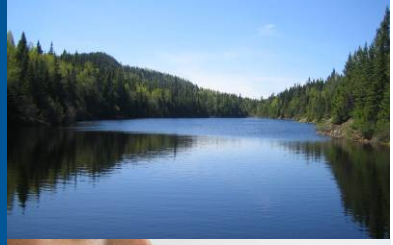




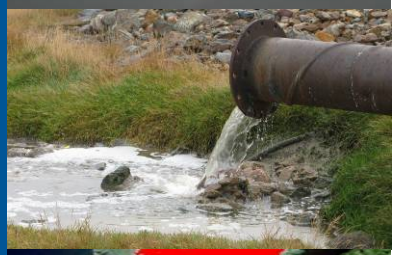


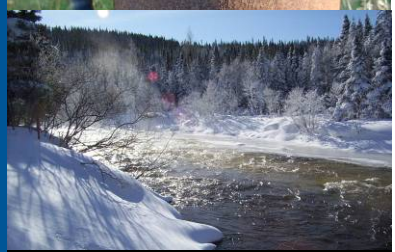

Real Time Water Quality Report

Humber River at Humber Village

Deployment Period
2016-04-14 to 2016-06-20

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

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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 regular 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. During the winter months the deployment periods tend to be longer as the instrument is often frozen into place and difficult to remove.
- This monthly deployment report, presents water quality and water quantity data recorded at the Humber River at Humber Village station from April 14, 2016, to June 20, 2016.

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.
- 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 the deployed instrument.
- The performances of four out of five of the sensors were rated good to excellent at the beginning and end of the deployment period (Table 1), however the specific conductivity sensor rated marginal at both the initial deployment and the removal. At the time of the deployment, and the removal, the flow in the Humber River at Humber Village was high due to spring runoff. During high flow the specific conductivity is more variable than usual making it more difficult to get a good comparison between the field instrument deployed from the bridge and the QA/QC instrument located at the shoreline near the bridge.
- **With the exception of water quantity data (stage height), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.

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

	Humber River	
Stage of deployment	**Beginning**	**End**
Date	2016-04-14	2016-06-20
Temperature	Excellent	Good
pH	Good	Good
Specific Conductivity	**Marginal**	**Marginal**
Dissolved Oxygen	Excellent	Excellent
Turbidity	Excellent	Good

Deployment Notes

Water quality monitoring for this deployment period started on April 14, 2016 and continued without any significant operational issues until June 20, 2016, when the instrument was removed for routine calibration and maintenance.

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

- **The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.

- During this deployment period stage values ranged from 2.28 m to 3.50 m at Humber River at Humber Village, with corresponding flow ranging from 266.56 m^3/sec to 504.51 m^3/sec (Figure 1).

- The most significant peak in stage height and flow for this deployment is approximately May 11th and 12th (See inside red oval) which appears to correspond with several days of warmer weather from May 7th to 9th (See climate data located in Appendix B).

- Flows over the deployment period were typical for the season with relatively high levels associated with spring runoff and considerable variability in flow associated with snowmelt on warm days, and/or rainfall events causing snowmelt.

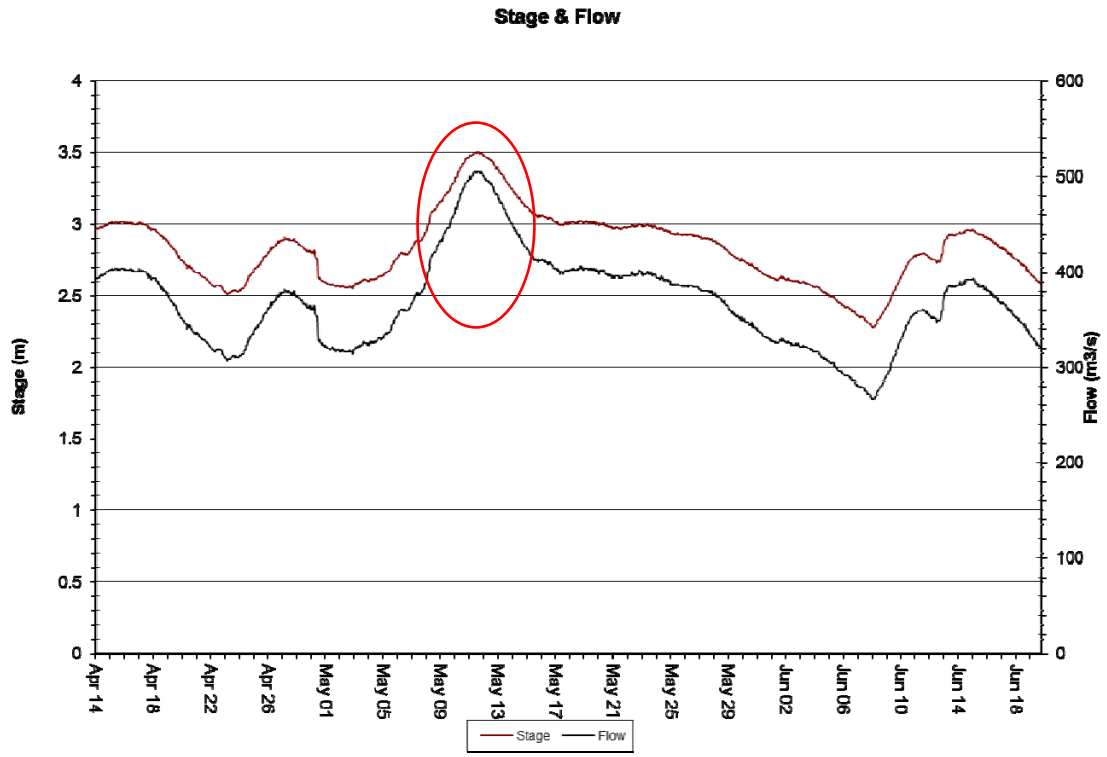

Figure 1: Stage Height (m) at Humber River from April 14, 2016, to June 20, 2016

Temperature

- During this deployment period the water temperature at Humber River ranged from 1.15˚C to 9.28˚C (Figure 2).
- Water temperature shows an increasing trend over the deployment period which is consistent with the transition from early to late spring.
- The water temperature shows a diurnal trend which is related to the diurnal air temperature trend.

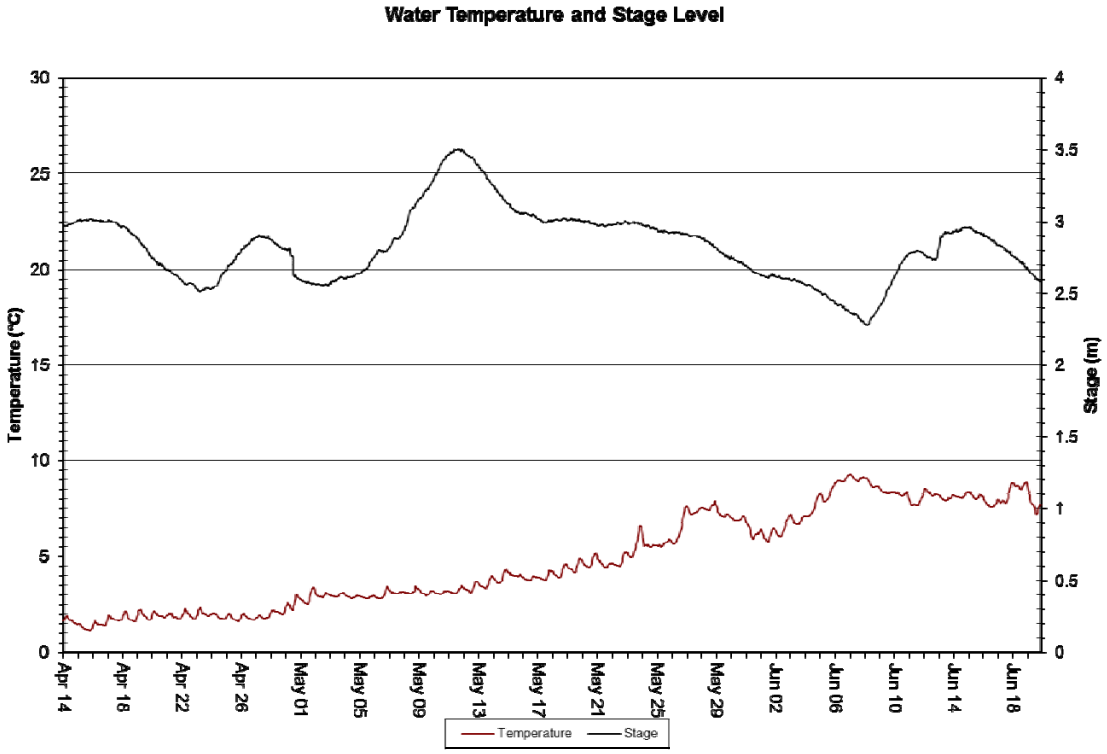

Figure 2: Temperature (^{o}C) at Humber River from April 14, 2016, to June 20, 2016

pH

- During this deployment period pH values at Humber River ranged from 6.56 units to 6.82 units (Figure 3).
- pH was quite stable throughout the deployment period with no apparent trends.
- With a median value of 6.66, all of the pH values recorded at Humber River during this deployment period were within the guidelines for pH for the protection of aquatic life (i.e., 6.5 to 9.0 units), as defined by the Canadian Council of Ministers of the Environment (2007).

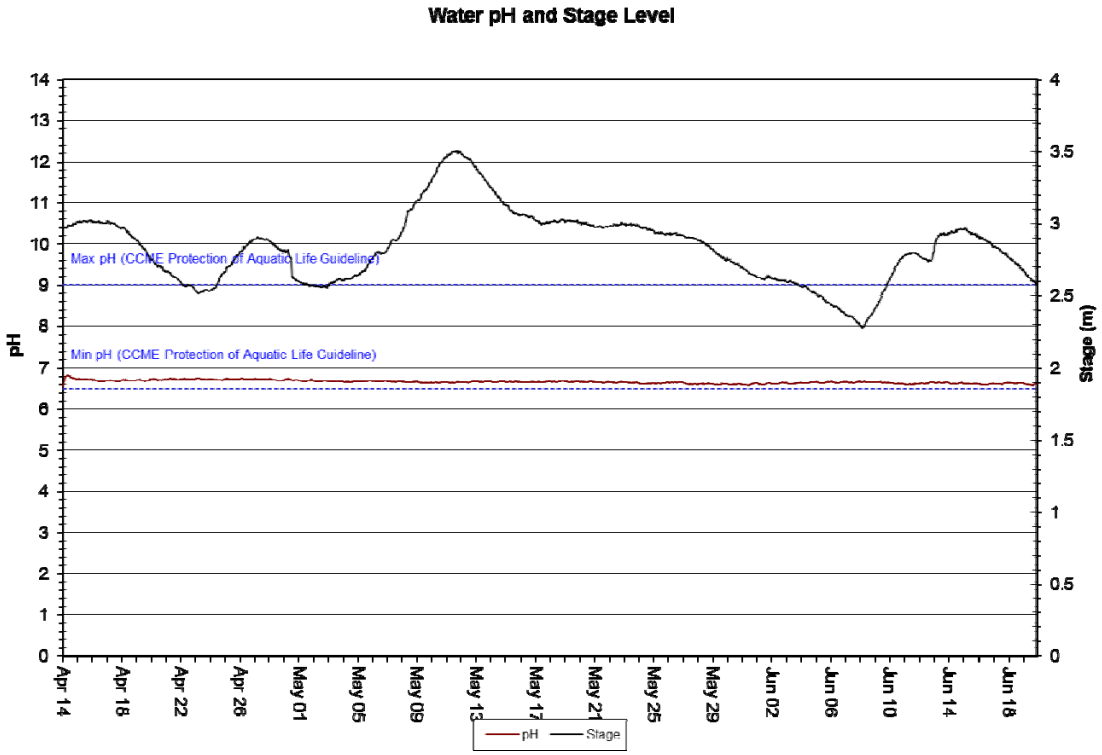

Figure 3: pH values recorded at Humber River from April 14, 2016, to June 20, 2016

Specific Conductivity

- During this deployment period specific conductivity at Humber River ranged from 35.3 µS/cm to 38.6 µS/cm (Figure 4).
- Specific conductivity was relatively stable during the deployment period with no noticeable trends apparent.

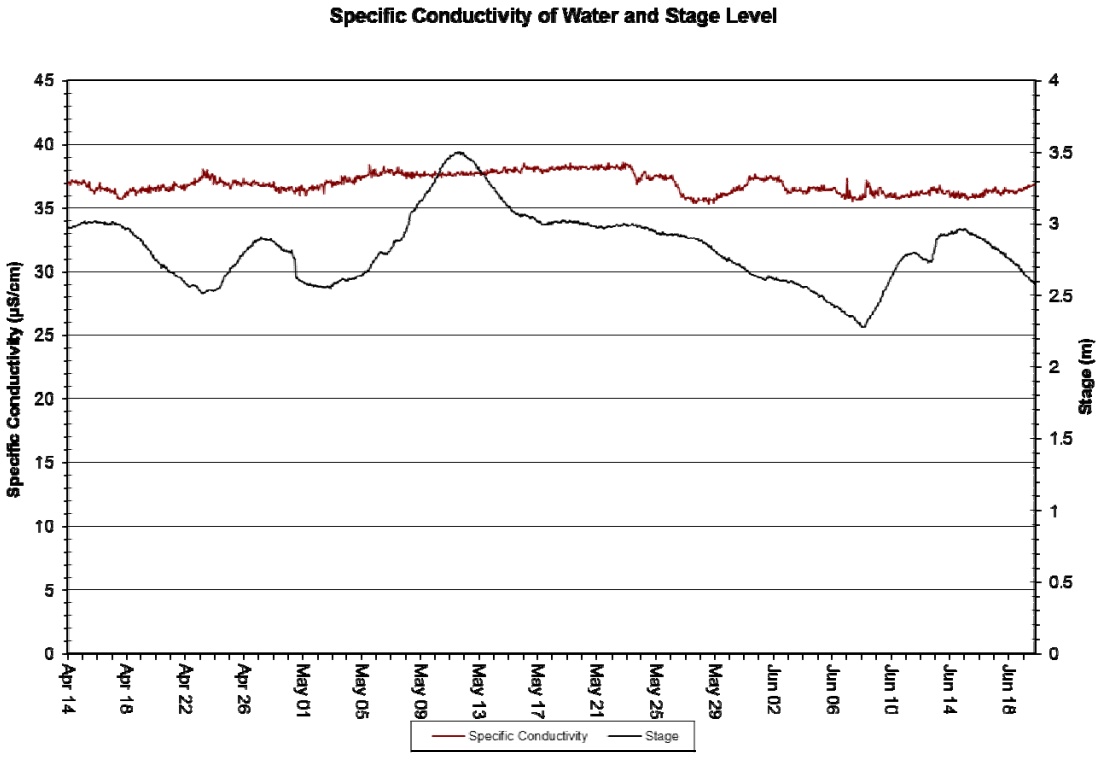

Figure 4: Specific conductivity (µs/cm) at Humber River from April 14, 2016, to June 20, 2016

Dissolved Oxygen

- During this deployment period dissolved oxygen [DO] values at Humber River ranged from 11.21 mg/l (90.6% saturation) to 13.02 mg/l (100.6% saturation) (Figure 5).
- Over the deployment period DO(mg/l) shows a decreasing trend which is related to the increasing temperature trend for the same period.
- DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations. This diurnal trend is most apparent in the percent saturation DO data.
- During this deployment period all of the DO values at Humber River were above the minimum guideline set for other life stages (6.5 mg/l), as well as the minimum guideline set for the protection of early life stages(9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

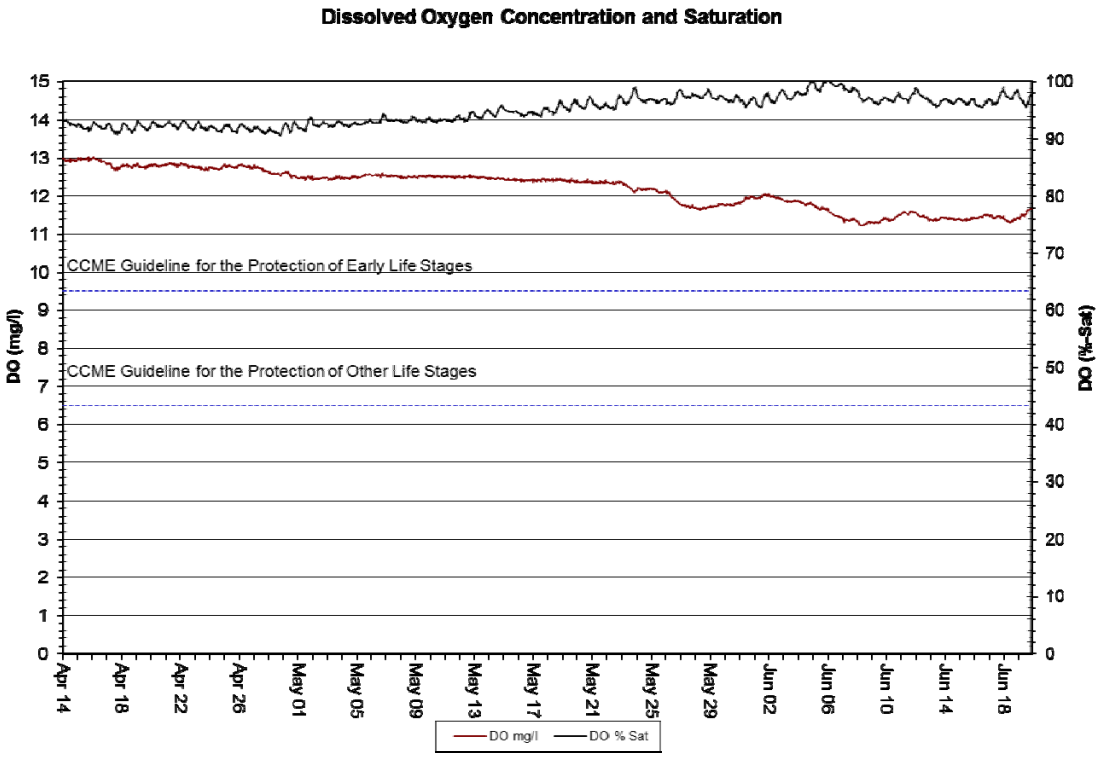

Figure 5: DO (mg/l & % saturation) at Humber River from April 14, 2016, to June 20, 2016

Turbidity

- During this deployment period turbidity values at Humber River ranged from 0.0 NTU to 4.4 NTU (Figure 6).
- During the deployment there were three small spikes in turbidity on May 8th and June 8th and 13th, (See inside red ovals) which all occur on dates with significant rainfall events (See climate data located in Appendix B).

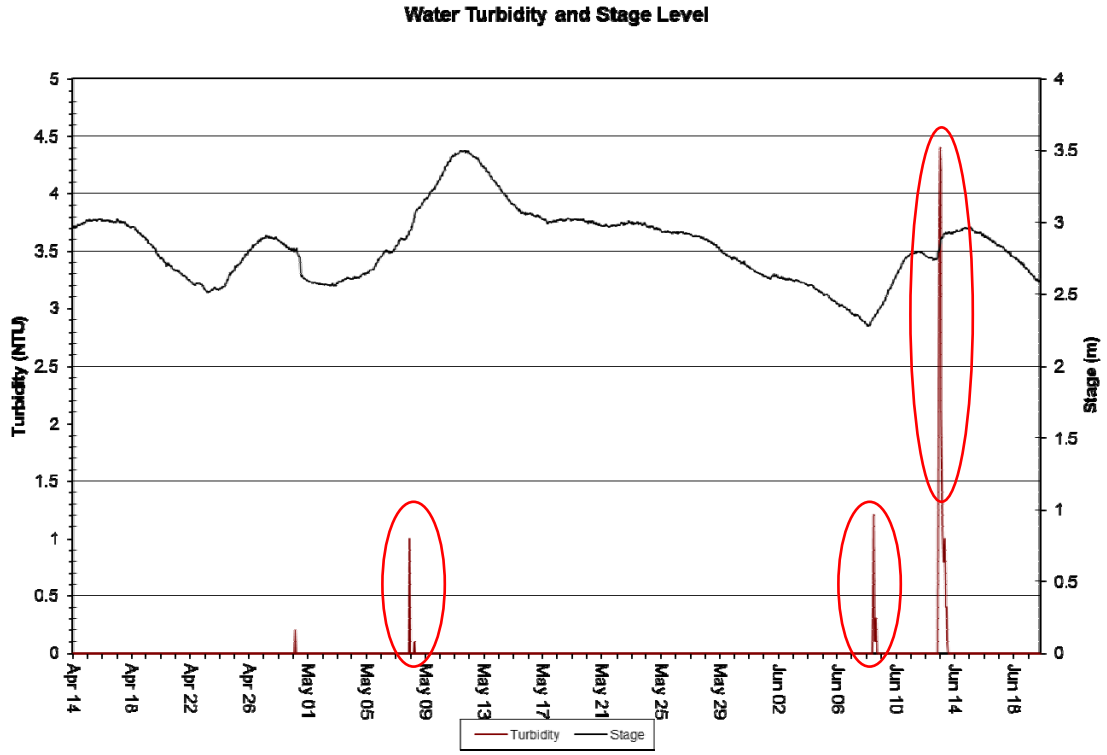

Figure 6: Turbidity (NTU) at Humber River from April 14, 2016, to June 20, 2016

Conclusion

- This monthly deployment report presents water quality and water quantity data recorded at Humber River at Humber Village from April 14, 2016, to June 20, 2016.
- The performance of four out of five of the sensors were rated good to excellent at the beginning and end of the deployment period, however the specific conductivity sensor rated marginal at both the initial deployment and the removal. This marginal rating can most likely be attributed to high flow conditions at the time of deployment and removal which caused increased variability in specific conductivity readings.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - During this deployment period stage values ranged from 2.28 m to 3.50 m at Humber River at Humber Village, with corresponding flow ranging from 266.56 m^3/sec to 504.51 m^3/sec. Flows over the deployment period were typical for the season with relatively high levels associated with spring runoff and considerable variability in flow associated with snowmelt on warm days and/or rainfall events causing snowmelt.
    - During this deployment period the water temperature at Humber River ranged from 1.15˚C to 9.28˚C with an increasing trend over the deployment period which is consistent with the transition from early to late spring.
    - During this deployment period pH values at Humber River ranged from 6.56 units to 6.82 units, and was quite stable. With a median value of 6.66, all of the pH values recorded at Humber River during this deployment period were within the guidelines for pH for the protection of aquatic life (i.e., 6.5 to 9.0 units), as defined by the Canadian Council of Ministers of the Environment (2007).
    - During this deployment period specific conductivity at Humber River ranged from 35.3 µS/cm to 38.6 µS/cm and was relatively stable with no noticeable trends apparent.
    - During this deployment period dissolved oxygen [DO] values at Humber River ranged from 11.21 mg/l (90.6% saturation) to 13.02 mg/l (100.6% saturation) with a decreasing trend. During this deployment period all of the DO values at Humber River were above the minimum guideline set for other life stages (6.5 mg/l), as well as the minimum guideline set for the protection of early life stages(9.5 mg/l), 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 4.4 NTU.

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 (04-14-2016 to 06-20-2016)

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
4/14/2016	6.5	1	3.8	14.2	0	0.8
4/15/2016	2	0	1	17	0	9.4
4/16/2016	2.5	-3	-0.3	18.3	0	0
4/17/2016	9.5	-1.5	4	14	0	0
4/18/2016	2	-1	0.5	17.5	0	0
4/19/2016	6.5	-7	-0.3	18.3	0	0
4/20/2016	5.5	-2.5	1.5	16.5	0	3.2
4/21/2016	4	-2.5	0.8	17.2	0	0.6
4/22/2016	11.5	0.5	6	12	0	0
4/23/2016	14.5	4.5	9.5	8.5	0	0
4/24/2016	12	2.5	7.3	10.7	0	12.2
4/25/2016	-0.5	-3.5	-2	20	0	0.4
4/26/2016	2	-4.5	-1.3	19.3	0	0.6
4/27/2016	2	-4	-1	19	0	0
4/28/2016	2	-3	-0.5	18.5	0	6.2
4/29/2016	2.5	-3	-0.3	18.3	0	0
4/30/2016	8	1	4.5	13.5	0	0
5/1/2016	13	-1.5	5.8	12.2	0	0
5/2/2016	12.5	-1.5	5.5	12.5	0	0
5/3/2016	10.5	0	5.3	12.7	0	2.4
5/4/2016	8	2.5	5.3	12.7	0	0
5/5/2016	7	1.5	4.3	13.7	0	12.6
5/6/2016	6	2.5	4.3	13.7	0	2.8
5/7/2016	18	3.5	10.8	7.2	0	0.4
5/8/2016	15	7	11	7	0	15
5/9/2016	15	7	11	7	0	2.4
5/10/2016	8	1	4.5	13.5	0	1.6
5/11/2016	6	2	4	14	0	0.4
5/12/2016	7.5	1.5	4.5	13.5	0	4.4
5/13/2016	8.5	1.5	5	13	0	0
5/14/2016	14.5	2	8.3	9.7	0	0
5/15/2016	16	4.5	10.3	7.7	0	3.4
5/16/2016	11	2.5	6.8	11.2	0	6.2
5/17/2016	7.5	2.5	5	13	0	0.8
5/18/2016	10.5	2.5	6.5	11.5	0	0
5/19/2016	15.5	4.5	10	8	0	0

5/20/2016	18.5	4.5	11.5	6.5	0	0
Date/Time	**Max Temp (°C)**	**Min Temp (°C)**	**Mean Temp (°C)**	**Heat Deg Days (°C)**	**Cool Deg Days (°C)**	**Total Precip (mm)**
5/22/2016	12.5	5	8.8	9.2	0	1.6
5/23/2016	22.5	4	13.3	4.7	0	0
5/24/2016	21.5	12	16.8	1.2	0	6.8
5/25/2016	19	13.5	16.3	1.7	0	6.8
5/26/2016	9	4.5	6.8	11.2	0	0.6
5/27/2016	14.5	1.5	8	10	0	5.4
5/28/2016	9.5	5	7.3	10.7	0	3
5/29/2016	13.5	2.5	8	10	0	0
5/30/2016	16	5	10.5	7.5	0	7.8
5/31/2016	18.5	5.5	12	6	0	0.8
6/1/2016	9	5	7	11	0	0.2
6/2/2016	10.5	-0.5	5	13	0	0
6/3/2016	14.5	1.5	8	10	0	0
6/4/2016	16.5	5.5	11	7	0	0
6/5/2016	17	7.5	12.3	5.7	0	0
6/6/2016	19.5	8	13.8	4.2	0	0.8
6/7/2016	15	8	11.5	6.5	0	1.2
6/8/2016	15.5	10	12.8	5.2	0	14.2
6/9/2016	11.5	5	8.3	9.7	0	1.6
6/10/2016	12	5.5	8.8	9.2	0	0
6/11/2016	18	6	12	6	0	0
6/12/2016	22	9	15.5	2.5	0	1.8
6/13/2016	10.5	6.5	8.5	9.5	0	15.2
6/14/2016	17.5	7	12.3	5.7	0	1
6/15/2016	12.5	7	9.8	8.2	0	0.8
6/16/2016	10.5	6.5	8.5	9.5	0	1.2
6/17/2016	12.5	6.5	9.5	8.5	0	0.6
6/18/2016	18.5	2.5	10.5	7.5	0	0
6/19/2016	23.5	8.5	16	2	0	0
6/20/2016	24.5	12.5	18.5	0	0.5	0