Real-Time Water Quality Report

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

Annual Deployment Period
May 8th, 2024 – December 3rd, 2024

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

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Introduction

The Water Resources Management Division (WRMD) maintain real-time water quality (RTWQ) and water quantity monitoring stations on John Fitzpatrick Pond and Outflow of Unnamed Pond south of Long Pond at the Canada Fluorspar Inc. mine site near St. Lawrence, Newfoundland and Labrador. The purpose of these stations is to monitor the impacts of mining activities on surface water downstream of the Tailings Management Facility and open pit mines.

Canada Fluorspar Inc. (CFI) entered a state of cold idle in 2022, halting all mining and production activities at the site. This status persisted throughout 2023. However, around June 2023, the mine restarted following its acquisition by a new owner with the goal to begin production at a later date. In April 2023, WRMD assumed responsibility for water quantity monitoring at each station which involves maintaining the datalogger and bubbler, periodic water level checks and other related duties.

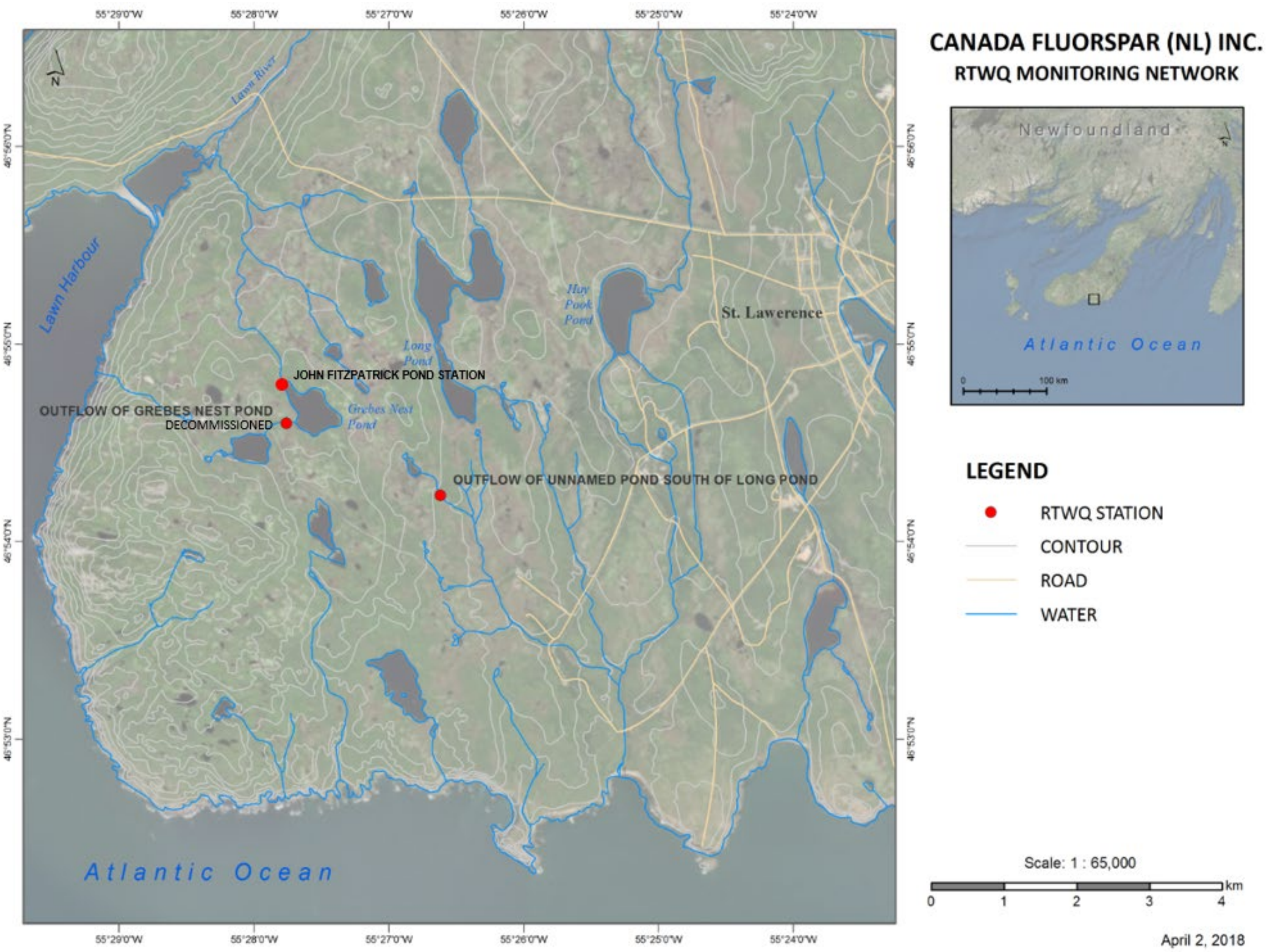

Figure 1: Real-Time Water Quality and Quantity Stations at Canada Fluorspar Inc.

Decommission of Outflow of Grebes Nest Pond

Due to a change in the water supply, it was determined that Outflow to Grebes Nest Pond would not provide adequate, consistent water supply to remain a monitoring station. A replacement station location was selected and the hut and water quality instrumentation were relocated in May 2022 to John Fitzpatrick Pond, which has consistent water supply and the capability to provide an overview of the water quality conditions.

John Fitzpatrick Pond

John Fitzpatrick Pond RTWQ station was established in May 2022, with an instrument first deployed in June 2022. The site was selected based on the location and consistent water supply throughout the year. Despite an expected small decrease in water level during the summer, this station provides stable and beneficial water quality data for the monitoring network (Figure 2).

The Real Time station was 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 bordered by the CFI mine on the southwest side (Figure 1). There are two small brooks that periodically flow into this pond. This station monitors 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 2: Real-Time station at John Fitzpatrick Pond. Station hut (left) and the instrument deployed in the pond (right)

Outflow of Unnamed Pond south of Long Pond

Outflow of Unnamed Pond south of Long Pond was established in December 2016 and is located downstream of the Tailings Management Facility (TMF). This station provides near real-time water quality and quantity data to ensure emerging issues associated with the TMF are detected, allowing the appropriate mitigation measures to be implemented in a timely manner, 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 3). The stream originates from a small unnamed pond and meanders through marshland adjacent to 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: **N 46° 54’ 14.1” W 55° 26’ 37.5”**. The station hut was placed on the west bank approximately 8 meters from the stream (Figure 3).

Figure 3: Real-Time station at Outflow of Unnamed Pond South of Long Pond Station. The hut (left) and the instrument deployed in the brook (right).

Station Setup

Water quality parameters are measured at each station using an EXO 2 multiprobe instrument (Figure 4).

Figure 4: EXO 2 used for monitoring water quality parameters.

Six water parameters are measured at each station, including five water quality parameters (water temperature, dissolved oxygen, pH, turbidity, and specific conductivity), and one water quantity parameter (stage). Additionally, the water quality instrument has the capability to use specific conductivity and water temperature to calculate the total dissolved solids (TDS) present in the brook.

Water quality data is collected on an hourly basis (every 60 minutes) at both stations. Water quantity data is logged at John Fitzpatrick Pond every 5 minutes and at the Outflow of Unnamed Pond every 15 minutes.

The data for both stations is viewable and downloadable online through WRMD's Real Time Water Monitoring webpage located here: Real Time Water Quality Monitoring Stations - Environment and Climate Change (gov.nl.ca)

Data Interpretation

WRMD staff with the Department of Environment & Climate Change (ECC) are responsible for maintenance of the real-time water monitoring equipment, as well as grooming, analyzing, and reporting on the water quality data recorded at the stations. Performance and data records are interpreted for both stations for the following parameters:

• Water Temperature (°C)	• pH (pH units)	• Specific Conductivity(µS/cm)	• Total Dissolved Solids (g/L)
• Dissolved Oxygen (mg/L)	• Dissolved Oxygen (%Sat)	• Turbidity (NTU)	• Stage (m)

A description of each parameter is outlined in Appendix I

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.**

The following report discusses the water quality parameters recorded from May 2024 to December 2024. These interpretations aim to point out seasonal trends and any significant issues influencing the water quality parameters.

Quality Assurance and Quality Control

To ensure accurate data collection, water quality instruments are subjected to quality assurance procedures to mitigate any errors caused by biofouling and/or sensor drift. Quality assurance procedures include: (i) a thorough cleaning of the instrument, (ii) replacement of any small sensor parts that are damaged or unsuitable for reuse, and (iii) the calibration of the sensors using standard solutions. Approximately every six weeks, the instrument is removed from the waterbody to undergo quality assurance procedures, while a newly cleaned and calibrated instrument is deployed.

During 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. Table 1 below summarizes the deployment periods and comparison rankings for 2024. Additionally, grab samples are collected during deployment to compare pH, turbidity, and specific conductivity values against the field sonde. Grab sample – field sonde performance rankings can be found below in Table 2. Based on the degree of difference between the parameters on the Field Sonde and QA/QC Sonde/grab sample, the water quality data is assigned a performance ranking (i.e. poor, marginal, fair, good, excellent) which can be found in Table 3 below.

For more detailed analyses of a particular time period, date or deployment period, please refer to the individual deployment reports: Real Time Water Quality Information – Calibration Schedule and Deployment Reports - Environment and Climate Change (gov.nl.ca)

Table 1: 2024 Deployment Periods and Field Sonde-QA/QC Sonde Performance Rankings

Station	Date	Action	2024 Deployment Season Comparison Ranking				
			Temperature	pH	Specific Conductivity	Dissolved Oxygen	Turbidity
John Fitzpatrick Pond	May 8, 2024	Deployment	Excellent	Excellent	Fair	Excellent	Excellent
	July 4, 2024	Removal	Good	Good	Excellent	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	May 9, 2024	Deployment	Good	Excellent	Excellent	Excellent	Excellent
	July 4, 2024	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
John Fitzpatrick Pond	July 4, 2024	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	August 6, 2024	Removal	Excellent	Excellent	Good	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	July 4, 2024	Deployment	Good	Excellent	Excellent	Excellent	Excellent
	August 6, 2024	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
John Fitzpatrick Pond	August 6, 2024	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	August 26, 2024	Removal	Good	Excellent	Excellent	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	August 6, 2024	Deployment	Good	Excellent	Fair	Good	Excellent
	August 26, 2024	Removal	Good	Excellent	Excellent	Excellent	Fair
John Fitzpatrick Pond	August 26, 2024	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	October 16, 2024	Removal	Excellent	Excellent	Good	Good	Excellent
Outflow to Unnamed Pond south of Long Pond	August 26, 2024	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	October 16, 2024	Removal	Excellent	Excellent	Good	Good	Excellent
John Fitzpatrick Pond	October 16, 2024	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	December 3, 2024	Removal	Excellent	Good	Fair	Excellent	Excellent
Outflow to Unnamed Pond south of Long Pond	October 16, 2024	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	December 3, 2024	Removal	Excellent	Excellent	Good	Excellent	Excellent

Table 2: 2024 Deployment Season Grab Sample-Field Sonde Performance Rankings

Date	Station	2024 Deployment Season Grab Sample Comparison Ranking		
		pH	**Specific Conductivity**	**Turbidity**
May 8, 2024	**John Fitzpatrick Pond**	Excellent	Excellent	Excellent
May 9, 2024	**Outflow to Unnamed Pond south of Long Pond**	Fair	Excellent	Excellent
July 4, 2024	**John Fitzpatrick Pond**	Excellent	Excellent	Excellent
	Outflow to Unnamed Pond south of Long Pond	Good	Good	Good
August 6, 2024	**John Fitzpatrick Pond**	Excellent	Fair	Excellent
	Outflow to Unnamed Pond south of Long Pond	Good	Excellent	Excellent
August 26, 2024	**John Fitzpatrick Pond**	Excellent	Excellent	Excellent
	Outflow to Unnamed Pond south of Long Pond	Good	Excellent	Excellent
October 16, 2024	**John Fitzpatrick Pond**	Good	Excellent	Excellent
	Outflow to Unnamed Pond south of Long Pond	Excellent	Excellent	Excellent

Table 3: 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

Concerns or Issues during the 2024 Season

During a site visit to the Outflow of Unnamed Pond South of Long Pond RTWQ station, a water level survey identified inaccuracies in the hydrometric plate's measurements. As a result, hydrometric data recorded within July 30, 2024 to October 16, 2024, has been excluded from this report.

It should be noted that Water Resources Management Division hydrometric data (stage and flow) 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.

The John Fitzpatrick Pond RTWQ station encountered transmission problems on July 29th, 2024. During an investigation of the station, it was discovered that the main antenna cable on the outside of the hut, had been chewed through. There was evidence of an animal, likely a bear having been at the hut. This has happened at other locations with known bear activity, however a first for CFI stations. Due to this there is no stage data available for John Fitzpatrick pond from July 29th, 2024 to October 17th, 2024.

In the Spring of 2026, the dataloggers that currently transmit raw data from the stations will become obsolete. ECC has provided CFI with quotes for several dataloggers that are compatible with the station infrastructure and can replace the current one. Once the dataloggers have been purchased by CFI, these upgrades will happen in the summer of 2025.

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

Water Temperature

The John Fitzpatrick Pond water temperature ranged from 4.05 °C to 24.07 °C while the Outflow of Unnamed Pond south of Long Pond water temperature ranged from 2.73 °C to 26.7 °C. (Table 4).

Water temperatures at both stations display large diurnal variations (Figure 5/6). This is typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures (Figure 5). Trends in water temperature corresponded well with trends in air temperatures, displaying increases from June through August and decreases as Fall then Winter sets in.

Table 4: Summary of the 2024 Water Temperature data at CFI Real-Time Stations

	Water Temperature (°C)	
	John Fitzpatrick	Outflow of Unnamed
Min	4.05	2.73
Max	24.07	26.7
Median	14.79	14.45

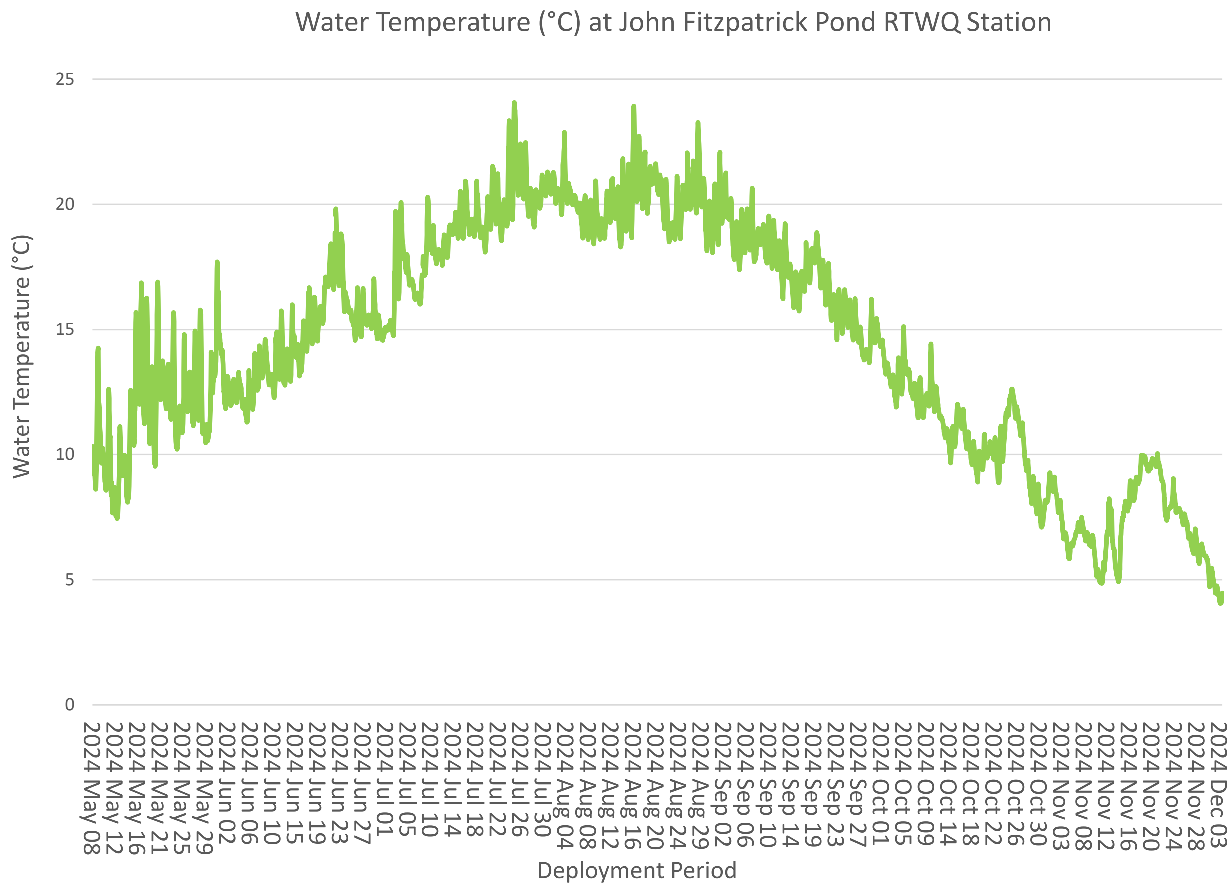

Figure 5: Water temperature (°C) recorded at John Fitzpatrick Pond RTWQ station

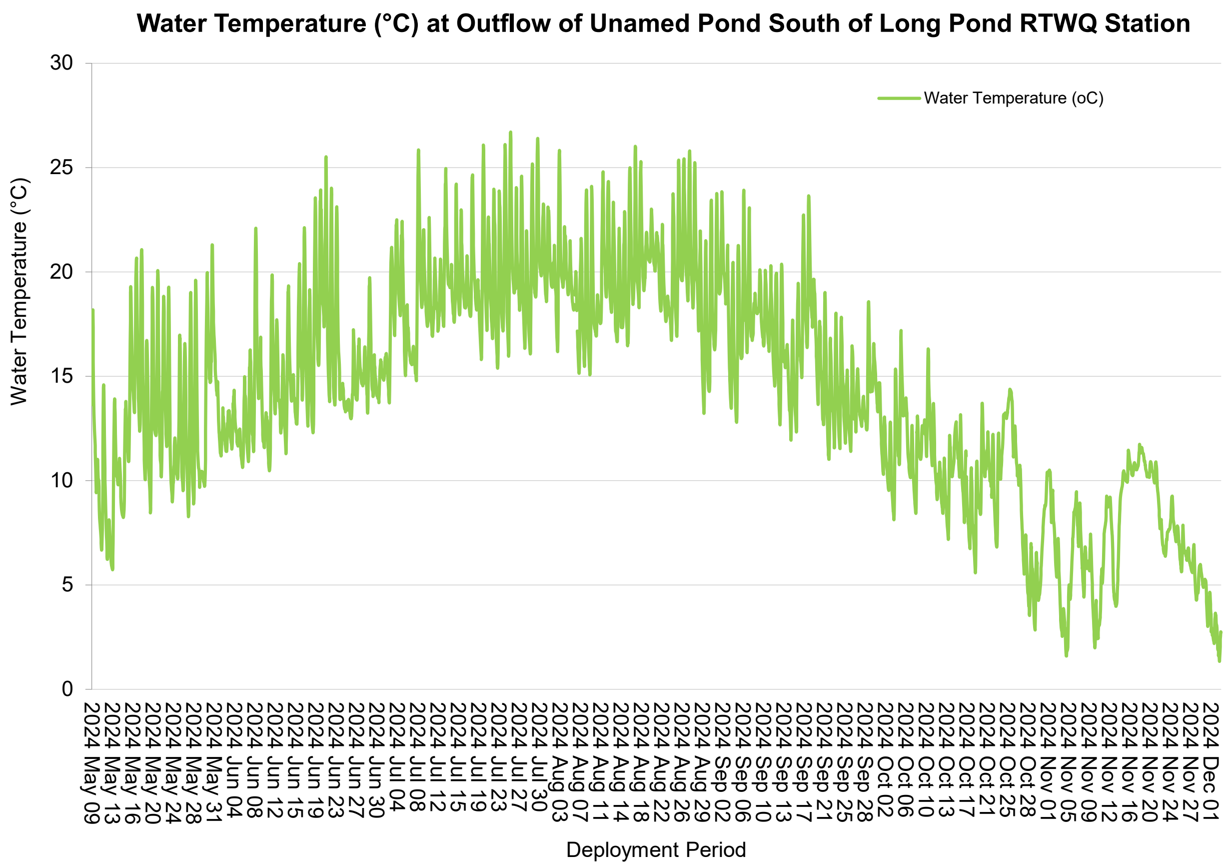

Figure 6: Water temperature (°C) recorded at Outflow of Unnamed RTWQ station

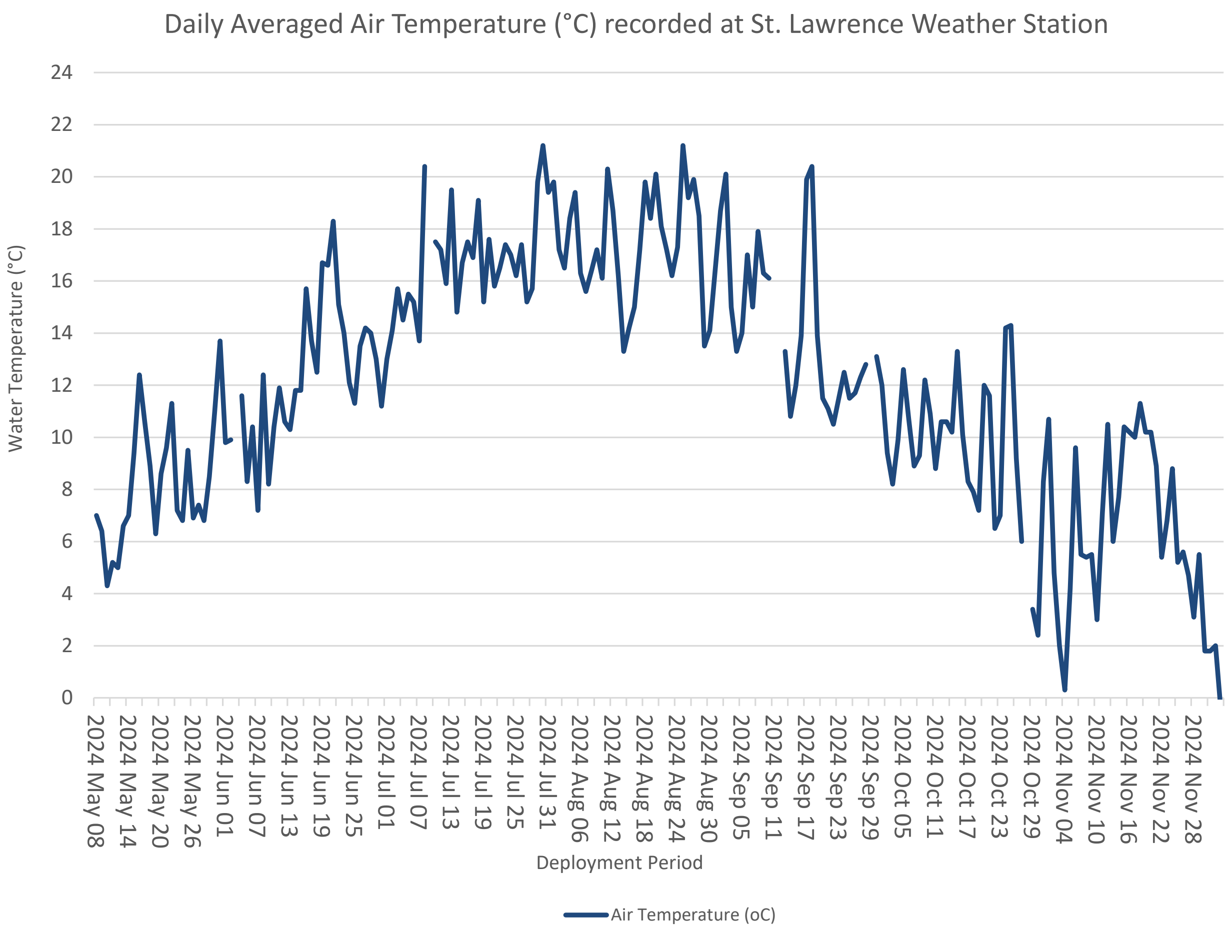

Figure 7: Daily Averaged Air Temperature (°C) recorded at St. Lawrence Weather Station

pH

John Fitzpatrick Pond pH ranged from 7.16 to 8.49 pH units while at the Outflow of Unnamed Pond South of Long Pond station, the pH ranged from 7.65 to 7.93 pH units (Table 4). The Outflow of Unnamed typically experiences larger fluctuations due to it being a small brook that is easily influenced by environmental factors. John Fitzpatrick Pond had a median of 8.05 pH units which is slightly higher than the 2023 median of 7.75 (see Appendix II), which can likely be related to pumping of the open pit mines flowing into the pond. Outflow of Unnamed 2024 median of 7.7 pH units, did not change from the 2023 median of 7.78.

pH at both stations was relatively consistent throughout the deployment season, remaining within the CCME Guidelines for the Protection of Aquatic Life of 6.5 – 9.0 pH units. There were several incidences where pH dipped down below background levels which can often be attributed to an increase in stage levels (Figure 8/9). Stage increases are typically the result of precipitation events.

Table 5: Summary of 2024 pH data at CFI Real-Time Stations

	pH (pH units)	
	John Fitzpatrick	Outflow of Unnamed
Min	7.16	7.65
Max	8.49	7.93
Median	8.05	7.7

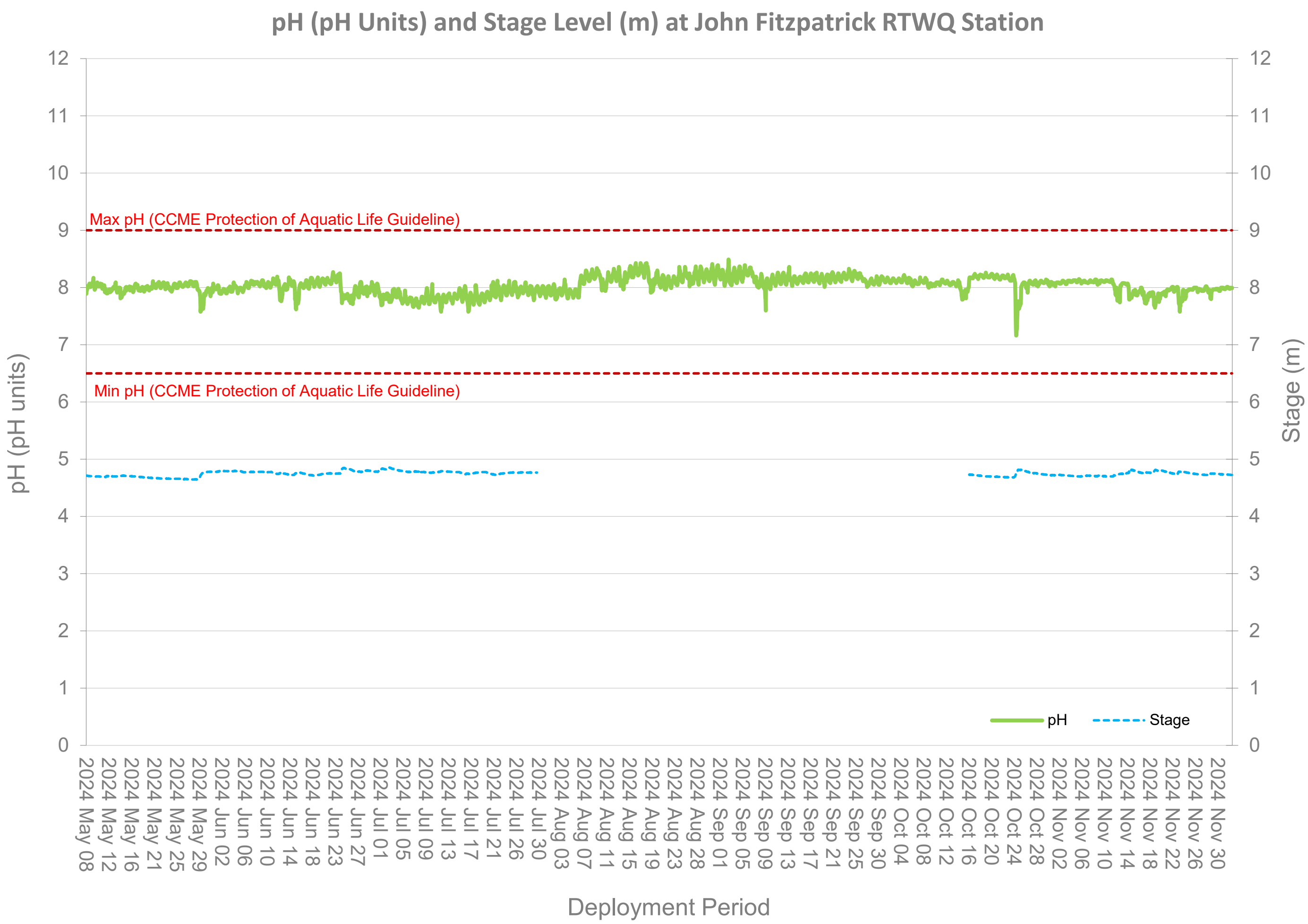

Figure 8: pH and Stage Level (m) recorded at John Fitzpatrick Pond RTWQ Station

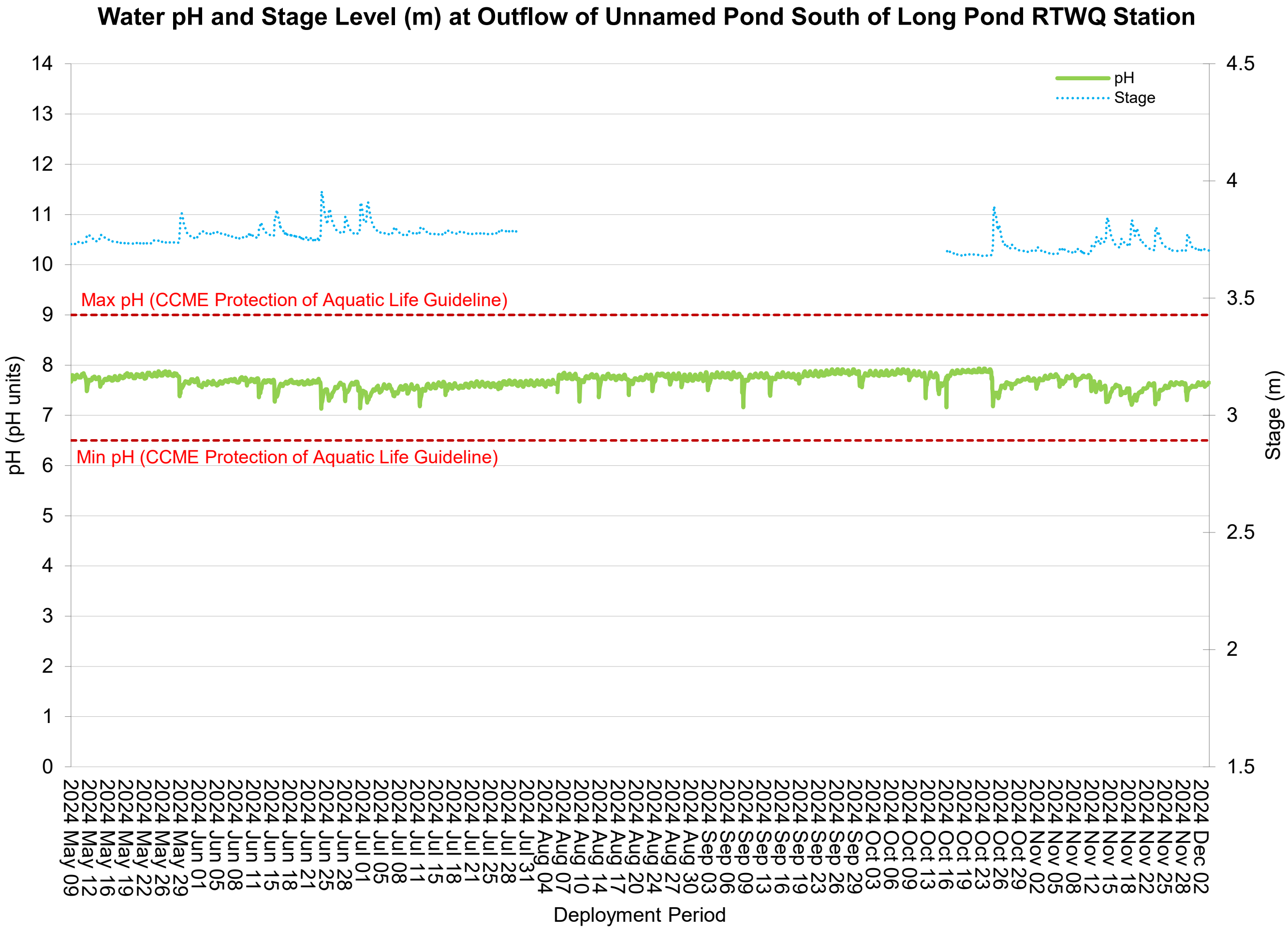

Figure 9: pH and Stage (m) recorded at Outflow of Unnamed Pond South of Long Pond RTWQ Station

Specific Conductivity

During the 2024 deployment season, conductivity levels ranged from 106.29 µS/cm to 224.41 µS/cm at John Fitzpatrick Pond and, 209.91 µS/cm to 322.77 µS/cm at Outflow of Unnamed Pond south of Long Pond (see Table 5). There is a direct relationship between conductivity and stage. Generally during rainfall events, the additional water dilutes the minerals and material present in the water column, lowering the conductivity levels. However, if sediment or materials from the surrounding environment are flushed into the brook, conductivity levels may rise.

Specific conductivity recorded at John Fitzpatrick Pond had a median of 195.35 µS/cm, slightly lower from the 2023 median of 197.1 µS/cm. Conductivity overall displayed a relatively constant trend. Many of the dips and increases in the data can be attributed to precipitation events and the pumping of the open pit mines into John Fitzpatrick Pond.

Specific conductivity recorded at Outflow of Unnamed Pond south of Long Pond had a 2024 median of 243.23 µS/cm, which is comparable to the 2023 median of 242.8 µS/cm. This station is located downstream from the Tailings Management Facility so typically any leaks from the TMF will cause noticeable increases in the conductivity levels. The fluctuations in conductivity observed throughout 2024 likely stem from precipitation events leading to increases in water levels. Significant drops coincide with spikes in water levels, followed by a gradual return of conductivity levels to their baseline (refer to Figure 11).

Table 6. Summary of 2024 specific conductivity data at the CFI Real-Time Stations

	Specific Conductivity (µS/cm)	
	John Fitzpatrick	Outflow of Unnamed
Min	106.29	209.91
Max	224.41	322.77
Median	195.35	243.23

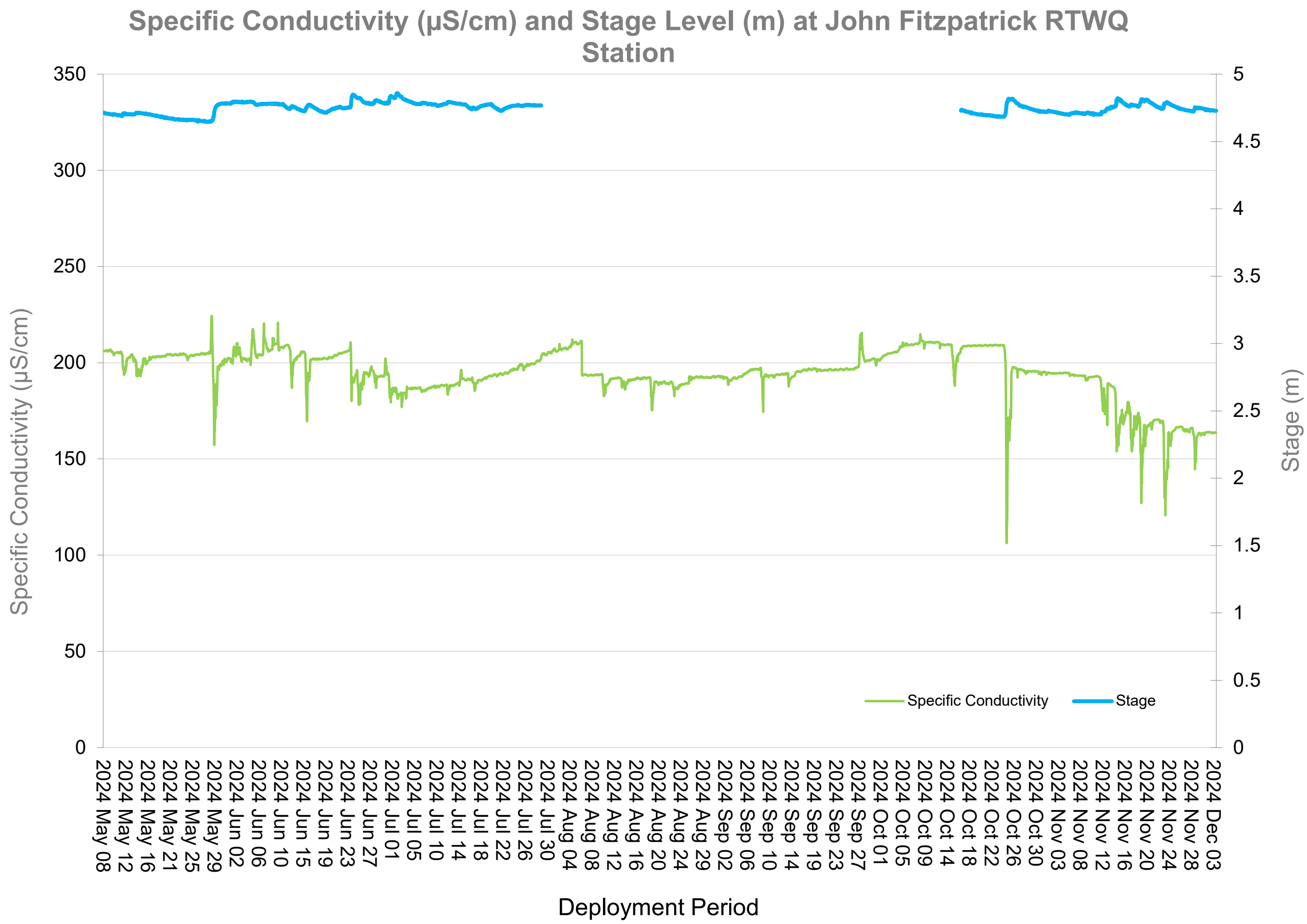

Figure 10: Specific conductivity (µS/cm) recorded at John Fitzpatrick Pond Real-Time Station

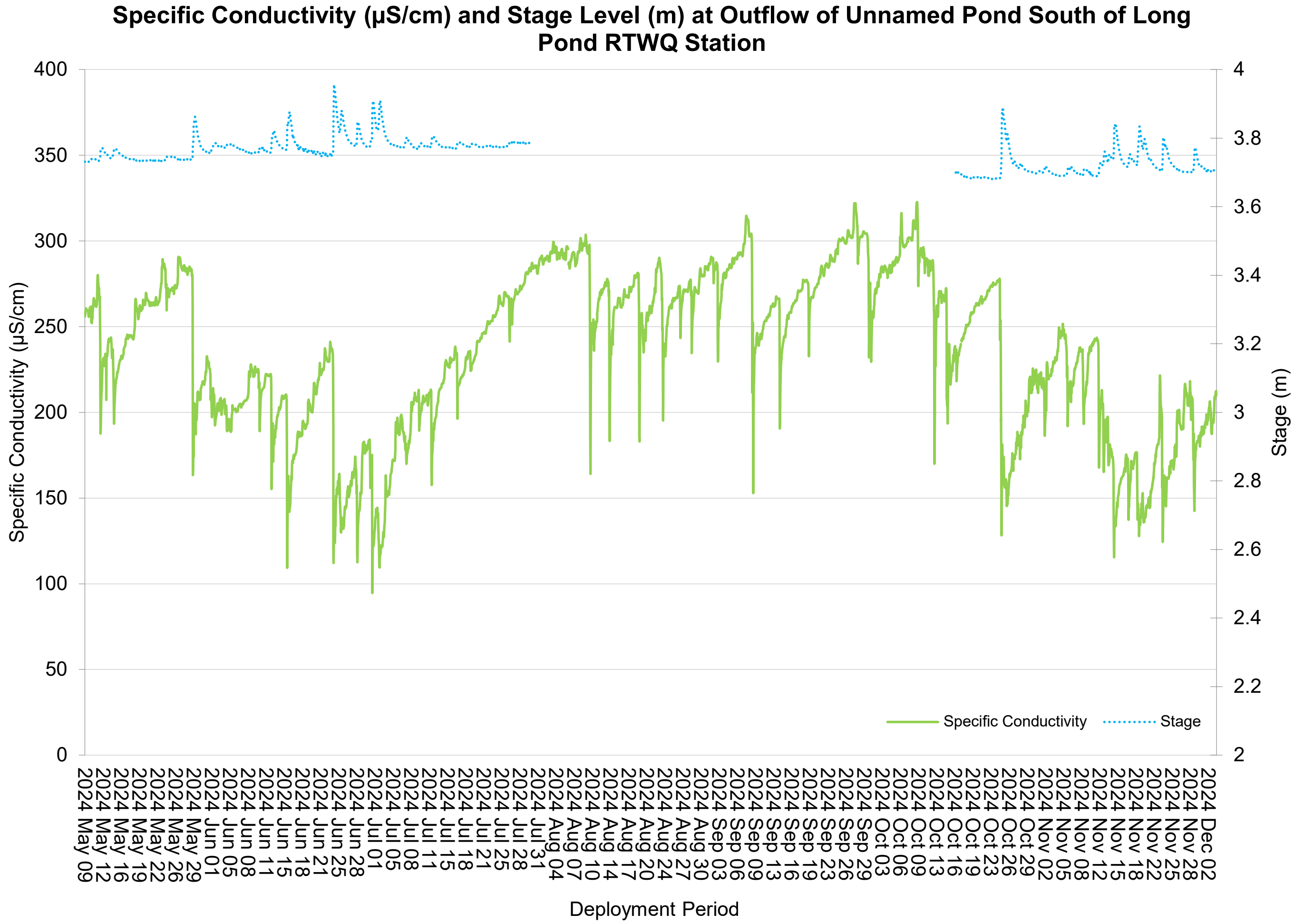

Figure 11: Specific conductivity (µS/cm) at the Outflow of Unnamed Pond South of Long Pond Real-Time Station

Dissolved Oxygen (DO)

Over the 2024 annual deployment period, the dissolved oxygen concentrations ranged from 8.45mg/L to 12.82mg/L at John Fitzpatrick Pond, with percent saturation levels ranging between 91.5% to 119.5%. Outflow of Unnamed Pond south of Long Pond dissolved oxygen concentrations ranged from 10.5 mg/L to 13.93 mg/L and percent saturation ranged from 100 % to 107.7 % (see Table 6). DO for both stations remained above the CCME Guideline for the Protection of Other Life Stages of Aquatic Life (6.5 mg/L) throughout the year and close to or above the Guideline for the Protection of Early Life Stages (9.5 mg/L) for a portion of the year.

Dissolved oxygen levels exhibited natural daily fluctuations at both locations due to changes in temperature and the photosynthetic activity of aquatic organisms regarding CO_2. The patterns observed in DO align with the inverse relationship with water temperature; colder water tends to hold more dissolved oxygen compared to warmer water.

Table 7. Summary of 2024 Dissolved oxygen data at Canada Fluorspar Inc. Real-Time Stations

	John Fitzpatrick Dissolved Oxygen		Unnamed Pond Dissolved Oxygen	
	mg/L	%Sat	mg/L	%Sat
Min	8.45	91.5	10.5	100
Max	12.82	119.5	13.93	107.7
Median	10.53	100.8	10.08	98.3

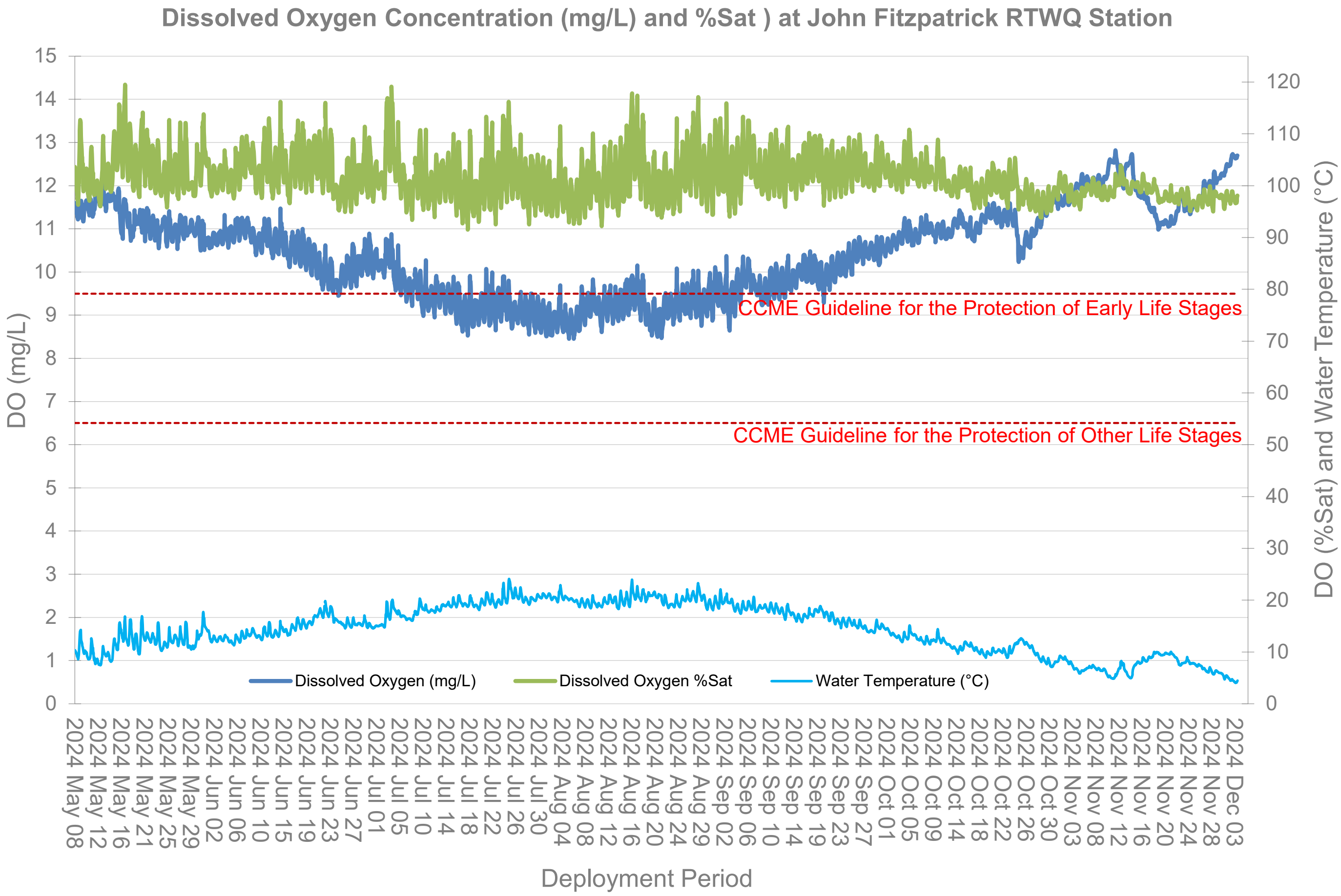

Figure 12: Dissolved Oxygen (%Sat and mg/l) and Water Temperature (°C) at John Fitzpatrick Pond Real-Time Station

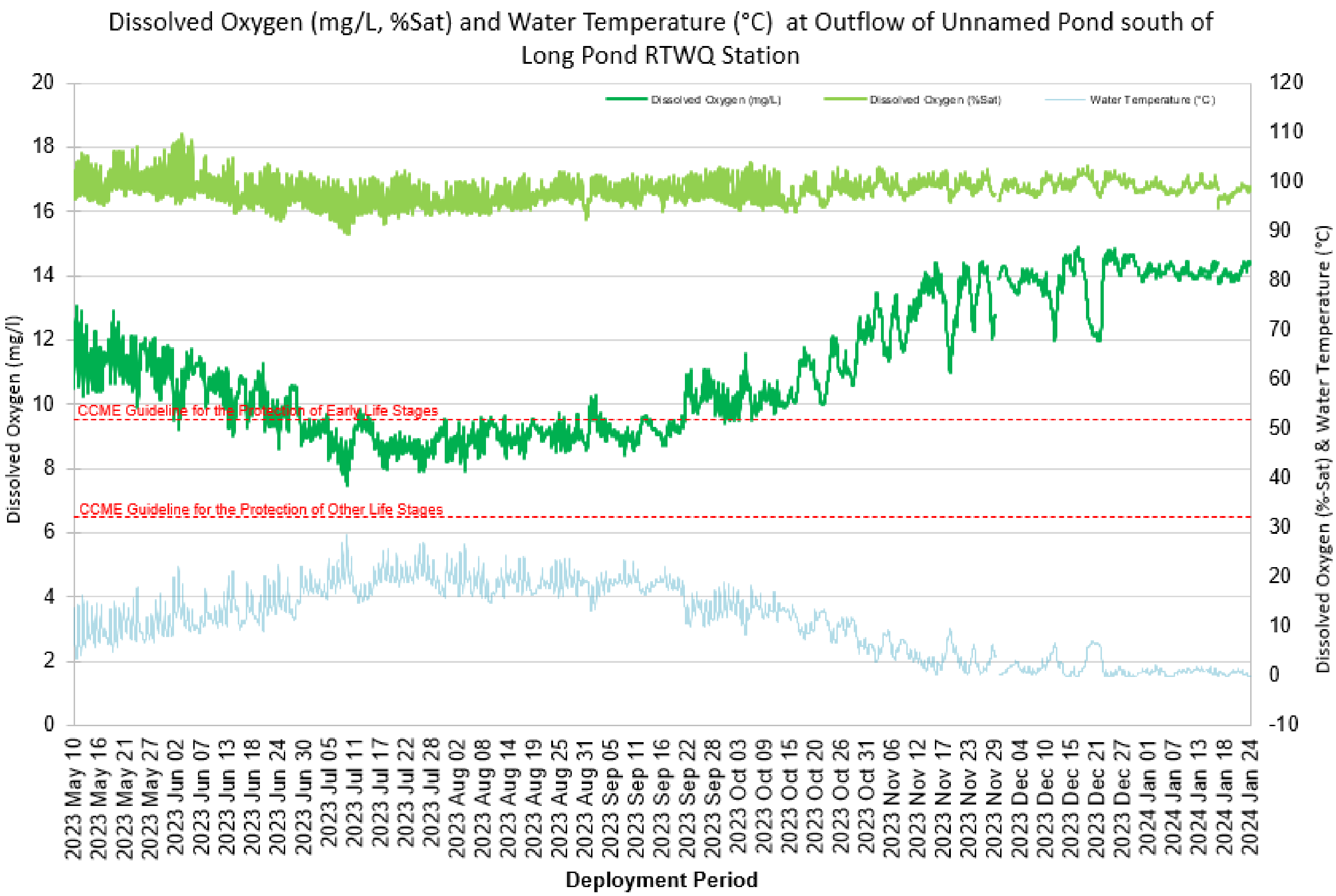

Figure 13: Dissolved Oxygen (%Sat and mg/l) and Water Temperature (°C) at Outflow of Unnamed Real-Time Station

Turbidity

Turbidity levels during the deployment ranged from 0.31 NTU to 26.1 NTU at John Fitzpatrick Pond and 1.3 NTU to 116.1 NTU at Outflow of Unnamed Pond south of Long Pond.

Outside of the high spike of 191.9 NTU at Outflow of Unnamed station, the turbidity levels at this station remained relatively low and consistent, staying below 50 NTU majority of the year. Spikes in the data are typically a result of precipitation events that could result in increased sediment entering the water column from run-off, or disturbed sediment in the water column. Turbidity returned to background values shortly after spikes.

Table 8. Summary for 2024 Turbidity data at CFI Real-Time stations

	Turbidity (NTU)	
	John Fitzpatrick	Outflow of Unnamed
Min	0.31	1.3
Max	26.1	116.1
Median	1.21	1.6

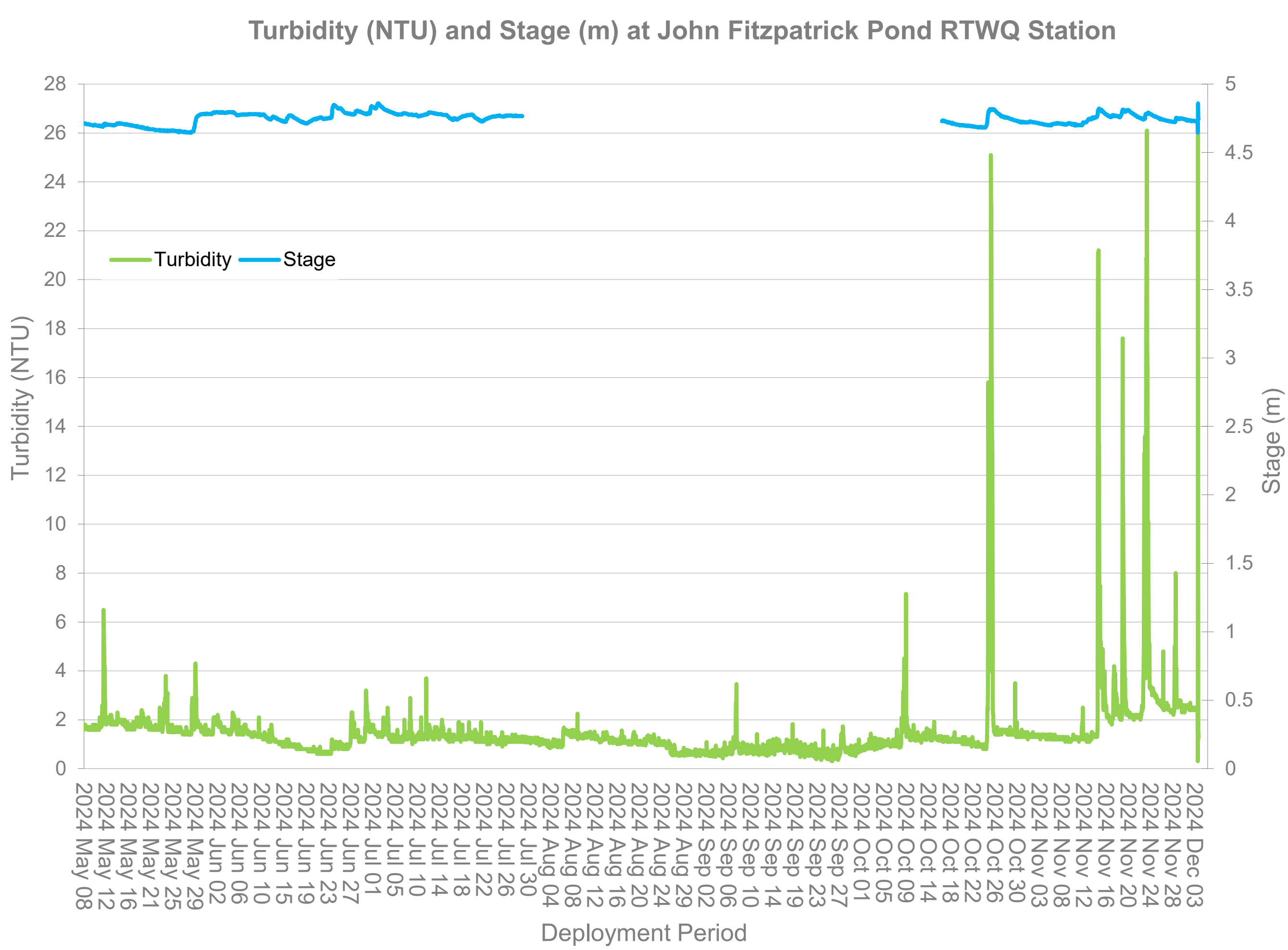

Figure 14: Turbidity (NTU) measurements record at John Fitzpatrick Pond Real-Time Station

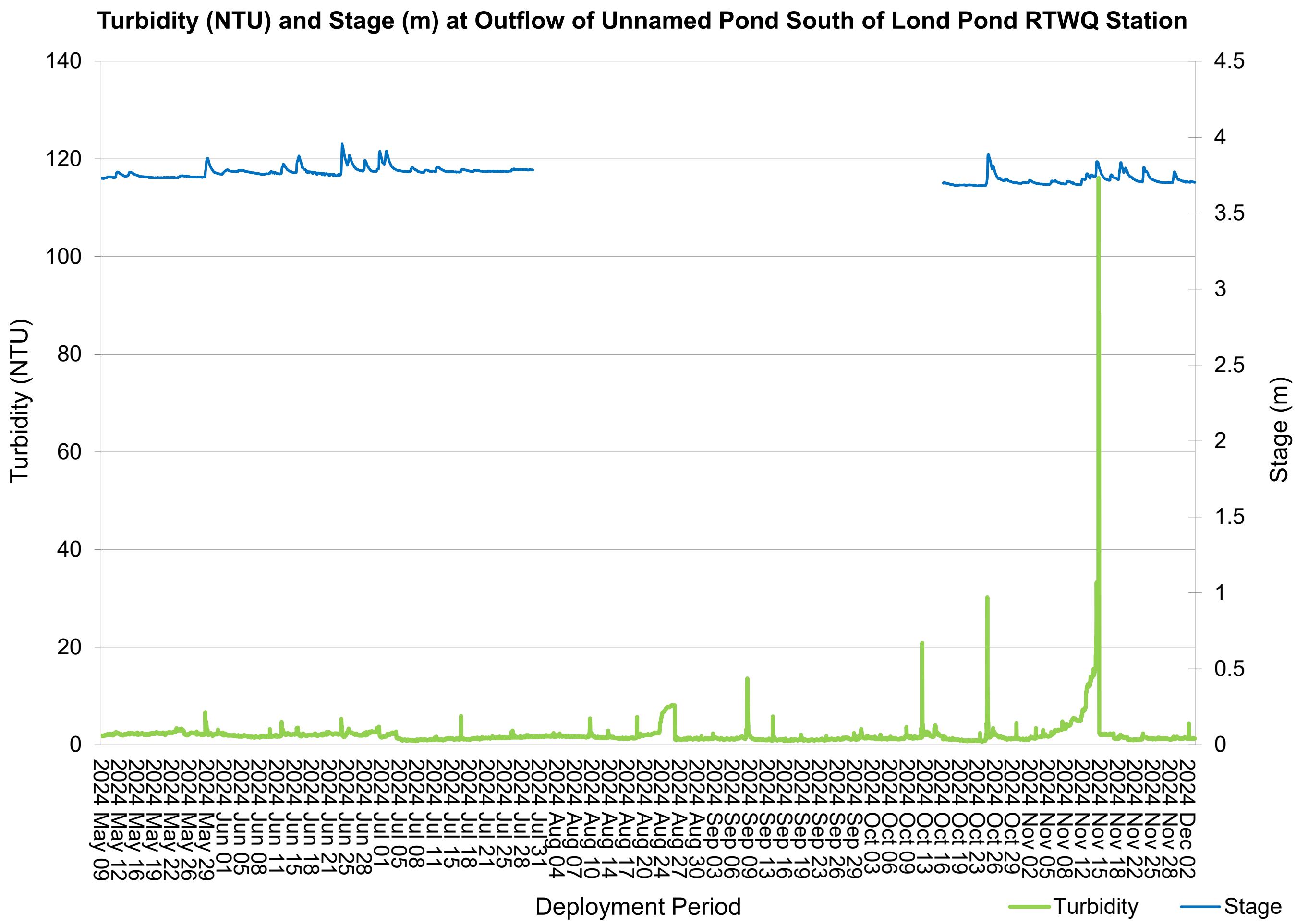

Figure 15: Turbidity (NTU) values at Outflow of Unnamed Pond South of Long Pond Real Time Station

Total Precipitation & Daily Averaged Stage Data

Stage is important as it provides an estimation of water level at the station and can explain some of the fluctuations that are occurring in relation to other parameters (i.e. Specific Conductivity, DO, turbidity). Stage will increase naturally during rainfall events (Figure 16) and during any surrounding snow or ice melt as runoff collects in the brooks. Total hourly precipitation data was obtained from Environment Canada's St. Lawrence weather station. Although the stations are not on the same river, both sites had similar peaks in stage during the rainfall events.

During a site visit to the Outflow of Unnamed Pond South of Long Pond RTWQ station, a water level survey identified inaccuracies in the hydrometric plate's measurements. As a result, hydrometric data recorded within July 30, 2024 to October 16, 2024, has been excluded from this report.

Due to a potential animal interference at John Fitzpatrick Pond station this there is no stage data available for July 29th, 2024 to October 17th, 2024.

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.

Table 9. Summary of 2024 Stage data at CFI Real-Time stations

	Stage (m)	
	John Fitzpatrick	Outflow of Unnamed
Min	4.65	3.703
Max	4.86	3.957
Median	4.75	3.758

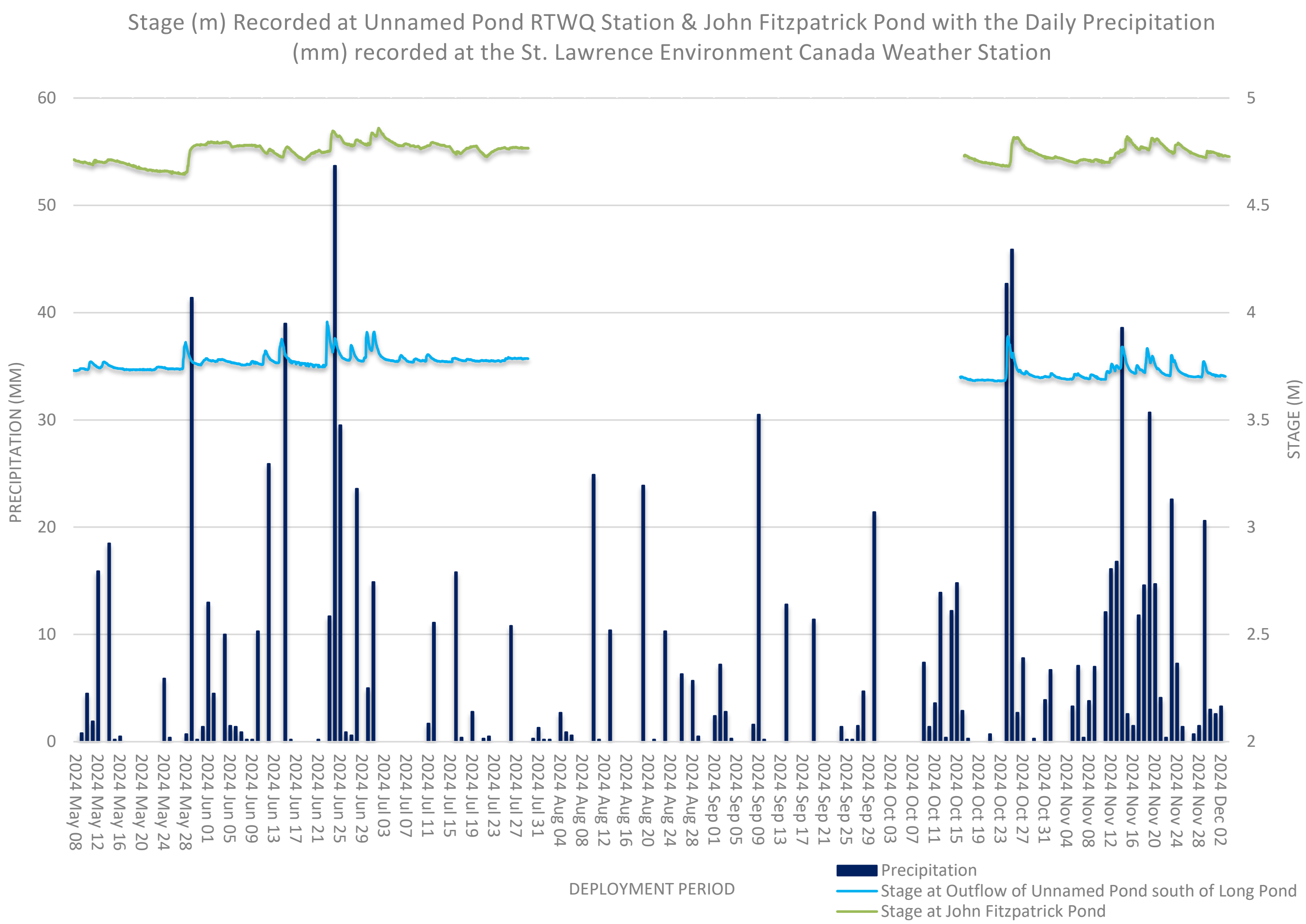

Figure 16: 2024 Stage values and total hourly precipitation from St. Lawrence Weather Station

Conclusion

The water quality monitoring for the Canada Fluorspar Inc. network commenced at John Fitzpatrick Pond and Outflow to Unnamed Pond south of Long Pond on May 8th, 2024 and May 9th, 2024, respectively. The year of data continued until December 2, 2024 when it was determined best to remove the instruments due to weather conditions. The instruments remained out of the brooks for the winter season and will be redeployed as soon as the ice thaws.

As with many brooks and streams, precipitation and runoff influence the water quality within a water body. Catchment areas for Outflow of Unnamed Pond south of Long Pond and John Fitzpatrick Pond are impacted by anthropogenic changes from adjacent mining activity. The health of a brook can be determined by how quickly it returns to its background data level after a water quality event.

Throughout deployment, water temperatures followed the expected seasonal trend of increasing during the summer and decreasing into the fall. pH at both stations remained relatively consistent across deployments. Specific conductivity fluctuated with stage increases at Outflow of Unnamed, while conductivity at John Fitzpatrick Pond remained low and consistent, which would be expected of a pond. Turbidity remained low at John Fitzpatrick Pond, with Outflow of Unnamed remaining below 50 NTU until the end of the year where there was an increase in turbidity for a short period of time. The higher turbidity events have been linked to precipitation events within the same time frame.

The water quality parameters displayed expected data for surface water bodies that can be periodically impacted by anthropogenic events.

Path Forward 2025

- The water quality instruments will undergo proficiency testing and evaluation during the winter of 2024-2025. ECC will inform Canada Fluorspar of any instrument performance issues or sensor replacements.
- In the Spring of 2026, the dataloggers that currently transmit raw data from the stations will become obsolete. ECC has provided CFI with quotes for several dataloggers that are compatible with the station infrastructure and can replace the current one. Once the dataloggers have been purchased by CFI, these upgrades will happen in the summer of 2025.
- Additional upgrades that will occur at the real-time stations are a new battery for Outflow of Unnamed Pond south of Long Pond. And due to the assumed presence of bears in the area the communication cable will require new steel reenforced conduit for both stations.
- ECC staff will deploy real time water quality instruments in spring 2025, when ice conditions allow and perform regular site visits throughout the 2025 deployment season for calibration and maintenance of the instruments. If necessary, deployment techniques will be evaluated and modified, ensuring secure and suitable conditions for RTWQ monitoring.
- ECC will continue to work on its Automatic Data Retrieval System, to incorporate new capabilities in data management and data display.
- ECC staff will continue monitoring water level, recording water quantity measurements, and maintaining equipment upkeep.
- Ongoing liaison between ECC and Canada Fluorspar to monitor or respond to emerging issues on a proactive basis. Canada Fluorspar will receive deployment reports and an annual report, summarizing the events of the deployment season throughout the year.

APPENDIX I

WATER QUALITY PARAMETER DEFINITIONS

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 effluent, saline inflows, precipitation, 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 25˚C. 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).

APPENDIX II

COMPARISON STATISTICS ACROSS DEPLOYMENTS AT CANADA FLUORSPAR INC

Comparison Statistics from 2019

	Water Temperature °C	
	Outflow of Grebes	Outflow of Unnamed
Min	2.41	-0.04
Max	22.58	26.88
Median	9.54	11.62

	pH (pH units)	
	Outflow of Grebes	Outflow of Unnamed
Min	6.21	7.31
Max	8.13	8.44
Median	7.6	8.01

	Specific Conductivity (µS/cm)	
	Outflow of Grebes	Outflow of Unnamed
Min	190.2	182.12
Max	586.91	507.59
Median	344.145	357.94

	Dissolved Oxygen (mg/L)	
	Outflow of Grebes	Outflow of Unnamed
Min	7.36	7.98
Max	13.27	14.59
Median	10.41	10.81

	Dissolved Oxygen (%Sat)	
	Outflow of Grebes	Outflow of Unnamed
Min	70.7	90.8
Max	131	103.6
Median	90.6	98.4

	Turbidity (NTU)	
	Outflow of Grebes	Outflow of Unnamed
Min	-0.4	6.5
Max	3548.1	166
Median	24.3	48.6

Comparison Statistics from 2020

	Water Temperature °C	
	Outflow of Grebes	Outflow of Unnamed
Min	1.93	-0.02
Max	20.4	27.1
Median	10.33	12.75

	pH (pH units)	
	Outflow of Grebes	Outflow of Unnamed
Min	7.06	6.66
Max	8.21	7.87
Median	7.9	7.38

	Specific Conductivity (µS/cm)	
	Outflow of Grebes	Outflow of Unnamed
Min	86.16	66.04
Max	456	221.76
Median	318.74	154.97

	Dissolved Oxygen (mg/L)	
	Outflow of Grebes	Outflow of Unnamed
Min	9.18	8.04
Max	13.89	14.94
Median	10.96	10.38

	Dissolved Oxygen (%Sat)	
	Outflow of Grebes	Outflow of Unnamed
Min	86.1	88
Max	116.7	124.1
Median	97.9	99.3

	Turbidity (NTU)	
	Outflow of Grebes	Outflow of Unnamed
Min	0.6	3.9
Max	4117.1	280.6
Median	24.35	21.9

Comparsion Statistics from 2021

	Water Temperature (oC)	
	Outflow of Grebes	Outflow of Unnamed
Min	0	-0.01
Max	19.2	27.28
Median	9.78	10.87

	pH(pH units)	
	Outflow of Grebes	Outflow of Unnamed
Min	6.88	6.37
Max	8.35	8.02
Median	7.76	7.46

	Specific Conductivity (µS/cm)	
	Outflow of Grebes	Outflow of Unnamed
Min	144.9	76.08
Max	497.95	510.94
Median	341.1	169.41

	Dissolved Oxygen (mg/L)	
	Outflow of Grebes	Outflow of Unnamed
Min	8.91	7.98
Max	14.16	14.25
Median	10.85	10.93

	Dissolved Oxygen (%Sat)	
	Outflow of Grebes	Outflow of Unnamed
Min	85.8	88.1
Max	108.6	118.4
Median	97.6	98.4

	Turbidity (NTU)	
	Outflow of Grebes	Outflow of Unnamed
Min	0.8	3.1
Max	6616	792.5
Median	12.4	20

Comparsion Statistics from 2022

	Water Temperature (oC)	
	John Fitzpatrick	Outflow of Unnamed
Min	-0.21	-0.17
Max	25.36	28.49
Median	13.05	13.16

	pH(pH units)	
	John Fitzpatrick	Outflow of Unnamed
Min	6.59	6.43
Max	7.85	8.15
Median	7.61	7.71

	Specific Conductivity (µS/cm)	
	John Fitzpatrick	Outflow of Unnamed
Min	92.2	70.24
Max	165.6	358.74
Median	155.75	248.88

	Dissolved Oxygen (mg/L)	
	John Fitzpatrick	Outflow of Unnamed
Min	8.2	8.04
Max	15.4	15.12
Median	10.92	10.45

	Dissolved Oxygen (%Sat)	
	John Fitzpatrick	Outflow of Unnamed
Min	89.1	90.9
Max	114.7	108.3
Median	101.3	98.8

	Turbidity (NTU)	
	John Fitzpatrick	Outflow of Unnamed
Min	0.04	0.3
Max	95.54	202.3
Median	1.18	3.8

Comparsion Statistics from 2023

	Water Temperature (oC)	
	John Fitzpatrick	Outflow of Unnamed
Min	0.01	-0.06
Max	24.8	28.58
Median	12.25	11.99

	pH(pH units)	
	John Fitzpatrick	Outflow of Unnamed
Min	7.03	6.78
Max	8	8.1
Median	7.75	7.78

	Specific Conductivity (µS/cm)	
	John Fitzpatrick	Outflow of Unnamed
Min	98.4	88.88
Max	272.52	365.26
Median	197.06	242.84

	Dissolved Oxygen (mg/L)	
	John Fitzpatrick	Outflow of Unnamed
Min	8.01	7.44
Max	15.28	14.9
Median	11.02	10.58

	Dissolved Oxygen (%Sat)	
	John Fitzpatrick	Outflow of Unnamed
Min	88.3	89.3
Max	114.7	109.8
Median	99.8	98.2

	Turbidity (NTU)	
	John Fitzpatrick	Outflow of Unnamed
Min	0.3	0.59
Max	18.5	14.1
Median	1.45	2.2

Statistics from the 2024 deployment for the Canada Flurospar Ltd

Comparsion Statistics from 2024		
	Water Temperature (oC)	
	John Fitzpatrick	Outflow of Unnamed
Min	4.05	2.73
Max	24.07	26.7
Median	14.79	14.45
	pH(pH units)	
	John Fitzpatrick	Outflow of Unnamed
Min	7.16	7.65
Max	8.49	7.93
Median	8.05	7.7
	Specific Conductivity (µS/cm)	
	John Fitzpatrick	Outflow of Unnamed
Min	106.29	209.91
Max	224.41	322.77
Median	195.35	243.23
	Dissolved Oxygen (mg/L)	
	John Fitzpatrick	Outflow of Unnamed
Min	8.45	10.5
Max	12.82	13.93
Median	10.53	10.08
	Dissolved Oxygen (%Sat)	
	John Fitzpatrick	Outflow of Unnamed
Min	91.5	100
Max	119.5	107.7
Median	100.8	98.3
	Turbidity (NTU)	
	John Fitzpatrick	Outflow of Unnamed
Min	0.31	1.3
Max	26.1	116.1
Median	1.21	1.6