

Real Time Water Quality Report Humber River at Humber Village

Deployment Period
2021-07-29 to 2021-11-04



Government of Newfoundland & Labrador
Department of Environment and Climate Change
Water Resources Management Division

General

The following public report is a presentation and interpretation of qualitative and quantitative data taken in real-time at the Humber River in Humber Village station. The deployment period took place between July 29, 2021, and November 4, 2021.

This station is a year-round operation as part of the Provincial Real Time Water Quality (RTWQ) network. A multi-parameter sonde device is deployed and tracks variables of interest including: temperature (°C), pH, dissolved oxygen (mg/L), specific conductivity (µS/cm), and turbidity (NTU). The sondes are linked to the monitoring network with staff at the Department of Environment and Climate Change (Water Resources Management Division-WRMD) monitoring the data remotely on a regular basis.

In the event of anomalous activity, staff can travel to the location and investigate any inquiries that could arise from internal or external disruptions. This site in particular is easy to access. Typically, the instrument is removed on monthly to bi-monthly intervals in order to conduct routine maintenance/calibration, after which the instrument is redeployed within 48 hours.

Quality Assurance/Quality Control (QA/QC)

During the beginning and end of deployment periods, a routine QA/QC performance test is administered on both the instrument that is being removed and the new one to be deployed. The methodology of this protocol can be found in Appendix A.

The purpose is to determine the accuracy of the instrument’s sensors by cross-examining its initial readings against a control sonde which is deployed at the same time to compare parameters. Depending on these readings, the sensors of each parameter receive a qualitative rank (See Table 1) based on whether or not readings fall within a specified threshold. This will further ensure the integrity of the data’s accuracy, so that WRMD scientists deliver reliable results to the public.

Table 1: QA/QC protocol for deployment performance testing of sonde equipment for ranking of data accuracy.

Parameter	Rating				
	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

With the exception of water quantity data (i.e. stage height), all other data used in the preparation of graphs and subsequent discussion below adhere to the stringent QA/QC protocol. The stage data is raw data that is transmitted via satellite and published on WRMD’s webpage. It has not been corrected for backwater effect. Water Survey of Canada is responsible of QA/QC of water quantity data. Corrected data can be obtained upon request.

Table 2: QA/QC water quality performance results for the beginning and end of deployment period.

Station: Humber River at Humber Village		
Stage of Deployment (Date)	Deployment (July 29, 2021)	Removal (November 4, 2021)
<i>Parameter (Unit)</i>	<i>Rank</i>	<i>Rank</i>
Temperature (°C)	Good	Excellent
pH (dimensionless unit)	Good	Fair
Specific Conductivity (µS/cm)	Excellent	Excellent
Dissolved Oxygen (mg/L)	Excellent	Excellent
Turbidity (NTU)	Poor ¹	Excellent
1) Possible issue with QA/QC sonde tainted result.		

Deployment Notes

This deployment took place over the course of 95 days (July 29, 2021, to November 4, 2021), during which there were no significant interruptions or data loss.

Data Interpretation

The following interpretations for the Humber River stations will cover the following six parameters: (1) Stage (m); (2) Temperature (°C); (3) pH; (4) Specific Conductivity (µS/cm); (5) Dissolved Oxygen (mg/L); (6) Turbidity (NTU).

1) Stage

- Stage ranged between 1.74 m and 3.08 m with an average stage height of 2.37 m
- Flow ranged from 181.12 m³/s to 415.93 m³/s with an average speed of 285.01 m³/s.
- Fluctuations of stage height were frequent throughout this deployment period with most peaks correlating to the weather data (See Appendix C) with events of high precipitation very near or on the same day the stage and flow values rose.
- This behaviour is anticipated as the summer transitions into fall, which generally yields precipitation in large volumes from tropical and autumn storm systems.

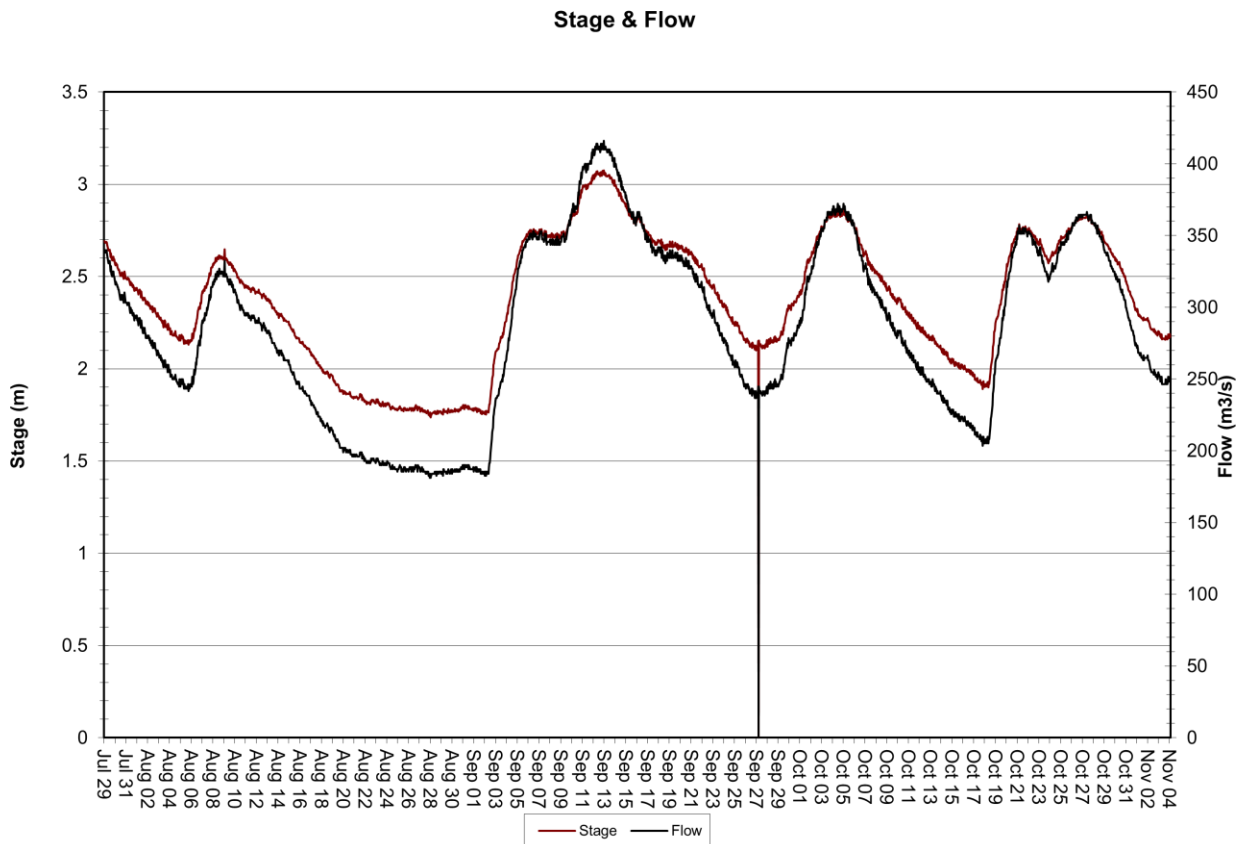


Figure 1: Stage & Flow at Humber River from July 29 to November 4, 2021

2) Temperature

- Throughout the deployment period, the water temperature ranged between 9.15 °C and 19.88 °C, with an average temperature of 15.04 °C.
- Temperatures steadily increased from the start of this deployment onward towards the latter end of August, after which water temperature began a seasonal decline, indicative that the summer season was ending.
- The maximum water temperature of 2021 was recorded on August 23, 2021 at 19.88 °C.
- During early September, many precipitation events occurred according to data provided by Environment Canada (Appendix C), which rapidly decreased the water temperature for short durations between September 7 and 13.
- October data featured a downward trend as summer transitioned to fall. Water temperature data steadily decreased, with readings below 10 °C by the end of the deployment period.

Water Temperature and Stage Level

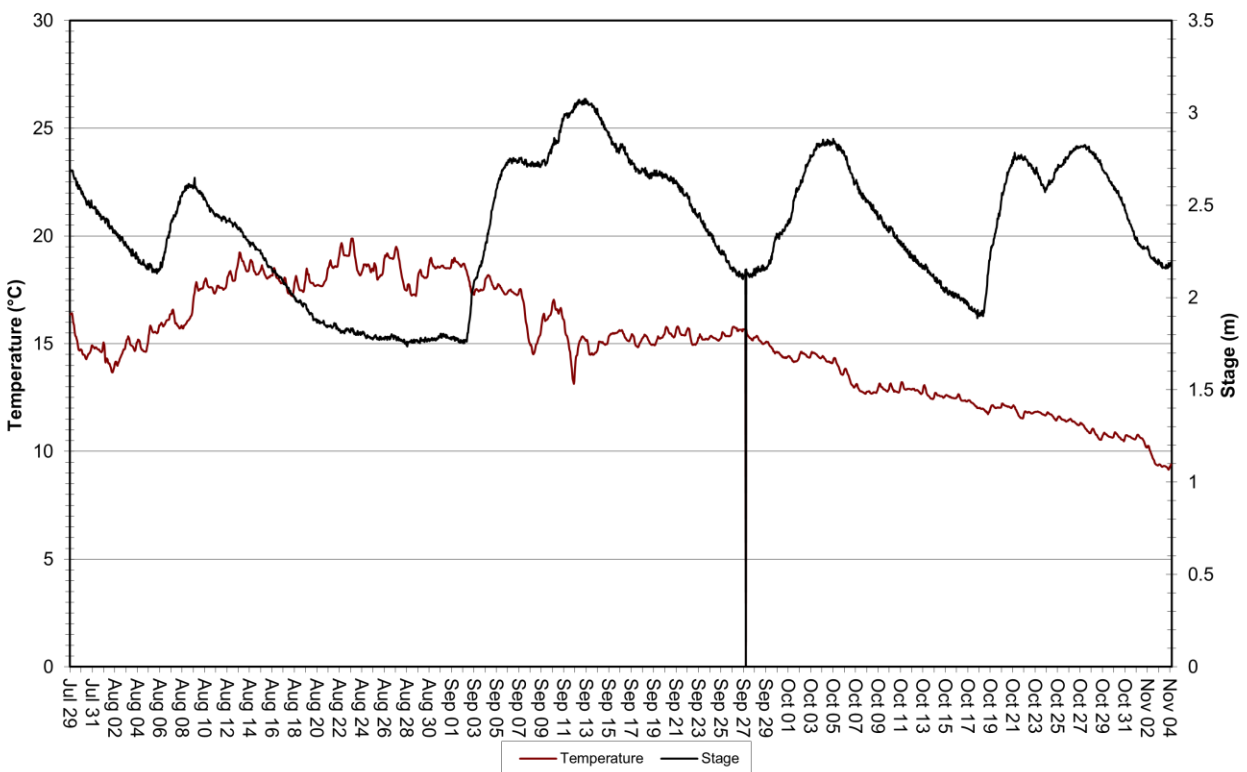


Figure 2: Temperature (°C) at Humber River from July 29 to November, 2021

3) pH

- pH ranged between 6.83 and 7.20 during the deployment period, with an average of 7.04 pH units.
- This parameter was generally stable throughout the course of the deployment period, with two notable disturbances that correspond to the dates of the aforementioned rainfall of early September. Precipitation can affect pH balance. Based on the remarkable rainfall events (the sum of precipitation between September 1 and 10, inclusively, equalled 132.8 mm), high volumes of slightly acidic rain decreased pH at this station for a short period of time.
- There is also the possibility that the rain formed a mechanism of transfer for land-based runoff from sources such as nearby farms, recreational parks, roads, etc.
- The pH data remained within the threshold of acceptance for the protection of aquatic life as outlined by the Canadian Council of Ministers of the Environment (CCME) (2007).

Water pH and Stage Level

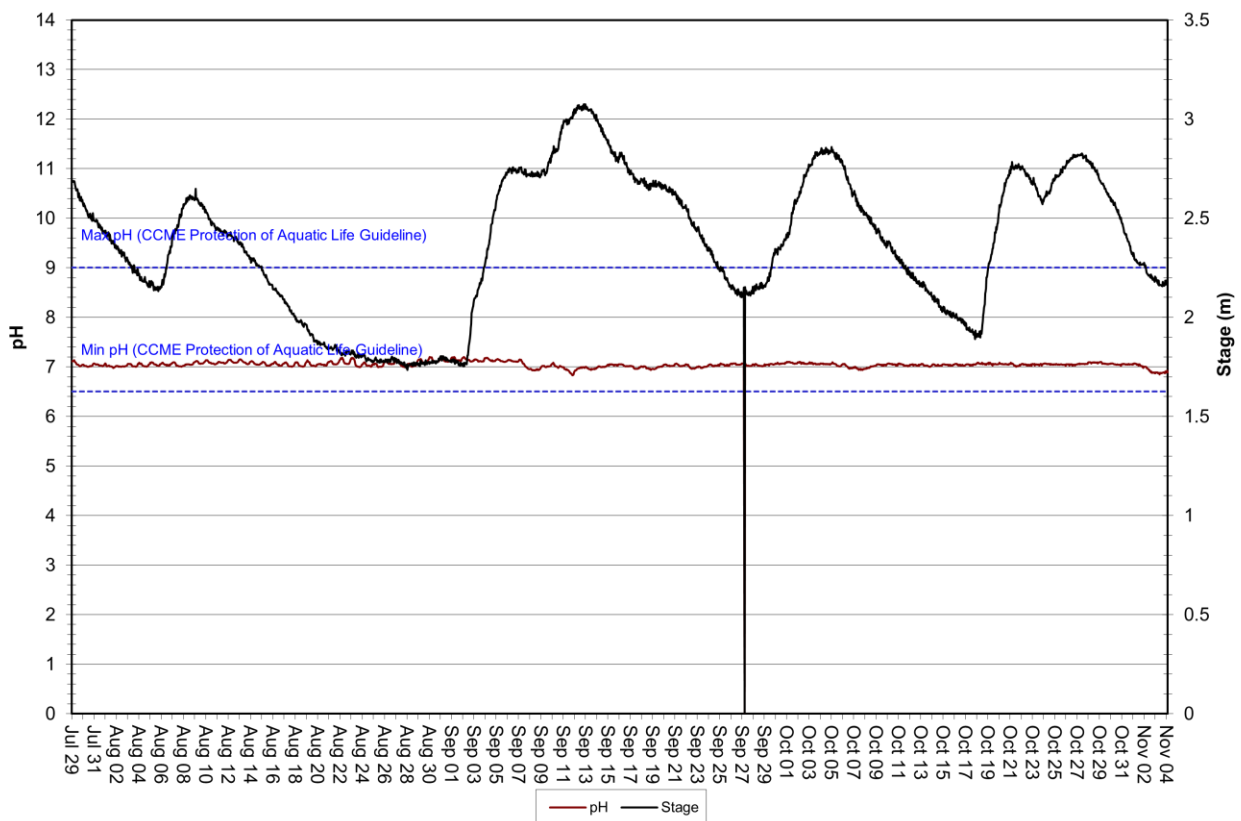


Figure 3: pH values recorded at Humber River from July 29 to November 4, 2021

4) Specific Conductivity

- Throughout the deployment period, specific conductivity ranged between 40.9 $\mu\text{S}/\text{cm}$ and 44.7 $\mu\text{S}/\text{cm}$, with an average of 42.6 $\mu\text{S}/\text{cm}$.
- Data showed a slight upward trend in August when stage levels were low, before decreasing slightly in early September as heavy precipitation increased stage, diluted the system and decreased conductivity for a period of time.
- A spike at the beginning of the stage increase in September may indicate that sediment and runoff were swept into the river at the start of the deluge, increasing the solutes in the river for a short time before the rain diluted the system. This increase is brief, and the subsequent precipitation episodes throughout the start of September would bring specific conductivity to its aforementioned minimum.
- For the remainder of the deployment period thereafter, specific conductivity demonstrated a gradual increase into late October before dipping again by the end of the 95 days.

Specific Conductivity of Water and Stage Level

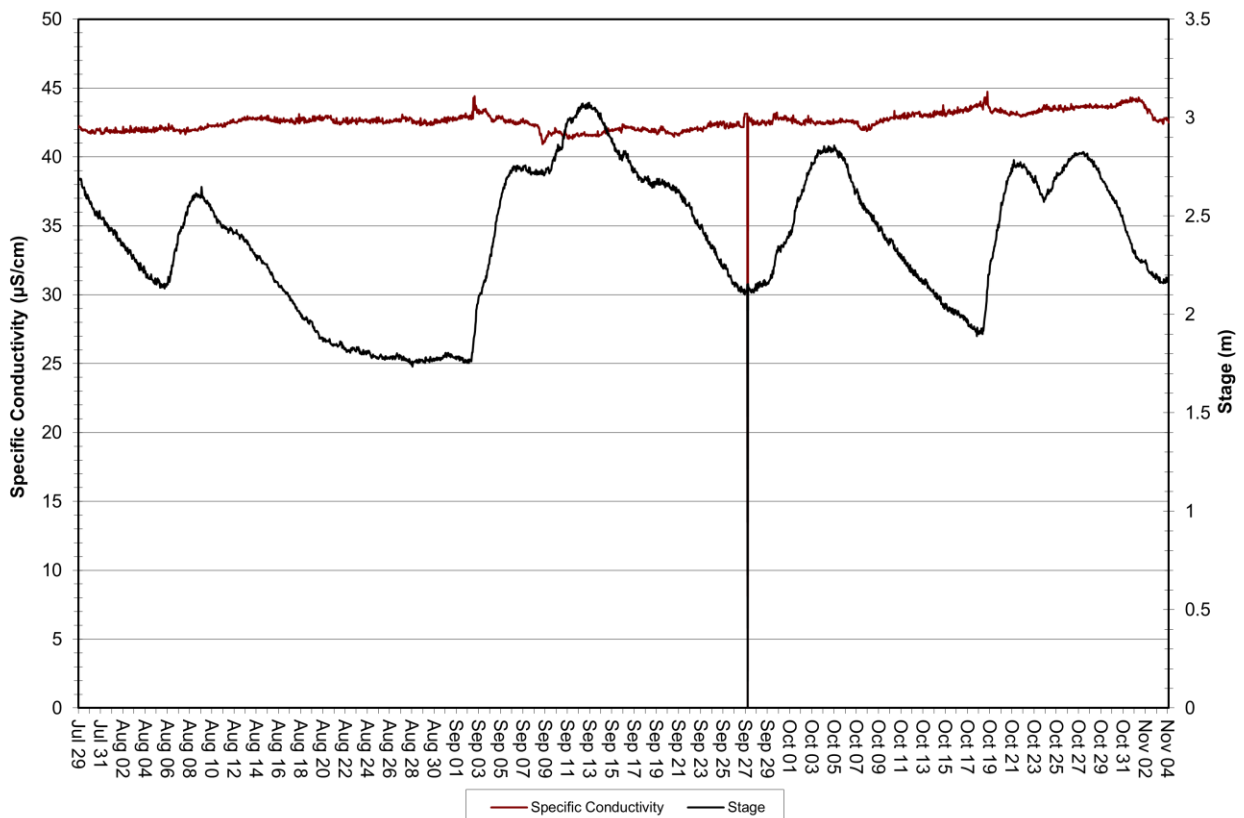


Figure 4: Specific conductivity ($\mu\text{S}/\text{cm}$) at Humber River from July 29 to November 4, 2021

5) Dissolved Oxygen

- During the deployment period, dissolved oxygen values ranged from 9.02 mg/L to 11.03 mg/L, with an average of 9.87 mg/L.
- Concentrations were inversely proportional to the water temperature. This is normal as temperature directly affects water’s capacity to dissolve oxygen.
- Dissolved oxygen showed a continued decrease into August as water temperatures continued to climb, before increasing mid-September onward into the fall season as water temperatures cooled off.
- The warm month of August reduced oxygen concentrations to below the minimum CCME Freshwater Aquatic Life guideline for the protection of early life stages (CCME, 2007). Values rose above the minimum guideline when water temperatures cooled into Fall. Dissolved oxygen levels remained above the minimum guideline for other life stages for the duration of the deployment.

Dissolved Oxygen Concentration and Saturation with Water Temperature

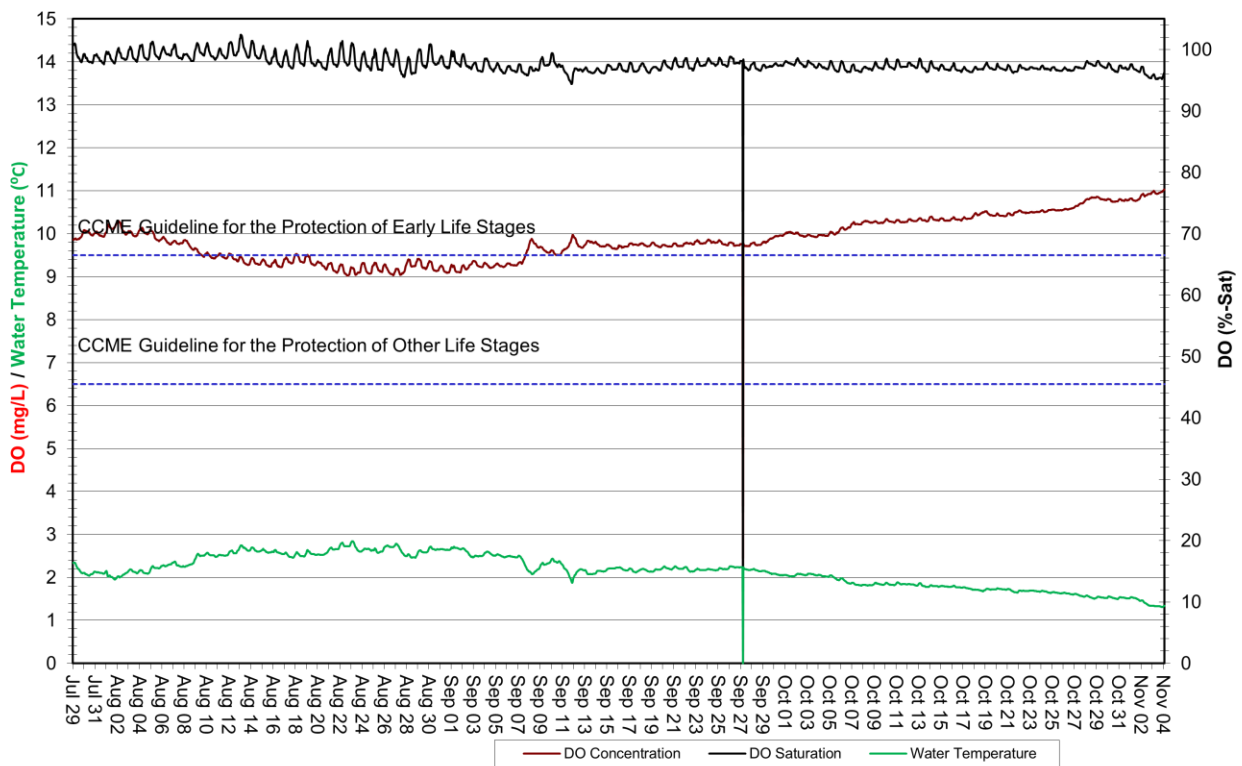


Figure 5: DO (mg/L & % saturation) with Water Temperature (°C) at Humber River from July 29 to November 4, 2021

6) Turbidity

- Throughout the deployment period, turbidity ranged from 0.7 NTU to 2.9 NTU, with an average turbidity of 0.8 NTU.
- Turbidity was relatively stable through August, with several major fluctuations corresponding to high precipitation events and subsequent stage increases. High volumes of rain over a few hours likely disturbed the water column and stirred the sediments.

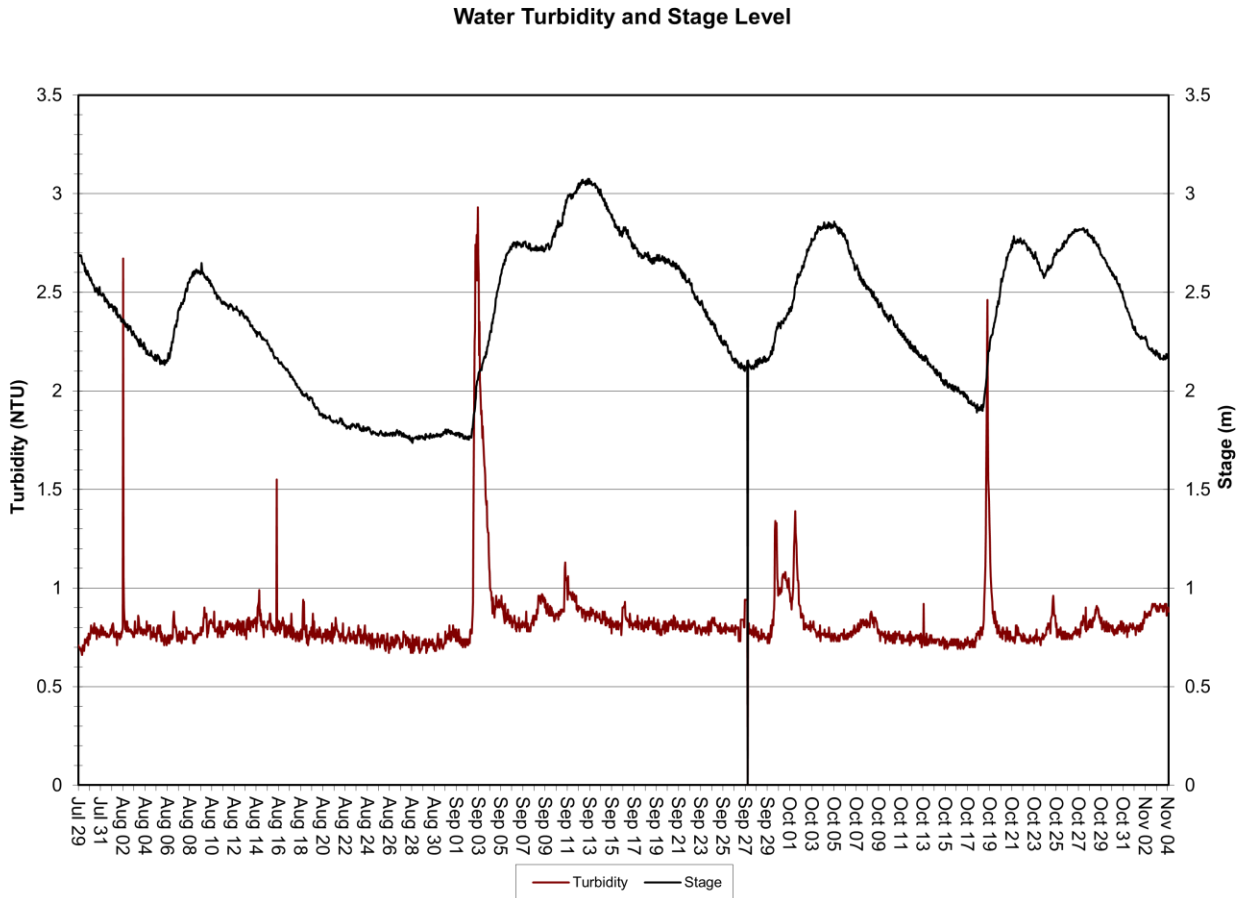


Figure 6: Turbidity (NTU) at Humber River from July 29 to November 4, 2021

Conclusions

- This deployment report outlines the findings of water quality and water quantity data recorded over a period of 95 days at the Humber River at Humber Village July 29, 2021, and November 4, 2021.
- QA/QC rankings at the start of the deployment duration were *mostly* satisfactory, with 2/5 sensors ranking “Excellent”, 2/5 sensors ranking “Good”, and 1/5 sensors (turbidity) ranking as “Poor”. At removal, nearly all performances had improved with the exception of pH, which the absolute differences of the performance test scores decreased the sensors quality to a “Fair” ranking. All other sensors either remained within or achieved the threshold necessary to accommodate an “Excellent” ranking.
- As seen in the previous deployment report, the turbidity sensor performance test *at deployment* was questionable as the QA/QC sonde returned a value that greatly exceeded the result of the field sonde (which returned a value that was consistent with the data trend monitored throughout that deployment). A similar scenario has occurred at the start of this deployment period, and after consulting the grab sample to field sonde results, the turbidity sensor for the QA/QC sonde was likely erroneous.
- The QA/QC rank for the field sonde’s turbidity sensor would later improve to an “Excellent” ranking at removal, indicative that the QA/QC sonde used at deployment was likely flawed.
- The following are summarized statements regarding the findings at Humber River:
 - o Stage & Flow: Stage ranged from 1.74 m to 3.08 m, averaging at 2.37 m. Flow ranged from 181.12 m³/s to 415.93 m³/s, averaging 285.01 m³/s. The frequent fluctuation in the data is likely attributed to precipitative events that increased the parameters simultaneously throughout the deployment period.
 - o Water Temperature: Ranged from 9.15 °C to 19.88 °C, averaging 15.04 °C. Steadily increased before peaking around mid-August, after which there would be a downtrend across the rest of the deployment as summer transitioned into fall.
 - o pH: Ranged from 6.83 to 7.20, averaging 7.04 pH units. Remained mostly stable, only facing a brief increase in acidity during an interval of high precipitation during early September. Data fell within the threshold of acceptance for the protection of aquatic life as outlined by the CCME.
 - o Specific Conductivity: Ranged from 40.9 µS/cm to 44.7 µS/cm, averaging at 42.6 µS/cm. Gradually increased throughout August before decreasing in September due to precipitation and becoming mildly turbulent for the remainder of the deployment period, increasing overall.
 - o Dissolved Oxygen: Ranged from 9.02 mg/L to 11.03 mg/L, averaging at 9.87 mg/L. Concentrations followed a decreasing trend in the warm month of August, but would begin to steadily increase from September onward, indicative of the cooler air and water temperatures into Fall. Most data remained above the minimum guidelines for the protection of aquatic life except during the warmest portion of the summer months.
 - o Turbidity: Ranged from 0.7 NTU to 2.9 NTU, averaging 0.8 NTU. Was relatively stable through August, becoming more disrupted across late summer through mid-Fall, likely due to increased presence and intensity of precipitation events.

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://cegg-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.

Parameter	Rating				
	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

WRMD Climate Station – Humber Village at Humber Village Bridge

Date	Air Temp (Avg) °C	Air Temp (Min) °C	Air Temp (Max) °C	Total Precipitation (mm)
July 29, 2021	17.285	13.950	20.840	0
July 30, 2021	17.563	12.310	22.300	0
July 31, 2021	16.548	14.120	19.950	0
August 1, 2021	18.553	15.190	22.250	0
August 2, 2021	20.248	15.900	25.520	0
August 3, 2021	18.400	15.180	22.830	0
August 4, 2021	18.914	12.300	21.980	0
August 5, 2021	19.706	10.970	27.190	0
August 6, 2021	21.450	18.510	23.740	0
August 7, 2021	22.178	20.090	25.820	0
August 8, 2021	17.580	11.270	21.160	0
August 9, 2021	15.870	8.400	25.440	0
August 10, 2021	18.376	10.690	24.260	0
August 11, 2021	20.798	16.010	26.520	0
August 12, 2021	20.340	14.660	29.940	0
August 13, 2021	24.803	20.890	29.170	0
August 14, 2021	25.066	21.070	31.840	0
August 15, 2021	22.296	18.760	27.150	0
August 16, 2021	19.131	13.580	23.050	0
August 17, 2021	20.898	14.020	26.530	0
August 18, 2021	23.980	19.610	30.510	0
August 19, 2021	22.983	19.500	27.410	0
August 20, 2021	17.586	15.590	20.610	0
August 21, 2021	16.624	10.970	21.430	0
August 22, 2021	15.680	9.410	22.880	0
August 23, 2021	21.015	13.880	27.720	0
August 24, 2021	21.130	14.210	26.960	0
August 25, 2021	21.762	15.150	25.840	0
August 26, 2021	18.936	11.990	24.930	0
August 27, 2021	20.647	13.680	23.540	0
August 28, 2021	14.499	9.690	18.790	0
August 29, 2021	15.194	8.340	22.670	0
August 30, 2021	17.382	10.360	24.940	0
August 31, 2021	14.748	13.290	16.190	0
September 1, 2021	17.304	15.010	21.570	0
September 2, 2021	14.497	12.410	16.350	0

September 3, 2021	12.792	11.290	14.540	0
September 4, 2021	14.523	12.100	18.810	0
September 5, 2021	12.326	9.150	16.330	0
September 6, 2021	13.271	7.491	19.970	0
September 7, 2021	17.531	14.580	21.310	0
September 8, 2021	18.081	12.460	22.380	0
September 9, 2021	17.726	12.060	25.630	0
September 10, 2021	22.680	17.910	27.200	0
September 11, 2021	17.532	15.780	20.800	0
September 12, 2021	17.318	10.540	22.030	0
September 13, 2021	16.618	14.950	18.440	0
September 14, 2021	12.921	6.959	15.380	0
September 15, 2021	10.225	3.704	16.130	0
September 16, 2021	16.123	11.570	18.520	0
September 17, 2021	15.149	9.710	21.690	0
September 18, 2021	18.965	13.770	23.410	0
September 19, 2021	14.628	7.505	19.310	0
September 20, 2021	10.453	6.138	15.970	0
September 21, 2021	14.695	5.893	22.560	0
September 22, 2021	17.272	14.000	20.560	0
September 23, 2021	18.829	12.340	22.810	0
September 24, 2021	12.712	10.590	14.720	0
September 25, 2021	13.660	11.190	20.010	0
September 26, 2021	17.293	12.980	21.640	0
September 27, 2021	16.370	12.080	18.930	0
September 28, 2021	14.245	11.500	17.810	0
September 29, 2021	11.252	8.900	14.090	0
September 30, 2021	10.814	10.110	11.710	0
October 1, 2021	10.348	9.830	11.020	0
October 2, 2021	11.684	9.480	15.730	0
October 3, 2021	10.776	9.320	13.540	0
October 4, 2021	9.046	5.453	12.940	0
October 5, 2021	9.425	5.371	13.110	0
October 6, 2021	12.614	6.136	19.950	0
October 7, 2021	10.083	5.189	15.050	0
October 8, 2021	7.741	3.848	10.350	0
October 9, 2021	5.585	1.647	11.550	0
October 10, 2021	8.176	1.988	14.270	0
October 11, 2021	12.476	6.990	20.220	0
October 12, 2021	11.041	8.140	12.810	0
October 13, 2021	9.491	4.969	15.090	0

October 14, 2021	8.545	4.044	12.100	0
October 15, 2021	11.373	10.520	12.760	0
October 16, 2021	9.747	4.855	12.630	0
October 17, 2021	7.214	4.915	8.490	0
October 18, 2021	8.370	7.002	9.720	0
October 19, 2021	9.928	6.778	12.980	0
October 20, 2021	10.543	8.740	13.030	0
October 21, 2021	9.186	4.543	10.370	0
October 22, 2021	8.992	3.401	14.660	0
October 23, 2021	10.223	8.760	11.520	0
October 24, 2021	9.758	8.530	11.520	0
October 25, 2021	6.229	4.499	7.655	0
October 26, 2021	6.844	4.607	9.000	0
October 27, 2021	5.616	3.164	8.390	0
October 28, 2021	5.888	3.541	9.220	0
October 29, 2021	5.508	2.014	11.220	0
October 30, 2021	3.112	-0.564	9.900	0
October 31, 2021	5.538	0.082	11.610	0
November 1, 2021	12.663	9.680	16.390	0
November 2, 2021	9.226	5.204	12.260	0
November 3, 2021	6.791	3.721	9.920	0
November 4, 2021	4.485	1.737	7.459	0

Note: Abnormal precipitation data points to possible issues with precipitation monitoring equipment.

APPENDIX C

Environment Canada – Historical Climate Data (Precipitation Only) in Corner Brook Vicinity (Near Humber Village)

Date	Total Precipitation (mm)
July 29, 2021	0
July 30, 2021	9
July 31, 2021	10.4
August 1, 2021	0
August 2, 2021	10
August 3, 2021	1.8
August 4, 2021	0
August 5, 2021	17
August 6, 2021	24.4
August 7, 2021	9.4
August 8, 2021	0
August 9, 2021	0
August 10, 2021	0
August 11, 2021	0
August 12, 2021	0
August 13, 2021	0
August 14, 2021	0
August 15, 2021	0
August 16, 2021	0
August 17, 2021	0
August 18, 2021	0
August 19, 2021	0
August 20, 2021	1.8
August 21, 2021	0
August 22, 2021	0
August 23, 2021	0
August 24, 2021	0.6
August 25, 2021	0
August 26, 2021	0.6
August 27, 2021	6
August 28, 2021	0.2
August 29, 2021	0
August 30, 2021	6
August 31, 2021	7.8
September 1, 2021	6.4

September 2, 2021	54.6
September 3, 2021	1.6
September 4, 2021	6.8
September 5, 2021	9.4
September 6, 2021	12
September 7, 2021	0.6
September 8, 2021	0
September 9, 2021	18.4
September 10, 2021	16.6
September 11, 2021	1
September 12, 2021	5.6
September 13, 2021	0.4
September 14, 2021	0.6
September 15, 2021	18.6
September 16, 2021	0.4
September 17, 2021	2.6
September 18, 2021	0
September 19, 2021	0
September 20, 2021	0
September 21, 2021	0
September 22, 2021	0
September 23, 2021	0.6
September 24, 2021	0
September 25, 2021	0
September 26, 2021	22.2
September 27, 2021	5
September 28, 2021	0.4
September 29, 2021	25.6
September 30, 2021	2.4
October 1, 2021	6
October 2, 2021	6
October 3, 2021	2.8
October 4, 2021	0.4
October 5, 2021	0
October 6, 2021	0
October 7, 2021	4
October 8, 2021	2.4
October 9, 2021	0
October 10, 2021	0
October 11, 2021	3
October 12, 2021	0.4

October 13, 2021	0
October 14, 2021	0
October 15, 2021	1
October 16, 2021	0.6
October 17, 2021	1.4
October 18, 2021	31.6
October 19, 2021	0.4
October 20, 2021	0
October 21, 2021	0
October 22, 2021	6
October 23, 2021	10.4
October 24, 2021	14.8
October 25, 2021	2.8
October 26, 2021	0
October 27, 2021	0
October 28, 2021	0
October 29, 2021	0
October 30, 2021	0.4
October 31, 2021	4.2
November 1, 2021	2
November 2, 2021	0.6
November 3, 2021	16.4
November 4, 2021	1.4