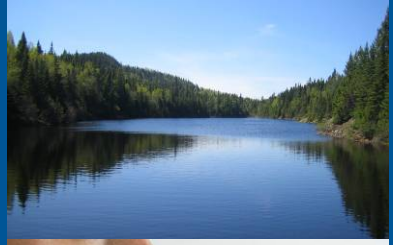







Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
January 12, 2018 to April 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 during the deployment period of January 12, 2018 until removal on April 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. WSC is responsible for handling stage and streamflow issues. The water quantity data is transmitted via satellite and published online with the water quality data on the Real-Time Stations 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 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	January 12	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	April 12	Removal	Good	Good	Good	Excellent	Excellent

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'. Parameters were acceptable for the initial deployment of the field instrument.

At removal of the instrument, water temperature, specific conductivity and turbidity parameters ranked as 'Excellent' and 'Good'.

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.

This was a long deployment for this site due to the ice coverage along the river bank related to the time of year. The instrument was not removed from the brook until it was safe to do so.

Just after deployment of the instrument the pH sensor failed. Therefore the pH data from January 12, 2018 to February 1, 2018 was not representative of the brook and the data was removed from the dataset in this report.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from -0.14°C to 6.84°C during this deployment period (Figure 2).

Over the duration of the deployment period the water temperature is generally consistent, there are 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 remain cool as the deployment progresses. 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 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.

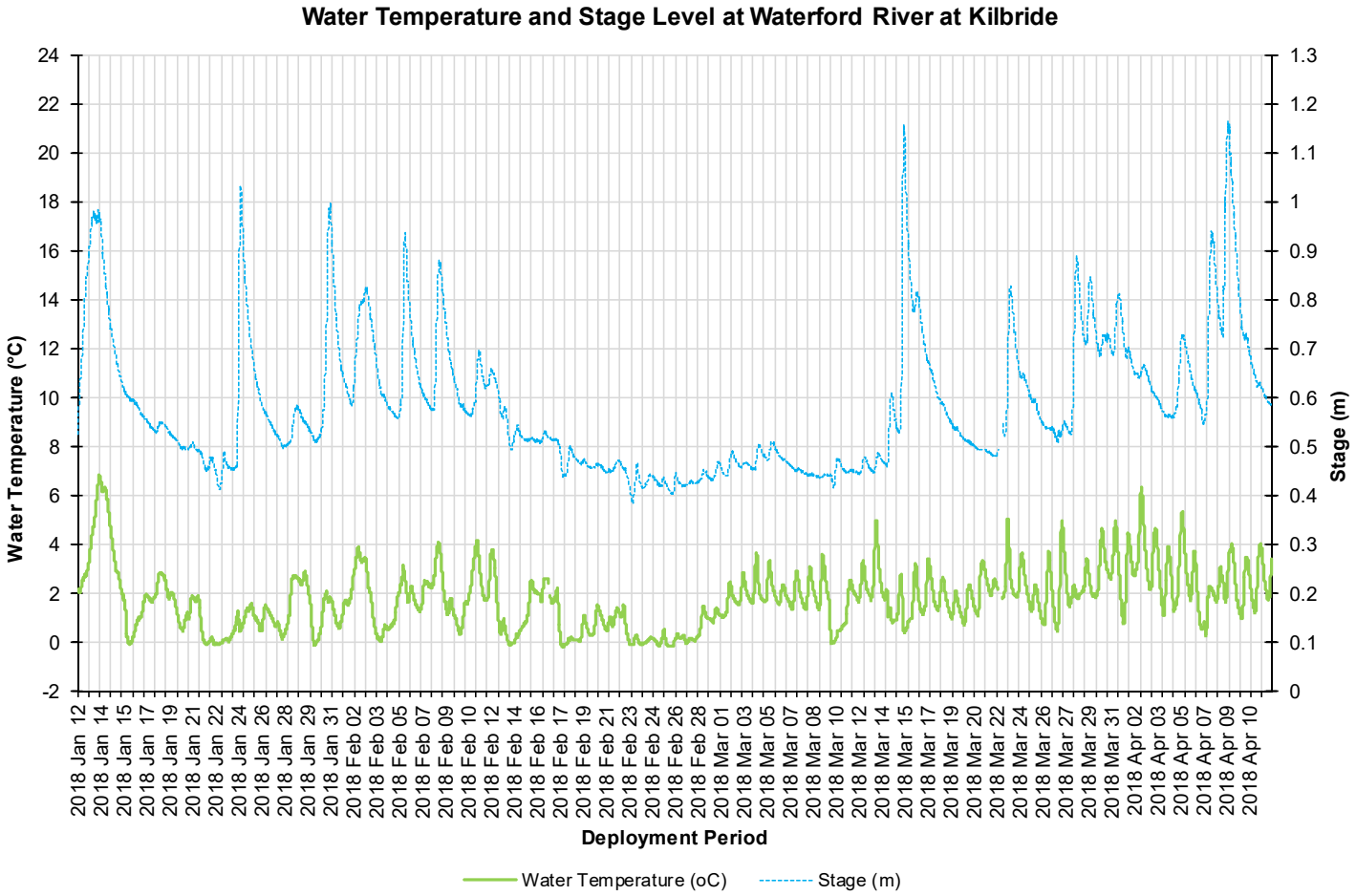

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 7.36 pH units and 7.59 pH units (Figure 3).

Shortly after initial deployment of the water quality instrument the pH sensor failed. Therefore the pH data from January 12, 2018 to February 1, 2018 was not representative of the brook and the data was removed from the dataset in this report. After replacement of the pH sensor the pH data displayed accurate values.

In this stream the CCME guideline provides a basis by which to judge the overall health of the brook. During this deployment the pH levels did not indicate that there were any immediate issues with water quality in Waterford River. The median pH level was 7.46 pH units, slightly higher than that of the previous deployment pH median of 7.00 pH units.

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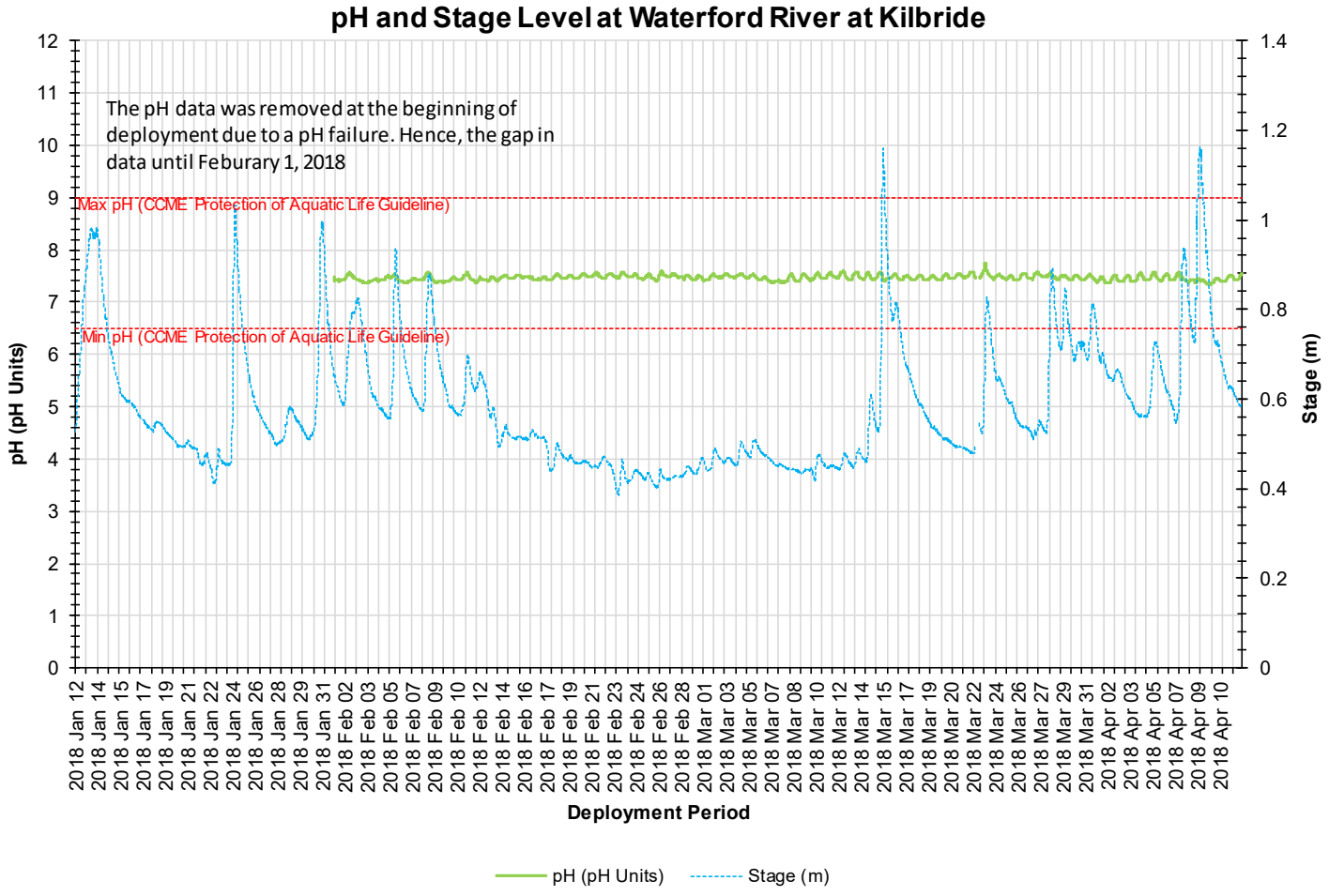

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 501.0 µS/cm and 4961.0 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.3250 g/L to 3.225 g/L (Figure 4).

At the beginning of the deployment period, when the stage levels increase, the specific conductance levels decrease. 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 January 14th, 2018). However, after January 24th 2018, 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.

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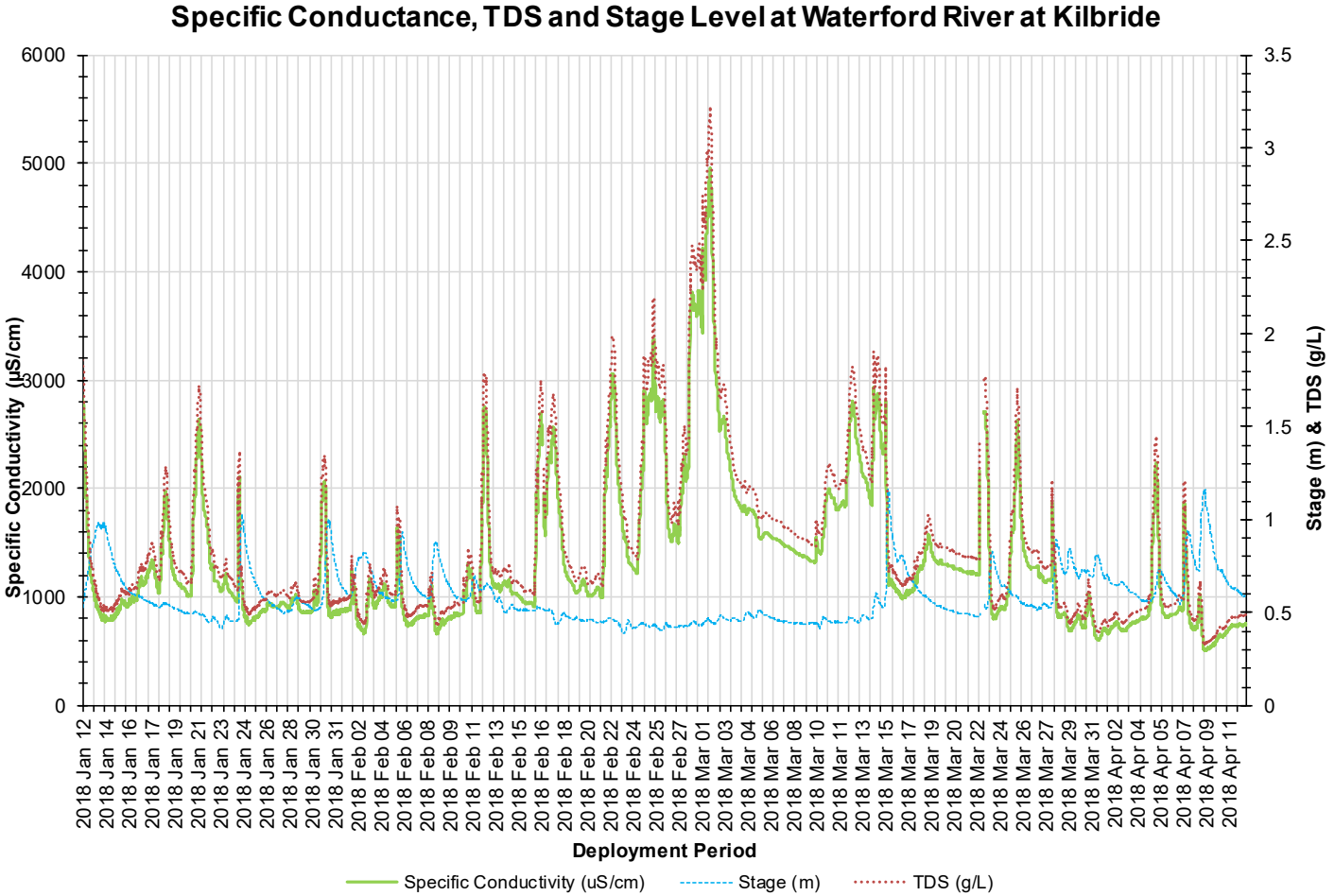

Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

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 within a minimum of 12.08 mg/L to a maximum of 14.89 mg/L. The percent saturation levels for dissolved oxygen ranged within 95.0 % Saturation to 105.4 % 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 will decrease the concentration of dissolved oxygen present in the brook. During this deployment, the dissolved oxygen levels remained above the minimum 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 waters remain cold in the winter months.

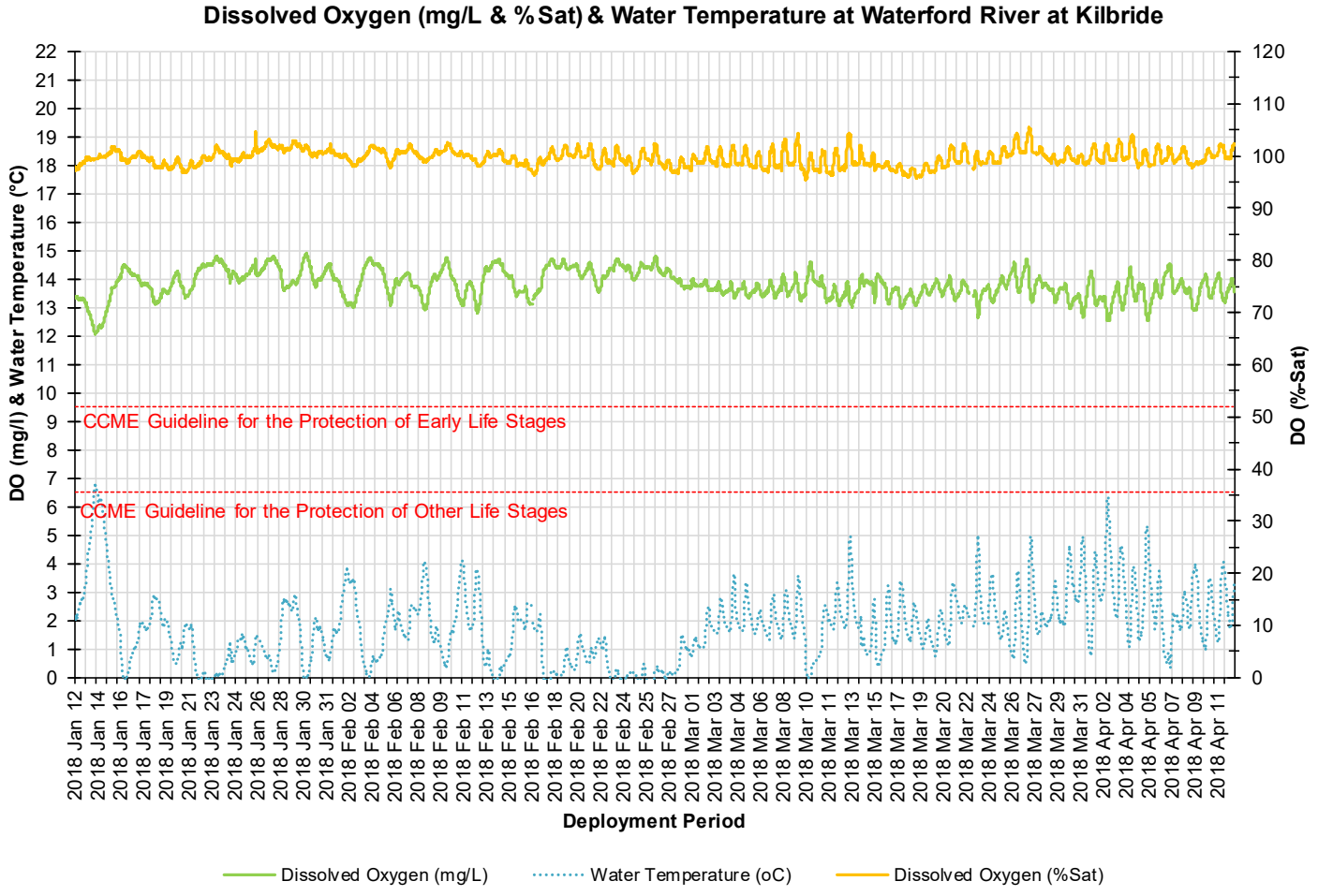

Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.1 NTU and 332.0 NTU (Figure 6). The deployment data had a median of 2.8 NTU which is lower than the previous deployment median of 5.0 NTU.

The higher turbidity events throughout the deployment period correlate with increases in stage. There was recorded precipitation 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. The turbidity data returns to background 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.

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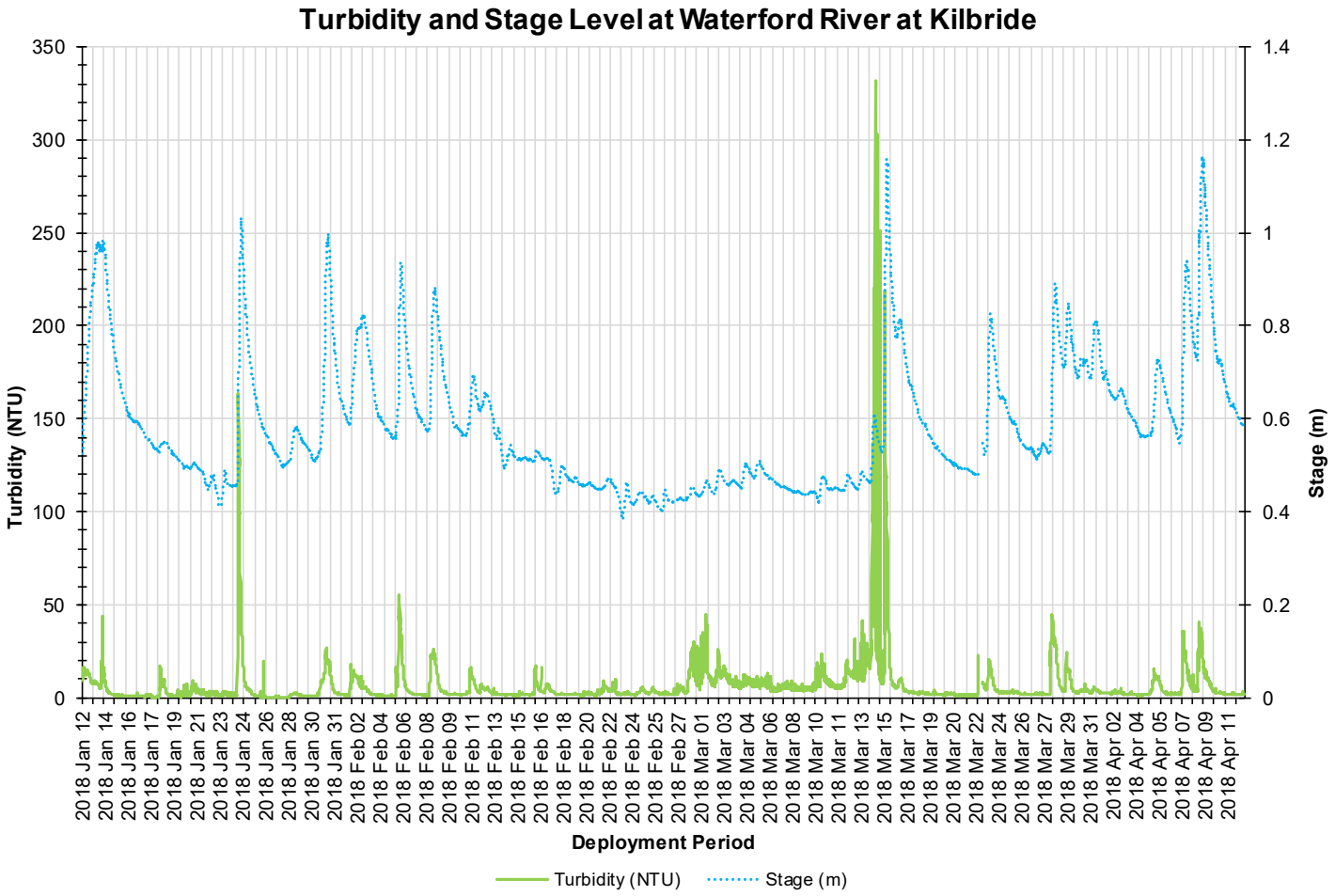


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 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 0.39m to 1.16m. The larger peaks in stage do correspond with substantial rainfall events as noted on Figure 7. Total Precipitation data was obtained from Environment Canada's St. John's International Airport weather station. Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 36.6 mm on January 16th 2018.

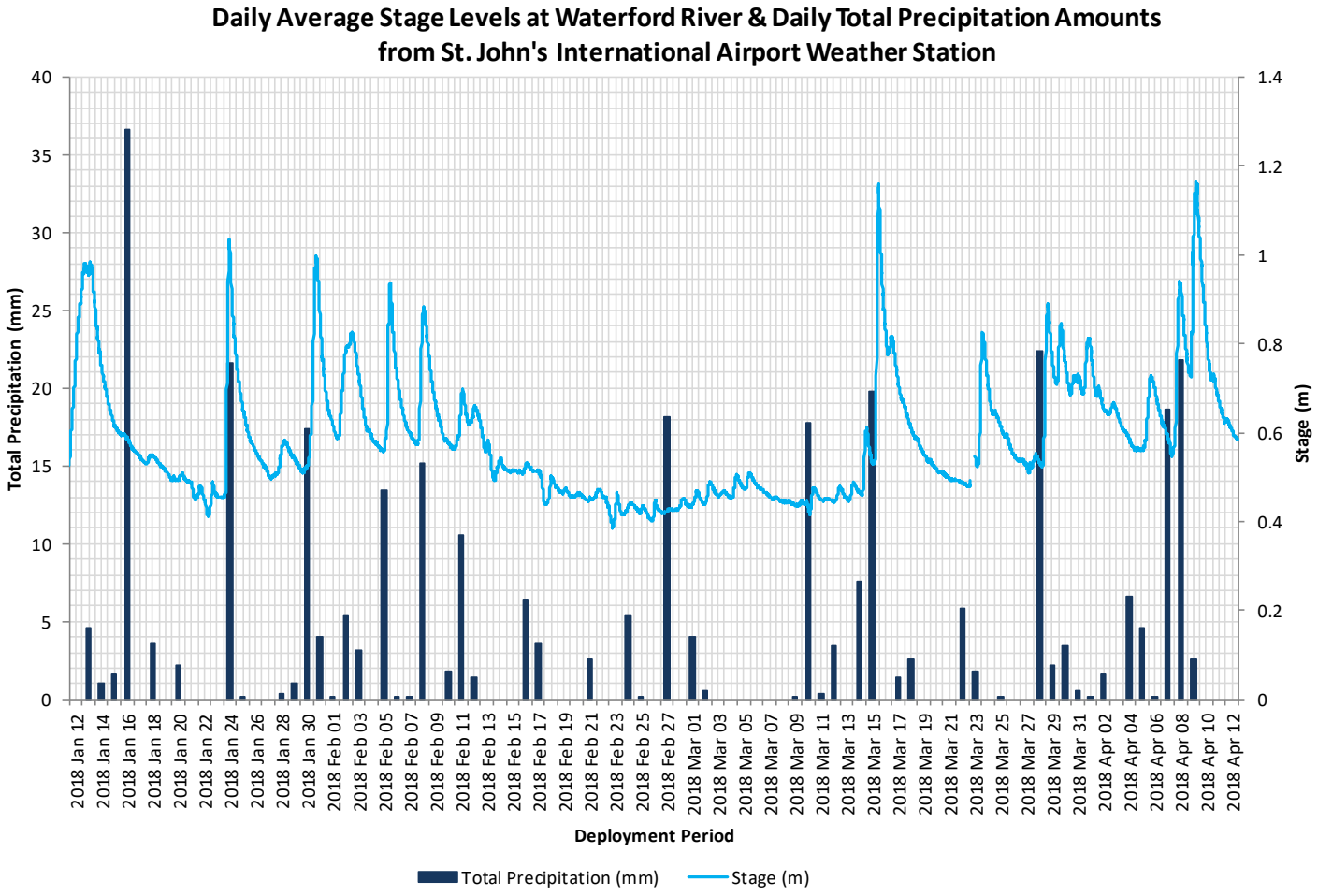


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

Conclusion

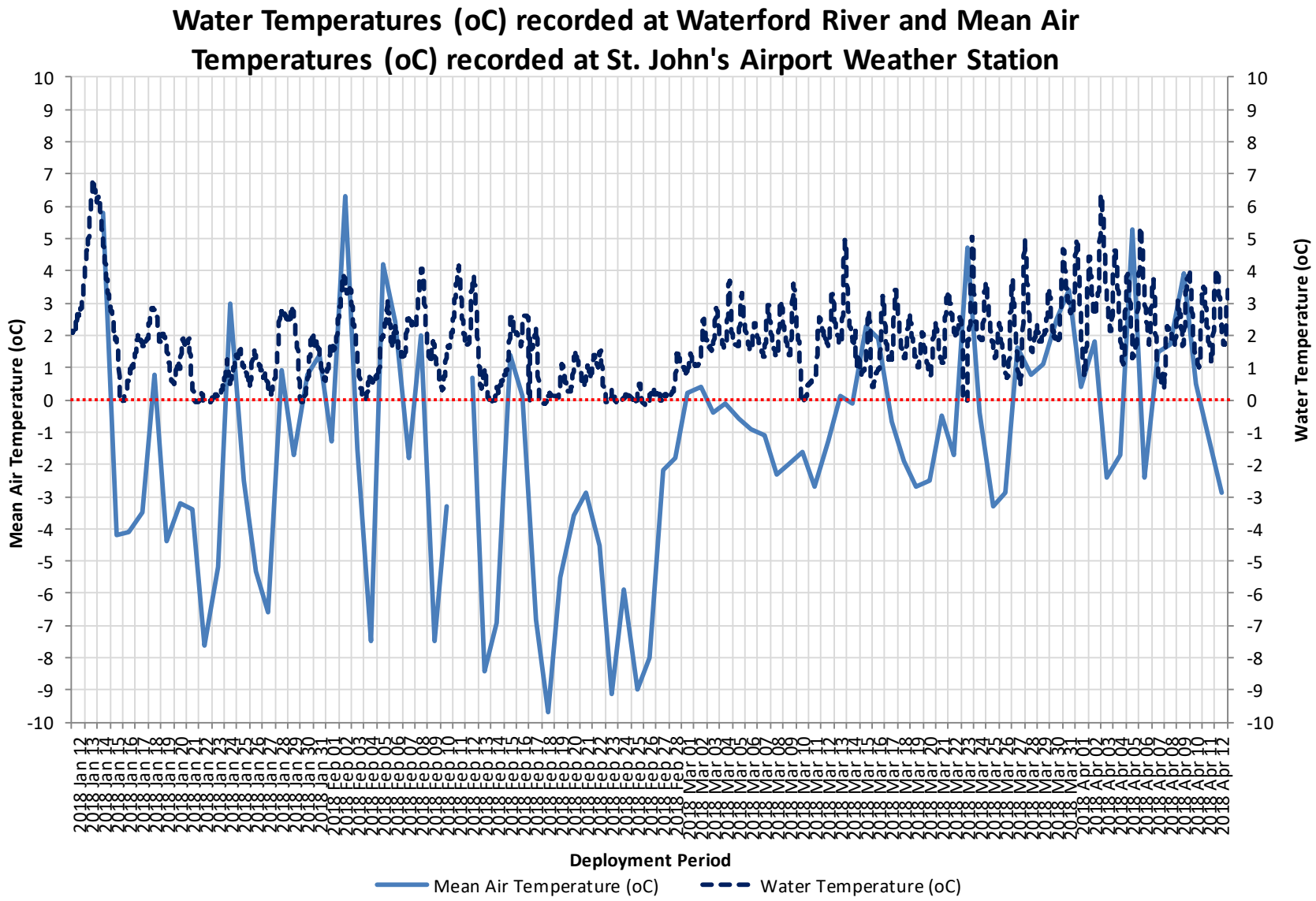
Waterford River at Kilbride flows through significant developed areas, including residential and industrial zones. Waterford River also borders along several heavily used urban roadways and thoroughfares. The proximity to these factors, combined with precipitation and runoff, can influence and adjust 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 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 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 road salting during the lower air temperature periods. Despite the removal of pH data at the beginning of the deployment period, the remaining pH values were reasonably consistent for this deployment. Dissolved oxygen was reasonably constant, with small increases during the lower temperature events. There was a significant increase in turbidity during a high stage event on March 13th, 2018 however, the data returned to previous levels on March 15th, 2018.

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 during the winter.

APPENDIX I


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

Waterford River at Kilbride, Newfoundland and Labrador