· 2019-2021 ·

British Columbia and Northwest Territories

Working Together

TO MANAGE OUR SHARED WATERS

British Columbia-Northwest Territories Bilateral Water Management Agreement:
Information and Implementation Report

The Liard River, NWT – Stefan Goodman

Preface

This report provides an overall summary of work done between April 1, 2019, and March 31, 2021, to meet the commitments of the British Columbia-Northwest Territories Bilateral Water Management Agreement.

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Executive Summary

In October 2015, British Columbia (B.C.) and the Northwest Territories (NWT) signed an agreement to cooperatively manage shared transboundary waters. As part of the B.C.-NWT Bilateral Water Management Agreement (Agreement), a Bilateral Management Committee (BMC) was formed to be responsible for implementing and reporting on the Agreement. This is the Committee's second implementation report, which describes how the B.C. and NWT governments work together and highlights activities undertaken between April 1, 2019, and March 31, 2021, related to the B.C.-NWT Agreement. The report also recognizes linkages to work in the broader Mackenzie River Basin as informative to the bilateral work.

Many activities support greater understanding of our shared transboundary waters. These activities include efforts by the Mackenzie River Basin Board through its State of the Aquatic Ecosystem Reporting Steering Committee, Traditional Knowledge and Strengthening Partnerships Committee, and Water Quality Task Team. Community-based efforts by Fort Nelson First Nation, Prophet River First Nation, Acho Dene Koe First Nation and Dehcho Aboriginal Aquatics Resource Ocean Management program broaden capacity at the local level, enhance local stewardship of the Liard Basin's aquatic ecosystems, and tell us about the health of specific areas in the Liard River Basin. Long-term monitoring of water quality and quantity builds a long-term picture of the Liard River Basin's aquatic ecosystem health.

Specific initiatives, such as assessing of hydrocarbon data in the Liard and other transboundary rivers, building a hydrological model for the Liard River Basin, and using biological monitoring from Indigenous and western science perspectives, will further our knowledge of the Basin. Assessments of groundwater resources and active monitoring of groundwater wells are also beginning to give us a clearer understanding of groundwater in the Liard River Basin. Research is also underway to understand how thawing permafrost affects the flow and storage of water in southern NWT. Further, innovative partnerships such as the Northeast Regional Strategic Environmental Assessment in B.C. sees B.C. and seven Treaty 8 First Nations undertaking ecosystem assessment, monitoring and cumulative effects work to improve knowledge and inform collaborative management options.

The BMC looks forward to continued and enhanced collaboration on initiatives that improve our understanding of the Liard River Basin and support action to meet the commitments of the Agreement.

The Liard River, NWT – Stefan Goodman

Sommaire

En octobre 2015, la Colombie-Britannique (C.-B.) et les Territoires du Nord-Ouest (TNO) ont signé une entente pour la gestion collaborative des eaux communes. Dans le cadre de l'Entente bilatérale C.-B.—TNO sur la gestion des eaux (l'Entente), un Comité bilatéral de gestion (CBG) a été formé pour assurer la mise en œuvre de l'Entente et produire des rapports sur celle-ci. Le présent document constitue le deuxième rapport du Comité sur la mise en œuvre, qui décrit la coopération entre les gouvernements de la Colombie-Britannique et des Territoires du Nord-Ouest et présente les activités entreprises entre le 1er avril 2019 et le 31 mars 2021 relativement à l'Entente. Le rapport soulève également des liens existants avec le travail effectué dans le bassin du fleuve du Mackenzie, qui orientera le travail bilatéral.

Beaucoup d'activités contribuent à une meilleure compréhension de nos eaux communes. Parmi ces activités, on compte les efforts déployés par le Conseil du bassin du Mackenzie, par l'intermédiaire de son comité directeur sur l'état de l'écosystème aquatique, son comité sur le savoir traditionnel et le renforcement des partenariats et son équipe de travail sur la qualité de l'eau. Les efforts communautaires fournis par la Première Nation de Fort Nelson, la Première Nation de Prophet River, la Première Nation Acho Dene Koe et le Programme autochtone de gestion des ressources aquatiques et océaniques du Dehcho permettent d'accroître la capacité au niveau local, d'améliorer la gestion locale des écosystèmes aquatiques du bassin de la rivière Liard et de connaître l'état de certaines zones du bassin de la rivière Liard. Par la surveillance à long terme de la quantité et de la qualité des eaux, on peut dresser un portrait de la santé des écosystèmes aquatiques du bassin de la rivière Liard.

L'analyse minutieuse des données sur les hydrocarbures dans la rivière Liard et d'autres rivières transfrontalières, la création d'un modèle hydrologique pour le bassin de la rivière Liard, ainsi que l'utilisation de techniques de surveillance biologique fondées sur les principes autochtones et sur la science occidentale, sont des exemples d'initiatives qui nous permettront d'approfondir nos connaissances sur le bassin. Par ailleurs, l'évaluation des ressources en eaux souterraines et la surveillance active des puits d'eaux souterraines favorisent une meilleure compréhension des eaux souterraines du bassin de la rivière Liard. On mène aussi des études pour comprendre de quelle façon le dégel du pergélisol affecte le débit et les réserves d'eau dans le sud des TNO. De plus, des partenariats innovateurs, telle l'évaluation environnementale stratégique régionale du Nord-Est en Colombie-Britannique, donnent lieu à une collaboration entre la Colombie-Britannique et sept Premières nations du Traité no 8 afin d'entreprendre l'évaluation des écosystèmes, la surveillance des effets cumulatifs, ainsi que des travaux sur ces effets, de sorte à améliorer les connaissances et à orienter les options de gestion collaborative.

Le CBG se réjouit de continuer à collaborer à des initiatives qui améliorent notre compréhension du bassin de la rivière Liard et favorisent la réalisation des engagements de l'Entente.

The Liard River, NWT – Stefan Goodman

Background

In 1997, the governments of Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories, and the Yukon signed the *Mackenzie River Basin Transboundary Waters Master Agreement*, committing the jurisdictions to cooperate in protecting the waters of the Mackenzie River Basin. The NWT and B.C. later developed a Bilateral Water Management Agreement to ensure that their shared waters, including the Liard, Petitot, and Kakisa sub-basins, are managed in a collaborative and sustainable way. This Agreement helps make sure that the waters are safeguarded from pollution and that there is enough water to support the aquatic ecosystem, which includes all the living things that depend upon clean and sufficient water.

The Agreement sets out how the two jurisdictions will cooperate and protect the ecological integrity of the shared aquatic ecosystems. The Agreement requires B.C. and NWT to consult, notify, and share information with each other on developments and activities that might affect the aquatic ecosystem of the other jurisdiction.

The Agreement also requires B.C. and NWT to:

- Work together to develop learning plans to better understand the aquatic ecosystem and its needs;
- Create a common set of acceptable conditions for surface and groundwater quality and quantity, and aquatic life, and ensure adequate monitoring to demonstrate conditions are being achieved; and
- Report regularly on the implementation efforts of the Agreement and the health of the aquatic ecosystem to contribute to decision making.

Technical details related to learning, objective setting, monitoring, and management actions are set out in the Appendices to the Agreement.

It is important to note that the Agreement does not negatively affect any recognized or asserted Aboriginal rights. Rather, it serves to support those rights by ensuring clean and sufficient water for generations to come.

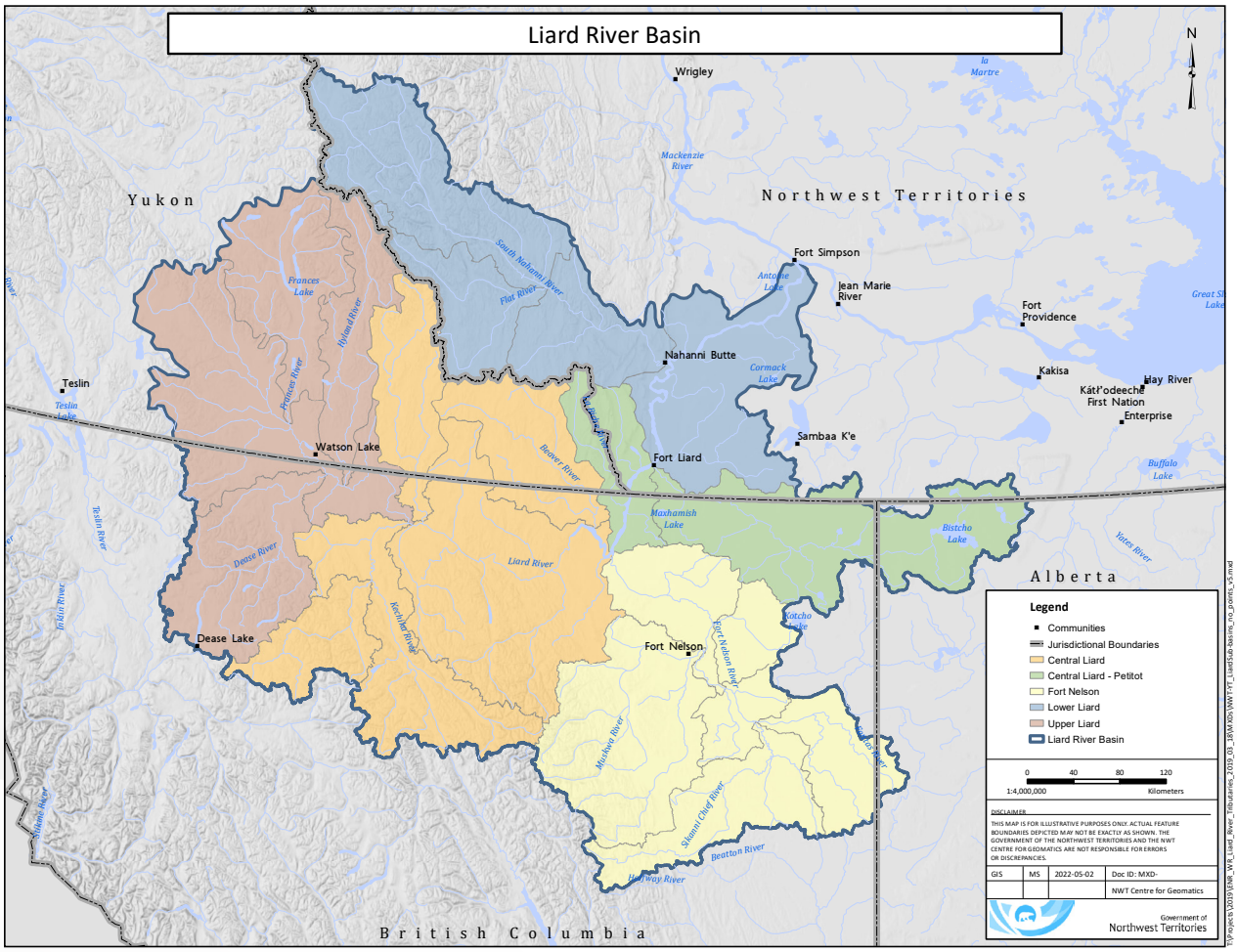

Figure 1. Liard Basin

Management of the Agreement

The B.C.-NWT Bilateral Management Committee

The B.C.-NWT BMC is the main body that oversees work related to the Agreement. The BMC includes one government member and one Indigenous representative from B.C. and the NWT. The current members are:

British Columbia

Ted Zimmerman
Executive Director, Water Protection and Sustainability Branch
Ministry of Environment and Climate Change Strategy
Government of British Columbia

Lana Lowe
Director, Lands, Resources and Treaty Rights
Fort Nelson First Nation

Northwest Territories

Nathen Richea
A/Assistant Deputy Minister, Environment and Climate Change
Environment and Natural Resources
Government of the Northwest Territories

Frank Kotchea
Acho Dene Koe First Nation
Representing the NWT Water Strategy Indigenous Steering Committee

A Terms of Reference for the BMC was completed in 2020 and is publicly posted to the B.C. and NWT government websites.

The BMC meets at least once each year and routinely shares information throughout the year. One sharing method, established in 2019, is a SharePoint site where members can share documents. Regular engagement of BMC members also helps ensure the right people are connected quickly if there are more urgent matters to discuss, such as emerging flood risks.

Risk Informed Management

The work undertaken and the decisions made relating to the Agreement are guided by a Risk Informed Management approach. This approach is defined in the Agreement and sets out a classification system, as well as requirements for waters in each class.

Classification of Waters and Current Status

The classification of water bodies is based on risk that considers:

- The level of upstream development, such as industry, agriculture and drinking water for upstream communities;
- The extent of traditional use;
- Drinking water use in downstream communities;
- Observed changes in conditions; and
- The sensitivity of the related ecosystem.

Class 1 transboundary water bodies are at low risk and only require the level of monitoring already being undertaken by B.C. and the NWT. Class 2 water bodies are at moderate risk and therefore require learning plans to better understand the historical, current and potential future of water quality, quantity, and health of the overall aquatic ecosystem. Class 3 water bodies are considered at a higher risk. In addition to learning plans, Class 3 waters require the development and monitoring of site-specific objectives. Class 4 is only assigned if objectives for a body of water are not being met, and corrective action is needed.

The Liard and Petitot Rivers are designated as Class 2 for surface water and groundwater quality. All other B.C.-NWT transboundary rivers and streams are Class 1. These classifications have not changed since the Agreement was signed in 2015.

Learning Plans

A learning plan is very much what it seems – a plan to learn more. All work associated with the Agreement contributes to the learning plan and helps us better understand our shared waters.

In 2017, a State of Knowledge Report for the Liard and Petitot was compiled for the learning plans of these rivers. The report provides a summary of what is known about the Liard and Petitot rivers' surface water and groundwater, including Indigenous and scientific knowledge. It notes current monitoring programs and knowledge gaps to assist in identifying priorities for future work.

Some of the key recommendations from the report are to:

- Initiate a biological monitoring program on the Liard and Petitot rivers starting with benthic macroinvertebrates (small, spineless creatures, such as worms, snails, beetles, and dragonfly larvae, that live on the bottom of rivers, lakes, and other bodies of water);
- Collect additional Indigenous and local knowledge; and
- Increase our knowledge of permafrost and evaluate potential risks to human health, safety, and the environment from the thawing of permafrost due to climate change.

This report, along with the *Preliminary State of Groundwater Knowledge in the Transboundary Region of the Mackenzie River Basin, Northwest Territories* (2016), provides valuable information for guiding future work.

Linkages to the Broader Mackenzie River Basin

The work under the Agreement does not occur in isolation. Instead, the work at the bilateral level informs and influences the work at the Mackenzie River Basin level, specifically the work by the Mackenzie River Basin Board. The work at the Mackenzie River Basin level informs and supports the work to implement the bilateral water management agreements.

The Mackenzie River Basin Board

The Mackenzie River Basin Board (Board) was established by the *Mackenzie River Basin Transboundary Waters Master Agreement* (Master Agreement). The Board coordinates transboundary water-related issues that involve all or most of the governments that are part of the Master Agreement. The Board facilitates coordination and collaboration, and currently supports three sub-committees with priority interests relevant to the implementation of the B.C.-NWT Bilateral Agreement. These include the:

- State of the Aquatic Ecosystem Report Steering Committee;
- Traditional Knowledge and Strengthening Partnership Steering Committee; and
- Water Quality Task Team.

State of the Aquatic Ecosystem Report Steering Committee

All signatories to the Master Agreement participate in this committee that prepares the State of the Aquatic Ecosystem Report (SOAER). The purpose of the report is to document the conditions and changes within the entire Mackenzie River Basin, to inform the public about the aquatic ecosystem health, and to support decision making. Reports from 2003 and 2012 are available on the Board's website. The 2021 SOAER report is now available as a web-based platform, on the SOAER website.

Traditional Knowledge and Strengthening Partnership Steering Committee

The Committee includes Indigenous members from each province and territory of the Mackenzie River Basin, as well as government representatives. The Committee's role is to advise the Board about Indigenous partnership activities and the collection and use of traditional knowledge in water management. The Committee's goals include:

- Assisting in the development of common principles for the cooperative management of the aquatic ecosystem in the Mackenzie River Basin;
- Applying traditional knowledge in appropriate reports and documents and ensuring full Indigenous participation in the administration and application of these principles;
- Ensuring recognition of the inherent value of full Indigenous participation and governance in the Mackenzie River Basin Board activities and encouraging the meaningful integration of Traditional Knowledge and effective engagement practices into the MRBB's activities; and
- Monitoring the level of Indigenous participation and engagement in the Board's activities, and providing advice and guidance when asked and when necessary.

The Committee also played a critical role in development of the latest SOAER, working closely

with the SOAER Committee as a Joint Steering Committee (SOAER JSC). This collaboration established a "braided approach" for the 2021 SOAER, which is described in the SOAER as aiming to: "bring together Indigenous knowledge and scientific information to inform the assessment. The SOAER JSC felt it was important to select a methodological approach that brings together Indigenous knowledge and scientific knowledge without comparison or integration of one knowledge system into the other. Knowledge from both systems is considered valuable and used to inform a holistic understanding of current conditions and environmental change".[1]

Water Quality Task Team

The Water Quality Task Team's mandate is to promote greater coordination and efficiency of tasks related to water quality to achieve the principles of the Master Agreement. The Task Team is comprised of the Board's Executive Director and one member representing the federal government and each province or territory party to the Board.

This team assists with the implementation of the Master Agreement and the Bilateral Agreements by:

- Providing a regular opportunity for communication and information exchange on water quality related topics;
- Recommending common approaches to assessing water quality throughout the Mackenzie River Basin; and
- Developing reporting tools that support the SOAER and annual reporting requirements for Bilateral Agreements.

The Water Quality Task Team is currently working on standard methods to assess data to report on water quality conditions and changes across the Mackenzie River Basin. It is expected that these will be a set of agreed methods for input to the future SOAERs and/or for reporting on Bilateral Agreements.

Monitoring our Shared Aquatic Ecosystems

Community-based Monitoring in the B.C.-NWT Transboundary Region

In 2021, B.C. provided $20,000 to support the Fort Nelson First Nation's winter low flow water quality and quantity sampling program. A local consultant, Barry Ortman, has been coordinating the work of sampling and volume measures from four priority water bodies: Kiwigana River, Dilly Creek, Sahtaneh River, and Deasum Creek. The program also includes training for Fort Nelson First Nation's Guardians on safe winter sampling techniques, as well as interpreting and presenting data.

A copy of the water quantity data is stored in the provincial Aquarius database. A copy of the water quality data is stored in the Mackenzie DataStream and the provincial Environmental Monitoring System.

The Government of the NWT's Department of Environment and Natural Resources works with partners to support communities in the development and implementation of community-based monitoring programs. Since 2013, the Dehcho First Nations Aboriginal Aquatics Resource Ocean Management program has led the program near the community of Fort Simpson and collects samples from the Liard River, upstream of the ferry crossing.

[1] *Mackenzie River Basin Board (2021) State of the Aquatic Ecosystem Report. About. https://soaer.ca/about/#introduction*

Water Quality Monitoring

Long-term Water Quality Monitoring

The Canada-B.C. Water Quality Monitoring Program collects data at the Petitot River site. This site was established in 2015 to address concerns about potential impacts of unconventional oil and gas development. This followed a three-year baseline monitoring study conducted by Environment and Climate Change Canada (ECCC) to assess and monitor water quality conditions in northeast B.C.[2]

To date, five years of water quality data have been collected at this site. Preliminary review of these data shows no concerns when compared to applicable guidelines for protection of freshwater life.[3] Trend analyses will be undertaken when a sufficient number of years of data have been collected. Two Indigenous communities were engaged to support monitoring efforts. In May 2021, Fort Nelson First Nation took on the responsibility for monitoring for this site, and has taken over conducting the monthly sampling at the Petitot River site. This sampling will provide for a better understanding of naturally occurring differences and increase the usefulness of future trend analyses.

There are also two monitoring sites on the Liard River at Fort Liard (est. 1960; operated by ECCC) and upstream of Kotaneelee River (est. 1992; operated by the Government of the NWT in partnership with members of the Acho Dene Koe First Nation). Both sites were established to collect transboundary baseline water quality data and to identify any changes over time. Water and suspended sediment samples are collected annually and analyzed for many different substances including nutrients, metals and organic compounds of concern.

Assessment of Hydrocarbon Data in Transboundary Rivers

An assessment of polycyclic aromatic hydrocarbons (PAHs) in transboundary rivers will be completed in late 2022. While some PAHs occur naturally in the environment, some are from human activities and can have negative effects on aquatic life. Although this project is being completed under the AB-NWT Bilateral Water Management Agreement, it will include other major Mackenzie River Basin transboundary rivers, including the Liard River.

Water Quantity Monitoring

Long-term Water Quantity Monitoring

There are 26 hydrometric stations operating in the Liard River basin (Figure 2). The Water Survey of Canada operates these stations, which measure the flow rates and water levels in partnership with the respective provincial/territorial government. Real-time and historic hydrometric (i.e. water quantity) data are available on the Water Survey of Canada website.[4]

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[2] *Pappas, S., D.P. Shaw, L. Shrimpton, S. Strachan, K. Trainor, and A. Yeow (2019) Baseline Surface Water Quality in the Petitot River Basin and Surrounding Watersheds: Examining Potential Impacts of Shale Gas Development in the Horn River Basin, British Columbia. Environment and Climate Change Canada. https://publications.gc.ca/collections/collection_2019/eccc/En84-147-2017-eng.pdf*

[3] *B.C. Ministry of Environment and Climate Change Strategy (ENV) (2021) Approved Water Quality Guidelines. https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines*

[4] *https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html*

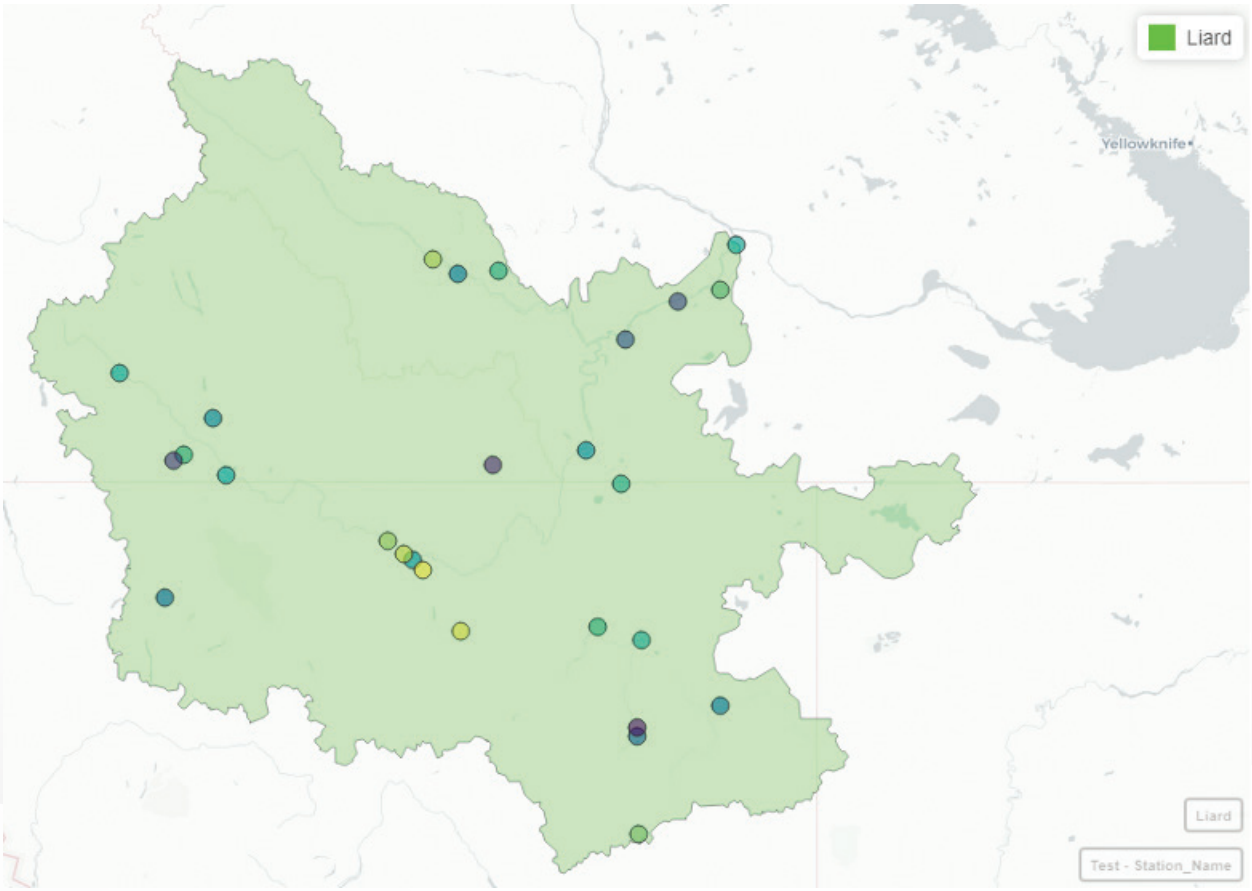

Figure 2. Hydrometric gauges in the Liard River basin.

Status of Water Quantity in the Liard and Petitot Basins

There are two hydrometric gauges located near the NWT-B.C. border: Liard River at Fort Liard; and the Petitot River below Highway No. 77.

The Liard River gauge began operation as a seasonal gauge in 1942 and there is a continuous record from 1966 to present. The average annual runoff on the Liard River is 277 millimeters. This is a relatively high value for a northern basin and is caused by rapid runoff from the mountains. There has been little change in annual runoff over the period of record. There has been a slight increase in runoff during the winter months (January to March).

The Petitot River gauge initially ran from 1992 to 1996 and started again in 2012. The average annual runoff on the Petitot River is 87 millimeters, which is relatively low. This is a result of the large area of wetlands and lakes in the basin, which provide high storage capacity. There are too few years of data, at present, to be able to assess trends.

Development of a Hydrological Model for the Liard River Basin

A hydrological model was developed for the Liard River Basin using the Raven Hydrological Modelling Framework.[5] The model performs very well for the Liard River near the NWT-B.C. border.[6] The model structure was developed and calibrated by Professor J. Craig's lab at the University of Waterloo. The development of the project was, in part, the result of a partnership between Wilfrid Laurier University (along with other collaborating researchers) and the Government of the NWT. The calibrated model can be used for predictive analysis of potential climate change scenarios, or as an operational tool for flow forecasting. Scientists at the Government of NWT are working with the University of Waterloo and consultants[7] to integrate the Liard model into the Deltares Delft-FEWS system. This system is a flow forecasting platform that other Canadian jurisdictions use for flood and flow early warning.

Partnership Between B.C. Oil and Gas Commission and Prophet River First Nation

In 2019, the B.C. Oil and Gas Commission and Prophet River First Nation collaboratively installed a hydrometric station on Martin Creek (see Figure 3). The long-term objective of this partnership is to build stronger relationships with First Nations, support First Nations' interests, address any data gaps, to increase knowledge sharing, integrate Indigenous knowledge with measures of streamflow, and to increase the usefulness of the Northeast Water Tool that provides information for water management decision-making.

Figure 3. New hydrometric monitoring station installed at Martin Creek, south of Fort Nelson, B.C. (circled in red).

Biological Monitoring

Monitoring of biological indicators is an effective tool to assess the health of the aquatic ecosystem and help to inform bilateral water management on the state of transboundary rivers. A biological indicator is a species, community, or biological process that can provide information about changes in the aquatic environment. By studying biological indicators repeatedly over time, we become better informed about potential changes in the water and can then investigate the cause of these changes.

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[5] *Craig, J.R., G. Brown, R. Chlumsky, W. Jenkinson, G. Jost, K. Lee, … and B.A. Tolson. 2020. Flexible watershed simulation with the Raven hydrological modelling framework, Environmental Modelling and Software, 129, 104728, doi:10.1016/j.envsoft.2020.104728.*

[6] *Brown, G., and J.R. Craig. 2020. Multi-gauge calibration of a hydrological model of the Liard river basin, Canadian Water Resources Journal, 45:4, 287-303, doi:10.1080/07011784.2020.1803143.*

[7] *https://www.deltares.nl/en/software/flood-forecasting-system-delft-fews-2/*

The Canadian Aquatic Biomonitoring Network, known as CABIN, is a program for assessing the health of the aquatic environment through the collection of benthic macroinvertebrates. In 2018, B.C. and Environment and Climate Change Canada updated the model for Northeast B.C.[8] that covers the Fort Nelson, Petitot, and Central Liard river basins. This model can be used to assess the effects of several human-caused stressors on the aquatic ecosystem in this area.

The Province of B.C., Fort Nelson First Nation and Kaska Dena partnered in 2019 and 2020 to collect reference data from sites in the Liard Basin that will be used to maintain and update the Northeast B.C. CABIN model. B.C. also provided funding for two Fort Nelson First Nation members to obtain CABIN training and certification so that they would be able to support the monitoring efforts.

Acho Dene Koe First Nation conducted a cumulative impacts analysis and traditional knowledge study with the support of the NWT Cumulative Impact Monitoring Program to address internal knowledge gaps on traditional fishing practices on water bodies within their traditional territory, as well as changes that have occurred due to environmental, industrial, societal, and cultural factors. The project identified historical and contemporary observations of change in the health of the aquatic environment, as well as community members' perceptions of change, the sustainability of the current aquatic environment within their territory, and their understanding of the implications of any changes that have occurred. These results support the community by informing decisions around land use and development and participation on various committees and agreements.

Groundwater Monitoring

Water below the earth's surface is called groundwater. Groundwater is found in small pockets of sediments, such as sand, and in cracks in large rock formations. Some groundwater is very close to the earth's surface, while in other cases it is far below. Groundwater and surface water are connected. Often, water above ground seeps down and water underground eventually flows to the surface. The units of sediments and rocks where water is found are called aquifers.

Figuring out where an aquifer exists, and where it begins and ends, is difficult but very important. If land above or close to an aquifer is polluted, the pollution can seep into the aquifer, and can eventually be carried into rivers and lakes. Water from wells drilled into an aquifer is sometimes the only source of drinking water for a community, so it is important to keep groundwater safe from pollution. We also need to understand the relationship between groundwater and surface water, and to identify potential sources of groundwater.

[8] *Bennett, S. (2018) Reference Model Supporting Documentation for CABIN Analytical Tools: Northeast B.C. Model 2018. Prepared by Limnotek Research and Development Inc., April 2018.*

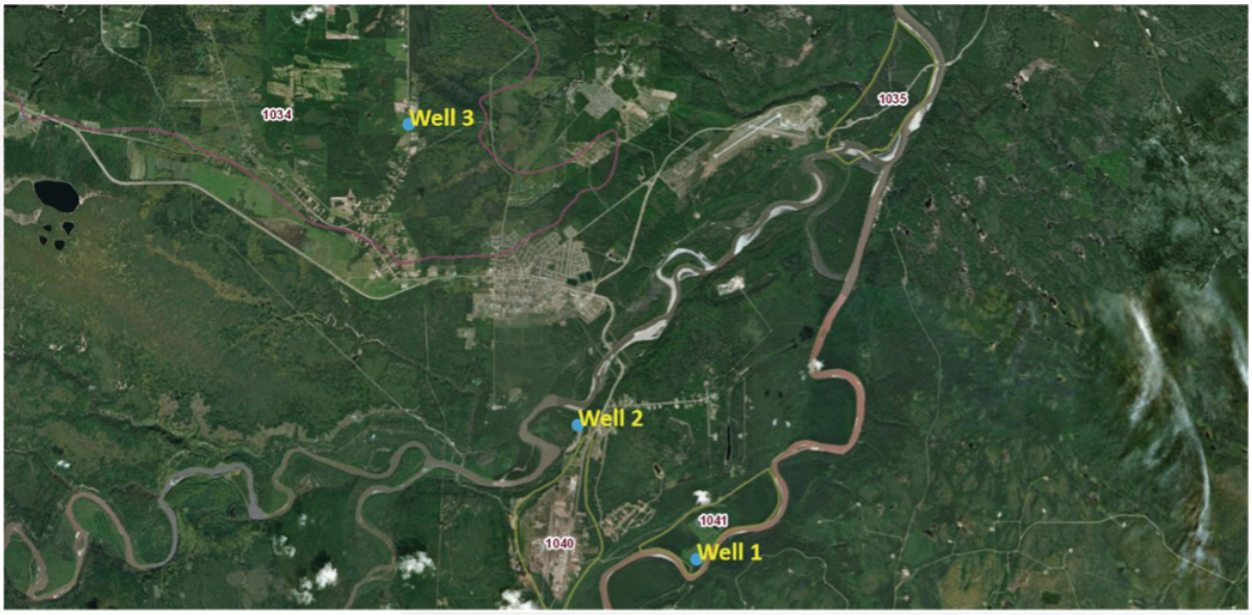


Figure 4. New observation well sites near Fort Nelson, B.C. in the Liard - Petitot Basins.

Liard and Petitot Sub Basins Transboundary Groundwater Resources Assessment

One project to assist with these efforts was completed in 2018.[9] The Liard and Petitot Sub Basins Transboundary Groundwater Resources Assessment project collected and reviewed information about water, rock, and sediment below the surface, and prioritized areas for further study. Land use impacts on groundwater quantity and quality were used to prioritize the 28 drainage basins in the area. The Fort Nelson and Muskwa drainage basins were identified as high priority areas in the Liard and Petitot basins. A feasibility study was then done to assist in identifying potential monitoring sites. Three well sites were chosen for drilling between 2018 and 2020:

1. Lower Fort Nelson River alluvial aquifer (Well 1, Figure 4), which is on the Fort Nelson First Nation's Reserve Land.
2. Upland glaciofluvial aquifer between the Fort Nelson and Muskwa River valleys (Well 2, Figure 4).
3. Confined bedrock aquifer north of the City of Fort Nelson, B.C. (Well 3, Figure 4).

[9] *Levson, V.M., H. Blyth, T. Johnsen and M. Fournier (2018) Liard and Petitot Sub Basins Transboundary Groundwater Resources Assessment. Water Science Series, WSS2018-01. Prov. B.C., Victoria B.C.*

Fort Nelson and Muskwa Area Aquifers

Following the groundwater resources assessment, a multi-year collaborative project began to characterize and study the aquifers in the Fort Nelson and Muskwa areas, with participation from Environment and Climate Change Canada, the B.C. ministries of Forest, Lands, Natural Resource Operations, and Rural Development and Energy, Mines and Low Carbon Innovation, and Fort Nelson First Nation.

The main objective was to generate high quality data to better understand the groundwater resources and potential surface water-groundwater interaction. The data will contribute to the implementation of the Agreement, provide key information for the implementation of B.C.'s *Water Sustainability Act*, and respond to related recommendations of B.C.'s *Scientific Hydraulic Fracturing Review Panel Report*.[10] Training on groundwater sampling, and maintenance and operation of the provincial observation wells, was scheduled for 2020, but was postponed due to COVID-19 restrictions. The training will be rescheduled and will allow the Fort Nelson First Nation to co-maintain the observation wells in the area, and provide field assistance.

Well 2 Data

Well 2 (also known as Groundwater Observation Well #482) was drilled in 2018. Water bearing silt and fine sand layers were found between 230 and 385 feet below ground. Analysis of the groundwater chemistry indicated the samples were typically of the sodium-bicarbonate-chloride type. This indicates that the water in the confined sand and gravel aquifer (#1040) is mainly from recent rain or snow fall.

Continuous groundwater level data are available for this well since March 2020. Figure 5 shows groundwater level in one graph and rain/snow fall amount in the other. The two patterns of peaks and valleys also suggest a relationship between rain/snow fall and groundwater level.

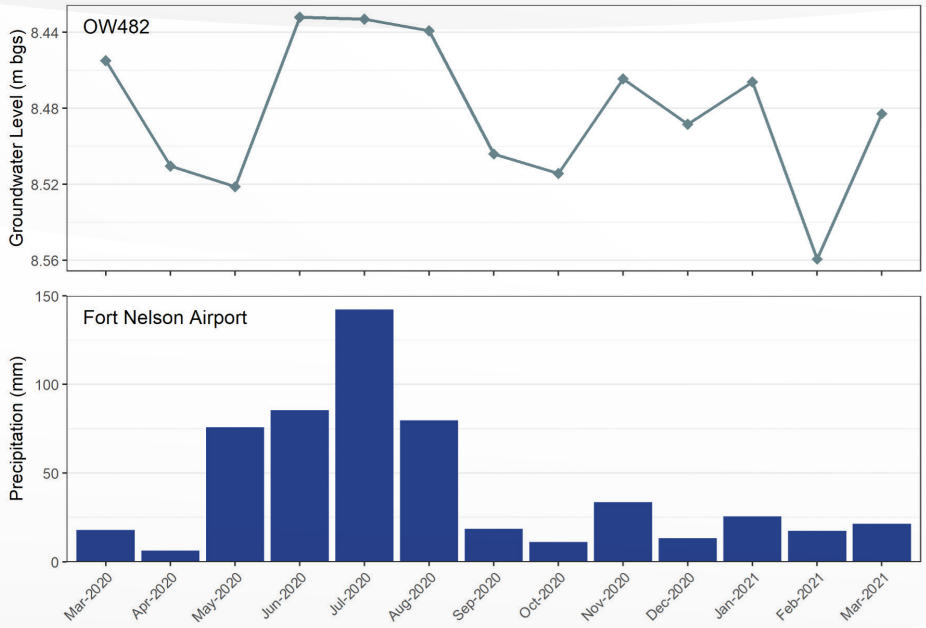


Figure 5. Observation Well 482 monthly groundwater level hydrograph and monthly precipitation at the Fort Nelson Airport.

[10] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-gas-oil/responsible-oil-gas-development/scientific_hydraulic_fracturing_review_panel_final_report.pdf

Liard River Basin Transboundary Aquifer Assessment

The Liard River Basin Transboundary Aquifer Assessment was completed in 2020 by consulting firm Palmer, in association with Aurora Geosciences, on behalf of the governments of the Yukon and the NWT. The report identifies potential freshwater aquifers located in loose sediments in the portions of the Liard River Basin in the Yukon and the NWT. The report also highlights important gaps in data, and in knowledge about permafrost, especially in response to climate change. The work broadly aligns with a similar assessment by Levson et al. in 2018 for the portion of the Liard River Basin in B.C.

Learning More about Liard River Basin Aquifers

Beginning in 2018, the NWT partnered with the University of Guelph to better understand the aquifers in the Liard Basin. The objectives of this partnership are to:

1. Develop a conceptual model of the regional freshwater aquifers;
2. Develop an approach for groundwater baseline monitoring in areas with high potential of future oil and gas development; and
3. Install a groundwater monitoring network in the Liard Basin.

Following three years of literature review, fieldwork, and data analysis, the conceptual model was created. The model will be used as reference for future work. The second phase of the project is to install a groundwater monitoring network. This is currently planned for 2022.

Permafrost

Permafrost is ground that is at or below 0°C for two or more years. With ongoing climate change, the thawing of permafrost may have a considerable impact on the flow and storage of water. Rates of permafrost thaw have been increasing in recent years as a result of climate change. Little is known about exactly how the thawing of permafrost will affect waters in the area.

To learn more, the Government of the NWT established a partnership with Wilfrid Laurier University to collect all available information to summarize what is known about permafrost in the NWT's southern transboundary regions. The study focused on the Liard, Petitot, Hay, Buffalo, Slave, and Talston river basins, and the potential impacts of climate change and permafrost thaw on surface water and groundwater volume and quality. The report has been completed and is currently being reviewed.

The Government of the NWT is also working with Wilfrid Laurier University to better understand the impacts of thawing permafrost in peatland terrains on basin water balance. University researchers will monitor permafrost conditions and water levels at Scotty Creek in the NWT and Suhm Creek in northern B.C. The data collected will be used to develop models that will better predict how landscapes will respond to thawing permafrost.

Northeast Regional Strategic Environmental Assessment

Since 2015, the Northeast Regional Strategic Environmental Assessment (RSEA) has been an important part of B.C.'s Environmental Stewardship Initiative. The RSEA is an innovative partnership between the Province of B.C. and seven Treaty 8 Nations. Petroleum and natural gas industries and associations sit as observers, providing technical assistance and advice.

Projects focus on ecosystem assessment and monitoring. The resulting information is used to credibly assess the effects of natural resource development on the rights of participating First Nations, and to recommend management responses that avoid, minimize, mitigate, offset, or otherwise respond appropriately to the effects identified on Treaty 8 rights.

The Water Working Group for RSEA developed a Cumulative Watershed Disturbance Model to assess the impact of development on surface water. The model compares the current condition of the watersheds with the anticipated level of disturbance in area surrounding development, if it occurs. It considers the pressures of the development footprint relative to the size and type of watershed. The model shows the expected water quality disturbance from developments such as agriculture, forestry clear cuts, oil and gas activity, mining, road and line cuts, and residential communities (Figure 6, left pane). Direct discharge into streams from industrial effluent and sewage was also included. Water quantity disturbance was assessed using the amount of water estimated to be required for the development as a percentage of the estimated average annual discharge (Figure 6, right pane).

The results are relative to the other watersheds, showing the most and least impacted rather than a measurable level of "disturbance" because there is not enough historical data to compare to. The results indicate that the greatest disturbance would occur in the Peace Montney Region in the 100 km surrounding Fort St. John. Other pockets of higher disturbance are just north of Prince George and near Fort Nelson. Areas of disturbance in water quality are similar to those for water quantity.

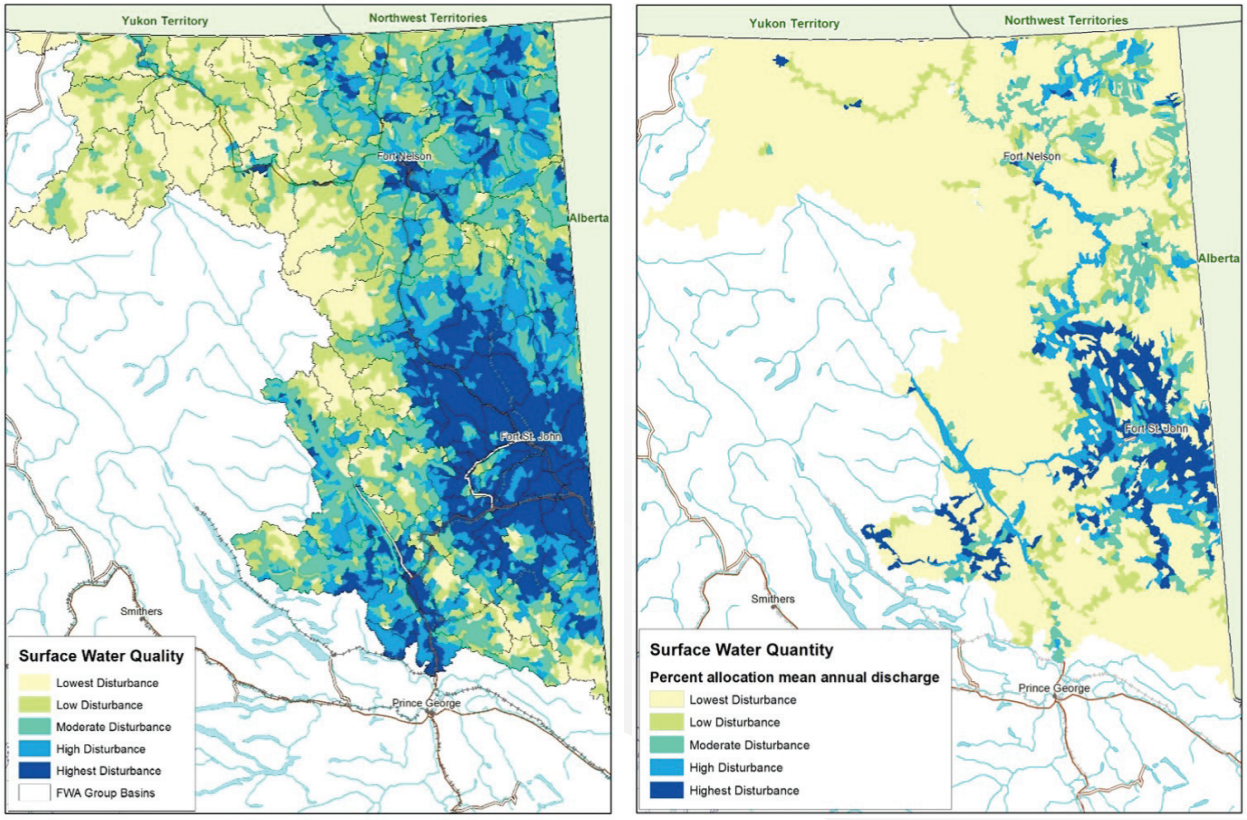


Figure 6: Surface Water Quality (left) and Surface Water Quantity (right) outputs from the Cumulative Watershed Disturbance Model.

Conclusion and Next Steps

The Agreement provides a long-term framework to cooperatively manage B.C. and NWT shared waters and protect the aquatic ecosystem. Considerable learning took place since the signing of the Agreement in 2015. Increasing our knowledge about the aquatic ecosystem allows the jurisdictions to make informed decisions to maintain the health of the aquatic ecosystem for the generations to come. The collaborative work and the regular sharing of information between the two jurisdictions allow us to identify priorities and proactively address risk to shared waters.

In coming years, B.C. and NWT scientists will continue their work towards development of consensus-based approaches to assess water quality in transboundary rivers as part of the Mackenzie River Basin Board Water Quality Task Team. Progress towards characterizing and assessing ambient levels of hydrocarbons in the Liard River and other transboundary rivers is ongoing. B.C. and NWT will continue to support monitoring through community-based monitoring programs and territorial/provincial and federal long-term water quality and quantity monitoring programs. Learning about groundwater in the Liard is a priority and some projects are underway. The installation of a groundwater monitoring network in the Liard Basin is beginning in 2022; training will take place for community members to co-maintain the observations wells in the area and provide field assistance.

Appendix A – Report Links

British Columbia-NWT Bilateral Water Management Agreement (2015):

https://www.enr.gov.nt.ca/sites/enr/files/nwt-bc_transboundary_water_management_agreement_oct_15_2015.pdf

Appendices to the British Columbia -NWT Bilateral Water Management Agreement (2015):

https://www.enr.gov.nt.ca/sites/enr/files/web_pdf_nwt-bc_transboundary_water_management_agreement_ppendices_15_october_2015.pdf

Terms of Reference for Bilateral Management Committee Members – Bilateral Water Management Agreement between BC/NWT (2020)

B.C. government website: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/water-planning/tor_for_bmc_-_bc_nwt_final_june_2020.pdf

NWT government website: https://www.enr.gov.nt.ca/sites/enr/files/resources/terms_of_reference_for_bmc_members_bc-nwt_bwma.pdf

Liard and Petitot River Basins State of Knowledge Report (2017)

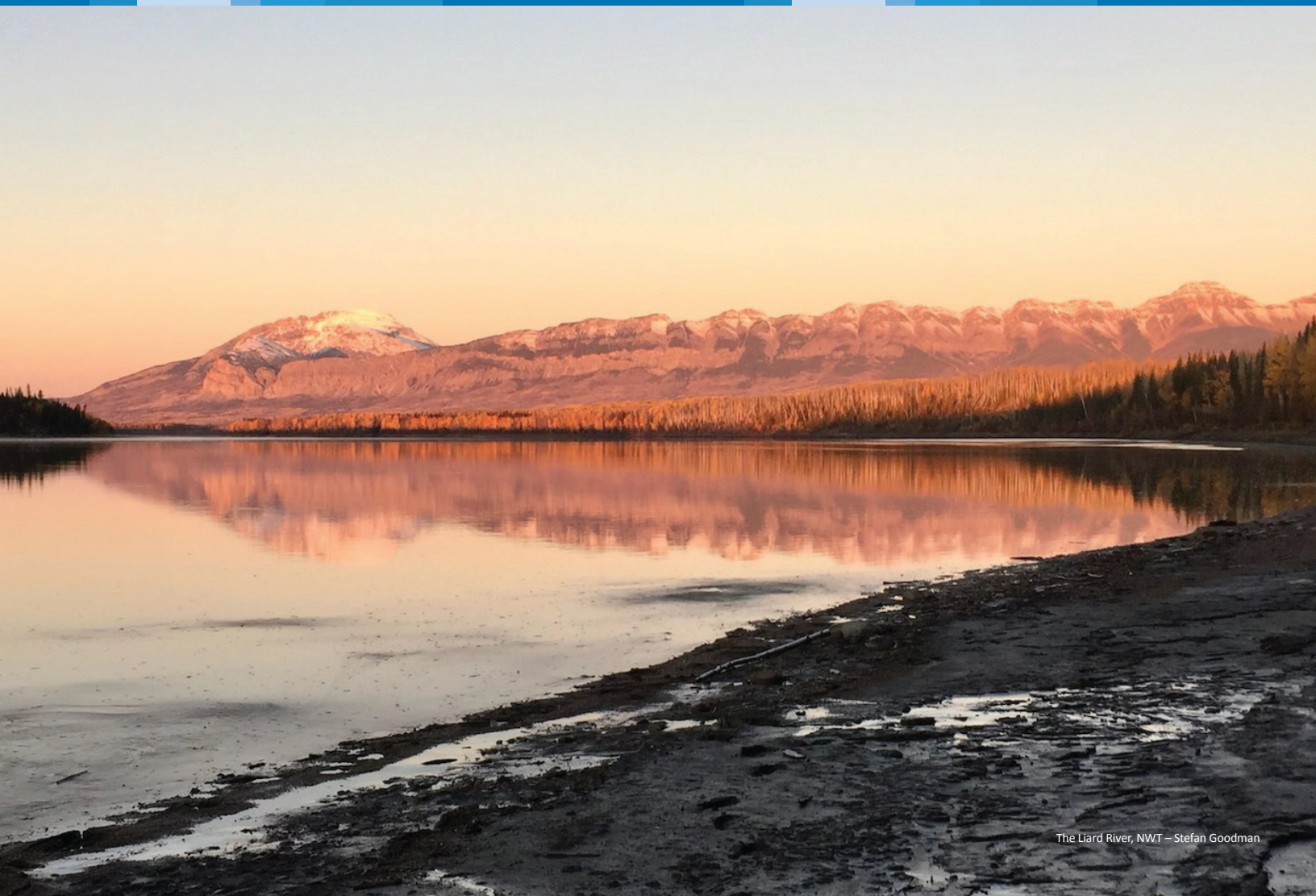
https://www.enr.gov.nt.ca/sites/enr/files/resources/liard_and_petitot_river_basins_state_of_knowledge_report.pdf

Preliminary State of Groundwater Knowledge in the Transboundary Region of the Mackenzie River Basin, Northwest Territories (2016)

https://www.enr.gov.nt.ca/sites/enr/files/preliminary_state_of_groundwater_knowledge_in_the_transboundary_region_of_the_mackenzie_river_basin_nwt_march_2016.pdf

Liard and Petitot Sub Basins Transboundary Groundwater Resources Assessment (2018)

https://smex-ctp.trendmicro.com:443/wis/clicktime/v1/query?url=https%3a%2f%2fwww2.gov.bc.ca%2fassets%2fgov%2fenvironment%2fair%2dland%2dwater%2fwater%2fnortheast%2dwater%2dstrategy%2fwss%5f2018%2d01%5fliard%5fpetitot%5fgroundwater%5fassesment.pdf&umid=a83cff52-1eca-4af5-8ef6-f57e462d1f92&auth=dd9bdcb0088eb594002e44c504f7dbf268a16782-3bc8e75a6aebc45b92eddee9d3a1bc92c75f2bdd



The Liard River, NWT – Stefan Goodman