WSP Indicator Analysis for the Babine Lake Watershed:

Stream Crossing Density

Freshwater Atlas (FWA) Assessment Watersheds

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Note to reader:

These Wild Salmon Policy (WSP) habitat indicator assessment reports are intended as a coarse filter approach to identify watersheds that are potentially at risk of exceeding thresholds for four WSP habitat indicators (Road Density, Stream Crossing Density, Total Land Cover Alteration, and Riparian Disturbance). These reports present the results of GIS-based (Tier 1) methods for assessing the status of a particular freshwater aquatic habitat pressure indicator and determining the watershed indicator "risk" status by comparing the measured values to indicator benchmarks. Pressure indicators are identified by Canada's WSP as proactive measures of identifying potential impacts to salmon habitat within a watershed. Additional information on the WSP is available at https://www.pac.dfo-mpo.gc.ca/fm-gp/salmon-saumon/wsp-pss/ip-pmo/ip-smm-pmo-eng.html#assessment.

The analysis presented in this report was carried out using standardized provincial datasets and did not integrate field-based (Tier 2) information or industry datasets. The results are presented for informational purposes and are not intended to replace operational watershed assessments.

Acknowledgments

[Acknowledgements]

WSP Indicator Analysis for the Babine Lake Watershed

Pressure Indicator: Stream Crossing Density

Assessment Units: FWA Assessment Watersheds

Description of Pressure Indicator

Stream crossings at road intersections present potential barriers to fish passage as well as potential inputs of fine sediment into waterways and interruptions to natural flow regimes (Porter et al., 2019). Fish passage barriers interfere with or block access to upstream spawning or rearing habitats, and thereby decrease the total amount of available salmon habitat in a watershed (Pacific Salmon Foundation [PSF], 2020). The stream crossings indicator is used in this analysis to address the fish passage concern from stream crossings rather than sedimentation (this is addressed by the road density indicator) so stream crossing density is measured here as the number of stream crossings per kilometer of modelled salmon habitat, as opposed to a similar metric which is reported as stream crossings per watershed area. This approach was followed in order to maintain consistency with the methodology used by the PSF in the development of relative thresholds for the Skeena Region (PSF, 2020).

Study Area

The Babine Lake Watershed is situated in the interior of northwest BC and covers an area of 6,555 km^2 (Figure 1). Babine Lake is one of the largest natural lakes in BC and hosts an important salmon spawning and rearing habitat.

This report presents results for BC Freshwater Atlas (FWA) assessment watersheds within the Babine Lake Watershed. FWA assessment watersheds are mesoscale groupings of fundamental watersheds with a target size of between 2,000 ha and 10,000 ha (Province of BC, 2020). A reference map of the study area with FWA assessment watersheds identified is included in Appendix A.

Figure 1: The study area is indicated in red. The grey polygon indicates the outline of the Skeena River watershed.

Methodology

Data layers used to perform the spatial analysis include:

- Digital Road Atlas (BC Ministry of Land, Water and Resource Stewardship [MLWRS], 2024)
- Forest Tenure Road Section Lines (BC Ministry of Forests, 2024)
- Fish Habitat and Road Crossings Model (BC Ministry of Environment and Climate Change Strategy [MECCS], 2024)
- Freshwater Atlas Assessment Watersheds (BC MFLNRORD, 2019)

An updated roads layer was developed for the purposes of this analysis. Overlapping roads within the DRA and FTEN subsets were removed by applying a 30 m buffer to the DRA subset and selecting FTEN roads outside of the buffer. The extracted DRA and FTEN roads were then merged to produce the input roads dataset.

Stream crossing locations were computed through the intersection of the updated roads layer and the streams layer from the Fish Habitat and Road Crossings Model (BC MECCS, 2022). Stream crossings along railways from the crossings layer of the Fish Habitat and Road Crossings Model were added to complete the dataset. The stream crossings were filtered by fish habitat type, with crossings identified within accessible salmon habitat (i.e. with a gradient of less than or equal to 15% and no natural barriers preventing salmon access) retained for use in the stream crossing density analysis (Mount et al., 2011; Norris, 2022). The stream crossing data does not include any culvert information collected directly by the industry.

Modelled accessible salmon habitat length (km) was calculated using the streams layer from the Fish Habitat and Road Crossings Model (BC MECCS, 2022) filtered by accessible salmon habitat.

FWA assessment watersheds were used as assessment units for the stream crossing density analysis. The total number of stream crossings within the salmon habitat and the total length of the salmon habitat (km) was summed for each FWA assessment watershed. Stream crossing density (stream crossings/km of accessible salmon habitat) was calculated by dividing the total number of stream crossings by the length of modeled salmon habitat within each assessment unit. An overview of stream crossings within fish habitat for the study area is provided in Figure 2.

This analysis follows the methodology set out by the Pacific Salmon Foundation (2020) for stream crossing density with the addition of the intersection calculation using the more accurate updated roads dataset and allows for results comparison with the thresholds published by PSF based on the relative distribution of values across the Skeena Region (Porter et al., 2014). This approach differs from similar stream-crossing analysis

methodology (e.g. the BC Cumulative Effects Framework), which reports stream-crossing density based on watershed area (Provincial Aquatic Ecosystems Technical Working Group, 2020).

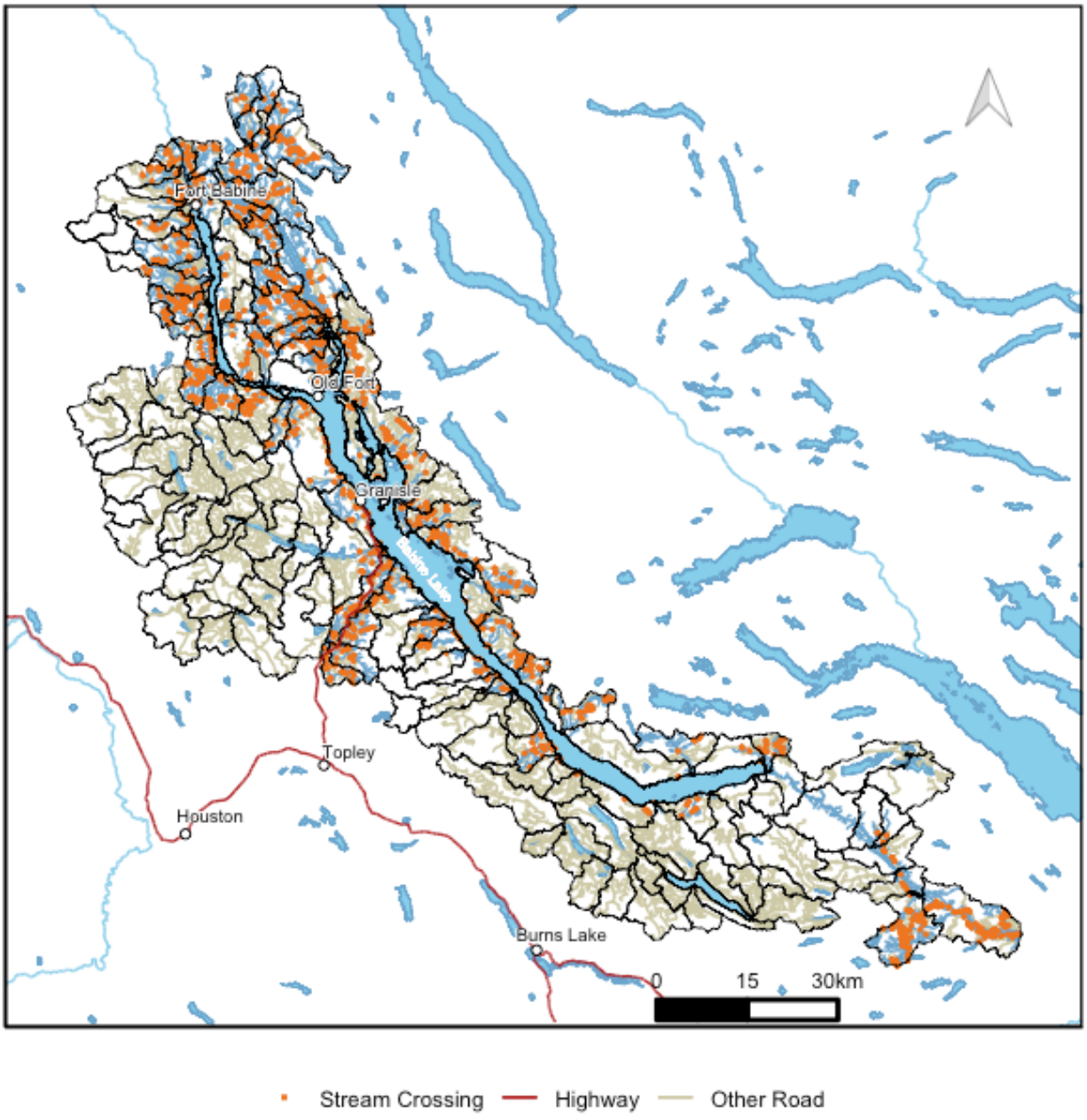

Figure 2: Stream crossings and modelled accessible salmon habitat within in the study area.

Risk Thresholds

Categorical risk thresholds applied were generated by the Pacific Salmon Foundation based on the relative distribution of values across all Skeena River watersheds (Porter et al., 2014) and are tabulated below:

Threshold Rating	Stream Crossing Density (crossings / km)
Low	< 0.20
Moderate	0.20 - 0.58
High	> 0.58

Results of Analysis

A summary of the results of the stream crossing density analysis with categorical risk thresholds for each assessment unit are shown in Figure 3; Figure 4 provides an overview of the results distribution. Detailed results for each assessment unit are tabulated in Appendix B, and the distribution of the assessment results are shown as a series of figures in Appendix C.

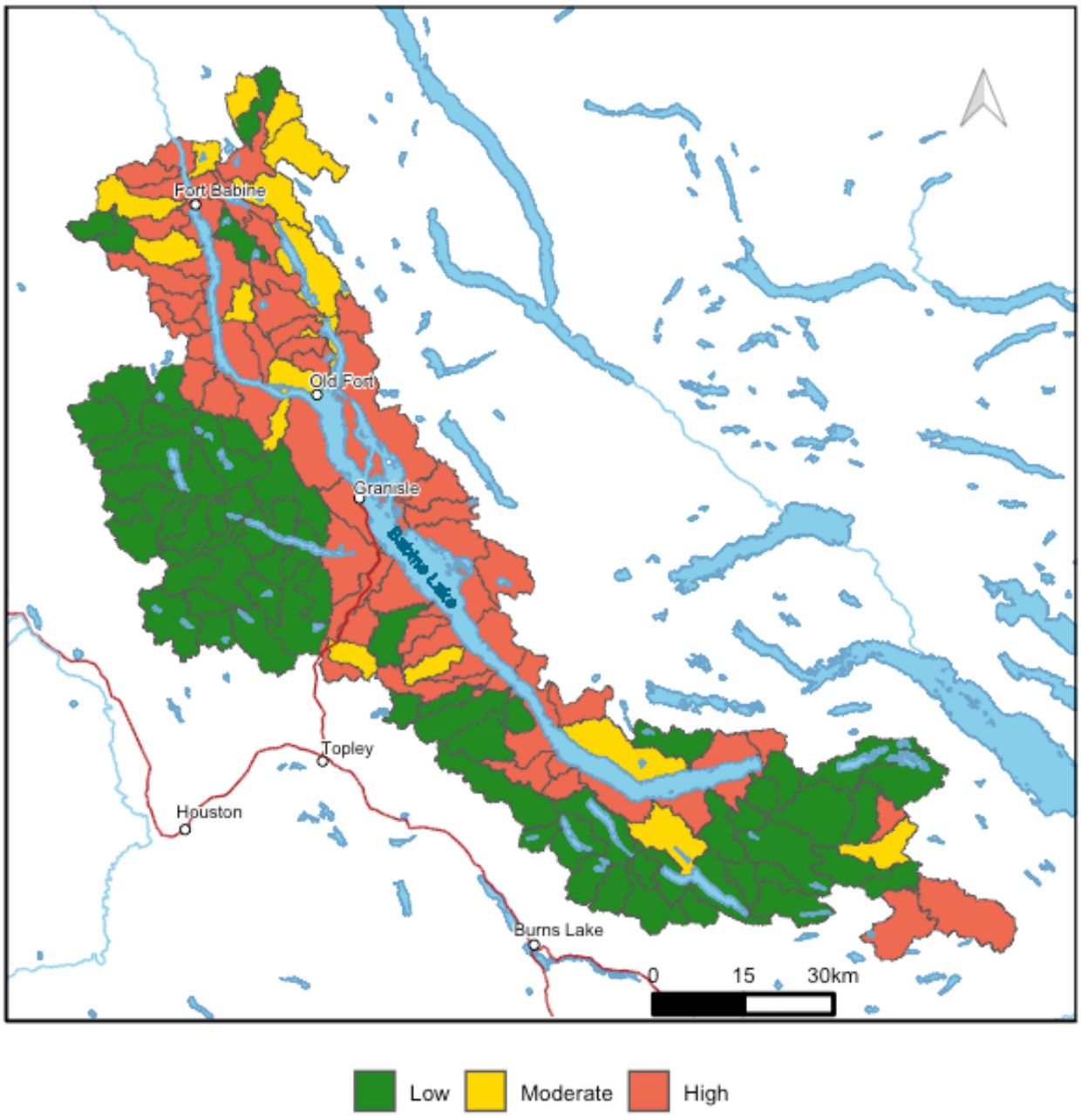

Figure 3: Stream crossing density (stream crossings/km) for each boundary in the study area is shown on a study area map. The results are colorized by risk threshold (low risk < 0.2 crossings/km, moderate risk 0.2-0.58 crossings/km, high risk > 0.58 crossings/km).

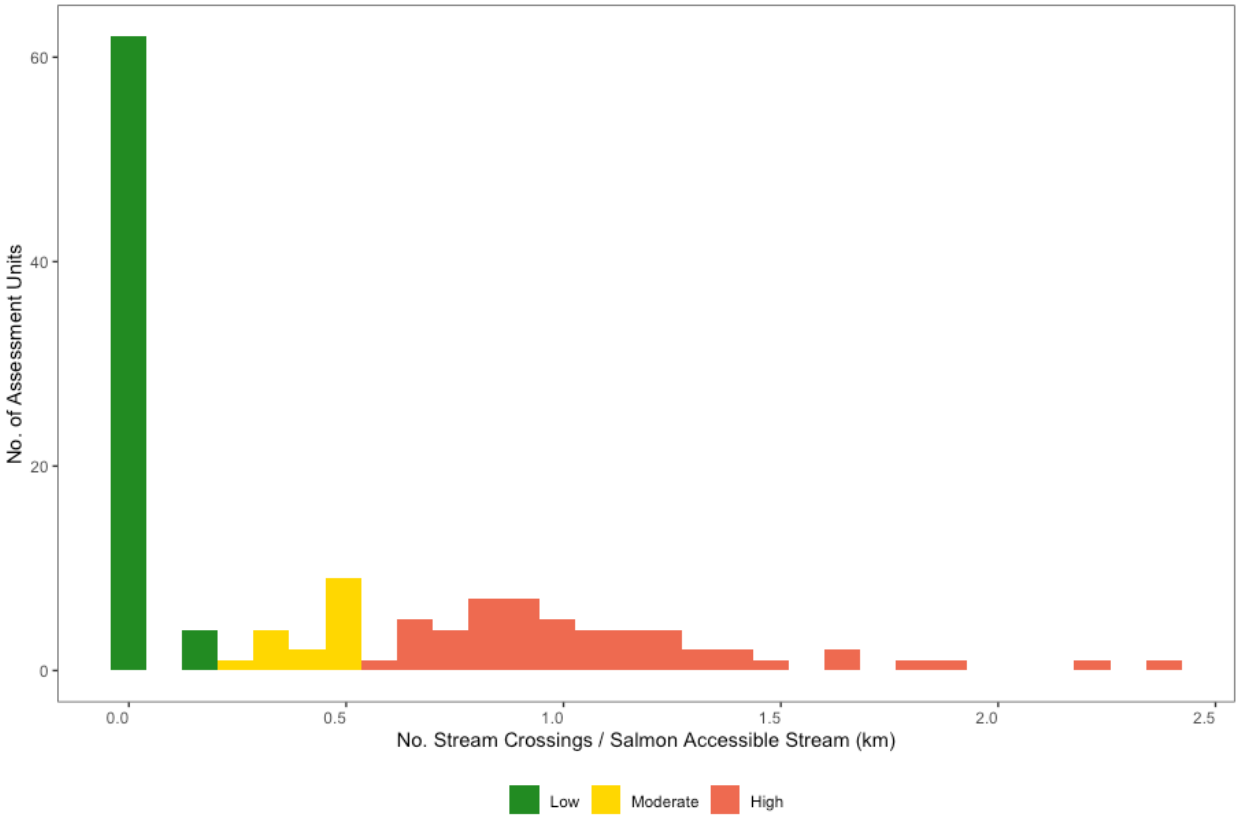

Figure 4: Distribution of results showing the number (count) of assessment units by stream crossing density. The results are colorized by risk threshold (low risk < 0.2 crossings/km, moderate risk 0.2-0.58 crossings/km, high risk > 0.58 crossings/km).

Stream crossing density of crossings situated within accessible salmon habitat was calculated for a total of 134 FWA watersheds within the study area. Stream crossing density ranged from 0 to 2.38 crossings/km (Figure 4). Stream crossing densities for 52 assessment units were above the upper threshold of 0.58 crossings/km and 16 assessment units had stream crossing densities in the moderate risk threshold rating (Figure 4; Appendix B and Appendix C).

The majority of assessment units with moderate and high stream crossing densities are concentrated in sub-watersheds with accessible salmon habitat adjacent to Babine Lake and Babine River (Figures 2 and 3).

Summary

Stream crossing density for FWA watersheds within the study area ranged from 0 to 2.38 crossings/km. Assessment units with stream crossing densities in the high and moderate risk range were concentrated in the central portion of the study area.

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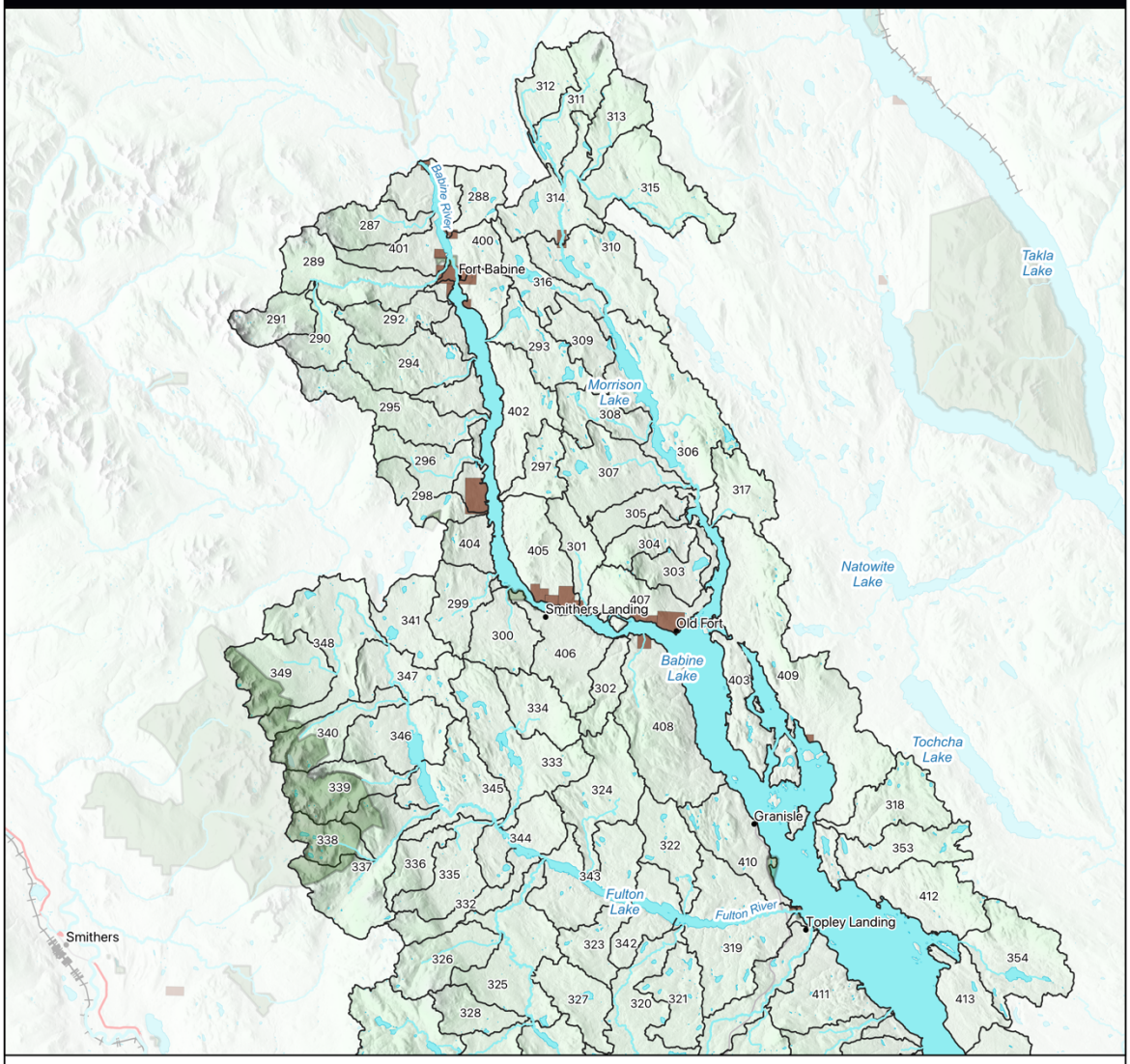
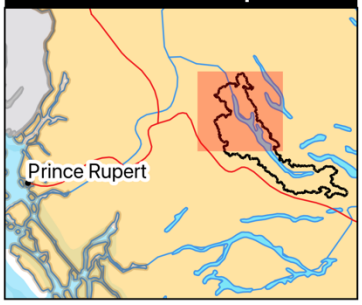
Appendix A: Reference Maps

Babine Lake Reference Map - Northwest



Location Map



Legend

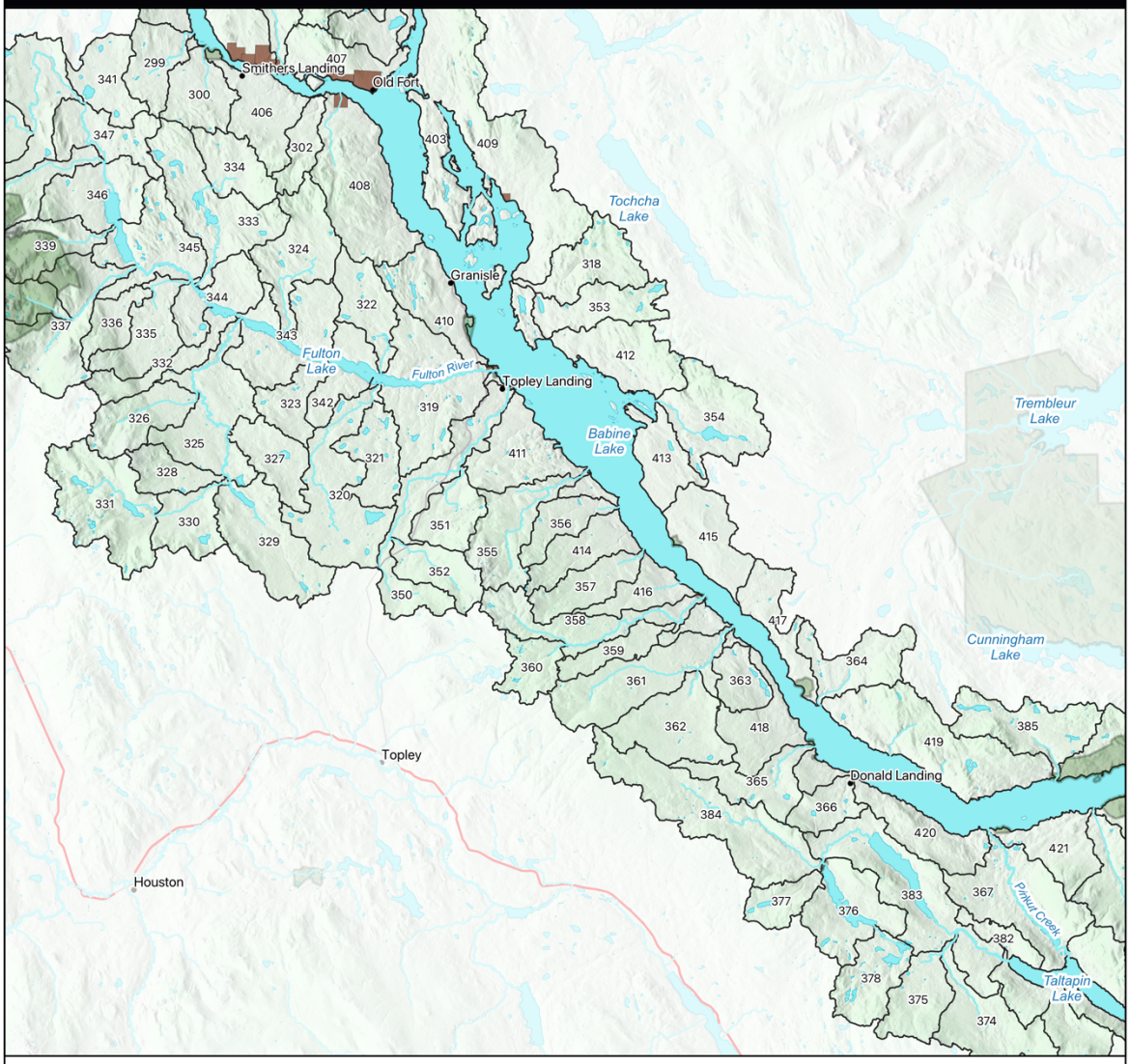
- FWA Assessment Watershed
- Park
- Reserve

0 10 20 km

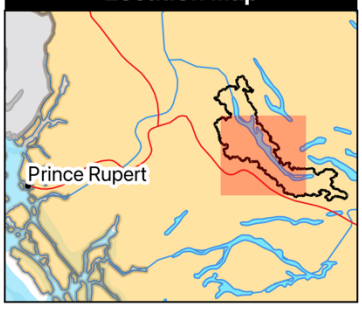
N W E S

Prepared by Eclipse Geomatics Ltd., May 2024

Babine Lake Reference Map - Centre



Location Map



Legend

- FWA Assessment Watershed
- Reserve
- Park

0 10 20 km

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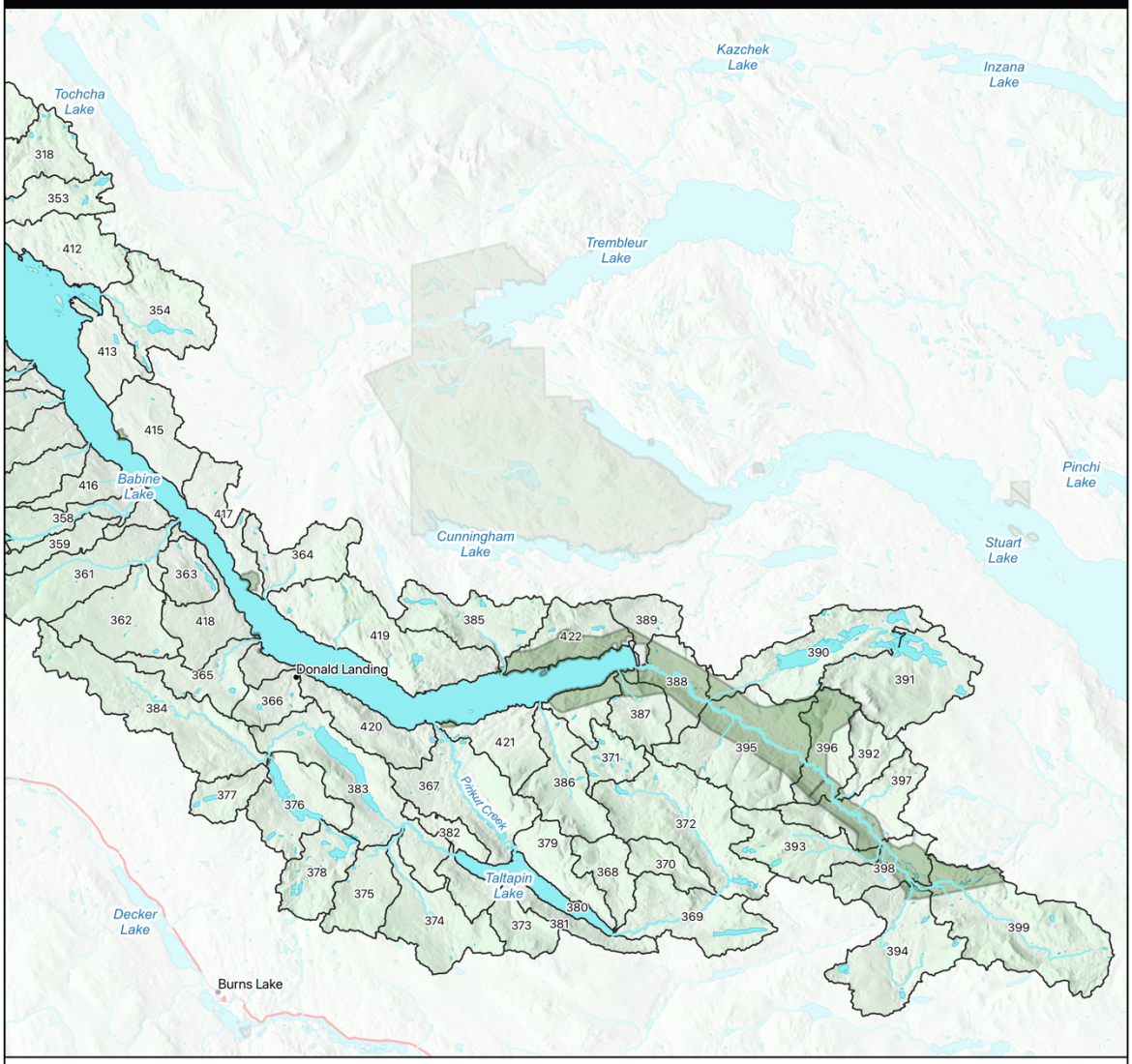
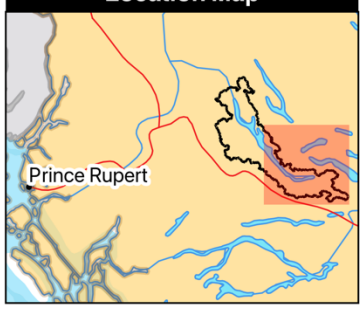
Prepared by Eclipse Geomatics Ltd., May 2024

Babine Lake Reference Map - Southeast



Location Map



Legend

- FWA Assessment Watershed
- Reserve
- Park

0 10 20 km

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Prepared by Eclipse Geomatics Ltd., May 2024

Appendix B: Results Tables

Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
287		23.77	29	1.22	High
288		30.05	15	0.50	Moderate
289	Tsezakwa Creek	16.15	8	0.50	Moderate
290		0.00	0	0.00	Low
291		0.00	0	0.00	Low
292	Heal Creek	23.55	26	1.10	High
293		1.02	0	0.00	Low
294	Five Mile Creek	75.02	36	0.48	Moderate
295		52.02	38	0.73	High
296		49.17	59	1.20	High
297		12.96	6	0.46	Moderate
298		27.98	24	0.86	High
299		62.31	74	1.19	High
300		55.45	51	0.92	High
301		40.92	25	0.61	High
302		24.94	9	0.36	Moderate
303		31.86	20	0.63	High
304		30.64	36	1.18	High
305		36.72	52	1.42	High
306	Morrison Creek	103.22	33	0.32	Moderate
307		98.76	90	0.91	High
308		56.50	46	0.81	High

Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
309		45.00	37	0.82	High
310	Tahlo Creek	97.16	38	0.39	Moderate
311		58.05	11	0.19	Low
312		41.01	12	0.29	Moderate
313		45.47	22	0.48	Moderate
314	Tahlo Creek	73.90	47	0.64	High
315	Tahlo Creek	102.18	50	0.49	Moderate
316	Haul Creek	54.62	43	0.79	High
317		23.36	34	1.46	High
318		17.46	23	1.32	High
319	Fulton River	28.75	21	0.73	High
320		0.00	0	0.00	Low
321		0.00	0	0.00	Low
322		0.00	0	0.00	Low
323	Nicholson Creek	0.00	0	0.00	Low
324	Broughton Creek	0.00	0	0.00	Low
325	Guess Creek	0.00	0	0.00	Low
326	Doray Creek	0.00	0	0.00	Low
327		0.00	0	0.00	Low
328	Betty Creek	0.00	0	0.00	Low
329		0.00	0	0.00	Low
330	Guess Creek	0.00	0	0.00	Low
331	Guess Creek	0.00	0	0.00	Low
332	Byron Creek	0.00	0	0.00	Low

Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
333	Tanglechain Creek	0.00	0	0.00	Low
334	Tanglechain Creek	0.00	0	0.00	Low
335	Bristow Creek	0.00	0	0.00	Low
336	Fink Creek	0.00	0	0.00	Low
337	McKendrick Creek	0.00	0	0.00	Low
338	Little Joe Creek	0.00	0	0.00	Low
339	Cronin Creek	0.00	0	0.00	Low
340	Nata Creek	0.00	0	0.00	Low
341	Bristol Creek	0.00	0	0.00	Low
342	Fulton River	0.00	0	0.00	Low
343	Fulton River	0.00	0	0.00	Low
344	Fulton River	0.00	0	0.00	Low
345	Fulton River	0.00	0	0.00	Low
346	Fulton River	0.00	0	0.00	Low
347	Fulton River	0.00	0	0.00	Low
348	Fulton River	0.00	0	0.00	Low
349	Fulton River	0.00	0	0.00	Low
350	Tachek Creek	102.78	113	1.10	High
351		43.02	31	0.72	High
352	Strimboldh Creek	44.34	22	0.50	Moderate
353		26.22	30	1.14	High
354	Big Loon Creek	56.12	51	0.91	High
355		4.01	0	0.00	Low

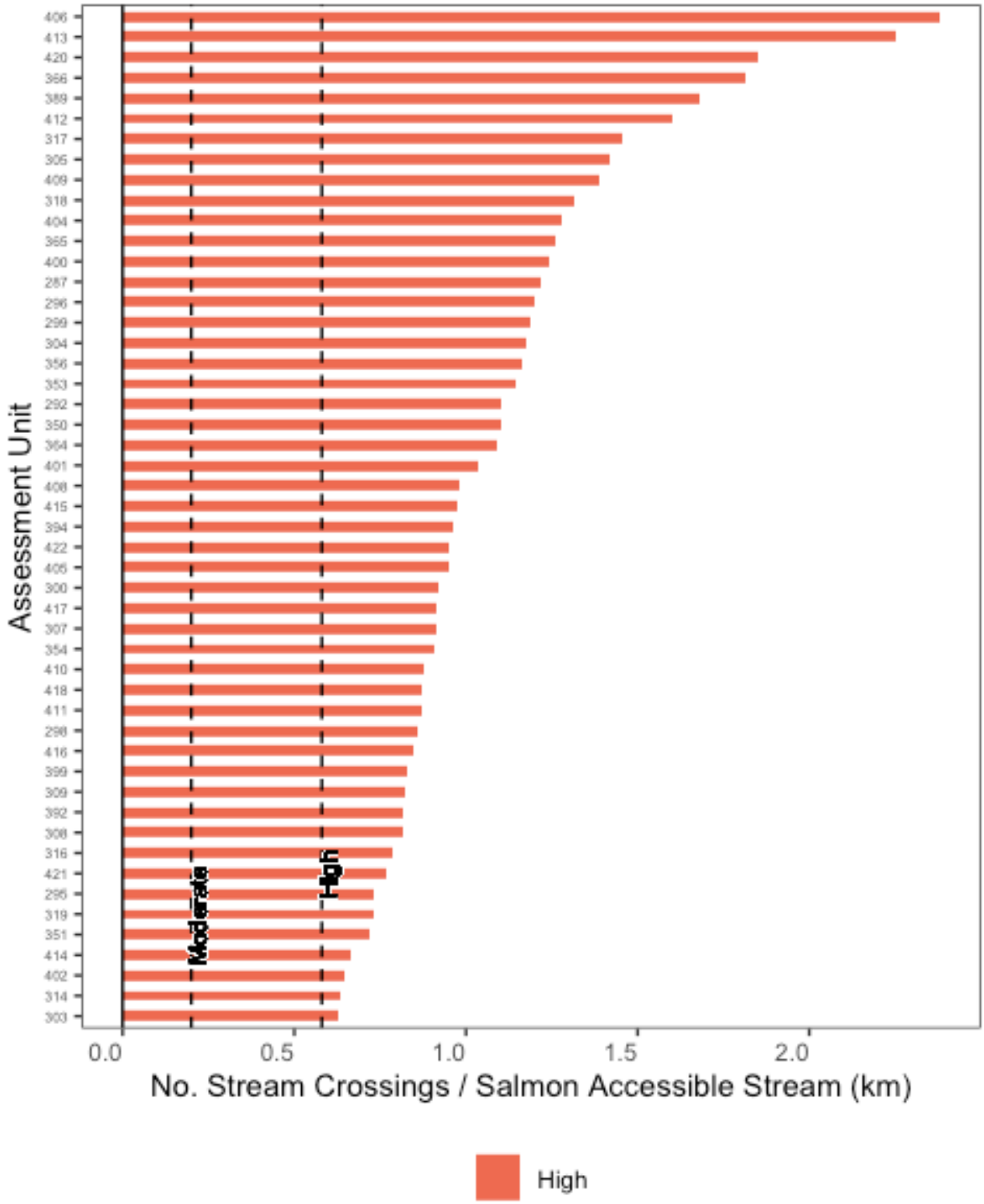
Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
356		26.59	31	1.17	High
357		11.55	3	0.26	Moderate
358	Pierre Creek	9.62	6	0.62	High
359		0.00	0	0.00	Low
360		0.00	0	0.00	Low
361	Twain Creek	2.86	0	0.00	Low
362		0.00	0	0.00	Low
363		0.23	0	0.00	Low
364		44.89	49	1.09	High
365	Cross Creek	1.59	2	1.26	High
366	Donalds Creek	2.20	4	1.82	High
367	Pinkut Creek	2.54	1	0.39	Moderate
368	Marlin Creek	0.00	0	0.00	Low
369	Henrietta Creek	0.00	0	0.00	Low
370	Coldwater Creek	0.00	0	0.00	Low
371		0.00	0	0.00	Low
372	Henrietta Creek	0.00	0	0.00	Low
373		0.00	0	0.00	Low
374		0.00	0	0.00	Low
375		0.00	0	0.00	Low
376		0.00	0	0.00	Low
377		0.00	0	0.00	Low
378	Ling Creek	0.00	0	0.00	Low

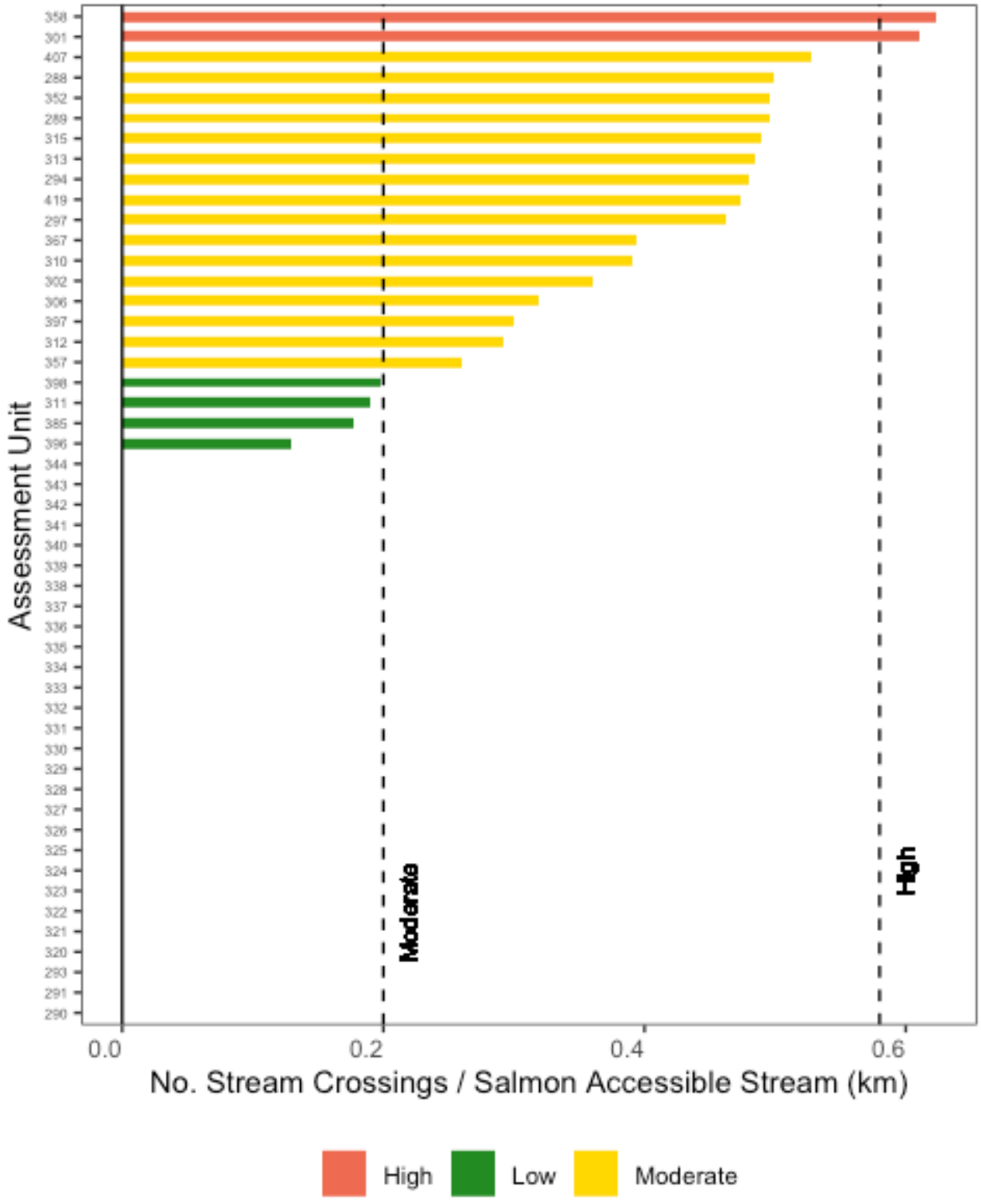
Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
379	Pinkut Creek	0.00	0	0.00	Low
381		0.00	0	0.00	Low
382	Pinkut Creek	0.00	0	0.00	Low
383	Pinkut Creek	0.00	0	0.00	Low
384	Pinkut Creek	0.00	0	0.00	Low
385	Gullwing Creek	56.67	10	0.18	Low
386	Four Mile Creek	1.68	0	0.00	Low
387		0.80	0	0.00	Low
388	Sutherland River	25.36	0	0.00	Low
389		28.57	48	1.68	High
390	Shass Creek	1.36	0	0.00	Low
391	Shass Creek	0.00	0	0.00	Low
392		9.81	8	0.82	High
393		2.21	0	0.00	Low
394	Duncan Creek	140.30	135	0.96	High
395	Sutherland River	48.80	0	0.00	Low
396	Sutherland River	31.07	4	0.13	Low
397	Sutherland River	39.94	12	0.30	Moderate
398	Sutherland River	35.47	7	0.20	Low
399	Sutherland River	155.43	129	0.83	High
400	Babine River	43.45	54	1.24	High
401	Babine River	45.48	47	1.03	High

Assessment Unit	Sub-Watershed Name	Salmon Accessible Stream Length (km)	Stream Crossings	Stream Crossing Density (Crossings per km)	Risk
402		38.69	25	0.65	High
404		56.36	72	1.28	High
405		24.17	23	0.95	High
406		24.78	59	2.38	High
407		26.55	14	0.53	Moderate
408		48.87	48	0.98	High
409		119.03	165	1.39	High
410		49.19	43	0.87	High
411		51.60	45	0.87	High
412		29.96	48	1.60	High
413		11.98	27	2.25	High
414		27.10	18	0.66	High
415		45.17	44	0.97	High
416		27.24	23	0.84	High
417		32.77	30	0.92	High
418		43.55	38	0.87	High
419		8.45	4	0.47	Moderate
420		4.33	8	1.85	High
421		20.83	16	0.77	High
422		8.39	8	0.95	High

Appendix C: Results Distribution

Results are colourized by risk threshold (low risk < 0.2 crossings/km, moderate risk 0.2-0.58 crossing/km, high risk > 0.58 crossings/km).




Assessment Unit
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Moderate
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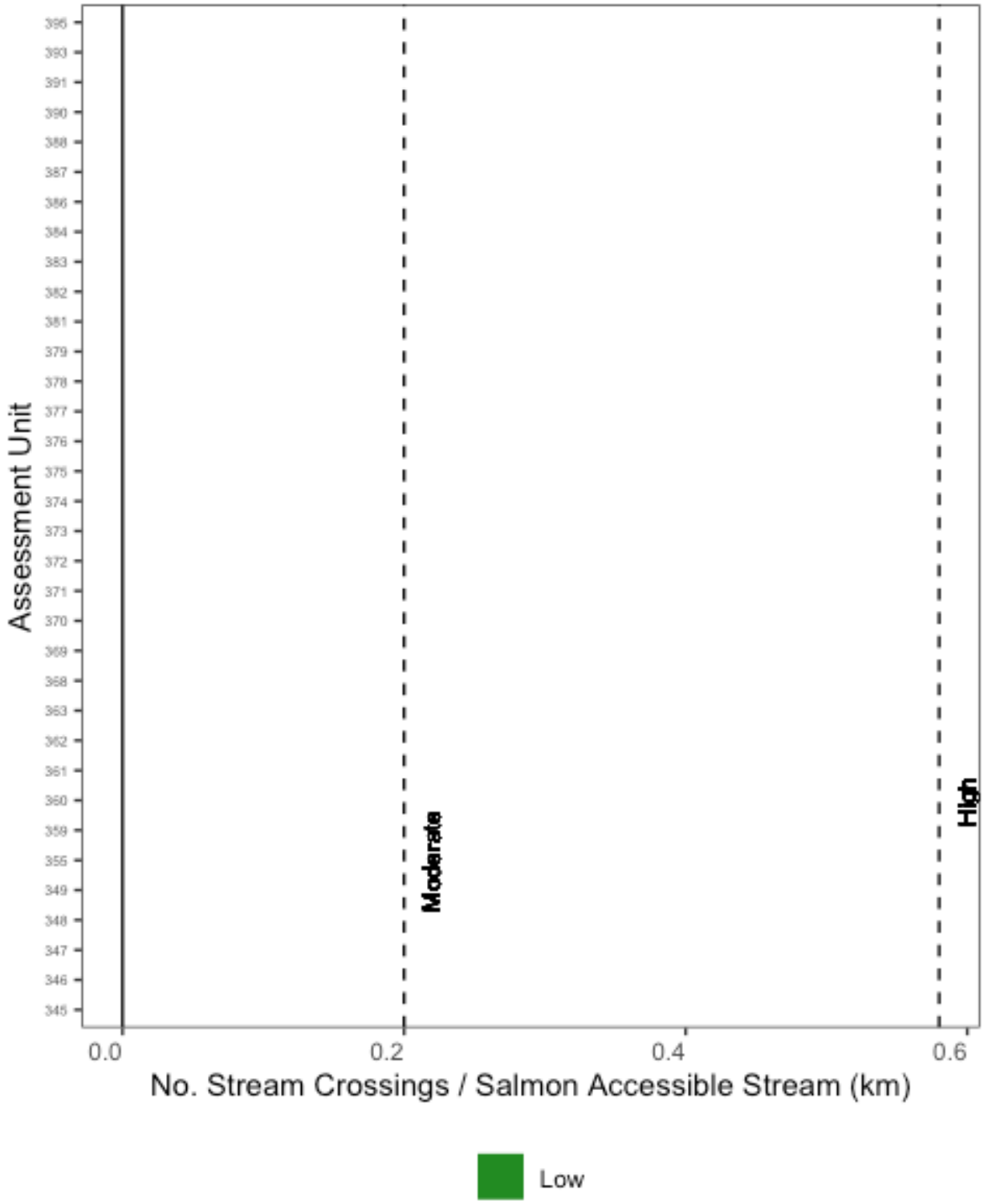
No. Stream Crossings / Salmon Accessible Stream (km)
High
Low
Moderate


Assessment Unit
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Moderate
High
0.0
0.2
0.4
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No. Stream Crossings / Salmon Accessible Stream (km)
Low