

# Real-Time Water Quality Report

## Waterford River at Kilbride NL02ZM0009

Deployment Period  
June 29, 2023 to August 22, 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 June 29, 2023 until removal on August 22, 2023.



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	June 29	Deployment	Poor	Good	Excellent	Excellent	Excellent
		Grab Sample # 1706	N/A	Excellent	Good	N/A	Excellent
	August 22	Removal	Excellent	Excellent	Marginal	Fair	Poor

Upon deployment, all sensors ranked 'Excellent' or 'Good' with the exception of temperature which ranked 'Poor' when compared to the QA/QC sonde.

Waterford River at Kilbride, Newfoundland and Labrador

Upon removal of the instrument, rankings ranged from 'Excellent' to 'Poor'. The unfavorable rankings may be due to the extended deployment period (53 days) and some sensor drift or fouling.

## DATA INTERPRETATION

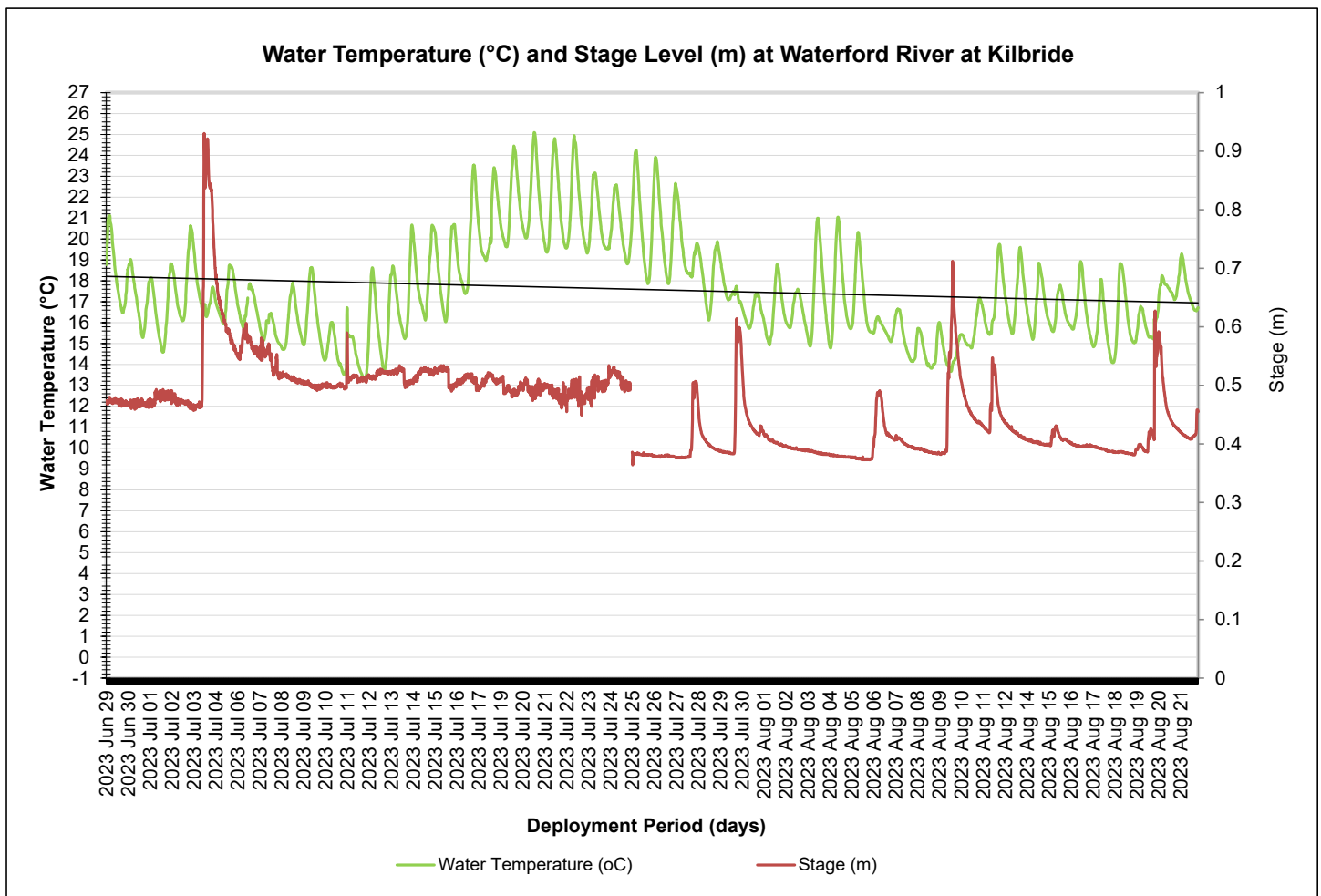
### Water Temperature

Water temperature ranged from 13.30 °C to 25.09 °C during this deployment period (Figure 2).

The water temperature was variable and correlated with air temperature (see Appendix A) throughout the deployment period, with an overall increasing trend over the first portion of the deployment followed by a decreasing trend for the second portion.

During high stage events, the water temperature often decreased for a short period due to the addition of cooler precipitation, as seen on July 29, 2023.

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
17.58	17.11	13.30	25.09

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

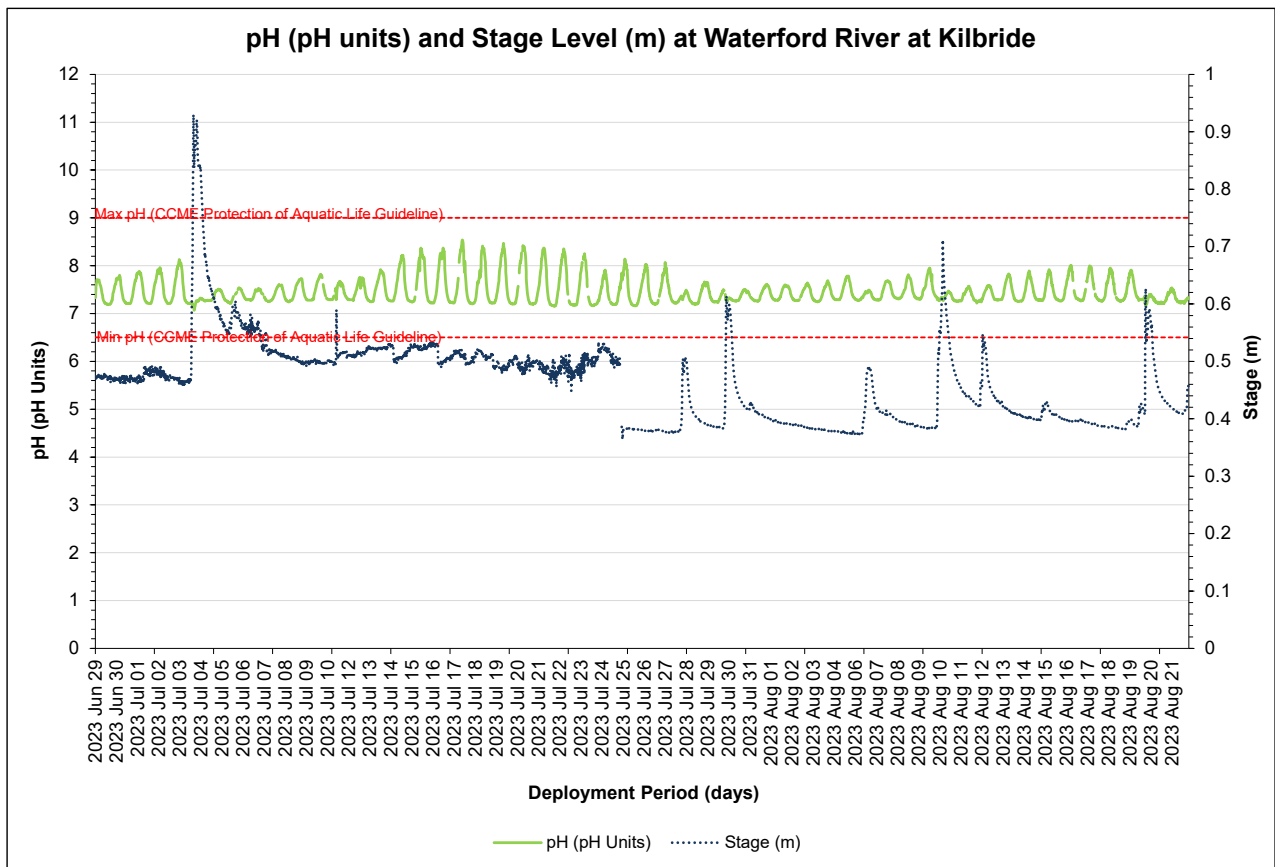
## pH

Throughout the deployment period, pH was fairly stable, with a range between 7.07 pH units and 8.54 pH units, a mean of 7.47 and median of 7.37 pH units (Figure 3). The highest values were reached over an extended period in late July and are higher than normally found in the river.

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.

A diurnal variation pattern was visible throughout the deployment period. The magnitude of variation correlates to daily water temperature range, length of days and fluctuations in photosynthesis and respiration rates as expected at this time of the year. Variation decreased during higher stage events due to the addition of lower pH rainwater, as seen around July 4<sup>th</sup>, 30<sup>th</sup> and August 10<sup>th</sup>.

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
7.47	7.37	7.07	8.54

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



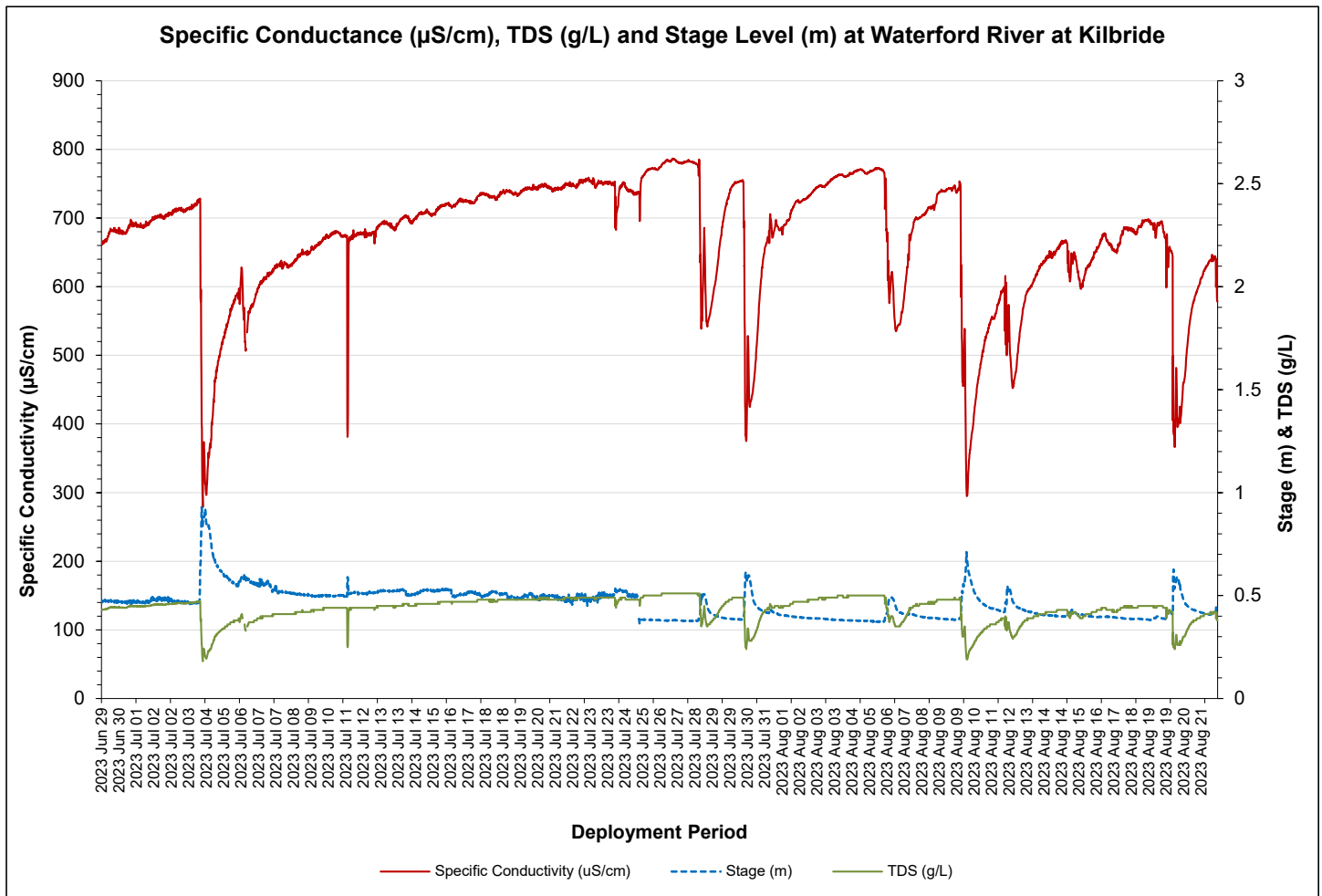
### Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 279  $\mu\text{S/cm}$  and 786.7  $\mu\text{S/cm}$ . TDS (a calculated value) ranged from 0.1810 g/L to 0.5100 g/L.

Conductivity levels were noticeably influenced by high stage events, decreasing as stage rose. 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. Given the location, the river is highly influenced by urban roads, residential housing and pedestrian traffic.

Conductivity showed a decreasing trend near the end of the deployment (Figure 4).

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 ( $\mu\text{S/cm}$ )	670.6	690.4	279.0	786.7
TDS (mg/L)	0.4361	0.4500	0.1810	0.5100

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

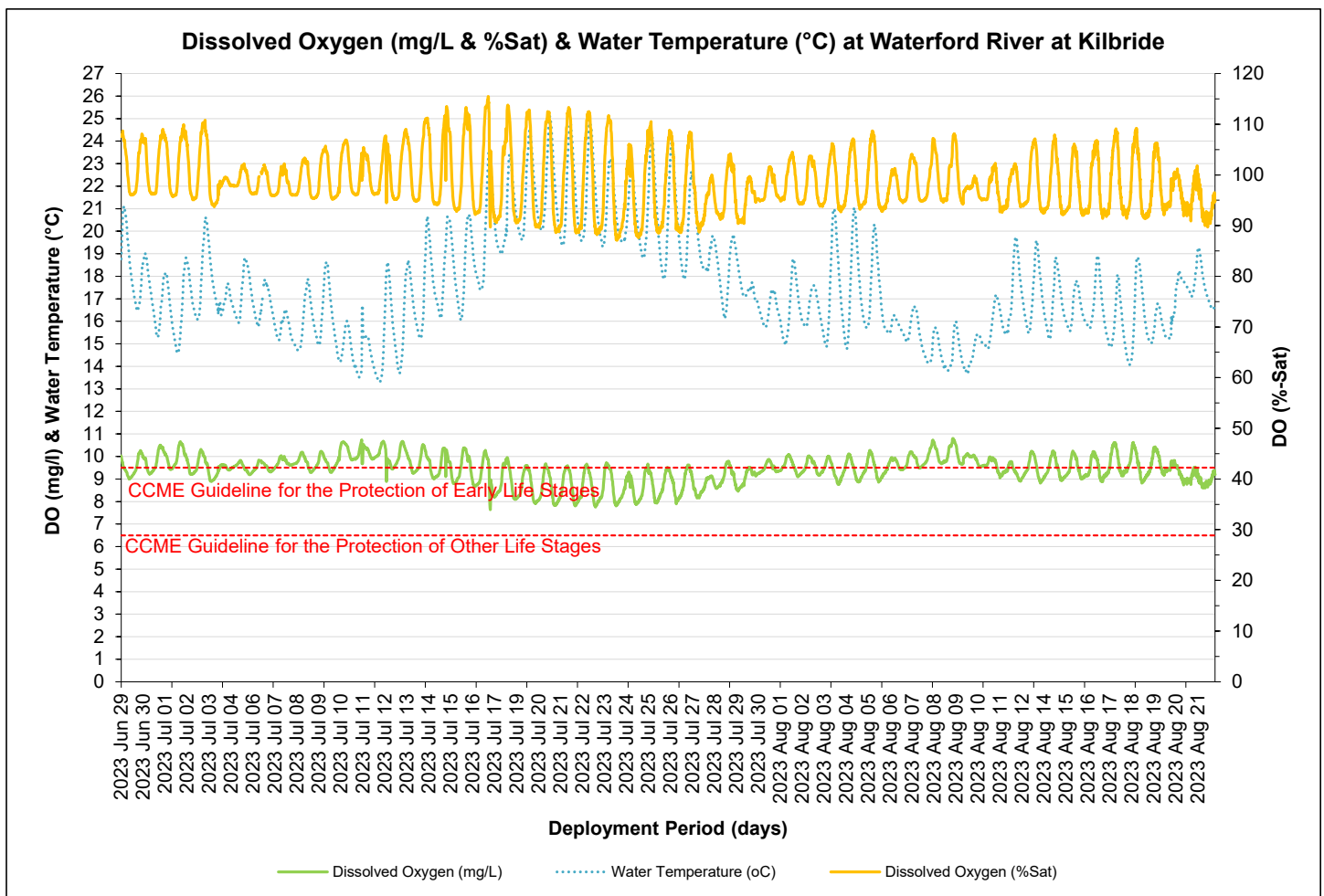
## Dissolved Oxygen

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 7.64 mg/L to a maximum of 10.80 mg/L. The percent saturation (%) levels for dissolved oxygen ranged within 87.1% to 115.5% saturation (Figure 5).

For the majority of the deployment period, dissolved oxygen was generally stable, but was noticeably influenced by substantial increases in water temperature in late July: as temperatures rose, dissolved oxygen decreased. This is a natural relationship as warmer water holds less oxygen.

Dissolved oxygen concentrations remained above the Guideline for Other Life Stages (6.5 mg/L) and hovered around the CCME Guideline for the Protection of Early life stages (9.5mg/L) throughout the deployment period.



	Mean	Median	Min	Max
DO (%Sat)	98.7	97.5	87.1	115.5
DO (mg/L)	9.42	9.46	7.64	10.80

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

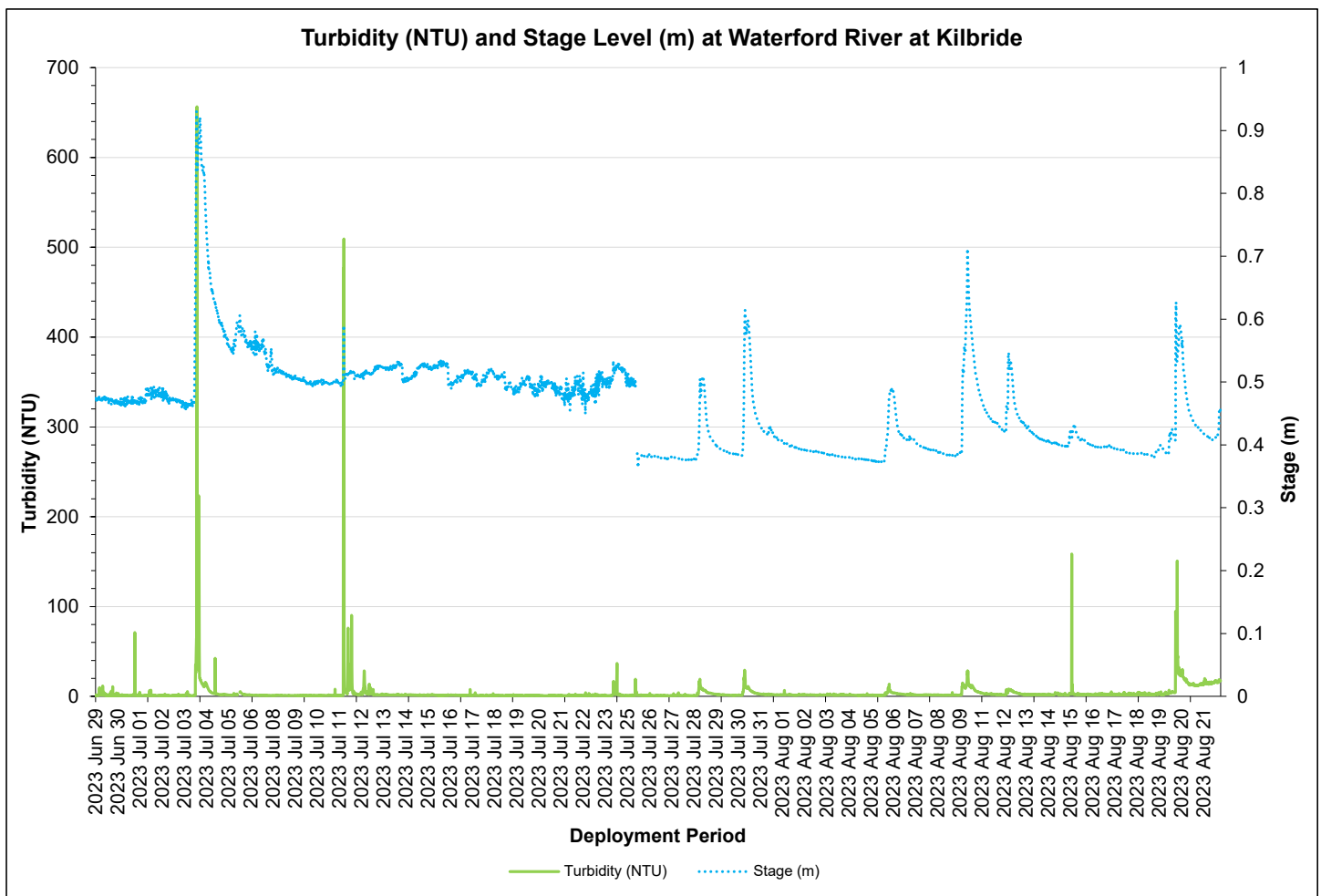
## Turbidity

Turbidity levels during the deployment period range from 0.6 NTU and 656.5 NTU, with a mean of 3.6 NTU and median of 1.5 NTU (Figure 6).

Turbidity events above baseline values are the result of higher stage events and an associated increase in flow which 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.

Sediments and debris can also become temporarily lodged within the sonde casing during normal water flow and cause increases in turbidity values as observed August 19-22, 2023. This explains the 'poor' QA/QC ranking for the turbidity sensor 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
3.6	1.5	0.6	656.6

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

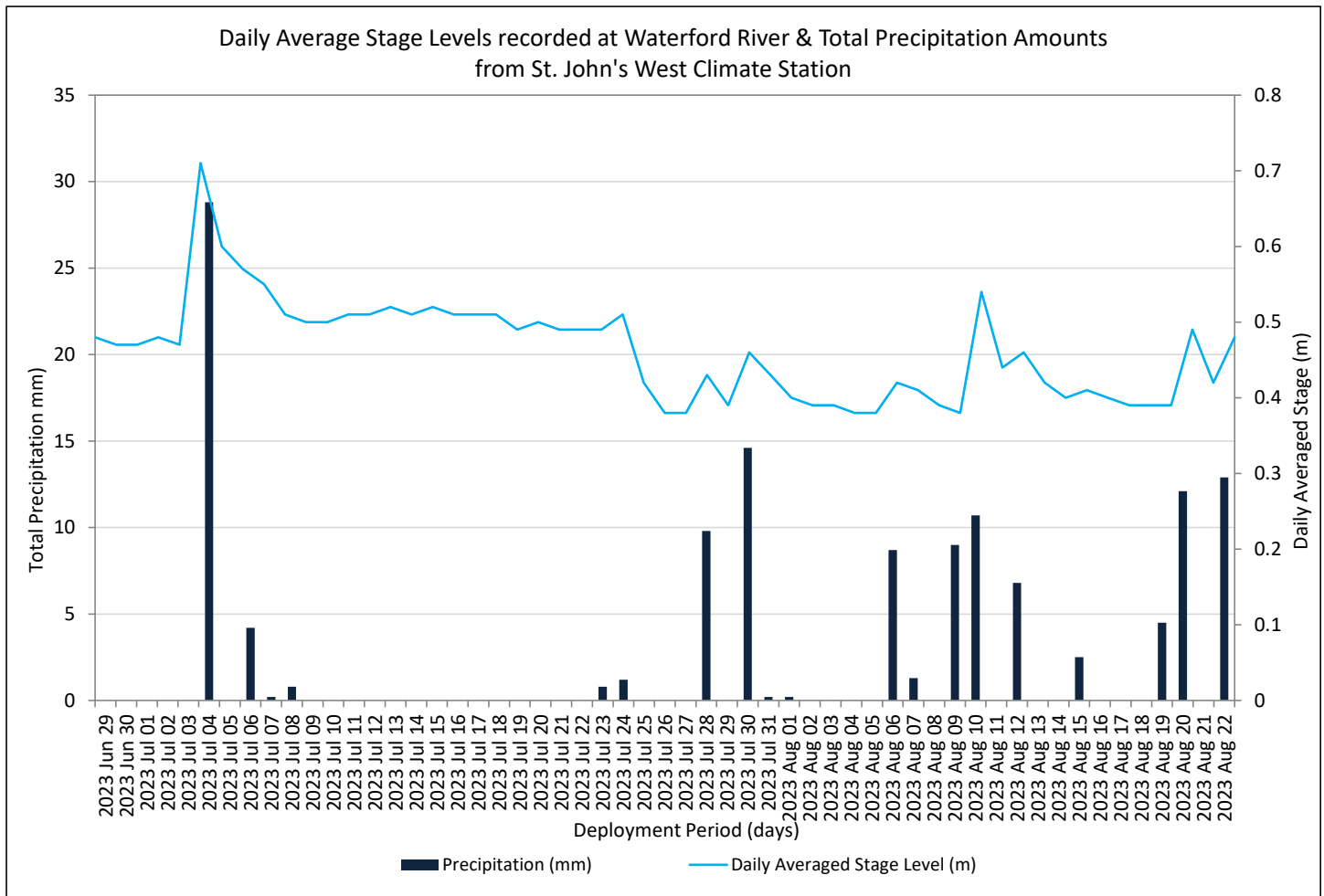
## Stage and Precipitation

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 0.36 m to 0.93 m. The larger peaks in stage correspond with substantial rainfall events as observed on July 4<sup>th</sup>, 30<sup>th</sup> and August 10<sup>th</sup>. Stage was generally decreasing during this deployment period.

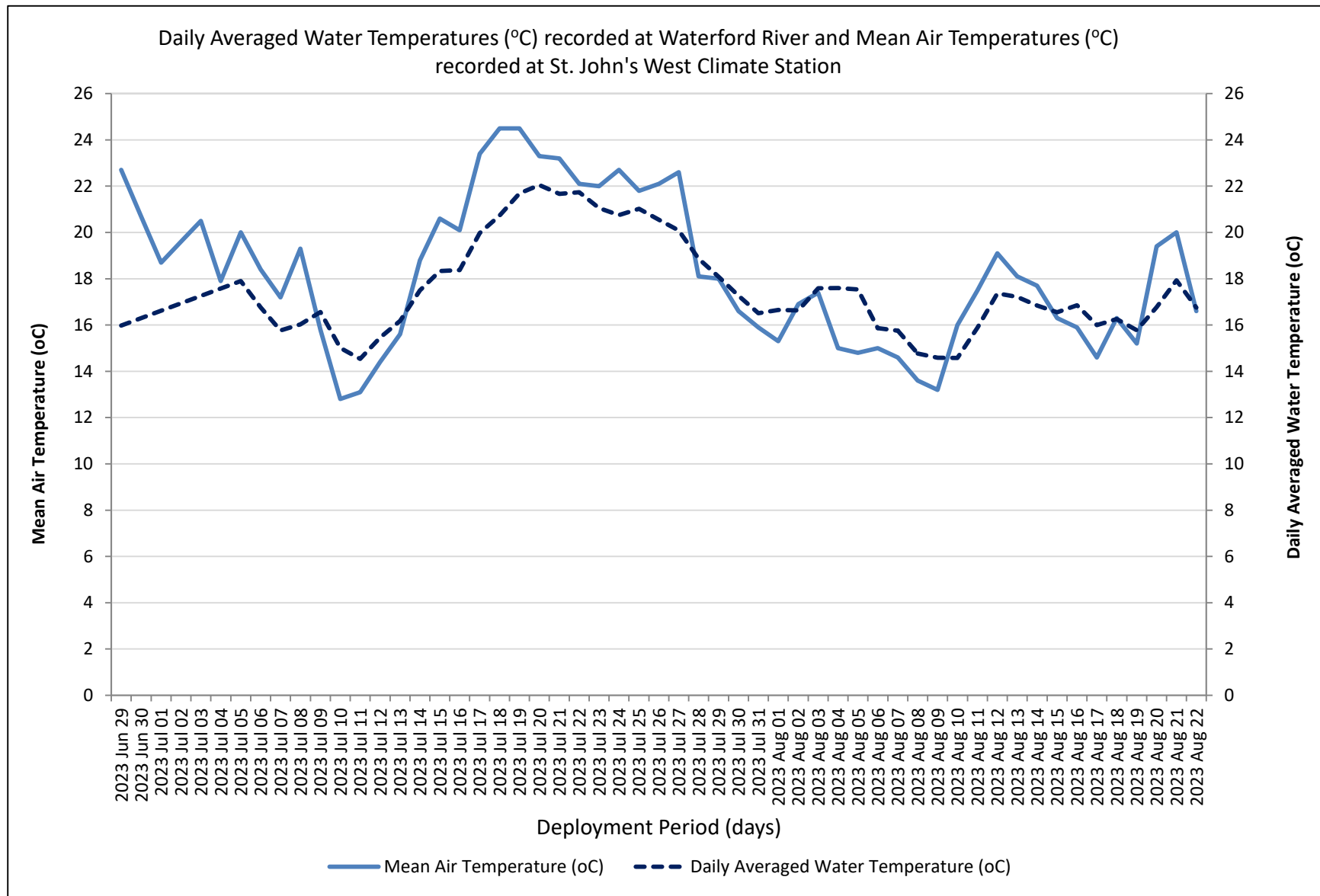
Precipitation data was collected by Environment Canada’s St. John’s West Climate station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 28.8 mm on July 4, 2023.



Mean	Median	Min	Max
0.46	0.47	0.36	0.93

**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 #: C3J4349  
Report Date: 2023/07/21

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

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
WGS963 WATERFORD RIVER @ KILBRIDE								
Sampling Date		2023/06/29 12:10						
Matrix		W						
Sample #		2023-1706-SI-SP						
Registration #		SA-0000						
<b>RESULTS OF ANALYSES OF WATER</b>								
<b>Calculated Parameters</b>								
Hardness (CaCO3)	-	43	1.0	mg/L	N/A	2023/07/20		8765609
Nitrate (N)	-	0.66	0.050	mg/L	N/A	2023/07/21		8765612
Total dissolved solids (calc., EC)	-	380	1.0	mg/L	N/A	2023/07/17		8765636
<b>Inorganics</b>								
Conductivity	-	690	1.0	uS/cm	N/A	2023/07/17	KMC	8792634
Chloride (Cl-)	-	180	1.0	mg/L	N/A	2023/07/11	SUR	8775671
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2023/07/11	SUR	8775671
Sulphate (SO4)	-	15	1.0	mg/L	N/A	2023/07/11	SUR	8775671
Total Alkalinity (Total as CaCO3)	-	16	2.0	mg/L	N/A	2023/07/17	KMC	8792635
Colour	-	18	5.0	TCU	N/A	2023/07/19	TGO	8796289
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2023/07/17	KMC	8792636
Total Kjeldahl Nitrogen (TKN)	-	0.27	0.10	mg/L	2023/07/11	2023/07/12	KJP	8780888
Nitrate + Nitrite (N)	-	0.68	0.050	mg/L	N/A	2023/07/20	TGO	8796282
Nitrite (N)	-	0.015	0.010	mg/L	N/A	2023/07/19	TGO	8796270
Nitrogen (Ammonia Nitrogen)	-	0.077	0.050	mg/L	N/A	2023/07/13	TGO	8784489
Dissolved Organic Carbon (C)	-	3.4	0.50	mg/L	N/A	2023/07/17	CPP	8792801
Total Organic Carbon (C)	-	3.4	0.50	mg/L	N/A	2023/07/18	CPP	8795213
pH	-	7.35		pH	N/A	2023/07/17	KMC	8792633
Total Phosphorus	-	0.029	0.004	mg/L	2023/07/12	2023/07/12	SPC	8783336
Total Suspended Solids	-	2.0	1.0	mg/L	2023/07/06	2023/07/13	RDM	8771319
Turbidity	-	0.72	0.10	NTU	N/A	2023/07/19	KMC	8798087
<b>MERCURY BY COLD VAPOUR AA (WATER)</b>								
<b>Metals</b>								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2023/07/14	2023/07/17	SGK	8789138
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Aluminum (Al)	-	0.039	0.0050	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Antimony (Sb)	-	ND	0.0010	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Arsenic (As)	-	ND	0.0010	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Barium (Ba)	-	0.018	0.0010	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Boron (B)	-	ND	0.050	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Cadmium (Cd)	-	0.000013	0.000010	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Calcium (Ca)	-	14	0.10	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Chromium (Cr)	-	ND	0.0010	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Copper (Cu)	-	0.0019	0.00050	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Iron (Fe)	-	0.14	0.050	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Lead (Pb)	-	ND	0.00050	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Magnesium (Mg)	-	2.1	0.10	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Manganese (Mn)	-	0.050	0.0020	mg/L	2023/07/18	2023/07/19	BCZ	8795905





BUREAU  
VERITAS

Bureau Veritas Job #: C3J4349  
Report Date: 2023/07/21

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

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
WGS963 WATERFORD RIVER @ KILBRIDE								
Sampling Date		2023/06/29 12:10						
Matrix		W						
Sample #		2023-1706-SI-SP						
Registration #		SA-0000						
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Phosphorus (P)	-	ND	0.10	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Potassium (K)	-	1.6	0.10	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Selenium (Se)	-	ND	0.00050	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Sodium (Na)	-	110	0.10	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Strontium (Sr)	-	0.053	0.0020	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Uranium (U)	-	ND	0.00010	mg/L	2023/07/18	2023/07/19	BCZ	8795905
Total Zinc (Zn)	-	0.0053	0.0050	mg/L	2023/07/18	2023/07/19	BCZ	8795905