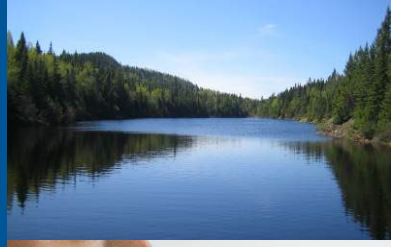
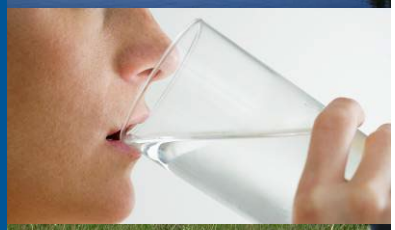



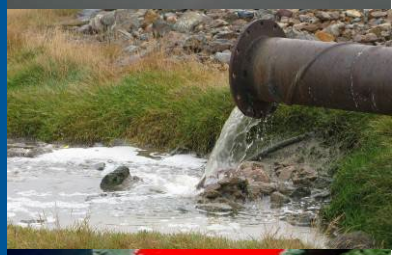


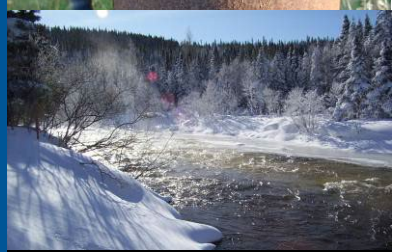

Real Time Water Quality Report

Tata Steel Minerals Canada

Elross Lake/Joan Brook Network

Deployment Period
2021-07-16 to 2021-09-08

Newfoundland Labrador

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

Prepared by:

Department of Environment & Climate Change
Water Resources Management Division

General

- The Water Resources Management Division (WRMD), in partnership with Tata Steel Minerals Canada Limited (TSMC) and Environment and Climate Change Canada (ECCC), maintains two real-time water quality and water quantity stations in close proximity to the Elross Lake Iron Ore Mine in western Labrador, near Schefferville, QC.
- The official name of each station is ELROSS CREEK BELOW PINETTE LAKE INFLOW and JOAN BROOK BELOW OUTLET OF JOAN LAKE, hereafter referred to as the *Elross Creek Station* and the *Joan Brook Station,* respectively.
- A third station, previously known as GOODREAM CREEK 2KM NORTHWEST OF TIMMINS 6, was removed in 2018 for relocation further downstream near Triangle Lake. In 2021, the station was still awaiting relocation by TSMC.
- Station sites were selected to monitor all surface water outflows from the Elross Lake and the DSO4 Project 2B mining sites. The Elross Creek Station is situated downstream of the Timmins 1 pit, and downstream of Pinette Lake. The original Goodream Creek Station served to monitor potential impacts from groundwater flowing from Timmins 6 pit into the surface water of Goodream Creek. The new Goodream Station will monitor impacts from the development of the Howse deposit. The Joan Brook station is downstream of the five pits (Kivivic 1, 2, 3N, 4 and 5) which are included in the DSO4 Project 2B mining operation.
- The Water Resources Management Division will inform Tata Steel Minerals Canada Limited of any significant water quality events by email notification and by monthly deployment reports.
- This monthly deployment report presents water quality and water quantity data recorded at the Elross Creek and Joan Brook stations from July 16th to September 8th, 2021, which was the third and final deployment period for the 2021 field season.
- Due to site access limitations due to the Covid-19 pandemic, instruments were shipped to TSMC via charter flight and installed at the stations by TSMC staff. Limited shipping options prevented collection of proper QA/QC grab samples. Stations were removed for the winter September 8th by WRMD staff via helicopter.
- The Elross Creek station suffered repeated animal damage in 2021. WSC replaced cables damaged by animals (likely squirrels) on June 2, July 8, and September 30. The September WSC maintenance trip installed new cabling in protective conduit to prevent further damage.

Quality Assurance / Quality Control

- Water quality instrument performance is tested at the beginning and end of its deployment period. The process is outlined in Appendix A.

- Instruments are assigned a performance ranking (i.e., poor, marginal, fair, good or excellent) for each water quality parameter measured.
- Table 1 shows the performance rankings of five water quality parameters (i.e., temperature, pH, specific conductivity, dissolved oxygen and turbidity) measured by instruments deployed at the water monitoring stations.
- With the exception of water quantity data (stage height), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Table 1: Water quality instrument performance at the beginning and end of deployment

	Elross Creek		Joan Brook	
Stage of deployment	Beginning	End	Beginning	End
Date	2021-7-16	2021-9-8	2021-7-15	2021-9-8
Temperature	NA	Excellent	NA	Excellent
pH	NA	Excellent	NA	Good
Specific Conductivity	NA	Excellent	NA	Excellent
Dissolved Oxygen	NA	Excellent	NA	Excellent
Turbidity	NA	Good	NA	Poor

- Sensor performance rankings were not obtained for the beginning of deployment.
- Instruments were removed by WRMD staff on September 8th. All removal rankings were 'Good' or 'Excellent' with the exception of turbidity at Joan Brook which ranked 'Poor'. The field sonde recorded 30.1NTU while the QAQC as 2.0NTU. Closer analysis of turbidity shows there may have been some sediment buildup around the sensor as this was a very long deployment.

Deployment Notes

- Water quality monitoring for this deployment period started on July 15th, 2021, at Joan Brook and July 16th, 2021 at Elross Creek.
- Elross Creek continued to experience issues with transmissions, so a logged file was used for water quality parameters for the majority of the deployment. Stage data is unavailable as it is not logged by the water quality instrument. Elross Creek also experience issues with the turbidity sensor due to power loss, thus data is limited.

Data Interpretation

- Data records were interpreted for each station during the deployment period for the following six parameters:

  (i.) Stage (m)
  (ii.) Temperature (°C)
  (iii.) pH
  (iv.) Specific conductivity (µS/cm)
  (v.) Dissolved oxygen (mg/l)
  (vi.) Turbidity (NTU)

Stage

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- Limited stage data is available for Elross Creek during this deployment due to transmission and equipment issues from animal damage (Figure 1). During the deployment period, stage values ranged from 1.12m to 1.17m at Elross Creek (limited data – Figure 1) and from 1.58m to 1.65 at Joan Brook (Figure 2).
- Both stations showed a downward trend in stage for the start of deployment and Joan Brook showed an upward trend for the second half of deployment.

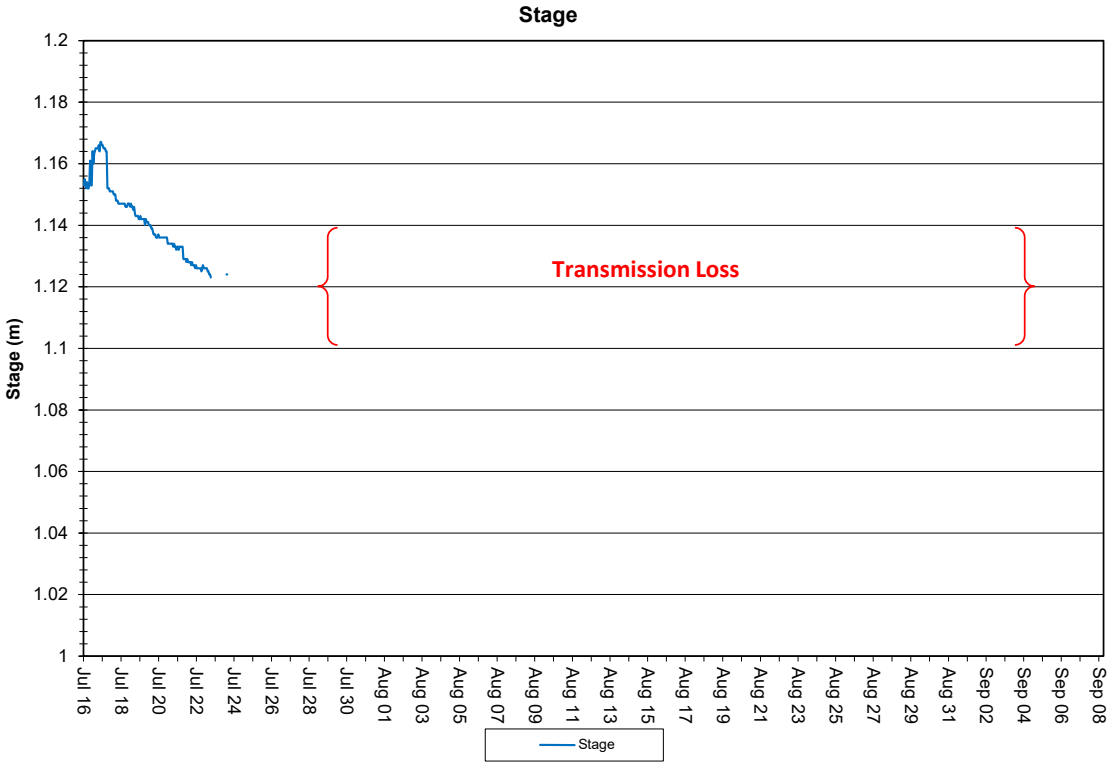

Figure 1: Stage at Elross Creek

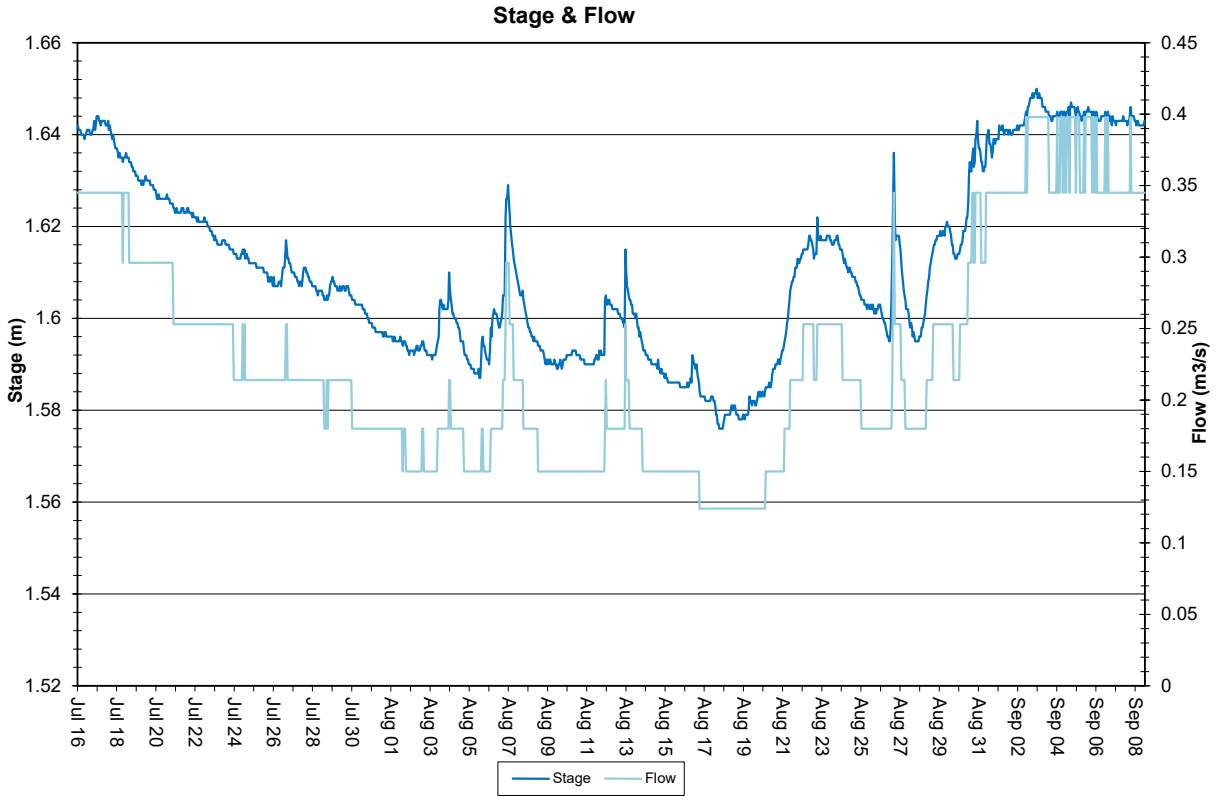

Figure 2: Stage & Flow at Joan Brook

Temperature

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period, water temperature ranged from 7.63˚C to 16.07˚C at Elross Creek and from 5.10˚C to 16.70˚C at Joan Brook (Figures 3-4).
- Both stations display noticeable diurnal variations, typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures.
- Temperatures at both stations were relatively stable throughout this long summer deployment. A slight decline in water temperature is noticeable at both stations late August onwards. This is typical as summer cools into fall.

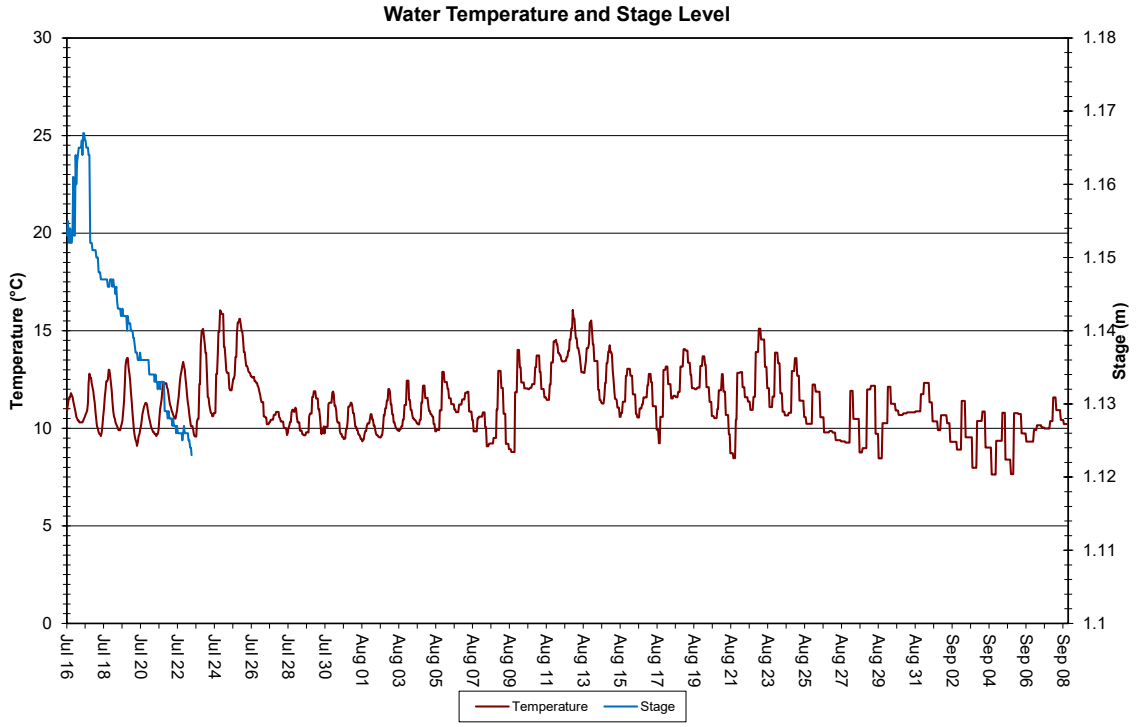

Figure 3: Water Temperature & Stage at Elross Creek

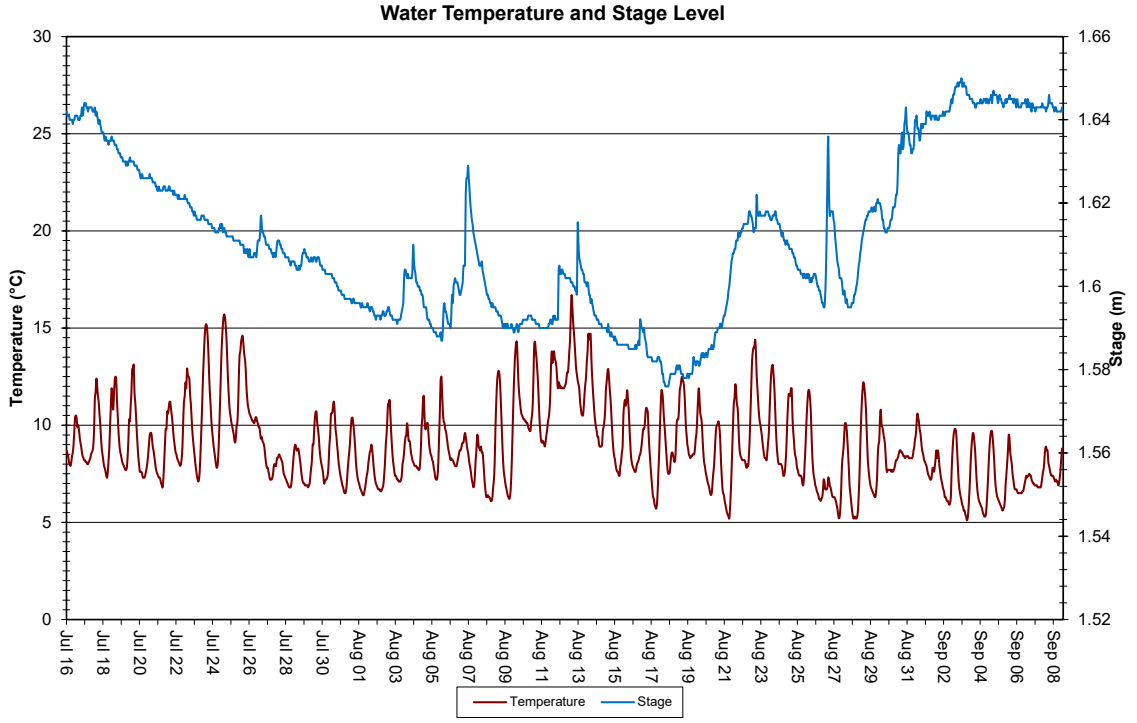

Figure 4: Water Temperature & Stage at Joan Brook

pH

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period, pH values ranged from 6.36 units to 6.94 units at Elross Creek and from 6.45 units to 6.89 units at Joan Brook (Figures 5-6).
- pH tends to show a diurnal trend which is related to the diurnal temperature trend. This diurnal trend is visible at both stations.
- pH appears to be relatively stable at both stations during this deployment period. A slight drop in pH at Elross Creek August 7th may be the result of precipitation as stage rose at Joan Brook at this time.
- pH values at both stations hovered around the guidelines set for the protection of aquatic life (i.e., 6.5 – 9.0 units), as defined by the Canadian Council of Ministers of the Environment (CCME) (2007). It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally below the 6.5 unit guideline.

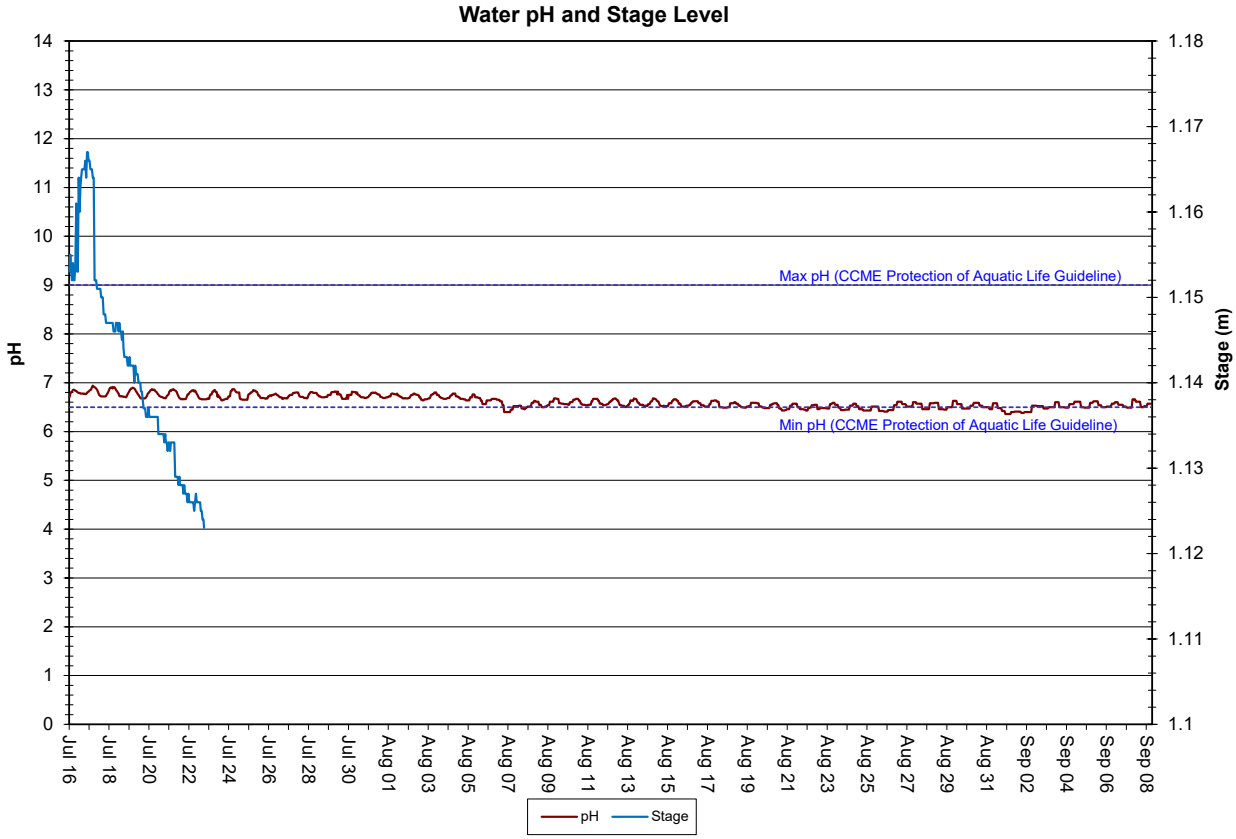

Figure 5: pH & Stage at Elross Creek

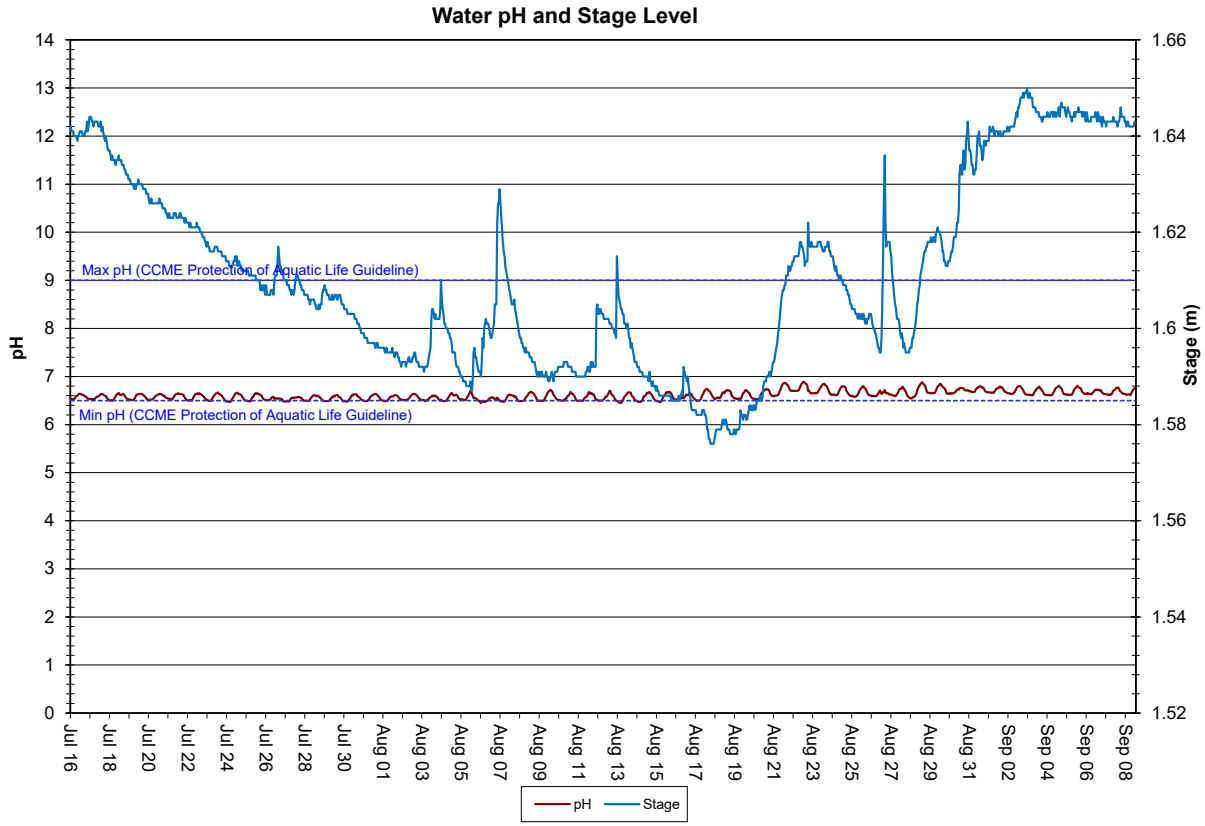

Figure 6: pH & Stage at Joan Brook

Specific Conductivity

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period, specific conductivity ranged from 17.0 µs/cm to 23.0 µs/cm at Elross Creek and from 7.6 µs/cm to 16.2 µs/cm at Joan Brook (Figures 7-8).
- Elross Creek exhibited a gradual decreasing conductivity trend over the deployment while Joan Brook was gradually increasing.
- Both stations exhibit the natural relationship between conductivity and stage values: as stage levels go up and more water is added to the system, conductivity decreases due to dilution and vice versa. Both stations were influenced by high stage levels from precipitation on August 7th, resulting in decreased conductivity for a short time (Figures 7-8). Other stage increases at Joan Brook increased the conductivity levels in the brook during the later portion of the deployment.

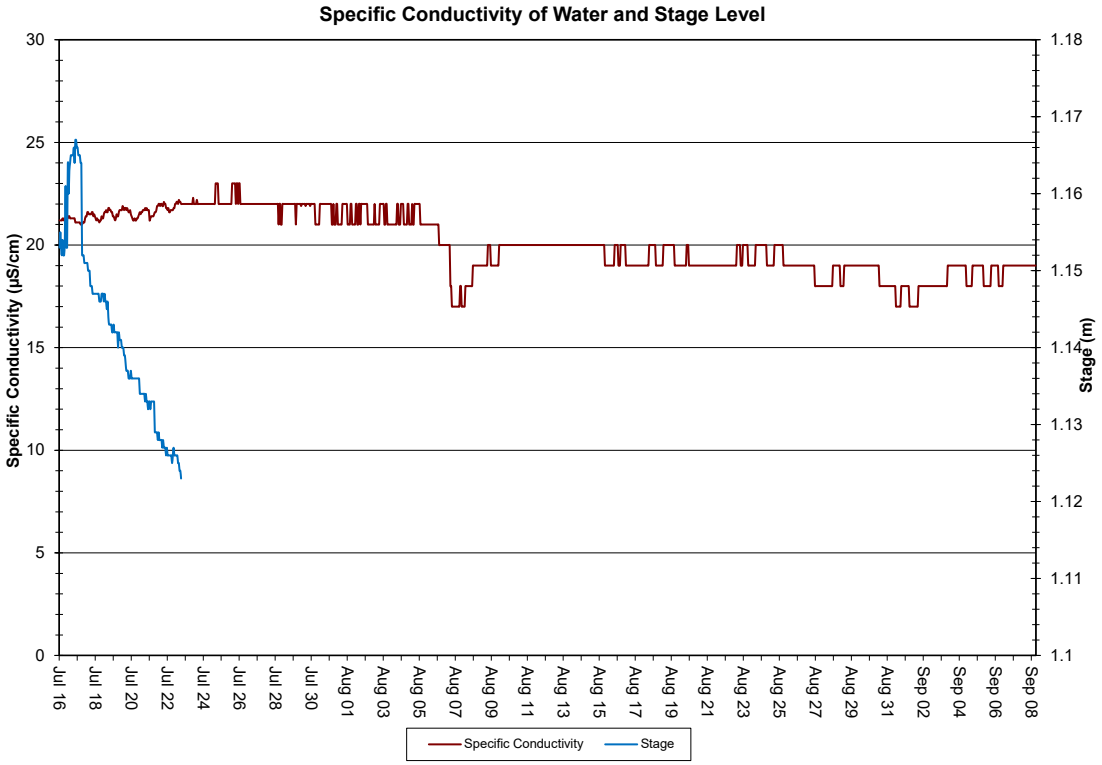

Figure 7: Specific Conductivity & Stage at Elross Creek

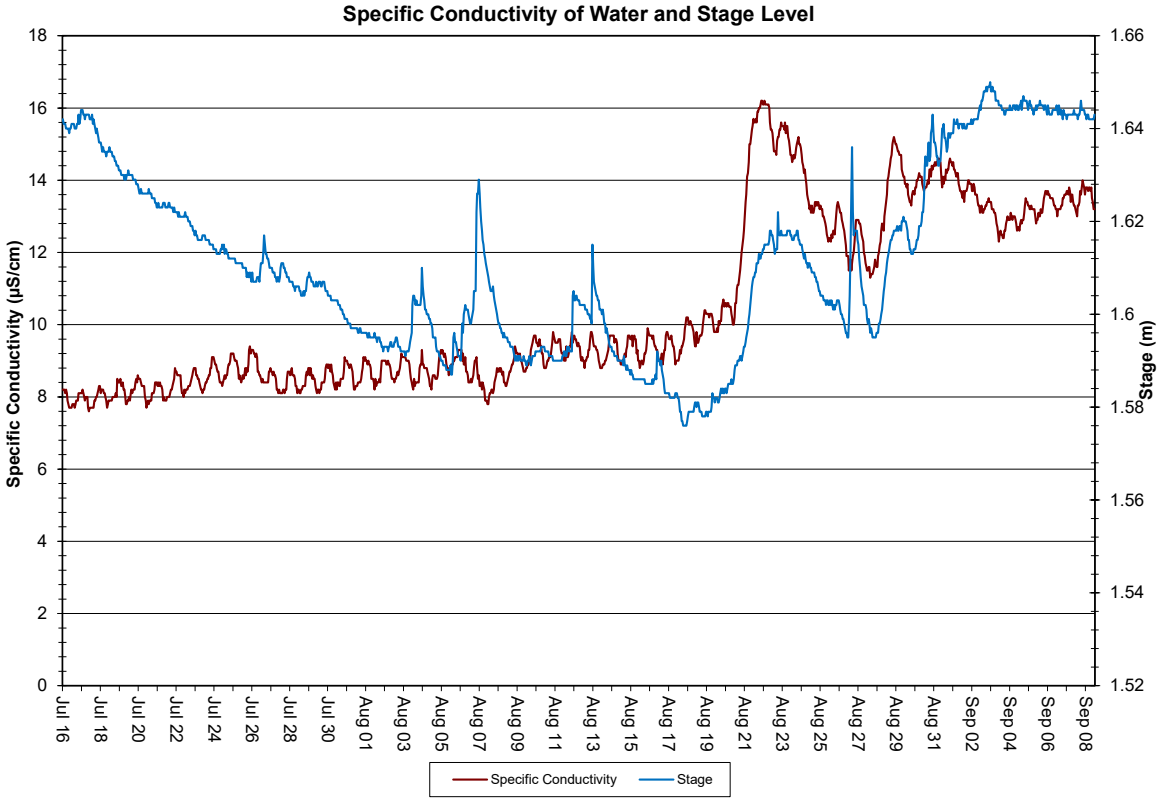

Figure 8: Specific Conductivity & Stage at Joan Brook

Dissolved Oxygen

- During the deployment period, dissolved oxygen (DO) values ranged from 8.05 mg/l (80.9% saturation) to 10.40 mg/l (89.0% saturation) at Elross Creek and from 8.53 mg/l (80.9% saturation) to 10.78 mg/l (90.1% saturation) at Joan Brook (Figures 9-10).
- DO at both stations was fluctuated in relation to the water temperature, but was relatively stable for this deployment. Both stations had a slight increasing trend near the end of deployment as temperatures cooled into fall. This is a natural relationship as cooler water can hold more dissolved oxygen.
- The DO values at Elross Creek and Joan Brook remained above the minimum guideline set for other life stages (6.5 mg/l) but hovered above and below the guideline for early life stages (9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

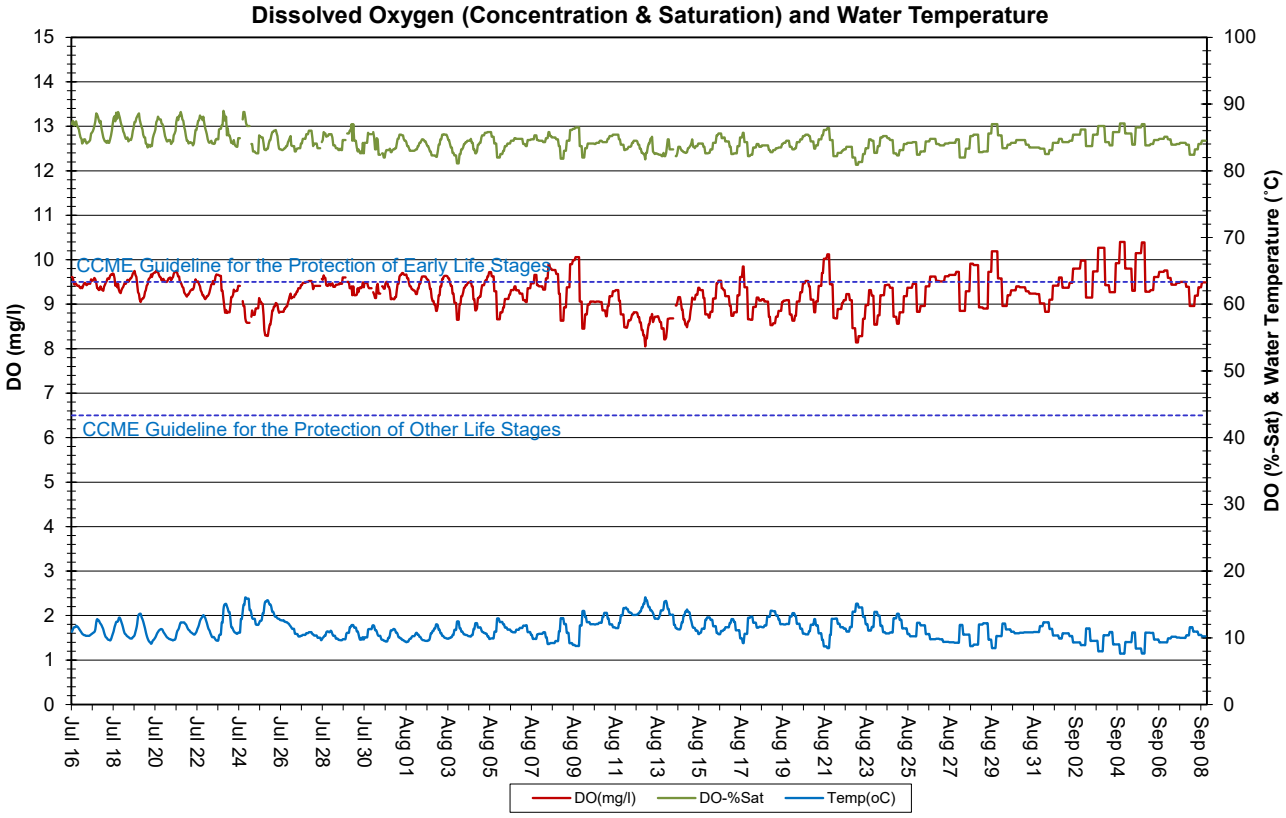

Figure 9: Dissolved Oxygen & Water Temperature at Elross Creek

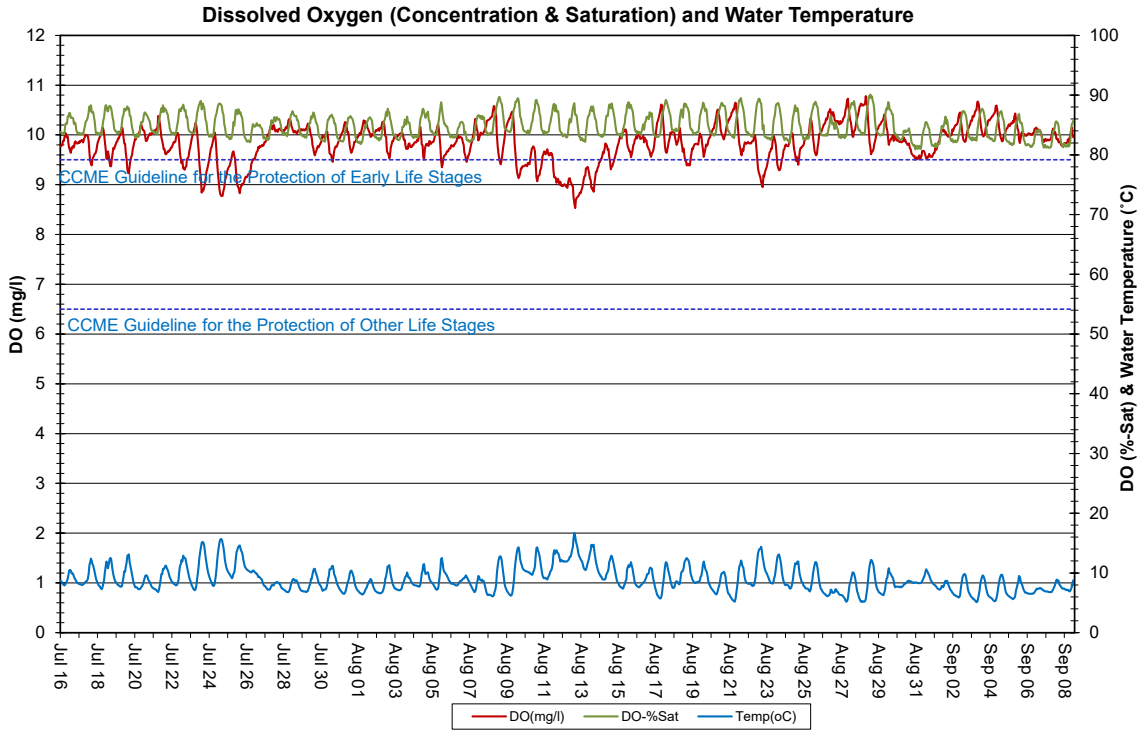

Figure 10: Dissolved Oxygen & Water Temperature at Joan Brook

Turbidity

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period, turbidity values ranged from 8.1 NTU to 179.8 NTU at Elross Creek and from 0.0 NTU to 2834.0 NTU at Joan Brook (Figures 11-12a/b). However, it should be noted that there is limited turbidity data for Elross Creek due to power issues with internal logging of the instrument.
- According to the available data, Elross Creek remained turbid during the first portion of the deployment (median 12.2NTU) but was less turbid than the previous deployments. Joan Brook, which normally records minimal turbidity, recorded a median of 20.4NTU (Figure 12b). This was likely due to sedimentation buildup around the sensor as the QAQC sonde upon removal recorded 2.0NTU but the field sonde recorded 30.1NTU.

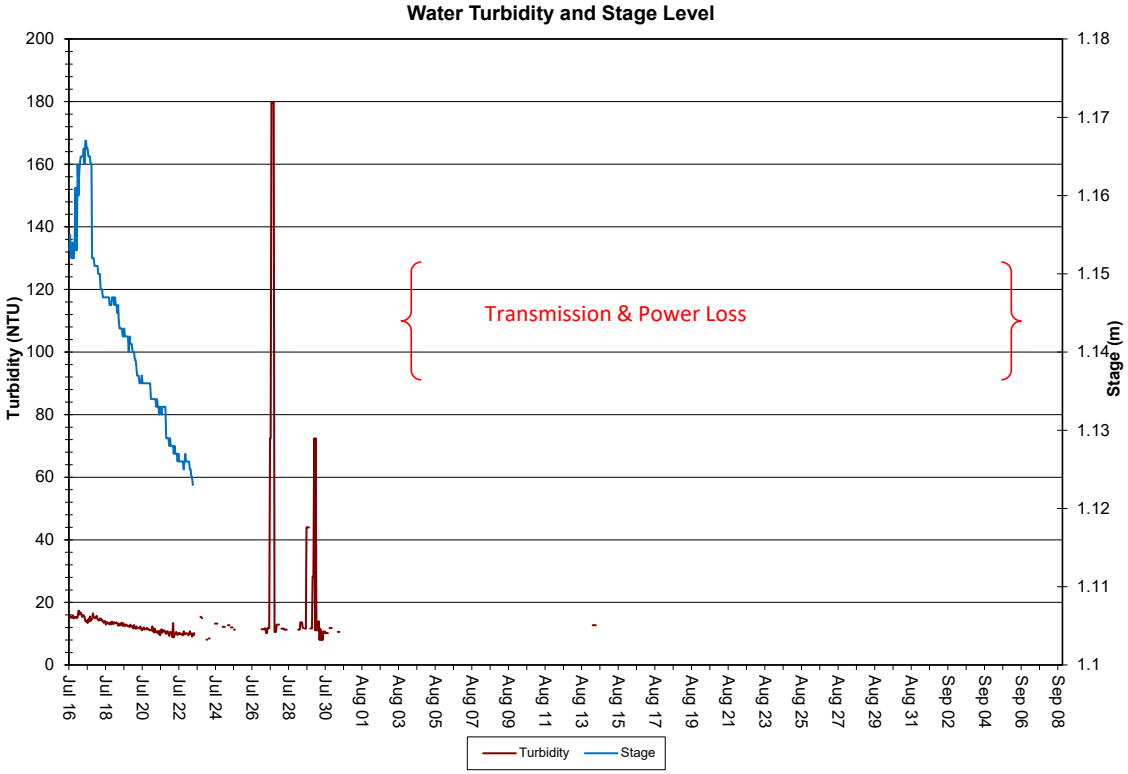

Figure 11: Turbidity & Stage at Elross Creek

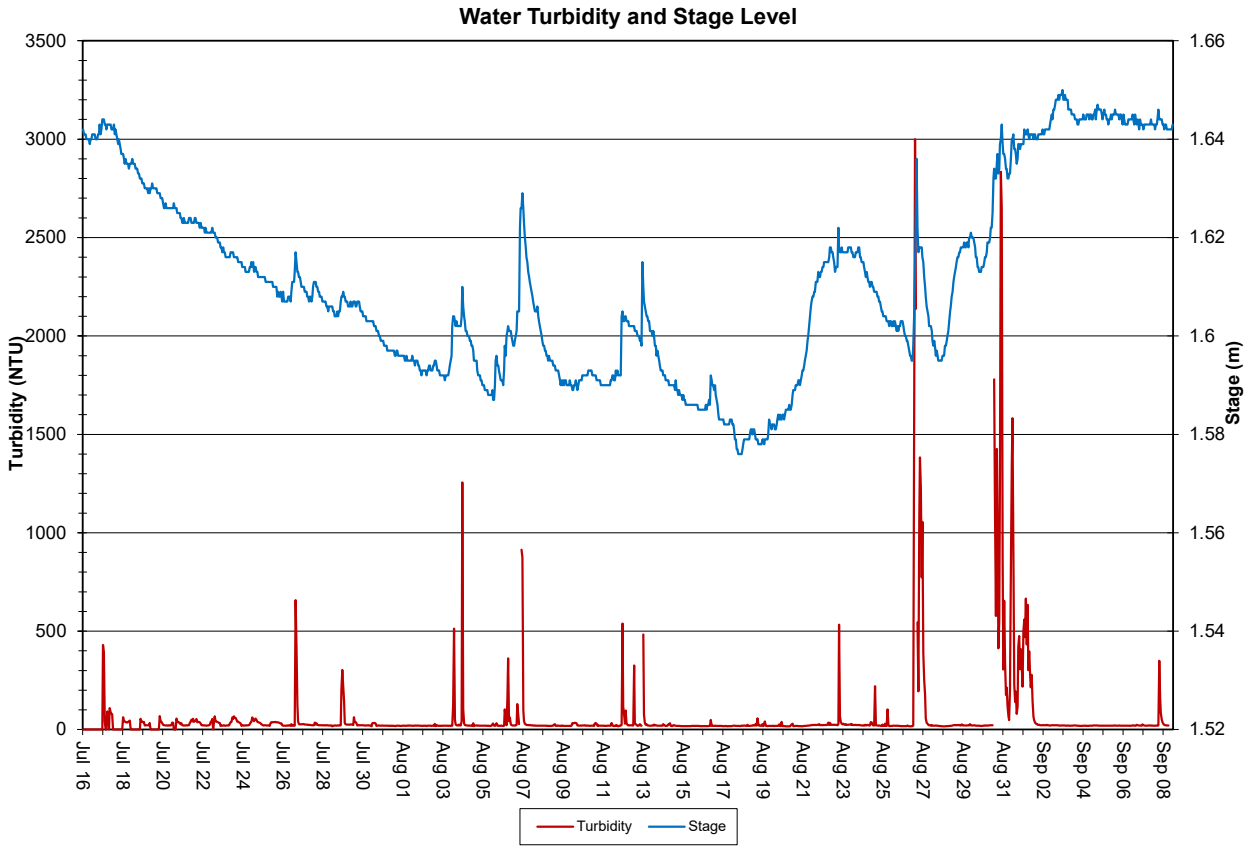

Figure 12a: Turbidity & Stage at Joan Brook

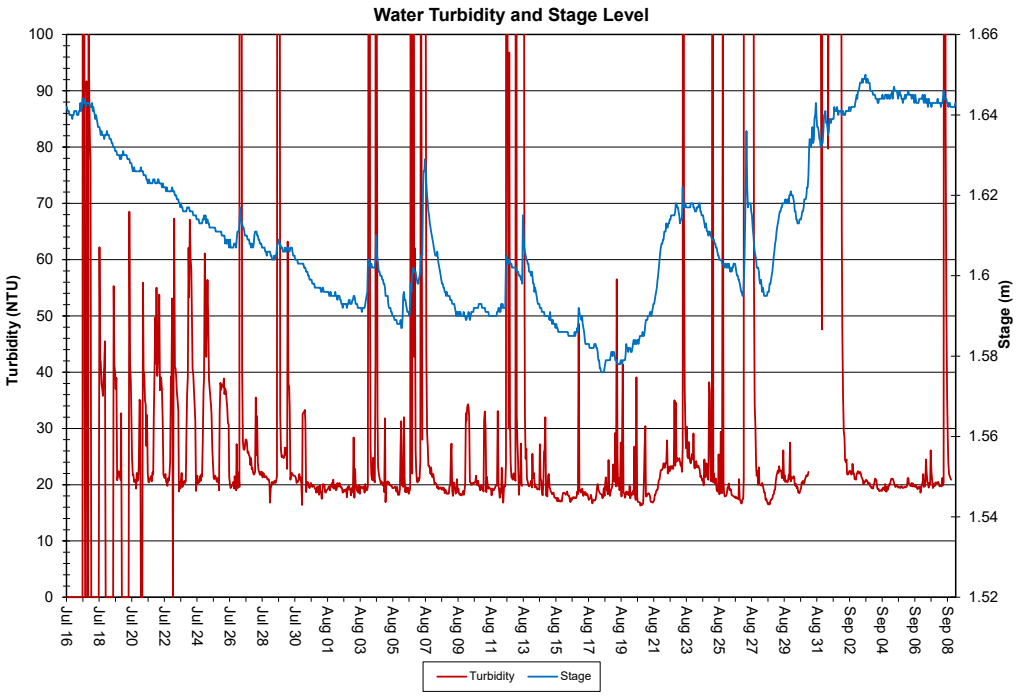

Figure 12b: Turbidity & Stage at Joan Brook

Conclusions

- This deployment report presents water quality and water quantity data recorded at the Elross Creek and Joan Brook real time monitoring stations from July 16th to September 8th, 2021. Is it notable that data from Elross Creek was limited due to continued issues with cabling damage at the station by animals.
- Field instruments for both stations performed well over the deployment period despite numerous transmission and power issues caused by animal-damaged cabling. The majority of data from Elross was from a logged file.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - At both stations, stage was typical for summer into early fall, decreasing early in the deployment. Stage at Joan increased during the second portion of deployment, likely related to fall precipitation events.
    - At both stations, temperature was relatively stable before starting to decline in late August, typical of the transition into fall.
    - pH values ranged from 6.36 units to 6.94 units at Elross Creek and from 6.45 units to 6.89 units at Joan Brook. pH was relatively stable at both stations, hovering around the recommended guidelines.
    - Specific conductivity ranged from 17.0 µs/cm to 23.0µs/cm at Elross Creek and from 7.6 µs/cm to 16.2 µs/cm at Joan Brook. Elross Creek exhibited a gradual decreasing trend over the deployment while Joan Brook was gradually increasing. Conductance at both stations was influenced by precipitation events.
    - Dissolved oxygen (DO) values ranged values ranged from 8.05 mg/l (80.9% saturation) to 10.40 mg/l (89.0% saturation) at Elross Creek and from 8.53 mg/l (80.9% saturation) to 10.78 mg/l (90.1% saturation) at Joan Brook. Both stations were relatively stable before increasing slightly near the end of deployment as water temperatures began to cool. Both were influenced by water temperature and hovered around the CCME guideline for all early life stages (9.5 mg/l).
    - Turbidity values ranged from 8.1 NTU to 179.8 NTU at Elross Creek and from 0.0 NTU to 2834 NTU at Joan Brook. At both locations, stage level increases caused spikes in turbidity. Higher than normal turbidity values at Joan Brook were likely due to accumulated sediment around the turbidity sensor.

References

Canadian Council of Ministers of the Environment. 27007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated December, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

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 beginning 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 beginning 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.

[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*

	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 (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) (% Sat)	≤ ±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 (%)	≤ ±5	> ±5 to 10	> ±10 to 15	> ±15 to 20	> ±20

APPENDIX B
Environment Canada Weather Data – Schefferville (July-August 2021)