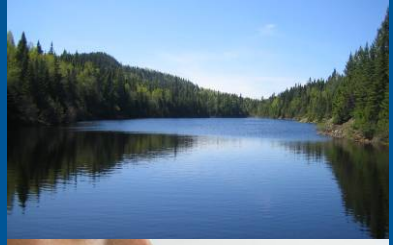







Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
June 28, 2017 to August 30, 2017

Newfoundland Labrador

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

Waterford River at Kilbride, Newfoundland and Labrador

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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.

This deployment report discusses water quality related events occurring at this station.

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

This report covers the period from deployment on June 28, 2017 to removal on August 30, 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 (Municipal Affairs and Environment (MAE)) is responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Tara Clinton, under the supervision of Renee Paterson, is MAE's main contact for the real-time water quality monitoring operation at Waterford River station, and is 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 (Environment and Climate Change Canada (ECCC)) under the management of Howie Wills, play an essential role in the data logging/communication aspect of the network and the maintenance of the water quantity monitoring equipment. WSC-ECCC staff visit the site regularly to ensure the data logging and data transmitting equipment are working properly. WSC is responsible for handling stage and streamflow issues. The quantity data is raw data that is transmitted via satellite and published online along with the water quality data on the Real-Time Stations website. 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

	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

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	June 28	Deployment	Excellent	Fair	Excellent	Excellent	Excellent
	August 30	Removal	Poor	Good	Excellent	Fair	Poor

On deployment the ranking of the field data against the QAQC data was: water temperature, specific conductivity, dissolved oxygen and turbidity data ranked as 'Excellent', with the pH data ranked as 'Fair'. The 'Fair' pH ranking is likely a result of the instruments not being acclimatized before the data was recorded. The pH probe on both the field instrument and QA instrument require some time to stabilize. All other rankings for the water quality parameters were acceptable for the initial deployment of the field instrument.

At removal of the instrument, it was determined that the instrument was buried in heavy mud and silt at the bottom of the protective casing. Some of the probes were cased in mud. The ranking of 'Poor' for water temperature and turbidity and 'Fair' for dissolved oxygen data, likely reflect this interference. Specific conductivity data was ranked as 'Excellent' and pH data was ranked as 'Good' at removal.

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 August 29th to August 30th, 2017 was removed as it did not reflect Waterford River at Kilbride during this time.

During the removal visit to Waterford River at Kilbride there was bridge construction occurring directly above the river. Large portions of cement were being removed, it is unclear if the cement that was cut out of the bridge was retrieved and disposed of or allowed to drop into the river.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from 10.19°C to 22.08°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 reasonably consistent, there are several dips and slight increases that correspond with the changes in the stage levels. This is a warmer time of the year therefore the water temperature maintains a higher normal, with the median for this deployment being 15.73°C. During high stage events water temperature decreases for a short period of time.

Please note the stage data is raw data that is published on the ECCC web page. 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.

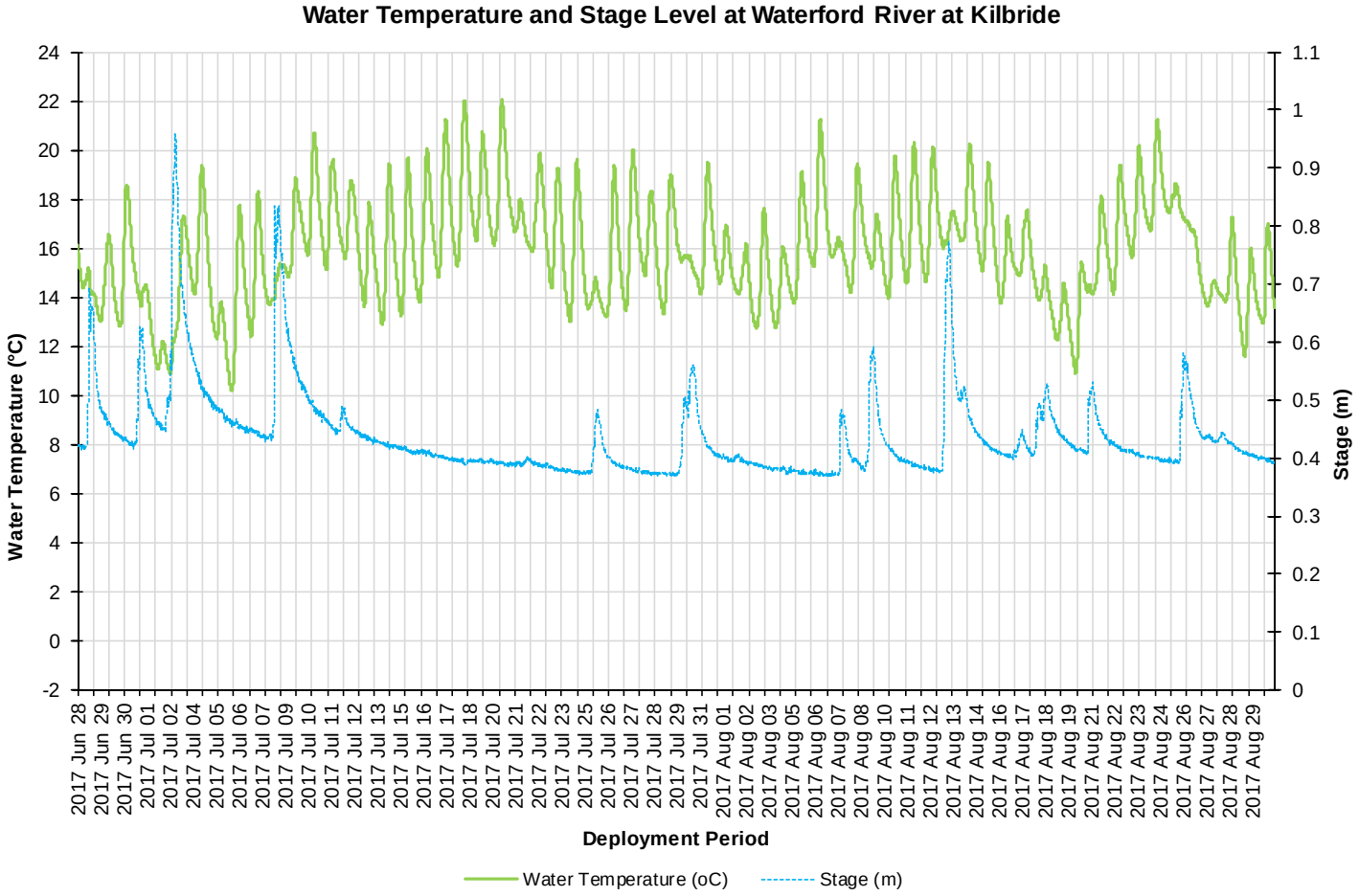

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 7.06 pH units and 8.23 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. During lows in stage there are slight increases in the pH levels for that time frame.

In this stream the CCME guideline provides 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 7.24 pH units, slightly higher than the past deployment of 7.06 pH units.

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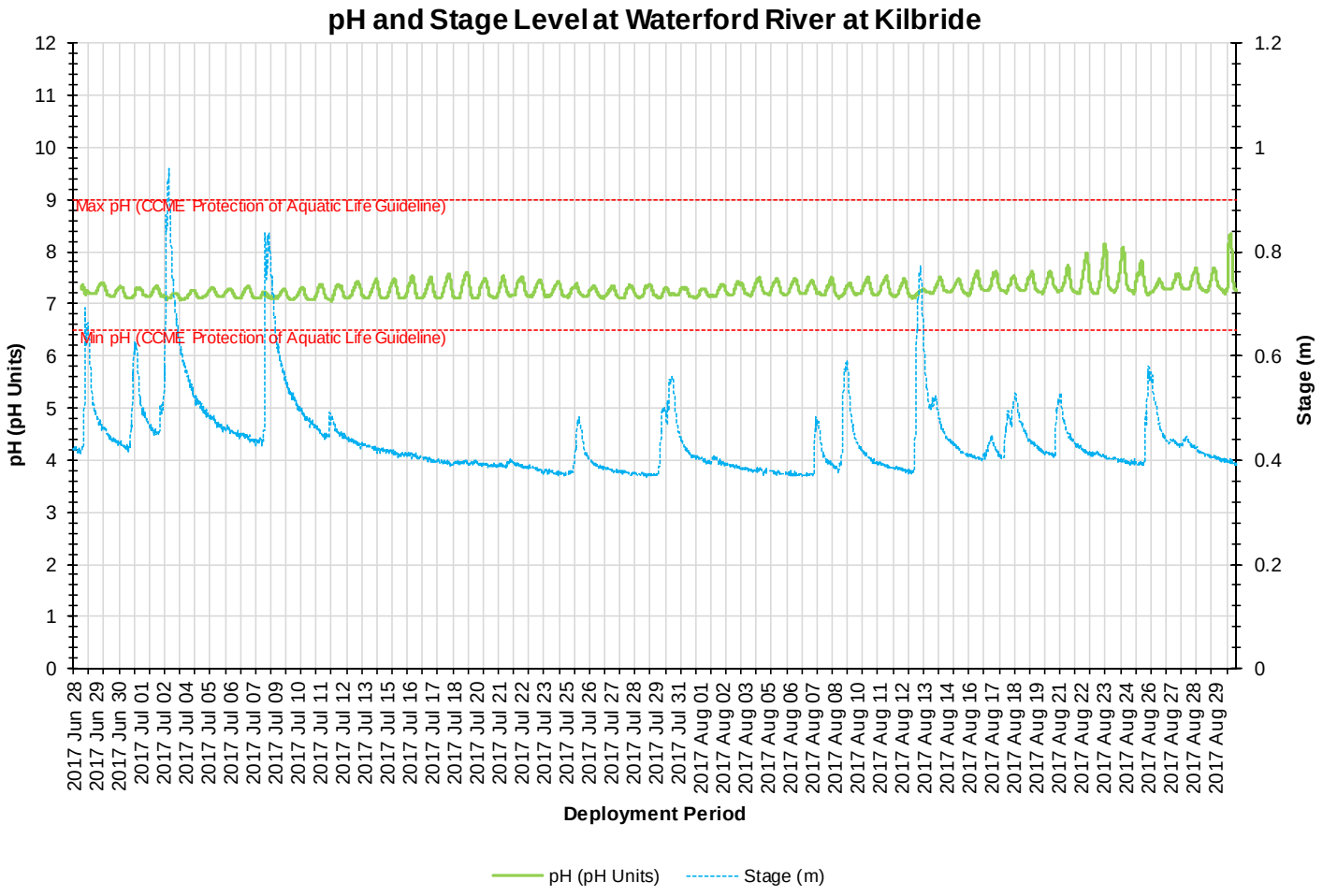

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 245.0 µS/cm and 704.0 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.1590 g/L to 0.4570 g/L (Figure 4).

When the stage levels rise, the 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 is diluted for a period of time (as noted on Figure 4). Each of the higher stage levels are a 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.

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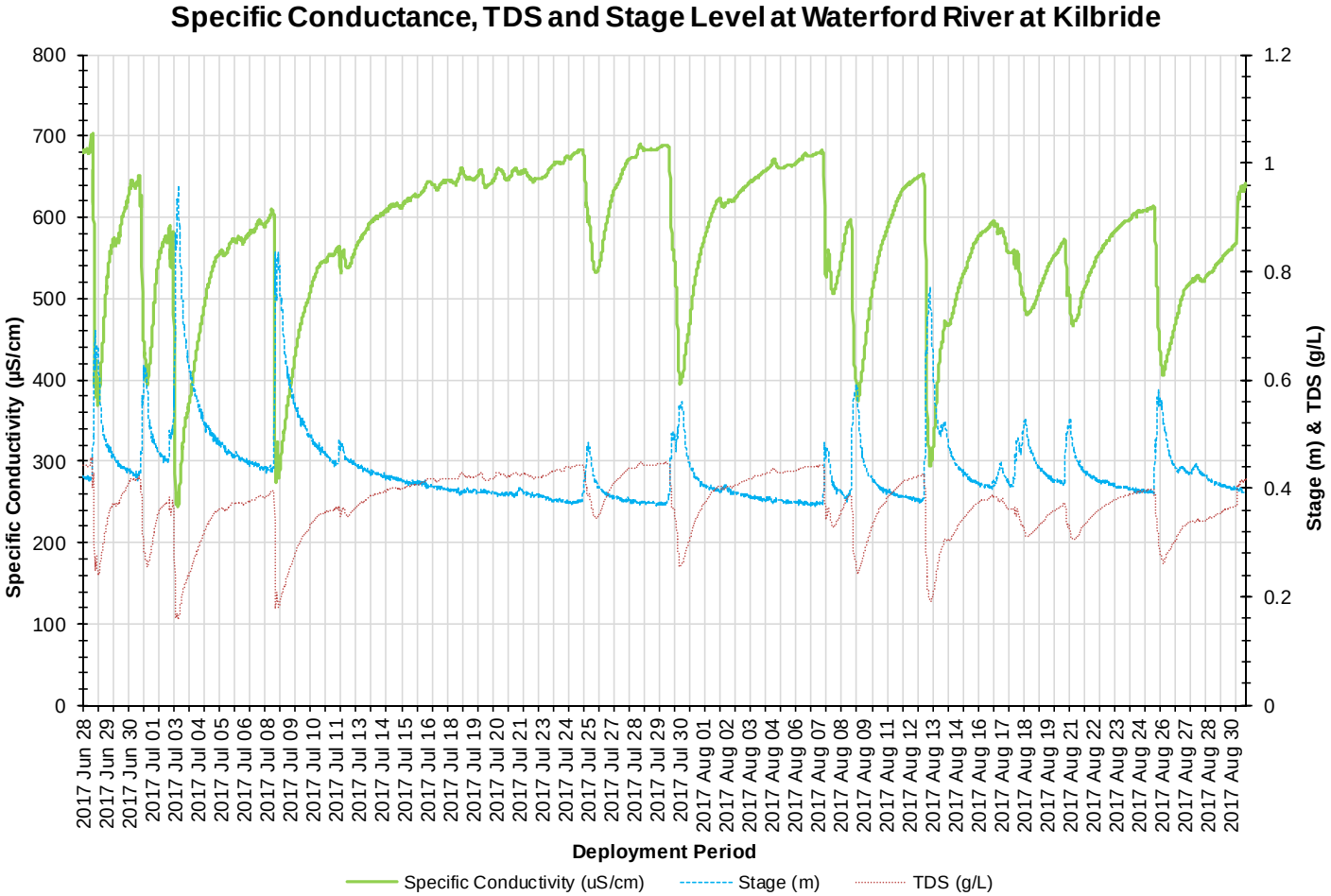


Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe and then the instrument calculates percent saturation (% Sat) taking into account the water temperature.

During the deployment the dissolved oxygen concentration levels ranged within a minimum of 8.48 mg/L to a maximum of 11.32 mg/L. The percent saturation levels for dissolved oxygen ranged within 92.3 % Saturation to 110.1 % 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 are going to decrease the concentration level of dissolved oxygen being present in the brook. During this deployment the dissolved oxygen levels were sitting on the maximum CCME Guideline for the Protection of Early life stages (9.5mg/L), this is a normal occurrence for this time of year.

As the summer season continues there will be an increase in water temperature and a gradual decrease in the dissolved oxygen concentration in the water.

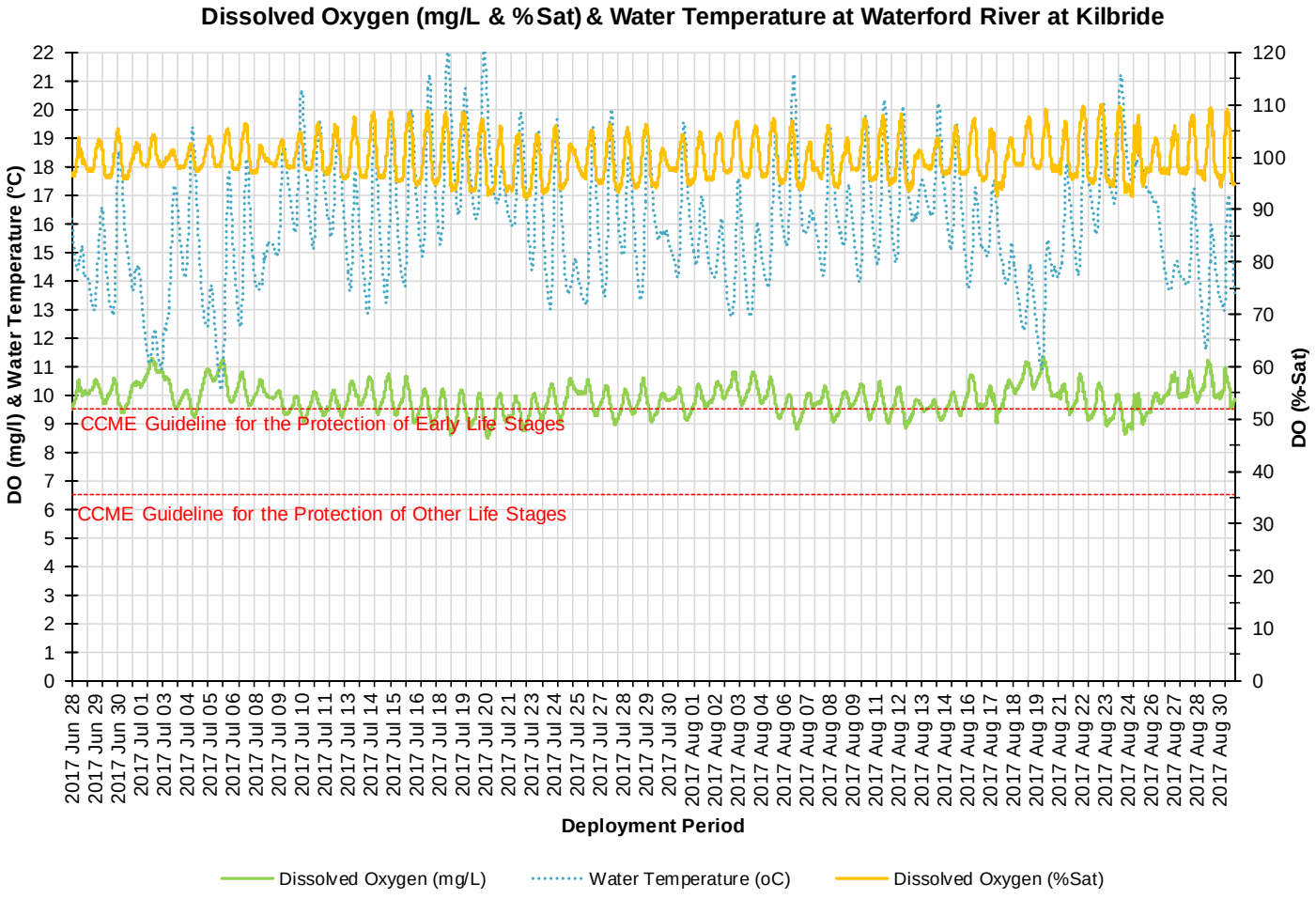


Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.8 NTU and 430.9 NTU (Figure 6). The deployment data had a median of 2.5 NTU just slightly lower than the previous deployment median of 3.8 NTU.

The higher turbidity events throughout the deployment period correlate with increases in stage. There was recorded rainfall on all of the high stage increases (Figure7). 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 August 29th, to August 30th, 2017 was removed as it did not reflect Waterford River at Kilbride water quality during this time.

Please note the stage data is raw data that is published on the ECCC web page. 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.

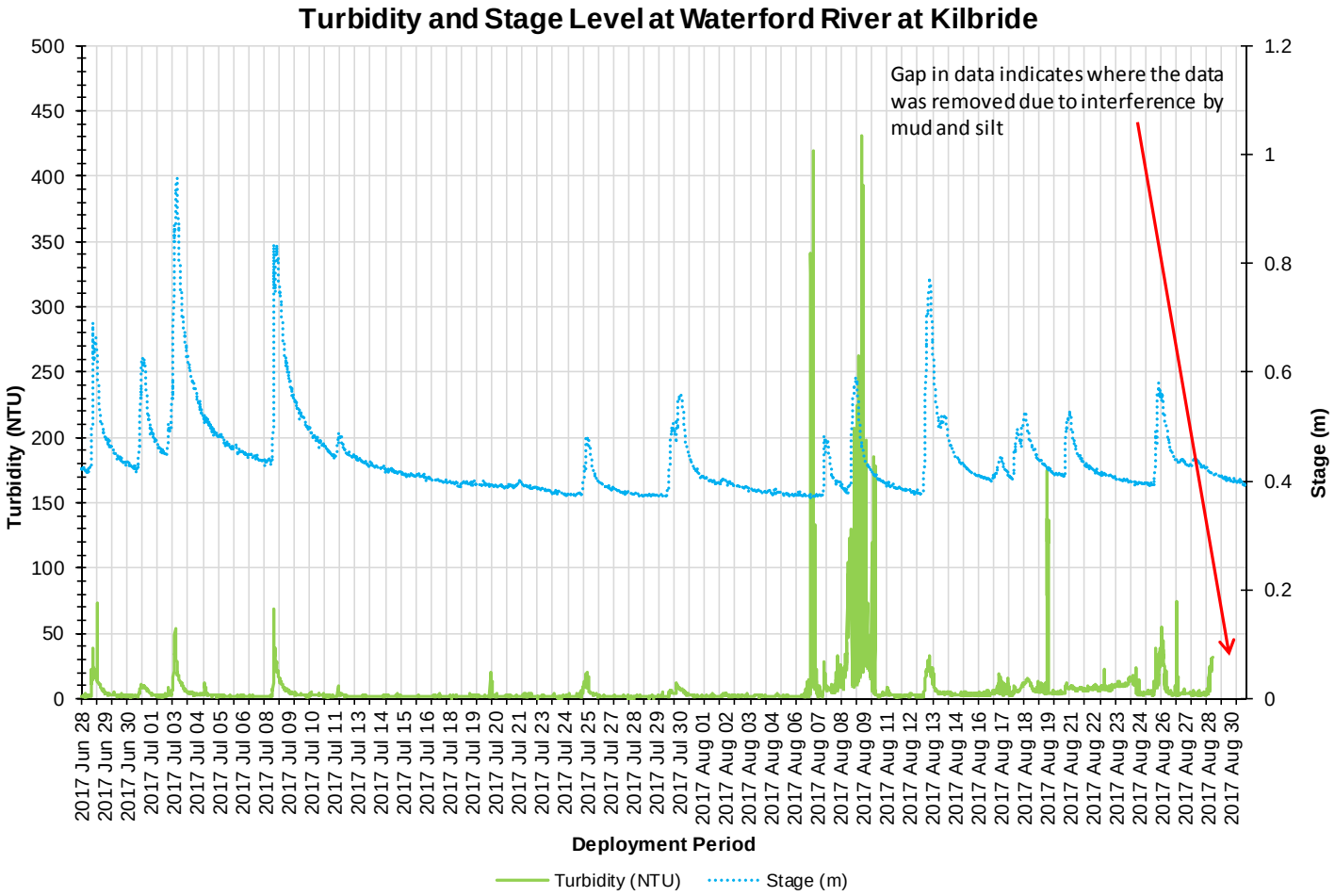


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 is important to display as it 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 0.37m to 0.96m. The larger peaks in stage do 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 30.6 mm on August 13th 2017.

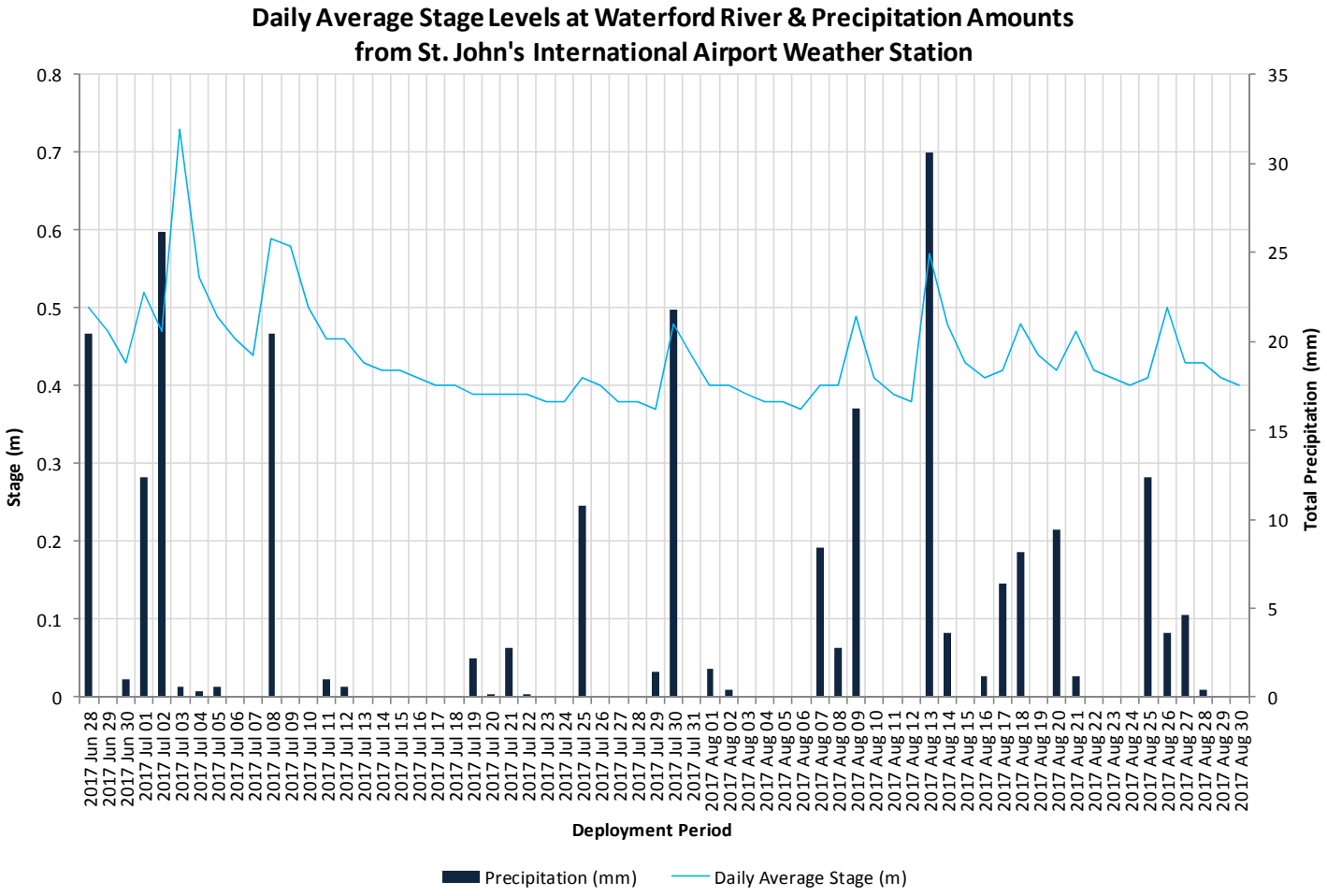


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

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 factors, combined with precipitation and runoff, can influence and adjust 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 did create varying effects with the water quality parameters pH, conductivity, dissolved oxygen and turbidity. As the seasons adjust there is an increase 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 slight change in water temperature influenced the movement in the dissolved oxygen concentrations in the brook.

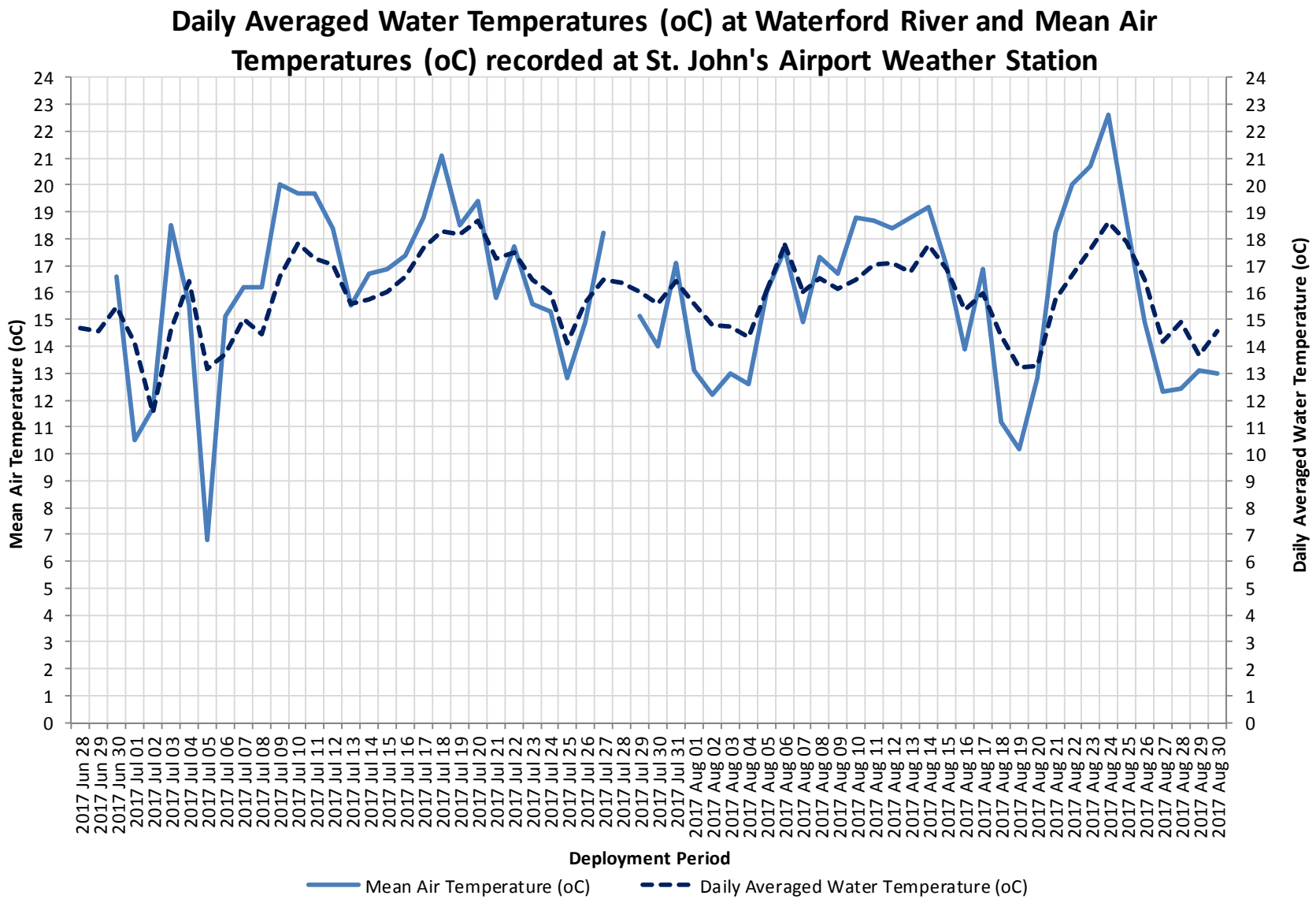
There were evident dips in specific conductivity, a result of the high stage increases from subsequent rainfall events. The pH values were reasonably consistent for this deployment, with slight increases at low stage times. Dissolved oxygen was reasonably constant, with small increases during the lower temperature events. There was movement in the turbidity data over the deployment, however the high turbidity levels 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, and the turbidity data had to be removed from August 29th to August 30th, 2017 as it did not represent 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 previous 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

Waterford River at Kilbride, Newfoundland and Labrador



Waterford River at Kilbride, Newfoundland and Labrador