Real-Time Water Quality Report

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

Deployment Period
August 29, 2022 to September 27, 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

	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	Aug 29, 2022	Deployment	Excellent	Good	Good	Excellent	Good
	Sept 27,2022	Removal	Good	Excellent	Good	Excellent	Excellent
Unnamed Pond	Aug 29, 2022	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Sept 27, 2022	Removal	Excellent	Good	Good	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 sonde data when compared. After 30 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 'Excellent' and 'Good'.

Issues during the August 29th to September 27th Deployment Period

There is no stage data for John Fitzpatrick Pond station. Presently there is no stage instrumentation established at John Fitzpatrick, however this will change in the future.

Please note that the stage data recorded for Outflow of Unnamed Pond south of Long Pond 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 12.57°C to 23.83°C during the deployment period (Figure 3). The average water temperature for the deployment is 17.58°C, slightly cooler than the previous deployment average of 18.97°C, which is to be expected as the season adjusts to Fall temperatures.

Water temperature has a natural diurnal pattern. Diurnal patterns exhibit high temperatures during the daylight hours and low temperatures during the nighttime hours (Figure 4). As the deployment continues the temperatures decrease as the air temperatures continue to drop.

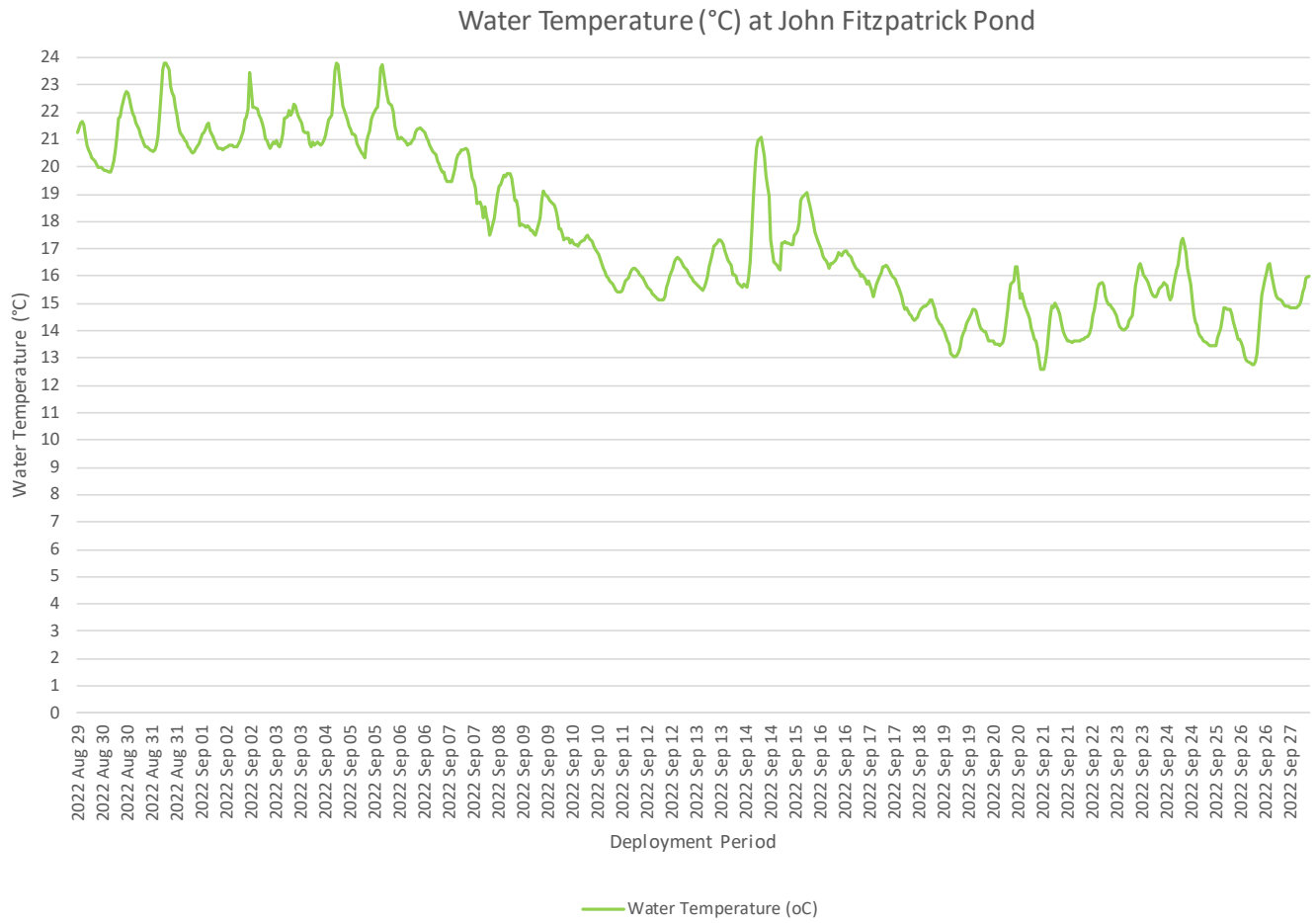


Figure 3: Water temperature (°C)

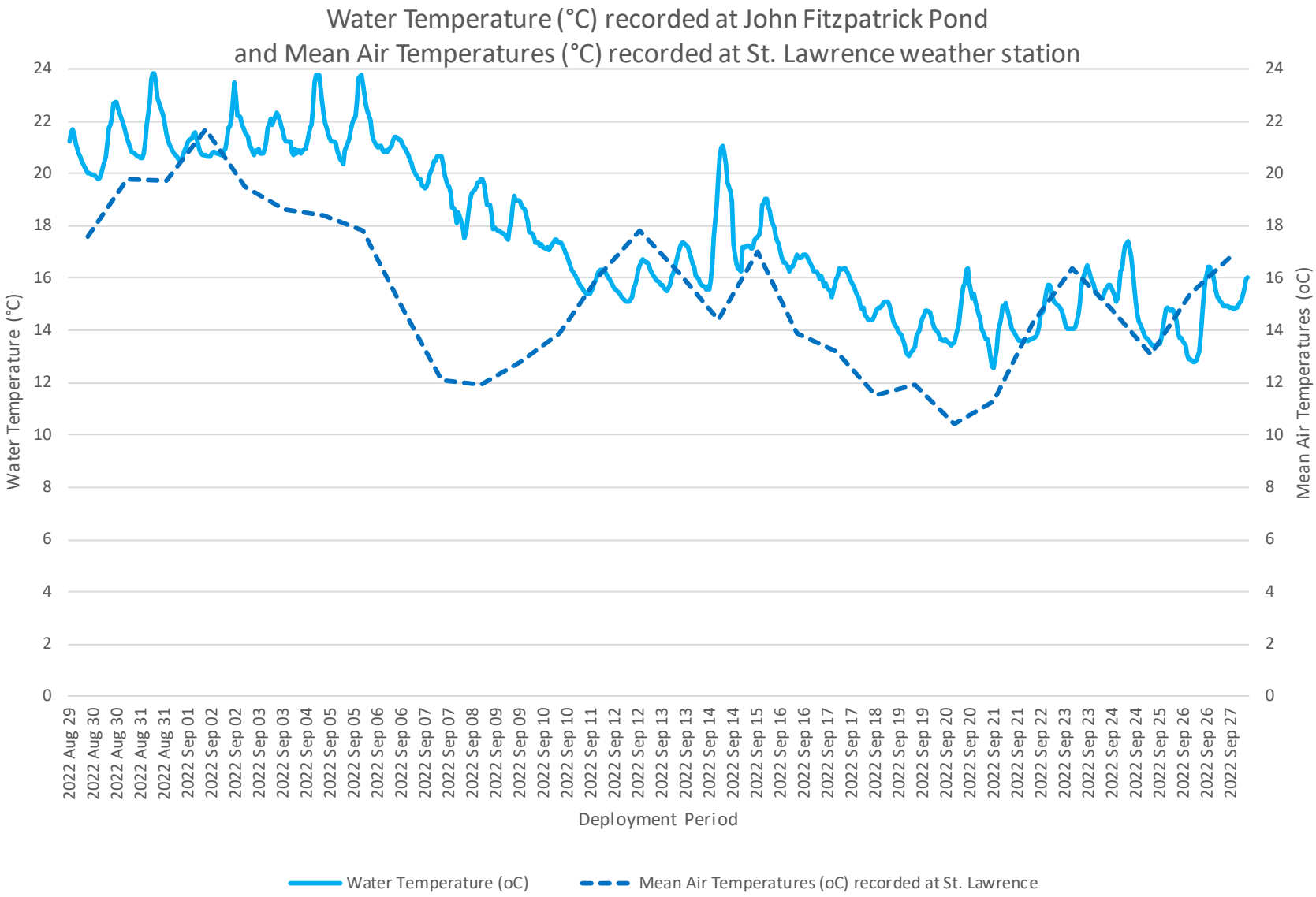


Figure 4: Water Temperature (°C) at John Fitzpatrick Station vs. Mean Air Temperatures (°C) at St. Lawrence Weather Station

pH

Throughout the deployment period, pH values ranged between 7.24 pH units and 7.72 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 1st, is likely a result of the rainfall event (Appendix I). There is no other evident change in pH from August 29th to September 27th, 2022.

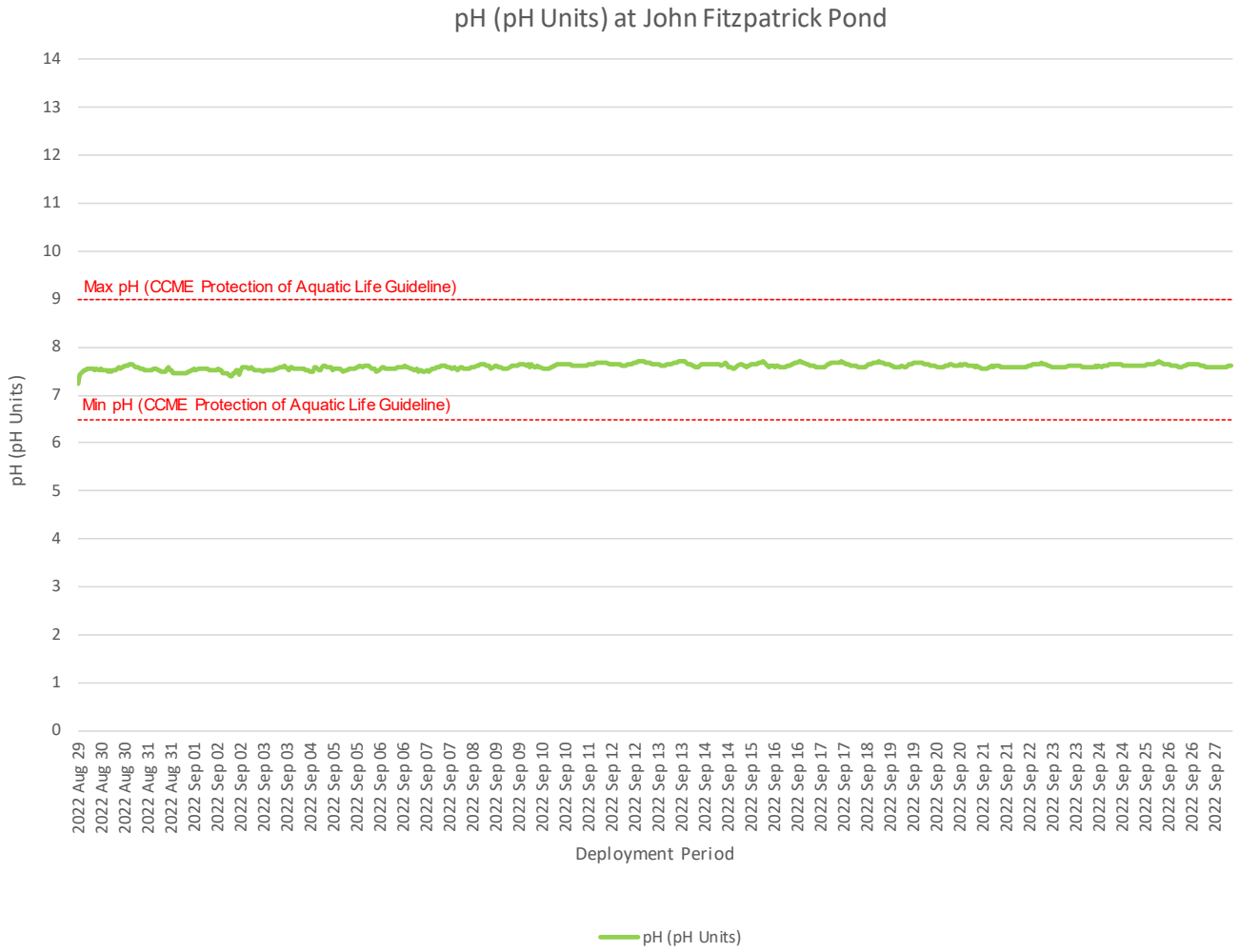


Figure 5: pH (pH units) values

Specific Conductivity

The conductivity levels are within 152.8 µS/cm and 162.4 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 fluctuated 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 1st, September 14th, 21st and 26th. 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.

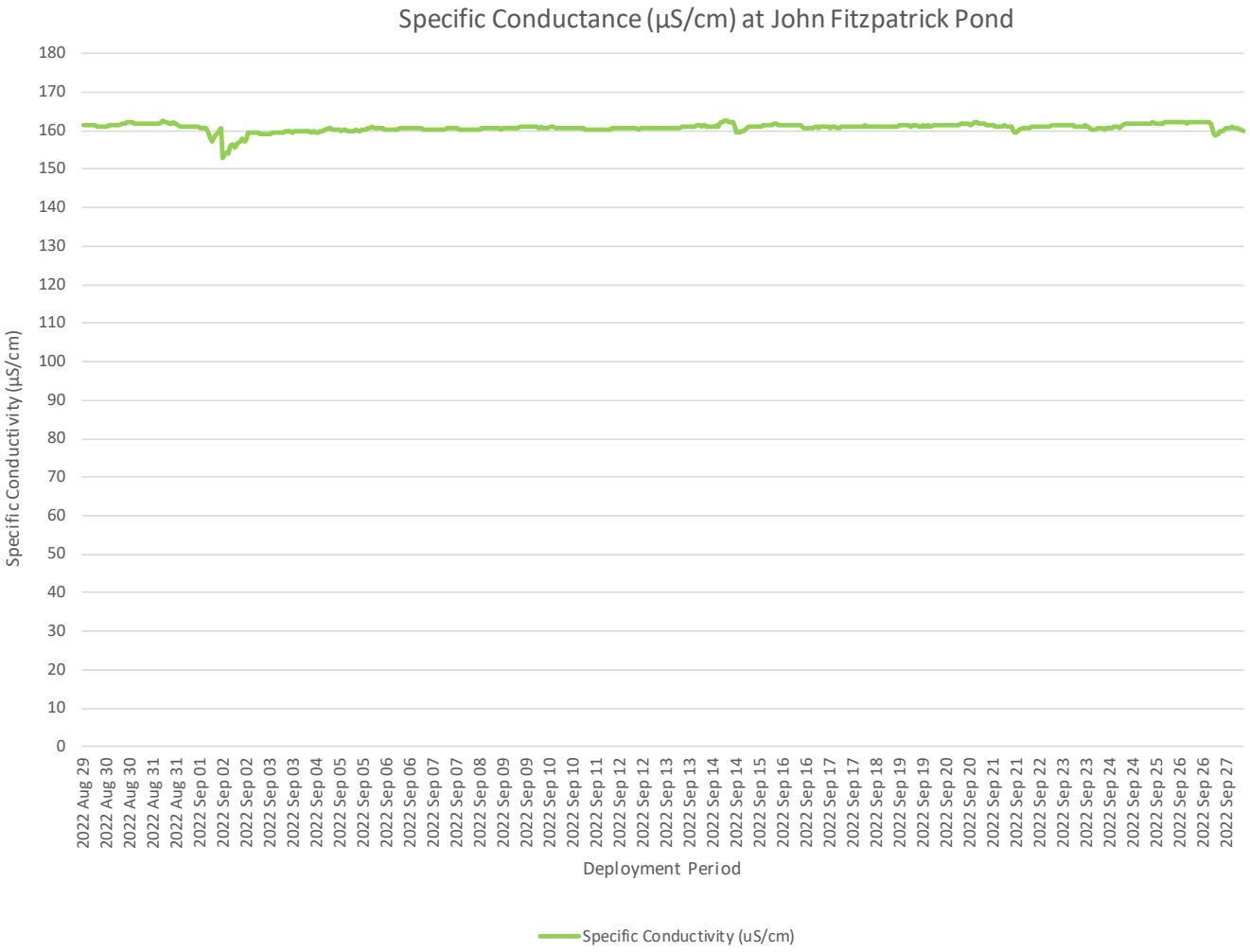


Figure 6: Specific conductivity (µS/cm) values

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 8.66 mg/L to a maximum of 10.69 mg/L. The dissolved oxygen percent saturation levels ranged within 94.9 % Saturation to 109.2 % Saturation (Figure 6). As the water temperature decreased in September, the percent saturation of dissolved oxygen increased within the same timeframe (Figure 7).

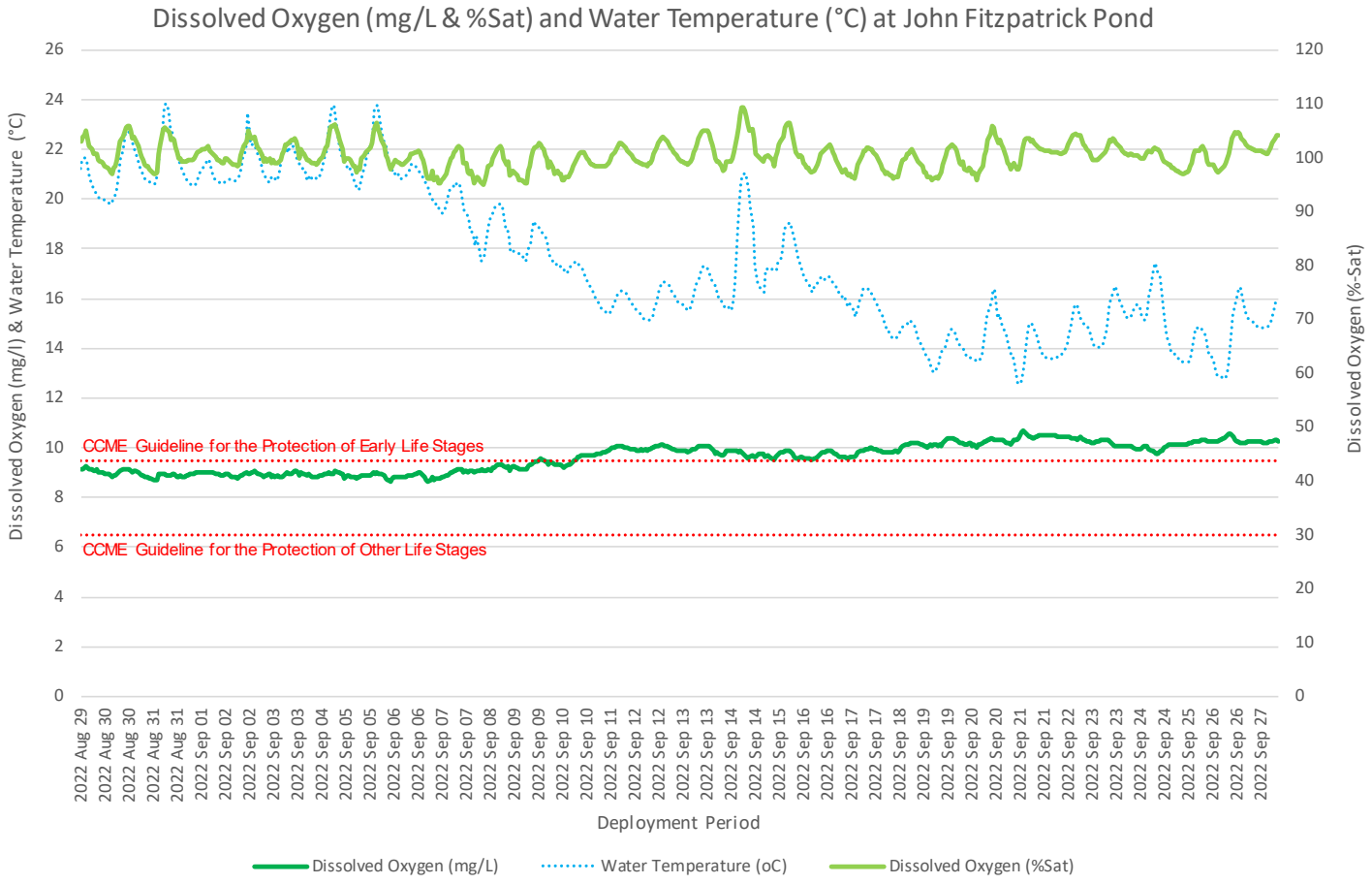


Figure 7: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C)

Turbidity

Turbidity levels during the deployment ranged within 0.23 NTU and 44.75 NTU (Figure 7). The deployment data had a median of 0.52 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 and low siltation present (Figure 8).

Turbidity was stable during this deployment, with the largest spike of 44.75 NTU occurring on September 24th, which was likely a result of several rainfall events (Appendix I) before and on September 24th, increasing the particular matter in the water column for a short period of time.

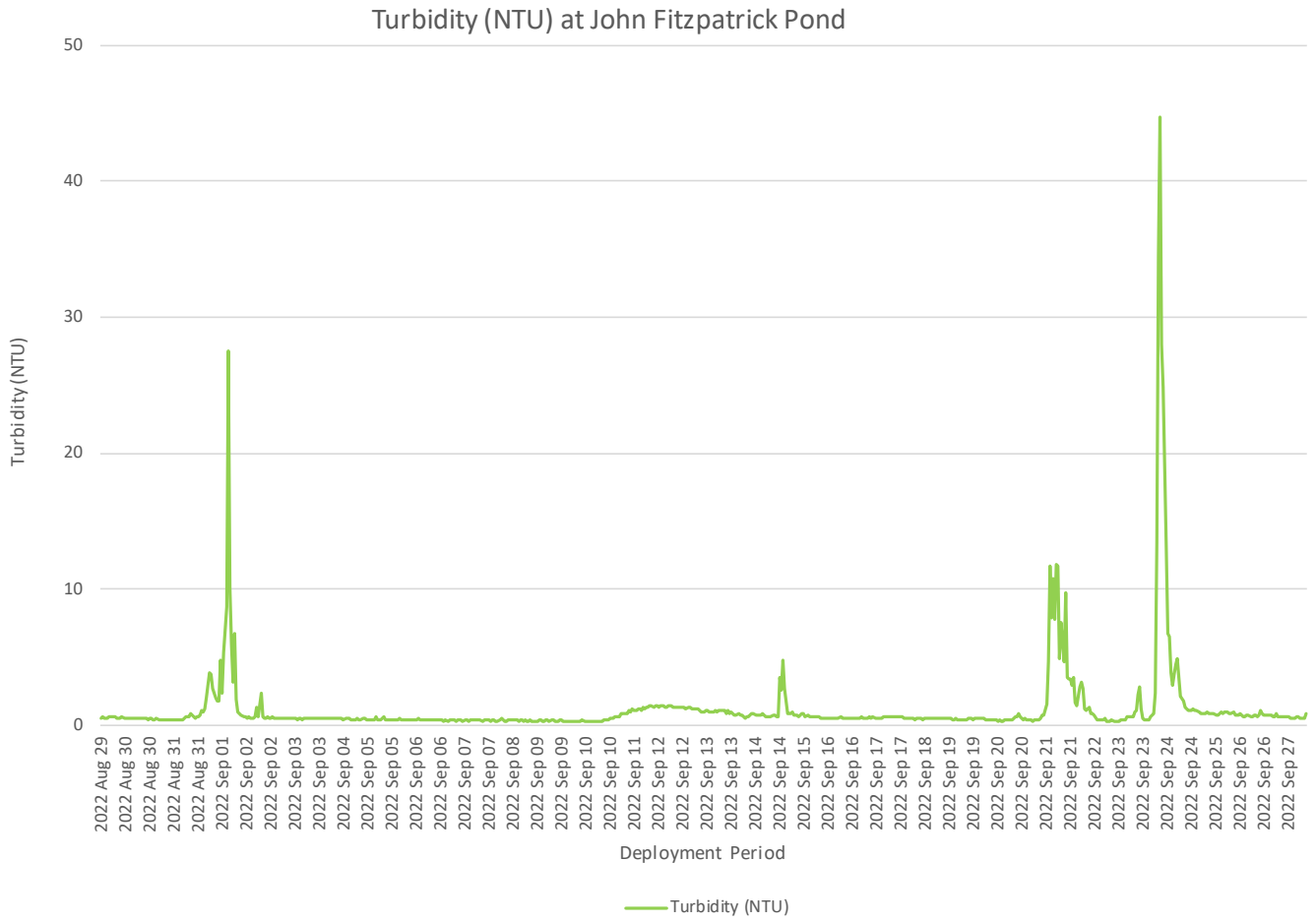


Figure 8: Turbidity (NTU) values.

Outflow of Unnamed Pond south of Long Pond

Water Temperature

Water temperature ranged from 9.18ºC to 26.25ºC during the deployment period (Figure 9). 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.

Outside of the diurnal movement of the water temperature, the data does indicate small fluctuations corresponding to stage changes. As stage increases there is a slight decrease in the water temperature for a short period of time. These stage changes could be 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.

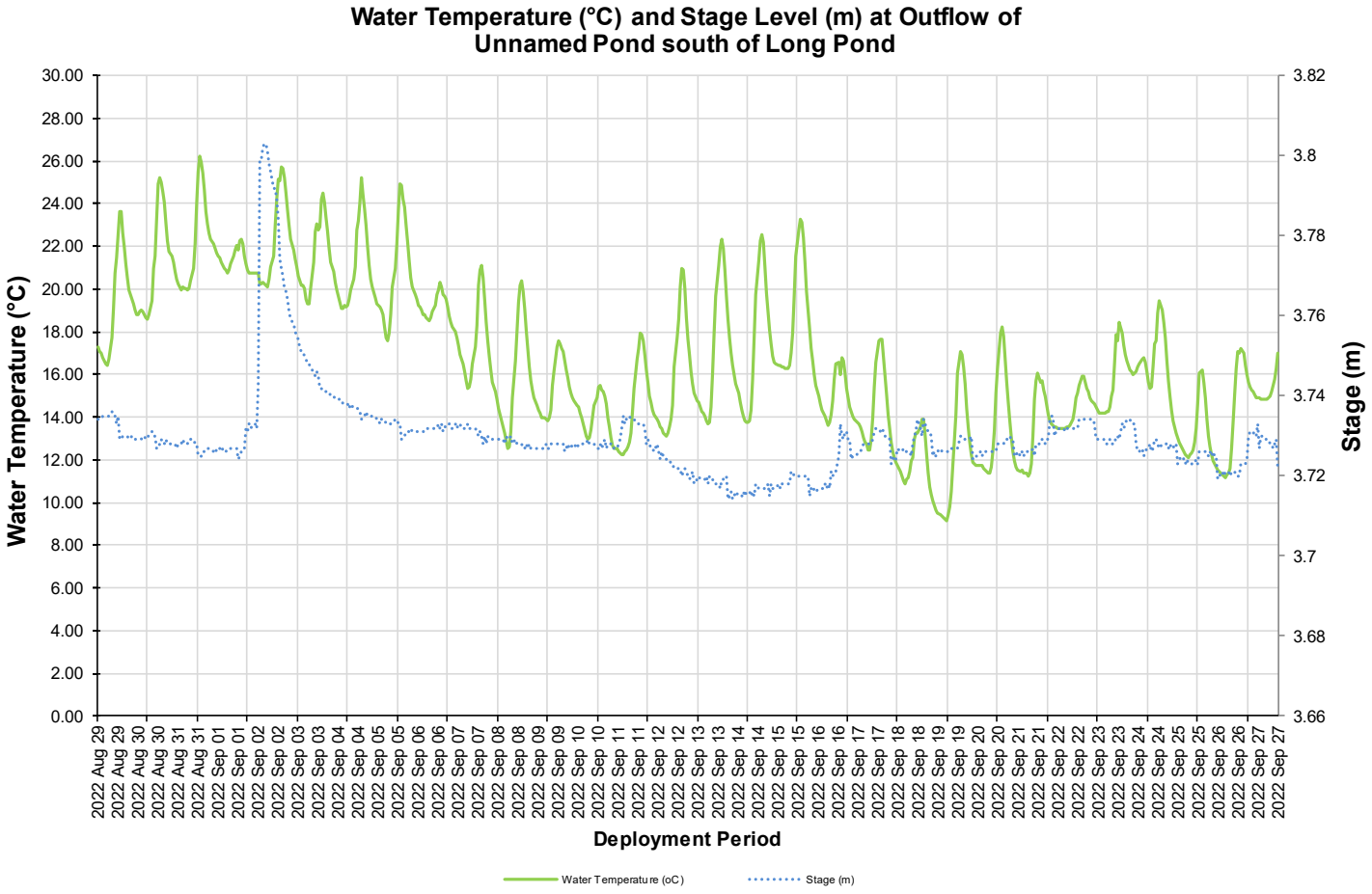


Figure 9: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond

pH

Throughout this deployment period, pH values ranged within 7.05 pH units and 7.87 pH units (Figure 10), 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 10. 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.

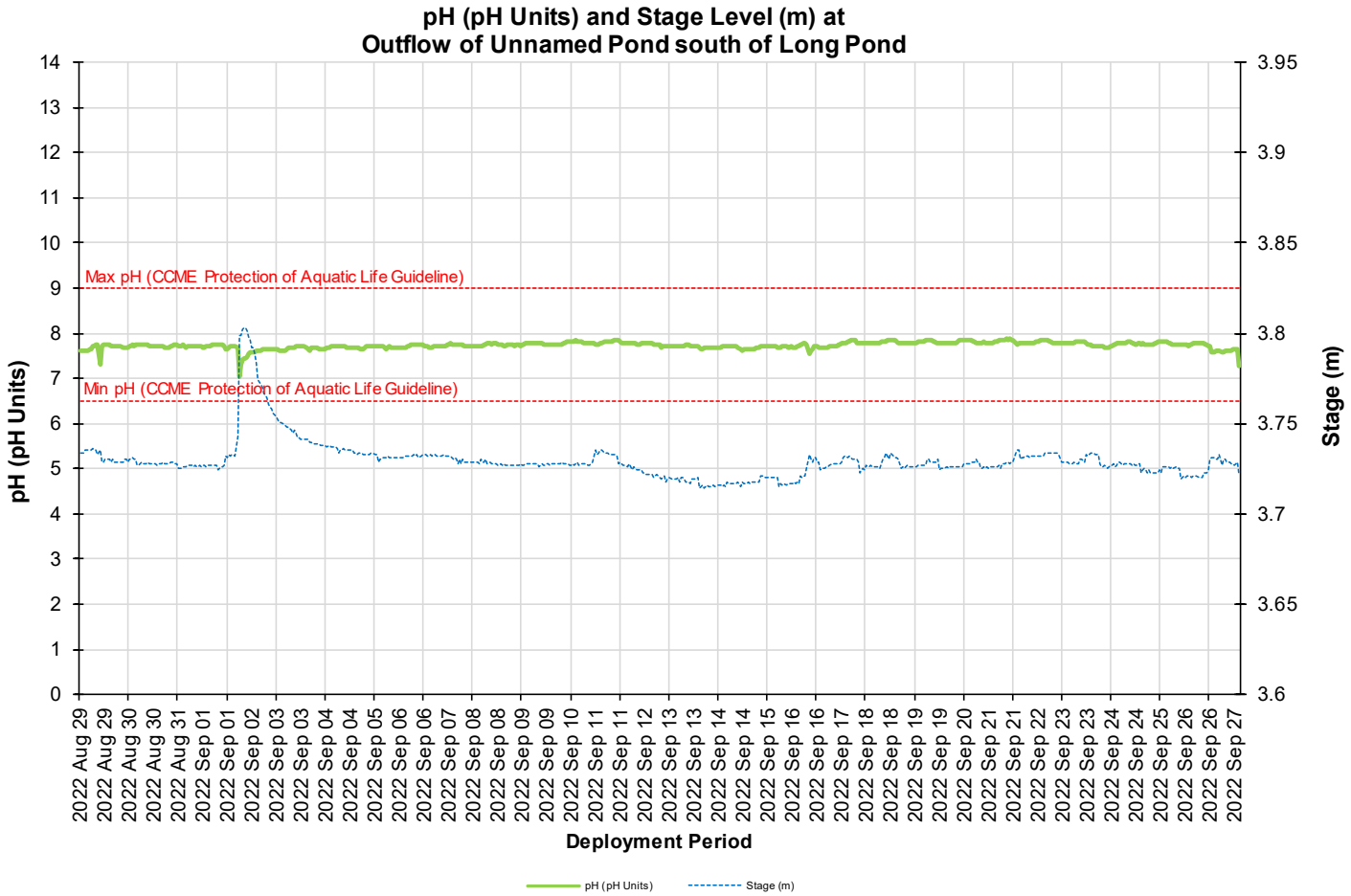


Figure 10: pH (pH units) at Outflow of Unnamed Pond south of Long Pond

Specific Conductivity

The conductivity levels ranged between 143.11 µS/cm and 328.87 µS/cm during deployment (Figure 11). The deployment period had a median of 292.55 µS/cm.

Changes in stage will influence the conductivity data (Figure 11). 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 2, 2022 and again on September 16, 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.

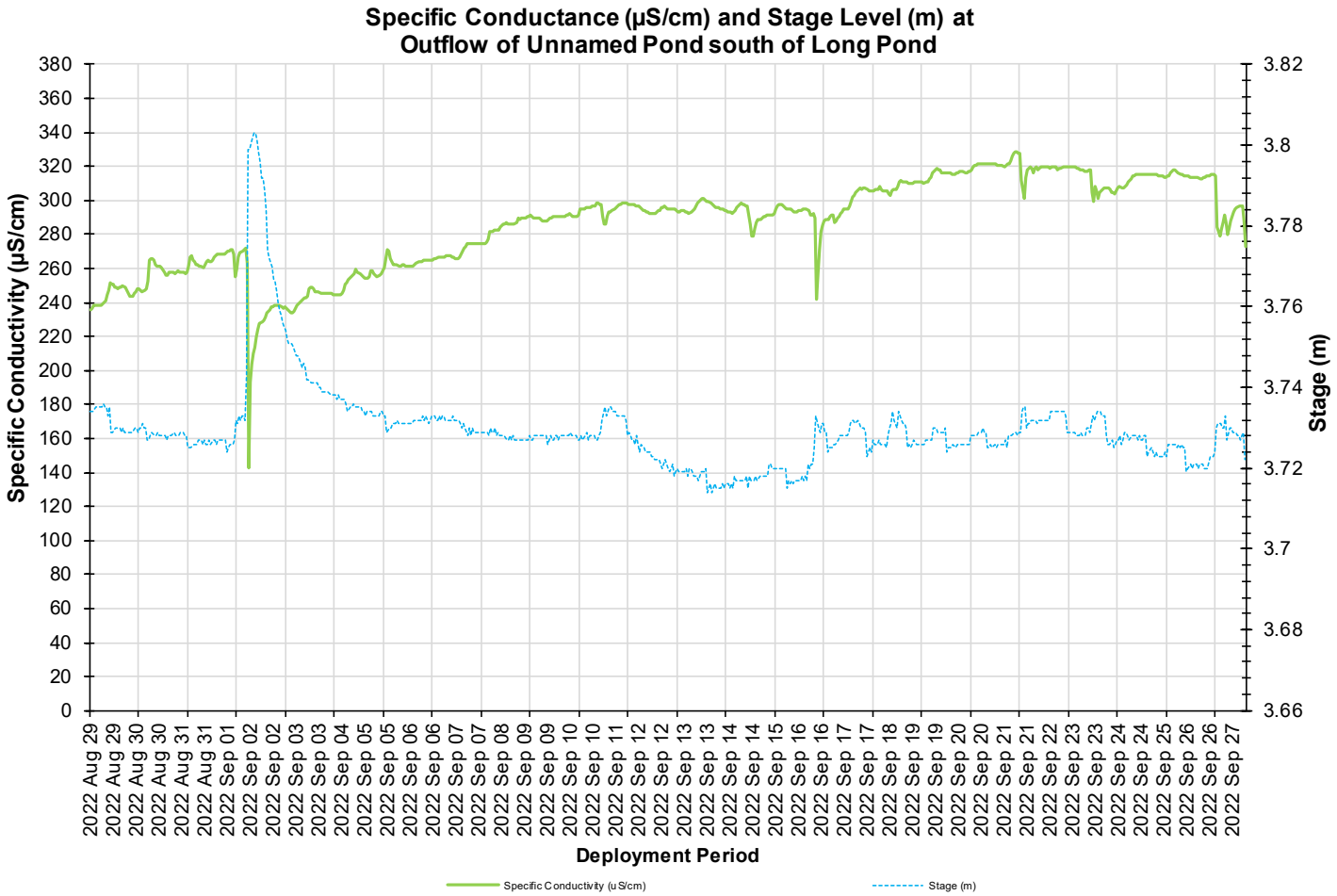


Figure 11: Specific conductivity (µS/cm) at Outflow of Unnamed Pond south of Long Pond

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 8.16 mg/L and 11.35 mg/L for concentration and 93.5 % and 104.9 % for percent saturation.

There is a natural diurnal pattern present in aquatic environments with dissolved oxygen. Oxygen concentration levels will fluctuate throughout night and day. Cooler night temperatures influence higher dissolved oxygen concentrations and warmer day temperatures influence lower concentrations. The movement in the diurnal pattern is evident on Figure 12. All other prominent dips/peaks - outside of the diurnal pattern - are a result of fluxes in water temperature or influences from rainfall/runoff.

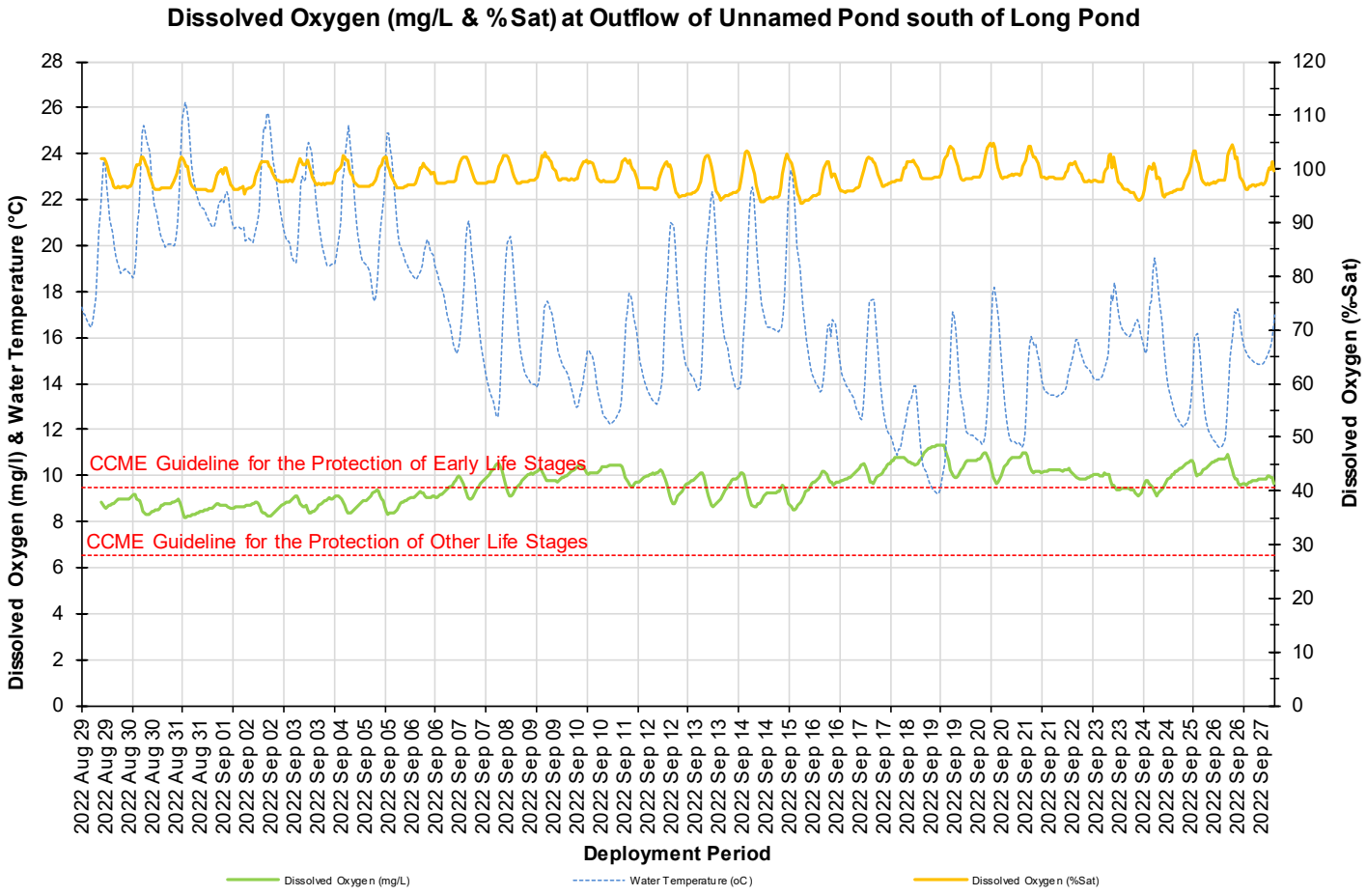


Figure 12: Dissolved Oxygen (%Sat & mg/L) at Outflow of Unnamed Pond south of Long Pond

Turbidity

Turbidity levels during the deployment ranged within 1.7 NTU and 15.3 NTU (Figure 13). The deployment data had a median of 3.0 NTU, indicating a slight increase in turbidity levels compared to previous deployment.

Turbidity remained below 15 NTU, outside the one large spike on September 24th which reached 15.3 NTU, before decreasing slightly at the end of the deployment. Turbidity conditions continued to remain relatively low during this deployment which was likely a result of the work CFI have completed on reducing the runoff from the settling ponds upstream.

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.

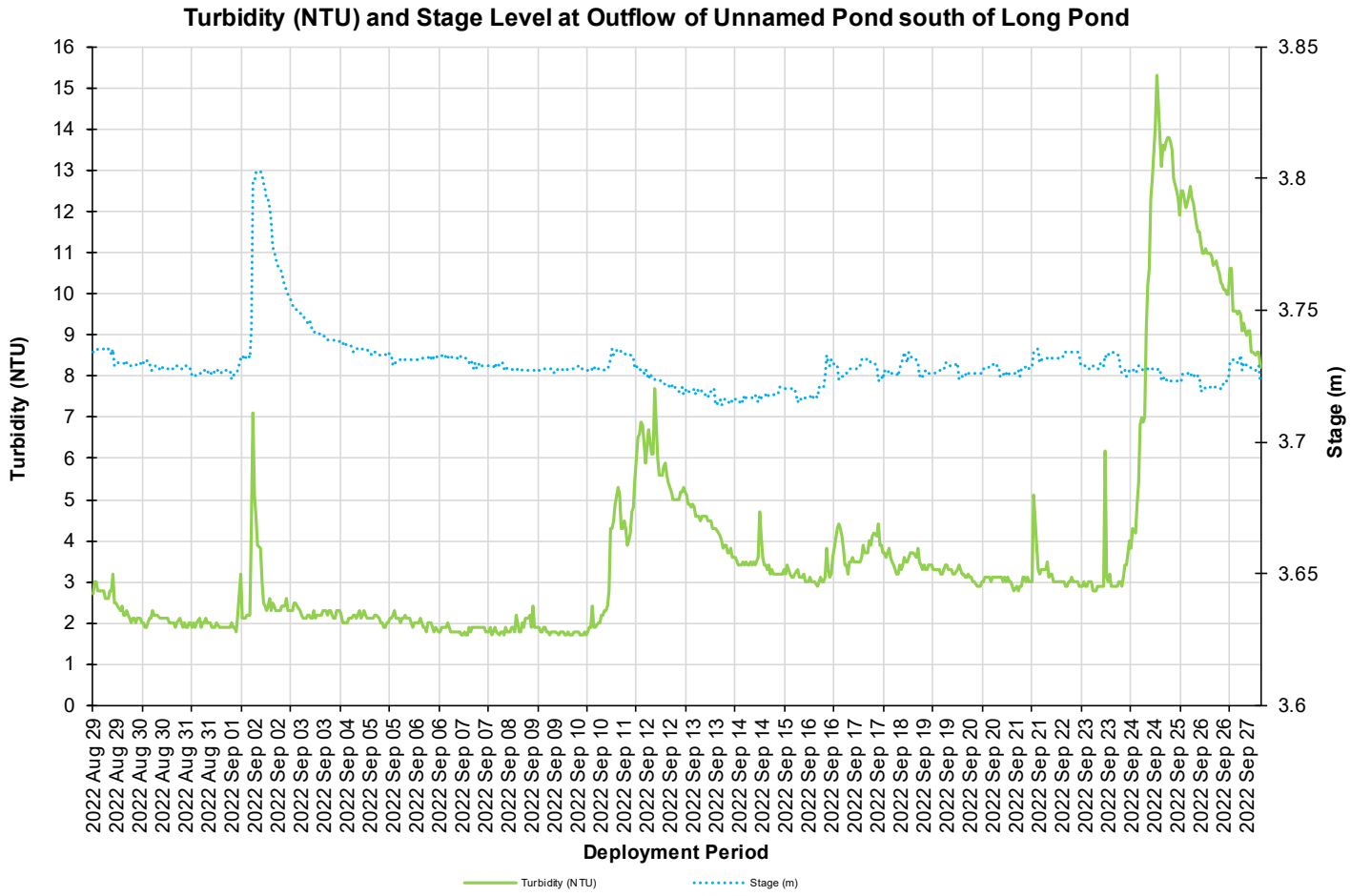


Figure 13: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond

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 3.8m 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 1st, 2022 at 15.1 mm.

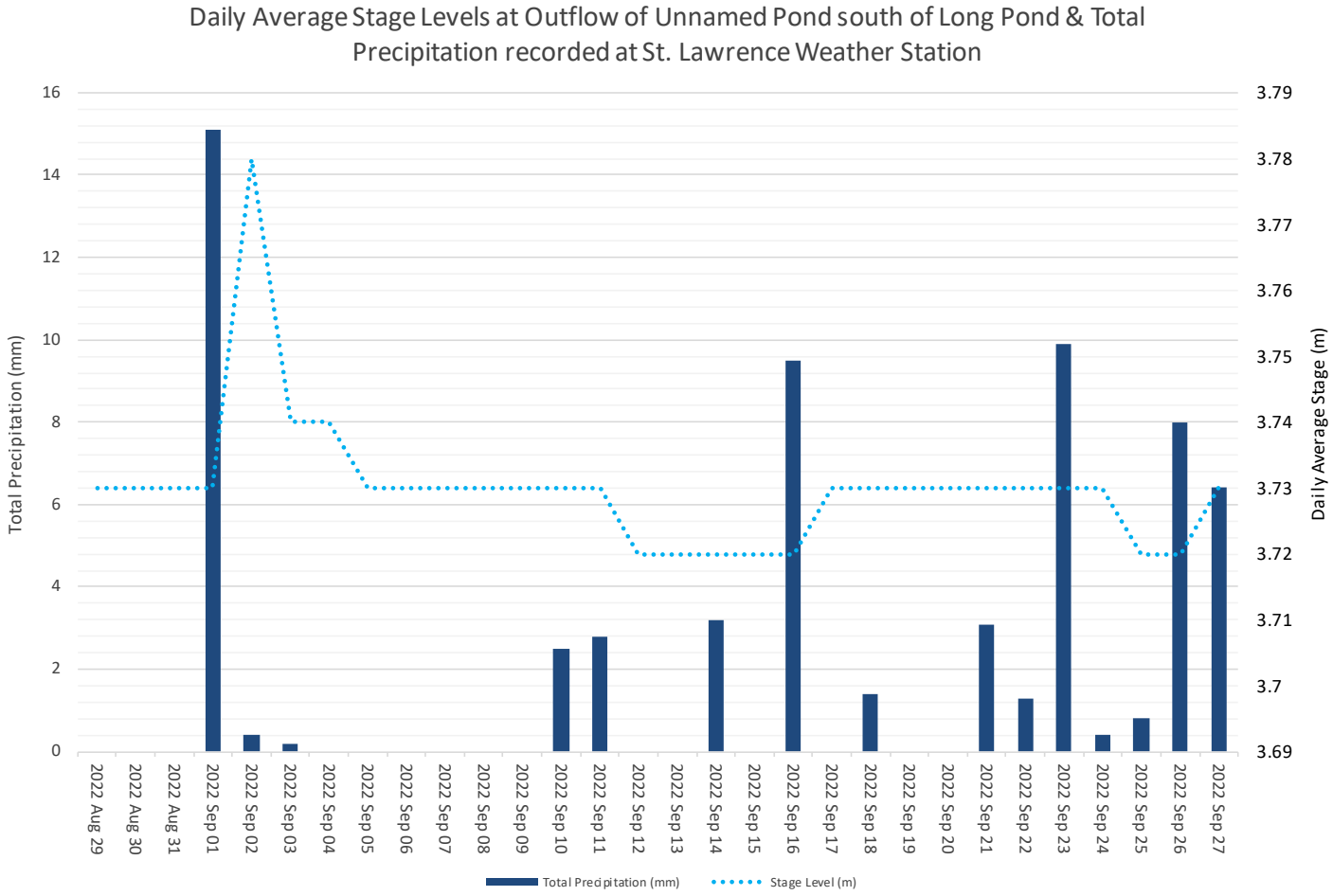
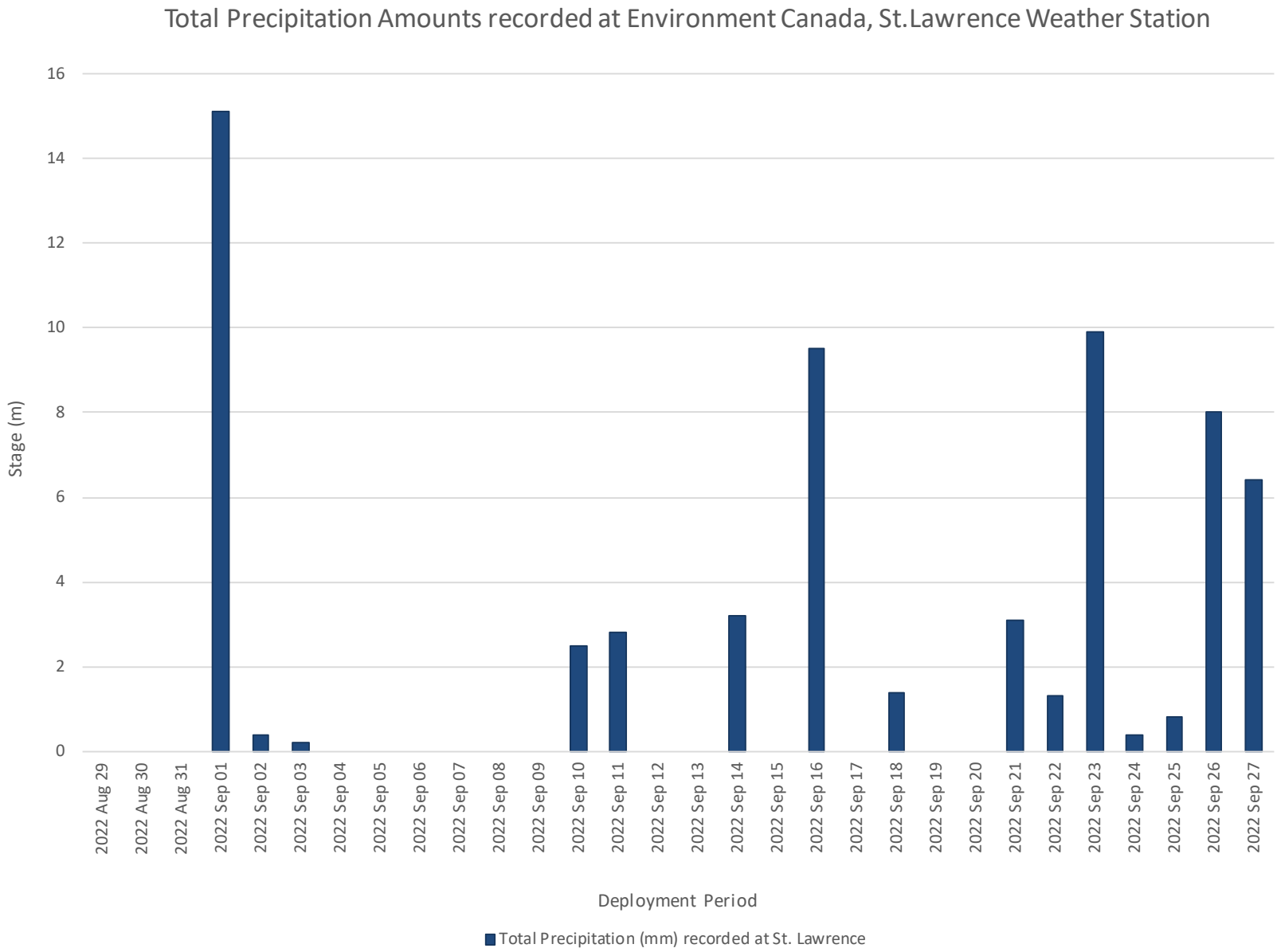


Figure 14: Daily averaged stage values and total precipitation.

APPENDIX I

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


Total Precipitation Amounts recorded at Environment Canada, St.Lawrence Weather Station
Stage (m)
16
14
12
10
8
6
4
2
0
2022 Aug 29
2022 Aug 30
2022 Aug 31
2022 Sep 01
2022 Sep 02
2022 Sep 03
2022 Sep 04
2022 Sep 05
2022 Sep 06
2022 Sep 07
2022 Sep 08
2022 Sep 09
2022 Sep 10
2022 Sep 11
2022 Sep 12
2022 Sep 13
2022 Sep 14
2022 Sep 15
2022 Sep 16
2022 Sep 17
2022 Sep 18
2022 Sep 19
2022 Sep 20
2022 Sep 21
2022 Sep 22
2022 Sep 23
2022 Sep 24
2022 Sep 25
2022 Sep 26
2022 Sep 27
Deployment Period
Total Precipitation (mm) recorded at St. Lawrence