Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
May 23, 2017 to June 28, 2017

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Municipal Affairs & Environment
Water Resources Management Division

Prepared by:

Tara Clinton
Environmental Scientist
Water Resources Management Division
Department of Municipal Affairs and Environment
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
Ph. No.: (709) 729 - 5925
Fax No.: (709) 729 - 0320
taraclinton@gov.nl.ca

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.

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 May 23, 2017 to removal on June 28, 2017

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 (Municipal Affairs and Environment (MAE)) 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 MAE'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 and Climate Change Canada (ECCC)) 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-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 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	May 23	Deployment	Excellent	Excellent	Good	NA	Excellent
	June 28	Removal	Excellent	Poor	Excellent	Good	Good

On deployment the ranking of the field data against the QAQC data was: water temperature, pH, and turbidity data ranked as 'Excellent', with the specific conductivity data ranked as 'Good'. Dissolved oxygen was not ranked as the QA instrument was having dissolved oxygen issues and the data was not representative of the brook, therefore there were no rankings calculated. All other rankings for the water quality parameters were acceptable for the initial deployment of the field instrument.

At removal of the instrument, the ranking for water temperature and specific conductivity data was ranked as 'Excellent'. Dissolved oxygen and turbidity data was ranked as 'Good' and pH data ranked as 'Poor'. The 'Poor' pH ranking was linked back to a pH issue on the QA instrument. The deployment data for pH does not indicate any issues during the time the instrument was deployed.

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.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from 4.10°C to 23.15°C during this deployment period (Figure 2).

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

Over the duration of the deployment period the water temperature gradually increases as the air temperatures increase with the warmer temperatures approaching summer. During high stage events there is a slight decrease in the water temperatures for a short period of time until the temperatures return to the natural diurnal pattern.

Please note the stage data is raw data that is published on the ECCC 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.

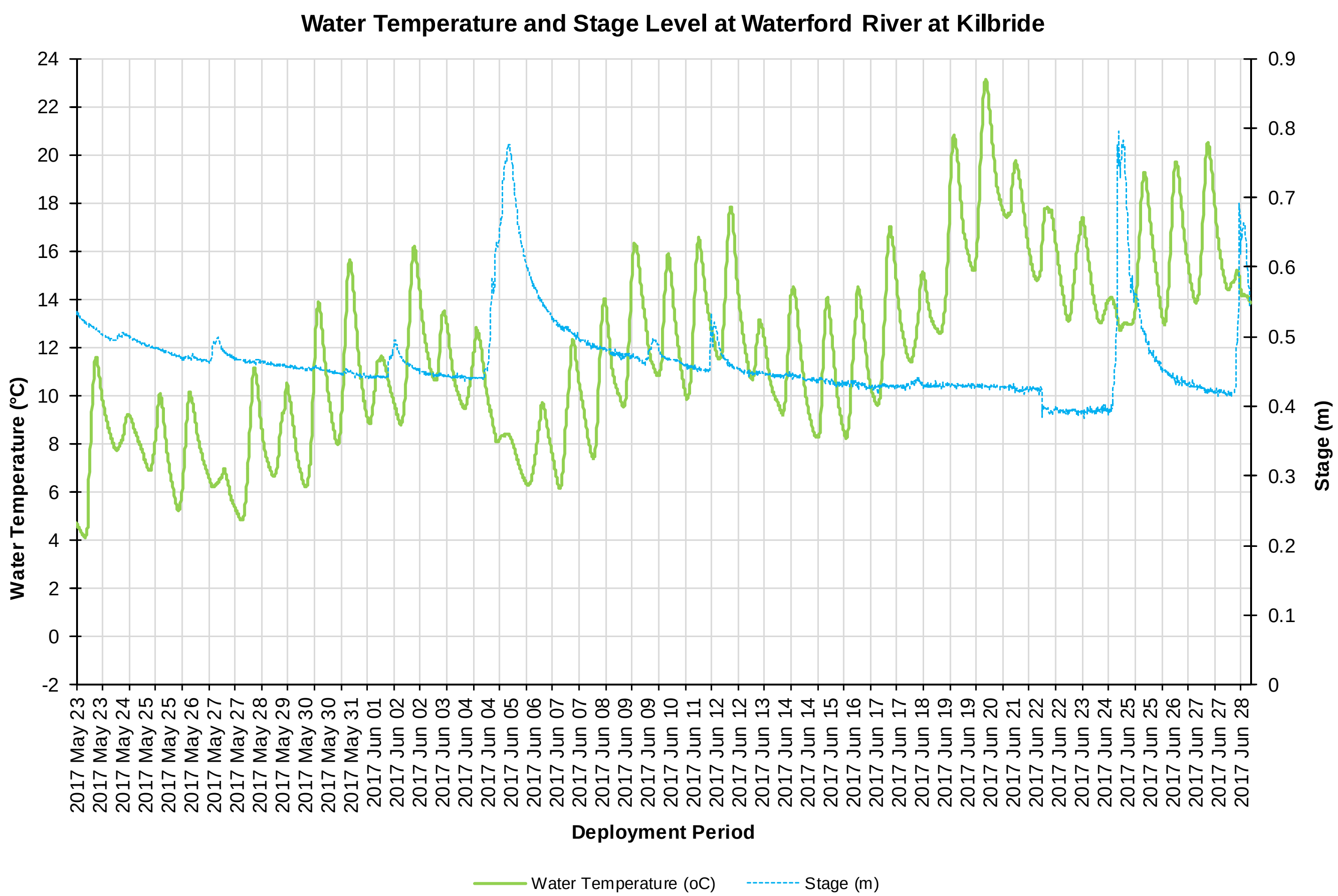


Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.72 pH units and 7.53 pH units (Figure 3).

The pH levels are reasonably consistent and remained within the guidelines indicated on the graph, within the CCME guidelines. During high stage events there are slight dips in pH data for a short period of time.

In this stream the CCME guideline provides 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 7.05 pH units.

Please note the stage data is raw data that is published on the ECCC 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.

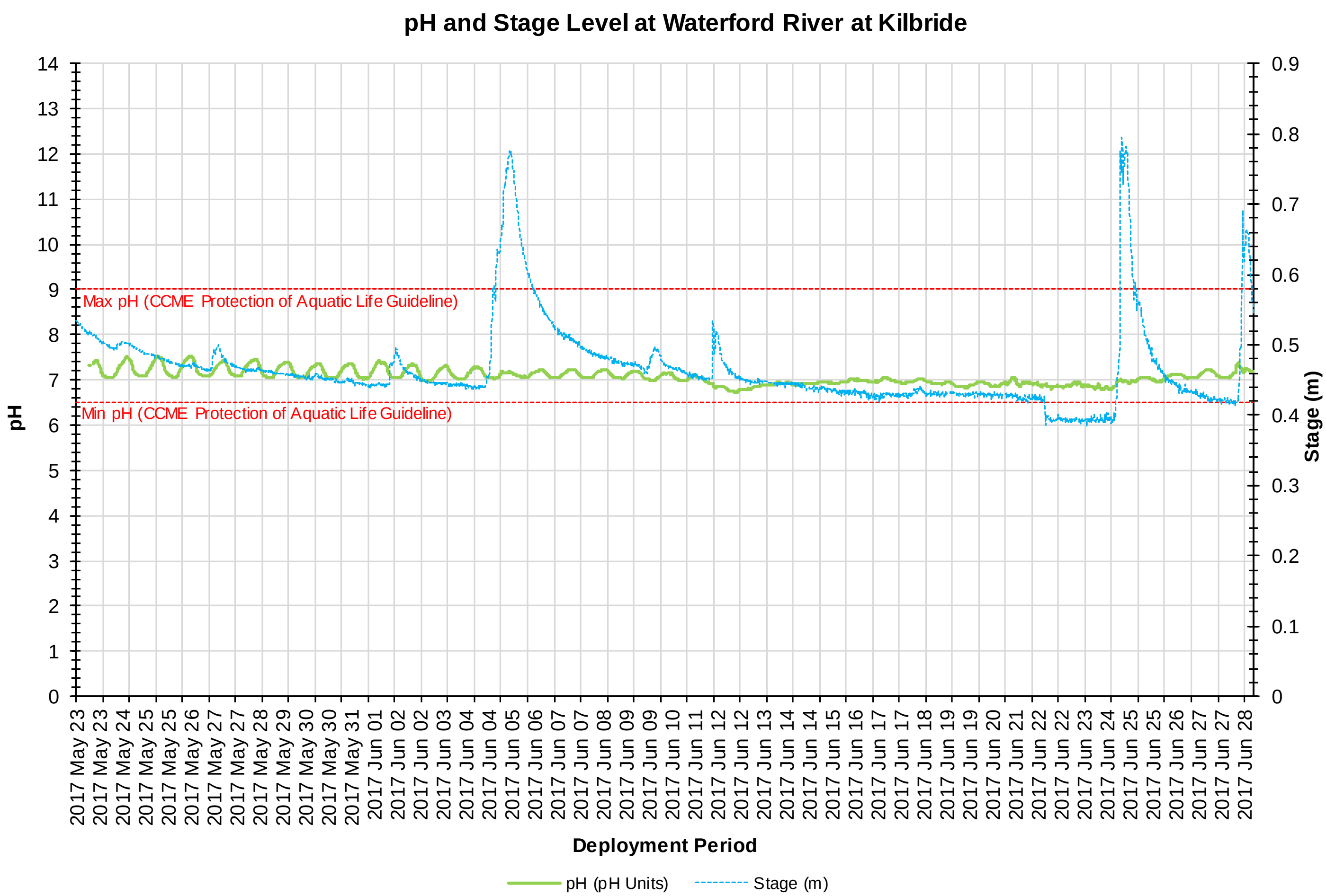


Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 313.0 µS/cm and 750.0 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.2040 g/L to 0.4870 g/L (Figure 4).

When the stage levels rise, the specific conductance levels drop in response. This is a result of the increased amount of water in the river system dilutes the particle matter that is present (as noted on Figure 4) in the brook. This is evident on the graph on June 5th, 2017 and June 24th, 2017. Both of these two dates also had significant rainfall likely influencing the higher stage levels.

Please note the stage data is raw data that is published on the ECCC 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.

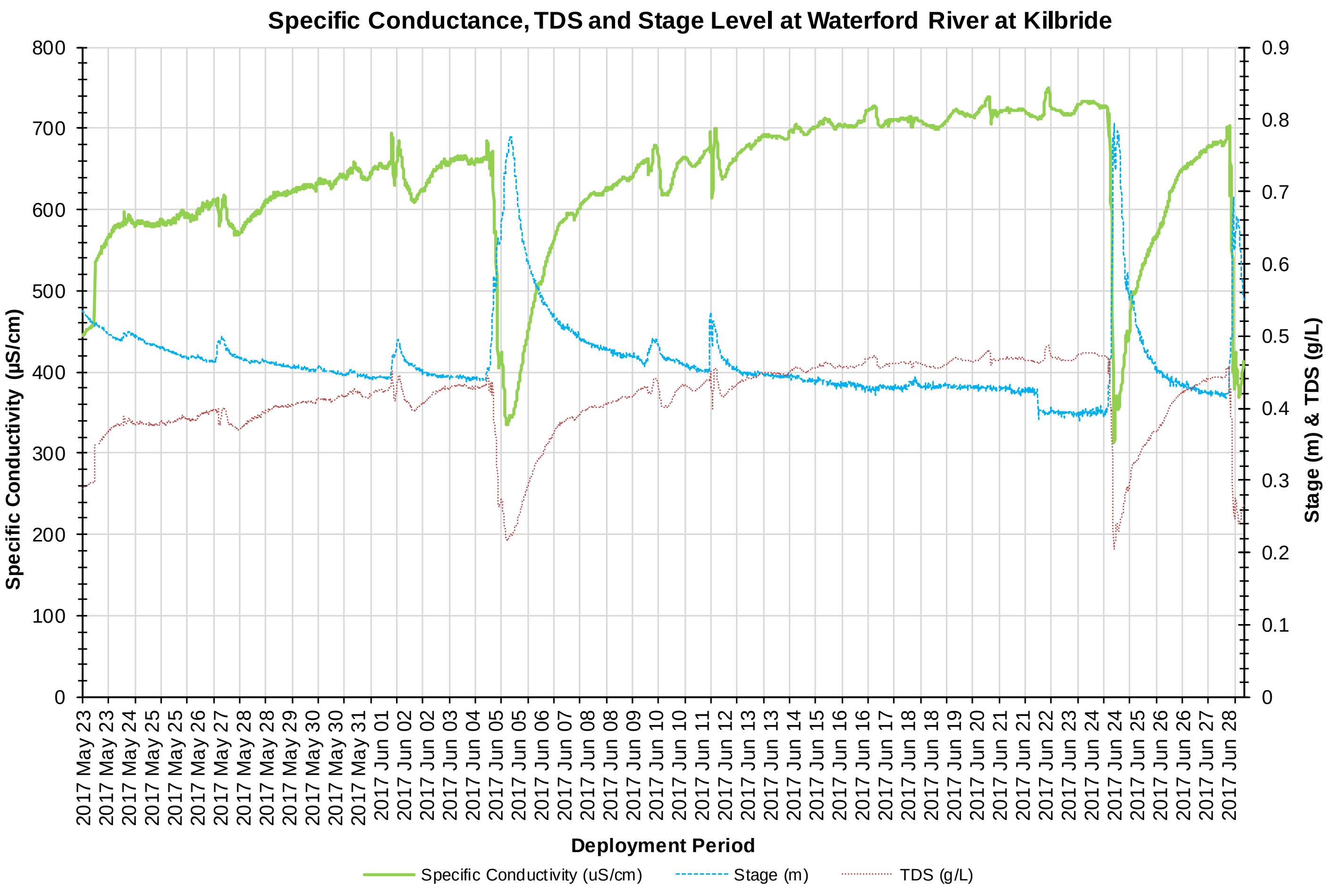


Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

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

During the deployment the dissolved oxygen concentration levels ranged within a minimum of 8.26mg/L to a maximum of 13.41mg/L. The percent saturation levels for dissolved oxygen ranged within 91.8% Saturation to 112.8% Saturation (Figure 5).

The dissolved oxygen concentration remained above the Guideline for the Protection of Early Life Stages (9.5mg/L) for the majority of deployment, until June 19th 2017. Water temperature is graphed with dissolved oxygen as it directly influences the concentration levels of dissolved oxygen in the water column. When the dissolved oxygen is below the CCME guideline on June 19th 2017, the water temperatures have increased during that time frame as well. This data is representing the natural relationship between temperature and dissolved oxygen.

As the spring season moves into summer there will be an increase in water temperature and a gradual decrease in the dissolved oxygen concentration in the water.

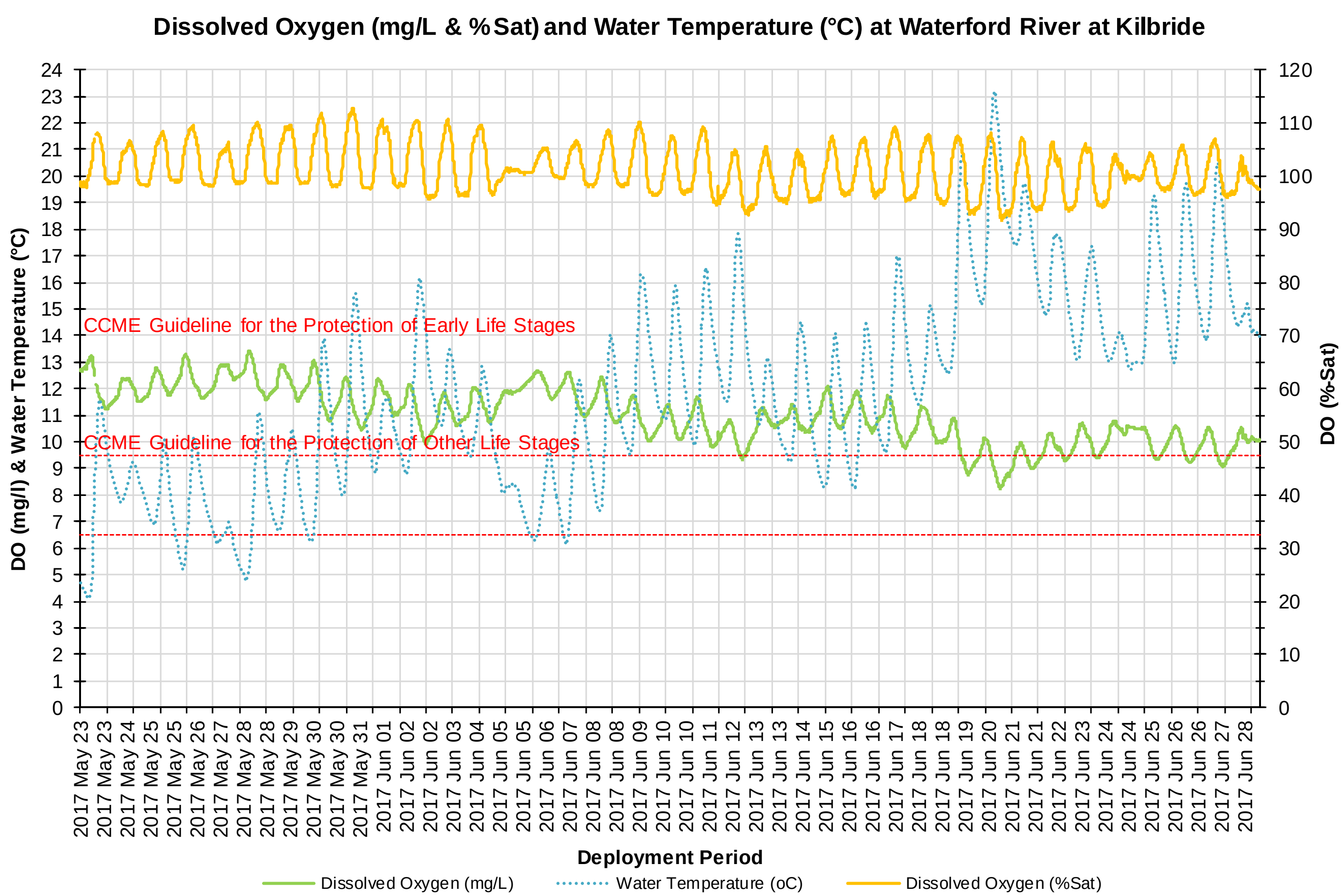


Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 1.2 NTU and 1133.9 NTU (Figure 6). The deployment data had a median of 3.8NTU.

The higher turbidity events throughout the deployment period correlate with increases in stage. There was recorded rainfall on June 5th and June 24th, 2017 the same days as two of the turbidity events. 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.

Please note the stage data is raw data that is published on the ECCC 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.

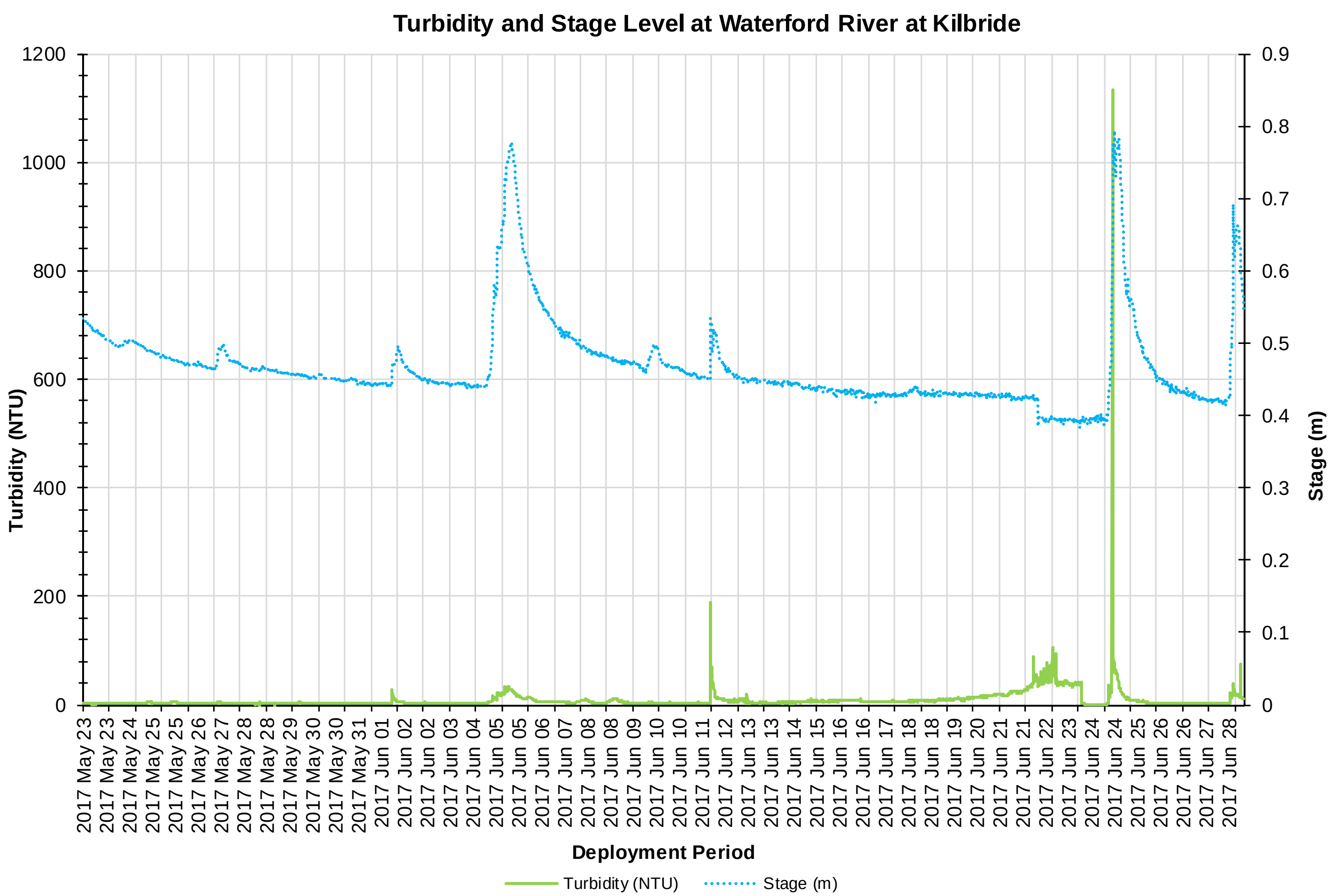


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 stage to rise significantly.

During the deployment period, the stage values ranged from 0.38m to 0.80m. 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 32.6 mm on June 5th 2017.

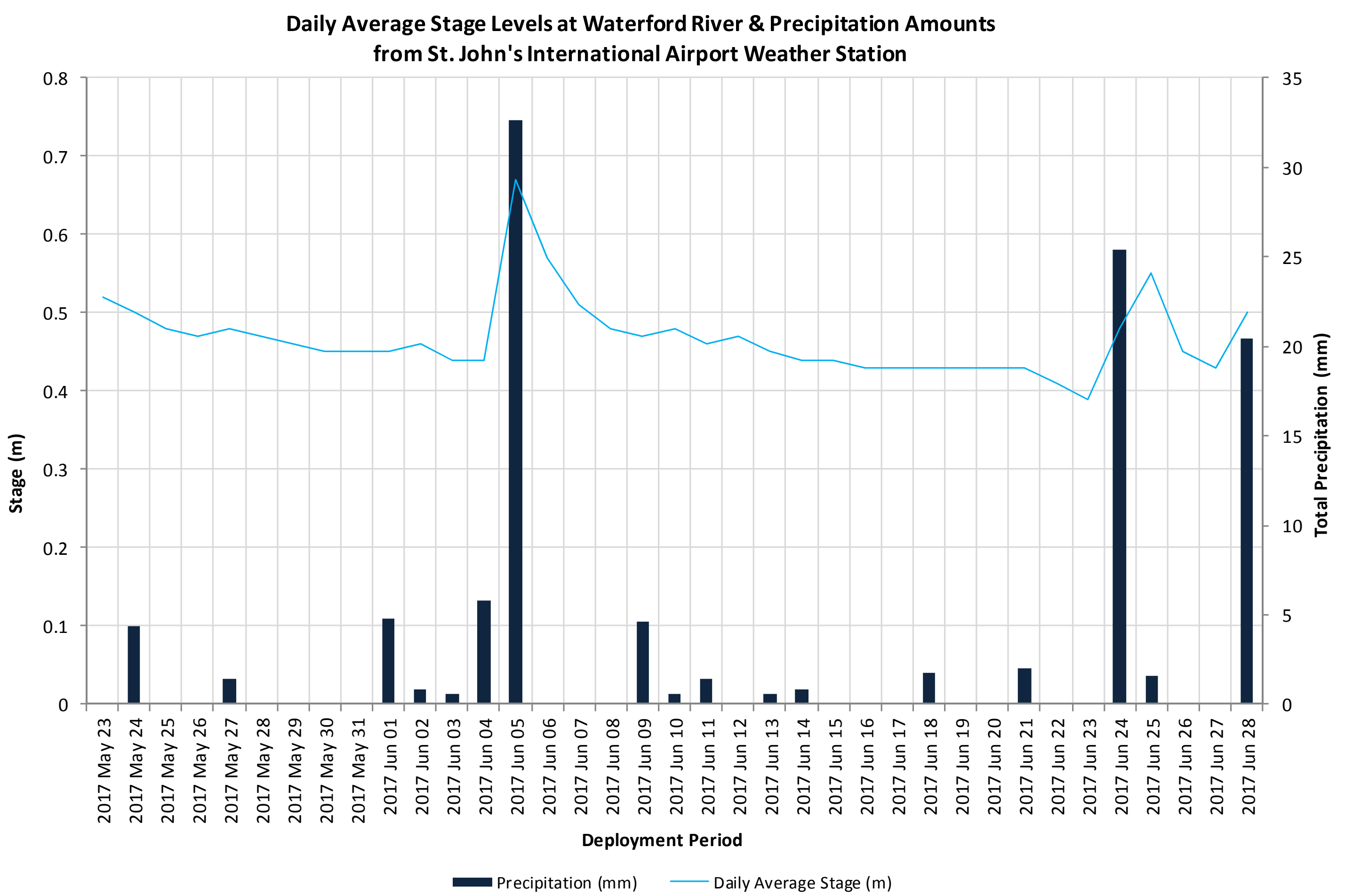


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

Conclusion

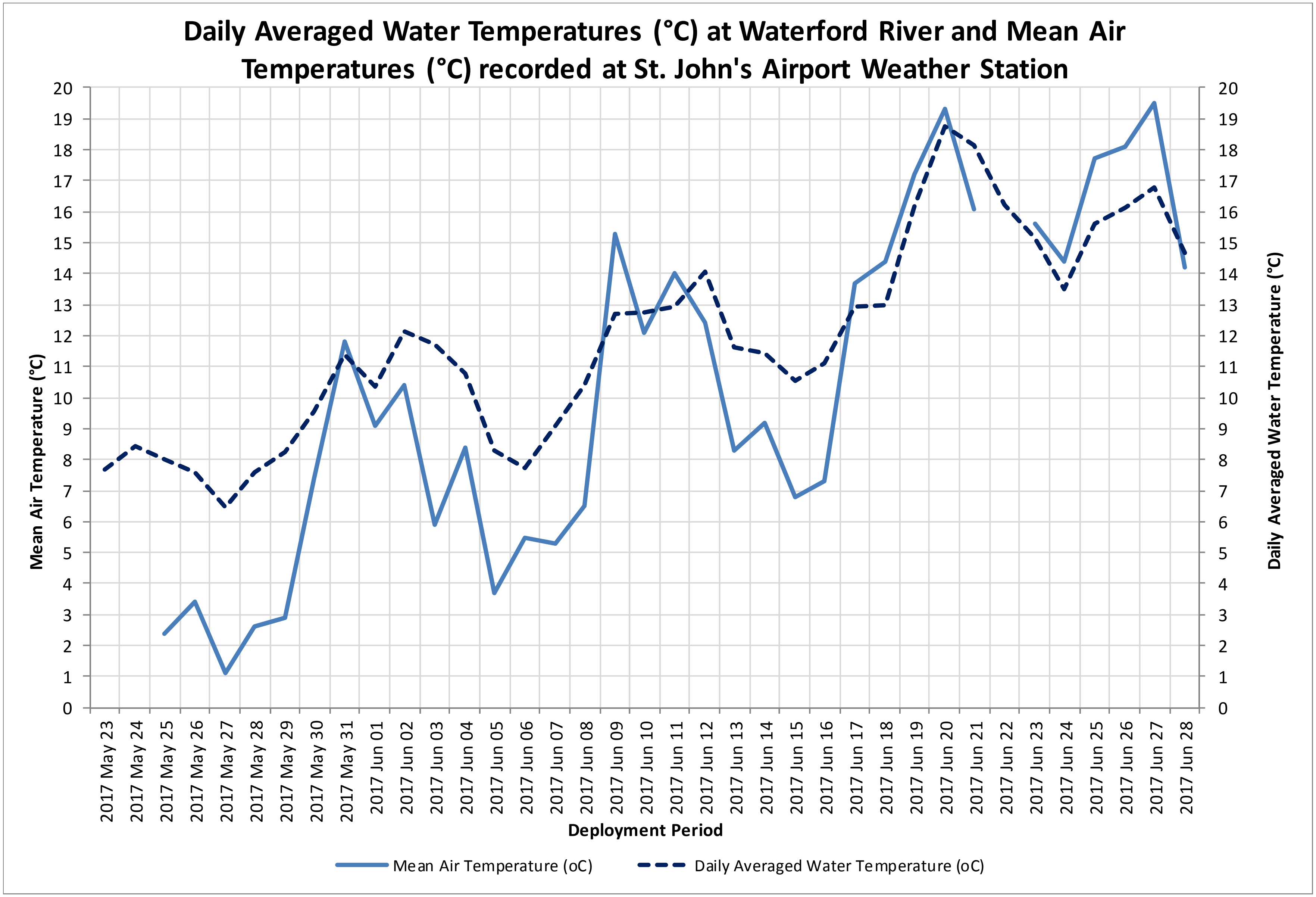
Waterford River at Kilbride flows through significant developed areas, including residential and industrial zones. Waterford River also borders along several heavily used urban road ways and thoroughfares. The proximity to these factors, combined with precipitation and runoff, can influence and adjust 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 adjust there is an increase 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 visible changes in the pH, whereby at several periods during deployment, the pH levels dip during high stage events. However for most of the deployment, the pH values were reasonably consistent. Conductivity dips were a result of high stage levels, likely rainfall events. There were dips in conductivity during deployment. Most of the conductivity dips were linked to high stage levels. There was movement in the turbidity data over the deployment, high turbidity values were also linked to the high stage levels and subsequent rainfall periods.

This instrument sits on the riverbed to record data. 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. 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.

APPENDIX I


Daily Averaged Water Temperatures (°C) at Waterford River and Mean Air Temperatures (°C) recorded at St. John's Airport Weather Station
Mean Air Temperature (°C)
Daily Averaged Water Temperature (°C)
Deployment Period
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
2017 May 23
2017 May 24
2017 May 25
2017 May 26
2017 May 27
2017 May 28
2017 May 29
2017 May 30
2017 May 31
2017 Jun 01
2017 Jun 02
2017 Jun 03
2017 Jun 04
2017 Jun 05
2017 Jun 06
2017 Jun 07
2017 Jun 08
2017 Jun 09
2017 Jun 10
2017 Jun 11
2017 Jun 12
2017 Jun 13
2017 Jun 14
2017 Jun 15
2017 Jun 16
2017 Jun 17
2017 Jun 18
2017 Jun 19
2017 Jun 20
2017 Jun 21
2017 Jun 22
2017 Jun 23
2017 Jun 24
2017 Jun 25
2017 Jun 26
2017 Jun 27
2017 Jun 28
Mean Air Temperature (oC)
Daily Averaged Water Temperature (oC)

Waterford River at Kilbride, Newfoundland and Labrador