# Real-Time Water Quality Report

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

**Deployment Period**
**October 24, 2022 to November 22, 2022**

Newfoundland
Labrador

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

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## General

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada (WSC) -Environment and Climate Change Canada (ECCC), maintain real-time water quality and water quantity monitoring stations on John Fitzpatrick Pond and Outflow of Unnamed Pond south of Long Pond, brooks that are 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. It was decided to decommission Outflow to Grebes Nest station. In replacement, a new site was selected and the hut and all the water quality instrumentation was relocated to an area that has a consistent water supply and the capability to provide an overview of the water quality conditions (Figure 1). The new site was named John Fitzpatrick Pond and this report will cover the water quality data recorded at John Fitzpatrick Pond station.

### John Fitzpatrick Pond

John Fitzpatrick station was established May 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 will provide stable and beneficial water quality data for this site (Figure 1).

The Real Time station is established on the North West bank of John Fitzpatrick Pond, close to the only outflow from the pond. This pond is surrounded by natural habitat on the North East side, and on the south west 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 meters. 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**

**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.**

## Quality Assurance and Quality Control

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.

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 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).

WRMD staff (Environment & Climate Change (ECC)) are responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Tara Clinton is ECC's main contact for the real-time water quality monitoring operation at Canada Fluorspar (NL) Inc, and is responsible for maintaining and calibrating the water quality instrument, as well as grooming, analyzing and reporting on water quality data recorded at the station.

WSC staff have an essential role in the data logging/communication aspect of the network and the maintenance of the water quantity monitoring equipment. WSC staff visit the site regularly to ensure the data logging and data transmitting equipment are working properly. WSC is responsible for handling stage and streamflow issues. The quantity data is raw data that is transmitted via satellite and published online along with the water quality data on the Real-Time Stations website. Quantity data has not been corrected or groomed when published online or used in the monthly reports for the stations. WSC is responsible for QA/QC of water quantity data. Corrected stage and streamflow data can be obtained upon request to WSC.

**Table 1: Instrument Performance Ranking classifications for deployment and removal**

| Parameter | Rank | | | | |
|---|---|---|---|---|---|
| | 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 should be noted that 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.

**Table 2: Instrument performance rankings**

| Station | Date | Action | Comparison Ranking | | | | |
| | | | Temperature | pH | Conductivity | Dissolved Oxygen | Turbidity |
| --- | --- | --- | --- | --- | --- | --- | --- |
| John Fitzpatrick | Oct 24, 2022 | Deployment | Excellent | Good | Good | Excellent | Good |
| | Nov 22, 2022 | Removal | Good | Good | Excellent | Excellent | Excellent |
| Unnamed Pond | Oct 24 ,2022 | Deployment | Excellent | Excellent | Excellent | Excellent | Excellent |
| | Nov 22, 2022 | Removal | Fair | Excellent | Good | Good | Excellent |

During the deployment of the field instrument at John Fitzpatrick Pond site, the water temperature, pH, specific conductivity, dissolved oxygen and turbidity all ranked 'Excellent' or 'Good' against the QA instrument data when compared.  After ~27 days the instrument was compared against the QA at removal and the water quality parameters ranked from 'Excellent' to 'Good'.  See table 2 above.

When compared to the QAQC instrument at Outflow of Unnamed Pond south of Long Pond, the field instrument data ranked 'Excellent' for all water quality parameters during the deployment. At removal, the rankings against the QA instrument determined that the temperature data ranked as 'Fair', with pH and turbidity data ranked as 'Excellent' and conductivity and dissolved oxygen ranked as 'Good'.  This is to be expected at the end of the deployment as natural debris and biofouling in the brook can influence the instrument over the course of the deployment.

**Issues during the Deployment Period**

Please note that the stage data recorded and displayed in this report, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Due to issues with the turbidity sensor on the instrument deployed at the John Fitzpatrick Pond site, there is not a full dataset for the deployment period.

**John Fitzpatrick Pond**

**Water Temperature**

Water temperature ranged from 1.68°C to 14.02°C during the deployment period (Figure 3).  The average water temperature for this deployment is 8.19°C. Temperatures were much cooler than the previous deployment average of 13.23°C, which is to be expected as the season adjusts to late Fall into Winter temperatures, as can be seen from the temperature trend line in Figure 3.

Water temperature displayed a natural diurnal pattern, water temperatures mirror the surrounding air temperatures (Figure 4).  Water temperatures will be warmer during the daylight hours and then lower during the nighttime (Figure 3).
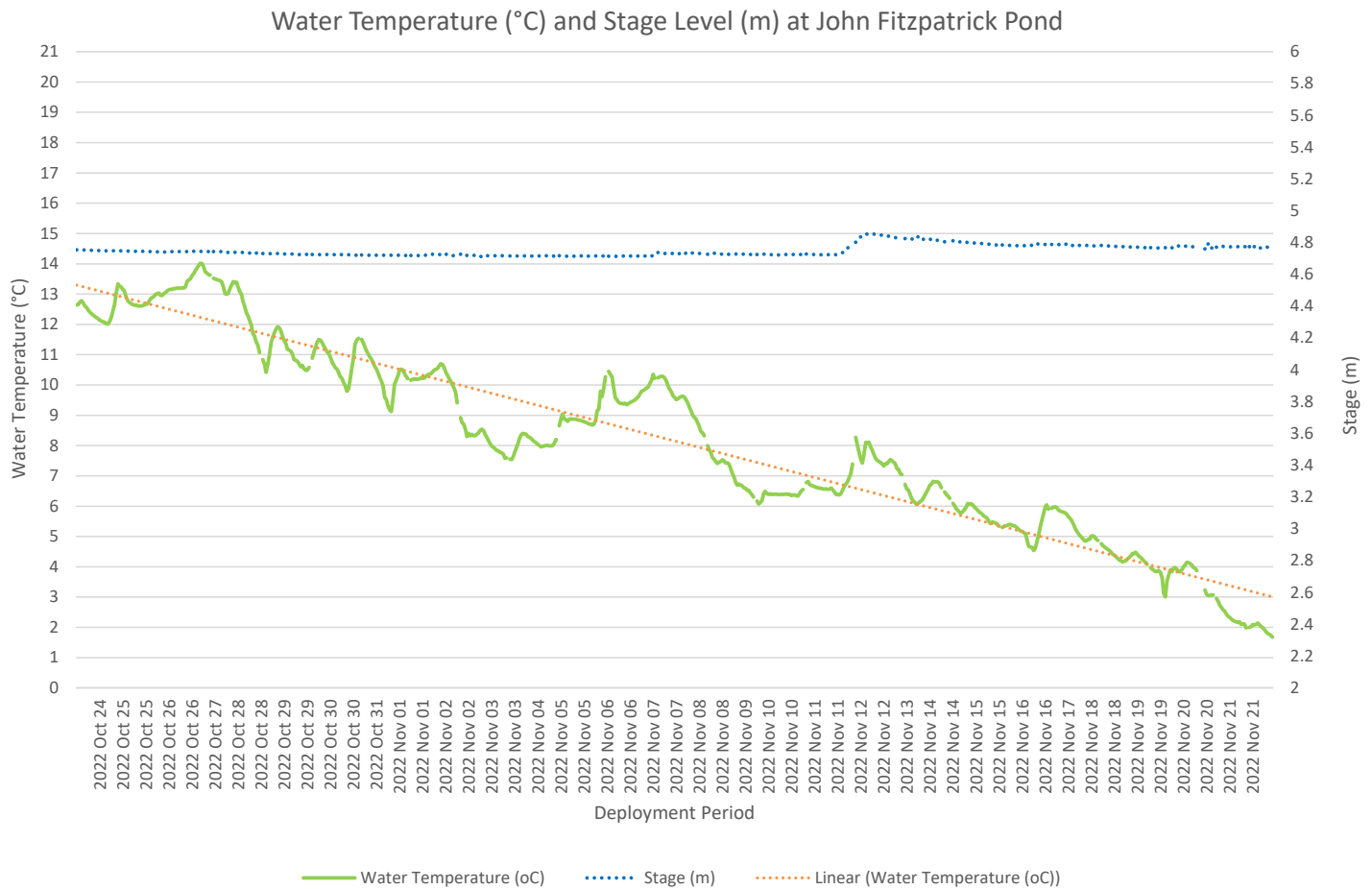


**Figure 3: Water temperature (°C)**
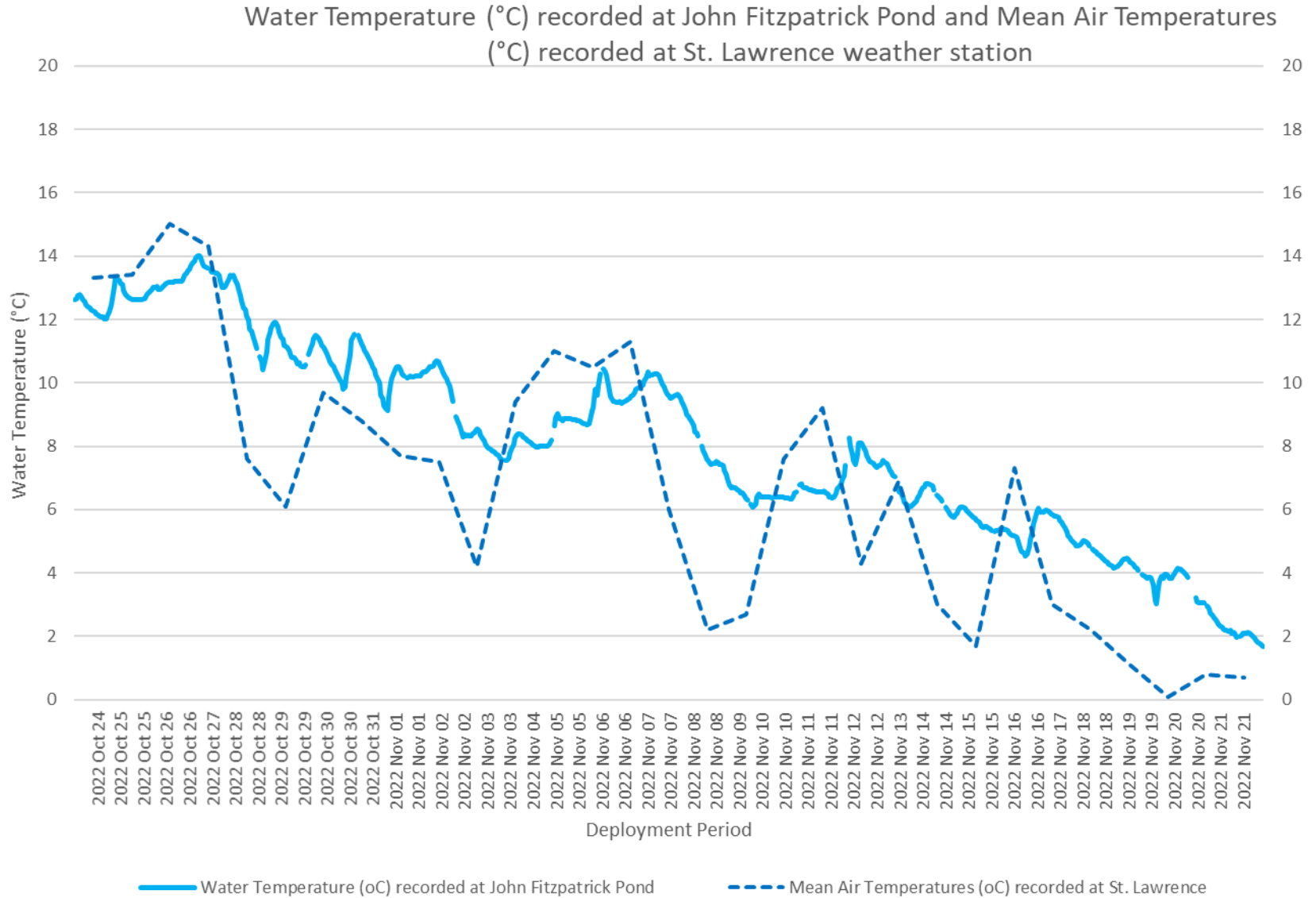
**Figure 4: Water Temperature (°C) at John Fitzpatrick Station vs. Mean Air Temperatures (°C)   at St. Lawrence Weather Station**

**pH**

Throughout the deployment period, pH values ranged between 6.59 pH units and 7.80 pH units, with an average of 7.67 pH units. The pH data remained within the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life for the duration of the deployment (Figure 5).

The slight decrease in pH on November 12th, 2022 is likely a result of the rainfall events (Appendix I) recorded on and around that same date. The dips at the end and beginning of the data are a result of the instrument being removed from the water.
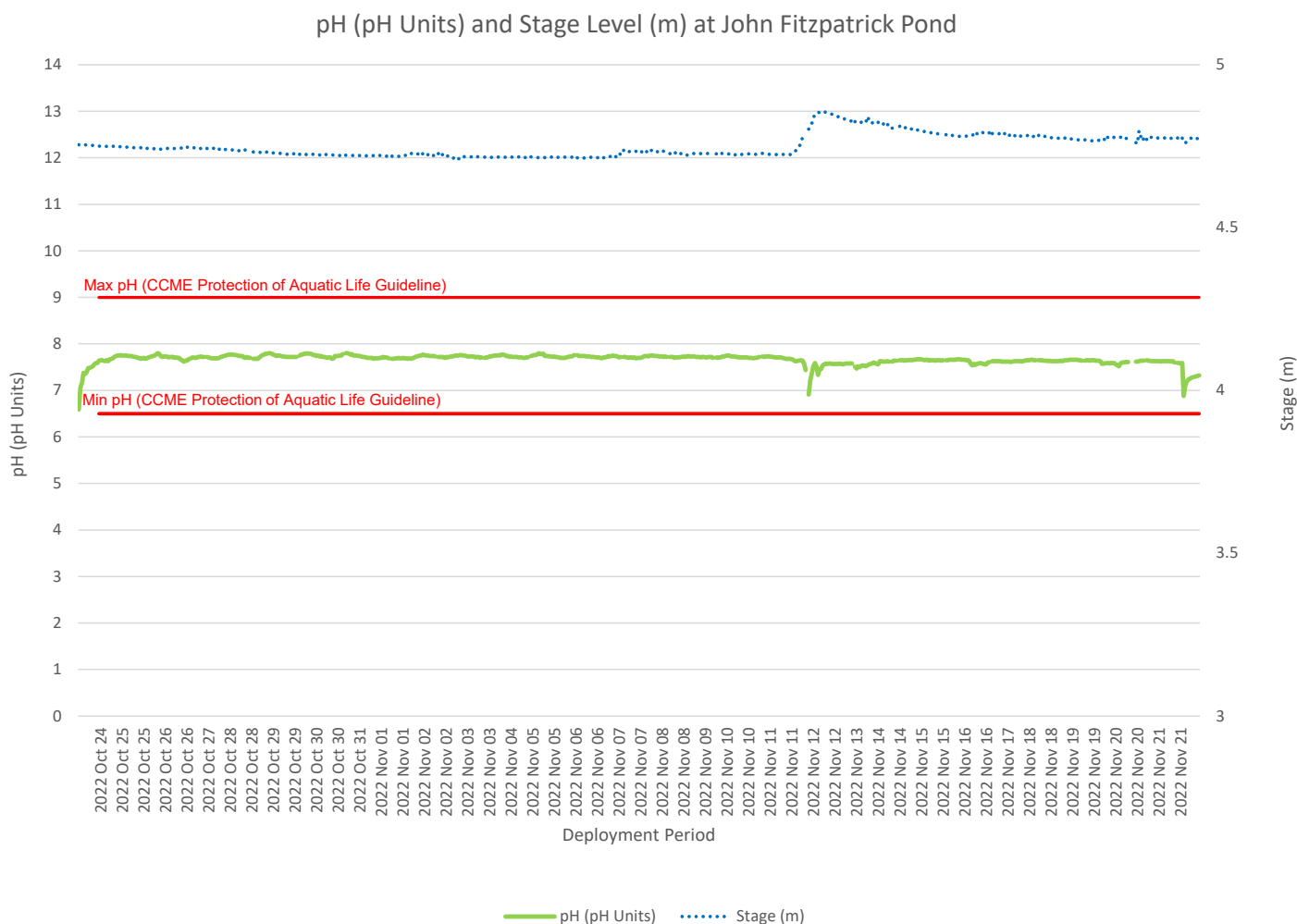


**Figure 5: pH (pH units) values**

**Specific Conductivity**

The conductivity levels were within 103.34 μS/cm and 149.81 μS/cm, with an average of 145.50 μS/cm during this deployment period (Figure 6). The specific conductivity probe measures the diluted salts and inorganic materials present in the brook.

Conductivity in John Fitzpatrick pond will fluctuate with the changes in water level and during any rainfall event. Conductivity was stable throughout the deployment, apart from some minor dips and an abrupt decrease on November 12th, 2022 which coincides with a significant rainfall that also occurred on that date (see Appendix I). The rain dilutes the water column for a short period of time, this reduces the presence of any suspended particles or diluted salts, which in turn decreases specific conductivity.
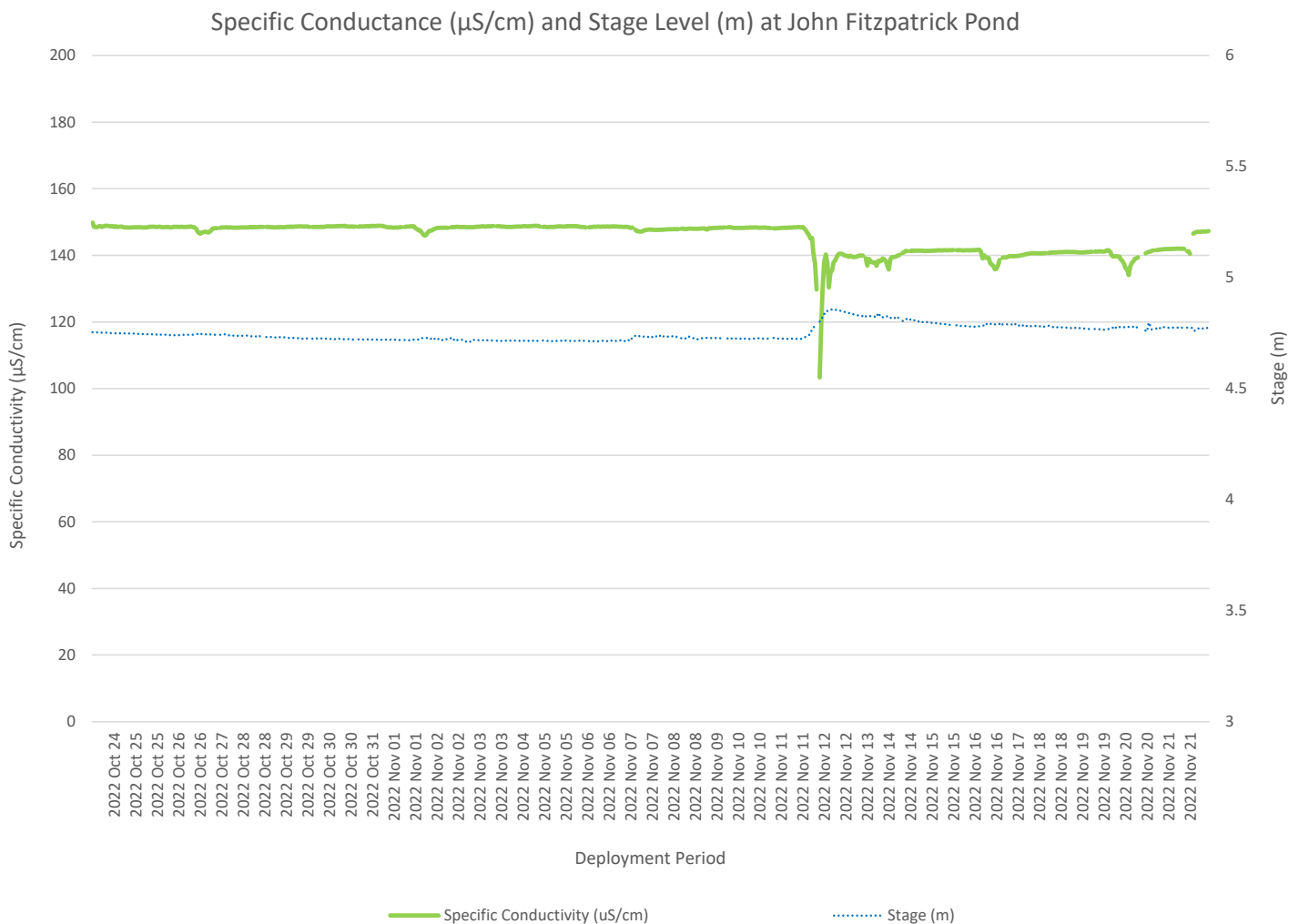


**Figure 6: Specific conductivity (μS/cm) values**

**Dissolved Oxygen**

The water quality instrument directly measures dissolved oxygen (mg/L) with the dissolved oxygen probe. The instrument then calculates percent saturation (% Sat) taking into account the water temperature.

During the deployment, the dissolved oxygen concentration levels ranged within a minimum of 10.31 mg/L to a maximum of 13.98 mg/L. The dissolved oxygen percent saturation levels ranged within 95.3% saturation to 106.3% saturation (Figure 7). As the water temperature decreased throughout the deployment period, the dissolved oxygen (mg/L) increased within the same timeframe (Figure 7).
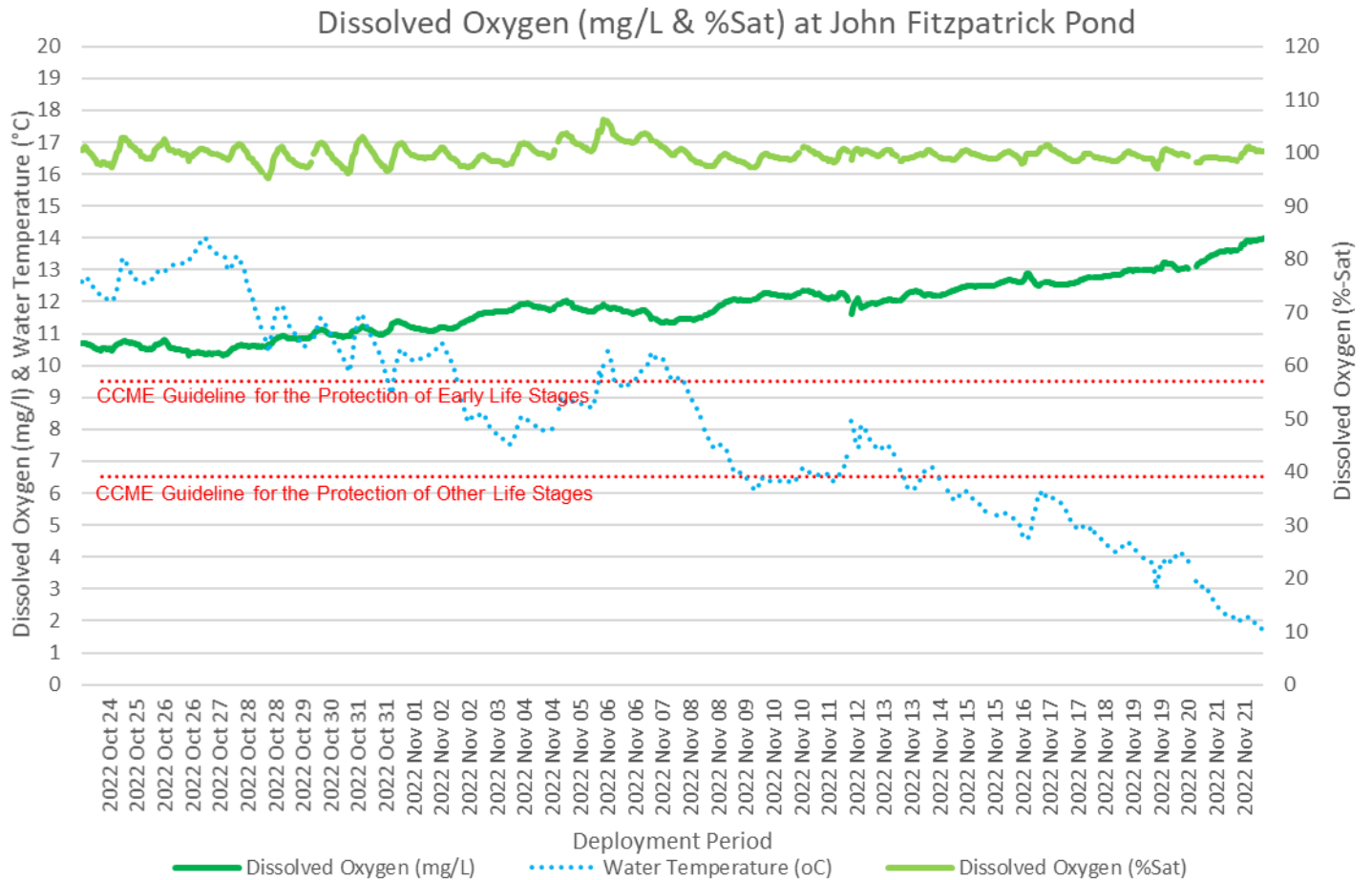


**Figure 7: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C)**

**Turbidity**

Due to a malfunction of the turbidity sensor throughout the deployment period, there is limited turbidity data available

Turbidity levels during the deployment ranged within 0.1 NTU and 17.1 NTU (Figure 7). The deployment data had an average of 2.08 NTU (Figure 8). The large increase on November 14th, 2022 was a result on the rainfall events that occurred in the days before that date (Appendix 1).
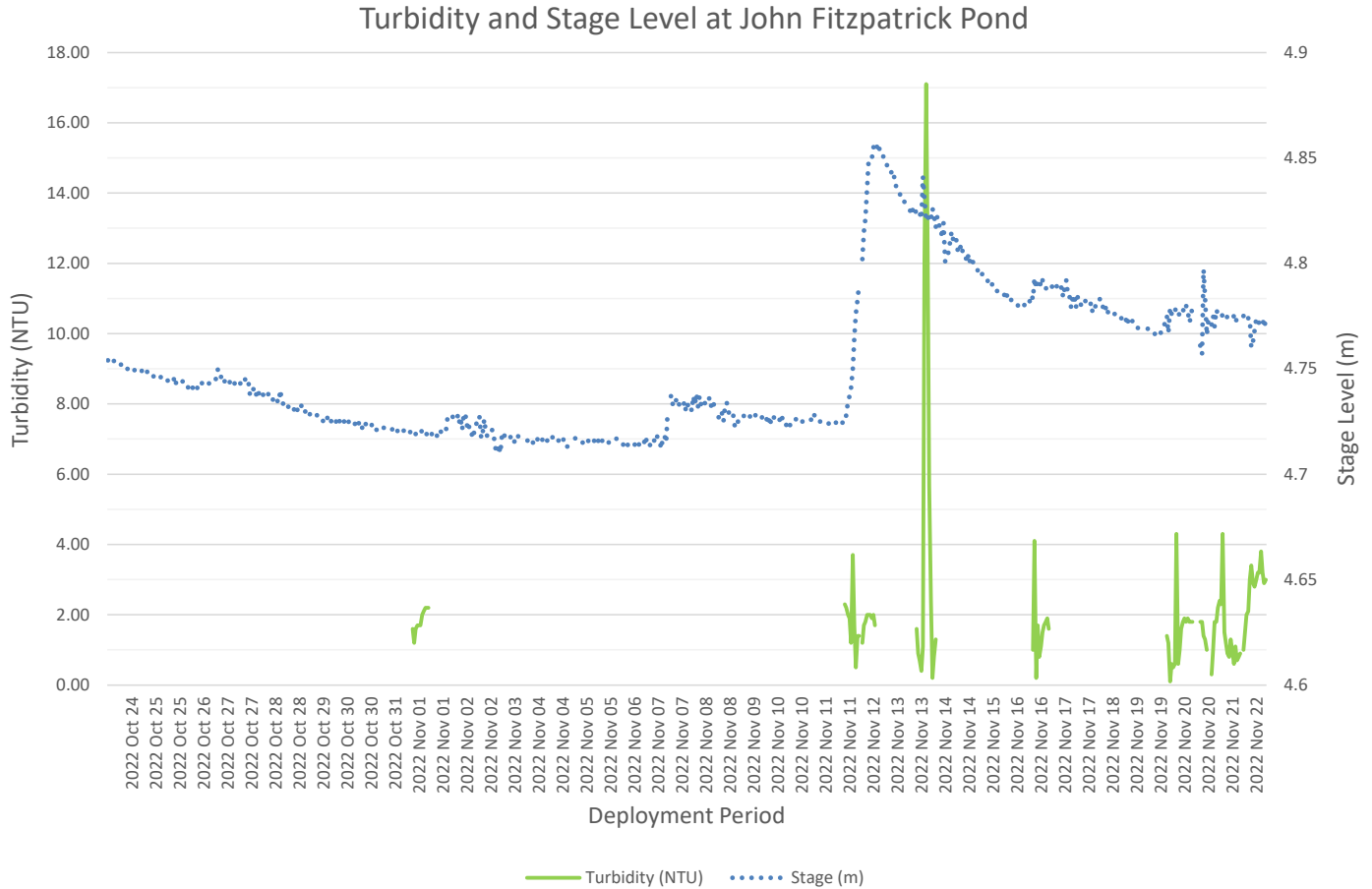


**Figure 8: Turbidity (NTU) values.**

### Daily Averaged Stage Level and Total Precipitation

Please note the stage data on the graph below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Stage is an estimation of water level at the station and can explain some differences occurring with water quality parameters (i.e. Specific Conductivity, DO, turbidity). Stage ranged between 4.72m to 4.84m, with an average of 4.75m during the deployment.

Large peaks in stage correspond with the total precipitation events as noted on Figure 9. Total Precipitation data was obtained from Environment Canada's St. Lawrence weather station. The highest total precipitation was recorded on November 12th, 2022 with a total precipitation of 71.6mm. Stage peaks shortly after this rainfall event.
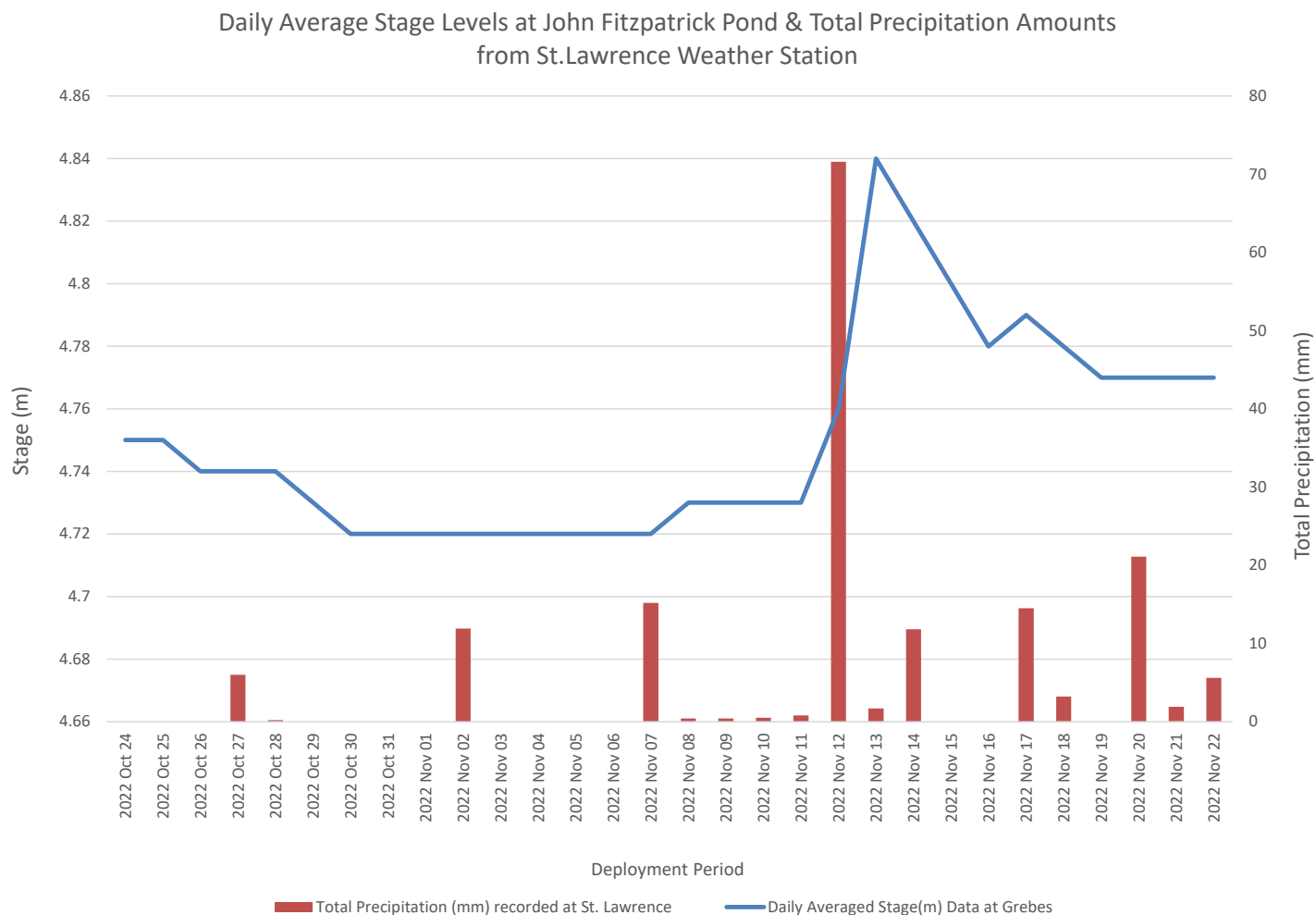


**Figure 9: Daily averaged stage values and total precipitation.**

### Outflow of Unnamed Pond south of Long Pond

### Water Temperature

Water temperature ranged from -0.15°C to 15.97°C during the deployment period (Figure 10). Water temperature displayed the natural diurnal pattern representing the influence of air temperature on the brook, with the high temperatures during the daylight hours and the low temperatures representing the nighttime hours. With the minimum water temperature recorded at -0.15°C, it is evident that the temperatures are decreasing as the climate changes from Fall into Winter.

Decreases in water temperature correspond with higher stage. These stage changes are likely a result of precipitation. Please note that the stage data in this document is raw data. The data has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.
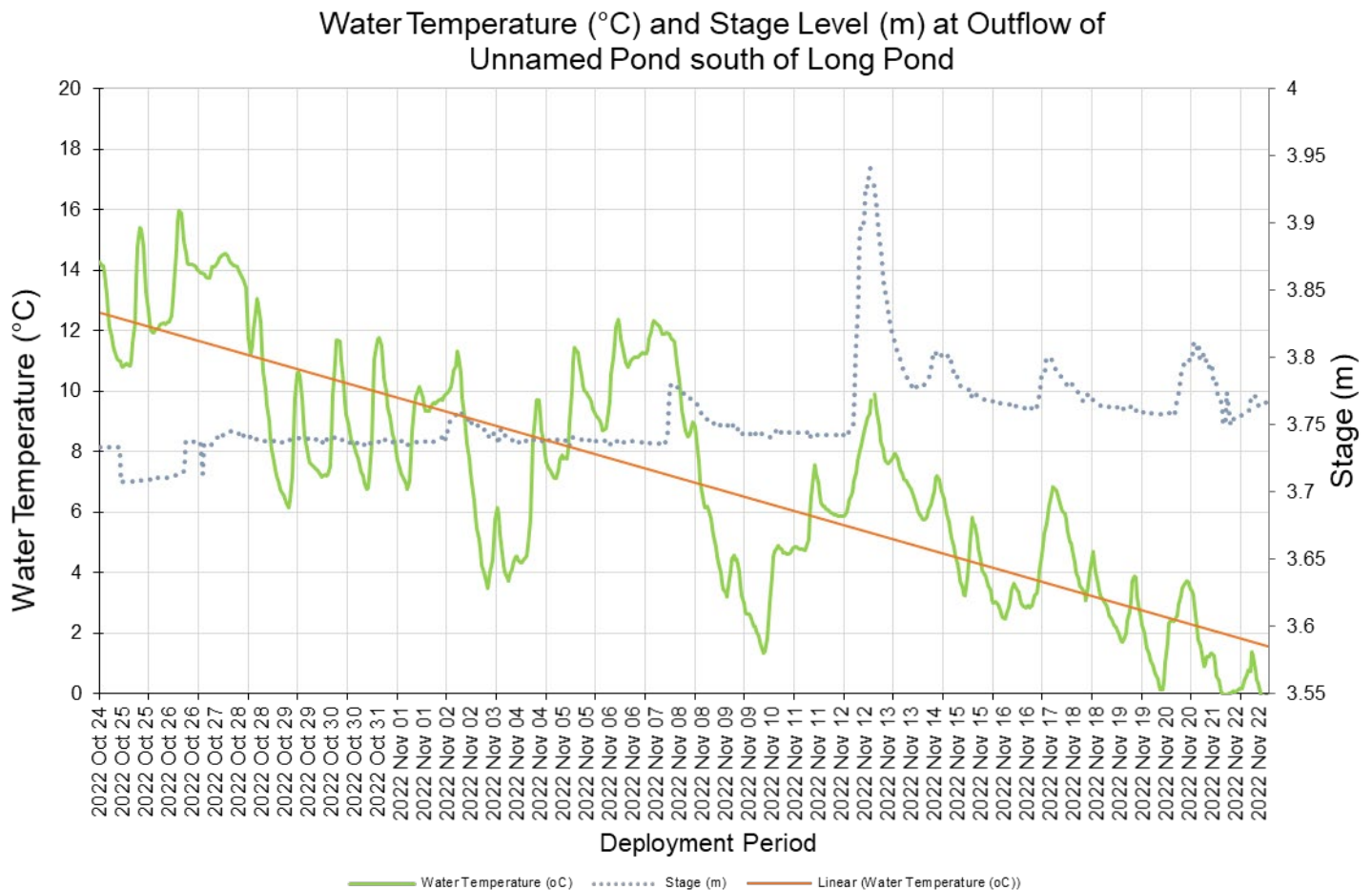


**Figure 10: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond**

## pH

Throughout this deployment period, pH values ranged within 7.08 pH units and 7.81 pH units (Figure 11), remaining within the Canadian Council of Ministers of the Environment (CCME) guidelines for aquatic life. The guidelines provide the overall range for the protection of aquatic life across all waterways in Canada. Every brook is different with its own specific natural background range.

Small decreases in pH during stage peaks are evident on Figure 11. pH does return to background levels after each event, and overall the pH data was consistent across deployment. Natural processes such as rainfall and surrounding runoff will alter the pH of a brook for a period; however, it is the persistent long-term changes in pH that create the most damage to the natural aquatic environment.

Please note the daily averaged stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.
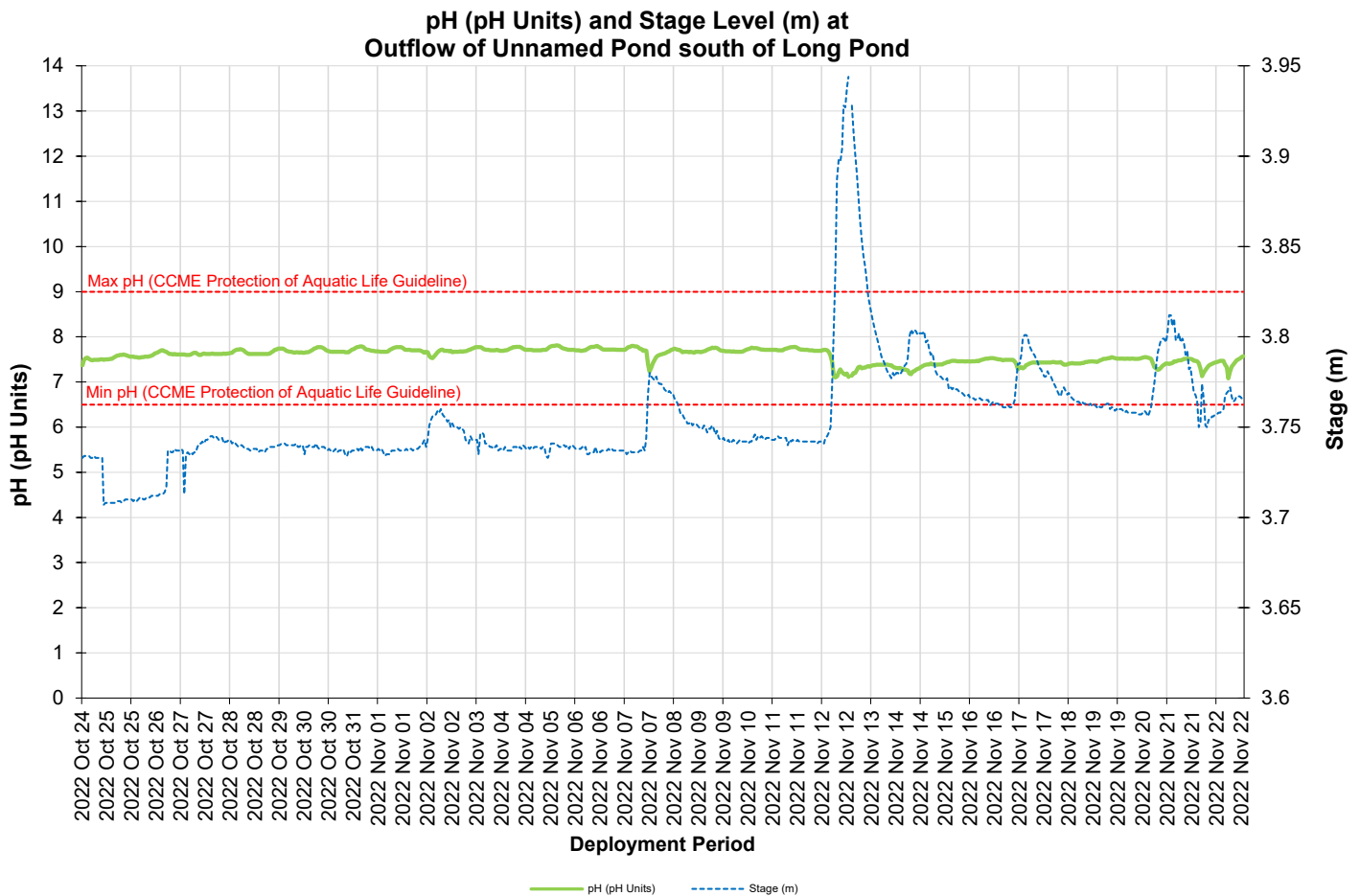


**Figure 11: pH (pH units) at Outflow of Unnamed Pond south of Long Pond**

## Specific Conductivity

The conductivity levels ranged between 133.8 µS/cm and 286.22 µS/cm during deployment (Figure 12). The deployment period had a median of 248.8 µS/cm.

Changes in stage will influence the conductivity data (Figure 12). The extra volume of water during a stage increase will dilute the particulate matter present in a water column.

Please note the daily averaged stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.
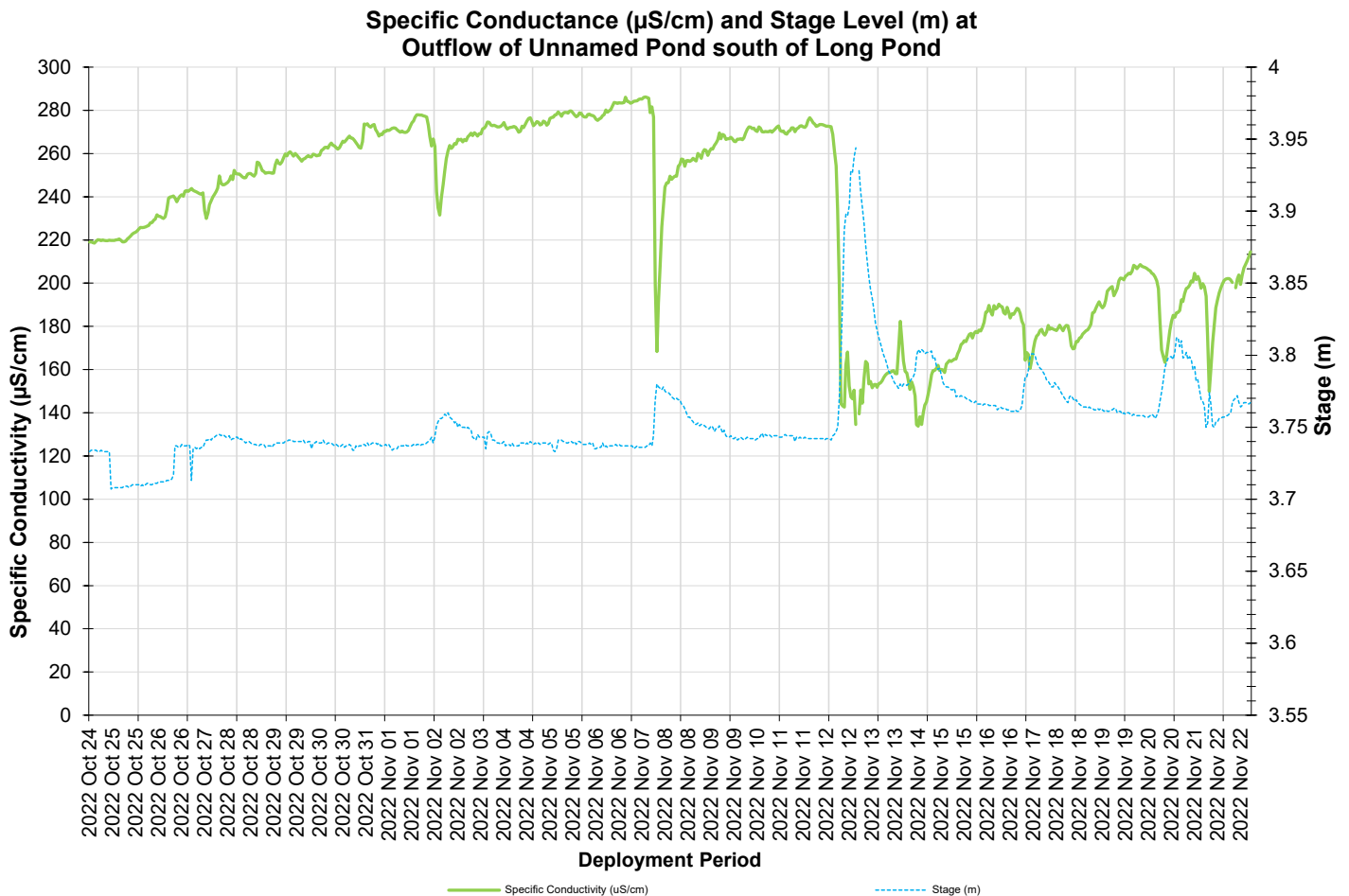


**Figure 12: Specific conductivity (µS/cm) at Outflow of Unnamed Pond south of Long Pond**

### Dissolved Oxygen

The water quality instrument directly measures dissolved oxygen (mg/L) with the dissolved oxygen probe. The instrument then calculates percent saturation (% Sat) taking into account the water temperature. During this deployment, the dissolved oxygen levels ranged within 9.41 mg/L and 11.79 mg/L for concentration and 92.5 % and 102.9 % for percent saturation.

Dissolved Oxygen has a natural diurnal pattern in aquatic environments. Oxygen concentration levels will fluctuate throughout night and day. Cooler night temperatures influence higher dissolved oxygen concentrations and warmer day light temperature create lower concentrations. All other prominent dips/peaks - outside of the diurnal pattern - are a result of fluxes in air temperature or influences from rainfall/runoff (Figure 13).
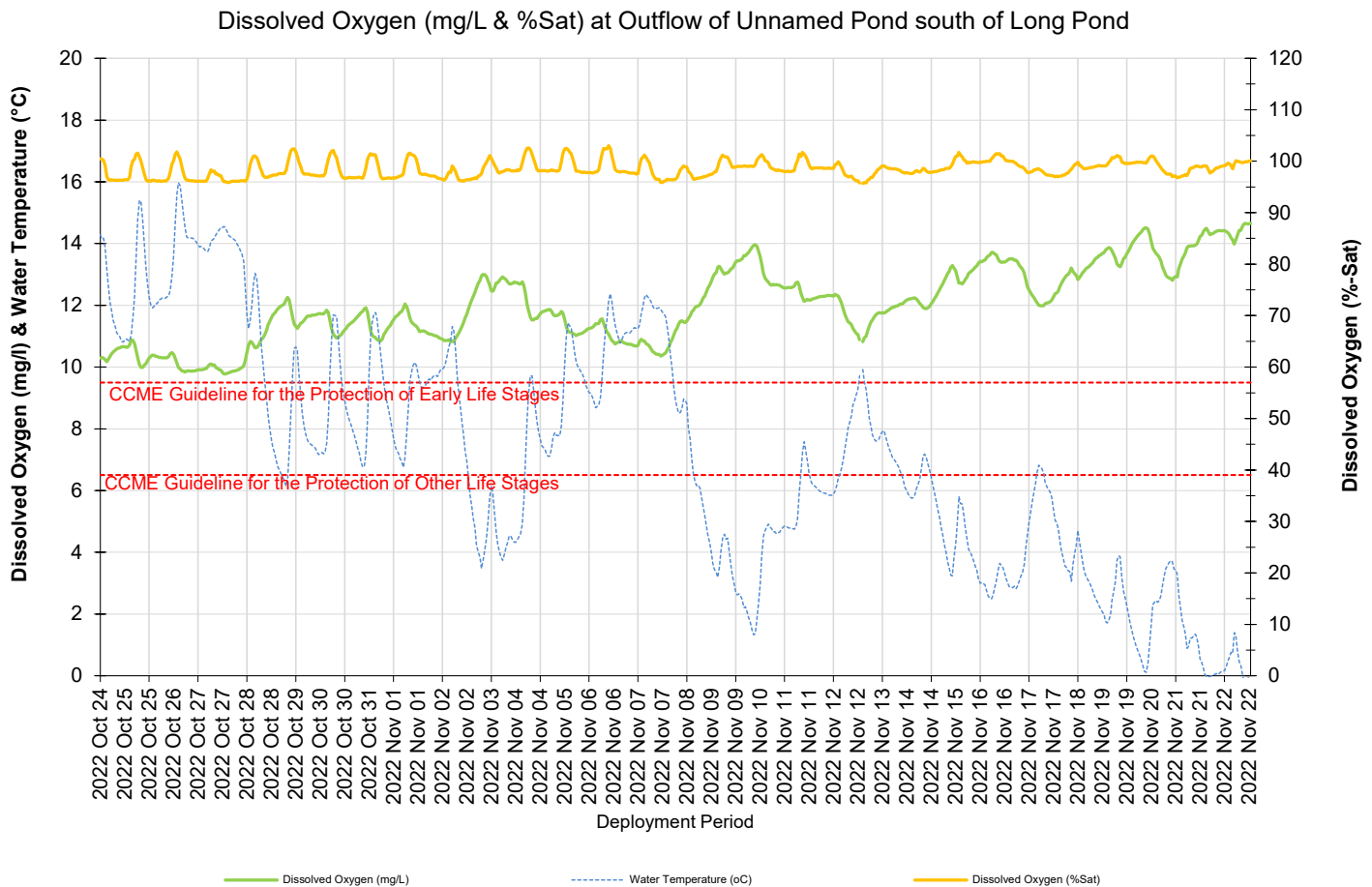


**Figure 13: Dissolved Oxygen (%Sat & mg/L) at Outflow of Unnamed Pond south of Long Pond**

### Turbidity

Turbidity levels during the deployment ranged within 2.5 NTU and 23.8 NTU (Figure 14). The deployment data had a median of 5.21 NTU, a decrease compared to the previous deployment median of 22 NTU.

Turbidity remained relatively consistent throughout the deployment period with turbidity peaks consistent with rainfall events. There were noticeable increases on November 12th and November 15th, 2022 with the highest turbidity increase on November 21st, 2022 of 23.8 NTU.

Please note the daily averaged stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.
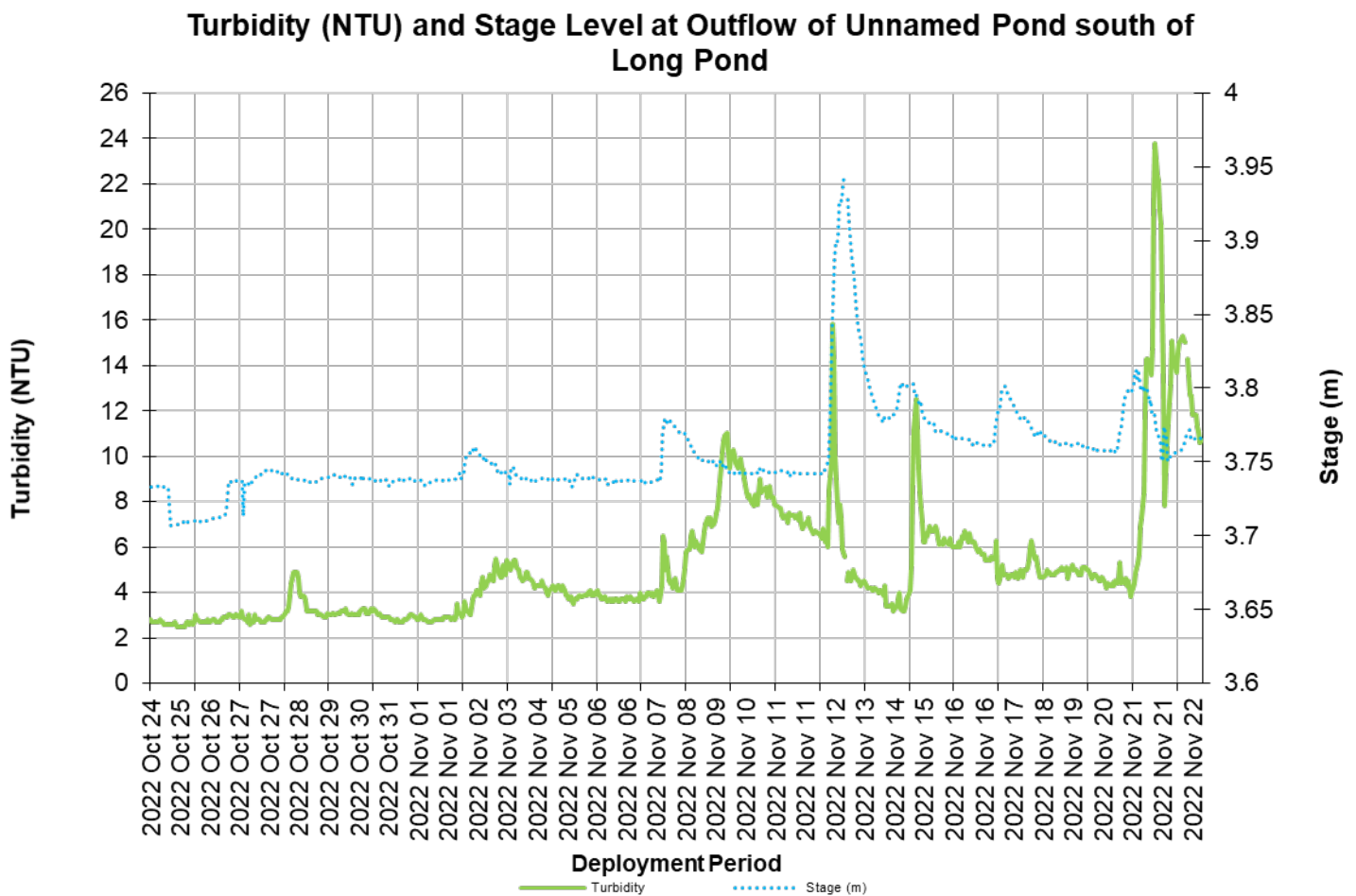


**Figure 14: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond**

### Daily Averaged Stage Level and Total Precipitation

Please note the stage data on the graph below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Stage is an estimation of water level at the station and can explain fluctuations occurring with other parameters (i.e. Specific Conductivity, DO, turbidity). Stage ranged between 3.71 m to 3.94m during the deployment, with an average stage of 3.76 m.

Large peaks in stage correspond with the total precipitation events as noted on Figure 14. Total Precipitation data was obtained from Environment Canada's St. Lawrence weather station. The highest total precipitation was recorded on November 12th, 2022 at 71.6 mm.
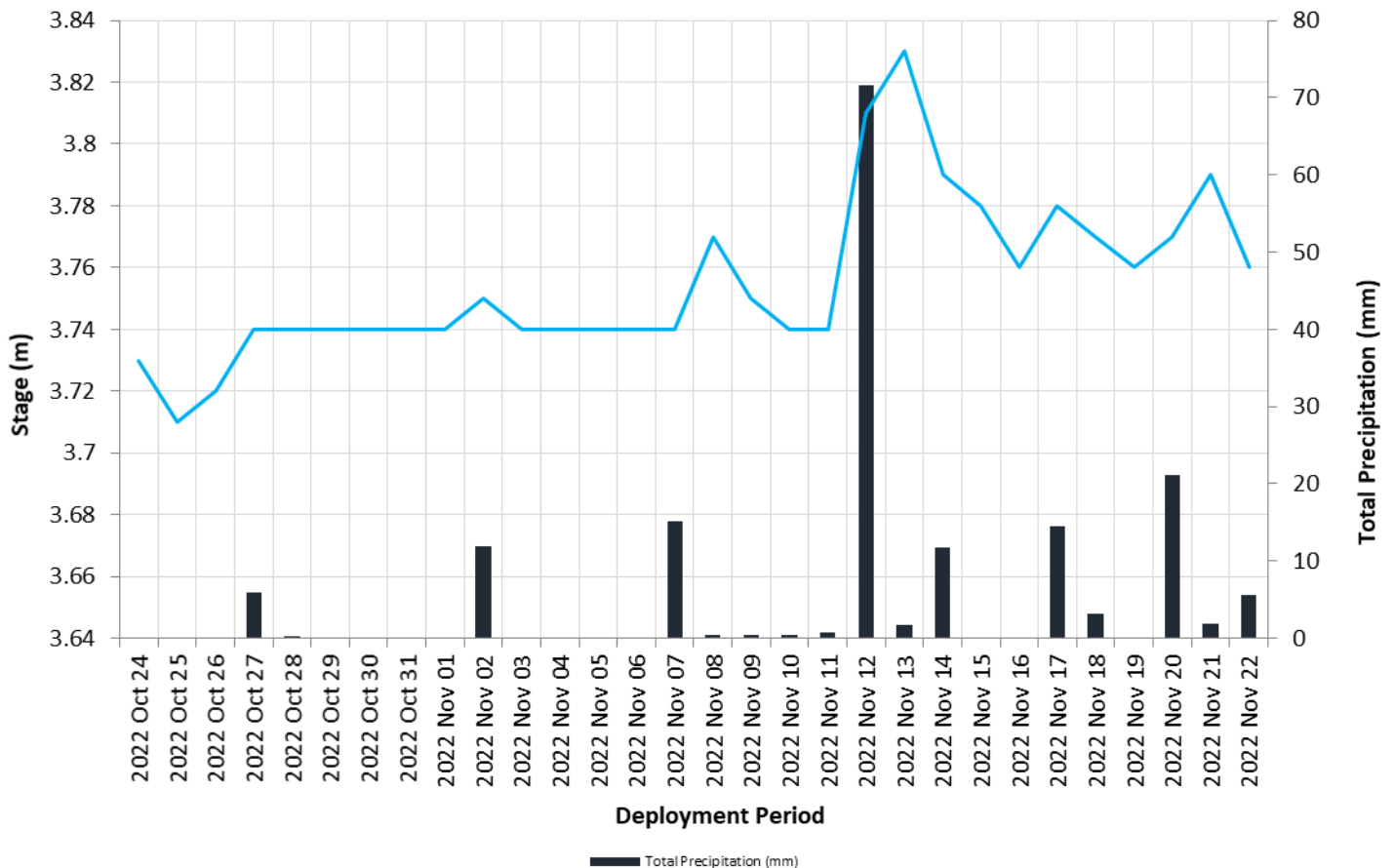


**Figure 14: Daily averaged stage values and total precipitation.**

APPENDIX I

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

## Total Daily Precipitation Amounts (mm) from St.Lawrence Weather Station



**Deployment Period**

■ Total Precipitation (mm)