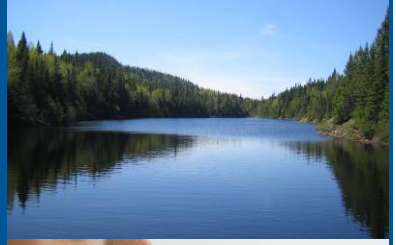







Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
November 1, 2017 to January 12, 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.

This report covers the period from deployment on November 1, 2017 with removal on January 12, 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 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 and data transmitting equipment are working properly and are responsible for stage and streamflow measurements. 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

	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	November 1	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	January 12	Removal	Excellent	Fair	Good	NA	NA

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

At removal of the instrument, water temperature and specific conductivity parameters ranked as 'Excellent' and 'Good'. The pH data ranked against the QA as 'Fair'. The dissolved oxygen data ranking was not applicable, as the QAQC instruments dissolved oxygen probe failed during use. The turbidity sensor was buried at the end of the deployment and unable to provide a valid reading.

Concerns or Issues during the Deployment Period

The pH data was not representative of the water quality of the brook on November 7th to 9th, and November 16th to November 26th, 2017. There was a pH sensor failure and the instrument had to be replaced, the pH data was removed during these times.

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 December 24th, 2017 to the end of deployment 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 -0.05ºC to 12.31ºC during this deployment period (Figure 2).

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 progresses 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.

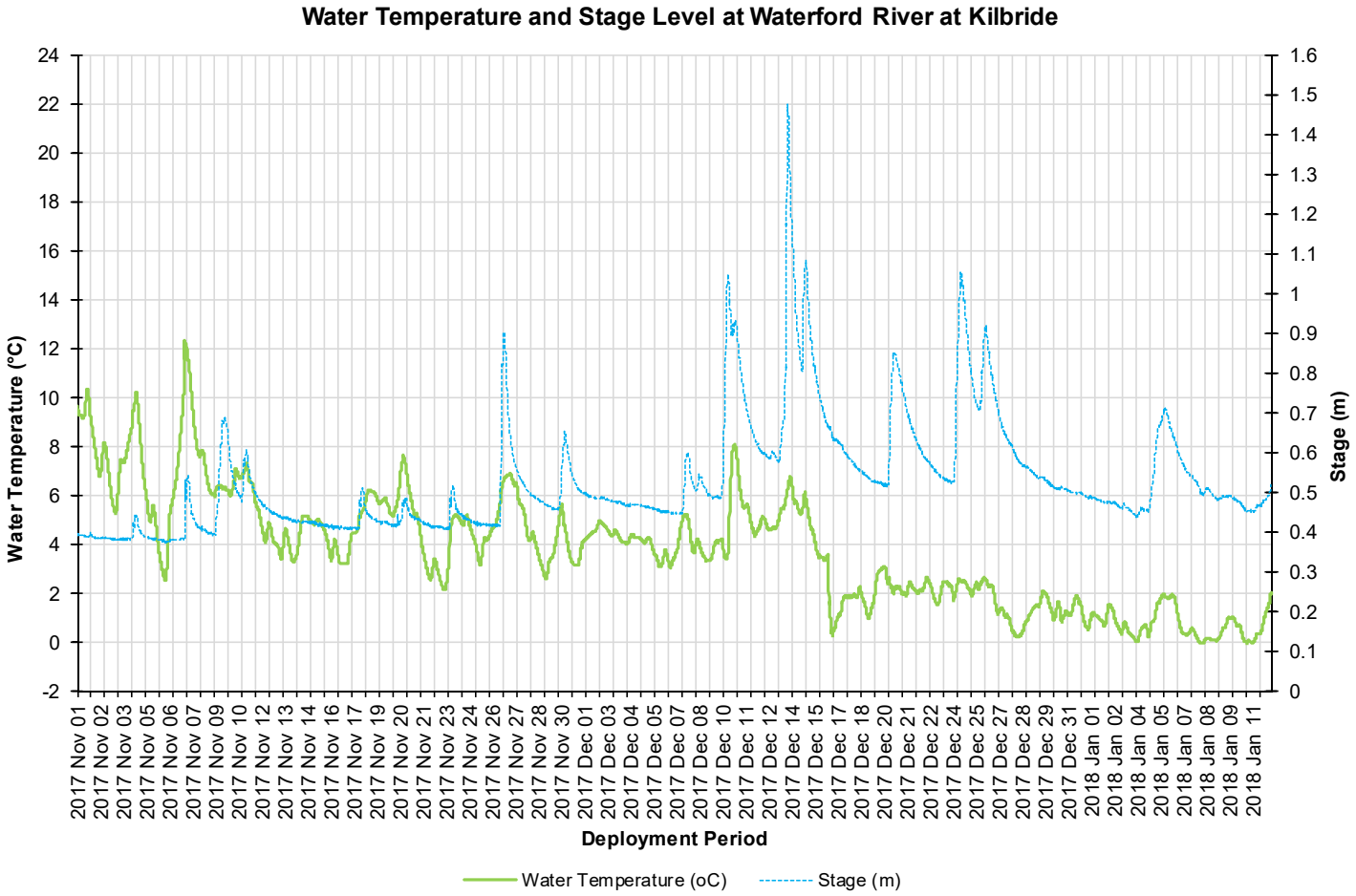

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.26 pH units and 7.77 pH units (Figure 3).

The pH levels are generally consistent. During stage events there are dips in pH data for a short period of time. The pH data was not representative of the water quality of the brook on November 7th to 9th, and November 16th to November 26th, 2017. There was a pH sensor failure and the instrument had to be replaced, the pH data was removed during these times.

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 7.00 pH units, similar to that of the past deployment pH median of 7.20 pH units.

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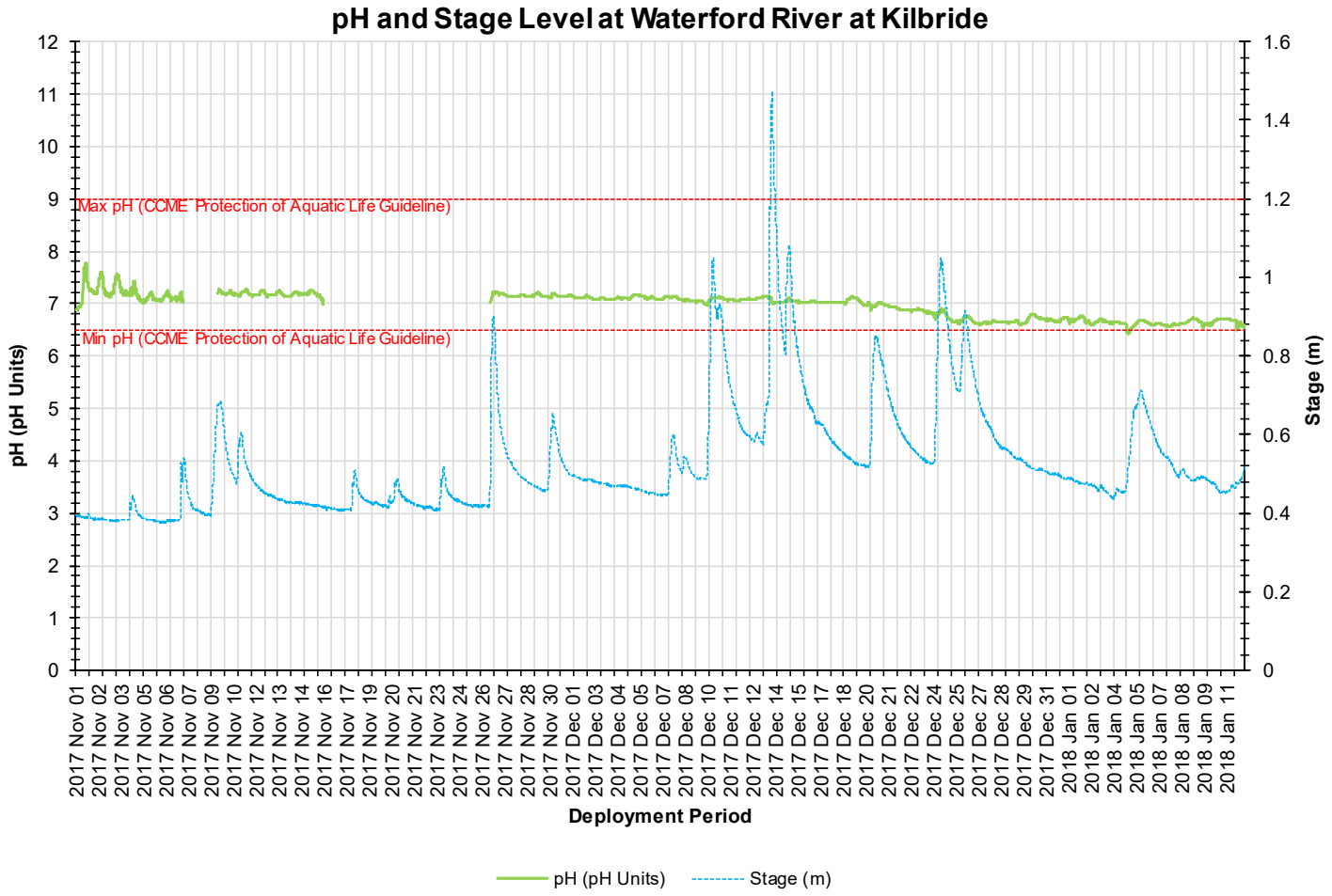

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 188.0 µS/cm and 2276.0 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.1220 g/L to 1.4790 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). However, after November 29th, when there is an increase in stage there is an increase in conductivity levels, this change is a result of road salting on the surrounding urban street. Road salt increases the particle matter in the brook when it is washed in from the roadway.

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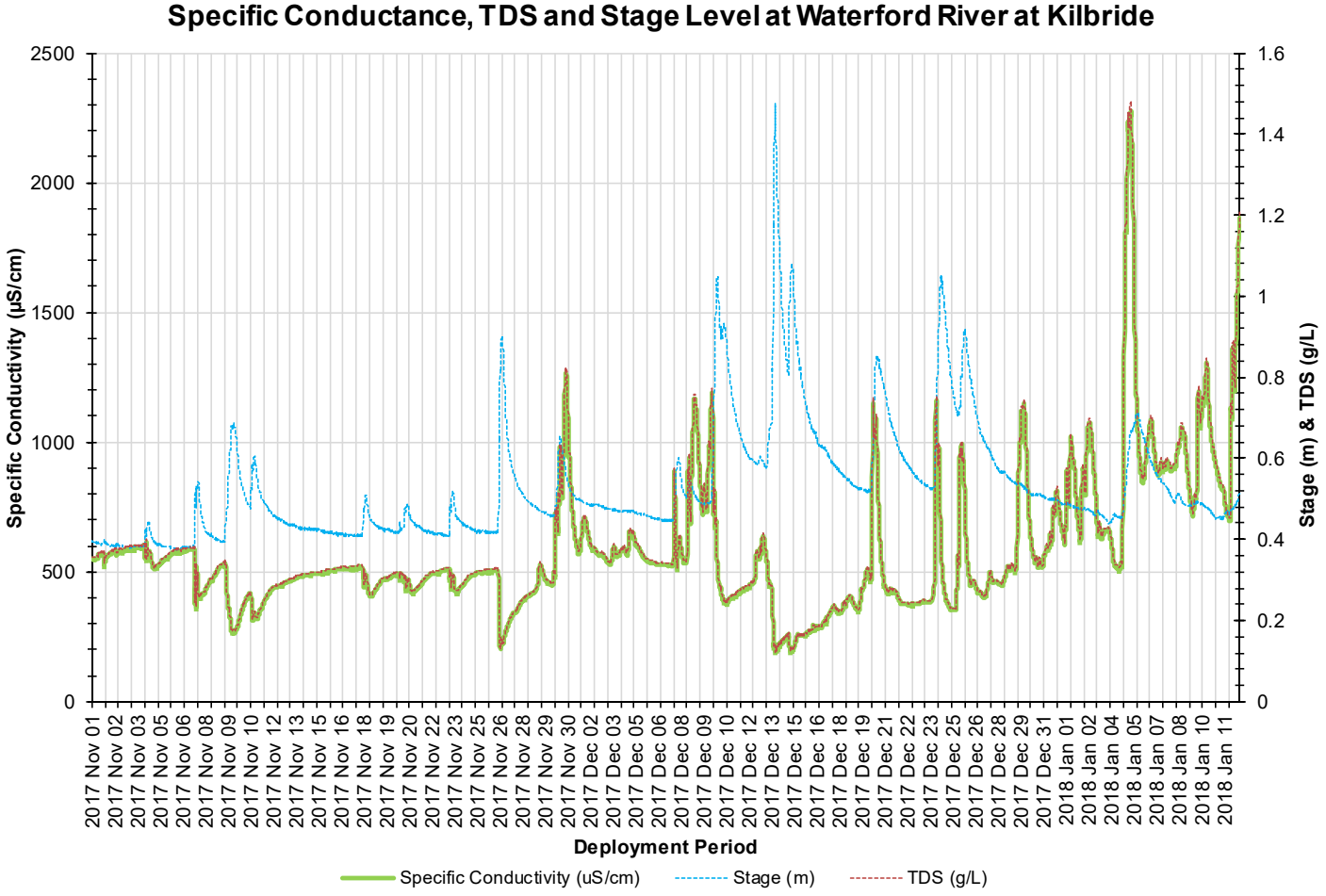

Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

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

During the deployment, the dissolved oxygen concentration levels ranged from a minimum of 10.36 mg/L to a maximum of 13.97 mg/L. The percent saturation levels for dissolved oxygen ranged within 85.0 % Saturation to 106.3 % Saturation (Figure 5).

Water temperature is displayed with dissolved oxygen as it directly influences the concentration levels of dissolved oxygen in the water column. Higher water temperatures decrease the concentration of dissolved oxygen present in the brook. During this deployment, the dissolved oxygen levels remained 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 as the water is very cold.

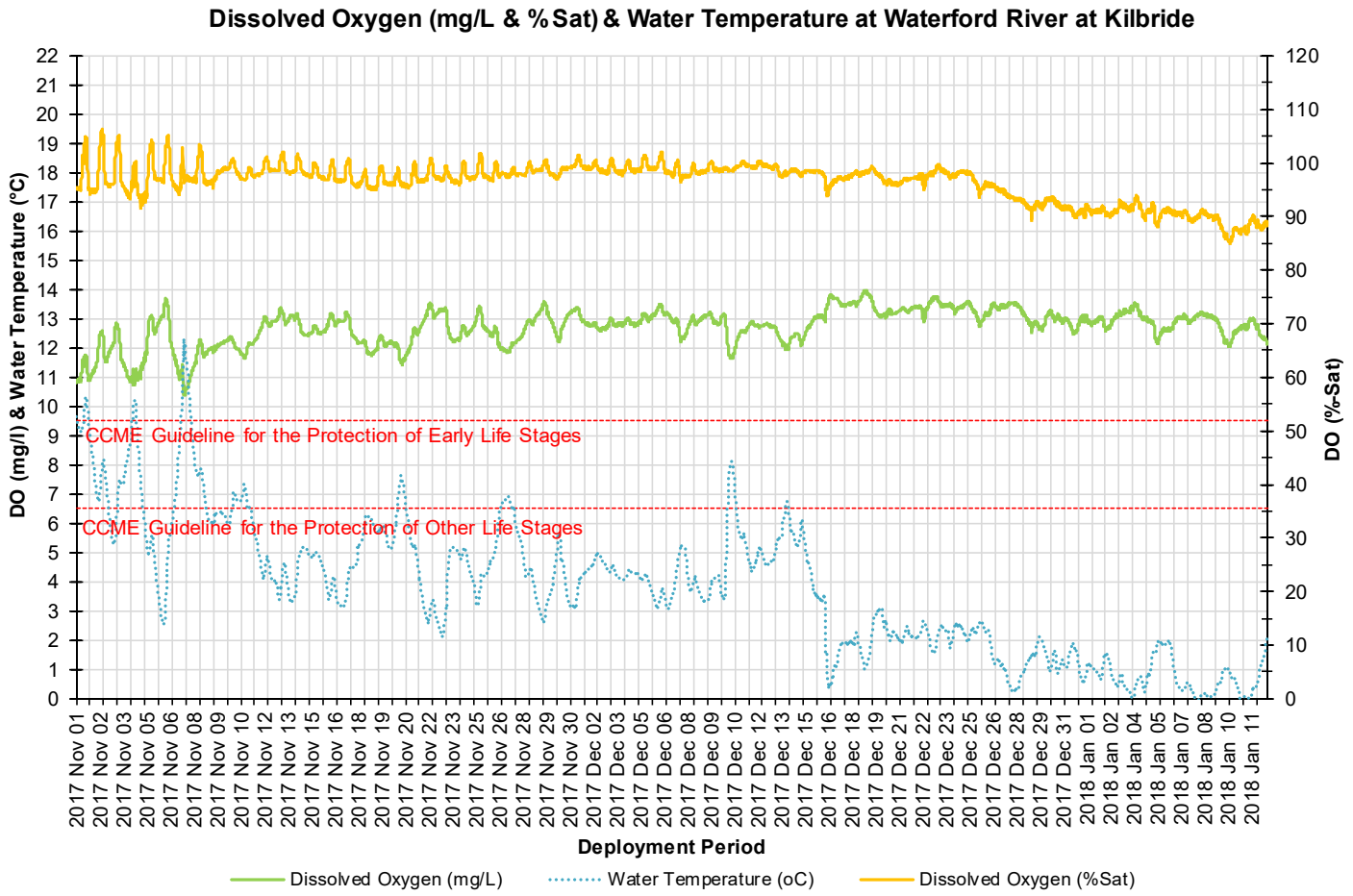

Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.1 NTU and 1233.3 NTU (Figure 6). This deployment dataset had a median of 5.0 NTU, which was lower than the previous deployment median of 16.2 NTU.

Several of the turbidity events correlate with increases in stage. On December 15th the high turbidity event was likely a result of a number of days of rainfall that occurred on December 13th and 14th, 2018. 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. The turbidity data from December 23rd, 2017 to end of deployment was removed as it did not reflect Waterford River at Kilbride water quality during this time.

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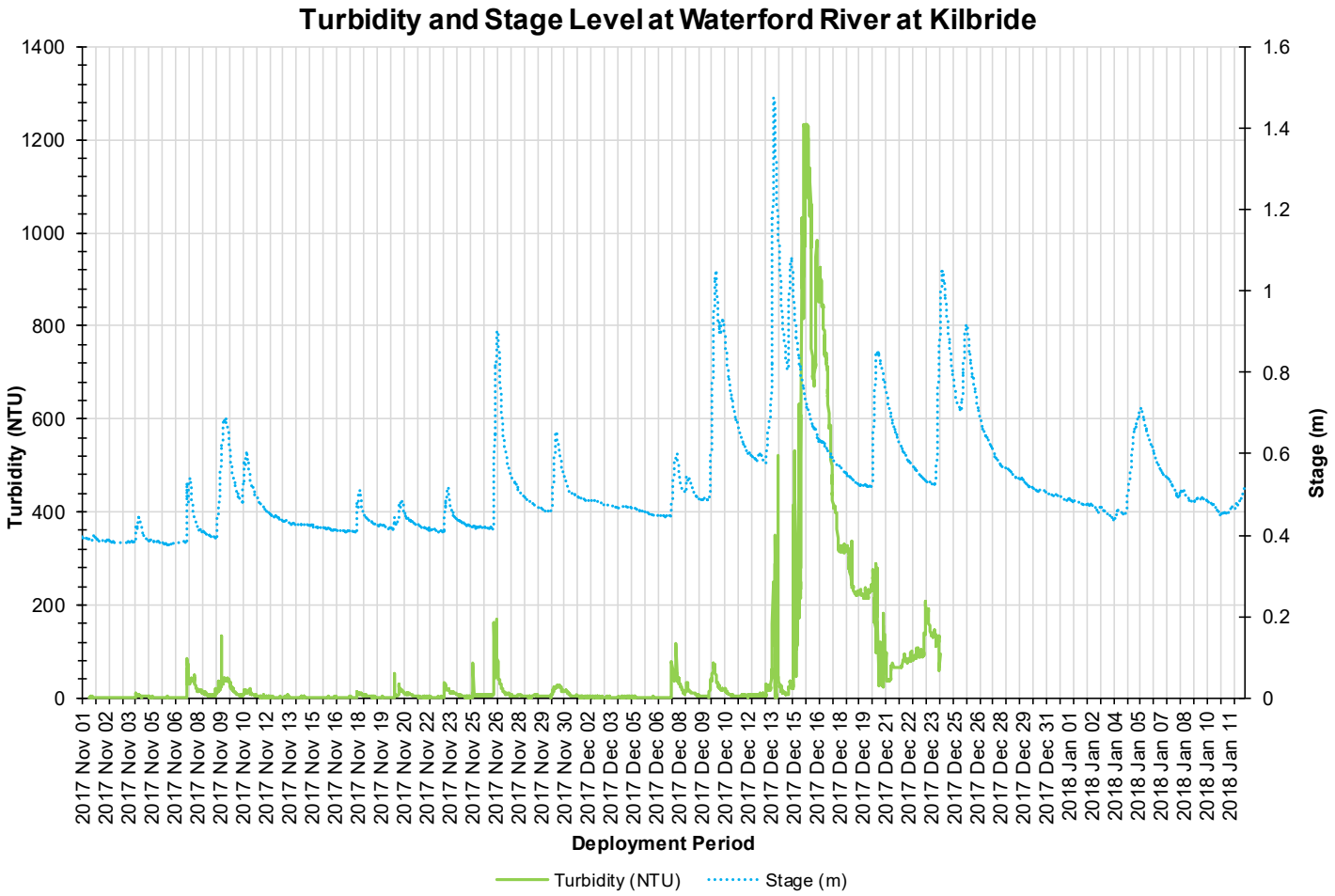


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 changes 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 1.47m. 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 International Airport weather station. Daily Precipitation totals for the deployment period were a minimum of 0.0 mm and a maximum of 34.4 mm on December 13th 2017.

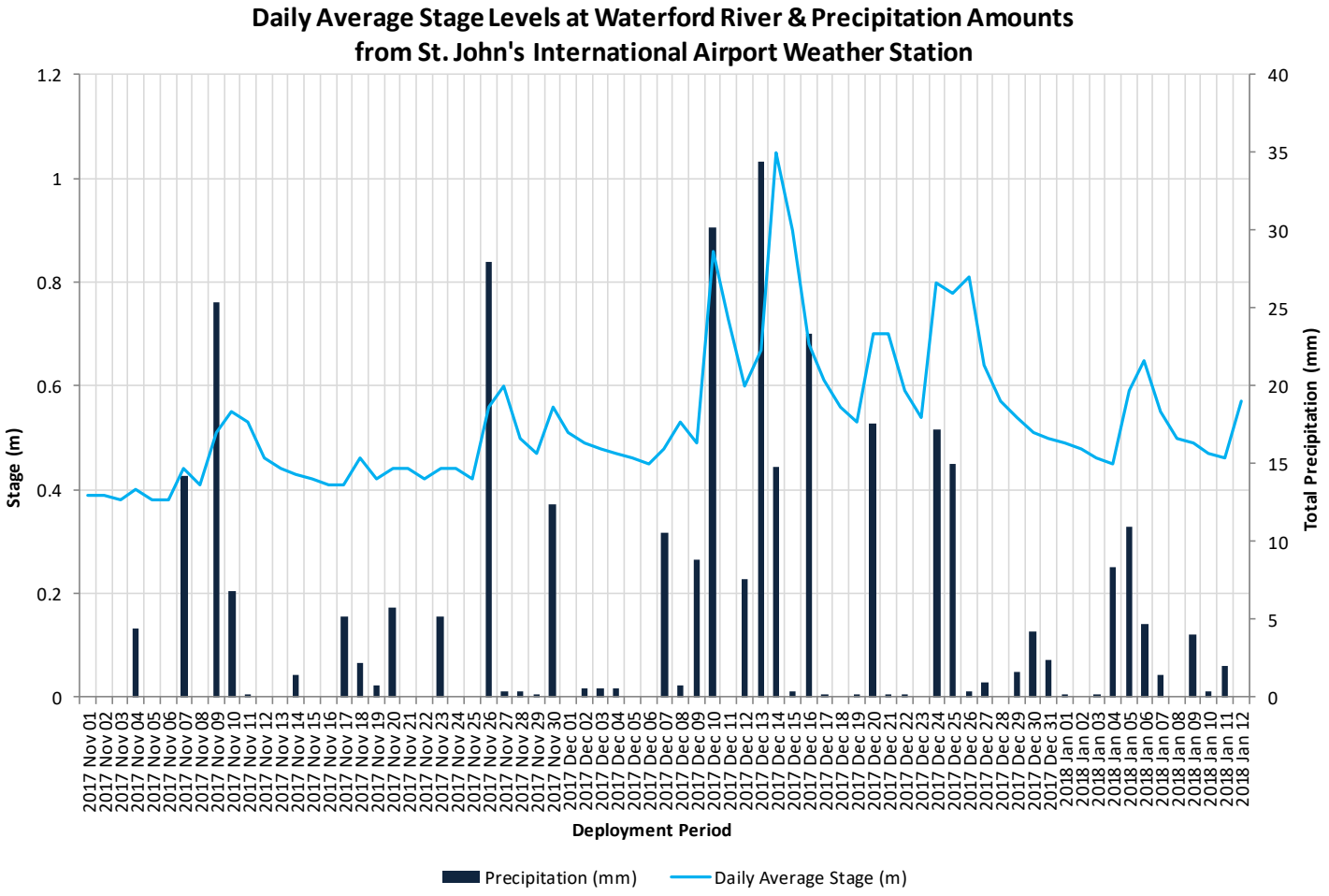


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

Conclusion

Waterford River at Kilbride flows through significant developed areas, including residential and industrial zones. Waterford River also borders along several heavily used urban roadways and thoroughfares. The proximity to these developments, combined with precipitation and runoff can influence parameters.

When reviewing the graphs as a whole, it is evident that the larger precipitation events created varying effects with the water quality parameters pH, conductivity, dissolved oxygen and turbidity. As the seasons change, there is an 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 slight change in water temperature influenced the movement in the dissolved oxygen concentrations in the brook.

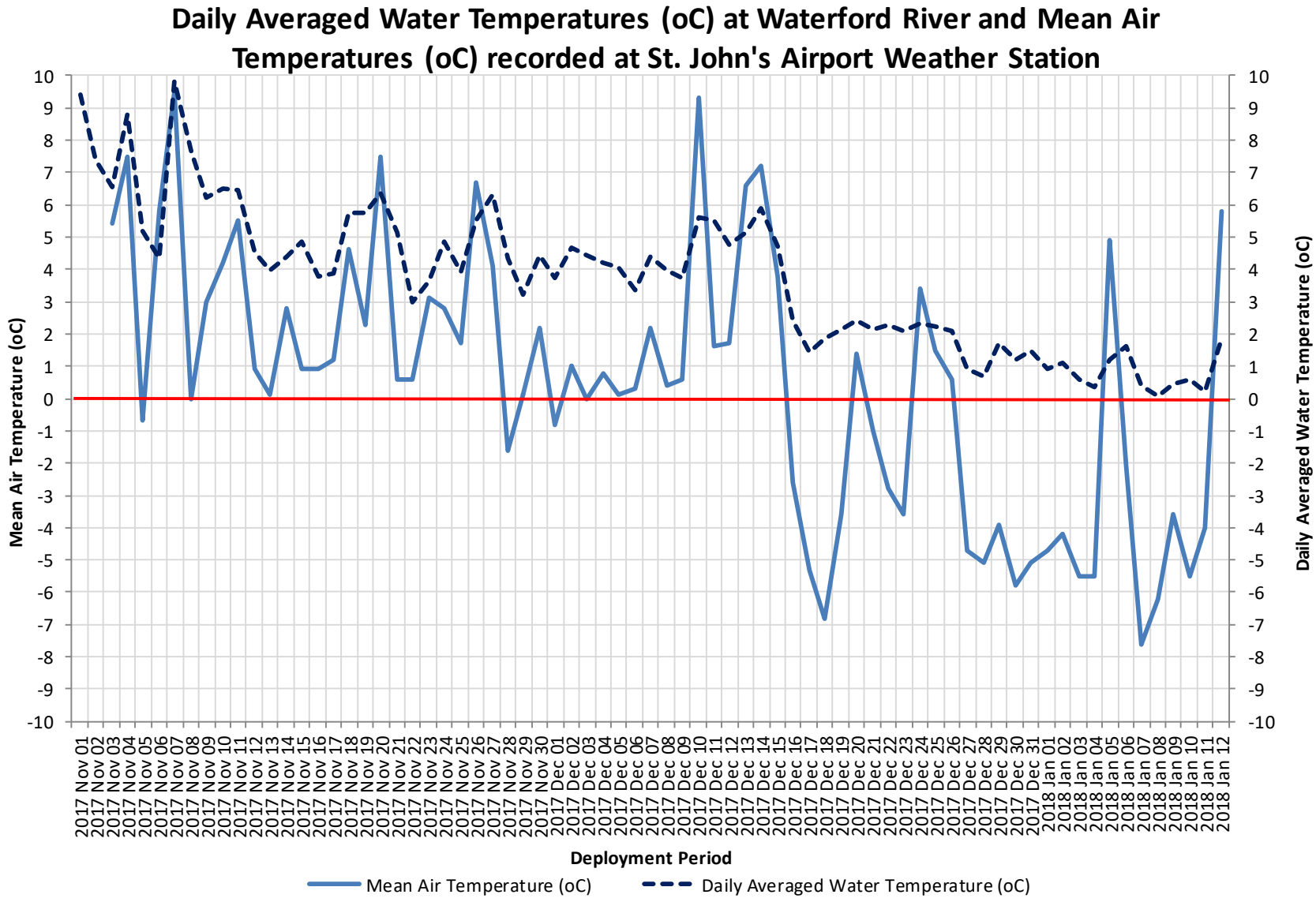
There were evident increases in specific conductivity as a result of the road salting and subsequent rainfall events flushing the material into the brook. The pH values were reasonably consistent for this deployment,. Dissolved oxygen was reasonably constant, with small increases during the lower temperature events. This instrument sits on the riverbed to record data. Turbidity values displayed what would be expected of an urban brook, with higher levels during high stage events.

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. During high stage events large debris can become trapped and interfere with the individual sensors ability to record data. When this is evident, the data is removed from statistical analysis, as it is not a true representation of the brook. After the highest stage event for the deployment on December 14th, turbidity levels increased as expected, however, the data did not return to background level. The turbidity data from December 25th to the end of the deployment was removed from this report due to fouling from the sediment.

The water quality data displayed in this report is typical for 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