Field Study to Enhance Analysis of Cumulative Effects on Stream Health and Riparian Function in Areas of Oil and Gas Development in North Eastern BC

FUNDING & SUPPORT:
BC Oil & Gas Research & Innovation Society,
BC Oil and Gas Commission, and
Halfway River First Nation

Integra Forest Consulting Ltd.
and the
BC Oil and Gas Commission

November 2019

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Executive Summary

This project involved a strategic field-data collection program to capture stream health data using the FREP Routine Riparian Effectiveness Evaluation protocol at 56 stream sample locations selected within six high risk water management basins in northeast BC.

A key element of this project was the opportunity for engagement and training of both indigenous communities and industry operators through collaborative field opportunities to ensure questions and interests are addressed through shared dialogue, and to enhance the translation of the study results to practical (regulatory) applications including Area-Based Analysis (ABA).

The key findings were that the major causes of impairment of the functioning condition of streams were from natural causes, specifically mass wasting, flooding and animal activity (beaver mostly, but also cattle). A further causal factor is from road crossings, and specifically related to the sediment inputs from surface erosion.

Opportunities for mitigation of the impacts to stream health and riparian function consist of addressing road crossing construction, maintenance and deactivation practices that would reduce hydrologic connectivity for sediment delivery. Cattle access to streams and riparian areas can be managed by protecting or installing strategic range barriers during oil and gas development near streams. Beaver impacts can also be managed by installing culvert exclusions.

A significant amount of field data was collected over summer months of 2019 followed by analysis of findings presented in this report. A solid statistical relationship between field results and disturbance information was found to be limited given project budget and timelines. Further research is recommended to continue the detailed statistical analysis to understand the nature of any relationship between oil and gas activity and stream health.

Project Information

Project title: A field study to enhance analysis of cumulative effects on stream health and riparian function in areas of oil and gas development in BC.

Acknowledgments: This project was primarily funded by the **BC Oil and Gas Research & Innovation Society's (OGRIS) Funding Envelope,** Environmental Research – Water (Streams and Riparian Areas), and by the financial support of **Halfway River First Nation** to fund the sampling of the Lower Halfway River basin sites. In-kind contributions by the BC Oil and Gas Commission (OGC) is also recognized for project coordination, leadership and management of this initiative, program planning, sampling design, GIS work for site selection, access planning, location scouting, field safety and stakeholder engagement. Funding for a training session in July was provided by the Resource Planning and Assessment Branch of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

General Project Background and Rationale: The OGC deployed Area-based Analysis (ABA) in 2015 as a desktop tool to manage land disturbance and associated potential cumulative impacts to riparian reserve zones in northeast BC. The BC Forest and Range Evaluation Program (FREP) Routine Riparian Effectiveness Evaluation protocol (FREP protocol), which involves systematic measurement of 15 stream health indicator parameters, was identified by the Commission as a science-based field methodology that could be used to validate the riparian risk ratings of ABA. Preliminary field studies conducted in 2017/2018 using the FREP protocol identified some challenges with the predictive capabilities of ABA for some watershed management areas. The need for further field data collection and analysis of stream health indicators to support science-based enhancements to ABA, including tool validation, establishing baseline conditions and informing monitoring strategies was, therefore, identified. Such a dataset is not currently available for Northeast BC.

This project involved a strategic field-data collection program in selected watersheds using the FREP protocol. Use of the FREP protocol will provide a consistent scientifically defensible methodology to support the development of a robust dataset, useful for this study and other long-term initiatives. The FREP protocol is also consistent with the indicator concepts of the provincial Cumulative Effects Framework.

A key element of this project was the opportunity for engagement and training of both indigenous communities and industry operators through collaborative field opportunities to ensure questions and interests are addressed through shared dialogue, and to enhance the translation of the study results to practical (regulatory) applications including ABA. Six individuals from the training also joined the field work component for at least 1 day to expand their understanding of the field assessment process.

Project description and methodology overview: The project involved a field program to capture stream health data using the FREP protocol at 56 sample locations in select high-risk water management basins in the northeast: Lower Halfway River, Doig River, Lower Kiskatinaw River, Lower Petitot River and Cameron River. Data collection measured the following stream health indicators: riparian structure, channel morphology, channel bed intactness, sedimentation, debris accumulations, connectivity, fish cover, bank micro-climate, shade, bare erodible soil, invasive plants and biodiversity.

In each watershed, approximately 5-7 sets of paired locations were identified using GIS analysis using selection criteria related to accessibility, spatial distribution, industrial activity, land disturbance and stream class. For most sample location pairs, one location was planned to be upstream of oil and gas activity and one to be downstream. Selection of paired sample locations also included at least one control pair per watershed (no land use disturbance between sample locations). The location selection approach was designed to provide data useful to inform a preliminary assessment of stream health

impacts specific to oil and gas development and, and at the same time, provide baseline data useful to validate and enhance ABA.

Project extension: The database developed from this study includes monitoring locations, site attributes, and riparian health indicator parameters. Such a database will be useful for establishing baseline conditions, and to support long term monitoring of stream health for trends and cumulative effects. There is further potential to expand the parameter set at locations to include other environmental indicators such as water quality (water chemistry), water quantity (stream flow), or groundwater measurements.

Functioning Condition

The primary goal of the FREP protocol's Routine Riparian Effectiveness Evaluation is to assess the characteristics or health of stream reaches to see if they are in Proper Functioning Condition (PFC). PFC is the ability of a stream or river and its riparian area to:

- withstand normal peak flood events without experiencing accelerated soil loss, channel movement, or bank movement;
- filter runoff;
- store and safely release water;
- maintain the connectivity of fish habitats in streams and riparian areas;
- maintain an adequate riparian root network or LWD supply; and
- provide shade and reduce bank microclimate change.

To determine the PFC of a stream/river, several observations and measurements are made to then enable the assessor to answer 15 questions (field card is appended). Nine of the questions are directly related to the in-channel conditions, while six of the questions are related to the riparian area alongside the stream/river. The outcome of the evaluation is its measure of PFC. One can conclude the following based upon the number of questions receiving a NO answer:

- Properly functioning if 0-2 No's
- Functioning but a Risk if 3-4 No's
- Functioning but at High Risk if 5-6 No's
- Not Properly Functioning if more than 6 No's

An important part of the assessment process is to identify the main causal factors affecting the functioning condition. Broadly, the main reasons for impairment are categorized as being Current Logging, Old Logging, Animal Disturbance (e.g., beavers, livestock), Roads, Other Impacts (e.g., agriculture, oil/gas development), Natural Impacts and Upstream Unknown factors. Natural impacts are typically a result of insects, fire, floods, mass wasting, diseases that are clearly unrelated to a land-use activity in the riparian area for the stream. Also, there can be more than one main cause for an impaired question.

Riparian Assessment Accomplishments

Access was a significant challenge within the Doig and Lower Petitot areas, mostly because of access constraints from beaver flooded areas, impassable winter roads, and burnt bridges (e.g., Doig). As a result, minimal sampling was accomplished, and efforts were focused on the other subject basins where access was more promising. Ideally, sampling is done during the summer low flow conditions. In most FREP years, sampling in August can be a favorable time to conduct riparian sampling, but in 2019 an abnormally wet summer resulted in many sites having higher than ideal water levels. The sampling accomplishments in

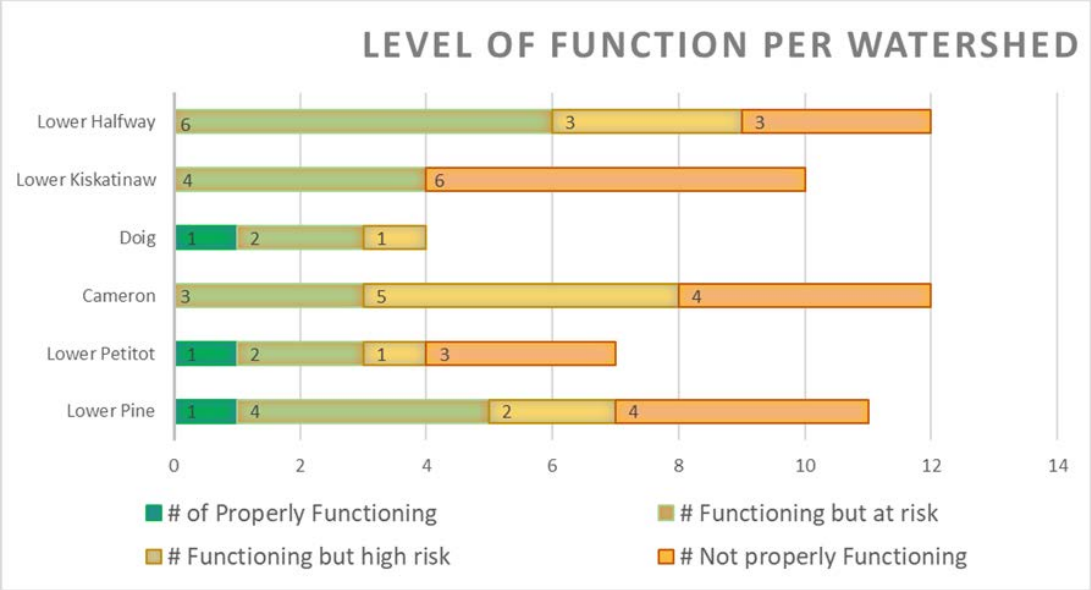
table 1 will augment sampling that has been done the previous 2 years by the OGC. This work will help the Area-Based Analysis process used by the OGC to manage land disturbance and associated potential cumulative impacts to riparian reserve zones in northeast BC. Stakeholder participation was achieved during the field work at the Lower Petitot (1 site), Lower Halfway (2 sites), Cameron (2 sites) and Lower Kiskatinaw (2 sites). The six participants attended a single day of sampling and commented on how this opportunity was helpful to gaining a better understanding of the assessment process.

TABLE 1: Field sampling accomplishments in 2019

Sample Basin	# of Samples	# Properly Functioning	# Functioning but at Risk	# Functioning but High Risk	# Not Properly Functioning
Lower Pine	11 sites	1	4	2	4
Lower Petitot	7 sites	1	2	1	3
Cameron	12 sites	0	3	5	4
Doig	4 sites	1	2	1	0
L. Kiskatinaw	10 sites	0	4	0	6
L. Halfway	12 sites	0	6	3	3
TOTALS	**56 sites**	**3**	**21**	**12**	**20**

The assessment outcomes in Table 1 are summarized in Figure 1 below and a brief summary is provided for each river basin sampled. All data collected during the assessments were entered onto the FREP Riparian Assessment FileMakerGo app and sent to the OGC for their higher-level analysis.

Figure 1: Summary of Functioning Condition by Stream Basin



Overview of Sampling Outcomes

In 2019, a total of 56 riparian assessment samples were completed across 6 stream basins. In this assessment the most notable and consistent finding was that when a functioning indicator question was answered as “NO” (meaning there is impairment), that in 57% of the cases this impairment was attributed to natural causes (and typically from mass wasting, flooding or naturally high sediment levels) and from animals in 19% of the cases (beaver mainly, but also cattle). Roads were attributed to impairment in 11% of the cases; old logging/land clearing in 7% of the cases; current land use (logging, oil/gas, agriculture) accounted for 5% of the cases; and upstream and unknown factors accounted for 1% of the cases where impairment was detected but not attributable to a specific cause.

Out of a total of 56 stream samples, 36 of the streams are functioning and 20 stream samples were not properly functioning. In terms of which functioning factors were impacted the most frequently, the sampling reveals that foundationally, sediment delivery exceeds the carrying capacity of the streams, leading to aggradation; consequently, the high sediment loading affects indicator questions 1, 2, 4, 6, 7, and 8. The sources of sediment are basically from hill-slope mass wasting and from flooding pressure, but also from road surface erosion. Flooding and beavers also affected the connectivity function, which is another common impairment which in turn contributes to the signs of aggradation.

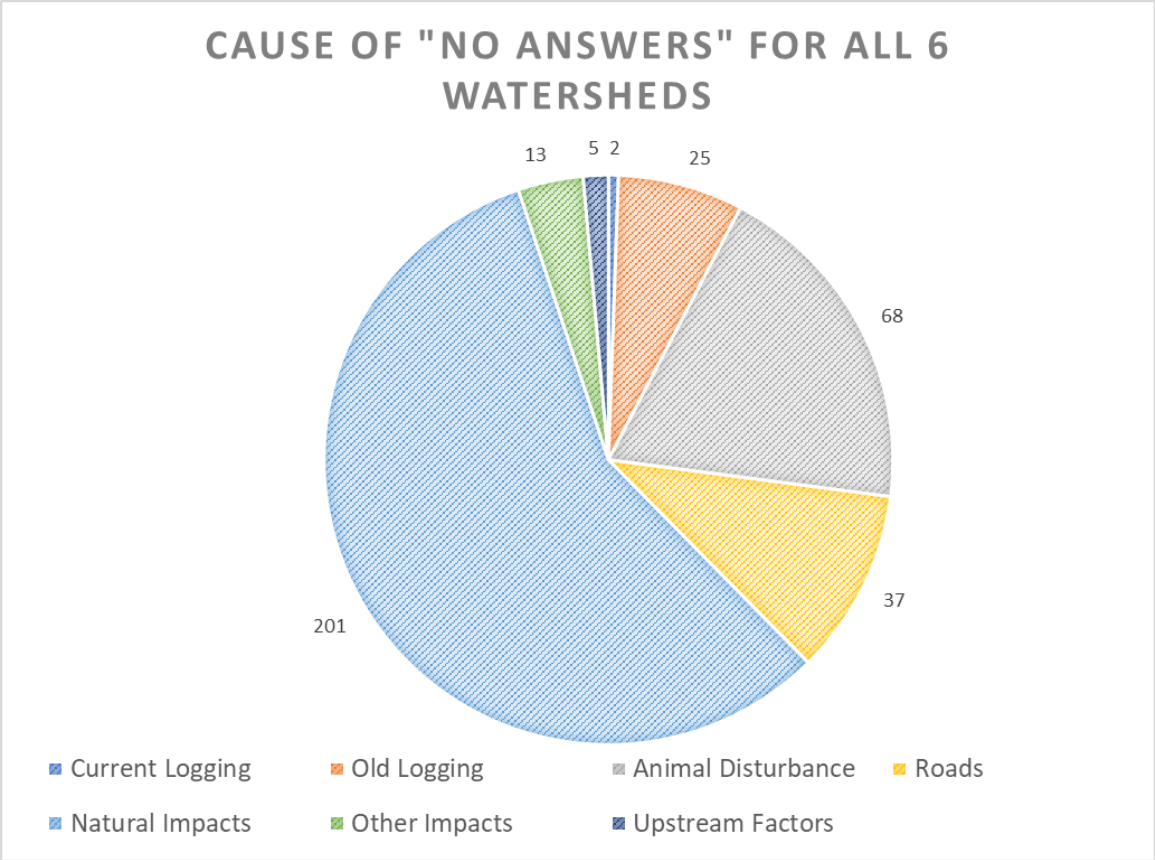
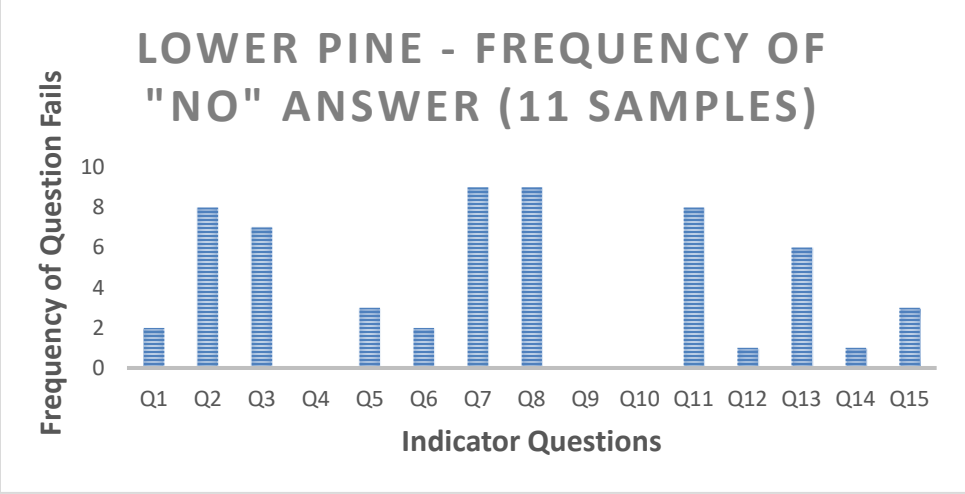


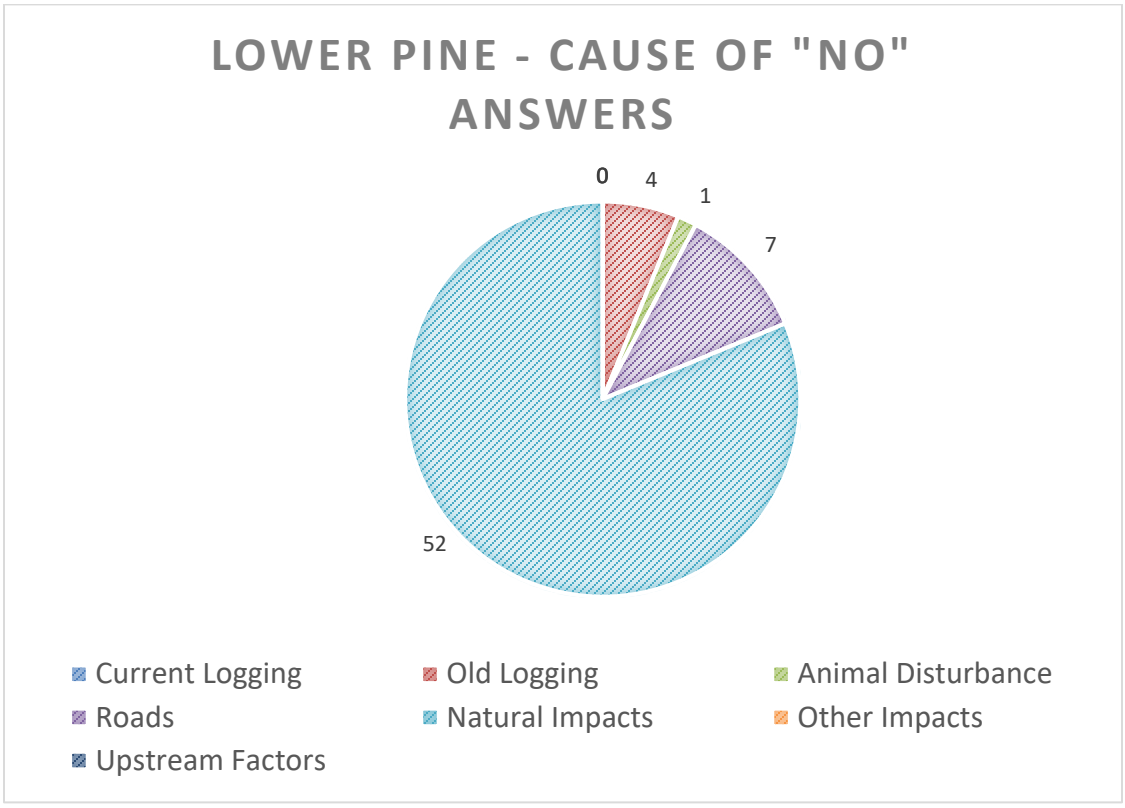
Figure 2: Causes for Functioning Impairment across entire sample

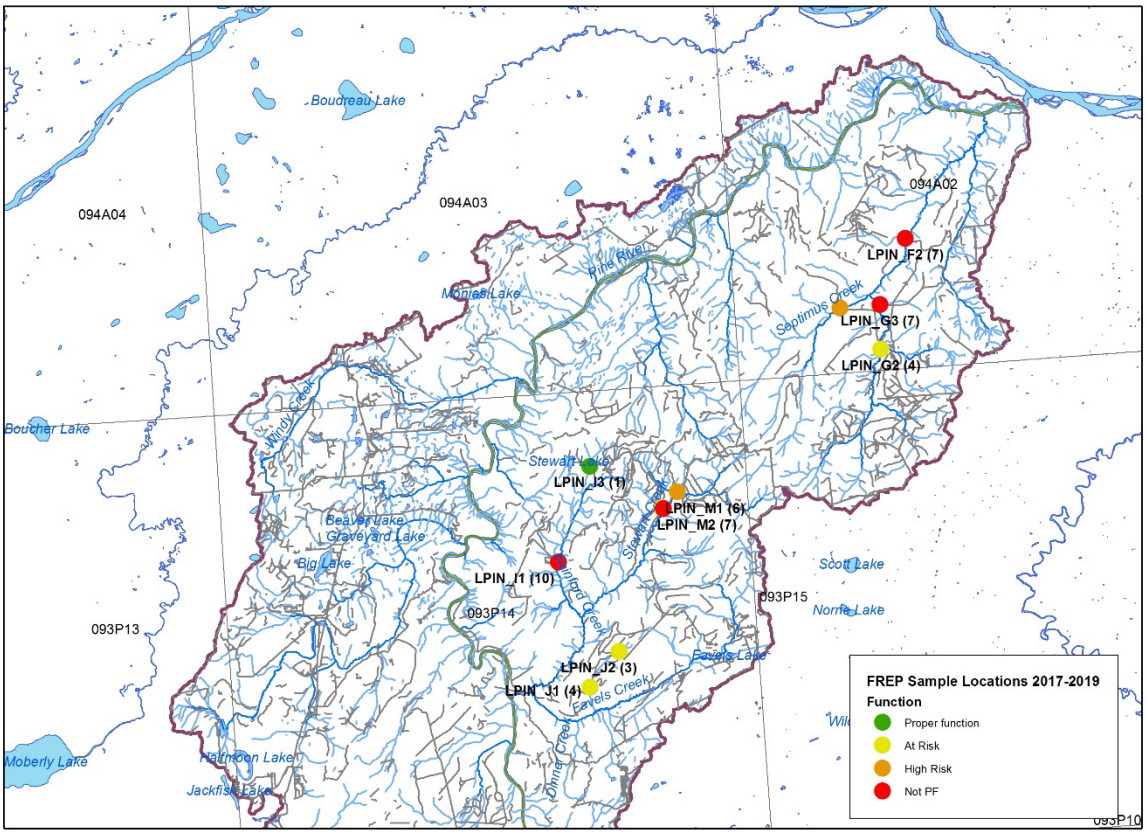
Lower Pine Assessment Outcomes:

The eleven (11) assessments in the Lower Pine revealed that impacts on functioning condition are mainly from natural sources related to mass wasting and flooding. Flooding and mass wasting are impacting the channel banks (Q2), LWD processes (Q3), presence of bare, erodible soils (Q13). Road surface erosion accounts for a noticeable level of impact at two sites, and primarily affecting bare erodible ground (Q11), sediment levels (Q8) and moss (Q7); and these road related impacts are causal factors that can be remedied more easily than impacts by flooding or mass wasting events. Sites F1, F2, G2, G3 and M1 were found to have Canadian thistle, an invasive plant, establishing and spreading within the riparian area.

Sample	Site	Outcome	Cause of No's	Functioning Condition	Comments of Main Issues
1control	J1	4 No's	4-Natural	Functioning but at Risk	Flooding impacts
2control	J2	3 No's	3-Natural	Functioning but at Risk	Flooding impacts
3	I3	1 No	1-Animal & Old logging	Properly Functioning	Old logging and ungulates
4	I1	10 No's	7-Natural, 4-Roads, 3-Old logging	Not Properly Functioning	Mass wasting & floods, road erosion, old logging
5	F1	6 No's	6-Natural	Functioning but High Risk	Mass wasting and flooding; Canadian thistle
6	G3	7 No's	7-Natural	Not Properly Functioning	Mass wasting and flooding; Canadian thistle present
7	F2	7 No's	7-Natural	Not Properly Functioning	Mass wasting and flooding; Canadian thistle established
8	M2A	4 No's	1-Natural, 3-Roads	Functioning but at Risk	Road erosion, floods
9	M2	7 No	7-Natural	Not Properly Functioning	Mass wasting and flooding
10	M1	6 No's	6-Natural	Functioning but High Risk	Mass wasting and flooding; Canadian thistle
11	G2	4 No's	4-Natural	Functioning but at Risk	Mass wasting and flooding; Canadian thistle





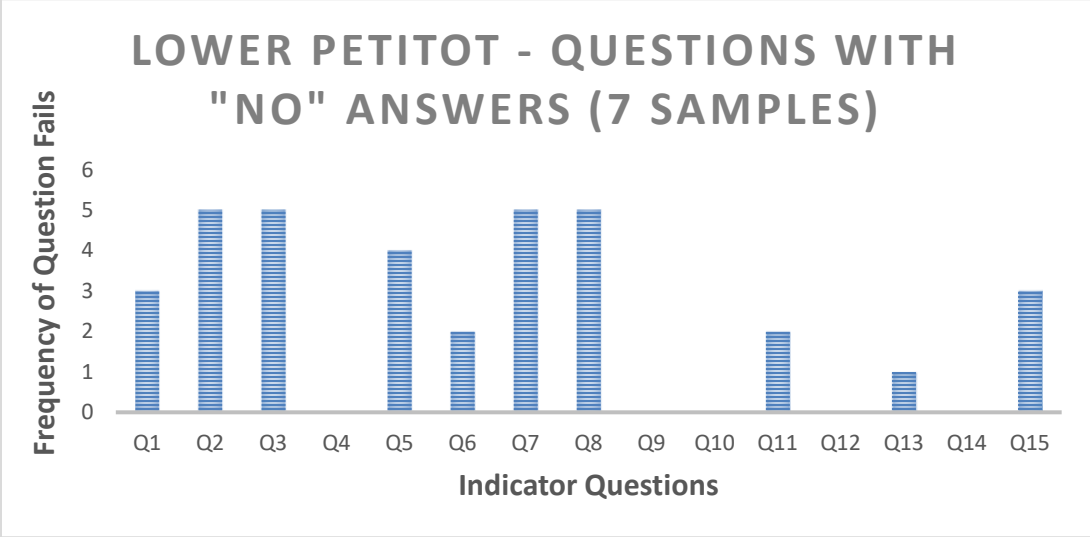


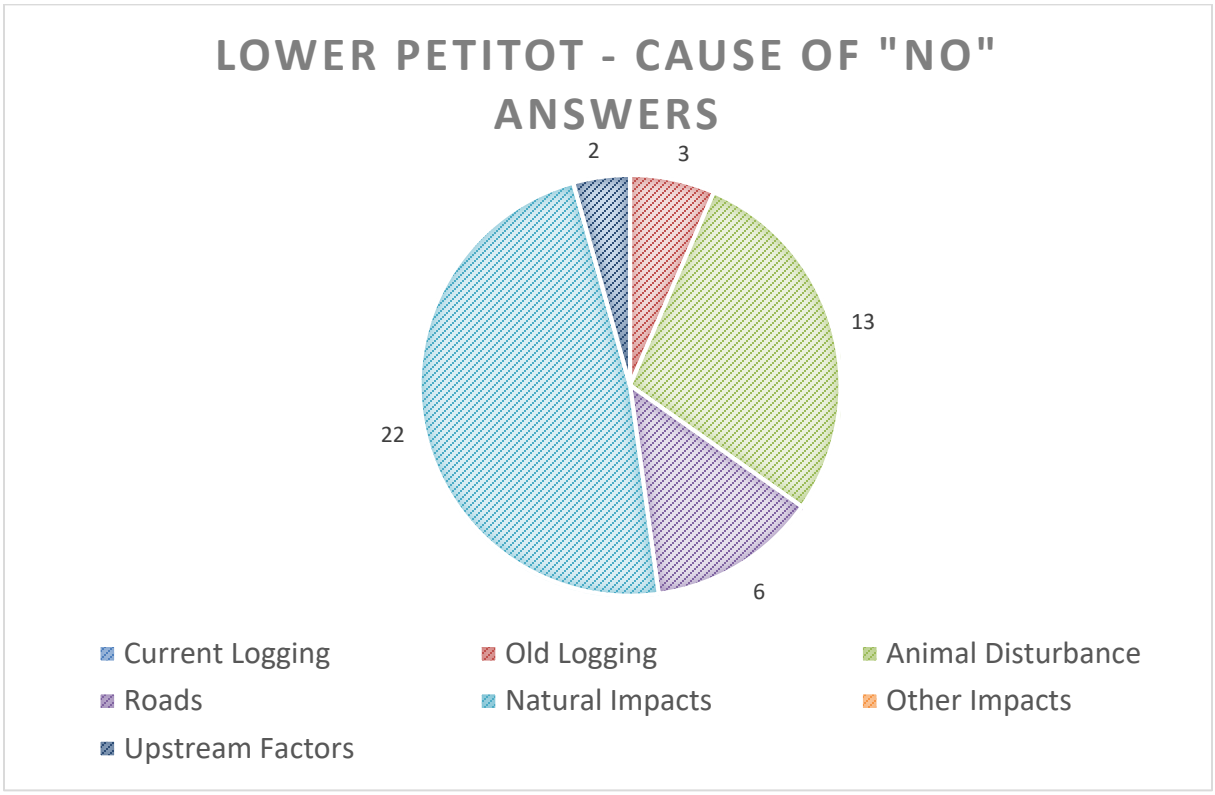
Overview of the locations of the sample sites visited in the Lower Pine.

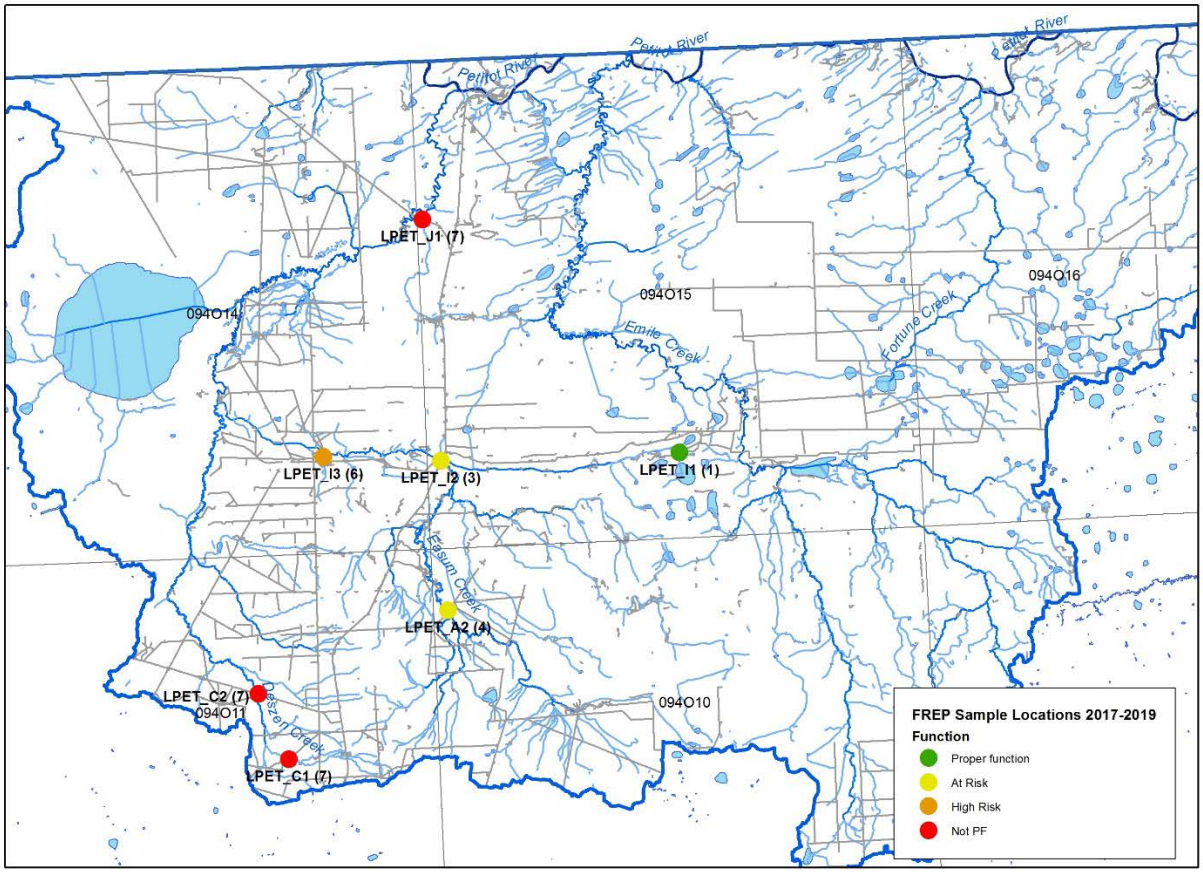
Lower Petitot Assessment Outcomes:

The seven (7) assessments in the Lower Petitot revealed that impacts on functioning condition are mainly from natural sources related to mass wasting, flooding and high background sediment levels. Flooding and mass wasting typically affect the channel banks (Q2) and bed (Q1), LWD processes (Q3), condition of moss (Q7) and fines sediments (Q8). The common occurrence of beaver activity noticeably affects channel bed (Q1) and banks (Q2), LWD process (Q3) and fish cover diversity (Q6). Old logging creates a forest structure stress (Q15) on functioning condition (3 of the samples) and beaver activity appeared to be more noticeable in such forested environments. Road surface erosion accounts for a noticeable level of impact at two sites to Q7 and Q8, and a crossing barrier to fish (Q5) at one of the sites. Beaver management, crossings structures and road surface erosion are possible areas of attention that can aid in supporting riparian function.

Sample	Site	Outcome	Cause of No's	Functioning Condition	Comments of Main Issues
1	J1	7 No's	4-Roads, 3-Natural	Not Properly Functioning	Road erosion, flooding impacts
2	I3	6 No's	6-Natural	Functioning but High Risk	Mass wasting and flood impacts
3	I1	1 No	1-Natural	Properly Functioning	Flood impacts
4	I2	3 No's	3- Natural	Functioning but at Risk	Naturally high fines, flood and upstream sources unknown
5	C2	7 No's	7-Animals, 2-Roads, 1-Natural, 1-Old logging	Not Properly Functioning	Beavers, road erosion, floods, old logging
6 control	A2	4 No's	2-Natural, 2-Animals, 1-Old logging	Functioning but at Risk	Flooding, Beavers, and old logging
7	C1	7 No's	6-Natural, 4-Animals, 1-Old logging	Not Properly Functioning	Flood activity, beavers, old logging





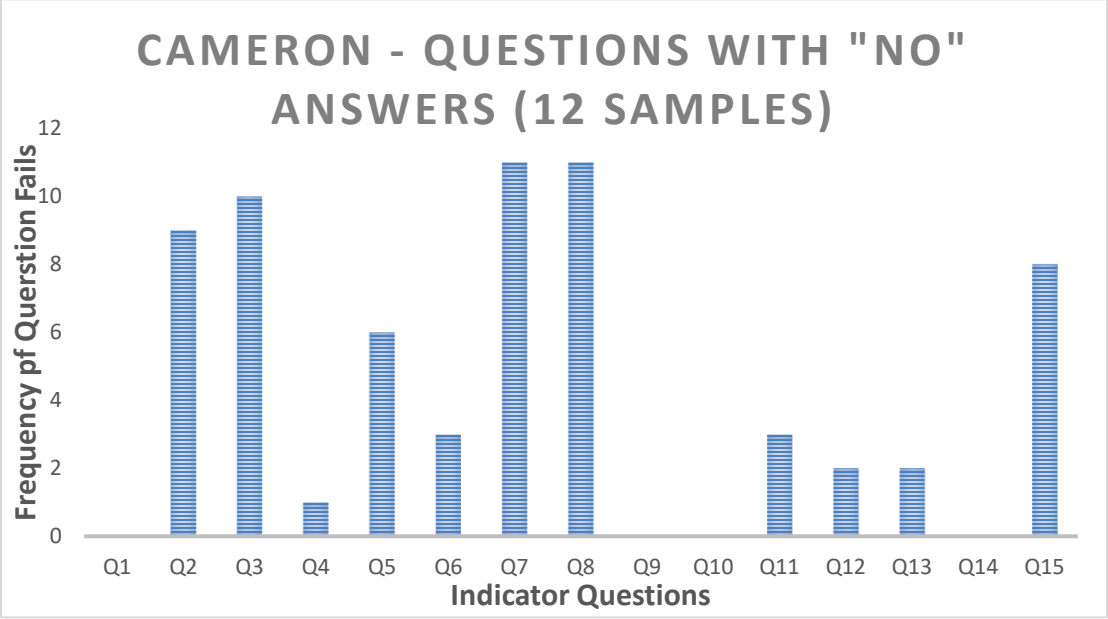


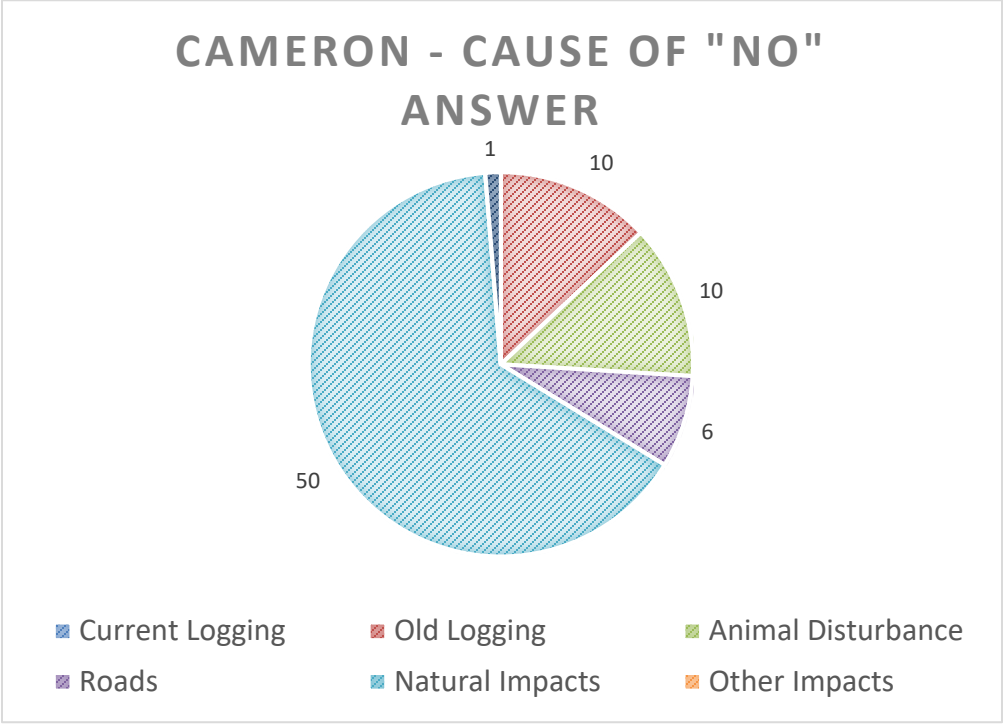
Overview of the locations of the sample sites visited in the Lower Petitot.

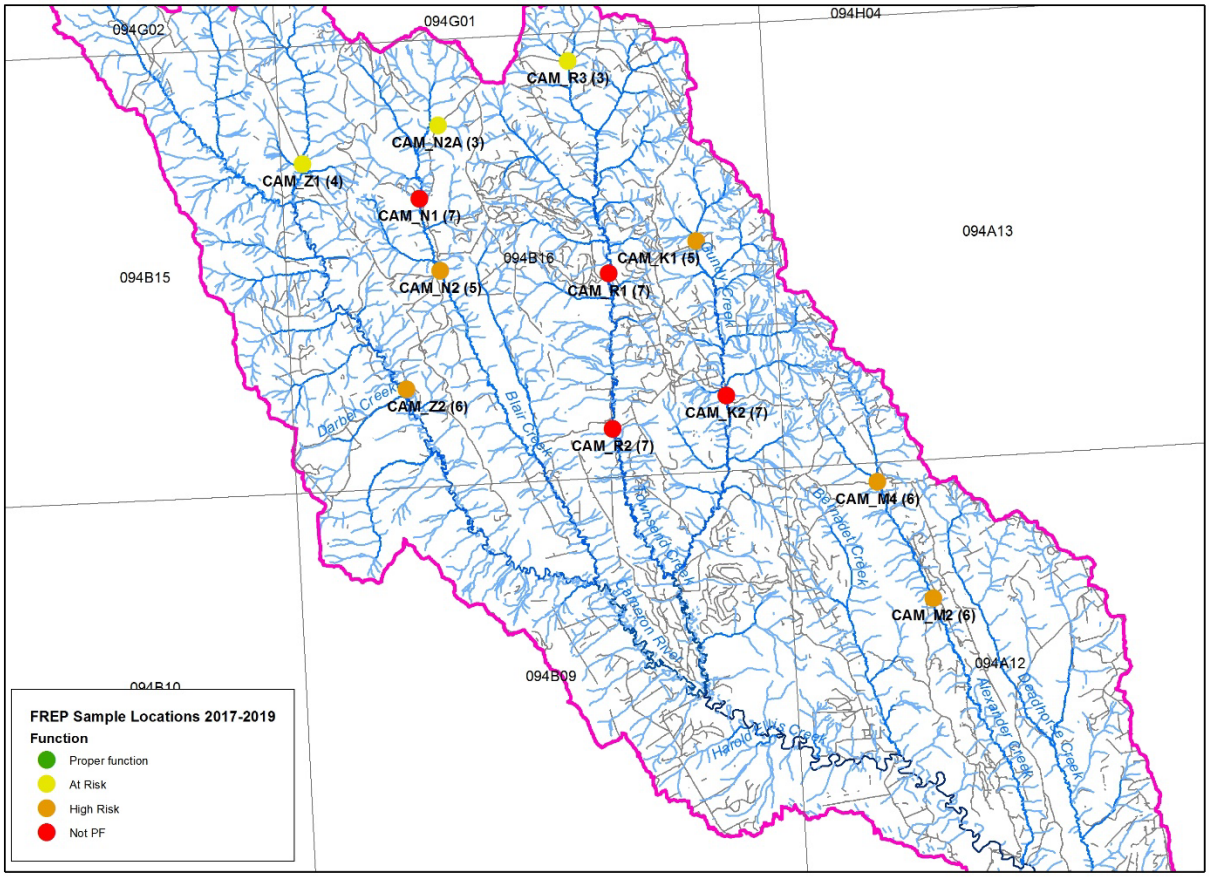
Cameron Assessment Outcomes:

The twelve (12) assessments in the Cameron River revealed that impacts on functioning condition are mainly from natural sources related to mass wasting, flooding and naturally high sediment levels. Flooding and mass wasting are noticeably accountable for extensive channel bank disturbances (Q2), degraded large woody debris processes (Q3), elevated fine sediments (Q8) and reduced moss levels and health (Q7). Beaver activity at 6 sites is noticeably impacting the connectivity of aquatic habitat (Q5), as well as affecting forest structure (Q15) as did old logging. Road surface erosion accounts for a noticeable level of impact to the level of fine sediment (Q8) and moss(Q7) at three (3) sites; and these beaver and road related issues are causal factors that can be remedied more easily than mass wasting and flooding events. Note also that an invasive plant, Canadian thistle, was observed within the riparian area of site M2.

Sample	Site	Outcome	Cause of No's	Functioning Condition	Comments of Main Issues
1	K1	5 No's	4-Natural, 1-Old logging	Functioning but High Risk	Mass wasting and flooding impacts
2	K2	7 No's	5- Natural, 1-Animals, 2-Roads, 1-Old logging	Not Properly Functioning	Flood impacts, beaver, road erosion, old logging
3	M2	6 No's	3-Natural, 3-Animals, 2-Old Logging	Functioning but High Risk	Floods, beavers and old logging; Canadian thistle is establishing
4	M4	6 No's	5-Natural, 1-Animals, 1-Old logging	Functioning but High Risk	Floods, high sediments, beaver, fire and old logging
5	N1	7 No's	7-Natural, 2-old logging	Not Properly Functioning	Floods, mass wasting, fire, old logging
6	N2A	3 No's	1-Old logging, 2-Roads	Functioning but at Risk	Road erosion, old logging
7	N2	5 No's	4-Natural 2- Roads, 1-Old Logging	Functioning but High Risk	Mass wasting, floods, road erosion, old logging
8 control	Z1	4 No's	4 - Natural	Functioning but at Risk	Mass wasting and floods
9 control	Z2	6 No's	6- Natural	Functioning but High Risk	Floods and mass wasting
10	R2	7 No's	5-Natural, 1-Animals, 1-Old logging	Not Properly Functioning	Floods, mass wasting, beaver, old logging
11	R3	3 No's	2- Natural, 3-Animals	Functioning but at Risk	Flooding and beaver
12	R1	7 No's	6-Natural, 1-Animals	Not Properly Functioning	Flooding, mass wasting and beavers


CAMERON - QUESTIONS WITH "NO" ANSWERS (12 SAMPLES)
Frequency pf Querstion Fails
0
2
4
6
8
10
12
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Indicator Questions


CAMERON - CAUSE OF "NO" ANSWER
1
10
10
6
50
Current Logging
Old Logging
Animal Disturbance
Roads
Natural Impacts
Other Impacts

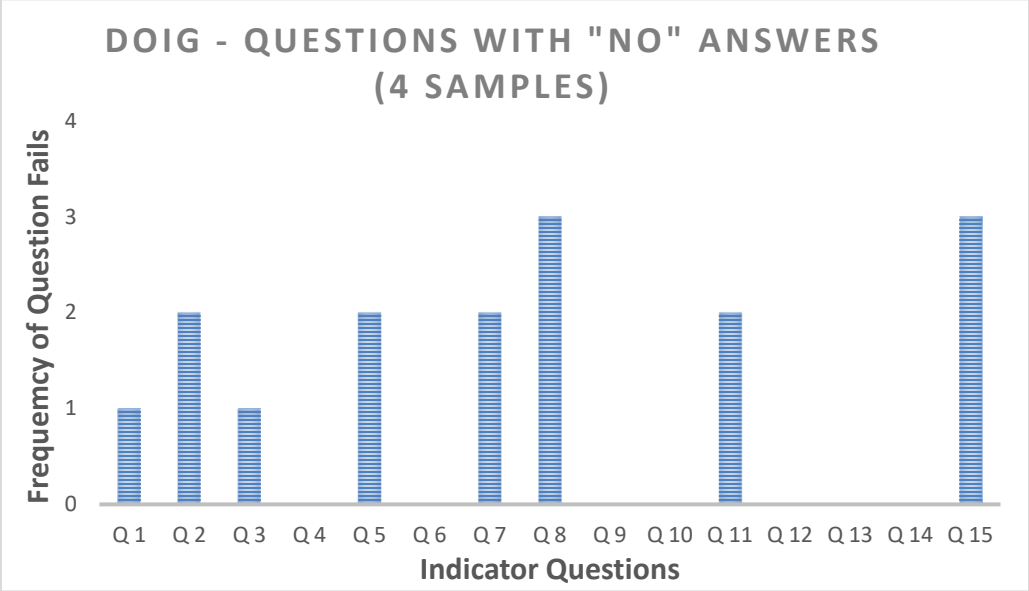


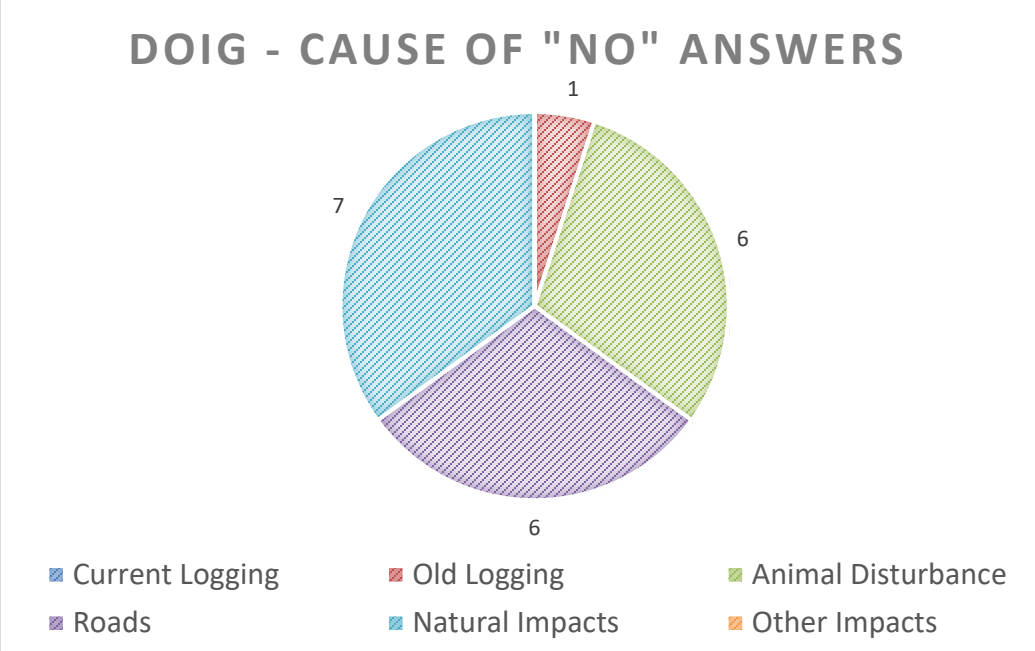
Overview of the locations of the sample sites visited in the Cameron.

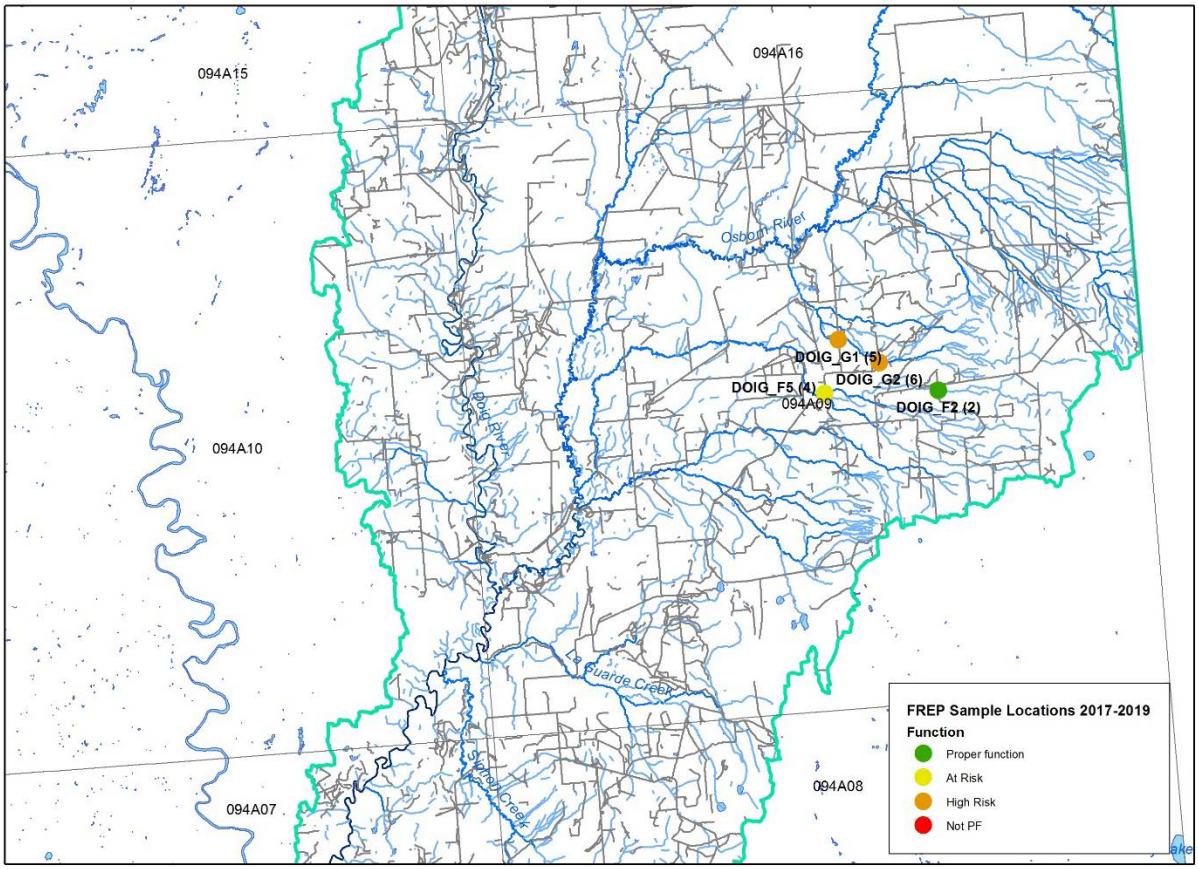
Doig Assessment Outcomes:

The four (4) assessments completed did not include any control sites. The assessments in the Doig River revealed that impacts on functioning condition are mainly from natural sources related to flooding and wildfire. Flooding has impacted channel bed (Q1) channel banks (Q2), moss vigour (Q7) and sediment mobility (Q8). Beaver significantly impacted functioning condition at one site by affecting channel bed (Q1) banks (Q2), LWD distribution (Q3), connectivity (Q5), sediment migration (Q8) and forest structure (Q15). Road surface erosion accounts for a noticeable level of impact to moss (Q7) and sediment buildup (Q8) at two sites and a crossing was an impediment to fish movement (Q5) at one site. Road related causal factors can be remedied more easily than flooding.

Sample	Site	Outcome	Cause of No's	Functioning Condition	Comments of Main Issues
1	G1	4 No's	2-Natural, 2-Roads	Functioning but at Risk	Fire, floods and road sedimentation
2	G2	6 No's	6-Animals, 3-Natural, 1-Old logging	Functioning but High Risk	Beavers, floods, and old logging
3	F2	2 No's	2-Natural	Properly Functioning	Fire and floods
4	F5	4 No's	4- Roads	Functioning but at Risk	Road sedimentation and crossing


DOIG - QUESTIONS WITH "NO" ANSWERS
(4 SAMPLES)
Frequemcy of Question Fails
0
1
2
3
4
Q 1
Q 2
Q 3
Q 4
Q 5
Q 6
Q 7
Q 8
Q 9
Q 10
Q 11
Q 12
Q 13
Q 14
Q 15
Indicator Questions


DOIG - CAUSE OF "NO" ANSWERS
1
6
6
7
Current Logging
Old Logging
Animal Disturbance
Roads
Natural Impacts
Other Impacts

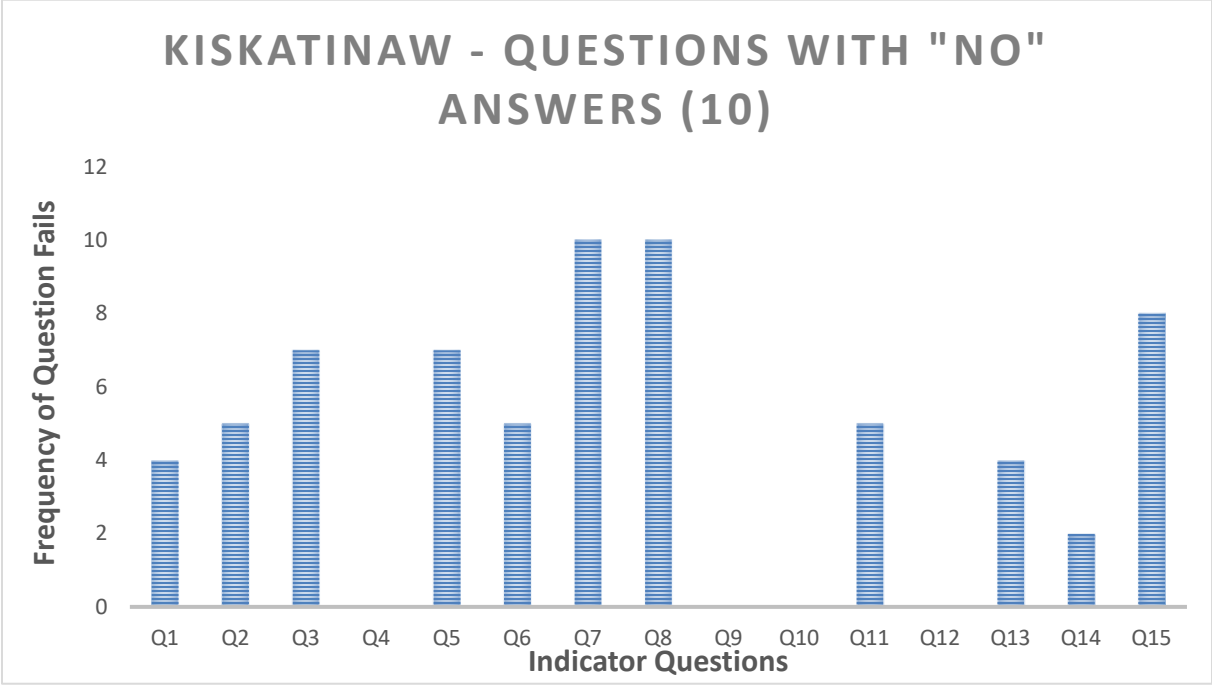


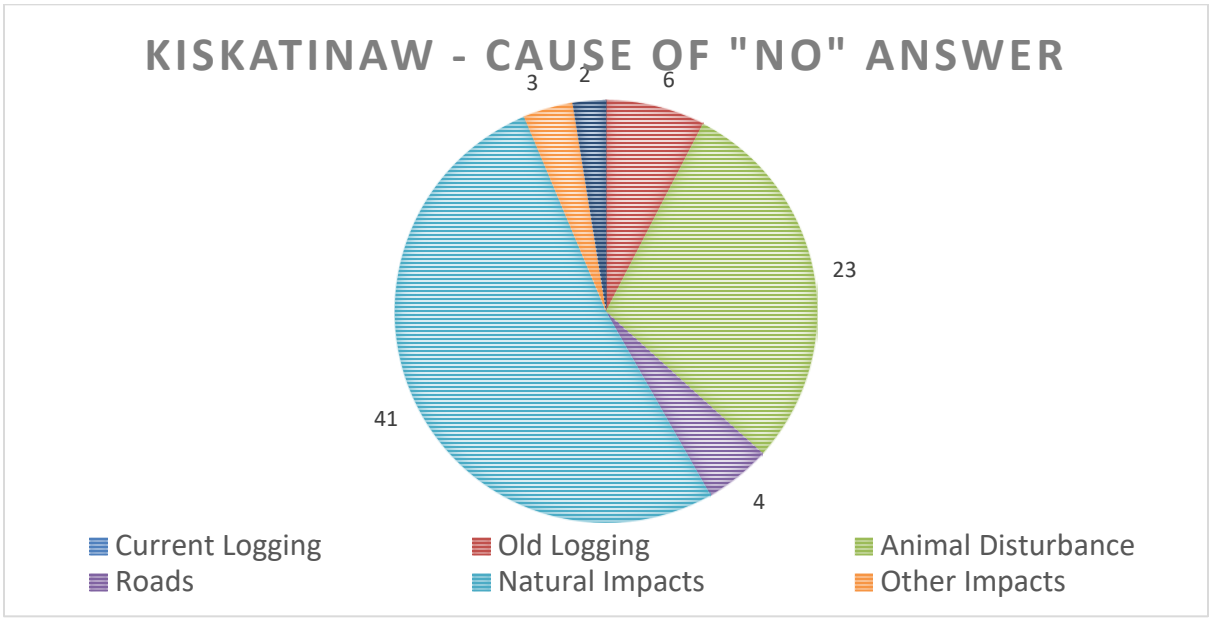
Overview of the locations of the sample sites visited in the Doig.

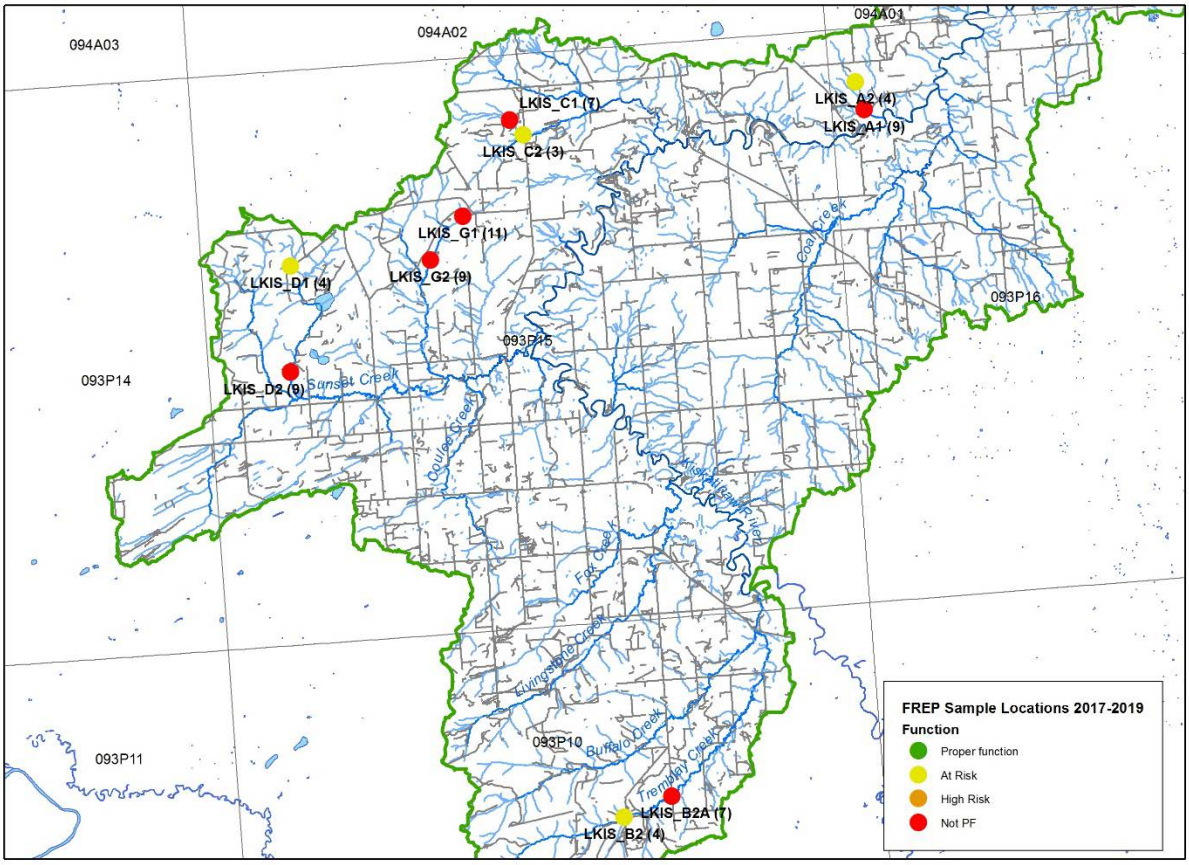
Lower Kiskatinaw Assessment Outcomes:

The ten (10) assessments in the Lower Kiskatinaw revealed that impacts on functioning condition are commonly from natural sources related to mass wasting, flooding and naturally high sediment levels. Animal impacts were notable in 5 of the sites, with cattle accounting for 83% of Animal incurred No causes and beavers 17% of the animal incurred No causes. Beaver typically affect the LWD(Q3) and connectivity (Q5) aspects, whereas cattle impacts were significantly affecting channel bed (Q1), channel banks (Q2), diversity of fish cover(Q6), levels of moss (Q7) and sedimentation (Q8), levels of bare erodible ground (Q11), barren areas where overgrazing was seen also had higher levels of invasive plants (Q14). Canadian thistle (invasive plant) is spreading within the cattle impacted areas. Land clearing from logging and for agriculture were noticeably affecting the riparian forest alongside the stream (Q15) in six of the sites visited. Road surface erosion accounts for a noticeable level of impact at two sites. Impacts from cattle, roads and riparian forest management are causal factors that can be remedied more easily than the flooding and mass wasting events. Note also that an invasive plant, Canadian thistle, was observed within the riparian area of sites A1, B2, B2A, G1 and G2 and Bull thistle was observed at site D1.

Sample	Site	Outcome	Cause of No's	Functioning Condition	Comments of Main Issues
1	G1	11 No's	8-Cattle, 3-Animals, 1-Old logging	Not Properly Functioning	Cattle primarily, and beavers, old logging; Canadian thistle spreading
2	G2	9 No's	8-Cattle, 1-Natural, 1-Old logging	Not Properly Functioning	Cattle primarily, floods and old logging; Canadian thistle spreading
3	B2	4 No's	3-Natural, 1-Other	Functioning but at Risk	Mass wasting, floods and agriculture; Canadian thistle is present
4	B2A	7 No's	5-Natural, 2-Other, 2-roads, 1-Cattle	Not Properly Functioning	Mass wasting and floods, agriculture, road erosion, cattle; Canadian thistle is present
5	C1	7 No's	6-Natural, 1-Old logging	Not Properly Functioning	Floods and old logging
6 control	A1	9 No's	9-Natural, 1-Old logging	Not Properly Functioning	Mass wasting, old logging Canadian thistle is establishing
7	D2	9 No	8-Natural, 2-Roads, 1-Old logging	Not Properly Functioning	Mass wasting, road erosion, old logging Canadian thistle is establishing.
8	D1	4 No's	3-Natural, 2-Cattle, 1-Old logging	Functioning but at Risk	Flood impacted, cattle and old logging; Bull thistle establishing
9	C2	3 No's	2-Natural, 2-Upstream, 1-Animals	Functioning but at Risk	Naturally high sediment, beavers (unknown sediment sources)
10 control	A2	4 No's	4-Natural	Functioning but at Risk	Flood impacted





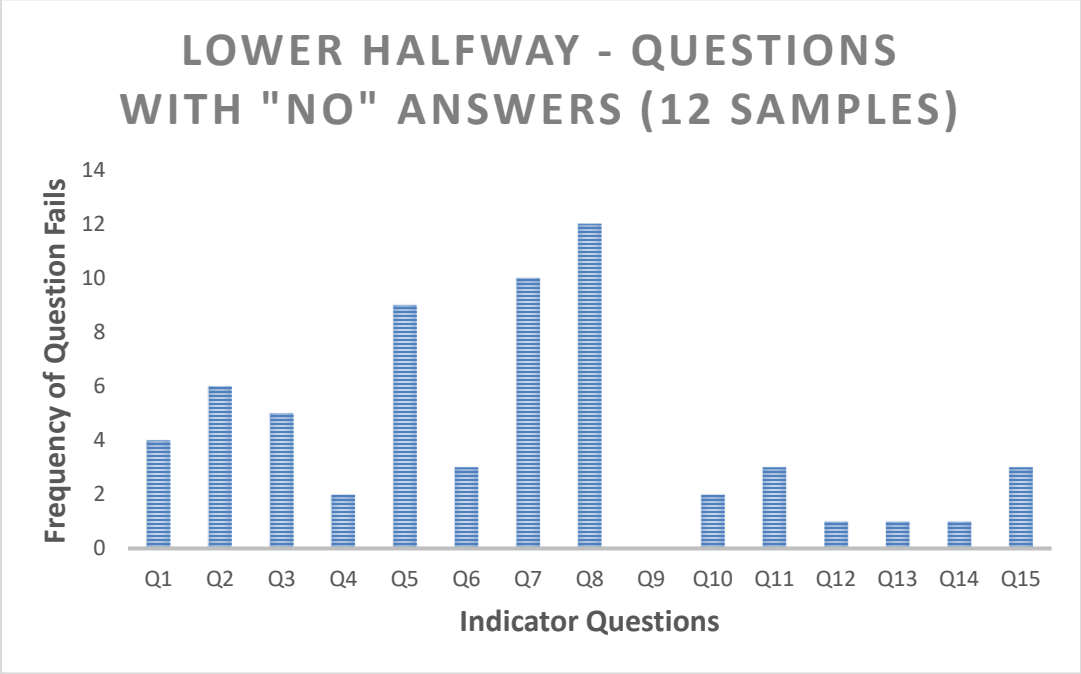


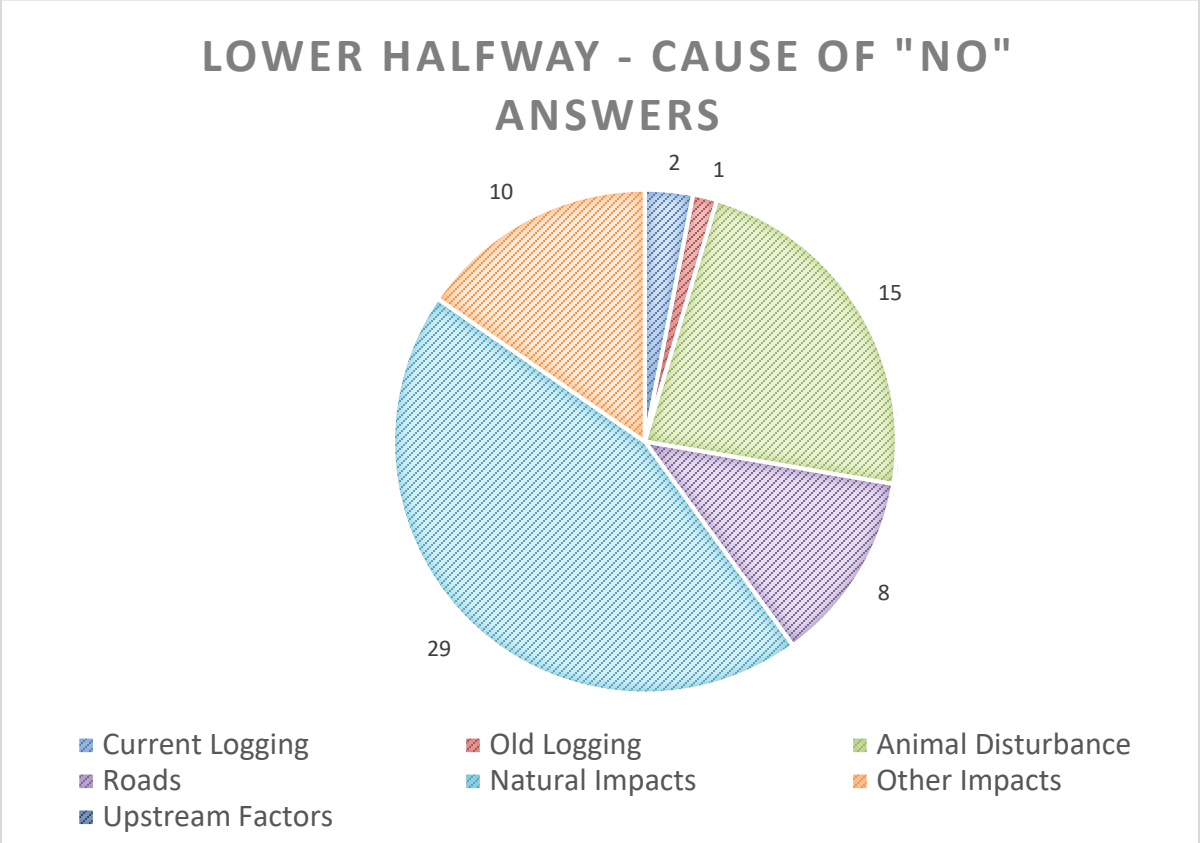
Overview of the locations of the sample sites visited in the Lower Kiskatinaw.

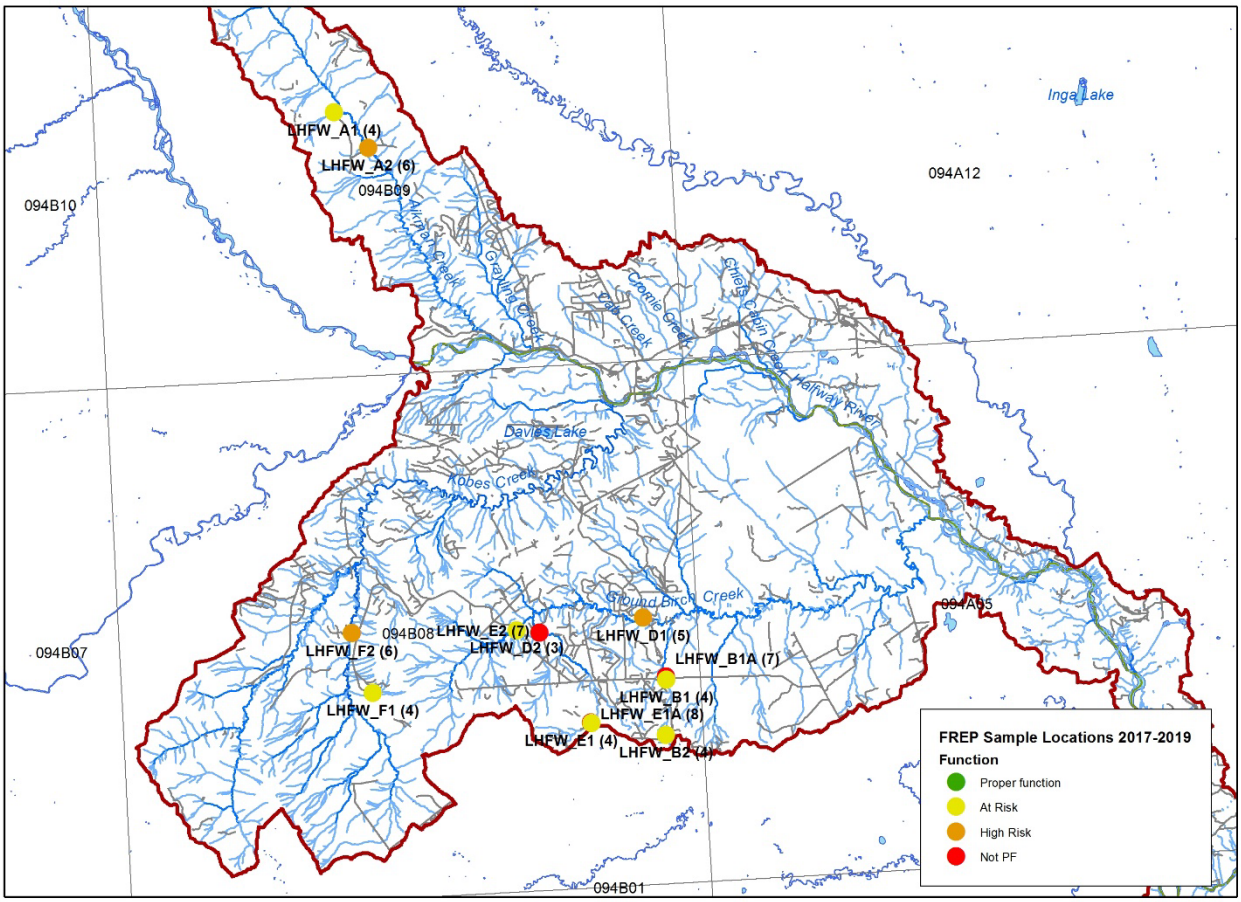
Lower Halfway Assessment Outcomes:

The twelve (12) assessments in the Lower Halfway revealed that impacts on functioning condition are mainly from natural sources related to mass wasting (channel bed and banks) and flooding (LWD processes). A significant number of sites (6 sites) were also impacted by beavers creating channel blockages (Q5), but the beaver also affect channel bed (Q1) and banks (Q2), sediment migration (Q8) and increased embedding of moss (Q7). The presence of pipeline construction (recent and current) was also a contributor to impaired riparian function on two of the sites, affecting channel banks (Q2), LWD processes (Q3), fish habitat diversity (Q6), impacts to moss (Q7) and sediment delivery (Q8), inadequate LWD supply (Q12), elevated levels of disturbance increasers in the riparian area (Q14) and a riparian area lacking forest structure attributes (Q15). Road surface erosion accounts for a noticeable level of impact at two sites and primarily affecting moss (Q7) and sediment levels (Q8), but also channel bed (Q1), channel morphology (Q4) and fish cover diversity (Q6). Recent logging at two sites resulted in accelerated windthrow (Q10). Construction of oil and gas installation, construction and maintenance of roads, and the development of new harvesting cutblocks are strategic areas where additional care and attention to mitigating impacts to riparian function can be readily undertaken. A recent road construction project downstream from one of the samples (sample A1) was observed and is another case where sediment delivery to a stream was directly impacting riparian function and yet need not occur if sediment delivery was more actively managed during construction.

Sample	Site	Outcome	Cause of No's	Functioning Condition	Comments of Main Issues
1 control	A1	4 No's	3-Natural, 1-Animal, 1-Old logging	Functioning but at Risk	High background fines, insects, flood damage, beavers, old logging
2 control	A2	6 No's	4-Natural, 4-Animals	Functioning but High Risk	Mass wasting & flood impacts, beavers
3	D2	3 No's	2-Natural, 1-Animals	Functioning but at Risk	Flooding and beavers
4	B2	4 No's	4-Animals	Functioning but at Risk	Beavers
5	B1A	7 No's	5-Roads, 2-Natural	Not Properly Functioning	Road erosion, flooding
6	B1	4 No's	4-Animals	Functioning but at Risk	Beavers
7	D1	5 No's	5-Natural	Functioning but High Risk	Mass wasting and flooding
8	F1	4 No's	3-Natural, 1-Current logging	Functioning but at Risk	Floods, recent windthrow
9	E1	4 No's	2-Other, 1-Natural, 1-Animals	Functioning but at Risk	New pipeline construction, flooding, beavers
10	F2	6 No's	3-Roads, 2-Natural, 1-Current logging	Functioning but High Risk	Road erosion, flooding, recent windthrow
11	E2	7 No's	7-Natural	Not Properly Functioning	Mass wasting and flood
12	E1A	8 No's	8-Other	Not Properly Functioning	New pipeline construction


LOWER HALFWAY - QUESTIONS WITH "NO" ANSWERS (12 SAMPLES)
Frequency of Question Fails
14
12
10
8
6
4
2
0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Indicator Questions


LOWER HALFWAY - CAUSE OF "NO" ANSWERS
2
1
10
15
8
29
Current Logging
Old Logging
Animal Disturbance
Roads
Natural Impacts
Other Impacts
Upstream Factors



Overview of the locations of the sample sites visited in the Lower Halfway.

Mitigation of Stream Impacts:

Landforms with steep slopes of fine textured soils can be a challenge for developing and managing oil and gas resources. Of significant importance is the risk to developing on unstable slopes where subsequent mass wasting (slides and slumps) will directly impact streams and rivers. Where mass wasting is active, stakeholders need to consider how to cost-effectively mitigate or minimize the erosion and deposition of fine textured materials into the streams. Where new development plans would bring construction into sensitive soils and landforms at or near streams, the OGC should work with stakeholders to explore Best Management Practices to prevent subsequent mass wasting.

The sampling in 2019 identified opportunities where the negative impacts related to road crossings could be avoided or at least lessened. OGC can promote the needs to plan, construct, maintain and deactivate roads to minimize the transport of fines to streams. Crossings (in-service or decommissioned) should be managed to ensure mobilized woody debris does not create a blockage and risk washing out or over the road (photo 2). Cross ditches should be installed on inactive roads to divert surface water away from streams; and once installed, these should be maintained to ensure they are functioning (photo 3). Where road surfaces are hydrologically linked (photos 4, 10) to the streams (transporting fine sediments into the stream), road construction and maintenance efforts should be taken, such as:

- Construct and maintain a crowned road surface that will shed water and fines into ditches and into the forest;
- Ensure culvert inlets are maintained free of debris; replace culverts when the inlet is damaged by grading efforts (restrictions to flow result is sediment build-ups);
- When grading a road, ensure the grader berms are breached periodically to enable surface water to escape from the road and into the forest;
- Install sediment traps and sumps when ditches are connected to the stream (and maintain these features);
- To lessen the hydrologic supply of water and fines to a stream, install cross-drain culverts where there are long ditch lines connected to stream crossings;
- Raise the approach to stream crossings (photo 5) to minimize the length of road surface delivering fines to the stream;
- Armor highly erodible road surfaces at the stream crossings to lessen sediment delivery during road use; and
- Ensure properly sized culverts are installed for the discharge of the stream.

In addition to the road construction and maintenance measures mentioned above, management practices to minimize cattle impacts (photo 6) to streams are also required. Negative impacts can be minimized by maintaining natural range barriers, installing new/additional barriers during harvesting and oil and gas installations along sections of the creeks and/or building watering ponds and troughs which are out of the stream channel, especially in areas where stream banks are sensitive and experiencing mass wasting.

The OGC should promote a practice of modifying the level of development (clearing width) for pipelines constructed in riparian reserve zones and riparian management zones (photo 7). This could be achieved by developing best management practices for installations within riparian zones that prescribe partial retention of bank-anchored vegetation (shrubs, understory and low-stature trees) within 5-m of streams, spreading large woody debris over cleared areas after installations, and minimizing the clearing widths. A minimum 5-m “light touch” alongside streams would help to maintain the buffering capacity, bank stability and resistance to increases in peak flow and erosion. Promote the recovery of woody shrubs and trees along cleared seismic and pipeline access routes that cross streams. Such efforts will encourage a greater buffering capacity, bank stability and resistance to increases in peak flows. Where sites are being decommissioned, consider deactivating access and seismic lines by installing cross drains to break the long gradient approaches to streams. If sediment control measures are installed, these also need to be maintained or replaced if they are ineffective (photo 8).

Beaver are creating havoc at a number of the sites visited during this project. Their activities are flooding large sections of the riparian area. Beaver dams constructed at or near road crossings (photo 9) further exacerbates sediment delivery to streams and hinder connectivity for fish, sediment and woody debris migration processes along a stream. Installing deterrents at culvert inlets (and cleaning these out) are effective control measures.

PHOTO 1: View of extensive mass wasting, where sediment delivery is exceeding the capacity of the stream to transport and redistribute these inputs. Site F1, Lower Pine.

PHOTO 2: A burnt bridge and now debris jam forces the stream to flood and overflow the banks and deactivated road. Site M4 in the Cameron.

PHOTO 3: Continued sediment delivery by recreation ATV users at site I1 in the Lower Pine.

PHOTO 4: Road approaches will transport fines into a stream if the surface drainage is hydrologically connected to the stream. Site N2A at the Cameron.

PHOTO 5: Raised bridge crossings and importing coarse fill are effective measures to reducing fine sediment delivery to streams. Site C2, Lower Petitot.

PHOTO 6: Example of cattle impacts to the stream and riparian area, causing bank damage and sediment delivery. Site G1 at Lower Kiskatinaw.

PHOTO 7: Example of the clearing widths for a pipeline. Consider modifying the clearing widths when passing through riparian zones. Site I1, Lower Pine.

PHOTO 8: View of sediment delivery controls installed (red arrows) at construction but no longer maintained – sediment delivery is active and impacting riparian function. Site N2A at the Cameron.

PHOTO 9: Example of the impasse a beaver dam has created, resulting in extensive bank disturbance and sediment aggradation upstream. Site R3, Cameron.

PHOTO 10: View of new road construction where surface sediment is flowing directly into the stream at the crossing (red arrow). Site A1, Lower Halfway.

Riparian Assessment and Monitoring Discussion

The interest by the OGC, and stakeholders like Halfway River First Nations, to use the FREP assessment process in assessing the status of riparian function is commendable. Modifying some of the methodologies and measurement references to adapt to the specific needs of the OGC and Stakeholders is encouraged. For example, the time since disturbance dictates how one assesses various riparian functioning elements (bank erosion, windthrow, etc). Some of the site reference information may need to be elaborated to help tie the assessment to installations (e.g, well reference number, seismic line or pipeline, or service road).

The FREP assessment process for field sampling is based upon a randomized listing of sites harvested within the past 1-3 years within the resource district. Field assessment is subsequently easy to accomplish because access to the sites is current, and stakeholders get feedback of how their management actions are affecting the riparian function of the streams sampled, enabling them to adjust their practices accordingly. Essentially the FREP program captures trends in current management practices and their resulting effects on riparian function. In addition, personnel may encounter problem sites requiring early intervention or further study.

The OGC sampling process was similarly randomized to identify several potential sites that would give an indication of the relative functioning condition of streams within the selected watershed basins. The data from the 2017, 2018 and 2019 field seasons will provide a summary of the range of riparian function within these sampled watersheds. The use of FREP data already gathered by the Peace District can also be utilized to build a larger inventory of stream data and functioning condition to further assist the OGC in its stewardship monitoring and compliance efforts. The next steps for the OGC and Stakeholders may now be to focus subsequent assessments closer to current operational activities to capture the general state of riparian management – with a focus on visiting pipeline crossings and access construction, maintenance and deactivation.

Recommendations:

- Pre-field planning efforts to confirm access and eligibility of potential stream reaches was a significant success of the 2019 season. This planning effort hastened the time required to access and evaluate the streams, compared to the earlier sampling years. Knowing the history of the site and obtaining the level of catchment development prior to field sampling will also help accurately attribute causal factors to any known impacts. Knowing the fishery status of each sample site prior to visiting the site is needed; in this project, all low gradient streams were classed as fishery status unless non-fish status was communicated by locals.
- The OGC could better inform stakeholders about the impacts of stream management by undertaking these riparian assessments on streams near current installations (well sites, access roads, seismic lines, etc). The periodic assessments of active installations would support a performance monitoring system for implemented mitigations and management responses.
- Consider re-sampling in areas where remedial measures are taken to protect streams. This follow-up sampling at 5 years post construction, deactivation or remediation would help capture the recovery of riparian function.
- Plans for additional sampling is 2020 should commence as early as possible to optimize dry road conditions and low stream flows. Consider augmenting the sampling at the Doig and Lower Petitot, which were under sampled because of access issues.

Prepared and respectfully submitted by,
Integra Forest Consulting Ltd.
Dean McGeough, R.P.F.

Appendix 1

FREP Routine Riparian Effectiveness Evaluation Field Checklist (2019)

Sample No. _____ Date Y Y Y Y / M M / D D Evaluator(s) _____

Stream/Opening Identification

District: _____ Opening ID: _____ Licensee: _____

Forest licence: _____ Block: _____ Harvest year: _____

Stream name: _____

Harvest location: Both sides ☐ Left side ☐ Right side ☐

Stream location: Within block ☐ Adjacent to block(s) ☐

Stream class (plan) ___ (field) ___ Not a high value S6 ☐ Harvest method: _____

Stream order: _____ Stand age (yrs): Left _____ Right _____

Number of road crossings: Above reach in block: _____ Above block: _____

% of watershed developed upstream: _____ Main development(s): _____

Reach location: _____ to _____ m US ☐ DS ☐ from _____

UTM at US ☐ DS ☐ End of reach: Zone: _____ East: _____ North: _____

Channel width (m): _____ Channel depth (m): _____ Channel gradient (%): _____

Wetted width (m): _____ Wetted depth (m): _____ D95 (cm): _____ D50 (cm): _____

Dominant substrate: Bedrock ☐ Boulders ☐ Cobbles ☐ Gravel ☐ Sand ☐ Fines ☐

Channel morphology: Riffle-cascade/pool ☐ Step/pool ☐ Non-alluvial ☐

Water pH _____ Temp _____ Total reach length (m) _____

Riparian Retention Information (Do not factor road crossings into width measurements)

	Left Side	Right Side
Length of sample reach with full retention (m):	_____	_____
Length of sample reach with partial retention (m):	_____	_____
Average width of full retention present (max. 100 m):	_____	_____
Average width of partial retention present (max. 100 m):	_____	_____
Average retention in partial retention area (% of basal area):	_____	_____
Average distance (m) from stream edge to trees or stumps:	_____	_____

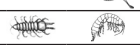
Photographs

Sample No. _____

Field Data

Question Indicator	Point Indicators (Measure at 6 equidistant points or transects along the reach)							Total	Mean
	Transect No.	1	2	3	4	5	6		
NA	Width of buffer strip on left side								
NA	Width of buffer strip on right side								
Q7(a)	% Moss								
Q8 (a)	% Fines/sands in riffles								
Q9 (a)	No. sensitive invertebrate types								
Q9 (b)	No. major invertebrate groups								
Q9 (c)	No. insect types								
Q9 (d)	Total No. invertebrate types								
Q13 (b)	% Shade								
Q14 (a)	% Disturbance – increaser species								
Q14 (b)	% Noxious weeds/invasives								

Record the number of different types of invertebrates observed in each sub-group, at each transect sampled. The numbers recorded under each "transect number" are the numbers you use to complete the point indicators table above.

Major Group	Sub Group	Sensitivity	Transect Number					
			1	2	3	4	5	6
Insects	Mayflies 	Yes						
	Stoneflies 	Yes						
	Caddisflies 	Yes						
	Chironomids ('midges') 	No						
	Other Diptera 	No						
	Riffle beetle larvae 	Yes						
	Other beetle larvae, adults 	No						
Bivalves	Clams, mussels 	Yes						
Snails	Right side snails 	Yes						
	Left side snails 	No						
Flatworms	Flatworms ("Planaria") 	No						
Nematodes	Nematodes 	No						
Worms	Segmented worms 	No						
Crustaceans	Crustaceans 	No						
Arachnids	Spiders, mites 	No						
Others	Consult field guide in Appendix 2 of Protocol for identification of "other" invertebrates and their sensitivity.							

Sample No. _____

Field Data					
Question No. (Indicator)	**Stream Types**	**Continuous Indicators** (These are measured all along the reach to determine total length, numbers or areas present, as appropriate. Record the totals in the "Total" column, even if the total is an estimate. Calculate the percentage of the reach length, riparian area or number of trees represented by each total.)		**Total**	**%**
Q1(a)	RC	Mid-channel bars, wedges (m), measure all but no overlap			
Q1(c)	RC	Lateral bars (m), measure all but no overlap			
Q1(b,c)	RCS	Multiple or braided channels (m), measure all but no overlap			
Q1(a)	Non-alluvial	Moss along the channel bed (m), measure all but no overlap			
Q2	All	Naturally erodible banks (m), measure all but no overlap			
Q2(a,a,b)	All	Recently disturbed bank (m), measure all but no overlap			
Q2(c,c)	RCS	Stable undercut bank (m), measure all but no overlap			
Q2(b,b,a)	All	Shallow rooted banks (m), measure all but no overlap			
Q2(d,d,c)	All	Recently upturned bank root wads, (m) measure all but no overlap			
Q4(a)	RC	Pool length (m)			
Q10	All	No. New windthrow (live trees only)			
Q10	All	No. Old windthrow (but alive when windthrown)			
Q10	All	No. Standing trees			NA
Q11(a)	All	Bare erodible ground in first 10m (m^2), do not include active roads			
Q13(a)	All	Bare erodible ground exposed to rain in first 10m (m^2, do not include active roads)			
Q11(b)	All	Bare erodible ground in first 10m, **plus** all bare soil hydrologically connected to first 10m (m^2)			
Q11(c)	All	Compacted (disturbed) ground in first 10m (m^2, do not include active roads)			
Q11(d)	All	Compacted (disturbed) ground in first 10m, **plus** all compacted (disturbed) ground hydrologically connected to first 10m (m^2)			

% New Windthrow = (# New Windthrow) / (# New Windthrow + # Standing Trees) X 100
% Old Windthrow = (# Old Windthrow) / (# Old Windthrow + # New Windthrow + # Standing Trees) X 100

Sample No. _____

Other Indicators to Note (Answer Yes, No, or NA as appropriate for the questions)				
Q01-04	**Boulder Line/Step Pool Characteristics – For Step-Pool Streams Only** (Use Table 1 to help answer the questions)	**Yes**	**No**	**NA**
Q1(a)	Do 50% or more of the boulder lines/steps span the channel?	☐	☐	☐
Q1(b)	Do 25% or more of the boulder lines/steps have moss?	☐	☐	☐
Q4(a)	Do 25% or more of the boulder lines/steps have plunge pools as deep as the largest rock in the line?	☐	☐	☐
Q4(b)	Do cascades lacking boulder lines/steps represent less than 25% of the reach?	☐	☐	☐
Q01	**Sediment and LWD Storage Characteristics – For Non-Alluvial Streams Only**			
Q1(b)	Do sediment and/or LWD deposits that completely fill the channel up to the top of the banks represent less than 5% of the reach length?	☐	☐	☐
Q1(c)	Are moveable sediments widely distributed in small pockets along the whole stream reach, not concentrated in a few relatively large compartments?	☐	☐	☐
Q03	**Wood Characteristics** (Use Table 2 to help answer the questions. Q3(b) is NA for non-alluvial streams)			
Q3(a)	Is the wood in the channel mainly “old”?	☐	☐	
Q3(b)	Do 1-12 accumulations of wood span the channel?	☐	☐	☐
Q3(c,c,b)	Do half or more of the wood accumulations present lack “new” wood?	☐	☐	
Q3(d,d,c)	Is the wood in the channel mainly across or diagonal to the main axis of the stream, not parallel?	☐	☐	
Q3(e,e,d)	Is the wood in the channel intact; i.e. not recently lost or moved by hand, catastrophic floods, debris flows, debris torrents?	☐	☐	
Q04	**Surface Sediment Texture – For Riffle and Cascade Pool Streams Only**			
Q4(b)	Is the texture of the surface substrate mainly heterogenous?	☐	☐	☐
Q04	**Deep Pools – For Riffle, Cascade, and Step Pool Streams Only**			
Q4(b)	Are two or more deep pools present? (Tip: A deep pool is a pool whose depth from the deepest spot of the pool to the top of the bank is twice the same depth at riffle crests)	☐	☐	☐
Q05	**Connectivity**			
Q5(a)	Are temporary blockages to fish, sediment or debris absent?	☐	☐	
Q5(b)	Is down-cutting that blocks fish movements or isolates the channel from the adjacent floodplain absent?	☐	☐	
Q5(c)	Are sediment or debris buildups absent at or in all crossing structures?	☐	☐	☐
Q5(d)	Is down-cutting below any crossing structure that blocks fish movements upstream by any size fish at any time absent?	☐	☐	☐
Q5(e)	Are all crossing structures on fish bearing streams open-bottomed structures?	☐	☐	☐

Sample No. _____

Other Indicators to Note (Answer Yes, No, or NA as appropriate for the Questions)				
Q05	**Connectivity** (continued)	**Yes**	**No**	**NA**
Q5(f)	Is dewatering absent?	☐	☐	
Q5(g)	Are trails, roads or levees that isolate off-channel areas or divert normal overland flow away from the reach absent?	☐	☐	
Q5(h)	Is all water in the stream still flowing in its original channel, not withdrawn or diverted elsewhere?	☐	☐	
Q06	**Fish Cover Diversity – For Fish-Bearing Streams Only** (To be considered present, each type of cover should cover 1% or more of the total channel area)			
Q6(a)	Are deep pools present?	☐	☐	☐
Q6(b)	Are unembedded boulders present?	☐	☐	☐
Q6(c)	Is woody debris or other organic debris present?	☐	☐	☐
Q6(d)	Are undercut banks present?	☐	☐	☐
Q6(e)	Is aquatic vegetation present?	☐	☐	☐
Q6(f)	Is overhanging vegetation present?	☐	☐	☐
Q6(g)	Are there stable gravels and cobbles present with spaces for fish to hide in?	☐	☐	☐
Q08	**Fine Inorganic Sediments**			
Q8(a)	Are riffles or pool/riffle breaks free of fine or sand/sized inorganic sediments that “blanket” the streambed?	☐	☐	☐
Q8(b)	Is the channel free of “quick sand” or “quick gravel”?	☐	☐	☐
Q8(c)	Is the substrate mostly unembedded?	☐	☐	☐
Q13	**Bank Microclimate**			
Q13(c)	Are moisture-loving plants present and in good condition?	☐	☐	
Q13(d)	Are the bank soils all moist and cool?	☐	☐	
Q15	**Riparian Structure** (Use Table 3 to help answer this question)			
Q15(a)	Does the distribution and relative abundance of the vegetation layers and forest components present collectively approach 75% of what the healthy unmanaged riparian plant community would normally be along the reach?	☐	☐	
Q15	**Riparian Form, Vigor, and Recruitment** (Use Table 4 to help answer this question)			
Q15(b)	Does the form, vigor and recruitment of the vegetation layers or forest components present collectively approach 75% of what the healthy unmanaged riparian plant community would normally be along the reach?	☐	☐	
Q15	**Browsing, Grazing**			
Q15(c)	Is heavy browse absent? (TIP: Mark “No” if even one plant shows heavy browse)	☐	☐	
Q15(d)	Is most (90%) of the available forage free of heavy grazing?	☐	☐	

Sample No. _____

Field Data Summary Tables

Table 1. Boulder-line/step characteristics of step-pool type reaches (Q1B, Q4B)

Number of boulder lines/ steps	Number of channel spanning boulder lines/steps	Number of boulder lines/ steps with moss	Number of boulder lines/ steps with a deep plunge pool	Length of reach with no boulder steps and plunge pools

Table 2. Wood characteristics of sample reach (Q3)

Number of wood Accumulations	Number of wood accumulations with new, recently deposited wood	Number of channel spanning wood accumulations (NA for non-alluvial streams)	Main age of wood in each accumulation (Record "O" for old, "N" for new)	Main orientation of wood in each accumulation (Record "P" for parallel, "X" for across or diagonal)

Table 3. Riparian Structure (Q15a) Using the table below, estimate whether the distribution or relative abundance of the forest components present collectively approach 75% of what the healthy unmanaged riparian plant community would normally be along the reach.

Snags (%)	Gaps (%)	Over-story trees (%)	Under-story trees (%)	Tall shrubs (%)	Low shrubs (%)	Herbs (%)	Mosses (%)	Lichens (%)	CWD (%)	Total (Sum of %'s)	Average % (Answer to Q15a)

Table 4. Riparian Vegetation Form, Vigor, and Recruitment (Q15b) Using Yes or No answers for each table cell below, determine if 75% or more of the cells have Yes answers, indicating that, collectively, form, vigor and recruitment is satisfactory.

	Snags	Gaps	Over-story trees	Under-story trees	Tall shrubs	Low shrubs	Herbs	Mosses	Lichens	CWD	Total possible number of Yes answers	Actual number of Yes answers	% of cells with Yes answers (Answer to Q15b)
Form													
Vigor	NA	NA								NA			
Recruitment													

Sample No. _____

Riparian Effectiveness Routine Evaluation Checklist

Question 1. Is the channel bed undisturbed?	**Yes** ☐	**No** ☐
Note: For Question 1, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A, B or C)		
A) Riffle-pool or cascade-pool channels		
a) Does less than 50% of the reach have active sediment wedges or mid-channel bars?	☐	☐
b) Does less than 50% of the reach have active multiple channels and/or braids?	☐	☐
c) Does more than 50% of the reach have lateral bars?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 1. Otherwise mark the "No" box.		
B) Step-pool channels		
a) Do more than 50% of the steps present span the channel?	☐	☐
b) Do more than 25% of the steps have moss?	☐	☐
c) Does less than 25% of the reach have active multiple channels and/or braids?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 1. Otherwise mark the "No" box.		
C) Non-alluvial channels		
a) Does 25% or more of the channel bed length have moss on the substrate?	☐	☐
b) Do moveable sediments and/or debris deposits that completely fill the channel up to the top of the banks represent less than 5% of the total reach length?	☐	☐
c) Are moveable sediments widely distributed in small pockets along the whole stream reach, not concentrated in a few relatively large compartments?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 1. Otherwise mark the "No" box.		

Please refer to "What is Stream Channel Morphology" in the riparian protocol for descriptions, tables and figures on channel morphology. If you are using the summary table that describes the general features of each type of channel morphology, base your decision on all the characteristics listed. The degree of channel incisement and the presence or absence of floodplains formed by sediments deposited by the stream and later vegetated are key criteria. If a stream is not meandering or depositing sediments that will eventually re-vegetate (i.e. "alluvial"), but just cutting through peat lands, colluvial deposits or glacial fluvial deposits and not adding material to the adjacent areas, call these streams non-alluvial.

Sample No. _____

Question 2. Are the channel banks intact?	**Yes** ☐	**No** ☐
Note: For Question 2, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A, B or C)		
A) Riffle-pool or cascade-pool channels		
a) Does less than 15% of the total reach length have recently disturbed banks (e.g. banks disturbed by stream flows, sloughs, slumps, windthrow, infilling, animals, roads, or harvest and silviculture activities)?	☐	☐
b) Are more than 65% of the banks on naturally erodible sections of the reach deeply rooted?	☐	☐
c) Does more than 50% of the naturally erodible reach length have stable undercut banks?	☐	☐
d) Does less than 10% of the total reach length have recently upturned (wind thrown) root wads along the banks?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 2. Otherwise mark the "No" box		
B) Step-pool channels		
a) Does less than 10% of the total reach length have recently disturbed banks (e.g. banks disturbed by stream flows, slumps, sloughs, windthrow, infilling, animals, roads, or harvest and silviculture activities)?	☐	☐
b) Are more than 75% of the banks on naturally erodible sections of the reach deeply rooted?	☐	☐
c) Does more than 50% of the naturally erodible reach length have stable undercut banks?	☐	☐
d) Does less than 25% of the total reach length have recently upturned (wind thrown) root wads along the banks?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 2. Otherwise mark the "No" box		
C) Non-alluvial channels		
a) Does less than 10% of the total reach length have recently disturbed banks (e.g. banks disturbed by stream flows, sloughs, slumps, windthrow, infilling, animals, roads, or harvest and silviculture activities)?	☐	☐
b) Are more than 75% of the banks on naturally erodible sections of the reach deeply rooted?	☐	☐
c) Does less than 25% of the total reach length have recently upturned (wind thrown) root wads along the banks?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 2. Otherwise mark the "No" box		

Please refer to the Riparian Protocol for more descriptions of stable, vegetated undercut banks versus unstable, overhanging banks.

Sample No. _____

Question 3. Are channel LWD processes undisturbed?	**Yes** ☐	**No** ☐
Note: For Question 3, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A, B or C)		
A) Riffle-pool or cascade-pool channel		
a) Is wood in the channel mainly old and/or stable?	☐	☐
b) Do one to twelve accumulations of wood span the channel?	☐	☐
c) Do half or more of all wood accumulations present lack new or recently deposited wood that is unstable?	☐	☐
d) Is wood in the channel mainly across or diagonal to the main axis of the channel, not parallel?	☐	☐
e) Is the wood in the channel mostly intact, (i.e. not recently lost or moved by hand, floods, debris torrents, debris flows)?	☐	☐
If there are 4 or more "Yes" answers, mark the "Yes" box for Question 3. Otherwise mark the "No" box.		
B) Step-pool channel		
a) Is wood in the channel mainly old and/or stable?	☐	☐
b) Are one to twelve accumulations of wood present in the channel?	☐	☐
c) Do half or more of all wood accumulations present lack new or recently deposited wood that is unstable?	☐	☐
d) Is wood in the channel mainly across or diagonal to the main axis of the channel, not parallel?	☐	☐
e) Is the wood in the channel mostly intact, (i.e. not recently lost or moved by hand, floods, debris torrents, debris flows)?	☐	☐
If there are 4 or more "Yes" answers, mark the "Yes" box for Question 3. Otherwise mark the "No" box.		
C) Non-alluvial channel		
a) Is wood in the channel mainly old and/or stable?	☐	☐
b) Do half or more of all wood accumulations present lack new or recently deposited wood that is unstable?	☐	☐
c) Is wood in the channel mainly across or diagonal to the main axis of the channel?	☐	☐
d) Is the wood in the channel mostly intact, (i.e. not recently lost or moved by hand, floods, debris torrents, debris flows)?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 3. Otherwise mark the "No" box.		

TIP: "Old" wood is wood that is stable, and well incorporated into the streambed, streambanks or pre-existing log jams. The wood is usually mossy. "New" wood is any wood that is not yet stable or well incorporated into the streambed, streambanks or stable log jams. New wood is usually wood that was recently deposited after road building and the latest harvesting was started. This could include stems or branches that were blown off trees after harvesting started, or old wood that has recently moved and is no longer stable. TIP: If half or more of the reach length is completely filled with wood, consider this to be more than 12 accumulations of wood.

Sample No. _____

Question 4. Is the channel morphology intact? (Mark NA if the channel is non-alluvial, and therefore lacking a riffle-pool, cascade-pool or step-pool morphology)	**Yes** ☐	**No** ☐	**NA** ☐
Note: For Question 4, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A or B)			
A) Riffle-pool or cascade-pool channel			
a) Are pools present along >25% of the reach?	☐	☐	
b) Is the surface sediment texture mainly heterogenous and well sorted, i.e. is the range of sediment classes (sands, gravel, cobbles, etc.) present on the streambed large and well sorted by water?	☐	☐	
c) Are two or more deep pools present? (A deep pool is a pool with a channel depth twice the average channel depth at riffle crests).	☐	☐	
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 4. Otherwise mark the "No" box.			
B) Step-pool channel			
a) Are plunge pools frequent, i.e. are >25% of the steps associated with a plunge pool with depths similar to the size of the largest rock in the step?	☐	☐	
b) Does the channel alternate almost exclusively between steps and pools (i.e. less than 25% of the channel consists of relatively long cascades)?	☐	☐	
c) Are two or more deep pools present? (A deep pool is a pool with a channel depth twice the average channel depth at the steps, i.e. the "riffle crests").	☐	☐	
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 4. Otherwise mark the "No" box.			

TIP: A stream reach can have aspects of both cascade-pool and step-pool morphology. Use the predominant morphology to decide which set (A or B) of indicator statements to use.

TIP: Steep streams (with gradients between approximately 5-15%) that look like long cascades could be step-pool streams that are filled in with abundant sediment. Even steeper streams (with gradients much greater than 15%) are probably non-alluvial, especially small streams.

TIP: Only measure the lengths of the main pools present. These are the pools that extend from one side of the wetted channel to the other. Do not include the small pools that are often present behind boulders in riffles or cascades or the small backwater or back eddy pools that might be present along the margins of riffles and cascades.

Sample No. _____

Question 5. Are all aspects of the aquatic habitat sufficiently connected to allow for normal, unimpeded movements of fish, organic debris, and sediments?	**Yes** ☐	**No** ☐	**NA**
a) Are temporary blockages to fish movements upstream or debris or sediment movements downstream absent (e.g. weirs, dams, culverts, beaver dams, impermeable log jams)?	☐	☐	
b) Is down cutting in the main channel that now isolates the floodplain from normal flooding or blocks access to tributary streams or off-channel areas absent?	☐	☐	
c) Are build-ups of sediment or debris above or within any crossing structure absent, i.e. is the ability of the crossing to transport water and sediments downstream unimpaired?	☐	☐	☐
d) Are all crossing structures free of any down cutting that blocks fish movements upstream by any size fish at any time?	☐	☐	☐
e) On fish bearing streams, are all crossing structures open bottom structures?	☐	☐	☐
f) Is dewatering over the entire channel width due to excessive new accumulations of sediment absent?	☐	☐	
g) Are all off-channel or overland flow areas still connected to the main channel, not isolated or cut off by roads or levees?	☐	☐	
h) Is all water in the stream still in the stream, not withdrawn or diverted elsewhere?	☐	☐	
If there are any "No" answers, mark the "No" box for Question 5. Otherwise mark the "Yes" box.			

TIP: For Question 5, part (a), consider a temporary blockage a "blockage" if more than 2/3 of the flow seeps through or spills over the blockage when the water level is close to the rooted edge. Note that active beaver dams will almost always be temporary blockages. TIP: "Down cutting" refers to channel incisement; i.e. the vertical movement of the channel downwards into the channel bed.

Question 6. Does the stream support a good diversity of fish cover attributes? To qualify as cover, each cover attribute should represent at least 1% of the total stream area observed. (Mark NA if the stream is non-fish bearing; i.e. classes S5 or S6)	**Yes** ☐	**No** ☐	**NA** ☐
a) Is deep pool habitat available?	☐	☐	
b) Are stable, unembedded boulders present?	☐	☐	
c) Are stable rootwads, woody debris or other organic material that fish can hide in present? "Other" organic debris is made up mostly of uncompacted leaf and/or wood particles that small fish can hide under.	☐	☐	
d) Are stable, deep-rooted undercut banks present?	☐	☐	
e) Is submerged or emergent aquatic vegetation present?	☐	☐	
f) Is overhanging vegetation present within 1 m of the top of the channel?	☐	☐	
g) Are stable unembedded gravels and cobbles with void spaces for fish to hide in present?	☐	☐	
If there are five or more "Yes" answers, mark the "Yes" box for Question 6. Otherwise, mark the "No" box.			

TIP: Question 6 is "NA" if the stream is non-fish bearing. Also, if there are no deep pools, there is no deep pool habitat.

Sample No. _____

Question 7. Does the amount of moss present in shallow areas of the channel indicate a stable and productive system? (Mark "NA" if the sample is all pool habitat or the streambed naturally lacks a stable mineral substrate for moss to grow on)	**Yes** ☐	**No** ☐	**NA** ☐
a) Are moss patches on stable mineral substrates easily observed from almost any point along the margins, riffles or shallow pools of the stream? Where visibility is poor, is average coverage on mineral substrates 1% or more of the channel bed?	☐	☐	
b) Are half or more of the moss patches present (even uncommon, occasional or rare patches) generally intact, not embedded with sediments, buried or damaged by scouring? Mark "NA" if no moss is present.	☐	☐	☐
c) Are moss patches generally vigorous, not stressed, dried or dead? Mark "NA" if no moss is present.	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 7. Otherwise, mark the "Yes" box.			

Question 8. Has the introduction of sand or fine sized inorganic sediments been minimized? (Mark "NA" when the largest mobile sediment present in the reach is sand from natural sources only)	**Yes** ☐	**No** ☐	**NA** ☐
a) Are inorganic ("gritty" feeling) fine and sand-sized sediments in riffles or critical spawning areas best described as little or lacking? Little or lacking is when average coverage in riffles or critical spawning areas is less than 10%, and no one area of this habitat equal to 1% or more of the total channel area is completely covered ("blanketed") with fines or sands.	☐	☐	
b) Are individual wetted areas of gravel or sand that a foot can be easily pushed or wiggled into all smaller than an area equal to 1% of the total channel area?	☐	☐	
c) Are gravels and cobbles unembedded in a matrix of sand or finer sized particles? Unembedded means that most of the gravel and cobbles are touching each other and easy to move.	☐	☐	
d) Is there an average of one or more sensitive invertebrate types at invertebrate sample sites? Mark "NA" if high water conditions prevent effective sampling or the sample sites are dry due to natural conditions.	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 8. Otherwise, mark the "Yes" box.			

TIP: If the stream banks from top to bottom on both sides are all naturally composed of sand or finer size sediments, then it is probable the fines on the streambed are also natural.

Question 9. Does the stream support a diversity of aquatic invertebrates? (Mark "NA" if high water conditions prevent effective sampling or sample sites are dry due to natural conditions)	**Yes** ☐	**No** ☐	**NA** ☐
a) Is an average of one or more sensitive invertebrate (e.g. a caddisfly, stonefly, mayfly or freshwater clam) present at the sites sampled?	☐	☐	
b) Is an average of two or more different major invertebrate groups (e.g. insects, worms, crustaceans, etc.) present at the sites sampled?	☐	☐	
c) Is an average of three or more recognizably different insects present at the sites sampled?	☐	☐	
d) Is an average of four or more recognizably different invertebrates present at the sites sampled?	☐	☐	
If there are two or more "Yes" answers, mark the "Yes" box for Question 9. Otherwise, mark the "No" box.			

Sample No. _____

Question 10. Has the vegetation retained in the RMA been sufficiently protected from windthrow? (Note: only dominant or co-dominant trees that were alive when they were windthrown count as windthrow).	**Yes** ☐	**No** ☐	**NA**
a) The incidence of post-treatment windthrow (living trees) in S1-S3 RRZs or S4-S6 RMZs with WTPs does not exceed 5% of the living stems, over and above what occurs naturally in the area. Mark NA and answer 10 b) if there is no reserve zone, or management zone with wildlife trees or wildlife tree patches.	☐	☐	☐
b) The incidence of post-treatment windthrow (living trees) in S4-S6 RMZs that are not part of a WTP does not exceed 10% of the living stems, over and above what occurs naturally in the area. Mark NA if there is a reserve zone or wildlife tree patch adjacent to the stream, and answer 10 a).	☐	☐	☐
c) Designated wildlife trees in S1-S6 RMAs are still standing, or if windthrown (living trees), still functional as wildlife trees (e.g. above-ground bear dens). Mark NA if there are no designated wildlife trees.	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 10. Otherwise, mark the "Yes".			

1. % *Old Windthrow* = $\frac{\textit{(\# Old Windthrow Trees)}}{\textit{(\# Standing Trees + \# Old Windthrow + \# New Windthrow)}}$ x 100

2. % *New Windthrow* = $\frac{\textit{(\# New Windthrow Trees)}}{\textit{(\# Standing Trees + \# New Windthrow)}}$ x 100

To calculate % new windthrow over and above the natural pre-treatment windthrow, subtract (1) from (2).

Question 11. Has the amount of bare erodible ground or soil compaction in the riparian area been minimized?	**Yes** ☐	**No** ☐
a) Is total bare erodible ground area present in the first 10 m of the riparian area (not counting active road right-of-ways) less than 1% of the total riparian area?	☐	☐
b) Is total bare erodible ground area present in the first 10 m of the riparian area, **plus** all other bare erodible ground hydrologically linked to the first 10 m of riparian area less than 5% of the total riparian area?	☐	☐
c) Is the total area compacted (disturbed) by animals or machinery in the first 10 m of the riparian area (not counting active road right-of-ways) less than 10% of the total riparian area?	☐	☐
d) Is the total area compacted (disturbed) by animals or machinery in the first 10 m of the riparian area, **plus** all other compacted areas hydrologically linked to the first 10 m of riparian zone less than 15% of the total riparian area?	☐	☐
If there are any "No" answers, mark the "No" box for Question 11. Otherwise, mark the "Yes" box.		

TIP: Sediment deposited on the ground from upslope sources is considered bare ground for Question 11, but not if the sediment is deposited due to flooding (i.e. over-bank deposits).

Sample No. _____

Question 12. Has sufficient vegetation been retained or managed to maintain an adequate root network or LWD supply?	Yes ☐	No ☐	NA
a) On all streams, are all under-story trees taller than 1.3 m, shrubs, and herbaceous vegetation present to the fullest extent possible within 5 m of the stream banks?	☐	☐	
b) On S1 to S3 size streams, is the first 10 m of the riparian reserve zone intact (regardless of windthrow), thereby providing for 80% or more of the LWD normally supplied to streams with no additional inputs from upstream or the adjacent hillslopes?	☐	☐	☐
c) On S4 streams, where the windthrow hazard was not assessed, or where windthrow hazard was assessed as not high, are all windfirm trees with roots embedded in the bank, and 50% of all other trees (excluding dominant conifers) within 10 m of the stream banks still present?	☐	☐	☐
d) On S4 streams, where the windthrow hazard was assessed as high, are all under-story trees taller than 1.3 m present within 10 m of the stream banks, to the fullest extent possible?	☐	☐	☐
e) On valley bottom S5 streams with alluvial banks and a floodplain, are 50% of dominant and codominant windfirm stems within 30 m of the stream banks still present?	☐	☐	☐
f) On non-valley, LWD dependent S5 streams, are all leaners within 10 m of the stream banks and all under-story trees taller than 1.3 m within 5 m of the streambank still present to the fullest extent possible?	☐	☐	☐
g) On LWD dependent S6 streams, or S6 that flow directly into fish-bearing waters, are at least 10 under-story trees taller than 1.3 m present within 5 m of the stream banks?	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 12. Otherwise, mark the "Yes" box.			

TIP: All streams require an answer to indicator statement 12 (a). At most, only one other indicator statement will be applicable. Right-of-ways should not be considered a factor for Question 12 unless the right-of-ways represent more than 25% of the riparian habitat.

Question 13. Has sufficient vegetation been retained to provide shade and reduce bankmicroclimate change?	Yes ☐	No ☐
a) With the exception of active roads at stream crossings, is the bare erodible ground directly exposed to rain less than 1% of the riparian area?	☐	☐
b) Does shade (the average amount of sky not visible due to vegetation) average more than 60%, as estimated visually for any two of the east, south and west aspects at 60° above the horizontal?	☐	☐
c) Are moisture loving macrophytes, mosses, ferns or other bryophytes present and in vigorous condition, with no indication of stress due to sunburn, drought or desiccation?	☐	☐
d) Is the soil in the riparian habitat cool and moist to the touch?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 13. Otherwise, mark the "No" box.		

Sample No. _____

Question 14. Have the number of disturbance-increaser species, noxious weeds, and/or invasive plant species present been limited to a satisfactory level?	**Yes** ☐	**No** ☐
a) Do disturbance-increaser plants (domestic grasses, dandelions, pineapple weed, buttercups, etc.) occupy less than 25% of total area in the first 10 m of the riparian zone?	☐	☐
b) Do noxious weeds and/or other invasive plant species occupy less than 5% of total area in the first 10 m of the riparian area?	☐	☐
If there are any "No" answers, mark the "No" box for Question 14. Otherwise, mark the "Yes" box.		

TIP: To estimate coverage by disturbance-increaser plants or weeds and other invasive plants at a sample site, record the percentage of two10 m long line transect (one on each side of the stream) that is occupied by these plants. Start the line transects at the edge of the stream and go 10 m at right angles to the main axis of the stream reach.

Question 15. Is the riparian vegetation and forest structure within the first 10 m from the edge of the stream generally characteristic of what the healthy unmanaged riparian plant community would normally be along the reach?	**Yes** ☐	**No** ☐
a) Are all the major vegetation layers and structural components of the expected healthy unmanaged riparian plant community (e.g. snags, CWD, gaps, tall trees, understory, tall shrubs, low shrubs, herbaceous plants, mosses and lichens) adequately represented? Adequate representation is 1) the presence of all expected layers and components over 75% of the reach, 2) 75% of the expected layers or components over all of the reach, or 3), any combination of 1) and 2) that collectively averages 75% or more.	☐	☐
b) Do the major vegetation layers and structural components of the expected healthy unmanaged riparian plant community exhibit good vigor, normal growth form, and satisfactory recruitment? Vigor or growth form is poor if plants are discolored, defoliated, brittle, burned, broken, heavily browsed, "mushroomed", wind thrown, harvested or dead. Mark "No" if collectively less than 75% of all the plants and structural components expected show good vigor, form, and recruitment.	☐	☐
c) Is heavy browse absent? Heavy browse on a plant is browse down to second year wood over most (>50% of the branches) of the plant.	☐	☐
d) Is 90% or more of the available grazing area free of heavy grazing? Heavy grazing is defined as less than the recommended target stubble height for the dominant forage species present.	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 15. Otherwise, mark the "No" box.		

TIP: All four statements can always be answered "Yes" or "No". There are no NA statements.

TIP: If more than 25% of the total reach length is more or less bare of vegetation, as could be the case at road crossings, then 15(a) and 15(b) should probably be marked "No". If more than 25% of all the vegetation along both sides of the total reach length is removed, as would be the case for a complete clearcut along the reach, then 15(a) and 15(b) would again be marked "No".

TIP: The answer to Q15(c) on browse is "No" if even one plant shows heavy browse. Please refer to the riparian protocol for a description of heavy browse.

Sample No. _____

Summary		Yes	No	NA
Question 1.	Is the channel bed undisturbed?	☐	☐	
Question 2.	Are the channel banks intact?	☐	☐	
Question 3.	Are channel LWD processes intact?	☐	☐	
Question 4.	Is the channel morphology intact?	☐	☐	☐
Question 5.	Are all aspects of the aquatic habitat sufficiently connected to allow for normal, unimpeded movements of fish, organic debris, and sediments?	☐	☐	
Question 6.	Does the stream support a good diversity of fish cover attributes?	☐	☐	☐
Question 7.	Does the amount of moss present on the substrates indicate a stable and productive system?	☐	☐	☐
Question 8.	Has the introduction of fine sediments been minimized?	☐	☐	☐
Question 9.	Does the stream support a diversity of aquatic invertebrates?	☐	☐	☐
Question 10.	Has the vegetation retained in the RMA been sufficiently protected from windthrow?	☐	☐	
Question 11.	Has the amount of bare erodible ground or soil compaction in the riparian area been minimized?	☐	☐	
Question 12.	Has sufficient vegetation been retained to maintain an adequate root network or LWD supply?	☐	☐	
Question 13.	Has sufficient vegetation been retained to provide shade and reduce bank microclimate change?	☐	☐	
Question 14.	Have the number of disturbance-increaser plants, noxious weeds and/or invasive plant species present been limited to a satisfactory level?	☐	☐	
Question 15.	Is the riparian vegetation within the first 10m from the edge of the stream generally characteristic of what the healthy unmanaged riparian plant community would normally be along the reach?	☐	☐	

of "Yes" answers: _____ + # of "No" answers: _____ + # of "NA" answers: _____ = Total # of answers: _____

Conclusion on Functioning Condition (check one):

- ☐ Properly Functioning (0-2 "No's")
- ☐ Functioning but at Risk (3-4 "No's")
- ☐ Functioning but at High Risk (5-6 "No's")
- ☐ Not Properly Functioning (>6 "No's")

List the questions that had a "No" answer below, and check what you believe was the main reason(s) for the problem. A "No" answer due to natural causes would include any natural events such as insects, fires, floods, slides, diseases etc. that were clearly unrelated to man's activities in the stream or adjacent riparian area. Check Logging, Livestock, Roads or Other Manmade as a cause if these factors directly affected the stream or riparian area assessed in this evaluation. Check Upstream Factors if the "No" answer was the result of some event or condition that occurred upstream, regardless if it was manmade or natural.

"No" answer questions	Causes of "No" Answers						
	Current Logging	Old Logging	Livestock	Roads	Other Manmade	Natural Events	Upstream Factors
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐

Sample No. _____

Specific Causes of "No" Answers and Proximity to Reach of Each Cause.

Check off each Question with a "No" answer, then beside each main specific cause that applies, record a 1 for within the reach, 2 for above the reach, and 3 for within and above the reach

Cause of "No" Answers	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐	11 ☐	12 ☐	13 ☐	14 ☐	15 ☐
OLD LOGGING															
Low retention															
Falling and yarding															
Machine disturbance															
Windthrow															
Mass wasting															
Stream diversions															
Road/debris blockages															
Forest structure issues															
Other															
CURRENT LOGGING															
Low retention															
Falling and yarding															
Machine disturbance															
Windthrow															
Mass wasting															
Stream diversions															
Road/debris blockages															
Other															
ROADS, TRAILS															
Encroachment on RMA															
Running surface erosion															
Other ROW erosion															
Mass wasting															
Crossing structure															
Other															
ANIMAL DISTURBANCE															
Livestock															
Beavers															
Other ungulates															
Humans															
Other															
NATURAL IMPACTS															
High sediment levels															
Fire															
Insects															
Diseases															
Wind															
Mass wasting															
Floods															
Other															
OTHER IMPACTS															
Non-logging roads, trails															
Utility corridors															
Recreation															
Agriculture															
Mining															
Urban, industry															
Other															
UNKNOWN															

Sample No. _____

Final Comments

	Yes	No
Does the conclusion on functioning condition generally agree with your personal opinion on the functioning condition of this stream reach? If not, please describe why not.	☐	☐
All "No" answers are weighted equally. Were any specific problems identified that affected the assessment more than others?	☐	☐
Were there any notable management practices prescribed and implemented on this stream? If so, please describe and comment on their effectiveness.	☐	☐
Is the sample reach a potential "Reference Stream" with no impacts in the reach due to human activity beside the reach and little human related activity in the watershed area upstream of the sample reach?	☐	☐
Were any invasive plants observed? Remember to complete an Invasive Plant field card if the answer is "Yes".	☐	☐
Was there WQ sampling completed at any upstream crossings? If so, please enter sample ID #'s.	☐	☐

Draw a map of the stream and illustrate the retention and location of other significant features present (e.g. roads, crossings, slides). Also mark the stream assessed on a map in a way that will be legible when scanned.

Sample No. _____ Date Y Y Y Y / M M / D D Evaluator(s) _____

Stream/Opening Identification

District: _____ Opening ID: _____ Licensee: _____

Forest licence: _____ Block: _____ Harvest year: _____

Stream name: _____

Harvest location: Both sides ☐ Left side ☐ Right side ☐

Stream location: Within block ☐ Adjacent to block(s) ☐

Stream class (plan) ___ (field) ___ Not a high value S6 ☐ Harvest method: _____

Stream order: _____ Stand age (yrs): Left _____ Right _____

Number of road crossings: Above reach in block: _____ Above block: _____

% of watershed developed upstream: _____ Main development(s): _____

Reach location: _____ to _____ m US ☐ DS ☐ from _____

UTM at US ☐ DS ☐ End of reach: Zone: _____ East: _____ North: _____

Channel width (m): _____ Channel depth (m): _____ Channel gradient (%): _____

Wetted width (m): _____ Wetted depth (m): _____ D95 (cm): _____ D50 (cm): _____

Dominant substrate: Bedrock ☐ Boulders ☐ Cobbles ☐ Gravel ☐ Sand ☐ Fines ☐

Channel morphology: Riffle-cascade/pool ☐ Step/pool ☐ Non-alluvial ☐

Water pH _____ Temp _____ Total reach length (m) _____

Riparian Retention Information (Do not factor road crossings into width measurements)

	Left Side	Right Side
Length of sample reach with full retention (m):	_____	_____
Length of sample reach with partial retention (m):	_____	_____
Average width of full retention present (max. 100 m):	_____	_____
Average width of partial retention present (max. 100 m):	_____	_____
Average retention in partial retention area (% of basal area):	_____	_____
Average distance (m) from stream edge to trees or stumps:	_____	_____

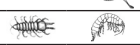
Photographs

Sample No. _____

Field Data

Question Indicator	Point Indicators (Measure at 6 equidistant points or transects along the reach)							Total	Mean
	Transect No.	1	2	3	4	5	6		
NA	Width of buffer strip on left side								
NA	Width of buffer strip on right side								
Q7(a)	% Moss								
Q8 (a)	% Fines/sands in riffles								
Q9 (a)	No. sensitive invertebrate types								
Q9 (b)	No. major invertebrate groups								
Q9 (c)	No. insect types								
Q9 (d)	Total No. invertebrate types								
Q13 (b)	% Shade								
Q14 (a)	% Disturbance – increaser species								
Q14 (b)	% Noxious weeds/invasives								

Record the number of different types of invertebrates observed in each sub-group, at each transect sampled. The numbers recorded under each "transect number" are the numbers you use to complete the point indicators table above.

Major Group	Sub Group	Sensitivity	Transect Number					
			1	2	3	4	5	6
Insects	Mayflies 	Yes						
	Stoneflies 	Yes						
	Caddisflies 	Yes						
	Chironomids ('midges') 	No						
	Other Diptera 	No						
	Riffle beetle larvae 	Yes						
	Other beetle larvae, adults 	No						
Bivalves	Clams, mussels 	Yes						
Snails	Right side snails 	Yes						
	Left side snails 	No						
Flatworms	Flatworms ("Planaria") 	No						
Nematodes	Nematodes 	No						
Worms	Segmented worms 	No						
Crustaceans	Crustaceans 	No						
Arachnids	Spiders, mites 	No						
Others	Consult field guide in Appendix 2 of Protocol for identification of "other" invertebrates and their sensitivity.							

Sample No. _____

Field Data					
Question No. (Indicator)	**Stream Types**	**Continuous Indicators** (These are measured all along the reach to determine total length, numbers or areas present, as appropriate. Record the totals in the "Total" column, even if the total is an estimate. Calculate the percentage of the reach length, riparian area or number of trees represented by each total.)		**Total**	**%**
Q1(a)	RC	Mid-channel bars, wedges (m), measure all but no overlap			
Q1(c)	RC	Lateral bars (m), measure all but no overlap			
Q1(b,c)	RCS	Multiple or braided channels (m), measure all but no overlap			
Q1(a)	Non-alluvial	Moss along the channel bed (m), measure all but no overlap			
Q2	All	Naturally erodible banks (m), measure all but no overlap			
Q2(a,a,b)	All	Recently disturbed bank (m), measure all but no overlap			
Q2(c,c)	RCS	Stable undercut bank (m), measure all but no overlap			
Q2(b,b,a)	All	Shallow rooted banks (m), measure all but no overlap			
Q2(d,d,c)	All	Recently upturned bank root wads, (m) measure all but no overlap			
Q4(a)	RC	Pool length (m)			
Q10	All	No. New windthrow (live trees only)			
Q10	All	No. Old windthrow (but alive when windthrown)			
Q10	All	No. Standing trees			NA
Q11(a)	All	Bare erodible ground in first 10m (m^2), do not include active roads			
Q13(a)	All	Bare erodible ground exposed to rain in first 10m (m^2, do not include active roads)			
Q11(b)	All	Bare erodible ground in first 10m, **plus** all bare soil hydrologically connected to first 10m (m^2)			
Q11(c)	All	Compacted (disturbed) ground in first 10m (m^2, do not include active roads)			
Q11(d)	All	Compacted (disturbed) ground in first 10m, **plus** all compacted (disturbed) ground hydrologically connected to first 10m (m^2)			

% New Windthrow = (# New Windthrow) / (# New Windthrow + # Standing Trees) X 100
% Old Windthrow = (# Old Windthrow) / (# Old Windthrow + # New Windthrow + # Standing Trees) X 100

Sample No. _____

Other Indicators to Note (Answer Yes, No, or NA as appropriate for the questions)				
Q01-04	**Boulder Line/Step Pool Characteristics – For Step-Pool Streams Only** (Use Table 1 to help answer the questions)	**Yes**	**No**	**NA**
Q1(a)	Do 50% or more of the boulder lines/steps span the channel?	☐	☐	☐
Q1(b)	Do 25% or more of the boulder lines/steps have moss?	☐	☐	☐
Q4(a)	Do 25% or more of the boulder lines/steps have plunge pools as deep as the largest rock in the line?	☐	☐	☐
Q4(b)	Do cascades lacking boulder lines/steps represent less than 25% of the reach?	☐	☐	☐
Q01	**Sediment and LWD Storage Characteristics – For Non-Alluvial Streams Only**			
Q1(b)	Do sediment and/or LWD deposits that completely fill the channel up to the top of the banks represent less than 5% of the reach length?	☐	☐	☐
Q1(c)	Are moveable sediments widely distributed in small pockets along the whole stream reach, not concentrated in a few relatively large compartments?	☐	☐	☐
Q03	**Wood Characteristics** (Use Table 2 to help answer the questions. Q3(b) is NA for non-alluvial streams)			
Q3(a)	Is the wood in the channel mainly “old”?	☐	☐	
Q3(b)	Do 1-12 accumulations of wood span the channel?	☐	☐	☐
Q3(c,c,b)	Do half or more of the wood accumulations present lack “new” wood?	☐	☐	
Q3(d,d,c)	Is the wood in the channel mainly across or diagonal to the main axis of the stream, not parallel?	☐	☐	
Q3(e,e,d)	Is the wood in the channel intact; i.e. not recently lost or moved by hand, catastrophic floods, debris flows, debris torrents?	☐	☐	
Q04	**Surface Sediment Texture – For Riffle and Cascade Pool Streams Only**			
Q4(b)	Is the texture of the surface substrate mainly heterogenous?	☐	☐	☐
Q04	**Deep Pools – For Riffle, Cascade, and Step Pool Streams Only**			
Q4(b)	Are two or more deep pools present? (Tip: A deep pool is a pool whose depth from the deepest spot of the pool to the top of the bank is twice the same depth at riffle crests)	☐	☐	☐
Q05	**Connectivity**			
Q5(a)	Are temporary blockages to fish, sediment or debris absent?	☐	☐	
Q5(b)	Is down-cutting that blocks fish movements or isolates the channel from the adjacent floodplain absent?	☐	☐	
Q5(c)	Are sediment or debris buildups absent at or in all crossing structures?	☐	☐	☐
Q5(d)	Is down-cutting below any crossing structure that blocks fish movements upstream by any size fish at any time absent?	☐	☐	☐
Q5(e)	Are all crossing structures on fish bearing streams open-bottomed structures?	☐	☐	☐

Sample No. _____

Other Indicators to Note (Answer Yes, No, or NA as appropriate for the Questions)				
Q05	**Connectivity** (continued)	**Yes**	**No**	**NA**
Q5(f)	Is dewatering absent?	☐	☐	
Q5(g)	Are trails, roads or levees that isolate off-channel areas or divert normal overland flow away from the reach absent?	☐	☐	
Q5(h)	Is all water in the stream still flowing in its original channel, not withdrawn or diverted elsewhere?	☐	☐	
Q06	**Fish Cover Diversity – For Fish-Bearing Streams Only** (To be considered present, each type of cover should cover 1% or more of the total channel area)			
Q6(a)	Are deep pools present?	☐	☐	☐
Q6(b)	Are unembedded boulders present?	☐	☐	☐
Q6(c)	Is woody debris or other organic debris present?	☐	☐	☐
Q6(d)	Are undercut banks present?	☐	☐	☐
Q6(e)	Is aquatic vegetation present?	☐	☐	☐
Q6(f)	Is overhanging vegetation present?	☐	☐	☐
Q6(g)	Are there stable gravels and cobbles present with spaces for fish to hide in?	☐	☐	☐
Q08	**Fine Inorganic Sediments**			
Q8(a)	Are riffles or pool/riffle breaks free of fine or sand/sized inorganic sediments that “blanket” the streambed?	☐	☐	☐
Q8(b)	Is the channel free of “quick sand” or “quick gravel”?	☐	☐	☐
Q8(c)	Is the substrate mostly unembedded?	☐	☐	☐
Q13	**Bank Microclimate**			
Q13(c)	Are moisture-loving plants present and in good condition?	☐	☐	
Q13(d)	Are the bank soils all moist and cool?	☐	☐	
Q15	**Riparian Structure** (Use Table 3 to help answer this question)			
Q15(a)	Does the distribution and relative abundance of the vegetation layers and forest components present collectively approach 75% of what the healthy unmanaged riparian plant community would normally be along the reach?	☐	☐	
Q15	**Riparian Form, Vigor, and Recruitment** (Use Table 4 to help answer this question)			
Q15(b)	Does the form, vigor and recruitment of the vegetation layers or forest components present collectively approach 75% of what the healthy unmanaged riparian plant community would normally be along the reach?	☐	☐	
Q15	**Browsing, Grazing**			
Q15(c)	Is heavy browse absent? (TIP: Mark “No” if even one plant shows heavy browse)	☐	☐	
Q15(d)	Is most (90%) of the available forage free of heavy grazing?	☐	☐	

Sample No. _____

Field Data Summary Tables

Table 1. Boulder-line/step characteristics of step-pool type reaches (Q1B, Q4B)

Number of boulder lines/ steps	Number of channel spanning boulder lines/steps	Number of boulder lines/ steps with moss	Number of boulder lines/ steps with a deep plunge pool	Length of reach with no boulder steps and plunge pools

Table 2. Wood characteristics of sample reach (Q3)

Number of wood Accumulations	Number of wood accumulations with new, recently deposited wood	Number of channel spanning wood accumulations (NA for non-alluvial streams)	Main age of wood in each accumulation (Record "O" for old, "N" for new)	Main orientation of wood in each accumulation (Record "P" for parallel, "X" for across or diagonal)

Table 3. Riparian Structure (Q15a) Using the table below, estimate whether the distribution or relative abundance of the forest components present collectively approach 75% of what the healthy unmanaged riparian plant community would normally be along the reach.

Snags (%)	Gaps (%)	Over-story trees (%)	Under-story trees (%)	Tall shrubs (%)	Low shrubs (%)	Herbs (%)	Mosses (%)	Lichens (%)	CWD (%)	Total (Sum of %'s)	Average % (Answer to Q15a)

Table 4. Riparian Vegetation Form, Vigor, and Recruitment (Q15b) Using Yes or No answers for each table cell below, determine if 75% or more of the cells have Yes answers, indicating that, collectively, form, vigor and recruitment is satisfactory.

	Snags	Gaps	Over-story trees	Under-story trees	Tall shrubs	Low shrubs	Herbs	Mosses	Lichens	CWD	Total possible number of Yes answers	Actual number of Yes answers	% of cells with Yes answers (Answer to Q15b)
Form													
Vigor	NA	NA								NA			
Recruitment													

Sample No. _____

Riparian Effectiveness Routine Evaluation Checklist

Question 1. Is the channel bed undisturbed?	**Yes** ☐	**No** ☐
Note: For Question 1, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A, B or C)		
A) Riffle-pool or cascade-pool channels		
a) Does less than 50% of the reach have active sediment wedges or mid-channel bars?	☐	☐
b) Does less than 50% of the reach have active multiple channels and/or braids?	☐	☐
c) Does more than 50% of the reach have lateral bars?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 1. Otherwise mark the "No" box.		
B) Step-pool channels		
a) Do more than 50% of the steps present span the channel?	☐	☐
b) Do more than 25% of the steps have moss?	☐	☐
c) Does less than 25% of the reach have active multiple channels and/or braids?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 1. Otherwise mark the "No" box.		
C) Non-alluvial channels		
a) Does 25% or more of the channel bed length have moss on the substrate?	☐	☐
b) Do moveable sediments and/or debris deposits that completely fill the channel up to the top of the banks represent less than 5% of the total reach length?	☐	☐
c) Are moveable sediments widely distributed in small pockets along the whole stream reach, not concentrated in a few relatively large compartments?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 1. Otherwise mark the "No" box.		

Please refer to "What is Stream Channel Morphology" in the riparian protocol for descriptions, tables and figures on channel morphology. If you are using the summary table that describes the general features of each type of channel morphology, base your decision on all the characteristics listed. The degree of channel incisement and the presence or absence of floodplains formed by sediments deposited by the stream and later vegetated are key criteria. If a stream is not meandering or depositing sediments that will eventually re-vegetate (i.e. "alluvial"), but just cutting through peat lands, colluvial deposits or glacial fluvial deposits and not adding material to the adjacent areas, call these streams non-alluvial.

Sample No. _____

Question 2. Are the channel banks intact?	**Yes** ☐	**No** ☐
Note: For Question 2, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A, B or C)		
A) Riffle-pool or cascade-pool channels		
a) Does less than 15% of the total reach length have recently disturbed banks (e.g. banks disturbed by stream flows, sloughs, slumps, windthrow, infilling, animals, roads, or harvest and silviculture activities)?	☐	☐
b) Are more than 65% of the banks on naturally erodible sections of the reach deeply rooted?	☐	☐
c) Does more than 50% of the naturally erodible reach length have stable undercut banks?	☐	☐
d) Does less than 10% of the total reach length have recently upturned (wind thrown) root wads along the banks?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 2. Otherwise mark the "No" box		
B) Step-pool channels		
a) Does less than 10% of the total reach length have recently disturbed banks (e.g. banks disturbed by stream flows, slumps, sloughs, windthrow, infilling, animals, roads, or harvest and silviculture activities)?	☐	☐
b) Are more than 75% of the banks on naturally erodible sections of the reach deeply rooted?	☐	☐
c) Does more than 50% of the naturally erodible reach length have stable undercut banks?	☐	☐
d) Does less than 25% of the total reach length have recently upturned (wind thrown) root wads along the banks?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 2. Otherwise mark the "No" box		
C) Non-alluvial channels		
a) Does less than 10% of the total reach length have recently disturbed banks (e.g. banks disturbed by stream flows, sloughs, slumps, windthrow, infilling, animals, roads, or harvest and silviculture activities)?	☐	☐
b) Are more than 75% of the banks on naturally erodible sections of the reach deeply rooted?	☐	☐
c) Does less than 25% of the total reach length have recently upturned (wind thrown) root wads along the banks?	☐	☐
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 2. Otherwise mark the "No" box		

Please refer to the Riparian Protocol for more descriptions of stable, vegetated undercut banks versus unstable, overhanging banks.

Sample No. _____

Question 3. Are channel LWD processes undisturbed?	**Yes** ☐	**No** ☐
Note: For Question 3, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A, B or C)		
A) Riffle-pool or cascade-pool channel		
a) Is wood in the channel mainly old and/or stable?	☐	☐
b) Do one to twelve accumulations of wood span the channel?	☐	☐
c) Do half or more of all wood accumulations present lack new or recently deposited wood that is unstable?	☐	☐
d) Is wood in the channel mainly across or diagonal to the main axis of the channel, not parallel?	☐	☐
e) Is the wood in the channel mostly intact, (i.e. not recently lost or moved by hand, floods, debris torrents, debris flows)?	☐	☐
If there are 4 or more "Yes" answers, mark the "Yes" box for Question 3. Otherwise mark the "No" box.		
B) Step-pool channel		
a) Is wood in the channel mainly old and/or stable?	☐	☐
b) Are one to twelve accumulations of wood present in the channel?	☐	☐
c) Do half or more of all wood accumulations present lack new or recently deposited wood that is unstable?	☐	☐
d) Is wood in the channel mainly across or diagonal to the main axis of the channel, not parallel?	☐	☐
e) Is the wood in the channel mostly intact, (i.e. not recently lost or moved by hand, floods, debris torrents, debris flows)?	☐	☐
If there are 4 or more "Yes" answers, mark the "Yes" box for Question 3. Otherwise mark the "No" box.		
C) Non-alluvial channel		
a) Is wood in the channel mainly old and/or stable?	☐	☐
b) Do half or more of all wood accumulations present lack new or recently deposited wood that is unstable?	☐	☐
c) Is wood in the channel mainly across or diagonal to the main axis of the channel?	☐	☐
d) Is the wood in the channel mostly intact, (i.e. not recently lost or moved by hand, floods, debris torrents, debris flows)?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 3. Otherwise mark the "No" box.		

TIP: "Old" wood is wood that is stable, and well incorporated into the streambed, streambanks or pre-existing log jams. The wood is usually mossy. "New" wood is any wood that is not yet stable or well incorporated into the streambed, streambanks or stable log jams. New wood is usually wood that was recently deposited after road building and the latest harvesting was started. This could include stems or branches that were blown off trees after harvesting started, or old wood that has recently moved and is no longer stable. TIP: If half or more of the reach length is completely filled with wood, consider this to be more than 12 accumulations of wood.

Sample No. _____

Question 4. Is the channel morphology intact? (Mark NA if the channel is non-alluvial, and therefore lacking a riffle-pool, cascade-pool or step-pool morphology)	**Yes** ☐	**No** ☐	**NA** ☐
Note: For Question 4, decide what the predominant channel morphology is and then complete the section for that morphology only (i.e. Part A or B)			
A) Riffle-pool or cascade-pool channel			
a) Are pools present along >25% of the reach?	☐	☐	
b) Is the surface sediment texture mainly heterogenous and well sorted, i.e. is the range of sediment classes (sands, gravel, cobbles, etc.) present on the streambed large and well sorted by water?	☐	☐	
c) Are two or more deep pools present? (A deep pool is a pool with a channel depth twice the average channel depth at riffle crests).	☐	☐	
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 4. Otherwise mark the "No" box.			
B) Step-pool channel			
a) Are plunge pools frequent, i.e. are >25% of the steps associated with a plunge pool with depths similar to the size of the largest rock in the step?	☐	☐	
b) Does the channel alternate almost exclusively between steps and pools (i.e. less than 25% of the channel consists of relatively long cascades)?	☐	☐	
c) Are two or more deep pools present? (A deep pool is a pool with a channel depth twice the average channel depth at the steps, i.e. the "riffle crests").	☐	☐	
If there are 2 or more "Yes" answers, mark the "Yes" box for Question 4. Otherwise mark the "No" box.			

TIP: A stream reach can have aspects of both cascade-pool and step-pool morphology. Use the predominant morphology to decide which set (A or B) of indicator statements to use.

TIP: Steep streams (with gradients between approximately 5-15%) that look like long cascades could be step-pool streams that are filled in with abundant sediment. Even steeper streams (with gradients much greater than 15%) are probably non-alluvial, especially small streams.

TIP: Only measure the lengths of the main pools present. These are the pools that extend from one side of the wetted channel to the other. Do not include the small pools that are often present behind boulders in riffles or cascades or the small backwater or back eddy pools that might be present along the margins of riffles and cascades.

Sample No. _____

Question 5. Are all aspects of the aquatic habitat sufficiently connected to allow for normal, unimpeded movements of fish, organic debris, and sediments?	**Yes** ☐	**No** ☐	**NA**
a) Are temporary blockages to fish movements upstream or debris or sediment movements downstream absent (e.g. weirs, dams, culverts, beaver dams, impermeable log jams)?	☐	☐	
b) Is down cutting in the main channel that now isolates the floodplain from normal flooding or blocks access to tributary streams or off-channel areas absent?	☐	☐	
c) Are build-ups of sediment or debris above or within any crossing structure absent, i.e. is the ability of the crossing to transport water and sediments downstream unimpaired?	☐	☐	☐
d) Are all crossing structures free of any down cutting that blocks fish movements upstream by any size fish at any time?	☐	☐	☐
e) On fish bearing streams, are all crossing structures open bottom structures?	☐	☐	☐
f) Is dewatering over the entire channel width due to excessive new accumulations of sediment absent?	☐	☐	
g) Are all off-channel or overland flow areas still connected to the main channel, not isolated or cut off by roads or levees?	☐	☐	
h) Is all water in the stream still in the stream, not withdrawn or diverted elsewhere?	☐	☐	
If there are any "No" answers, mark the "No" box for Question 5. Otherwise mark the "Yes" box.			

TIP: For Question 5, part (a), consider a temporary blockage a "blockage" if more than 2/3 of the flow seeps through or spills over the blockage when the water level is close to the rooted edge. Note that active beaver dams will almost always be temporary blockages. TIP: "Down cutting" refers to channel incisement; i.e. the vertical movement of the channel downwards into the channel bed.

Question 6. Does the stream support a good diversity of fish cover attributes? To qualify as cover, each cover attribute should represent at least 1% of the total stream area observed. (Mark NA if the stream is non-fish bearing; i.e. classes S5 or S6)	**Yes** ☐	**No** ☐	**NA** ☐
a) Is deep pool habitat available?	☐	☐	
b) Are stable, unembedded boulders present?	☐	☐	
c) Are stable rootwads, woody debris or other organic material that fish can hide in present? "Other" organic debris is made up mostly of uncompacted leaf and/or wood particles that small fish can hide under.	☐	☐	
d) Are stable, deep-rooted undercut banks present?	☐	☐	
e) Is submerged or emergent aquatic vegetation present?	☐	☐	
f) Is overhanging vegetation present within 1 m of the top of the channel?	☐	☐	
g) Are stable unembedded gravels and cobbles with void spaces for fish to hide in present?	☐	☐	
If there are five or more "Yes" answers, mark the "Yes" box for Question 6. Otherwise, mark the "No" box.			

TIP: Question 6 is "NA" if the stream is non-fish bearing. Also, if there are no deep pools, there is no deep pool habitat.

Sample No. _____

Question 7. Does the amount of moss present in shallow areas of the channel indicate a stable and productive system? (Mark "NA" if the sample is all pool habitat or the streambed naturally lacks a stable mineral substrate for moss to grow on)	**Yes** ☐	**No** ☐	**NA** ☐
a) Are moss patches on stable mineral substrates easily observed from almost any point along the margins, riffles or shallow pools of the stream? Where visibility is poor, is average coverage on mineral substrates 1% or more of the channel bed?	☐	☐	
b) Are half or more of the moss patches present (even uncommon, occasional or rare patches) generally intact, not embedded with sediments, buried or damaged by scouring? Mark "NA" if no moss is present.	☐	☐	☐
c) Are moss patches generally vigorous, not stressed, dried or dead? Mark "NA" if no moss is present.	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 7. Otherwise, mark the "Yes" box.			

Question 8. Has the introduction of sand or fine sized inorganic sediments been minimized? (Mark "NA" when the largest mobile sediment present in the reach is sand from natural sources only)	**Yes** ☐	**No** ☐	**NA** ☐
a) Are inorganic ("gritty" feeling) fine and sand-sized sediments in riffles or critical spawning areas best described as little or lacking? Little or lacking is when average coverage in riffles or critical spawning areas is less than 10%, and no one area of this habitat equal to 1% or more of the total channel area is completely covered ("blanketed") with fines or sands.	☐	☐	
b) Are individual wetted areas of gravel or sand that a foot can be easily pushed or wiggled into all smaller than an area equal to 1% of the total channel area?	☐	☐	
c) Are gravels and cobbles unembedded in a matrix of sand or finer sized particles? Unembedded means that most of the gravel and cobbles are touching each other and easy to move.	☐	☐	
d) Is there an average of one or more sensitive invertebrate types at invertebrate sample sites? Mark "NA" if high water conditions prevent effective sampling or the sample sites are dry due to natural conditions.	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 8. Otherwise, mark the "Yes" box.			

TIP: If the stream banks from top to bottom on both sides are all naturally composed of sand or finer size sediments, then it is probable the fines on the streambed are also natural.

Question 9. Does the stream support a diversity of aquatic invertebrates? (Mark "NA" if high water conditions prevent effective sampling or sample sites are dry due to natural conditions)	**Yes** ☐	**No** ☐	**NA** ☐
a) Is an average of one or more sensitive invertebrate (e.g. a caddisfly, stonefly, mayfly or freshwater clam) present at the sites sampled?	☐	☐	
b) Is an average of two or more different major invertebrate groups (e.g. insects, worms, crustaceans, etc.) present at the sites sampled?	☐	☐	
c) Is an average of three or more recognizably different insects present at the sites sampled?	☐	☐	
d) Is an average of four or more recognizably different invertebrates present at the sites sampled?	☐	☐	
If there are two or more "Yes" answers, mark the "Yes" box for Question 9. Otherwise, mark the "No" box.			

Sample No. _____

Question 10. Has the vegetation retained in the RMA been sufficiently protected from windthrow? (Note: only dominant or co-dominant trees that were alive when they were windthrown count as windthrow).	**Yes** ☐	**No** ☐	**NA**
a) The incidence of post-treatment windthrow (living trees) in S1-S3 RRZs or S4-S6 RMZs with WTPs does not exceed 5% of the living stems, over and above what occurs naturally in the area. Mark NA and answer 10 b) if there is no reserve zone, or management zone with wildlife trees or wildlife tree patches.	☐	☐	☐
b) The incidence of post-treatment windthrow (living trees) in S4-S6 RMZs that are not part of a WTP does not exceed 10% of the living stems, over and above what occurs naturally in the area. Mark NA if there is a reserve zone or wildlife tree patch adjacent to the stream, and answer 10 a).	☐	☐	☐
c) Designated wildlife trees in S1-S6 RMAs are still standing, or if windthrown (living trees), still functional as wildlife trees (e.g. above-ground bear dens). Mark NA if there are no designated wildlife trees.	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 10. Otherwise, mark the "Yes".			

1. % *Old Windthrow* = $\frac{\textit{(\# Old Windthrow Trees)}}{\textit{(\# Standing Trees + \# Old Windthrow + \# New Windthrow)}}$ x 100

2. % *New Windthrow* = $\frac{\textit{(\# New Windthrow Trees)}}{\textit{(\# Standing Trees + \# New Windthrow)}}$ x 100

To calculate % new windthrow over and above the natural pre-treatment windthrow, subtract (1) from (2).

Question 11. Has the amount of bare erodible ground or soil compaction in the riparian area been minimized?	**Yes** ☐	**No** ☐
a) Is total bare erodible ground area present in the first 10 m of the riparian area (not counting active road right-of-ways) less than 1% of the total riparian area?	☐	☐
b) Is total bare erodible ground area present in the first 10 m of the riparian area, **plus** all other bare erodible ground hydrologically linked to the first 10 m of riparian area less than 5% of the total riparian area?	☐	☐
c) Is the total area compacted (disturbed) by animals or machinery in the first 10 m of the riparian area (not counting active road right-of-ways) less than 10% of the total riparian area?	☐	☐
d) Is the total area compacted (disturbed) by animals or machinery in the first 10 m of the riparian area, **plus** all other compacted areas hydrologically linked to the first 10 m of riparian zone less than 15% of the total riparian area?	☐	☐
If there are any "No" answers, mark the "No" box for Question 11. Otherwise, mark the "Yes" box.		

TIP: Sediment deposited on the ground from upslope sources is considered bare ground for Question 11, but not if the sediment is deposited due to flooding (i.e. over-bank deposits).

Sample No. _____

Question 12. Has sufficient vegetation been retained or managed to maintain an adequate root network or LWD supply?	Yes ☐	No ☐	NA
a) On all streams, are all under-story trees taller than 1.3 m, shrubs, and herbaceous vegetation present to the fullest extent possible within 5 m of the stream banks?	☐	☐	
b) On S1 to S3 size streams, is the first 10 m of the riparian reserve zone intact (regardless of windthrow), thereby providing for 80% or more of the LWD normally supplied to streams with no additional inputs from upstream or the adjacent hillslopes?	☐	☐	☐
c) On S4 streams, where the windthrow hazard was not assessed, or where windthrow hazard was assessed as not high, are all windfirm trees with roots embedded in the bank, and 50% of all other trees (excluding dominant conifers) within 10 m of the stream banks still present?	☐	☐	☐
d) On S4 streams, where the windthrow hazard was assessed as high, are all under-story trees taller than 1.3 m present within 10 m of the stream banks, to the fullest extent possible?	☐	☐	☐
e) On valley bottom S5 streams with alluvial banks and a floodplain, are 50% of dominant and codominant windfirm stems within 30 m of the stream banks still present?	☐	☐	☐
f) On non-valley, LWD dependent S5 streams, are all leaners within 10 m of the stream banks and all under-story trees taller than 1.3 m within 5 m of the streambank still present to the fullest extent possible?	☐	☐	☐
g) On LWD dependent S6 streams, or S6 that flow directly into fish-bearing waters, are at least 10 under-story trees taller than 1.3 m present within 5 m of the stream banks?	☐	☐	☐
If there are any "No" answers, mark the "No" box for Question 12. Otherwise, mark the "Yes" box.			

TIP: All streams require an answer to indicator statement 12 (a). At most, only one other indicator statement will be applicable. Right-of-ways should not be considered a factor for Question 12 unless the right-of-ways represent more than 25% of the riparian habitat.

Question 13. Has sufficient vegetation been retained to provide shade and reduce bankmicroclimate change?	Yes ☐	No ☐
a) With the exception of active roads at stream crossings, is the bare erodible ground directly exposed to rain less than 1% of the riparian area?	☐	☐
b) Does shade (the average amount of sky not visible due to vegetation) average more than 60%, as estimated visually for any two of the east, south and west aspects at 60° above the horizontal?	☐	☐
c) Are moisture loving macrophytes, mosses, ferns or other bryophytes present and in vigorous condition, with no indication of stress due to sunburn, drought or desiccation?	☐	☐
d) Is the soil in the riparian habitat cool and moist to the touch?	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 13. Otherwise, mark the "No" box.		

Sample No. _____

Question 14. Have the number of disturbance-increaser species, noxious weeds, and/or invasive plant species present been limited to a satisfactory level?	**Yes** ☐	**No** ☐
a) Do disturbance-increaser plants (domestic grasses, dandelions, pineapple weed, buttercups, etc.) occupy less than 25% of total area in the first 10 m of the riparian zone?	☐	☐
b) Do noxious weeds and/or other invasive plant species occupy less than 5% of total area in the first 10 m of the riparian area?	☐	☐
If there are any "No" answers, mark the "No" box for Question 14. Otherwise, mark the "Yes" box.		

TIP: To estimate coverage by disturbance-increaser plants or weeds and other invasive plants at a sample site, record the percentage of two10 m long line transect (one on each side of the stream) that is occupied by these plants. Start the line transects at the edge of the stream and go 10 m at right angles to the main axis of the stream reach.

Question 15. Is the riparian vegetation and forest structure within the first 10 m from the edge of the stream generally characteristic of what the healthy unmanaged riparian plant community would normally be along the reach?	**Yes** ☐	**No** ☐
a) Are all the major vegetation layers and structural components of the expected healthy unmanaged riparian plant community (e.g. snags, CWD, gaps, tall trees, understory, tall shrubs, low shrubs, herbaceous plants, mosses and lichens) adequately represented? Adequate representation is 1) the presence of all expected layers and components over 75% of the reach, 2) 75% of the expected layers or components over all of the reach, or 3), any combination of 1) and 2) that collectively averages 75% or more.	☐	☐
b) Do the major vegetation layers and structural components of the expected healthy unmanaged riparian plant community exhibit good vigor, normal growth form, and satisfactory recruitment? Vigor or growth form is poor if plants are discolored, defoliated, brittle, burned, broken, heavily browsed, "mushroomed", wind thrown, harvested or dead. Mark "No" if collectively less than 75% of all the plants and structural components expected show good vigor, form, and recruitment.	☐	☐
c) Is heavy browse absent? Heavy browse on a plant is browse down to second year wood over most (>50% of the branches) of the plant.	☐	☐
d) Is 90% or more of the available grazing area free of heavy grazing? Heavy grazing is defined as less than the recommended target stubble height for the dominant forage species present.	☐	☐
If there are 3 or more "Yes" answers, mark the "Yes" box for Question 15. Otherwise, mark the "No" box.		

TIP: All four statements can always be answered "Yes" or "No". There are no NA statements.

TIP: If more than 25% of the total reach length is more or less bare of vegetation, as could be the case at road crossings, then 15(a) and 15(b) should probably be marked "No". If more than 25% of all the vegetation along both sides of the total reach length is removed, as would be the case for a complete clearcut along the reach, then 15(a) and 15(b) would again be marked "No".

TIP: The answer to Q15(c) on browse is "No" if even one plant shows heavy browse. Please refer to the riparian protocol for a description of heavy browse.

Sample No. _____

Summary		Yes	No	NA
Question 1.	Is the channel bed undisturbed?	☐	☐	
Question 2.	Are the channel banks intact?	☐	☐	
Question 3.	Are channel LWD processes intact?	☐	☐	
Question 4.	Is the channel morphology intact?	☐	☐	☐
Question 5.	Are all aspects of the aquatic habitat sufficiently connected to allow for normal, unimpeded movements of fish, organic debris, and sediments?	☐	☐	
Question 6.	Does the stream support a good diversity of fish cover attributes?	☐	☐	☐
Question 7.	Does the amount of moss present on the substrates indicate a stable and productive system?	☐	☐	☐
Question 8.	Has the introduction of fine sediments been minimized?	☐	☐	☐
Question 9.	Does the stream support a diversity of aquatic invertebrates?	☐	☐	☐
Question 10.	Has the vegetation retained in the RMA been sufficiently protected from windthrow?	☐	☐	
Question 11.	Has the amount of bare erodible ground or soil compaction in the riparian area been minimized?	☐	☐	
Question 12.	Has sufficient vegetation been retained to maintain an adequate root network or LWD supply?	☐	☐	
Question 13.	Has sufficient vegetation been retained to provide shade and reduce bank microclimate change?	☐	☐	
Question 14.	Have the number of disturbance-increaser plants, noxious weeds and/or invasive plant species present been limited to a satisfactory level?	☐	☐	
Question 15.	Is the riparian vegetation within the first 10m from the edge of the stream generally characteristic of what the healthy unmanaged riparian plant community would normally be along the reach?	☐	☐	

of "Yes" answers: _____ + # of "No" answers: _____ + # of "NA" answers: _____ = Total # of answers: _____

Conclusion on Functioning Condition (check one):

- ☐ Properly Functioning (0-2 "No's")
- ☐ Functioning but at Risk (3-4 "No's")
- ☐ Functioning but at High Risk (5-6 "No's")
- ☐ Not Properly Functioning (>6 "No's")

List the questions that had a "No" answer below, and check what you believe was the main reason(s) for the problem. A "No" answer due to natural causes would include any natural events such as insects, fires, floods, slides, diseases etc. that were clearly unrelated to man's activities in the stream or adjacent riparian area. Check Logging, Livestock, Roads or Other Manmade as a cause if these factors directly affected the stream or riparian area assessed in this evaluation. Check Upstream Factors if the "No" answer was the result of some event or condition that occurred upstream, regardless if it was manmade or natural.

"No" answer questions	Causes of "No" Answers						
	Current Logging	Old Logging	Livestock	Roads	Other Manmade	Natural Events	Upstream Factors
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐

Sample No. _____

Specific Causes of "No" Answers and Proximity to Reach of Each Cause.

Check off each Question with a "No" answer, then beside each main specific cause that applies, record a 1 for within the reach, 2 for above the reach, and 3 for within and above the reach

Cause of "No" Answers	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐	11 ☐	12 ☐	13 ☐	14 ☐	15 ☐
OLD LOGGING															
Low retention															
Falling and yarding															
Machine disturbance															
Windthrow															
Mass wasting															
Stream diversions															
Road/debris blockages															
Forest structure issues															
Other															
CURRENT LOGGING															
Low retention															
Falling and yarding															
Machine disturbance															
Windthrow															
Mass wasting															
Stream diversions															
Road/debris blockages															
Other															
ROADS, TRAILS															
Encroachment on RMA															
Running surface erosion															
Other ROW erosion															
Mass wasting															
Crossing structure															
Other															
ANIMAL DISTURBANCE															
Livestock															
Beavers															
Other ungulates															
Humans															
Other															
NATURAL IMPACTS															
High sediment levels															
Fire															
Insects															
Diseases															
Wind															
Mass wasting															
Floods															
Other															
OTHER IMPACTS															
Non-logging roads, trails															
Utility corridors															
Recreation															
Agriculture															
Mining															
Urban, industry															
Other															
UNKNOWN															

Sample No. _____

Final Comments

	Yes	No
Does the conclusion on functioning condition generally agree with your personal opinion on the functioning condition of this stream reach? If not, please describe why not.	☐	☐
All "No" answers are weighted equally. Were any specific problems identified that affected the assessment more than others?	☐	☐
Were there any notable management practices prescribed and implemented on this stream? If so, please describe and comment on their effectiveness.	☐	☐
Is the sample reach a potential "Reference Stream" with no impacts in the reach due to human activity beside the reach and little human related activity in the watershed area upstream of the sample reach?	☐	☐
Were any invasive plants observed? Remember to complete an Invasive Plant field card if the answer is "Yes".	☐	☐
Was there WQ sampling completed at any upstream crossings? If so, please enter sample ID #'s.	☐	☐

Draw a map of the stream and illustrate the retention and location of other significant features present (e.g. roads, crossings, slides). Also mark the stream assessed on a map in a way that will be legible when scanned.