

Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
August 30, 2017 to November 1, 2017



Government of Newfoundland & Labrador
Department of Municipal Affairs & Environment
Water Resources Management Division

Prepared by:

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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.

This report covers the period from deployment on August 30 2017 to removal on November 1 2017.



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.

At deployment and removal, a QA/QC Sonde is temporarily deployed alongside 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 1).

WRMD staff at the Department of Municipal Affairs and Environment (MAE) 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-ECCC staff visit the site regularly to ensure the data logging, data transmitting equipment are working properly, and stage and streamflow measurements are correct. The raw water quantity data is transmitted via satellite and published online with the water quality data. 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 dependant, 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 taken too soon 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	August 30	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	November 1	Removal	Excellent	Excellent	Excellent	Excellent	Poor

On deployment the ranking of the field data against the QAQC data was ranked as 'Excellent' and 'Good' for: water temperature, pH, specific conductivity, dissolved oxygen and turbidity data. Parameters were acceptable for the initial deployment of the field instrument.

At removal of the instrument, all parameters ranked as 'Excellent' except the turbidity data which ranked as 'Poor'. This was a result of the instrument being trapped in muddy silt blocking the turbidity. Due to the interference the turbidity data was removed from October 21st, 2017 to the end of deployment.

Concerns or Issues during the Deployment Period

There were no detected issues with the instrument or any problems with the data being transmitted from the station during this deployment period.

A buildup of sediment around the base of the protective casing was evident at removal of the instrument. It was evident that the instrument had become buried under the heavy mud and silt from the river bed, therefore the turbidity data from October 21st to November 1st, 2017 was removed as it did not reflect the water quality of Waterford River at Kilbride during this time.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from 3.60°C to 20.49°C during this deployment period (Figure 2).

The water temperature at this station displays diurnal variations although slightly elongated due to the depth of water at this station. Deeper streams are influenced more subtly by natural diurnal variations in air temperatures (Appendix I).

Over the duration of the deployment period the water temperature is generally consistent, with several dips and slight increases that correspond with the changes in the stage levels. This is a cooler time of the year therefore the water temperatures are dropping as the deployment continues into fall. During high stage events water temperature decreases for a short period of time before returning to the diurnal pattern.

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.

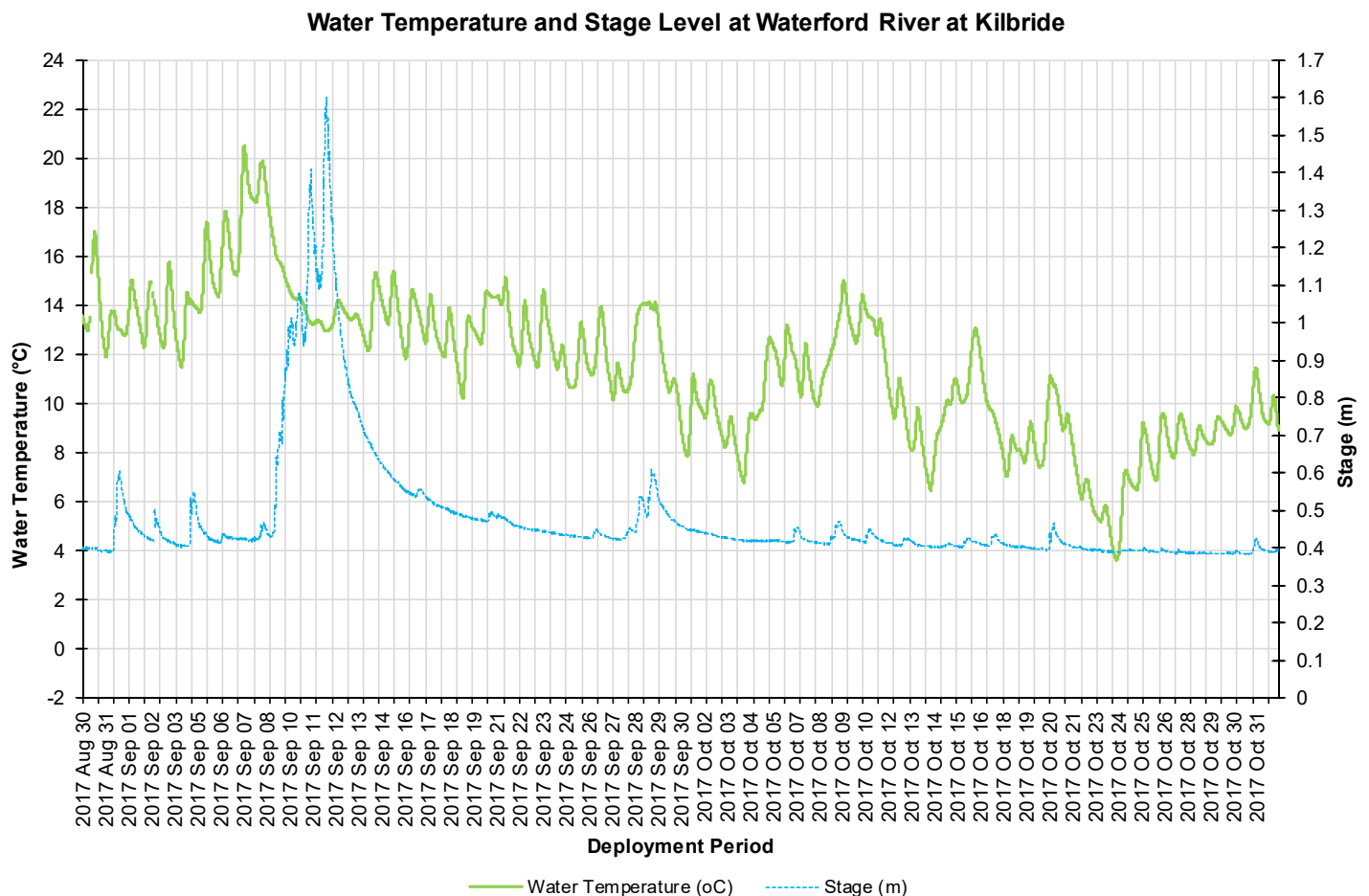


Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.77 pH units and 8.35 pH units (Figure 3).

The pH levels are reasonably consistent and remained within the guidelines indicated on the graph. During high stage events there are slight dips in pH data for a short period of time. The pH data varied slightly on October 23rd to October 26th, 2017 it was likely a result of snowfall.

In this stream the CCME guidelines provide a basis by which to judge the overall health of the brook. pH levels did not indicate that there were any immediate issues with water quality in Waterford River during this deployment. The median pH level was 7.20 pH units, similar to that of the past deployment pH median of 7.24 pH units.

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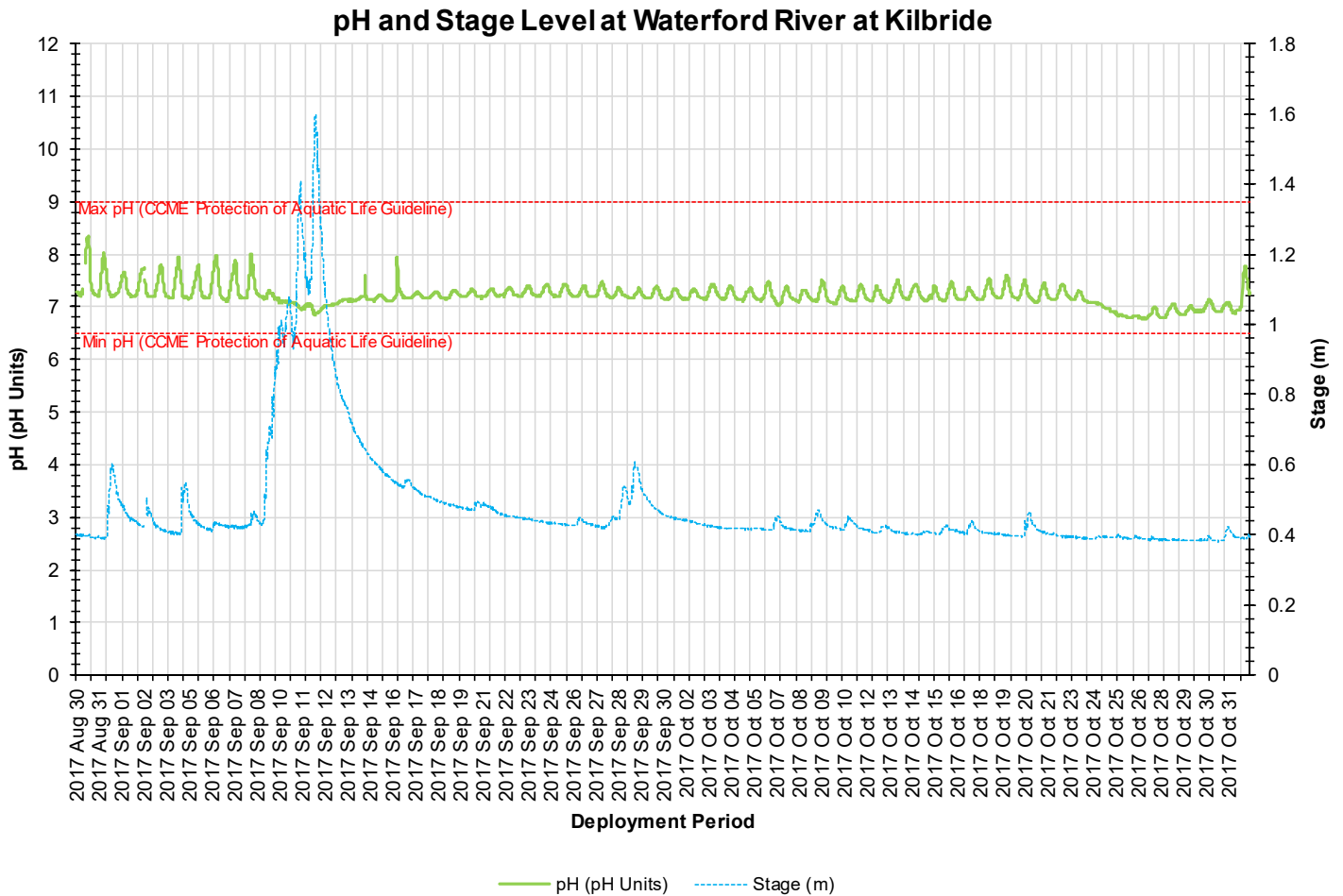


Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 189.0 $\mu\text{S}/\text{cm}$ and 649.0 $\mu\text{S}/\text{cm}$ during this deployment period. TDS (a calculated value) ranged from 0.1230 g/L to 0.4220 g/L (Figure 4).

When stage levels rise, specific conductance levels drop in response. This is a result of the increased amount of water in the river and the particle matter in the brook diluted for a period of time (as noted on Figure 4). Each of the stage level increases is the result of rainfall (Figure 7). The relationship between stage and conductivity is evident on the graph on several instances; this is a normal occurrence in urban brooks.

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.

Specific Conductance, TDS and Stage Level at Waterford River at Kilbride

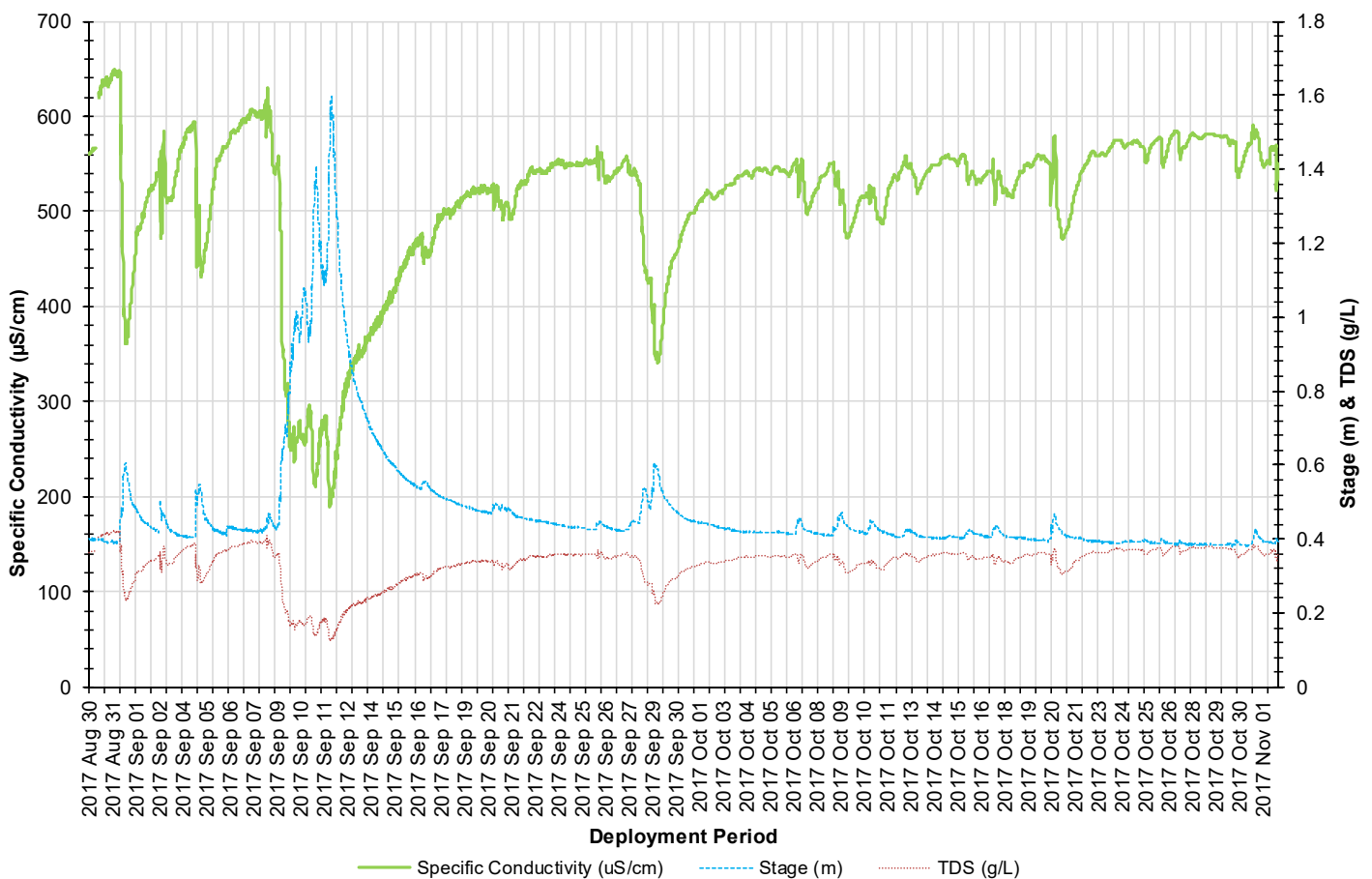


Figure 4: Specific conductivity ($\mu\text{S}/\text{cm}$), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

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, the dissolved oxygen concentration levels ranged within a minimum of 8.74 mg/L to a maximum of 13.54 mg/L. The percent saturation levels for dissolved oxygen ranged within 93.7 % Saturation to 110.5 % Saturation (Figure 5).

Water temperature is graphed with dissolved oxygen as it directly influences the concentration levels of dissolved oxygen in the water column. Higher water temperatures decrease the concentration level of dissolved oxygen present in the brook. During this deployment, the dissolved oxygen levels were generally above the CCME Guidelines for the Protection of Early life stages (9.5mg/L) and other life stages (6.5mg/L). This is a normal occurrence for this time of year.

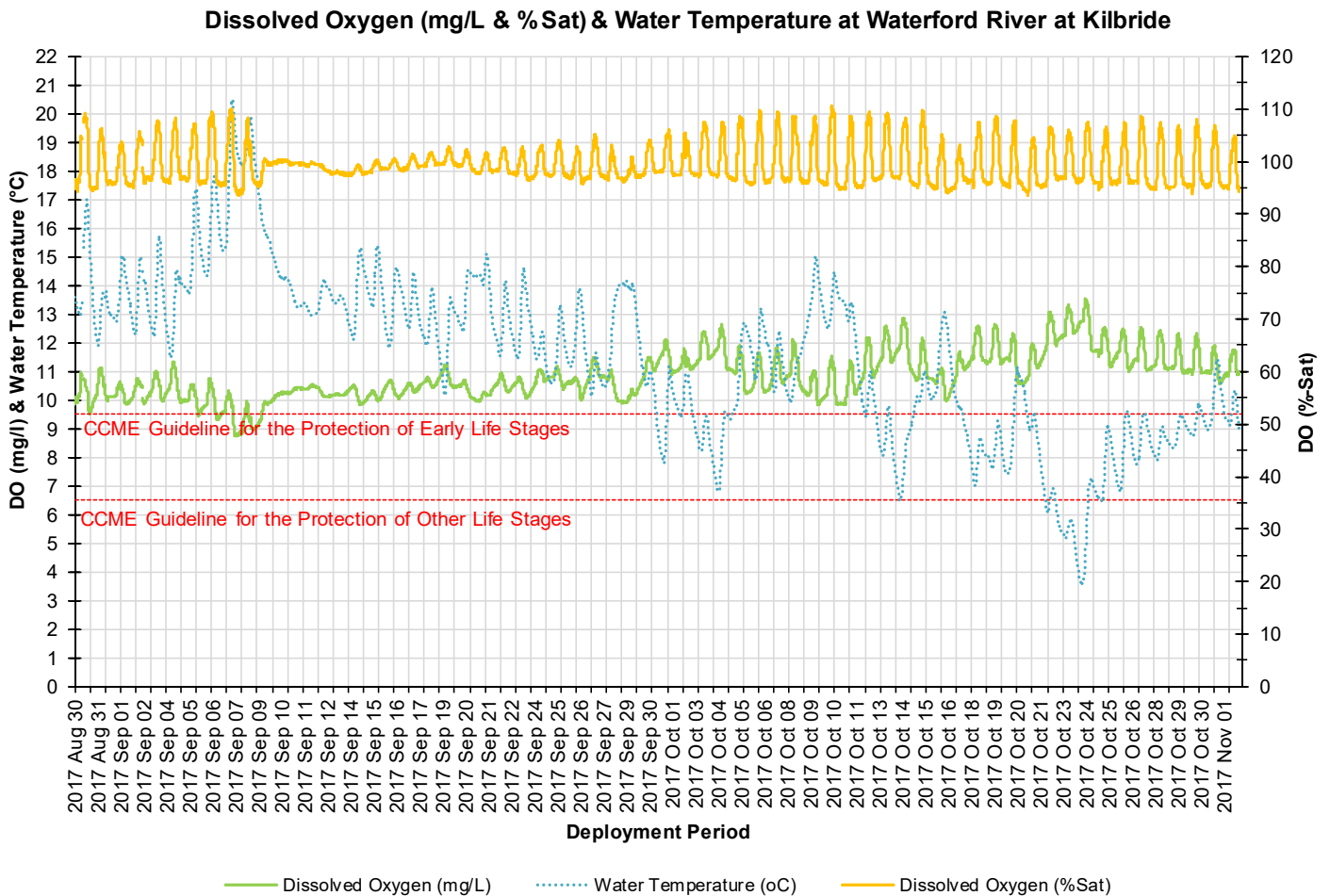


Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.1 NTU and 774.7 NTU (Figure 6). This deployment period had a median of 16.2 NTU, which was higher than the previous deployment median of 2.5 NTU.

The higher turbidity events throughout the deployment period correlate with increases in stage. There was rainfall recorded during all of the high stage increases (Stage & Precipitation graph: Figure 7). Precipitation can increase the presence of suspended material in water, through the movement of soil and sediment from nearby urban areas. The turbidity data returns to lower levels after the high peaks. Turbidity levels can change quickly at Waterford River. This site has a significant streamflow rate which can flush turbid water or sediments quickly through the brook. As this brook is in the heart of the City of St. John's the turbidity values can be heavily influenced by its surroundings.

At the end of the deployment it was evident that the instrument had become buried under heavy mud and silt from the river bed, therefore the turbidity data from October 21st to end of deployment was removed as it did not reflect Waterford River at Kilbride water quality during this time.

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.

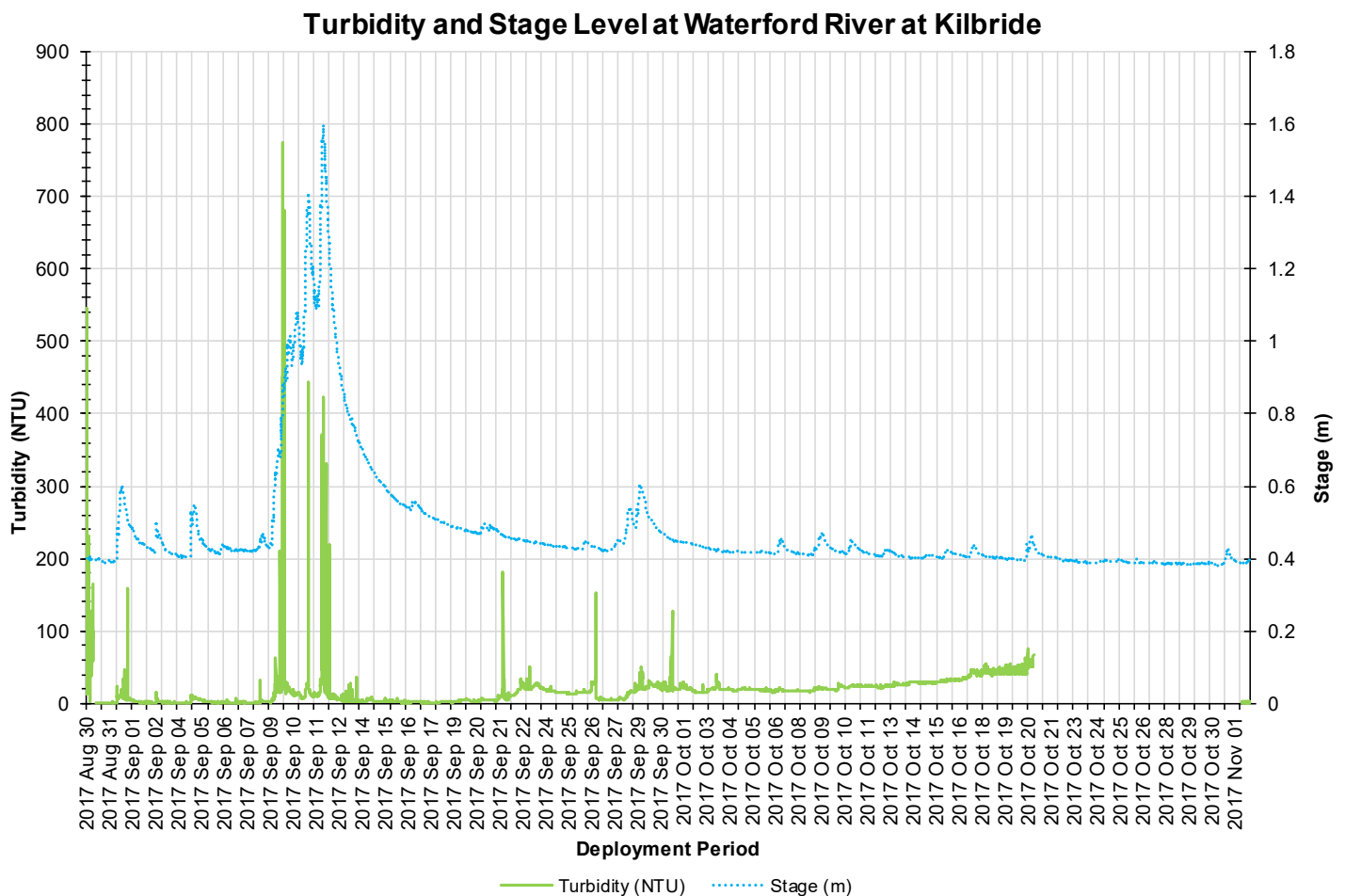


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 can be obtained upon request to WSC.

Stage provides 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 (Figure 7) and during any surrounding snow or ice melt as runoff will collect in the brooks. However, direct snowfall will not cause stage to rise significantly.

During the deployment period, the stage values ranged from 0.36m to 1.60m. The larger peaks in stage correspond with substantial rainfall events as noted on Figure 7. Precipitation data was obtained from Environment Canada’s St. John’s Airport weather station. Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 67.6 mm on September 11th 2017.

Daily Average Stage Levels at Waterford River & Precipitation Amounts from St. John’s International Airport Weather Station

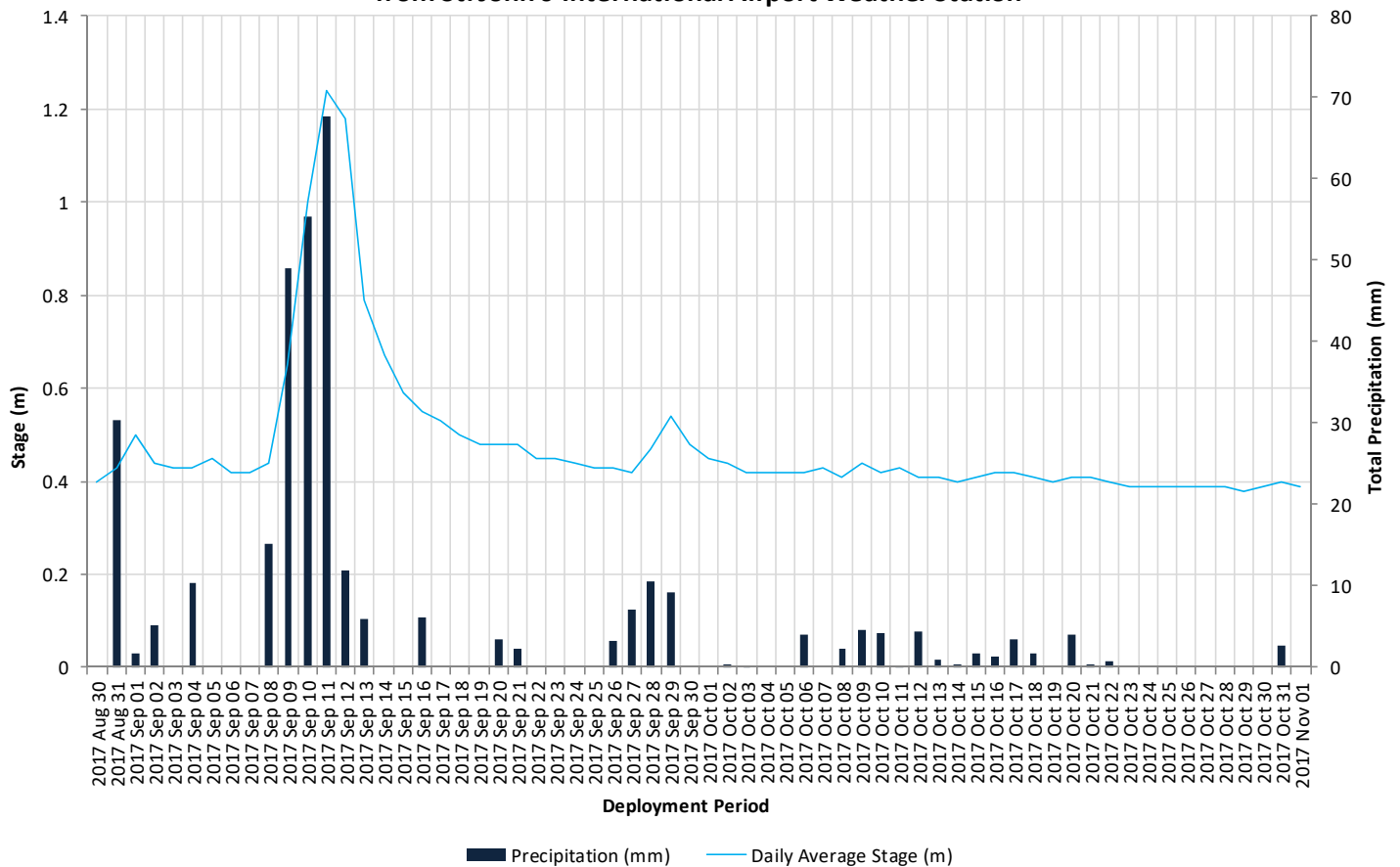


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John’s Airport Weather Station.

Conclusion

Waterford River at Kilbride flows through significant developed areas, including residential and industrial zones. Waterford River also borders along several heavily used urban road ways and thoroughfares. The proximity to these developments, combined with precipitation and runoff, influences the parameters that are recorded by the water quality instrument.

When reviewing the graphs as a whole, it is evident that the larger precipitation events create varying effects with the water quality parameters pH, conductivity, dissolved oxygen and turbidity. As the seasons change there is a decrease in the air temperatures in the city. Air temperatures will influence the water temperatures in surrounding brooks and rivers. Waterford River data indicates that the change in water temperature influenced the movement in the dissolved oxygen concentrations in the brook.

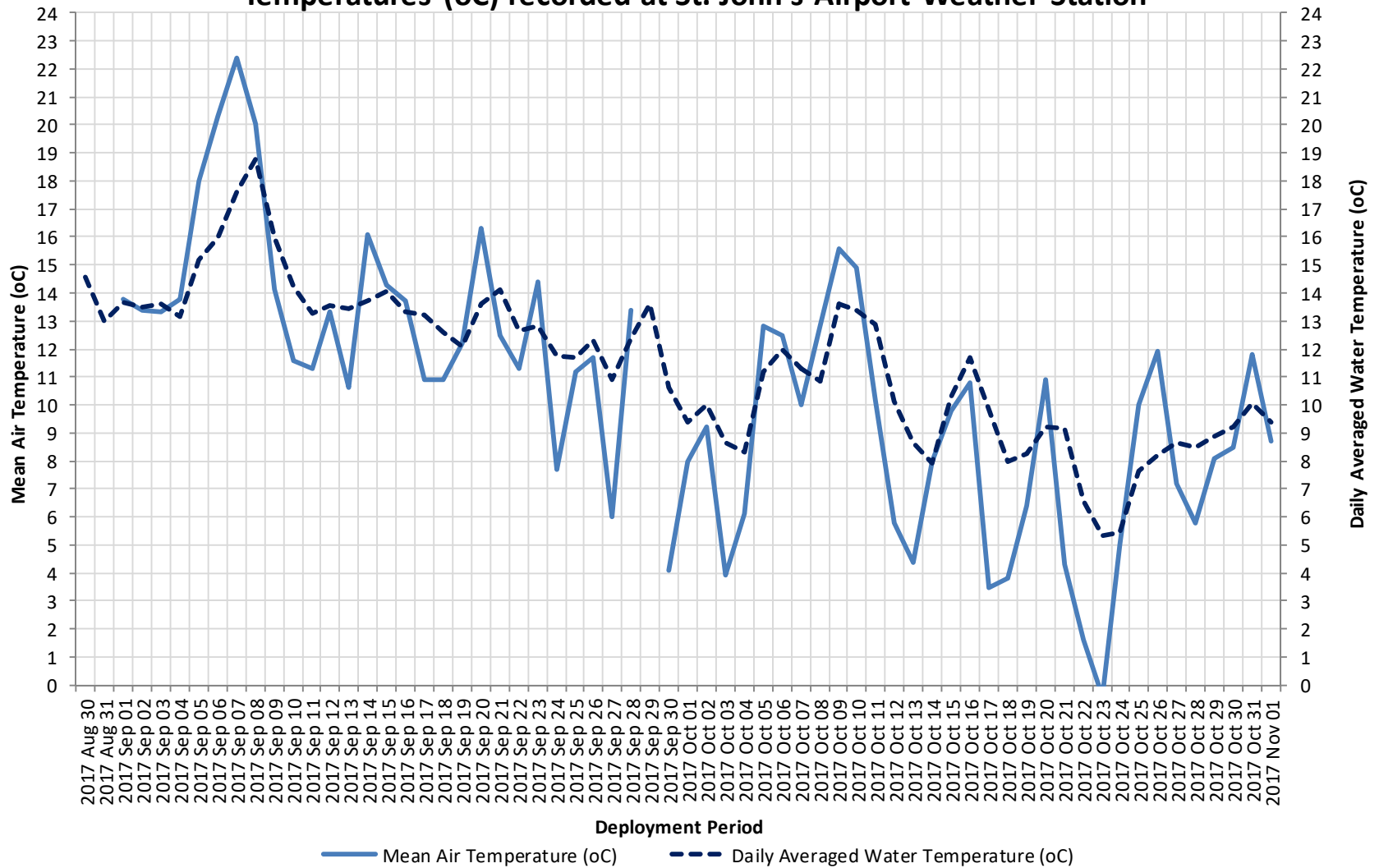
There were evident dips in specific conductivity as a result of the high stage increases from subsequent rainfall events. The pH values were reasonably consistent for this deployment. Dissolved oxygen was reasonably constant, with small decreases during the higher temperature events. High turbidity levels during deployment were directly linked with the high stage levels and subsequent rainfall periods.

This instrument sits on the riverbed to record data. There can be significant interference from the silty brook bottom or any debris that might snag on the protective casing that the instrument is secured in. Such was the case at the end of this deployment, resulting in the removal of the turbidity data from October 21st, 2017 to the end of deployment as it did not represent the water quality of the brook.

The water quality data displayed in this report is as expected of an urban brook. After each significant change in the data, the parameters returned to the background levels. Overall the water quality parameters recorded at Waterford River at Kilbride displayed natural events expected of a brook in an urbanized environment.

APPENDIX I

Daily Averaged Water Temperatures (oC) at Waterford River and Mean Air Temperatures (oC) recorded at St. John's Airport Weather Station



Waterford River at Kilbride, Newfoundland and Labrador