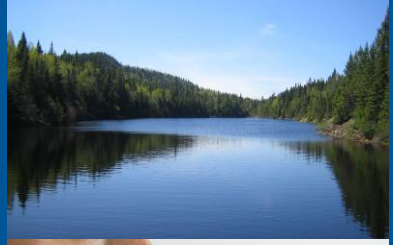







Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
August 28, 2018 to December 6, 2018

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.

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 instrument deployment on August 28 2018 until removal on December 6, 2018.

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 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 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

	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 recorded to 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	Aug 28	Deployment	Good	Excellent	Excellent	Excellent	Excellent
	Dec 6	Removal	Excellent	Good	Good	Excellent	Good

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

At removal of the instrument, water temperature, pH, conductivity, dissolved oxygen and turbidity ranked as 'Excellent' and 'Good'. Parameters were acceptable for the removal of the field instrument.

Concerns or Issues during the Deployment Period

This was a longer than normal deployment of 101 days. However, the instrument performed well, when the data was compared against the QAQC sonde at removal the ranking for each parameter was within Excellent and Good (Table 2).

Waterford River at Kilbride

Water Temperature

Water temperature ranged from 0.07°C to 19.84°C during this deployment period (Figure 2).

Over the duration of the deployment period, the water temperature is decreasing, as the weather cools down into Winter the water temperatures will mirror that of the air temperatures. During high stage events water temperature increases for a short period of time.

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.

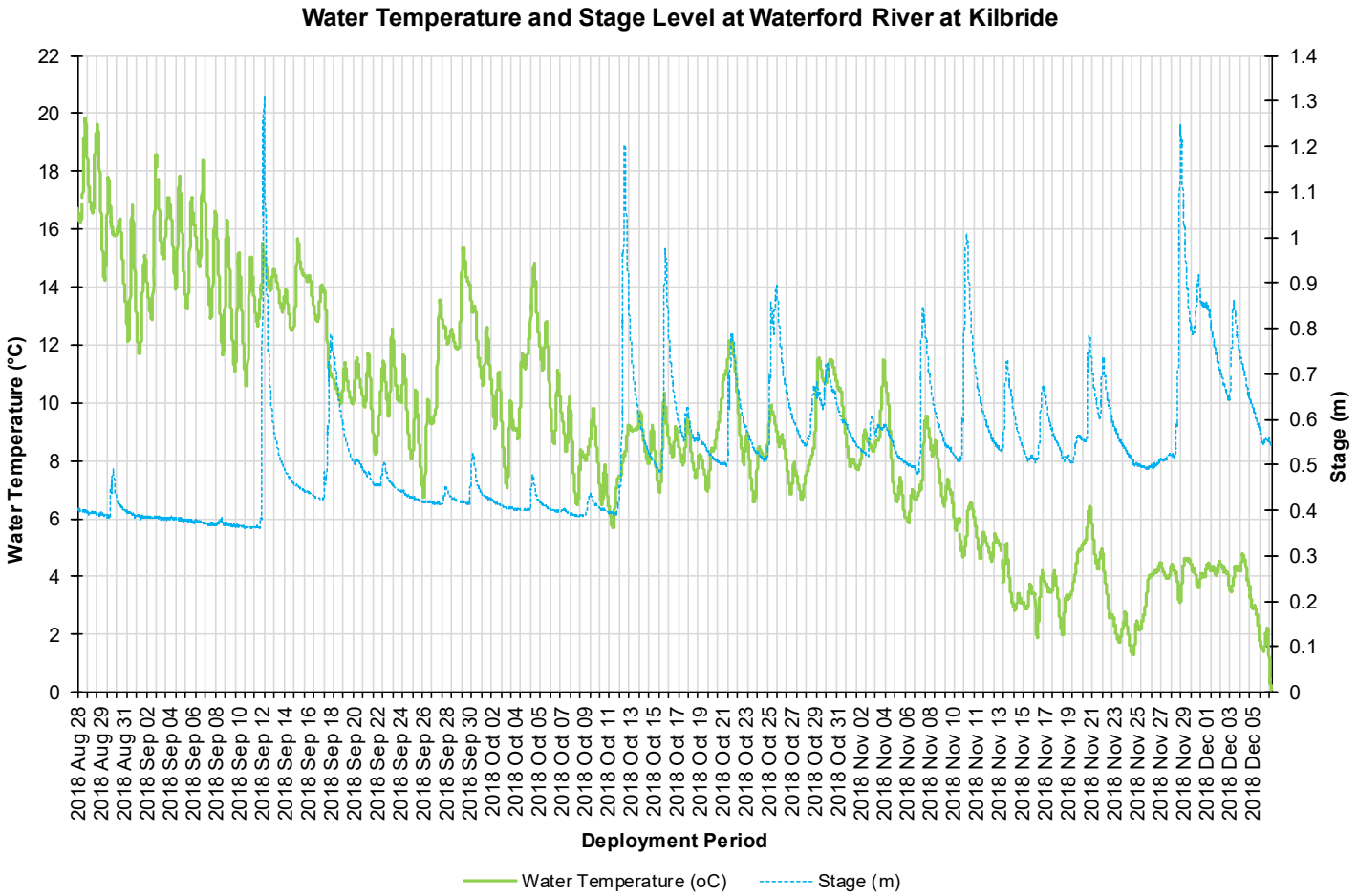


Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.8 pH units and 8.27 pH units (Figure 3).

In this graph the CCME guideline provides a basis by which to judge the overall health of the brook. Waterford River pH values remained between the guidelines. The median pH level was 7.33 pH units, slightly higher than that of the past deployment pH median of 7.06 pH units.

During the higher stage events the pH values dip for the duration of the peak in stage. However, the pH values return to background levels as the stage settles out again.

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.

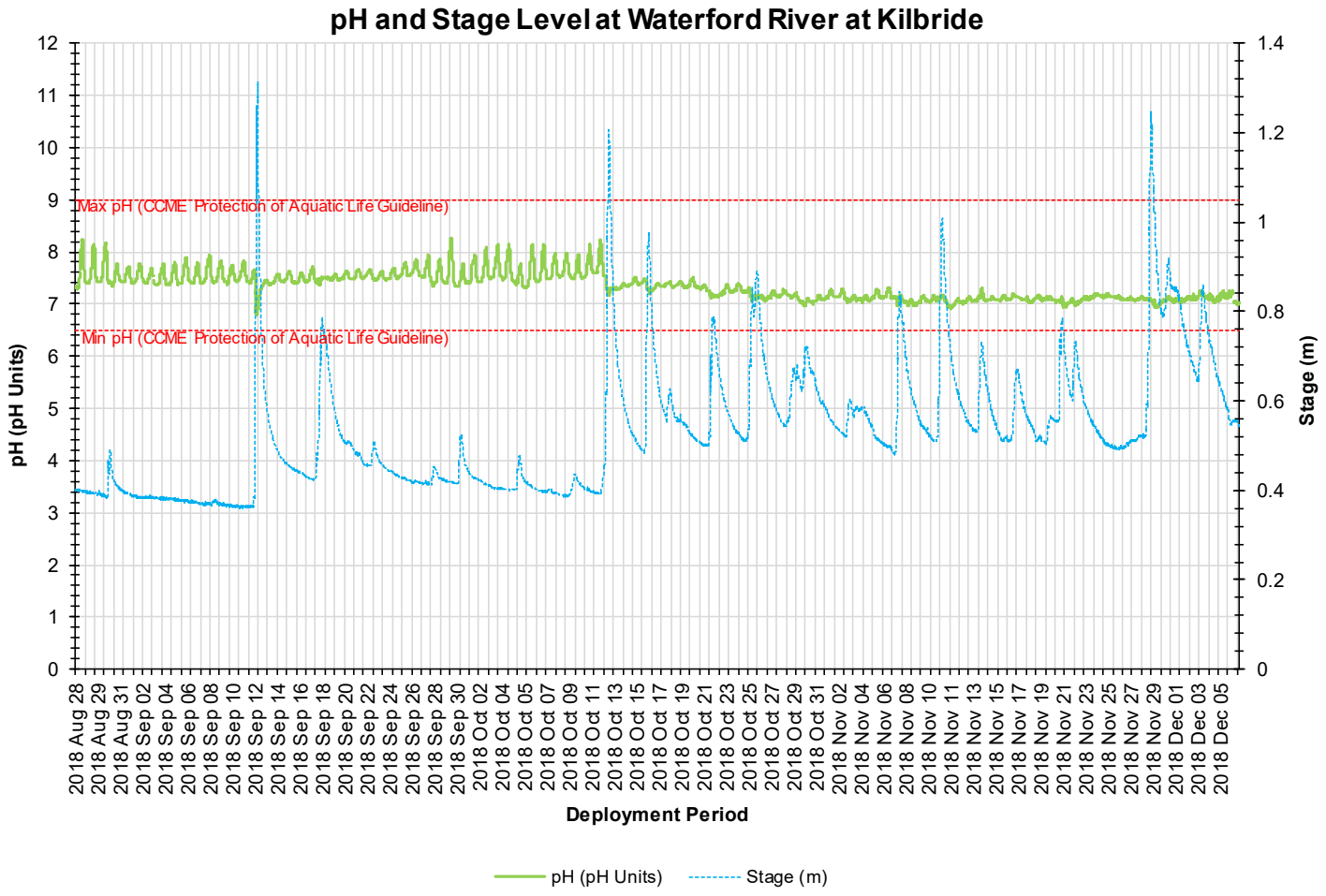


Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 143.0 µS/cm and 1150 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.093 g/L to 0.748 g/L (Figure 4).

The conductivity levels from August to early November react to the high stage events by decreasing for a period then returning to background levels. Around November 10 2018, the conductivity values start to increase with the stage spikes. Likely a result of road salting starting as the air temperatures start to dip. This relationship is evident to the end of the deployment.

Please note 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.

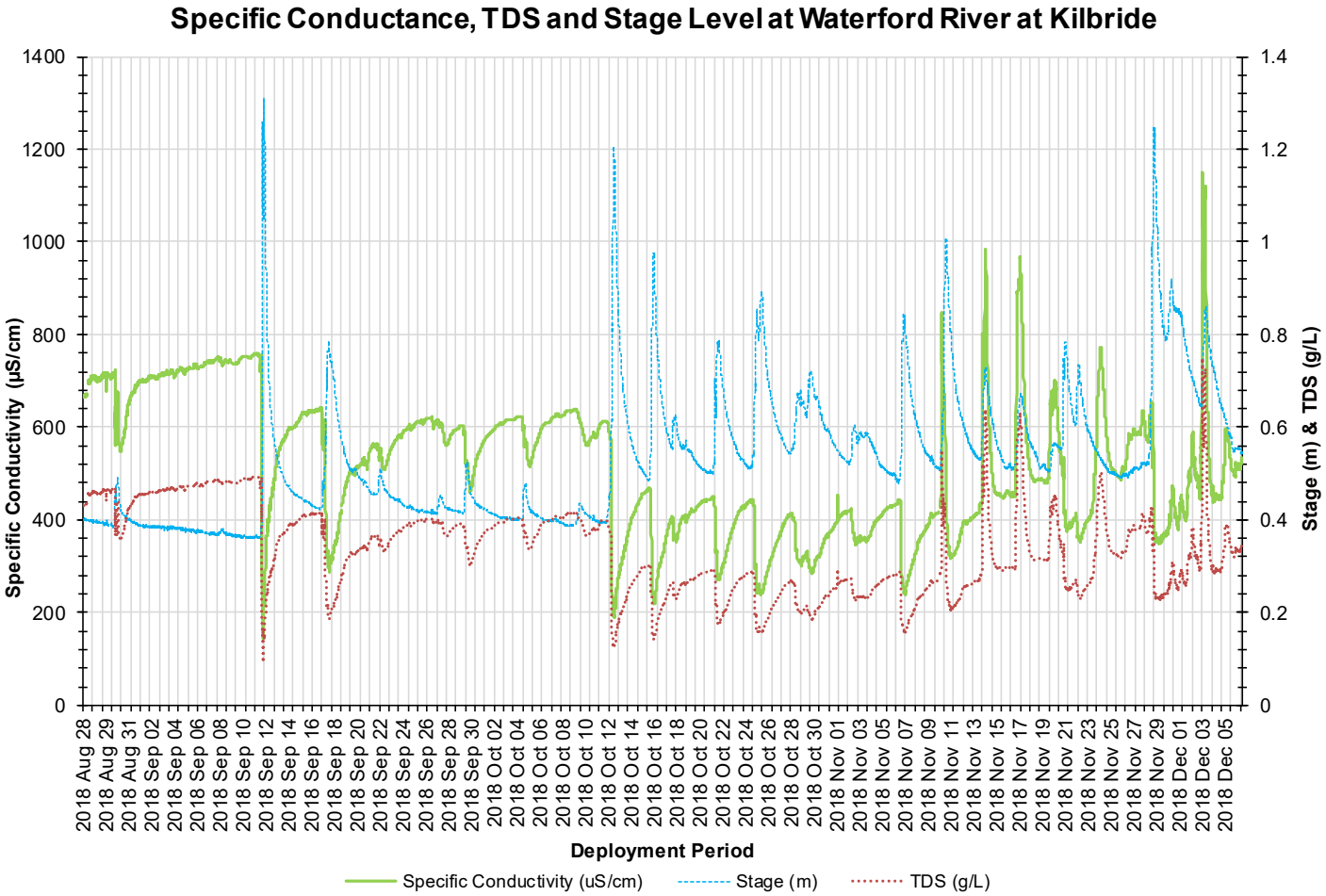


Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe. 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 8.95mg/L to a maximum of 14.27mg/L. The percent saturation levels for dissolved oxygen ranged within 9536 % Saturation to 112.2% Saturation (Figure 5).

As the water temperatures are decreasing it allows for the increase of dissolved oxygen present in the brook. For the majority of this deployment, the dissolved oxygen levels remained above the CCME Guideline for the Protection of Early life stages (9.5mg/L) and other life stages.

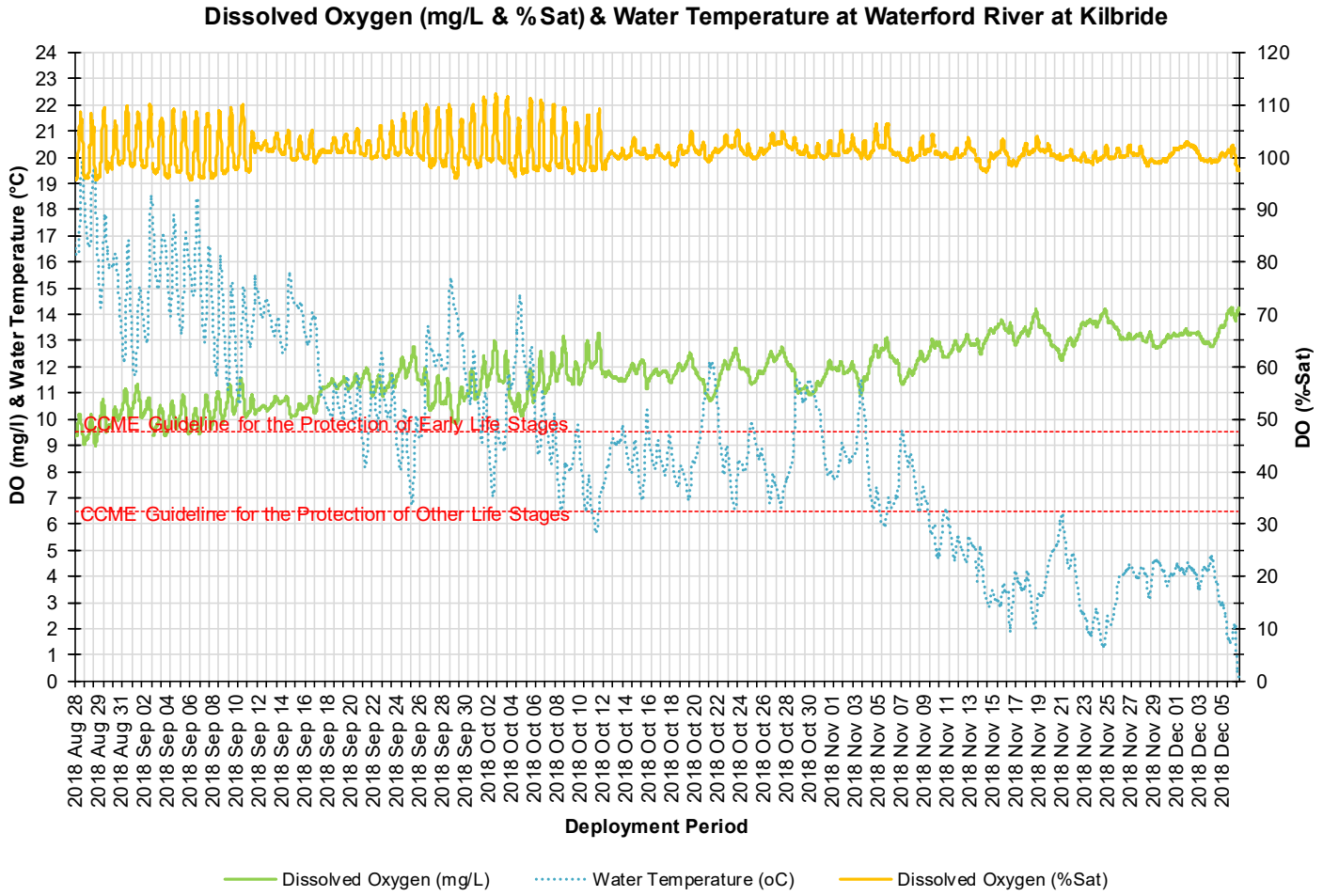


Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.2 NTU and 1071.1 NTU (Figure 6). The deployment data had a median of 29.9 NTU, which was significantly higher than the median of the previous deployment, 5.1 NTU.

The higher turbidity events throughout the deployment period correlate with increases in stage. There was recorded rainfall during all of the high stage increases (Figure 7). Precipitation can increase the presence of suspended material in water through the movement of soil and sediment from nearby urban areas. Data was removed from November 24 to November 28 as there was evidence of a buildup of sediment around the sensor that impacted the data.

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.

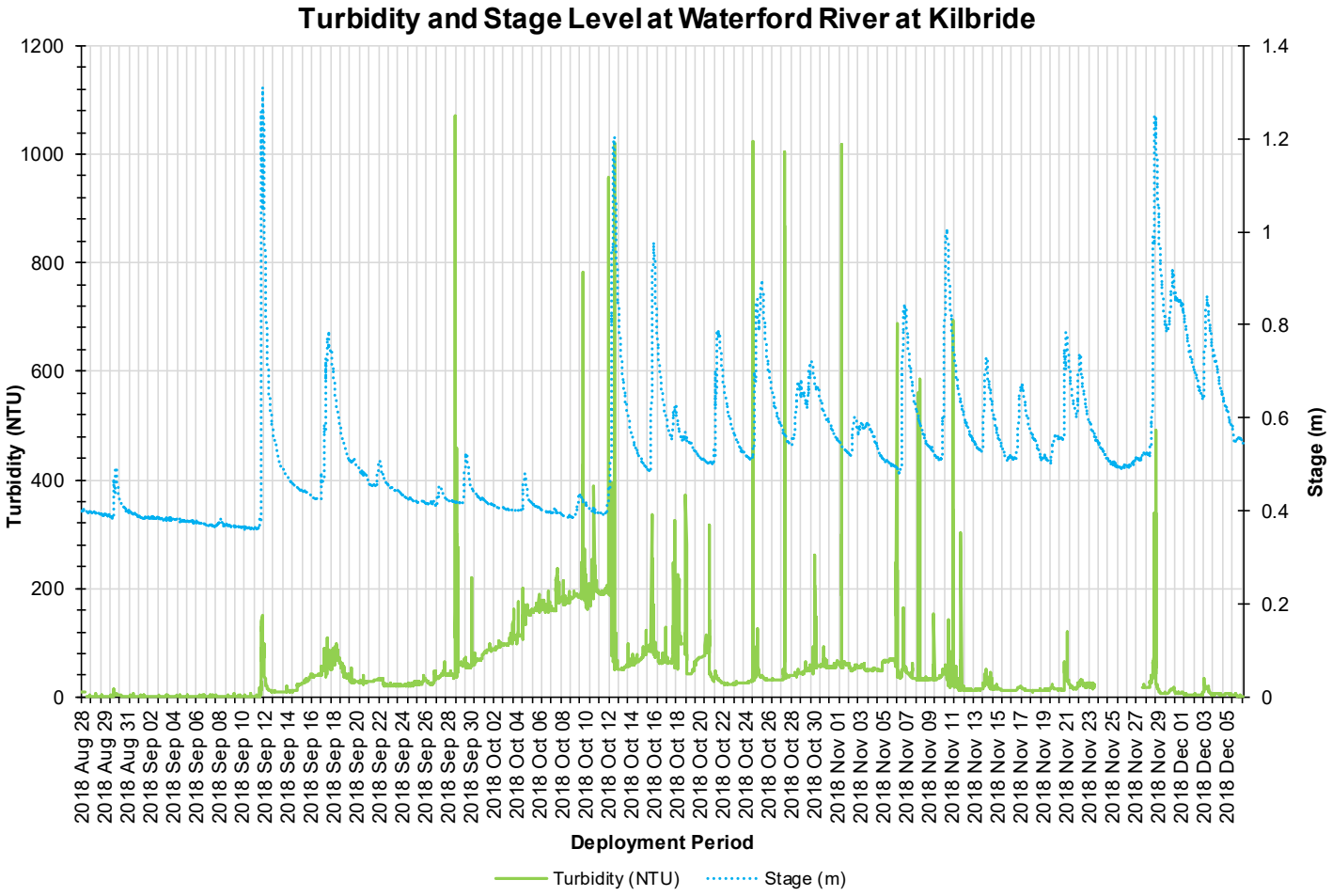


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 is available 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 0.36m to 1.312m. The larger peaks in stage correspond with substantial rainfall events as noted on Figure 7. Precipitation data was collected by Environment Canada's St. John's International Airport weather station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 59 mm on September 12 2018.

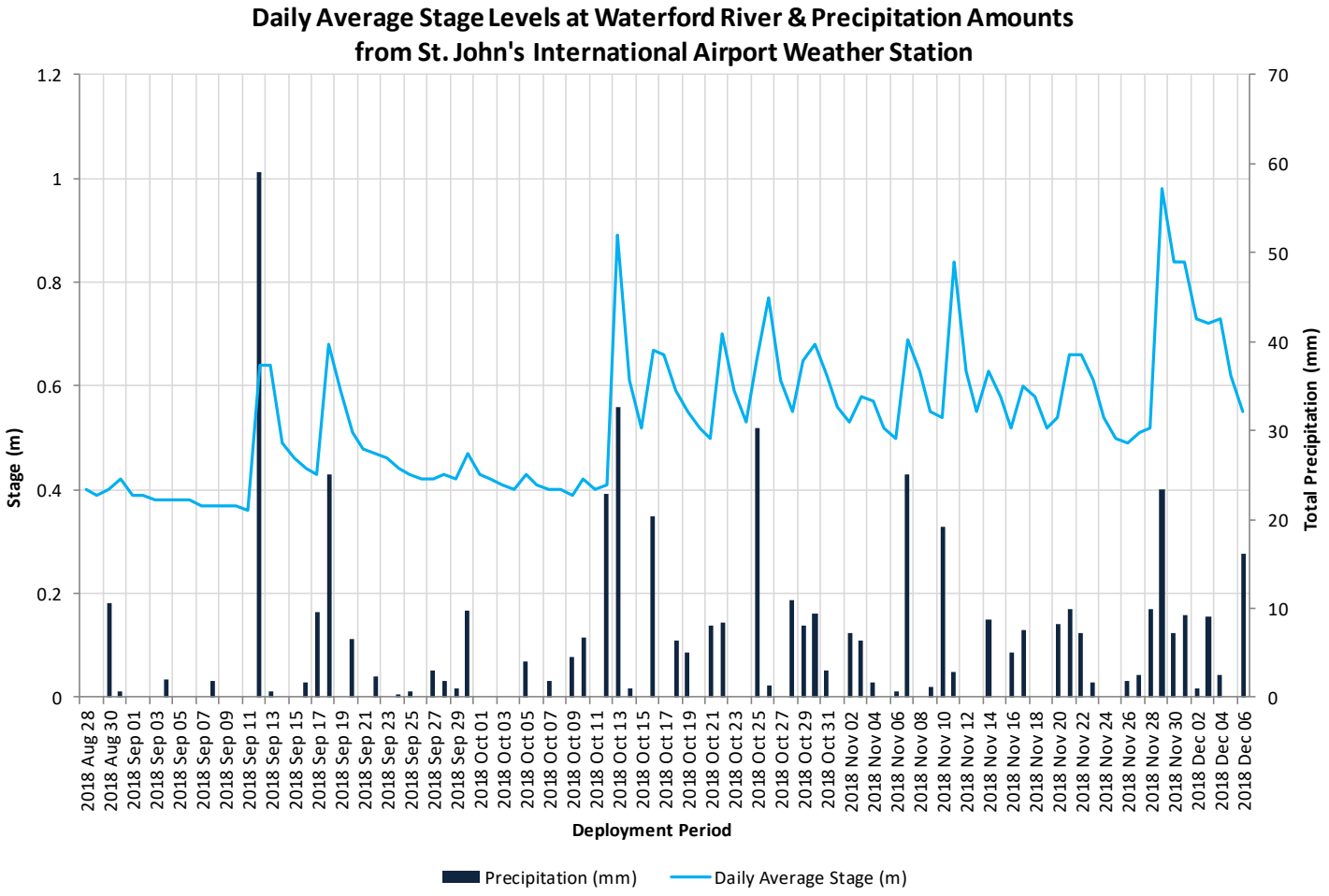


Figure 7: Stage values recorded at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

Conclusion

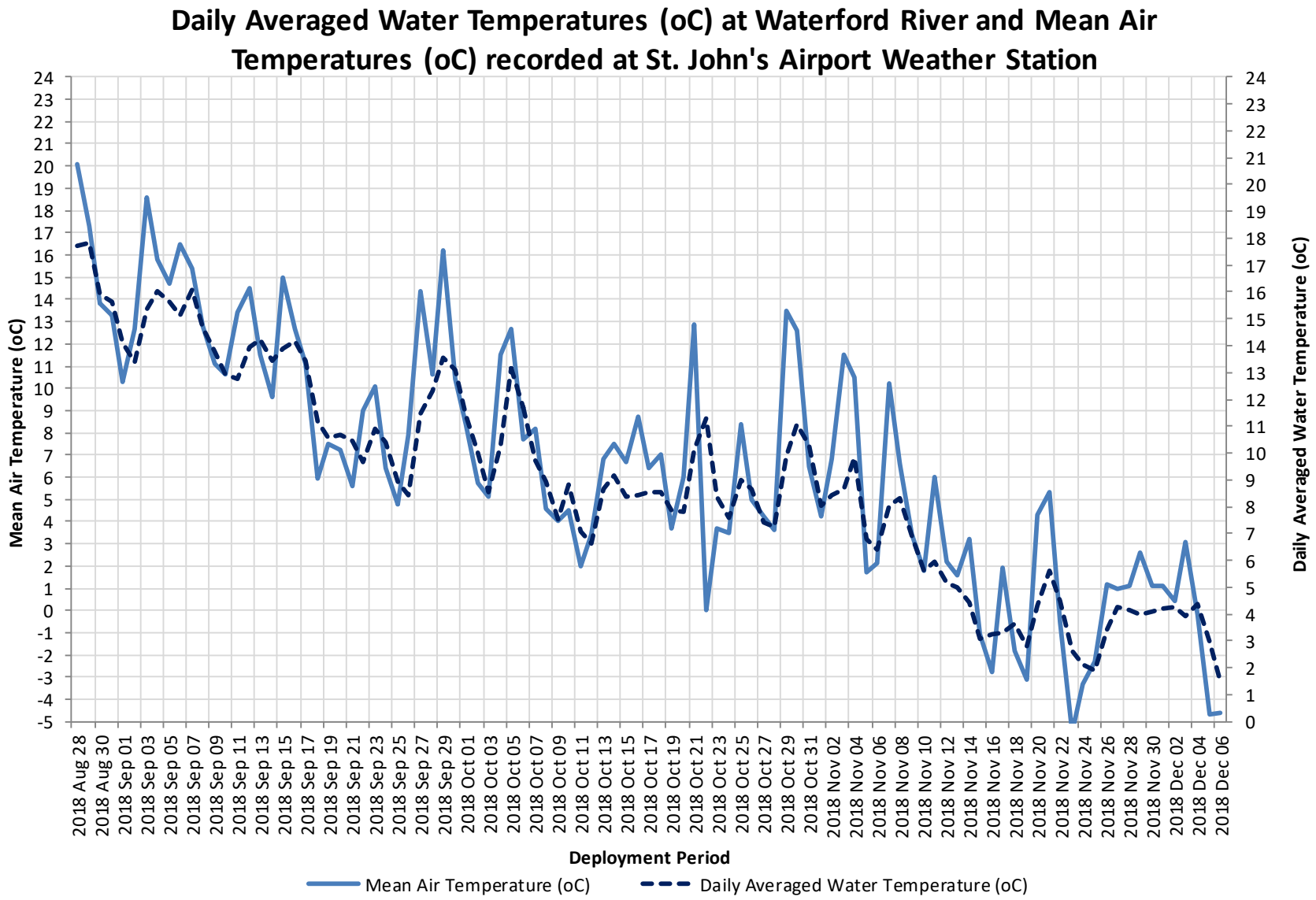
When reviewing the graphs as a whole it is evident that the larger precipitation events influenced the water quality parameters pH, conductivity, dissolved oxygen and turbidity. As the seasons adjust, there is an decrease in the air temperatures in the city. The length of this deployment captured the steady decrease in water temperatures as the seasons transitioned from summer, fall and beginning winter. As the water temperatures drop there will be a corresponding change in some of the water quality parameters.

The conductivity during this deployment displayed two different relationships with stage level. At the, beginning of the deployment, the conductivity levels would decrease during high stage events. However as air and water temperatures started to cool with the seasonal changes, the conductivity levels increased with the stage peaks. This change in conductivity was likely a result of the increased suspended material present in the brook due to road salt flushed into the waterways. This is a regular occurrence during the winter months.

Dissolved oxygen remained constant throughout the deployment. There was a slight increase in the concentration toward the end of the deployment as the air temperatures and water temperatures decrease.

There is a lot of movement in the turbidity data at this site. This brook is flashy and conditions can change quickly. The high peaks in turbidity are a result of the precipitation events, majority of the turbidity spikes return to background levels shortly after.

APPENDIX I


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

Waterford River at Kilbride, Newfoundland and Labrador