individual class accuracy using the validation sample data collected in the field. An alternative approach is to use a bootstrap method of the entire sample dataset; a method that relies on random sampling to estimate the measure of accuracy. Consistent with the NPS vegetation mapping inventory, 80 percent overall accuracy will be targeted.

2.6 Consistency with Generally Accepted Scientific Practice

Random forest classification is a widely accepted approach for land cover classification. OBIA is commonly used for high spatial resolution remote sensing where spectral resolution is confined to 3 or 4 bands (red, blue, green, infrared). OBIA has been shown to increase overall accuracy of high spatial resolution classifications and overall map aesthetics. The standard accuracy assessment outlined by Congalton and Green (2010) will be implemented.

2.7 Schedule

- Draft Study Plan – October 2019 for TRREWG review

- Revised Study Plan – March 2020
- Initial Model Run – Spring 2020
- Fieldwork – Summer 2020
- Data Analysis and Map Development – Autumn 2020
- Draft Report and Maps – February 2021

2.8 Level of Effort and Cost

The initial estimate for implementation and reporting associated with this study is approximately $300,000.

3.0 REFERENCES

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VEGETATION MAPPING DRAFT STUDY PLAN

ATTACHMENT A

CITY LIGHT RESPONSES TO LP COMMENTS ON THE STUDY PLAN

Table 1. City Light responses to LP comments on the study plan.

No.	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
1.	Brock Applegate (WDFW)	10/31/2019	Study Goals and Objectives, Page 2-1	Hi Ron, I am sorry it took this long to get to your request at the meeting. I just remembered. Please see PHS List : https://wdfw.wa.gov/publications/00165 Additional Habitat Parameters: https://wdfw.wa.gov/species-habitats/at-risk/phs/recommendations Species of Greatest Conservation Need and Habitats of Greatest Conservation Need: https://wdfw.wa.gov/species-habitats/at-risk/swap	WDFW noted at the October 10, 2019 TRREWG meeting that this information would be provided as a resource. Comment noted.
2.	Brock Applegate (WDFW)	10/31/2019	Study Goals and Objectives, Page 2-1	As stated in the past comments, SCL should include all important habitat parameters for Washington State Priority Species and Habitat and Species of Greatest Conservation Need Lists, which have much overlap I like the bullet that SCL has in the Wetland Assessment Draft Study because it captures my thought on this study as well. "Additional habitat-related data to inform other efforts, such as the rare, threatened, and endangered (RTE) plant, invasive plant, beaver, and amphibian studies."	City Light will use high resolution imagery, LiDAR, and other existing sources to develop the Group Level Vegetation Map and make generalized assessments based on these data for select PHS and SGCN species. The expansion of the species list is not necessary to inform relicensing. Information from the Wetland Assessment Study and other planned studies will feed into this effort. This mapping effort is a baseline data effort that will be used for later impact assessments and management recommendations.

No.	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
3.	Brock Applegate (WDFW)	10/31/2019	Background and Existing Information, Page 2-2	WDFW finds transmission line corridors important, including those near the project lands for sensitive species, especially ones that migrate substantial distance between habitats, (IE raptors, waterfowl, etc.)	See the above response to Comment #2.
4.	Brock Applegate (WDFW)	10/31/19	Background and Existing Information, Page 2-2	I like the continuation of other mapping projects, but we may need more information beyond this particular effort. Let's look at all the habitat parameter needs for each species and habitat and make sure that we have it covered in the mapping project before we start.	The Vegetation Mapping Study is one piece of foundational information. Other data such as wetlands, weeds, rare plants, and other studies will provide supplemental information that will be used to make a high level assessment of important wildlife species.
5.	Brock Applegate (WDFW)	10/31/19	Study Area, Page 2-3	Since SCL has lands in the South Fork of the Nooksack and on the Skagit River downstream, SCL should consider extending the boundaries to Concrete.	City Light is mapping the wildlife mitigation lands plus a 0.5-mile buffer that will provide context for general discussion of habitat connections.
6.	Brock Applegate (WDFW)	10/31/19	Study Area, Page 2-3	SCL should consider the quality of migration corridors between their wildlife mitigation lands. Do we have enough foraging and staging trees and snags for eagles? Should we focus on the quality of habitat in riparian areas for migration corridors? Riparian zones have some of the best quality habitat. SCL should consider the connection between the mitigation lands as trespass, dumping, and noxious weeds degrade habitat on and off mitigation lands. SCL should consider species entire home range, which often includes these riparian corridors. I see a connection with fish and aquatics resources group as they consider the quality of riparian zones on wildlife and fish resources. What does the surrounding habitat near the river look like? How should we focus or management of the mitigation lands?	The Vegetation Mapping Study concentrates on the wildlife mitigation lands where City Light has management control. An updated Mitigation Lands Management Plan will address specific goals and objectives for each parcel. No data will be collected outside of the mitigation lands and a 0.5-mile buffer. Habitat connections among the parcels may be assessed on a high-level scale using government and other protected lands data; such an assessment will not be done as a part of this study.

No.	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
7.	Mignonne Bevin (NPS)	10/31/19	Study Goals and Objectives, Page 2-1	In reference to adding spotted owl to the example species list.	The U.S. Fish and Wildlife Service (USFWS) said they have the information they need for spotted owl. Forest age will be part of the mapping data and will be available to LPs.
8.	Mignonne Bevin (NPS)	10/31/19	Background and Existing Information, Page 2-3	National Park Service - SRI - Soil Survey Geographic (SSURGO) for North Cascades National Park Complex, Washington	Reference added to bulleted list.
9.	Mignonne Bevin (NPS)	10/31/19	Methodology, Page 2-7	Define, how steep, major river crossing?	Safety is of paramount importance for all field work. No technical rope-work will be allowed. Steepness of terrain and any water crossings will be reviewed once we have a draft map and have identified areas that need to be surveyed. City Light and all team members will adhere to the comprehensive safety plan for all field work.
10.	Mignonne Bevin (NPS)	10/31/19	Methodology, Page 2-8	Spotted owl?	The USFWS has indicated that they have all the data they need to develop an effects assessment for spotted owl. No further work is planned for this species. City Light will work with USFWS and NPS to consolidate their spotted owl data and provide the vegetation mapping data for consolidation with USFWS existing information.

WETLAND ASSESSMENT
DRAFT STUDY PLAN

SKAGIT RIVER HYDROELECTRIC PROJECT
FERC NO. 553

Prepared for:
Seattle City Light

Prepared by:
ESA

March 2020

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List of Attachments

List of Acronyms and Abbreviations

City Light .....Seattle City Light
DO.....Director's Order
EO .....Executive Order
FERC.....Federal Energy Regulatory Commission
GIS .....geographic information system
GPS .....global positioning system
LP.....licensing participant
m .....meters
NPS .....National Park Service
NWI.....National Wetlands Inventory
O&M.....operations and maintenance
PAD.....Pre-Application Document
Project .....Skagit River Hydroelectric Project
RLNRA.....Ross Lake National Recreation Area
RM .....river mile
RWG .....Resource Work Group
TRREWG.....Terrestrial Resources and Reservoir Erosion Working Group
USACE .....U.S. Army Corps of Engineers
USFWS .....U.S. Fish and Wildlife Service
WDFW.....Washington Department of Fish and Wildlife
WIP .....Wetland Intrinsic Potential

1.0 INTRODUCTION

1.1 General Description of the Project

The Seattle City Light (City Light) Skagit River Hydroelectric Project (Project) is located in northern Washington State and consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities. The Project generating facilities are in the Cascade Mountains of the upper Skagit River watershed, between river miles (RM) 94 and 127. Power from the Project is transmitted via two 230-kilovolt powerlines that span over 100 miles and end just north of Seattle at the Bothell Substation. The Project also includes two City Light-owned towns, an Environmental Learning Center, several recreation sites, and several parcels of fish and wildlife mitigation lands.

Project generating facilities are all located in Whatcom County, although Ross Lake, the most upstream reservoir, crosses the U.S.-Canada border and extends for about one mile into British Columbia at normal maximum water surface elevation. Gorge Powerhouse, the most downstream facility, is approximately 120 miles northeast of Seattle and 60 miles east of Sedro-Woolley, the nearest large town. The closest town is Newhalem, which is part of the Project and just downstream of Gorge Powerhouse. The primary transmission lines cross Whatcom, Skagit, and Snohomish counties; the fish and wildlife mitigation lands are in the same counties.

The Project Boundary is extensive, spanning over 133 miles from the Canadian border to the Bothell Substation just north of Seattle, Washington. In addition, there are "islands" of fish and wildlife mitigation lands and recreation sites within the Skagit, Sauk, and South Fork Nooksack watersheds that are also within the Project Boundary. Project generating facilities are entirely within the Ross Lake National Recreation Area (RLNRA), which is administered by the National Park Service (NPS) as part of the North Cascades National Park Complex. The RLNRA was established in 1968 in the enabling legislation for North Cascades National Park to provide for the "public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge lakes." The Federal Energy Regulatory Commission (FERC; formerly the Federal Power Commission) maintains jurisdiction over the lands and waters within the Skagit River Hydroelectric Project, FERC No. 553, and the Newhalem Project, FERC No. 2705, within the RLNRA and existing hydrologic monitoring stations necessary for the proper operation of the hydroelectric projects listed herein (Public Law 90-544. Sec. 505 dated October 2, 1968, as amended by Public Law 100-668. Sec. 202 dated November 16, 1988).

1.2 Relicensing Process

The current FERC license for the Project expires on April 30, 2025, and City Light will apply for a new license no later than April 30, 2023. City Light will begin the relicensing process by filing a Notice of Intent and Pre-Application Document (PAD) with FERC on April 30, 2020. The PAD included descriptions of the Project facilities, operations, license requirements, and Project lands as well as a summary of the extensive existing information available on Project area resources and early consultation on potential resource issues to be addressed during the relicensing. The PAD included an outline of the goals and objectives of this study. City Light has convened a series of

Resource Work Group (RWG) to engage agencies and other licensing participants (LPs) in the study plan development process.

1.3 Study Plan Development

A baseline characterization of wetlands within the Project Boundary and vicinity was identified as an early study need during 2019 discussions with the Terrestrial Resources and Reservoir Erosion Resources Work Group (TRREWG). On October 10, 2019, a draft of the Wetland Assessment Study Plan was distributed to the TRREWG for review and comments were requested by November 4, 2019. The draft study plan was then discussed at the TRREWG meeting held on October 15, 2019. Following the meeting, written comments were received from the Washington Department of Fish and Wildlife (WDFW) and the NPS (see Attachment A to this study plan). In March 2020, a revised draft of the study plan was provided with the PAD for LP review and for discussions in 2020 TRREWG meetings.

2.0 STUDY PLAN ELEMENTS

2.1 Study Goals and Objectives

The goal of the Wetland Assessment Study is to map and describe wetlands within the study area that may be affected by Project operations and to rate the capability of these wetlands to provide water quality, hydrologic, and habitat functions. Overall condition and existing sources of impairment will also be evaluated. Specific objectives of this study are as follows:

- Gather information on wetlands currently mapped within the study area and downstream to the Sauk River confluence.
- Refine existing maps derived from remote sensing and map wetlands in a uniform manner based on the U.S. Fish and Wildlife Service (USFWS) *Classification of Wetlands and Deepwater Habitat of the United States* (Cowardin et al. 1979) classification system.
- Develop an overlay of Project-related potential disturbances to prioritize field survey efforts.
- Document plant species in sampled wetlands.
- Use the *Washington State Wetland Rating System for Western Washington* (Hruby 2014) to assess wetland functions and values.
- Identify possible sources of any observed impairments.
- Collect additional habitat-related data to inform other efforts, such as the rare plant, invasive plant, and amphibian studies.

2.2 Resource Management Goals

City Light's goal is to have accurate wetland mapping and functional analysis data for assessing wetlands in the study area and will provide basic information to the participating agencies, tribes, and non-government organizations necessary to meet their regulatory mandates within the FERC relicensing process. Management goals related to wetlands are described below.

- Protection of Wetlands, Executive Order (EO) 11990 of May 24, 1977 – This order requires federal agencies to consider alternatives to wetland sites and limit potential damage to minimize the destruction, loss, or degradation of wetlands to preserve and enhance the natural and beneficial values of wetlands.
- NPS Director's Order (DO) 77-1: Wetland Protection, effective October 30, 2002, establishes the policies, requirements, and standards for implementing EO 11990. Included in DO 77-1 are: 1) adoption of a "no net loss of wetlands" goal and 2) adoption of the Cowardin et al. (1979) wetland classification system as the NPS standard for defining, classifying, and inventorying wetlands.
- Ross Lake National Recreation Area General Management Plan and Environmental Impact Statement – Published by the NPS in 2012, this management plan includes several management strategies for the protection of wetlands within the RLNRA based on EO 11990 and DO 77-1.

- The National Forest Management Act includes provisions applicable to all projects and requires the following: (a) resource plans and permits, contracts, and other instruments shall be consistent with the forest land management plan; (b) ensure consideration of the economic and environmental aspects of management, to provide for outdoor recreation, range, timber, watershed, wildlife, and fish; and (c) provide for diversity of plant and animal communities.

2.3 Background and Existing Information

Since 1975, the USFWS National Wetlands Inventory (NWI) has been mapping wetlands throughout the United States. Wetlands mapped by NWI are classified according to the USFWS classification system (Cowardin et al. 1979). However, these mapping exercises are performed on a large scale and based on aerial imagery, frequently resulting in the exclusion of smaller-scale wetlands. Additionally, once NWI maps a wetland, these areas are rarely revisited or revised and natural or anthropogenic changes are not captured. Due to the variations of accuracy and precision of NWI maps, these resources are only used during high-level planning phases and a wetland reconnaissance or delineation is necessary where Project effects may occur. Skagit, Whatcom, and Snohomish counties have all based their county wetland inventories on NWI mapping. NWI currently maps approximately 820 acres of wetland within the Project Boundary.

Additionally, the NPS' *Vegetation Classification of Mount Rainier, North Cascades, and Olympic National Parks* study (Crawford et al. 2009) has mapped 1,647 acres of plant communities that may include wetlands within the Project Boundary within North Cascades National Park. Classification of vegetation has been performed according to the National Vegetation Classification System to the Association level. However, the data are mapped at the Alliance level, which is the mapping standard for NPS projects. Thus, some vegetation categories may include both wetland and non-wetland areas.

City Light owns about 10,700 acres of land in scattered tracts within the Sauk, Skagit, and South Fork Nooksack basins that they have acquired for natural resource protection over the course of the current Project license. These lands, known as the fish and wildlife mitigation lands, were purchased in according to the Wildlife Settlement Agreement and the Fisheries Settlement Agreement. City Light has mapped habitat cover types of most of these lands. Approximately 164 acres of wetlands have been mapped on the fish and wildlife mitigation lands. However, the evaluation of conditions was done between 2001 and 2003 and focused on seral stage and structures. Site conditions will likely change over time and require further site evaluation (City Light 2006). In addition, City Light did not apply the same vegetation mapping classifications as used by NPS and one of the goals of the relicensing studies is to develop a uniform set of terrestrial resource data. The goal of this study is to map wetland areas within the study area in a uniform way based on the USFWS Cowardin classification system.

Existing resources include the following:

- USFWS National Wetlands Inventory. https://www.fws.gov/wetlands/data/Mapper.html
- Vegetation Classification of Mount Rainier, North Cascades, and Olympic National Parks. Crawford et al., 2009. https://irma.nps.gov/DataStore/Reference/Profile/661669
- NPS Alliance-Level mapping within North Cascades National Park Service Complex.

- Washington Department of Fish and Wildlife Priority Habitats and Species Mapping. WDFW, 2019. http://apps.wdfw.wa.gov/phsontheweb/
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- Skagit Mitigation Lands Management Plan and internal vegetation cover type mapping. City Light, 2006.
- Skagit River System Cooperative mapping of the "Barnaby Reach" portion of the Skagit River floodplain between Illabot Creek and SR530 bridge, 2017.
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- Snohomish County Wetland Maps. Snohomish County, 2016. http://www.snoco.org/docs/scd/PDF/PDS_CAR/Critical_Areas_Wetlands_ALLCounty_20160201.pdf
- Seattle City Light Skagit River LiDAR – 2018.
- USGS Western Washington 3DEP LiDAR. 2016/2017. http://lidarportal.dnr.wa.gov/

2.4 Study Area

This study area will consist of the area within the Project Boundary and the channel migration zone from Gorge Powerhouse to the confluence of the Sauk and Skagit Rivers. Field sampling will emphasize wetlands that may be affected by Project operations and maintenance (O&M) or Project-related recreational activities, whereas wetlands farther from potentially affected areas will receive a lower level of assessment (i.e., desktop analysis). A location map of the Project Boundary is provided in Figure 2.4-1.

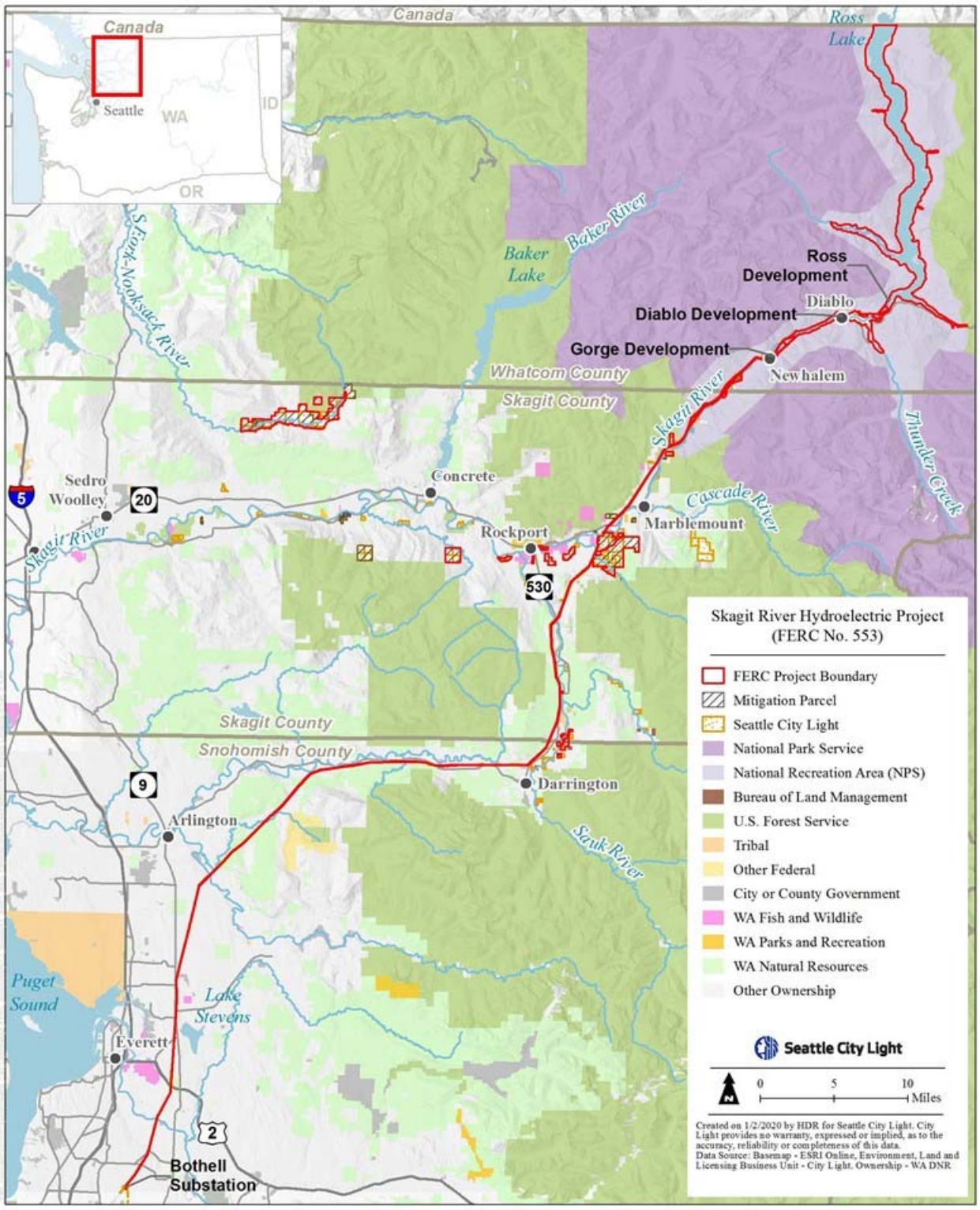

Figure 2.4-1. Location map of the Skagit River Project.

2.5 Methodology

2.5.1 Compile and Review Existing Information

The study team will prepare a preliminary map using existing NWI mapping as well as an interpretation of the most current high-resolution aerial photography. Working closely with City Light staff and the TRREWG, additional information on other wetland studies and inventories will be compiled. Results of the NPS's *Vegetation Classification of Mount Rainier, North Cascades, and Olympic National Parks* study (Crawford et al. 2009) will be analyzed to determine locations of water-related plant associations and added to the preliminary map. The team will assess the NPS mapping and flag those plant associations and areas where the presence of wetlands is not clear. The analysis will also draw upon the results of the separate Vegetation Mapping Study.

2.5.2 Collect Model Training Data

To improve the precision and accuracy of the model results, the team will conduct a limited field reconnaissance to verify existing wetland mapping (City Light, NPS, NWI, etc.). A field crew will assess the accuracy of the mapped data and wetland classifications and provide related information on plant species occurrence and cover. These data will be used to adjust the existing wetland data map that will be used by the remote sensing wetland model.

2.5.3 Wetland Remote Sensing Analysis

As a preliminary step, the Washington State Department of Natural Resources' newly developed wetland mapping tool, the Wetland Intrinsic Potential (WIP) tool, will be used to identify wetlands that are not included in existing wetland mapping inventories. The WIP tool was designed to identify wetlands that are hard to detect in aerial imagery because they are ephemeral in nature or under tree canopy. The WIP tool uses LiDAR-derived datasets and aerial imagery to identify the likelihood any given area is a wetland or not using a random forest model. Several topographic indices, such as plan curvature and profile, are created as an intermediate step of the WIP tool and used as inputs in the random forest model. Topographic indices are calculated at multiple scales (30 meters (m), 150 m, 300 m), and improve errors of omission created by hummocky wetlands under forest canopy.

In addition to this study, these topographic indices are integral inputs into the remote sensing modeling effort to classify vegetation habitat classes that will be conducted under the Vegetation Mapping Study. Therefore, running the WIP tool in the beginning of this study will benefit both of these efforts.

The random forest model will be trained using sample points derived from the NWI polygons and any other wetlands identified during early wetland inventory compilation efforts. The WIP tool outputs a raster where each pixel provides a probability that an area is a wetland or upland. Areas with a higher probability of being a wetland than upland will be assessed through visual interpretation of aerial imagery.

2.5.4 Develop Disturbance Potential Overlay for Study Area

Portions of the Project area that have a disturbance factor related to the Project's O&M and Project-related recreational activities will be identified. These areas will be the focus of the field and analytical portion of the study.

2.5.5 Conduct Field Data Collection of Wetlands within the Disturbance Overlay Portion of the Study Area

Plant species present at each site will be documented. Indicators of hydric vegetation, hydric soils, and wetland hydrology per the Regional Supplement to the U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE 2010) will be recorded when observed. Jurisdictional wetland delineations will not be completed and official wetland data plots will not be established.

Analytical methods will be developed for an appropriate level of assessment. Wetlands that are near areas of Project activities will undergo a functional analysis using the Wetland Rating System for Western Washington (Hruby 2014). Additionally, a supplemental rating form will be developed to capture information important to the relicensing process. These data will include sources of wetland hydrology, observed impairments and possible sources, and habitat information relevant to other studies such as the Rare Plant Study, Invasive Plant Study, and Amphibian Study.

The estimated boundaries of sampled wetlands will be recorded using iPads fitted with global positioning system (GPS) capability and aerial imagery and data will be collected on electronic forms using the iPads to increase the efficiency of data collection. Wetland polygons will be drawn onto the maps using vegetation and topography as guides. Electronic forms lead to a more efficient field effort that requires less time transcribing data forms post-survey, as well as providing a means of backing up data while in the field.

2.5.6 Data Analysis and Reporting

The wetland assessment will calculate the acreage of each wetland type within the study area based on the Cowardin classification system. General descriptions of wetland classifications, functions, and impairments will be included in a technical report. Potential Project effects to wetlands will also be discussed. Results of the assessments of individual wetlands will be included in tabular form in the report. Spatial data will be presented as a .kmz file that can be viewed on Google Earth. The attribute table will reflect the tabular data in the report.

Specific study products include:

- Geographic information system (GIS)-based map of wetlands within the study area.
- An overlay of potential Project-related disturbances to prioritize field survey efforts.
- List of plant species in each sampled wetland.
- An analysis of mapped wetland functions and values.
- Description of possible sources of any observed functional impairments.

- Additional habitat-related data to inform other efforts, such as the rare, threatened, and endangered plant, invasive plant, beaver, and amphibian studies.

2.6 Consistency with Generally Accepted Scientific Practice

The study methods (as described above) are consistent with guidance generally accepted by the USACE and the Washington State Department of Ecology, and other entities of the scientific community regarding procedures for conducting wetland reconnaissance and functional analyses.

2.7 Draft Schedule

- Draft Study Plan – October 2019 TRREWG review
- Revised Study Plan – March 2020
- Initial Model Run – Spring 2020
- Field Verification and Collection – Spring-summer 2020 (during vegetation growing period)
- Draft Technical Report and Map – February 2021
- Supplemental Data Collection – As needed in 2021 in conjunction with other terrestrial studies

2.8 Level of Effort and Cost

The initial estimate for implementation and reporting associated with this study is approximately $240,000.

3.0 REFERENCES

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WETLAND ASSESSMENT DRAFT STUDY PLAN

ATTACHMENT A

CITY LIGHT RESPONSES TO LP COMMENTS ON STUDY PLAN

Table 1. City Light responses to LP Comments on study plan.

No.	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
1.	Brock Applegate (WDFW)	10/31/2019	Study Plan Elements, page 2-1	I think that we talked about a special effort around Big Beaver Creek and associated wetlands as well, because of the habitat value.	City Light agreed to run the wetland model for the Big Beaver Valley that is within the FERC Boundary, but no field work will be conducted here. These wetlands are well above the influence of the reservoir and there are no other project-associated effects.
2.	Brock Applegate (WDFW)	10/31/2019	Study Plan Elements, page 2-1	For around the reservoirs, I would focus on Columbia spotted frogs, Western toad, evidence of bull frogs, and cavity-nesting ducks (snags). We might think about Oregon spotted frogs if SCL will look at wetlands further down the Skagit River.	A separate Amphibian Study will be developed. The field wetland work also will serve as a reconnaissance level survey to determine the suitability of habitat for amphibians. General notes of the wetland habitat will be recorded. Additionally, a Washington State Department of Ecology wetland rating form will be completed, which captures the presence of snags, as part of a general wildlife habitat assessment.
3.	Brock Applegate (WDFW)	10/31/2019	Study Plan Elements, page 2-5	SCL will want to map reed canarygrass in these disturbance areas, particularly in or near wetlands.	Wetland assessments will include notes on invasive species. A more detailed Invasive Plant Study Plan is under development and will provide more precise information on weeds.
4.	Mignonne Bevin (NPS)	10/31/2019	Study Plan Elements, page 2-5	You mean wetland right? Not riparian or is that included in this study?	No – the term here is correct. A specific NPS vegetation classification sometimes includes both wetland and non-wetland zones. This information will be obtained using a more refined wetland mapping model.
5.	Brock Applegate (WDFW)	10/31/2019	Study Plan Elements, page 2-6	WDFW assumes the study area includes all the mitigation lands as well.	Wetlands will be mapped on the mitigation lands but since there are no disturbance vectors here they will not be rated according to the Washington State Department of Ecology methods. Weed information will be collected, however.

No.	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
					Preliminary wetland ratings will be completed as a desktop exercise to inform long-term management planning on the mitigation lands. Follow-up work will be completed post-licensing as needed.

CULTURAL RESOURCES DATA SYNTHESIS
DRAFT STUDY PLAN

SKAGIT RIVER HYDROELECTRIC PROJECT
FERC NO. 553

Prepared for:
Seattle City Light

Prepared by:
Cardno, Inc.
Cascadia Archaeology, LLC
Cultural Geographics Consulting

March 2020

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List of Acronyms and Abbreviations

ACHP.....Advisory Council on Historic Preservation
APE.....Area of Potential Effects
CFR.....Code of Federal Regulations
City Light.....Seattle City Light
CRWG.....Cultural Resources Work Group
DAHP.....Department of Archaeology and Historic Preservation
DMS.....Document Management System
EO.....Executive Order
FERC.....Federal Energy Regulatory Commission
HPMP.....Historic Properties Management Plan
LP.....licensing participant
MOA.....Memorandum of Agreement
NHPA.....National Historic Preservation Act
NPS.....National Park Service
NRA.....National Recreation Area
NRHP.....National Register of Historic Places
PAD.....Pre Application Document
Project.....Skagit River Hydroelectric Project
RCW.....Revised Code of Washington
RLNRA.....Ross Lake National Recreation Area
RM.....river mile
RWG.....Resource Work Group
U&A.....Usual and Accustomed Use Areas
WISAARD.....Washington Information System for Architectural and Archaeological Records Data

1.0 INTRODUCTION

1.1 General Description of the Project

The Seattle City Light (City Light) Skagit River Hydroelectric Project (Project) is located in northern Washington State and consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities. The Project generating facilities are in the Cascade Mountains of the upper Skagit River watershed, between river miles (RM) 94 and 127. Power from the Project is transmitted via two 230-kilovolt powerlines that span over 100 miles and end just north of Seattle at the Bothell Substation. The Project also includes two City Light-owned towns, an Environmental Learning Center, several recreation sites, and several parcels of fish and wildlife mitigation lands.

Project generating facilities are all located in Whatcom County, although Ross Lake, the most upstream reservoir, crosses the U.S.-Canada border and extends for about one mile into British Columbia at normal maximum water surface elevation. Gorge Powerhouse, the most downstream facility, is approximately 120 miles northeast of Seattle and 60 miles east of Sedro-Woolley, the nearest large town. The closest town is Newhalem, which is part of the Project and just downstream of Gorge Powerhouse. The primary transmission lines cross Whatcom, Skagit, and Snohomish counties; the fish and wildlife mitigation lands are in the same counties.

The Project Boundary is extensive, spanning over 133 miles from the Canadian border to the Bothell Substation just north of Seattle, Washington. In addition, there are "islands" of fish and wildlife mitigation lands and recreation sites within the Skagit, Sauk, and South Fork Nooksack watersheds that are also within the Project Boundary. Project generating facilities are entirely within the Ross Lake National Recreation Area (RLNRA), which is administered by the National Park Service (NPS) as part of the North Cascades National Park Complex. The RLNRA was established in 1968 in the enabling legislation for North Cascades National Park to provide for the "public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge lakes." The Federal Energy Regulatory Commission (FERC; formerly the Federal Power Commission) maintains jurisdiction over the lands and waters within the Skagit River Hydroelectric Project, FERC No. 553, and the Newhalem Project, FERC No. 2705, within the RLNRA and existing hydrologic monitoring stations necessary for the proper operation of the hydroelectric projects listed herein (Public Law 90-544. Sec. 505 dated October 2, 1968, as amended by Public Law 100-668. Sec. 202 dated November 16, 1988).

1.2 Relicensing Process

The current FERC license for the Project expires on April 30, 2025, and City Light will apply for a new license no later than April 30, 2023. City Light will begin the relicensing process by filing a Notice of Intent and Pre-Application Document (PAD) with FERC on April 30, 2020. The PAD included descriptions of the Project facilities, operations, license requirements, and Project lands as well as a summary of the extensive existing information available on Project area resources and early consultation on potential resource issues to be addressed during the relicensing. The PAD included a draft of this study plan. City Light has convened a series of Resource Work Group

(RWG) to engage agencies and other licensing participants (LPs) in the study plan development process.

1.3 Study Plan Development

Project operations may be affecting, or may affect in the future, cultural resources that are listed, eligible, or unevaluated for listing in the National Register of Historic Places (NRHP). As defined in 36 Code of Federal Regulations (CFR) Part 800, "historic properties" could include archaeological resources, historic architectural structures or features, and properties of religious and cultural significance (e.g., traditional cultural properties, traditional cultural landscapes, sacred objects, tribal resources).

In early 2019, the Cultural Resources Work Group (CRWG) identified the need to develop a baseline of cultural resources information. On October 11, 2019, a draft of the Cultural Resources Synthesis Study Plan was distributed to the CRWG for review and comments were requested by November 13. 2019. The draft study plan was then discussed at the CRWG meeting held on October 16, 2019. Following the meeting, written comments were received from the Department of Archaeology and Historic Preservation (DAHP), NPS, and the Upper Skagit Indian Tribe (see Attachment A to this study plan). In March 2020, a revised draft of the study plan was provided with the PAD for LP review and for discussions in 2020 CRWG meetings.

2.0 STUDY PLAN ELEMENTS

2.1 Study Goals and Objectives

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties and includes procedures for the "identification…and evaluation of historic properties" (36 CFR § 800.4). The Cultural Resources Data Synthesis Study will be used to establish a baseline dataset for known cultural resources within the study area, which is defined in Section 2.5 below. The study entails reviewing existing information to summarize baseline cultural resources data and identify information gaps.

2.1.1 Goals

The goal of this study is to develop a baseline dataset for known cultural resources within the study area. This information will facilitate the design of other relicensing studies, an assessment of effects, and inform cultural resource management plans in compliance with Section 106 of the NHPA and other applicable federal and state laws and regulations, Executive Orders (EOs), and FERC guidelines.

2.1.2 Objectives

(1) Collate and synthesize existing archaeological, historical, and ethnographic data within the study area.
(2) Provide documentation of American Indian and Canadian First Nation affiliations and associations to the study area.
(3) Share dataset with the CRWG to collectively build upon the baseline of information.
(4) Analyze the dataset to identify data gaps and potential steps to fill those gaps (e.g., updates, new studies, and consultation).
(5) Analyze the dataset to identify areas of potential direct and indirect Project effects.
(6) Describe the baseline condition of cultural resources for use in identifying protection, mitigation, and enhancement measures and management plans.
(7) Provide status of previous Memorandums of Agreement (MOAs) and associated stipulations.

The CRWG will identify which information collected by this study will be confidential, and access to this information will be limited based on how LPs designate which individuals from their organization should have access to confidential documents and information. Note that separate reporting will be necessary for historic resources (e.g., built environment) as historic resources data are generally not considered to be confidential. Archaeological and tribal resources will be confidential to the extent allowable under applicable federal and state laws.

2.2 Resource Management Goals

This section summarizes City Light's and the NPS's goals related to the resources discussed in this study plan.

2.2.1 City Light

City Light's goal is to have accurate cultural resources information for assessing potential Project-related effects on historic properties and for informing Historic Properties Management Plans (HPMPs) for the Project. This goal assists City Light in meeting its obligations with the following laws, regulations, EOs, and guidelines:

- Section 106 of the NHPA,
- American Indian Religious Freedom Act,
- Archaeological Resources Protection Act,
- Native American Graves Protection and Repatriation Act,
- EO 13007 (Indian Sacred Sites),
- EO 13175 (Indian Tribal Consultation),
- Indian Treaties (Point Elliot, Medicine Creek),
- Boldt Decision,
- FERC Policy Statement on Consultation with Indian Tribes in Commission Proceedings, Order 635,
- Revised Code of Washington (RCW) Chapter 27.53 (Archaeological Sites and Resources),
- RCW Chapter 27.44 (Indian Graves and Records),
- RCW Chapter 42.56.300 (Public Records Act regarding archaeological sites/traditional cultural properties),
- NPS management policies,
- Settlement Agreements, and
- MOAs.

2.2.2 National Park Service (NPS)

NPS's goal is to manage cultural resources within national park boundaries in compliance with federal laws and regulations including Section 106 and 110 of the NHPA. The North Cascades National Park Service Complex boundary includes North Cascades National Park, RLNRA and Lake Chelan National Recreation Area. The RLNRA encompasses the Upper Skagit River Archaeological District, as well as cultural resources located outside the district boundary. NPS property boundaries also extend beyond the scope of the study area and potential effects of the Skagit River Hydroelectric Project.

City Light will confer with Resource Agencies and tribes that are interested in participating in development of this study plan and request that they provide language identifying specific management goals relevant to this study proposal.

2.3 Background and Existing Information

Existing information includes prior studies conducted by or for City Light, NPS, and American Indian tribes and Canadian First Nations, as well as studies completed for other projects that overlap with the study area. The study will entail compiling a list of available cultural resources data for the study area including, but not limited to:

- Existing management plans and guidance documents,
- Cultural resource surveys, testing, data recovery reports, and associated archives,
- Monitoring reports,
- Cultural resources site and property forms,
- Ethnographic and traditional cultural studies,
- Historic structures reports,
- Historic maps,
- Historic photographs,
- Videos, and
- Audio recordings.

Additionally, existing and available environmental studies will be reviewed to provide information regarding natural resources that are important to American Indian tribes and Canadian First Nations.

A body of resources is available for review on City Light's internal Document Management System (DMS) in both confidential and non-confidential sections. Outreach will also occur to the NPS and American Indian tribes and Canadian First Nations regarding existing documents or studies that are relevant to the study area but are not currently in City Light's DMS. LPs contributing information will self-identify who should have access to confidential documents and share confidential information.

Additionally, information available on the Washington Information System for Architectural and Archaeological Records Data (WISAARD), as well as archives, libraries, and online sources will be reviewed and summarized. A list of known references is included in Section 3.

2.4 Project Operations and Effects on Resources

The baseline information will be useful for formal evaluations of direct, indirect, and cumulative effects for each resource identified within the study area and will help to inform the development of the Area of Potential Effects (APE). Evaluation of Project effects will occur later during the relicensing process and is beyond the scope of this study.

For purposes of Section 106 of the NHPA, a project's APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historical resources, if any such cultural resources exist" (36 CFR § 800.16[d]).

The APE will be defined by the CRWG in 2020 and shall include both direct and indirect effects. Direct effects may be the result of a physical disturbance and may also include visual, auditory, or atmospheric impacts as well. The APE for direct effects will include areas subject to direct disturbance, which may result from the construction of temporary extra workspaces, storage yards, staging areas, aboveground or in-water facilities, new or improved access roads; road and facility maintenance; vibration; logging; and brush/vegetation clearing and burning, among others.

The APE for indirect effects should include all areas potentially subjected to the introduction of visual, atmospheric, or audible elements from the Project that may diminish the integrity or character of a nearby historic property. City Light will continue to consult with the DAHP, Indian tribes, and federal agencies to finalize the APE for direct and indirect effects for the Skagit Project.

2.5 Study Area

The study area includes all Project structures, reservoirs, company towns, the Gorge bypass reach, the Skagit River from Newhalem to the confluence with the Sauk River, the transmission line right-of-way from each of the three powerhouses to the Bothell substation, and the fish and wildlife mitigation lands. The study area will also include a one-mile buffer around these areas. An overview map of the entire Project vicinity, displaying Project Boundary and associated lands, is shown in Figure 2.5-1.

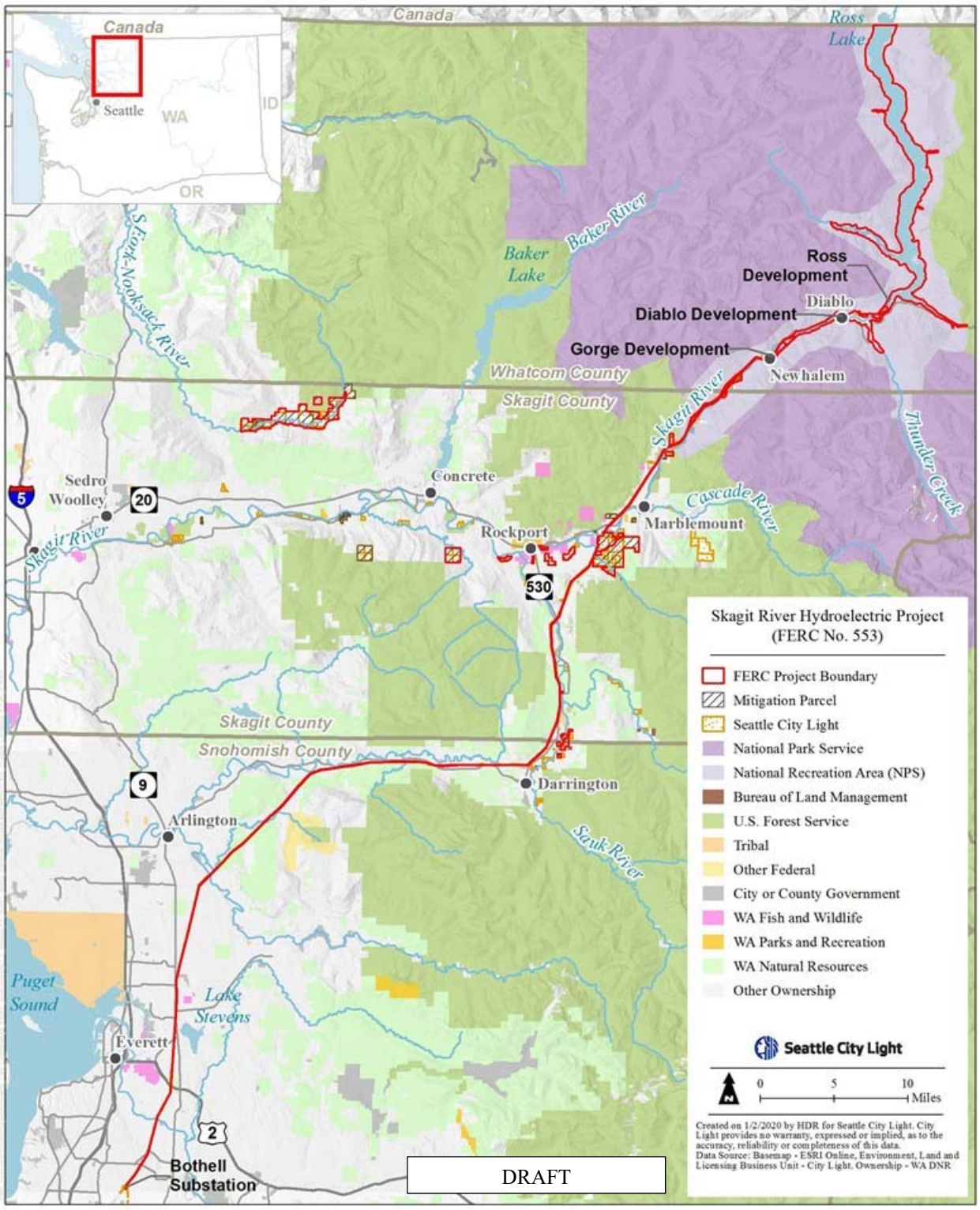

Figure 2.5-1. Location map of the Skagit River Project.

2.6 Methodology

Existing information concerning the study area will be gathered using steps to collate, synthesize, and disseminate available data as outlined below. No fieldwork is proposed as part of the study. The study will be undertaken by qualified cultural resources staff from Cardno, Cascadia, and Cultural Geographics. The study will be directed by staff who meet the Secretary of Interior professional qualification standards (36 CFR Part 61) for history, archeology, and architectural history, as well as ethnographers holding doctorates.

2.6.1 Step 1

Researchers will compile a list of available resources for the study area available at City Light, WISAARD, online maps and archives, and consultant libraries. The list of resources will build upon the references included in Section 3 of this document. The available resources may include existing management plans and guidance documents, cultural resource surveys, archaeology/historic properties of religious and cultural significance site forms, monitoring reports, traditional cultural studies, ethnographic and ethnohistoric literature and data, publicly available ethnohistorical and ethnographic reference materials from online and regional archives, historic structures reports, maps, photographs, videos, audio recordings or other materials.

2.6.2 Step 2

Researchers will work with NPS to identify internal documents that may not be accessible on WISAARD, including documents that relate to areas outside the Project Boundary, but within the study area.

2.6.3 Step 3

Researchers will contact American Indian tribes and Canadian First Nations to solicit existing documents or studies including tribal resources and areas of interest for the study area and interconnected resources (e.g., rivers, trails, traditions of trade and resource procurement) to complete the following tasks. This outreach is not formal consultation as defined under Section 106 of the NHPA.

(1) Confirm all American Indian tribes and Canadian First Nations that have previously participated in and/or have expressed interest and/or concerns with the study area.
(2) Potential interest, concerns, and associations with the geographical extent of the study area will be identified through several lines of examination and analysis, including treaties and Usual and Accustomed Use Areas (U&As) and associated historic properties and cultural resources (e.g., places, landscapes, objects, and ancestral/archaeological sites with traditional cultural significance) as defined by 36 CFR Part 800. It is important to note that treaty and U&A designations may not fully encompass entire geographic areas of traditional use or concern for some tribes. It is also important to point out that many American Indian tribes define their own U&As differently than the general outlines provided in the Boldt Decision.

2.6.4 Step 4

The researchers will provide a compiled list of materials gathered during Steps 1 through 3 above to the CRWG and other interested parties with a schedule for their review with the intent of incorporating any additional relevant information that was missed during study plan development and in Steps 1 through 3 above.

2.6.5 Step 5

Cardno will work with City Light to add any relevant documents, maps, or photographs not already uploaded into the DMS and store them in limited-access confidential folders, as needed. These data may also include non-confidential materials from other research disciplines (e.g., geology, geomorphology, vegetation). Adding relevant data may include scanning hardcopy documents or updating digital documents to an optical character recognition to include them in the DMS. Confidential files will remain confidential and access will be limited to the extent allowed by state and federal law,[1] but will include the cultural resources specialists identified by LPs, the consultants, and City Light who typically work with confidential information of this nature. LPs will self-identify the individuals from their agency who should have access to confidential documents.

2.6.6 Step 6

Researchers, in collaboration with City Light, will complete an analysis and audit of the existing MOAs and HPMPs, annual reporting, and training. A table listing what work remains to be accomplished or has not been accomplished will be developed. The state of curated collections, records management systems, and access will be assessed.

2.6.7 Step 7

A confidential summary report of findings will be prepared. The summary report will include a short descriptive summary of each item and its relevance to the study area as a baseline for understanding the cultural resources. In addition, cultural resources will be included in tables that summarize resource age, date of recordation, date of site form completion, resource eligibility, initial effects assessment (if available), and operations and maintenance recommendations. Maps detailing the extent of survey coverage and inaccessible/underwater areas with corresponding tabular data that identifies acreage and survey dates will be included. The summary report will also provide an overview of cosmography and worldview system for each participating American Indian tribe and Canadian First Nation, as well as known geographical areas, historic properties, and resources of concern for each American Indian tribe and Canadian First Nation.

The summary report will characterize the available information in order to:

(1) Identify any additional consulting parties appropriate to be added based on known/documented information and scope of the Project (see 36 CFR § 800.3);

[1] City Light with work to more fully describe the types of information which City Light will be able to protect as confidential in subsequent drafts of the study plan and prior to accepting any potentially confidential information from parties for use in the study.

(2) Identify resources that need to be evaluated for historic significance (see 36 CFR § 800.4);
(3) Provide an initial assessment of potential direct and indirect effects on historic properties or unevaluated cultural resources to assist in the development of the APE; and
(4) Prioritize site for future surveys and recommendations for evaluating sites.

The summary report will also identify data gaps of information or types of studies. The data gaps will be useful for the CRWG to consider for future studies or management planning. Maps will be included in the report; those containing confidential site locational data would be only provided in the confidential summary report.

A public (non-confidential) version of this summary report will be produced, which will not include any confidential information. Historic resources are not considered confidential; however, archaeological and tribal resources and properties of religious and cultural significance are considered confidential under federal and state laws.

Draft and final reports will be provided to the CRWG through the project SharePoint site for which access is restricted. City Light is working to fully describe the types of information which City Light will be able to protect as confidential and prior to accepting any potentially confidential information from parties for use in the study. City Light's consultants are subject to the same confidentiality considerations as City Light per executed contracts.

2.7 Consistency with Generally Accepted Scientific Practice

The study will follow standard methodology for a literature review and will be completed in compliance with Section 106 of the NHPA and in accordance with the DAHP's Washington State Standards for Cultural Resources Reporting and FERC's guidelines for cultural resources reporting. The study will also include requesting information on known tribal interests from the participating tribes regarding cultural resources within the study area. Coordination with participating American Indian tribes and Canadian First Nations may lead to a synthesis of new perspectives on relevancy or previously undocumented information relevant to identification of resources within the study area.

2.8 Schedule

- Study Plan
  - Proposed study plan in PAD (March 2020)
  - Review and comment by CRWG and LPs (March–April 2020)
- Document collection and review (February 2020–June 2020)
- Summary Reports
  - Draft summary reports will be produced by the end of the Summer 2020 and submitted to CRWG for review and comment.
  - Final summary reports will incorporate CRWG comments as feasible and will be produced by April 2021.

2.9 Level of Effort and Cost

Estimated cost: $150,000.

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CULTURAL RESOURCES DATA SYNTHESIS DRAFT STUDY PLAN

ATTACHMENT A

CITY LIGHT RESPONSES TO LP COMMENTS ON STUDY PLAN

Table 1. City Light Responses to LP Comments on Draft Study Plan.

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
1.	RGW/DAHP	10/22/2019 Letter (PDF)	Table of Contents Page i	Please have an Appendix Section on page I for the MOAs, Settlement Agreements etc.	These are current license documents that can be provided as background. It is not necessary to attach them to this study plan.
2.	RGW/DAHP	10/22/2019 Letter (PDF)	Table of Contents Page i	Please have a List of Tables on page i	Entered List of Tables and RGW comment in Draft. Note that there are no tables in the study plan.
3.	RGW/DAHP	10/22/2019 Letter (PDF)	List of Acronyms and Abbreviations Page ii	Please include on page ii ACHP, MOA, Tribe Names if abbreviated in the text, Seattle City Light, NRA, etc. and others in the text that don't appear on page ii.	Updated per comment. Not using abbreviated tribe names.
4.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2-1 Study Goals and Objectives Page 2-5	Page 2-5 Section 2.1 Please add a Goal (7) Detailing all Stipulations in prior MOAs and their status/completion/ date of completion.	Updated per comment.
5.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.2.1 City Light Pages 2-5, 2-6	Page 2-5 Section 2.2.1 add Settlement Agreements, MOAs to items on page 2.6	Updated per comment.
6.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.3 Background and Existing Information Page 2-6	Page 2-6, Section 2.3 add MOAs to list and also identify Section 110 responsibilities.	"Management plans" already in list - no change. Section 110 mentioned in Section 2.2 - does not need to be added to Section 2.3, which lists existing data.
7.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.4 Project Operations and Effects on Resources Page 2-7	Page 2-7 Section 2.4 paragraph 2 last sentence, please strikeout: ~~In general, the Project Boundary encompasses all land necessary for operation of the Project.~~	Updated per comment.
8.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.4 Project Operations and Effects on Resources Page 2-7	Page 2-7 paragraph 3 please change should to shall: The APE <u>shall</u> include.	Updated per comment.

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
9.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.5 Study Area Page 2-7	Page 2.7 Please note that the APE definition have yet to occur but ultimately the Study Area will encompass the APE, correct?	Clarified sentence to state "The APE will be defined by the CRWG in 2020 and shall include both direct and indirect effects."
10.	RGW/DAHP	10/22/2019 Letter (PDF)	Figure 2.5-1 Overview of Study Area Page 2-9	Page 2-9. Additional Figures should show expanded specific areas like Ross Lake, Diablo Development, Gorge Development, etc	Comment noted. No change. Detailed figures will be provided in the report. For the study plan, just the main figure is used with the Project Boundary depicted.
11.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Page 2-10	Page 2-10 Section 2.6 Methodology should state clearly the effort will be based upon existing information and no entail on-site field work that will be the subject to future relicensing work.	Clarified sentence to read: "Existing information concerning the study area will be gathered using steps to collate, synthesize, and disseminate available data as outlined below. No fieldwork is proposed as part of the synthesis study."
12.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Page 2-10	Page 2.10 Section 2.6 should also clearly state work will be done either by professional Sof Interior qualified staff; consultants or Seattle City Light staff.	Added: "The Synthesis Study will be undertaken by qualified cultural resources staff from Cardno, Cascadia, and Cultural Geographics. The study will be directed by staff who meet the Secretary of Interior professional qualification standards (36 CFR Part 61) for history, archeology, and architectural history, as well as ethnographers holding doctorates."
13.	RGW/DAHP	10/22/2019 Letter (PDF)	General	Need some discussion on quality control and how the assembled documents will be handled, organized and accessed. Please recall our conference call discussion regarding the secured server and public record law security on Seattle City Light vs. private corporate consultant server.	Added language to Section 2.8 that reads "Draft and final reports will be provided to the CRWG through the project SharePoint site for which access is restricted. City Light is working to fully describe the types of information which City Light will be able to protect as confidential and prior to accepting any potentially confidential information from parties for use in the study. City Light's consultants are subject to the same confidentiality considerations as City Light per executed contracts."
14.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Step 3	Page 2-10 states Step 3 need clarity on how the contact and by which agency contacts the consulting parties for information and what the	Text clarified to read: "Researchers will Contact American Indian tribes and Canadian First Nations to solicit existing documents or

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
			Page 2-10	role of the consultant is in relationship to the contact. Please note that cultural interest under 36CFR 800 is distinct from the referenced U&As.	studies including tribal resources and areas of interest for the study area and interconnected resources (e.g., rivers, trails, traditions of trade and resource procurement) to complete the following tasks. This outreach is not formal consultation as defined under Section 106 of the NHPA."
15.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Step 6 Page 2-11	Page 2-11 Step 6 notes tables on resource eligibility. Please also make sure there is a column for the date of the last on-site visit and the age of the existing site form.	Added to text.
16.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Step 6 Page 2-11	Page 2-11 Step 6 will also need a table and relevant maps detailing the extent of survey coverage, age of survey with a probable age of greater than 5 years, less than 5 years.	Added to text.
17.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Step 6 Page 2-11	Page 2-11 Step 6 will need a map and acreage of unaccessable/underwater areas.	Added to text.
18.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Step 7 Page 2-11	Page 2-11 Step 7 will need an analysis and audit of the existing MOAs, and what remains to be accomplished or has not been accomplished.	Added to text.
19.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Step 7 Page 2-11	Page 2-11 Step 7 needs to discuss the state of the curate collections, scope, records management systems, access etc.\	Added to text.
20.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.6 Methodology Step 7 Page 2-11	Page 2-11 Step 7 need to discuss and review the training elements and how that unfolded along with reporting required under MOAs and HPMPs.	Added to text.
21.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.7 Consistency with Generally Accepted Scientific	Page 2.11 Section 2.7 Consistency with GASP and BMP. We need some discussion on the state of the records management, digital and geospatial concurrency and any gaps and missing reports, forms etc. from Wisaard.	No changes. Process for including records in WISAARD will be discussed with the CRWG.

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
			Practice Page 2-11		
22.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.7 Consistency with Generally Accepted Scientific Practice Page 2-11	Page 2.-11. Section 2.7 do we need to have a Section on Crafting the Research Questions for a New Millennium with an outside peer review panel to review existing methods, questions, and products to refresh the research agenda?	No changes. Review will occur in the CRWG as outlined in the Study Plan. Further discussion with CRWG would occur when data gaps are identified and in planning any future surveys/studies.
23.	RGW/DAHP	10/22/2019 Letter (PDF)	Section 2.8 Page 2-12	Page 2-12 Section 2.8 need tables(s) with target dates and important milestones and also should probably plan for specific meetings/workshops/tours to inform and educate the work group.	No changes. Target dates will be developed as study kicks off. Unable to set dates with tribes who aren't participating yet. Recommend not including table.
24.	RGW/DAHP	10/22/2019 Letter (PDF)	General	We would also request receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).	Comment noted. No changes.
25.	RRM/USIT	11/13/2019 Word Doc (Email)	Title Page	1. Title Page: it would be clearer if the title was modified to read "Draft Cultural Resources Synthesis Study Plan", because the CRWG was asked to review the plan for a study. The study that results from plan implementation is yet to be written. Changing the title in this manner is consistent with the use of "study plan" throughout the remainder of the document.	Change made per comment.
26.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 1.0 Introduction Page 1-4	2. P. 1-4: it would be helpful in the Intro to define at the outset, "project area" and "study area"	See Section 2.5 for definitions.
27.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 1.0 Introduction Page 1-4	3. P. 1-4, 3rd paragraph: it's somewhat misleading say that FERC maintains jurisdiction over lands and waters; more accurately, FERC maintains jurisdiction over SCL operations, but NPS administers all lands under the reservoirs.	Comment noted.

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
28.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 2.1 Study Goals and Objectives Page 2-5	4. P. 2-5: last sentence under Goals paragraph should include "NPS Management Policies"	Added per comment.
29.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 2.1 Study Goals and Objectives Page 2-5	5. P. 2-5: need clarification on the meaning of "separate reporting" for historic cultural resources.	Added reason that historic resource data are generally not considered confidential.
30.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 2.2.1 City Light Page 2-5	6. P. 2-5, the last sentence: for clarity and accuracy, consider revising the sentence to read something like "This goal assists SCL in meeting its obligations to the following…." (by themselves, goals don't constitute compliance).	Clarified sentence to read: "This goal assists City Light in meeting its obligations with the following laws, regulations, EOs, and guidelines:"
31.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 2.2.1 City Light Page 2-6	7. P. 2-6: add "NPS Management Policies" to the bulleted list.	Added per comment.
32.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 2.2.2 National Park Service (NPS) Page 2-6	8. P. 2-6, under NPS: after mention of the Archaeological District, should 45WH64 and WH477 be mentioned, given they are determined eligible, also?	Comment noted. Not including individual eligible sites as there are more in the study area than just the two.
33.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 2.4 Project Operations and Effects on Resources Page 2-7	9. P. 2-7, 3rd paragraph in section 2.4: "direct effects" is too narrowly defined here for Sec. 106 purposes because direct effects includes far more than just ground disturbance; other operational activities can have direct effects on above ground sites, including dendroglyphs, culturally-modified trees, rock-piled walls and cairns, and pit features. Actions that can directly affect these include logging, brush and vegetation clearing, and burning of brush piles, among others. In the same paragraph: consider that "new and to-be-improved access roads" is too narrowly defined and it should be broadened to include all access roads--although existing roads are a	Clarified sentence to read: "Direct effects may be the result of a physical disturbance and may also include visual, auditory, or atmospheric impacts as well. The APE for direct effects will including areas subject to direct disturbance, which may result from the construction of temporary extra workspaces, storage yards, staging areas, aboveground or in-water facilities, new or improved access roads; road and facility maintenance; vibration; logging; and brush/vegetation clearing and burning, among others."

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
				prior condition, the wording here leaves out road maintenance, including for example, culvert and bridge repair, which are current and future operations.	
34.	RRM/USIT	11/13/2019 Word Doc (Email)	Section 3.0 References Pages 3-1, etc.	10. References are missing key sources, especially on Upper Skagit ethnography and ethnohistory: Boxberger, Daniel L. 1996 An Ethnographic Overview and Assessment of North Cascades National Park Service Complex. Prepared for National Park Service, Pacific Northwest Region, Seattle, Washington. NPS Management Policies 2006 (or whatever is the most current version) Lepofsky, Dana, Ken Lertzman, Emily Heyerdahl, Dave Schaepe, and Bob Mierendorf 2000 Cultural and Ecological History of Chittenden Meadow, Upper Skagit Valley, British Columbia. Report submitted to the Skagit Environmental Endowment Commission, Seattle, WA. Mierendorf, Robert R. 1999 Precontact Use of Tundra Zones of the Northern Cascades Range of Washington and British Columbia. Archaeology in Washington V. VII. Mierendorf, Robert R. and David J. Harry 1993 Results of a Subsurface Archaeological Survey on a Pleistocene Terrace in North Cascades National Park Service Complex.	Added references per comment.

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
				Archaeology in Washington Vol. V:39-49. Smith, Allan H. 1988 Ethnography of the North Cascades. Center for Northwest Anthropology, Washington State University, Project Report No. 7, Pullman, Washington. Prepared for North Cascades National Park Service Complex, Sedro-Woolley, Washington.	
35.	KD/NPS	11/8/2019	Section 1.0 Introduction Page 1-4	"Ross Lake National Recreation Area" Comment: I added that because preservation is a key component of the establishment, as well as recreation. And no enabling legislations trumps the purpose of the NPS which puts nat/cult preservation above recreation.	Added per comment.
36.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.1 Study Goals and Objectives Page 2-5	Comment: Has the Study Area been defined anywhere? Is this just another word for APE?	Study area is defined in Section 2.5. Added reference to Section 2.5 here. APE is not yet defined, as discussed in Section 2.4.
37.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.2.2 National Park Service (NPS) Page 2-6	Comment: If the NPS is included, I'm not sure why other stakeholders wouldn't also be included,... and then I don't know where to draw the line. While I appreciate be included here, I think since this is a SCL document you should keep to SCL goals.	Comment noted. NPS included as they are a land manager. One of the seven criteria for FERC study plan requests that relevant resource management goals of agencies or Indian tribes with jurisdiction over the resource to be studied be included in the study plan.
38.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.3 Background and Existing information Page 2-6	Edit: replace "photographs" with "archives" in "Cultural resource surveys, testing, data recovery reports, and associated photographs,"	Change made as suggested.
39.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.3 Background and Existing information Page 2-6	"Archaeology/historic/ properties of religious and cultural significance site/isolated find forms," Comment: I would re-word this so it's not such a mouthful.	Change made to "Cultural resources sites and property forms"

	Commenting Individual (Organization)	Date	Study Plan Section, Page	Comment	Response
40.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.4 Project Operations and Effects on Resources Page 2-7	This last sentence doesn't make sense to me as it relates to the topic as a whole. Do you mean that the Project Boundary should minimally be considered the APE?	Sentence deleted.
41.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.5 Study Area Page 2-7	Should this definition come early? This phrase is introduced at the beginning of the document.	Mention of "study area" in Section 2.1 is first occurrence, and now reader is referred to definition in section 2.5.
42.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.6 Methodology Step 6 Page 2-11	So is this summary report essentially an annotated bibliography?	No changes needed. Report will contain annotated information, as well as other types of data that are part of an in-depth desktop study. There is no fieldwork associated with the synthesis study.
43.	KD/NPS	11/8/2019 Track Changes (PDF)	Section 2.6 Methodology Step 6 Page 2-11	How is cosmography relevant to this study?	No changes needed. Understanding cosmography from tribal perspective sets the stage for identifying data gaps.

PRE-APPLICATION DOCUMENT

APPENDIX I

BASELINE STUDIES

PRE-APPLICATION DOCUMENT

ON-GOING BASELINE STUDIES

LANDFORM MAPPING FROM GORGE DAM TO THE ESTUARY MOA BETWEEN CITY LIGHT AND NPS

MEMORANDUM OF AGREEMENT #G9471191085, LANDFORM MAPPING
between the
North Cascades National Park Service Complex
and the
City of Seattle
Seattle City Light

This Memorandum of Agreement (MOA) is entered into by and between the U.S. DEPARTMENT OF INTERIOR (DOI), NATIONAL PARK SERVICE (NPS), by and through the Superintendent, NORTH CASCADES NATIONAL PARK SERVICE COMPLEX (NOCA) and the CITY OF SEATTLE, SEATTLE CITY LIGHT (City Light) acting through the Manager of the Skagit License Unit (Environment, Lands, and Licensing Business Unit), herein together being "the parties".

RECITALS:

WHEREAS, City Light owns and operates the Skagit River Hydroelectric Project (SRHP), which is within, but pre-dates, the Ross Lake National Recreation Area and NOCA, and;

WHEREAS, City Light has determined that the Scope of Work is necessary to adequately describe the Skagit River basin and important landforms and processes, and;

WHEREAS, The NPS has the specialized knowledge and expertise required to execute the proposed Scope of Work, and;

WHEREAS, City Light has determined that the services in question cannot be efficiently performed by other agencies or commercial firms.

NOW, THEREFORE, NPS shall furnish the services to City Light as described in Article III below.

ARTICLE I – BACKGROUND AND OBJECTIVES

Landforms along the Skagit River include features such as alluvial fans, floodplains, river terraces, landslides, gravel bars, road fills, and glacial moraines. The landforms that exist on the floor of Skagit valley provide a record of past river activity, an opportunity to further understanding of potential effects from the SRHP and plan appropriate mitigation and restoration for the next license.

The objective of this MOA is to provide a baseline map of land and channel forms within the channel migration zone of the Skagit River. The NPS (NPS, 2012) has benefited from geomorphic (landform) mapping at North Cascades National Park for management of wetlands, soils, floodplains, cultural resources, habitat, geologic hazards, and compliance issues (see Attachment A). The NPS proposes to extend and improve the scale of this geomorphic mapping from Gorge Dam to the estuary along the floor of the Skagit River valley. The focus would be on the channel migration zone (CMZ), which represents the area that the river has migrated across in the past several thousand years since a stable river base level and the 'modern' climate were

established (not to include recent rapid warming). Landforms in the CMZ are listed in Attachment A. Landforms adjacent to the CMZ on the valley floor will also be mapped due to their influence on river channel pattern, floodplain width, groundwater resources, and sediment and wood recruitment.

ARTICLE II - AUTHORITY

A. NPS:

Public Law 90-577, Intergovernmental Cooperation Act of 1968, authorizes Federal agencies to furnish specialized or technical services to State and local governments on a reimbursable basis. The lands and waters included in the FERC project boundary for the Skagit River Hydroelectric Project are within North Cascades National Park Service Complex, and NPS has special and technical expertise related to environmental compliance, as well as scientific data collection and analysis of natural, historical, and cultural resources of the North Cascades National Park Service Complex as a unit of the National Park System.

54 U.S.C §100101 1a, The Organic Act of August 25, 1916, as amended, declares that NPS shall promote and regulate the use of various federal areas known as the national park system by such means and measures as conform to the fundamental purpose of the national park system, which purpose is to conserve the scenery and natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

B. City Light:

Seattle Municipal Code (SMC) 21.49.130, which provides that City Light "may also enter into contracts of a general nature relating to the utility system."

Public Law 90-544, North Cascades National Park, Recreation, and Wilderness Areas – Washington, as amended, states in Section 505: Nothing in this Act shall be construed to supersede, repeal, modify, or impair the jurisdiction of the Federal Power Commission (now the FERC) under the Federal Power Act (41 Stat. 1063), as amended (16 U.S.C. 791a et seq.), in the recreation areas. City Light is authorized by the FERC to operate the Skagit River Hydroelectric Project under License No. 553 which was issued on May 16, 1995.

Seattle's DUNS Number: 009483629
Seattle's Tax Identification Number (TIN): 916001275

ARTICLE III – STATEMENT OF WORK, SCHEDULE, AND DELIVERABLES

A. The Parties agree to the following scope of work:

The area mapped will include the Skagit River valley floor from Gorge Dam to the estuary. The area from Newhalem Creek to Bacon Creek was mapped at 1:24,000 scale (Attachment A). The NPS will remap this area at a larger scale of 1:6000 (greater detail) to include features such as

gravel bars, side channels, and human manipulations of the landscape (e.g. road fill and gravel pits) not previously mapped.

The work would be conducted over a three year period in three phases described in detail below.

Phase 1. Prepare a Study Plan, Collect Existing Data and Initial Mapping

Task 1: NPS will prepare a more detailed study plan that is in the FERC-recommended format. Two drafts will be developed: the first for internal City Light review and the second (after revision) for review by parties consulting with City Light on relicensing the SRHP. The NPS will develop the study plan in consultation with City Light. The final study plan resulting from this review and consultation process will be implemented by the NPS.

Task 2: NPS will collect all other relevant sources of information, including well logs, published geologic maps, soil surveys, and aerial photographs. These data will be used to identify landforms and to elucidate their age and composition (i.e. gravel, sand silt).

Task 3: NPS will obtain and register all LiDAR surveys and produce a continuous high-resolution bare-earth digital elevation model (DEM). One tool NPS will develop from the DEM to complete this task is a Relative Elevation Model (REM) that will allow quick correlation of river terraces on both sides of the river and longitudinally. A Phase 1 Interim report will be developed summarizing progress on tasks 1-3, due to City Light February 2020.

Phase 2. Initial Mapping, Data Synthesis and Field Verification

In this phase of the project the NPS will utilize existing sources of data and existing NPS data interpretations based on two LiDAR surveys of the valley floor, including 2006 and 2017. This phase has three tasks (Tasks 4, 5 and 6):

Task 4: NPS will conduct initial mapping of landforms on LiDAR basemap with ArcGIS at 1:6000 scale (1-inch equals 500 ft). Landforms that will be mapped are listed in Tables 1 and 2, and include features identified in previous NPS surveys in Washington's National Parks. These features are important either because they are habitat and/or have the potential to deliver large wood and coarse sediment (bed load) to the river. Landforms will be identified based on changes in texture, morphology, geology, elevation, slope, vegetation, and soils.

Task 5: NPS will compare initial mapping based on the LiDAR to existing sources of data to create an initial understanding of individual landform type, age, and composition. Each landform will be given a temporary geomorphic and sedimentologic description. As part of this task NPS will also identify data gaps in the existing dataset that will be addressed in Phase 3.

Task 6: NPS will use field surveys to confirm landform geology and extent as initially mapped and characterized in Task 4. This is an important step so that measurement of recent channel migration can be linked with geology to understand what type of sediment (e.g. sand, gravel, silt) is being introduced. For example, erosion along a river cut bank into an alluvial terrace might produce spawning gravel, whereas erosion into a silt and clay bank would not.

Phase 3. Final Line Preparation and Deliverables

Task 7: NPS will produce final map polygons that will be edited and checked for accuracy, labeling, and consistency. Shapefiles will be backed-up and shared as a deliverable in ArcGIS compatible format. River reaches identified in Table 1 will be confirmed. NPS will add or remove new reaches if appropriate once more detailed geomorphology is mapped. Data on hydraulic geometry (e.g. sinuosity, channel width and pattern, incision, flood-prone width, etc.) and geologic characteristics (e.g. incision, confinement, bank stability and texture) of the 12 reaches will be summarized in a database (Table 1).

Task 8: NPS will prepare a technical summary report of the geomorphology of the Skagit River valley floor. The report will summarize the extent and location of each landform, along with its sedimentology and groundwater holding capacity. NPS will identify landform assemblages that differentiate the geologic, hydrologic, and habitat conditions in the Skagit River valley below the SHP. NPS will also examine the landscape history defined by the landforms, and the apparent and projected impacts of the SHP on the river landscape.

B. Schedule and Milestones

Two field seasons are needed to take advantage of limited low flow periods. In some cases, the timing of specific tasks overlaps to take advantage of two field seasons.

Task 1 (Study Plan): Summer 2019
Task 2 (Collect Existing Data): Summer-Fall 2019
Task 3 (Develop LiDAR Tools): Summer-Fall 2019
Task 4 (Initial Landform Mapping)
- Above Sauk: Summer-Fall 2019
- Below Sauk: Winter 2019-Spring-Summer 2020

Task 5 (Data Synthesis)
- Above Sauk: Winter 2019-Spring 2020
- Below Sauk: Winter 2020

Task 6 (Field Verification)
- Above Sauk: Summer 2020
- Below Sauk: Summer-Fall 2020

Task 7 (Final Lines)
- Above Sauk: Fall 2020
- Below Sauk: Winter 2021

Task 8: (Deliverables)
- Above Sauk: Fall-Winter 2020
- Below Sauk: Winter 2021

C. Deliverables

NPS will develop, complete, and provide City Light with the following deliverables:

Deliverable 1: Draft and final study plans as described in Task 1; Due: October 30, 2019
Deliverable 2: Interim report summarizing Tasks 1-3; Due March 31 2020.

Deliverable 3: ArcGIS shapefiles of the landforms of Skagit River valley floor, including descriptions of each landform unit; Due November 30, 2021; and

Deliverable 4: Draft and final reports on geomorphology of two segments of the Skagit River valley floor. Includes characteristics of each landform and identification of differences between the 12 reaches identified in Table 3. The report would also identify historic and recent changes that could be attributed to the SHP, identification of sources of gravel below the dams, and recommendations for future studies, linking with other pre-relicensing efforts, and license mitigation. Above Sauk segment draft due December 1, 2020 and below Sauk segment draft December 1, 2021.

ARTICLE IV – TERM OF AGREEMENT

This MOA will become effective upon final signature of both parties and extend through March 31, 2022.

ARTICLE V – KEY OFFICIALS

A. Key officials are essential to ensure maximum coordination and communication between the parties and the work performed. They are:

1. For NPS:

Signatory/Administrative
Karen Taylor-Goodrich, Superintendent
North Cascades NPS Complex
810 State Route 20
Sedro Woolley, WA 98284
360-854-7205

Local/Coordinating
Jon Riedel, Geologist
North Cascades National Park Complex
810 HWY 20
Sedro Woolley, WA 98284
(360) 854-7330

2. For Seattle City Light

Signatory/Administrative
Andrew Bearlin, Manager
Skagit License Unit
Environment, Lands, and Licensing Business Unit
Seattle City Light
700 Fifth Avenue, Suite 3300
P.O. Box 34023
Seattle, WA 98124-4023

206-733-9168

Local Coordinator
Erin Lowery, Senior Fisheries Biologist
Natural Resources and Hydro Licensing Division
Seattle City Light
700 Fifth Avenue, Suite 3300
P.O. Box 34023
Seattle, WA 98124-4023
206-615-1128

B. **Communications** – Seattle will address any communications on non-financial matters pertaining to this MOA to the NPS Local Coordinator. Communications that relate solely to financial matters may be conveyed to the NPS Chief of Administration.

C. **Changes in Key Officials** – Neither the NPS nor City Light may make any permanent change in a key official without written notice to the other party reasonably in advance of the proposed change. The notice will include a justification with sufficient detail to permit evaluation of the impact of such a change in the scope of work specified within this MOA. Any permanent change in key officials will be made only by modification to this MOA through a written amendment executed by both NPS and City Light.

ARTICLE VI – FUNDING AND REIMBURSEMENT

The total funding to be provided by City Light under this MOA shall not exceed Ninety Five Thousand Eight Hundred Dollars (**$95,800.00**), unless modified in writing by the parties to this MOA in accordance with Article XI.

The NPS will submit invoices to Seattle for compensation for completed work and approved expenses incurred by NPS for scope of work tasks described in Article III. Invoices will be submitted one month after each delivery date shown in Article III C, on November 30, 2019; April 30, 2020; December 31, 2020; and December 31, 2021. City Light will provide reimbursement payments for submitted and approved invoices within 30 days of the invoice date.

NPS will establish reimbursable account PR.RNOCA19N3.00.1 to track expenses related to this work.

ARTICLE VII – PRIOR APPROVAL

Changes to the SOW and budget will be handled by modification to this MOA per Article XI.

ARTICLE VIII – REPORTS AND/OR OTHER DELIVERABLES

The reports and other deliverables to be provided by NPS to City Light are described in Article III-A. Data will be available for use by all contributing parties (City Light and NPS).

ARTICLE IX – INSURANCE AND LIABILITY

City Light agrees to indemnify, save and hold harmless, and defend the United States against all fines, claims, damages, losses, judgments, and expenses to the extent arising out of, or from, any negligent act or omission of its officers, employees, representatives, or agents in any way connected to activities authorized pursuant to this MOA. This obligation shall survive the termination of this MOA.

The NPS agrees to cooperate, to the extent allowed by law, in the submission of claims pursuant to the Federal Tort Claims Act against the United States for personal injuries or property damage resulting from the negligent or wrongful act or omission of any employee of the United States while acting within the scope of their employment, arising out of this agreement.

ARTICLE X – PROPERTY UTILIZATION

Not applicable.

ARTICLE XI – MODIFICATION AND TERMINATION

This MOA may be modified only by a written amendment executed by the parties. Proposed changes are to be approved by both parties.

Either party may terminate this MOA by providing the other party with thirty (30) days of written notice. In the event that one party provides the other party with notice of its intention to terminate, the parties will meet promptly to discuss the reasons for the notice and to try to resolve the differences.

ARTICLE XII – STANDARD CLAUSES

Disputes - Should disagreement arise on the interpretation of the provisions of this agreement, or modifications and/or revisions thereto, that cannot be resolved at the local/coordinating level, the area(s) of disagreement shall be stated in writing by each party and presented to the other party for consideration by the NPS and City Light signatories.

Civil Rights - During the performance of this Agreement, the participants will not discriminate against any person because of race, religion, sex, or national origin. The participants will take affirmative action to ensure that applicants are employed without regard to their race, color, sexual orientation, national origin, disabilities, religion, age, or sex.

Promotions - SCL will not publicize or otherwise circulate promotional material (such as advertisements, sales, brochures, press releases, speeches, still and motion pictures, articles, manuscripts, or other publications) which states or implies Governmental, Departmental, bureau, or Government employee endorsement of a product, service, or position which City Light represents. No release of information relating to this Agreement may state or imply that the Government approves of City Light's work product or considers City Light's work product to be superior to other products or services.

Publications of Results of Studies - No party will unilaterally publish a joint publication without consulting the other party. This restriction does not apply to popular publication of previously published technical matter. Publications pursuant to this Agreement may be produced independently or in collaboration with others; however, in all cases proper credit will be given to the efforts of those parties contributing to the publication. In the event no agreement is reached concerning the manner of publication or interpretation of results, either party may publish data after due notice and submission of the proposed manuscripts to the other. In such instances, the party publishing the data will give due credit to the cooperation but assume full responsibility for any statements on which there is a difference of opinion.

Non-Exclusive Agreement - This Agreement in no way restricts City Light or NPS from entering into similar agreements, or participating in similar activities or arrangements, with other public or private agencies, organizations, or individuals.

Survival - Any and all provisions which, by themselves or their nature, are reasonably expected to be performed after the expiration or termination of this Agreement shall survive and been forcible after the expiration or termination of this Agreement. Any and all liabilities, actual or contingent, which have arisen during the term of and in connection with this Agreement and in connection with this Agreement shall survive expiration or termination of this Agreement.

Partial Invalidity - If any provision of this Agreement or the application thereof to any party or circumstance shall, to any extent, be held invalid or unenforceable, the remainder of this Agreement or the application of such provision to the parties or circumstances other than those to which it is held invalid or unenforceable, shall not be affected thereby and each provision of this Agreement shall be valid and be enforced to the fullest extent permitted by law.

Captions and Headings - The captions, headings, article numbers and paragraph numbers appearing in this Agreement are inserted only as a matter of convenience and in no way shall be construed as defining or limiting the scope or intent of the provision of this Agreement nor in any way affecting this Agreement.

No Employment Relationship - This Agreement is not intended to and shall not be construed to create an employment relationship between NPS and City Light or its representatives. No representative of City Light shall perform any function or make any decision properly reserved by law or policy to the Federal government.

No Third-Party Rights - This Agreement creates enforceable obligations between only NPS and City Light. Except as expressly provided herein, it is not intended nor shall it be construed to create any right of enforcement by or any duties or obligation in favor of persons or entities not a party to this Agreement.

Rights In Data – The parties to this Agreement agree to grant to each other a royalty-free, non-exclusive and irrevocable license to publish, reproduce and use, and dispose of in any manner and for any purpose without limitation, and to authorize or ratify publication, reproduction or use by others, of all copyrightable material first produced or composed under this Agreement by any individual or concern specifically employed or assigned to originate and prepare such material.

ARTICLE XIII – SIGNATURES

IN WITNESS WHEREOF, the parties hereto have executed this MOA on the date(s) set forth below.

FOR SEATTLE CITY LIGHT

Andrew Bearlin
Manager, Skagit License Unit

7-12-19
Date

FOR THE NATIONAL PARK SERVICE

for Karen F. Taylor-Goodrich, Superintendent
North Cascades National Park Service Complex

6.24.19
Date

Reviewed By:

Sarah J. Welch
Contract Specialist
North Cascades National Park Service Complex

6-20-2019
Date

Attachment A. Example of a landform map for Skagit valley near the mouth of Goodell Creek printed at ~1:30,000 scale. The map data was compiled initially at 1:24,000 scale, and later was remapped with LiDAR. The expanded scale of 1:6,000 in this study will allow for mapping of smaller features such as gravel bars, side channels, and road fill within the CMZ.

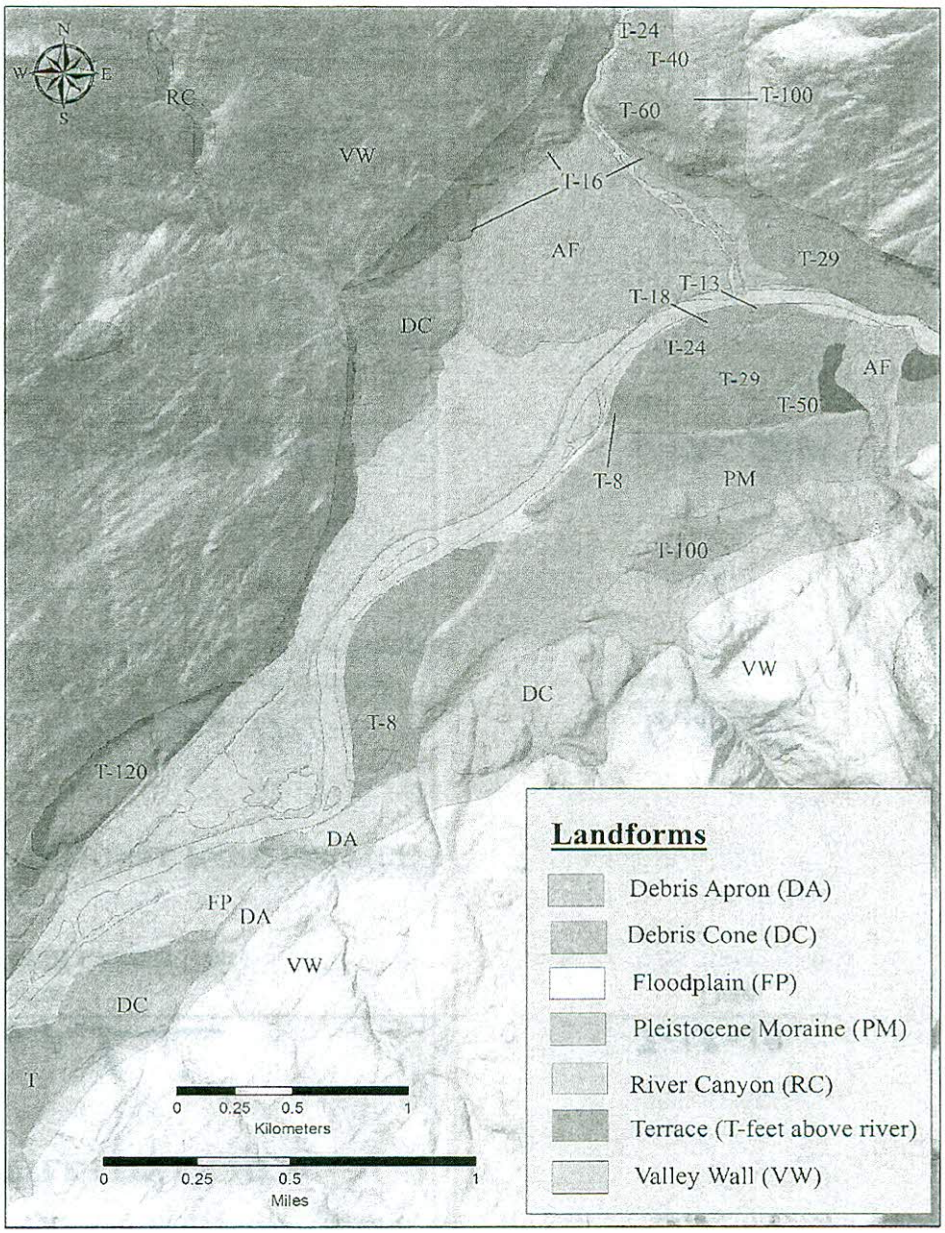

Table 1. Skagit River landscape-scale geomorphic provinces.

Approximate Reach Boundaries	Characteristics
1-Bypass Reach Skagit Gorge	Infrequent flows, narrow bedrock canyon
2-Newhalem to Damnation Landslide	Island-bar channel pattern, large project influence on channel pattern, side channel development, sediment recruitment and peak flow
3-Landslide Zone	River passes through 0.5 km wide landslide, narrow, steep single channel
4-End of LZ to Cascade R. mouth	Similar to (1), includes Bacon Creek addition.
5-Cascade to Illabot	Cascade and Illabot sediment inputs, meander channel pattern, Marblemount RB rip-rap, Corkindale terrace
6-Barnaby Reach	Wide meander channel pattern changed to island-bar, heavy side channel manipulation on LB
7-Sauk Mouth Reach	Skagit on north side of valley floor across Sauk River alluvial fan, large sand and gravel input
8-End Sauk Alluvial fan to Baker Mouth	Narrow, steep channel as river incised into 30-50m thick, over-consolidated glacial deposits (till, silt, sand, and gravel)
9-Baker to Finney Cr.	Channel still incised into glacial, large Sauk (KCA lahar) terraces (Birdsview), Baker Hydro Project influence on sediment, large wood, and channel pattern
10-Finney Cr. to Lyman	Meander pattern returns, strong right bank groundwater influence,
11-Lyman to Sedro-Wooley	Start of river levees, transition to sand bed, wide meander loops
12-Delta (SW to Skagit Bay)	Single channel(s) locked between levees on delta, split into two distributary channels, very limited sediment and LWD input.

PRE-APPLICATION DOCUMENT

ON-GOING BASELINE STUDIES

EARLY INFORMATION DEVELOPMENT FOR RELICENSING: FACTORS LIMITING NATIVE SALMONIDS ABOVE SKAGIT RIVER DAMS – PHASE 2 ("FOOD WEB STUDY") USGS SCOPE OF WORK

Attachment A
Scope of Work: 2019-2020

Skagit River Hydroelectric Project
Early Information Development for Relicensing:
Factors Limiting Native Salmonids Above Skagit River Dams-Phase 2

1. Background

Seattle City Light (City Light), a department of the City of Seattle (City), is one of the nation's largest municipally owned utilities in terms of the number of customers served. City Light owns and operates the Skagit River Hydroelectric Project (Project) in Whatcom County, Washington. The Project consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities. The three developments are hydraulically coordinated to act as a single project, which supplies approximately 20 percent of City Light's power requirements. The Project was first licensed by the Federal Power Authority in 1927 as Project 553. Following expiration of the original license in 1977, the project operated for 18 years under annual licenses while City Light undertook a comprehensive process of studies and negotiations to obtain a second license. The second license was issued by the FERC on May 1, 1995 for 30 years and will expire on April 30, 2025.

City Light needs to file the Notice of Intent to relicense the Project with the Federal Energy Regulatory Commission (FERC) between October 30, 2019 and April 30, 2020. The default process for relicensing is the Integrated Licensing Process (ILP); under this process, the formal study period of two years would occur from spring/summer 2020 through spring/summer 2022. City Light understands that two years may not be enough time to fill several identified data gaps and that some efforts are prerequisites or components of studies that require several years to complete. City Light is willing to initiate some early studies if there is:

1) Consensus by City Light and existing key stakeholders on the need for the study;
2) A clear nexus between the study need and the Project;
3) Available funding; and
4) Agreement by the stakeholders on the key study plan elements.

2. Study Need/Purpose

In preparation for FERC relicensing of the Skagit River Hydroelectric Project City Light has identified the need for additional information on habitat and environmental conditions and species interactions that affect production of native salmonids in reservoirs and major tributaries associated with the operations of Ross, Diablo, and Gorge dams on the Skagit River, Washington. This agreement articulates the set of Year 2 tasks that will build from Year 1 findings, inform and feed into subsequent years of work that are not part of this SOW.

During the last relicensing process, most of the studies focused on the effects of Project flows on salmonids in the Skagit River downstream of Gorge Powerhouse. Relatively little attention was paid to reservoir fisheries. Since that time, Bull Trout, which are present in all three Project reservoirs, were federally listed as threatened. In addition, populations of Redside Shiner and

Brook Trout, both non-native species, have increased. Redside Shiners in particular have become a dominant species in the reservoirs with serious implications for regulating the zooplankton community, competing with juvenile salmonids for key food resources in the reservoirs, and altering the predator-prey dynamics within and among species of native and non-native salmonids in the reservoirs.

Over the past decade, City Light and National Park Service (NPS) fisheries biologists have gathered some data on aquatic resources in the Project reservoirs, including Bull Trout movement, fish species assemblages, sport fishing catches (creel surveys; Ross Lake only), and water quality. While these efforts provide valuable baseline information, a comprehensive analysis of trophic interactions, environmental conditions, and Project operations that affect reservoir fish populations will be needed for relicensing. These data can also support more specific fishery monitoring and management activities, if necessary, post-license.
An understanding of the timing of migrations, distribution, abundance, growth, and interactions of native and non-native fish species that inhabit Project reservoirs is needed to evaluate the effects of existing operations. The instream flow needs of anadromous fishes downstream of the project will be a large driver in developing operational scenarios for the three reservoirs. The ability to model the hydrodynamics of the reservoirs coupled with the ecology of resident fishes will inform discussions concerning the management of habitat and flow conditions for anadromous fishes downstream of Gorge Powerhouse.

The multifaceted nature of biological investigations, coupled with the complexity of three reservoirs and their associated tributaries, is anticipated to take more time than the two-year formal study period associated with the ILP. The body of work scoped in this document will provide data for some components of a comprehensive suite of analyses needed to model reservoir conditions under various operational scenarios for the Project. As such, the study objectives proposed in 2019-2020 were deemed the top priority tasks that would then identify or inform subsequent research during subsequent Years that are anticipated as necessary next steps, but not part of this SOW.

3. Study Objectives

The goal of this study will be to identify and quantify factors that limit recruitment or production of native adfluvial salmonids that populate the reservoirs and associated tributaries above the mainstem dams on the Skagit River (Ross, Diablo, Gorge). During the years 2019-2020 of this project, USGS will focus on seasonal and size-structured food web interactions in the reservoirs, the ontogenetic connections of adfluvial salmonids to tributary habitats, expand on 1st year efforts to explore the presence and geographic extent of native and non-native fishes in the basin, and habitat suitability and production capacity of select tributaries. Food web interactions, distribution and growth of native salmonids will ultimately be linked to environmental conditions, and these will be evaluated within the context of projected changes in climate or dam operations. The specific objectives of this phase of the study include:

1) Quantify seasonal and size-structured tropic interactions within the reservoir food webs to determine the relative importance of seasonal food supply, competition, and predation as potential limits to production of native trout and char.

2) Develop a parameterized bioenergetics model for post-larval stages of Redside Shiners to enable us to perform more quantitative evaluations and predictions of their consumption demand, seasonal-spatial distribution patterns in relation to thermal stratification, and potential competition for key prey that are essential for growth and survival of juvenile salmonids.
3) Determine the feasibility of assigning natal streams of origin to adfluvial rainbow trout and native char captured in the reservoirs via comparison of geochemistry from tributary water samples with elemental analysis of fin rays, otoliths or other hard parts from fishes sampled in the reservoirs.
4) Estimate the spatial patterns of habitat suitability in tributary habitats for spawning and rearing Rainbow trout, Bull Trout, and Dolly Varden using watershed mapping tools, existing data, and field sampling from year 1 to assess the habitat suitability for targeted species in tributaries of the three main reservoirs.
5) Conduct follow-on eDNA sampling of tributaries not sampled in 2018 to increase the basin-wide eDNA coverage for Rainbow Trout, Bull Trout, Brook Trout, Dolly Varden, Cutthroat Trout, Brown Trout, Redside Shiner, and sculpin (Cottus spp) in tributaries.
6) Determine the extent of hybridization among charr (Bull Trout, Dolly Varden, and Brook Trout) and between Rainbow and Cutthroat Trout and the distribution of hybrids by conducting genetic analysis using fin tissue samples collected at spatially stratified locations in designated tributaries and within reservoirs

The above Study Need/Purpose and Objectives are further summarized in Sections 1 and 2 in Attachment B, which is the 2019-2020 Study Plan prepared by USGS for the multi-year investigation (Attachment B). The Scope of Work (SOW) for the pilot study, the deliverables, and schedule are described in the following sections.

4. 2019-2020 Scope of Work

The purpose of this SOW is for a study that would: (1) quantify seasonal and size-structured food web interactions in the reservoirs based on directed sampling; (2) develop a bioenergetics model for Redside Shiner; (3) explore the ontogenetic connections of adfluvial salmonids between life stages in tributary and reservoir habitats using water chemistry and elemental analysis or stale isotope analysis of otoliths, scales or other diagnostic hard parts from char and rainbow trout; (4)expand on the habitat suitability and production capacity of select tributaries; (5) expand on 1st year efforts to explore the presence and geographic extent of native and non-native fishes in the basin; and (6) determine the extent of hybridization among charr (Bull Trout, Dolly Varden, and Brook Trout) and between Rainbow and Cutthroat Trout.

It is expected that the results of the 2019-2020 study will address the following questions:

- How do thermal stratification patterns, as modified by current dam operations influence seasonal and size-structured food web interactions among native salmonids and nonnative fishes in terms of seasonal cycles in availability of food supply, and quantified seasonal competition and predation.

- Develop a parameterized bioenergetics model for Redside Shiner to address questions about how thermal stratification determines the role of Redside Shiners as competitors with native salmonids and seasonal prey for piscivorous sizes of native salmonids under current and projected climatic conditions and dam operations.
- Determine the feasibility of assigning natal streams of origin to adfluvial rainbow trout and native char captured in the reservoirs via elemental or stable isotope analysis.
- Evaluate the rearing capacity of various tributaries to support different species and life stages of native salmonids (and/or invasive species?), based on physical habitat, thermal regime, invertebrate drift, and bioenergetics. Explore the role tributaries play in supporting different stages of the life cycles for native salmonids.
- What is the distribution and occupancy of fish in tributaries (based on eDNA)? While this question was addressed in 2018, follow-on eDNA sampling could broaden the understanding of distribution and occupancy in tributaries.
- In what habitats do charr and rainbow-cutthroat hybrids occur, does hybridization lead to introgression in the charr, what are the mechanisms driving hybridization, and is hybridization a threat to the long-term persistence of native charr (Bull Trout and Dolly Varden) and Rainbow Trout?

Task 1: Seasonal and Size-structured Food Web Interactions

This task will include the following steps:

- Conduct seasonal and depth-stratified sampling to determine the size structure, growth, distribution and diets of native and non-native fishes in Ross and Diablo reservoirs.
- Use empirical biological and physical data obtained above as inputs for bioenergetics model simulations to quantify size-specific, seasonal consumption demand by rainbow trout, Bull trout, Dolly Varden, Brook Trout, and Redside Shiners. If reasonable size/age structure and relative abundance of the consumer populations can be reconstructed from sampling data, then size-structured seasonal consumption estimates per 1,000 consumers, greater than a species-specific minimum size threshold, will be computed for each species to determine predation impacts on key prey species and identify major contributors to the energy budgets of the consumers.
- Combine the data above with temporal patterns in thermal stratification of the reservoirs and depth-specific zooplankton densities to examine how seasonal change in thermal regime and food supply/accessibility affect trophic interactions among juvenile and adult native and non-native salmonids and Redside Shiners.

Task 2: Development of a Bioenergetics Model for Redside Shiner

Capture, hold, and perform experiments to parameterize and corroborate a bioenergetics model for Redside Shiners.

- Live-capture as wide a range of age/size classes of Redside Shiners and transport them for holding and experimentation at the USGS-WFRC lab in Seattle.

- Conduct a series of experiments for determining the temperature associated with the maximum daily consumption rate (Cmax) of Redside Shiners; the effect of a range of environmentally-relevant temperatures on Cmax (temperature-dependence of Cmax)
- Conduct a series of experiments for determining the effect of body mass on Cmax at the temperature associated with the maximum daily consumption rate for Redside Shiners (weight-dependence of Cmax). For a subset of size classes, Cmax experiments will continue for 3-4 consecutive days to determine whether initial binge feeding is a concern. If not, then all other Cmax expriments will be limited to 24-h trials. If so, all Cmax experiments will be conducted as 3- or 4-consecutive day trials.
- Conduct a series of experiments for determining respiration costs (R) as functions of body mass and temperature
- Perform bomb calorimetry on a range of sizes of Redside Shiners to determine energy density (ED, J/g wet weight) as a function of body mass and proportion dry weight (pDW)

Task 3: Determine the feasibility of assigning natal streams of origin to adfluvial rainbow trout and native char captured in the reservoirs via comparison of geochemistry from tributary water samples to elemental analysis of fin rays, otoliths or other hard parts from fishes sampled in the reservoirs.

- Collect water samples from fish-bearing tributaries not previously sampled in Year 1.
- Analyze the water chemistry results to determine if differences occurring among the tributaries are significant enough to characterize unique signatures per tributary or by geographic region.

Collect fish hard parts non-lethally (fin rays) or from mortalities (otoliths, fin rays) for chemical analysis in order to assign individual fish to their tributary or geographic region of origin.

Task 4: To determine the habitat suitability and relative production capacity of select tributary habitats for spawning and rearing by native salmonids, we will combine: 1) the physical habitat information generated by watershed mapping tools and corroborated-supplemented with field measurements with 2) stream temperature data, 3) size and growth measurements from fish sampling in the intensive tributaries, 4) drift sampling data on relative biomass and energetic content of invertebrate drift, 5) then synthesize these data into inputs to bioenergetic simulations of annual or seasonal growth potential within the selected tributaries and reaches.

Task 5: Directed eDNA sampling and tributary occupancy by native & non-native species
The eDNA task involves collection of water samples from designated tributaries and eDNA analysis. Tributaries to be sampled will be identified through eDNA estimates of co-occurrence of possibly hybridizing taxa from 2018 sampling, and in consultation with managers and using results from 2018 eDNA analysis. Some tributaries sampled in 2018 may be sampled at a different scale in 2019. eDNA analysis of water samples will determine occupancy of Rainbow Trout, Bull Trout, Brook Trout, Dolly Varden, Cutthroat Trout, Brown Trout, Redside Shiner, and sculpin (Cottus spp) in tributaries. Fin tissues and eDNA samples will be collected in summer 2019. Where possible, sampling in support of Task 4 will be used to provide tissue samples for hybridization screening in the tributaries, and samples collected for Task 1 will

supply tissue samples from the reservoirs. Sample processing and data analysis will be completed 2020.

Task 6: Hybridization Analysis

The hybridization task involves collection of fin tissue samples from spatially stratified locations in tributaries and from reservoirs followed by genetic analysis. Tributaries to be sampled will be identified through consultation with managers and agency reports. Reservoir samples will consist of the samples collected for size structure, growth distribution, and trophic interactions. Washington Department of Fish and Wildlife will sub-contracted to perform genetic screening for hybridization among charr. The genetic screening and hybridization analysis between rainbow and cutthroat trout will be performed at WFRC.

Task 7: Prepare Study Plan and Final Report

This task will involve the preparation of a detailed study plan for a full Reservoir Operations and Food Web Study and a Final Report that summarizes the existing data and analysis conducted under this SOW. The Study Plan will contain all the elements required by the FERC (Appendix A) and follow the recommended format. Two drafts will be developed—one for internal SCL review and one for review by the stakeholders, as represented by the existing Non-flow Coordinating Committee (NCC). The study plan will be included in the Preliminary Application Document. The final study plan will be agreed on by the NCC and will be implemented by the consultant in 2019 or 2020. Timing and scope of this activity to be mutually determined by SCL (Erin Lowery) & PI (Dave Beauchamp)

5. Schedule and Milestones

- Task 1: Field sampling May-October in 2019 and 2020, Ongoing lab processing of field samples during June 2019-February 2020, and June 2020-December 2021; ongoing analysis October 2019-January 2021. Final Report drafted March 2021 for review, revisions by June 2021.
- Task 2: Collection and acclimatization of Redside Shiner April-July 2019; Consumption experiments during June-September 2019, respiration experiments July 2019-September 2020; extended growth-consumption experiment during June-Aug 2019 and/or 2020; analysis September 2019-October 2020.
- Task 3: Year 1: **i)** Collect and ICPMS analyze water samples from a few additional sites in the U.S. and a few sites within Canada **May-October 2019 ii)** Perform data analysis on water and prepare an overall report on water sample results; a determination will be made on whether sufficient variation in water chemistry exists among locations to continue with Task 3 **November 2019** Year 2: **i)** Prepare and process collected fin rays or otoliths for LA-ICPMS **January-March 2020**. **ii)** Perform LA-ICPMS on collected samples **April 2020**. **iii)** Perform data analysis on year 1 samples **May-June 2020**. **iv)** Prepare and process year 2 collected fin rays or otoliths for LA-IPMS **July-October 2020**. **v)** Perform LA-ICPMS on collected samples from year 2 **October 2020**. **vi)** Perform data analysis on year 2 samples **November 2020**. **vii)** Provide a report presenting results on water chemistry, fish hard part chemistry and the degree of certainty

in assigning fish to tributaries or geographic region based on those results. **December 2020**.

- Task 4: Field sampling and data collection for Tasks 4-6 during July-September 2019 and (if needed) July-September 2020; Fish size, scales, diet, SIA, drift samples, etc. processed in lab August-November in 2019 and (if needed) 2020. Data analysis, modeling, and report October 2019-January 2020 and October 2020-January 2021.
- Task 5: Field sampling and data collection for Tasks 4-6 during July-September 2019 and (if needed) July-September 2020; eDNA processing and analysis September-November 2020; Report December 2020.
- Task 6: Field sampling and data collection for Tasks 4-6 during July-September 2019 and (if needed) July-September 2020; eDNA processing and analysis September-November 2020; Report December 2020.
- Task 7: Final Report drafted March 2021 for review, revisions by June 2021. The report will be a series of manuscripts intended for submission to peer-reviewed journals with additional information presented in Appendices.
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6. Deliverables

- Task 1: PowerPoint presentation on progress in April 2019, 2020, and 2021 for bioenergetics-based reservoir food web work.
- Task 2: Bioenergetics parameter estimation and model development for Redside Shiner
- Task 3: A report assessing the feasibility of assigning natal streams of origin to adfluvial rainbow trout and native char captured in the reservoirs via comparison of geochemistry from tributary water samples with elemental analysis of fin rays, otoliths or other hard parts from fishes sampled in the reservoirs. The report would present results on water chemistry, fish hard part chemistry and the degree of certainty in assigning fish to tributaries or geographic region based on those results.
- Task 4: A report of estimated spawning and rearing habitat and relative rearing capacity, for targeted species in selected tributaries in the upper Skagit River watershed
- Task 5: Results from any additional eDNA sampling will be added to species distribution maps and delivered in 2020.
- Task 6: Reports detailing the dynamics of hybridization among charr species and between Rainbow and Cutthroat Trout will be delivered in 2021.
- Task 7: A detailed study plan for a full Reservoir Operations and Food Web Study that contains all the elements required by the FERC.

7. Budget Assumptions

- Task 1: USGS will provide a dedicated research boat for the duration of the project, but also receive boating support as needed from SCL. SCL will provide housing

accommodations for field crews associated with Tasks 1,3,4,5,6 through the 2019-2020 sampling seasons. Reservoir samples will be collected independently and in collaboration with the NOCA annual July gillnetting program.

- Task 2: Assumes that an appropriate size range of Redside Shiners can be captured, transported to the WFRC Lab in Seattle and acclimated for feeding and respiration experiments.
- Task 3: Water sample collection, water analysis and fish hard part collection would occur as described in Year 1. Processing and chemical analysis of fish hard parts would only proceed if sufficient variation among locations exists from water analysis such that assignment of fish to natal origin is deemed possible. If the assignment of natal origin is not possible, money set aside for this task would be used to cover other project expenditures or returned to the funding agency.
- Task 4: Tasks 4-6 assume that field collections for all tasks can be obtained concurrently to benefit from economies of scale. Therefore, the costs of field collection will persist even if the scope of a specific task is reduced. Lab processing costs associated with a reduction in scope of any of these tasks would be reduced accordingly.
- Task 5: see task 4
- Task 6: see task 4

Attachment B
2019-2020 Study Plan
Factors Limiting Native Salmonids above Skagit River Dams-Phase 2
Prepared by USGS

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Year 2 Objectives: The goal of this study will be to identify and quantify factors that limit recruitment or production of native adfluvial salmonids that populate the reservoirs and associated tributaries above the mainstem dams on the Skagit River (Ross, Diablo, Gorge). During the years 2019-2020 of this project, USGS will focus on seasonal and size-structured food web interactions in the reservoirs, the ontogenetic connections of adfluvial salmonids to tributary habitats, expand on 1st year efforts to explore the presence and geographic extent of native and non-native fishes in the basin, and habitat suitability and production capacity of select tributaries. Food web interactions, distribution and growth of native salmonids will ultimately be linked to environmental conditions, and these will be evaluated within the context of projected changes in climate or dam operations. The specific objectives of this phase of the study include:

1. Quantify seasonal and size-structured tropic interactions within the reservoir food webs to determine the relative importance of seasonal food supply, competition, and predation as potential limits to production of native trout and char.
2. Develop a parameterized bioenergetics model for post-larval stages of Redside Shiners to enable us to perform more quantitative evaluations and predictions of their consumption demand, seasonal-spatial distribution patterns in relation to thermal stratification, and potential competition for key prey that are essential for growth and survival of juvenile salmonids.
3. Determine the feasibility of assigning natal streams of origin to adfluvial rainbow trout and native char captured in the reservoirs via comparison of geochemistry from tributary water samples with elemental analysis of fin rays, otoliths or other hard parts from fishes sampled in the reservoirs.
4. Determine the spatially explicit habitat suitability and production capacity of tributary habitats for spawning and rearing Rainbow trout, Bull Trout, and Dolly Varden. USGS will use a combination of watershed mapping tools, existing data, and field sampling to assess the habitat suitability for targeted species in tributaries of the three main reservoirs. Habitat potential for Bull Trout and Dolly Varden is determined by stream size, temperature, flow regime, and channel gradient (Petersen et al. 2013). USGS will assess the applicability of intrinsic potential modeling to inform habitat suitability and production capacity for rainbow trout.

5. Conduct follow-on eDNA sampling of tributaries not sampled in 2018 to increase the basin-wide eDNA coverage for Rainbow Trout, Bull Trout, Brook Trout, Dolly Varden, Cutthroat Trout, Brown Trout, Redside Shiner, and sculpin (Cottus spp) in tributaries.
6. Determine the extent of hybridization among charr (Bull Trout, Dolly Varden, and Brook Trout) and between Rainbow and Cutthroat Trout and the distribution of hybrids by conducting genetic analysis using fin tissue samples collected at spatially stratified locations in designated tributaries and within reservoirs.

Methods

USGS would develop a framework for understanding how seasonal changes in the physical environment (thermal and flow regimes and landscape-level modeling of capacity in streams, vertical temperature profiles, reservoir level) influence life history patterns of salmonids, food web structure, and trophic interactions that determine growth and survival of native salmonids. USGS would identify the key uncertainties related to life history, ontogenetic patterns in distribution, diet, growth, and survival of native salmonids and interacting species in reservoir and tributary habitats. The remaining important information gaps would be prioritized for directed sampling in subsequent years or for integration into ongoing monitoring programs. USGS would empirically determine the size-at-age, size structure, growth, seasonal and size-related diet composition and distribution (depth and nearshore-offshore distribution in reservoirs) of reservoir fishes for comparison to size structure and trophic position in tributaries.

We recommend that sampling in the reservoirs be repeated in two consecutive years to provide a measure of inter-annual variability and to allow the opportunity to refine the sampling design to fill additional knowledge gaps that may be revealed in the first year of reservoir sampling. Conditions within Diablo and Gorge reservoirs will be more dynamic and less predictable; therefore, sampling will be conducted at a more opportunistic and lower level of intensity in coordination with biologists from the National Park Service and Seattle City Light.

Task 1-Quantifying seasonal and size-specific reservoir food web interactions. To quantify food web interactions affecting native salmonids in the reservoirs, USGS would design and conduct directed seasonal sampling in the reservoirs to supplement the initial synthesis of existing information and archival samples related to reservoir and tributary habitats, species assemblages, growth, seasonal distribution and diet of key species, and environmental conditions. Using the empirical data generated from these efforts as inputs into bioenergetics modeling simulations, seasonal and size-structured consumption rates of major prey categories will be estimated to quantify food web interactions at the appropriate scales for evaluating whether seasonal food supply, competition, predation, or thermal conditions limit production of native salmonids in the basin (Beauchamp et al. 2007, Beauchamp 2009).

Fish sampling in the reservoirs would obtain supplemental samples for filling gaps in stable isotope analysis and provide diet, distribution, size and age samples for various size classes of Bull Trout, Rainbow trout, Dolly Varden, Brook Trout, Redside Shiners, Sculpin or other previously undiscovered fishes. Fish samples would be collected seasonally using a combination

of depth-stratified sinking gill nets, angling, seining, minnow trapping, and potentially trotlines (for sculpin) in nearshore and slope zone habitats (Beauchamp et al. 2009). The depth strata will represent the thermal layers above, within, and below the thermocline during thermally stratified periods, but we will sample the same depth intervals during unstratified or weakly stratified periods). Additional sampling in pelagic habitats would be supplemented with suspended curtain nets, angling or microtrolling to increase sample sizes for diets, age and growth as needed. Fishes in the lower reaches of key tributaries would be sampled via angling, backpack electrofishing, dip netting or seining. This sampling would be repeated in 3 regions of Ross Lake during 3-4 ecologically-relevant seasons (spring, summer, fall, plus potentially important recruitment or migration events that might alter predator-prey interactions significantly) each year for two years. USGS would minimize potential mortality on species of concern via the selection of net set timing, mesh sizes, and depths of deployment as outlined in the USFWS Section 10 permit # TE98709C-0 (permit period 8/8/2018-8/7/2023).

USGS would empirically determine the seasonal, size-specific diet composition and depth distribution, as well as size-at-age, size structure, and growth of native salmonids and Redside Shiners:

- To the extent possible, Bull trout, Dolly Varden, [and Rainbow Trout] would be processed immediately upon encounter to minimize potential mortality. Fish would be lightly anesthetized and measured (nearest 1 mm FL, 0.1 g Wt), and stomach contents would be removed via gastric lavage. For Bull Trout and Dolly Varden a portion of the pectoral fin would be removed and used for aging. The balance of the tissue would be archived for SIA and genetic samples; For Rainbow Trout, scales would be removed from the preferred area above the lateral line and posterior of the dorsal fin, and placed in "rite-in-the-rain" envelopes for subsequent age and growth analysis. These fish would be held in a recovery tank until they resumed normal behavior and then released close to the location of capture.
- For other fish species (i.e., Brook Trout, Brown Trout Redside Shiners), individuals would be euthanized immediately, placed in pre-labeled bags for each net set and mesh size, and placed on dry ice for processing back at the lab (FL, Wt, fin clips, gut samples, otoliths and scales). For large catches, a subset of 10 individuals from each 100-mm size class would be euthanized and handled as described above, and the remainder would be counted, measured (FL only), and released immediately.
- Diet composition, size structure, age and growth, and distribution will be determined following sample processing and data analysis in the lab. Seasonal diet composition from each size class of each species and habitat type would be estimated as the wet mass proportion of each functional prey group of insects or benthic invertebrates, zooplankton and fish. Prey fishes would be identified to species and measured (standard length, vertebral length, etc.) such that prey size can be reconstructed whenever possible.
- Age and growth would be estimated using length frequency data or scale back-calculations for some species (e.g., Rainbow trout, Redside Shiners), but USGS would rely on lengths and ages from sectioned fin rays for charr species. Size structure for various species in specific habitats would be generated from length frequency data after adjusting for size-selective biases associated with sampling gear. Seasonal distribution

patterns would be addressed by examining changes in CPUE among regions, depths, and habitats after accounting for gear selectivity. Temporal distribution patterns among depths, regions and habitats would be combined with vertical temperature profile and stream temperature logger data to reconstruct thermal experiences for different species and life stages for input into bioenergetics model simulations described below. The distributional analysis would be limited to seasonal shifts by sub-adult and adult fishes within the reservoir(s) and ontogenetic shifts by juveniles from tributary to reservoir habitats.

- USGS would combine the biological data obtained above with environmental data (primarily vertical temperature profiles and stream temperatures, supplemented by flow and reservoir level data as needed) for use as inputs to bioenergetics model simulations to estimate seasonal consumption demand of primary prey resources by native salmonids and their competitors (Beauchamp et al. 2007). The feeding rate of native salmonids and other key consumers will be reported as a percentage of their maximum consumption rate (%Cmax). Estimates of %Cmax serve as a useful indicators of food availability for various consumers after accounting for the effects of temperature and body size of the consumer on their consumption capability. In addition, this approach will be used to estimate predation mortality imposed on native salmonids via cannibalism and by other predators. To estimate seasonal and annual consumption rates, USGS will use species-specific bioenergetics models parameterized for Bull Trout (Mesa et al. 2013), Rainbow Trout (Rand et al. 1993), Brook Trout (Hartman and Sweka 2003, Hartman and Cox 2008), and Sculpin (Moss 2001, if discovered in the basin). Dolly Varden would be modeled using Bull Trout parameters.
- Bioenergetics models operate on a daily time step, so consumption estimates (g of each prey category eaten per day) can capture the seasonal dynamics of shifting diets, thermal experience and growth. Each age class of each species will be simulated separately to account for their unique combination of growth and consumption capacity, seasonal diet composition, and thermal experience. These age-specific seasonal consumption rates for each species will be expanded to standardized populations of 1,000 consumers by multiplying per capita consumption for each age by the relative proportion of each age class in the population, fitted to the observed size and age structure for that species (Beauchamp et al. 2007). This approach captures the major sources of variability due to seasonal and size-related diet, feeding, distribution, growth and abundance. From the perspective of the consumer's growth performance, this analysis will produce estimates for which prey contribute most to the annual energy budget for each life stage of each species, which seasons and prey groups support the majority of growth. From the perspective of predation impacts on prey species of concern, this approach will identify which species and size classes of predators impose significant predation on prey and how predation intensity varies among seasons. This information provides insight into conditions that potentially facilitate or interfere with predator-prey interactions and how changes in climate or water operations might influence trophic interactions that affect species of concern.

Task 2-Development of a Bioenergetics Model for Redside Shiner. Due to the importance of the thermal response of this species in terms of feeding rate, growth, and vertical distribution during thermal stratification and destratified periods, a species-specific model will be parameterized for Redside Shiners at WFRC. Mass- and temperature-specific functions for routine respiration costs and maximum consumption (Cmax) would be developed for Redside Shiners through a series of controlled experiments to encompass as much of the natural range of sizes (body mass: 0.1 g to 5-7 g) and ambient temperatures experienced (5-27^{o}C) across the natural range of the species. The specific methods for these experiments include:

- Live-capture as wide a range of age/size classes of Redside Shiners as possible and transport them for holding and experimentation at the USGS-WFRC lab in Seattle. Multiple age classes of Redside Shiners would be captured with dip nets or minnow traps from Ross Lake or Diablo Reservoir as early in the spring as possible. Supplemental sampling to obtain age-0 fish might occur later in the year, or ripe females might be artificially spawned and eggs fertilized on site, then transported to WFRC.
- Conduct a series of experiments for determining the temperature(s) associated with the maximum daily consumption rate (Cmax) of Redside Shiners from a commonly-available size (body mass held constant among temperature trials); the effect of a range of environmentally-relevant temperatures on Cmax (temperature-dependence of Cmax). Fish would be deprived of food for 24-h and acclimated in small test arenas (Volume = 1-4 L, depending on the size and number of individuals used per trial). Pilot feeding trials would determine whether fish could be tested individually versus in pairs or small groups if socialization with conspecifics is required to promote feeding. All subsequent feeding trials would then proceed using individuals or small groups, based on the outcome of these socialization trials. Fish would be fed a pre-weighed ad libitum ration of pre-thawed frozen krill or other invertebrate prey offered 3-5 times over a 24-h period. Remaining prey would be collected after each 24-h period, blotted dry and weighed to maintain an accurate accounting for prey eaten and prey remaining each day. Pilot trials will determine whether Cmax experiments can be limited to 24-h trials or need to run for several days due to biases created by binge feeding on day 1. For a subset of size classes, Cmax experiments will continue for 3-4 consecutive days to determine whether initial binge feeding is a concern. If not, then all other Cmax experiments will be limited to 24-h trials. If so, all Cmax experiments will be conducted as 3- or 4-consecutive day trials; day 1 would be excluded, and Cmax would only be computed from subsequent days when daily consumption stabilized at consistent ration levels among days.
- Conduct a series of experiments for determining the effect of body mass on Cmax at the temperature associated with the maximum daily consumption rate for Redside Shiners (weight-dependence of Cmax). At the temperature associated with maximum consumption within the pilot size class, repeat the Cmax experiments described above for at least five precisely graded body masses of Redside shiners ideally ranging from 0.1 g to 10.0 g.
- Conduct a series of experiments for determining routine respiration costs (R) as functions of body mass and temperature. Fish would be deprived of food for 24 h while acclimated in respirometry chambers. Respirometry trials would run for 24 h,

measuring initial and final DO concentrations within static sealed chambers or following protocols for scientific respirometers (Loligo Systems).

- Perform bomb calorimetry on a range of sizes of Redside Shiners to determine energy density (ED, J/g wet weight) as a function of body mass and proportion dry weight (pDW)

Task 3. Elemental Chemistry of tributary water and bony structures of fish for determining natal origins of native adfluvial salmonids- : Determine the feasibility of assigning natal streams of origin to adfluvial rainbow trout and native char captured in the reservoirs via comparison of geochemistry from tributary water samples with elemental analysis of fin rays, otoliths or other hard parts from fishes sampled in the reservoirs.

- Collect water samples from tributaries not previously sampled, specifically tributaries likely to contribute to the native charr population. This would ideally include parts of the watershed in Canada. Collection methods would follow the USGS National Field Manual for the Collection of Water-Quality Data (dirty hands/clean hands) protocol to minimize contamination and would include quality control samples (blanks and duplicates). Water samples would be filtered and acidified within 24 hours to stabilize the chemical and biological components. They will then be analyzed through a third party source for a suite of trace elements, as well as strontium isotope ratios, all of which have the potential for incorporation into the target fish hard parts.
- Analyze the water chemistry results to determine if differences occurring among the tributaries are significant enough to characterize unique signatures per tributary or geographic region. These signatures could then be used to assign fish of unknown origin to a tributary or geographic region of origin.
- Collect fish hard parts non-lethally (fin rays) or from mortalities (otoliths, fin rays) for analysis by laser-ablation inductively coupled mass spectrometry (LA-ICPMS). The chemical signature corresponding to the early life history of each fish would be used to assign the fish to a tributary or geographic region of origin.
    - Collect fin rays in the field, as described previously, from sampled fish prior to release, along with the usual fish size information. In the case of mortalities, the whole fin can be collected. as well as otoliths.
    - Process fin rays or otoliths in the lab by cleaning, embedding in resin and sectioning them. Fin ray sections and whole otoliths will be polished and mounted on a microscope slide with other samples in preparation for microchemical analysis. Ages can be determined at the time of processing.
    - If sufficient variation in water chemistry exists among locations, LA-ICPMS techniques will be applied to determine the amount of each element of interest (including Mg, Ca, Mn, Sr, Ba and others) present in the fin ray or otolith section corresponding to early development.
    - If strontium isotopes show sufficient variation among locations, LA-ICPMS techniques will be applied along with a multi-collector to determine the 87Sr/86Sr ratios present for each fish in the fin ray or otolith section corresponding to earlydevelopment.
    - Analyze the resulting chemical data from the hard parts for a natal chemical signature on each fish and see if it matches a water chemistry signal from a

known location. The certainty around fish-location assignments will then be determined.

Task 4 Tributary production capacity-Continuance of 2018 studies into the production capacity of select tributary habitats for targeted species will continue by completing analyses of ground truthing of NetMap DEM virtual watershed data and then application of ensemble IP models of adfluvial species. Also, preliminary data collected on invertebrate drift, stream temperatures, and fish size and age data will be processed, and needs for additional sampling will be assessed for 2019-2020 field endeavors. If additional field sampling is to be conducted, we propose additional electrofishing surveys at selected lower portions of tributaries, downstream of any stream barriers or distributions as determined by the 2018 field reconnaissance and eDNA surveys **(Table 1)**. These efforts of electrofishing and drift sampling will be coordinated with fish hybridization surveys discussed in task 5 below. In consultation with SCL and NOCA, we will select specific tributaries for bioenergetics analysis of growth potential for specific species and life stages of salmonids to provide insights into whether temperature or food supply limit production, and which seasons and life stages are associated with limitation (e.g., Lowery and Beauchamp 2015; Thompson and Beauchamp 2014, 2016). this past year we were able to collect sufficient numbers of Native Char and Rainbow trout in the areas where we were electrofishing (i.e., Canyon Creek (lower and middle) and Lightning Creek (lower only).

TASK 5- Follow-on eDNA sampling will be conducted to increase the basin-wide eDNA coverage for Rainbow Trout, Bull Trout, Brook Trout, Dolly Varden, Cutthroat Trout, Brown Trout, Redside Shiner, and sculpin (Cottus spp) in tributaries. Tributaries for eDNA sampling will be identified through consultation with managers and the results from Year-1 eDNA sampling may also be used to inform on follow-on eDNA sampling. Sample collection will follow the methods used in Year-1. Briefly, within each tributary, three spatially stratified sample sites will be identified (lower, middle, and upper sections) and three 1-Liter water samples will be collected and filtered at each site. Negative control water samples (store purchased bottled water) will be included during each sampling day to ensure detection of field contamination. Filters will be stored in 95% ethanol. eDNA embedded on filters will be extracted following a standard protocol. Extracted eDNA will be interrogated for the presence/non-presence of target species using quantitative PCR (qPCR). qPCR on all samples will be run in triplicate to ensure detection of low quality and/or low quantity DNA. Negative controls (in-field and in-lab) will be included to ensure detection of contamination. A standard curve consisting of a 5 point serial dilution of a synthetic DNA target fragment will be used to determine the mtDNA copy number per 1 liter water sample. The presence/non-presence data will be used to generate maps showing the spatial distribution of target species.

Task 6- Hybridization among Charr and between Rainbow and Cutthroat Trout:
=Tributaries where hybridization will be studied will be determined through consultation with managers, reports, and using eDNA results from 2018. Within tributaries, sample sites will be spatially stratified (for example lower, middle, and upper sections) in order to sample across diverse habitats and species distributions. Sampling will consist of collecting 0.5 – 1.0 cm^2 fin clips (non-lethally) from 35 – 50 individuals at each sample site by using various methods, which may include electrofishing, hook-and-line, and netting. Fin tissue samples will be stored in 95% ethanol.

We propose to sub-contract Washington Department of Fish and Wildlife (WDFW) to perform genetic screening for hybridization among charr. WDFW has previously performed genetic analysis on charr from the upper Skagit River reservoirs and tributaries and continued involvement of WDFW in genetic screening of charr will be an asset. The genetic screening and hybridization analysis between Rainbow and Cutthroat Trout will be performed at WFRC using a suite of species-specific markers (approximately 8-9) that differentiate the species. Hybridization analysis will include estimating the frequency of hybrid and pure individuals sampled at each site, estimating admixture proportions and identifying the maternal lineage for each individual, and development of hybrid index plots that summarize the distribution of genotypes at each sample site.

Results/Deliverables and Timeline:
We will provide annual progress reports on all tasks in April each year via PowerPoint presentations. A final report will be drafted March 2021 for 1-month review by SCL and other designated stakeholders, feedback and revisions will be incorporated into the final report by June 2021. The report will be a series of manuscripts intended for submission to peer-reviewed journals with additional information presented in Appendices.

- Task 1: PowerPoint presentations annually on progress in April 2019, 2020, and 2021 for bioenergetics-based reservoir food web analysis. Analysis and modeling based on the 2-year sampling program will be completed during winter 2021 and reported as one or more journal manuscripts with supplemental appendices that will also serve as sections of the final report.
- Task 2: Bioenergetics parameter estimation, model development and application for Redside Shiner: Consumption experiments and analysis completed in 2019; respiration experiments conducted during 2019-2020, analysis in 2020, application of model for quantifying consumption of Redside Shiners will contribute to the food web analysis in Task 1. This task will result in 1-2 journal manuscripts that will also serve as sections of the final report.
- Task 3: A report assessing the feasibility of assigning natal streams of origin to adfluvial rainbow trout and native char captured in the reservoirs via comparison of geochemistry from tributary water samples with elemental analysis of fin rays, otoliths or other hard parts from fishes sampled in the reservoirs. An evaluation of whether sufficient variation in water chemistry exists among tributaries to feasibly identify natal streams by elemental analysis of fish hard parts would be rendered by November 2019. If feasible, then analysis of hard parts would proceed in 2020. The final report would present results on water chemistry, at a minimum, but if analysis proceeds past the initial feasibility evaluation, then the report would also include fish hard part chemistry and the degree of certainty in assigning fish to tributaries or geographic region based on those results.
- Task 4: A report of estimated spawning and rearing habitat and relative rearing capacity, for targeted species in selected tributaries in the upper Skagit River watershed will be presented as part of the PowerPoint presentations in April 2019, 2020, and 2021, and the final product will be sections of the final report in the form of 1-2 journal manuscripts plus supplementary appendices submitted March 2021.

- Task 5: Results from any additional eDNA sampling will be added to species distribution maps and delivered in 2020.
- Task 6: Reports detailing the dynamics of hybridization among charr species and between Rainbow and Cutthroat Trout will be delivered in 2021.
- Task 7: A detailed study plan for a full Reservoir Operations and Food Web Study that contains all the elements required by the FERC. This task will be performed jointly by SCL and USGS over a mutually agreed upon period.

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Table 1. Preliminary results for detection and non-detection of target species eDNA in tributaries of the upper Skagit reservoirs sampled in summer 2018. Sample locations are indicated for each tributary as L (lower section), M (middle section), U (upper section), and B (above barrier/suspected barrier). Sample locations where target species were detected are indicated by letter (L, M, U, and/or B) and non-detections indicated by minus sign (-).

	Rainbow trout	Bull Trout/Dolly Varden	Brook trout	Westslope cutthroat trout	Coastal cutthroat trout	Brown trout	Cottus
Big Beaver (L, M, U, B)	L	M	-	-	-	-	M
Little Beaver (L, M, U)	L, M, U	-	M	-	-	-	-
Silver (L, B)	L, B	L, B	-	-	-	-	-
Lightning (L, M, U, B)	L, M, U, B	L, M, U	-	L	-	-	-
Roland (L, B)	L, B	L	L	-	-	-	-
Canyon (L, M, U, B)	L, M, U	L, M, U	-	L, M, U	-	-	L, M
Granite (L, M, U, B)	L, M, U, B	M, U	-	L, M, U, B	-	-	-
Slate (L)	L	L	-	L	-	-	-
Panther (L)	L	L	-	L	-	-	-
Thunder (L, M, U)	L, M, U	L	L, M, U	-	-	-	-
Stetattle (L)	L	L	-	-	-	-	-

Attachment C – City of Seattle Direct Expense Guidelines

The City will reimburse the USGS at actual cost for expenditures that are necessary and directly applicable to the work required by this Agreement provided that similar direct project costs related to the contracts of other clients are consistently accounted for in a like manner. Such direct project costs may not be charged as part of overhead expenses.

The billing for other direct expenses specifically identifiable with this project shall be an itemized listing of the charges. Copies of the supporting documents shall be available to the City for inspection upon request. All charges must be necessary for the services provided under this Agreement.

Travel
The City will reimburse USGS at actual cost for travel expenses incurred. Travel arrangements for all Government staff will be made in accordance with the Federal Travel Rules and Regulations, whether arranged by USGS and funded using either appropriated funds or Agreement funds, or arranged and funded directly by Collaborator. In summary:

Airfare = Airfare will be reimbursed at the actual cost of the airline ticket. The City will reimburse for Economy or Coach fare only.

Meals = Meals will be reimbursed at the Federal Per Diem daily meal rate for the city in which the work is performed. Receipts are not required as documentation. The City will not reimburse for alcohol at any time.

Lodging = Lodging may be billed at the published Federal Per Diem daily lodging rate for the city in which the work is performed. If this method is used, receipts are not required for documentation.

Vehicle Mileage = Vehicle mileage will be reimbursed at the Federal Travel Regulation Mileage Rate in affect at the time the mileage expense is incurred.

Rental Car = Rental car expenses will be reimbursed at the actual cost of the rental. The City will only pay for the rental of "Compact" vehicles unless three or more persons are sharing one vehicle in which case a "Mid-sized" vehicle rental is acceptable.

Miscellaneous Travel (e.g. parking, rental car gas, taxi, shuttle, toll fees, ferry fees, etc.) = Miscellaneous travel expenses will be reimbursed at the actual cost incurred.