Real Time Water Quality Report

Humber River at Humber Village

Deployment Period
2014-01-17 to 2014-04-23

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

Prepared by:

Ian Bell
Environmental Scientist

Department of Environment & Conservation
Water Resources Management Division
PO Box 2006, Corner Brook, NL, A2H 6J8

t. 709.637.2431
f. 709.637.2541
e. ianbell@gov.nl.ca

General

- This station is operated as part of the Provincial Real Time Water Quality (RTWQ) network.
- This station is operated year round.
- Staff of the Water Resources Management Division (WRMD) monitors the real-time web page on a daily basis. Any unusual observations are investigated.
- This site is easily accessed and the instrument is normally removed on a monthly to bi-monthly basis for maintenance and calibration and is reinstalled within one to two days.
- This monthly deployment report, presents water quality and water quantity data recorded at the Humber River at Humber Village station from January 17, 2014, to April 23, 2014.

Quality Assurance / Quality Control

- Water quality instrument performance is tested at the beginning and end of its deployment period. The process is outlined in Appendix A.
- quantity data. Corrected data can be obtained upon request
- Instruments are assigned a performance rating (i.e., poor, marginal, fair, good or excellent) for each water quality parameter measured.
- Table 1 shows the performance ratings of five water quality parameters (i.e., temperature, pH, specific conductivity, dissolved oxygen and turbidity) measured by instruments deployed at the water monitoring stations.

Table 1: Water quality instrument performance at the beginning and end of the deployment

	Humber River	
Stage of deployment	**Beginning**	**End**
Date	2014-01-17	2014-04-23
Temperature	Good	Good
pH	Good	Poor
Specific Conductivity	Fair	Good
Dissolved Oxygen	Excellent	Fair
Turbidity	Excellent	Excellent

The performances of all sensors were rated fair to excellent at the beginning and poor to excellent at the end of the deployment period (Table 1). The poor rating for pH at removal is most likely due to the relatively long deployment period causing the pH sensor to drift off calibration.

With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QAQC protocol. Water Survey of Canada is responsible for QAQC of water quantity data. Corrected data can be obtained upon request

Deployment Notes

Water quality monitoring for this deployment period started on January 17, 2014 and continued without any significant operational issues until April 23, 2014, when the instrument was removed for routine calibration and maintenance. This was a relatively long deployment period of 96 days, which is typical of the winter when freezing makes it more difficult to remove the field instrument. Fortunately, with cold water conditions water quality tends to be quite stable, there is less biofouling, and the field instrument keeps good calibration for extended periods.

Data Interpretation

- Data records were interpreted for each station during the deployment period for the following six parameters:

(i.) Stage (m)
(ii.) Temperature (^{o}C)
(iii.) pH
(iv.) Specific conductivity (µS/cm)
(v.) Dissolved oxygen (mg/l)
(vi.) Turbidity (NTU)

Stage

- During this deployment period stage values ranged from 1.59 m to 3.43 m at Humber River, with corresponding flow ranging from 156.00 m^3/sec to 496.0 m^3/sec (Figure 1).

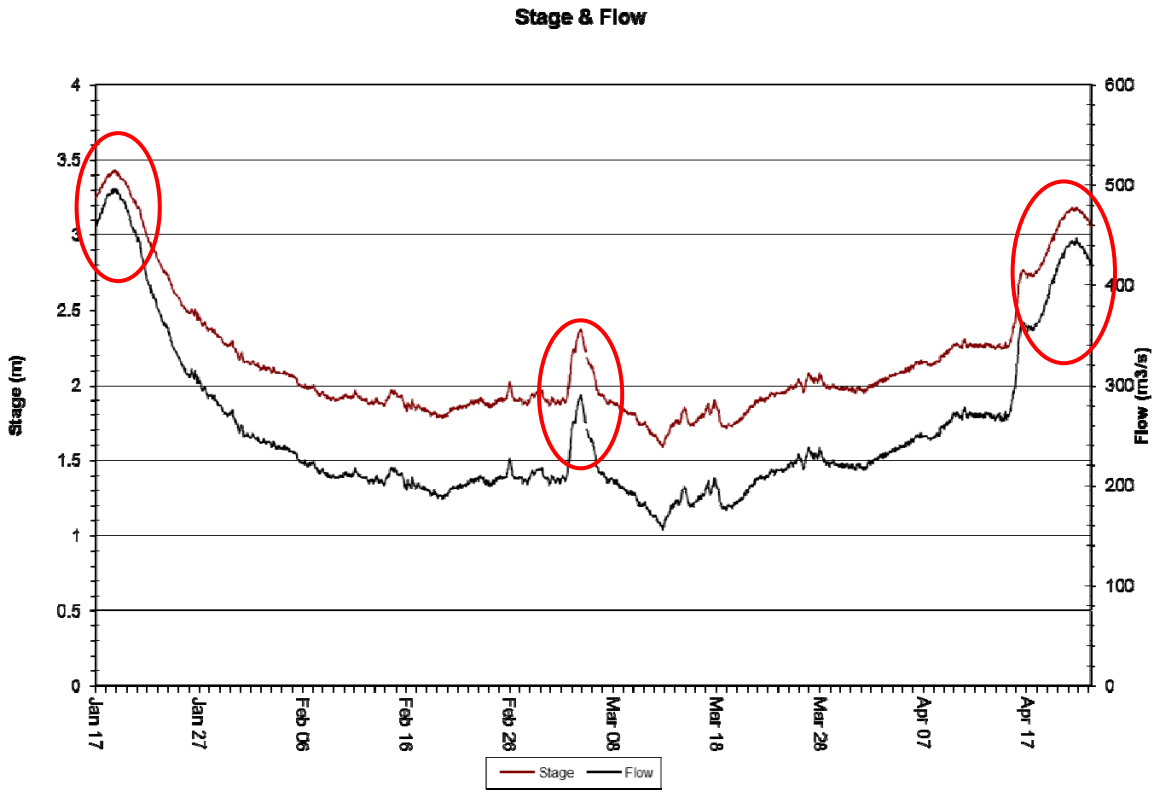

Figure 1: Stage Height (m) at Humber River from January 17, 2014, to April 23, 2014

- During the deployment period there were three significant spikes in flow (See inside red ovals – Figure 1). The first spike at the beginning of the deployment is related to a period of significant rainfall during the week prior to deployment (See weather data in Appendix B). The second spike is mostly likely not a true increase in flow but rather related to a period of extreme cold air temperatures and ice formation, causing a "backwater effect" which mimics a sharp increase in flow. At the end of the deployment period stage and flow show a sharp rise which is related to warmer weather and the beginning of spring runoff.

Temperature

- During this deployment period water temperature at Humber River ranged from -0.19˚C to 1.6˚C (Figure 2).
- Temperature is cold and stable over the deployment period which is consistent with the cold winter conditions.
- The water temperature shows a clear diurnal trend which is related to the diurnal air temperature trend.

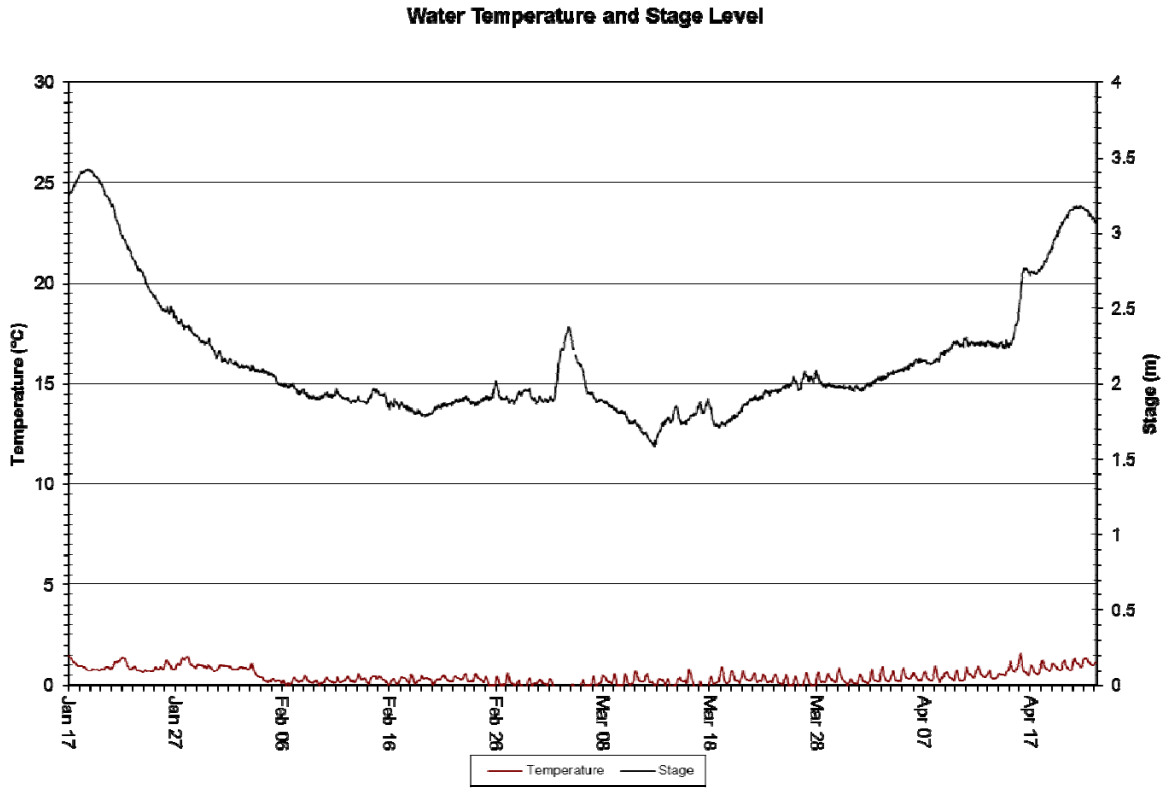

Figure 2: Temperature (°C) at Humber River from January 17, 2014, to April 23, 2014

pH

- During this deployment period pH values at Humber River ranged from 5.51 units to 6.84 units (Figure 3).
- pH was quite stable throughout the deployment period, however it is possible to see it drift off calibration and become more variable towards the end of the deployment period as the pH sensor loses accuracy.
- pH shows diurnal fluctuations which are related to the diurnal temperature fluctuations.
- With a median value of 5.97, the majority of pH values recorded at Humber River during this deployment period were below the minimum guidelines for pH for the protection of aquatic life (i.e., 6.5 units), as defined by the Canadian Council of Ministers of the Environment (2007). It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally below this 6.5 unit guideline.

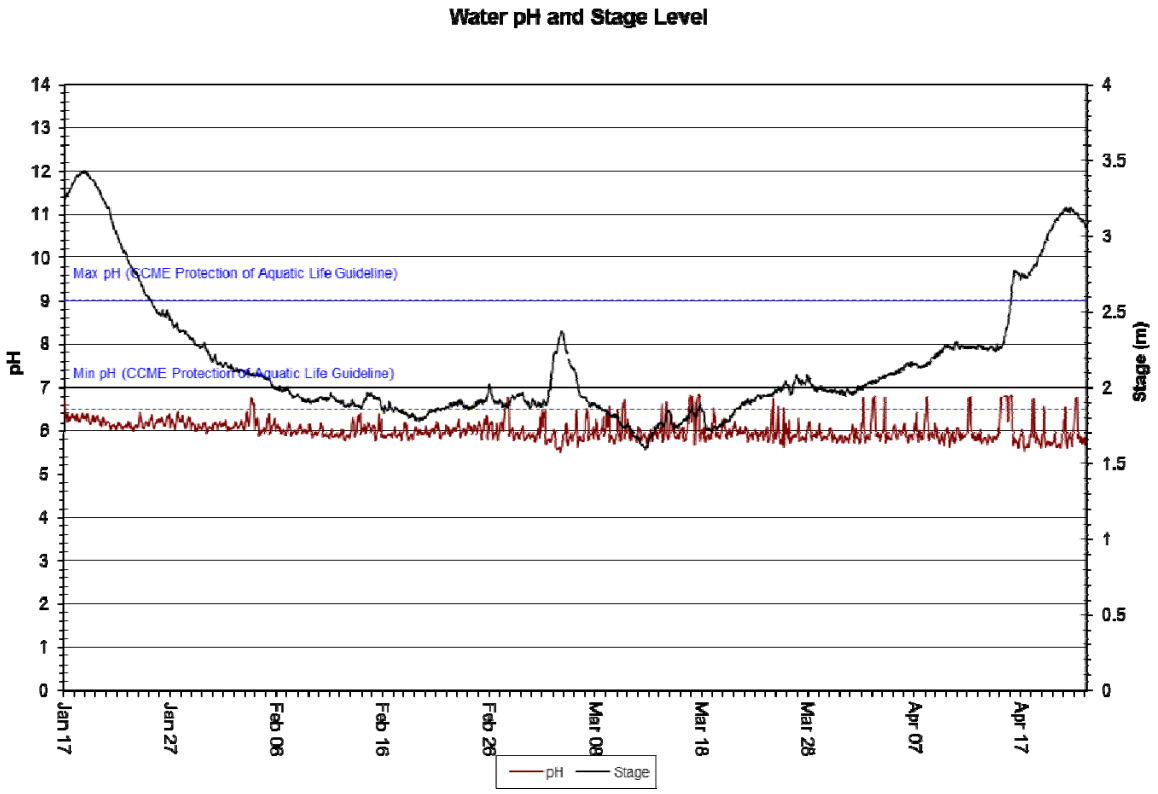

Figure 3: pH values recorded at Humber River from January 17, 2014, to April 23, 2014

Specific Conductivity

- During this deployment period specific conductivity at Humber River ranged from 23.5 µS/cm to 42.0 µS/cm (Figure 4).
- Specific conductivity appears to be relatively stable during the deployment period, however there are three distinct periods when specific conductivity takes a significant dip for a relatively brief period (See inside red ovals). All three of these dips in specific conductivity correspond with increases in stage height and flow. While the first of these increases in stage height may be related to extreme cold and ice buildup along the river the next two are more likely related to mild weather and significant precipitations events (See weather data in Appendix B).

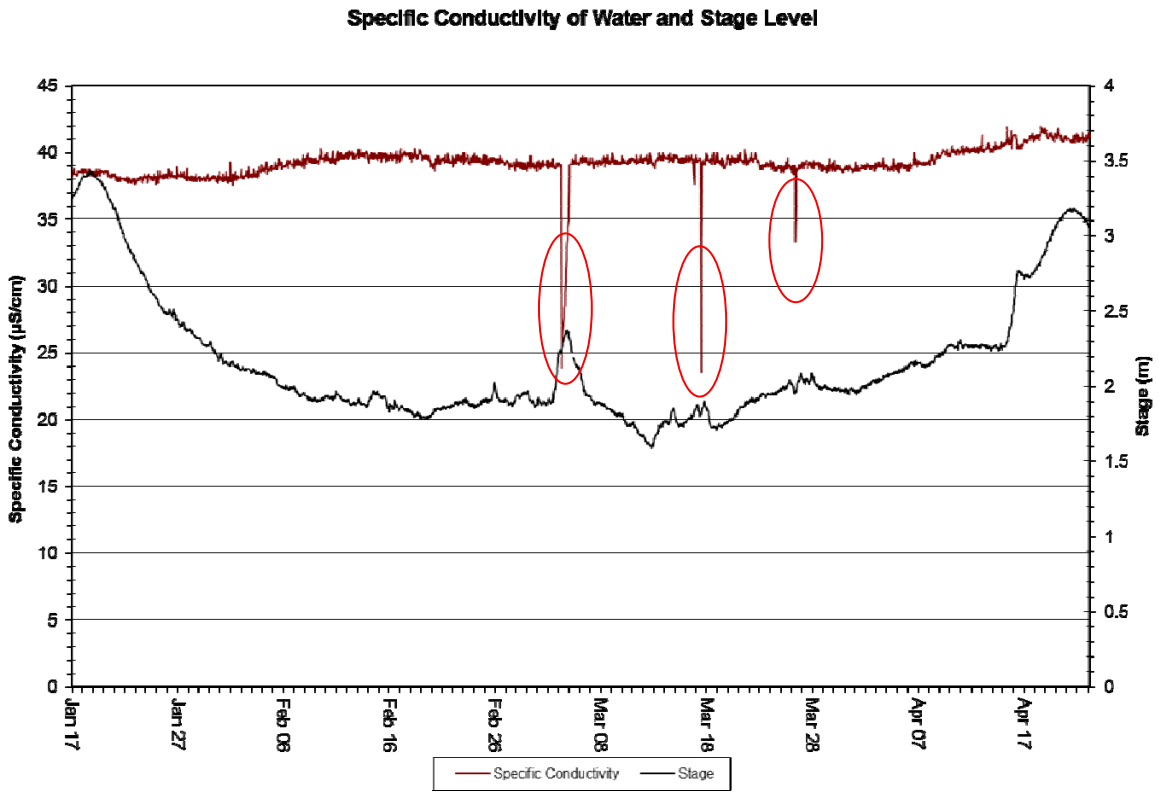

Figure 4: Specific conductivity (µs/cm) at Humber River from January 17, 2014, to April 23, 2014

Dissolved Oxygen

- During this deployment period dissolved oxygen [DO] values at Humber River ranged from 10.13 mg/l (68.8% saturation) to 13.49 mg/l (96.0% saturation) (Figure 5).
- Upon initial deployment DO values appear to be relatively high and over several days they stabilize to a reasonable level (see inside red oval – Figure 5). This is most likely related to technical issues with the older Clark Cell oxygen sensor, rather than reflecting natural conditions with oxygen levels in the river at the time of deployment.
- DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations.
- DO (mg/l) is relatively stable over the deployment period which is related to the correspondingly stable temperature trend over the deployment period. However, there are two noticeable dips in oxygen (see inside red ovals). The first dip is related to a spike in stage height related to extreme cold and ice buildup along the river and the second is related to significant increases in flow caused by mild weather and significant precipitation (See weather data in Appendix B).
- All of the DO values at Humber River were above both the minimum guideline set for other life stages (6.5 mg/l), as well as above the minimum guideline (9.5 mg/l) set for the protection of early life stages, as determined by the Canadian Council of Ministers of the Environment (2007).

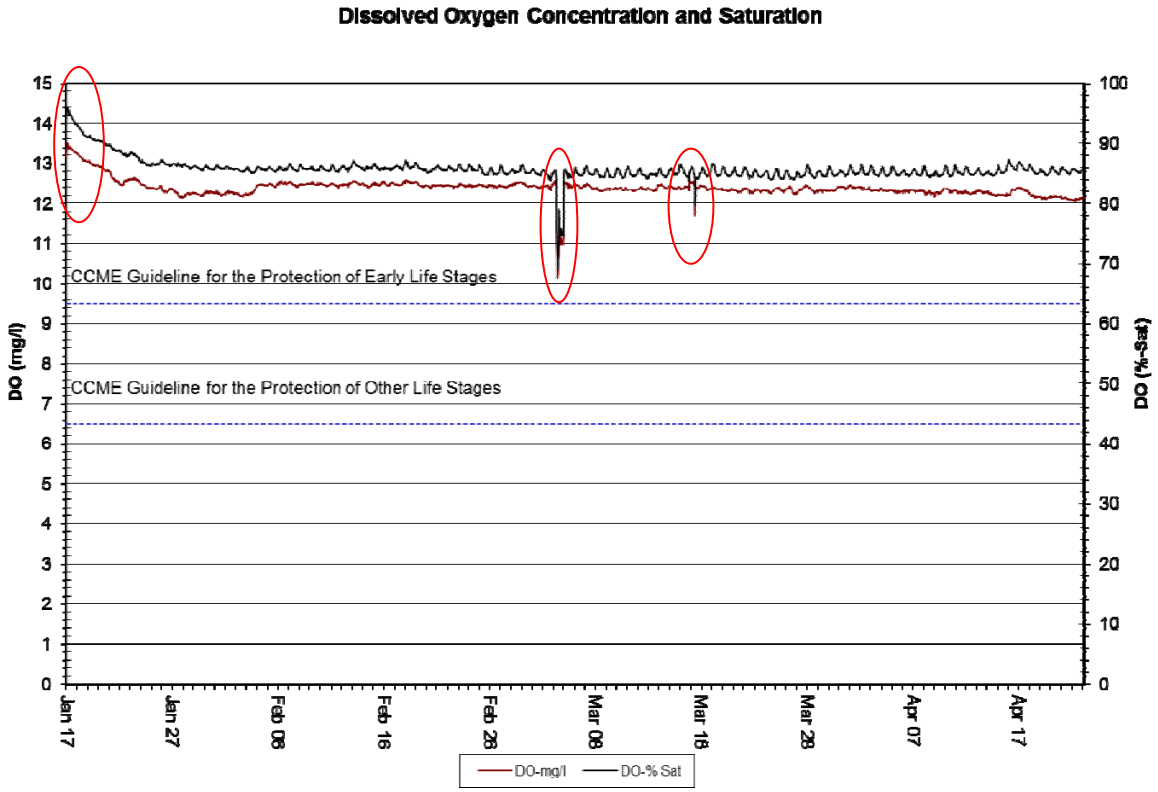

Figure 5: DO (mg/l & % saturation) at Humber River from January 17, 2014, to April 23, 2014

Turbidity

- During this deployment period turbidity values at Humber River ranged from 0.0 NTU to 712.0 NTU (Figure 6).
- Most turbidity readings during the deployment are stable and quite low, however there is a large spike (see inside red oval) from the evening of March 4th to the morning of March 5th which corresponds with a spike in stage height related to extreme cold and ice buildup along the river.

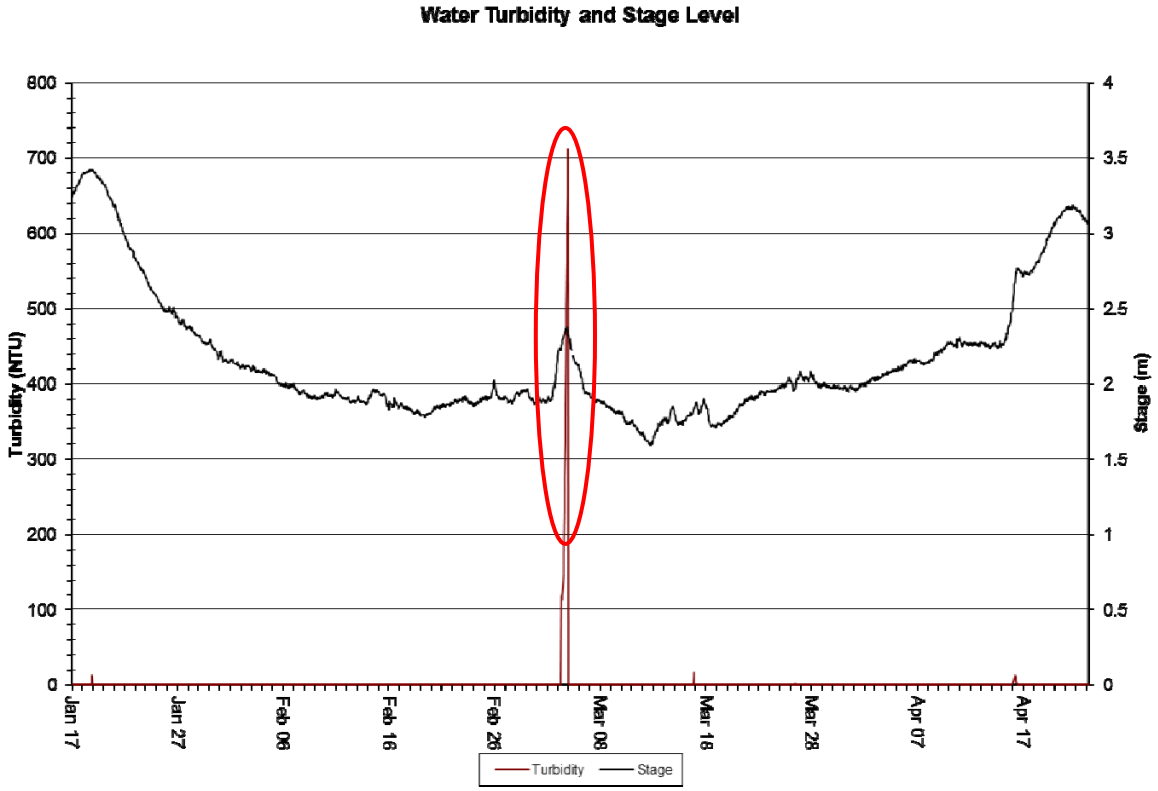

Figure 6: Turbidity (NTU) at Humber River from January 17, 2014, to April 23, 2014

Conclusion

- This monthly deployment report presents water quality and water quantity data recorded at Humber River from January 17, 2014, to April 23, 2014.
- The performances of all sensors were rated fair to excellent at the beginning and poor to excellent at the end of the deployment period. The poor rating for pH at removal is most likely due to the relatively long deployment period causing the pH sensor to drift off calibration.
- Variations in water quality/quantity values recorded at each station are summarized below:

- During this deployment period stage values ranged from 1.59 m to 3.43 m at Humber River, with corresponding flow ranging from 156.00 m^3/sec to 496.0 m^3/sec.
- During the deployment period there were three significant spikes in flow. The first spike at the beginning of the deployment is related to a period of significant rainfall during the week prior to deployment (See weather data in Appendix B). The second spike is mostly likely not a true increase in flow but rather related to a period of extreme cold air temperatures and ice formation, causing a "backwater effect" which mimics a sharp increase in flow. At the end of the deployment period stage and flow show a sharp rise which is related to warmer weather and the beginning of spring runoff.
- During this deployment period water temperature at Humber River ranged from -0.19˚C to 1.6˚C and was generally cold and stable.
- The water temperature shows a clear diurnal trend which is related to the diurnal air temperature trend.
- During this deployment period pH values at Humber River ranged from 5.51 units to 6.84 units and was quite stable throughout the deployment period, however it is possible to see it drift off calibration and become more variable towards the end of the deployment period as the pH sensor loses accuracy.
- pH shows diurnal fluctuations which are related to the diurnal temperature fluctuations.
- With a median value of 5.97, the majority of pH values recorded at Humber River during this deployment period were below the minimum guidelines for pH for the protection of aquatic life (i.e., 6.5 units), as defined by the Canadian Council of Ministers of the Environment (2007). It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally below this 6.5 unit guideline.
- During this deployment period specific conductivity at Humber River ranged from 23.5 µS/cm to 42.0 µS/cm and was relatively stable during the deployment period, however there are three distinct periods when specific conductivity takes a significant dip for a relatively brief period. All three of these dips in specific conductivity correspond with increases in stage height and flow.
- During this deployment period dissolved oxygen [DO] values at Humber River ranged from 10.13 mg/l (68.8% saturation) to 13.49 mg/l (96.0% saturation).
- Upon initial deployment DO values appear to be relatively high and over several days they stabilize to a reasonable level. This is most likely related to technical issues with the older Clark Cell oxygen sensor, rather than reflecting natural conditions with oxygen levels in the river at the time of deployment.
- DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations.

- DO (mg/l) is relatively stable over the deployment period which is related to the correspondingly stable temperature trend over the deployment period. However, there are two noticeable dips in oxygen. The first dip is related to a spike in stage height related to extreme cold and ice buildup along the river and the second is related to significant increases in flow caused by mild weather and significant precipitation.
- All of the DO values at Humber River were above both the minimum guideline set for other life stages (6.5 mg/l), as well as above the minimum guideline (9.5 mg/l) set for the protection of early life stages, as determined by the Canadian Council of Ministers of the Environment (2007).
- During this deployment period turbidity values at Humber River ranged from 0.0 NTU to 712.0 NTU.
- Most turbidity readings during the deployment are stable and quite low, however there is a large spike from the evening of March 4th to the morning of March 5th which corresponds with a significant spike in stage height related to extreme cold and ice buildup along the river.

References

Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated December, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. (Website: http://ceqg-rcqe.ccme.ca/download/en/222/)

APPENDIX A
Quality Assurance / Quality Control Procedures

- As part of the Quality Assurance / Quality Control (QA/QC) protocol, the performance of a station's water quality instrument (i.e., Field Sonde) is rated at the beginning and end of its deployment period. The procedure is based on the approach used by the United States Geological Survey (Wagner *et al.* 2006)[1].
- At the beginning of the deployment period, a fully cleaned and calibrated QA/QC water quality instrument (i.e., QA/QC Sonde) is placed *in-situ* with the fully cleaned and calibrated Field Sonde. After Sonde readings have stabilized, which may take up to five minutes in some cases, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde. If the readings from both Sondes are in close agreement, the QA/QC Sonde can be removed from the water. If the readings are not in close agreement, there will be attempts to reconcile the problem on site (e.g., removing air bubbles from sensors, etc.). If no fix is made, the Field Sonde may be removed for recalibration.
- At the end of the deployment period, a fully cleaned and calibrated QA/QC Sonde is once again deployed *in-situ* with the Field Sonde, which has already been deployment for 30-40 days. After Sonde readings have stabilized, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde.
- Performance ratings are based on differences listed in the table below.

	Rating				
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

[1] Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at *http://pubs.water.usgs.gov/tm1d3*

APPENDIX B

Environment Canada Weather Data – Corner Brook (Jan.11,2014, to Apr.23,2014)

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
1/11/2014	4.9	-7.2	-1.2	19.2	0	21.3
1/12/2014	9.2	-0.1	4.6	13.4	0	19.3
1/13/2014	0	-3.8	-1.9	19.9	0	0.7
1/14/2014	6.3	-1.8	2.3	15.7	0	6.7
1/15/2014	9.6	-0.2	4.7	13.3	0	19.1
1/16/2014	4.5	-0.3	2.1	15.9	0	4
1/17/2014	0.7	-1.6	-0.5	18.5	0	2.5
1/18/2014	2.2	-1.3	0.5	17.5	0	0.7
1/19/2014	-1.1	-4	-2.6	20.6	0	8.1
1/20/2014	-0.2	-5.5	-2.9	20.9	0	3.2
1/21/2014	-5.4	-10.8	-8.1	26.1	0	0.6
1/22/2014	-7	-10	-8.5	26.5	0	11.9
1/23/2014	-6.6	-10.3	-8.5	26.5	0	3.5
1/24/2014	-6.5	-11.5	-9	27	0	1.7
1/25/2014	-2.7	-12.7	-7.7	25.7	0	0.8
1/26/2014	4.1	-11.4	-3.7	21.7	0	20.3
1/27/2014	5.7	-12.6	-3.5	21.5	0	7.7
1/28/2014	4.4	-14.5	-5.1	23.1	0	0
1/29/2014	-9.4	-13.9	-11.7	29.7	0	1.5
1/30/2014	-8.5	-12.9	-10.7	28.7	0	1.3
1/31/2014	-1.8	-12.1	-7	25	0	1.4
2/1/2014	-4.4	-9.1	-6.8	24.8	0	0
2/2/2014	-1.6	-8.9	-5.3	23.3	0	7
2/3/2014	-3.6	-14.7	-9.2	27.2	0	0
2/4/2014	-7.9	-14.5	-11.2	29.2	0	0.7
2/5/2014	-6.8	-17	-11.9	29.9	0	0.8
2/6/2014	-12.8	-17.8	-15.3	33.3	0	1.4
2/7/2014	-7.6	-14.9	-11.3	29.3	0	0.6
2/8/2014	-7.2	-13	-10.1	28.1	0	3.5
2/9/2014	-11.8	-16.8	-14.3	32.3	0	1.4
2/10/2014	-10.8	-15.7	-13.3	31.3	0	0
2/11/2014	-12.1	-15.7	-13.9	31.9	0	3
2/12/2014	-10.2	-17.4	-13.8	31.8	0	0.7
2/13/2014	-4.8	-16.1	-10.5	28.5	0	0
2/14/2014	4.5	-8.8	-2.2	20.2	0	20.7
2/15/2014	0.7	-15	-7.2	25.2	0	0.9
2/16/2014	-2.3	-13	-7.7	25.7	0	15.8

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
2/17/2014	-4.3	-9.7	-7	25	0	2.2
2/18/2014	-8.4	-11.9	-10.2	28.2	0	0
2/19/2014	-4.7	-10.6	-7.7	25.7	0	1.4
2/20/2014	-3.4	-8	-5.7	23.7	0	15.7
2/21/2014	-3	-9.8	-6.4	24.4	0	0.8
2/22/2014	0.5	-8.4	-4	22	0	3.1
2/23/2014	0	-7.2	-3.6	21.6	0	0.7
2/24/2014	2.5	-8.3	-2.9	20.9	0	3.2
2/25/2014	-4.7	-13.7	-9.2	27.2	0	0.7
2/26/2014	-7.5	-15.5	-11.5	29.5	0	0
2/27/2014	-6.4	-20.1	-13.3	31.3	0	0
2/28/2014	-6.5	-14.2	-10.4	28.4	0	2.1
3/1/2014	-8	-14.7	-11.4	29.4	0	0.6
3/2/2014	-2.1	-18.5	-10.3	28.3	0	4.1
3/3/2014	-7.7	-20.5	-14.1	32.1	0	0.8
3/4/2014	-16	-21.4	-18.7	36.7	0	0
3/5/2014	-12.4	-21.4	-16.9	34.9	0	0
3/6/2014	-10.7	-17.7	-14.2	32.2	0	0
3/7/2014	-4.1	-15.2	-9.7	27.7	0	0.9
3/8/2014	1.2	-9.3	-4.1	22.1	0	2.5
3/9/2014	-6.3	-19.2	-12.8	30.8	0	0
3/10/2014	-6.8	-19.9	-13.4	31.4	0	0
3/11/2014	-2.9	-13.4	-8.2	26.2	0	0
3/12/2014	2.1	-7.1	-2.5	20.5	0	0.7
3/13/2014	9.2	-7.8	0.7	17.3	0	32.3
3/14/2014	0.3	-15.2	-7.5	25.5	0	0
3/15/2014	-0.9	-15	-8	26	0	0
3/16/2014	3.4	-9.6	-3.1	21.1	0	3.8
3/17/2014	-9.4	-13.5	-11.5	29.5	0	1
3/18/2014	-4.3	-10.6	-7.5	25.5	0	0
3/19/2014	-0.3	-7.6	-4	22	0	0
3/20/2014	2.1	-8.4	-3.2	21.2	0	0.7
3/21/2014	5.6	-2.8	1.4	16.6	0	0.8
3/22/2014	-0.1	-6	-3.1	21.1	0	0
3/23/2014	-0.2	-5.6	-2.9	20.9	0	1.9
3/24/2014	-4.4	-14.6	-9.5	27.5	0	0
3/25/2014	-6.9	-14.5	-10.7	28.7	0	0
3/26/2014	-2.3	-15.4	-8.9	26.9	0	11.6

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
3/27/2014	5	-6.2	-0.6	18.6	0	2.8
3/28/2014	-1.4	-7.1	-4.3	22.3	0	0
3/29/2014	2.8	-8.2	-2.7	20.7	0	1.4
3/30/2014	2.1	-12.4	-5.2	23.2	0	0
3/31/2014	-2.5	-7.8	-5.2	23.2	0	4.7
4/1/2014	0	-6.4	-3.2	21.2	0	0
4/2/2014	1.6	-5.7	-2.1	20.1	0	0
4/3/2014	2.7	-9.1	-3.2	21.2	0	0
4/4/2014	2.6	-9.5	-3.5	21.5	0	0
4/5/2014	5.8	-8.4	-1.3	19.3	0	0
4/6/2014	4.3	-1.2	1.6	16.4	0	1.6
4/7/2014	2.6	-4.5	-1	19	0	0
4/8/2014	9.3	-5.3	2	16	0	12.2
4/9/2014	9.7	-0.2	4.8	13.2	0	0.7
4/10/2014	-0.1	-6.3	-3.2	21.2	0	0
4/11/2014	8.2	-3.4	2.4	15.6	0	0.9
4/12/2014	7.7	-2.1	2.8	15.2	0	0
4/13/2014	0.6	-8.1	-3.8	21.8	0	0
4/14/2014	3.8	-7.7	-2	20	0	0
4/15/2014	15.8	3.8	9.8	8.2	0	0
4/16/2014	15	-3.2	5.9	12.1	0	3
4/17/2014	-0.7	-7.4	-4.1	22.1	0	0
4/18/2014	4.6	-7.9	-1.7	19.7	0	0
4/19/2014	4.8	-2.6	1.1	16.9	0	0
4/20/2014	0.5	-4	-1.8	19.8	0	0
4/21/2014	8	-5.4	1.3	16.7	0	0
4/22/2014	9.5	0.3	4.9	13.1	0	0
4/23/2014	4.3	-0.7	1.8	16.2	0	0