BMWA Appendix A – Risk Informed Management

A1. Overview

Risk Informed Management (RIM) is an approach that guides the identification and implementation of management actions and that is informed by an understanding of the risks to and uses of a transboundary water body. It applies to all Transboundary Waters, including both surface and groundwater.

The goals of the RIM approach are:

- To achieve the principles of the Master Agreement;
- To facilitate joint learning, and proactive and adaptive action;
- To apply human and financial resources in an efficient and effective manner.

Key principles include:

- The nature and intensity of action is commensurate with the nature and intensity of the risks to and uses of a water body;
- Action is based on a mutual understanding of the ecological integrity of the aquatic ecosystem;
- Bilateral Management builds on the Jurisdictional Water Management actions of each Party as required to achieve the commitments of the Bilateral Water Management Agreement.

The RIM approach will be implemented in a manner consistent with these goals and principles.

The RIM approach is one of several tools for collectively meeting the Master Agreement principles. It complements the oversight provided by the Mackenzie River Basin Board as well as each Party's Jurisdictional Water Management practices.

The specific RIM Commitments are documented in Section 4.3 of the Agreement. This appendix provides an overview of the approach, which will guide this Bilateral Water Management Agreement. Additional details that guide the implementation of this approach for Surface Water Quantity, Surface Water Quality, Groundwater and the Biological component are outlined in respective appendices and supplementary bilateral-specific RIM documents. RIM details will be further developed by the BMC.

A2. Classifying Transboundary Waters

Operationally, the RIM approach involves assigning Transboundary Waters to one of four classes (Figure 1), defining Bilateral Management actions commensurate with the class, and establishing a structured and transparent process for Bilateral Management.

Classifications will be applied to Transboundary Waters at the border. The classification will consider development and use in upstream tributaries and headwaters. Bilateral Management actions may be directed at those contributing water bodies, but the classification is applied at the border. Criteria for classifying Transboundary Waters will be based on the type and magnitude of development along with other quantitative and qualitative factors. Classification will consider both existing and projected development, and will be based on a detailed five-year development forecast, as well as consider the

longer term (ten-year) outlook. Assignment of a transboundary water body to a particular class will be a joint decision by the Parties.

Figure 1. Risk Informed Management Approach

The nature and intensity of Bilateral Management and Jurisdictional Water Management increase from Class 1 to Class 3 (varying levels of learning, Transboundary Objective-setting, monitoring, etc.).

Class 4 occurs when Transboundary Objectives are not met, indicating that the Ecological Integrity of the Aquatic Ecosystem may not be being maintained.

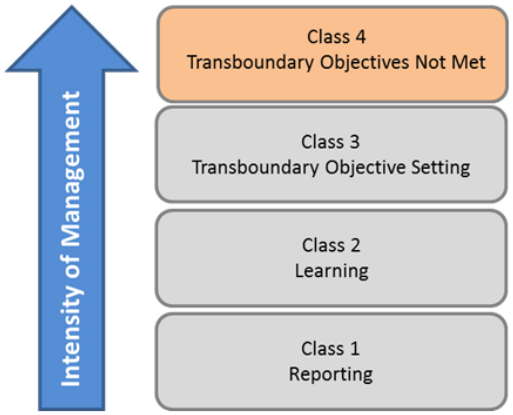


Table 1 provides a high level summary of the four classes, including key commitments at each class, and some considerations for classification. To improve the transparency and consistency of classification, the Appendices of each Bilateral Water Management Agreement may contain more specific criteria and representative conditions that correspond to each class. However, the Parties recognize the need to retain flexibility in the future, as it will be impossible to identify every possible consideration.

In general, as described in Table 1, water bodies with no or very low development/use are Class 1. At Class 1, it is expected that the Jurisdictional Water Management practices of each Party will be sufficient to meet transboundary commitments. Other than reporting, no Bilateral Management actions are required in this class. As warranted by increased development/use and other factors, Transboundary Waters will move to higher classes, where Bilateral Management actions are identified to complement Jurisdictional Water Management practices.

Some level of current or planned development/use is necessary for a water body to move from Class 1 to Class 2, but there is no single threshold of development/use that causes a water body to move to Class 2 or 3. To move from a Class 1 to 2 or from Class 2 to 3, the level of development/use is considered along with other factors to classify water bodies using a risk-informed approach. Other factors beyond development levels that may influence the assignment of a water body to Class 2 or Class 3 include, but are not limited to:

- natural or other anthropogenic stressors or vulnerabilities;
- sensitive water or ecosystem uses (e.g., traditional uses, drinking waters, heritage sites or parks);
- use conflicts or controversy;
- water quality and quantity conditions or trends;
- aquatic ecosystem (e.g., biological, human health or traditional use) conditions or trends.

In other words, a water body that is stressed or vulnerable (e.g., low winter flows, etc.), supports sensitive uses (e.g., traditional use, drinking water, etc.), experiences water use conflicts (e.g., conflicts among users or public controversy about water or ecosystem conditions), and/or demonstrates

negative conditions or trends in water quality, water quantity or aquatic ecosystem indicators, may move up in class at a lower level of development/use than a water body that does not.

The intensity of Bilateral Management will increase as required to support continued achievement of RIM Goals and Transboundary Objectives. At Class 2, a Learning Plan tailored to the needs of the water body, will be developed. Learning Plans will be developed using an integrated approach, and will address relevant water quality, water quantity, groundwater and biological considerations. As part of the Learning Plan, Triggers may be established to support learning, to prepare for setting and assessing the achievement of Transboundary Objectives, and to proactively address any negative trends. A Trigger is a pre-defined early warning of change in typical or extreme conditions that results in confirmation of change, and bilateral management oversight, actions and/or jurisdictional planning to address the change/trend. Multiple Triggers can be set to invoke additional actions as necessary (e.g. degrading conditions). At Class 3, Transboundary Objectives will be established based on detailed, site-specific analysis. Transboundary Objectives establish conditions that the responsible Party or Parties commit to meet. If the BMC determines that Transboundary Objectives are not met, the water body will be designated Class 4 at which point the responsible Party or Parties will identify and implement action as in 4.3 j) through n), with the goal of returning the water body to Class 3.

Table 1. Transboundary Classes

Class	Key Commitments	Classification Considerations
1 Reporting	Ensure that each Party's Jurisdictional Water Management practices meet transboundary commitments and that its policy/regulatory processes include a provision to check for transboundary impacts. Report on development activity and share available information on aquatic ecosystems. No additional Bilateral Management actions are required.	Examples of Transboundary Waters in this class include those characterized by no or very little existing and projected development.
2 Learning	Initiate a Learning Plan (e.g., issue scoping, monitoring, data analysis, investigations into potential effect pathways) to improve our understanding of the requirements for protecting the ecological integrity of the aquatic ecosystem. A Learning Plan will include the compilation and review of existing data and information and, if necessary, the collection of additional baseline data. The Learning Plan will form the basis for the setting of Transboundary Objectives, should they be required. As part of the Learning Plan, Triggers may be established that initiate various kinds of management oversight or action.	Examples of Transboundary Waters in this class include water bodies with a moderate level of existing and projected development. Water bodies that are stressed or vulnerable (e.g., low winter base flows), support sensitive uses (e.g., traditional uses, drinking water supply, etc.), experience a high degree of conflict or controversy, and/or demonstrate negative conditions or trends may move to Class 2 at a lower level of development/use than other water bodies.
3 Objective Setting	Set objectives or firm conditions that the responsible Party or Parties will meet. Initiate intensive Bilateral Management, to address specific	Examples of Transboundary Waters in this class include water bodies with either high levels of development, or a combination of moderate development with natural

Class	Key Commitments	Classification Considerations
	issues. Conduct site-specific analyses where needed to assess the needs for protecting the ecological integrity of the aquatic ecosystem and to establish Triggers and Transboundary Objectives. Establish joint and/or jurisdictional monitoring programs and investigations. A jurisdiction may prepare action plans to outline how they will ensure that Transboundary Objectives are met.	vulnerabilities, sensitive uses, use conflicts or controversy and/or negative condition or trends. As indicated above, some water bodies may move to Class 3 at lower levels of development/use than other water bodies.
4 **Objectives not met**	Initiate immediate action in support of meeting the Transboundary Objective, and report progress on an agreed schedule. Additional action can follow to consider alternative ways to address the situation, such as adjusting a Transboundary Objective. The terms in Section 4.3 j) through n) apply.	The intent of the RIM approach is to prevent any water body from moving to this class. Water bodies in this class have failed to meet Transboundary Objectives and the ecological integrity of the aquatic ecosystem may not be being maintained. The responsible Party or Parties must undertake Jurisdictional Management action in support of meeting Transboundary Objectives. The responsible Party will consult the other Party, but retain the right to select which actions are implemented in its jurisdiction. Either Party may request the consideration of alternative ways to address the situation. The Parties will establish an agreed timeframe to implement Jurisdictional Management action.

A3. Bilateral Management Actions

Bilateral Management actions that could apply at the different classes or under different conditions are documented in the Appendices or will be developed by the BMC. The intent is to provide sufficient documentation to ensure that action occurs when warranted, while giving the Parties flexibility to choose which actions are most appropriate given the actual conditions and priorities and updated information and knowledge.

Key guidelines for the selection of Bilateral Management actions include:

- Bilateral Management actions will be designed and implemented at a level of detail and rigor commensurate with the assigned class;
- The Parties will jointly decide on Bilateral Management actions;
- There may be both Jurisdictional Water Management actions (undertaken by one Party) and/or Bilateral Management actions (undertaken collaboratively by both Parties);
- There will be both mandatory and optional actions; Appendices to the Agreement may define Triggers that require action to be taken, along with an illustrative set of sample actions, while leaving the choice of which specific action to the discretion of the Bilateral Management Committee;
- A diversity of sources of relevant available knowledge, including scientific, local and traditional knowledge, and information from the general public may be considered;
- Actions will be designed in recognition of data availability constraints, opportunities and needs (Transboundary Waters with limited data availability may be subject to different actions than water bodies with more sufficient data).

A4. Annual Transboundary Meeting

The RIM approach includes a mandatory annual meeting of the Parties to discuss transboundary issues. At this meeting the Parties will:

- Share information about condition of and trends in the ecological integrity of the aquatic ecosystem, including but not limited to hydrological, meteorological, and ecological science, traditional knowledge and input from the general public of either Party;
- Share updated information about current and future Developments and Activities that could affect the ecological integrity of the aquatic ecosystem of the other Party;
- Share information about relevant activities, policies and programs (e.g., conservation programs, policy changes that could affect transboundary water management, etc.).

Based on updated information, the Parties will:

- Jointly determine the classification for Transboundary Waters and update the relevant Appendices to the Bilateral Water Management Agreement;
- Jointly develop and/or update Learning Plans, Tracking Metrics, Triggers, Transboundary Objectives, monitoring and other studies or investigations as required and update the relevant Appendices;
- Review the effectiveness of Bilateral Management and Jurisdictional Water Management actions and identify additional or revised actions;
- Identify any other issues that need to be addressed.

BMWA Appendix B – List of Transboundary Waters

A list of Transboundary Waters relevant to the BC-NWT BWMA is provided in Table 2. These water bodies were identified using 1:250,000 National Topographical System (NTS) maps available from Natural Resources Canada. All major Transboundary Waters are included on the list. The list is not exhaustive; all small water bodies may not be included. If development or water use occurs on Transboundary Waters that are not listed in Table 2, the water body will be added. All Transboundary Water with current or projected (1-5 years) development or use must be listed.

Table 2. List of BC-NWT Transboundary Waters

No.	Water Body Crossing at 60° N Latitude	Flow Direction	Longitude West	Area (km²)
1	Liard River 1	BC to NWT	-123.801	130,064
2	Unnamed tributaries to Big Island Creek	BC to NWT	-123.558	20
3	Unnamed lake to Big Island Creek	BC to NWT	-123.452	3
4	Unnamed lake to Petitot River	BC to NWT	-123.425	3
5	Unnamed tributary to Petitot River 4	BC to NWT	-123.100	49
6	Unnamed tributary to Petitot River 3	BC to NWT	-123.094	15
7	Petitot River 7	BC to NWT	-122.984	11,975
8	Petitot River 6	NWT to BC	-122.843	1,545
9	Petitot River 5	BC to NWT	-122.776	10,853
10	Petitot River 4	NWT to BC	-122.702	1,534
11	Petitot River 3	BC to NWT	-122.497	10,043
12	Celibeta Creek	NWT to BC	-122.361	175
13	Petitot River 2	NWT to BC	-122.334	1,243
14	Petitot River 1	BC to NWT	-122.218	9,694
15	Unnamed tributary to Petitot River 2	NWT to BC	-122.104	82
16	Unnamed tributary to Petitot River 1.2.2	NWT to BC	-121.845	N/A
17	Unnamed tributary to Petitot River 1.2.1	NWT to BC	-121.793	N/A
18	Unnamed tributary to Petitot River 1.1.5	NWT to BC	-121.734	N/A
19	Unnamed tributary to Petitot River 1.1.4	NWT to BC	-121.699	N/A
20	Unnamed tributary to Petitot River 1.1.3	NWT to BC	-121.613	N/A
21	Unnamed tributary to Petitot River 1.1.2	NWT to BC	-121.579	N/A
22	Unnamed tributary to Petitot River 1.1.1	NWT to BC	-121.482	N/A
23	Unnamed tributary to Hossitl Creek 4	NWT to BC	-121.391	15
24	Unnamed tributary to Hossitl Creek 3	NWT to BC	-121.303	18

No.	Water Body Crossing at 60° N Latitude	Flow Direction	Longitude West	Area (km²)
25	Unnamed tributary to Hossitl Creek 9	NWT to BC	-121.289	N/A
26	Unnamed tributary to Hossitl Creek 8	NWT to BC	-121.235	N/A
27	Unnamed tributary to Hossitl Creek 7	NWT to BC	-121.217	N/A
28	Unnamed tributary to Hossitl Creek 6	NWT to BC	-121.156	N/A
29	Unnamed tributary to Hossitl Creek 2	NWT to BC	-121.091	13
30	Unnamed tributary to Hossitl Creek 5	NWT to BC	-121.015	N/A
31	Unnamed lake to Hossitl Creek 2	BC to NWT	-120.994	1
32	Unnamed lake to Hossitl Creek 1	BC to NWT	-120.965	N/A
33	Unnamed tributary to Hossitl Creek 1	NWT to BC	-120.876	94
34	Hossitl Creek	NWT to BC	-120.798	84
35	Midwinter Creek	NWT to BC	-120.630	N/A
36	Unnamed lake to Calendar Creek 2	BC to NWT	-120.484	<1
37	Unnamed lake to Calendar Creek 1	BC to NWT	-120.466	<1
38	Calendar Creek	NWT to BC	-120.423	201
39	Unnamed tributary to Kakisa River 6	NWT to BC	-120.238	N/A
40	Unnamed tributary to Kakisa River 5	BC to NWT	-120.188	N/A
41	Unnamed tributary to Kakisa River 4	BC to NWT	-120.162	11
42	Unnamed tributary to Kakisa River 3	BC to NWT	-120.149	21
43	Unnamed tributary to Kakisa River 2	BC to NWT	-120.094	47
44	Unnamed tributary to Kakisa River 1	BC to NWT	-120.076	9

Note: Table 2 is sorted west to east by Longitude. The area in the upstream jurisdiction that contributes water to the boundary crossing is provided. N/A indicates the drainage area upstream of the boundary crossing has yet to be determined.

BWMA Appendix C - Force Majeure

Appendix C is intended to clarify the kinds of situations the Parties intend to address with the term "force majeure" in Section 4.3(n) of the Agreement. Force majeure includes situations involving changing natural conditions, as the result of natural processes or influences from outside the basin, which are outside the Parties' control and that could affect a Party's ability to meet the surface and groundwater quality and quantity and biological commitments within the Liard Basin under the Agreement. Although it is impossible to identify every related circumstance, the Parties provide this partial list to clarify the nature of the situations involving "changing natural conditions" to which Section 4.3(n) refers and is intended to apply.

Examples of natural processes that might affect surface and groundwater quality and quantity and biological parameters in the Liard basin (does not include what can be controlled by the Party):

- Extreme weather events
- Flooding
- Drought
- Extreme (low and high) rainfall/flow events
- Landslides
- Glacial runoff and permafrost melt (i.e., release of legacy contaminants)
- Wildfire
- Earthquakes

Examples of influences from outside of the basin on natural processes that might affect surface and groundwater quality and quantity and biological parameters in the Liard basin (does not include what can be controlled by the Party):

- Climate change
- Long – range transport and deposition
- Invasive species
- Volcanic eruptions

Where any of the above are related to human development or activity within a Party's jurisdiction, the Party's obligations are not limited, and the responsible Party will take management actions as required by RIM.

BWMA Appendix D – Surface Water Quantity

D1. Surface Water Quantity Classification

All Transboundary Waters listed in Table 2 of Appendix B are classified as Class 1 for surface water quantity. Classification of Transboundary Waters will be reviewed at least annually by the BMC.

The BMC will work to develop a reproducible approach to classification of Transboundary Waters that meets both Parties' interests for water quantity. The BMC will begin this work by reviewing relevant risk assessment tools (e.g., BC Oil & Gas Commission's North East Water Tool; Flow Risk Management Framework for North East).

Factors to be considered in the development of a reproducible approach to classification of Transboundary Waters include, but are not limited to, the sensitivity of fish species and aquatic habitats, the seasonal flow fluctuations (e.g. winter and summer low flows and spring-summer floods), statistical probabilities of extreme flow rates (e.g. flood and drought risks), the average recorded flow rate (e.g. mean monthly flows), stream size (e.g. as a function of long term mean annual discharge), the annual totals of licensed withdrawals and, when required, the estimation of consumption and return flows.

The Parties have agreed to continue supporting the existing hydrometric stations on the Liard and Petitot Rivers for at least the period of the Water Quality Learning Plans for those rivers (Appendix I).

D2. Learning Plans

A Learning Plan (Appendix H1) is required for Class 2 Transboundary Waters. The learning plan provides additional information to confirm or alter the assigned classification and contribute to baseline information for Transboundary Waters.

As part of the Learning Plan, ratios of allocated withdrawals (or of actual consumption) to stream flow will be tracked on an instantaneous, daily, weekly, monthly or annual basis in support of the future development of Triggers and Transboundary Water Quantity Objectives, as required. Tracking Metrics in water quantity conditions will include the tracking of stream flow and amount of water allocated for various uses. Learning Plans should help to understand baseline water quantity and reflect the seasonal site-specific characteristics of each water body. This information will be used to aid with evaluation of whether a water body should change RIM classification.

D3. Approach to Setting Transboundary Water Quantity Triggers

As described in Appendix A, a Trigger is a pre-defined early warning of change in typical or extreme conditions that result in confirmation of change and bilateral management oversight, actions and/or jurisdictional planning to address the change/trend. Multiple Triggers can be set to invoke additional actions as necessary (e.g. degrading conditions). For water quantity, a Trigger is a percentage of the Available Water (e.g., <50%) that, if exceeded, results in bilateral management actions and/or jurisdictional planning, that will be determined by the BMC.

Triggers may be set for Class 2 Transboundary Waters and will be set for Class 3 Transboundary Waters according to the RIM Approach.

D4. Approach to Setting Transboundary Water Quantity Objectives

Available Water will be shared as per Section 6.1 (c) of the Agreement and the sharing will be formalized into a Transboundary Water Quantity Objective if the relevant Transboundary Water reaches a Level 3 Classification.

The setting of Transboundary Water Quantity Objectives requires site-specific knowledge of stream flow and Available Water. Long-term continuous monitoring of stream flow is important to characterize hydrology of a water body and to estimate Available Water.

For Class 3 Transboundary Waters, the BMC will set Transboundary Water Quantity Objectives and identify, based on the best available scientific information and/or a desktop method and/or an instream flow needs study, the amount of water needed to maintain the ecological integrity of the aquatic ecosystem and the Available Water.

D5. Water Quantity Conditions and Actions

Table 3 outlines some of the required responses to certain water quantity conditions that may arise in Transboundary Waters. This list is not exhaustive and will be amended through the BMC.

Table 3. Water Quantity Conditions and Associated Actions

	Water Quantity Condition	Required Response	Sample Actions / Comments
1	· Development and/or water use occurs in a Transboundary Water not listed in Appendix B	· Transboundary Water will be added to the list in Appendix B. · Water body is classified.	· Licensed withdrawals (i.e. allocations) are tracked.
2	· Transboundary Water is designated as a Class 2	· Learning Plan is developed and implemented. · Triggers may be developed. · Amounts of withdrawals and return flows are estimated.	· Compile baseline data and assess need for new information. · Track ratios of licensed withdrawals to stream flow. · Improve understanding of aquatic ecosystem. · Prepare for the setting of Transboundary Water Quantity Objectives, if required.

	Water Quantity Condition	Required Response	Sample Actions / Comments
3	· A drought (or flood) event occurs in any classified Transboundary Water	· Notify other jurisdiction of event and identify any actions that will be taken immediately or if event persists.	· If required, assess impact to Water Quality, Groundwater and Biological components of the aquatic ecosystem. · Determine whether a Trigger or Transboundary Water Quantity Objective (if applicable) has been reached. · Suspend use as required to maintain ecosystem health (e.g. 2010 & 2012 BC Oil and Gas Commission decisions).
4	· Transboundary Water is designated as a Class 3	· Track actual withdrawals. · Develop Triggers and set Transboundary Water Quantity Objectives based on an agreed desktop method or an instream flow needs study.	· Assess need to conduct instream flow needs study.
5	· Total allocated water (licensed withdrawals) in upstream jurisdiction exceeds Trigger	· The BMC will seek confirmation of actual withdrawals and estimated return flows.	· Refine estimate of return flows.
6	· Actual water consumption exceeds Trigger (approaches Transboundary Water Quantity Objective)	· If Transboundary Water Quantity Objectives have not been set using an instream flow needs study, revise Trigger and/or Transboundary Water Quantity Objectives based on a refined desktop method or proceed with the determination of the Available Water through an instream flow needs study.	· Jurisdictional management
7	· Actual water consumption exceeds Transboundary Water Quantity Objective	· Clauses in 4.3 j, k, l and m of the Agreement apply. · Transboundary Water may be designated a Class 4	· Class 4 management actions, if designated.

D6. Water Quantity Objectives for Class 3 Water Bodies

At time of signing, no transboundary water bodies were designated as Class 3, therefore, no Transboundary Water Quantity Objectives were set.

Transboundary Water Quantity Objectives will be set so that the determined sum of the needs for maintaining the ecological integrity of the aquatic ecosystem protects the most sensitive use/user of the water body which includes:

- Drinking water
- Traditional uses
- Aquatic life
- Wildlife
- Recreation and aesthetics

Transboundary Water Quantity Objectives will be set by the BMC as required using an agreed upon desktop methodology or instream flow needs study.

BWMA Appendix E – Surface Water Quality

E1. Surface Water Quality Classification

At the time of signing, the Petitot and Liard Rivers were classified as a Class 2 for water quality (Table 4). All other transboundary water bodies listed in Table 2 of Appendix B were classified as a Class 1; no Class 3 water bodies were identified.

Table 4. Water body classification according to RIM

Water Body	RIM Class	Rationale/Comments
Petitot River	2	Development is present, high traditional use.
Liard River	2	Development is present, high traditional use, community drinking water supply.

A RIM classification of 2 was assigned to both the Petitot and Liard rivers based on the existing land development, and high rates of traditional use.

Ongoing monitoring of water quality in transboundary waters is essential for refining the approach used to assess risk to surface water quality. The Parties have agreed to continue surface water quality monitoring for at least the period of the Learning Plan on the Liard and Petitot Rivers as per Appendix I.

Classification of transboundary waters will be reviewed at least annually by the BMC.

The NWT and BC agree that a reproducible approach for classification of transboundary waters is warranted. The BMC will develop an approach that meets both Parties' interests. The BMC will begin this work by reviewing the existing draft *Water Quality Ranking System to Classify Transboundary Water Bodies* provided by BC and the *Receiving Water Classification System for the NWT* provided by the NWT. Other relevant approaches will also be considered.

E2. Learning Plans

A Learning Plan is required for Class 2 Transboundary Waters (see Appendix H1). The Learning Plan provides additional information to confirm the assigned classification and contribute to baseline information for a transboundary water body.

The Learning Plan will include a screening level risk assessment which may incorporate a monitoring strategy, dependent upon the availability of information, and the level of risk to receptors. A key objective of the Learning Plan will be to evaluate the current and projected level of risk posed to water quality, quantity, biology and the aquatic ecosystem. This will involve the review of all available relevant watershed information (e.g., land and water use, ongoing and proposed resource development, existing water quality, quantity, biological indicators data, and traditional use values) and the preparation of a conceptual model that describes the:

- point and non-point source discharges;
- parameters of concern and their environmental fate and transport pathways; and
- human, biological and ecological receptors.

As described in Appendix A, a Trigger is a pre-defined early warning of change in typical or extreme conditions that results in confirmation of change and bilateral management oversight, actions and/or jurisdictional planning to address the change/trend. Multiple Triggers can be set to invoke additional actions as necessary (e.g. to address degrading conditions). For water quality, Triggers may be set for the parameters of concern and human, biological, and ecological indicators at Class 2 and will be set at Class 3. The methodology for developing Triggers will be discussed as part of the Learning Plan. Traditional knowledge and traditional use will be considered in the derivation of Triggers.

Tracking Metrics will be developed for Class 2 water bodies to enhance learning. Tracking Metrics are for information, assessment and learning purposes. Tracking Metrics will be developed using valid methods to help understand baseline water quality, identify changes in water quality conditions, assess the risk of development, and enable the BMC to identify potential provincial/territorial water quality issues. Tracking Metrics will also help to identify any new or emerging parameters of concern as well as aid with the evaluation of whether a water body should change RIM classification. If a parameter that is not of concern based on the risk assessment begins to trend, the cause will be investigated and it will be determined if the status of the parameter should be changed to a parameter of concern.

Tracking Metrics will be developed by the BMC to reflect the seasonal site-specific characteristics of each water body. In the interim, percentile values will be used to describe typical (50P) or the upper boundary of typical, non-extreme conditions (e.g. 75P) whereas the upper boundary of extreme conditions will be described using, for instance the 90P or 95P. The Learning Plan and the information gathered from Tracking Metrics will be useful to support the development of Triggers and Transboundary Water Quality Objectives (Section E3 and E4), as required (see Appendix H1).

E3. Approach to Setting Water Quality Triggers

Triggers will be set for the water quality parameters of concern that have been identified through the Learning Plans for the Liard and Petitot Rivers (Table 5).

Table 5. Definitions, examples and potential management actions for Triggers that will be set for water quality parameters of concern as identified through the Learning Plan.

Definition	Examples	Potential Management Actions

	Definition	Examples	Potential Management Actions
Trigger 1	· A pre-defined early warning of potential changes in typical conditions which results in bilateral management actions and/or jurisdictional planning to confirm that change. Multiple Triggers can be set to invoke additional actions if conditions decline.	· Exceedance of a water quality concentration based on background conditions (e.g. 30-day average concentration) · Shift in central tendency (e.g., 50th percentile) and/or some other percentile (e.g. 75th) · A statistically significant degrading trend in water quality · A change in the dissolved/total ratio. · A pre-defined degree of change in land or water use.	· Jointly review water quality data/changes · Confirm the change is real · Jointly investigate cause and risk (i.e. have land uses changed?) · Investigate other media (water quality, sediment and/or biota), as appropriate, to provide supporting evidence
Trigger 2	- A second warning indication that extreme conditions are changing which results in bilateral management and/or jurisdictional planning.	· A second pre-defined early warning to provide additional information to confirm changes in conditions · For water quality or biological parameters this would be defined statistically (e.g. upper limit of background: 90th percentile or upper prediction limits: 95UPL)	· Continue investigation using an ecosystem approach using all available evidence (i.e. weight of evidence approach) · Adjust monitoring design (e.g., increase frequency, parameters, and/or sites) as necessary · Compare to upstream and/or regional sites · Discuss the need to change to Class 3

E4. Approach to Setting Transboundary Water Quality Objectives

For Class 3 water bodies, Transboundary Water Quality Objectives will be set for the water quality parameters of concern that have been identified as part of the Learning Plan.

Transboundary Water Quality Objectives will be set to protect the most sensitive use/user of the water body which includes:

- Drinking water
- Traditional uses
- Aquatic life
- Wildlife
- Agriculture (irrigation and livestock watering)
- Recreation and aesthetics
- Industrial water supplies including food processing.

In setting Transboundary Water Quality Objectives, the Parties will:

- Consider a range of relevant methods
- Select methods that are credible and transparent

- Utilize relevant science and traditional knowledge
- Ensure that methods and resulting Objectives are based on a weight of evidence approach (including science and traditional knowledge)
- Use best available data and information, and improve / adapt over time
- Consider the ecological significance of trends in water quality and quantity
- Design Objectives to protect all uses, including traditional uses
- For the protection of aquatic life, design Objectives to protect the most sensitive species at all life stages
- Consider the potential for synergistic and cumulative effects from multiple sources and parameters
- Recognize each party's right to use water and equitably share the assimilative capacity
- Recognize the terms of land claims agreements, which the parties have reviewed and understood which the parties have reviewed and understood, and other legal contracts and agreements
- Meaningfully engage other interested third parties and bring their input to the BMC

The Parties agree that the approach to develop and implement Transboundary Water Quality Objectives requires further discussion and resources (Table 6). This will be discussed at the BMC, within 3 years of the agreement being signed, unless land development significantly increases within this time period, and the BMC agrees to engage on the methodology sooner.

Table 6. Definitions, descriptions and potential management actions for water quality Objectives that will be set for water quality parameters of concern identified as part of the Learning Plan.

	Definition	Examples	Potential Management Actions
Objective	- A Transboundary Water Quality Objective is a conservative value that is protective of all water uses of the water body, including the most sensitive use. Exceedance of Transboundary Water Quality Objectives may represent unacceptable change and result in bilateral management including the responsible jurisdiction taking necessary action to stop trend and/or exceedance(s).	- A defined numerical value, agreed to by both Parties through the BMC; - A narrative statement describing the biological characteristics of the ecosystem e.g., fish abundance.	- Responsible jurisdiction takes necessary action to stop trend and/or exceedance(s). - Exceedance of a Transboundary Water Quality Objective may move the transboundary water body from a Class 3 to a Class 4.

E5. Toxic, Bioaccumulative and Persistent Substances

The organizations and delegations listed below have identified several human-made substances that have been slated for virtual elimination. This refers to reducing, in the medium to long-term, the concentration of designated substances to levels below or at the limits of measurable concentrations.

- USEPA List of Toxic Pollutants (Section 307(a)(1) of the Clean Water Act)
- International Joint Commission (Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes)
- Health Canada (Pest Management Regulatory Agency's Strategy for Implementing the Toxic Management Substances Policy)
- Environment Canada (Environment Canada's Risk Management Program: Toxic Substances Management Policy)
- Stockholm Convention (Persistent Organic Pollutants requiring control, Canada is a signatory)

a) As per Section 7(d) of the Agreement, The Parties are committed to pollution prevention and sustainable development to meet the objective of the virtual elimination for substances that are human-made, toxic, bioaccumulative and persistent (Table 7). Where the conceptual model developed under the Learning Plan identifies the risk of any of the substances listed in Table 7, monitoring efforts commensurate with that level of risk should be undertaken. If any of these substances are detected in transboundary waters[1] and have the potential to alter the ecological integrity of the aquatic ecosystem, the Party will identify and implement appropriate courses of action, including continued prioritised monitoring of that substance. It is recognized that, in some cases, it will take time to identify and implement alternative courses of action. The Parties will promote the use of safer chemical substances by supporting technologies that reduce or eliminate the use and release of substances that have been deemed toxic, bioaccumulative and persistent. It is recognized that some of these substances may occur as the result of Force Majeure.

b) The transboundary monitoring results of these substances will be shared with the Government of Canada's Chemicals Management Plan (CMP) Stakeholder Advisory Council (Health Canada) to raise awareness and, within reason help to understand potential sources. The CMP describes the Government of Canada's existing monitoring commitments (such as the Great Lakes Water Quality Agreement, Stockholm Convention on Persistent Organic Pollutants) as well as being responsive to newer emerging contaminants of concern.

c) Current status of toxic, bioaccumulative and persistent substances:

- The substances provided in Table 7 currently do not form part of the Petitot River Water Quality Monitoring Program. Should any of these substances be identified as substances of concern following the risk assessment (which will consider all available data), a table for the Petitot will be created and included in this Appendix and monitoring and management actions regarding these substances will be prioritized, commensurate with the level of risk.
- The substances indicated in Table 8 currently form part of the Liard River at Fort Liard and/or the Liard River above Kotaneelee River Water Quality Monitoring Programs. Monitoring will continue and be assessed as per (b) above.

[1] Presently, water quality monitoring occurs at two sites on the Petitot River: 1) below Highway 77 (BC) and 2) downstream of Tsea River (BC) and four sites on the Liard River: 1) at Upper Crossing (YT), 2) at Lower Crossing (BC), 3) at Fort Liard ((NT) and 4) below Kotaneelee River (NT). Only the Liard at Fort Liard and the Liard River above Kotaneelee River are monitored for VE substances.

- The substances indicated in Table 9 currently do not form part of the Liard River at Fort Liard and/or the Liard River above Kotaneelee River Water Quality Monitoring Programs. Should any of these substances be identified as substances of concern following the risk assessment, they will be added to Table 8 and monitoring of these substances will be prioritized, commensurate with the level of risk.

d) Should additional information be provided about persistent, toxic and bioaccumulative substances by other parties, after the risk assessment has been conducted, this information will be evaluated based on risk to determine if the substance (s) should be included in this Appendix. The BMC will periodically review the scientific literature to determine if a new substance should be considered for inclusion in Table 7. Consideration will be given if federal, provincial, territorial, or international programs or academia and/or the organizations, listed in section 1, have identified it as potentially harmful to the environment or human health.

Table 7. Substances that have been listed or nominated as toxic, bioaccumulative and persistent in accordance with E5(a).

Aldrin	Total Arolclors
Chlordane (alpha, gamma, trans, oxy)	Total PCBs
Dieldrin	Dioxins and Furans (mono, di, tri)
Endrin	Dioxin and Furans (homologues)
Heptachlor	2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin)
Hexachlorobenzene	2,3,7,8-TCDF (tetrachlorodibenzofuran)
Hexachlorobutadiene	1,4-dichlorobenzene
Hexachlorcyclohexane (HCH; alpha, beta, gamma, delta)	3,3-dischlorobenzidine
Mirex	Pentachlorobenzene
DDD (2'4; 4'4)	Tetrachlorobenzene (1,2,3,4 and 1,2,4,5)
DDE (2'4; 4'4)	4,4'-methylenebis(2-chloroaniline)
DDT (2'4; 4'4)	Chlordecone
Toxaphene	Dinitropyrene
Aroclor 1016	Heptabromodiphenyl ether (Hepta-BDE)
Aroclor 1221	Hexabromobiphenyl (HBB)
Aroclor 1232	Hexabromobiphenyl ether (Hexa BDE)
Aroclor 1242	Octachlorostyrene
Aroclor 1248	Pentabromodiphenyl ether (Penta-BDE)
Aroclor 1254	Perfluorooctane sulfonate
Aroclor 1260	Tetrabromodiphenyl ether (Tetra-BDE)

Table 8. Toxic, bioaccumulative and persistent substances currently part of the Liard River at Fort Liard and/or the Liard River above Kotaneelee River Water Quality Monitoring Programs

Aldrin	Toxaphene
Chlordane (alpha, gamma, trans, oxy)	Aroclor 1016
Dieldrin	Aroclor 1221
Endrin	Aroclor 1232
Heptachlor	Aroclor 1242
Hexachlorobenzene	Aroclor 1248
Hexachlorobutadiene	Aroclor 1254
Hexachlorcyclohexane (HCH; alpha, beta, gamma, delta)	Aroclor 1260
Mirex	Total Aroclors
DDD (2'4; 4'4)	Total PCBs
DDE (2'4; 4'4)	
DDT (2'4; 4'4)	

Table 9. Toxic, bioaccumulative and persistent substances currently NOT part of the Liard River at Fort Liard and/or the Liard River above Kotaneelee River Water Quality Monitoring Programs

Dioxin & Furans (mono, di, tri)	Chlordecone
Dioxin and Furan (homologues)	Dinitropyrene
2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin)	Heptabromodiphenyl ether (Hepta-BDE)
2,3,7,8-TCDF (tetrachlorodibenzofuran)	Hexabromobiphenyl (HBB)
1,4-dichlorobenzene	Hexabromobiphenyl ether (Hexa BDE)
3,3-dischlorobenzidine	Octachlorostyrene
Pentachlorobenzene	Pentabromodiphenyl ether (Penta-BDE)
Tetrachlorobenzene (1,2,3,4 and 1,2,4,5)	Perfluorooctane sulfonate
4,4'-methylenebis(2-chloroaniline)	Tetrabromodiphenyl ether (Tetra-BDE)

BMWA Appendix F – Groundwater

F1. Classification of Groundwater Areas

Hydrogeological information to delineate aquifers in the NWT-BC border region is scarce and most of the aquifers in this area are not defined and mapped; thus, watershed boundaries were used as a surrogate for delineating transboundary groundwater areas at the sub-basin level. Groundwater areas provide an area based framework for data collection and synthesis and identification of key information gaps. It was assumed that topographic slope reflects shallow groundwater flow directions and that surface sub-basins generally reflect groundwater flow patterns within the smaller discrete sub-watershed units in order to facilitate management and investigations of groundwater.

The Petitot sub-basin 1 & 2 and Liard sub-basin 1 were defined as transboundary Groundwater Areas (Figure 2) and were classified based on groundwater quality and quantity (Table 10). The three Transboundary Groundwater Areas were classified as Class 1 for quantity and Class 2 for quality.

Figure 2. Transboundary Groundwater Areas

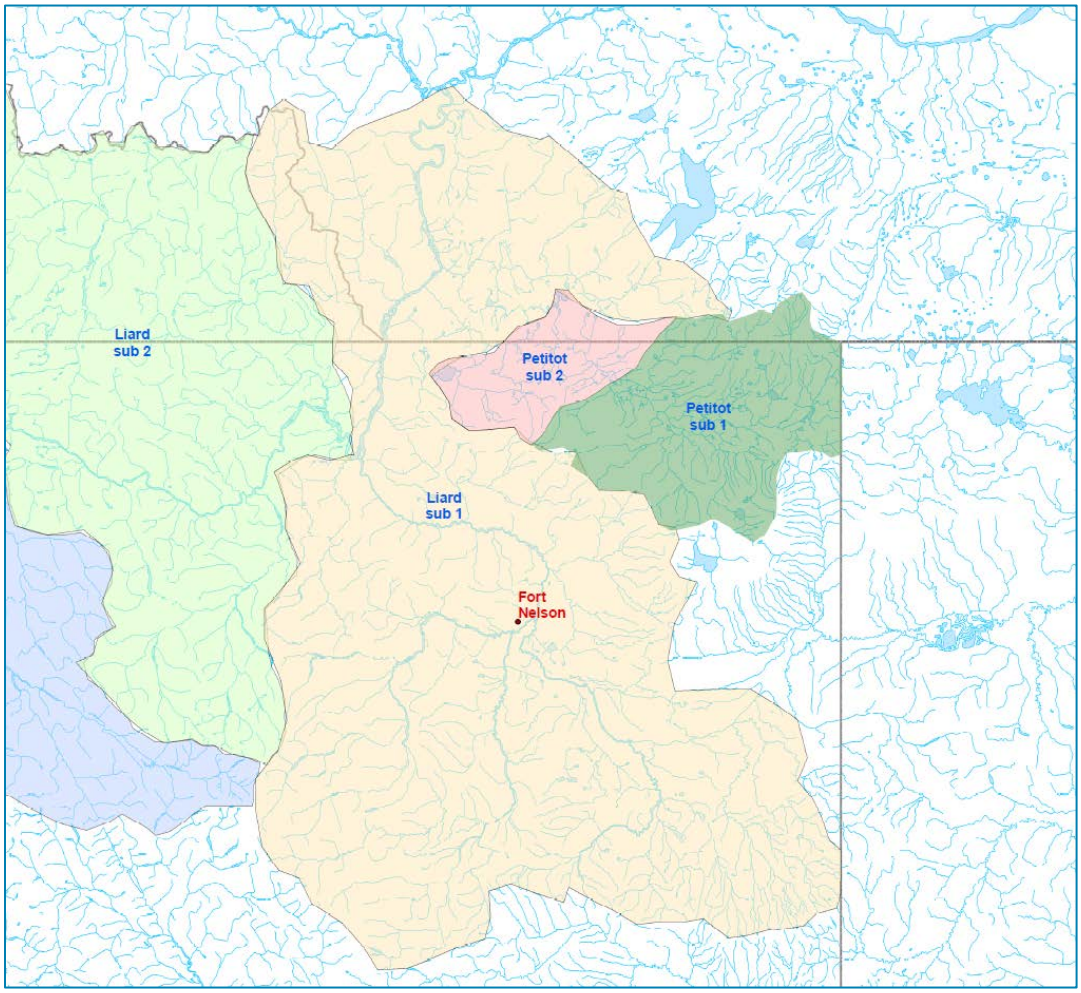


Table 10. Classification of Transboundary Groundwater Areas for Water Quality and Quantity

Groundwater Area	RIM Class		Rationale/Comments
	Quality	Quantity	
Liard sub basin 1	2	1	**Groundwater Quality:** Information on the intrinsic vulnerability and risk from development are insufficient, however, significant numbers of oil and gas wells exist within this area. Therefore, the Parties agree to classify the groundwater unit as a class 2 to allow for the development of a Learning Plan until adequate information is available.
			Groundwater Quantity: Available information such as well density and knowledge of water use indicate a low demand; therefore, the Parties agree to classify the groundwater unit as a Class 1.
Petitot sub basin 1	2	1	**Groundwater Quality:** Information on the intrinsic vulnerability and risk from development are insufficient; however, significant numbers of oil and gas wells exist within this area. Therefore, the Parties agree to classify the groundwater unit as a class 2 to allow for the development of a Learning Plan until adequate information is available.
			Groundwater Quantity: Available information such as well density and knowledge of water use indicate a low demand; therefore, the Parties agree to classify the groundwater unit as a Class 1.
Petitot sub basin 2	2	1	**Groundwater Quality:** Information on the intrinsic vulnerability and risk from development are insufficient; however, significant numbers of oil and gas wells exist within this area. Therefore, the Parties agree to classify the groundwater unit as a class 2 to allow for the development of a Learning Plan until adequate information is available.
			Groundwater Quantity: Available information such as well density and knowledge of water use indicate a low demand; therefore, the Parties agree to classify the groundwater unit as a Class 1.

The BMC will work to develop a reproducible approach for classification of Transboundary Groundwater Areas that meets both Parties' interests. The BMC will begin this work by reviewing relevant risk assessment tools (e.g., *The British Columbia, Yukon and Northwest Territories Trans-boundary Groundwater Area Classification Scheme*, a modified version of the BC Aquifer Classification System, produced by British Columbia). The method will improve over time as more data are collected.

Factors to be considered in the development of a reproducible approach to classification of Transboundary Waters include, but are not limited to, groundwater quality, groundwater quantity, domestic well density, community wells, irrigation and other large production wells, water source wells, surficial geology, hydrogeologic and subsurface geology data, land use (including assessment of risk from hydraulic fracturing and deep water injection, etc.).

F3. Learning Plans

Learning plans are initiated for Class 2 groundwater areas, where there is some concern that current conditions or predicted conditions resulting from a proposed land use will pose a risk to groundwater quality and quantity and associated aquatic resources. Learning plans provide additional information needed to confirm the assigned classification and contribute to the baseline information for a transboundary groundwater area.

A Learning Plan will provide a screening level risk assessment which may include an assessment and monitoring strategy, dependent upon the availability of information, and the level of risk to receptors. A key objective of the Learning Plan will be to evaluate the current level of risk posed to groundwater quantity and/or quality and the aquatic ecosystem. This will involve the review of available relevant information (e.g., land use, ongoing and proposed resource development, water quality, biological indicators data where applicable, etc.) and the preparation of a conceptual model that describes the:

- Sources of point and non-point discharges and substances of concern;
- Environmental fate and transport pathways for these substances; and
- Human, biological and ecological receptors (including traditional use values where appropriate).

As part of the Learning Plan, surficial and subsurface geological mapping to outline the physical structure and extent of the different rock and soil units that cover the transboundary groundwater areas may be conducted. This could include an assessment of local surficial and bedrock geology, including stratigraphy, depth, thickness, composition, water-bearing potential and lateral continuity.

As part of the Learning Plan, Tracking Metrics will be developed to help understand baseline groundwater quality and quantity. These Tracking Metrics will be used to aid with evaluation of whether a water body should change RIM classification.

The groundwater Learning Plan is further described in Appendix H2: Groundwater Learning Plan.

F4. Triggers and Objectives

The Parties will work towards preventing, better understanding and, potentially, resolving transboundary groundwater issues.

Triggers, Transboundary Groundwater Objectives and Management Actions will be determined at the BMC after signing. A Trigger is a pre-defined early warning of change in typical or extreme conditions that result in confirmation of change and bilateral management oversight, actions and/or jurisdictional planning to address, the change/trend. Multiple Triggers can be set to invoke additional actions as necessary (e.g. degrading conditions). A Transboundary Groundwater Objective identifies a change in conditions that if exceeded, results in bilateral management action. Methods to develop Transboundary

Groundwater Objectives for both quantity and quality will be discussed at the BMC. Transboundary Groundwater Objectives will be set for Class 3 groundwater areas in accordance with the RIM Approach.

Conditions that could be used to assess if a groundwater area moves from one class are included, but not limited to, the quantity and quality sections below. These will be further developed by the BMC.

F4.1 Quantity

- Temporal (and statistically significant) change in groundwater level in a groundwater area/ aquifer management unit at an established monitoring location.
- Impact to sensitive water body or wetland as demonstrated by water level changes.
- Decrease in base flow at a hydrometric station.
- Decreasing well supplies due to overall groundwater level decline.
- Accuracy of modeled versus measured conditions in established monitoring wells.
- Increase in Development and Activities

F4.2 Quality

- A significant trend in groundwater quality indicating a general degradation in quality.
- Occurrence of specific contaminants at levels above background at monitoring stations. Groundwater-quality results indicate health-related maximum acceptable concentration(s) have been exceeded or treatment limits for aesthetic parameters have been exceeded.
- Increase in Development and Activities

BWMA Appendix G – Biological

G1. Classification

The Parties agreed not to classify water bodies based on the biological component at this time. Biological considerations have been integrated into the Learning Plans for Class 2 water bodies. The need for separate classification based on the biological component of Liard Watershed Transboundary Waters will be re-assessed by the BMC.

The Parties agree that biological monitoring is not dependent on a change in water quality and/or water quantity and will be considered separately for the following reasons:

- Considering that biota are sensitive indicators, biological monitoring can be used as an early warning that a change in the environment is occurring, which allows for an adaptive response.
- Biota can be affected by factors other than the quality or quantity of water such as cumulative effects, climate change, and loss of habitat or habitat degradation which can affect access, cover, substrate and food.
- The presence of exotic species cannot be detected through water quality or quantity monitoring.
- Contaminants can cause harm to aquatic life or pose a health hazard to people eating fish well before their concentrations in water indicate there is a problem.

G2. Learning Plans

The Biological component is incorporated into Appendix H1: Surface Water Learning Plan. Class 2 Transboundary Waters must have Learning Plans that include a biological component.

As part of the Learning Plan, biological indicators will be discussed at the BMC. A biological indicator is a species, community or biological process used to provide qualitative and/or quantitative information on the environment and how it changes over time.

G3. Biological Monitoring and Indicators

Biological indicators are used to track the status/conditions of living organisms in order to inform bilateral management, primarily the setting of Transboundary Objectives. Monitoring biological indicators (e.g. plants, invertebrates, fish) provides complementary information to physical and chemical monitoring programs to assess ecosystem health with respect to the cumulative effects of multiple substances, water withdrawals, climate change and habitat alteration. It can also provide an early warning of change or stress in the aquatic environment which allows for a proactive and adaptive response to ensure the protection of all uses and to ensure the protection of the health of aquatic organisms, wildlife and humans. In determining appropriate biological indicators and developing biological monitoring programs, the Parties will apply the following guidelines:

- Biological indicators will be identified through the use of conceptual models developed for a water body as part of a Learning Plan.

- The selection of biological indicators and intensity of monitoring will be guided by site-specific needs and commensurate with the nature and intensity of the risks.
- Biological indicators apply to all components (i.e., water quality, quantity and groundwater) and will be used to track conditions and/or monitor Transboundary Objectives for other components where appropriate.
- Biological indicators will employ the use of statistical methods to identify when conditions are moving outside of natural variability and/or reference sites. The management framework described in Appendix E, Section 3 will apply to biological indicators identified through the Learning Plan and/or adopted as Transboundary Biological Objectives.
- Methods that will be explored by the BMC for the monitoring of biological indicators may include, but are not limited to:
    - Comparison to historical tissue metal concentrations, nutrients and organic compounds and guidelines for large or small bodied fish and benthic invertebrates
    - Presence/absence of fish compared to historical accounts for large and small bodied fish
    - Hepatosomatic Index (**HSI**) and Gonadosomatic Index (**GSI**), weight at age, condition of fish for large bodied fish
    - Critical Effects Size
    - Benthic invertebrate bio-monitoring (e.g., CABIN protocol, BACI design)

Tracking Metrics will be developed as part of the Learning Plan.

Triggers will be identified through Learning Plans. A Trigger is a pre-defined early warning of change in typical or extreme conditions that result in confirmation of change and bilateral management oversight, actions and/or jurisdictional planning to address the change/trend. Multiple Triggers can be set to invoke additional actions as necessary (e.g. degrading conditions).

G4. Transboundary Biological Objectives

Transboundary Biological Objectives may be established for Class 3 water bodies in the future as deemed necessary and appropriate by the BMC. Transboundary Biological Objectives would have specific associated management actions. The development of Transboundary Biological Objectives will be informed by biological monitoring programs, with different associated management actions.

BMWA Appendix H1 –
Surface Water Learning Plan - Class 2 Transboundary Waters

This Appendix provides a draft Surface Water Learning Plan table of contents for a typical Class 2 transboundary water body. This Table of Contents is not exhaustive. The BMC will jointly decide where to place effort on a case-by-case basis.

1.0 Watershed Profile
- 1.1 Introduction
  - 1.1.1 Climate
  - 1.1.2 Topography
  - 1.1.3 Geomorphology and geology (including soils)
  - 1.1.4 Vegetation
  - 1.1.5 History
- 1.2 Current and proposed development activities (agriculture, forestry, urban and rural population distribution, infrastructure, resource extraction, and industries)

2.0 Water Uses
- 2.1 Water licenses and short-term use approvals
- 2.2 Traditional/cultural use
- 2.3 Aquatic ecosystem & wildlife
- 2.4 Tourism and recreation
- 2.5 Community water supplies
- 2.6 Navigation (including barge traffic)
- 2.7 Other designated uses

3.0 Influences on Water Resources
- 3.1 Licensed water withdrawals and return flows
- 3.2 Point source discharges
- 3.3 Fisheries (commercial and recreational)
- 3.4 Non-point source loadings
- 3.5 Air emissions (local and long range transport of atmospheric pollutants)
- 3.6 Climate change
- 3.7 Cumulative effects
- 3.8 Future development
- 3.9 Other (e.g. wildfires)

4.0 Ambient Environmental Conditions
- 4.1 Existing Traditional knowledge related to aquatic ecological health
- 4.2 Existing water quality conditions (including comparison to water quality guidelines and/or objectives)

- 4.3 Existing sediment quality conditions (including comparison to water quality guidelines and/or objectives)

- 4.4 Hydrology
  - 4.4.1 Regional and basin-wide water quantity
    - 4.4.1.1 Trends in total annual and seasonal flows
  - 4.4.2 Frequency and severity of floods and droughts
    - 4.4.2.1 Trends in flood and drought conditions
  - 4.4.3 Flow and water quality
  - 4.4.4 Flow and biology
  - 4.4.5 Groundwater and surface water interactions

- 4.5 Aquatic Ecosystem Structure
  - 4.5.1 Aquatic plants
  - 4.5.2 Zooplanktons
  - 4.5.3 Benthic invertebrates
  - 4.5.4 Fish (diversity, abundance, distribution, habitat conditions)
  - 4.5.5 Wildlife

5.0 Conceptual Model
- 5.1 Point source waste discharges
- 5.2 Non-point sources of pollution
- 5.3 Parameters of concern
  - 5.3.1 Environmental fate and pathways analysis for parameters of concern
  - 5.3.2 Bioaccumulation/biomagnification risk of parameters of concern
- 5.4 Receptors
  - 5.4.1 Analysis and rationale for human receptors
  - 5.4.2 Analysis and rationale for biological receptors
  - 5.4.3 Analysis and rationale for ecological receptors
- 5.5 Biological Indicators
  - 5.5.1 Analysis and rationale for biological indicators

6.0 Receptor Risk Assessment
- 6.1 Risks to water uses
- 6.2 Risks to aquatic ecosystem structure and components
- 6.3 Human health

7.0 Knowledge Gaps

8.0 Monitoring Requirements
- 8.1 Monitoring approaches, procedures, methodology
- 8.2 Monitoring Sites
  - 8.2.1 Water Quality Monitoring Schedule

8.2.2 Biological Indicators Monitoring Schedule
8.2.3 Hydrometric Monitoring
8.2.4 Data analysis and reporting
8.2.4.1 Tracking Metrics
8.2.4.2 Triggers

BMWA Appendix H2 – Groundwater Learning Plan

This Appendix further describes the commitments of the Parties to learn about Transboundary groundwater as defined in Section 2.2 and referred to in Section 4.3(c) of the Agreement. The following is a draft Groundwater Learning Plan Table of Contents. This Table of Contents is not exhaustive; further work will be conducted by the BMC, as required.

1.0 Fundamental - hydrologic, geological, and geographic framework
- 1.1 Watershed characteristics (e.g., hydrology, topography, soils, etc.)
- 1.2 Spatial information on surficial and bedrock geological units (to help identify potential aquifers)
- 1.3 Immediate and proposed development activities and human pressures (agriculture, forestry, urban and rural population distribution, traditional use, infrastructure, resource extraction, and water demand)

2.0 Estimating Groundwater Uses
- 2.1 Method used to estimate groundwater use (e.g., licensed withdrawals, number of water wells, demand to inform and provide summary of existing quantity data)
- 2.2 Identify specific areas, aquifers and direction of groundwater flow where significant groundwater use is occurring
- 2.3 Future pressures/demands
- 2.4 Current state of knowledge of resource, gaps and opportunities for learning
- 2.5 Learning: Assessment and monitoring requirements for GW quantity.

3.0 Other Influences
- 3.1 Licensed water withdrawals
- 3.2 Point source discharges from water
- 3.3 Future development
- 3.4 Potential for cumulative effects

4.0 Reconnaissance Survey - Summary of existing data for groundwater quantity and quality

5.0 Risks to groundwater quality
- 5.1 Environmental fate and pathways analysis for variables of concern (identify land and resource use activities and their risks and vulnerable aquifers, etc.,)
- 5.2 Receptor Risk Assessment
  - 5.2.1 Risks to water uses
  - 5.2.2 Risks to aquatic organisms (e.g., aquatic plants, invertebrates, fish, birds, ungulates, habitat)
  - 5.2.3 Human health (e.g., drinking water, plants, fish, wildlife)
- 5.3 Knowledge Gap Analysis for Groundwater Quality

6.0 Assessment and monitoring requirements for groundwater quantity and quality

- 6.1 Monitoring approaches, procedures, methodology
- 6.2 Monitoring schedule
- 6.3 Data analysis and reporting
  - 6.3.1 Tracking Metrics
  - 6.3.2 Triggers

7.0 Groundwater-surface water interactions

BMWA Appendix I – Monitoring

This Appendix describes the commitments of the Parties to BWMA, and regional and basin-level monitoring as defined in Section 10.2 of the Agreement.

I 1. Context

Long-term monitoring is critical to understanding whether significant changes are taking place in the natural environment. Long-term datasets reveal important patterns, which allow trends, cycles, and rare events to be identified. This is particularly important for complex, large systems where signals may be subtle and slow to emerge. Long-term datasets are essential to test hypotheses that may have been overlooked at the time the monitoring was started. With increasing hydroclimatic variability, long-term monitoring is critically important.

As part of the Learning Plan for Class 2 water bodies (Appendix H1), the Parties will assess the need for monitoring and the appropriate locations for monitoring Transboundary Waters with regard to surface and groundwater quality, water quantity, and biology. The Parties may consider the addition of social and/or air monitoring in the future. In the meantime, the Parties will continue to encourage and support the long-term monitoring conducted by Environment Canada and Mackenzie River Basin jurisdictions (see Table 11).

I 2. BWMA Regional and Basin Level Monitoring

The identification of monitoring stations that may be monitored over the long-term, for the BWMA will be based on a scientific and traditional knowledge assessment. These stations can also form part of the regional and basin level monitoring. For Class 2 or 3 water bodies this is likely to include, but is not limited to, information derived from Learning Plans. Monitoring stations in unclassified and classified level 1 water bodies may be included to provide comparisons to background or reference conditions.

Table 11 lists the present status of the Transboundary Water Quality and Hydrometric Stations in the Liard Basin. The stations that will be monitored while the Learning Plans for the Liard and Petitot rivers are completed, and those that are proposed as part of a regional and basin level monitoring program are also identified. Further scientific and traditional knowledge assessment will occur and may result in modifications to the stations included in both programs. The BMC will also consider the advice of the MRBB Science and Monitoring Committee.

I 2.1 Joint Monitoring Arrangements

The stations identified in Table 11 will be monitored through existing hydrometric and water quality agreements currently in place between British Columbia, the Northwest Territories and Environment Canada, subject to Clause 1.4 of the Liard BMWA. The applicable agreements include:

- [LIST OF APPLICABLE AGREEMENTS TO BE COMPLETED]

I 2.2 Water Quantity

For the BWMA, surface water quantity is monitored to ensure equitable sharing of Available Water between Parties and to maintain the ecological integrity of the aquatic ecosystem. To accomplish this, surface water quantity should be monitored on a regional, basin-wide level and tracked with water withdrawals and return flows, water quality and the biological components in the aquatic ecosystem.

There are currently 24 water quantity stations in the Liard River basin that record and report data in real time. The Parties agree to support ongoing operation of one key station located on the Petitot River, and jointly operated by BC and Environment Canada, subject to Section 13.2 of this agreement. The Parties also recommend that three stations, which lie along the main stem of the Liard River, and which are operated by Environment Canada and Yukon (for one of these stations (Figure 3Figure 3. Current Location of Transboundary Water Quality and Hydrometric Monitoring Stations in the Liard Basin. and Table 11), be included in the long-term regional and basin level monitoring program.

I 2.3 Water Quality

The primary goals of monitoring Transboundary Waters are to track changes in water quality over time, determine anthropogenic and natural drivers for changes in water quality, and ultimately ensure that water quality is protected for all water uses. While monitoring can help ensure the upstream jurisdiction does not cause unreasonable harm to the ecological integrity of the aquatic ecosystem in the downstream jurisdiction, monitoring should also be used to demonstrate that the downstream jurisdiction in not causing unreasonable harm as some aquatic resources (e.g., fish) may occur in both jurisdictions.

There are seven water quality monitoring sites in the BC-YT-NWT region (Figure 2; Table 11). The four sites located on the Liard River were originally established out of federal/provincial/territorial interest (e.g. transboundary). The main goal of these sites is to examine long-term changes in water quality to assess trends. The Liard River at Fort Liard, the Liard River at Upper Crossing and the Liard River above Kotaneelee River are long-term active sites. The Liard River at Lower Crossing site was discontinued[2] in 1994. The three sites in the Petitot River watershed (two on the Petitot River and one on a tributary to the Petitot) were recently established to collect baseline data to more effectively monitor potential anthropogenic pressures, including resource extraction, on or near the river.

To support the development of the Learning Plan and the potential development of Triggers, the Parties agree to continue monitoring at the Petitot River below Highway 77 at no less than the schedule described in Table 11 while Learning Plans are ongoing, subject to Section 13.2 of the agreement. Regional and basin level monitoring is recommended to resume or continue on the Liard River at 4 stations, including at Upper Crossing, Lower Crossing, Fort Liard and above Kotaneelee River (Table 11).

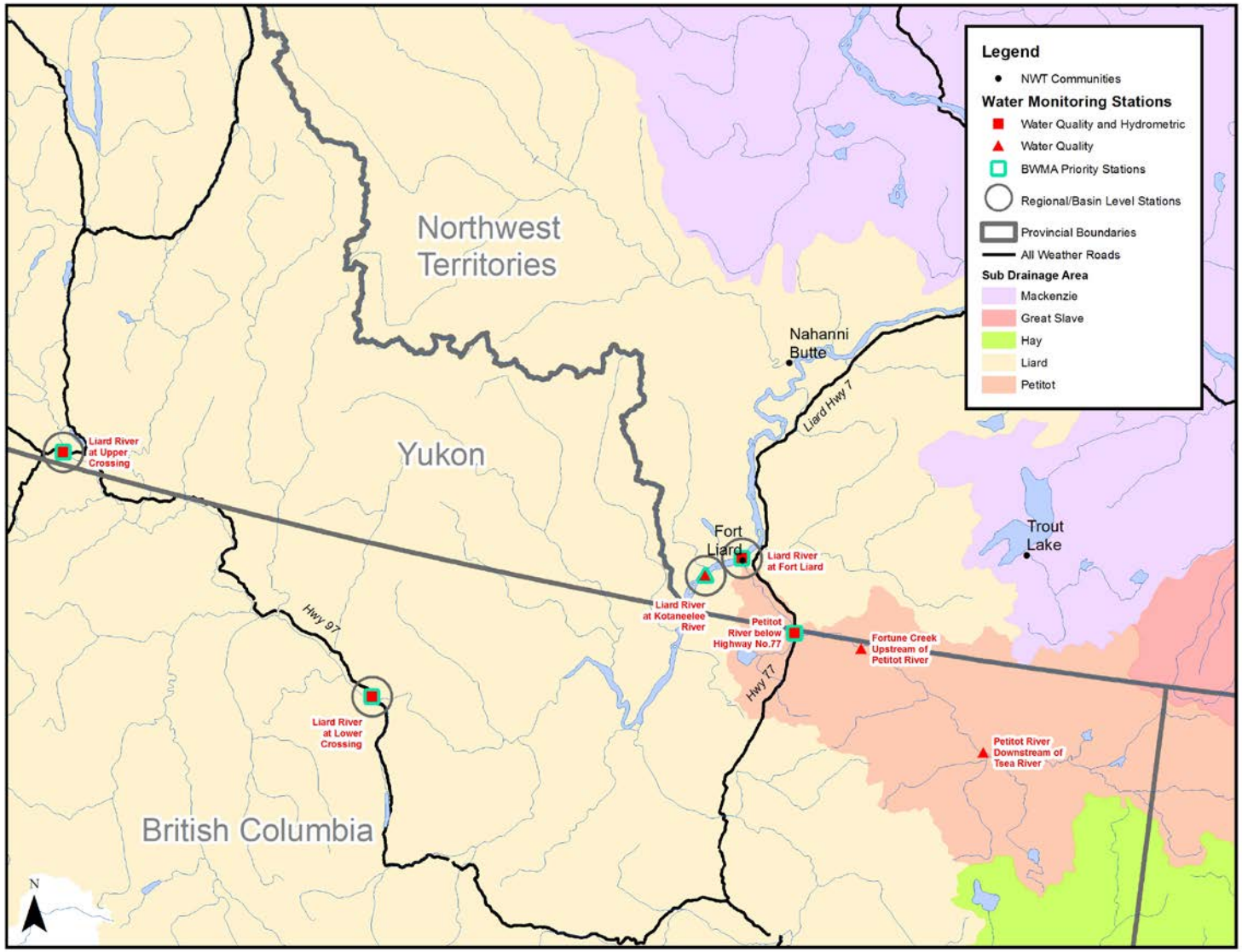
Data collected on the Petitot River downstream of Tsea River, and at Fortune Creek upstream of the Petitot River, will be used to inform Learning Plans and may be recommended as part of the BWMA or regional and basin level monitoring programs.

Table 11. Current (2014) Status of Transboundary Water Quality and Hydrometric Monitoring Stations in the Liard Basin.

SITE INFORMATION				QUALITY				HYDROMETRIC		
Site Name	Coordinates		Jur	Station #	Funder	Freq	Period of Record	Station #	Funder	Period of Record
Liard River at Upper Crossing#	60.047	-128.902	YT	YT10AA0001	Fed-YT	12X/yr (suspended in 2014)	1991-2013	YT10AA0001	Fed-YT	1942-present
Liard River at Lower Crossing#	59.413	-126.094	BC	BC10BE0005	Discon't	Discon't	1984-1994	BC10BE0005	Fed	1944-present
Liard River at Fort Liard#	64.243	-123.479	NWT	NW10ED0001	Fed	4-6X/yr	1998-present	NW10ED001	Fed	1960-present
Liard River above Kotaneelee River#	60.154	-123.743	NWT	n/a	NT	2-3X/yr	1992-present	--	--	--
Petitot River below Highway No.77*	59.989	-122.960	BC	BC10DA0002	Fed-BC	4X/yr	2011-present	BC10DA001	Fed-BC	1992-1996, 2012-present
Petitot River Downstream of Tsea River	59.644	-121.350	BC	E290871	BC	4X/yr	2012-present	--	--	--
Fortune Creek upstream of Petitot River	59.972	-122.421	BC	E290869	BC	4X/yr	2012-present	--	--	--

* Denotes proposed BWMA Priority Stations
# denotes long-term stations proposed as part of the regional and basin level monitoring program. These will also be used as part of the BWMA.

Figure 3. Current Location of Transboundary Water Quality and Hydrometric Monitoring Stations in the Liard Basin.



I 4. Biology

Ecosystem health and diversity is evaluated by monitoring biological indicators, hence the importance of incorporating these in BWMA and regional and basin level monitoring programs.

Some biological monitoring has taken place in the NWT-BC border region as listed below. Additional biological monitoring may have occurred in the region. Further research on past and current monitoring will be done by the BMC.

Benthic Invertebrates
Biological monitoring is currently occurring in Northeastern British Columbia to establish baseline benthic macroinvertebrate conditions for the development of a reference condition model for future water quality assessment. In the past two years, approximately 25 sites per year were sampled by Environment Canada following CABIN[3] protocol. It is expected that a model will be developed next year. The British Columbia Ministry of Environment and their partners and stakeholders, subject to available resources, will be collecting biomonitoring information that will be used for the development of the reference condition model.

Fish
In 1998, the Liard River Environmental Quality Monitoring Program (EQMP) was developed and measured the baseline condition of the aquatic ecosystem to compare with future samples (Taylor et al, 1998[4]). The program provided baseline data on contaminant levels in Liard River fish, water and suspended sediment to ensure that any present hazards were known, and to support transboundary water negotiations. The program gave special attention to contaminants likely to result from metal mining and oil and gas development.

Biomonitoring Indicators and Locations
The Parties acknowledge the importance of monitoring biological components and agree that it will be considered when developing a monitoring program at the regional and basin-wide level. Biological indicators and sampling locations may be determined as part of the Liard River and Petitot River Learning Plans at the BMC after signing.

Approach for the Inclusion of Biological Monitoring
The approach for the inclusion of biological monitoring will be determined at the BMC after signing as per the Learning Plan. The Parties agree that biological monitoring can be developed independently from a water quality and/or quantity monitoring program for a variety of reasons, as listed in Appendix G.

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[3] Canadian Aquatic Biomonitoring Network
[4] Taylor., B, J. Sanderson and C. Lafontaine. Liard River Environmental Quality Monitoring Program: Final Study Report. Water Resources Division, Department of Indian Affairs and Northern Development (DIAND). 1998. 232 pp.

BWMA Appendix J –
Costs to Administer and Implement the Agreement

Clause 13.2 a) states:
The costs to administer and implement this Agreement (as outlined in Appendix J) will be shared appropriately, as determined by the Parties on a case by case basis, and limited by (b), (c) and (d).

Although it is impossible to identify every cost that may arise, the Parties provide this partial list to clarify the nature of envisioned costs.

Costs associated with the BWMAs are anticipated in three categories: Administration, Bilateral Implementation and Jurisdictional Implementation. Tasks may be completed with either in-kind effort or direct resourcing (allocated from within a Party) or externally sub-contracted services, and may involve both capital and operating costs. The following is provided for illustration of anticipated costs:

1. **Administration of Agreement [costs to be borne by each jurisdiction separately]:**

- Participation on BMC and its technical committees (e.g., staff time, travel, meeting costs, etc.)
- BWMA documentation and reporting
- Participation on the SMC (e.g., staff time, travel, meeting costs, etc.) under BMC direction
- Resources allocated as a Party's share to SMC administration

2. **Bilateral Implementation of Agreement [costs to be shared as appropriate]:**

- Monitoring: Capital and operating costs associated with the maintenance of existing or purchase, installation and operation of new monitoring and gauging stations related to:
    - developing and implementing Learning Plans
    - setting and monitoring Transboundary Objectives
    - other monitoring or research as directed by the BMC or agreed to through the SMC
- Learning Plans: Costs associated with preparation, development and implementation of Learning Plans (e.g., studies, monitoring, fieldwork, research, analysis)
- SMC: Resources allocated as a Party's share to SMC support for BWMA implementation
- Research: Costs associated with research as directed by the BMC or agreed to through the SMC

3. **Jurisdictional Implementation of Agreement [costs to be borne by each jurisdiction separately]:**

- Consultation
- Coordination with other jurisdictions (upstream and downstream)
- Costs associated with information sharing, notification and consultation (e.g. Section 5, 12)
- Costs associated with on-going assessment of Triggers
- Costs associated with meeting Transboundary Objectives:
    - Regulatory actions or changes
    - Policy or planning actions or changes
    - Additional monitoring or studies
    - Mitigation, enhancement activities, and/or financial measures.