Real-Time Water Quality Report

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

Deployment Period
May 25th, 2022 to June 20th, 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. However 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 & 2). The new site was named John Fitzpatrick Pond.

John Fitzpatrick Pond

John Fitzpatrick station was established May 2022. The site was selected based on the location and a stable water supply. Despite small changes in water level during the summer, this station will provide beneficial water quality data for this industry partner (Figure 2).

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.

Figure 1: Real-Time Water Quality and Quantity Station at John Fitzpatrick Pond

Figure 2: 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 3). 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 3).

Figure 3: 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	May 25th, 2022	Deployment	N/A	Good	Fair	N/A	Excellent
	June 20th, 2022	Removal	N/A	N/A	N/A	N/A	N/A
Unnamed Pond	May 25th, 2022	Deployment	Good	Good	Marginal	Good	Excellent
	June 20th, 2022	Removal	Marginal	Excellent	Good	Excellent	Good

When compared to the QAQC instrument at Outflow of Unnamed Pond south of Long Pond, the field instrument data ranked 'Marginal' for conductivity during the deployment and 'Marginal' for temperature during the removal. This could be the result of not letting the QA/QC sonde remain in the pond long enough to completely stabilize. All other parameters ranked 'Excellent' or 'Good' during the deployment and removal.

Since there was no field sonde deployed at John Fitzpatrick Pond for this deployment period, there are no comparison rankings of the field sonde against the QAQC sonde. The QAQC was still deployed to compare the data against the grab sample data which was used to determine the rankings above in Table 2.

Issues during the May 25th, 2022 to June 20th, 2022 Deployment Period

Given that the John Fitzpatrick Pond station was just being installed at this time, there is no water quality or stage data for that station for this deployment period. Grab samples were collected from John Fitzpatrick Pond on May 25th, 2022 when staff visited the site to assess the new location. The QA/QC instrument was also deployed at this time so the grab sample data can be compared to the QA data (comparison rankings found above in table 2).

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.

Outflow of Unnamed Pond south of Long Pond

Water Temperature

Water temperature ranged from 5.42ºC to 24.84ºC, with an average temperature of 12.74°C during the deployment period (Figure 4). 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.

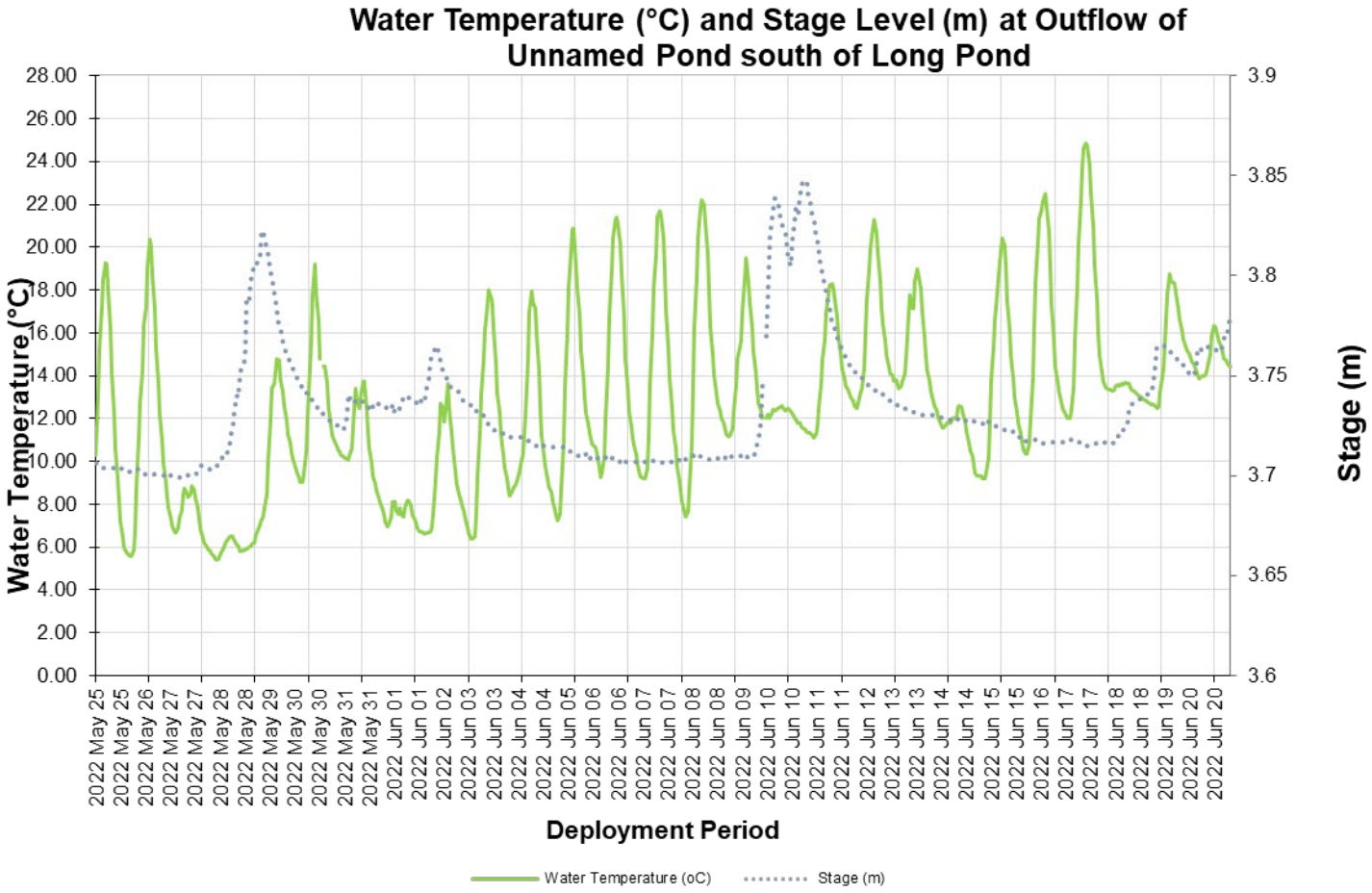


Figure 4: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond

pH

Throughout this deployment period, pH values ranged within 6.43 pH units to 7.68 pH units, with an average of 7.28 pH units (Figure 5), 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 5, particularly on May 29th, 2022 and June 10th, 2022. The pH values returned to background levels shortly 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.

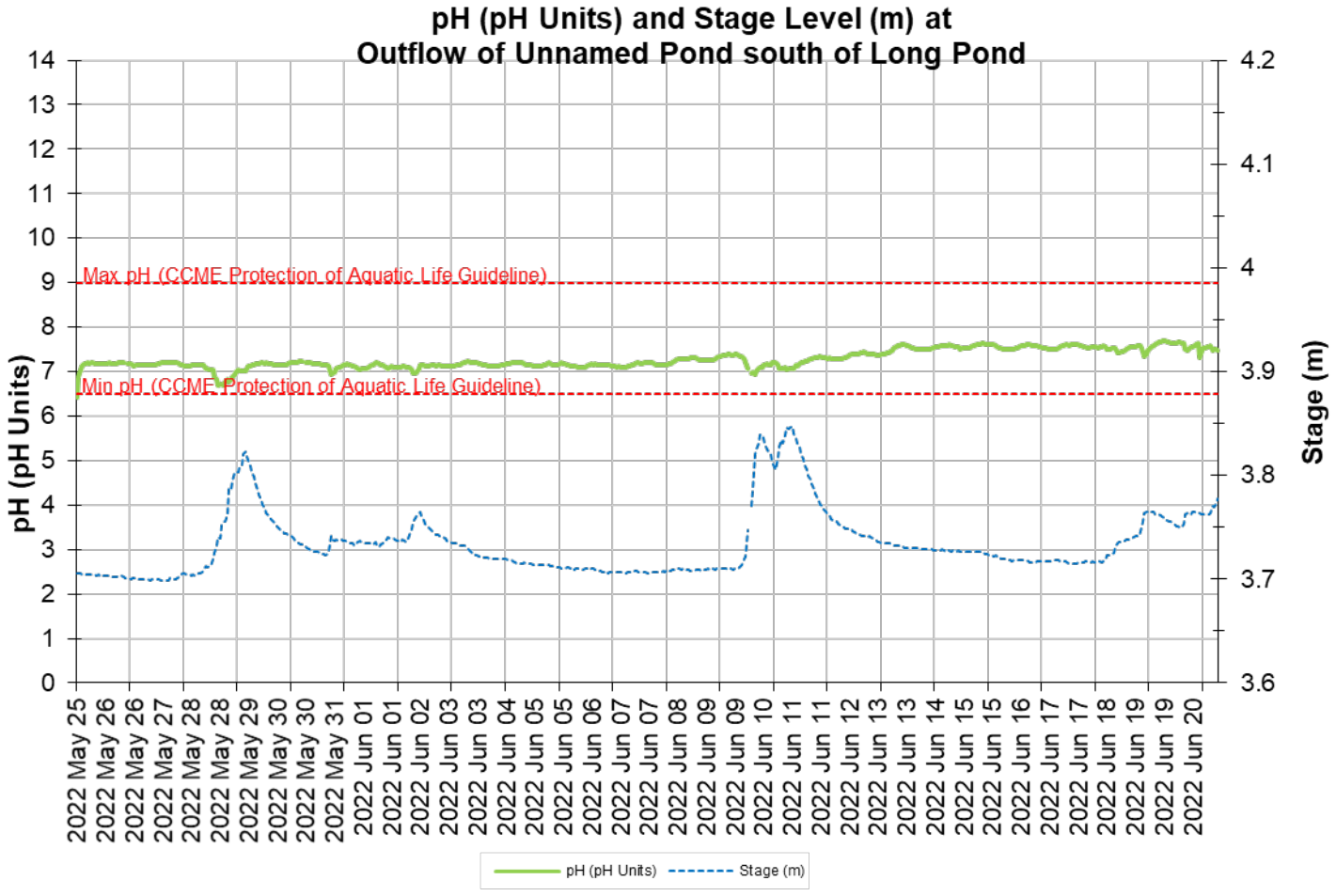


Figure 5: pH (pH units) at Outflow of Unnamed Pond south of Long Pond

Specific Conductivity

The conductivity levels ranged between 70.24 µS/cm and 185.97 µS/cm, with an average conductivity of 118.81 µS/cm during deployment (Figure 6). Conductivity remained fairly consistent during the deployment period, except for occasional spikes that can be linked to occurrences of rainfall.

Changes in stage will influence the conductivity data (Figure 6). An increase in water level during an event 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.

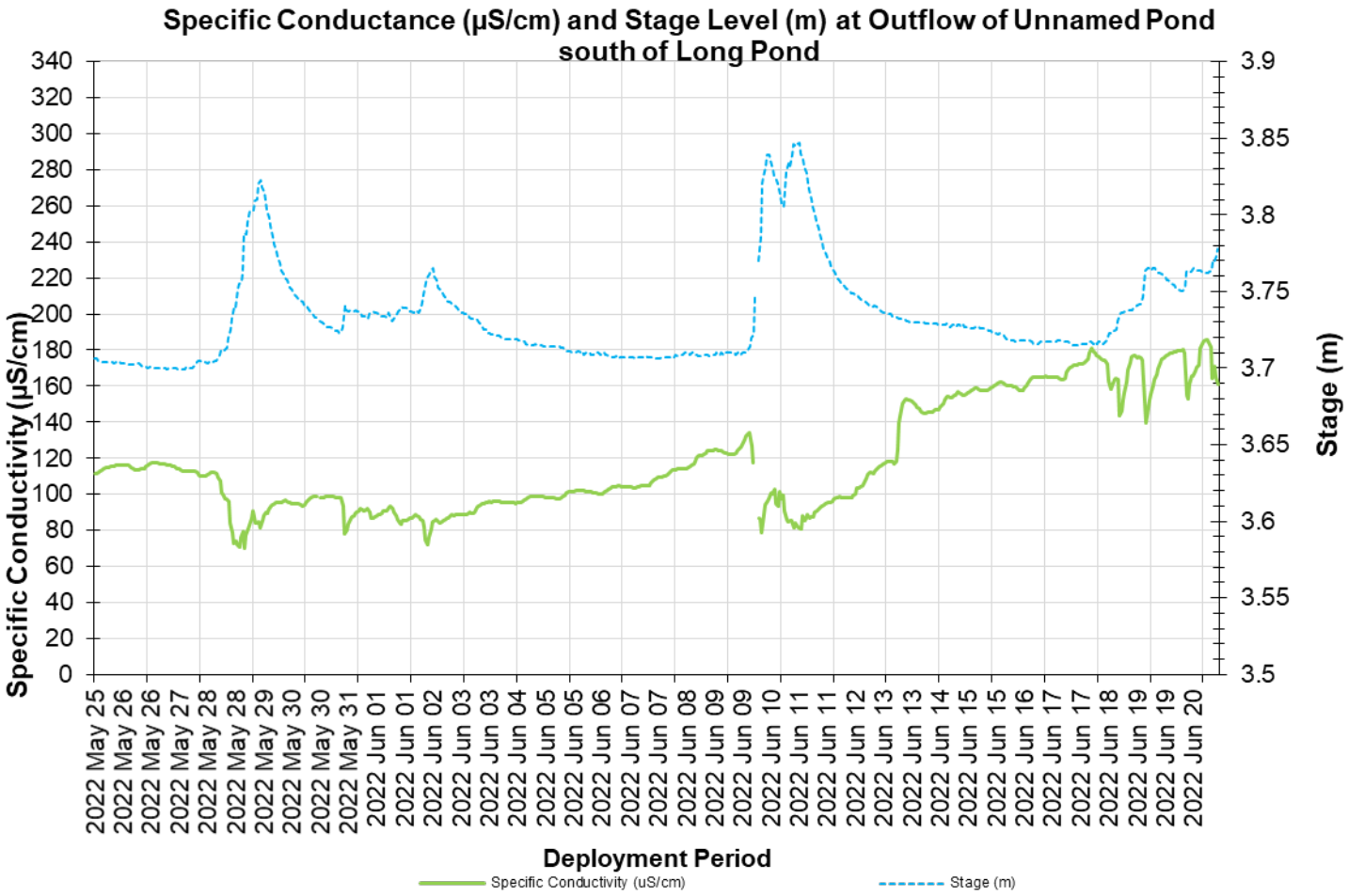


Figure 6: Specific conductivity (µS/cm) at Outflow of Unnamed Pond south of Long Pond

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 the deployment, the dissolved oxygen concentration levels ranged within a minimum of 8.15 mg/L to a maximum of 11.98 mg/L, with an average of 10.25 mg/L. The dissolved oxygen percent saturation levels ranged within 90.9% saturation to 108.3% saturation, with an average of 96.1% saturation throughout the deployment period (Figure 7).

Dissolved oxygen concentrations exhibited a steady decline, as can be seen from the trend line on Figure 7, which is to be expected as water temperatures increase heading into summer. As temperatures warm up, the water has less capacity for holding dissolved oxygen, thus concentrations decrease.

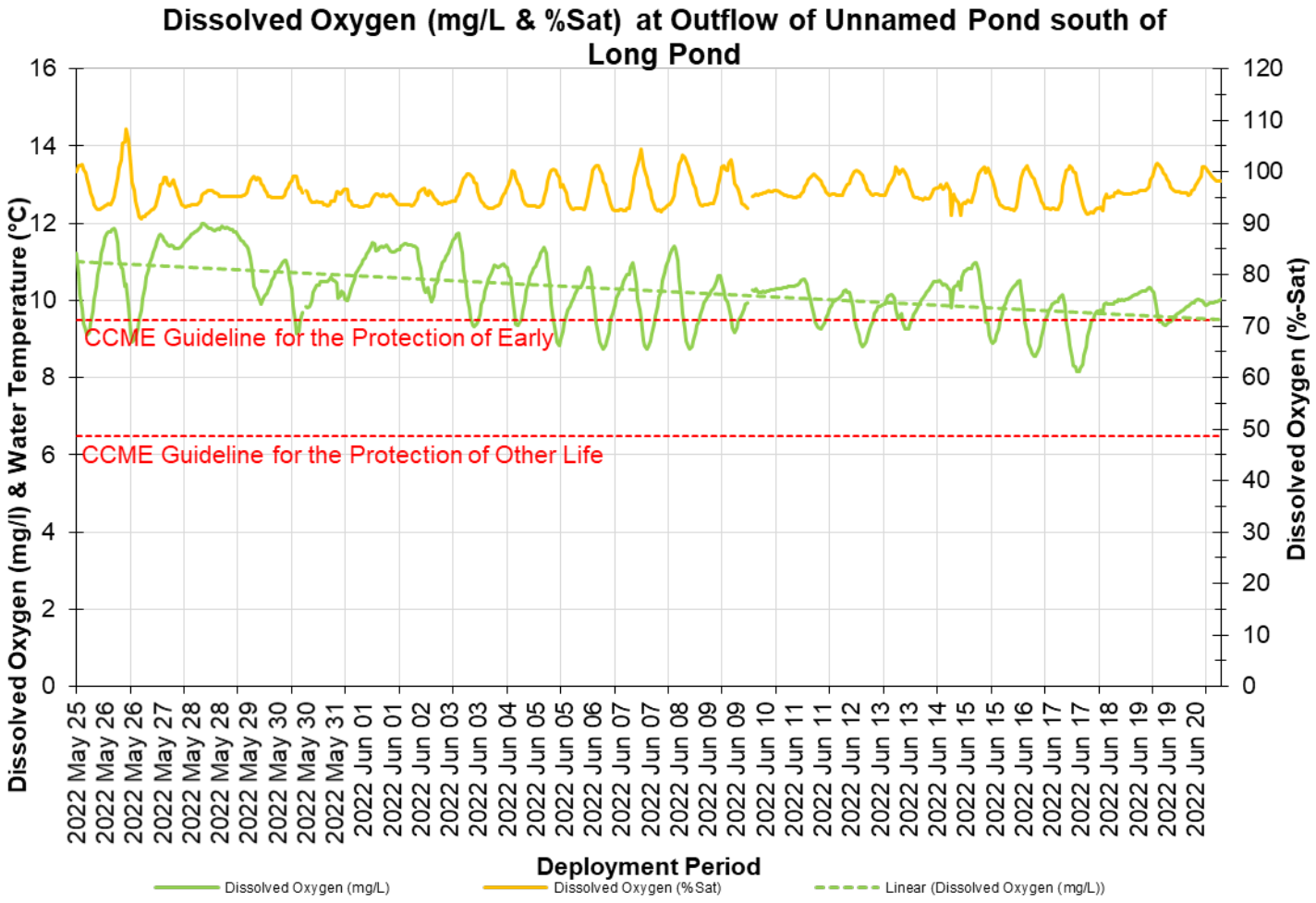


Figure 7: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C)

Turbidity

Turbidity levels during the deployment ranged within 2.6 NTU and 38.5 NTU, with an average of 10.7 NTU (Figure 8). Turbidity started increasing around June 1st, 2022 which was likely a result of increased rain activity in the days prior. It remained elevated until returning to background levels around June 12th, 2022. Spikes in turbidity are often a result of precipitation events which can be seen on Figure 8 below. Turbidity can increase when there are stage increases, like on June 2nd 2022, because precipitation can cause an increase run-off entering the water column and rain can potentially disturb sediment and particulate within the pond.

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.

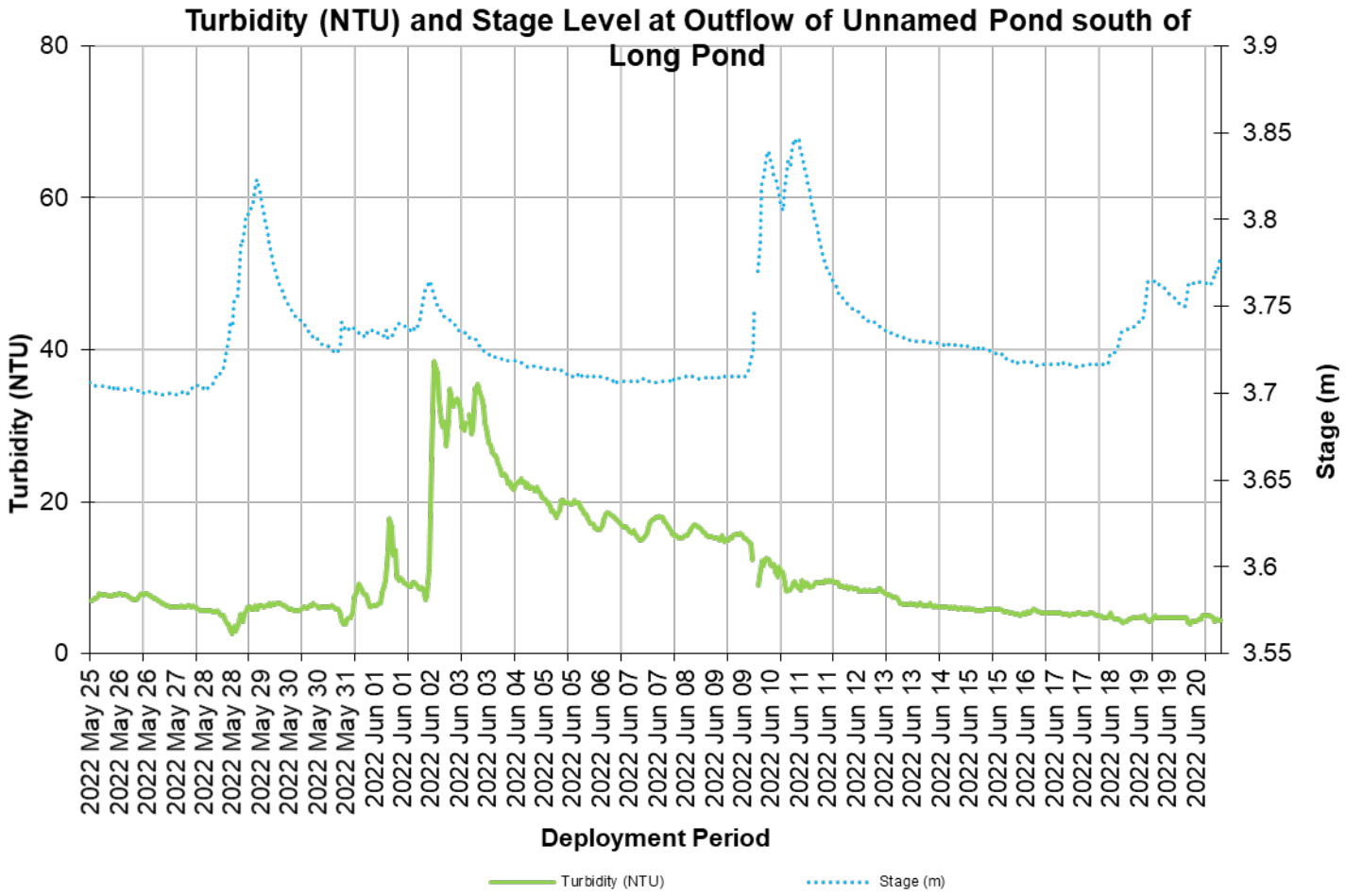


Figure 8: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond

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 3.70 m to 3.85m during the deployment. Stage increases during rainfall events (Figure 9) and during any surrounding snow or ice melt. However, direct snowfall will not cause stage to rise significantly. Please note that the graph below, Figure 9, uses daily stage averages as opposed to the continuous data.

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. The highest total precipitation was recorded on June 10th, 2022 at 39.7mm.

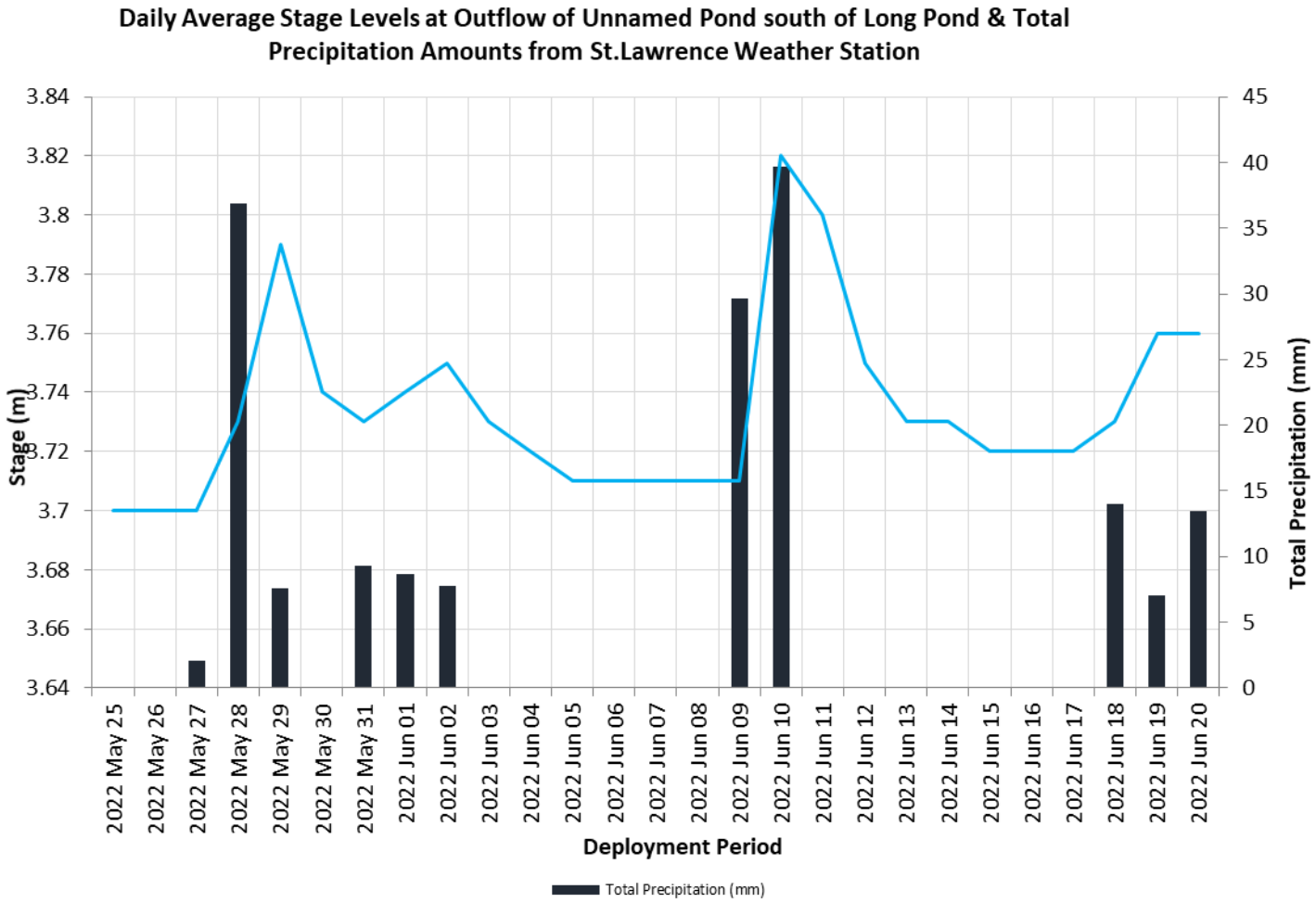
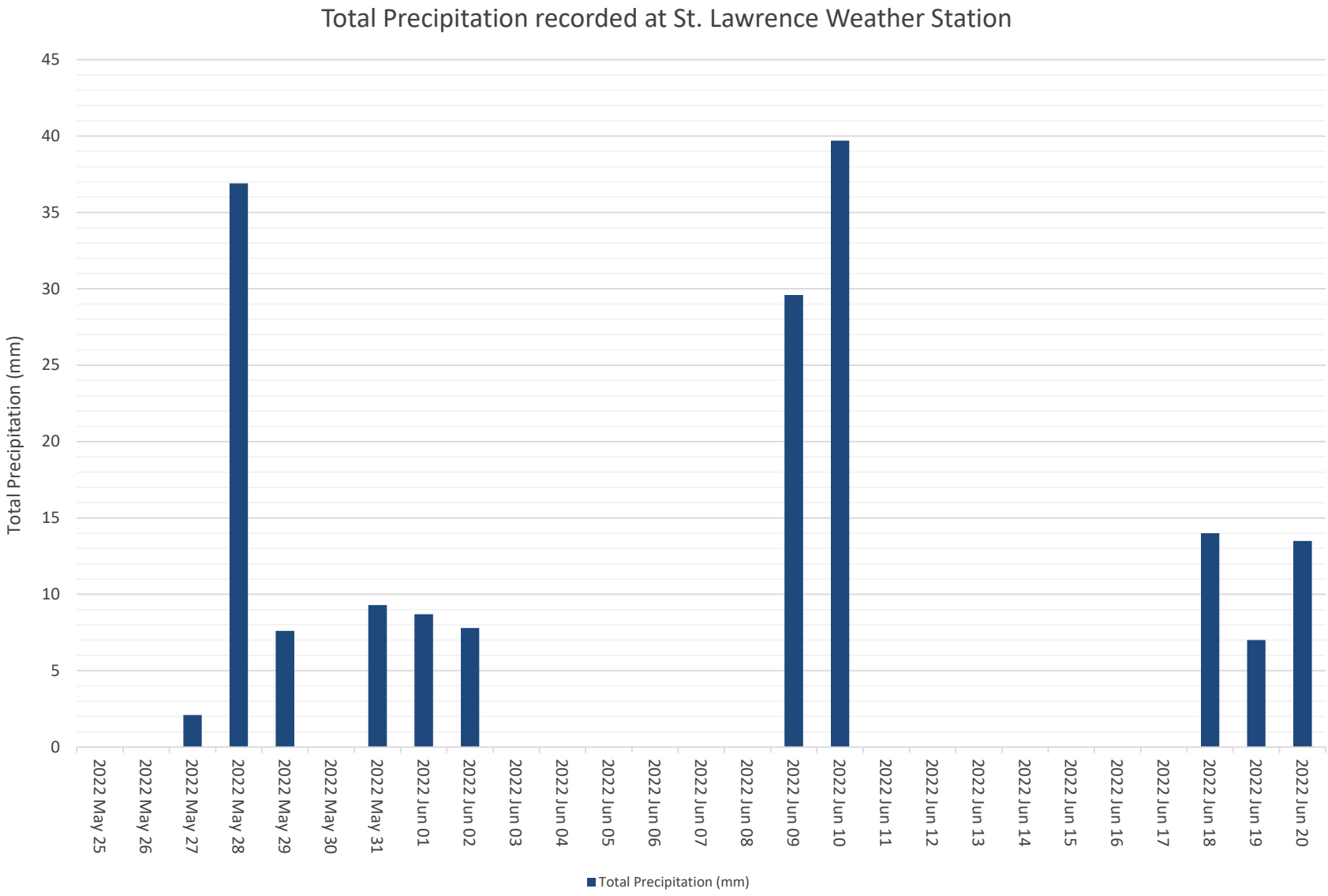


Figure 8: Daily averaged stage values and total precipitation.

APPENDIX I

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


Total Precipitation recorded at St. Lawrence Weather Station
Total Precipitation (mm)
45
40
35
30
25
20
15
10
5
0
2022 May 25
2022 May 26
2022 May 27
2022 May 28
2022 May 29
2022 May 30
2022 May 31
2022 Jun 01
2022 Jun 02
2022 Jun 03
2022 Jun 04
2022 Jun 05
2022 Jun 06
2022 Jun 07
2022 Jun 08
2022 Jun 09
2022 Jun 10
2022 Jun 11
2022 Jun 12
2022 Jun 13
2022 Jun 14
2022 Jun 15
2022 Jun 16
2022 Jun 17
2022 Jun 18
2022 Jun 19
2022 Jun 20
Total Precipitation (mm)