

Real-Time Water Quality Report

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

Deployment Period

September 21st, 2023 to October 24th, 2023



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

Prepared by:

Victoria Hollohan
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
victoriahollohan@gov.nl.ca

General

The Water Resources Management Division (WRMD) maintain real-time water quality and water quantity monitoring stations in John Fitzpatrick Pond and on Outflow of Unnamed Pond south of Long Pond, 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 May 2022. 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. 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 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. 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

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: QA/QC vs. Field Instrument performance rankings

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
John Fitzpatrick	Sept. 21 st , 2023	Deployment	Excellent	Good	Good	Excellent	Excellent
	Oct. 24 th 2023	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
Unnamed Pond	Sept. 21 st , 2023	Deployment	Excellent	Good	Good	Excellent	Excellent
	Oct. 24 th 2023	Removal	Excellent	Excellent	Excellent	Excellent	Excellent

When compared to the QAQC instrument data, both stations ranked Excellent or Good for all parameters.

Table 3: Grab sample vs. Field Instrument Comparison Rankings

Station	Date	Action	pH	Comparison Ranking	
				Conductivity	Turbidity
John Fitzpatrick	Sept. 21st,2023	Deployment	Good	Fair	Excellent
Unnamed Pond	Sept. 21st,2023	Deployment	Good	Good	Excellent

When comparing the field instrument to grab sample data, all parameters rank excellent or good, except for conductivity at John Fitzpatrick Pond which ranked fair.

John Fitzpatrick Pond

Water Temperature

Water temperature ranged from 10.16°C to 18.15°C during the deployment period (Figure 3). The average water temperature for this deployment was 13.66°C, cooler than the previous deployment period average of 20.06°C. Colder water temperatures are to be expected as the season transitions to autumn. Water temperature displayed a natural diurnal pattern. Water temperatures will be warmer during the daylight hours and then lower during the nighttime (Figure 3).

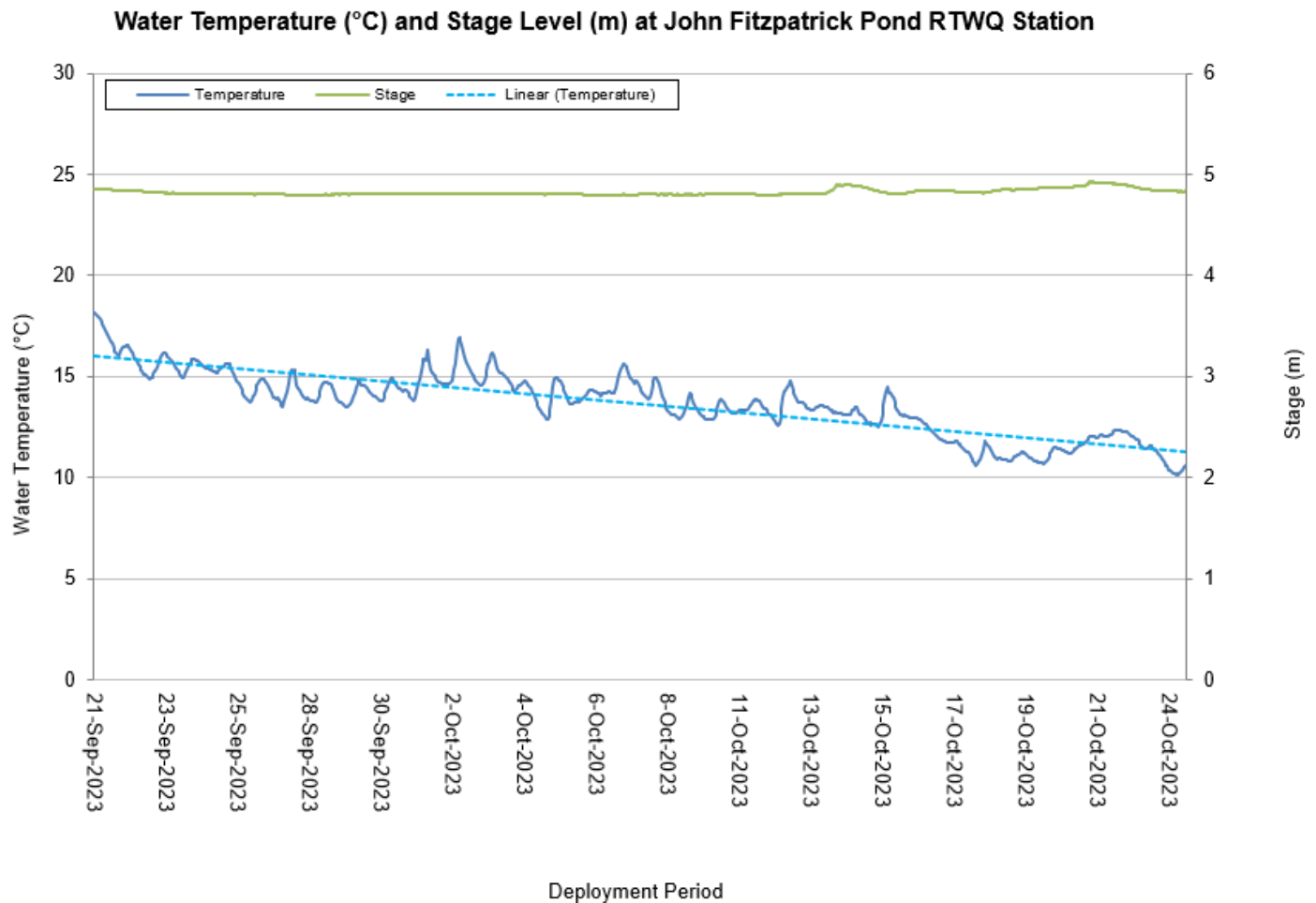


Figure 3: Water temperature at John Fitzpatrick Pond RTWQ Station (°C)

pH

Throughout the deployment period, pH values ranged between 7.47 pH units to 8.00 pH units with an average of 7.82 and remained stable other than small fluctuations (Figure 4).

A pH sensor measures the acidity or alkalinity of a water body. pH is a measure of the concentration of hydrogen ions (H^+) in a solution. 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 John Fitzpatrick 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 4).

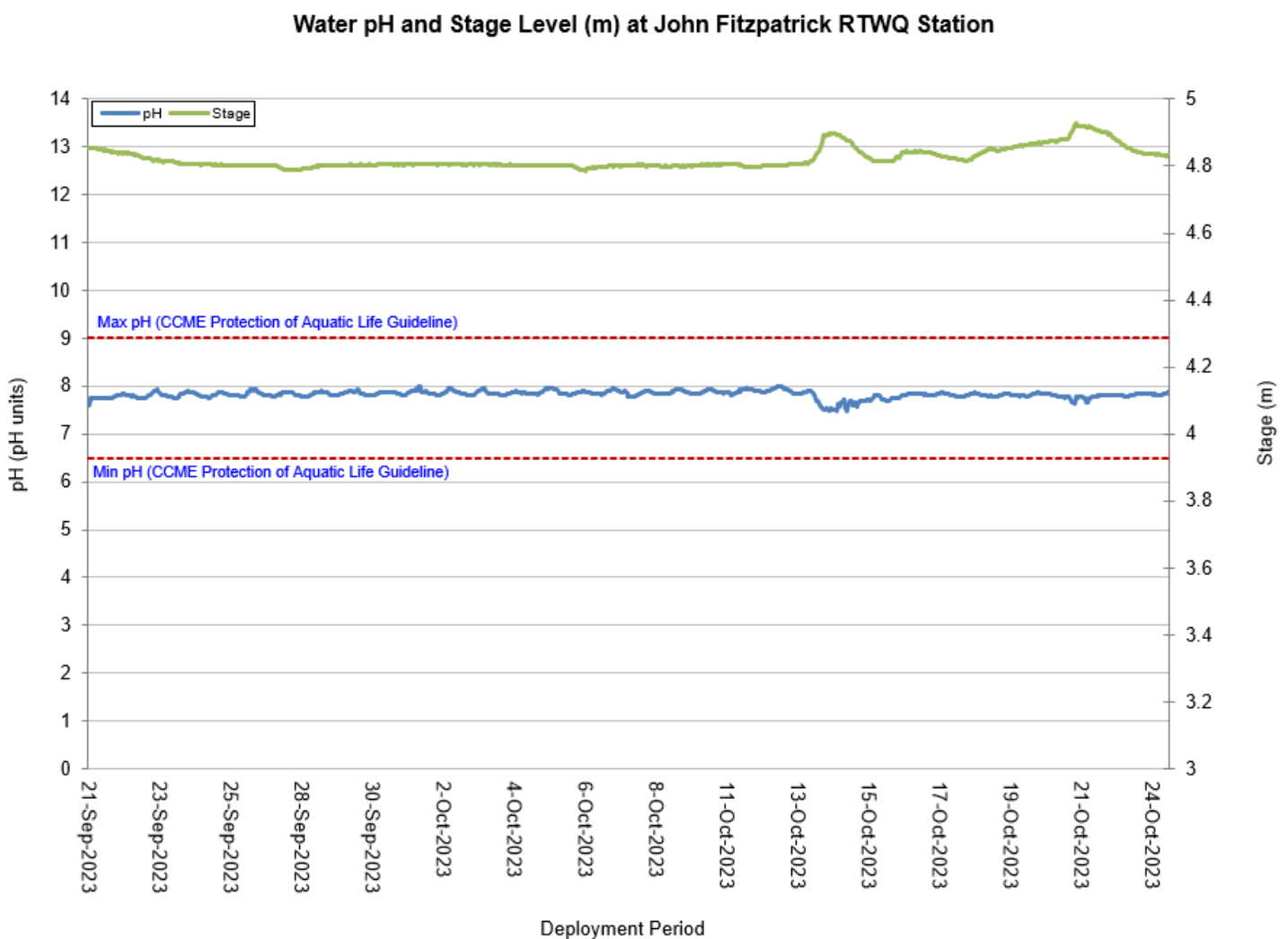


Figure 4: pH (pH units) values at John Fitzpatrick Pond RTWQ Station

Specific Conductivity

The conductivity levels were within 185.1 $\mu\text{S}/\text{cm}$ and 242.5 $\mu\text{S}/\text{cm}$ during this deployment period, with an average of 212.2 (Figure 5). 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.

Conductivity in John Fitzpatrick Pond will fluctuate with the changes in water level and during rainfall events. Conductivity was steadily increasing but stable throughout the first half of the deployment period, becoming slightly erratic after October 7th as water continues to be pumped from the open mine pits. Several dips were recorded that were likely a result of the rainfall (Appendix I) that was recorded by the weather station in St. Lawrence. The rain dilutes the water column for a short period of time, this reduces the presence of any suspended particles or diluted salts.

Specific Conductivity ($\mu\text{S}/\text{cm}$) and Stage Level (m)) at John Fitzpatrick RTWQ Station

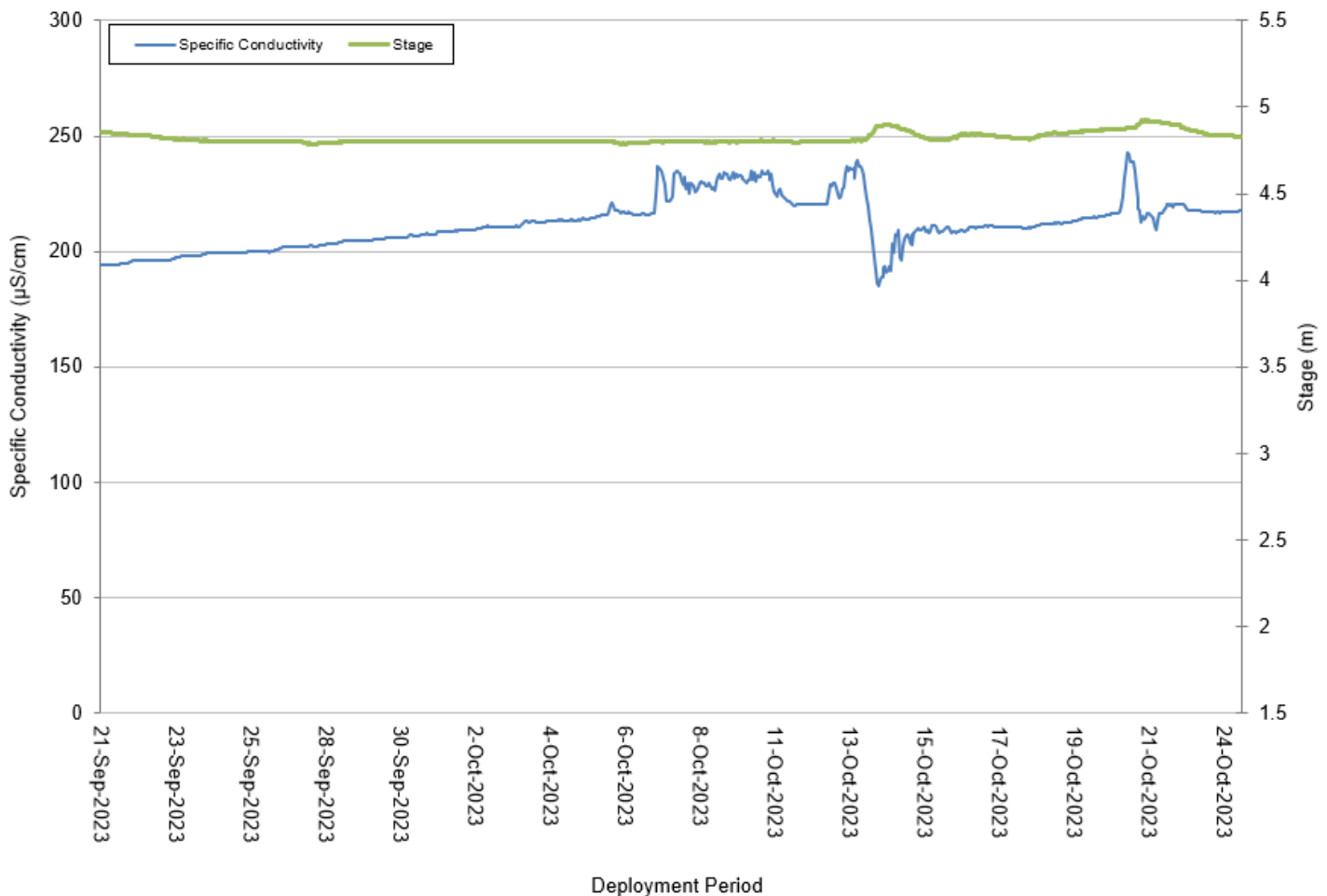


Figure 5: Specific conductivity ($\mu\text{S}/\text{cm}$) values at John Fitzpatrick Pond RTWQ Station

Dissolved Oxygen

Throughout the deployment, the concentrations of dissolved oxygen (DO) ranged from 9.34 mg/L to 11.24 mg/L. The corresponding dissolved oxygen percent saturation levels varied from 95.3% to 109.5% (Figure 6). DO concentrations were outside of the CCME Guidelines for the Protection of Aquatic Life throughout the deployment but that would be expected given the cooler water temperatures of autumn months.

The DO probe directly measures oxygen dissolved (mg/L) in the water. The instrument then calculates percent saturation (% Sat) factoring in the water temperature. The level of dissolved oxygen in water 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.

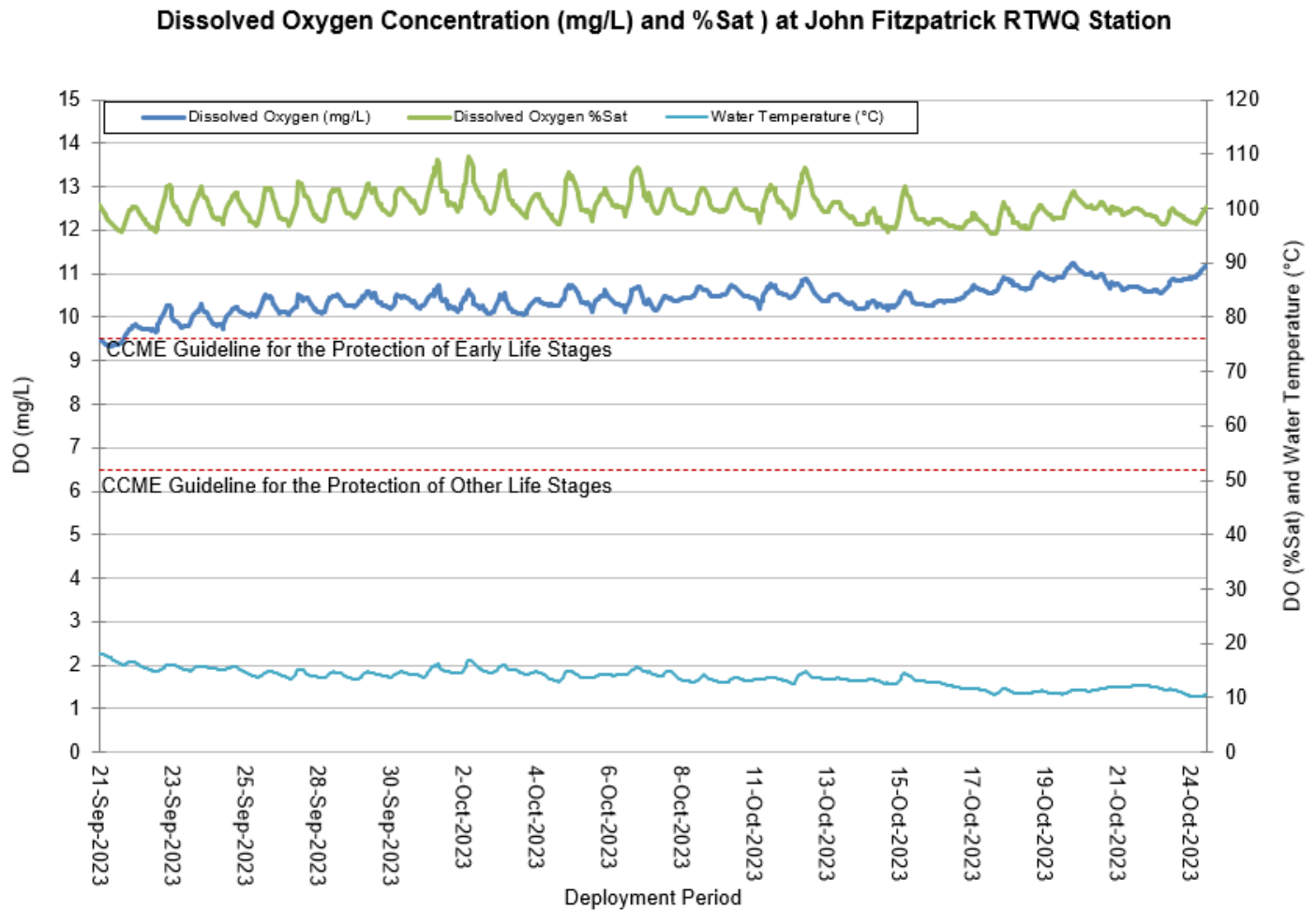


Figure 6: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C) at John Fitzpatrick Pond RTWQ Station

Turbidity

Turbidity levels during the deployment ranged within 0.9 NTU and 18.5 NTU, with an average of 1.5 NTU (Figure 7). 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 1). Turbidity remained relatively low and stable throughout the deployment period other than a few spikes. The spike on October 14th was likely due to the precipitation event that also occurred during that time (Figure 8). Precipitation can increase run-off and disturb sediment on the waterbed that can temporarily increase turbidity.

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.

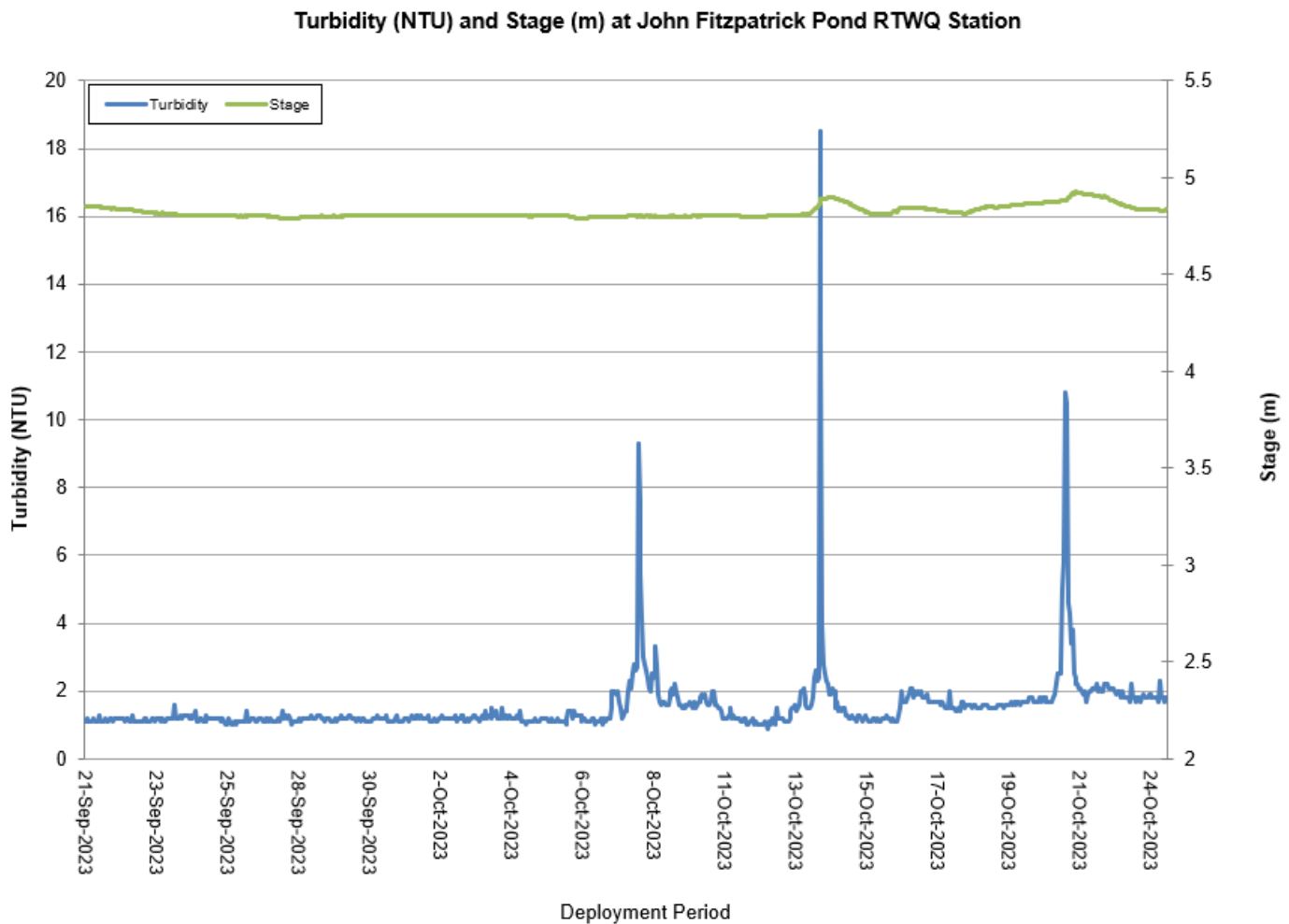


Figure 7: Turbidity (NTU) values at John Fitzpatrick Pond RTWQ Station

Daily Averaged Stage Level and Total Precipitation

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 4.79m to 4.93m during the deployment. Large peaks in stage correspond with the total precipitation events as noted on Figure 8. Total Precipitation data was obtained from Environment Canada’s St. Lawrence weather station.

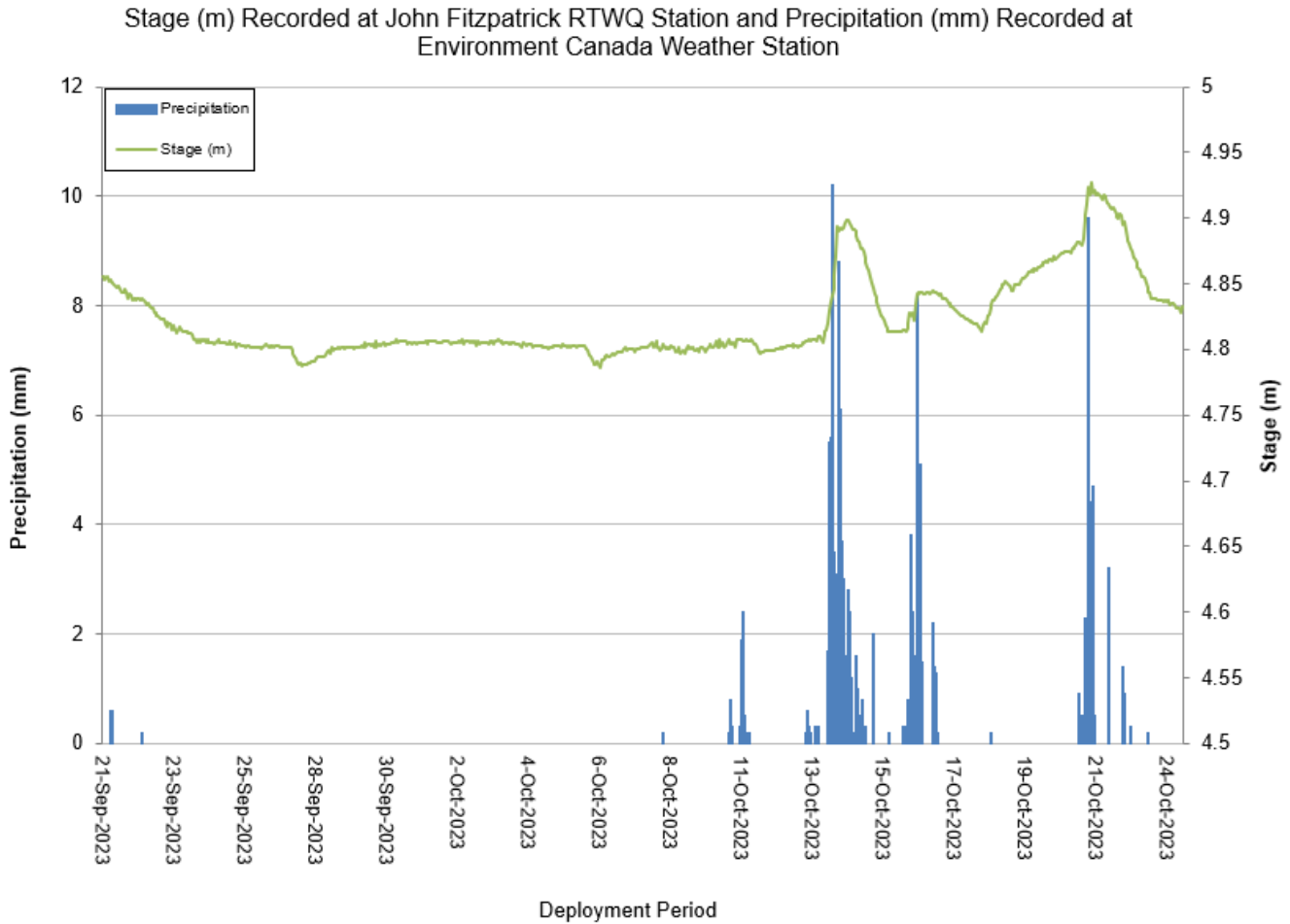


Figure 8: Stage values at John Fitzpatrick Pond RTWQ Station and total precipitation.

Outflow of Unnamed Pond south of Long Pond

Water Temperature

Water temperature ranged from 6.75°C to 18.88°C during the deployment period, with an average of 12.71 °C (Figure 9). Decreases in water temperature correspond with higher stage, likely due to increased precipitation run-off. Temperature decreased throughout the deployment period, which is typical for cooling autumn months.

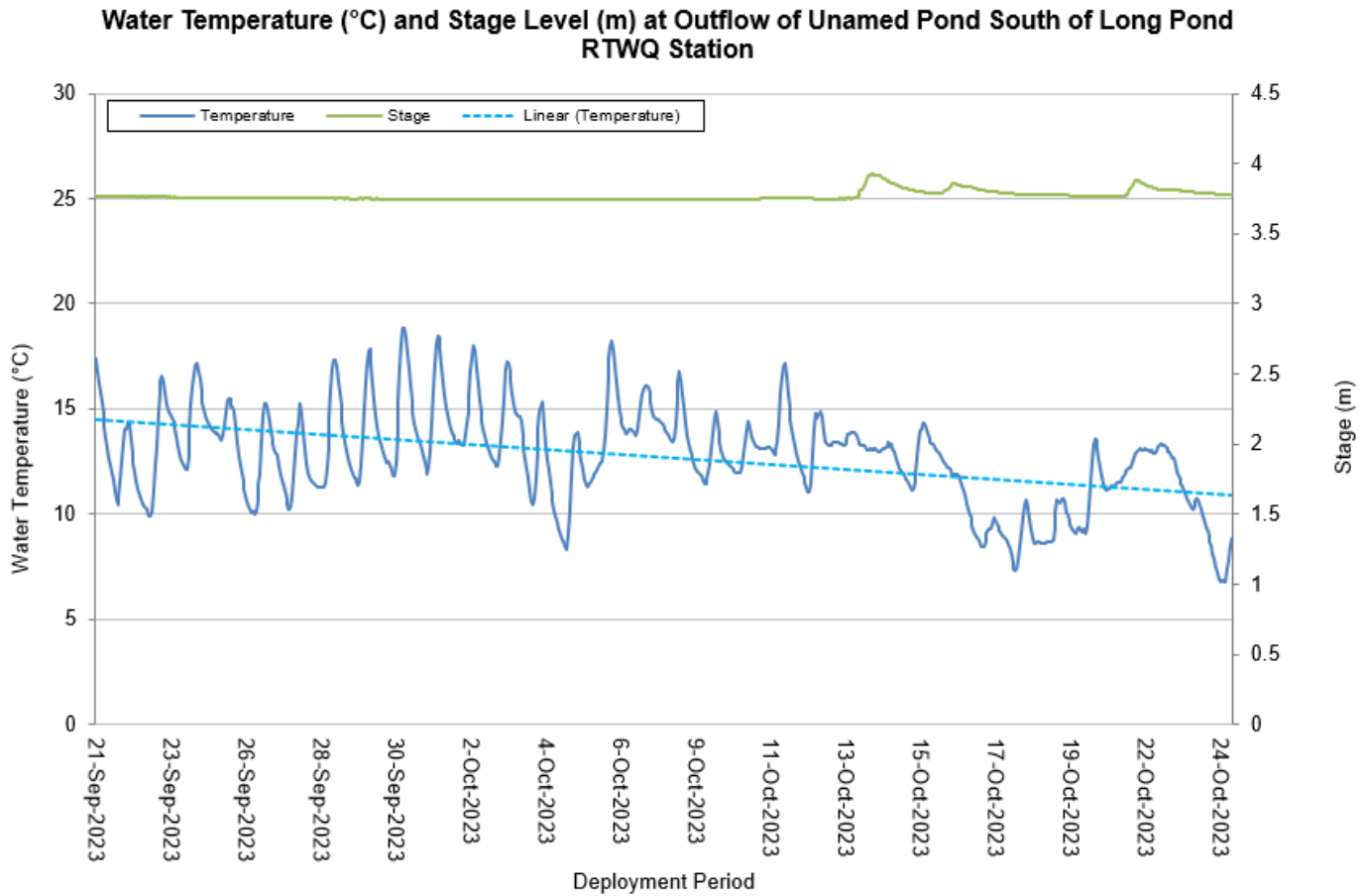


Figure 9: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond

pH

Throughout this deployment period, pH values ranged within 7.22 pH units and 7.98 pH units with an average of 7.73 pH units (Figure 10), 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 during stage peaks are evident on Figure 10. pH does return to background levels after each event, and overall, the pH data was consistent across deployment.

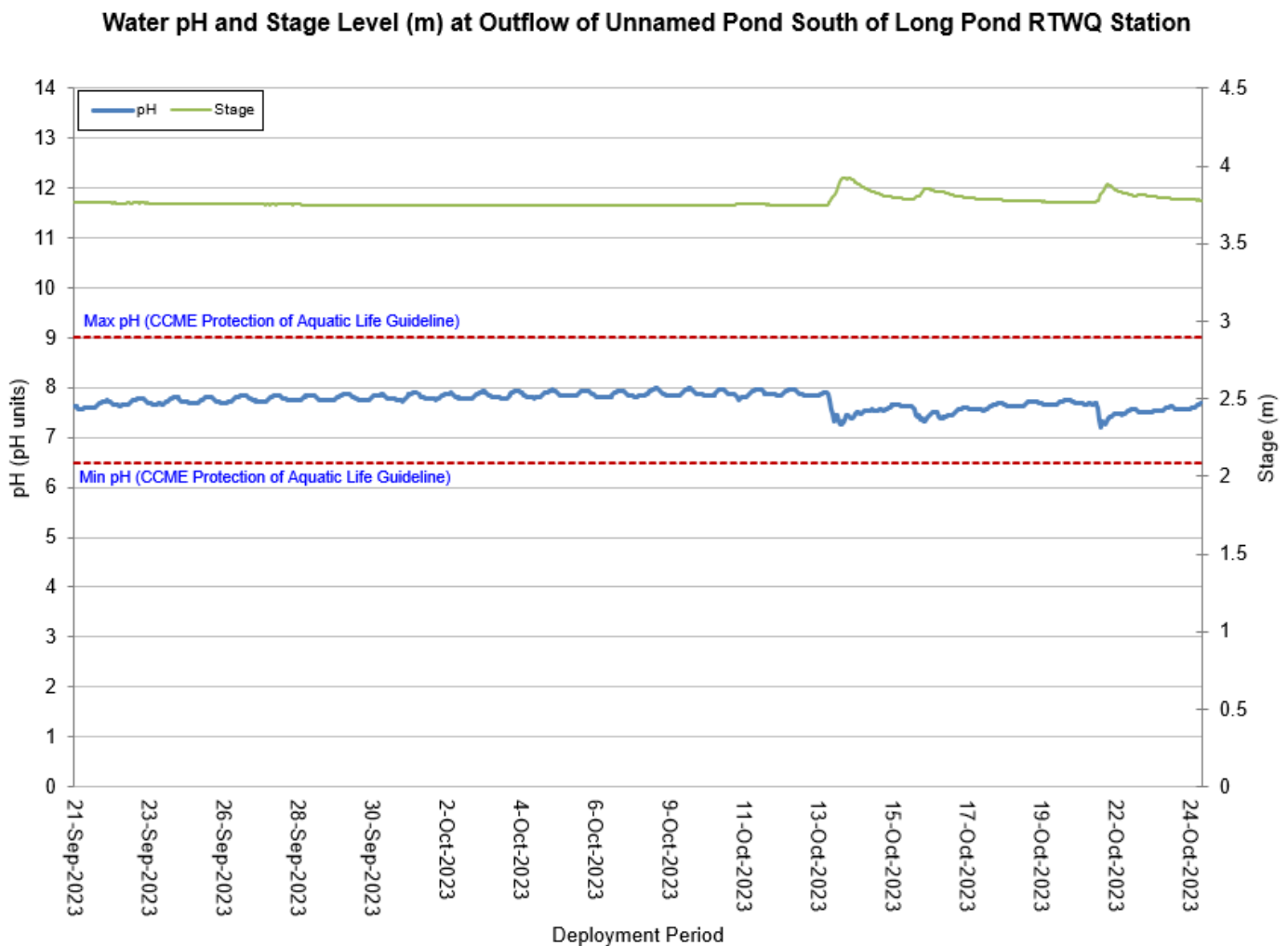


Figure 10: pH (pH units) at Outflow of Unnamed Pond south of Long Pond

Specific Conductivity

The conductivity levels ranged between 130.6 $\mu\text{S}/\text{cm}$ and 321.6 $\mu\text{S}/\text{cm}$, with an average of 237.2 $\mu\text{S}/\text{cm}$ during deployment (Figure 11).

Variations in water level, as depicted in the graph below, have a notable impact on conductivity data. This is evident in instances such as October 14th and October 16th, as highlighted below in the red box (Figure 11). When the water stage rises, often in response to precipitation events, conductivity tends to decrease. However, it generally returns to normal levels within a few days to weeks.

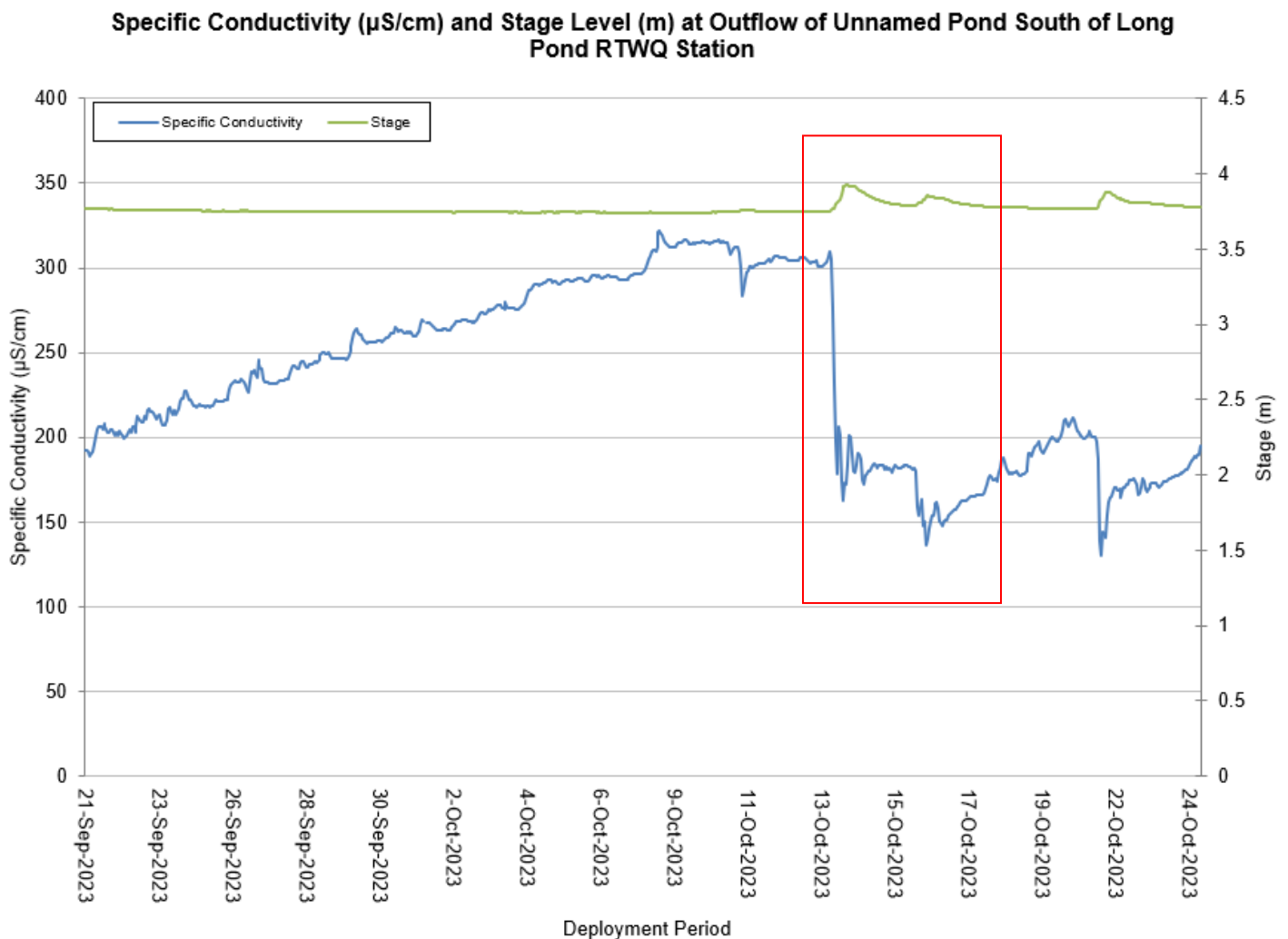


Figure 11: Specific conductivity ($\mu\text{S}/\text{cm}$) at Outflow of Unnamed Pond south of Long Pond

Dissolved Oxygen

During this deployment, the dissolved oxygen levels ranged within 9.31 mg/L and 12.11 mg/L for concentration and 93.8 % and 103.8 % for percent saturation. DO concentration levels were outside of the CCME Guidelines for the Protection of Aquatic Life which is to be expected given the cooler water temperatures.

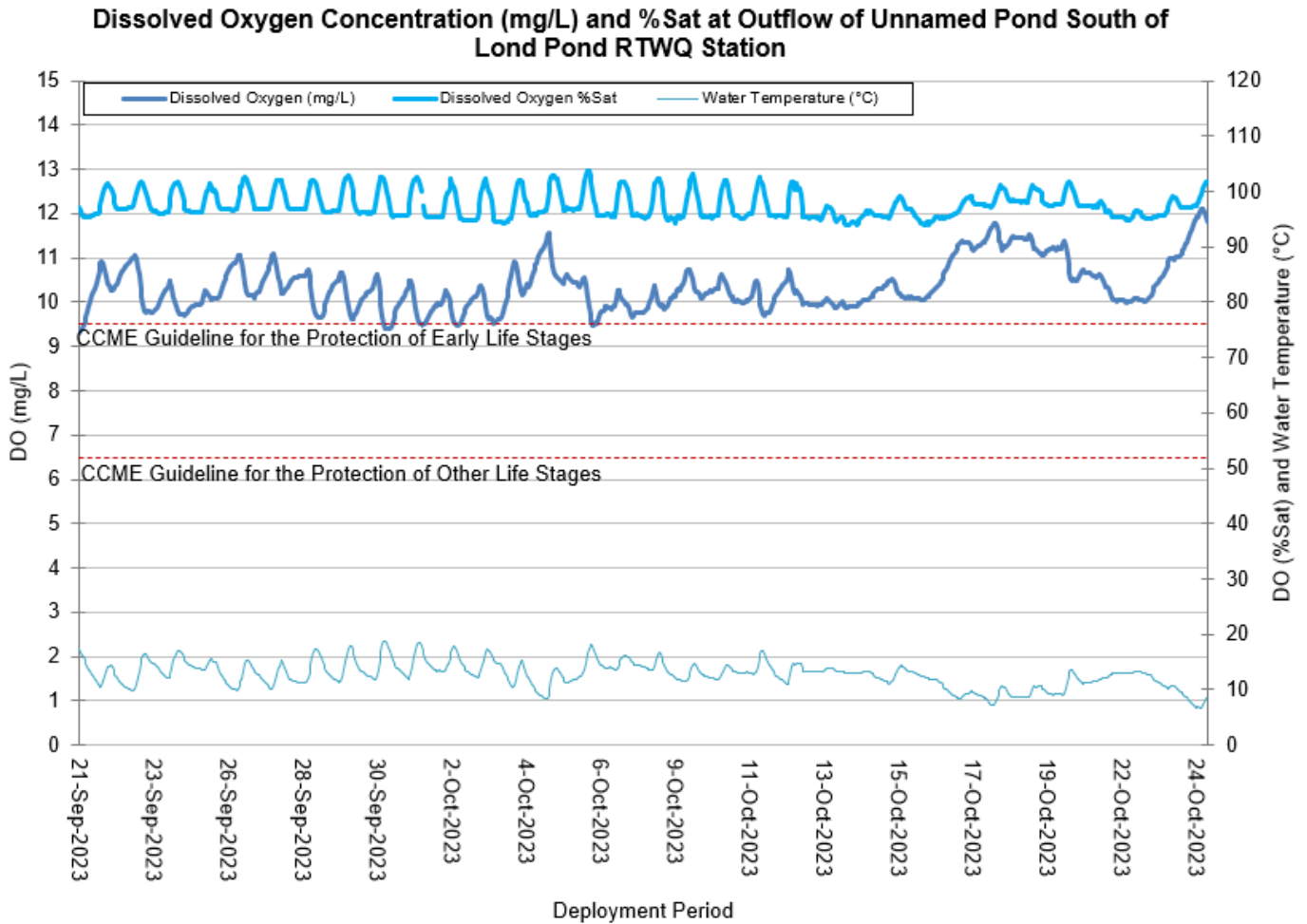


Figure 12: Dissolved Oxygen (%Sat & mg/L) at Outflow of Unnamed Pond south of Long Pond

Turbidity

Turbidity levels during the deployment ranged within 1.1 NTU and 13.4 NTU, with an average of 2.7 NTU (Figure 13). Turbidity started increasing towards the end of the deployment period but still remained relatively low. Spikes in the data, like October 14th, can be attributed to stage increases from rainfall events (Appendix I).

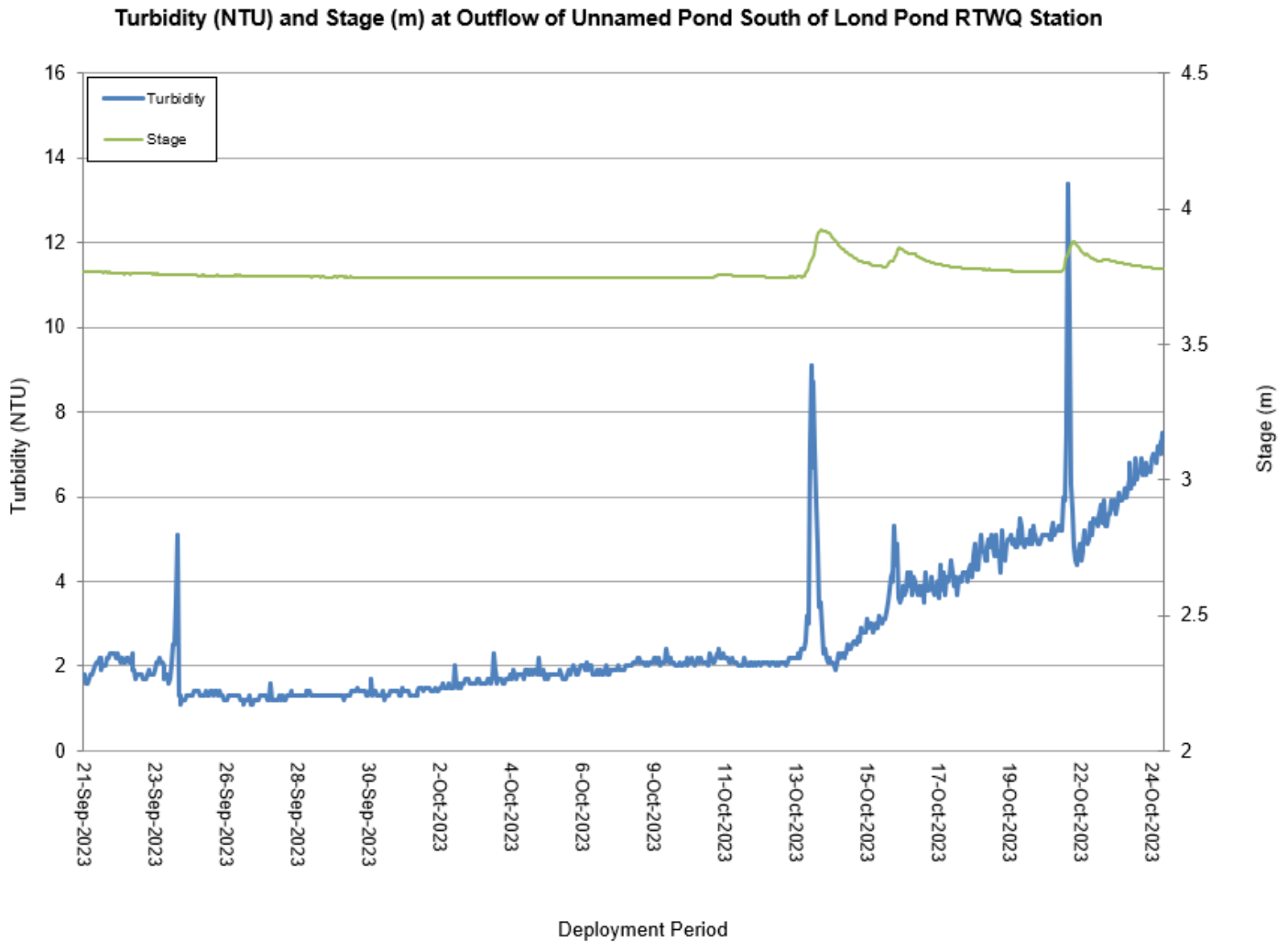


Figure 13: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond

Daily Averaged Stage Level and Total Precipitation

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 3.74m to 3.92m during the deployment. 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 (Appendix I).

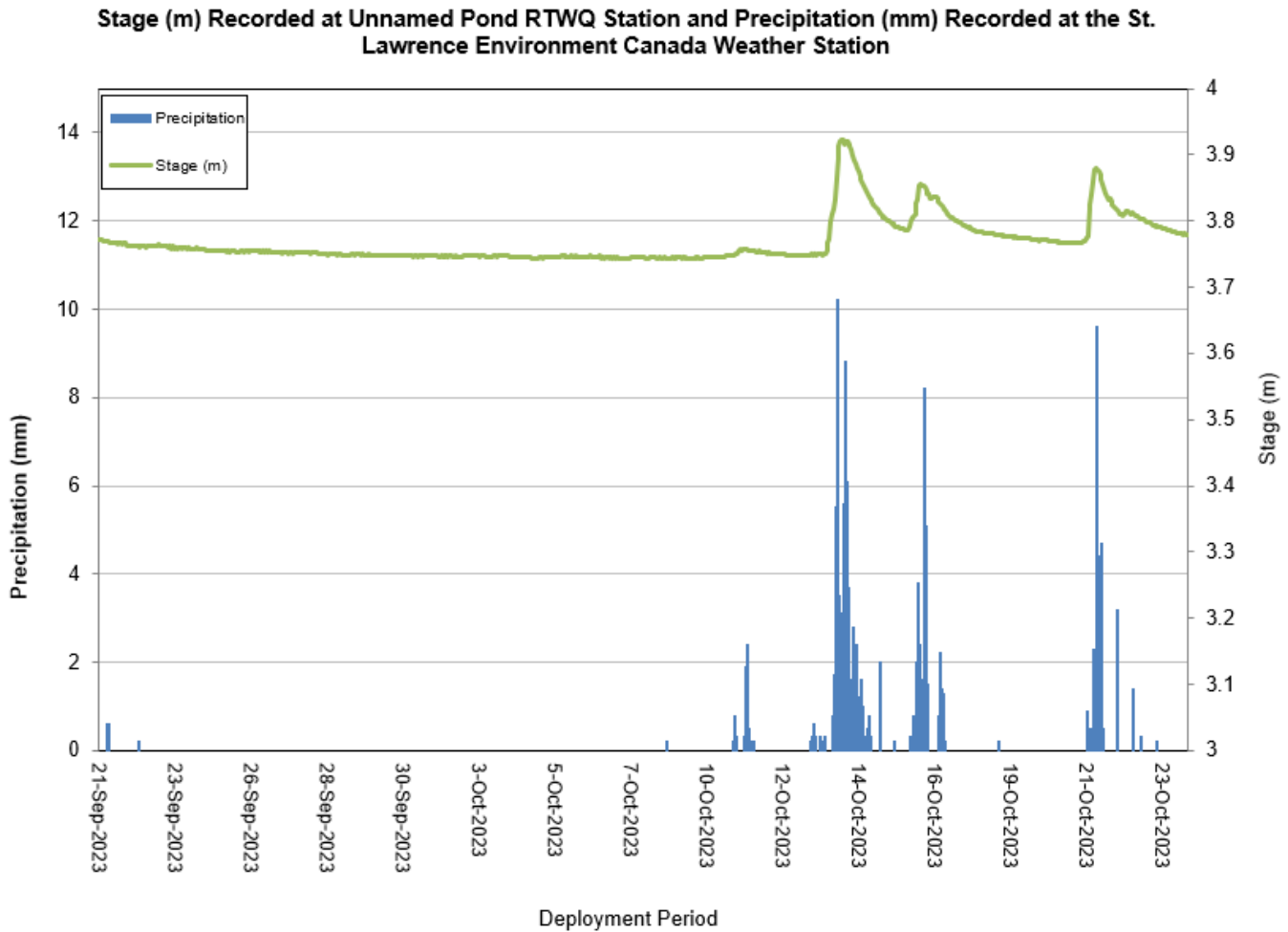


Figure 14: Daily averaged stage values and total precipitation.

APPENDIX I

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

Parameter statistics for each RTWQ Station

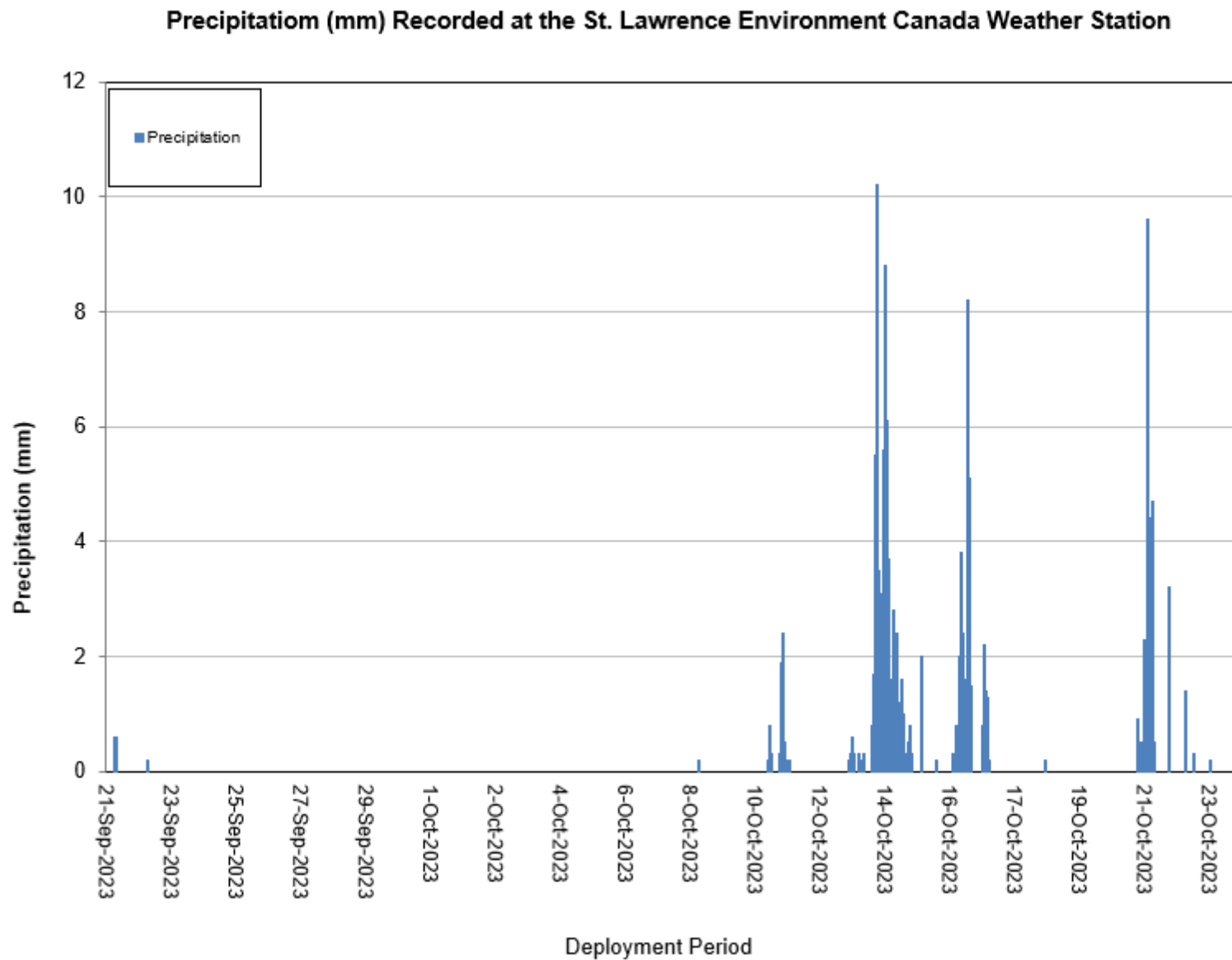


Figure 15: Precipitation recorded at Environment Canada Weather Station during the deployment period.

Parameter Statistics for CFI RTWQ Stations

John Fitzpatrick Pond RTWQ Station

Parameter	Max.	Min.	Median	Mean
Temperature(°C)	18.15	10.16	13.80	13.66
pH	8.00	7.47	7.83	7.82
Specific Conductivity (µS/cm)	242.54	185.08	210.86	212.19
TDS (g/mL)	0.16	0.12	0.14	0.14
Dissolved Oxygen (%Sat)	109.50	95.30	99.80	100.18
Dissolved Oxygen (mg/L)	11.24	9.34	10.41	10.40
Turbidity (NTU)	18.50	0.90	1.20	1.54
Stage (m)	4.93	4.79	4.81	4.82

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

Outflow of Unnamed Pond South of Long Pond RTWQ Station

Parameter	Max.	Min.	Median	Mean
Temperature(°C)	18.88	6.75	12.95	12.71
pH	7.98	7.22	7.76	7.73
Specific Conductivity (µS/cm)	321.63	130.58	234.81	237.18
TDS (g/mL)	0.21	0.08	0.15	0.15
Dissolved Oxygen (%Sat)	103.80	93.80	96.80	97.51
Dissolved Oxygen (mg/L)	12.11	9.31	10.24	10.36
Turbidity (NTU)	13.40	1.10	2.10	2.70
Stage (m)	3.92	3.74	3.75	3.77
Flow	0.26	0.01	0.01	0.02

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