Waterford River
@
Kilbride

NF02ZM0009

July 2013

Government of Newfoundland & Labrador

Department of Environment and Conservation

Real Time Water Quality Monthly Report
Waterford River - St. John’s, NL
June 27 to July 23, 2013

General

- Data from the Waterford River real-time station is regularly monitored by the Water Resources Management Division (WRMD).
- The instrument used for the deployment period from June 27 to July 23, 2013 was a YSI 6600 series multi-probe, which continuously measured water temperature, dissolved oxygen, pH, specific conductivity and turbidity. The duration of the deployment was 26 days.

Maintenance and Calibration of Instruments

- **Table 1** displays the dates when routine cleaning, maintenance and calibration were performed on the water quality probe during this deployment.

Table 1: **Table of Water Quality Probe Installation and Removal**

Date Deployed	Date Removed
June 27, 2013	July 23, 2013

- Water quality readings were taken with a second freshly cleaned and calibrated water quality instrument at the time of deployment and removal, in compliance with WRMD quality assurance and quality control protocol.

Deployment

- Deployment comparison rankings between the field instrument and the QAQC instrument are summarized in **Table 2**.

Table 2: Field sonde to QAQC sonde comparison rankings for deployment of the RTWQ instrument on June 27, 2013

Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	10.67	10.65	0.02	Excellent
pH	7.01	6.87	0.14	Excellent
Specific Conductivity (µS/cm)	493.0	494.0	0.2	Excellent
Total Dissolved Solids (g/l)	0.3200	0.3220	0.0020	
Dissolved Oxygen (%-Sat)	99.6	99.3	0.3	
Dissolved Oxygen (mg/l)	11.05	10.97	0.08	Excellent
Turbidity (NTU)	4.1	3.9	0.2	Excellent

- **Deployment rankings** of “excellent” for water temperature, pH, specific conductivity, dissolved oxygen and turbidity indicate successful cleaning and calibration, which enable these sensors to produce reliable data during the deployment period.

Removal

- Removal comparison rankings between the field instrument and the QAQC instrument are summarized in **Table 3**.

Table 3: Field sonde to QAQC sonde comparison rankings for removal of the RTWQ instrument on July 23, 2013

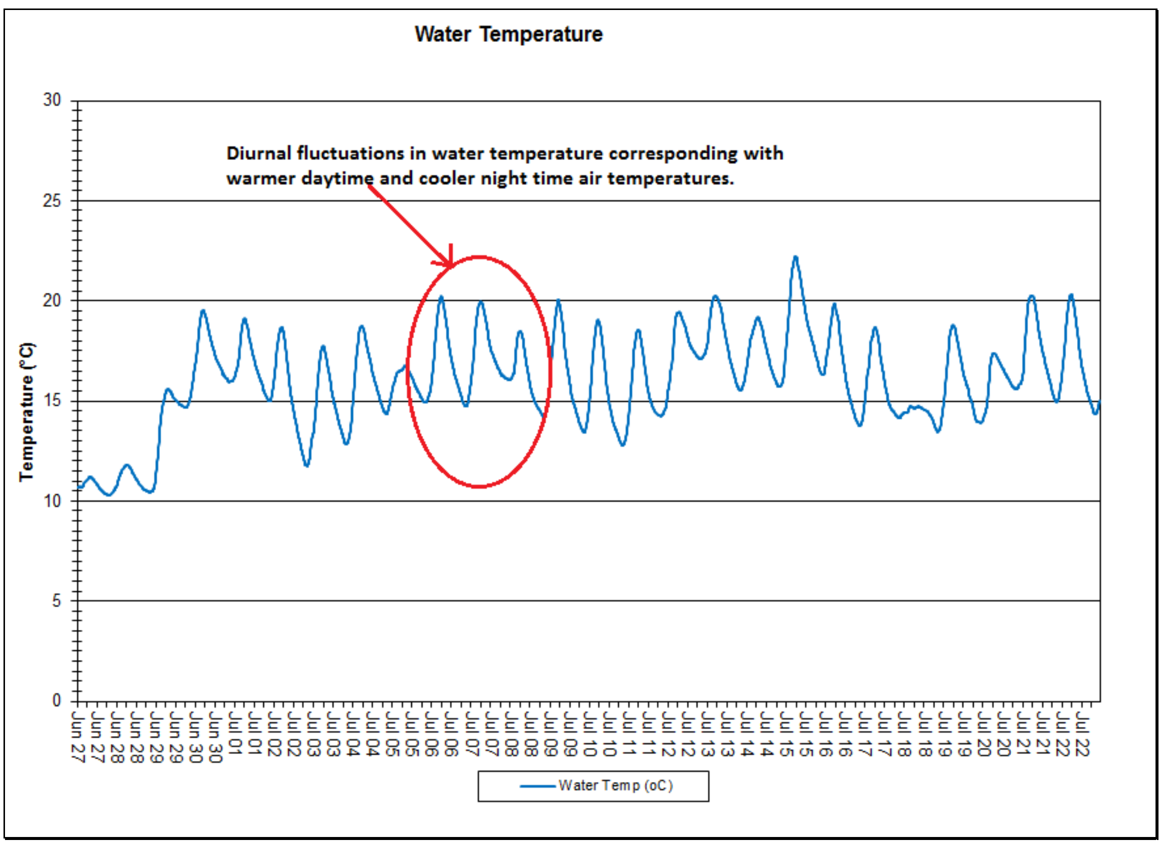
Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	14.97	15.19	0.22	Good
pH	7.19	7.37	0.18	Excellent
Specific Conductivity (µS/cm)	576.0	587.5	2.0	Excellent
Total Dissolved Solids (g/l)	0.3740	0.3759	0.0019	
Dissolved Oxygen (%-Sat)	100.6	102.7	2.1	
Dissolved Oxygen (mg/l)	10.14	9.84	0.30	Good
Turbidity (NTU)	0.9	1.0	0.1	Excellent

- **Removal rankings** of "good" and "excellent" for water temperature, pH, specific conductivity, dissolved oxygen and turbidity increase confidence that the data collected for these parameters over the duration of this deployment are reliable.

Data Interpretation

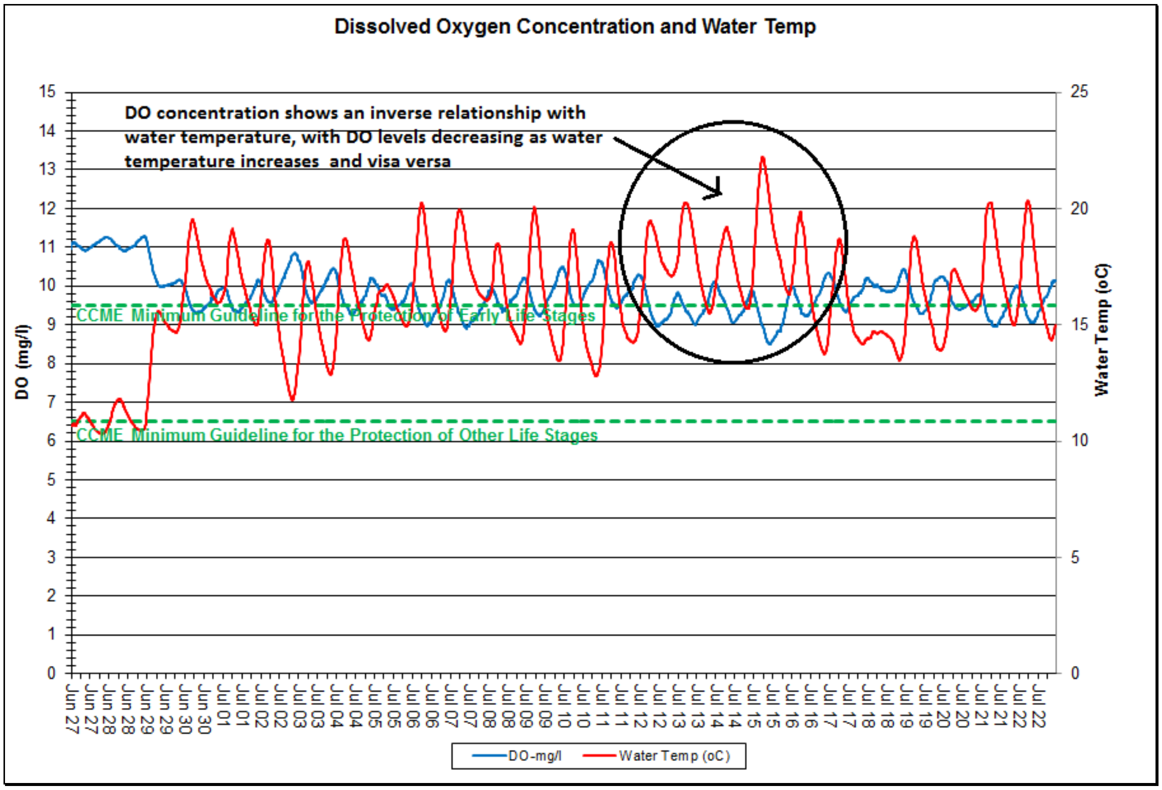
- A graph of **water temperature,** which fluctuated between 10.30 and 22.23^{o}C during this deployment period, is shown in blue ink in **Figure 1**, below. Diurnal variation in water temperature is clearly seen with colder temperatures occurring at night and warmer temperatures occurring during the day, corresponding with cooler nightly air and warmer daily air temperatures. There appears to be a slight overall increasing trend in water temperature during this deployment, corresponding with seasonally increasing air temperature. Environment Canada's Daily Climate Data is shown in **Appendix 1,** at the end of this report.

Figure 1: Water Temperature



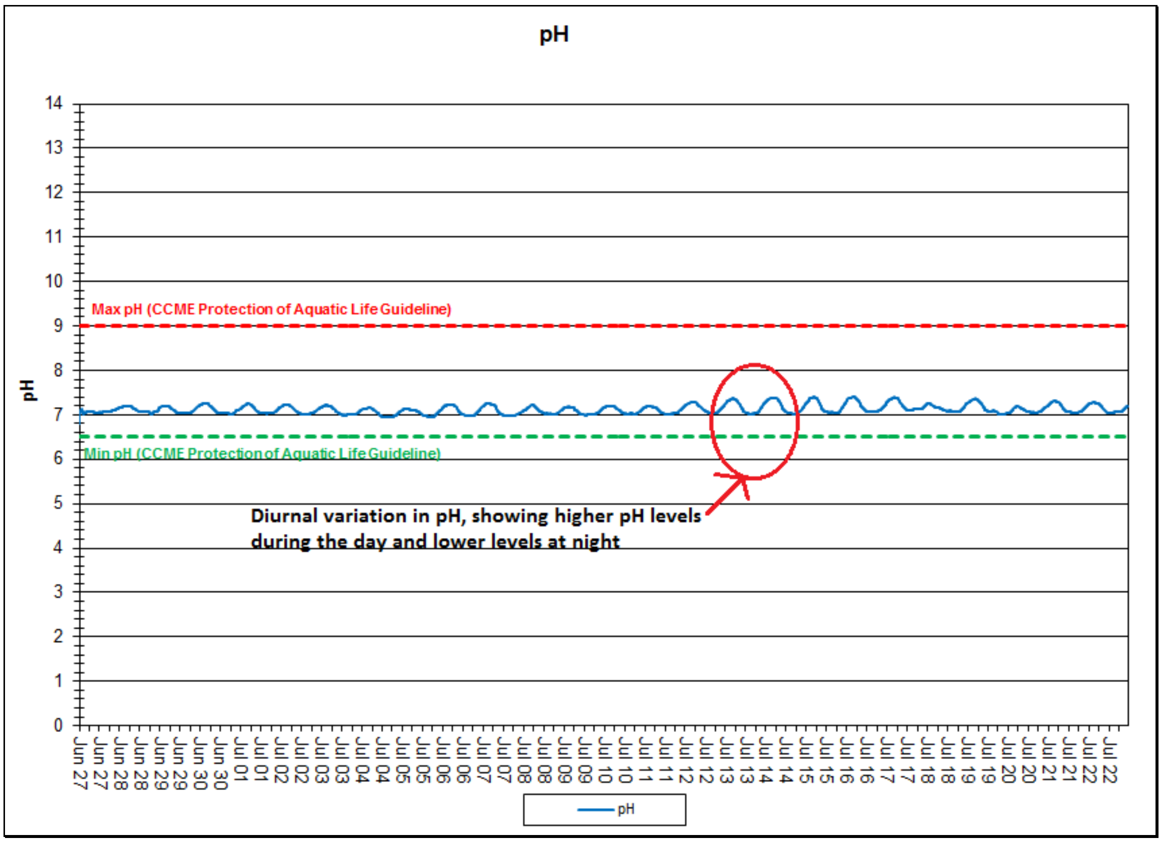
▪ **Dissolved Oxygen** (DO) measurements during this deployment ranged between 8.49 and 11.28 mg/l. DO concentrations during this deployment are shown in blue in the graph in **Figure 2**, along with water temperatures which are shown in red. The inverse relationship between dissolved oxygen concentration and water temperature is apparent in the graph, as DO levels decrease in response to increasing water temperatures. This relationship is based on the fact that the solubility of oxygen is greater in colder water than in warmer water. Most DO measurements were above the minimum guidelines recommended by the CCME for the protection of freshwater aquatic life, of 9.5 mg/L for early life stages and 6.5 mg/L for other life stages in cold water systems. Some DO values fell below 9.5 mg/L during this deployment, corresponding with the seasonally warmer water temperatures. It isn't unusual for DO concentrations to fall below 9.5mg/L for short durations, while seasonal water temperatures approach 20°C and higher.

Figure 2: Dissolved Oxygen



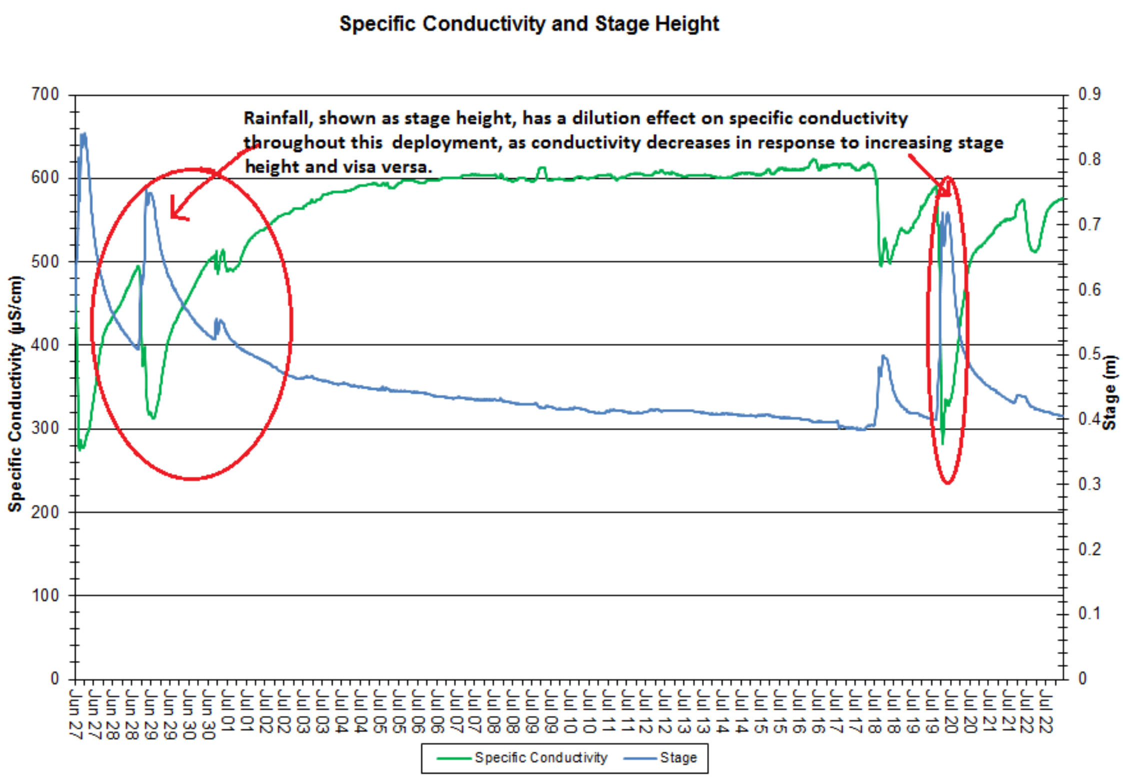
- The **pH** of water is a measure of the concentration of hydrogen ions, with pH decreasing as the concentration of hydrogen ions increases. The pH of water determines the solubility and biological availability of chemical constituents such as nutrients and heavy metals. Both natural (precipitation) and human (urban run-off) processes determine the pH of water. Metals tend to be more toxic at lower pH because they are more soluble. Photosynthesis uses up hydrogen molecules, which causes the concentration of hydrogen ions to decrease and therefore the pH to increase. For this reason, pH may be higher during daylight hours and during the growing season, when photosynthesis is at a maximum. Not only does the pH of a stream affect organisms living in the water, a changing pH in a stream can be an indicator of increasing pollution or some other environmental factor. pH values during this deployment period were quite stable, ranging from 6.81 to 7.41 pH units. All pH measurements were within the CCME recommended guideline range for the protection of aquatic life, of 6.5 - 9.0 pH units. pH values for this deployment are shown in blue in the graph in **Figure 3.**

Figure 3: pH



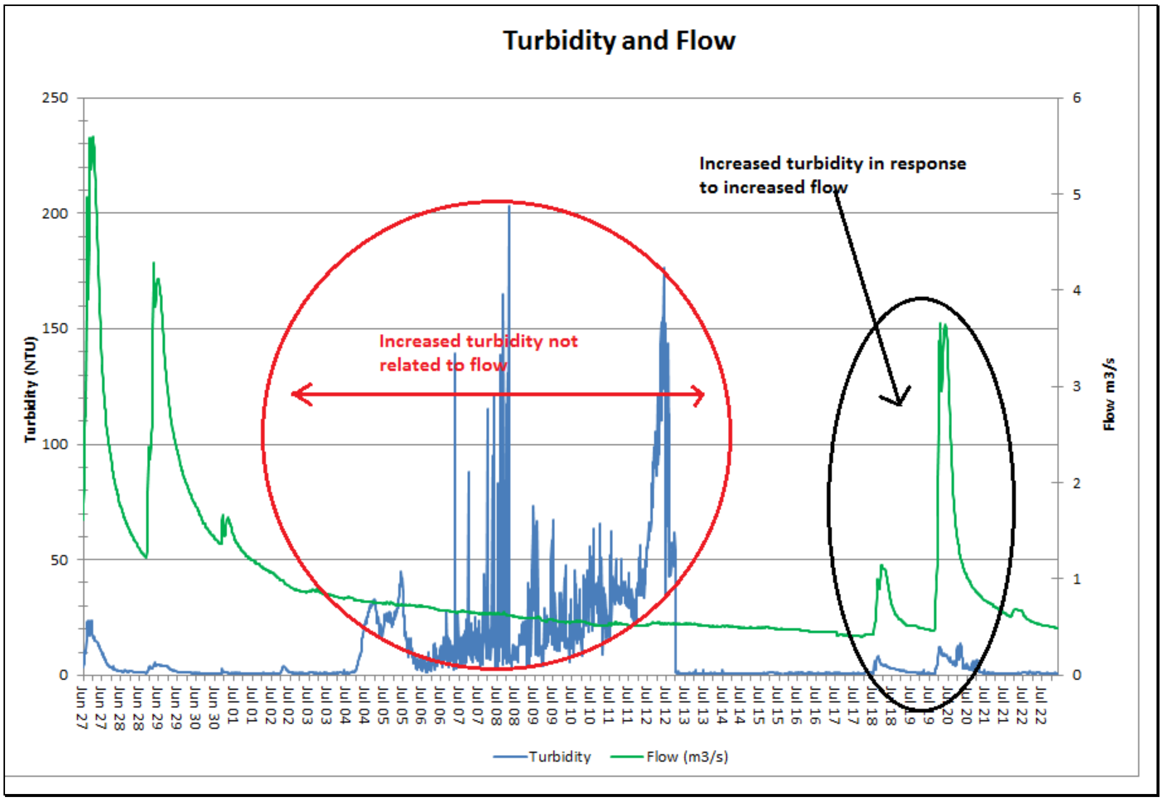
▪ **Specific conductivity (SpC)** measures the ability of water to pass an electrical current. Conductivity in streams and rivers is affected by the geology of the area through which the water flows. Streams that run through granite bedrock tend to have lower conductivity than those that flow through limestone and clay soils. High specific conductance readings are often influenced by urban run-off. The effects of urban run-off are dependent upon the season. During warmer temperatures, when road salt is not being used for ice control, rainfall and urban run-off can have a dilution effect, causing specific conductivity levels to decrease as stage level increases. However, during the winter months when road salting operations are in effect, urban run-off can result in spikes in specific conductivity. In **Figure 4,** below, increased stage height appears to have a dilution effect on conductivity, as spikes in stage, shown in blue, correspond with drops in conductivity, shown in green. Specific conductivity tends to increase during dry spells with no rain. This observation is supported by Environment Canada Daily Climate Data, presented in **Appendix 1,** at the end of this report. The climate data indicate significant rainfall occurred on June 27 and 29, and from July 18-20, which coincide with concurrent spikes in stage height and dips in conductivity. Specific conductance values in Waterford River during this deployment period were within the expected range for this river at this time of year, ranging between 274 and 624µS/cm.

Figure 4: Specific Conductance and Stage



- **Turbidity** is a measure of water clarity, and the degree to which material suspended in water decreases the passage of light through the water. Suspended materials include soil particles (clay, silt, and sand), algae, plankton, microbes, and other substances. Turbidity values were at background levels of up to 8NTU for much of the deployment period, showing spikes in response to rainfall on June 27 and 29 and July 18 and 20. Turbidity is shown in blue in the graph in **Figure 5** below, and rainfall is represented as increased flow in green. Turbidity was very unsettled from July 4 to 13 spiking between 8 and 203 NTU. Flow did not increase during this period indicating that land-based activity upstream from the monitoring station was potentially the cause of the high turbidity.

Figure 5: Turbidity



Appendix 1: Environment Canada Daily Climate Data (June 27-30, 2013) St. John's International Airport

June	Max Temp	Min Temp	Mean Temp	Total Rain	Max Wind Gust
	°C	°C	°C	mm	km/h
27 -	10.9	6.2	8.6	**27.4**	65
28 -	10.6	6.9	8.8	0.6	41
29 -	23.8	7.6	15.7	**12.6**	56
30 -	23.8	17.4	20.6	0.4	69

Environment Canada Daily Climate Data (July 1-31, 2013)
St. John's International Airport

	Max Temp	Min Temp	Mean Temp	Total Rain	Max Wind Gust
July	°C	°C	°C	mm	km/h
01	21	14.2	17.6	6.8	56
02	17.5	6.1	11.8	0	46
03	22.8	6.7	14.8	0	46
04	23.9	10.6	17.3	0	59
5.0					
6	28.7	12.2	20.5	0	41
07	26.4	12	19.2	0	39
08	18.5	9.5	14	0	39
09	17.9	7.5	12.7	0	33
10	14.5	4.2	9.4	0	<31
11	18.3	3.5	10.9	0	43
12	26.5	11.3	18.9	0.6	46
13	23.4	16.1	19.8	TT	35
14	27.3	15.9	21.6	0	35
15	31.2	15.1	23.2	TT	54
16	16.2	8.1	12.2	TT	52
17	19.7	7.3	13.5	TT	46
18	16.2	10.6	13.4	**8.6**	65
19	20.3	7.8	14.1	**4**	43
20	21.3	11.2	16.3	**18.6**	69
21	26.5	12.7	19.6	TT	65
22	22.4	10.4	16.4	0	39
23	23.8	11.7	17.8	0	54
24	25.9	12.4	19.2	7.2	72
25	28.3	21.5	24.9	TT	69
26	28.7	19.4	24.1	0	54
27	28.4	19.1	23.8	20.4	52
28	19.2	9.4	14.3	2.4	52
29	17.9	9.6	13.8	0	35
30	21.9	12.1	17	TT	50
31	24.9	14.8	19.9	4.6	59

TT = Trace; Blank spaces indicate no data available

Report prepared by: *Joanne Sweeney*
Department of Environment and Conservation
St. John's NL A1B 4J6; Tel. (709) 729-0351
joannesweeney@gov.nl.ca