

Real-Time Water Quality Report

Waterford River at Kilbride NL02ZM0009

Deployment Period
October 20 to December 5, 2023



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 -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 October 20, 2023 until removal on December 5, 2023, 45 days later.



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. 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	October 20	Deployment	Excellent	Good	Excellent	Excellent	Excellent
		Grab Sample # 1721	N/A	Fair	Good	N/A	Excellent
	December 5	Removal	Good	Excellent	Poor	Poor	Poor

Upon deployment, all sensors ranked ‘Excellent’ or ‘Good’.

Waterford River at Kilbride, Newfoundland and Labrador

On removal, temperature and pH were 'good' to excellent, however, conductivity, dissolved oxygen and turbidity all ranked 'poor'. Data analysis will provide reasoning for these rankings.

The Waterford River station experienced a loss of transmission of both water quality and quantity from October 23rd to 31st. For this timeframe, logged data from the instrument was used to supplement the water quality data.

DATA INTERPRETATION

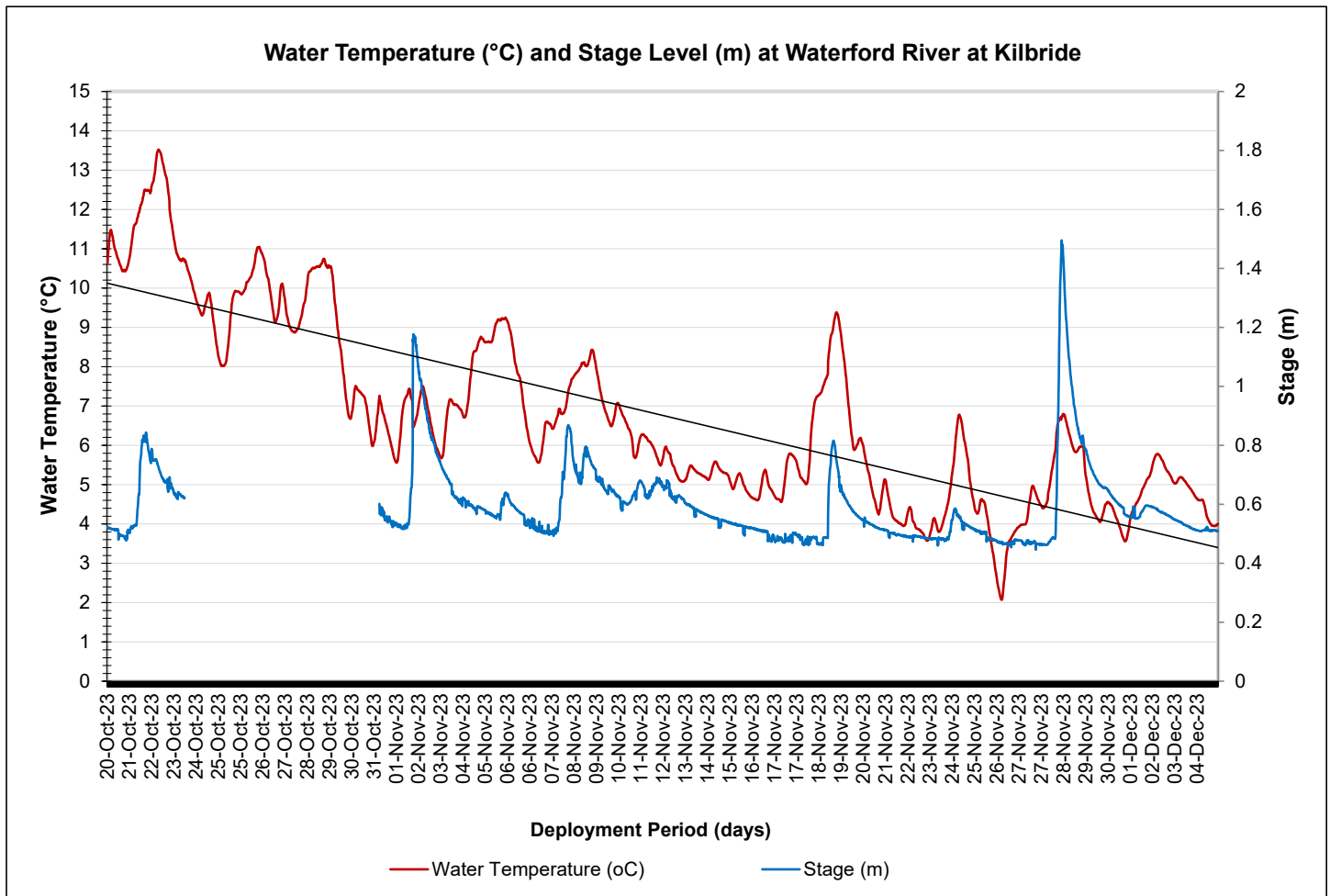
Water Temperature

Water temperature ranged from 2.07 °C to 13.52 °C during this deployment period (Figure 2).

The water temperature was variable but correlated with air temperature (see Appendix A) throughout the deployment period, with an overall decreasing trend throughout the deployment. This is expected as air and water temperatures cool into the Fall months.

During high stage events, the water temperature often increased for a short period due to the addition of warmer water as precipitation from tropical storms affecting the area, as seen on October 21, November 7, November 19 and November 29.

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
6.76	6.18	2.07	13.52

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

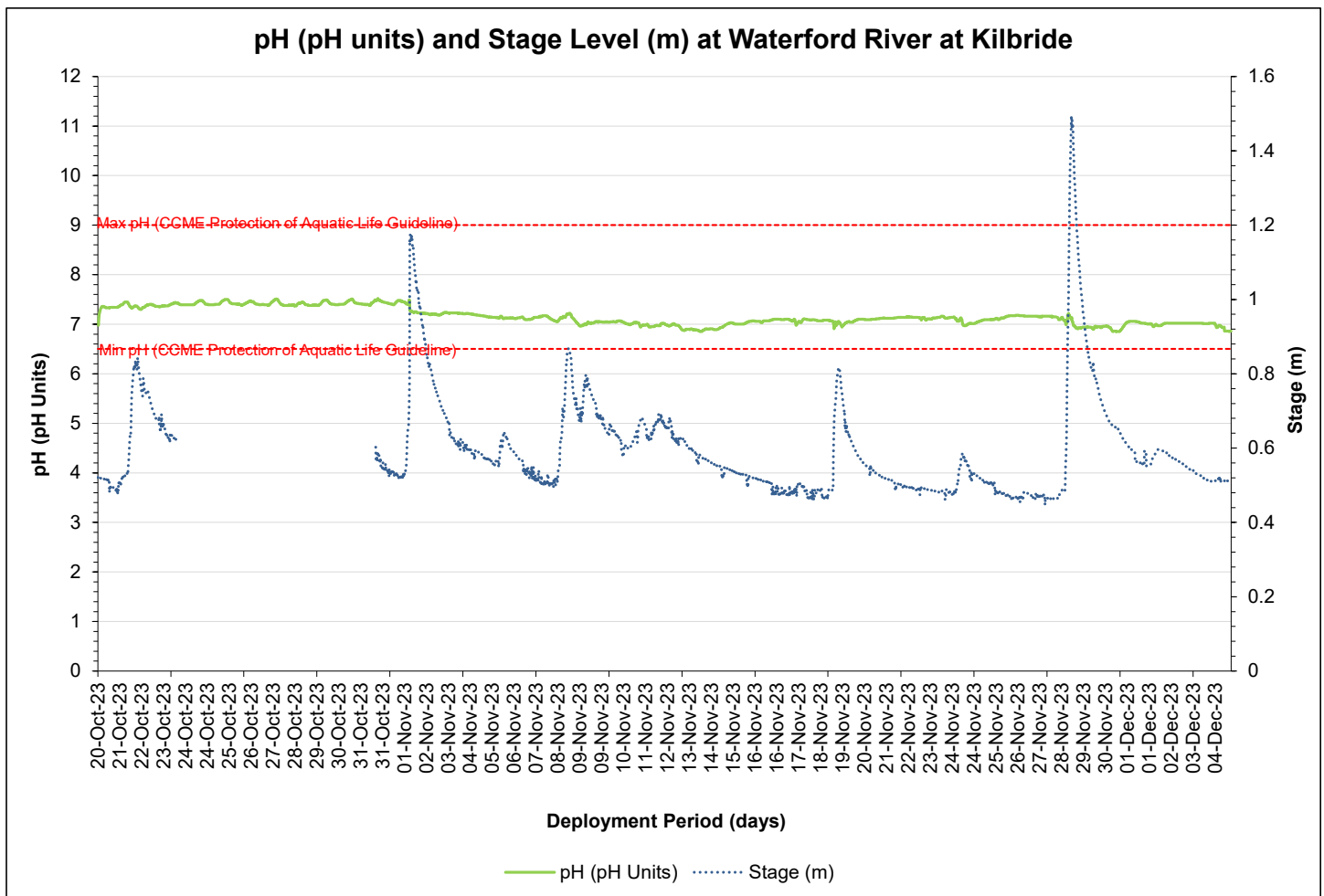
pH

Throughout the deployment period, pH exhibited a slight decreasing trend, with a range between 6.85 pH units and 7.52 pH units, a mean of 7.16 and median of 7.12 pH units (Figure 3). The highest values were reached at the beginning of the deployment.

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. The CCME guideline provides a basis by which to judge the overall health of the brook. Waterford River maintained a pH level within these guidelines for the duration of the deployment period.

Short-term drops in pH were evident on multiple occasions as stage increases brought more, slightly acidic water to the system via precipitation. This was particularly noticeable around November 1 and November 28.

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
7.16	7.12	6.85	7.52

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride.

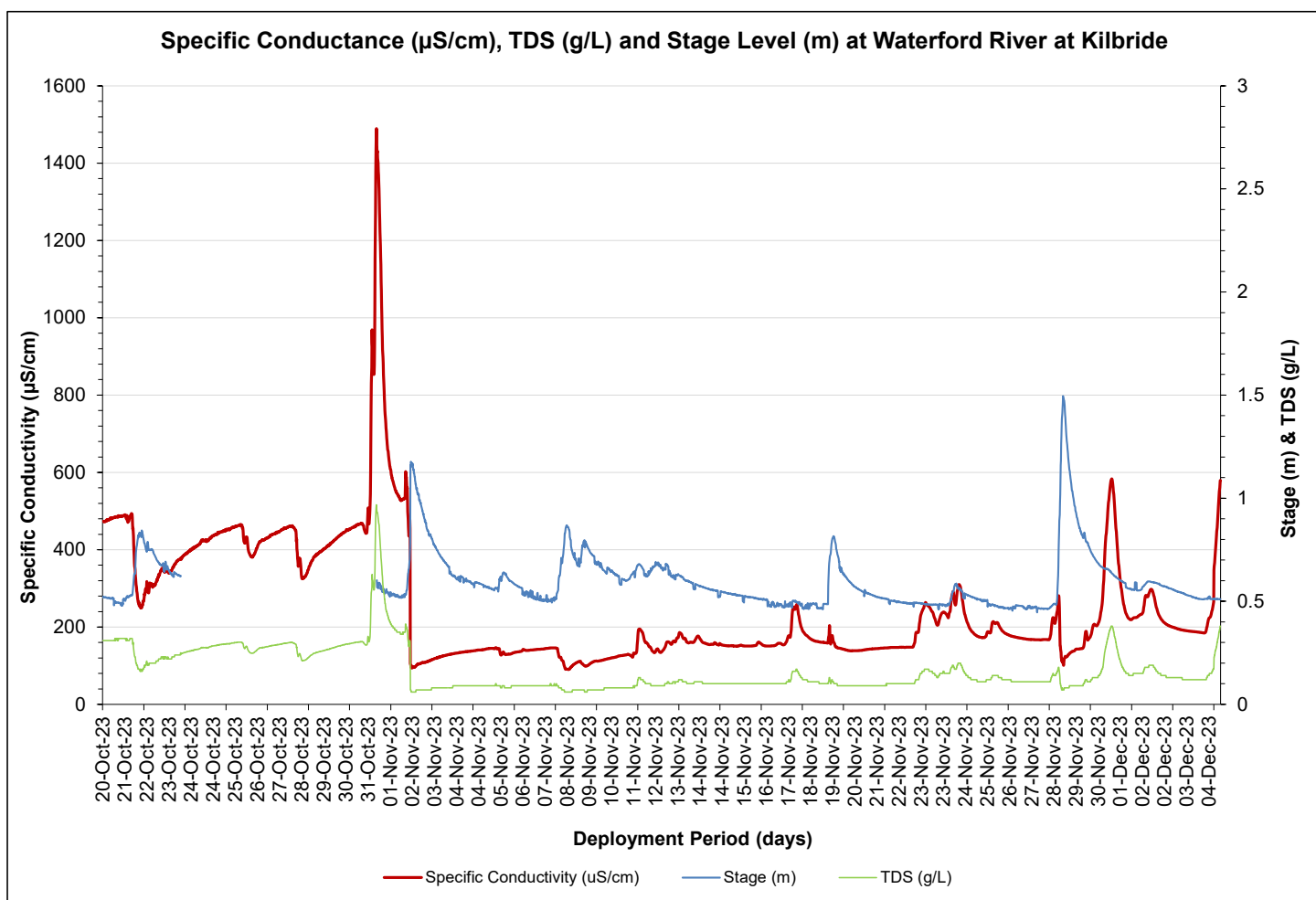
Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 90.2 $\mu\text{S}/\text{cm}$ and 1489.6 $\mu\text{S}/\text{cm}$. TDS (a calculated value) ranged from 0.0600 g/L to 0.9680 g/L.

Conductivity levels were noticeably influenced by high stage events. Some events led to increased conductivity as sediment, salt and debris washed into the system, such as on November 1 and November 28. Other events led to conductivity decreases as increased stage added more freshwater to the system, such as on October 31 and November 23. This is a result of the dilution of minerals and dissolved material present in the brook and short-term flushing before returning to background levels. This river is highly influenced by urban roads, residential housing and pedestrian traffic.

Conductivity was generally decreasing across this deployment period. The ‘poor’ QA/QC ranking at removal is likely the result of stirred up particles near the instruments during removal.

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 (µS/cm)	252	178.2	90.2	1489.6
TDS (mg/L)	0.1635	0.1200	0.0600	0.9680

Figure 4: Specific conductivity (µS/cm), TDS (g/mL) and stage (m) values at Waterford River at Kilbride.

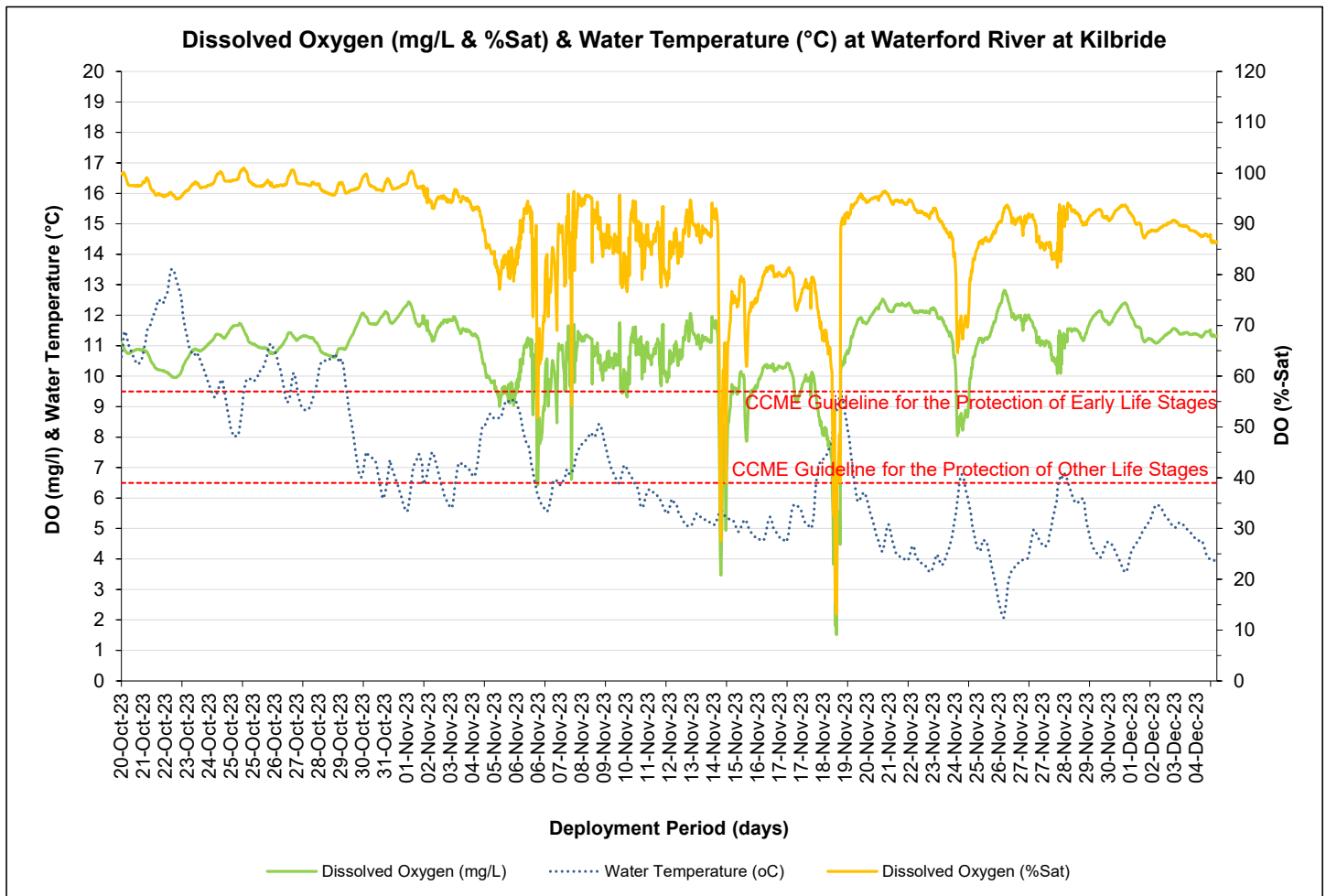
Dissolved Oxygen

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 1.52 mg/L to a maximum of 12.82 mg/L. The percent saturation (%) levels for dissolved oxygen ranged within 13.1% to 100.9% saturation (Figure 5).

Dissolved oxygen was variable throughout the deployment and recorded some lower than normal values on multiple occasions. As water temperatures cooled into Fall, we would expect dissolved oxygen to show a corresponding overall increase, but it does not. This observation, combined with the rapid decreases and 'poor' QA/QC ranking upon removal, indicate there may have been issues with the sensor near the end of deployment.

With the exception of the odd rapid drops in dissolved oxygen, concentrations remained above the Guideline for Other Life Stages (6.5 mg/L) throughout the deployment and were above the Guideline for the Protection of Early life stages (9.5mg/L) for the majority of deployment.



	Mean	Median	Min	Max
DO (%Sat)	89.3	91.6	13.1	100.9
DO (mg/L)	10.91	11.17	1.52	12.82

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

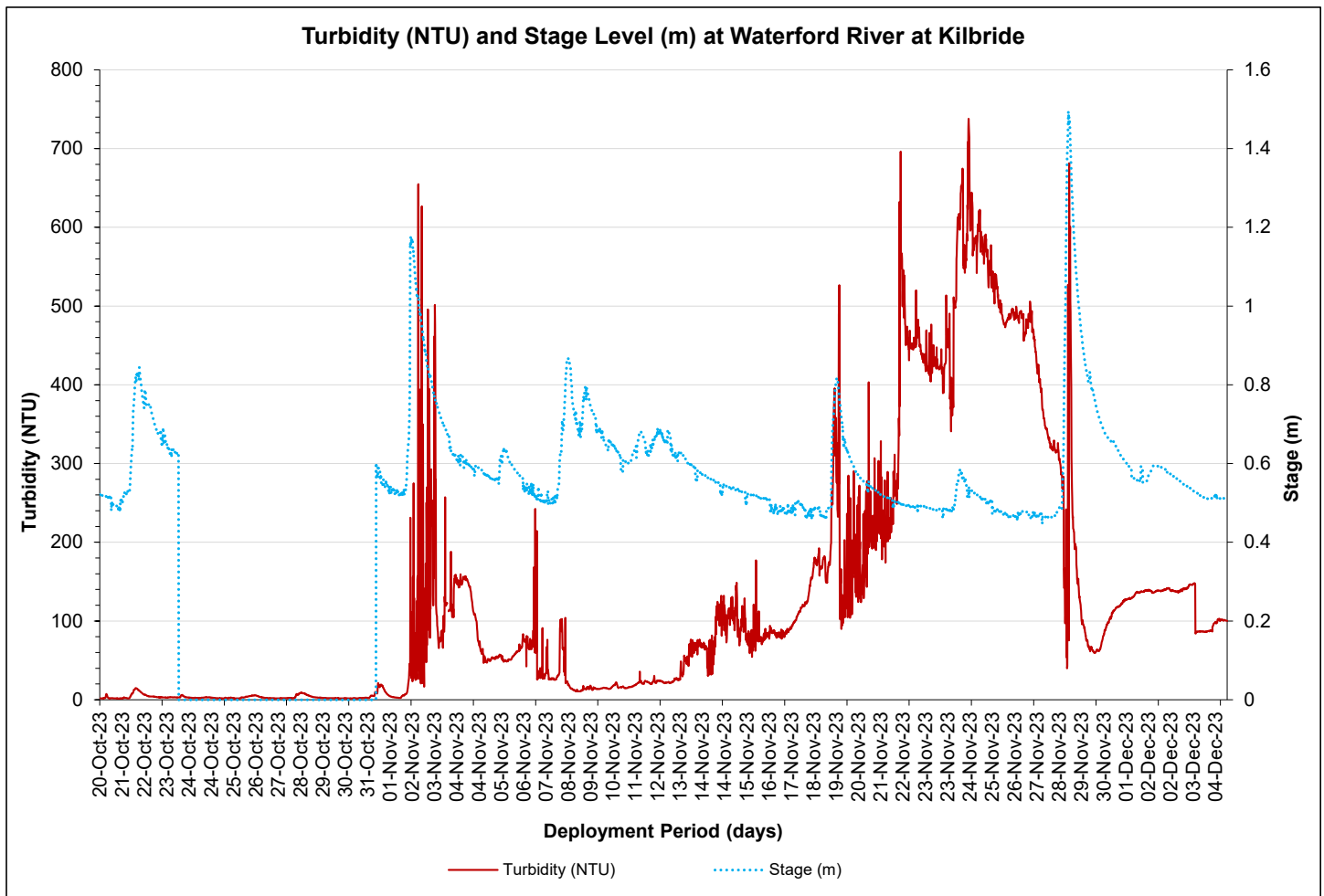
Turbidity

Turbidity levels during the deployment period range from 1.5 NTU and 738.0 NTU, with a mean of 129.1 NTU and median of 73.3 NTU (Figure 6).

Turbidity events above baseline values are the result of higher stage events and an associated increase in flow which washes sediment and debris into the system and disturbs the water column. This increases the presence of suspended material in water through the movement of runoff, soil and sediment from nearby urban areas.

Turbidity rose rapidly on November 1 during a stage event and while it continued to fluctuate based on stage increases and decreases, it never fully returned to baseline values. This indicates likely sediment buildup around the sensor and would explain the 'poor' QA/QC ranking upon removal.

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
129.1	73.3	1.5	738.0

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

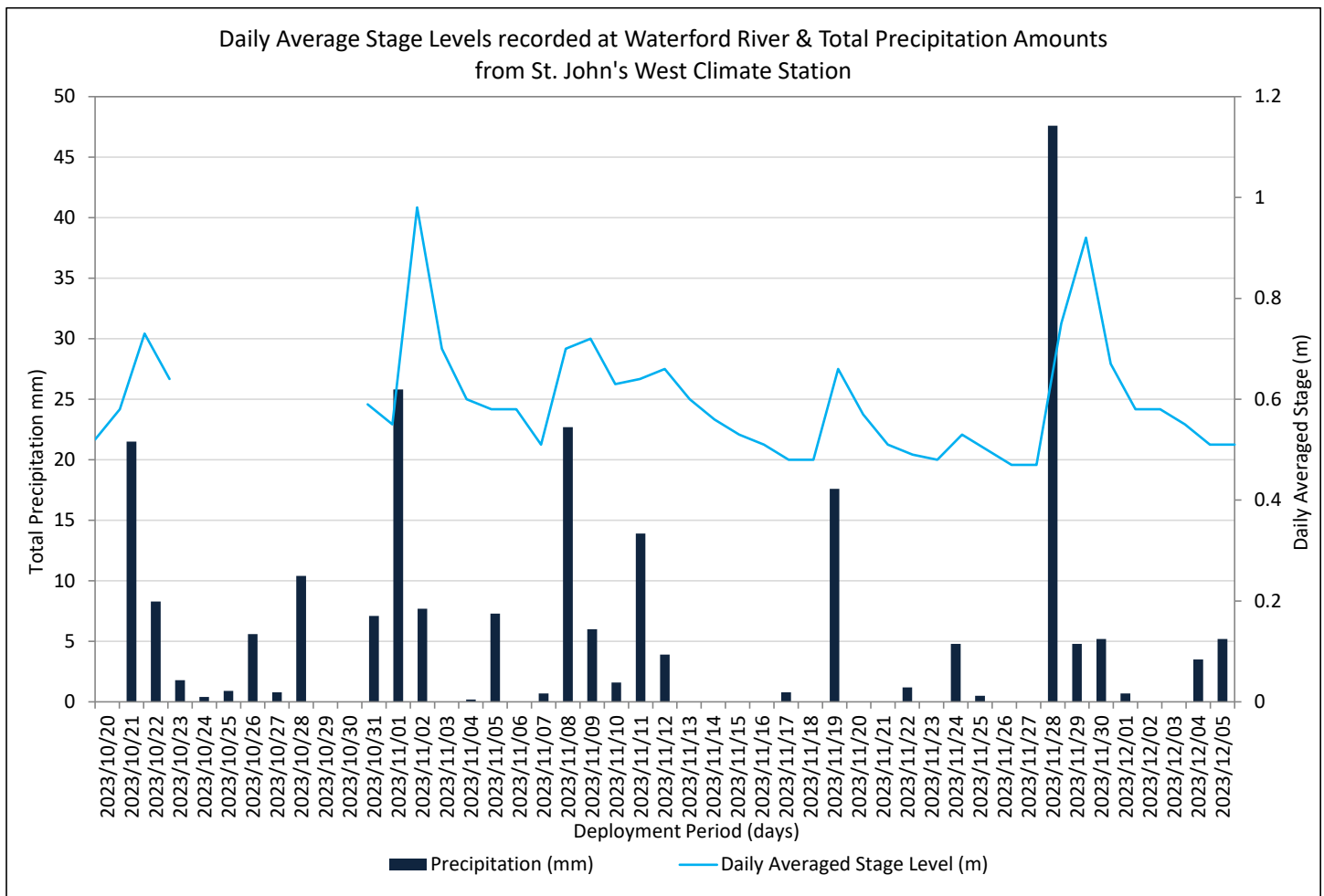
Stage and Precipitation

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. A week of stage data is missing due to a transmission gap from the hydrometric equipment.

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 but may not increase if precipitation falls as snow.

During the deployment period, the stage values range from 0.45 m to 1.18 m. The larger peaks in stage correspond with substantial rainfall events as observed on November 1st and 28th. Stage was relatively stable during this deployment period, fluctuating after rainfall for a short period of time.

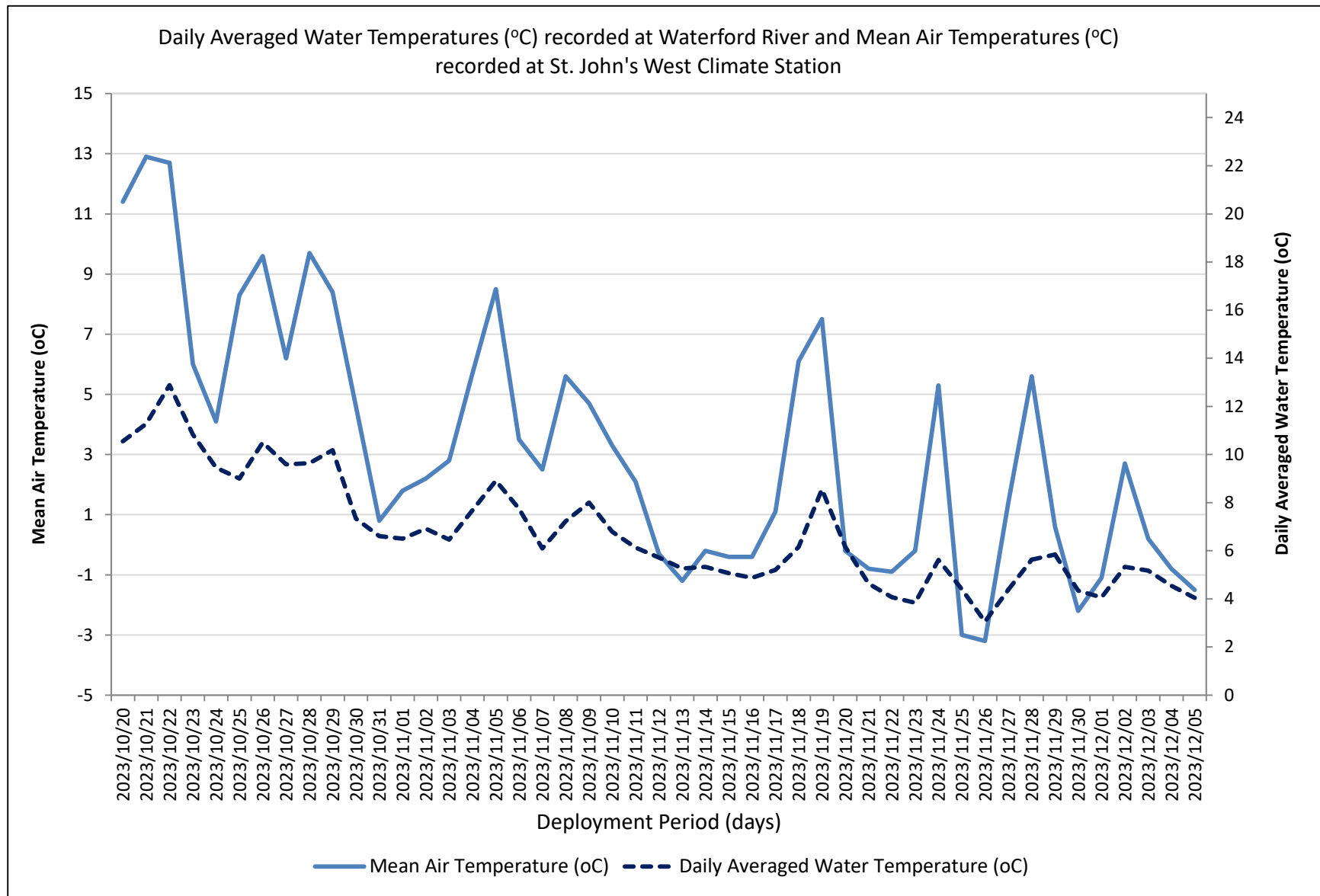
Precipitation data was collected by Environment Canada’s St. John’s West Climate station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 47.6 mm on November 28th, 2023.



Mean	Median	Min	Max
0.59	0.55	0.45	1.18

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 #: C3W8971
Report Date: 2023/11/06

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 220028978-9
Sampler Initials: LB

Sample Details/Parameters	MAC	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
XJE997 WATERFORD RIVER @ KILBRIDE								
Sampling Date		2023/10/20 12:20						
Matrix		W						
Sample #		2023-1721-00-SI-SP						
Registration #		SA-0000						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	34	1.0	mg/L	N/A	2023/11/02		8998675
Nitrate (N)	10	0.92	0.050	mg/L	N/A	2023/11/03		8998680
Total dissolved solids (calc., EC)	-	290	1.0	mg/L	N/A	2023/10/28		8998993
Inorganics								
Conductivity	-	510	1.0	uS/cm	N/A	2023/10/27	LJV	9008736
Chloride (Cl-)	-	130	1.0	mg/L	N/A	2023/10/30	LKH	9006346
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2023/10/30	LKH	9006346
Sulphate (SO4)	-	17	1.0	mg/L	N/A	2023/10/30	LKH	9006346
Total Alkalinity (Total as CaCO3)	-	20	2.0	mg/L	N/A	2023/10/27	LJV	9008741
Colour	-	30	5.0	TCU	N/A	2023/11/02	MCN	9023389
Dissolved Fluoride (F-)	1.5	ND	0.10	mg/L	N/A	2023/10/27	LJV	9008754
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2023/10/27	2023/10/31	KJP	9011063
Nitrate + Nitrite (N)	-	0.93	0.050	mg/L	N/A	2023/11/02	MCN	9023394
Nitrite (N)	1	0.014	0.010	mg/L	N/A	2023/11/02	MCN	9023397
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2023/11/03	TGO	9017367
Dissolved Organic Carbon (C)	-	4.7	0.50	mg/L	N/A	2023/10/26	CPP	9008103
Dup.Dissolved Organic Carbon (C)	-	4.9	0.50	mg/L	N/A	2023/10/26	CPP	9008103
Total Organic Carbon (C)	-	4.6	0.50	mg/L	N/A	2023/10/25	CPP	9002874
pH		7.42		pH	N/A	2023/10/27	LJV	9008733
Total Phosphorus	-	0.016	0.004	mg/L	2023/10/27	2023/10/27	SPC	9010951
Total Suspended Solids	-	1.2	1.0	mg/L	2023/10/26	2023/10/31	DME	9007611
Turbidity	-	2.5	0.10	NTU	N/A	2023/10/28	KMC	9011867
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	0.001	ND	0.000013	mg/L	2023/10/31	2023/11/01	SGK	9017422

MAC: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, Septemeber 2022

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminum guideline value of 0.1 mg/L is for treatment plants using aluminum-based coagulants, 0.2mg/L applies to other types of treatment systems.

Malathion updated January 24, 2023



BUREAU
VERITAS

Bureau Veritas Job #: C3W8971
Report Date: 2023/11/06

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 220028978-9
Sampler Initials: LB

Sample Details/Parameters	MAC	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
XJE997 WATERFORD RIVER @ KILBRIDE								
Sampling Date 2023/10/20 12:20								
Matrix W								
Sample # 2023-1721-00-SI-SP								
Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	2.9	0.089	0.0050	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Antimony (Sb)	0.006	ND	0.0010	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Arsenic (As)	0.010	ND	0.0010	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Barium (Ba)	2.0	0.013	0.0010	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Boron (B)	5	ND	0.050	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Cadmium (Cd)	0.007	0.000012	0.000010	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Calcium (Ca)	-	11	0.10	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Chromium (Cr)	0.05	ND	0.0010	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Copper (Cu)	2	0.0018	0.00050	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Iron (Fe)	-	0.24	0.050	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Lead (Pb)	0.005	ND	0.00050	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Magnesium (Mg)	-	1.9	0.10	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Manganese (Mn)	0.12	0.049	0.0020	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Nickel (Ni)	-	ND	0.0020	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Phosphorus (P)	-	ND	0.10	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Potassium (K)	-	1.6	0.10	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Selenium (Se)	0.05	ND	0.00050	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Sodium (Na)	-	75	0.10	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Strontium (Sr)	7.0	0.040	0.0020	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Uranium (U)	0.02	ND	0.00010	mg/L	2023/11/01	2023/11/01	MTZ	9020202
Total Zinc (Zn)	-	0.0054	0.0050	mg/L	2023/11/01	2023/11/01	MTZ	9020202

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Malathion updated January 24, 2023