Waterford River
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Kilbride

NF02ZM0009

November 2013

Government of Newfoundland & Labrador

Department of Environment and Conservation

Real Time Water Quality Monthly Report
Waterford River - St. John's, NL
October 30 to December 4, 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 October 30 to December 4, 2013 was a YSI 6600 series multi-probe, which continuously measured water temperature, pH, dissolved oxygen, specific conductivity and turbidity. The duration of the deployment was 34 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
October 30, 2013	December 4, 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 October 30, 2013

Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	6.95	7.07	0.12	Excellent
pH				Cannot Rank
Specific Conductivity (µS/cm)	389.0	380.9	2.1	Excellent
Total Dissolved Solids (g/l)	0.2530		#VALUE!	
Dissolved Oxygen (%-Sat)	103.3	102.1	1.2	
Dissolved Oxygen (mg/l)	12.54	12.36	0.18	Excellent
Turbidity (NTU)	1.4	1.7	0.3	Excellent

- **Deployment rankings** of "excellent" for water temperature, specific conductivity, dissolved oxygen and turbidity indicate successful cleaning and calibration, which enable these sensors to produce reliable data during the deployment period. The pH sensor is damaged, thus pH data is not available for this deployment.

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 December 4, 2013

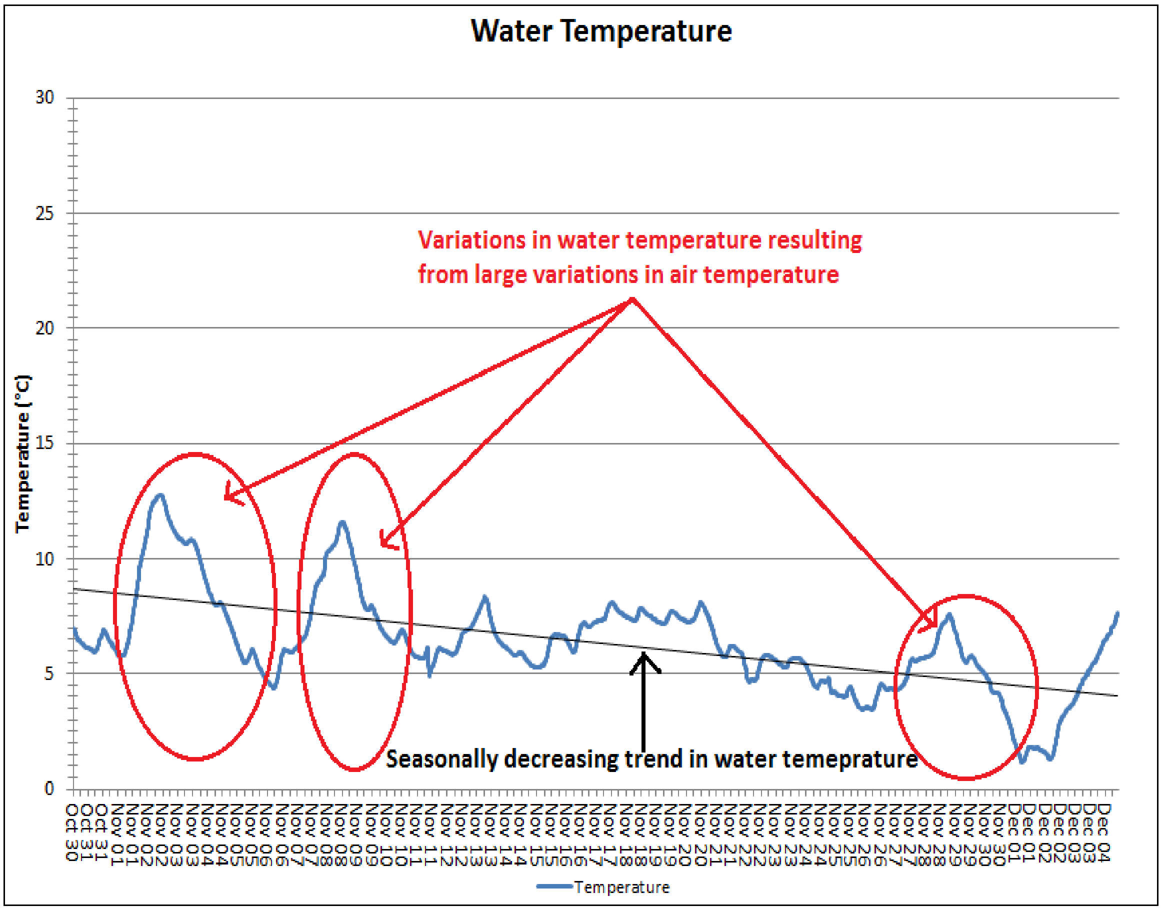
Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	7.62	7.64	0.02	Excellent
pH		7.14	#VALUE!	Cannot Rank
Specific Conductivity (µS/cm)	239.0	268.0	12.1	Fair
Total Dissolved Solids (g/l)	0.1560	0.1740	0.0180	
Dissolved Oxygen (%-Sat)	98.9	103.5	4.6	
Dissolved Oxygen (mg/l)	11.82	12.36	0.54	Fair
Turbidity (NTU)	35.4	34.0	1.4	Excellent

Removal rankings of “excellent” for water temperature and turbidity increase confidence that the data collected for these parameters over the duration of this deployment are reliable. Removal rankings of “fair” for specific conductivity and dissolved oxygen indicate that the difference in measurements for each of these parameters, from the field sonde as compared to the QAQC sonde, is approaching the acceptable limits of WRMD’s QAQC protocol. Since the difference for each of these parameters still lies within the acceptable limits, all DO and specific conductivity data collected during this deployment period is deemed reliable. As indicated above, the pH sensor is damaged and pH data is not available for this deployment period.

Data Interpretation

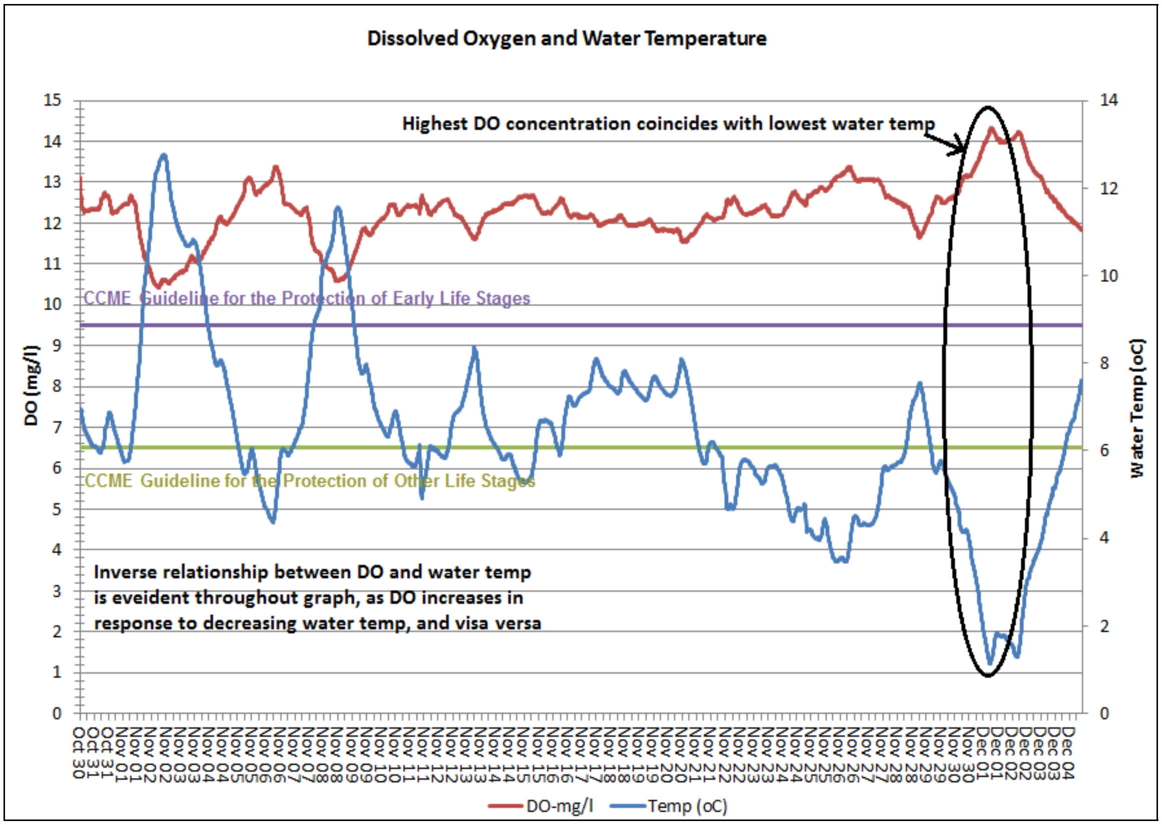
- A graph of **water temperature,** which fluctuated between 1.15 and 12.77°C during this deployment period, is shown in blue in **Figure 1**, below. Diurnal variation in water temperature is clearly seen with colder temperatures occurring at night and warmer temperatures occurring during the day, corresponding with cooler nightly air and warmer daily air temperatures. Water temperature during this deployment is showing an overall decreasing trend in response to seasonally decreasing air temperature. Daily air temperatures for the month of November, and December 1-4, 2013 are shown in Environment Canada's Daily Climate Data, in **Appendix 1** at the end of this report.

Figure 1: Water Temperature



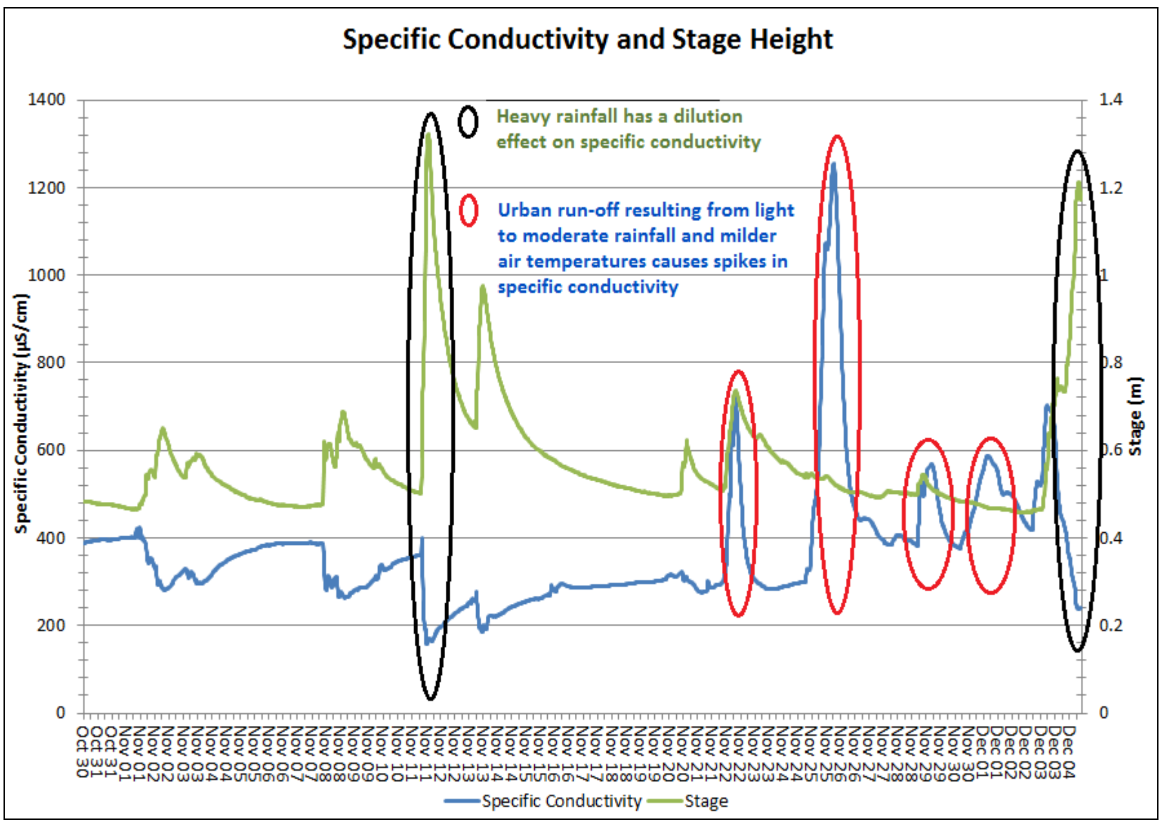
- **Dissolved Oxygen** (DO) measurements during this deployment ranged between 10.43 and 14.34 mg/l. DO concentrations are shown in red in the graph in **Figure 2**, along with water temperatures which are shown in blue. The inverse relationship between dissolved oxygen concentration and water temperature is apparent in the graph, as DO levels increase in response to decreasing water temperatures, and visa versa. This relationship is based on the fact that the solubility of oxygen is greater in colder water than in warmer water. All 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

Figure 2: Dissolved Oxygen



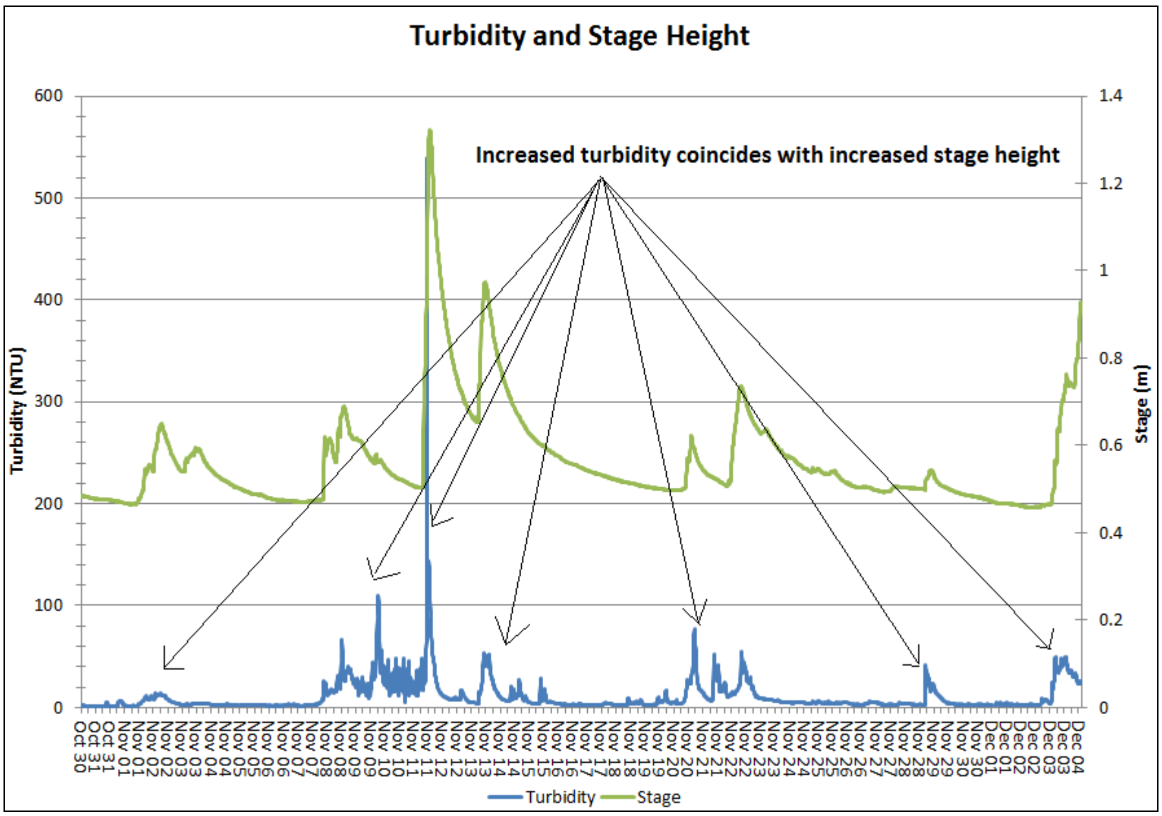
- **Specific conductivity (SpC)** measures the ability of water to pass an electrical current. Conductivity in streams and rivers is affected by the geology of the area through which the water flows. Streams that run through granite bedrock tend to have lower conductivity than those that flow through 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 height increases. However, during the winter months when road salting operations are in effect, urban run-off can result in spikes in specific conductivity. The graph in **Figure 4** demonstrates the effect that changes in stage height, shown in green, had on specific conductivity, shown in blue, over the course of this deployment. During the first half of the deployment period while air temperatures were seasonally milder, road salting operations were not in effect rainfall and increased stage height had a dilution effect on conductivity. Later in the deployment period as air temperatures decreased, road salt was being used for ice control and light to moderate precipitation and resulting run-off caused specific conductivity to increase. Heavy rainfall during the last couple of days of the deployment had a dilution effect on conductivity. These observations are supported by Environment Canada's Daily Climate Data, presented in **Appendix 1,** at the end of this report. Specific conductance values in Waterford River during this deployment period were within the expected range for the river at this time of year, fluctuating between 157 and 1255 µS/cm, with a mean of 369µS/cm and a median of 333µS/cm.

Figure 4: Specific Conductance and Stage Height



▪ **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 measurements were stable and near background levels for most of this deployment, with the exception of a few spikes, all of which coincided with increased stage height. A graph of turbidity for this deployment period is found in **Figure 5**, which shows turbidly in blue, and stage height in green. According to Environment Canada's Daily Climate Data, found in **Appendix 1,** precipitation occurred on November 1-3, 7-8, 11, 13, 20-24 and on December 3-4. These dates coincide with concurrent spikes in stage height and specific conductivity. According to the Daily Climate data, there was no precipitation on November 29 despite the occurrence of a turbidity spike. The increased turbidity probably resulted from snowmelt, as the maximum air temperature on November 28 was 10^{o}C, and 6cm of snow fell in the preceding days.

Figure 5: Turbidity



Appendix 1:

Environment Canada Daily Climate Data (November, 2013)
St. John's International Airport

November	Max Temp	Min Temp	Mean Temp	Total Rain	Total Snow	Total Precip	Ground Snow	Max WindGust
2013	°C	°C	°C	mm	cm	mm	cm	km/h
DAY								
01	**17.1**	1	9.1	5.8	0	**5.8**		**107**
02	**17.1**	10.2	13.7	5.2	0	**5.2**		**104**
03	10.2	2.3	6.3	8.6	0	**8.6**		32
04	3.9	**-1.7**	1.1	0	0.2	T	0	48
05	0.6	**-2.5**	-1	0	0	0		48
06	5.2	**-2.3**	1.5	T	0	T		50
07	**14.4**	4.9	9.7	8.6	0	**8.6**		85
08	**15.6**	11.6E	13.6E	M	M	**11.2E**		M
09	6	0.1	3.1	0	0.2	0.2		50
10	3.5	**-2.3**	0.6	0	0	0		<31
11	5.8	**-0.3**	2.8	37	1	**38**	0	76
12	8.8	**0.3**	4.6	0.2	T	0.2		72
13	9.6	**-0.6**	4.5	13.6	0.2	**13.8**		78
14	0.7	**-1.4**	-0.4	0	T	T		46
15	5.9	**-0.3**	2.8	0.2	T	0.2		<31
16	8.3	1.6	5	T	0	T		<31
17	8.5	4.6	6.6	0	0	0		44
18	7	3.7	5.4	T	0	T		35
19	6	4.1	5.1	0.4	0	0.4		67
20	7.7	0.2	4	10.2	0	**10.2**		57
21	4.2	-0.6	1.8	1.6	4	**5.6**	2	46
22	3.3	1.1	2.2	8.2	0	**8.2**	1	56
23	2.8	0.8	1.8	2	0	**2**		69
24	3.5	-0.5	1.5	0	5.6	**5.6**	0	82
25	0.5	-2.6	-1.1	0	0.2	0.2	2	65
26	1.4	-0.7	0.4	0	0.6	0.4	2	50
27	**7.3**	1	4.2	0.2	0	0.2	1	72
28	**10.1**	3.6	6.9	3	0	3		**100**
29	4.3	-0.8	1.8	0	T	T		52
30	-0.4	-10	-5.2	0	1	1	0	43

*Blank cells = no data available; T = Trace; E = Estimated; M = Missing

Environment Canada Daily Climate Data (December 1-4, 2013)
St. John's International Airport

December	Max Temp	Min Temp	Mean Temp	Total Rain	Total Snow	Total Precip	Ground Snow	Max WindGust
2013	°C	°C	°C	mm	cm	mm	cm	km/h
DAY								
1	-2	-10.7	-6.4	0	0	0	1	37
2	3.4	-5.7	-1.2	0.4	T	0.4	1	57
3	9.2	3.4	6.3	19.2	0	**19.2**		78
4	11.8	2	6.9	19.2	0	**19.2**		**102**

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