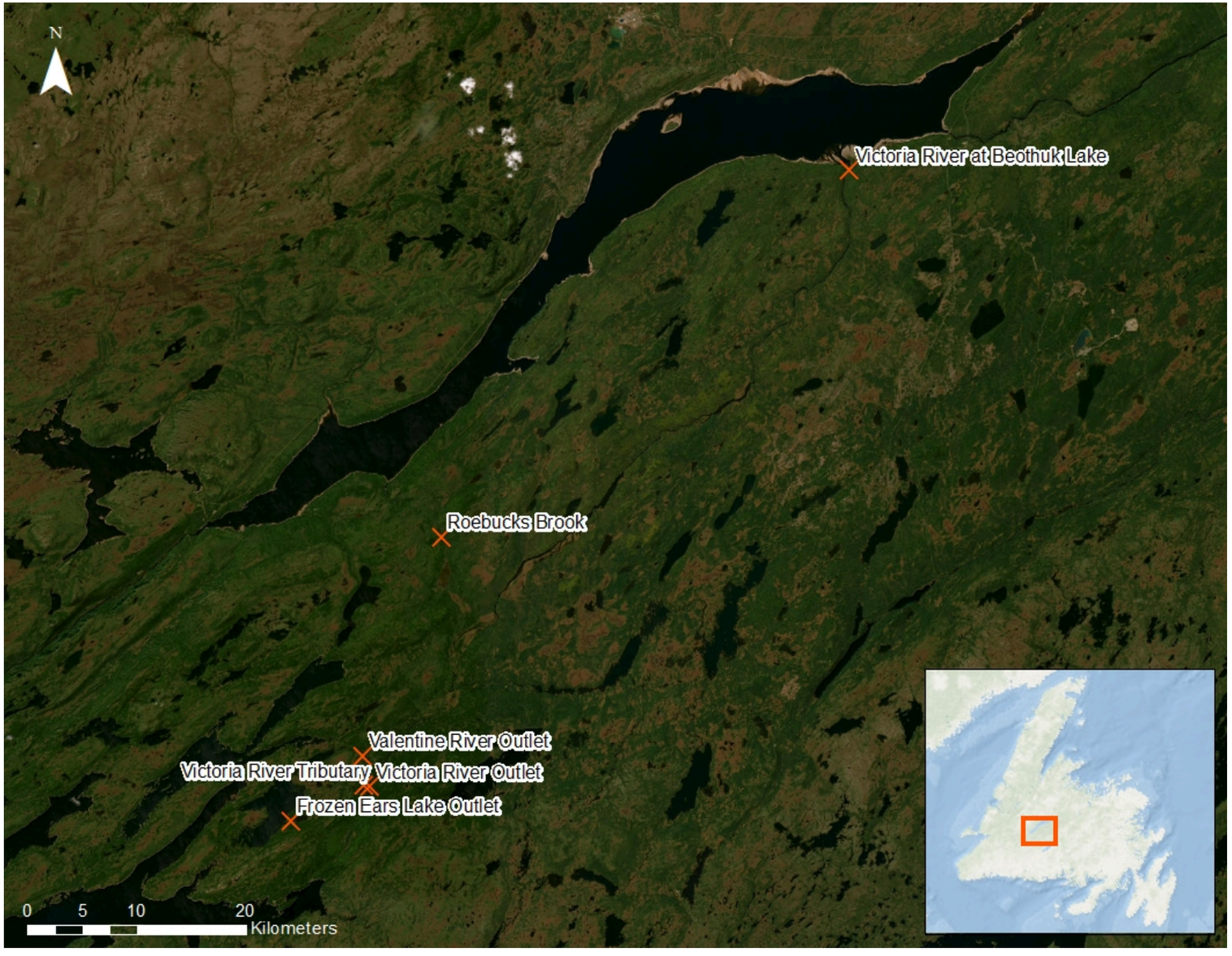
Real Time Water Quality Deployment Report
Calibre Mining: Valentine Gold Mine Network

2024-09-10 to 2024-10-10

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

Valentine Gold Mine Network



The Water Resources Management Division (WRMD), in collaboration with Calibre Mining (formerly Marathon Gold) maintain twelve real-time water quality (RTWQ) and water quantity monitoring stations. These stations are part of a real-time network designed to monitor, process, and share water quality and quantity data with both WRMD and Calibre Mining, supporting the evaluation and management of water resources. The network also provides early detection of potential or emerging water issues, allowing for prompt response and implementation of mitigation measures.

Six of these stations focus on surface water and will be addressed in this report. The remaining six stations are groundwater monitoring wells which are reported annually. The six surface water stations are located at Victoria River at Beothuk Lake, Roebucks Brook at Access Road, Valentine River Outlet, Victoria River Tributary, Victoria River Outlet, and Frozen Ears Outlet. Victoria River at Beothuk Lake and Frozen Ear Outlet are both new stations, installed on June 10, 2024, and June 11, 2024, respectively.

This report covers the monitoring period from 2024-09-10 to 2024-10-10.

Station Name	Station Number	Latitutde	Longitude
Frozen Ear Lake Outlet	NF02YN0052	48.39	-57.14
Victoria River Outlet	NF02YN0047	48.41	-57.07
Victoria River Tributary	NF02YN0050	48.41	-57.08
Valentine River Outlet	NF02YN0048	48.42	-57.08
Roebucks Brook	NF02YN0049	48.54	-57.01
Victoria River at Beothuk Lake	NF02YN0051	48.74	-56.68

Quality Assurance and Quality Control Procedures

As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey. With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

Parameter	Excellent	Good	Fair	Marginal	Poor
pH	≤ ± 0.2 units	≤ ± 0.21 - 0.5 units	≤ ± 0.51 - 0.8 units	≤ ± 0.81 - 1 units	> ± 1 units
Water Temperature	≤ ± 0.2°C	≤ ± 0.21 - 0.5°C	≤ ± 0.51 - 0.8°C	≤ ± 0.81 - 1°C	> ± 1°C
Dissolved oxygen	≤ ± 0.3 mg/L	≤ ± 0.31 -0.5 mg/L	≤ ± 0.51 - 0.8 mg/L	≤ ± 0.81 - 1 mg/L	> ± 1 mg/L
Turbidity	≤ ± 2 turbidity units or ≤ ± 5%, whichever is greater	≤ ± 2.1-5 turbidity units or ≤ ± 5.1-10 %, whichever is greater	≤ ± 5.1-8 turbidity units or ≤ ± 10.1-15 %, whichever is greater	≤ ± 8.1-10 turbidity units or ≤ ± 15.1-20 %, whichever is greater	> ± 10 turbidity units or > ± 20 %, whichever is greater
Specific Conductance	≤ ± 3 µS/cm or ≤ ± 3%, whichever is greater	≤ ± 3.1-10 µS/cm or ≤ ± 3.1-10%, whichever is greater	≤ ± 10 - 15 µS/cm or ≤ ± 10.1-15 %, whichever is greater	≤ ± 15.1 - 20 µS/cm or ≤ ± 15.1-20 %, whichever is greater	> ± 20 µS/cm or > ± 20 %, whichever is greater

At deployment and removal, a QA/QC Sonde is temporarily deployed adjacent to the Field Sonde. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments**.** Based on the degree of difference between parameters recorded by the Field Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality. There are a few circumstances which may cause QA/QC rankings below excellent, including the placement of the QA/QC sonde in relation to the field sonde, the amount of time each sonde was given to stabilize before readings were recorded, and deteriorating performance of one of the sensors.

The temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependent, temperature compensated, and temperature independent. Due to the temperature sensor's location on the sonde, the entire sonde must be at a constant temperature before the temperature sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is taken too soon it may not accurately portray the water body.

Additionally, grab samples are collected during deployment to compare pH, specific conductivity and turbidity values between the field instrument and grab samples. Variability in results may be attributed to differences in the sampling location or depth relative to the sonde's deployment site or insufficient equilibration time for the sonde when initial field data was collected.

Hydrometric Data

Water Resources Management Division hydrometric (stage and flow) data is quality controlled on a less frequent basis than water quality data due to differences in protocols. The hydrometric data shown in this report is provisional and has not undergone quality control checks.

QAQC

Deployment Rankings

At the time of deployment and removal, the rankings at each station all ranged between excellent to good for each parameter indicating minimal differences between field sonde measurements and QAQC sonde measurements.

Grab sample rankings ranged between excellent to good, except for pH at Victoria River Outlet and Roebucks Brook which ranked fair. The fair ranking is likely a result of differences in the sampling location/depth compared to the field sonde or insufficient equilibration time for the field sonde before taking initial measurements.

QAQC Rankings

Station	Parameter	Deployment Rank	Grab Sample Rank	Removal Rank
Frozen Ear Lake Outlet	Dissolved Oxygen (mg/l)	Excellent		Excellent
Frozen Ear Lake Outlet	pH	Excellent	Excellent	Good
Frozen Ear Lake Outlet	Specific Conductivity (µS/cm)	Good	Good	Good
Frozen Ear Lake Outlet	Temperature (°C)	Excellent		Excellent
Frozen Ear Lake Outlet	Turbidity (NTU)	Excellent	Excellent	Excellent
Roebucks Brook	Dissolved Oxygen (mg/l)	Excellent		Excellent
Roebucks Brook	pH	Good	Fair	Excellent
Roebucks Brook	Specific Conductivity (µS/cm)	Excellent	Good	Good
Roebucks Brook	Temperature (°C)	Excellent		Excellent
Roebucks Brook	Turbidity (NTU)	Excellent	Excellent	Good
Valentine River Outlet	Dissolved Oxygen (mg/l)	Excellent		Excellent
Valentine River Outlet	pH	Good	Excellent	Good
Valentine River Outlet	Specific Conductivity (µS/cm)	Excellent	Excellent	Excellent
Valentine River Outlet	Temperature (°C)	Excellent		Excellent
Valentine River Outlet	Turbidity (NTU)	Excellent	Excellent	Excellent
Victoria River at Beothuk Lake	Dissolved Oxygen (mg/l)	Excellent		Excellent
Victoria River at Beothuk Lake	pH	Good	Excellent	Good
Victoria River at Beothuk Lake	Specific Conductivity (µS/cm)	Good	Excellent	Good
Victoria River at Beothuk Lake	Temperature (°C)	Excellent		Good
Victoria River at Beothuk Lake	Turbidity (NTU)	Excellent	Excellent	Excellent
Victoria River Outlet	Dissolved Oxygen (mg/l)	Excellent		Excellent
Victoria River Outlet	pH	Good	Fair	Excellent
Victoria River Outlet	Specific Conductivity (µS/cm)	Excellent	Excellent	Good
Victoria River Outlet	Temperature (°C)	Excellent		Excellent
Victoria River Outlet	Turbidity (NTU)	Excellent	Excellent	Good
Victoria River Tributary	Dissolved Oxygen (mg/l)	Excellent		Excellent
Victoria River Tributary	pH	Excellent	Good	Excellent
Victoria River Tributary	Specific Conductivity (µS/cm)	Good	Good	Excellent
Victoria River Tributary	Temperature (°C)	Excellent		Excellent
Victoria River Tributary	Turbidity (NTU)	Excellent	Excellent	Excellent

Water Temperature

Deployment Period Statistics (°C)				
Station Name	**Minimum**	**Maximum**	**Average**	**Median**
Frozen Ears Lake Outlet	**5.45**	**25.18**	**12.37**	**11.62**
Roebucks Brook	**4.98**	**20.21**	**11.32**	**10.89**
Valentine River Outlet	**6.75**	**21.02**	**12.80**	**12.44**
Victoria River at Beothuk Lake	**7.81**	**21.92**	**13.28**	**12.90**
Victoria River Outlet	**8.32**	**21.01**	**13.11**	**12.68**
Victoria River Tributary	**6.12**	**17.67**	**11.77**	**11.60**

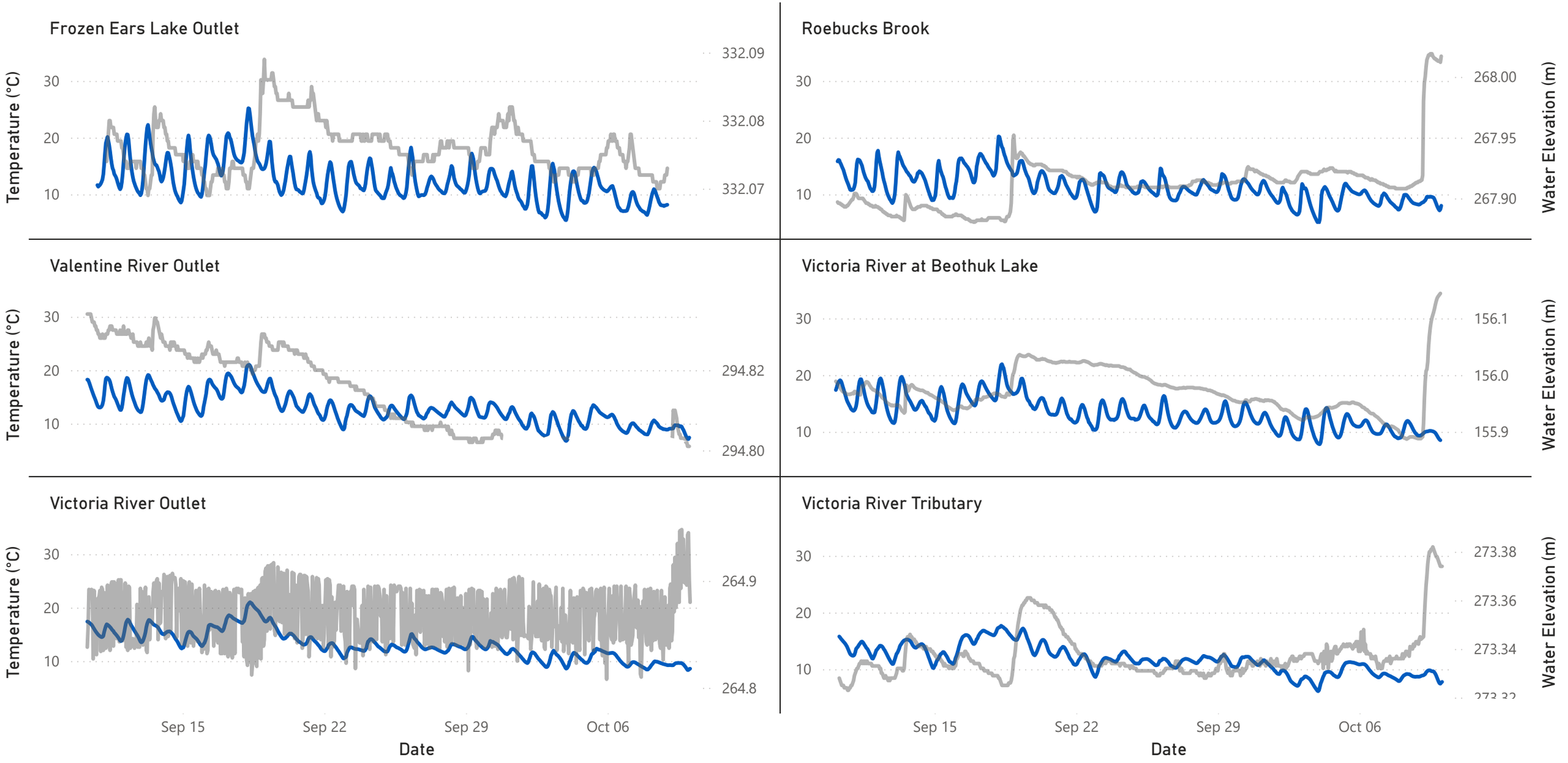
Water temperature is a critical parameter for wildlife, as many organisms cannot regulate their own body temperatures and instead depend on surrounding air and water conditions. Water temperature can be influenced by industrial inputs or alterations to natural environments, such as the removal of trees and vegetation, which eliminates the protective canopy they provide. Additionally, water temperature impacts other monitored parameters, including dissolved oxygen and specific conductivity.

Water temperatures were consistent throughout the deployment period, with an evident decreasing trend observed at all stations. Decreasing water temperatures would be expected given the seasonal transition from summer to autumn. A natural daily cycle was also observed, with higher temperatures during the day and lower temperatures at night.

Water Temperature Station Graphs

Temperature (°C) and Water Elevation (m)

● Temperature (°C) ● Water Elevation (m)



pH

Newfoundland Labrador

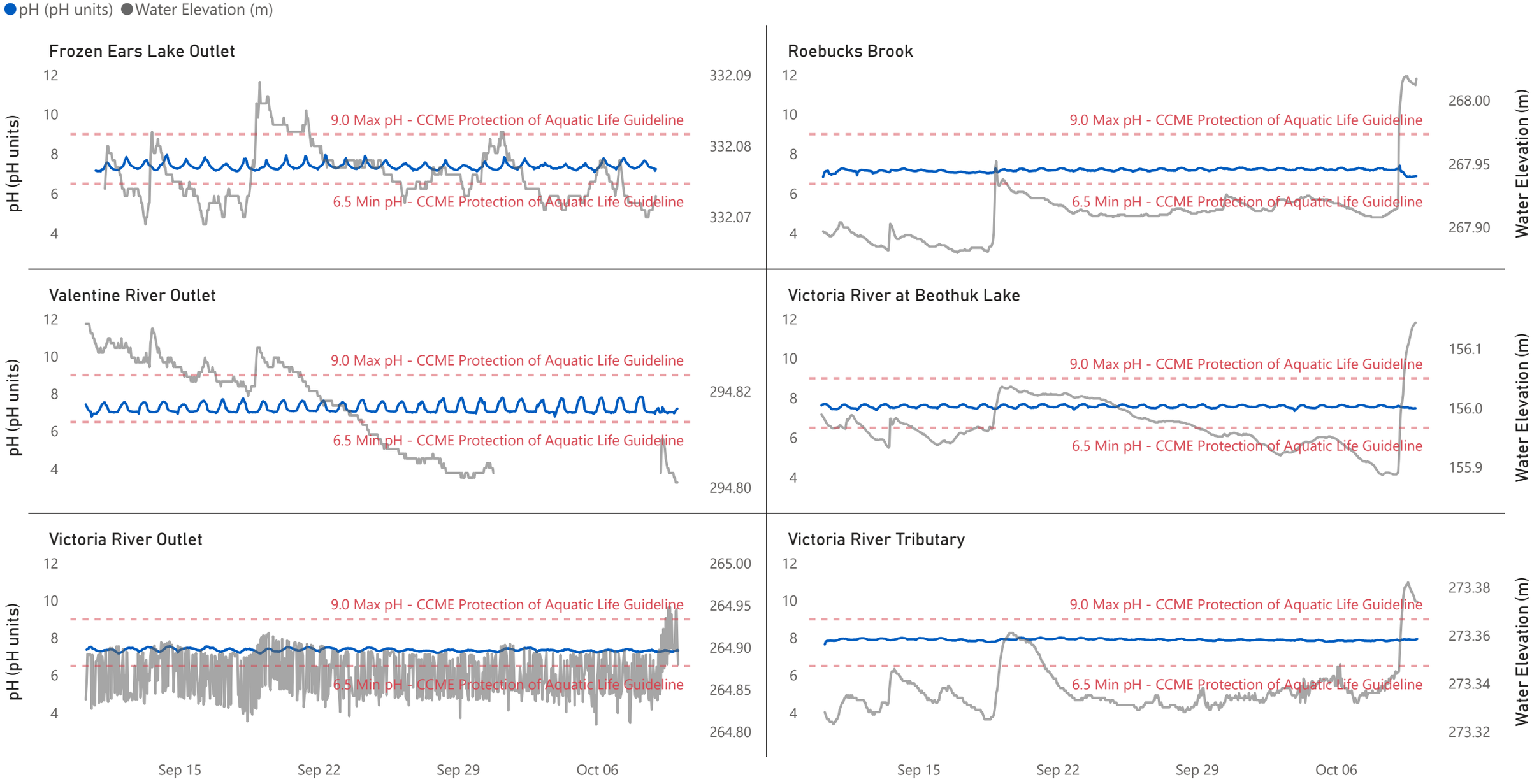
Deployment Period Statistics (pH Units)

Station Name	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	7.08	7.95	7.38	7.34
Roebucks Brook	6.83	7.41	7.18	7.19
Valentine River Outlet	6.78	7.85	7.23	7.10
Victoria River at Beothuk Lake	7.35	7.71	7.58	7.57
Victoria River Outlet	7.17	7.56	7.35	7.35
Victoria River Tributary	7.65	8.01	7.90	7.90

pH relates to the free hydrogen ions in water, and it is a measure of acidity in water. pH is a critical parameter because it influences the solubility of minerals and chemicals, the availability of nutrients, and the biological processes that occur in aquatic ecosystems. The Canadian Council of Ministers of the Environment (CCME) Freshwater Aquatic Life guideline provides a basis by which to judge the overall health of the brook. Their freshwater guidelines recommend a minimum pH of 6.5 and a maximum pH of 9.0; however, many rivers in Newfoundland and Labrador are naturally more acidic due to the local geology.

pH at all six stations remained within the CCME Guidelines for the Protection of Aquatic Life throughout the deployment period. pH remained generally stable, with small fluctuations attributed to precipitation events, such as at Valentine River Outlet and Roebucks Brook on October 9th. Rainwater, with its naturally lower pH, temporarily dilutes the water column, causing a short-term decrease in pH. However, pH levels typically return to baseline within a few days. Medians are similar at all stations, except for Victoria River Tributary where pH values are slightly higher,

pH Station Graphs



Specific Conductivity

Newfoundland Labrador

Deployment Period Statistics (µS/cm)

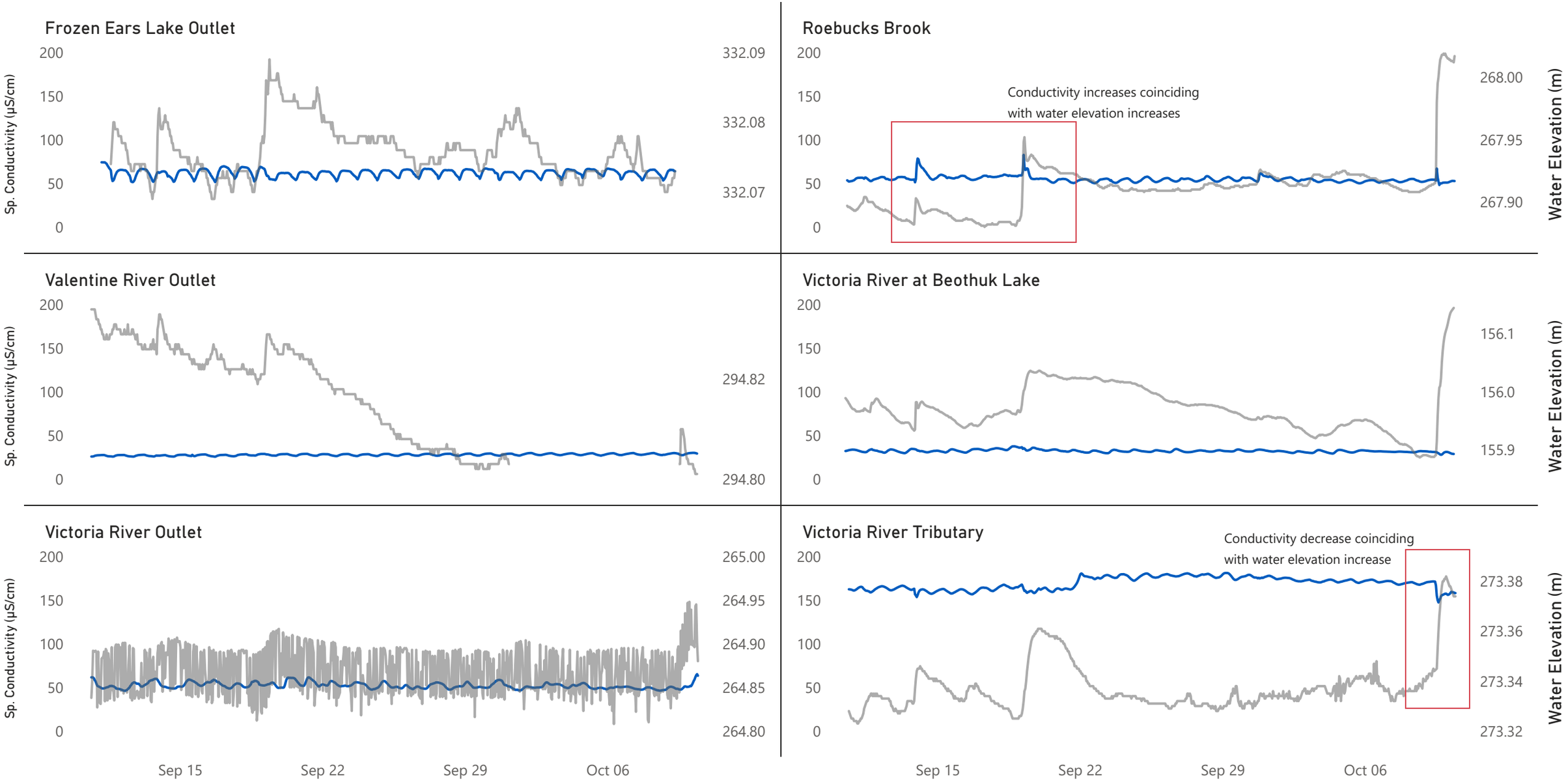
Station Name	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	51.35	74.09	61.87	62.77
Roebucks Brook	48.03	82.60	54.87	54.38
Valentine River Outlet	25.53	29.93	27.76	27.73
Victoria River at Beothuk Lake	27.67	37.49	32.06	31.85
Victoria River Outlet	46.05	65.16	52.09	51.27
Victoria River Tributary	147.27	181.06	169.34	170.72

Specific conductivity is a common indicator of the concentration of dissolved ions in water, such as salts, acids, and bases. Higher concentrations of dissolved ions result in higher specific conductivity, while pure water exhibits low conductivity. Specific conductivity is often affected by precipitation. During precipitation events, rainwater can temporarily dilute the water column, resulting in a short-term decrease in conductivity. However, high precipitation events can also cause a temporary increase in conductivity if sediment from the bottom of the waterbody is disturbed around the sensor or if runoff carrying dissolved ions enters the water column.

Across all six stations, conductivity generally remains stable and consistent throughout the deployment period. Minor fluctuations can be attributed to precipitation events, which are evident on the station graphs on the next page. At Roebucks Brook, small spikes coincide with water elevation increases, likely due to runoff from precipitation carrying sediment into the water, causing a temporary rise in conductivity. Similarly, Victoria River Outlet shows increased conductivity during water elevation rises, typically a result of precipitation runoff entering the water body. In contrast, Victoria River Tributary experiences a drop in conductivity during water elevation increases associated with rainfall, as the rainwater temporarily dilutes the water. Conductivity values return to background levels shortly after.

Specific Conductivity Station Graphs

Specific Conductivity (µS/cm) Water Elevation (m)



Dissolved Oxygen

Newfoundland Labrador

Deployment Period Statistics

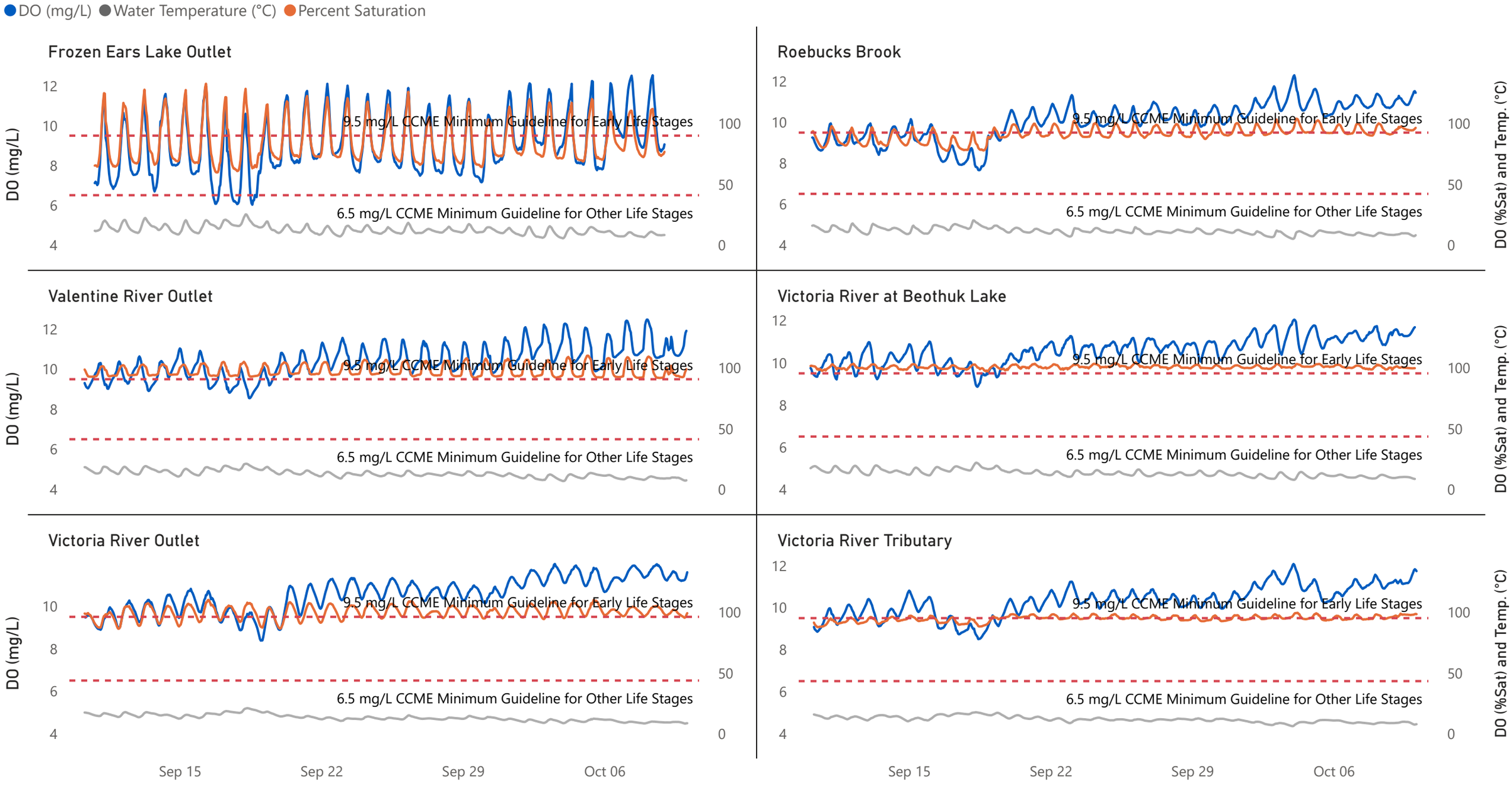
Station Name	Minimum (mg/L)	Minimum (% Sat.)	Maximum (mg/L)	Maximum (% Sat.)	Average (mg/L)	Average (% Sat.)	Median (mg/L)	Median (% Sat.)
Frozen Ears Lake Outlet	6.02	59.80	12.54	133.00	9.11	85.58	8.90	78.90
Roebucks Brook	7.66	77.60	12.31	104.10	10.06	91.53	10.16	91.75
Valentine River Outlet	8.55	91.80	12.48	110.30	10.40	97.96	10.35	95.50
Victoria River at Beothuk Lake	8.86	97.20	12.05	104.70	10.60	100.87	10.70	100.70
Victoria River Outlet	8.38	86.50	11.99	110.40	10.57	100.21	10.67	100.60
Victoria River Tributary	8.50	87.90	12.08	99.70	10.32	94.96	10.36	95.00

Dissolved oxygen (DO) is crucial for supporting aquatic life, and the CCME (Canadian Council of Ministers of the Environment) Freshwater Aquatic Life guidelines establish reference values to evaluate waterway health. The minimum DO guideline is 9.5 mg/L for early life stages in cold water species and 6.5 mg/L for other life stages. DO concentrations can fluctuate due to factors such as water temperature, atmospheric pressure, and the presence of other dissolved substances. Warmer water typically holds less dissolved oxygen than cooler water.

Throughout the deployment period, daily fluctuations in dissolved oxygen (DO) levels were observed at all six stations, primarily driven by temperature changes and the respiration of aquatic plants. An inverse relationship between DO levels and water temperature was evident, as shown in the station graphs on the following page. DO levels remained above the CCME guideline for the protection of other life stages (6.5 mg/L) at all stations except for Frozen Ears Lake Outlet, where brief dips below the minimum guideline were recorded when temperatures were the warmest. At all stations except Frozen Ears Lake Outlet, DO levels generally remained just below or at the CCME guideline for the protection of early life stages (9.5 mg/L) during the first half of the deployment period before stabilizing above the minimum guideline for the latter half when water temperature cooled.

The Frozen Ears Lake Outlet station is an exposed area with no vegetation cover, characterized by shallow, slow-moving water, and is particularly sensitive to air temperature changes. Additionally, DO at this station may be influenced by reduced aeration and/or stagnant pools of water due to low water levels, as well as potentially significant biological activity during the summer. These conditions lead to pronounced diurnal variations in DO levels, as illustrated in the figure on the next page.

Dissolved Oxygen Station Graphs



Turbidity

Deployment Period Statistics (NTU)				
Station Name	**Minimum**	**Maximum**	**Average**	**Median**
Frozen Ears Lake Outlet	**-0.41**	**3.14**	**-0.04**	**-0.08**
Roebucks Brook	**0.12**	**423.69**	**4.44**	**0.57**
Valentine River Outlet	**-0.10**	**0.96**	**0.03**	**-0.01**
Victoria River at Beothuk Lake	**-0.64**	**0.62**	**-0.32**	**-0.33**
Victoria River Outlet	**-0.87**	**1.34**	**-0.47**	**-0.50**
Victoria River Tributary	**0.00**	**1.02**	**0.14**	**0.07**

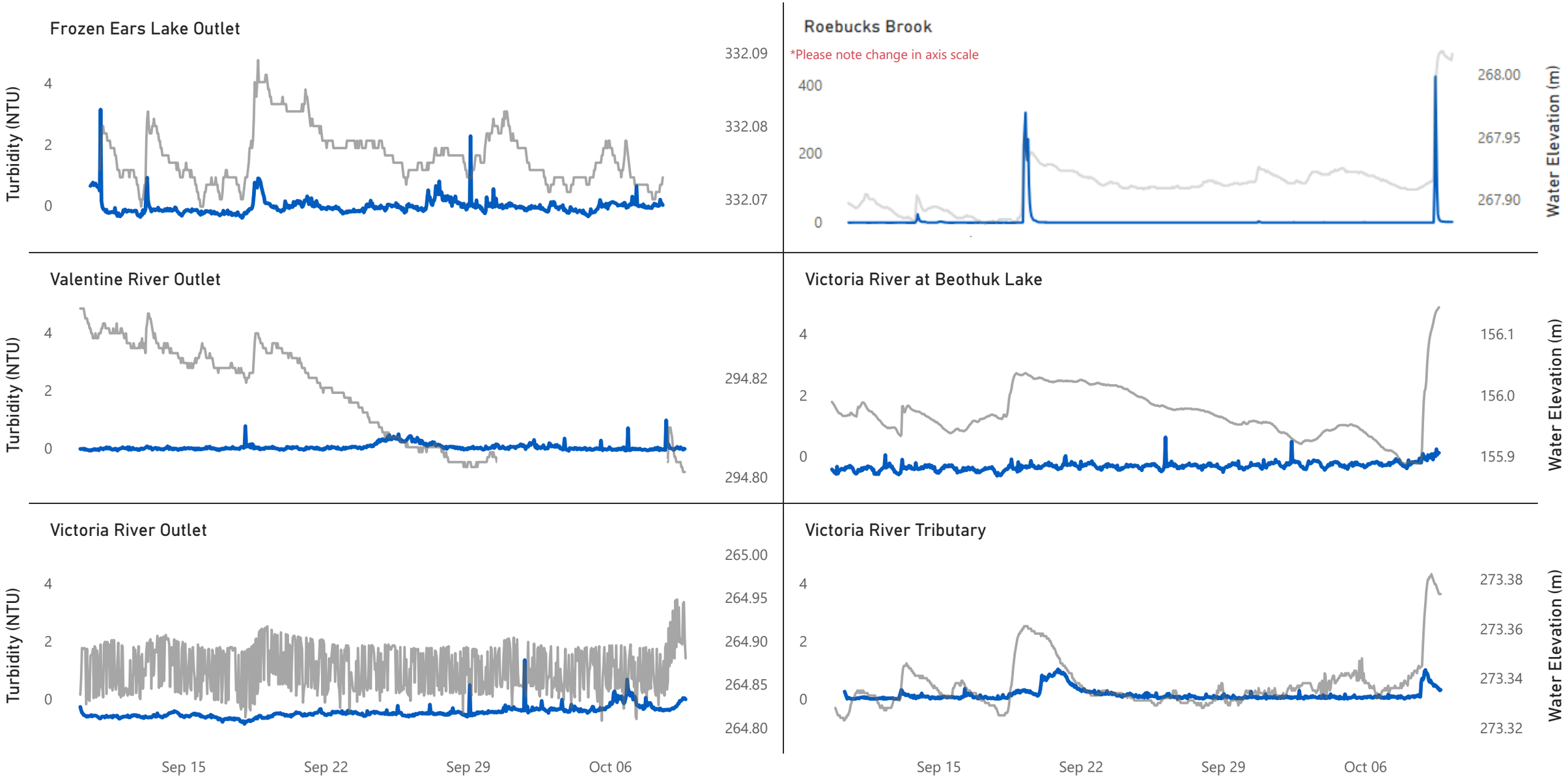
Turbidity, a measure of water cloudiness, often increases during precipitation events as runoff carries silt and debris into the waterbody. High turbidity values can reduce light penetration for aquatic plants, disrupt benthic habitats and potentially harm fish gills or damage monitoring equipment. Negative turbidity values occur when the water being measured has lower turbidity than the zero standards used during calibration. These values were kept in the dataset to monitor trends and investigate the relationship between turbidity and elevation however the values are inaccurate. Minimizing negative turbidity values will be addressed prior to the 2025 field season.

Throughout the deployment period, turbidity levels remained consistently low at all six stations, indicating clear and pristine water conditions. Medians were comparable at all stations. In general, water elevation increases associated with precipitation events led to short-term turbidity spikes. Precipitation run-off can carry silt and debris into the water column, temporarily increasing turbidity. Background turbidity levels and spikes are slightly higher at Roebucks Brook due to the sonde's placement downstream of a bridge crossing a dirt access road. Turbidity spikes coincide with elevation increases, however values do return to background levels shortly after.

Turbidity Station Graphs

Newfoundland Labrador

● Turbidity (NTU) ● Water Elevation (m)



Water Elevation

Newfoundland Labrador

Deployment Period Statistics (m)

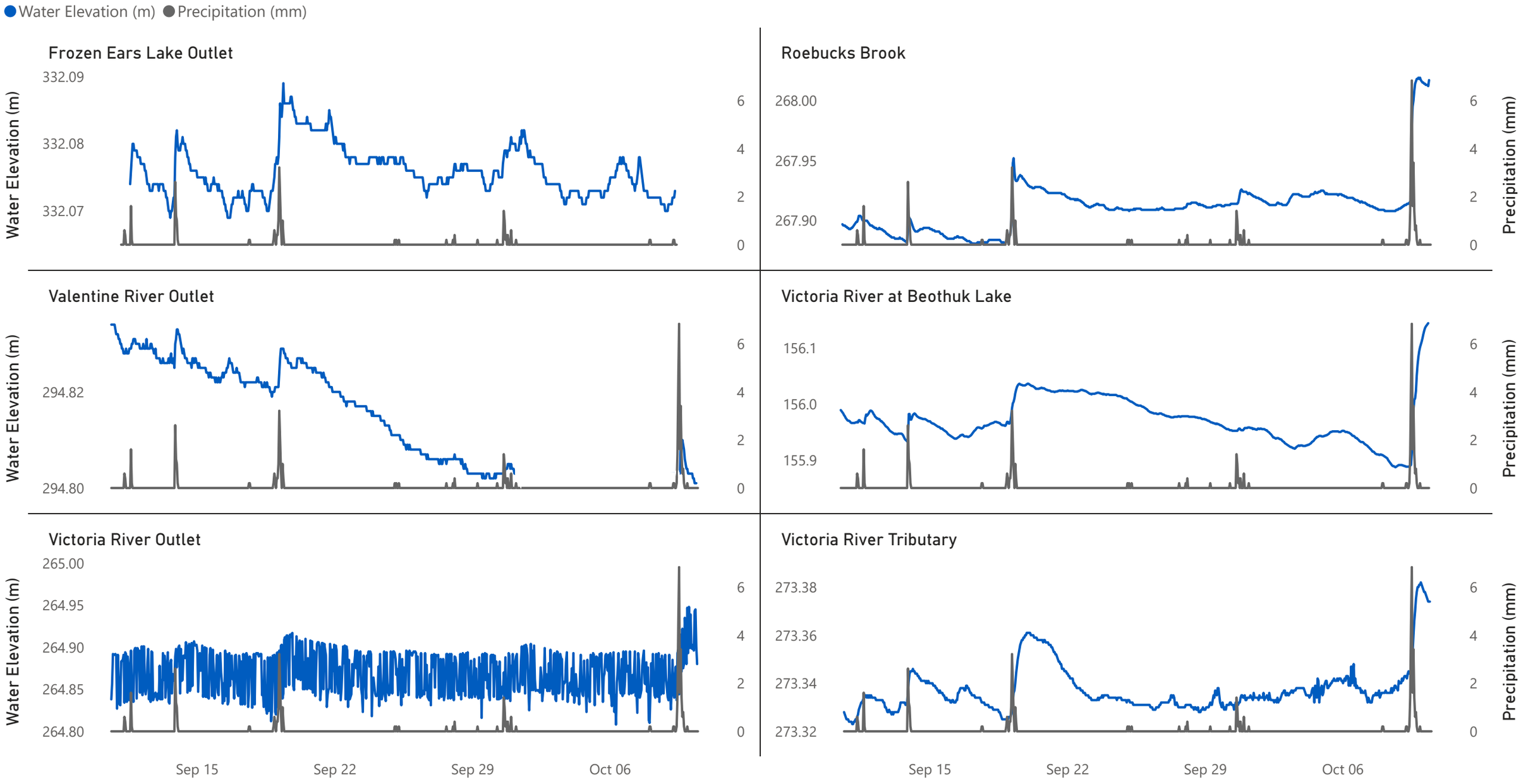
Station Name	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	332.07	332.09	332.08	332.08
Roebucks Brook	267.88	268.02	267.91	267.91
Valentine River Outlet	294.80	294.83	294.82	294.82
Victoria River at Beothuk Lake	155.89	156.14	155.97	155.97
Victoria River Outlet	264.81	264.95	264.87	264.87
Victoria River Tributary	273.32	273.38	273.34	273.33

WRMD transitioned from reporting stage values to water elevation in Fall 2024. Water elevation provides an estimate of the water level at a monitoring station and plays a vital role in analyzing trends in water quality data, particularly for parameters such as specific conductivity, pH, and turbidity. Water elevation generally rises during precipitation events as rainwater and runoff enter the water column. By monitoring water elevation alongside precipitation events, we can better interpret our data, distinguish whether an elevation increase is caused by rainfall or potential industrial activities, and assess its impact on water quality. Precipitation data was obtained from the Calibre Mining (Marathon Gold) meteorological (MET) station, which is located on-site and maintained collaboratively by WRMD and Calibre Mining.

The station graphs on the following page demonstrates the effect of precipitation events on water elevation, showing distinct elevation spikes occurring during or shortly after rainfall. There is an evident spike towards the end of the deployment period on October 9th when substantial rainfall resulted in water elevation increasing across all five stations, except for Frozen Ear Lake Outlet which was removed the morning of October 9th prior to the rainfall.

Water elevation at Victoria River Outlet fluctuates more frequently due to an upstream dam where flow is regulated. Due to substantial drops in water elevation as a result of an abnormally dry season, the hydrometric plate was no longer submerged in the river at Valentine River Outlet station from October 1st to October 9th. There is no elevation data for that station during that time period.

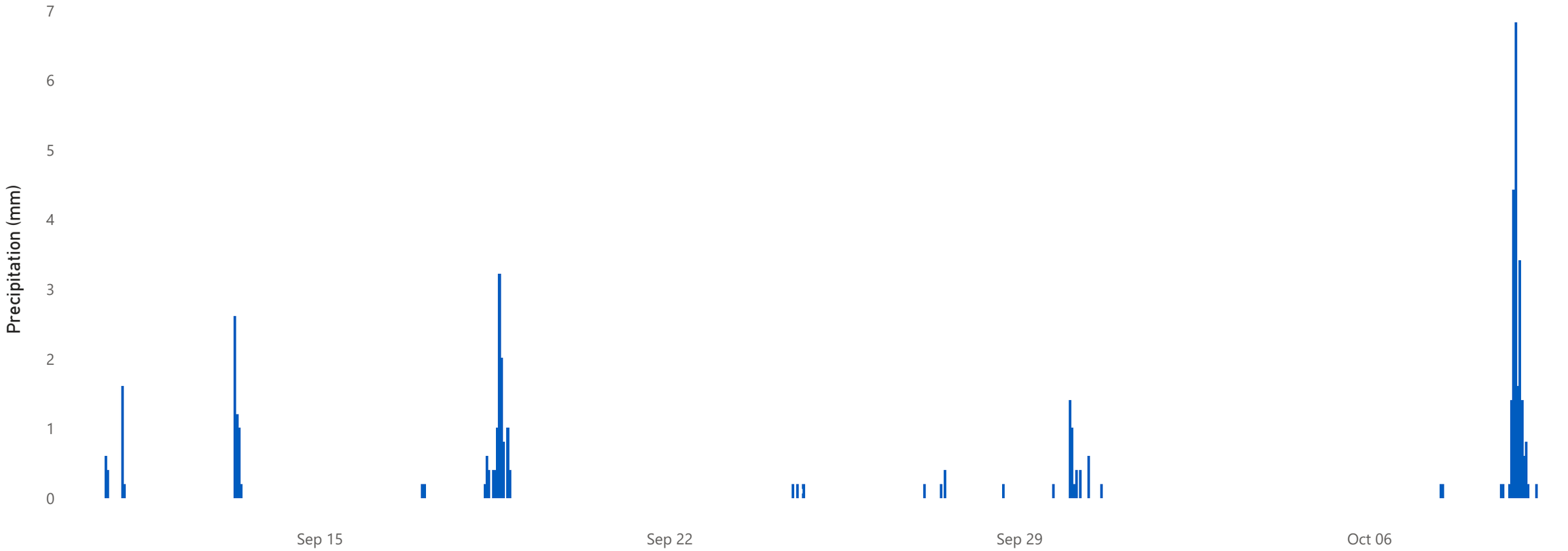
Water Elevation Station Graphs



Precipitation Data

Retrieved from the Calibre Mining (Marathon Gold) MET Station

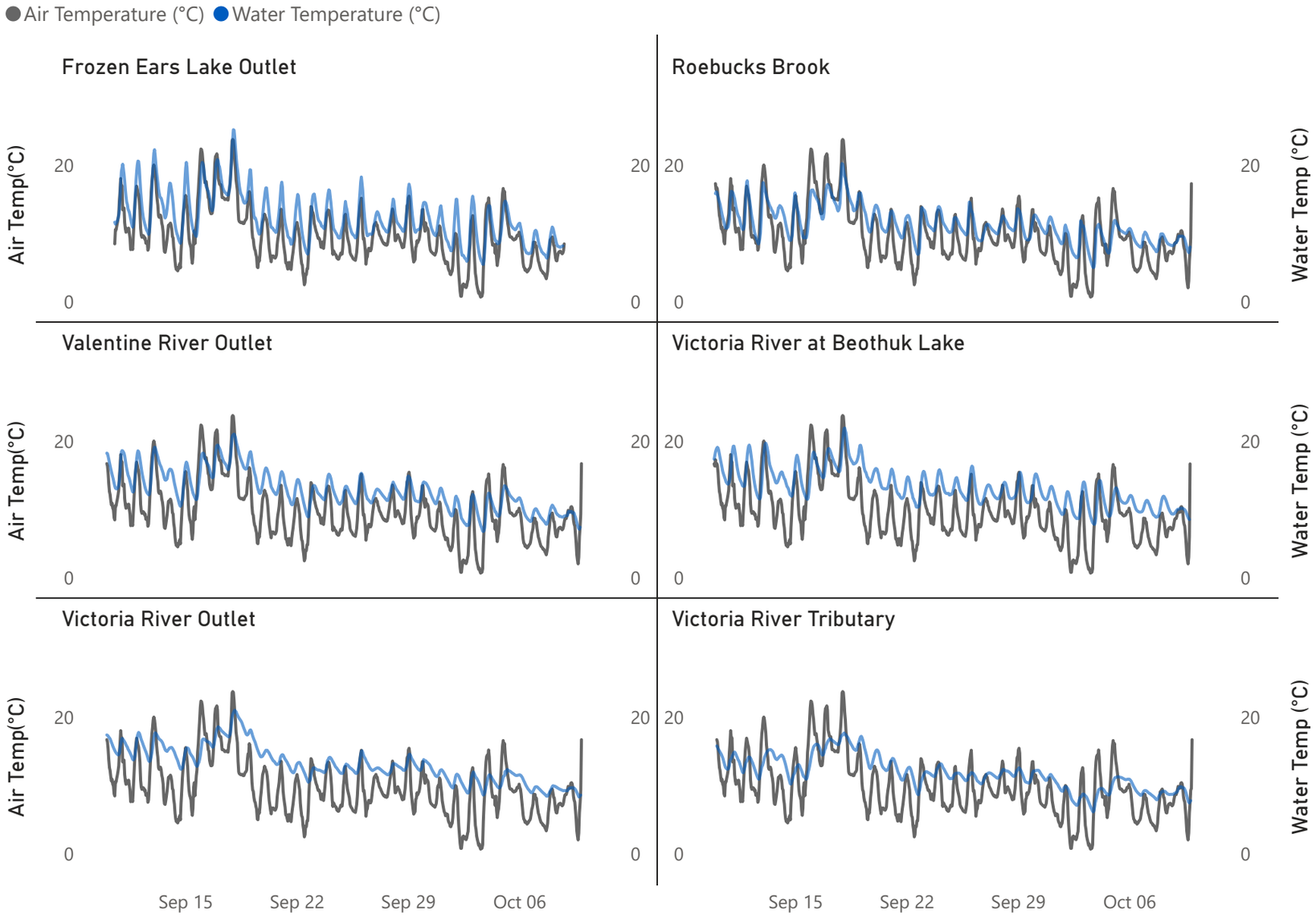
0.07	0.00	0.00	6.83	46.63
Average (mm/hr)	Minimum (mm/hr)	Median (mm/hr)	Maximum (mm/hr)	Total Precip. (mm)

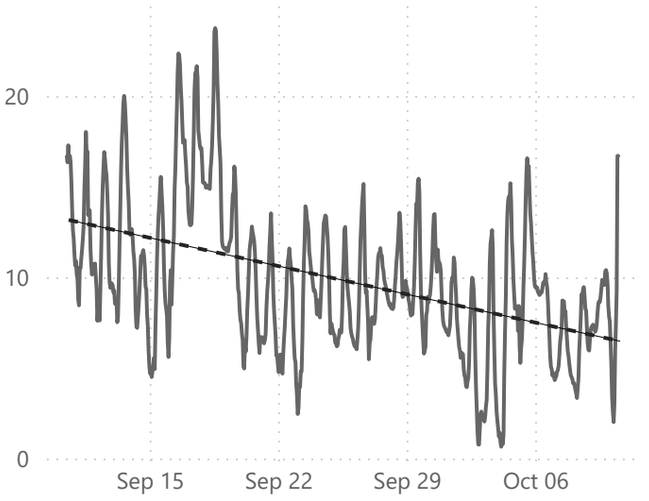


Air Temperature Data

Retrieved from the Calibre Mining (Marathon Gold) MET Station

Newfoundland Labrador





9.79	9.30
Average (°C)	Median (°C)
0.65	23.75
Minimum (°C)	Maximum (°C)