



# Real-Time Water Quality Deployment Report

## Paddy's Pond at Outlet

June 7, 2022 to July 20, 2022



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## General

The Department of Environment and Climate Change, Water Resources Management Division staff monitor water quality in real-time at Paddy's Pond at outlet to Three Arm Pond (47.488129N, 52.893809W).



Figure 1: Paddy's Pond at Outlet Real-Time Water Quality Station location

## Maintenance and Calibration of Instrument

As part of the Quality Assurance and Quality Control protocol (QAQC), 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.

Upon deployment, a QA/QC Sonde is temporarily deployed *in situ*, adjacent to the Field Sonde. Depending on the degree of difference between each parameter from the Field and QA/QC sondes, a qualitative rank is assigned (See Table 1). The possible ranks, from most to least desirable, are: Excellent, Good, Fair, Marginal, and Poor. A grab sample is also taken for additional confirmation of conditions at deployment and to allow for future modelling studies.

**Table 1: 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

At the end of a deployment period, a freshly cleaned and calibrated QA/QC Sonde is placed *in situ*, adjacent to the Field Sonde. Deployment and removal comparison rankings for the station at Paddy's Pond deployed between June 7 and July 20, 2022 are summarized in Table 2.

**Table 2: Qualitative QA/QC comparison rankings for Paddy's Pond at outlet station June 7, 2022 through July 20, 2022.**

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Paddy's Pond at Outlet	2022-06-07	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	2022-06-07	Grab Sample #2021-1706-00-SI-SP	N/A	Fair	Fair	N/A	Excellent
	2022-07-20	Removal	Excellent	Fair	Good	Excellent	Excellent

- On June 7, 2022, a real-time water quality monitoring instrument was deployed at the station Paddy's Pond at Outlet. The instrument was deployed for a period of 44 days and was removed on July 20, 2022.
- Upon deployment, all sensors ranked 'Excellent' against the calibrated QA/QC sonde.
- Upon deployment, the measured field grab sample parameter sensors ranked 'Excellent', and 'Fair' against the field sonde. Potential causes for less than excellent QA/QC rankings to be obtained include: the location of grab sample in comparison to the field sonde, the amount of time the field sonde was given to stabilize before readings were recorded and any delays in sample analysis at the laboratory that may have influenced pH.
- At removal of the instrument, parameter rankings varied between 'Excellent', 'Good' and 'Fair' against the QA/QC sonde.

## DATA INTERPRETATION

The following graphs and discussion illustrate water quality data obtained hourly from June 7, 2022 through July 20, 2022 at Paddy's Pond at outlet to Three Arm Pond, St. John's, NL.

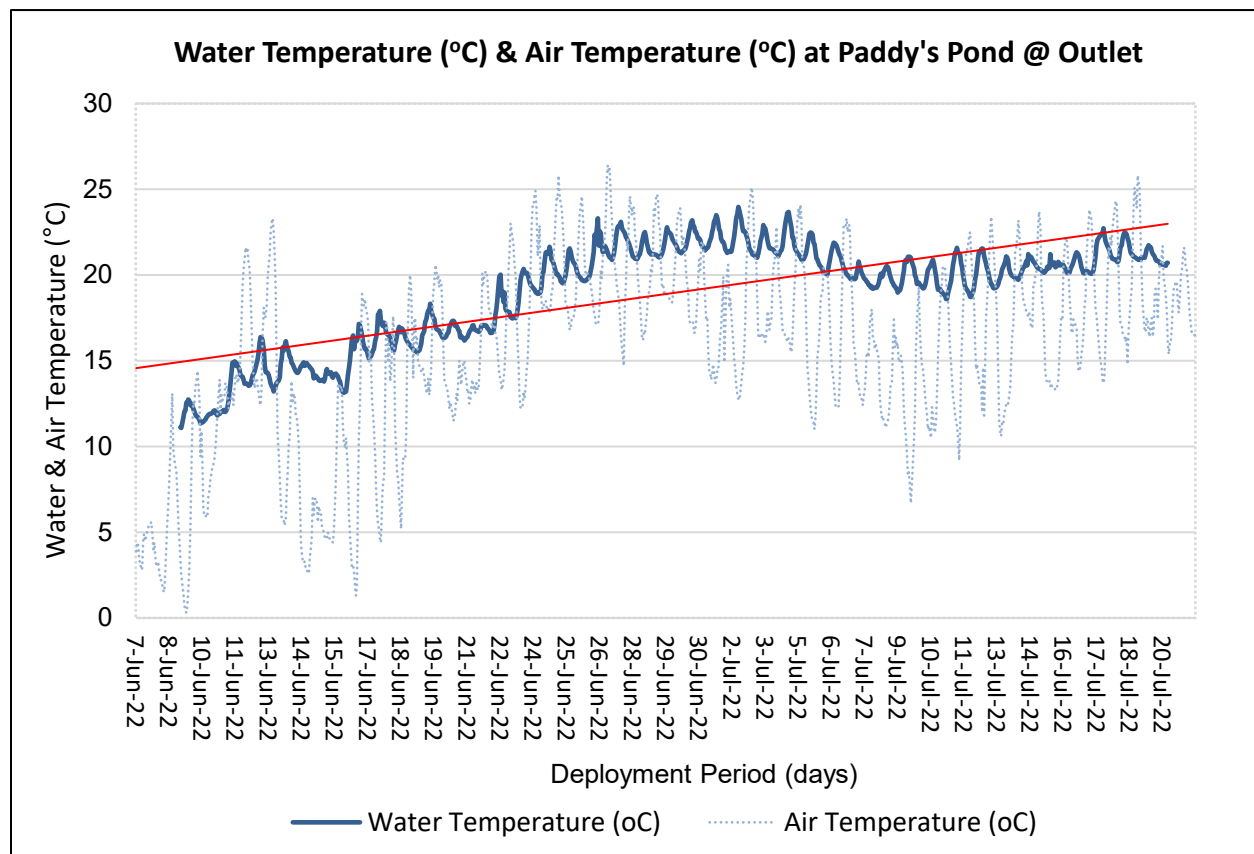
Stage is not monitored at this station and as such cannot be discussed with respect to other monitored water quality parameters. All data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol.

Mean daily temperature and total precipitation data was obtained from the ECCC historical weather data at [https://climate.weather.gc.ca/historical\\_data/search\\_historic\\_data\\_e.html](https://climate.weather.gc.ca/historical_data/search_historic_data_e.html) and can be found illustrated in Appendix A. Gaps in available daily data were removed for graphing purposes.

Water quality data from June 7, 2022 to June 9, 2022 was removed from analysis due to an error in the sonde parameter set up order (programming). This error was corrected and data from June 9, 2022 to July 20, 2022 is presented within this report.

### Water Temperature

- Water Temperature is a major factor used to describe water quality. Temperature has major implications on both the ecology and chemistry of a water body, governing processes such as the metabolic rate of aquatic plants and animals and the degree of dissolved oxygen saturation.
- It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be broken down into three groups: temperature dependent, temperature compensated and temperature independent. As the temperature sensor is not isolated from the rest of the sonde, the entire sonde must be at the same temperature before the 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.



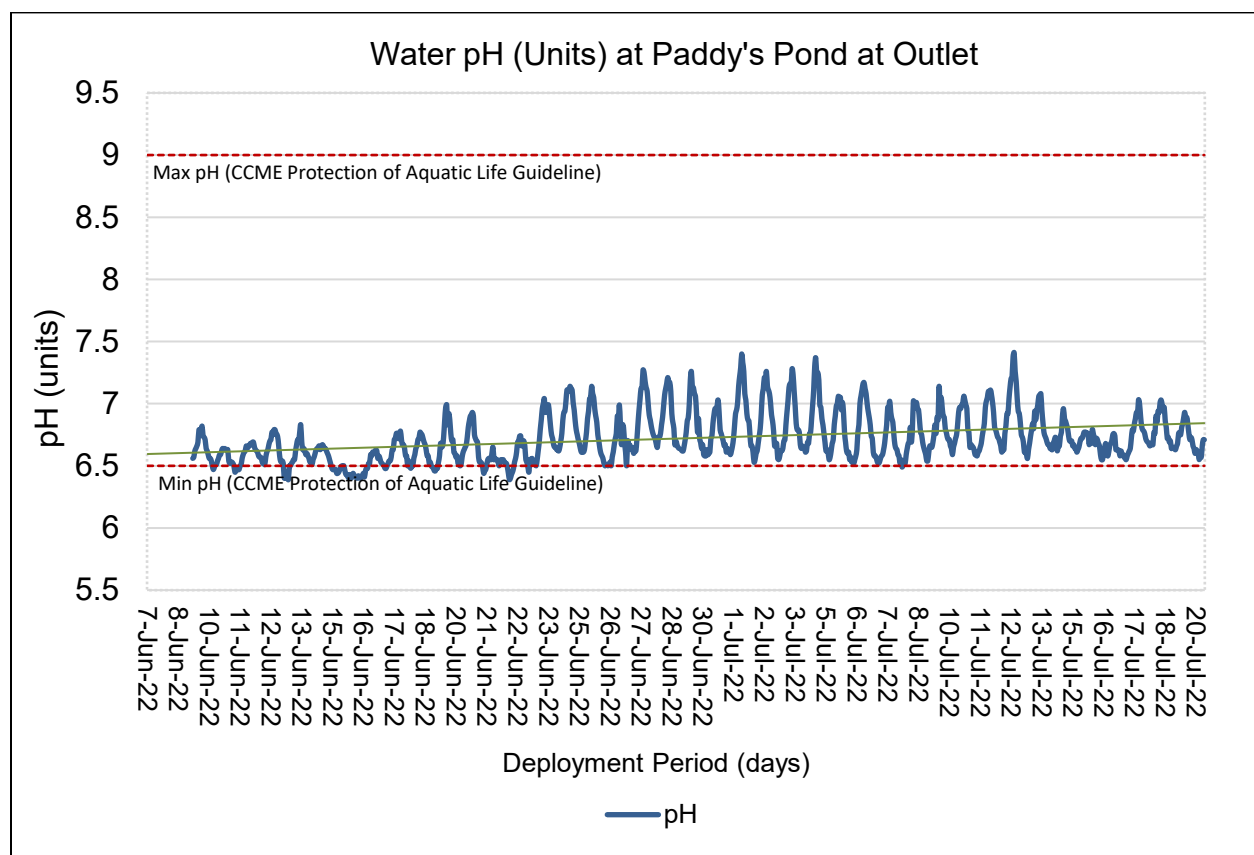
Mean	Median	Min	Max
18.96	20.08	11.08	23.97

Figure 2: Water temperature (°C) values at Paddy's Pond at Outlet.

- Over the 44-day deployment period, water temperature fluctuated naturally in correlation to air temperature, increasing into the summer. The mean temperature was 18.96°C with a median of 20.08°C.
- Minimum water temperature of 11.08°C was observed on June 9, 2022 and a maximum water temperature of 23.97 °C was observed on July 2, 2022 (Figure 2).
- A continuous increase in the water temperature was observed from June 9, 2022 to June 25, 2022, and plateaued then until July 7, 2022 in correlation with air temperatures. Decreases in water temperature observed below the trend, are associated with decreases in air temperature and precipitation events due to the addition of cool water as seen on July 7, 2022 (See Figure 7- Appendix A).
- A natural diurnal temperature pattern with temperatures increasing during the day and decreasing overnight was observed.

pH

- pH is used to give an indication of the acidity or basicity of a solution. A pH of seven (7) denotes a neutral solution while lower values are acidic and higher values are basic. Technically, the pH of a solution indicates the availability of protons to react with molecules dissolved in water. Such reactions can affect how molecules function chemically and metabolically.
- pH values are temperature dependant as well as influenced by photosynthesis and respiration by aquatic organisms. The concentration of dissolved carbon dioxide in the water throughout the day, especially overnight when oxygen production is reduced relative to carbon dioxide levels. Carbon dioxide dissolved in water yields a slightly acidic solution.



**Figure 3: pH (pH units) at Paddy's Pond at outlet from June 7, 2022 through July 20, 2022.**

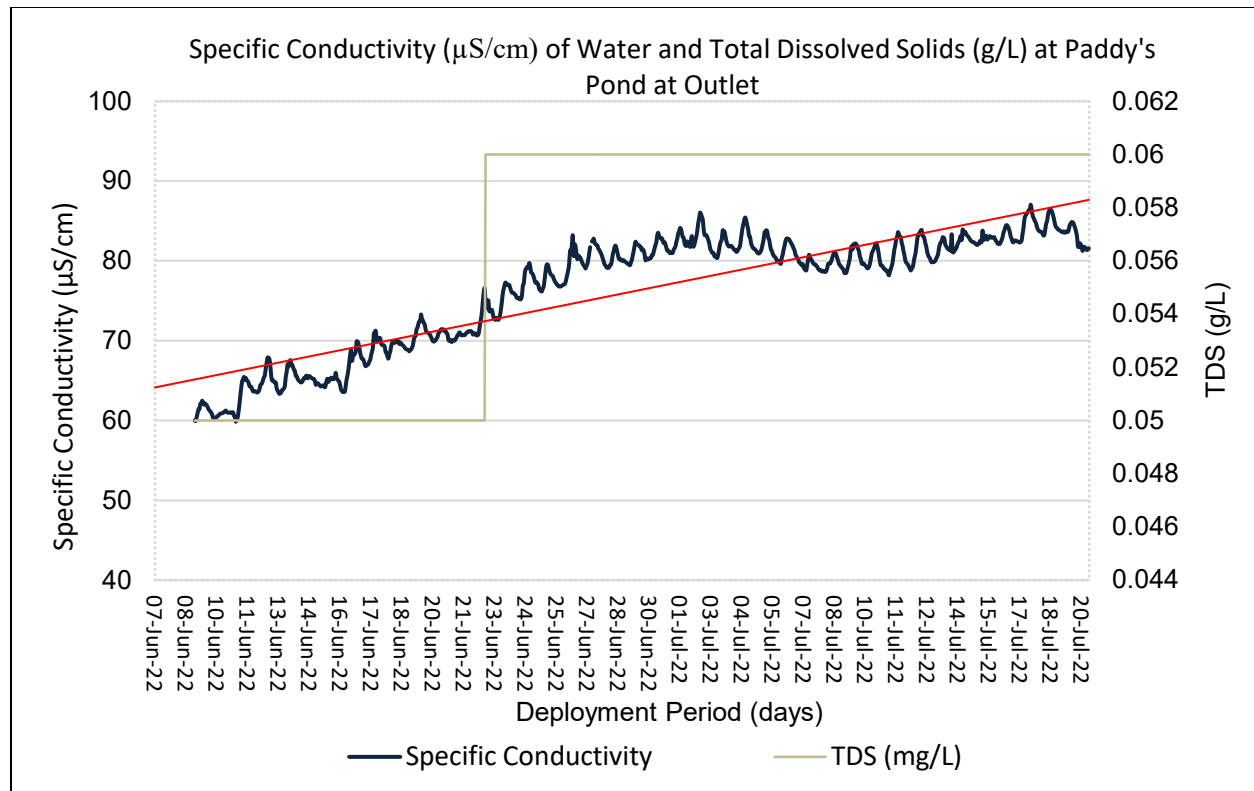
- Throughout the deployment period, pH values remained relatively stable with a range from 6.39 to 7.41 pH units, with a mean unit value of 6.72 and median of 6.67 units (Figure 3).

- A gradual increase in pH (Figure 2) was observed over the duration of the deployment period as air and water temperatures increased.
- The CCME guideline for the protection of aquatic life states the requirement of a minimum pH value of 6.5 and maximum value of 9.0. This guideline provides a basis for the overall health of the waterbody. Paddy's Pond at Outlet pH values decreased slightly below the minimum guideline on a number of occasions in the month of June. This may be the result of an increase in photosynthesis and respiration by aquatic organisms expected at this time of the year, as well as the addition of more acidic water during precipitation events such as observed on June 10-11 and on June 20-21, 2022. The pH level also decreased below the minimum guideline on July 7, 2022 (pH 6.49) and is mostly likely the result of a precipitation event. See Figure 7 – Appendix A.
- Diurnal variation pattern was visible throughout the deployment period. The magnitude of variation is in correlation to the increase in daily water temperature range, length of days and increase in photosynthesis and respiration as expected at this time of the year.

#### Specific Conductivity

- Conductivity relates to the ease of passing an electric charge – or resistance – through a solution. Conductivity is highly influenced by the concentration of dissolved ions in solution: distilled water has zero conductivity (infinite resistance) while salty solutions have high conductivity (low resistance). Specific Conductivity is corrected to 25°C to allow comparison across variable temperatures.





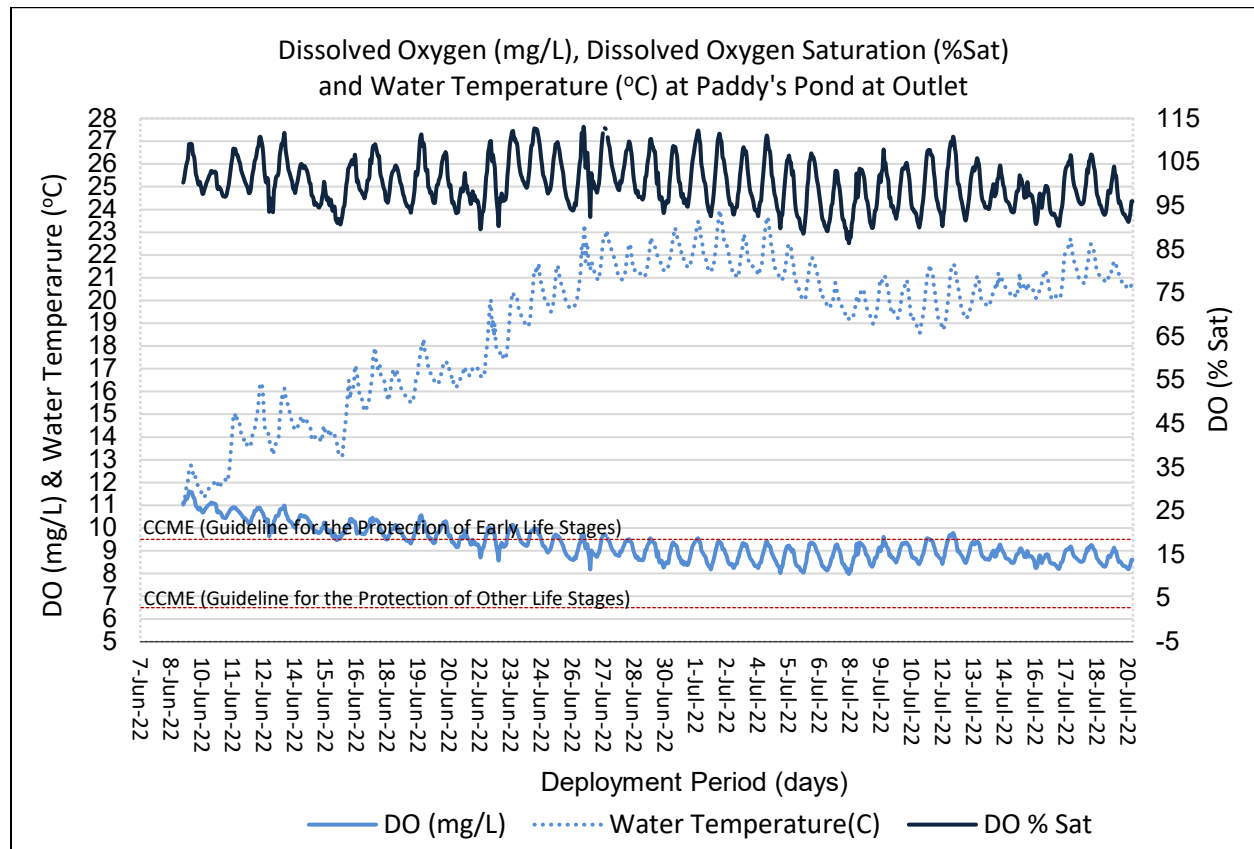
Mean	Median	Min	Max
76.4	79.7	59.9	86.0

Figure 4: Specific conductivity ( $\mu\text{S}/\text{cm}$ ) values at Paddy's Pond at Outlet.

- Specific conductivity values increased throughout the deployment period with a slight decrease in early July in correlation with a precipitation event. Conductivity then began to increase and plateau at the end of the deployment period. A maximum conductivity value of 86.0  $\mu\text{S}/\text{cm}$  and a minimum value of 59.9  $\mu\text{S}/\text{cm}$  (Figure 4) were observed. Mean conductivity was 76.4  $\mu\text{S}/\text{cm}$  with a median conductivity value of 79.7  $\mu\text{S}/\text{cm}$ .
- Variability in specific conductivity values throughout the deployment period is likely the result of temperature variations and precipitation events (Appendix A – Figure 7). A reduction in conductivity can be expected after rainfall, as the amount of water increases, solids concentration is reduced, decreasing conductivity.
- Given the isolated station location, sources of disturbances that may affect conductivity are considered minimal.
- The calculated Total Dissolved Solids (TDS) values increased from 0.05  $\text{g}/\text{L}$  to 0.06  $\text{g}/\text{L}$  on June 22, 2022.

### Dissolved Oxygen

- Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.



Parameter	Mean	Median	Min	Max
DO (mg/L)	9.35	9.25	7.98	11.61
DO ( % Sat)	100.2	99.8	86.4	113.1

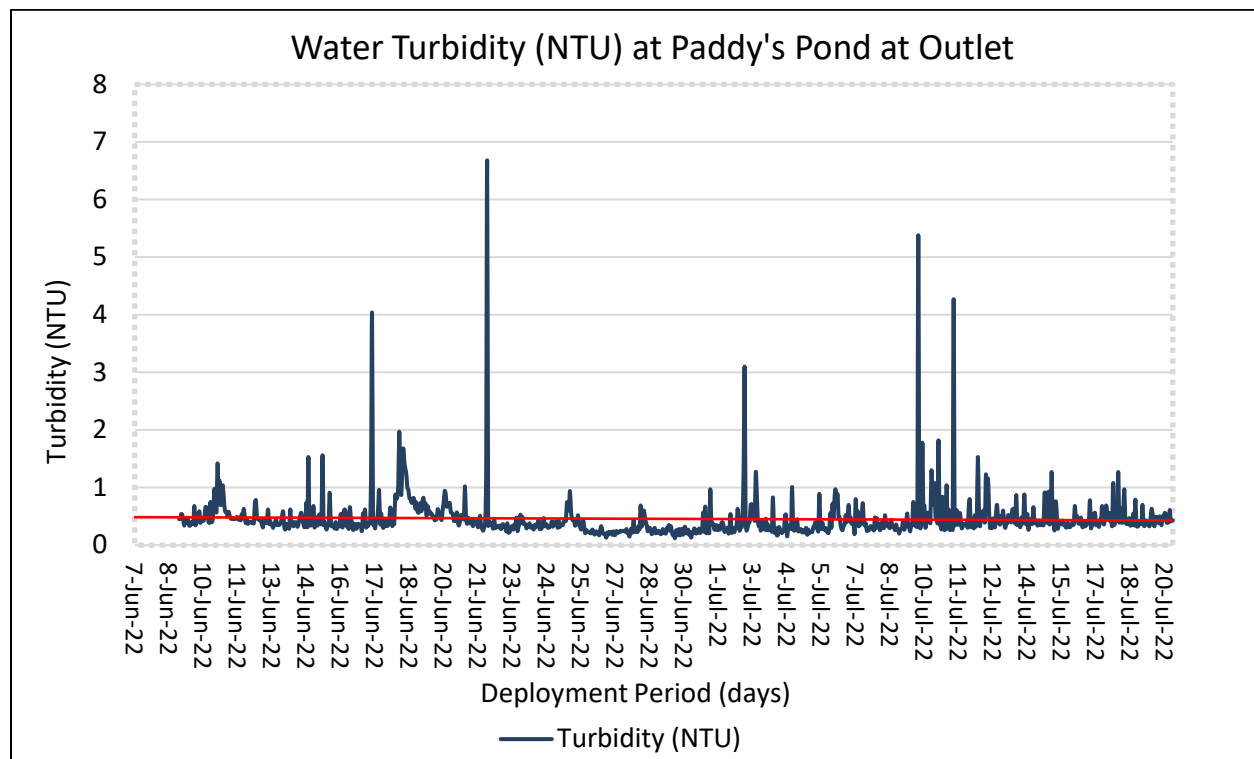
Figure 5: Dissolved Oxygen (mg/L & Percent (%) Saturation) values at Paddy's Pond at Outlet.

Dissolved Oxygen (DO) concentrations gradually decreased from early to late June and stabilized during the remainder of the deployment period with a maximum DO of 11.61 mg/L (113.1% Sat) to a minimum DO of 7.98 mg/L (86.4 % Sat).

- Diurnal variations were observed throughout the deployment period due to temperature ranges from day to night. The magnitude of diurnal variation increased in late June through mid July as a result of an increase in the length of days and greater temperature ranges from day to night. Variations can be influenced by water depth during deployment as shallow water temperatures will change more rapidly.
- The dissolved oxygen values decreased below the CCME Guideline for the Protection of Early Life Stages (9.5 mg/L) but remained above the CCME Guideline for the Protection of Other Life Stages (6.5mg/L). This is an expected natural trend due to the seasonal increase in water temperature.

**Turbidity**

- Turbidity is typically caused by fine suspended solids such as silt, clay, or organic material. Consistently high levels of turbidity tend to block sunlight penetration into a waterbody, discouraging plant growth. High turbidity can also damage the delicate respiratory organs of aquatic animals and cover spawning areas.



Mean	Median	Min	Max
0.5	0.4	0.1	6.7

**Figure 6: Water turbidity (NTU) values at Paddy's Pond at Outlet during deployment period June 7, 2022 through July 20, 2022.**

- Turbidity values range from 0.1 to 6.7 NTU, with a mean of 0.5 NTU and a median value of 0.4 NTU (Figure 6). Turbidity measurements over the deployment period indicated low turbidity values with a slight decreasing trend.
- Turbidity levels were low during this deployment period; however, events above baseline levels did occur, as seen on June 1<sup>st</sup>, 21<sup>st</sup>, July 2<sup>nd</sup> and 11<sup>th</sup>, and are likely influenced by debris, suspended algae, siltation due to wave action and precipitation events. Specifically, the precipitation event seen on July 21, 2022 (total precipitation 7.1mm) and the associated turbidity spike of 6.79 NTU.

**APPENDIX A : MEAN DAILY TEMPERATURE AND TOTAL PRECIPITATION**

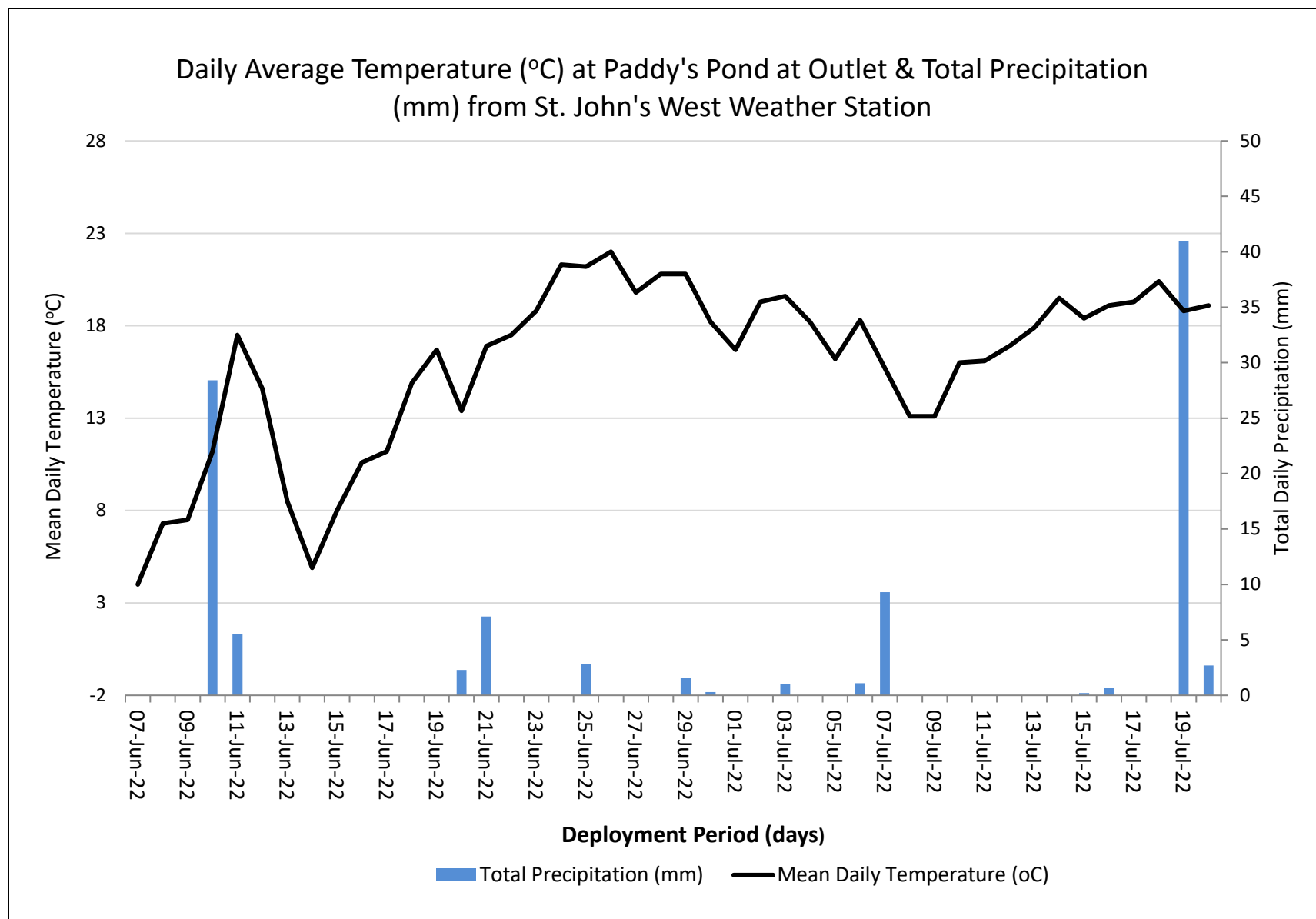


Figure 7: Mean daily air temperature and total precipitation at St. John's West near Paddy's Pond June 7, 2022 to July 20, 2022.

**APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS**