Real-Time Water Quality Report

Canada Fluorspar (NL) Inc, Real-Time Water Quality Stations

Deployment Period
October 16th, 2024, to December 3rd, 2024

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

Prepared by:

Tara Clinton
Environmental Scientist
Water Resources Management Division
Department of Environment & Climate Change
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
taraclinton@gov.nl.ca

General

The Water Resources Management Division (WRMD) maintains real-time water quality and water quantity monitoring stations in John Fitzpatrick Pond and on Outflow of Unnamed Pond south of Long Pond, within the site of Canada Fluorspar (NL) Inc, St. Lawrence, Newfoundland & Labrador.

Decommission of Outflow of Grebes Nest Pond

Due to a change in the water supply for Outflow to Grebes Nest Pond station, it was determined that this brook would not provide consistent water supply to remain a monitoring station. Outflow to Grebes Nest station was decommissioned in May 2022. Instrumentation was relocated to John Fitzpatrick Pond (Figure 1).

John Fitzpatrick Pond

The site was selected based on the location and consistent water supply throughout the year. It is expected to provide stable and beneficial water quality data for this site (Figure 1).

The Real Time station is established on the northwest bank of John Fitzpatrick Pond, close to the only outflow from the pond. This pond is surrounded by natural habitat on the northeast side, and on the southwest side bordered by the CFI mine (Figure 1). There are two small brooks that periodically flow into this pond. This station will monitor the water quality and the stage level of the pond. The instrument is deployed, at a depth of approximately 1.0 meter. The GPS coordinates for this site are as follows: N 46° 54' 47.95" W 055° 27' 46.97" (Figure 1).

Figure 1: Real-Time Station at John Fitzpatrick Pond. Station hut (left) and instrument deployed in pond (right)

Outflow of Unnamed Pond south of Long Pond

The Outflow of Unnamed Pond south of Long Pond is established downstream of the Tailings Management Facility (TMF). This station will provide near real-time water quality and quantity data to ensure emerging issues associated with the TMF are detected, to allow the appropriate mitigation measures to be implemented in a timely manner, thus reducing any adverse effect on the downstream systems.

The location of Outflow of Unnamed Pond south of Long Pond was selected due to accessibility to the brook and the sufficient pool available to place the water quality and quantity instruments (See Figure 2). The stream originates from a small unnamed pond and meanders through a marsh environment alongside the TMF. The stream is approximately 1.0 to 2.0 meters wide. Where the instrument is deployed, there is a depth of approximately 1.0 to 1.5 meters. The GPS coordinates for this site are as follows: N46° 54’ 14.1” W055° 26’ 37.5”. The station hut was placed on the right bank looking downstream approximately 8 meters from the stream (Figure 2).

Figure 2: Real-Time Water Quality and Quantity Station at Outflow of Unnamed Pond south of Long Pond. Station hut (left) and instrument deployed in brook (right).

Quality Assurance and Quality Control

WRMD staff are responsible for maintenance and calibration of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is conducted at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.

During deployment and removal, a QA/QC Sonde is temporarily deployed adjacent to the Field Sonde. Based on the degree of difference between the parameters on the Field Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 1). Values for temperature, pH, conductivity, dissolved oxygen, and turbidity are compared between the two instruments (Table 2). Additionally, grab samples are collected during deployment to compare pH, specific conductivity and turbidity values between the field instrument and grab samples (Table 3).

Table 1: Instrument Performance Ranking classifications for deployment and removal

	Rank				
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

It's important to note that the temperature sensor on any sonde is crucial. All other parameters can be categorized into subgroups: temperature-dependent, temperature-compensated, and temperature-independent. Due to the temperature sensor's placement on the sonde, the entire sonde must be at a constant temperature before the temperature sensor stabilizes. The values may take some time to reach the appropriate reading; if a reading is taken too soon, it may not accurately represent the conditions of the water body.

Table 2: QA/QC vs. Field Instrument performance rankings

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
John Fitzpatrick	Oct 16th, 2024	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	Dec 3rd, 2024	Removal	Excellent	Excellent	Good	Good	Excellent
Unnamed Pond	Oct 16th, 2024	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	Dec 3rd, 2024	Removal	Excellent	Excellent	Good	Good	Excellent

When comparing the field instrument to the QAQC instrument data, both stations ranked Excellent or Good for all parameters upon deployment and removal. Given that the rankings were only "Good" for specific conductivity and dissolved oxygen at both stations upon removal, it is likely that an issue with the QAQC sonde contributed to the less-than-Excellent rankings.

Table 3: Grab sample vs. Field Instrument Comparison Rankings

			Comparison Ranking		
Station	**Date**	**Action**	**pH**	**Conductivity**	**Turbidity**
John Fitzpatrick	**Oct 16th, 2024**	**Deployment**	Excellent	Excellent	Excellent
Unnamed Pond	**Oct 16th, 2024**	**Deployment**	Good	Excellent	Excellent

When comparing the field instrument to grab sample data, all parameters rank Excellent, except for pH at Unnamed Pond which ranked Good. 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.

Outflow of Unnamed Pond South of Long Pond

Water Temperature

Water temperatures ranged from 1.34°C to 14.38°C during the deployment period, with a median of 7.61°C. A decreasing trend was observed throughout this deployment period, which would be expected as the season transitions from autumn to winter. A natural diurnal pattern was observed, with warmer temperatures during daylight hours and cooler temperatures at night (Figure 3). The dip in water temperature at the end of the deployment is representative of the water temperatures steadily getting cooler with the change in air temperature (Figure 4).

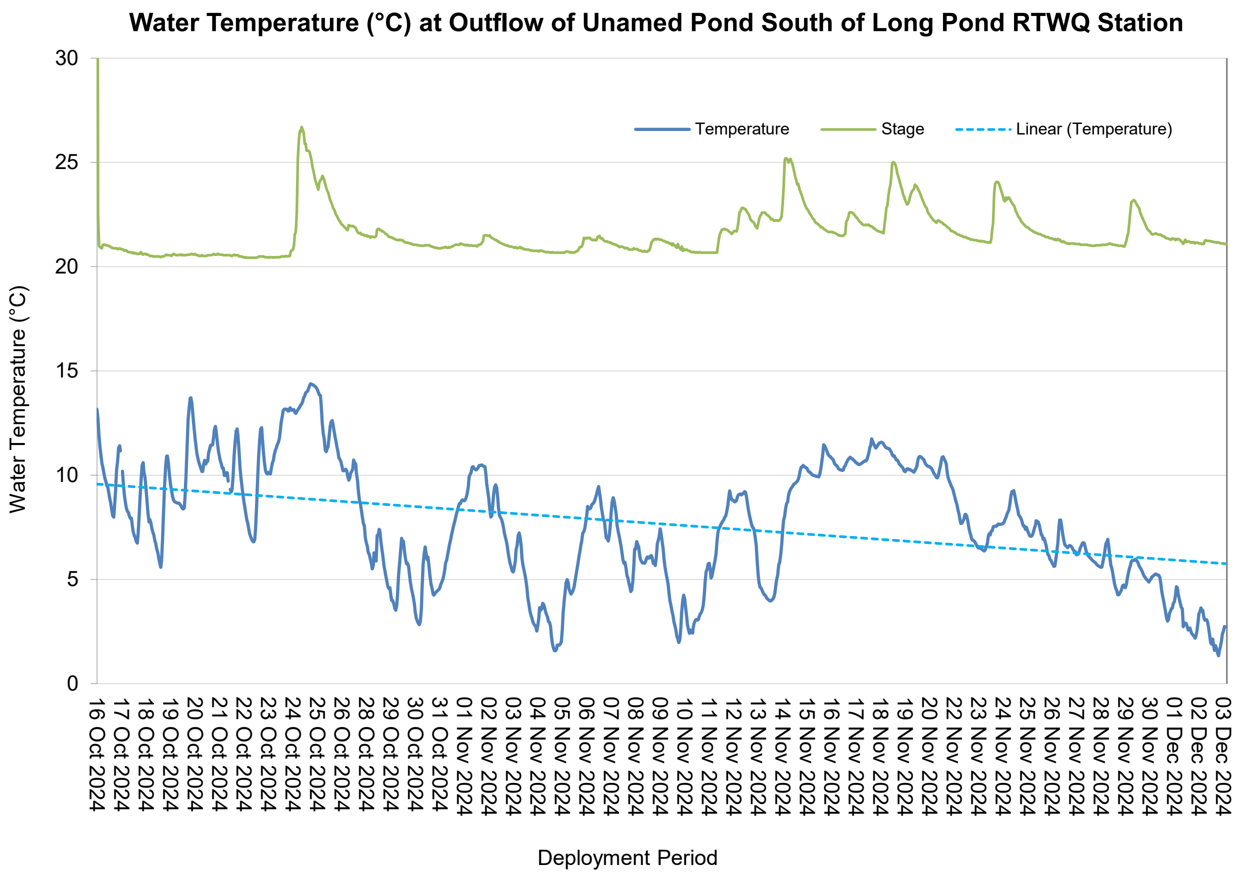

Figure 3: Water temperature at Outflow of Unnamed Pond south of Long Pond

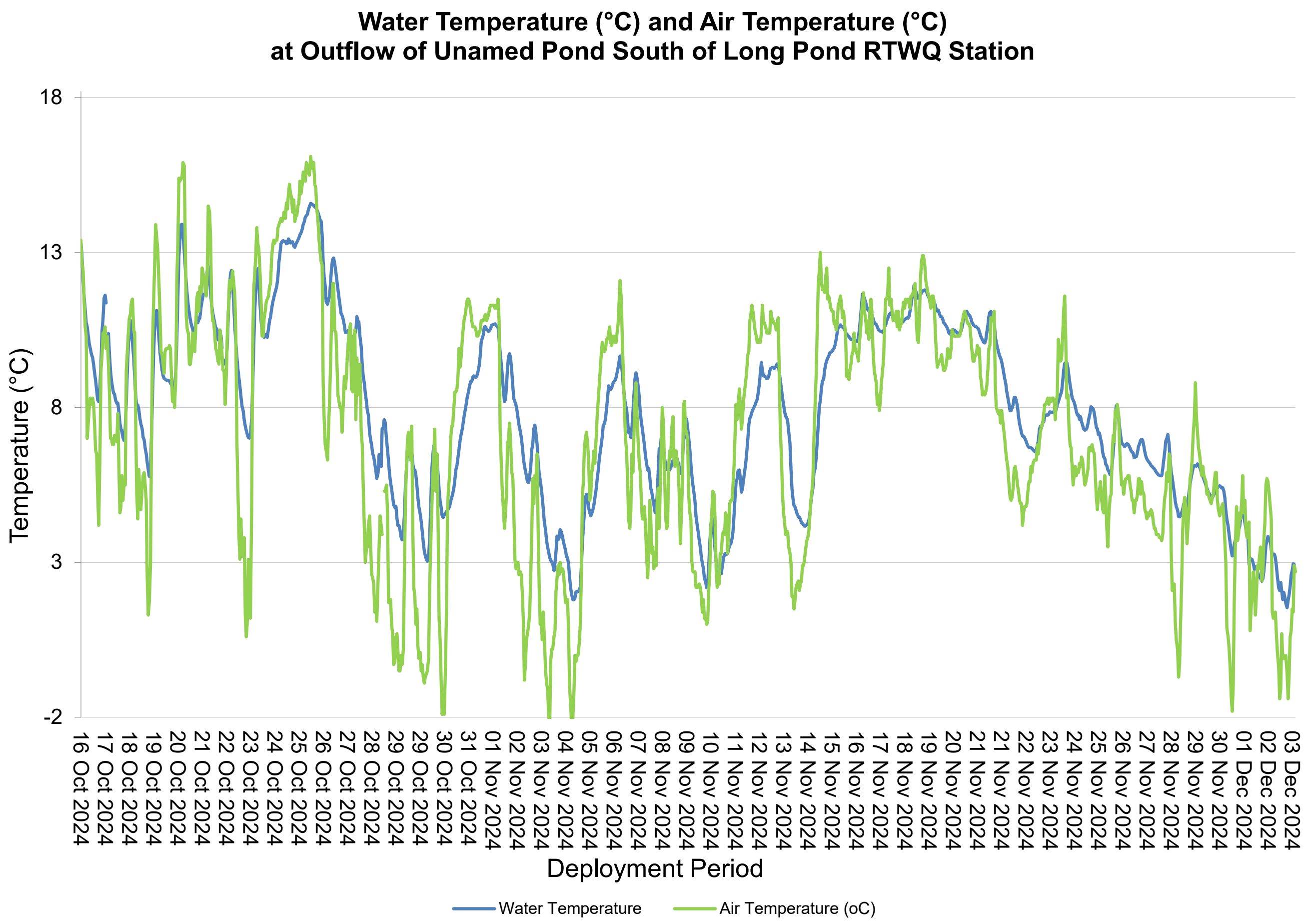

Figure 4: Water and Air Temperature (°C) at Outflow of Unnamed Pond south of Long Pond

pH

Throughout the deployment period, pH values ranged from 7.16 to 7.93, with a median of 7.64 (Figure 5). The pH levels remained stable and consistent, with only minor fluctuations attributed to precipitation events.

A pH sensor measures the acidity or alkalinity of a water body. 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. Most aquatic organisms have a preferred pH range for optimal growth and survival, and deviations from this range can have significant ecological implications. The pH data at Outflow of Unnamed Pond South of Long Pond remained within the Canadian Council of Ministers of the Environment (CCME) guidelines of 6.5-9.0 pH units for the protection of aquatic life for the duration of the deployment period (Figure 5).

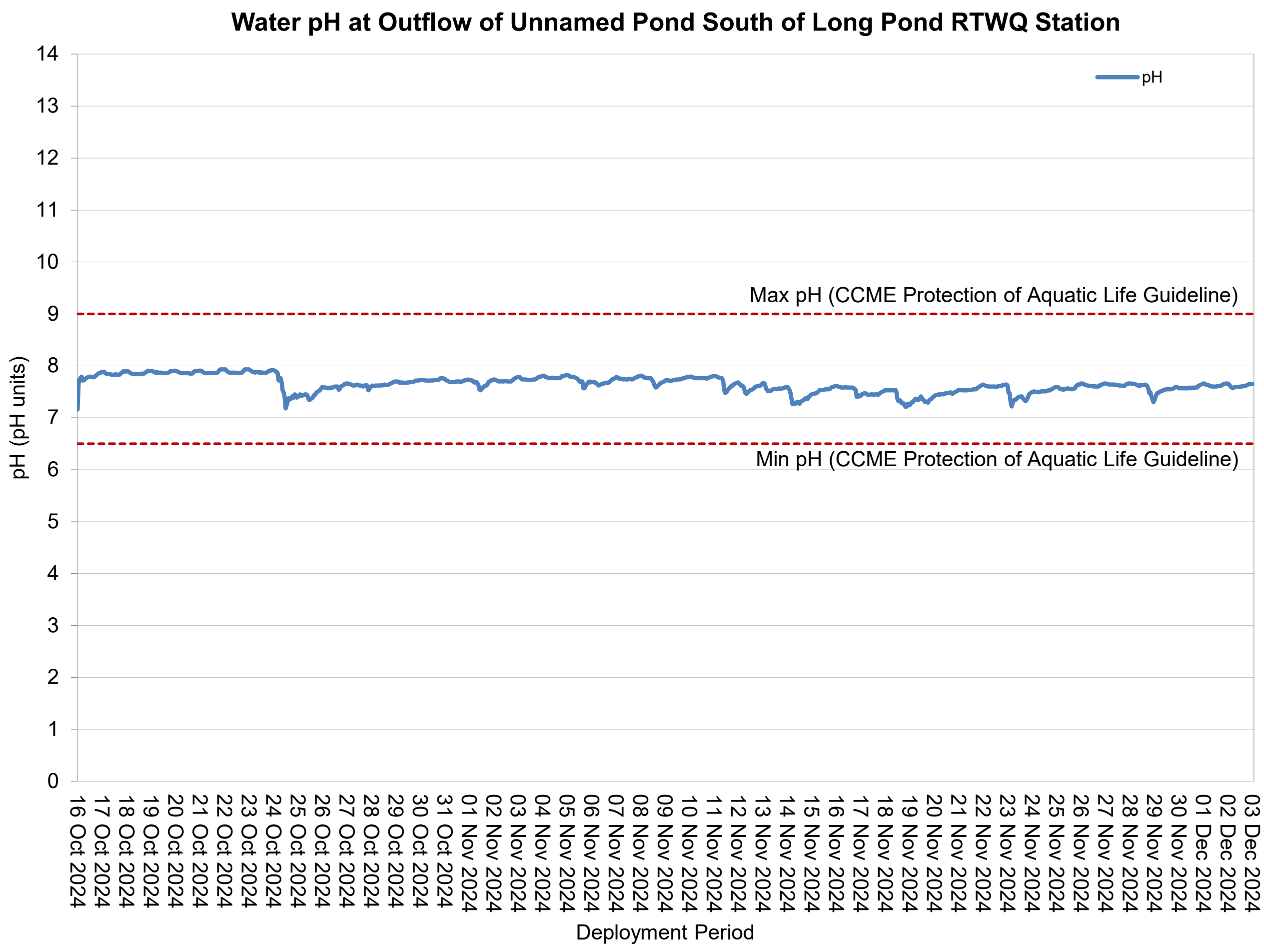

Figure 5: pH (pH units) values at Outflow of Unnamed Pond South of Long Pond

Specific Conductivity

The specific conductivity levels were within 115.4 µS/cm and 278.0 µS/cm during this deployment period, with a median of 201.9 µS/cm (Figure 6). Conductivity increased slightly but remained stable across the deployment period, with small periodic dips and increases. Dips in conductivity levels coincide with precipitation events (Appendix I). The rain dilutes the water column for a short period of time, which reduces the concentration of any suspended particles or diluted salts. Small increases can likely be attributed to pumping of the open pits.

Specific conductivity is commonly used as an indicator of the concentration of dissolved ions in water. These ions can include electrolytes like salts, acids, and bases. The higher the concentration of dissolved ions, the higher the specific conductivity of the water.

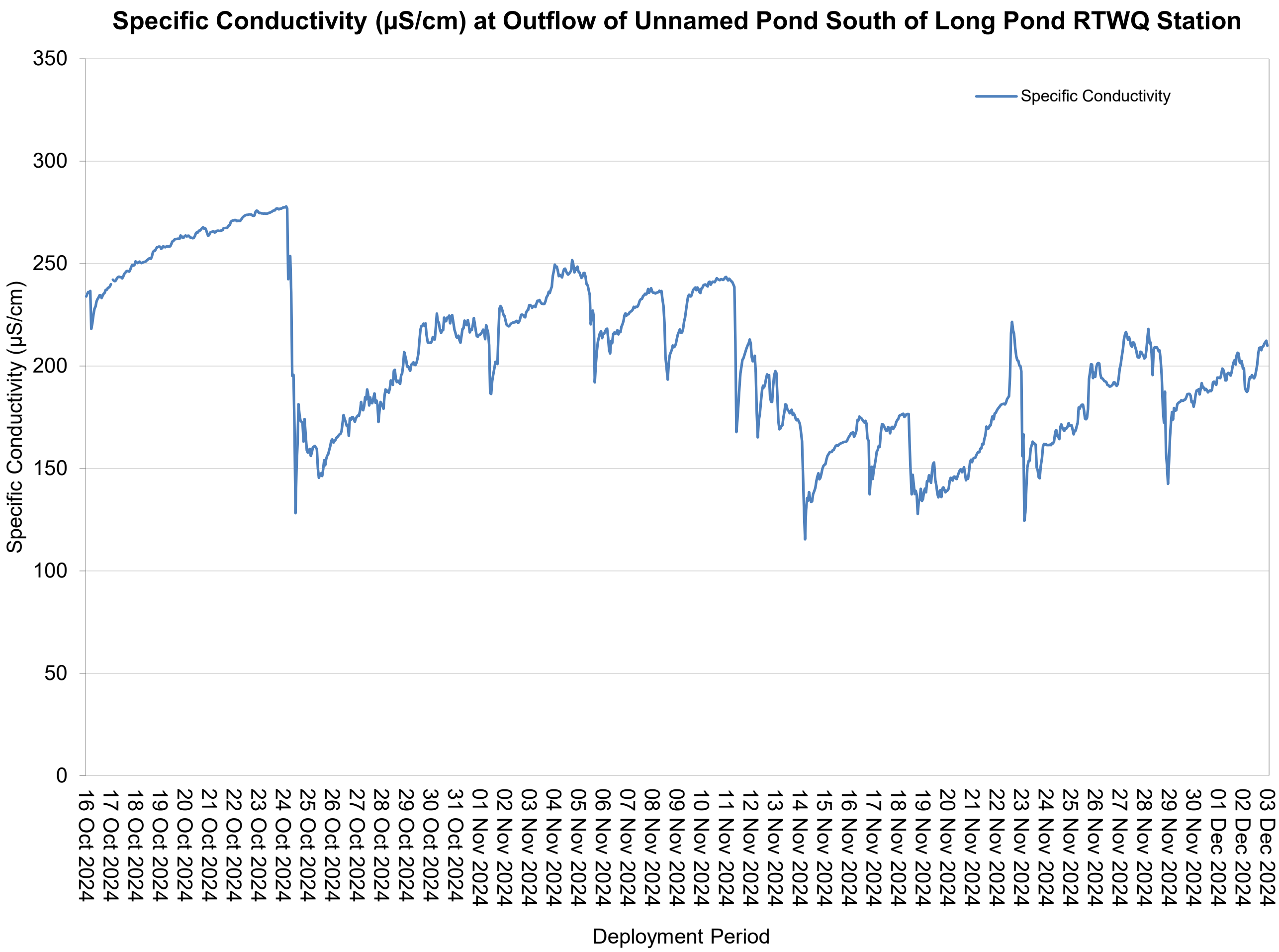

Figure 6: Specific conductivity (µS/cm) values

Dissolved Oxygen

Throughout the deployment, dissolved oxygen (DO) concentrations ranged from 9.77 mg/L to 13.93 mg/L, with corresponding DO percent saturation levels varying from 94.3% to 102.8% (Figure 7). Concentration values remained above the CCME Guideline for the Protection of Other Life Stages and the CCME Guideline for the Protection of Early Life Stages throughout the deployment. DO levels remained stable, with a gradual increasing trend, which is consistent with the decreasing water temperature.

The DO probe measures oxygen directly dissolved in the water in milligrams per liter (mg/L). The instrument then calculates percent saturation (% Sat), considering the water temperature. Dissolved oxygen levels can vary based on factors such as temperature, pressure, and the presence of other dissolved substances. Warmer water tends to hold less dissolved oxygen than cooler water. Additionally, the presence of organic matter, pollutants, and certain chemical reactions can influence dissolved oxygen levels.

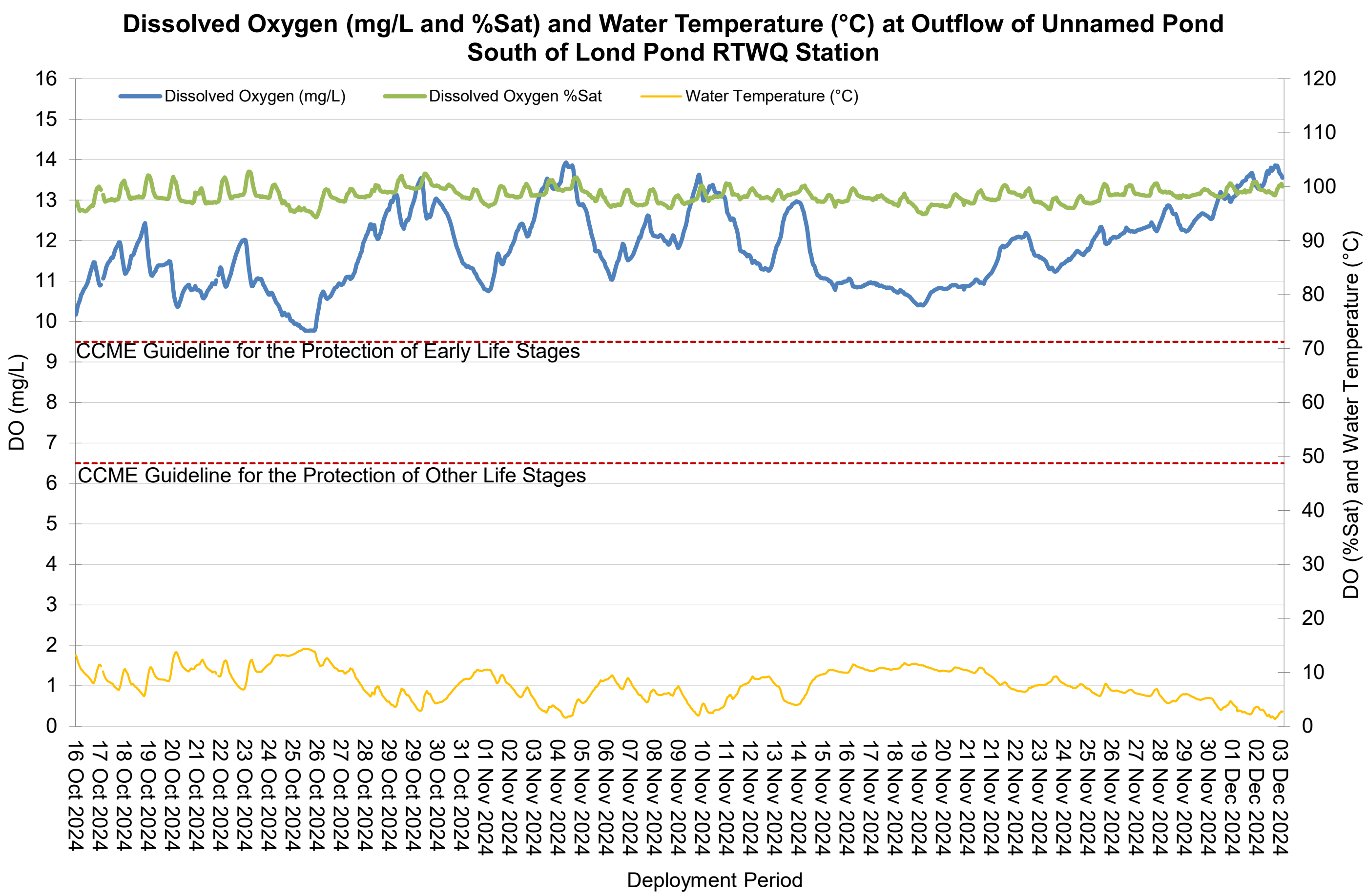

Figure 7: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C)

Turbidity

Turbidity levels during the deployment ranged within 0.7 NTU and 191.9 NTU, with a median of 1.4 NTU.

The turbidity levels remained consistently low and stable throughout the deployment period. Minor fluctuations and two larger spikes on November 15th and November 20th can be linked to precipitation events (Appendix I). Precipitation increases runoff, carrying debris into the water body and disturbing the substrate at the bottom, which temporarily elevates turbidity levels (Figure 8).

There may have been a buildup of sediment around the sensor from early to mid-November, visible in the graph as a gradual increase, before precipitation increased the stage and flushed out the system and the debris from around the sensor.

Turbidity sensors use light scattering or absorption principles to quantify the degree of cloudiness in the water. Turbidity is caused by suspended particles, such as silt, clay, organic matter, and plankton, that scatter and absorb light.

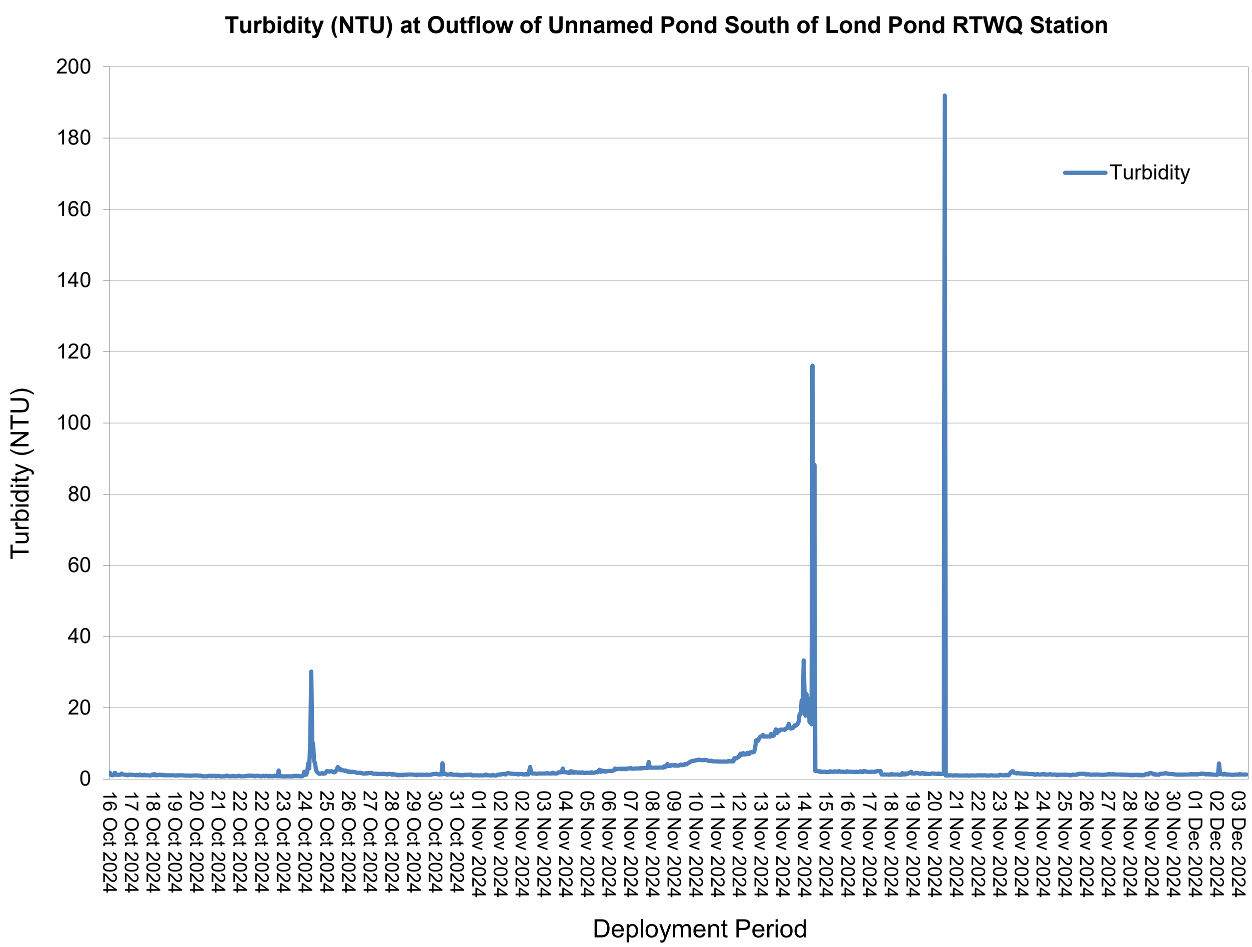

Figure 8: Turbidity (NTU) values

Stage

Stage is an estimation of water level at the station and can account for variations in water quality parameters (e.g., Specific Conductivity, Dissolved Oxygen, turbidity). The stage ranged between 3.68m and 3.89m throughout the deployment.

Significant peaks in stage align with total precipitation events, as indicated in Figure 9. Total Precipitation data were obtained from Environment Canada's St. Lawrence weather station.

Water Resources Management Division hydrometric 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.

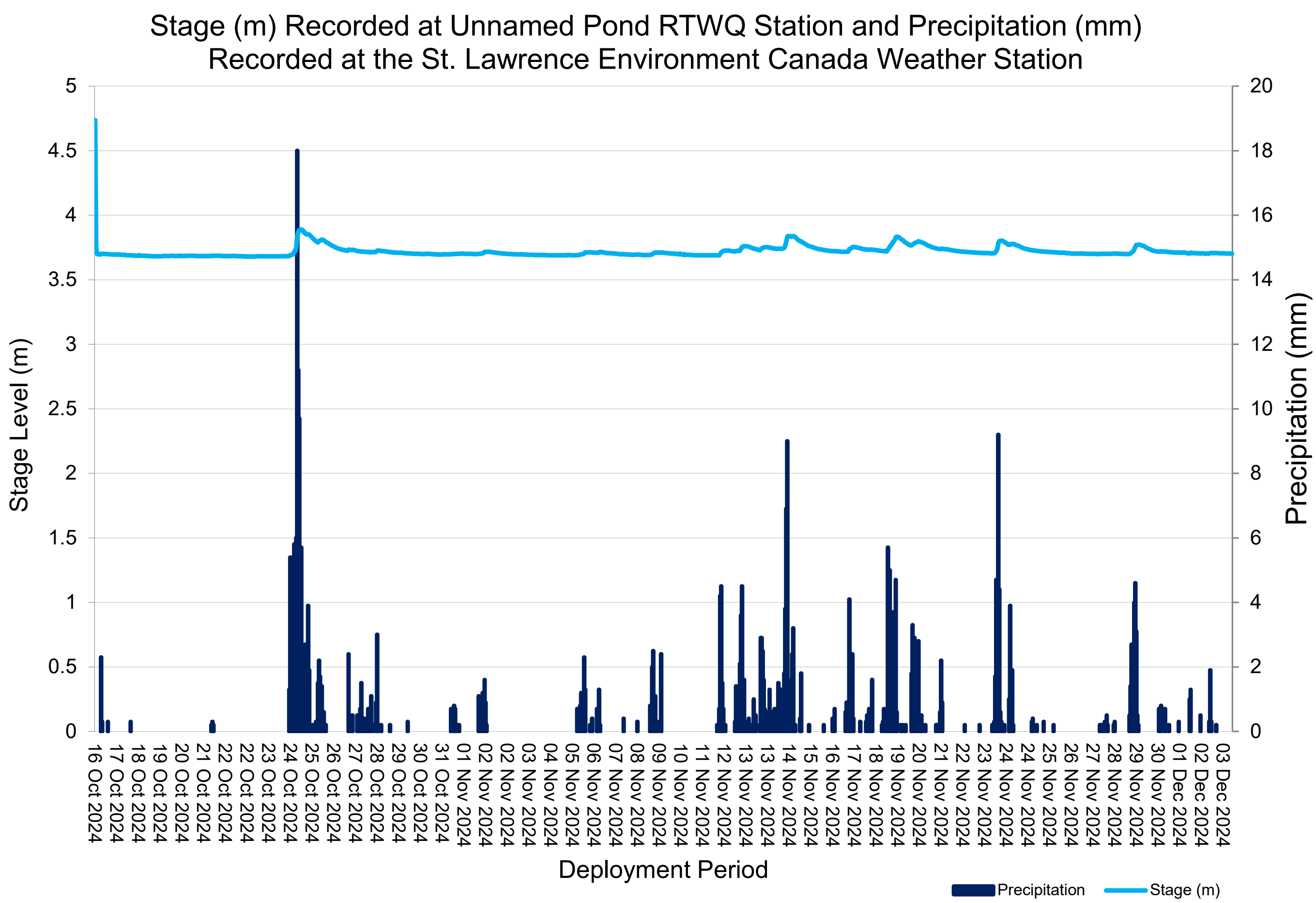

Figure 9: Stage (m) values

John Fitzpatrick Pond

Water Temperature

Water temperature ranged from 4.05ºC to 12.62ºC during the deployment period, with a median of 8.00°C (Figure 10). Temperature remained stable throughout the deployment period with a slight decreasing trend which would be expected given the seasonal transition from autumn to winter. A diurnal pattern was also observed. The dip in water temperature at the end of the deployment is a result of the cooling air temperatures (Figure 11).

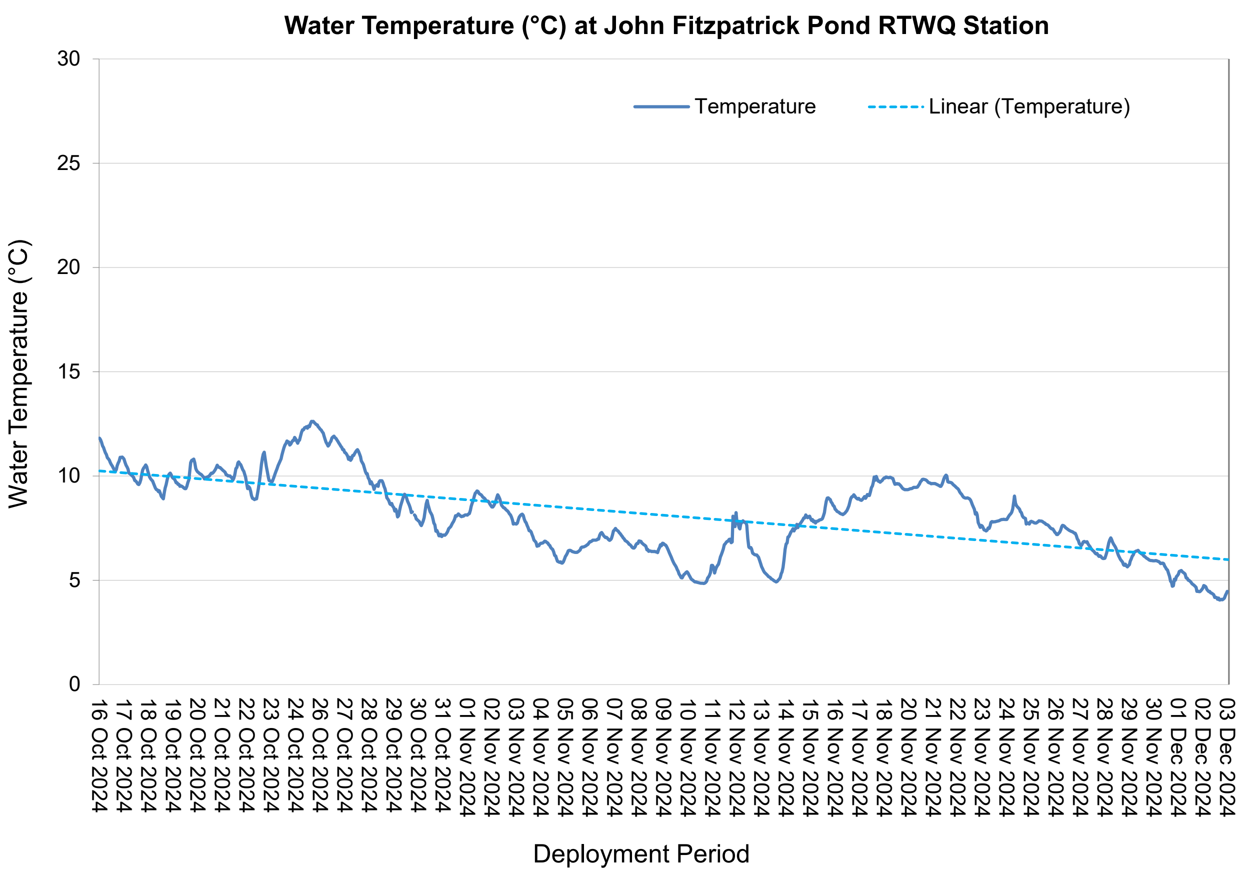

Figure 10: Water temperature (°C) values

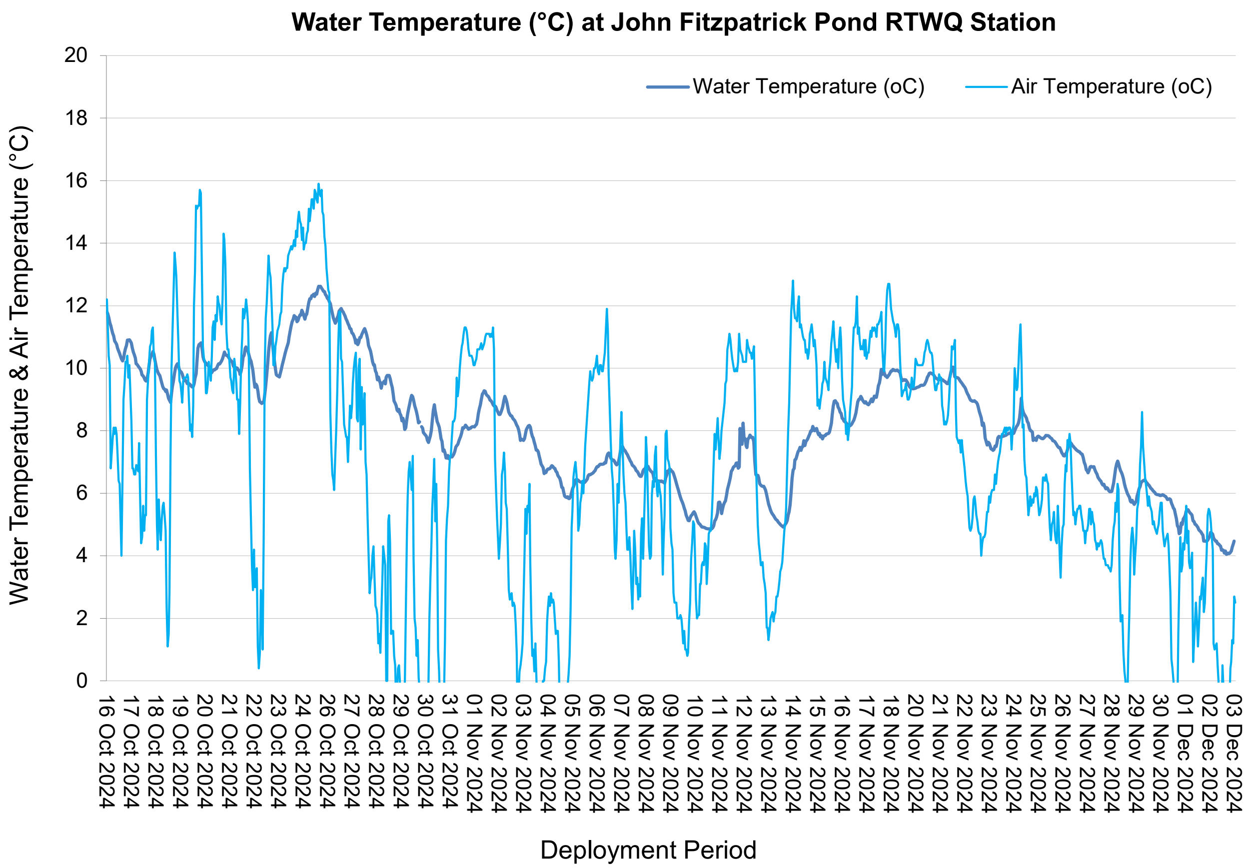

Figure 11: Water temperature (°C) and Air Temperature (°C) values

pH

Throughout this deployment period, pH values ranged within 7.16 pH units and 8.26 pH units with a median of 8.06 pH units (Figure 12), remaining within the Canadian Council of Ministers of the Environment (CCME) Guidelines for aquatic life of 6.5-9.0 pH units.

Small decreases in pH are evident on Figure 12. These coincide with precipitation events (Appendix I). pH does return to background levels after each event, and overall, the pH data was consistent across the deployment.

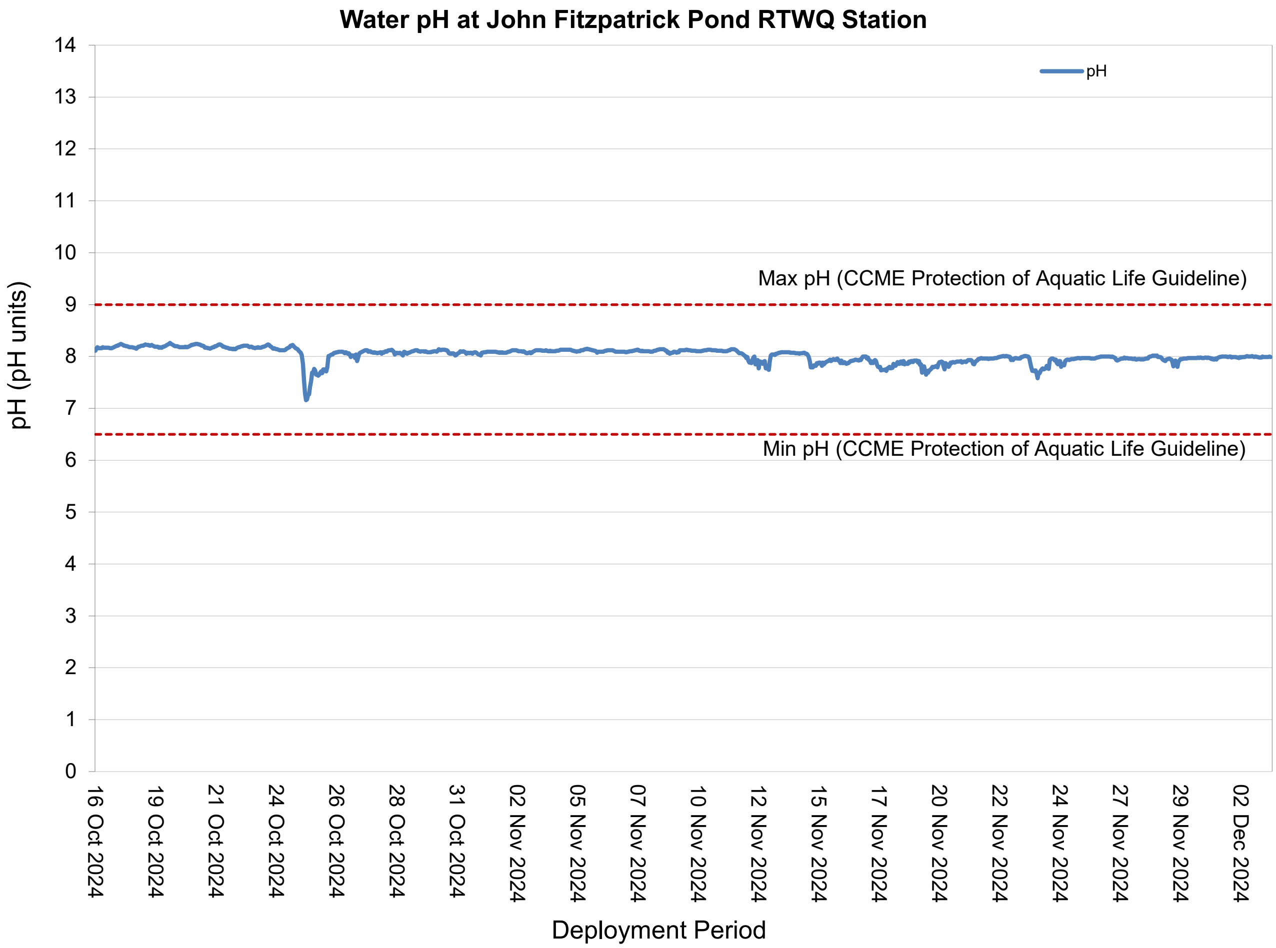

Figure 12: pH (pH units)

Specific Conductivity

Conductivity levels ranged between 106.3 µS/cm and 209.3 µS/cm, with a median of 192.6 µS/cm during the deployment period.

There are several dips in conductivity on the graph below that can be linked to precipitation events (Appendix I) that occurred at the same time. Conductivity tends to decrease when the water body is diluted with rainwater, however, levels generally return to normal values within a few days. The Outflow of Unnamed Pond South of Long Pond is a relatively small stream, making it susceptible to noticeable impacts from precipitation (Figure 13).

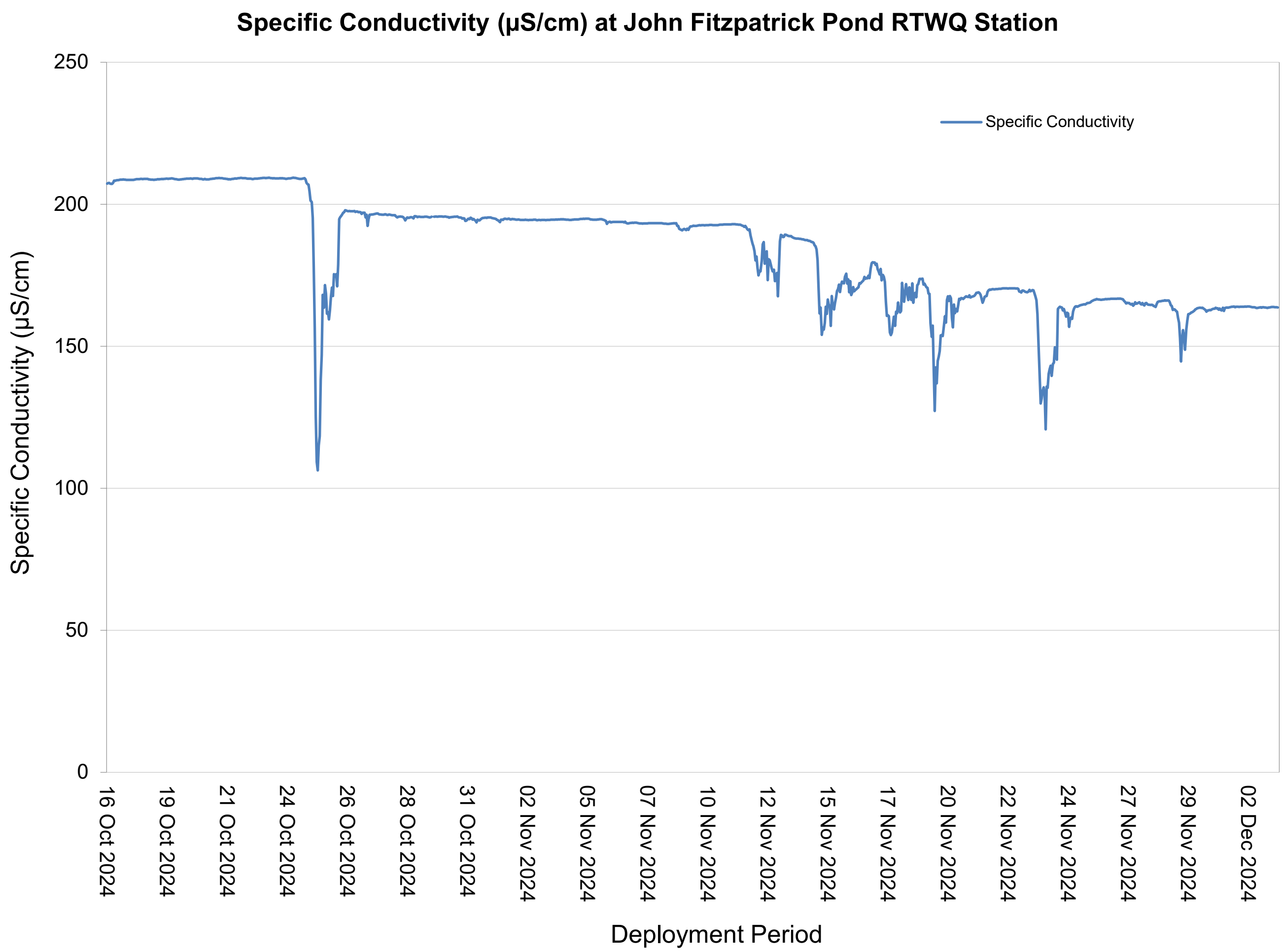

Figure 13: Specific conductivity (µS/cm)

Dissolved Oxygen

During this deployment, dissolved oxygen concentrations ranged from 10.23 mg/L to 12.82 mg/L, with corresponding percent saturation values between 93.8% and 105.4%.

Concentration values remained above the CCME Guidelines for the Protection of Other Life Stages and Early Life Stages throughout the period. DO levels remained stable during this period, with a gradual increasing trend, which correlates with the decreasing water temperature (Figure 14).

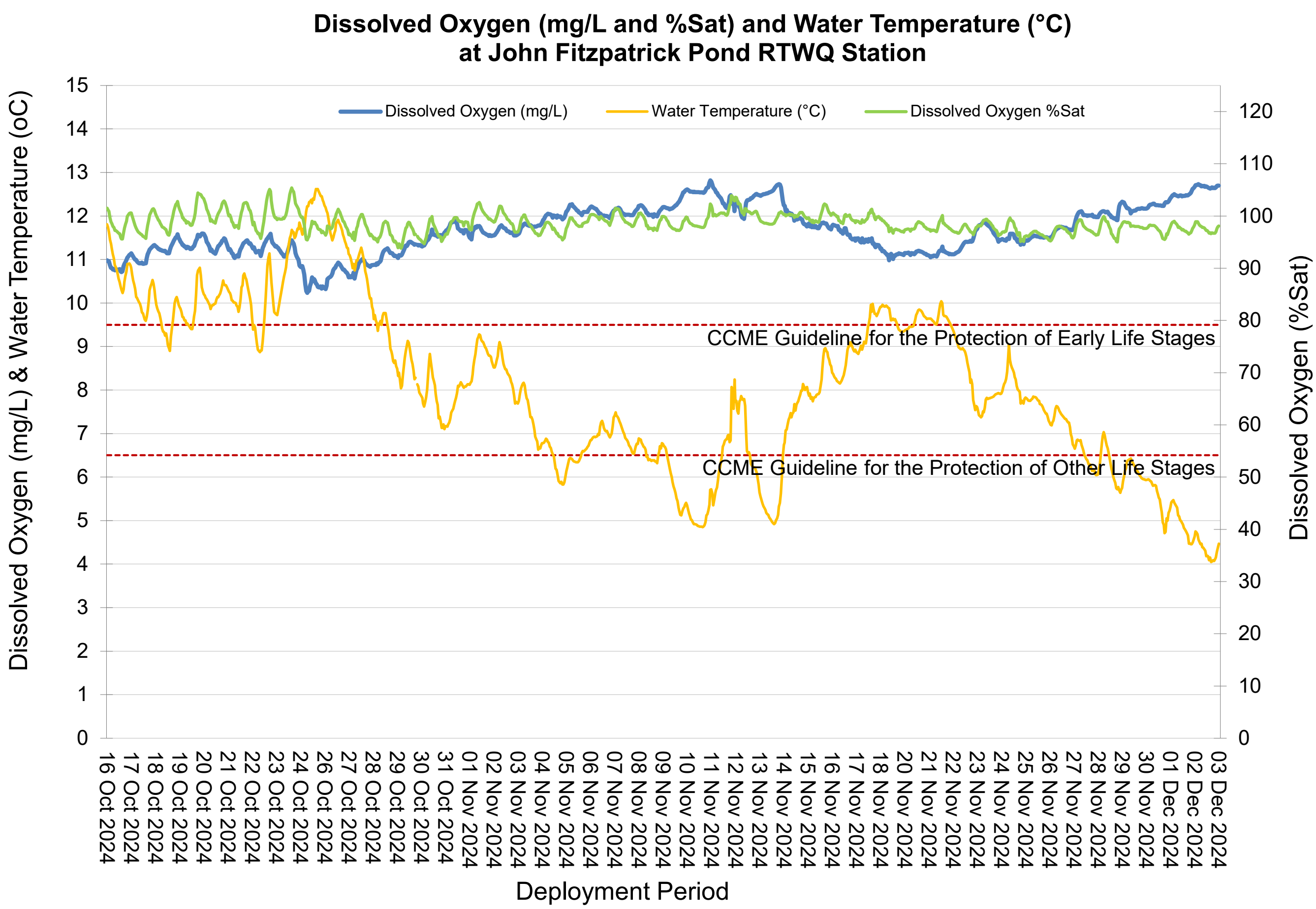

Figure 14: Dissolved Oxygen (%Sat & mg/L)

Turbidity

Turbidity levels during the deployment ranged within 0.8 NTU and 26.1 NTU, with a median of 1.4 NTU (Figure 15).

During a site visit to this station, it was noted that the pond is extremely clear with a rocky bottom made up of large rocks (Figure 15). Turbidity remained consistently low and stable throughout the deployment with periodic spikes that can be attributed to precipitation events.

Minor fluctuations and the larger spikes from October 24th through November can be linked to precipitation events (Appendix I). Precipitation increases runoff, carrying debris into the water body and disturbing the substrate at the bottom, which temporarily elevates turbidity levels.

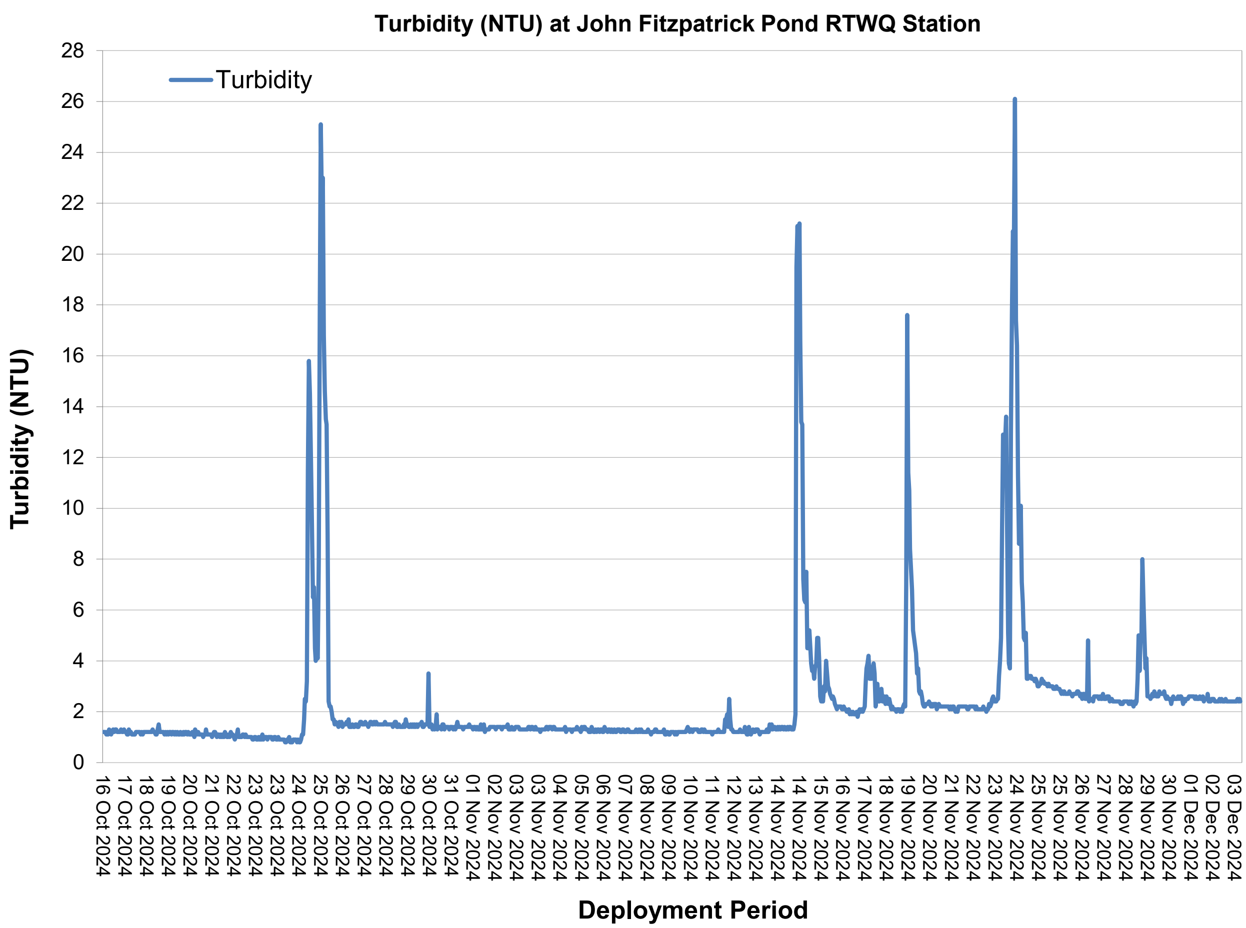

Figure 15: Turbidity (NTU)

Stage

Stage is an estimation of water level at the station and can account for variations in water quality parameters (e.g., Specific Conductivity, Dissolved Oxygen, turbidity). The stage ranged between 4.68m and 4.82m throughout the deployment.

Significant peaks in stage align with total precipitation events, as indicated in Figure 16. Total Precipitation data were obtained from Environment Canada's St. Lawrence weather station.

Water Resources Management Division hydrometric 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.

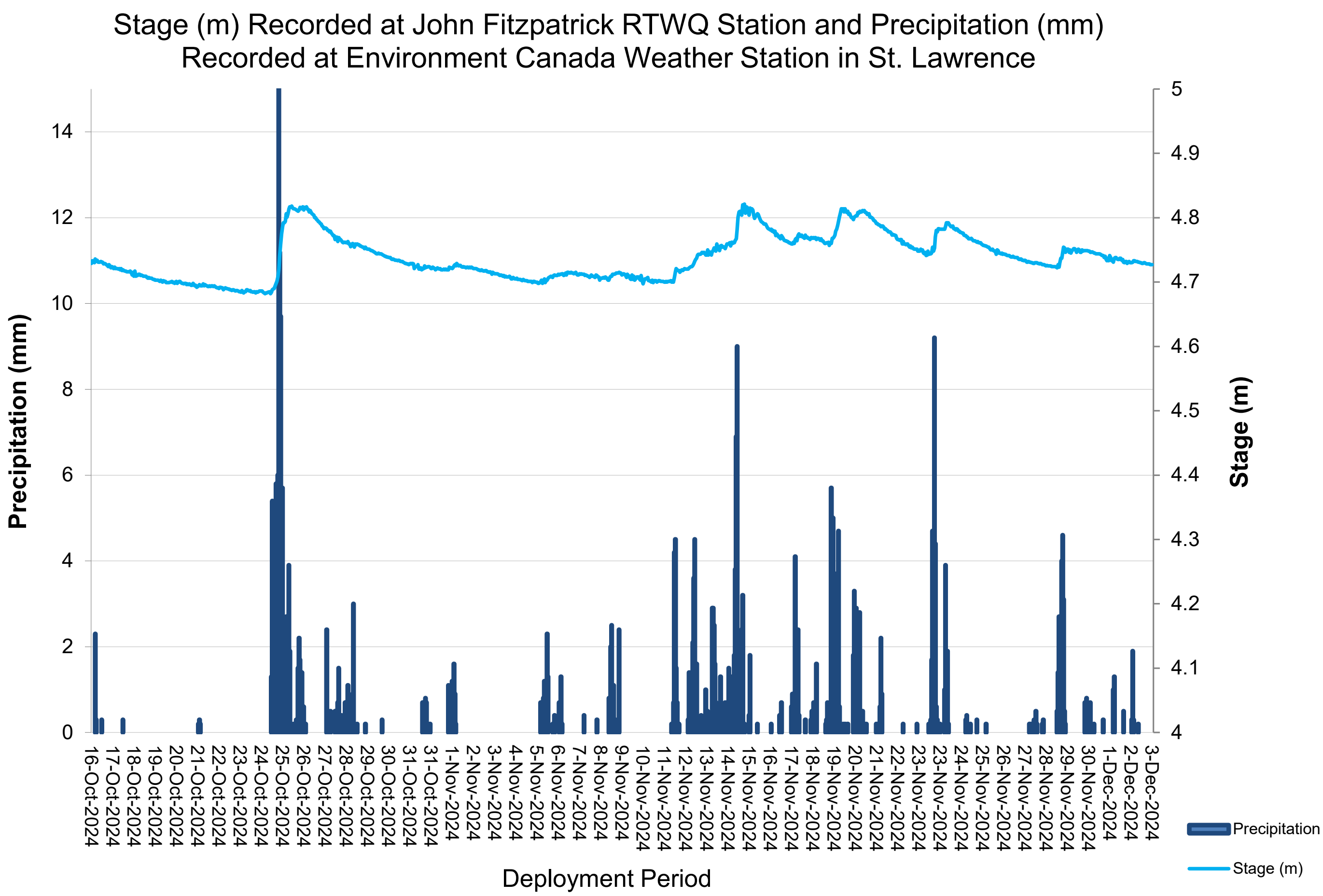

Figure 16: Stage (m)

APPENDIX I

Total Precipitation and Air Temperature recorded at Environment Canada, St. Lawrence Weather Station

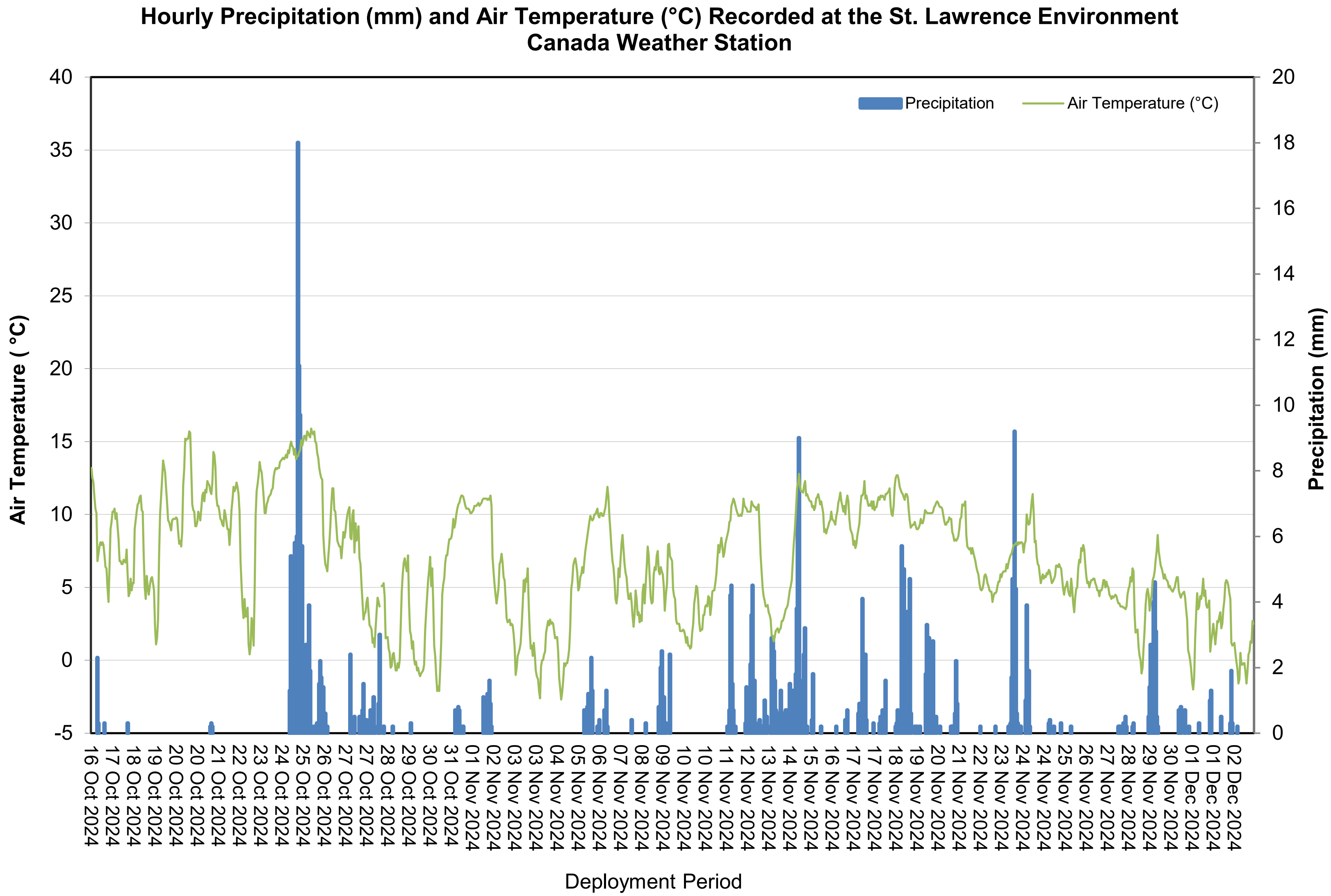

Figure 15: Precipitation recorded at Environment Canada Weather Station during the deployment period.

Appendix II

Parameter statistics for RTWQ Stations

Parameter Statistics

Deployment period: October 16th, 2024 to December 3rd, 2024

John Fitzpatrick Pond

Parameter	Max.	Min.	Median	Mean
Temperature(°C)	12.62	4.05	8.00	8.11
pH	8.26	7.16	8.06	8.03
Specific Conductivity (µS/cm)	209.33	106.29	192.57	183.69
TDS (g/mL)	0.14	0.07	0.13	0.12
Dissolved Oxygen (%Sat)	105.40	93.80	98.50	98.61
Dissolved Oxygen (mg/L)	12.82	10.23	11.62	11.66
Turbidity (NTU)	26.10	0.80	1.40	2.36
Stage (m)	4.82	4.68	4.73	4.74
Flow	No	Pond	Flow	Data

Table 3: John Fitzpatrick Pond RTWQ station deployment period parameter statistics.

Outflow of Unnamed Pond South of Long Pond

Parameter	Max.	Min.	Median	Mean
Temperature(°C)	14.38	1.34	7.61	7.66
pH	7.93	7.16	7.64	7.64
Specific Conductivity (µS/cm)	277.96	115.44	201.85	203.80
TDS (g/mL)	0.18	0.08	0.13	0.13
Dissolved Oxygen (%Sat)	102.80	94.30	98.20	98.29
Dissolved Oxygen (mg/L)	13.93	9.77	11.72	11.79
Turbidity (NTU)	191.90	0.70	1.40	2.88
Stage (m)	4.74	3.68	3.71	3.72
Flow	0.16	0.00	0.00	0.01

Table 4: Outflow of Unnamed Pond South of Long Pond RTWQ station deployment period parameter statistics