



Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
January 20, 2023 to May 09, 2023



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

Prepared by:

Water Resources Management Division
Department of Environment & Climate Change
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6

TABLE OF CONTENTS

GENERAL 4

QUALITY ASSURANCE AND QUALITY CONTROL 4

DATA INTERPRETATION 7

Water Temperature 7

pH – Port Failure – No data collected..... 8

Specific Conductivity & Total Dissolved Solids..... 8

Dissolved Oxygen 9

Turbidity 10

Stage and Precipitation 11

APPENDIX A : MEAN DAILY AIR TEMPERATURE AND AVERAGE WATER TEMPERATURE 12

APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS..... 14

GENERAL

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada -Environment and Climate Change Canada (WSC-ECCC), maintain a real-time water quality and water quantity monitoring station on Waterford River at Kilbride.

The purpose of the real-time water quality station is to monitor, process and publish real-time water quality data.

This deployment report discusses water quality related events occurring at this station from the instrument deployment on January 20, 2023, until removed on May 9, 2023. Please note that data for the pH parameter was not obtained due to port failure. The sonde was removed on January 31, 2023 (09:00) for troubleshooting with no success and redeployed (13:30) for continuous monitoring of all other parameters.



Figure 1: Waterford River at Kilbride Real-Time Water Quality and Quantity Station.

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 (Table 1).

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.

Waterford River at Kilbride, Newfoundland and Labrador

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 2).

WRMD staff at the Department of Environment & Climate Change (ECC) are 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 are responsible for the data logging/communication aspect of the network and 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 and are responsible for handling stage and streamflow data issues. The water quantity data is transmitted via satellite and published online with the water quality data on the WRMD website. Water 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.

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

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 recorded too early it may not accurately portray the water body.

Table 2: Instrument performance rankings for Waterford River at Kilbride

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Waterford River @ Kilbride	January 20, 2023	Deployment	Excellent	N/A	Good	Excellent	Excellent
		Grab Sample # 1700	N/A	N/A	Good	N/A	Excellent
	May 9, 2023	Removal	Excellent	N/A	Excellent	Good	Good

Waterford River at Kilbride, Newfoundland and Labrador

As previously noted, pH data was not obtained due to port failure and as such, could not be ranked or included in statistical analysis.

Upon deployment, all sensors ranked 'Excellent' or 'Good'.

All measured grab sample (#2022-1700-00-SI-SP) parameters ranked 'Good' or 'Excellent' in comparison to the field sonde.

Upon removal of the instrument, all functioning parameters continued to rank 'Excellent' or 'Good' despite the long deployment period of 110 days.

DATA INTERPRETATION

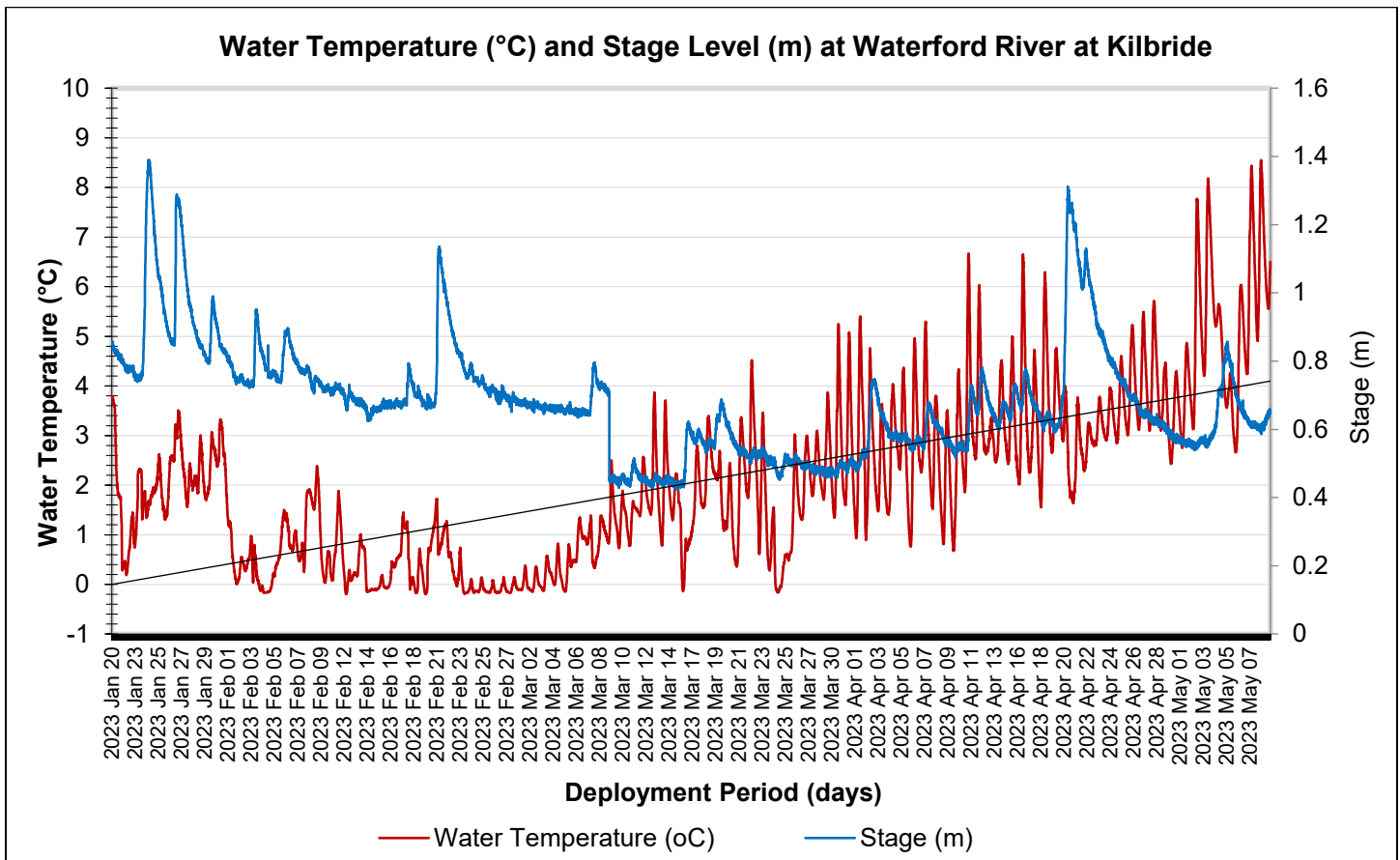
Water Temperature

Water temperature ranged from -0.19 °C to 8.55 °C during this deployment period (Figure 2) and was relatively stable with slight variability until March 1, 2023, when water temperature began to gradually increase for the remainder of the deployment period in correlation to winter to spring air temperatures.

During higher than baseline stage events, the water temperature often decreased for a short period due to the addition of cooler precipitation, as seen on February 3rd, February 21st, and on April 20th, 2023. (Appendix A).

Water temperature values display a natural diurnal pattern with temperatures increasing during the day and decreasing overnight. The magnitude of variation was influenced by daily air temperature fluctuations as well as precipitation events. As spring season and associated temperatures increased during the day, the magnitude of diurnal variation increased.

Please note the stage data 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.



Mean	Median	Min	Max
2.05	1.81	-0.19	8.55

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

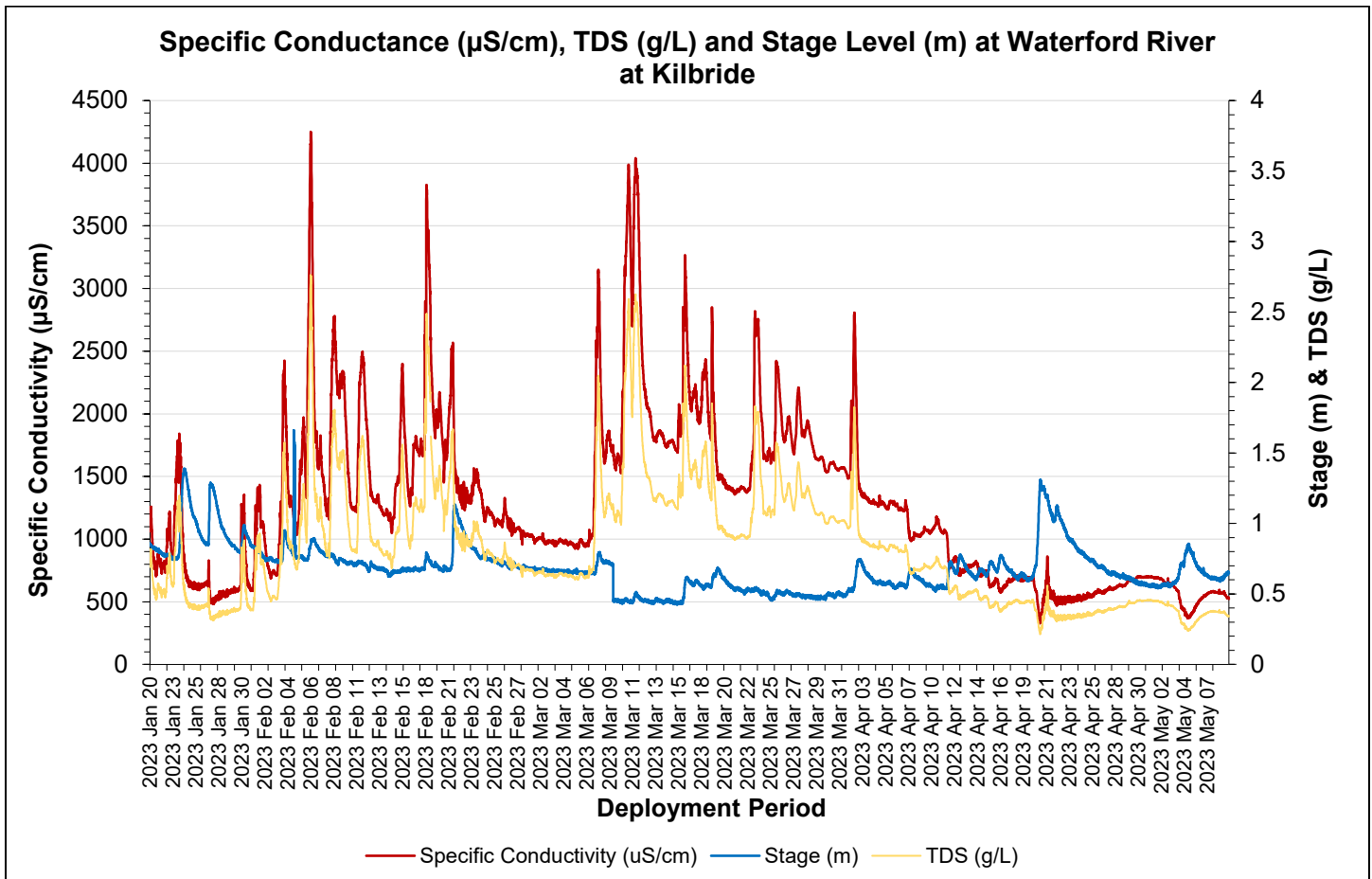
pH – Port Failure – No data collected

Specific Conductivity & Total Dissolved Solids

Conductivity levels were variable from January 20, 2023, to May 9, 2023, as depicted in Figure 4. The conductivity levels were within 328.0 $\mu\text{S/cm}$ and 4248.0 $\mu\text{S/cm}$. TDS (a calculated value) ranged from 0.2130 g/L to 2.7610 g/L.

Throughout the deployment period, conductivity levels at Waterford River increased during high stage events before decreasing slightly. This is a result of the addition of minerals and highly ionic stormwater runoff from salted roads during winter months. However, it was observed that the high stage event on April 20th, 2023, caused a decrease rather than an increase in conductivity, indicating dilution and that road salts were no longer being washed into the river. Given the location, the river is highly influenced by urban roads, residential housing, and pedestrian traffic.

Please note that the stage data is raw. It is not corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.



	Mean	Median	Min	Max
Specific Conductivity ($\mu\text{S/cm}$)	1266.9	1164.0	328.0	4248.0
TDS (mg/L)	0.8230	0.7560	0.2130	2.7610

Figure 4: Specific conductivity ($\mu\text{S/cm}$), TDS (g/mL) and stage (m) values at Waterford River at Kilbride.

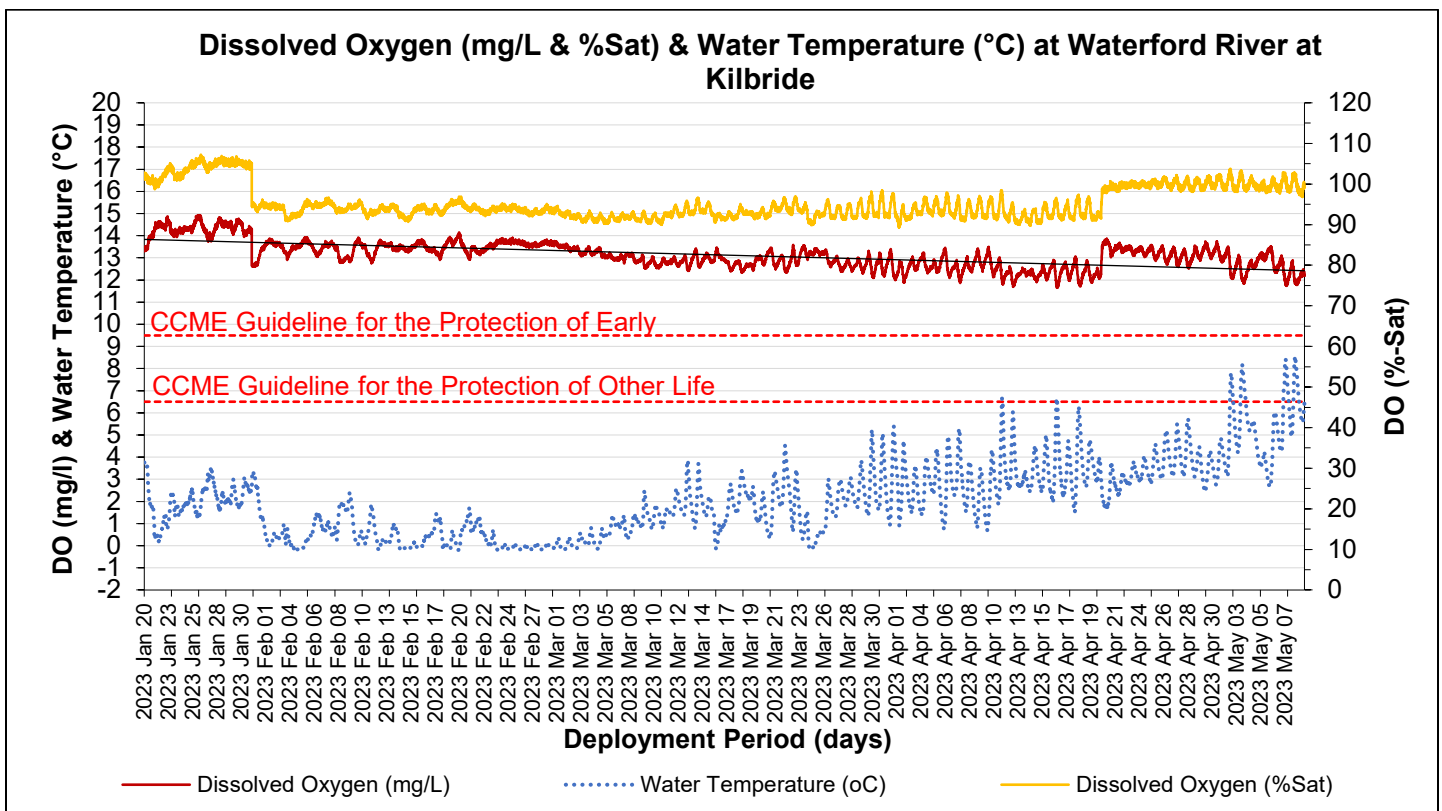
Dissolved Oxygen

The water quality instrument 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, dissolved oxygen concentration levels range within a minimum of 11.65 mg/L to a maximum of 14.93 mg/L. The percent saturation (%) levels for dissolved oxygen ranged within 89.3% to 107.2% saturation (Figure 5).

A very gradual decrease in dissolved oxygen concentration over the deployment period was observed in correlation with natural warming water temperatures. A sudden decrease in dissolved oxygen as seen on February 3 correlates with a rise in water temperature. A sudden increase in dissolved oxygen on April 21 correlates to a sudden decrease in water temperature. These are natural responses to changes in the waterbody as warmer water holds less oxygen.

Dissolved oxygen concentrations remained above the Guidelines for Other Life Stages (6.5 mg/L) and Early life stages (9.5mg/L) throughout the deployment period.



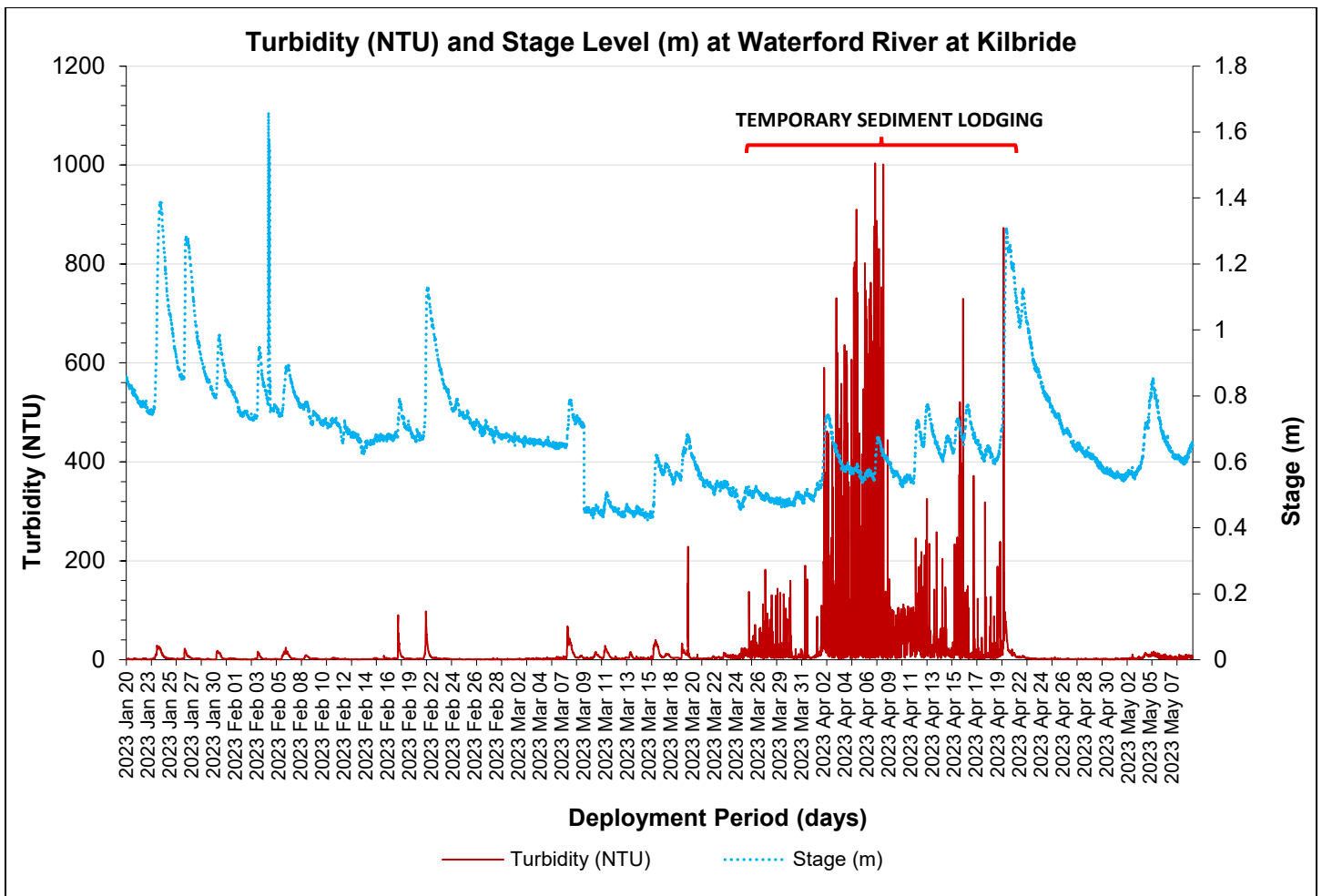
	Mean	Median	Min	Max
DO (%Sat)	95.3	93.9	89.3	107.2
DO (mg/L)	13.13	13.12	11.65	14.93

Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

The low turbidity levels observed during the deployment period until March 24th are typical for this station. Data above the baseline is likely the result of precipitation events where higher stage and flow ensue. Turbidity data between March 24, 2023, through April 21, 2023, are considered erroneous due to the temporary lodging of sediment and debris within the sonde casing. A significant decrease in turbidity, back to baseline level, was observed on April 20, 2023, when 36.9mm of precipitation was received causing an increase in stage and flow washing the sediment and organic material from the sonde. Statistical analysis for the entire deployment period has been calculated for review and indicate a range from 0.5 NTU and 1509.2 NTU, with a mean of 17 NTU and median of 3.1 NTU (Figure 6).

Please note the stage data is raw. 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.



Mean	Median	Min	Max
17	3.1	0.5	1509.2

Figure 6: Turbidity (NTU) and stage (m) values at Waterford River at Kilbride.

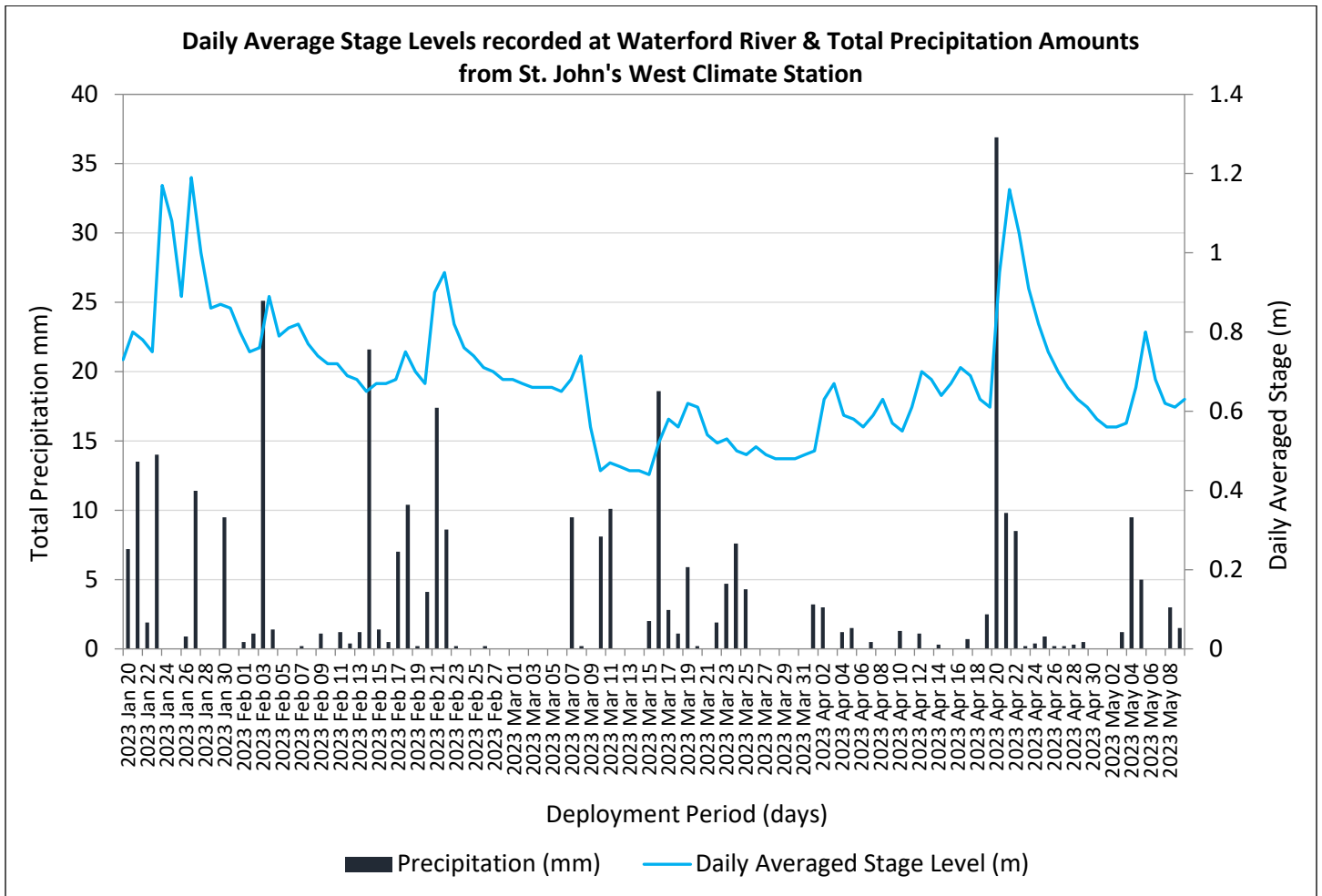
Stage and Precipitation

Please note the stage data graphed below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data is available upon request to WSC.

Stage is an estimation of water level at the station and can explain some of the events that are occurring with other parameters (i.e., specific conductivity, DO, turbidity). Stage will increase during rainfall events as depicted in Figure 7.

During the deployment period, the stage values range from 0.42m to 1.66m. The larger peaks in stage correspond with substantial rainfall events for example on April 19-22, 2023, a total of 57.7 mm of rain fell.

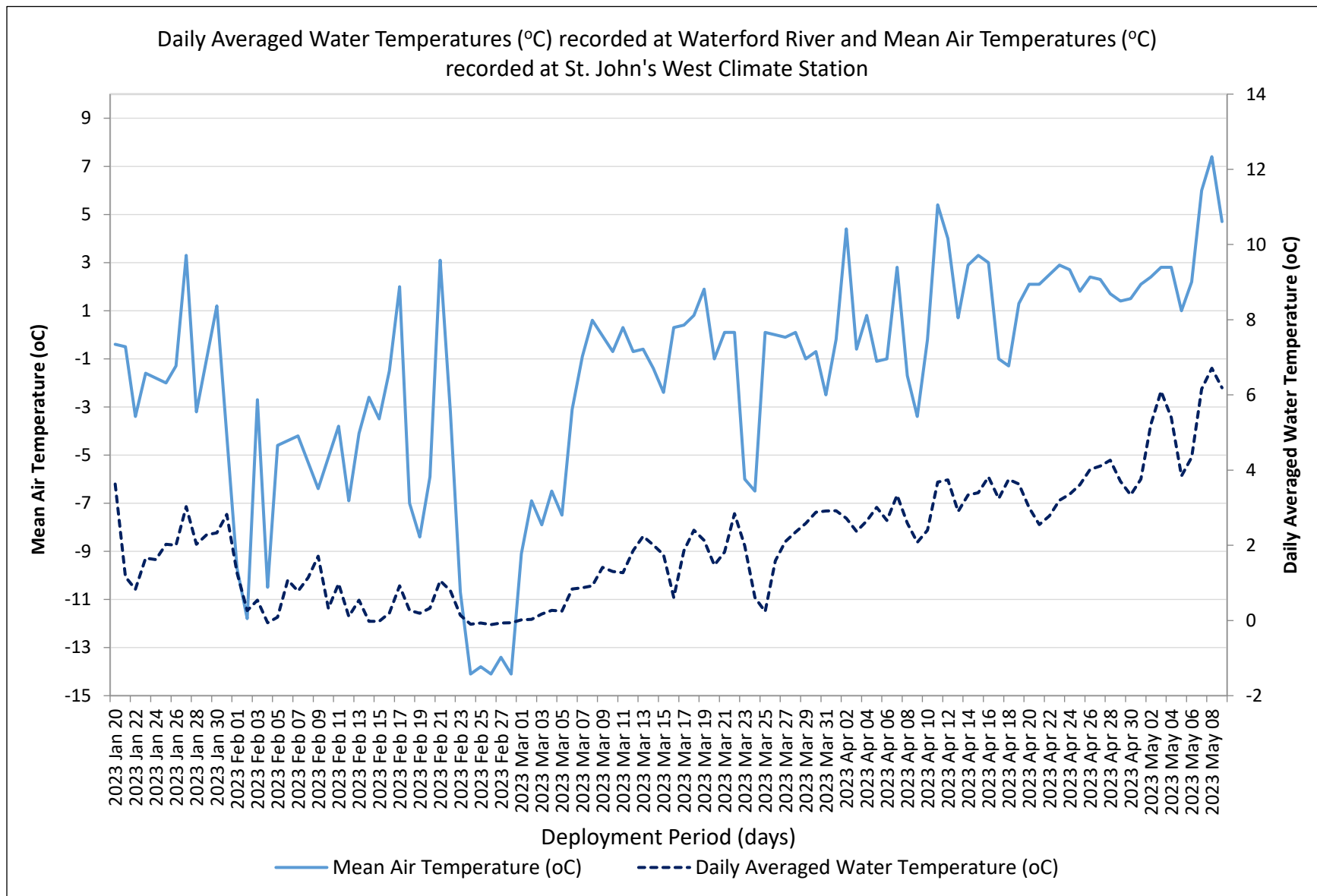
Precipitation data was collected by Environment Canada’s St. John’s West Climate station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 36.9 mm on April 20, 2023.



Mean	Median	Min	Max
0.68	0.67	0.42	1.66

Figure 7: Daily average stage (m) values recorded at Waterford River at Kilbride and daily total precipitation (mm) from St. John’s West Climate Station.

APPENDIX A : MEAN DAILY AIR TEMPERATURE AND AVERAGE WATER TEMPERATURE



APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS



BUREAU
VERITAS

Bureau Veritas Job #: C323260
Report Date: 2023/02/01

NL Department of Environment, Climate Change and
Municipalities

Site Location: WATERFORD RIVER @ KILBRIDE

Your P.O. #: 220028978-6

Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
UWV498 WATERFORD RIVER @ KILBRIDE								
Sampling Date		2023/01/20 13:45						
Matrix		W						
Sample #		2023-1700-00-SI-SP						
Registration #		SA-0000						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	39	1.0	mg/L	N/A	2023/01/31		8470073
Nitrate (N)	-	0.92	0.050	mg/L	N/A	2023/01/31		8470076
Total dissolved solids (calc., EC)	-	560	1.0	mg/L	N/A	2023/01/31		8470661
Inorganics								
Conductivity	-	1000	1.0	uS/cm	N/A	2023/01/30	NGI	8474741
Chloride (Cl-)	-	270	2.0	mg/L	N/A	2023/02/01	LKH	8478099
Dup.Chloride (Cl-)	-	270	2.0	mg/L	N/A	2023/02/01	LKH	8478099
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2023/02/01	LKH	8478099
Dup.Bromide (Br-)	-	ND	1.0	mg/L	N/A	2023/02/01	LKH	8478099
Sulphate (SO4)	-	17	1.0	mg/L	N/A	2023/02/01	LKH	8478099
Dup.Sulphate (SO4)	-	17	1.0	mg/L	N/A	2023/02/01	LKH	8478099
Total Alkalinity (Total as CaCO3)	-	11	2.0	mg/L	N/A	2023/01/30	NGI	8474749
Colour	-	19	5.0	TCU	N/A	2023/01/30	TGO	8476254
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2023/01/30	NGI	8474769
Total Kjeldahl Nitrogen (TKN)	-	0.14	0.10	mg/L	2023/01/30	2023/01/31	JJH	8476827
Nitrate + Nitrite (N)	-	0.92	0.050	mg/L	N/A	2023/01/30	TGO	8476256
Nitrite (N)	-	ND	0.010	mg/L	N/A	2023/01/31	TGO	8476257
Nitrogen (Ammonia Nitrogen)	-	0.069	0.050	mg/L	N/A	2023/01/30	TGO	8473314
Dissolved Organic Carbon (C)	-	3.9	0.50	mg/L	N/A	2023/01/27	CPP	8472438
Total Organic Carbon (C)	-	4.0	0.50	mg/L	N/A	2023/01/31	SSI	8476383
pH	-	7.09		pH	N/A	2023/01/30	NGI	8474731
Total Phosphorus	-	0.018	0.004	mg/L	2023/01/30	2023/02/01	SPC	8476840
Total Suspended Solids	-	1.4	1.0	mg/L	2023/01/27	2023/01/27	RMK	8472428
Turbidity	-	0.41	0.10	NTU	N/A	2023/01/30	AA0	8475852
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2023/01/30	2023/01/30	EPU	8475726
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.092	0.0050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Aluminum (Al)	-	0.11	0.0050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Antimony (Sb)	-	ND	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Antimony (Sb)	-	ND	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Arsenic (As)	-	ND	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Arsenic (As)	-	ND	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Barium (Ba)	-	0.021	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Barium (Ba)	-	0.021	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Boron (B)	-	ND	0.050	mg/L	2023/01/27	2023/01/31	JHY	8476335



BUREAU
VERITAS

Bureau Veritas Job #: C323260
Report Date: 2023/02/01

NL Department of Environment, Climate Change and
Municipalities

Site Location: WATERFORD RIVER @ KILBRIDE

Your P.O. #: 220028978-6

Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
UWV498 WATERFORD RIVER @ KILBRIDE								
Sampling Date		2023/01/20 13:45						
Matrix		W						
Sample #		2023-1700-00-SI-SP						
Registration #		SA-0000						
ELEMENTS BY ICP/MS (WATER)								
Metals								
Dup.Total Boron (B)	-	ND	0.050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Cadmium (Cd)	-	0.000025	0.000010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Cadmium (Cd)	-	0.000026	0.000010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Calcium (Ca)	-	13	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Calcium (Ca)	-	13	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Chromium (Cr)	-	ND	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Chromium (Cr)	-	ND	0.0010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Copper (Cu)	-	0.0017	0.00050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Copper (Cu)	-	0.0017	0.00050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Iron (Fe)	-	0.15	0.050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Iron (Fe)	-	0.16	0.050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Lead (Pb)	-	ND	0.00050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Lead (Pb)	-	ND	0.00050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Magnesium (Mg)	-	1.9	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Magnesium (Mg)	-	1.9	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Manganese (Mn)	-	0.062	0.0020	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Manganese (Mn)	-	0.062	0.0020	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Nickel (Ni)	-	ND	0.0020	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Nickel (Ni)	-	ND	0.0020	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Phosphorus (P)	-	ND	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Phosphorus (P)	-	ND	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Potassium (K)	-	2.3	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Potassium (K)	-	2.3	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Selenium (Se)	-	ND	0.00050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Selenium (Se)	-	ND	0.00050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Sodium (Na)	-	160	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Sodium (Na)	-	160	0.10	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Strontium (Sr)	-	0.045	0.0020	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Strontium (Sr)	-	0.046	0.0020	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Uranium (U)	-	ND	0.00010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Uranium (U)	-	ND	0.00010	mg/L	2023/01/27	2023/01/31	JHY	8476335
Total Zinc (Zn)	-	0.012	0.0050	mg/L	2023/01/27	2023/01/31	JHY	8476335
Dup.Total Zinc (Zn)	-	0.012	0.0050	mg/L	2023/01/27	2023/01/31	JHY	8476335