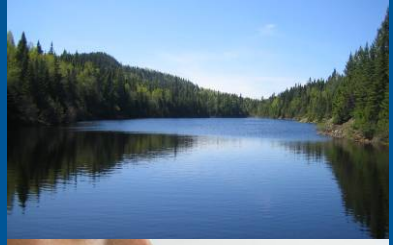







Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
July 12 2018 to August 28 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 July 12 2018 until removal on August 28 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	July 12	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	August 28	Removal	Excellent	Good	Good	Excellent	Fair

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, pH, conductivity and dissolved oxygen ranked as 'Excellent' and 'Good'. These parameters rankings provided confidence that the data over the deployment was accurate and precise. Turbidity data ranked as 'Fair', this is likely a result of buildup of debris and sediment that is present in this brook, around the base of the instrument.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from 12.21°C to 23.51°C during this deployment period (Figure 2).

Over the duration of the deployment period the water temperature is generally consistent, as the water temperatures continue across the Summer. Several decreases and increases in water temperature correspond with the changes in the stage levels. 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.

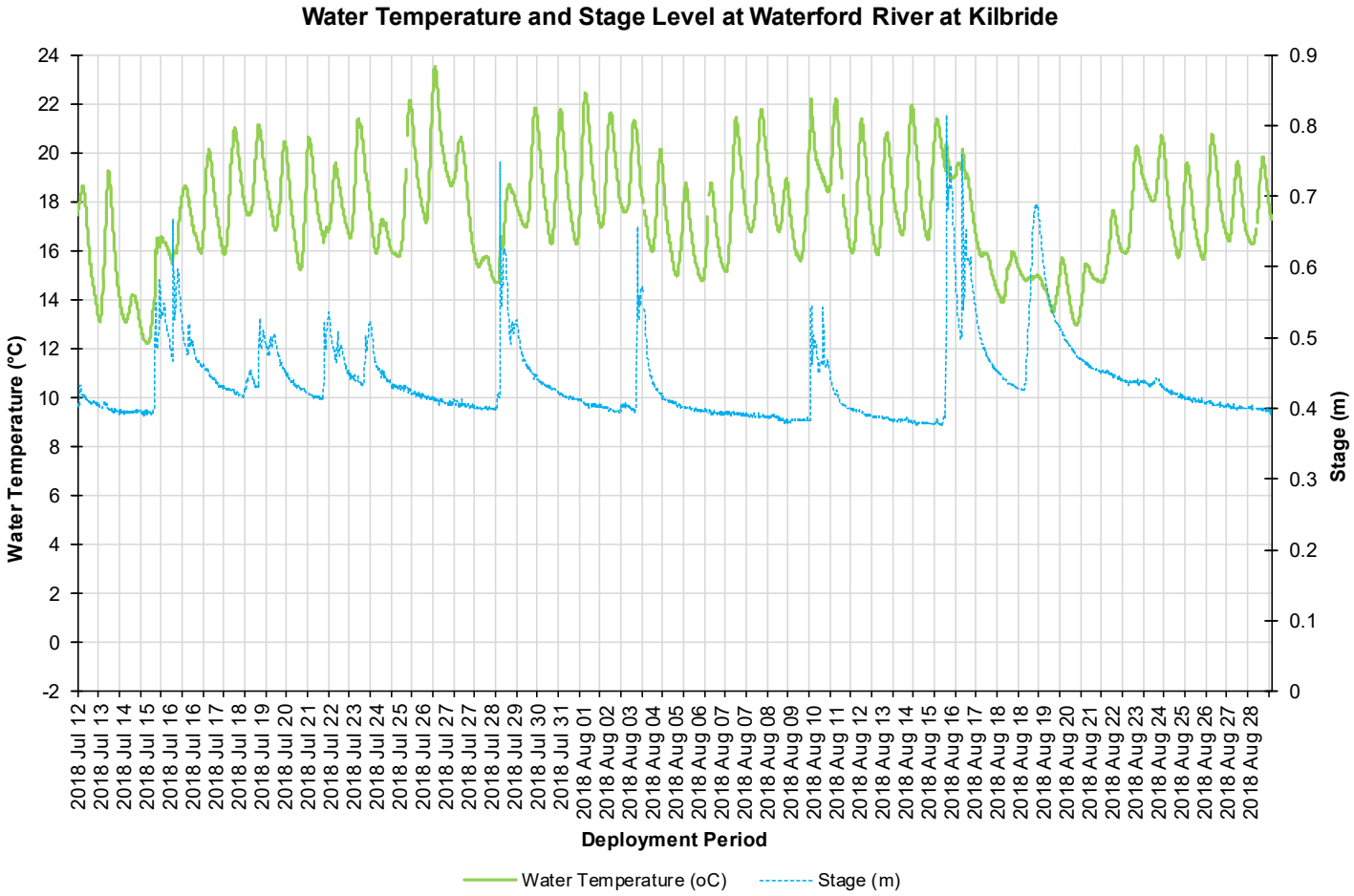

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 7.11 pH units and 8.71 pH units (Figure 3).

In this graph 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 as values remained between the guidelines. At the beginning of the deployment period the pH values were higher than what was recorded for the rest of deployment. This peak in pH was likely a result of the lower stage level at that time.

The median pH level was 7.34pH units, slightly higher than that of the past deployment median of 7.06 pH units.

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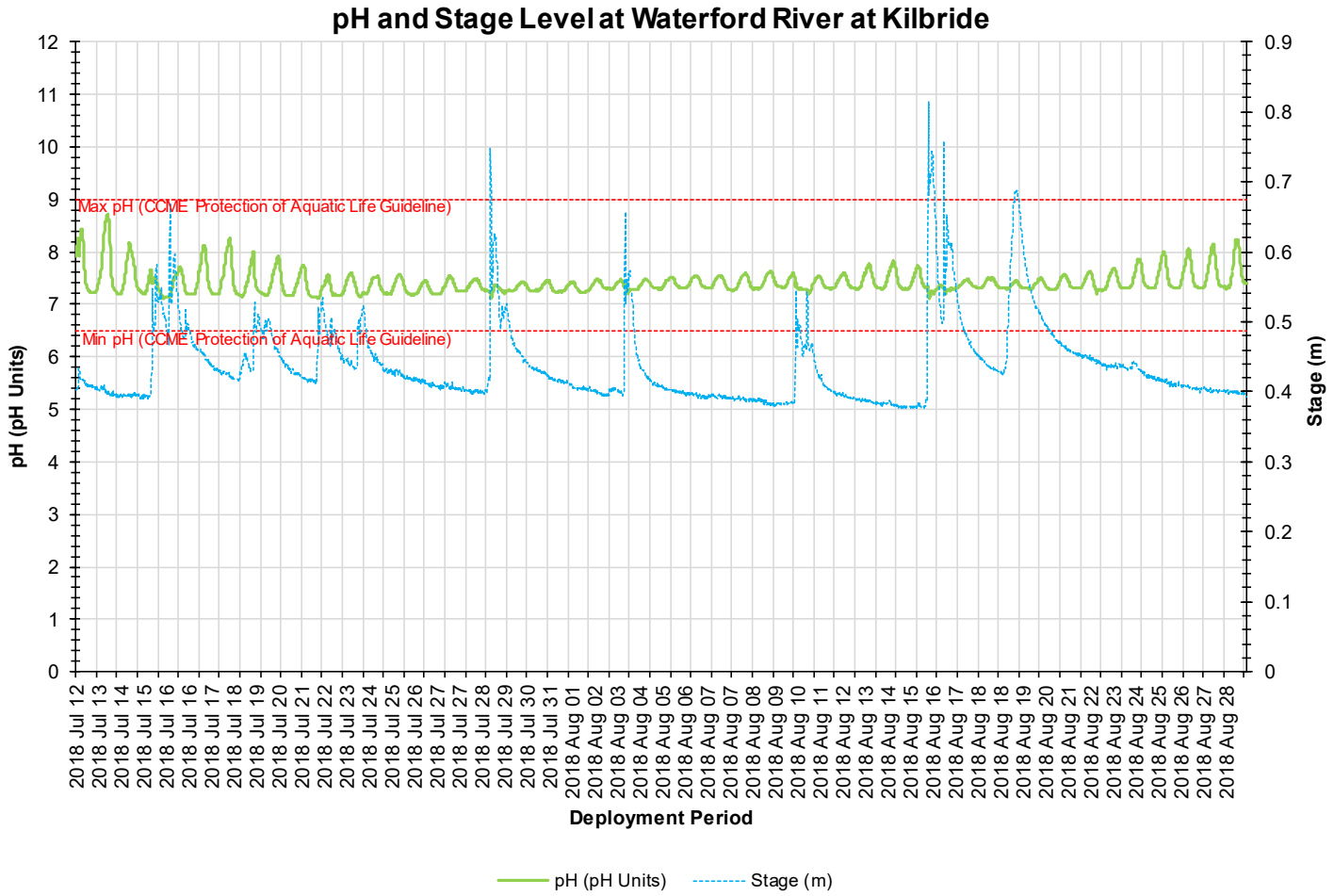

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 247 µS/cm and 776 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.161 g/L to 0.504 g/L (Figure 4).

During this deployment period the specific conductivity level decreased at each stage increase. The stage increases were likely a result of rainfall. The increase in water present in Waterford River dilutes the particulars and material present in the water column. After a period of time the conductivity levels start to rise again with evaporation.

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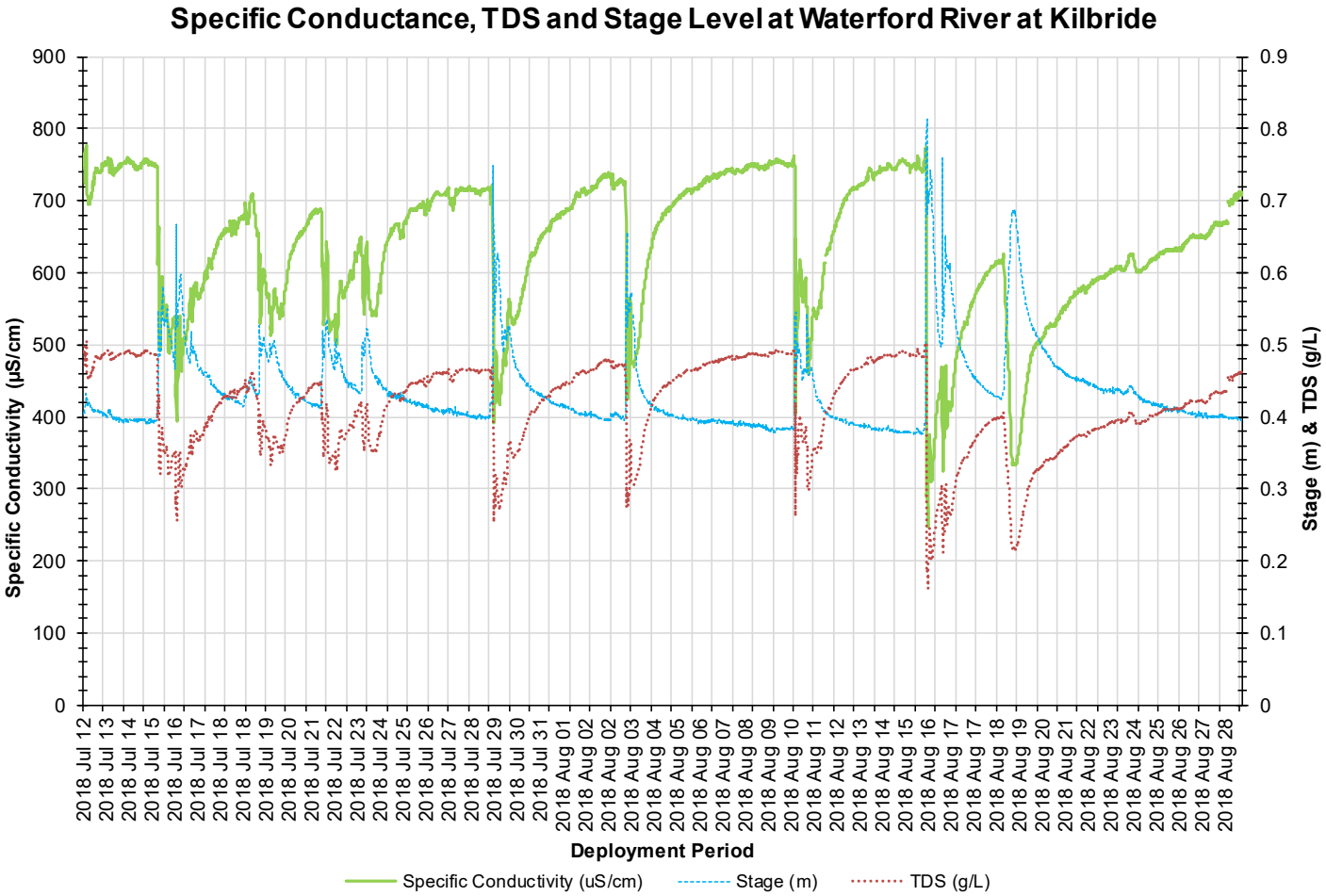


Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

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 8.4 mg/L to a maximum of 11.35 mg/L. The percent saturation levels for dissolved oxygen ranged within 93 % Saturation to 112.7 % Saturation (Figure 5).

Higher water temperatures decrease the concentration level of dissolved oxygen present in the brook. For the majority of this deployment, the dissolved oxygen levels were consistent with what would be expected of a waterway during the summer months.

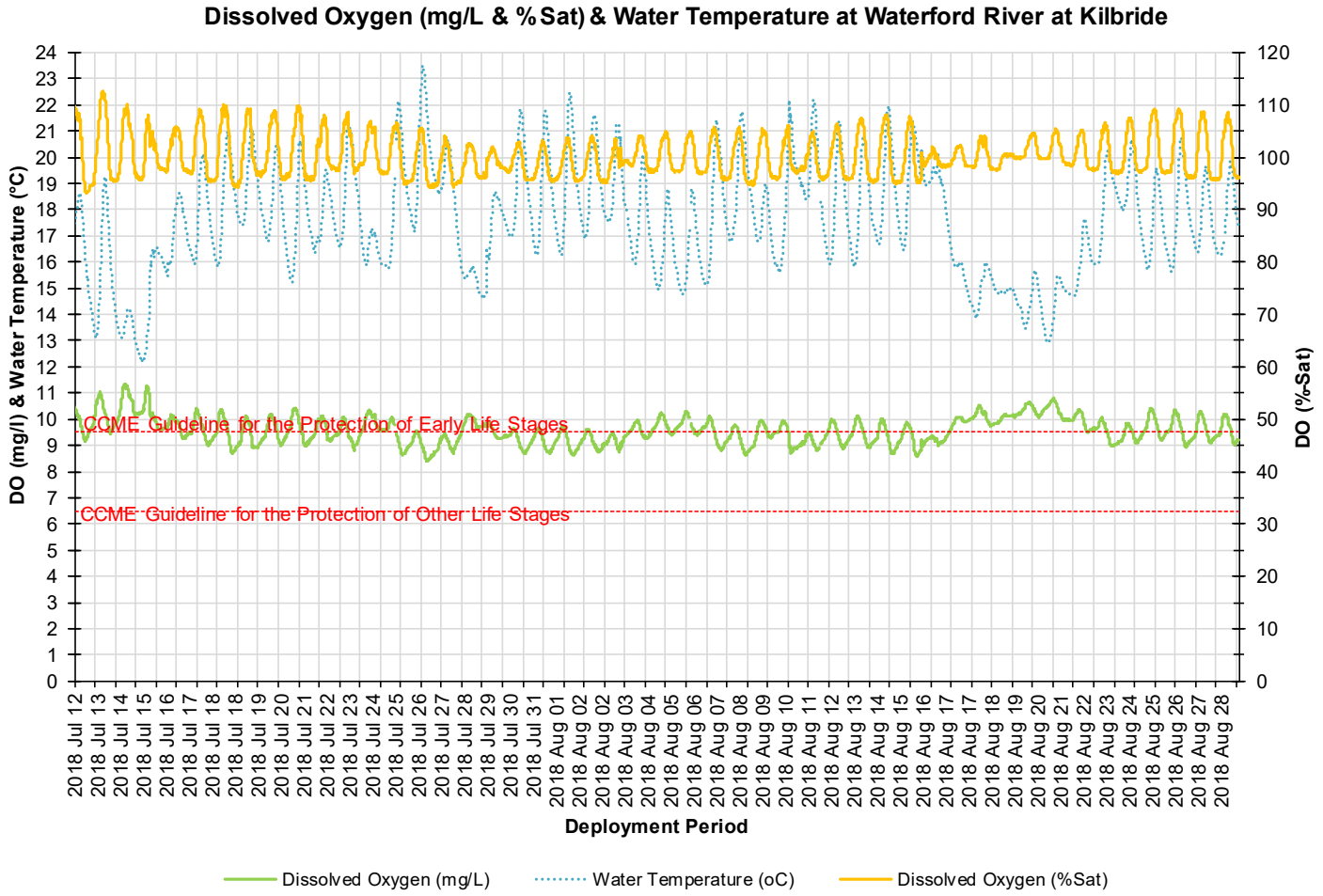


Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.9 NTU and 616.7 NTU (Figure 6). The deployment data had a median of 12.8 NTU which was higher than the median of the previous deployment, 5.1 NTU.

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.

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 the end of the deployment as the 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.

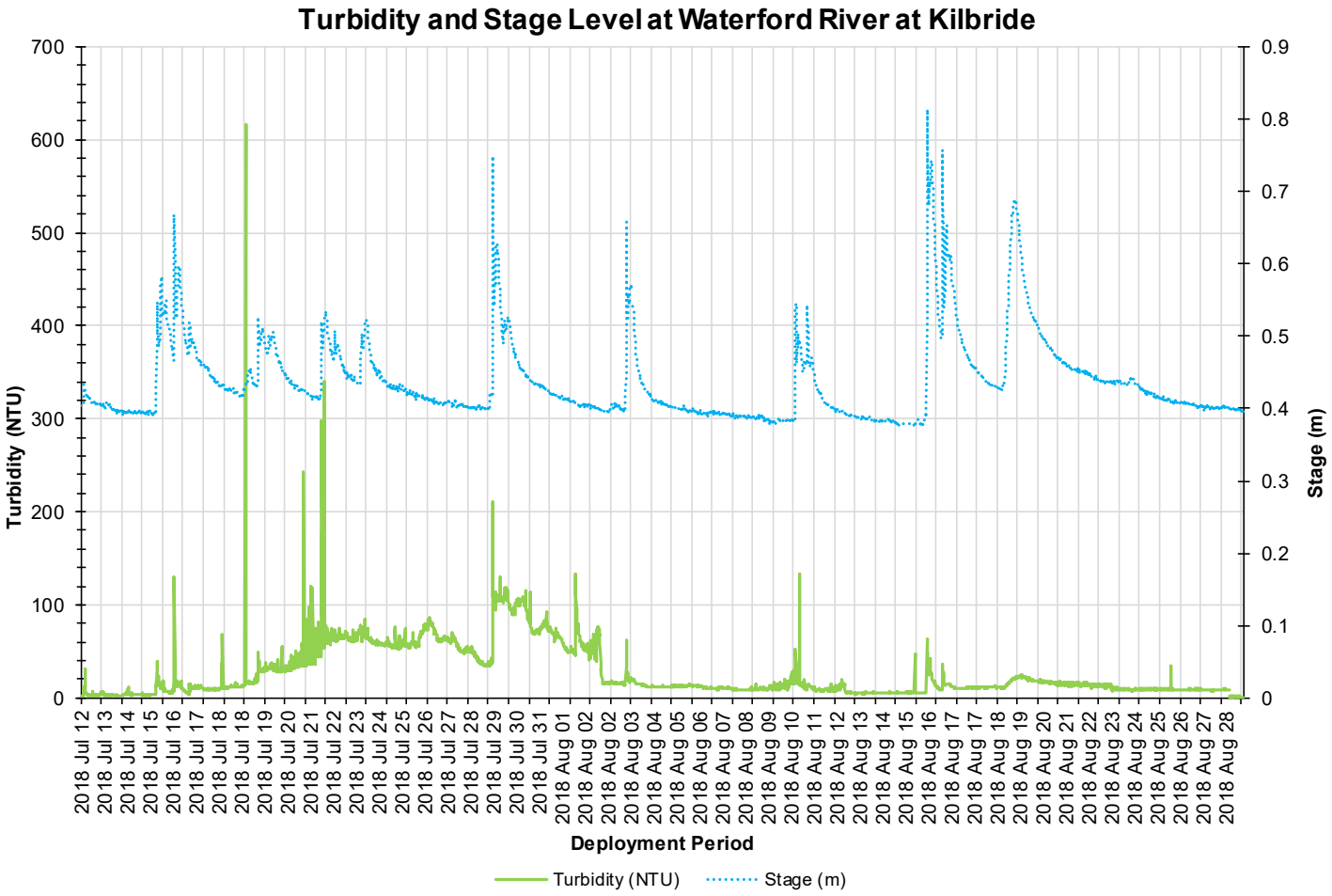


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

Stage and Precipitation

Please note the stage data graphed below is raw data. It is 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 0.38m to 0.81m. 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 22.4 mm on August 15, 2018.

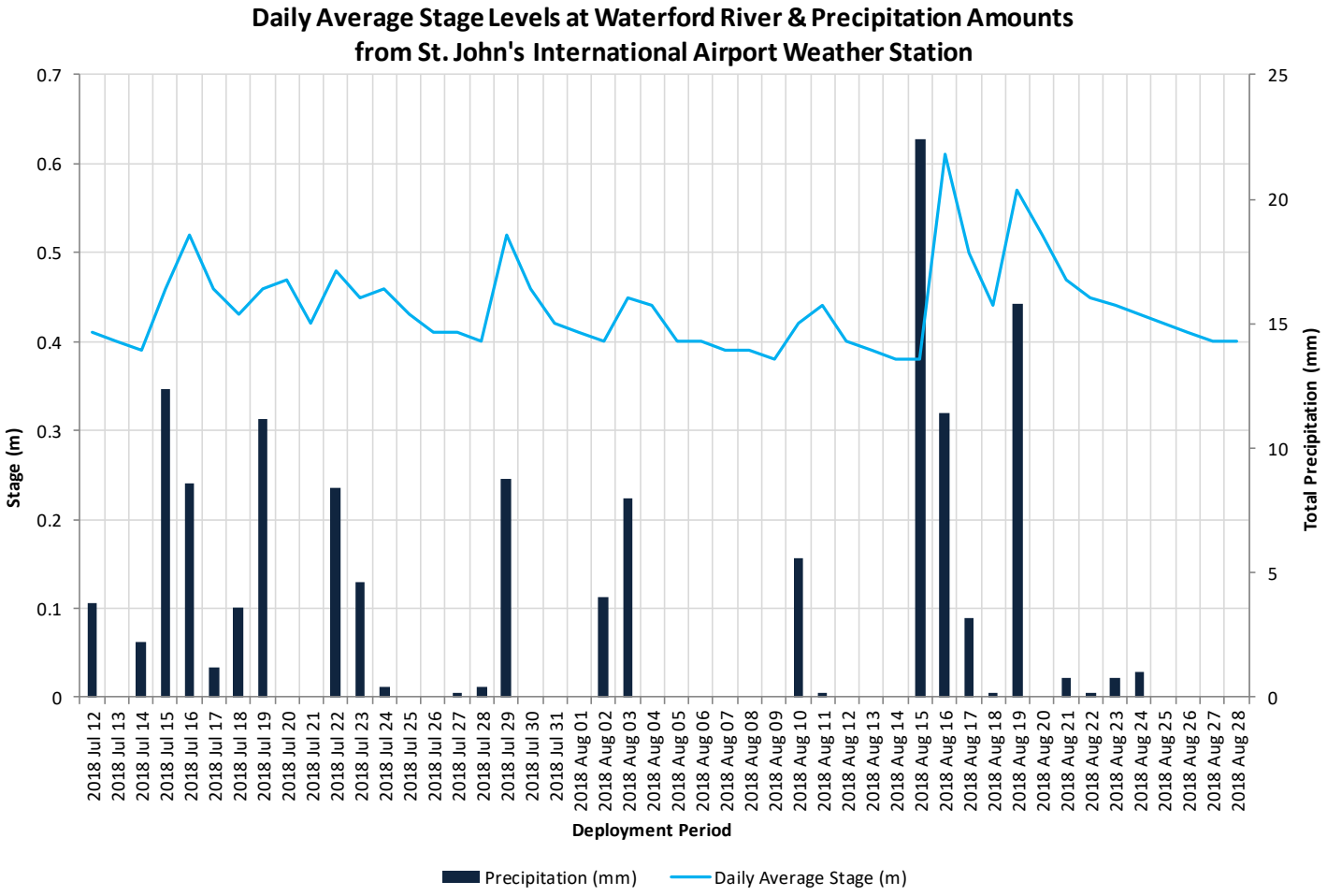
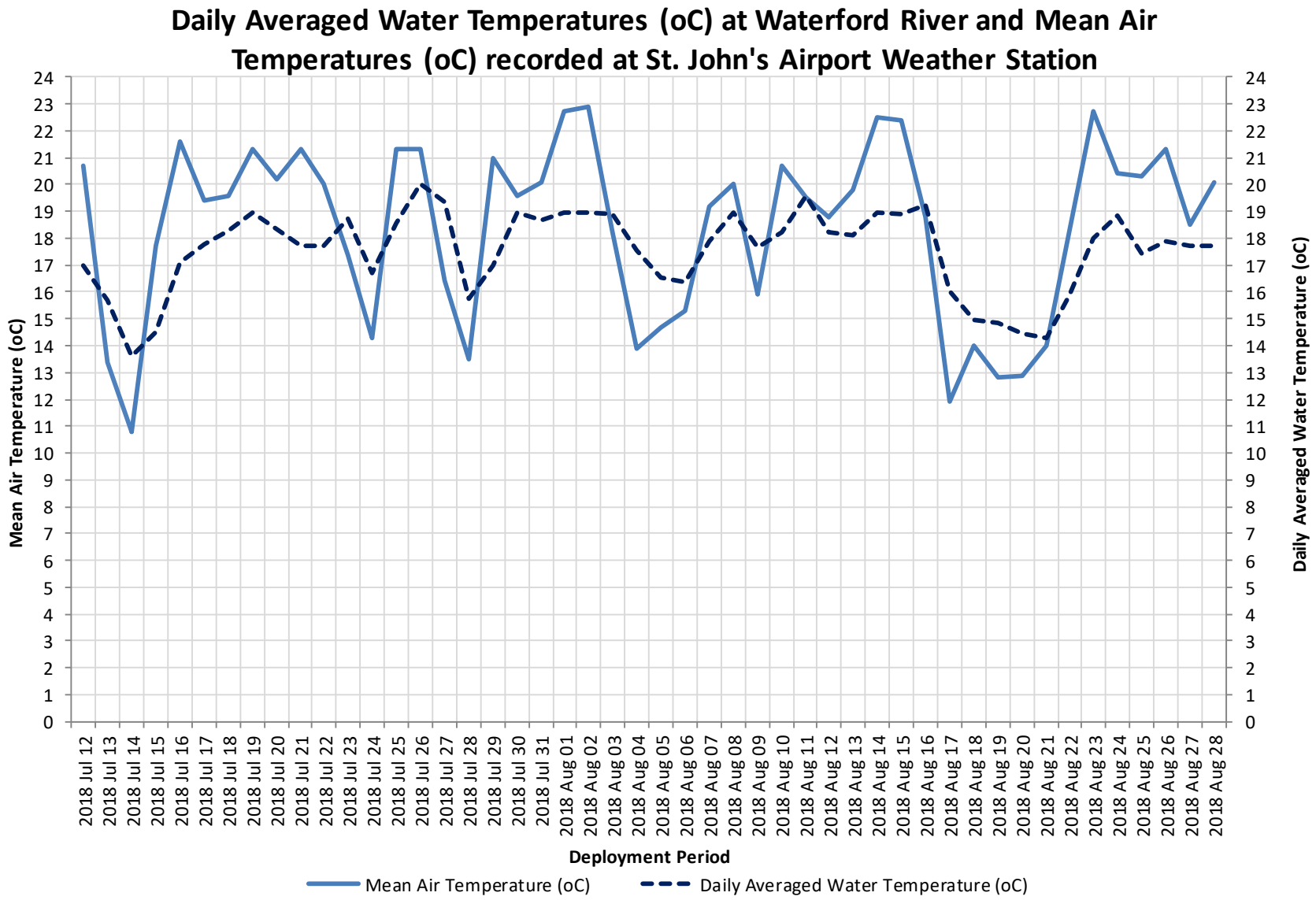


Figure 7: Stage values recorded at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

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