Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
August 20, 2015 to October 8, 2015

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division

Waterford River at Kilbride, Newfoundland and Labrador

Prepared by:

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General

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada - Environment Canada (WSC-EC), 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 August 20, 2015 until removal on October 8, 2015.

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 (Environment and Conservation (ENVC)) 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 ENVC'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 Canada (EC)) 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-EC 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	August 20	Deployment	Good	Excellent	Good	Excellent	Excellent
	October 8	Removal	Marginal	Excellent	Excellent	Poor	Excellent

On deployment the rankings of the field data against the QAQC data was as follows; water temperature and conductivity data ranked as 'Good' with dissolved oxygen, pH and turbidity data ranked as 'Excellent'.

At removal of the instrument, the water temperature data ranked as 'Marginal'. The conductivity and pH and turbidity data ranked as 'Excellent'. The dissolved oxygen data ranked as 'Poor' at removal. It should be noted that the QAQC instrument used to compare against the field instrument was actually a Clark Cell Dissolved Oxygen probe. This probe reads dissolved oxygen slightly different from the field instrument. There is likely a difference in dissolved oxygen values due to the differences in the instruments.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from 7.78°C to 22.17°C during this deployment period (Figure 2). There were noticeable increases and decreases in the water temperature. This would likely be consistent with ambient air temperatures over this time period, generally temperatures will increase during daylight hours and cool overnight.

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 subtlety by natural diurnal variations in air temperatures (Appendix I).

Please note, the stage data is raw data that is published on the ENVC 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.

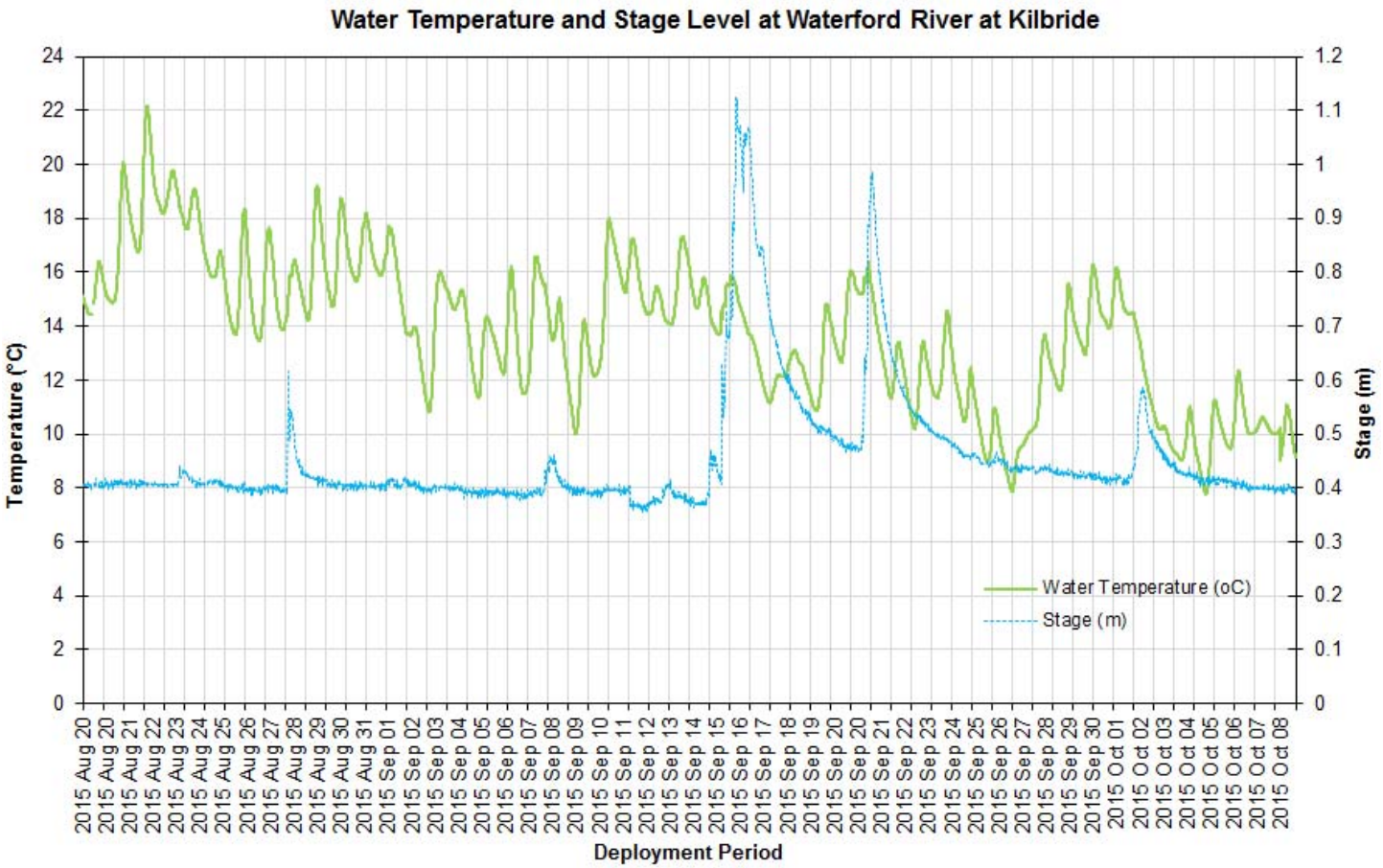

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 7.06 pH units and 7.65 pH units (Figure 3).

During this deployment, the pH data was reasonably consistent. The pH values at this station were above the minimum CCME Guideline for the Protection of Aquatic Life (above 6.5 pH units).

The CCME guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. During the deployment period the median pH level was 7.29 pH units.

During the higher stage periods the pH values flattening slightly before returning to its pervious values. Please note the stage data is raw data that is published on the ENVC 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.

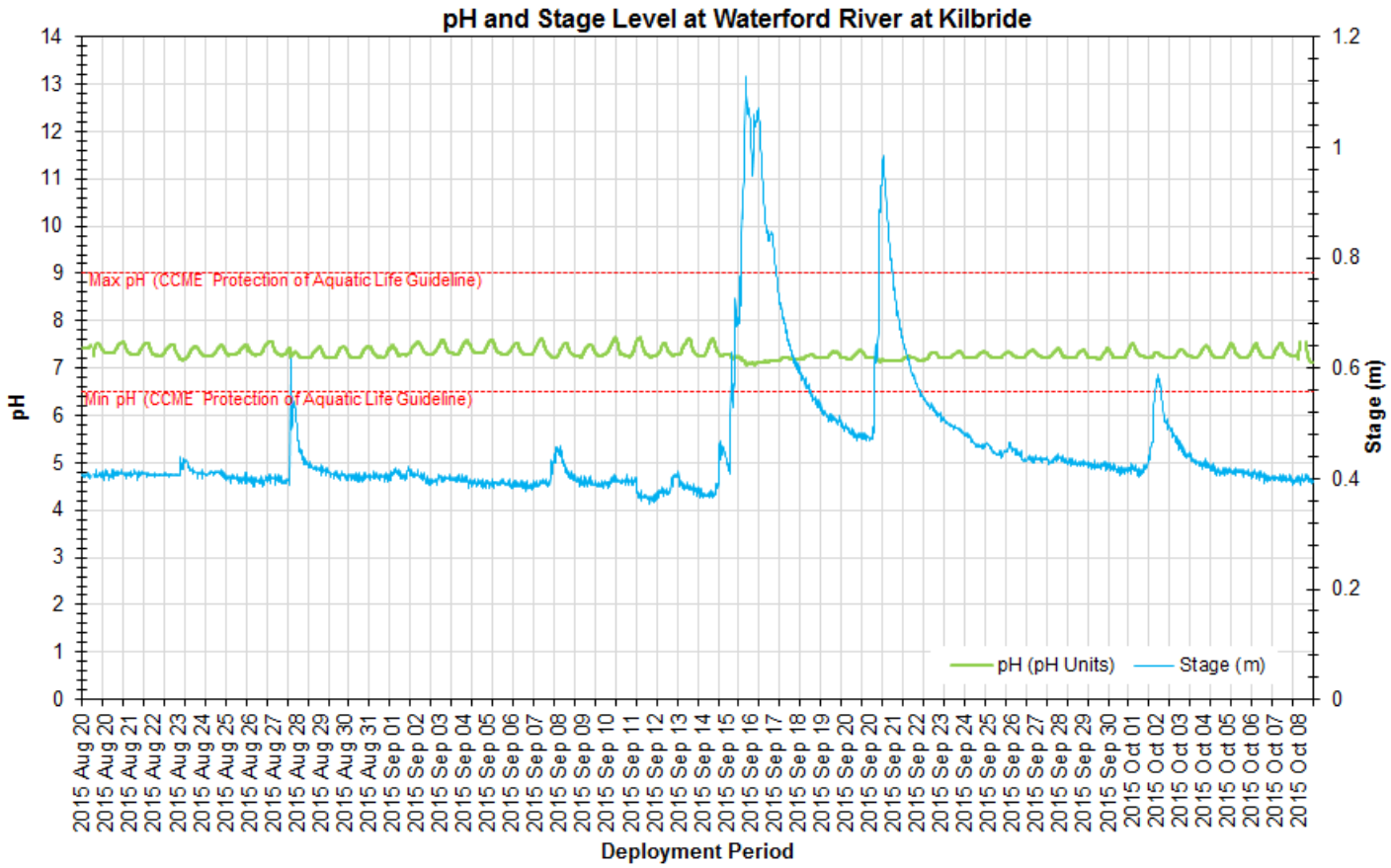

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 210 µS/cm and 805 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.1370 g/L to 0.5230 g/L.

Commonly the relationship between conductivity and stage level is inversed. When stage levels rise, the specific conductance levels drop in response as the increased amount of water in the river system dilutes the solids that are present. This relationship is evident in this deployment period in the circled conductivity events on Figure 4.

Spikes in conductivity, as seen toward the end of deployment, may be a result runoff into the brook from the nearby roadways and storm water drains. Additional material and dissolved substances in the brook are captured by the conductivity probe before the levels drop back down.

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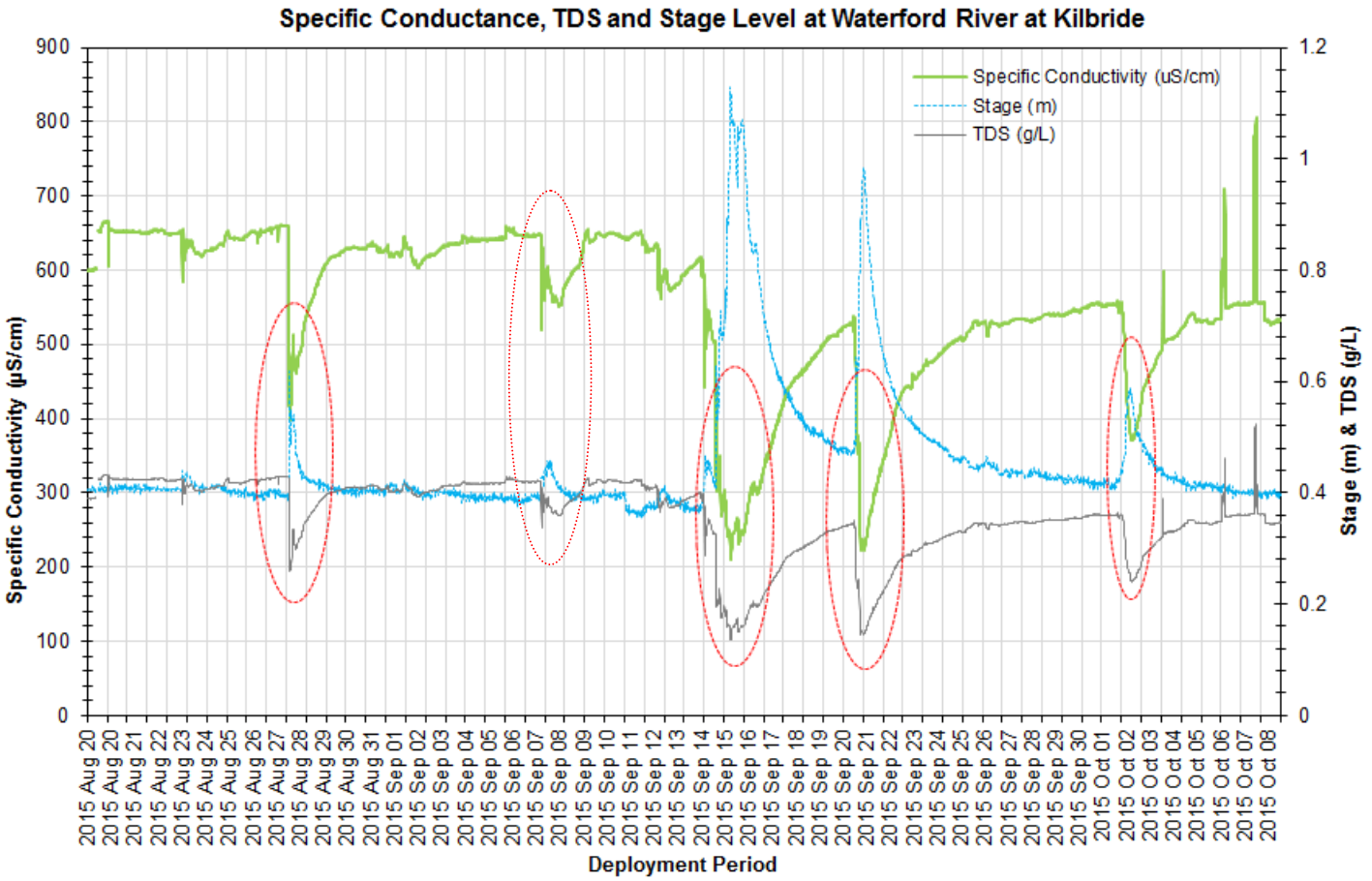


Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

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

During the deployment the dissolved oxygen concentration levels ranged within a minimum of 8.65mg/L to a maximum of 12.13mg/L. The percent saturation levels for dissolved oxygen ranged within 89.3 %Sat to 108.0 %Sat (Figure 5).

The dissolved oxygen concentration remains constant through deployment. The dissolved oxygen levels do dip below the CCME guideline for the Protection of Early Life Stages (9.5) however it was just for a short period of time before the dissolved oxygen returned to pervious levels. Warmer water temperatures will influence the dissolved oxygen levels over the summer period.

The circled areas on the graph are displaying the changes in dissolved oxygen during high stage levels, likely a result of rainfall.

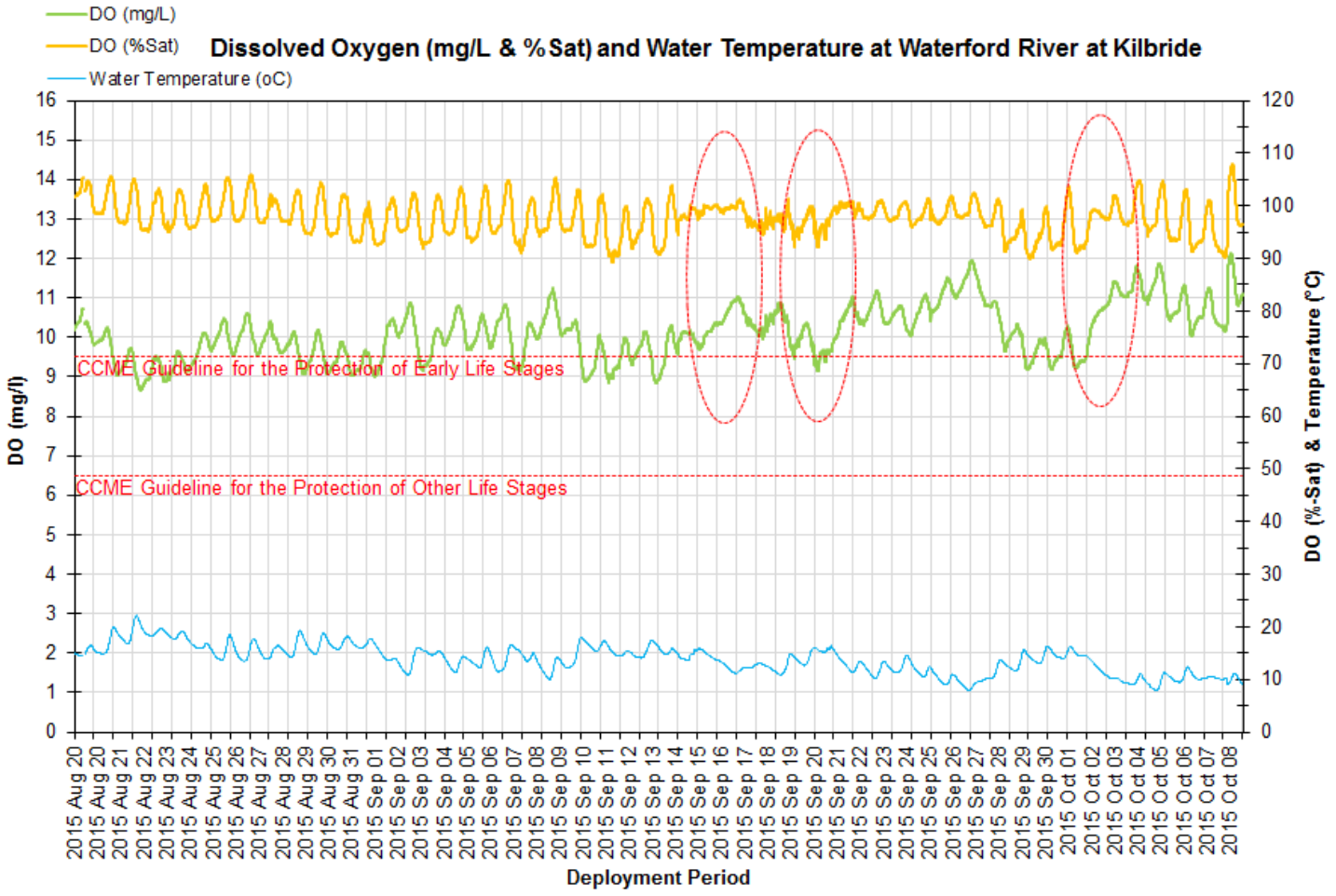


Figure 5: Dissolved oxygen (mg/L & Percent Saturation) and Water Temperature (oC) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.6 NTU and 103.3 NTU (Figure 6). The deployment data had a median of 0.0 NTU.

There was turbidity data removed from the dataset graphed below. This instrument was recording negative values for turbidity. The negative values for turbidity were removed to ensure they were not included in any statistical analysis. The negative values just signified that the brook water was clearer than the calibration standard of 0.0 NTU.

The majority of the turbidity events in the deployment period correlate with increases in stage potentially from precipitation. Precipitation can increase the presence of suspended material in water. After the peak in turbidity the values return to a lower level. Please note the stage data is raw data that is published on the ENVC 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.

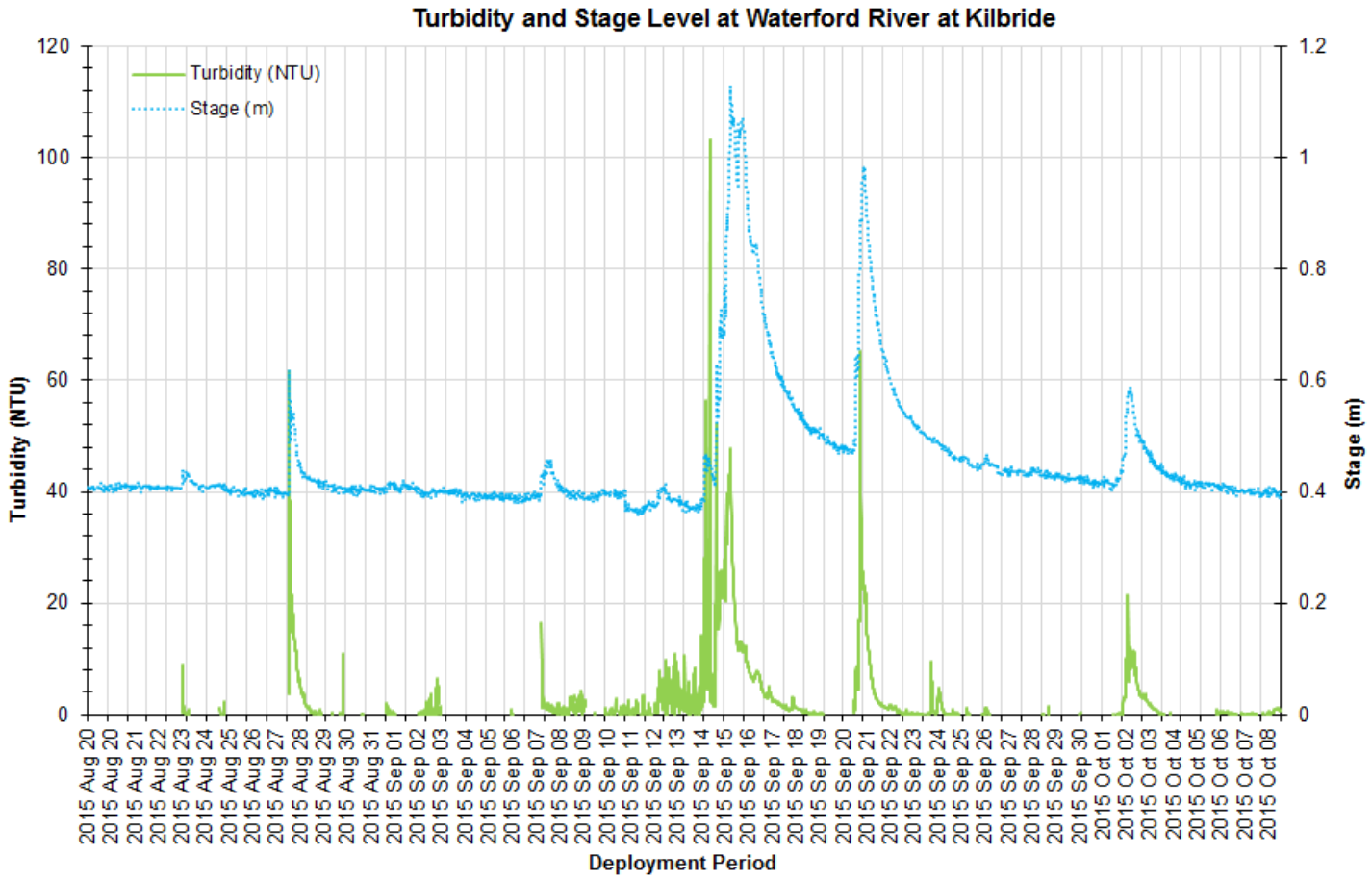


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 them to rise significantly.

During the deployment period, the stage values ranged from 0.36m to 1.13m. 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 67 mm on September 15th, 2015.

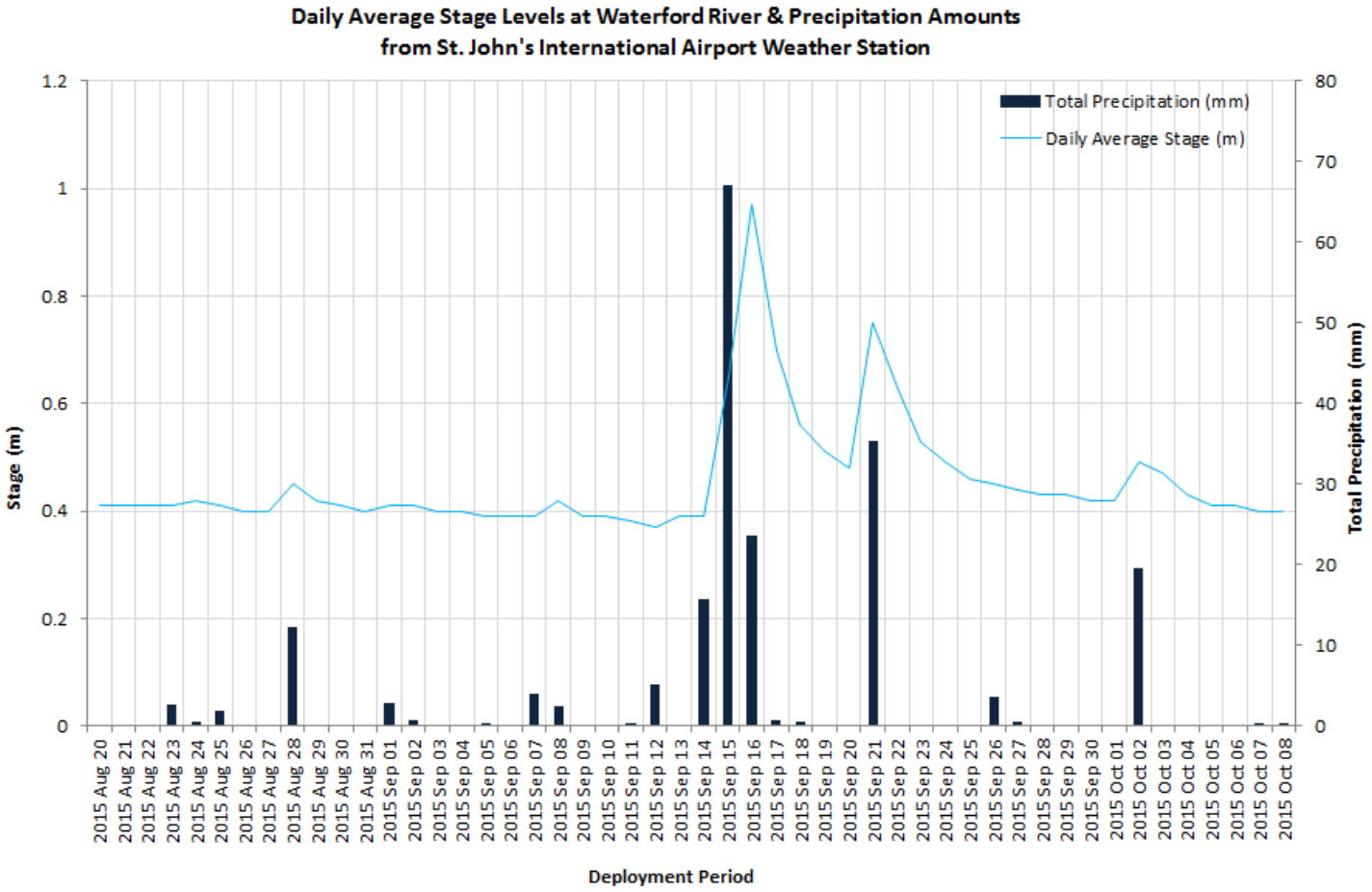


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

Conclusion

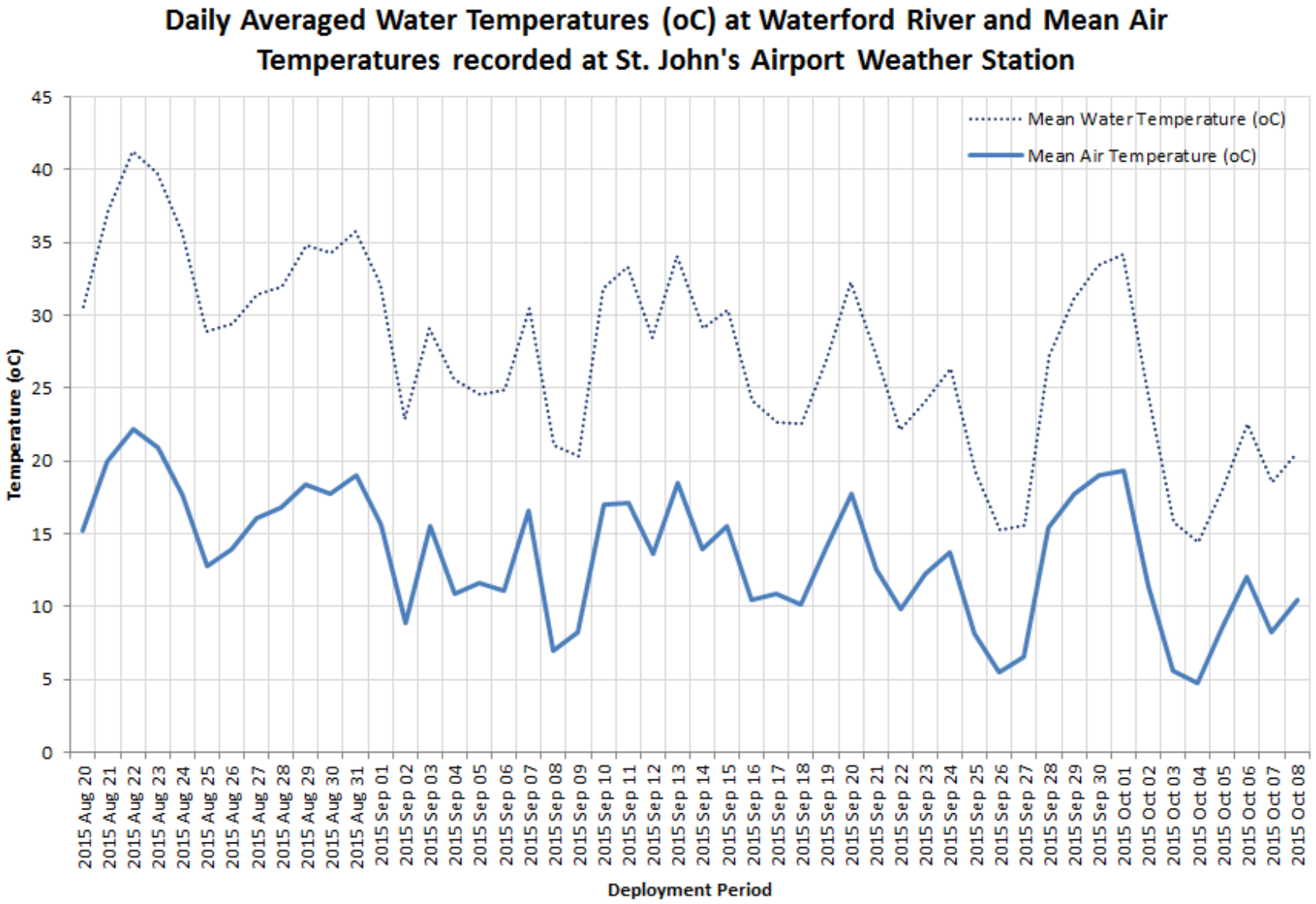
As with many urban brooks and streams, precipitation and runoff events play a role in influencing the water quality within the water body. Waterford River flows through significant developed areas, including residential and industrial zones, the brook can also be found along the boundaries of heavily used road ways, all these factors can influence the parameters that are recorded by the water quality instrument.

It is evident by the recorded data that precipitation events have influenced fluctuations in stage and streamflow. 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.

Despite the changes in the water quality parameters during the higher stage events the data was as expected of an urban brook during this time of the year. After each event the data for all the parameters returned to its 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


Daily Averaged Water Temperatures (oC) at Waterford River and Mean Air Temperatures recorded at St. John's Airport Weather Station
Mean Water Temperature (oC)
Mean Air Temperature (oC)
Temperature (oC)
0
5
10
15
20
25
30
35
40
45
2015 Aug 20
2015 Aug 21
2015 Aug 22
2015 Aug 23
2015 Aug 24
2015 Aug 25
2015 Aug 26
2015 Aug 27
2015 Aug 28
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2015 Aug 31
2015 Sep 01
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2015 Sep 24
2015 Sep 25
2015 Sep 26
2015 Sep 27
2015 Sep 28
2015 Sep 29
2015 Sep 30
2015 Oct 01
2015 Oct 02
2015 Oct 03
2015 Oct 04
2015 Oct 05
2015 Oct 06
2015 Oct 07
2015 Oct 08
Deployment Period