Real Time Water Quality Report

Tata Steel Minerals Canada: Elross Lake Network

Annual Deployment Report 2024

2024-06-18 to 2024-10-28

Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division

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ACKNOWLEDGEMENTS

The comprehensive Real-Time Water Quality/Quantity Monitoring Network near the Elross Lake Iron Ore Mine in western Labrador is fully funded by Tata Steel Minerals Canada Limited (TSMC). Its effectiveness hinges on a collaborative partnership among TSMC, Environment and Climate Change Canada (ECCC), and the Newfoundland & Labrador Department of Environment and Climate Change (ECC). Managers and program leaders from each entity are dedicated to the network's operation, ensuring it delivers meaningful and precise water quality/quantity data.

In 2024, TSMC provided assistance to ECC staff during fieldwork operations following the initial deployment. This aid was crucial in overcoming equipment and instrumentation challenges, in addition to on-site water level monitoring and reducing travel times to the site, thereby minimizing delays in repairs or interruptions in water quality data collection and monitoring.

ECCC assumes a critical role in managing the data logging/communication aspect of the network. Specifically, staff from the Water Survey of Canada (WSC), under ECCC, regularly visit network stations to verify the functionality of data logging and transmission equipment. ECC holds responsibility for recording and overseeing water quality data. While WSC oversees the hydrometric component of these stations, due to differences in protocols, quality control for WSC hydrometric data occurs less frequently than for water quality data. The hydrometric data presented in this report is provisional and has not undergone quality control checks. Accurate hydrometric data can be accessed at https://wateroffice.ec.gc.ca/ or by request to Water Survey Canada.

INTRODUCTION

On April 18, 2011, a formal agreement was established between the Newfoundland & Labrador Department of Environment and Climate Change (ECC) and Tata Steel Minerals Canada Limited (TSMC) to deploy two real-time water quality/quantity stations near the Elross Lake Iron Ore Mine in western Labrador, adjacent to Schefferville, QC.

Subsequently, an amendment to the original agreement was enacted on February 10, 2015, to introduce an additional station at Joan Brook, situated below the outlet of Joan Lake. This additional station aimed to monitor the effects of mining activities on surface water downstream of the five pits (Kivivic 1, 2, 3N, 4, and 5) within the DSO4 Project 2B mining operation, located approximately 24 km northwest of the primary mine complex. Goodream Creek – Sept 12, 2011

The agreement has been extended in accordance with the terms and conditions outlined in the original agreement, subsequent amendments (February 2015, March 2018, December 2021), and extension letters (April 2016, March 2018, August 2020).

Each station is officially designated as follows: ELROSS CREEK BELOW PINETTE LAKE INFLOW, GOODREAM CREEK 2KM NORTHWEST OF TIMMINS 6 (now GOODREAM CREEK ABOVE TRIANGLE LAKE), and JOAN BROOK BELOW OUTLET OF JOAN LAKE, hereafter referred to as the Elross Creek Station, the Goodream Creek Station, and the Joan Brook Station, respectively (refer to Figure 1).

Throughout the ice-free months, each station diligently measures six parameters, encompassing five water quality parameters (temperature, pH, specific conductivity, dissolved oxygen, and turbidity) and one water quantity parameter (stage). ECC undertakes the responsibility of collecting and managing the hourly recorded water quality data, typically spanning from early June to early October when streams are devoid of ice, while ECCC oversees the year-round collection and management of stage data recorded on an hourly basis.

Additionally, ECCC is tasked with logging and transmitting all water quality and quantity data to a centralized repository via satellite communications. This real-time network's primary objective is to monitor, process, and distribute water quality and quantity data to TSMC, ECC, and ECCC for the evaluation and management of water resources. It also functions to provide early warnings of any potential or emerging water issues, enabling timely implementation of mitigative measures. ECC remains responsible for communicating significant water quality events to TSMC through email notifications, while deployment and annual reports are compiled to document the parameters measured at these stations.

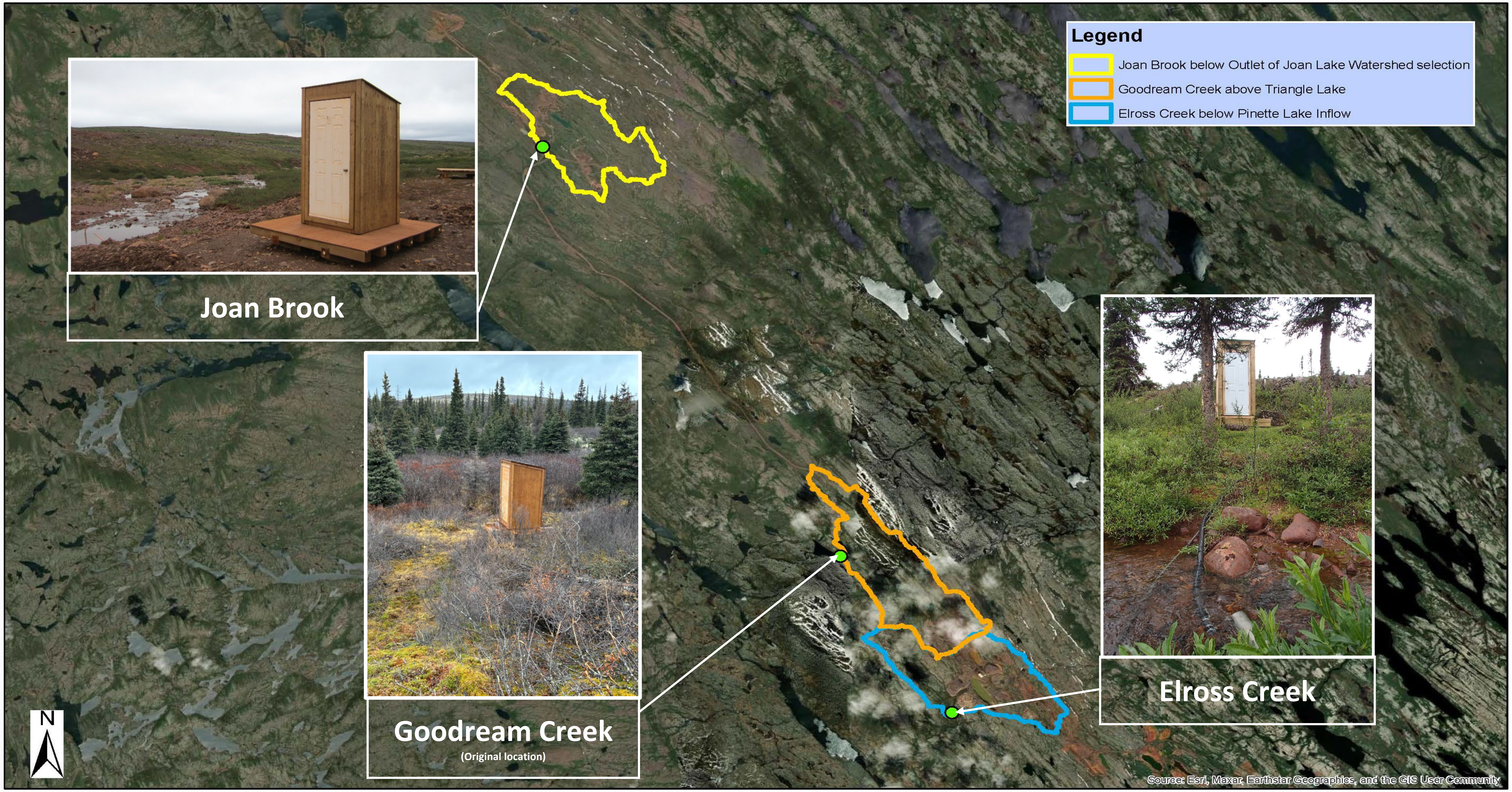


Figure 1: Map and images of TSMC Schefferville, RTWQ station watersheds located alongside Elross Creek, Goodream Creek & Joan Brook.

JOAN BROOK STATION

The Joan Brook station is within a watershed that covers an area of 10.12km^2 and is responsible for monitoring surface water downstream of five pits (Kivivic 1, 2, 3N, 4, and 5) within the DSO4 Project 2B mining operation. Operational since June 2016, it assesses stage values and water quality. Originating from Joan Lake and fed by various tributaries, Joan Brook is a small stream flowing southwest into Howells River. The distance from its headwaters to the sampling site (NF03OB0042) is approximately 1.2 km, with a distance to the outlet at Howells River of around 7.4 km.

ELROSS CREEK STATION

The Elross Creek station site was strategically chosen to oversee all surface water outflows from both the Elross Lake mining site and the DSO4 Project 2B mining sites, as depicted in Figure 2. This station focuses on monitoring surface water within the 11.91 km^2 watershed, downstream of the Timmins 1 pit and downstream of Pinette Lake. Commencing operations on October 17-18, 2011, the station initially recorded only stage values for seven months until June 5, 2012, when water quality instruments were deployed for the first time.

This station sits about 1.2 km southwest of the Timmins 1 pit within the Elross Basin, and 60 m downstream from the confluence of water inflows from Pinette Lake into Elross Creek. Originating from Pinette Lake and the Timmins 1 pit of the Elross Lake Iron Ore Mine in western Labrador, Elross Creek flows primarily southwest into Elross Lake, part of the Churchill River drainage basin. The distance from its headwaters to the sampling site (NF03OB0039) is approximately 3 km, while the distance from the sampling site to the mouth of the Churchill River at Lake Melville spans around 1000 km.

GOODREAM CREEK STATION

Operation of the original Goodream Creek Station, 2KM Northwest of Timmins 6, was temporarily halted in 2017 to facilitate its relocation to a new site further downstream, close to Triangle Lake. This relocation was completed early Fall during the 2024 field season, with the objective of having the station fully operational at its new location by the beginning of the 2025 Spring season.

The Goodream Creek Station at Triangle Lake is situated within the 12.76 km^2 watershed and is northwest of the Timmins 6 pit within the Goodream Basin and was established to monitor potential impacts stemming from groundwater flow from the Timmins 6 pit into the surface water of Goodream Creek. Additionally, this station will extend monitoring to assess impacts from the Howse deposit.

Monitored since October 17-18, 2011, the Goodream Creek stations initially collected stage values exclusively for seven months until June 5, 2012, when water quality instruments were introduced. Goodream Creek, originating from wetlands near the Timmins 6 pit of the Elross Lake Iron Ore Mine in western Labrador, flows northwest into Triangle Pond, forming part of the Churchill River drainage basin. The distance from its headwaters to the sampling site (NF03OB0040) is approximately 2 km, with a further approximate distance of 1000 km to the mouth of the Churchill River at Lake Melville.

During the 2024 season, a Hydrolab DS5X instrument was deployed at the Goodream Creek above Triangle Lake station, with data being logged internally for subsequent statistical analysis and interpretation.

Table 1. Geographic coordinates of Elross Creek, Goodream Creek (old location) and Joan Brook Stations. Coordinates for the new Goodream Creek station will be confirmed during next site visit. 5

	Elross Creek Station		Goodream Creek Station (New location highlighted yellow)		Joan Brook Station	
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
Instrument	54.877757	-67.099728	*54.9175 (54.927898)	*-67.123889 (-67.153892)	*55.03334	*-67.17597
Gauge house	54.877698	-67.099848	*54.92794	*67.15597	*55.03334	*-67.17597
Helicopter pad	54.877604	-67.100014	*54.92794	*67.15597	*55.03334	*-67.17597

*General Site Location

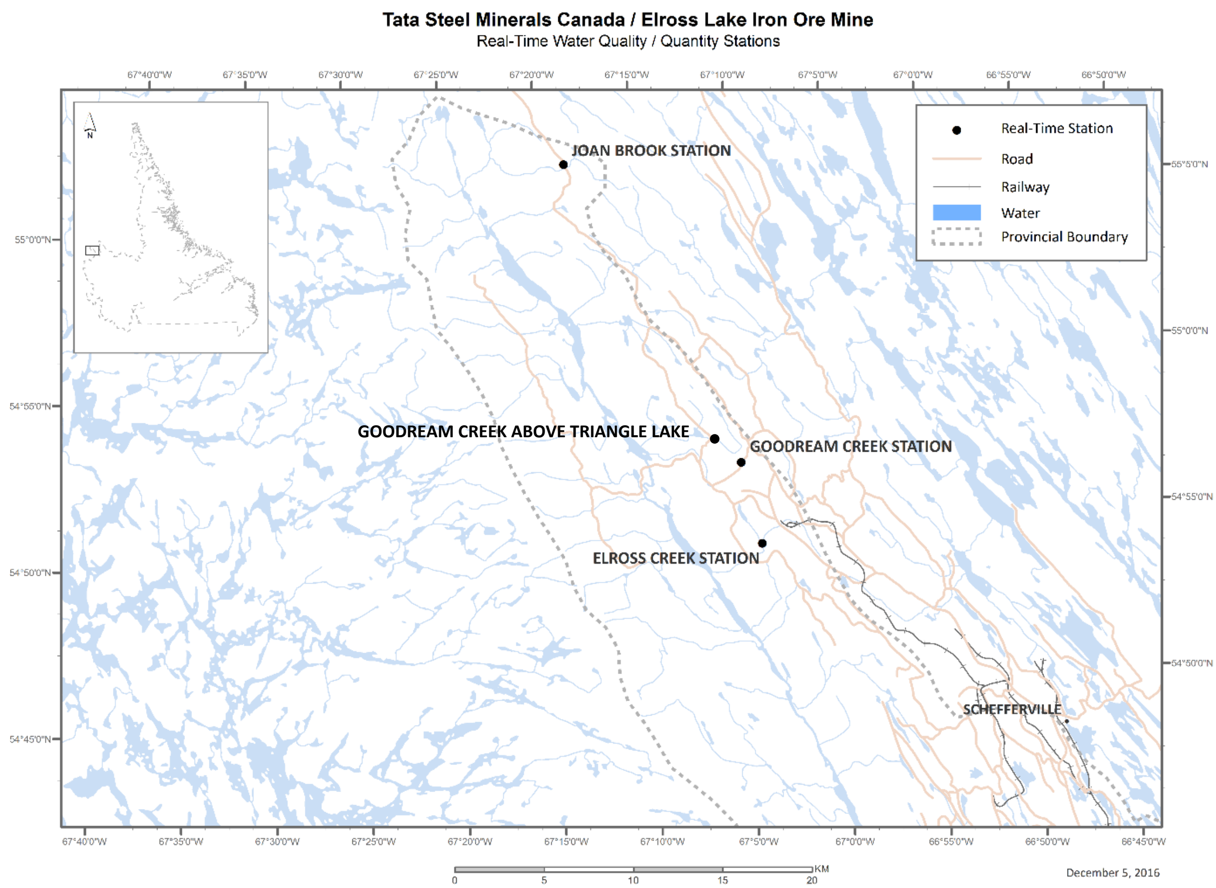


Figure 2. Map of real-time water quality/quantity stations in the vicinity of Elross Lake Iron Ore Mine in Western Labrador.

QUALITY ASSURANCE & QUALITY CONTROL

The Department of Environment and Climate Change implement quality control and quality assessment procedures in order to ensure accurate data collection.

For more information on the ECC's QA/QC procedures please see Appendix A or the Government of NL webpage https://www.gov.nl.ca/ecc/waterres/watermonitoring/rtwq/qa/

Figure 3. Xylem EXO3 DataSonde used for monitoring five surface water quality parameters.

To ensure the success of the RTWQ program, it is crucial to stay acquainted with the latest advancements in water quality monitoring technology. In the network's history, OTT DS5X instrumentation was deployed for both short and long-term deployment. However, due to the aging condition of the DS5X sondes, both Joan Brook and Elross Creek instrumentation were upgraded to YSI EXO3 instruments in 2024. Goodream Creek continued to use the OTT DS5X for the 2024 season as the station had not yet been installed at the new location above Triangle Lake.

Quality assurance procedures are carefully implemented, encompassing thorough instrument cleaning to mitigate errors induced by biofouling and/or sensor drift, replacement of damaged or unsuitable sensor parts, and calibration of four key instrument sensors (i.e., pH, specific conductivity, dissolved oxygen, and turbidity sensors). These procedures are typically conducted both at the commencement and conclusion of each new deployment period, as detailed in Table 2.

Additionally, as part of quality control measures, instrument performance undergoes testing at the initiation and conclusion of each deployment period, with the process delineated in Appendix A. Instruments are evaluated and assigned a performance rating (ranging from poor, marginal, fair, good to excellent) for each water quality parameter measured, ensuring robust data collection and maintenance of data integrity.

This report discusses water quality related events occurring at Joan Brook and Elross Creek stations from the instrument's deployment on June 18, 2024, until removal on August 14, 2024, 58 days later, as well as the deployment at Goodream Creek for 133 days (removal on October 28, 2024). It was necessary to remove instrumentation from Joan Brook and Elross Creek due to low water level conditions for the prevention of instrument and/or sensor damage.

JOAN BROOK AT OUTLET OF JOAN LAKE (August 20th, 2024)

ELROSS CREEK BELOW PINETTE LAKE (August 20th, 2024)

Table 2. Water quality instrument deployment start and end dates for 2024 at Elross Creek, Goodream Creek and Joan Brook.

Station	Start date	End date	Duration (days)
Elross Creek	2024-06-18	2024-08-14	58

Joan Brook	2024-06-18	2024-08-14	58
Goodream Creek	2024-06-18	2024-10-28	133

The rankings of field instrument sensors to QAQC instrument sensors could not be provided at the time of removal, as adjacent QAQC readings were limited due to low water levels. Grab samples were collected during some point of deployment and compared to field values near collection time to provide another way to QAQC three of the sensors. Table 3 below indicates the comparison rankings of the instrument to the corresponding grab sample, when available.

Table 3. Field instrument sensor performance (data from ADRS & log file) compared to QAQC instrument and grab sample during deployment for the Elross Creek, Joan Brook and Goodream Creek RTWQ stations.

Station	Start date		Temperature	pH	Conductivity	Dissolved Oxygen (mg/L)	Turbidity
Elross Creek	2024-06-18	QaQc Sonde	Excellent	Good	Excellent	Excellent	Excellent
		Grab Sample	N/A	Poor	Poor	N/A	Excellent
Joan Brook	2024-06-18	QaQc Sonde	Excellent	Excellent	Excellent	Excellent	Excellent
		Grab Sample	N/A	Good	Good	N/A	Excellent
Goodream Creek	2024-06-18	QaQc Sonde	Fair	Good	Excellent	Fair	Excellent
		Grab Sample	N/A	Good	Poor	N/A	Excellent

For less than desirable rankings observed in Table 3, acknowledgement of the inherent challenges posed by transportation delays in sample submission to the analytical laboratory for testing must be considered. Specifically, the method of transportation via charter plane from the collection site to St. John's introduces potential temperature fluctuations, impacting the pH, conductivity, and turbidity of grab samples. Furthermore, environmental factors such as exposure to air, biological activity, chemical reactions, and physical disturbances further complicate the preservation of sample integrity.

In effort to mitigate these challenges, rigorous protocols are implemented, including the use of insulated containers with ice packs to stabilize temperatures during transportation, streamlining logistics to reduce time delays between sample collection and analysis, and comprehensive quality assurance measures encompassing personnel training and robust monitoring and control mechanisms. Through these concerted efforts, WRMD and TSMC strive to ensure the accuracy and consistency of analytical results, upholding commitments to excellence in water quality assessment.

DEPLOYMENT NOTES

Mining Operations - 2024

Mining operations at TSMC in 2024 consisted of mining from 6 deposits. Deposits located in Area 4 include Goodwood (Quebec) and Kivivic 3 (NL), deposits located in Area 3 include Timmins 3N, Timmins 4S, Timmins 7 and Flemming 7N. Mine operations was supported by 3 main contractors: Castonguay (drill and blast), HME (equipment rental and maintenance) and Equipment Nordiques (rock crushing). The rock crushing activities were conducted in KM20 quarry again with the blasted rock being hauled from KM14 rock source.

Goodwood was the primary source of DSO in 2024 with a small amount also coming from Flemming 7N. Plant 2 was the main destination for hauling DSO, when the Concentrator was not running some DSO was also hauled to Plant 1. The ore feed for Concentrator was primarily supplied from Kivivic 3, Timmins 3N, Timmins 4S, Timmins 7, and Flemming 7N in order to meet the target quality.

RC exploration drilling was carried out in Area 3 and Area 4 by Earth Drilling in 2024 to further define ore bodies in the various pits. The results from the exploration program were positive and TSMC is currently seeking the necessary approvals for expanding the pit in Timmins 3.

The Goodream Creek Station 2km Northwest of Timmons 6 was not active for the 2024 season pending its move to a new location further downstream near Triangle Lake. A Hydrolab DS5X was deployed, and data was collected via internal logging at the new station location for continued water quality monitoring. It is intended that all instrumentation and equipment will be installed by WRMD for full functionality by June 30, 2025 once procured by TSMC.

DATA INTERPRETATION

Data records were interpreted for each station during the deployment period for the following six parameters. A description of each parameter is provided in Appendix B.

(i) Stage (m)

(ii) Temperature (°C)

(iii) pH

(iv) Specific conductivity (µs/cm)

(v) Dissolved oxygen (mg/l)

(vi) Turbidity (NTU)

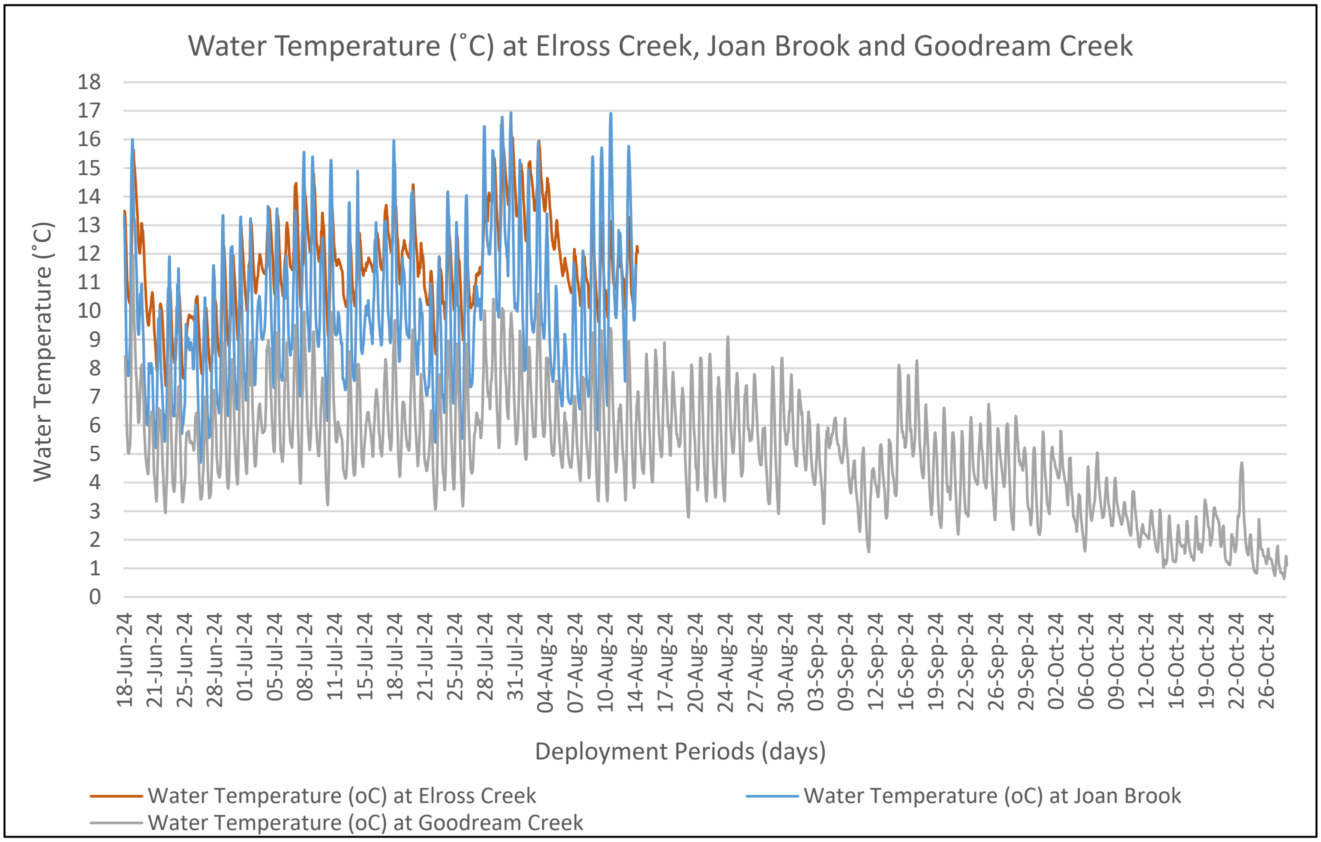
Water Temperature

Water temperature is a crucial determinant of water quality due to its profound impact on biological activity, oxygen solubility, chemical reactions, stratification, habitat suitability, and pollution transport. It affects the metabolic rates of aquatic organisms, with warmer water generally increasing oxygen demand and decreasing dissolved oxygen levels. Cold water holds more dissolved oxygen, essential for supporting aquatic life. Temperature influences chemical reactions and nutrient cycling, while stratification can create hypoxic conditions in deeper layers of lakes and reservoirs. Additionally, temperature fluctuations can disrupt habitat suitability and stress sensitive species, ultimately affecting the ecological balance of aquatic ecosystems and the transport and behavior of pollutants. Thus, managing and monitoring water temperature is vital for maintaining healthy aquatic environments.

The water temperature trends show distinct variations over the monitoring period from mid-June to late October (Figure 4). Data trends beyond August 18, 2024, for both Elross Creek and Joan Brook could not be analyzed due to the depletion of the waterbodies beyond adequate instrument operational conditions. Elross Creek exhibits temperatures ranging between approximately 7°C and 16°C, following a gradual warming trend until mid-August before cooling down. Its fluctuations align closely with those of Joan Brook, suggesting similar environmental influences. Joan Brook, however, shows a minimally wider range of temperature variations, from 4.7°C to peaks exceeding 16°C. This indicates a more dynamic temperature profile, possibly due to factors such as shallower depth, stronger surface water interactions, or greater exposure to sunlight.

Goodream Creek, in contrast, maintains significantly lower temperatures, between 0.63°C and 11.93°C. Unlike the other two water bodies due to necessary removal, its temperature steadily declines from August onward, reaching close to 3°C by late October. This suggests that Goodream Creek may be influenced by groundwater inputs, increased shading, or different hydrological characteristics that keep it cooler. Although stage was not monitored at this station, site visit information indicates that water levels remained low-moderate throughout the deployment period.

The significant diurnal fluctuations in water temperatures observed at all stations are characteristic of shallow water streams, where the water responds swiftly to changes in ambient air temperatures. However, Joan Brook displays a notably wider daily temperature range, consistently reaching lower temperatures compared to Elross Creek. This disparity likely stems from various factors including differences in water depth, flow dynamics, and surrounding vegetation cover, all of which can impact the rate of temperature change within the water body. The heightened temperature variability in Joan Brook suggests that it may be more susceptible to rapid environmental shifts, potentially influencing the ecological dynamics and species composition within its ecosystem.



Water Temperature (oC)	JOAN BROOK	ELROSS CREEK	GOODREAM CREEK
MAX	16.94	16.29	11.93
MIN	4.7	7.38	0.63
MEAN	9.93	11.62	5.04
MEDIAN	9.64	11.57	5.1

Figure 4: Hourly Water Temperature (°C) at Joan Brook, Elross Creek and Goodream Creek.

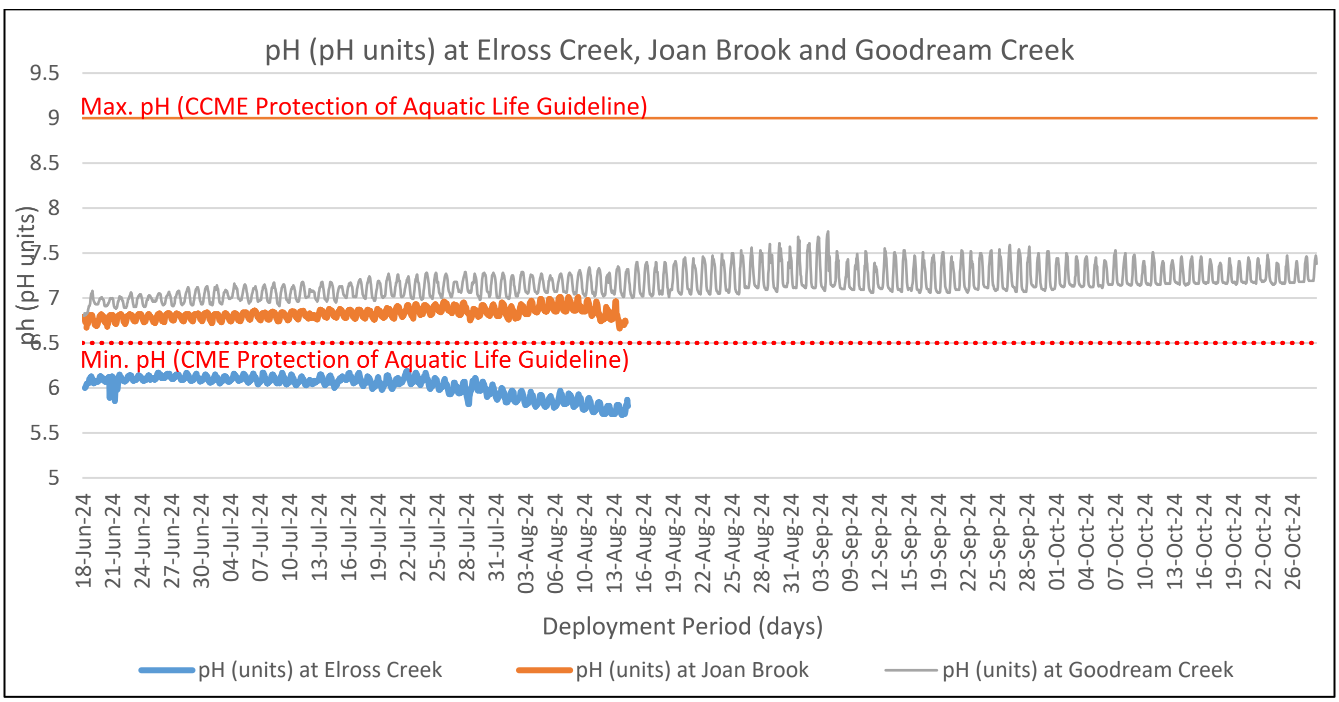
pH

pH is used to give an indication of the acidity or basicity of a solution. A pH of 7 denotes a neutral solution while lower values are acidic and higher values are basic. Technically, the pH of a solution indicates the availability of protons to react with molecules dissolved in water. Such reactions can affect how molecules function chemically and metabolically.

Over the deployment period, the pH data for Joan Brook, Elross Creek, and Goodream Creek within the TSMC mine area reveal notable distinctions in the water quality characteristics of each river. Joan Brook consistently maintains a relatively narrow pH range from 6.66 to 7.01 pH units, with minor fluctuations between its maximum and minimum pH values. The mean (6.83) and median (6.82) pH values suggest stable conditions around neutral to slightly acidic levels throughout the monitoring period.

Elross Creek exhibits a slightly broader pH range (5.70 to 6.19 pH units) compared to Joan Brook, with lower pH values overall (6.02). Despite this, the pH data indicates relatively stable conditions, albeit with a tendency towards slightly more acidic levels. Goodream Creek stands out with consistently higher pH values compared to the other two rivers, indicating a wider range of values (6.80 to 7.74 pH units) and neutral to slightly alkaline conditions. Both the mean (7.17) and median (7.14) pH values for Goodream Creek suggest a stable pH regime, similar to Joan Brook.

At Joan Brook and Goodream Creek, pH remained within the CCME guidelines for the protection of aquatic life (6.5 to 9.0 pH units) throughout the deployment year. Elross Creek consistently displays pH values below the recommended minimum guideline of 6.5 for freshwater ecosystems. Despite the minor fluctuations observed in pH levels over the monitoring period, the data indicates that Elross Creek tends to have slightly lower pH values. Potential influences such as geological characteristics, land use practices, and proximity to mining activities within the TSMC mine area may be contributing to the observed pH levels.



pH	JOAN BROOK	ELROSS CREEK	GOODREAM CREEK
MAX	7.01	5.7	7.74
MIN	6.66	6.19	6.80
MEAN	6.83	6.02	7.17
MEDIAN	6.82	6.06	7.14

Figure 5: Hourly pH (pH units) data at Joan Brook, Elross Creek and Goodream Creek.

Specific Conductivity and TDS

Conductivity relates to the ease of passing an electric charge – or resistance – through a solution. Conductivity is highly influenced by the concentration of dissolved ions in solution: distilled water has zero conductivity (infinite resistance) while salty solutions have high conductivity (low resistance). Specific Conductivity is corrected to 25°C to allow comparison across variable temperatures. Monitoring specific conductivity is crucial for assessing water quality, identifying potential sources of contamination, and ensuring the health of aquatic ecosystems. Deviations from expected conductivity levels may signal the need for further investigation and management actions to maintain water quality and ecosystem integrity.

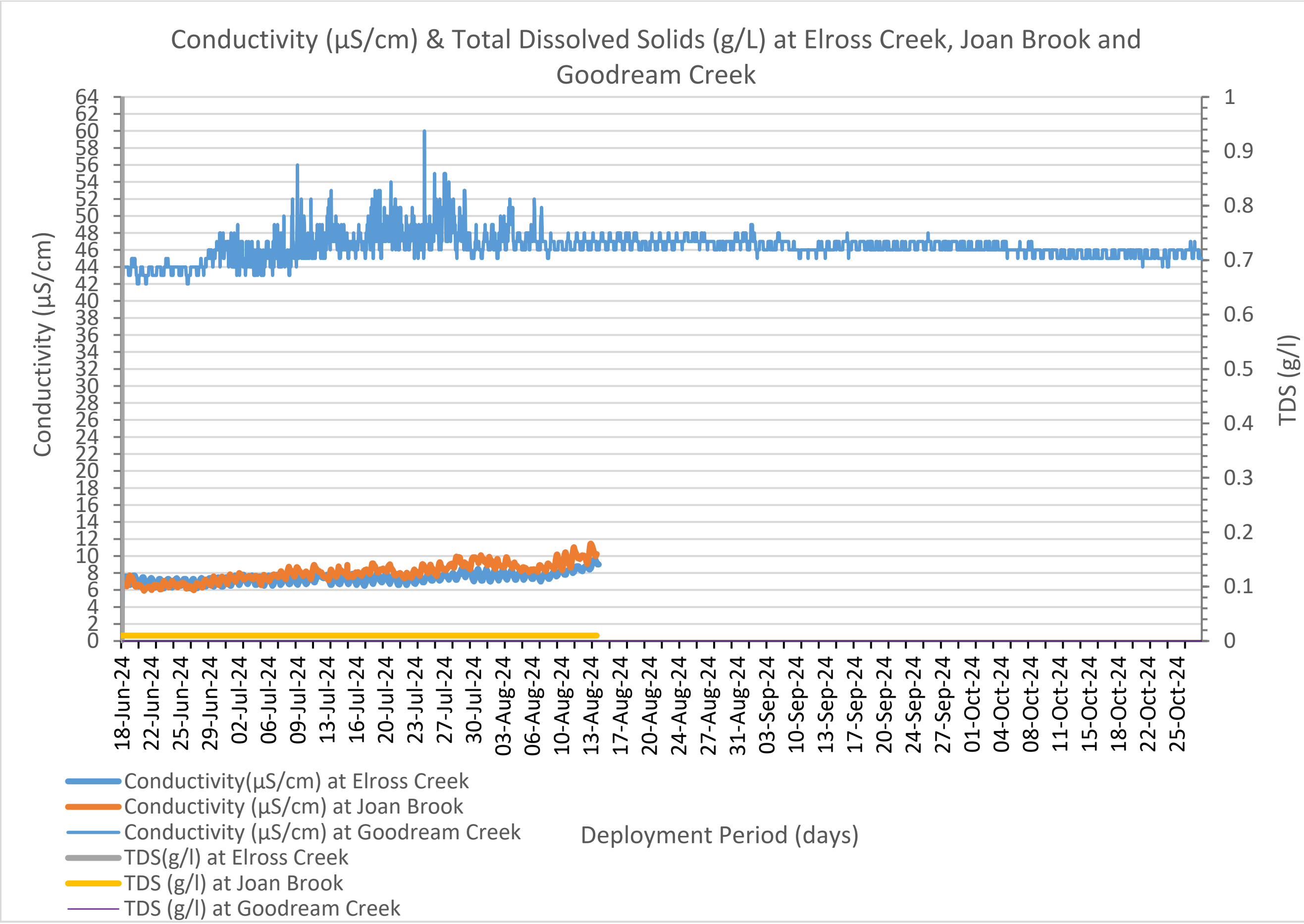
The provided data in Figure 6 outlines conductivity measurements for the station specific monitoring period. For Joan Brook, the data reveals a minimum specific conductance of 5.91 µS/cm and maximum of 11.44 µS/cm and 0.010 g/L total dissolved solids throughout the monitoring period.

Elross Creek exhibits lower specific conductance and TDS values compared to Joan Brook, with a range in specific conductance of 6.2 to 9.6 µS/cm and maximum TDS of 0.010 g/L. These values indicate slightly lower levels of dissolved ions and minerals compared to Joan Brook, possibly influenced by local geological conditions.

Lastly, Goodream Creek displays the highest specific conductance, with a specific conductance range of 42.0 to 60.0 µS/cm and the lowest TDS values among the three rivers, of 0.000 g/L. Overall, conductivity was consistent with some fluctuation early in the deployment period. This is most likely due to precipitation and runoff events. These elevated values suggest a higher concentration of dissolved ions and minerals in the water, potentially influenced by factors such as runoff or activities in the watershed. Sudden decreases in conductivity are likely the result of precipitation events and the addition of freshwater. In analyzing freshwater conductivity, a calculated total dissolved solids (TDS) value of zero (0) seems unusual and likely indicates a discrepancy in the estimation/calculation process. This discrepancy may arise from an inappropriate conversion factor, measurement error, or unusual water chemistry.

Diurnal fluctuations observed at all stations are characteristic of shallow water streams and ponds, where the water responds swiftly to changes in ambient air temperatures. This disparity likely stems from various factors including differences in water depth, flow dynamics, and surrounding vegetation cover, all of which can impact the rate of temperature change within the water body.

Low water specific conductivity and Total Dissolved Solids (TDS), as observed in the three waterbodies, indicate high water purity and minimal contamination.



Variable	JOAN BROOK		ELROSS CREEK		GOODREAM CREEK	
	SP. COND	TDS	SP. COND	TDS	SP. COND	TDS
MAX	11.44	0.010	9.60	0.006	60	0
MIN	5.91	0.010	6.2	0	42	0
MEAN	8.06	0.010	7.41	0.005	46.3	0
MEDIAN	8.04	0.010	5.00	0.005	46.0	0

Figure 6: Hourly Specific Conductivity (µS/cm) and Total Dissolved Solids – TDS (g/L) data at Joan Brook, Elross Creek & Goodream Creek.

Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, principally temperature – the saturation of oxygen in water is inversely proportional to water temperature. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.

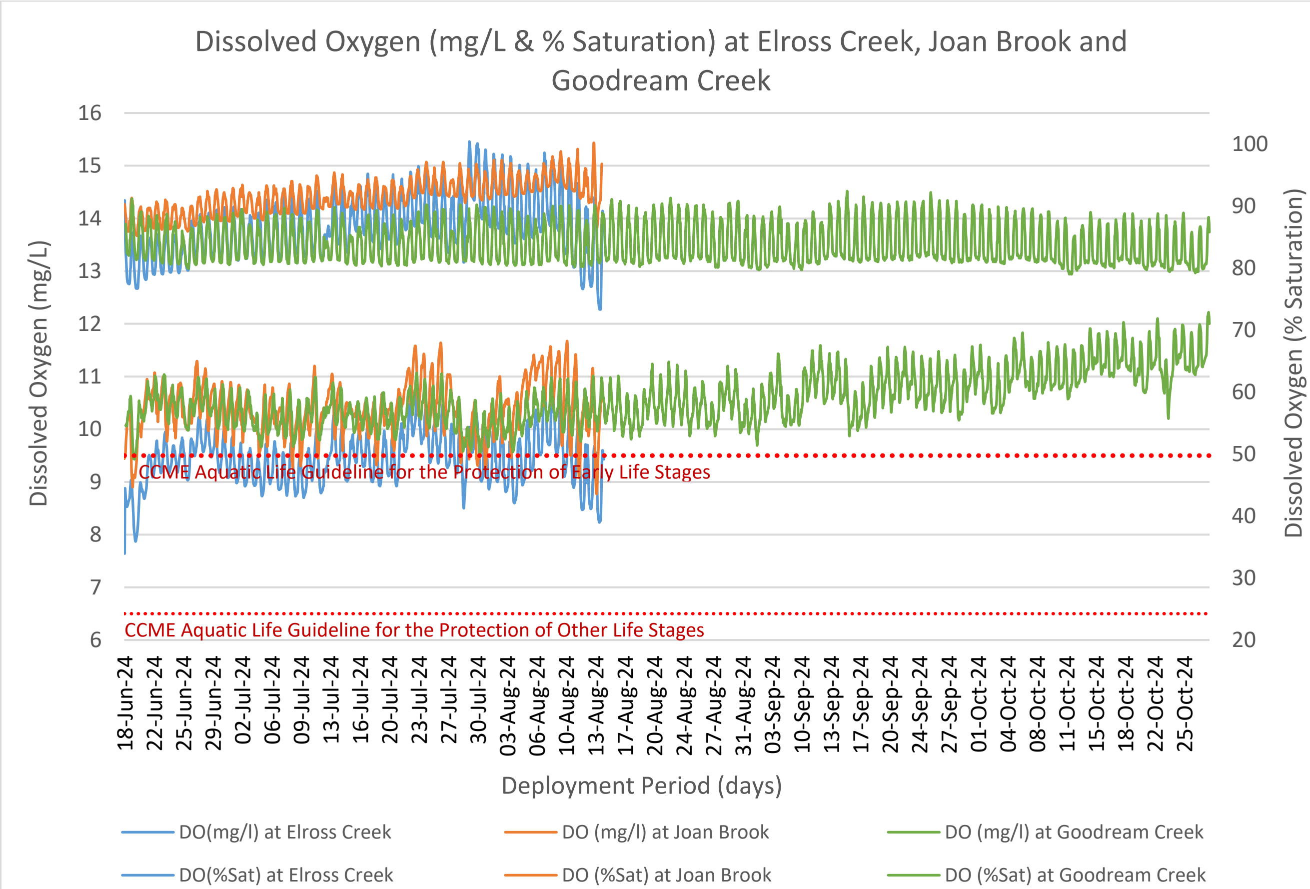
The statistical data for dissolved oxygen (DO) concentrations (mg/L) and percent saturation (% Sat) offers valuable insights into the water quality dynamics of each freshwater river within the monitoring period. Due to low water levels at Joan Brook and Elross Creek Stations on August 14, 2024, both sondes were removed.

Data collected at Joan Brook reveals a wide range of DO concentrations, with a maximum of 11.67 mg/L (100.2%) and a minimum of 8.77 mg/L (85.2%), indicating variability in oxygen levels. Despite this variability, the median and mean DO concentrations of 8.04 mg/L (91.7%) and 8.06 mg/L (91.6%), respectively, suggest relatively stable oxygen levels on average.

Elross Creek exhibits slightly lower DO concentrations compared to Joan Brook, with a maximum of 10.72 mg/L (100.4%) and a minimum of 7.64 mg/L (73.3%). The median and mean DO concentrations of 9.47 mg/L (86.5%) and 9.44 mg/L (86.8%) respectively, indicate consistent oxygen levels overall. Meanwhile, Goodream Creek demonstrates oxygen levels similar to Joan Brook, with a maximum DO concentration of 12.22 mg/L (92.4%) and a minimum of 9.43 mg/L (79%). The median and mean DO concentrations of 10.55 mg/L (82.9%) and 10.59 mg/L (84.0%) further confirm stable oxygen levels, reflecting the health of this freshwater ecosystem.

The observed increase in dissolved oxygen (DO) levels from July to October in Goodream Creek corresponds to decreasing water temperatures throughout deployment. As temperatures dropped due to the natural transition from summer to fall, the solubility of oxygen in water increased due to the colder water's ability to hold more dissolved gases. Dissolved oxygen level remained consistently above the Canadian Council of Ministers of the Environment (CCME) Guideline for the Protection of the Other Life Stages (6.5 mg/L), and at or above the CCME guideline of 9.5 mg/l for the protection of early life stage cold water biota for most of the deployment period.

Seasonal trends indicate a general increase in DO levels over time, with periodic dips, particularly in early August and late September. The % saturation values follow a similar pattern, showing diurnal variations and a slight upward trend. Data indicates that Joan Brook has the most stable and highest DO levels, while Elross Creek appears to be the most vulnerable to low oxygen



Variable	JOAN BROOK		ELROSS CREEK		GOODREAM CREEK	
	mg/L	**%Sat**	**mg/L**	**% Sat**	**mg/L**	**% Sat**
MAX	11.67	100.2	10.72	100.4	12.22	92.4
MIN	8.77	85.2	7.64	73.3	9.43	79
MEAN	8.06	91.58	9.44	86.8	10.59	84.03
MEDIAN	8.04	91.7	9.47	86.5	10.53	82.9

Figure 7: Hourly Dissolved Oxygen (mg/L & % Saturation) at Joan Brook, Elross Creek & Goodream Creek.

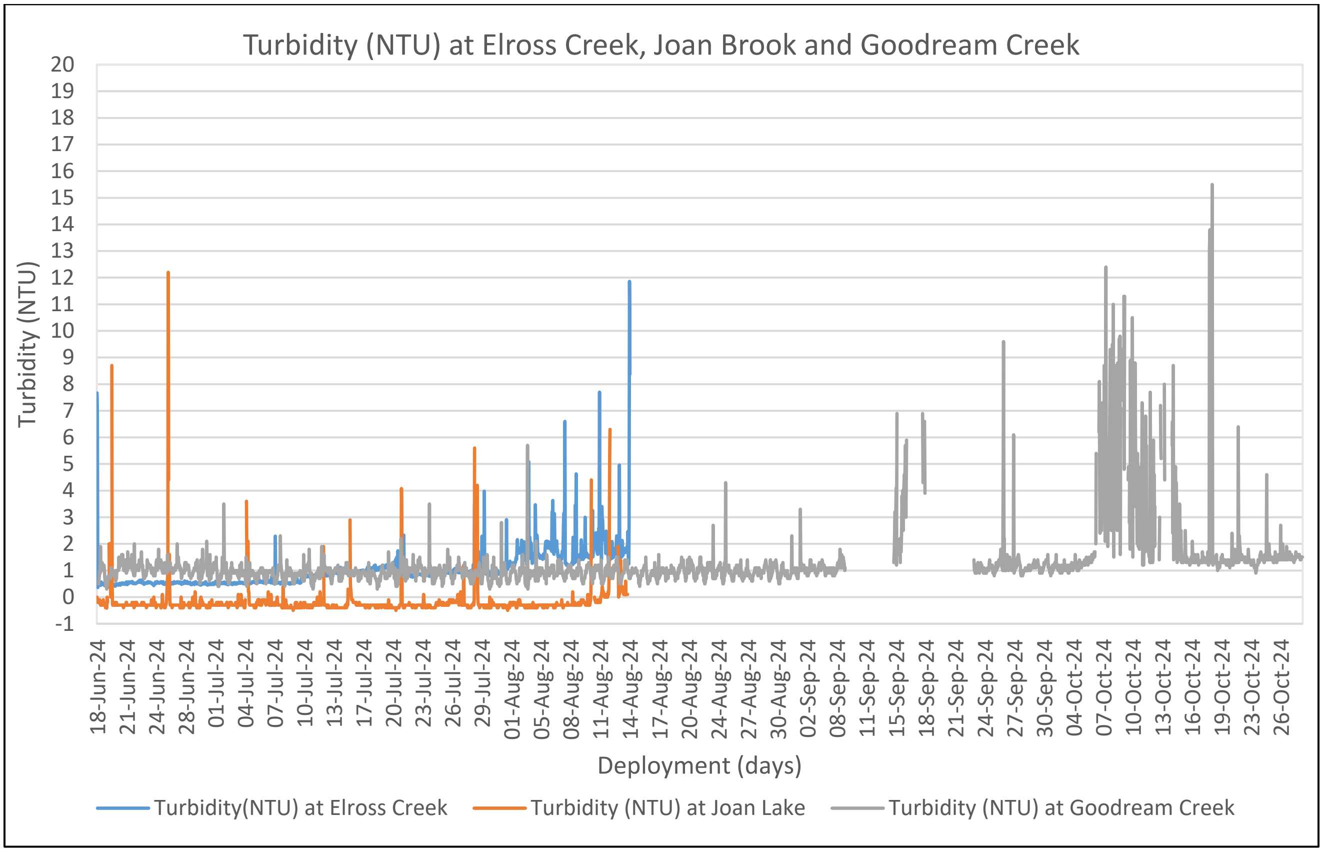
Turbidity

Water turbidity is characterized by the cloudiness or haziness caused by suspended particles and can significantly impact water quality. High turbidity reduces light penetration, hindering photosynthesis and affecting aquatic vegetation growth and habitat suitability. It can lead to temperature fluctuations, oxygen depletion from microbial decomposition of organic matter, and sedimentation, smothering benthic habitats and compromising biodiversity. Turbidity can also transport nutrients and pollutants, contributing to eutrophication, algal blooms, and contamination of drinking water sources. Furthermore, it highlights the significance of monitoring and managing turbidity levels to uphold the health and functionality of aquatic ecosystems.

Throughout the observation period, all three locations consistently registered minimal turbidity, with some sporadic instances of elevated readings, particularly in August and October. Goodream Creek generally exhibited slightly higher turbidity levels compared to Joan Lake and Elross Creek, with maximum readings reaching 15.5 NTU (October 19th). Joan Lake recorded its highest maximum turbidity value of 12.2 NTU (June 26th), indicating a temporary increase in suspended particles, possibly due to external factors such as rainfall, erosion or runoff events. Elross Creek showed lower turbidity levels, with maximum readings of 11.86 NTU (August 14th). Despite variations in maximum turbidity levels, all three waterbodies consistently record minimum and median turbidity readings of -0.3 to 1.0 NTU, suggesting periods of relatively clear water. The mean turbidity values indicate similar trends, with Goodream Creek having the highest mean turbidity of 1.30 NTU, followed by Elross Creek at 1.00 NTU, and Joan Brook at -0.189 NTU. These variations may be indicative of differences in sedimentation rates, flow dynamics, or land use practices within each waterbody.

Turbidity measurements at Joan Brook indicated very low turbidity including negative values. This situation is most likely to happen when measuring low-level turbidity. Natural variations in all measurements, instrument and non-instrument related, can lead to a negative result. Some other turbidimeters are designed to round up a negative number to 0.00 NTU, since a result of less than 0.00 NTU is theoretically impossible. However, in practice, these results are actually quite meaningful. The problem could be operator technique or sonde error. It could also indicate a problem with the low turbidity/turbidity-free water used for a blank or a problem with the calibration. If the meter rounds the negative result to 0.00 NTU, the user will not be alerted to a potential problem.

Overall, despite occasional fluctuations, the turbidity levels remained relatively low across all locations, suggesting good water quality conditions in these freshwater ecosystems during the observation period. Ongoing monitoring and further investigation into the factors influencing turbidity spikes are essential to ensure the continued health and sustainability of these water bodies.



Variable	JOAN BROOK	ELROSS CREEK	GOODREAM CREEK
MAX	12.2	11.86	15.5
MIN	-0.5	0.36	0.3
MEAN	-0.188	1.01	1.30
MEDIAN	-0.30	0.87	1.0

Figure 8: Hourly Turbidity (NTU) at Joan Brook, Elross Creek and Goodream Creek.

Stage

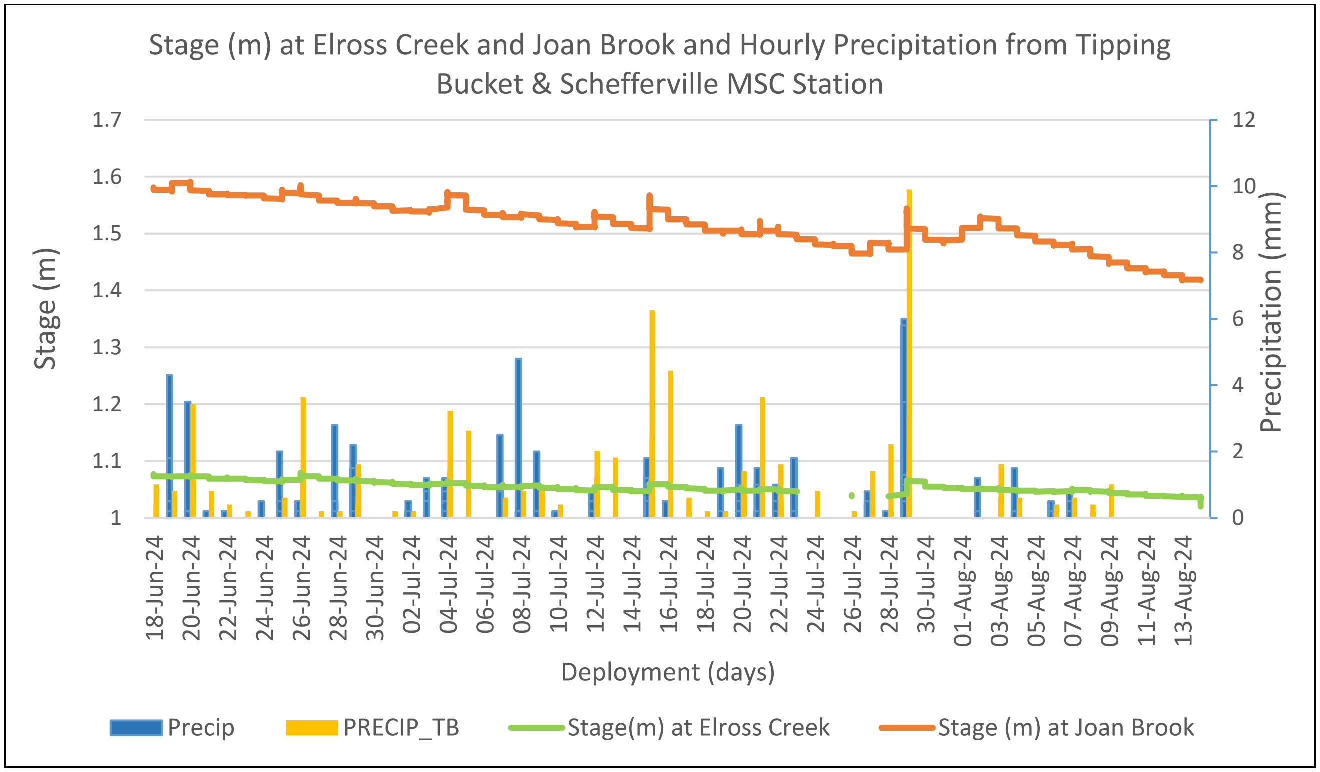
Stage values are determined by a vertical reference specific to each station, rendering absolute stage values incomparable between stations. However, relative change in stage can be meaningfully compared across stations.

The provided data in Figure 9, offers insights into the stage measurements of two of the three freshwater rivers, Joan Brook and Elross Creek. Goodream Creek stage data was not collected due to the decommissioning of the station in 2018. Hydrometric monitoring will be reinstated upon installation at the new location in Spring 2025. The water levels in Joan Brook showed a steady decline from June to August, with the maximum recorded level being 1.59 meters, the mean at 1.52 meters, and the median also at 1.52 meters. Similarly, Elross Creek exhibits a maximum value (1.08m) and the mean (1.06m) and median (1.05m) values with a continuous decline over the monitoring period.

Both Joan Brook and Elross Creek, being naturally small waterbodies, are highly sensitive to changes in precipitation. Since small bodies of water generally have limited capacity to retain water, they are particularly affected by periods of low rainfall. This could explain the gradual decrease in water levels, as the waterbodies likely depend on regular rainfall to maintain its levels. The low precipitation received, and summer air temperatures resulted in a steady depletion to levels unacceptable for the proper operation of the instrumentation.

The precipitation data collected from the newly installed tipping bucket at Joan Brook Station and the precipitation records from the MSC station (Schefferville airport) revealed differences in accuracy and responsiveness. The tipping bucket, being directly located at the monitoring site, provided higher-resolution data, capturing localized rainfall events that the MSC station occasionally missed. In contrast, the MSC station offered broader regional precipitation trends but lacked the precision needed to assess site-specific water quality impacts. While both sources demonstrated similar long-term trends, the tipping bucket proved to be more effective in identifying short-term fluctuations in precipitation, which are crucial for real-time water quality assessments.

As mentioned previously, while WSC oversees the hydrometric component of these stations, due to differences in protocols, quality control for WSC hydrometric data occurs less frequently than for water quality data. The hydrometric data presented in this report is provisional and has not undergone quality control checks. Accurate hydrometric data can be accessed at https://wateroffice.ec.gc.ca/ or by request to Water Survey Canada.



Variable	JOAN BROOK	ELROSS CREEK	GOODREAM CREEK
MAX	1.59	1.08	N/A
MIN	1.42	1.02	
MEAN	1.52	1.06	
MEDIAN	1.52	1.05	

Figure 9: Hourly Stage Level (m) at Joan Brook and Elross Creek and precipitation data from Schefferville Int Airport and Joan Brook tipping bucket.

CONCLUSIONS

Deployment

- Considering the age-related concerns and maintenance issues linked with the Hydrolab DS5 instrumentation, four (4) YSI EXO3 sondes were procured, configured and calibrated for Elross Creek and Joan Brook. The additional sondes were used for Qa/Qc and a spare. The purchasing of additional instrumentation has been discussed in order to ensure uninterrupted water quality monitoring throughout the deployment period.
- Water quality monitoring instruments were deployed at established stations near the Elross Lake and DSO4 Project 2B, Iron Ore Mine, between June 18th and August 14th, 2024. The instruments at Elross Creek and Joan Brook were deployed for a total of 58 days, while Goodream Creek was deployed for 133 days.
- Goodream Creek Station 2km Northwest of Timmons 6 has been relocated downstream, near Triangle Lake. WRMD will complete this relocation early in the 2025 field season, aiming for full operational readiness at the new site in June 2025. Additionally, during the 2024 season, a Hydrolab DS5X instrument was deployed at the new station location downstream nearer to Triangle Lake, utilizing internal data logging for subsequent statistical analysis and interpretation. These actions represent significant steps towards enhancing monitoring capabilities and ensuring the reliability of data for informed decision-making in water resource management.
- It was necessary to remove instrumentation from both Elross Creek Station and Joan Brook Station on August 14, 2024, due to low water levels preventing the proper operation and monitoring of instrumentation. There were some issues with timing of deployments and grab sample collection, however, the overall QAQC result comparisons indicated the instruments functioned well during the season.
- Continued hydrometric monitoring over the next season is necessary to help determine if station relocation will be required to maintain adequate water levels.

Data Interpretation

- The comprehensive analysis of water temperature data from Elross Creek, Joan Brook, and Goodream Creek underscores the critical role of temperature in shaping aquatic ecosystems. The distinct seasonal patterns observed across all three rivers highlight their unique thermal characteristics, with Elross Creek, on average, warmer, Joan Brook exhibiting intermediate temperatures, and Goodream Creek maintaining cooler conditions. Further examination of minimum and maximum temperatures reveals variations in thermal extremes, indicating differential heating and cooling dynamics among the water bodies. Additionally, the significant diurnal fluctuations, particularly pronounced in Joan Brook, emphasize the influence of local factors such as water depth and vegetation cover on temperature variability.

- pH data analysis reveals distinct water quality profiles for each river. Joan Brook consistently maintains a stable pH range around neutral to slightly acidic levels throughout the monitoring period, indicative of relatively stable conditions for aquatic life. Conversely, Elross Creek exhibits slightly lower pH values, consistently falling below the recommended guidelines for freshwater ecosystems, suggesting potential concerns for aquatic organisms. Goodream Creek stands out with consistently higher pH values, indicating a wider range of values and neutral to slightly alkaline conditions, also within the acceptable range for aquatic life protection. The observed variations in pH levels among the rivers may be influenced by a combination of factors including geological characteristics, land use practices, and proximity to mining activities within the TSMC mine area. Monitoring and addressing pH fluctuations in Elross Creek are essential to ensure the long-term health and sustainability of the aquatic ecosystem in the region.

- Specific conductivity data analysis highlights distinct water quality characteristics within the monitoring period. Joan Brook consistently demonstrates low specific conductance and total dissolved solids (TDS) values, indicating good water quality with minimal contamination. Elross Creek exhibits slightly lower average specific conductance and TDS values compared to Joan Brook, potentially influenced by local geological conditions. Conversely, Goodream Creek shows the highest specific conductance, suggesting a higher concentration of dissolved ions and minerals, possibly influenced by runoff or watershed activities. Diurnal fluctuations in conductivity levels are evident across all stations, reflecting the dynamic nature of shallow water bodies. While no consistent trend in conductivity changes is observed, fluctuations likely result from environmental factors such as temperature, precipitation, and human activities. Overall, the low specific conductivity and TDS levels across the three water bodies indicate high water purity and minimal contamination.

- Dissolved oxygen (DO) data analysis reveals variability in oxygen levels within Joan Brook, Elross Creek, and Goodream Creek, with relatively stable median and mean concentrations. Available data for Joan Brook suggests favorable oxygen levels across the monitored period. Elross Creek exhibits slightly lower DO concentrations compared to Joan Brook, while Goodream Creek demonstrates similar levels, reflecting overall ecosystem health. The increase in DO levels from June to October corresponds to decreasing water temperatures, aligning with the natural solubility of oxygen in colder water. Importantly, DO levels remained consistently above Canadian Council of Ministers of the Environment (CCME) guidelines for aquatic life protection throughout most of the deployment period. Diurnal variations in DO levels are evident, influenced by factors such as temperature ranges and rates of photosynthesis and respiration, with a decrease in variability during the summer-fall season. This highlights the importance of continued monitoring and management to sustain the health and integrity of these freshwater ecosystems.

- The analysis of turbidity data for Elross Creek, Joan Lake, and Goodream Creek indicates generally minimal turbidity levels with sporadic instances of elevated readings, particularly in August and October. Despite some fluctuations, all three locations consistently maintained relatively low turbidity levels throughout the observation period, suggesting good water quality conditions in these freshwater ecosystems as historically observed. The occasional spikes in turbidity, such as the temporary increase recorded in Joan Lake in August, may be attributed to external factors like rainfall, erosion, or runoff events.

- Stage measurements for Joan Brook and Elross Creek indicate relatively consistent decreasing patterns, with total depletion observed in Joan Brook and near depletion of Elross Creek. The absence of stage data for Goodream Creek limits comprehensive comparisons across all three sites, highlighting potential shifts in monitoring priorities or operational changes within the mine site. Fluctuations in stage correspond well with rainfall events, suggesting a direct influence of precipitation on water levels in these freshwater rivers.

- The Joan Brook tipping bucket, installed in 2023, proved to be effective in identifying short-term fluctuations in precipitation, which are crucial for real-time water quality assessments.

PATH FORWARD

- ECC – WRMD will assume responsibility from WSC for hydrometric monitoring and maintenance of all three (3) stations in 2025.
- ECC staff will redeploy RTWQ instruments at Elross Creek, Joan Brook and Goodream Creek in the spring of 2025, when ice conditions allow. The field season, typically June to October will consist of one (1) deployment contingent on instrument and sensor functionality, and ECC staff with the assistance of TSMC staff will perform regular maintenance of the instruments to ensure continuous accurate data collection and transmission.
- ECC staff will continue to work co-operatively with TSMC staff to co-ordinate the installation of all required instrumentation and equipment at the new Goodream Creek Station location further downstream on Goodream Creek above Triangle Lake.
- ECC staff will continue to rely on input and assistance from TSMC staff in the operation and maintenance of all three TSMC Real Time Water Quality stations at Elross Creek, Goodream Creek and Joan Brook. Every effort will be made to coordinate in advance with TSMC staff for site visits during the 2025 field season. ECC staff are very appreciative of the field assistance provided by TSMC staff during the 2024 field season and are hoping to carry on with this arrangement again next year if necessary to maintain network operations.
- If necessary, deployment techniques will be evaluated and adapted to each site, ensuring secure and suitable conditions for RTWQ monitoring.
- ECC staff will update TSMC staff on any changes to processes and procedures with handling, maintaining, and calibrating the real-time instruments.
- ECCC staff will perform regular site visits to ensure water quantity instrumentation is correctly calibrated and providing accurate measurements.
- TSMC will continue to be informed of data trends and any significant water quality events in the form of email and/or monthly deployment reports, when the deployment season begins. TSMC will also receive an annual report, summarizing the events of the deployment season.
- ECC has begun development of models using water quality monitoring data and grab sample data to estimate a variety of additional water quality parameters (e.g., TSS and major ions). This work will continue with a goal in implementing these models for RTWQ data collected.

- ECC will continue to work on its Automatic Data Retrieval System, to incorporate new capabilities in data management and data display.
- ECC will be active in creating new value-added products using the RTWQ data and water quality indices.
- Open communication will continue to be maintained between ECC and TSMC employees involved with the agreement, in order to respond to emerging issues on a proactive basis.

APPENDIX A - Quality Assurance / Quality Control Procedures

As part of the Quality Assurance / Quality Control (QA/QC) protocol, the performance of a station's water quality instrument (i.e., Field Sonde) is rated at the start and end of its deployment period. The procedure is based on the approach used by the United States Geological Survey (Wagner *et al.* 2006)[1].

At the start of the deployment period, a fully cleaned and calibrated QA/QC water quality instrument (i.e., QA/QC Sonde) is placed *in-situ* with the fully cleaned and calibrated Field Sonde. After Sonde readings have stabilized, which may take up to five minutes in some cases, water quality parameters, as measured by both sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde. If the readings from both sondes are in close agreement, the QA/QC Sonde can be removed from the water. If the readings are not in close agreement, there will be attempts to reconcile the problem on site (e.g., removing air bubbles from sensors, etc.). If no fix is made, the Field Sonde may be removed for recalibration.

At the end of the deployment period, a fully cleaned and calibrated QA/QC Sonde is once again deployed *in-situ* with the Field Sonde, which has already been deployment for 30-40 days. After Sonde readings have stabilized, water quality parameters, as measured by both sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde.

Performance ratings are based on differences listed in the table below.

	Rating				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (°C)	≤ ±0.2	> ±0.2 to 0.5	> ±0.5 to 0.8	> ±0.8 to 1	> ±1
pH (unit)	≤ ±0.2	> ±0.2 to 0.5	> ±0.5 to 0.8	> ±0.8 to 1	> ±1
Sp. Conductance ≤ 35 (µS/cm)	≤ ±3	> ±3 to 10	> ±10 to 15	> ±15 to 20	> ±20
Sp. Conductance > 35 (µS/cm)	≤ ±3	> ±3 to 10	> ±10 to 15	> ±15 to 20	> ±20
Dissolved Oxygen (mg/l)	≤ ±0.3	> ±0.3 to 0.5	> ±0.5 to 0.8	> ±0.8 to 1	> ±1
Turbidity ≤ 40 NTU (NTU)	≤ ±2	> ±2 to 5	> ±5 to 8	> ±8 to 10	> ±10
Turbidity > 40 NTU (NTU)	≤ ±5	> ±5 to 10	> ±10 to 15	> ±15 to 20	> ±20

[1] Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at *http://pubs.water.usgs.gov/tm1d3*

APPENDIX B - Water Parameter Description

Dissolved Oxygen - The amount of Dissolved Oxygen (DO) (mg/l) in the water is vital to aquatic organisms for their survival. The concentration of DO is affected by such things as water temperature, water depth and flow (e.g., aeration by rapids, riffles etc.), consumption by aerobic organisms, consumption by inorganic chemical reactions, consumption by plants during darkness, and production by plants during the daylight (Allan 2010).

pH - pH is the measure of hydrogen ion activity and affects: (i) the availability of nutrients to aquatic life; (ii) the concentration of biochemical substances dissolved in water; (iii) the efficiency of hemoglobin in the blood of vertebrates; and (iv) the toxicity of pollutants. Changes in pH can be attributed to industrial effluence, saline inflows or aquatic organisms involved in the photosynthetic cycling of CO_2 (Allan 2010).

Specific conductivity - Specific conductivity (µS/cm) is a measure of water's ability to conduct electricity, with values normalized to a water temperature of 25ºC. Specific conductance indicates the concentration of dissolved solids (such as salts) in the water, which can affect the growth and reproduction of aquatic life. Specific conductivity is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Allan 2010; Swanson and Baldwin 1965).

Stage – Stage (m) is the elevation of the water surface and is often used as a surrogate for the more difficult to measure flow.

Temperature - Essential to the measurement of most water quality parameters, temperature (^oC) controls most processes and dynamics of limnology. Water temperature is influenced by such things as ambient air temperature, solar radiation, meteorological events, industrial effluence, wastewater, inflowing tributaries, as well as water body size and depth (Allan 2010; Hach 2006).

Total Dissolved Solids - Total Dissolved Solids (TDS) (g/l) is a measure of alkaline salts dissolved in water or in fine suspension and can affect the growth and reproduction of aquatic life. It is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Allan 2010; Swanson and Baldwin 1965).

Turbidity - Turbidity (NTU) is a measure of the translucence of water and indicates the amount of suspended material in the water. Turbidity is caused by any substance that makes water cloudy (e.g., soil erosion, micro-organisms, vegetation, chemicals, etc.) and can correspond to precipitation events, high stage, and floating debris near the sensor (Allan 2010; Hach 2006; Swanson and Baldwin 1965.

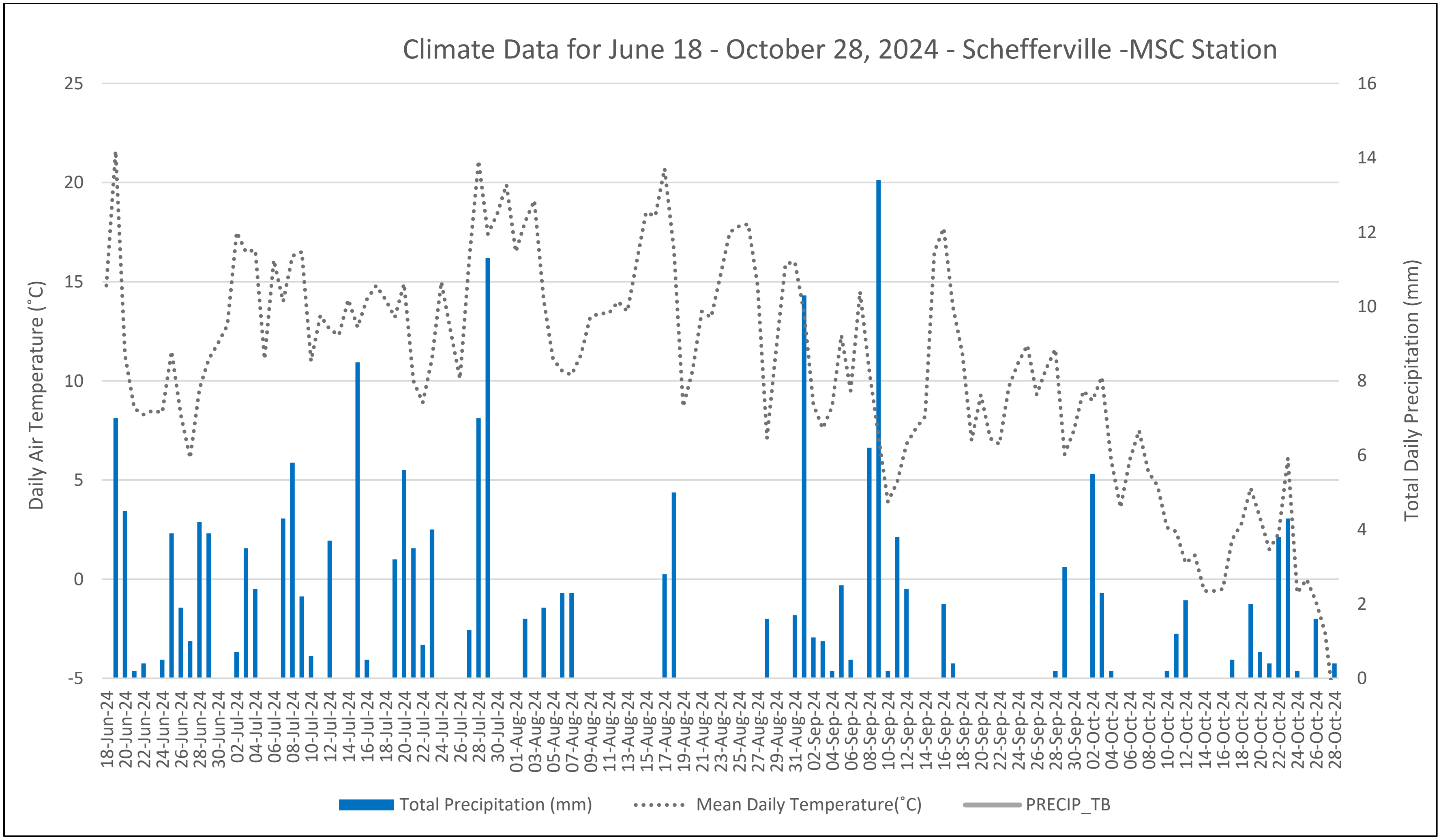
Important Terminology

ADRS – Automated Data Retrieval System: A database management system designed to collect data from a variety of telemetry sources such as GOES, Iridium, and cell network in order to populate a database of all water quality, hydrometric, and climate systems in the province. The system is also responsible for generating graphs for public consumption amongst other operations.

Field Sonde: The multi-parameter water quality monitoring device deployed as per recommended protocols.

QAQC Sonde: The multi-parameter water quality monitoring device cleaned and recalibrated before each field visit, to be used as an unfouled data source for comparison to the Field Sonde.

APPENDIX C – Daily Air Temperature & Total Precipitation from Nav Canada Station: Schefferville - 7117823



APPENDIX D - QA/QC Grab Sample Results

Your P.O. #: 220028978-13
Site Location: TATA MINE SITE
Your C.O.C. #: N/A

Attention: Robert Richard Harvey

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
St. John's, NL
CANADA A1B 4J6

Report Date: 2024/07/16
Report #: R8236036
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4J9546
Received: 2024/07/02, 08:52

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	1	N/A	2024/07/10	ATL SOP 00142	SM 24 2320 B
Alkalinity	2	N/A	2024/07/11	ATL SOP 00142	SM 24 2320 B
Anions (1)	2	N/A	2024/07/04	CAM SOP-00435	SM 23 4110 B m
Anions (1)	1	N/A	2024/07/05	CAM SOP-00435	SM 23 4110 B m
Colour	2	N/A	2024/07/10	ATL SOP 00020	SM 24 2120C m
Colour	1	N/A	2024/07/15	ATL SOP 00020	SM 24 2120C m
Organic carbon - Diss (DOC) (2)	3	N/A	2024/07/10	ATL SOP 00203	SM 24 5310B m
Conductance - water	1	N/A	2024/07/10	ATL SOP 00004	SM 24 2510B m
Conductance - water	1	N/A	2024/07/11	ATL SOP 00004	SM 24 2510B m
Conductance - water	1	N/A	2024/07/15	ATL SOP 00004	SM 24 2510B m
Fluoride	1	N/A	2024/07/10	ATL SOP 00043	SM 24 4500-F- C m
Fluoride	2	N/A	2024/07/11	ATL SOP 00043	SM 24 4500-F- C m
Hardness (calculated as CaCO3)	3	N/A	2024/07/10	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	3	2024/07/11	2024/07/12	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	1	2024/07/10	2024/07/10	ATL SOP 00058	EPA 6020B R2 m
Metals Water Total MS	2	2024/07/09	2024/07/09	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	3	N/A	2024/07/11	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	2	N/A	2024/07/10	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrate + Nitrite	1	N/A	2024/07/15	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	2	N/A	2024/07/10	ATL SOP 00017	SM 24 4500-NO2- B m
Nitrogen - Nitrite	1	N/A	2024/07/15	ATL SOP 00017	SM 24 4500-NO2- B m
Nitrogen - Nitrate (as N)	2	N/A	2024/07/11	ATL SOP 00018	ASTM D3867-16
Nitrogen - Nitrate (as N)	1	N/A	2024/07/15	ATL SOP 00018	ASTM D3867-16
pH (3)	1	N/A	2024/07/10	ATL SOP 00003	SM 24 4500-H+ B m
pH (3)	2	N/A	2024/07/11	ATL SOP 00003	SM 24 4500-H+ B m
Calculated TDS (DW Pkg)	1	N/A	2024/07/11	N/A	Auto Calc
Calculated TDS (DW Pkg)	2	N/A	2024/07/12	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	3	2024/07/05	2024/07/08	CAM SOP-00938	OMOE E3516 m
Organic carbon - Total (TOC) (2)	1	N/A	2024/07/03	ATL SOP 00203	SM 24 5310B m
Organic carbon - Total (TOC) (2)	2	N/A	2024/07/04	ATL SOP 00203	SM 24 5310B m
Total Phosphorus (Colourimetric) (1)	3	2024/07/05	2024/07/09	CAM SOP-00407	SM 24 4500-P I

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Your P.O. #: 220028978-13
Site Location: TATA MINE SITE
Your C.O.C. #: N/A

Attention: Robert Richard Harvey

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
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CANADA A1B 4J6

Report Date: 2024/07/16
Report #: R8236036
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4J9546
Received: 2024/07/02, 08:52

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Total Suspended Solids	3	2024/07/03	2024/07/04	ATL SOP 00007	SM 24 2540D m
Turbidity	3	N/A	2024/07/15	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.
(3) The APHA Standard Method requires pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Maryann Comeau, Customer Experience Supervisor/PM
Email: Maryann.COMEAU@bureauveritas.com
Phone# (902)420-0203 Ext:298
==
This report has been generated and distributed using a secure automated process.
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Bureau Veritas Job #: C4J9546
Report Date: 2024/07/16

NL Department of Environment, Climate Change and Municipalities
Site Location: TATA MINE SITE
Your P.O. #: 220028978-13
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZPK832 ELROSS CREEK BELOW PINETTE LAKE INFLOW								
Sampling Date 2024/06/18 15:16								
Matrix W								
Sample # 2024-1707-00-SI-SP								
Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	21	1.0	mg/L	N/A	2024/07/10		9489077
Nitrate (N)	-	0.15	0.050	mg/L	N/A	2024/07/15		9489079
Total dissolved solids (calc., EC)	-	24	1.0	mg/L	N/A	2024/07/12		9489083
Inorganics								
Conductivity	-	44	1.0	uS/cm	N/A	2024/07/11	LJV	9508580
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2024/07/04	VP2	9495448
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/07/04	VP2	9495448
Sulphate (SO4)	-	2.6	1.0	mg/L	N/A	2024/07/04	VP2	9495448
Total Alkalinity (Total as CaCO3)	-	18	2.0	mg/L	N/A	2024/07/11	LJV	9508586
Colour	-	ND	5.0	TCU	N/A	2024/07/15	EMT	9510724
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2024/07/11	LJV	9508587
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/07/05	2024/07/08	KJP	9497463
Nitrate + Nitrite (N)	-	0.15	0.050	mg/L	N/A	2024/07/15	EMT	9510735
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/07/15	MCN	9510743
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507879
Dissolved Organic Carbon (C)	-	0.63	0.50	mg/L	N/A	2024/07/10	MKY	9504862
Total Organic Carbon (C)	-	0.79	0.50	mg/L	N/A	2024/07/04	MKY	9491403
pH	-	7.43		pH	N/A	2024/07/11	LJV	9508568
Total Phosphorus	-	ND	0.004	mg/L	2024/07/05	2024/07/09	VKH	9497484
Total Suspended Solids	-	ND	1.0	mg/L	2024/07/03	2024/07/04	DME	9491508
Turbidity	-	0.18	0.10	NTU	N/A	2024/07/15	LJV	9514232
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/11	2024/07/12	JEP	9507984
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.0051	0.0050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Barium (Ba)	-	0.0033	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Boron (B)	-	ND	0.050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Calcium (Ca)	-	3.9	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Copper (Cu)	-	ND	0.00050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Iron (Fe)	-	ND	0.050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Magnesium (Mg)	-	2.9	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703

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Bureau Veritas Job #: C4J9546
Report Date: 2024/07/16

NL Department of Environment, Climate Change and Municipalities
Site Location: TATA MINE SITE
Your P.O. #: 220028978-13
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZPK832 ELROSS CREEK BELOW PINETTE LAKE INFLOW Sampling Date 2024/06/18 15:16 Matrix W Sample # 2024-1707-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.0041	0.0020	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Potassium (K)	-	0.36	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Sodium (Na)	-	0.65	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Strontium (Sr)	-	0.0063	0.0020	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/09	2024/07/09	MTZ	9502703

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Bureau Veritas Job #: C4J9546
Report Date: 2024/07/16

NL Department of Environment, Climate Change and Municipalities
Site Location: TATA MINE SITE
Your P.O. #: 220028978-13
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZPK833 GOODREAM CREEK ABOVE TRIANGLE LAKE								
Sampling Date 2024/06/18 17:25								
Matrix W								
Sample # 2024-1708-00-SI-SP								
Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	2.0	1.0	mg/L	N/A	2024/07/10		9489077
Nitrate (N)	-	ND	0.050	mg/L	N/A	2024/07/11		9489079
Total dissolved solids (calc., EC)	-	4.2	1.0	mg/L	N/A	2024/07/12		9489083
Inorganics								
Conductivity	-	7.6	1.0	uS/cm	N/A	2024/07/15	M2C	9510729
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2024/07/04	VP2	9495448
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/07/04	VP2	9495448
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2024/07/04	VP2	9495448
Total Alkalinity (Total as CaCO3)	-	2.4	2.0	mg/L	N/A	2024/07/11	LJV	9508586
Colour	-	10	5.0	TCU	N/A	2024/07/10	EMT	9504843
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2024/07/11	LJV	9508587
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/07/05	2024/07/08	KJP	9497463
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2024/07/10	EMT	9504844
Nitrite (N)	-	0.016	0.010	mg/L	N/A	2024/07/10	EMT	9504845
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507881
Dissolved Organic Carbon (C)	-	1.3	0.50	mg/L	N/A	2024/07/10	MKY	9503143
Total Organic Carbon (C)	-	1.6	0.50	mg/L	N/A	2024/07/03	MKY	9491386
pH	-	6.51		pH	N/A	2024/07/11	LJV	9508568
Total Phosphorus	-	ND	0.004	mg/L	2024/07/05	2024/07/09	VKH	9497484
Total Suspended Solids	-	6.8	1.0	mg/L	2024/07/03	2024/07/04	DME	9491508
Turbidity	-	1.4	0.10	NTU	N/A	2024/07/15	LJV	9514222
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/11	2024/07/12	JEP	9507984
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.020	0.0050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Barium (Ba)	-	0.0011	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Boron (B)	-	ND	0.050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Calcium (Ca)	-	0.37	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Copper (Cu)	-	ND	0.00050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Iron (Fe)	-	ND	0.050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Magnesium (Mg)	-	0.27	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703

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Bureau Veritas Job #: C4J9546
Report Date: 2024/07/16

NL Department of Environment, Climate Change and Municipalities
Site Location: TATA MINE SITE
Your P.O. #: 220028978-13
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZPK833 GOODREAM CREEK ABOVE TRIANGLE LAKE Sampling Date 2024/06/18 17:25 Matrix W Sample # 2024-1708-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.0020	0.0020	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Potassium (K)	-	ND	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Sodium (Na)	-	0.55	0.10	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Strontium (Sr)	-	0.0022	0.0020	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/09	2024/07/09	MTZ	9502703
Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/09	2024/07/09	MTZ	9502703

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Bureau Veritas Job #: C4J9546
Report Date: 2024/07/16

NL Department of Environment, Climate Change and Municipalities
Site Location: TATA MINE SITE
Your P.O. #: 220028978-13
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZPK834 JOAN BROOK @ OUTLET OF JOAN LAKE Sampling Date 2024/06/18 10:24 Matrix W Sample # 2024-1709-00-SI-SP Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	3.6	1.0	mg/L	N/A	2024/07/10		9489077
Nitrate (N)	-	0.065	0.050	mg/L	N/A	2024/07/11		9489079
Total dissolved solids (calc., EC)	-	5.3	1.0	mg/L	N/A	2024/07/11		9489083
Inorganics								
Conductivity	-	9.6	1.0	uS/cm	N/A	2024/07/10	LJV	9504869
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2024/07/05	LKH	9495951
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/07/05	LKH	9495951
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2024/07/05	LKH	9495951
Total Alkalinity (Total as CaCO3)	-	4.4	2.0	mg/L	N/A	2024/07/10	LJV	9504870
Colour	-	ND	5.0	TCU	N/A	2024/07/10	EMT	9504843
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2024/07/10	LJV	9504871
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/07/05	2024/07/08	KJP	9497463
Nitrate + Nitrite (N)	-	0.065	0.050	mg/L	N/A	2024/07/10	EMT	9504844
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/07/10	EMT	9504845
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507881
Dissolved Organic Carbon (C)	-	0.54	0.50	mg/L	N/A	2024/07/10	MKY	9504862
Total Organic Carbon (C)	-	0.51	0.50	mg/L	N/A	2024/07/04	MKY	9491403
pH	-	6.82		pH	N/A	2024/07/10	LJV	9504868
Total Phosphorus	-	ND	0.004	mg/L	2024/07/05	2024/07/09	VKH	9497484
Total Suspended Solids	-	ND	1.0	mg/L	2024/07/03	2024/07/04	DME	9491508
Turbidity	-	0.23	0.10	NTU	N/A	2024/07/15	LJV	9514232
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/11	2024/07/12	JEP	9507984
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	ND	0.0050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Aluminum (Al)	-	ND	0.0050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Barium (Ba)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Barium (Ba)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Boron (B)	-	ND	0.050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Boron (B)	-	ND	0.050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/07/10	2024/07/10	MTZ	9504873

Bureau Veritas Job #: C4J9546
Report Date: 2024/07/16

NL Department of Environment, Climate Change and Municipalities
Site Location: TATA MINE SITE
Your P.O. #: 220028978-13
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZPK834 JOAN BROOK @ OUTLET OF JOAN LAKE Sampling Date 2024/06/18 10:24 Matrix W Sample # 2024-1709-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Calcium (Ca)	-	0.68	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Calcium (Ca)	-	0.68	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Copper (Cu)	-	ND	0.00050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Copper (Cu)	-	ND	0.00050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Iron (Fe)	-	ND	0.050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Iron (Fe)	-	ND	0.050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Magnesium (Mg)	-	0.45	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Magnesium (Mg)	-	0.45	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Manganese (Mn)	-	ND	0.0020	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Manganese (Mn)	-	ND	0.0020	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Potassium (K)	-	0.12	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Potassium (K)	-	0.12	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Sodium (Na)	-	0.33	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Sodium (Na)	-	0.31	0.10	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Strontium (Sr)	-	0.0028	0.0020	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Strontium (Sr)	-	0.0030	0.0020	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/10	2024/07/10	MTZ	9504873
Dup.Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/10	2024/07/10	MTZ	9504873

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	6.0°C

Samples received and analyzed past the 7 day recommended holding time for TSS.

Sample ZPK833 [GOODREAM CREEK ABOVE TRIANGLE LAKE] : NOX < NO2 : Both values fall within the method uncertainty for duplicates and are likely equivalent.

Results relate only to the items tested.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Anastassia Hamanov, Scientific Specialist

Janah Rhyno, Scientific Specialist

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