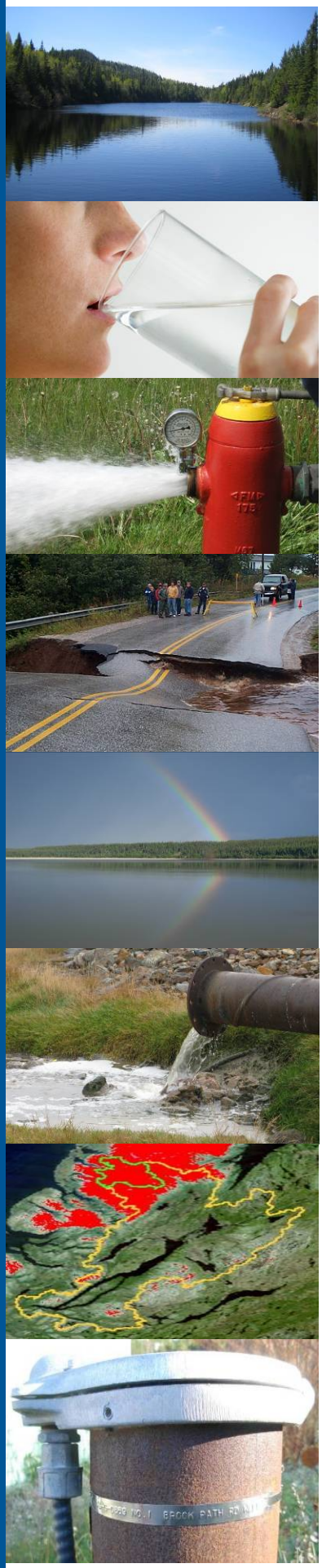


Waterford River @ Kilbride

NF02ZM0009

August-September 2012

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

Real Time Water Quality Monthly Report
Waterford River - St. John's NL
July 25 – September 28, 2012

General

- Data from the Waterford River real-time station is regularly monitored by the Water Resources Management Division (WRMD) staff.
- The instrument used for the deployment period from July 25 to September 28 was a YSI 6600 series multi-probe, which continuously measured water temperature, pH, specific conductivity, dissolved oxygen and turbidity. The duration of the deployment was 65 days.

Maintenance and Calibration of Instrumentation

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

Table 1: Table of Water Quality Probe Installation and Removal

Date Installed	Date Removed
July 25, 2012	September 28, 2012

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

Quality Assurance and Quality Control (QAQC)

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

Table 2: Comparison rankings for deployment of RTWQ instrument on July 25, 2012

Deployment

Field Sonde to QAQC Sonde Comparisons

Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	21.71	21.36	0.35	Good
pH	-3.70	7.10	10.80	Poor
Specific Conductivity (µS/cm)	592.0	594.0	0.3	Excellent
Dissolved Oxygen (mg/l)	9.10	9.16	0.06	Excellent
Turbidity (NTU)	1.7	1.5	0.2	Excellent

- **Deployment rankings** of "excellent" and "good" for water temperature, specific conductivity, dissolved oxygen and turbidity indicate successful cleaning and calibration, which enabled these sensors to produce reliable data during the subsequent deployment period. The pH sensor did not calibrate successfully and has operated beyond its recommended shelf life. The pH sensor will be replaced and pH data collected during this deployment period is not reliable and will not be included in this report.

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

Table 3: Comparison rankings for removal of RTWQ instrument on September 28, 2012

Removal

Field Sonde to QAQC Sonde Comparisons

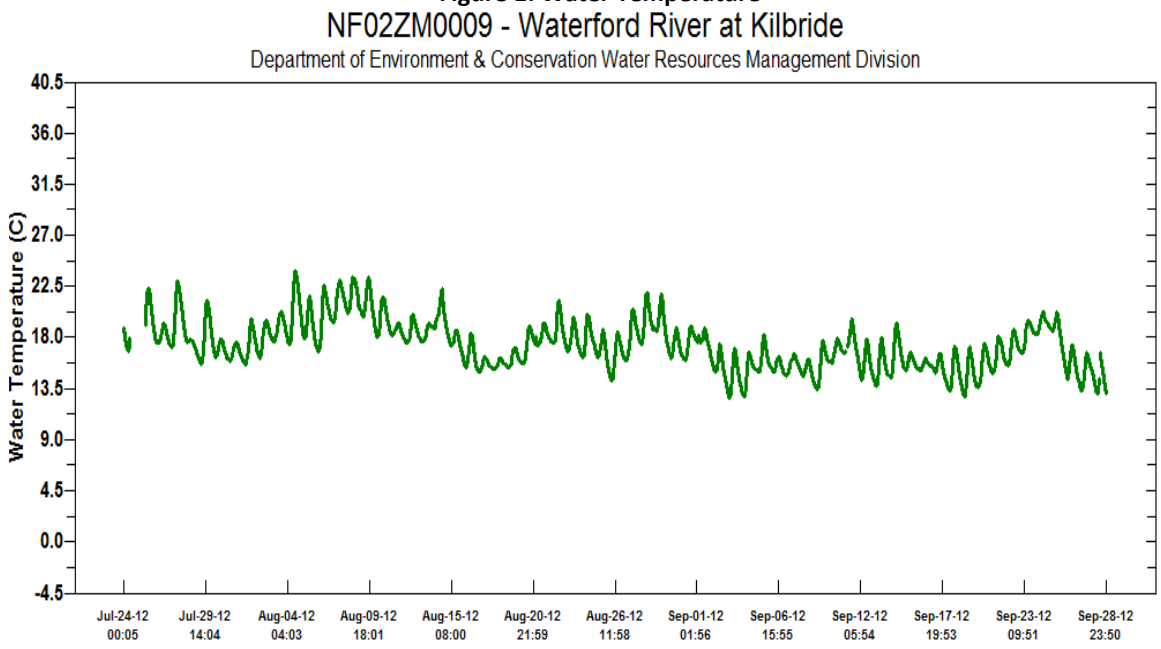
Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	13.89	14.14	0.25	Good
pH	7.37	8.40	1.03	Poor
Specific Conductivity (µS/cm)	539.0	543.0	0.7	Excellent
Dissolved Oxygen (mg/l)	10.94	14.13	3.19	Poor
Turbidity (NTU)	18.7	3.0	15.7	Poor

- **Removal rankings** of "excellent" and "good" for water temperature and specific conductivity increase confidence that the data collected for these parameters over the duration of this deployment are reliable. A removal ranking of "poor" for dissolved oxygen and turbidity indicate that these sensors became fouled during the lengthy deployment period and data collected, specifically toward the end of the deployment, may not be reliable for these parameters. A removal ranking of "poor" for pH was expected as this sensor did not calibrate successfully prior to deployment.

Data Interpretation

- **Water temperatures** fluctuated between 12.19 and 23.32^{o}C during this deployment period, showing diurnal variation and a slight seasonally decreasing trend. Water temperature data are shown in green ink in **Figure 1**. The overall decreasing trend in water temperature corresponds to the seasonal decrease in air temperature, as shown in the Daily Climate Data for this period, in **Appendix 1** at the end of this report.

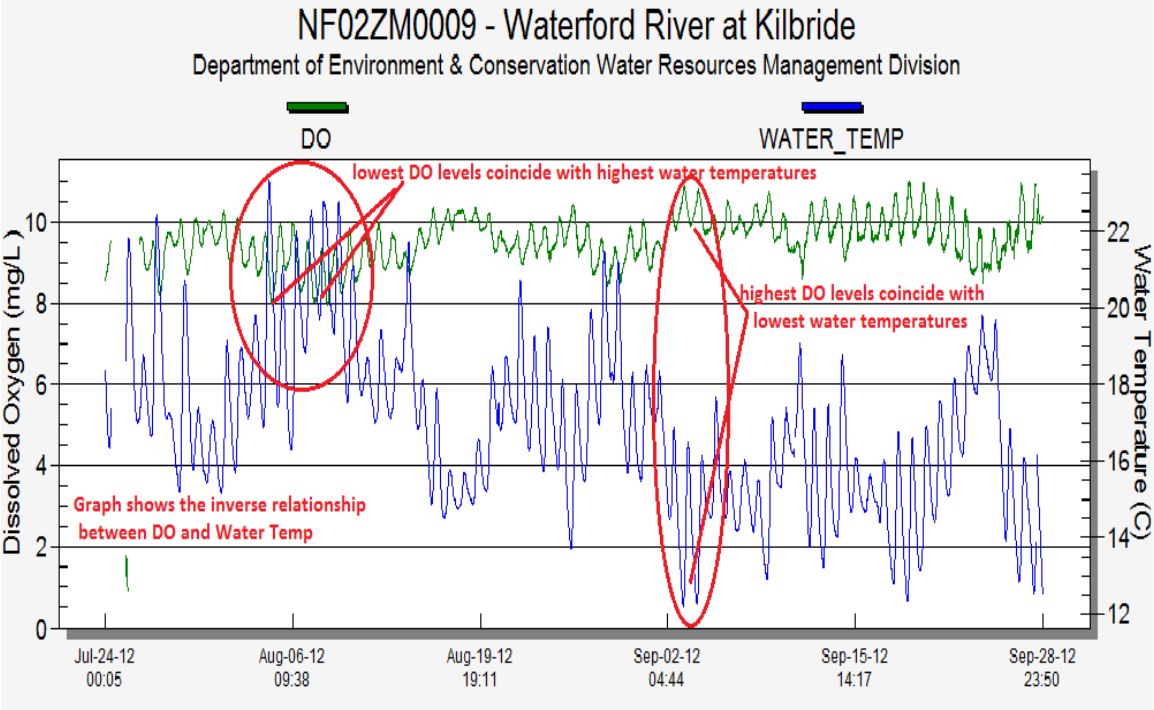
Figure 1: Water Temperature



- **Dissolved Oxygen (DO)** values were within the range of 7.96 and 11.0mg/L during this deployment period. DO displayed a slight increasing trend, in response to an overall decreasing trend in water temperature. The solubility of oxygen is greater in colder water

than in warmer water, thus as water temperatures decrease DO levels increase, and visa versa. The DO and water temperature data collected during this deployment period demonstrate this inverse relationship, as shown in **Figure 2**. DO data are shown in green ink and water temperature in blue ink. DO levels during this period were generally above the minimum guidelines recommended by the CCME for the protection of freshwater aquatic life, of 6.5 mg/L for early life stages and 9.5 mg/L for other life stages in cold water systems. The lowest DO level of 7.96 mg/L was recorded on August 8, and this corresponds with the 3-day period from August 5-8, during which the warmest water temperatures for the deployment period were reached.

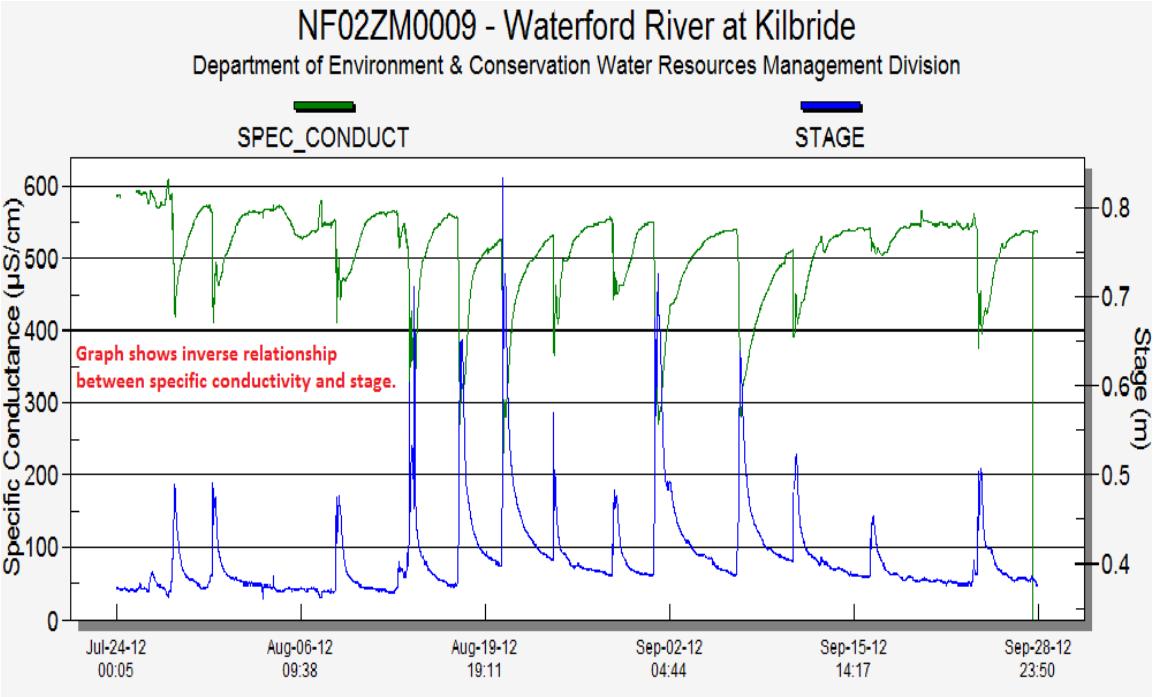
Figure 2: Dissolved Oxygen



- The pH sensor was not functioning correctly during this deployment. pH data are not reliable and are not included in this report.

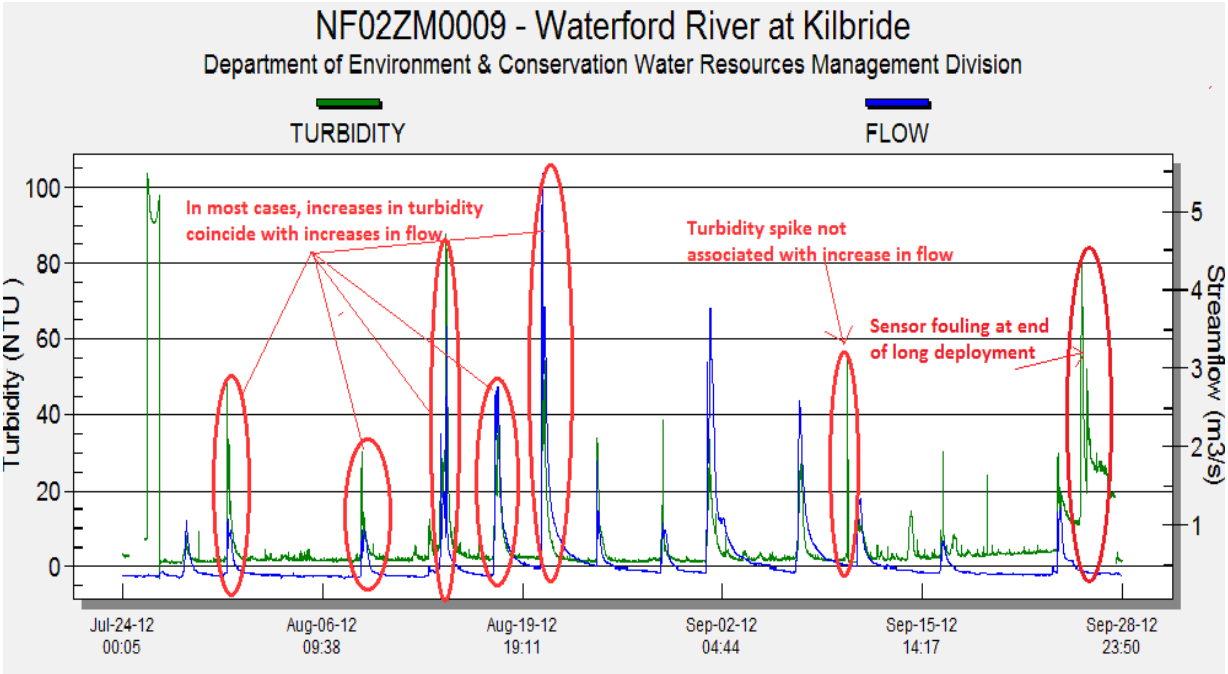
- **Specific conductivity (SpC)** values were within the expected range for an urban river throughout this deployment, with values between 215 and 609µS/cm. Precipitation can have a dilution effect on specific conductivity during the summer months, whereby increased rainfall causes increased stage height (water level) and results in decreased conductivity. This relationship is demonstrated in **Figure 3**, where specific conductivity is shown in green ink and stage height is shown in blue ink. This relationship may not be true during the winter season when road salt is used, because increased precipitation results in increased road salt deposition in surface water bodies, causing specific conductivity to increase.

Figure 3: Specific Conductance and Stage



- **Turbidity** data showed numerous spikes during the deployment period, most of which correspond with rainfall events and increased flow. Turbidity levels are shown in green ink in **Figure 4** and flow levels are shown in blue ink. Precipitation data for this deployment period are shown below in **Appendix 1**, as recorded by the Provincial Department of Environment and Conservation Weather Station at Pippy Park in St. John's. A turbidity spike that occurred on September 10 does not appear to be associated with increased flow. This instantaneous spike may have occurred when suspended matter passed directly in front of the turbidity sensor as it was recording a reading. The turbidity spike at the end of the deployment is most likely the result of sensor fouling at the end of a long deployment period.

Figure 4: Turbidity and Flow



Appendix 1: Provincial Environment and Conservation Climate Data, St. John's, July 25-Sept 28, 2012

2012/07/25	16.77	13.34	22.64	0	0
2012/07/26	17	13.22	23.41	0.25	0.25
2012/07/27	21.26	15.84	27.94	1.27	1.27
2012/07/28	14.54	12.91	16.23	11.94	11.94
2012/07/29	17.41	11.53	23.84	0	0
2012/07/30	15.18	12.74	18.53	5.32	5.32
2012/07/31	15.34	13.07	17.84	0.51	0.51
2012/08/01	16.07	13.05	23.14	0	0
2012/08/02	17.81	13.14	22	0	0
2012/08/03	20.72	17.89	23.72	0.76	0.76
2012/08/04	21.23	14.5	28.79	0	0
2012/08/05	15.9	12.2	19.73	0	0
2012/08/06	19.87	13.51	26.93	0	0
2012/08/07	23.31	20.39	27.64	0	0
2012/08/08	23.22	20.48	29.11	6.6	6.6
2012/08/09	20.77	15.01	26.48	3.3	3.3
2012/08/10	17.93	13.43	23.2	0	0
2012/08/11	17.84	15.34	21.66	0	0
2012/08/12	17.68	15.94	22.15	0	0
2012/08/13	18.99	15.81	26.1	11.66	11.66
2012/08/14	19.82	13.64	26.36	8.63	8.63
2012/08/15	14.49	12.92	16.86	2.02	2.02
2012/08/16	13.91	9.01	18.61	0	0
2012/08/17	14.23	12.6	16.52	15.73	15.73
2012/08/18	14.78	13.95	15.98	1.52	1.52
2012/08/19	15.21	14.08	17.29	0.51	0.51
2012/08/20	17.93	14.26	23.26	2.54	2.54
2012/08/21	19.48	16.72	24.62	17.25	17.25
2012/08/22	20.8	16.7	25.72	0	0
2012/08/23	18.72	15.18	23.4	0	0
2012/08/24	18.66	13.92	25.41	11.68	11.68
2012/08/25	13.75	9.16	18.82	0.25	0.25
2012/08/26	17.22	9.81	22.9	0	0
2012/08/27	20.65	16.69	25.93	0.25	0.25
2012/08/28	21.82	18.46	26.74	0	0
2012/08/29	19.66	14.27	24.6	6.6	6.6
2012/08/30	16.57	13.06	20.5	0.25	0.25
2012/08/31	18.85	15.25	23.67	0	0
2012/09/01	17.37	11.34	20.86	23.32	23.32
2012/09/02	12.2	8.91	17.44	1.02	1.02
2012/09/03	12.55	6.42	18.43	0	0
2012/09/04	13.21	7.12	17.26	0.25	0.25
2012/09/05	15.01	12.27	19.43	0.25	0.25
2012/09/06	13.52	12.57	16.03	0	0
2012/09/07	14.8	12.37	20.13	26.88	26.88
2012/09/08	12.69	9.4	16.43	0.25	0.25
2012/09/09	16.6	10.46	22.92	0	0
2012/09/10	17.57	15.55	20.98	0	0
2012/09/11	17.24	11.04	22.49	6.53	6.53
2012/09/12	15.15	8.37	21.29	0	0

2012/09/13	16.89	11.95	22.37	0	0
2012/09/14	17.49	12.59	24	0	0
2012/09/15	13.27	10.93	16.79	0	0
2012/09/16	14.42	13.56	15.07	4.57	4.57
2012/09/17	14.31	11.51	16.95	0.25	0.25
2012/09/18	14.84	9.72	21.77	0	0
2012/09/19	15.54	8.44	24.01	0	0
2012/09/20	16.76	12.37	22.9	0	0
2012/09/21	15.9	10.66	21.61	0	0
2012/09/22	17.44	14.3	22.62	0	0
2012/09/23	19.96	16.17	24.68	0	0
2012/09/24	-9.87	-59.63	23.53	2.53	2.03
2012/09/25	-40	-40	-40	1.02	
2012/09/26	-40	-40	-40	0	
2012/09/27	-40	-40	-40	1.01	
2012/09/28	-8.94	-70.3	13.69	0	0

***Note: Air temperature sensor failed on Sept 24. Air temps from Sept 24-28 are incorrect.**

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