Real-Time Water Quality Report

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

Deployment Period
September 27, 2022 to October 24, 2022

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

Prepared by:

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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

	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 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	Sept 27,2022	Deployment	Excellent	Good	Good	Excellent	Good
	Oct 24, 2022	Removal	Good	Good	Excellent	Excellent	Excellent
Unnamed Pond	Sept 27,2022	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Oct 24, 2022	Removal	Fair	Excellent	Excellent	Excellent	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’ or ‘Good’ for all water quality parameters during the deployment. At removal, the rankings against the QA instrument determined the parameter data was ‘Fair’ and ‘Excellent’, as can be seen in Table 2.

Issues during the September 27th to October 24th 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.

John Fitzpatrick Pond

Water Temperature

Water temperature ranged from 10.58°C to 16.14°C during the deployment period (Figure 3). The average water temperature for this deployment is 13.23°C, cooler than the previous deployment average of 17.58°C, which is to be expected as the season adjusts to late Fall into Winter temperatures.

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). As the deployment continues the water temperature remain stable while decreasing slightly.

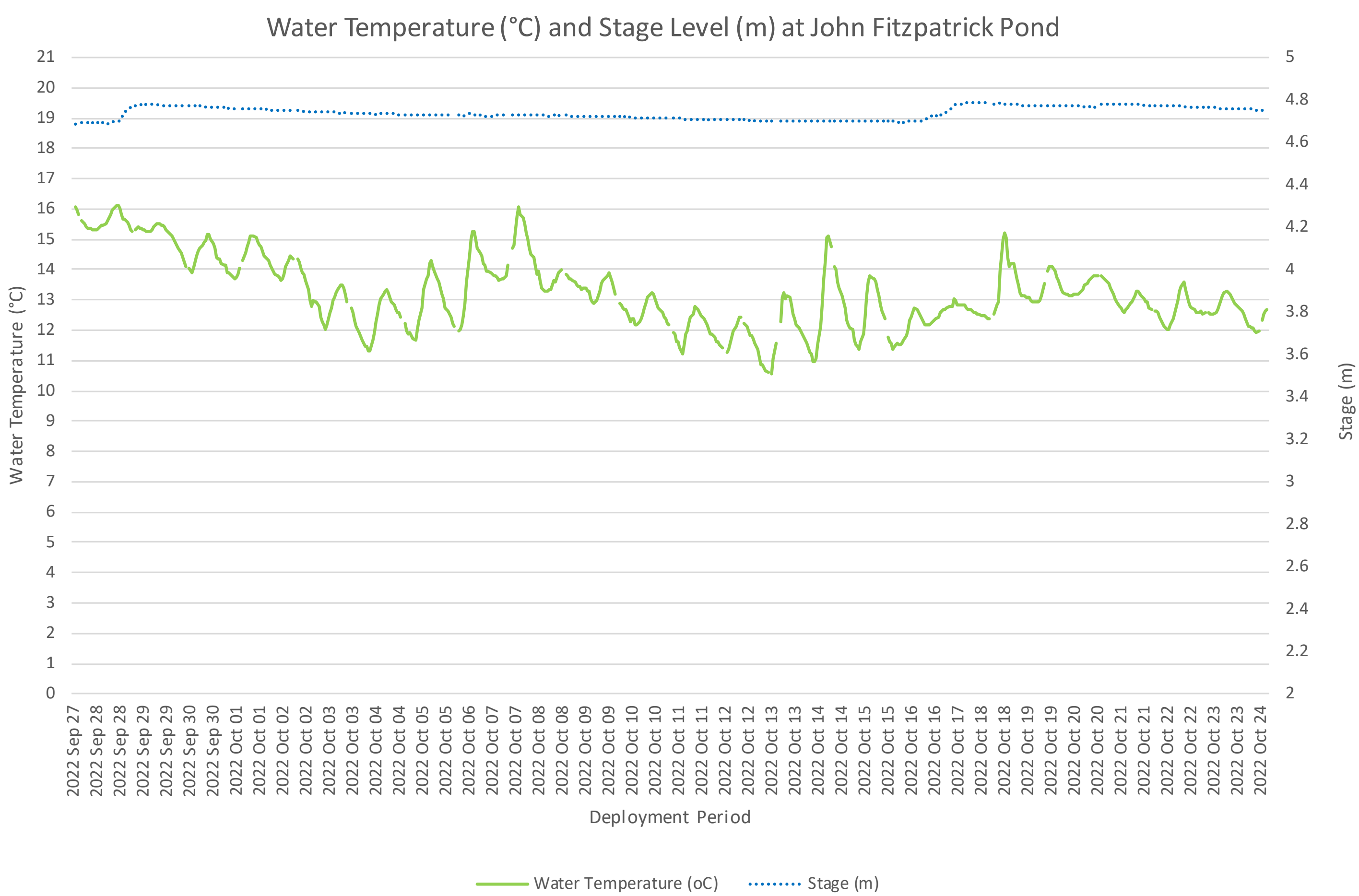


Figure 3: Water temperature (°C)

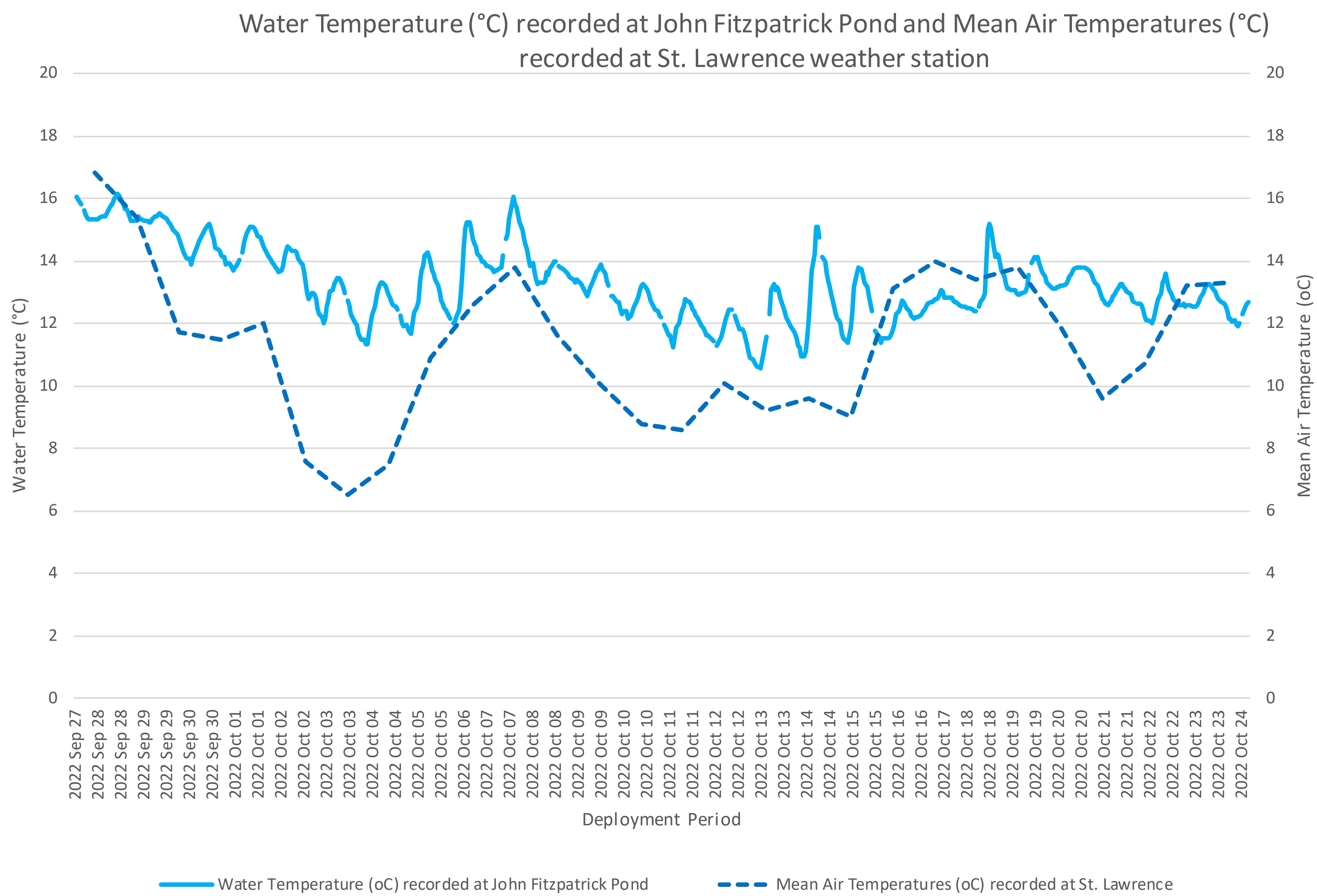


Figure 4: Water Temperature (°C) at John Fitzpatrick Station vs. Mean Air Temperatures (°C) at St. Lawrence Weather Station

pH

Throughout the deployment period, pH values ranged between 6.59 pH units and 7.79 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 September 29th and October 17th is likely a result of the rainfall events (Appendix I) recorded on and around those same dates.

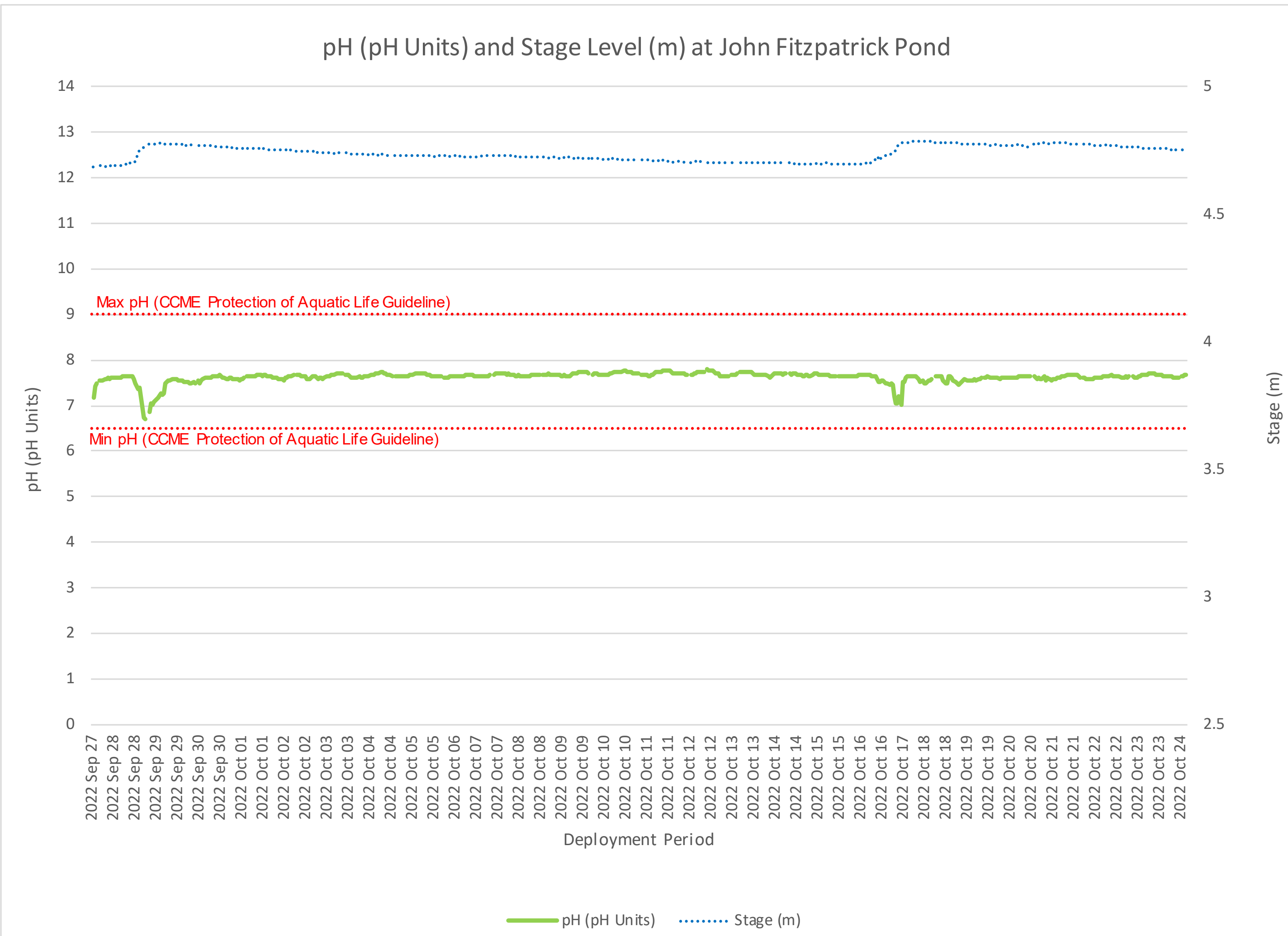


Figure 5: pH (pH units) values

Specific Conductivity

The conductivity levels are within 123.54 µS/cm and 159.92 µS/cm during this deployment period (Figure 6). The specific conductivity probe measured 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 several small dips recorded on September 28th and October 17th. These dips 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.

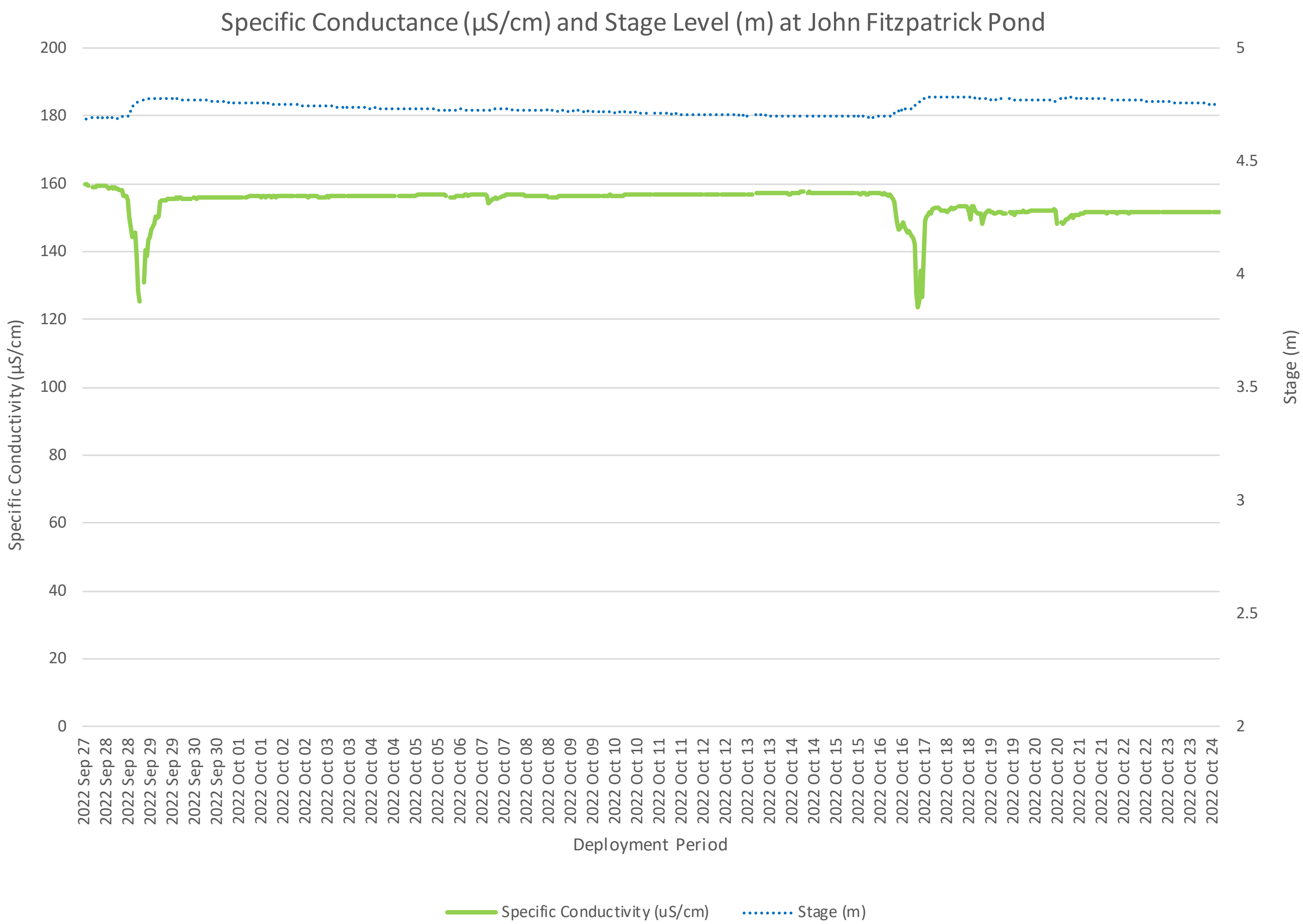


Figure 6: Specific conductivity (µS/cm) values

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 9.5 mg/L to a maximum of 11.66 mg/L. The dissolved oxygen percent saturation levels ranged within 94.8% Saturation to 114.7% Saturation (Figure 7). As the water temperature decreased throughout October, the percent saturation of dissolved oxygen increased within the same timeframe (Figure 7).

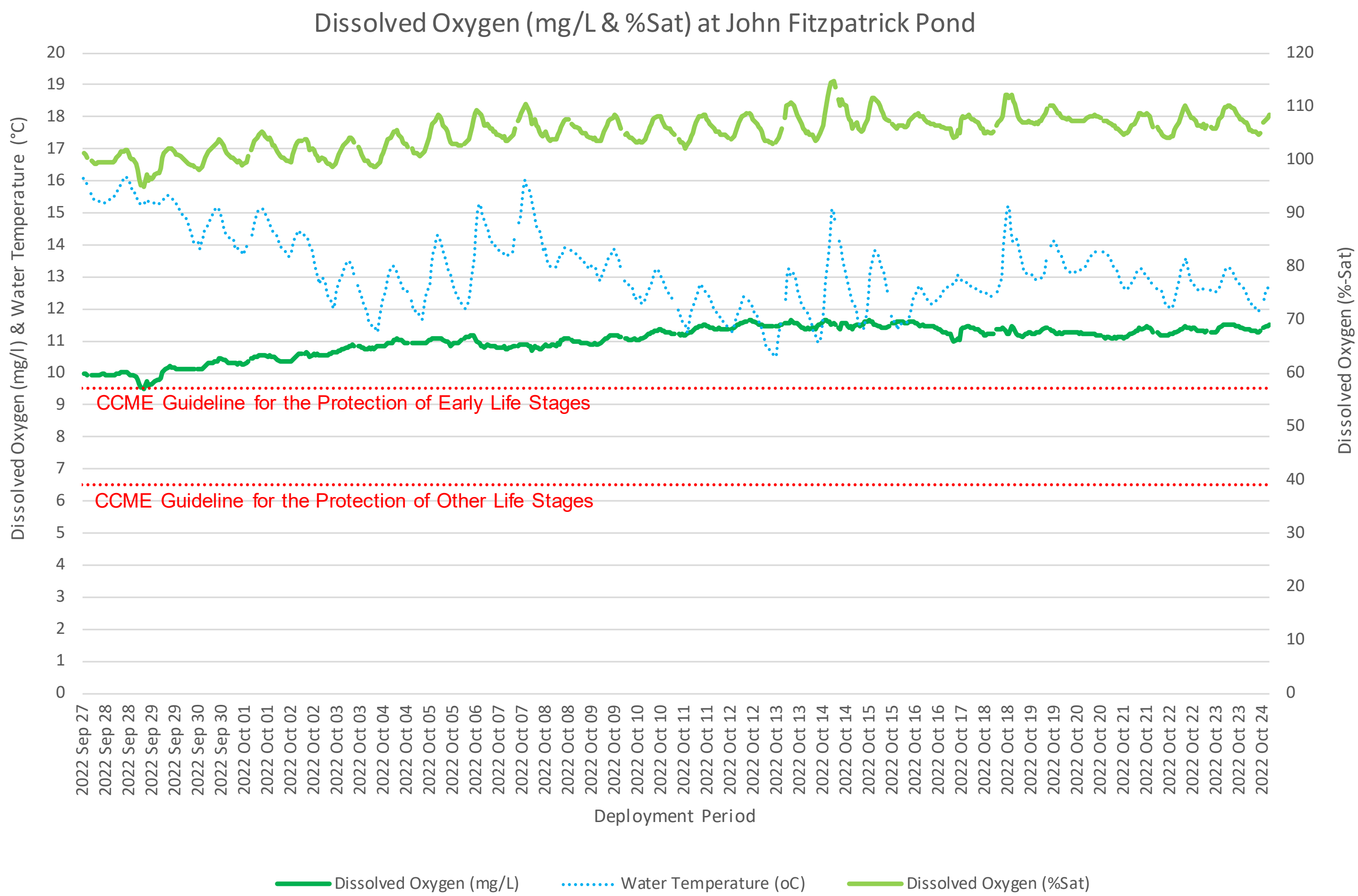


Figure 7: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C)

Turbidity

Turbidity levels during the deployment ranged within 0.5 NTU and 5.1 NTU (Figure 7). The deployment data had a median of 0.7 NTU. During the site visit to this station it was noted that the pond is extremely clear with a rocky bottom made up of large rocks (Figure 8).

Turbidity was stable during the deployment, with the largest spike of 5.1 NTU occurring on October 16th. There was another small increase in turbidity on October 20th. The changes in turbidity was a result of rainfall (Appendix I) on and around October 16th and October 17th, and again on October 20th. The rainfall likely increased the particle matter in the water column for a short period of time.

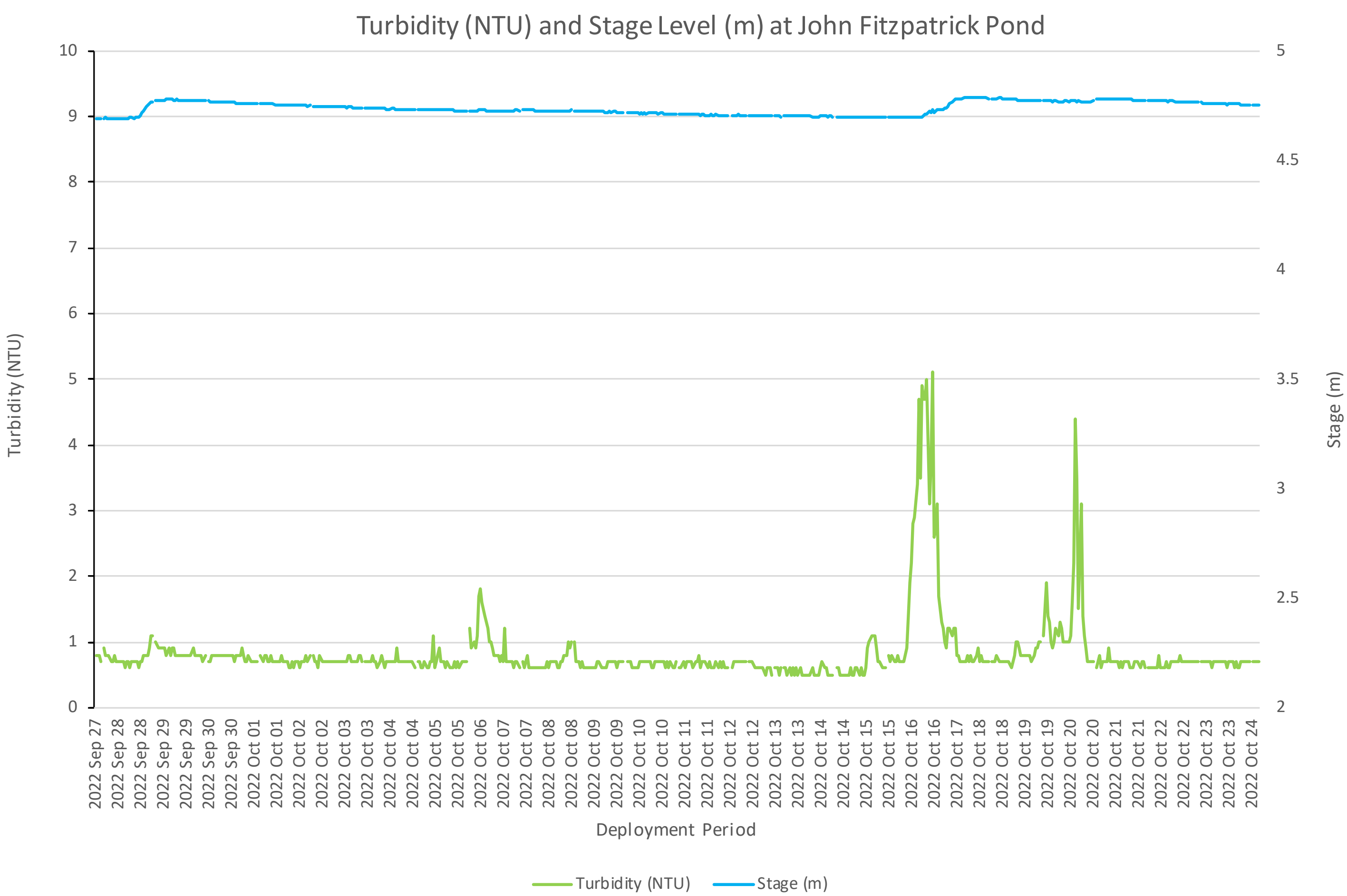


Figure 8: Turbidity (NTU) values.

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 4.7m to 4.79m 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 September 28th, 2022 at 45.6 mm.

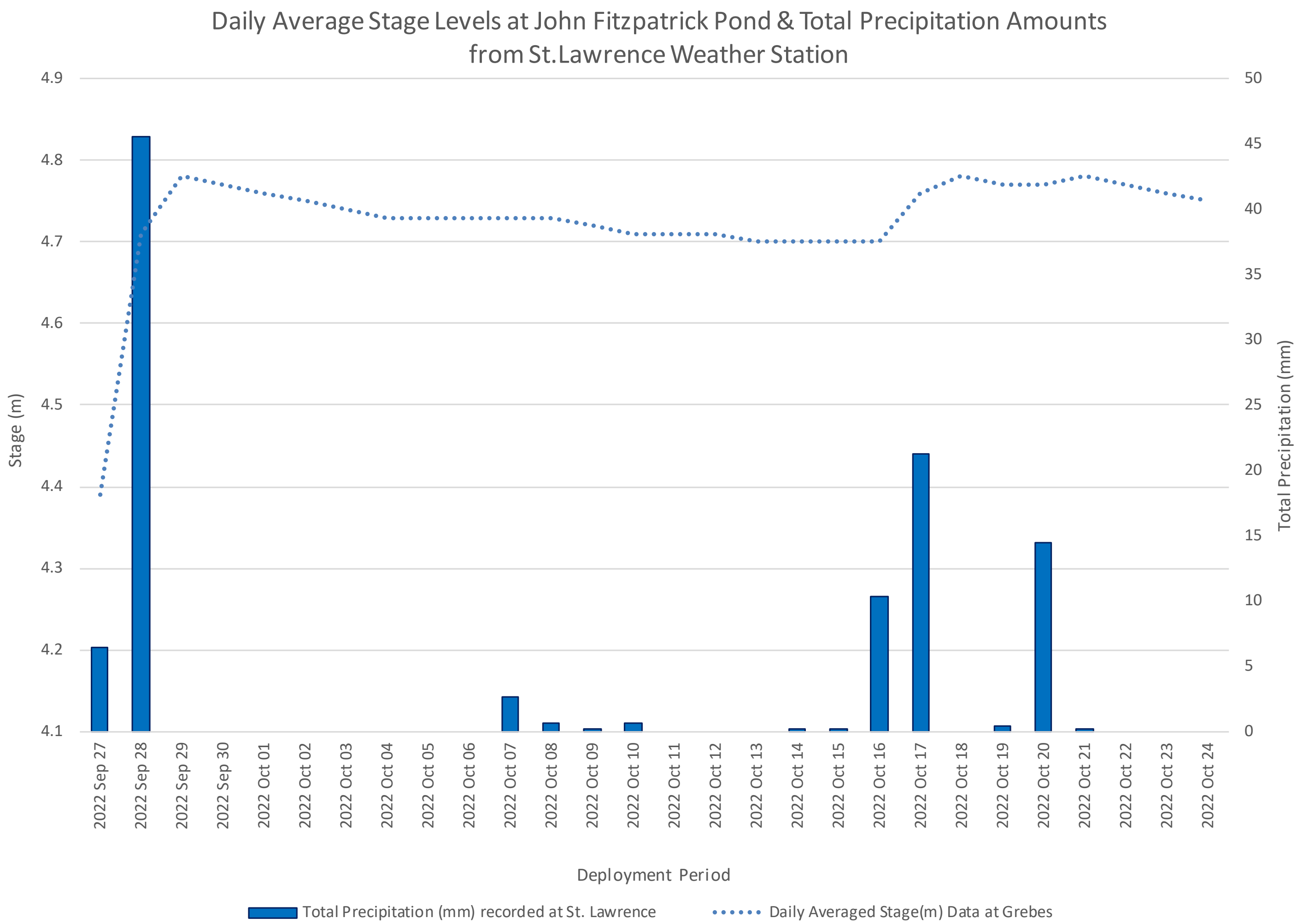


Figure 9: Daily averaged stage values and total precipitation.

Outflow of Unnamed Pond south of Long Pond

Water Temperature

Water temperature ranged from 7.55ºC to 17.54ºC 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.

Water temperature will naturally flow in a diurnal pattern. 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.

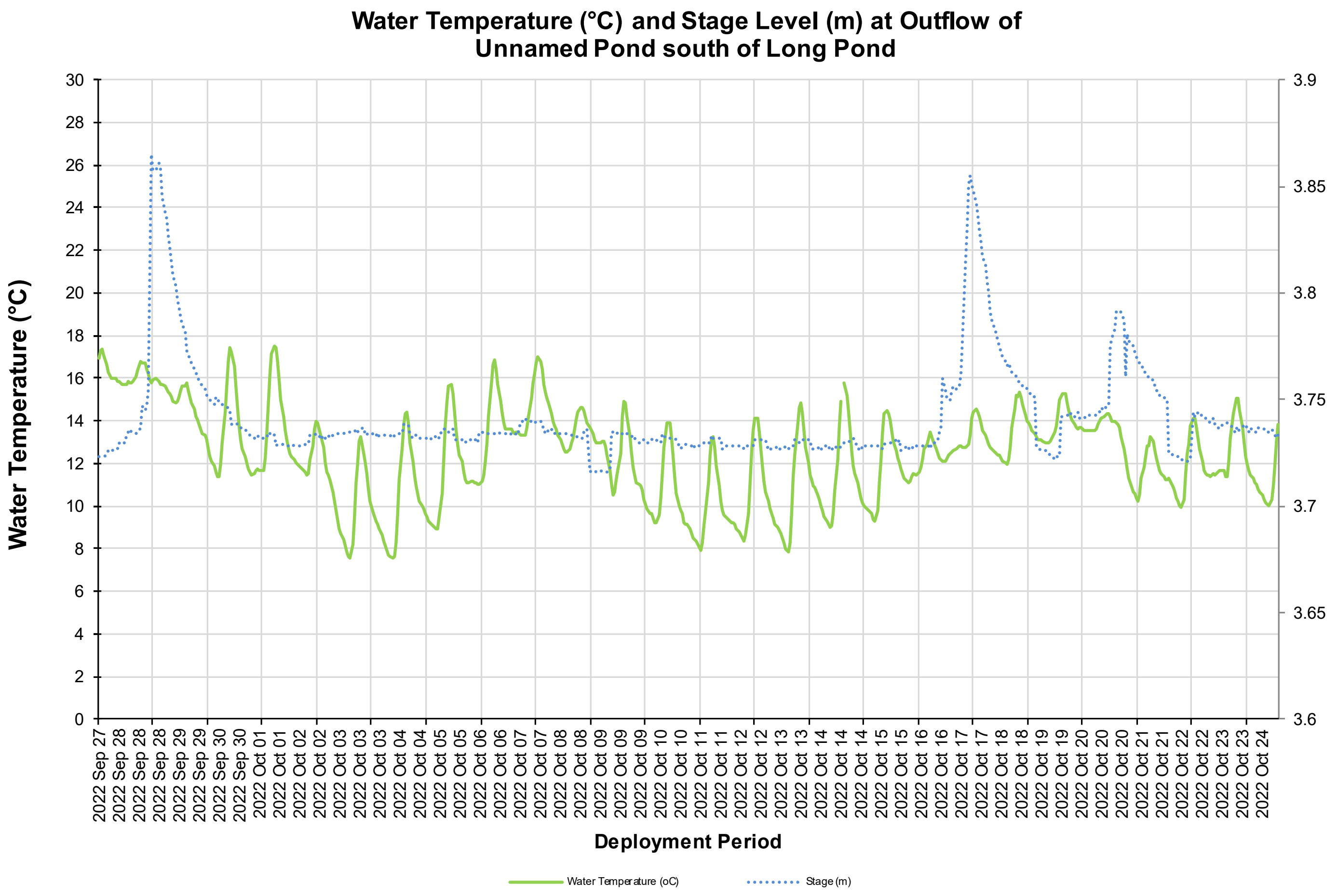


Figure 10: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond

pH

Throughout this deployment period, pH values ranged within 6.95 pH units and 7.85 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.

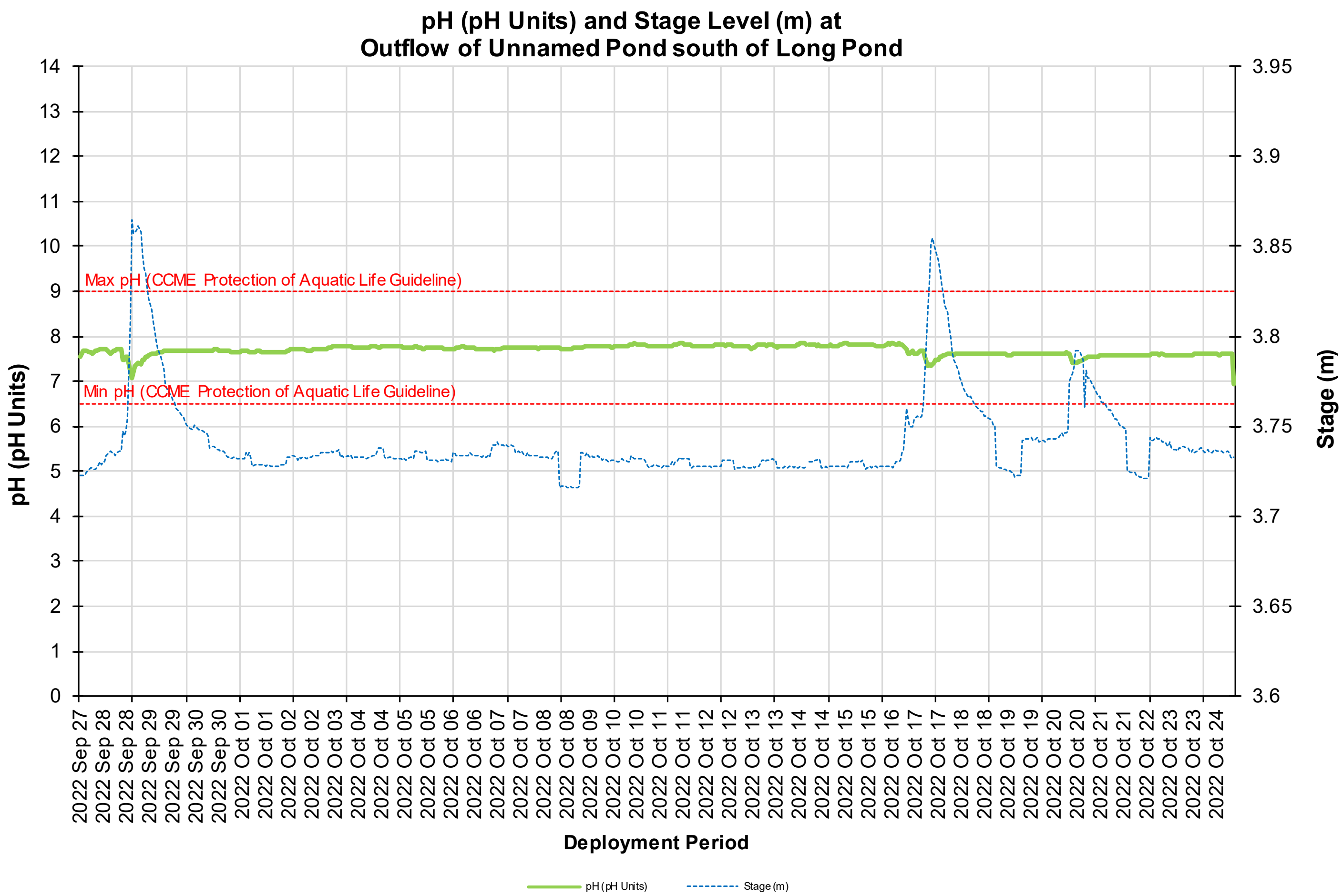


Figure 11: pH (pH units) at Outflow of Unnamed Pond south of Long Pond

Specific Conductivity

The conductivity levels ranged between 133.77 µS/cm and 313.81 µS/cm during deployment (Figure 12). The deployment period had a median of 252.73 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. This is most evident on September 28th, 2022 and again on October 17th, 2022.

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.

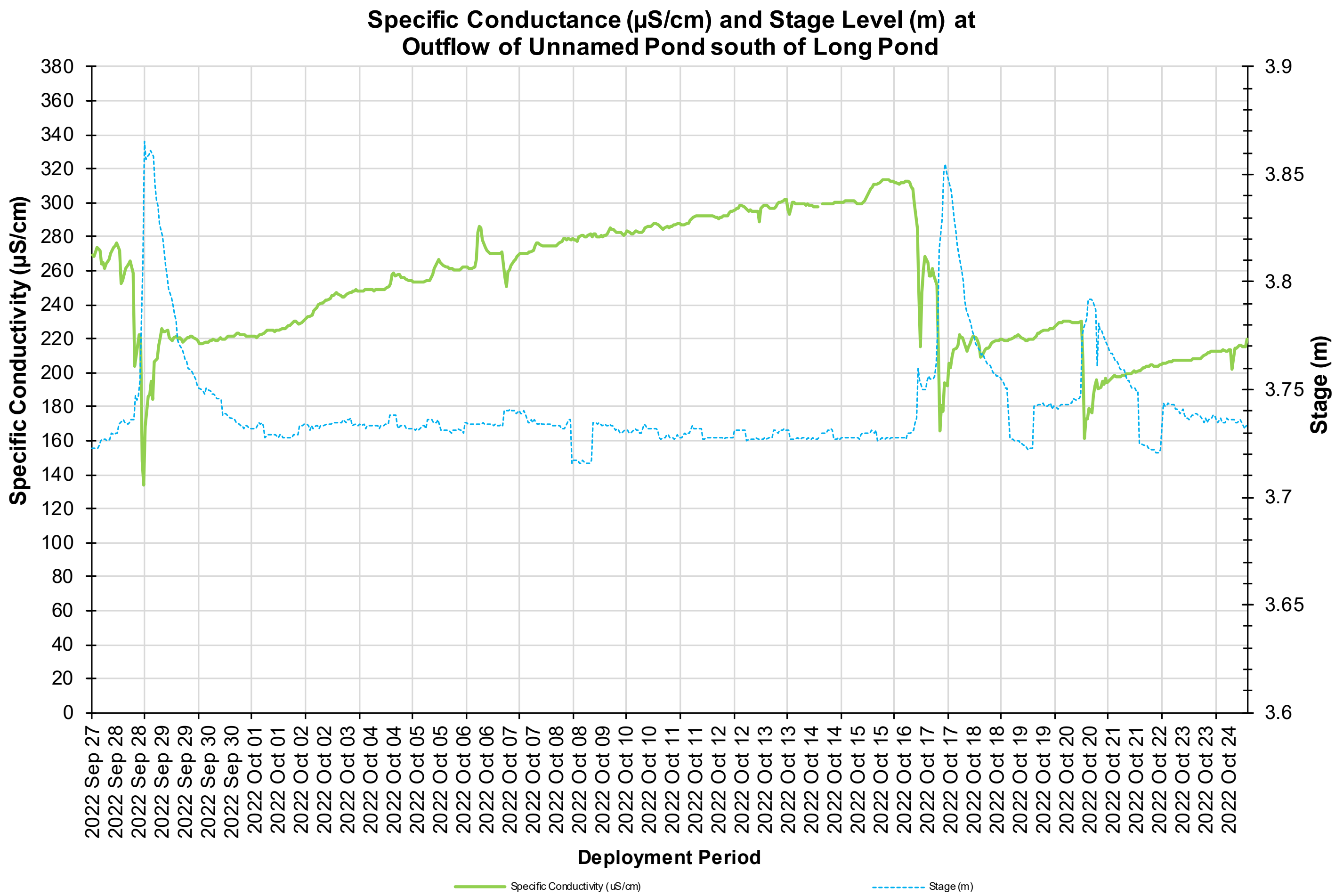


Figure 12: Specific conductivity (µS/cm) at Outflow of Unnamed Pond south of Long Pond

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).

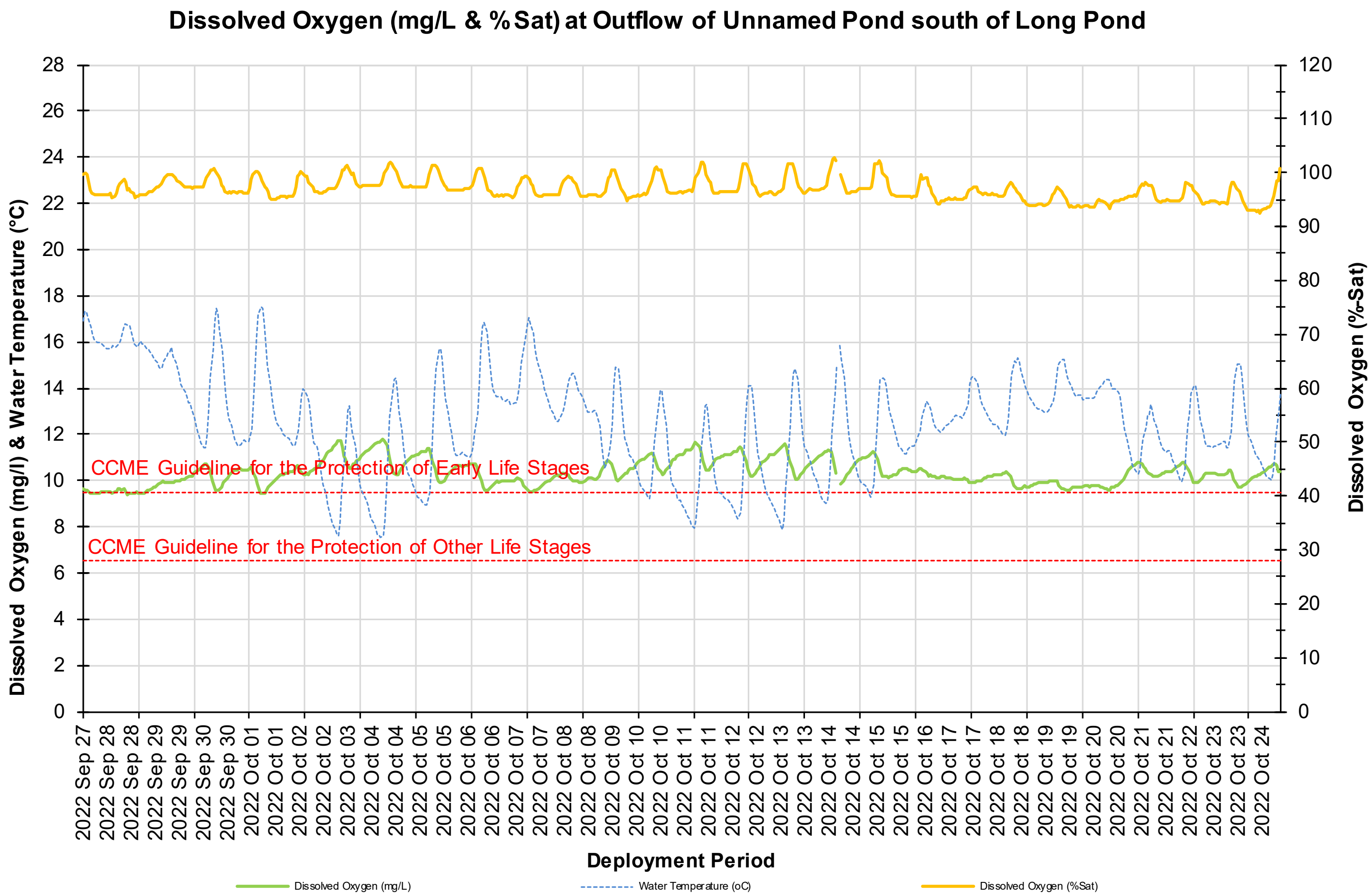


Figure 13: Dissolved Oxygen (%Sat & mg/L) at Outflow of Unnamed Pond south of Long Pond

Turbidity

Turbidity levels during the deployment ranged within 7.3 NTU and 202.3 NTU (Figure 14). The deployment data had a median of 22 NTU, an increase compared to the previous deployment median of 3 NTU.

Turbidity remained below 60 NTU until an increase on October 17th when values reached ~200 NTU. Turbidity conditions remained high as the deployment ended. The increase in turbidity corresponded with rainfall on both October 16th and October 17th which may have influenced the level of particle matter present in the water. The turbidity remaining high indicate that the turbidity sensor may have become blocked by silt preventing the data to return to lower values.

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.

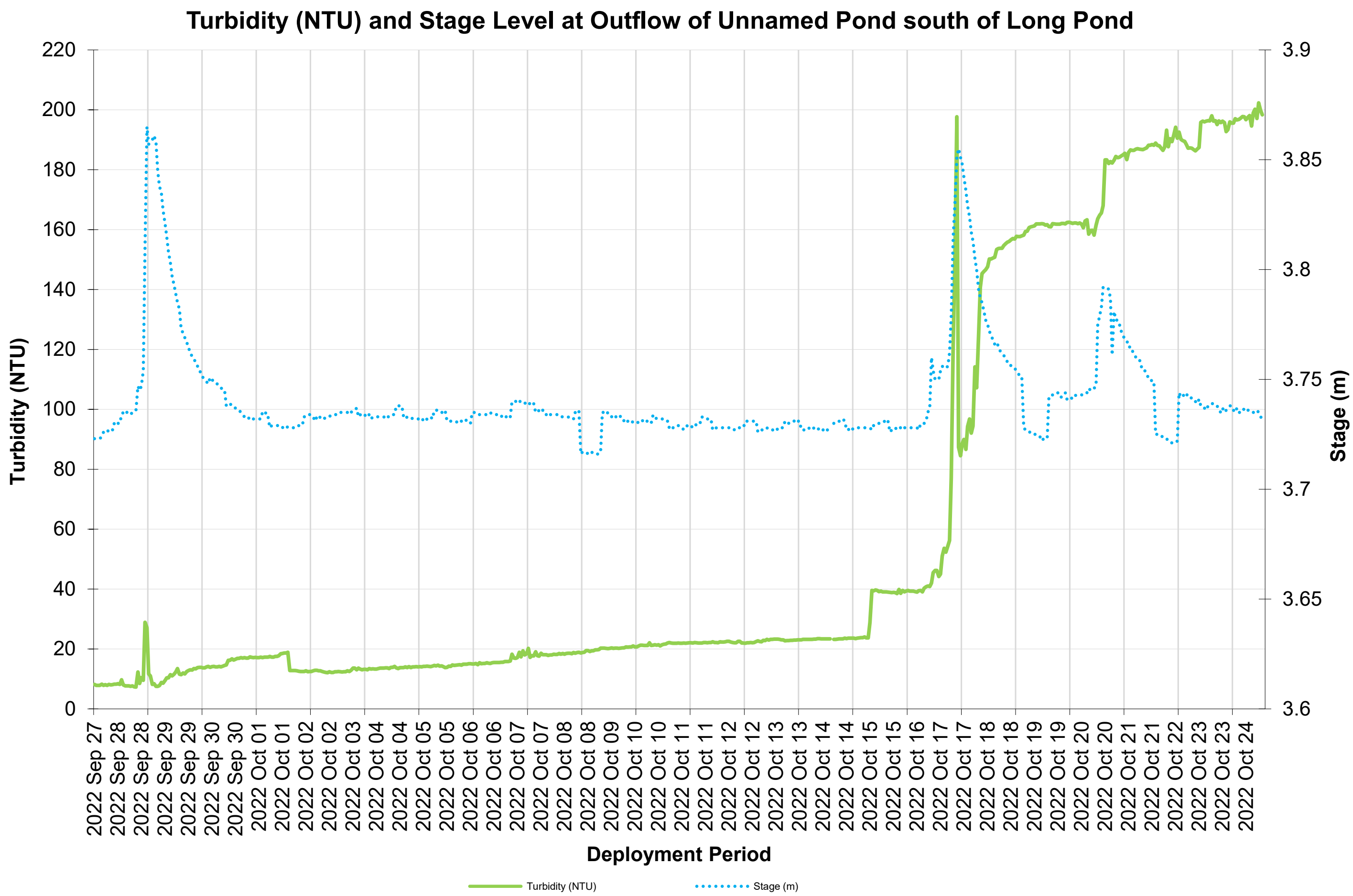


Figure 14: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond

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 3.73 m to 3.80m 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. The highest total precipitation was recorded on September 28th, 2022 at 45.6mm.

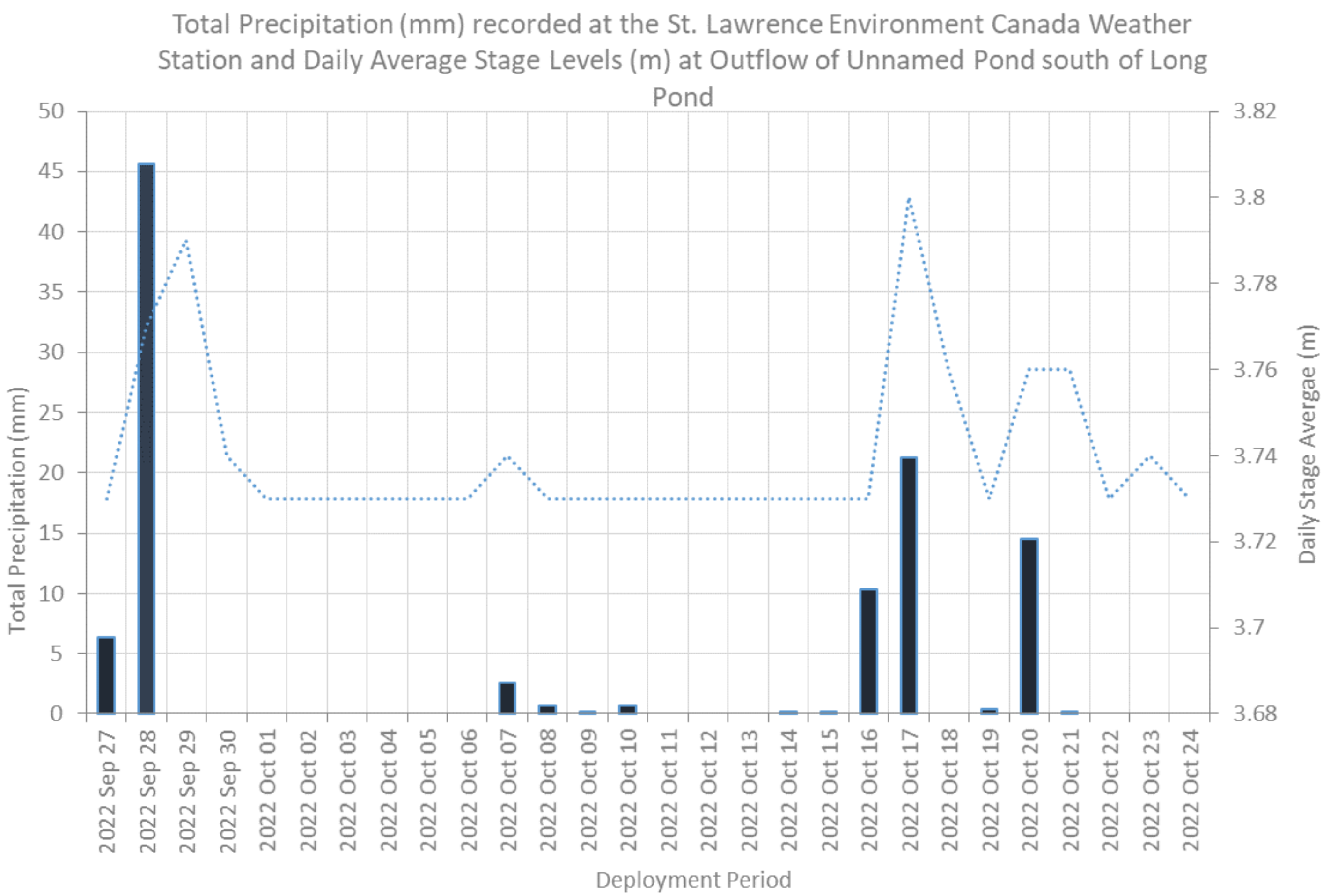
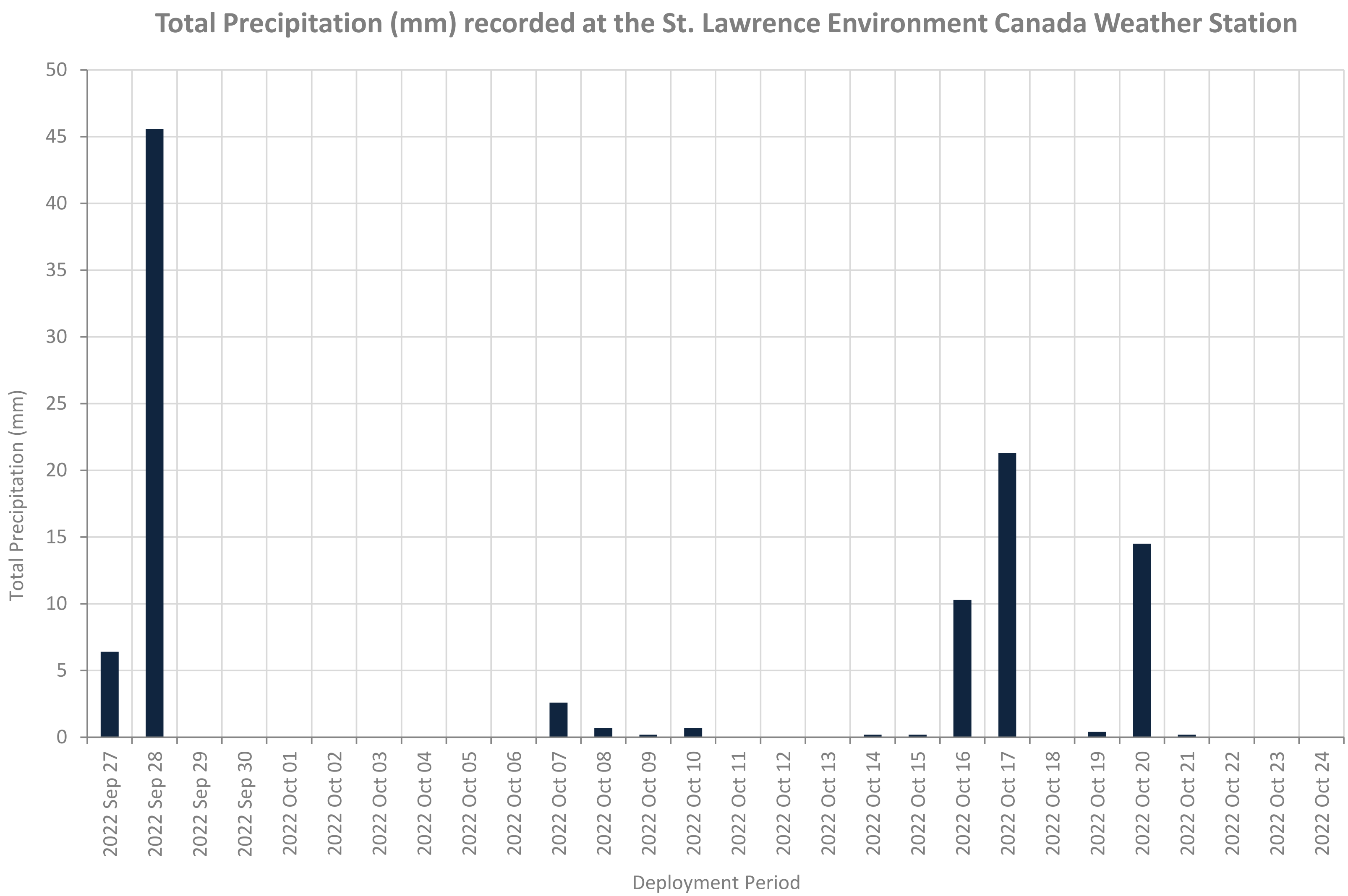


Figure 14: Daily averaged stage values and total precipitation.

APPENDIX I

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


Total Precipitation (mm) recorded at the St. Lawrence Environment Canada Weather Station
Total Precipitation (mm)
0
5
10
15
20
25
30
35
40
45
50
2022 Sep 27
2022 Sep 28
2022 Sep 29
2022 Sep 30
2022 Oct 01
2022 Oct 02
2022 Oct 03
2022 Oct 04
2022 Oct 05
2022 Oct 06
2022 Oct 07
2022 Oct 08
2022 Oct 09
2022 Oct 10
2022 Oct 11
2022 Oct 12
2022 Oct 13
2022 Oct 14
2022 Oct 15
2022 Oct 16
2022 Oct 17
2022 Oct 18
2022 Oct 19
2022 Oct 20
2022 Oct 21
2022 Oct 22
2022 Oct 23
2022 Oct 24
Deployment Period