WSP Indicator Analysis for the Kispiox TSA:

Stream Crossing Density

Interior Watershed Assessment Protocol (IWAP) 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 the 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.

Acknowledgements

We would like to thank Sarah Railton, Greg Knox, and Julia Hill Sorochan for their contributions and feedback, and to Glen Buhr for his assistance and guidance.

WSP Indicator Analysis for the Kispiox TSA

Pressure Indicator: Stream Crossing Density

Assessment Units: IWAP 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 and intercepted flow (Porter et al., 2019). Open-bottom structures, such as bridges and some larger culverts, typically retain or emulate natural stream channel morphology and fish habitat, whereas smaller closed-bottom structures (CBS), such as culverts (corrugated metal pipes), often do not. The change to stream morphology created by installation of a CBS often creates a barrier to fish passage (Mount et al., 2011). The stream crossings indicator is used to address the fish passage concern rather than sedimentation (this is addressed by the road density indicator) and so stream crossing density is only reported for CBS within observed or inferred fish habitat areas (Stalberg et al., 2009). Stream crossing density is measured as crossings per square kilometer (km^2), and is related to road development, which has been ranked as a high value indicator by the Wild Salmon Policy (WSP) Habitat Working Group (Stalberg et al., 2009).

Study Area

The Kispiox timber supply area (TSA) is situated in the interior of northwest BC and encompasses the District of New Hazelton and the communities of Hazelton, South Hazelton, Kitwanga, Cedarvale, Kispiox, Gitsegukla, Gitwangak, Gitanyow, Hagwilget, Glen Vowell and Gitanmaax (Figure 1). The Kispiox TSA is part of the Skeena Natural Resource Region and is administered by the Skeena Stikine Natural Resource District office in Smithers.

The Kispiox TSA is comprised of seven TSA supply blocks (12A to 12G), with the Cranberry TSA consolidated with the Kispiox TSA on March 31, 2009 as Block 12G. The current allowable annual cut for the Kispiox TSA is 1,087,000 cubic metres (Province of BC, 2019).

This report presents results for Interior Watershed Assessment Protocol (IWAP) watersheds within the Kispiox TSA and the neighbouring upper Kispiox River and Swan Lake watersheds. The IWAP watersheds are primarily fourth order historical assessment watersheds delineated by the Kispiox Expert Water Panel and used as reporting units for 2004-2019 watershed assessment and monitoring projects (BC Ministry of Environment and Climate Change Strategy [BC MECCS], 2004). Reporting watershed assessment results by IWAP watershed allows for continuity and comparison with historical results. Reference maps showing the study area with Kispiox TSA and IWAP boundaries are included as 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:

- Kispiox Road Inventory (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development [BC MFLNRORD], 2017)
- Digital Road Atlas (BC MFLNRORD, 2020a)
- Forest Tenure Road Section Lines (BC MFLNRORD, 2020b)
- Fish Habitat and Road Crossings Model (BC MECCS, 2019)
- IWAP Watersheds (BC MECCS, 2004)

The Kispiox Road Inventory data layer was developed by BC MFLNRORD Skeena-Stikine District staff using information sourced from provincial TRIM base mapping, the Digital Road Atlas (DRA), Forest Tenure Road Section Lines (FTEN), and major licensee digital road files. The dataset was refined using best available orthophoto and satellite imagery and non-existent roads were removed (e.g. phantom duplicate or parallel road sections and planned roads that were never constructed) while deactivated roads were left in the data set (G. Buhr, personal communication, October 15, 2020).

An updated roads layer was developed for the purposes of this analysis by adding new (post-2017) road segments from the DRA and FTEN data layers that do not appear in the Kispiox Road Inventory. These additional segments were extracted from the 2020 DRA and FTEN datasets by applying a buffer of 30 m to the Kispiox Road Inventory and selecting DRA and FTEN roads outside of this buffer added since 2017. 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 with the Kispiox Road Inventory to produce the input roads dataset.

Stream crossings were computed through the intersection of the updated Kispiox Road Inventory and Fish Habitat and Road Crossings Model (BC MECCS, 2019) data layers. The crossings were compared with the stream crossings in the Fish Habitat and Road Crossings Model in order to categorize the crossings as closed-bottomed structures (culverts) or open crossings, where open crossings consist of all points that are likely bridges or other open-bottomed structures (Norris and Mount, 2016). Where intersection points did not overlap with the reference data sets, points falling on single-lined streams were classified as culverts and points falling on double-lined streams as open crossings, following the methodology of Norris and Mount (2016). Stream crossings along railways from the Fish Habitat and Road Crossings Model were added to complete the dataset. The stream crossing data does not include any culvert information collected directly by industry.

Prior to analysis, the culvert crossings were filtered by fish habitat type, with crossings identified within observed or inferred salmon habitat (i.e. with a gradient of less than or equal to 15%) retained for use in the stream crossing density analysis.

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 Kispiox Road Inventory dataset.

IWAP watersheds were used as assessment units for the stream crossing density analysis. The total number of CBS (culverts) within observed or inferred salmon habitat was summed for each assessment unit. Stream crossing density (CBS crossings/km^2) was calculated by dividing the total number of CBS crossings by the area of each assessment unit. An overview of culverts within fish habitat and all open stream crossing locations for the study area is provided as Figure 2.

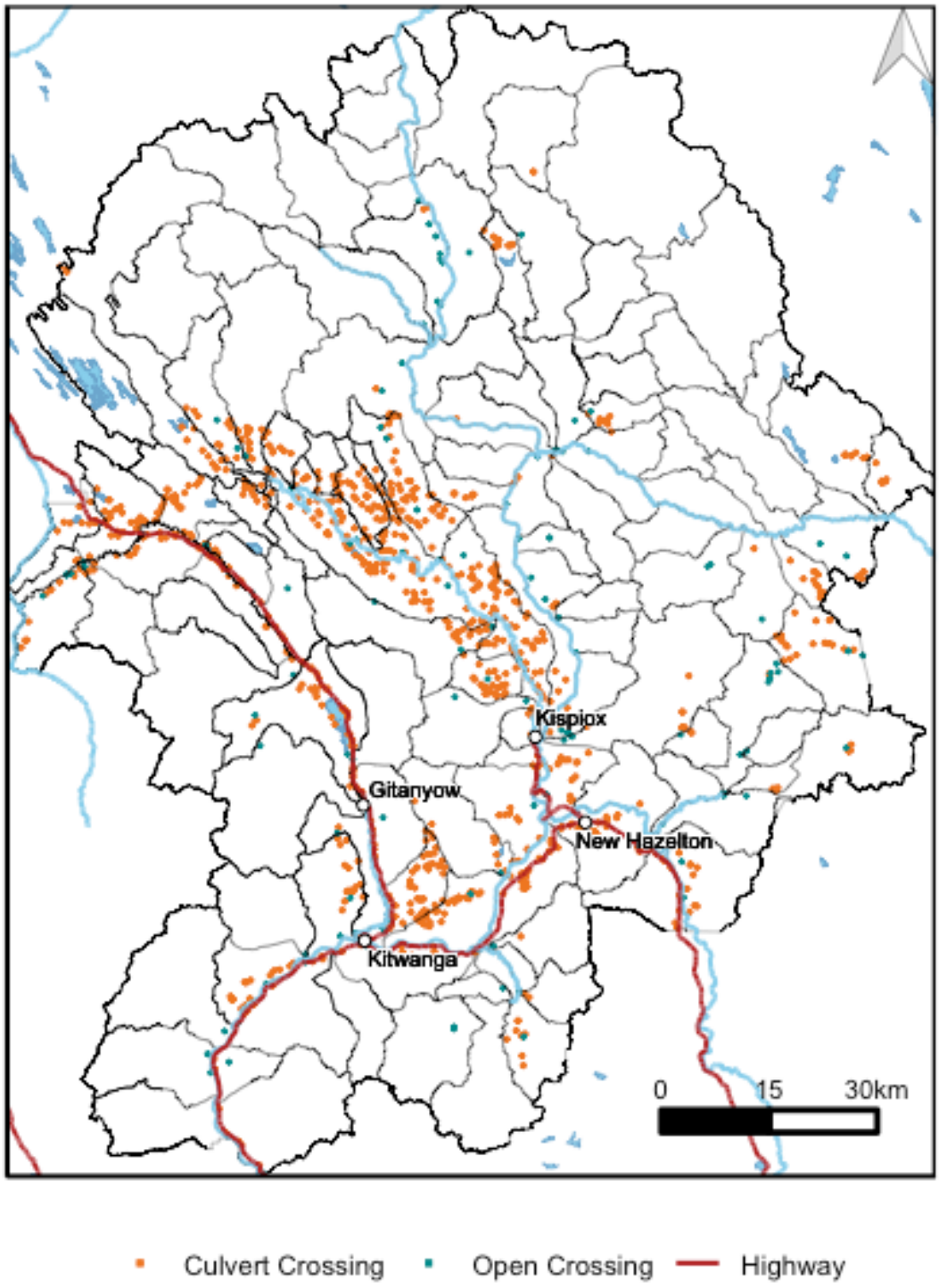

Figure 2: Stream crossings located within in the study area are shown, with closed-bottom (culvert) stream crossings within observed or inferred salmon habitat shown in red and open-bottom crossings (primarily bridges) shown in green.

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 / km²)
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 as 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.

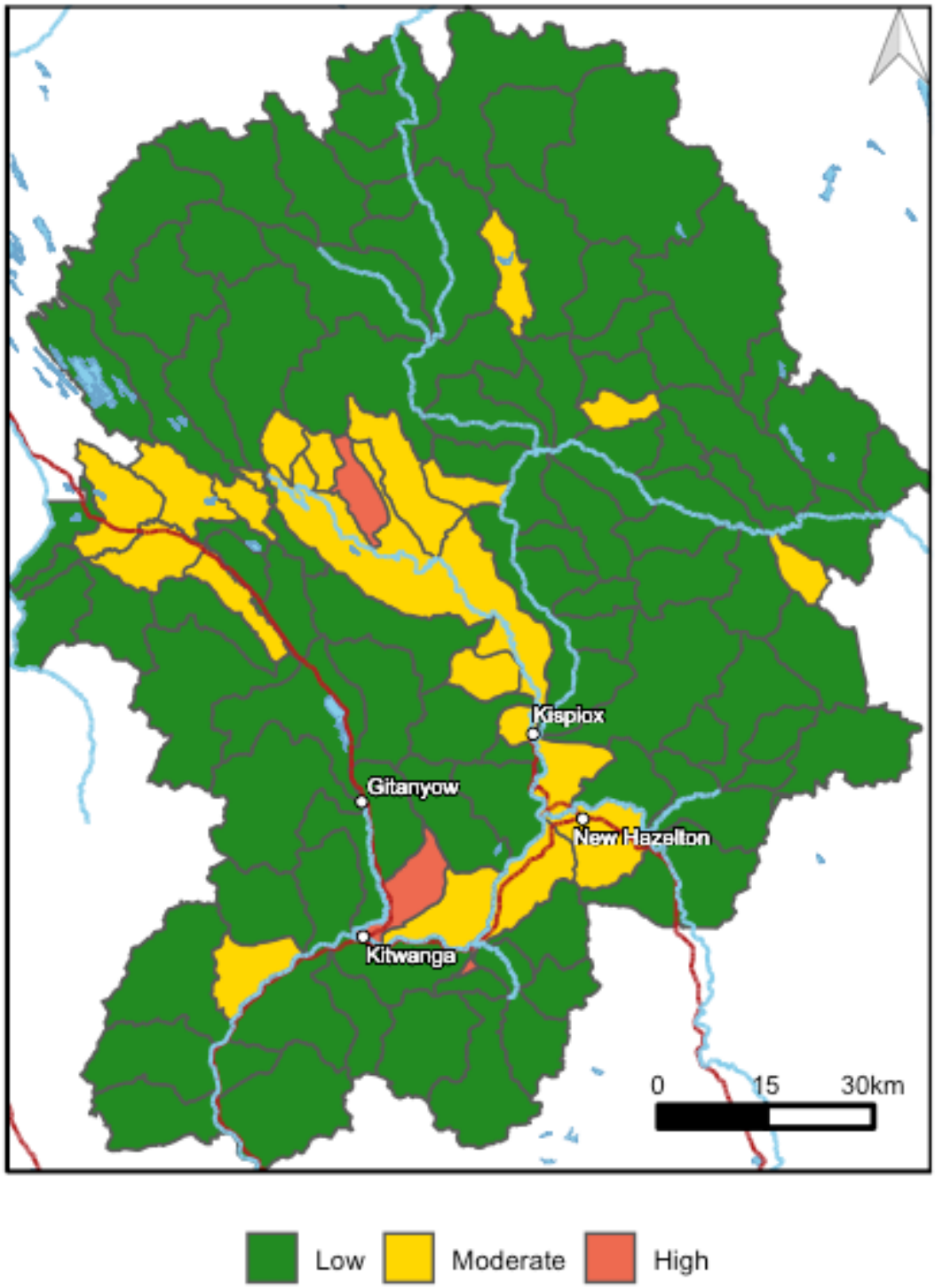

Figure 3: CBS stream crossing density (CBS crossings/km^2) for each boundary in the study area is shown on a study area map. The results are colorized by risk threshold (low risk < 0.2 crossings/km^2, moderate risk 0.2-0.58 crossing/km^2, high risk > 0.58 crossings/km^2).

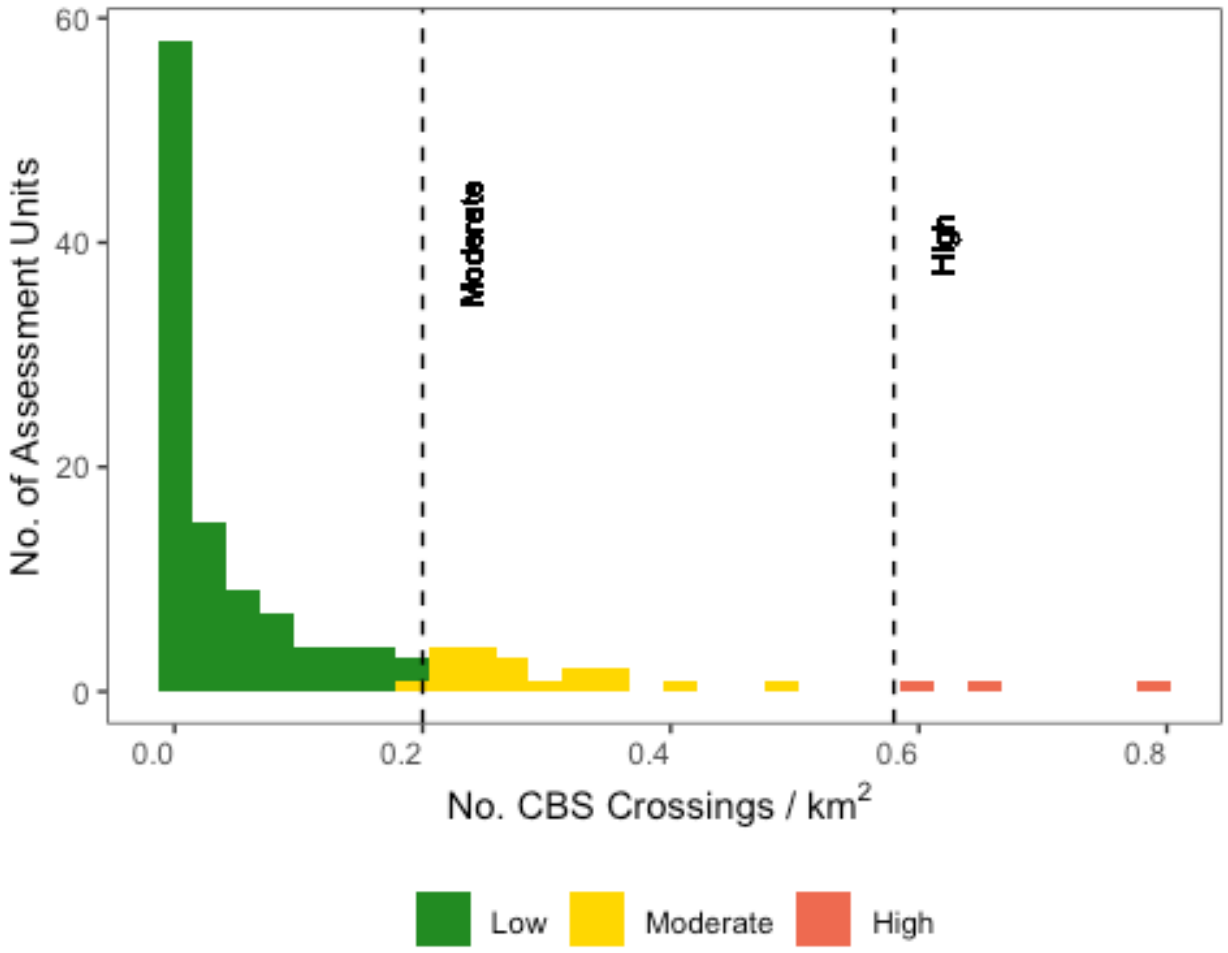

Figure 4: Distribution of results showing the number (count) of assessment units by CBS stream crossing density. The results are colourized by risk threshold (low risk < 0.2 crossings/km^2, moderate risk 0.2-0.58 crossing/km^2, high risk > 0.58 crossings/km^2).

Stream crossing density of CBS (culverts) was calculated for a total of 125 IWAP watersheds within the study area. Stream crossing density ranged from 0 to 0.79 crossings/km^2 (Figure 4). Stream crossing densities for three assessment units were above the upper threshold of 0.58 crossings/km^2 and nineteen 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 the central portion of the study area (Figures 2 and 3).

Interactive visualizations of the indicator analysis results calculated as part of the Kispiox TSA WSP Indicator Analysis are available at https://data.skeenasalmon.info/dataset/wild-salmon-policy-indicator-analysis-for-the-kispiox-tsa.

Summary

Stream crossing density estimations were calculated for 125 IWAP watersheds within the Kispiox TSA and adjacent Swan Lake and upper Kispiox River sub-watersheds using datasets sourced from the Province of BC. Risk categories derived by the Pacific Salmon Foundation were used to assess risk to freshwater habitat from stream crossings.

Stream crossing density of CBS for IWAP watersheds within the study area ranged from 0 to 0.79 crossings/km^2, with three assessment units at high and 19 assessment units at moderate risk of impacts from fish passage obstruction.

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Appendix A: Reference Maps

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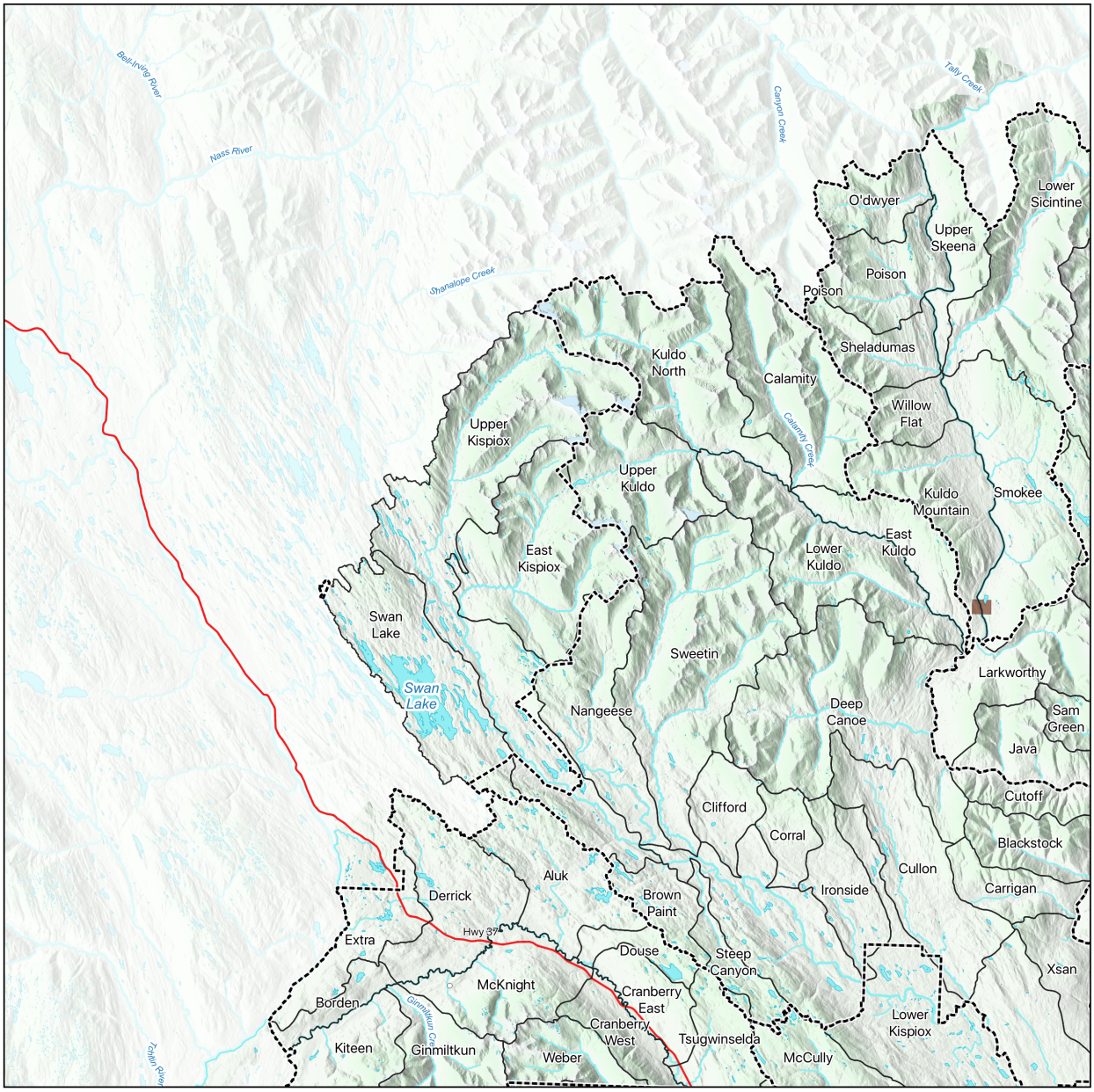
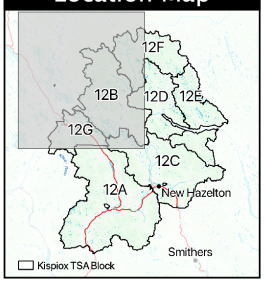
Kispiox Study Area Reference Map - Northwest



Location Map



Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

N
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Prepared for SkeenaWild
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June 2020

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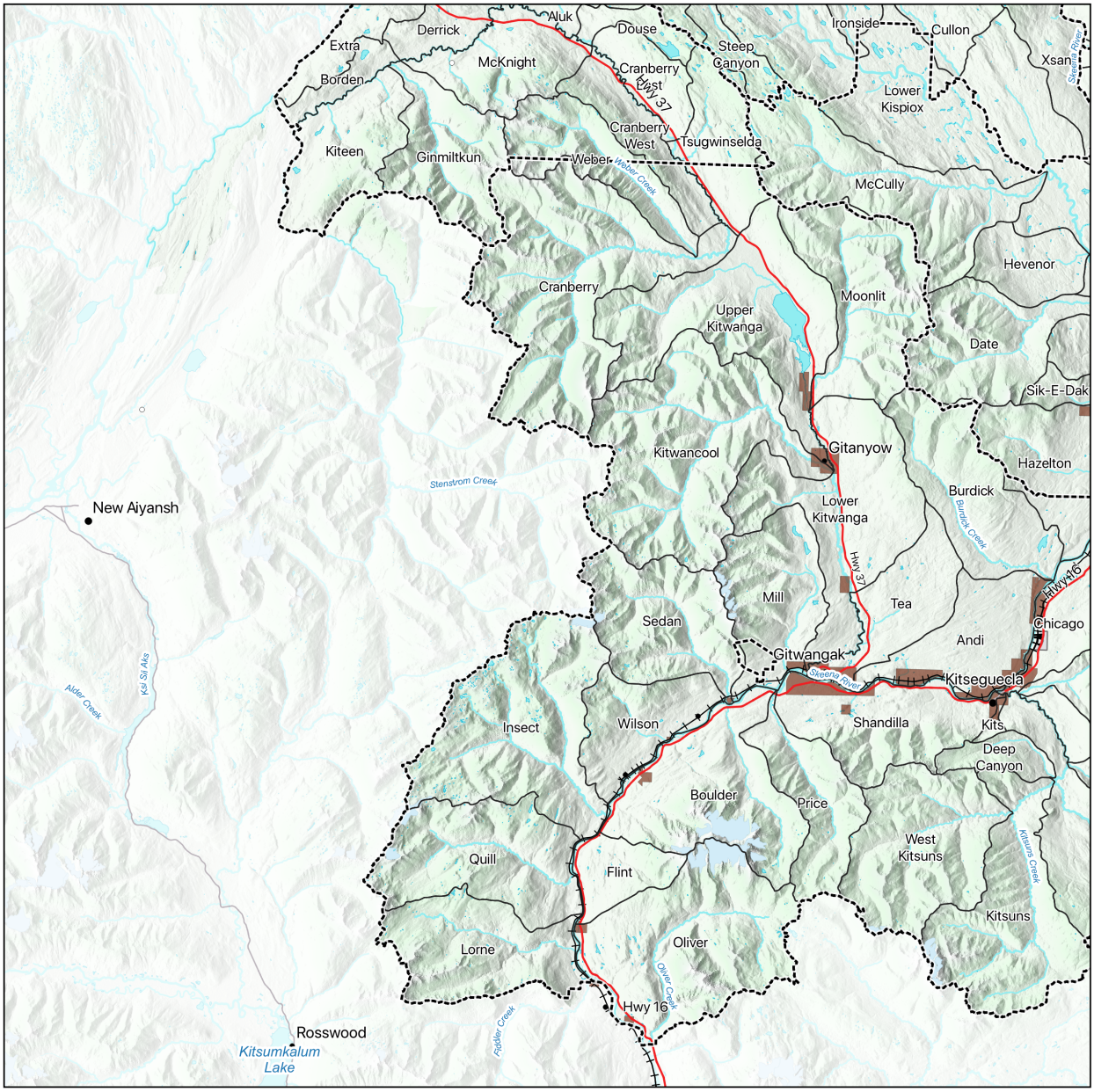
Kispiox Study Area Reference Map - Southwest



Location Map

Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

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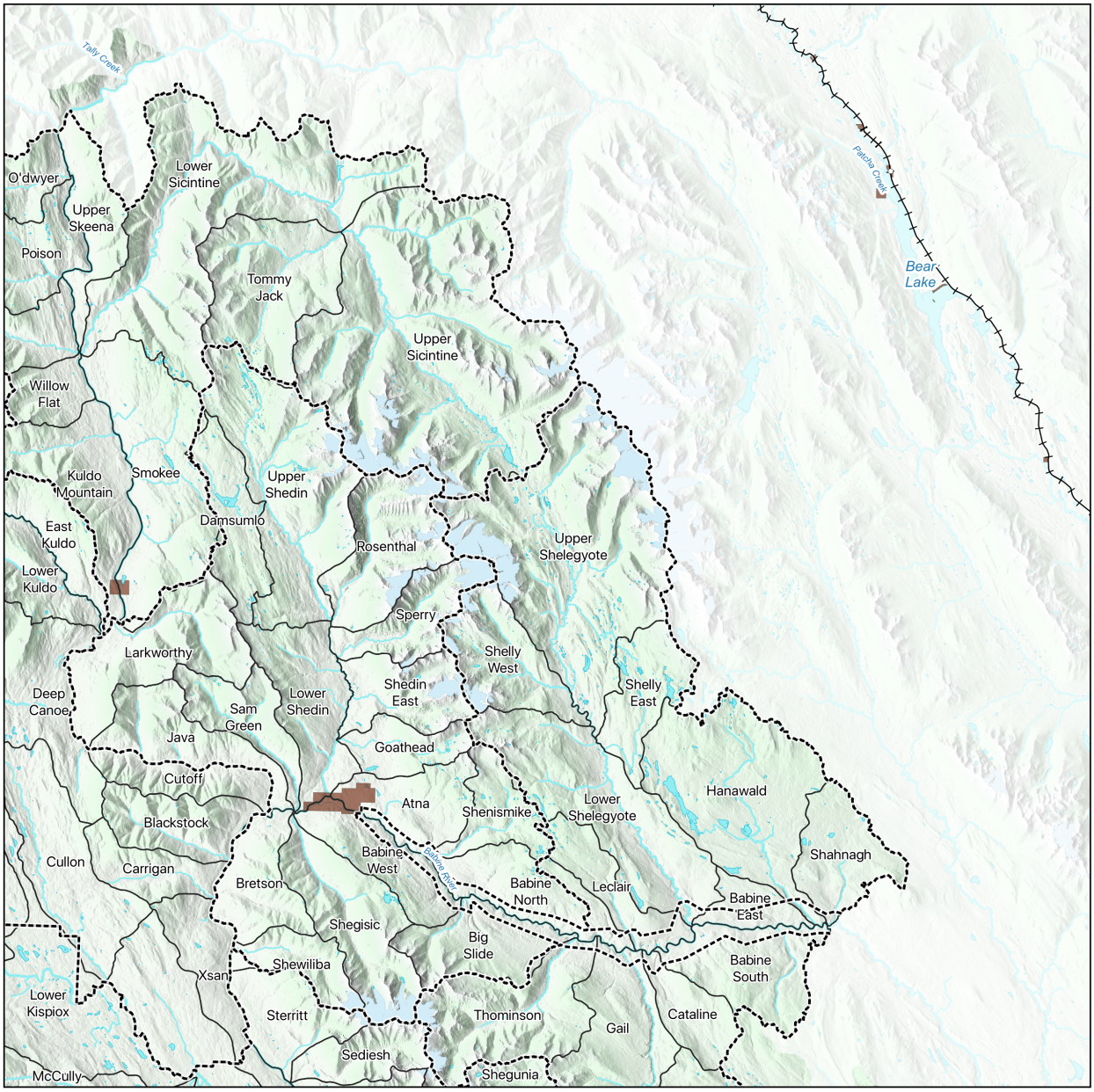
Kispiox Study Area Reference Map - Northeast



Location Map

Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

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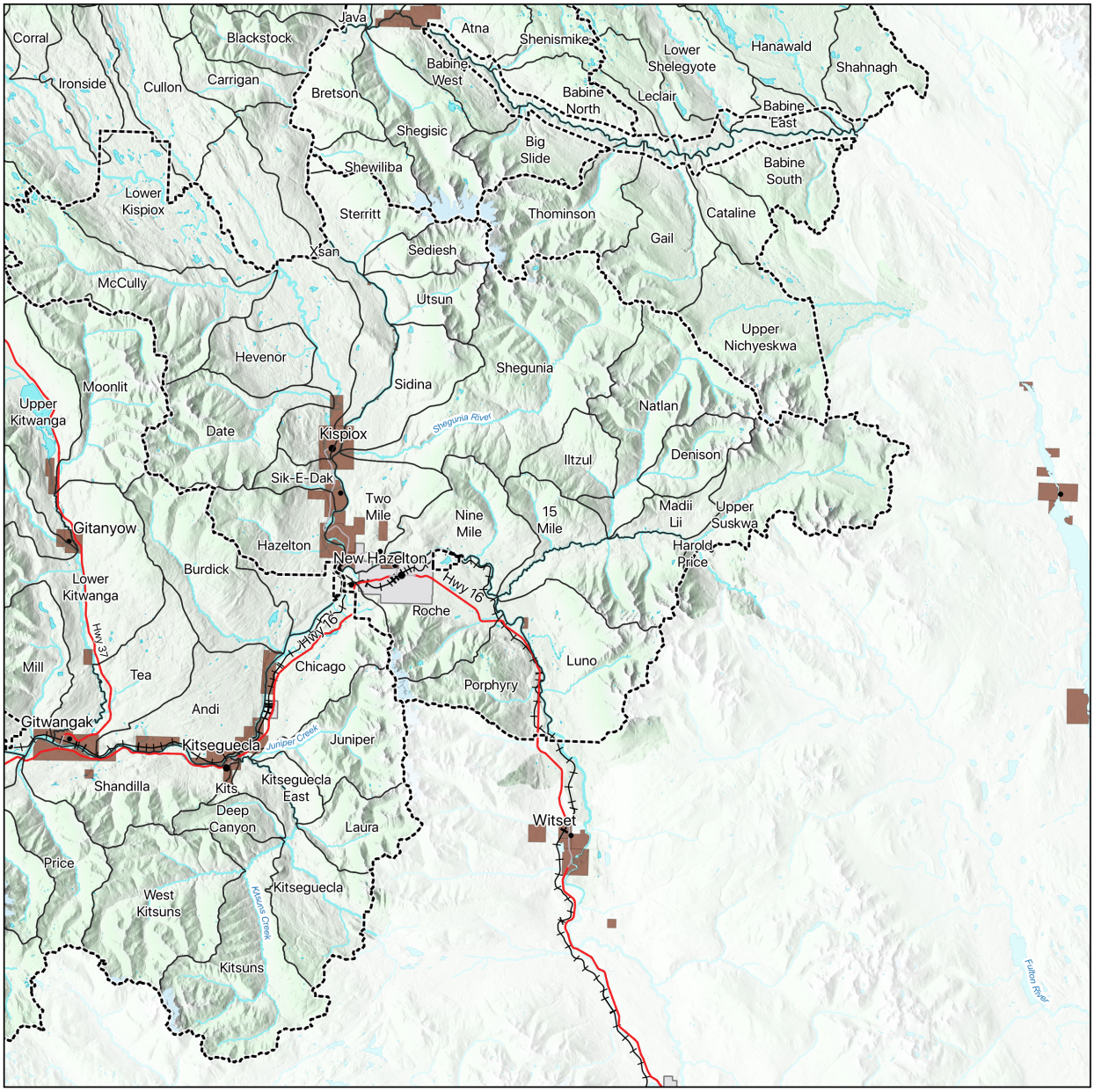
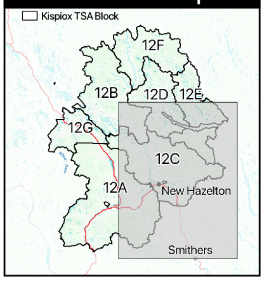
Kispiox Study Area Reference Map - Southeast



Location Map



Legend

Boundary

- IWAP Watershed Boundary
- Kispiox TSA Block
- Reserve Boundary

0 5 10 15 km

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June 2020

Appendix B: Results Tables

The following tables present total area for each boundary studied, number of closed-bottom (culvert) and open-bottom (primarily bridges) crossings, culvert density (crossings per km^2), and risk (determined by Wild Salmon Policy thresholds).

Assessment Unit	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
15 Mile	44.17	0	1	0.00	Low
Aluk	92.47	23	0	0.25	Moderate
Andi	95.46	24	1	0.25	Moderate
Atna	59.47	1	0	0.02	Low
Babine East	27.33	0	0	0.00	Low
Babine North	71.80	0	0	0.00	Low
Babine South	79.19	5	2	0.06	Low
Babine West	58.02	0	2	0.00	Low
Big Slide	66.94	0	0	0.00	Low
Blackstock	58.65	1	0	0.02	Low
Borden	24.06	2	3	0.08	Low
Boulder	157.08	8	2	0.05	Low
Bretson	57.83	2	1	0.03	Low
Brown Paint	36.41	12	0	0.33	Moderate
Burdick	125.74	13	1	0.10	Low
Calamity	143.52	0	0	0.00	Low
Carrigan	42.75	9	0	0.21	Moderate
Cataline	40.65	13	0	0.32	Moderate
Chicago	97.58	28	1	0.29	Moderate
Clifford	39.54	9	1	0.23	Moderate
Corral	29.92	8	0	0.27	Moderate
Cranberry	258.28	1	1	0.00	Low
Cranberry East	44.19	7	2	0.16	Low
Cranberry West	57.15	13	0	0.23	Moderate
Cullon	122.83	45	4	0.37	Moderate
Cutoff	40.70	0	0	0.00	Low
Damsumlo	59.14	12	0	0.20	Moderate
Date	114.07	1	2	0.01	Low
Deep Canoe	221.24	3	2	0.01	Low

Assessment Unit	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
Deep Canyon	26.81	0	1	0.00	Low
Denison	48.43	0	1	0.00	Low
Derrick	104.65	36	0	0.34	Moderate
Douse	23.68	1	1	0.04	Low
East Kispiox	159.70	0	0	0.00	Low
East Kuldo	58.96	0	2	0.00	Low
Extra	59.56	10	0	0.17	Low
Flint	44.50	2	1	0.04	Low
Gail	101.39	1	1	0.01	Low
Ginmiltkun	100.37	2	2	0.02	Low
Goathead	37.89	10	1	0.26	Moderate
Hanawald	171.46	6	0	0.03	Low
Harold Price	2.36	0	0	0.00	Low
Hazelton	105.88	15	1	0.14	Low
Hevenor	53.93	27	1	0.50	Moderate
Iltzul	46.48	2	1	0.04	Low
Insect	206.96	0	1	0.00	Low
Ironside	54.75	33	0	0.60	High
Java	66.66	1	1	0.02	Low
Juniper	92.62	1	1	0.01	Low
Kiteen	93.65	13	2	0.14	Low
Kits	3.80	3	0	0.79	High
Kitseguecla	105.43	9	1	0.09	Low
Kitseguecla East	18.43	0	0	0.00	Low
Kitsuns	163.67	0	0	0.00	Low
Kitwancool	242.75	0	1	0.00	Low
Kuldo Mountain	96.84	2	8	0.02	Low
Kuldo North	161.22	0	0	0.00	Low
Larkworthy	105.27	0	0	0.00	Low
Laura	58.15	2	2	0.03	Low
Leclair	47.45	0	0	0.00	Low

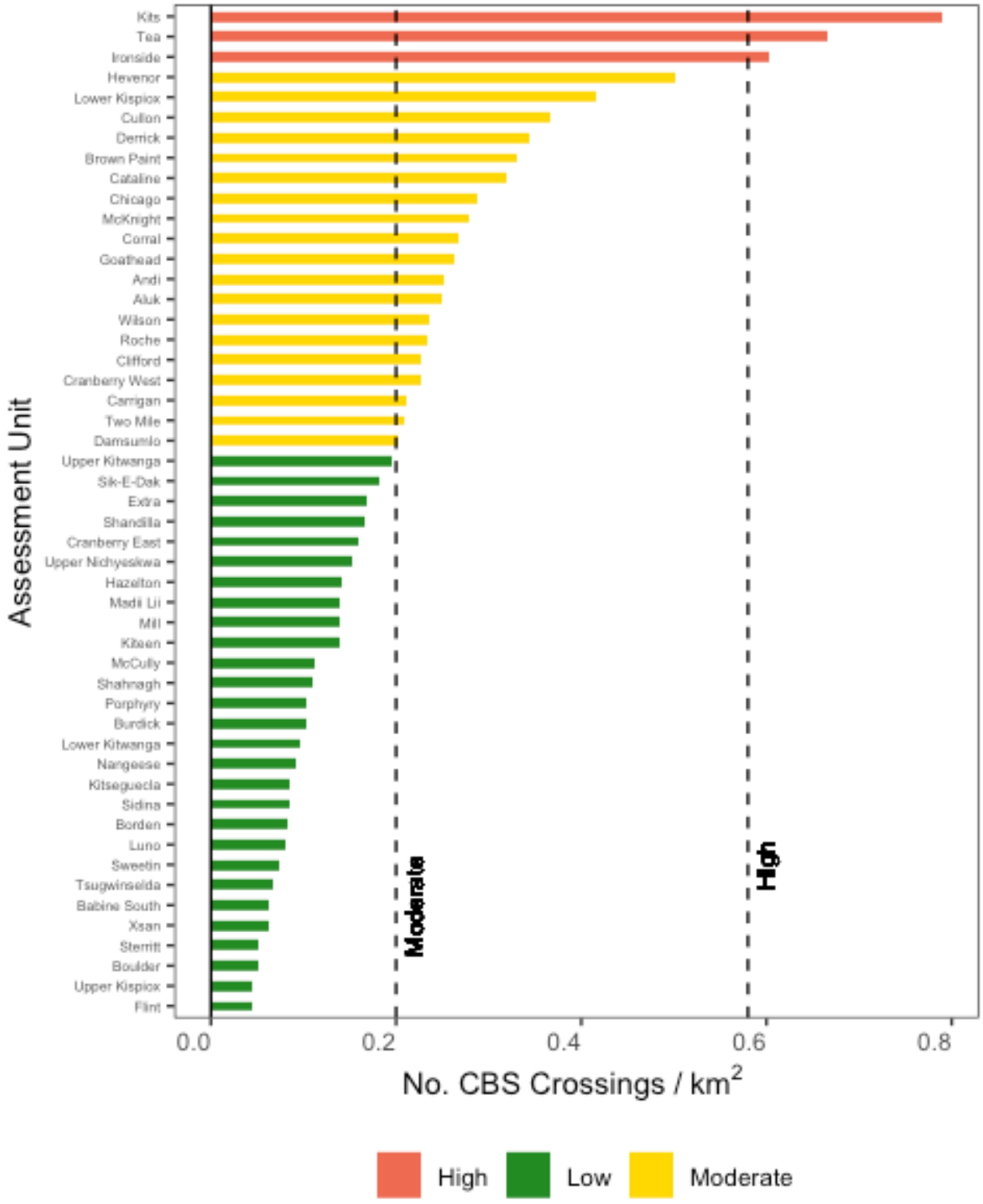
Assessment Unit	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
Lorne	121.90	0	0	0.00	Low
Lower Kispiox	445.68	185	7	0.42	Moderate
Lower Kitwanga	178.59	17	4	0.10	Low
Lower Kuldo	138.84	0	0	0.00	Low
Lower Shedin	82.54	0	1	0.00	Low
Lower Shelegyote	154.43	0	0	0.00	Low
Lower Sicintine	274.37	0	0	0.00	Low
Luno	125.91	10	3	0.08	Low
Madii Lii	28.68	4	0	0.14	Low
McCully	169.02	19	3	0.11	Low
McKnight	82.84	23	1	0.28	Moderate
Mill	107.54	15	2	0.14	Low
Moonlit	142.82	2	1	0.01	Low
Nangeese	109.48	10	2	0.09	Low
Natlan	137.62	2	7	0.01	Low
Nine Mile	84.59	1	1	0.01	Low
O'dwyer	48.44	0	0	0.00	Low
Oliver	205.76	5	1	0.02	Low
Poison	70.84	0	0	0.00	Low
Porphyry	77.36	8	0	0.10	Low
Price	80.93	0	1	0.00	Low
Quill	145.76	0	3	0.00	Low
Roche	111.68	26	1	0.23	Moderate
Rosenthal	92.51	0	0	0.00	Low
Sam Green	51.12	0	1	0.00	Low
Sedan	121.55	0	1	0.00	Low
Sediesh	43.50	0	2	0.00	Low
Shahnagh	64.31	7	0	0.11	Low
Shandilla	114.22	19	2	0.17	Low
Shedin East	58.85	0	0	0.00	Low
Shegisic	98.27	1	0	0.01	Low

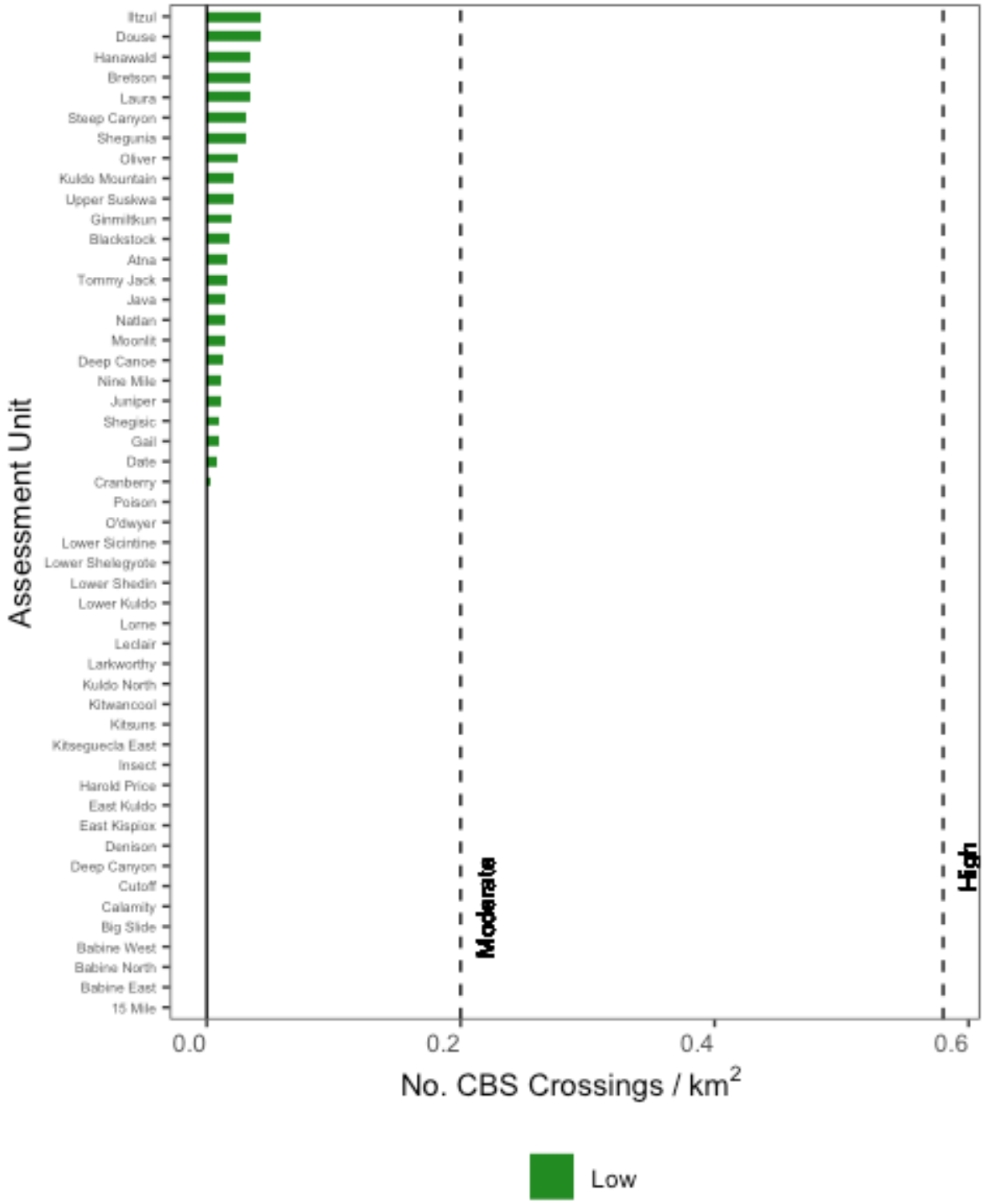
Assessment Unit	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
Shegunia	263.15	8	2	0.03	Low
Sheladumas	55.83	0	0	0.00	Low
Shelly East	59.22	0	0	0.00	Low
Shelly West	75.86	0	0	0.00	Low
Shenismike	44.67	0	0	0.00	Low
Shewiliba	38.89	0	3	0.00	Low
Sidina	70.72	6	4	0.08	Low
Sik-E-Dak	22.10	4	0	0.18	Low
Smokee	152.36	0	1	0.00	Low
Sperry	56.19	0	0	0.00	Low
Steep Canyon	31.80	1	0	0.03	Low
Sterritt	58.05	3	2	0.05	Low
Swan Lake	145.15	0	0	0.00	Low
Sweetin	244.45	18	1	0.07	Low
Tea	79.61	53	7	0.67	High
Thominson	111.14	0	2	0.00	Low
Tommy Jack	120.82	2	0	0.02	Low
Tsugwinselda	75.11	5	1	0.07	Low
Two Mile	71.46	15	3	0.21	Moderate
Upper Kispiox	330.67	15	0	0.05	Low
Upper Kitwanga	194.62	38	3	0.20	Low
Upper Kuldo	99.36	0	0	0.00	Low
Upper Nichyeskwa	131.29	20	2	0.15	Low
Upper Shedin	172.60	0	1	0.00	Low
Upper Shelegyote	293.06	0	0	0.00	Low
Upper Sicintine	418.47	0	0	0.00	Low
Upper Skeena	53.04	0	0	0.00	Low
Upper Suskwa	245.81	5	4	0.02	Low
Utsun	49.16	0	1	0.00	Low
Weber	86.32	0	0	0.00	Low
West Kitsuns	149.94	0	3	0.00	Low

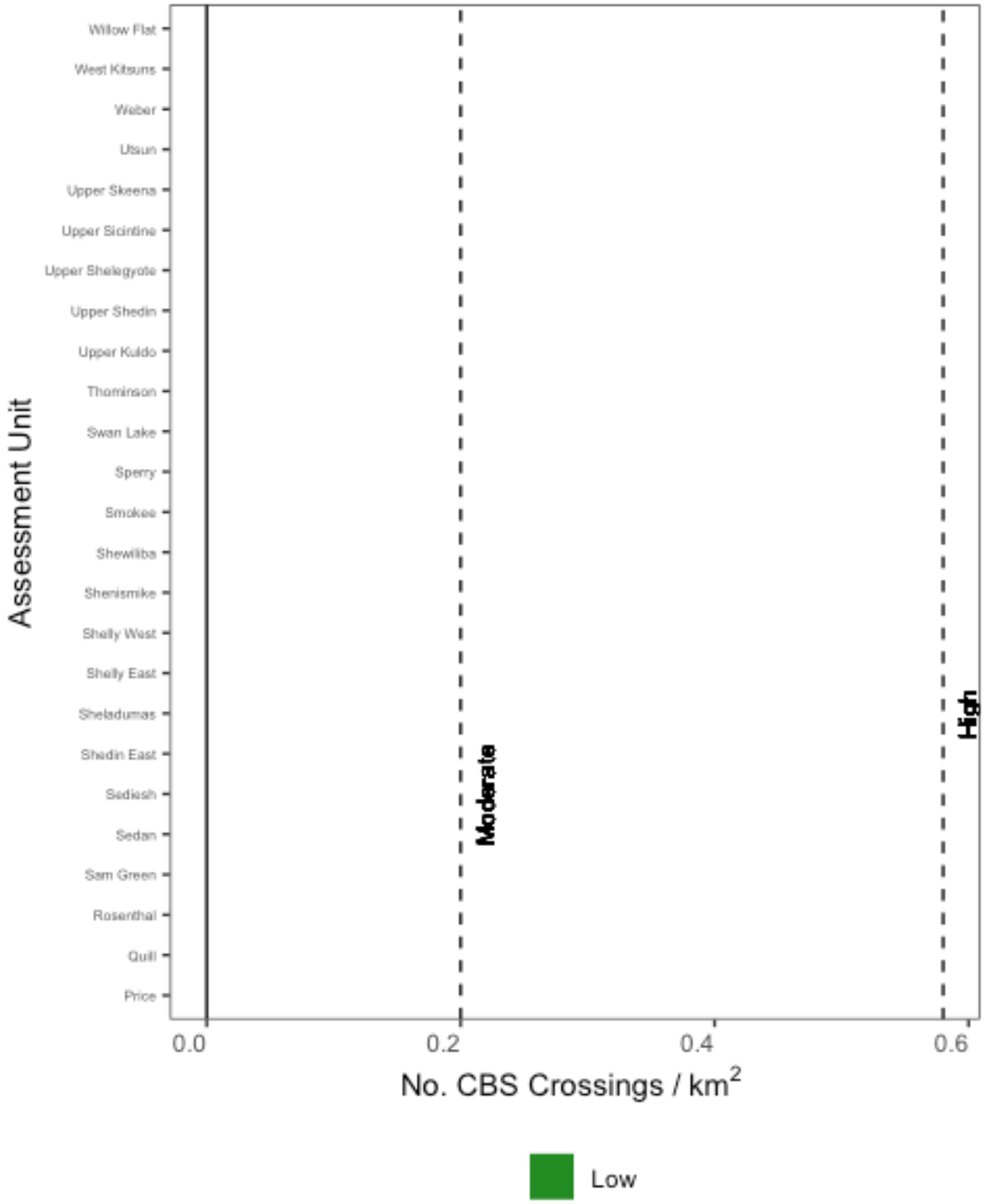
Assessment Unit	Area (km^2)	Culvert Crossings	Open Crossings	Culvert Density (Crossings per km^2)	Risk
Willow Flat	32.61	0	1	0.00	Low
Wilson	80.49	19	1	0.24	Moderate
Xsan	96.04	6	0	0.06	Low

Appendix C: Results Distribution

Results are colourized by risk threshold (low risk < 0.2 crossings/km^2, moderate risk 0.2-0.58 crossing/km^2, high risk > 0.58 crossings/km^2).




Assessment Unit
Itzul
Douse
Hanawald
Bretson
Laura
Steep Canyon
Shegunis
Oliver
Kuldo Mountain
Upper Suskwa
Ginmilfkun
Blackstock
Atna
Tommy Jack
Java
Natlan
Moonlit
Deep Canoe
Nine Mile
Juniper
Shegisic
Gail
Date
Cranberry
Poison
O'dwyer
Lower Sicintine
Lower Shalegyote
Lower Shedin
Lower Kuldo
Lorne
Leclair
Larkworthy
Kuldo North
Kitwancool
Kitsuns
Kitseguecla East
Insect
Harold Price
East Kuldo
East Kispiox
Denison
Deep Canyon
Cutoff
Calamity
Big Slide
Babine West
Babine North
Babine East
15 Mile
Moderate
High
0.0
0.2
0.4
0.6
No. CBS Crossings / km2
Low


Assessment Unit
Willow Flat
West Kitsuns
Weber
Utsun
Upper Skeena
Upper Sicintine
Upper Shelegyote
Upper Shedin
Upper Kuldo
Thominson
Swan Lake
Sperry
Smokee
Shewilibs
Shenismike
Shelly West
Shelly East
Sheladumas
Shadin East
Sediash
Sedan
Sam Green
Rosenthal
Quill
Price
Moderate
High
0.0
0.2
0.4
0.6
No. CBS Crossings / km2
Low