Real-Time Water Quality Deployment Report

Paddy's Pond at Outlet

June 9, 2021 to July 6, 2021

Government of Newfoundland & Labrador
Department of Environment and Climate Change
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

CONTENTS

General

The Department of Environment and Climate Change, Water Resources Management Division's staff currently monitor water quality in real-time at a station on Paddy's Pond near the outlet to Three Arm Pond at47° 29' 17''N, 52° 53' 39''W (Figure 1).

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 QAQC 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. At removal, a freshly cleaned and calibrated QA/QC Sonde is again placed *in situ*, adjacent to the Field Sonde and

values are again compared to determine how well the instrument performed during deployment and whether there is any indication of sensor drift or fouling.

Table 1: 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

Deployment and removal comparison rankings for the station at Paddy's Pond deployed between June 9, 2021 and July 6, 2021 are summarized in Table 2.

Table 2: Qualitative QA/QC comparison rankings for Paddy's Pond at outlet station June 9, 2021 through July 6, 2021.

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Paddy's Pond at Outlet	2021-06-09	Deployment	Excellent	Fair	Good	Excellent	Excellent
	2021-07-06	Removal	Excellent	Excellent	Excellent	Excellent	Excellent

- On June 9, 2021, a sonde was deployed at the station Paddy's Pond at Outlet for the first time since August 2019. The instrument was deployed for a period of 27 days and was removed on July 6, 2021.

- Upon deployment, all sensors ranked 'Excellent' and 'Good' with the exception of pH, which ranked 'Fair'. This may be due to the time required for the field sonde to acclimate to water conditions. The QAQC sonde read 6.94, while the field sonde read 6.33 but rose slowly to 6.92 during the first several hours of the deployment. The grab sample measured 6.68 (See Appendix B).

- Potential causes for less than desirable QA/QC rankings to be obtained include: the placement of the QA/QC sonde in relation to the field sonde, the amount of time each sonde was given to stabilize before readings were recorded; and deteriorating performance of one of the sensors.

- At removal of the instrument, all parameters ranked 'Excellent' against the QA/QC sonde.

DATA INTERPRETATION

The following graphs and discussion illustrate water quality data obtained hourly from June 9, 2021 through July 6, 2021 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 WRMD QA/QC protocol.

Mean daily temperature and total precipitation data were obtained from the St. John's West ECCC historical weather data at 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 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. Because 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.

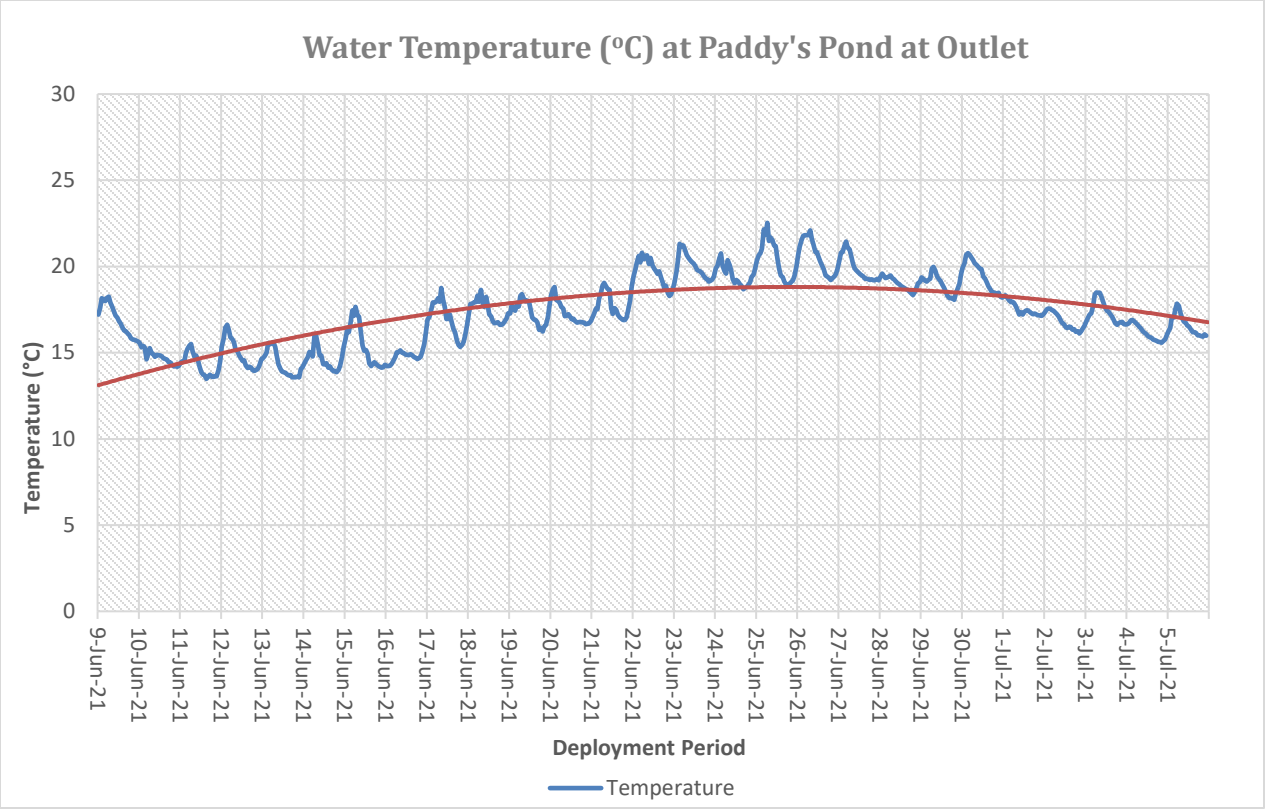

Figure 2: Water temperature (°C) values at Paddy's Pond at Outlet

- Over the 27-day deployment period, water temperature warmed as seasonal air temperatures increased. Mean water temperature increased from 13.48 ºC to a peak temperature of 22.53 ºC reached in late June. Water temperature began to cool slightly near the end of the deployment period corresponding to air temperature.

- The mean temperature was 17.37 ºC with the median temperature was 17.25 ºC

- 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 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.

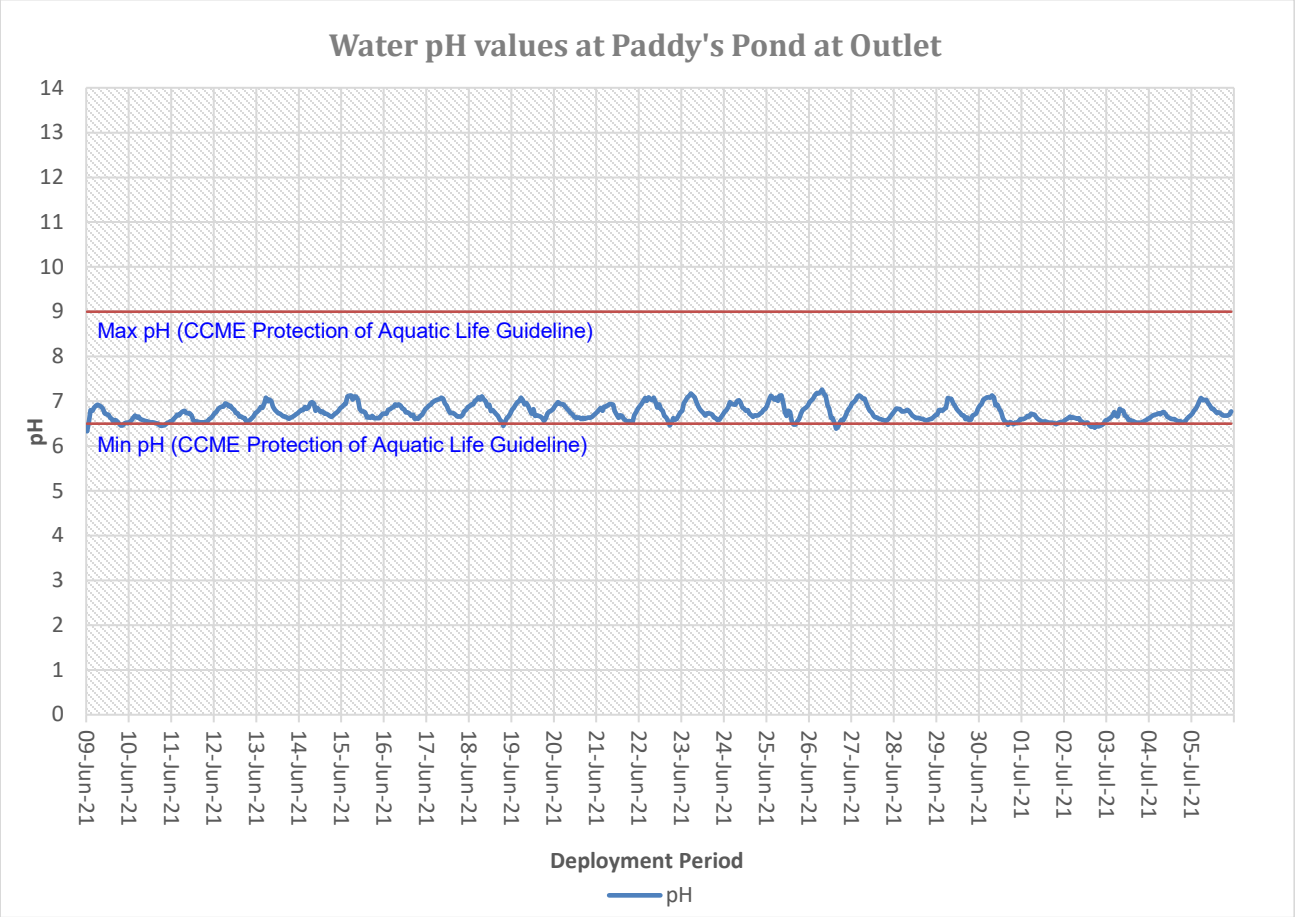

Figure 3: pH (pH units) at Paddy's Pond at outlet from June 9, 2021 through July 6, 2021.

- Throughout the deployment period, pH values ranged from 6.33 to 7.26 pH units, with a mean unit value of 6.75 and median of 6.72 units (Figure 3).

- The CCME pH 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 the waterbody. Paddy's Pond at Outlet pH values overall remained within the specified guidelines. With some exceptions including, a value of 6.33 on June 9, 2021 which is likely due to the time required for the instrument to acclimate as pH slowly increased to 6.92 over

several hours and on June 10th and July 3rd, 2021, where pH values decreased slightly below the recommended CCME guideline. This may be the result of precipitation events the days before.

- 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. Diurnal variation was most visible mid to late June when mean daily air temperatures peaked and length of days were the longest.

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.

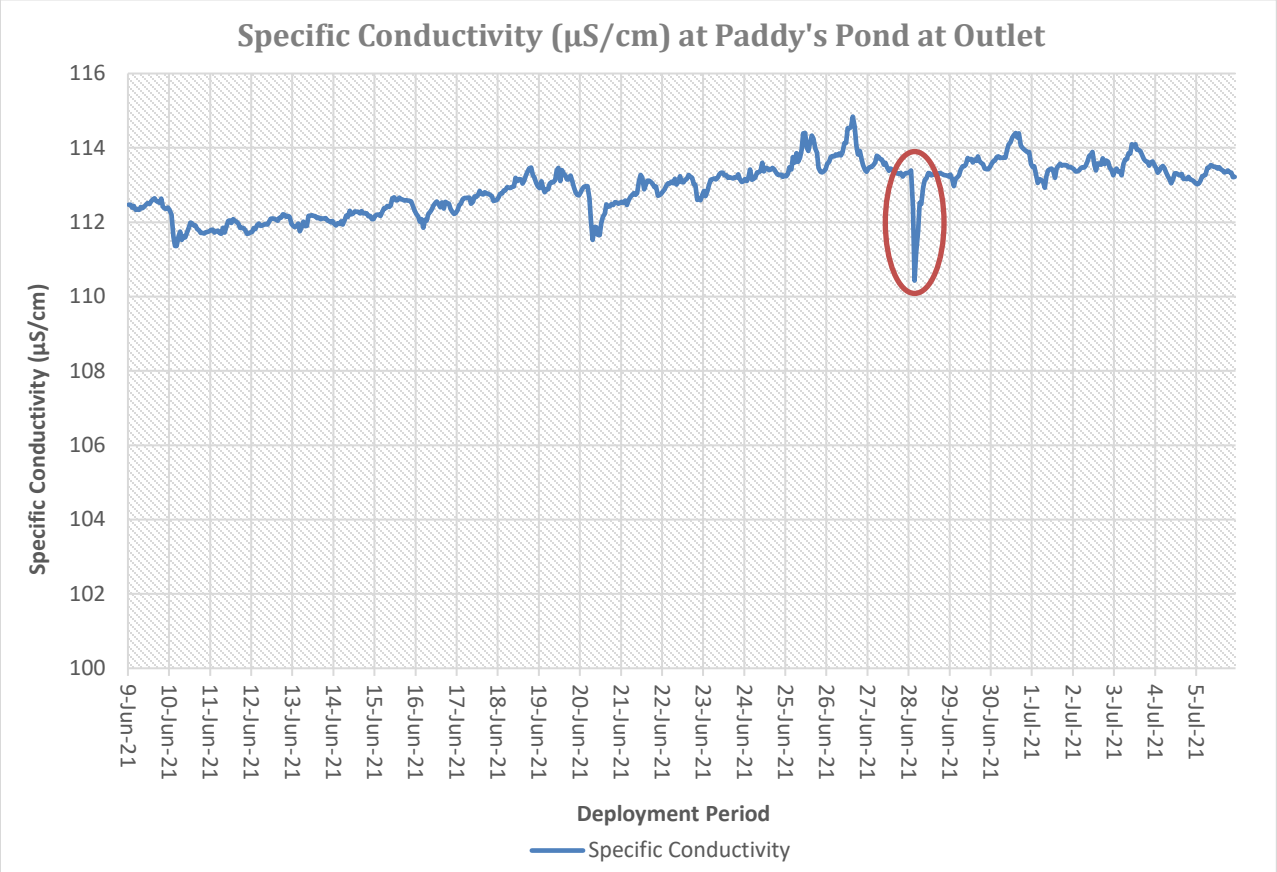

Figure 4: Specific conductivity (µS/cm) values at Paddy's Pond at Outlet

- Specific Conductivity levels were stable throughout the deployment period and within 110.4 µS/cm and 114.8 µS/cm (Figure 4). Mean conductivity was 112.9 µS/cm with a median of 113.1 µS/cm. Given the isolated station location, sources of disturbances that may affect conductivity are considered minimal.

- The slight decrease in specific conductivity on June 28, 2021 to 110.3 µS/cm is likely the result of a precipitation event (Identified in red in Figure 4). This can be expected after rainfall: as the amount of water increases, solids concentration is reduced, decreasing conductivity.

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.

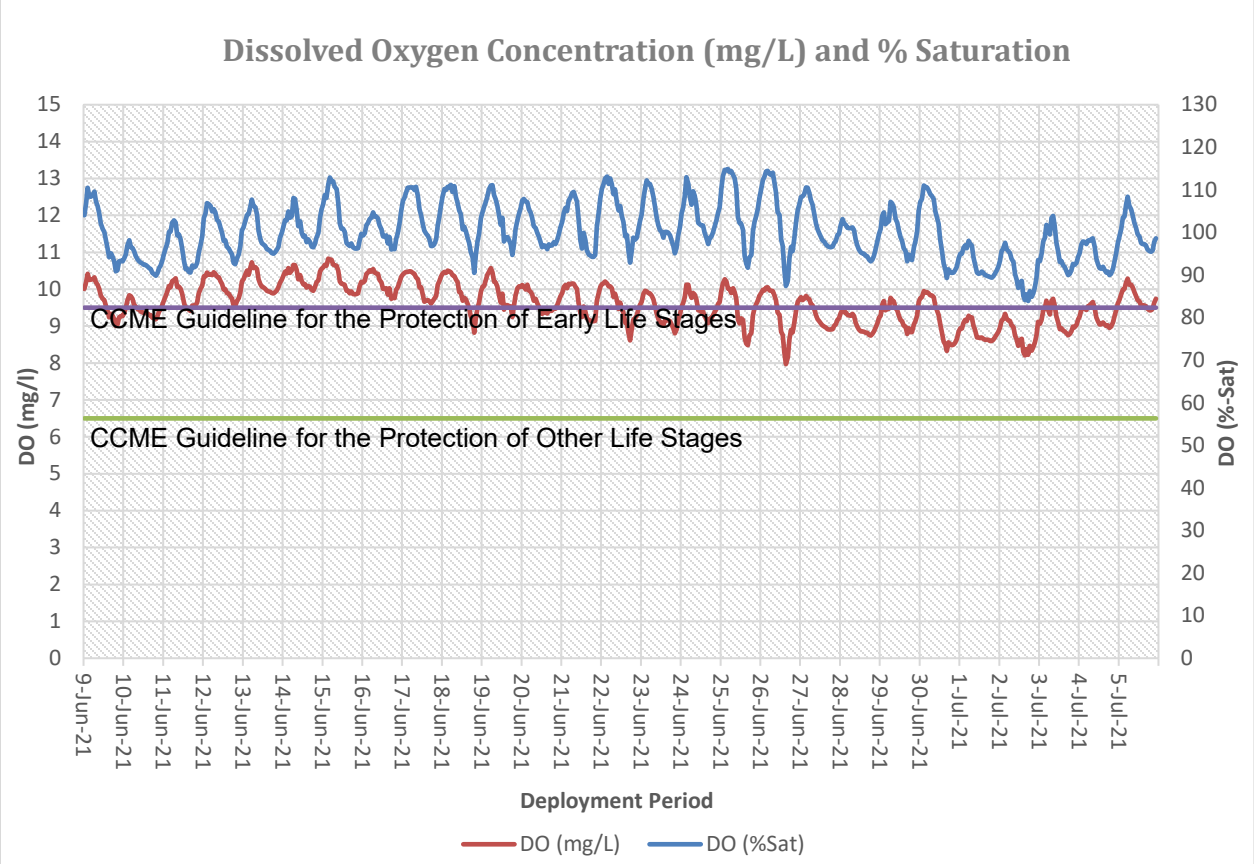

Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Paddy's Pond at Outlet.

- With increasing water temperature, dissolved oxygen concentrations declined slightly over the deployment period. The saturation of dissolved oxygen (%DO) ranged from 83.9 mg/L to 114.9 mg/L, with a mean %DO of 100.1. A range of 7.97 mg/L to 10.83 mg/L was found for the concentration of dissolved oxygen with a mean of 9.61 mg/L and median of 9.64 mg/L.

- By July 2, 2021, DO concentrations were predominantly below the 9.5 mg/l guideline for the protection of early life stage cold water biota, indicated on Figure 5. This is expected

for the time of year, as most aquatic organisms have developed beyond sensitive early stages by July.

- All values were above the minimum CCME Guideline for the Protection of Other Life Stages of 6.5 mg/l indicated on Figure 5.

- Dissolved oxygen content fluctuates diurnally and displays an inverse relationship to water temperature. DO increased then decreased slightly in this deployment period, following water temperature trends at this time inversely.

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.

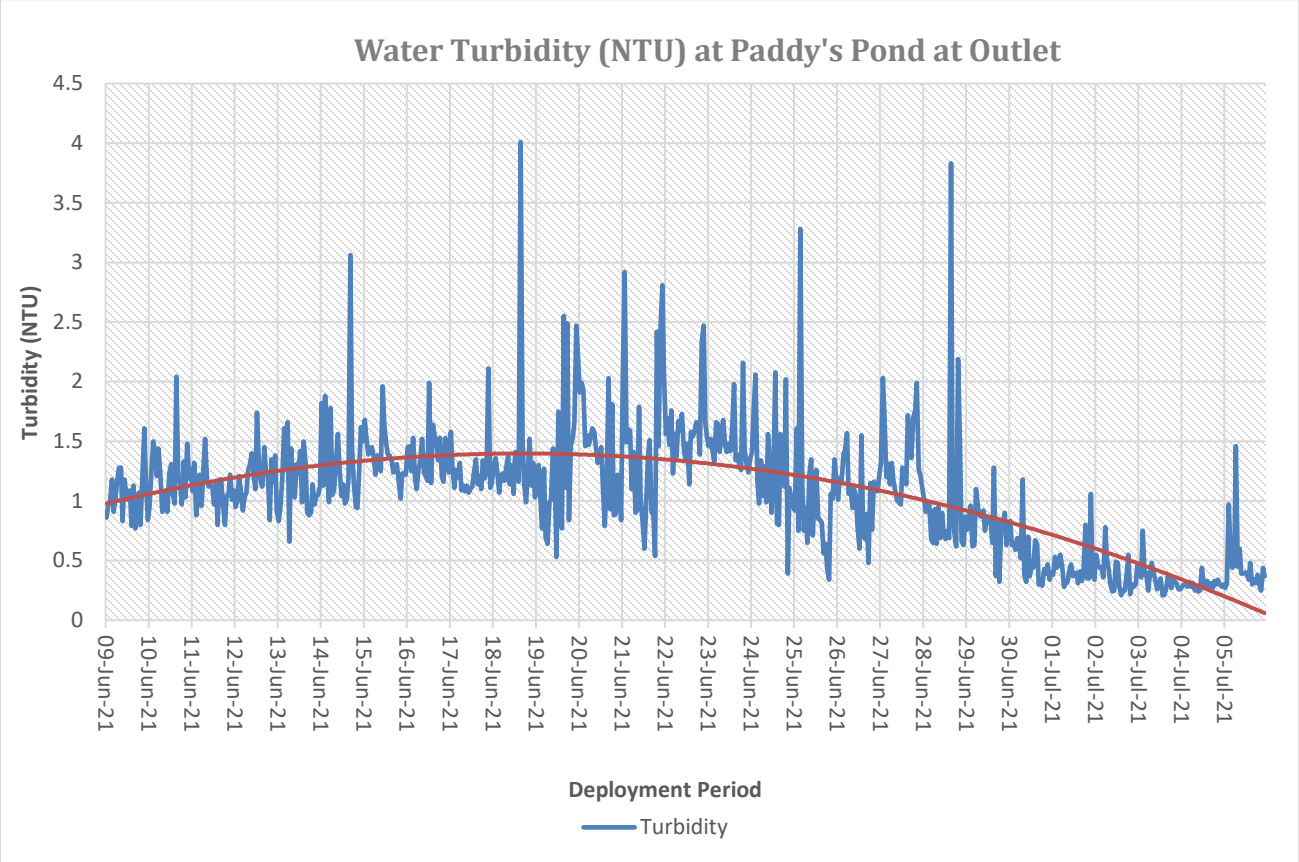

Figure 6: Water turbidity (NTU) values at Paddy's Pond at Outlet during deployment period June 9, 2021 through July 6, 2021.

- Turbidity values range from 0.2 NTU to 4.0 NTU, with a mean and median value of 1.1 NTU. Turbidity levels were low during this deployment period, however, levels slightly inclined through June and began to decline into early July.

- Fluctuations above baseline level are likely influenced by suspended algae, siltation due to wave action and precipitation events.

APPENDIX A : MEAN DAILY TEMPERATURE AND TOTAL PRECIPITATION

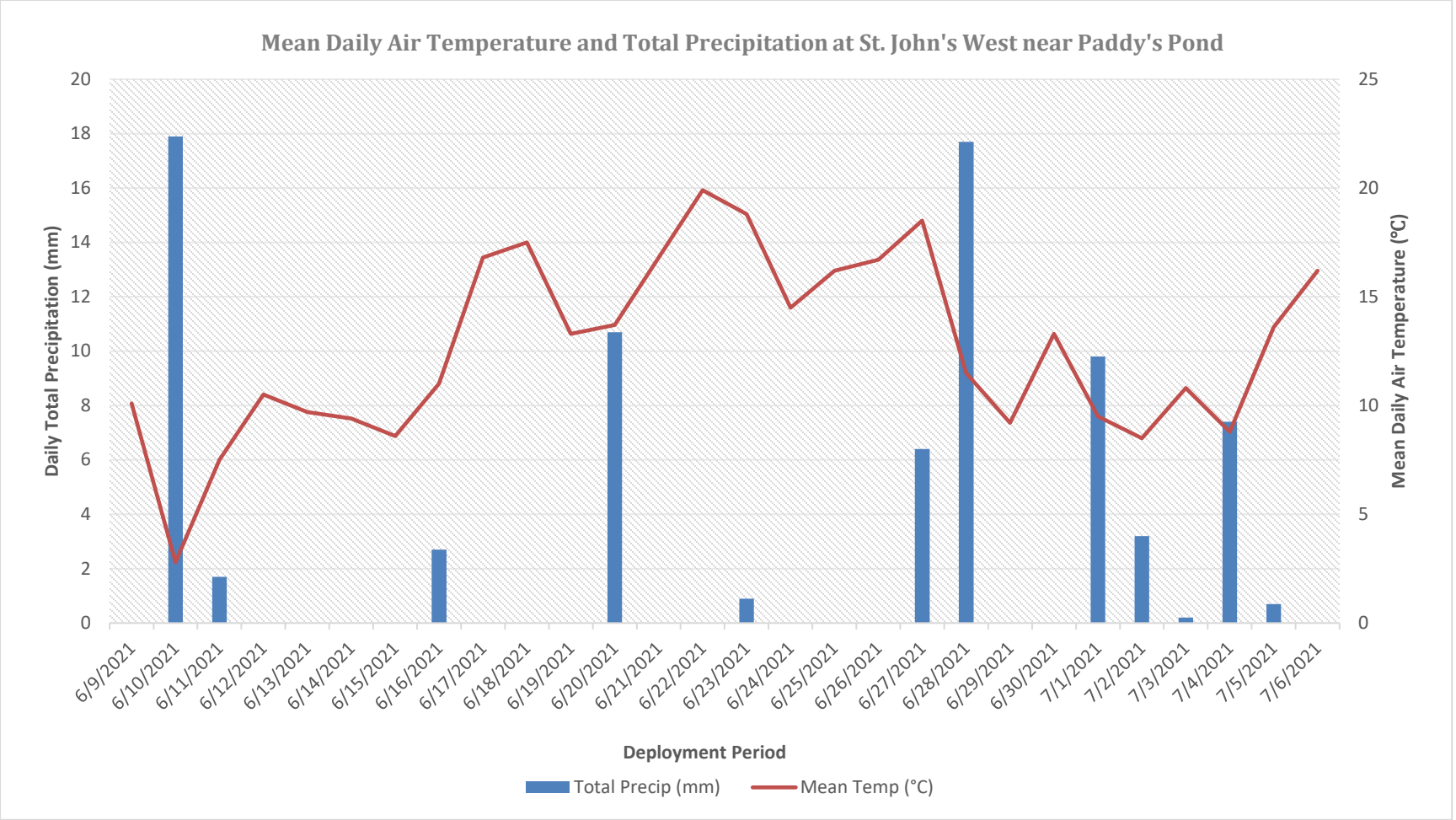

Figure 6: Mean daily air temperature and total precipitation at St. John's West near Paddy's Pond between June 9, 2021 and July 6, 2021

APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS

Confirmation of Sample Receipt

BV Labs Job Number: C1I8521
Job Received: 2021/07/07 09:26
Final Report Due: 2021/07/16 18:00
Disposal Date: 2021/08/06

Invoice Information

Attn: Robert Richard Harvey
NL Department of Environment, Climate Change and Municipalities
PO Box 8700
St. John's, NL, A1B 4J6
Email to:
rharvey@gov.nl.ca

Report Information

Attn: Robert Richard Harvey
NL Department of Environment, Climate Change and Municipalities
PO Box 8700
St. John's, NL, A1B 4J6
Email to:
rharvey@gov.nl.ca

Project Information

Quote #: C01296
PO/AFE#: 220028978-2
Project #:
Site Location: N/A
Sampled By: LH

Analytical Summary

A: Due On 2021/07/16 18:00

Lab ID	Client Sample ID	Sampling Date/Time	Matrix	Inorganics Package [1]	Total Suspended Solids
COC# 2021-1825-00-SI-SP					
QAQ506	PADDYS POND (Reg#: WS-S-0000)	2021/07/06	W	A	A

Include Criteria on CofA: No

[1] Test Location: Bureau Veritas Mississauga (Anions, Total Kjeldahl Nitrogen in Water, Total Phosphorus (Colourimetric))

Sample Inspection Observations & Comments

# of Samples Received: 1

Details: Sample(s) received in good condition.

Average Temperature:
Package 1: 3.3 °C
Package 2: 1.7 °C
Package 3: 3.7 °C
Package 4: 3.0 °C
Package 5: 0.0 °C
Package 6: 0.3 °C
Package 7: 2.0 °C
Package 8: 1.3 °C

Additional Notes

- Unless special storage arrangements are made, all samples will be disposed 30 days after receipt. Additional fees may be applied for extended storage.
- Additional fees may be applied for the disposal of hazardous samples.

The contents of this report are subject to change. For up to date information, please refer to the Customer Portal.

Parameter Summary

Package/Test	Parameter	RDL *	Unit	Samples
	Total Alkalinity (Total as CaCO3)	5	mg/L	All
	Dissolved Chloride (Cl-)	1	mg/L	All
	Dissolved Bromide (Br-)	1	mg/L	All
	Dissolved Sulphate (SO4)	1	mg/L	All
	Total dissolved solids (calc., EC)	1	mg/L	All
	Colour	5	TCU	All
	Conductivity	1	uS/cm	All
	Filter	N/A	N/A	All
	Dissolved Fluoride (F-)	0.1	mg/L	All
	Hardness (CaCO3)	1	mg/L	All
	Total Mercury (Hg)	0.000013	mg/L	All
	Total Aluminum (Al)	0.005	mg/L	All
	Total Antimony (Sb)	0.001	mg/L	All
	Total Arsenic (As)	0.001	mg/L	All
	Total Barium (Ba)	0.001	mg/L	All
	Total Boron (B)	0.05	mg/L	All
	Total Cadmium (Cd)	0.00001	mg/L	All
	Total Calcium (Ca)	0.1	mg/L	All
	Total Chromium (Cr)	0.001	mg/L	All
	Total Copper (Cu)	0.0005	mg/L	All
Inorganics Package	Total Iron (Fe)	0.05	mg/L	All
	Total Lead (Pb)	0.0005	mg/L	All
	Total Magnesium (Mg)	0.1	mg/L	All
	Total Manganese (Mn)	0.002	mg/L	All
	Total Nickel (Ni)	0.002	mg/L	All
	Total Phosphorus (P)	0.1	mg/L	All
	Total Selenium (Se)	0.0005	mg/L	All
	Total Sodium (Na)	0.1	mg/L	All
	Total Strontium (Sr)	0.002	mg/L	All
	Total Uranium (U)	0.0001	mg/L	All
	Total Zinc (Zn)	0.005	mg/L	All
	Nitrate (N)	0.05	mg/L	All
	Nitrate + Nitrite (N)	0.05	mg/L	All
	Nitrite (N)	0.01	mg/L	All
	Nitrogen (Ammonia Nitrogen)	0.05	mg/L	All
	Dissolved Organic Carbon (C)	0.5	mg/L	All
	Total Organic Carbon (C)	0.5	mg/L	All
	pH	N/A	pH	All
	Total Kjeldahl Nitrogen (TKN)	0.1	mg/L	All
	Total Phosphorus	0.004	mg/L	All
	Turbidity	0.1	NTU	All
Total Suspended Solids	Total Suspended Solids	0.5	mg/L	All

**RDLs are subject to change based on interferences present at the time of analysis.*

BV Labs PM: Maryann Comeau (Maryann.COMEAU@bureauveritas.com or 902-420-0203 Ext: 298)

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CHAIN OF CUSTODY RECORD

COC #:

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Environment, Climate Change and Municipalities	Company Name:	Quotation #: INORGANICS & TSS	✓ Regular TAT (5 business days) Most analyses
Contact Name: Robert Richard Harvey	Contact Name:	Purchase Order#: 220028978-2	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: PO Box 8700	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's NL A1B 4J6 PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709) 729-7634	Phone:	Site Province: NL	Early Results
Email: rharvey@gov.nl.ca	Email:	Site #:	
Report Copies: rharvey@gov.nl.ca	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		1 2, 1 2, 1 1	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	Inorganics Package	TSS	HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify)	COMMENTS Site Name
1	2021-1825-00-SI-SP	2021/07/06		water	8			x	x			Paddys Pond
2				water	8							
3				water	8							
4				water	8							
5				water	8							
6				water	8							
7				water	8							
8				water	8							
9				water	8							
10				water	8							

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
Leona Hyde	2021/07/06			JUL 06 2021	11:00	C1I8521

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