

Real Time Water Quality Report Humber River at Humber Village

Deployment Period 2021-11-05 to 2022-02-02



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 November 5, 2021, and February 2, 2022.

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 (μ S/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.

	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 > 35μ S/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 (November 5, 2021)	Removal (February 2, 2022)		
Parameter (Unit)	Rank	Rank		
Temperature (°C)	Excellent	Excellent		
pH (dimensionless unit)	Good	Good		
Specific Conductivity (µs/cm)	Excellent	Fair		
Dissolved Oxygen (mg/L)	Good	Good		
Turbidity (NTU)	Excellent	Excellent		

Deployment Notes

This deployment took place over the course of 90 days (November 5, 2021, to February 2, 2022), during which there were no significant interruptions or data loss.

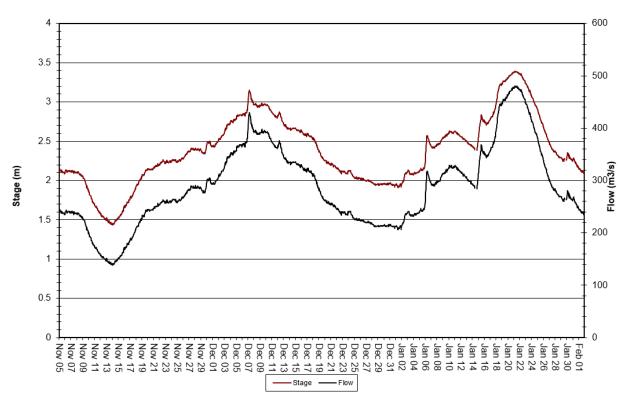
Data Interpretation

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 (μ S/cm); (5) Dissolved Oxygen (mg/L); (6) Turbidity (NTU).



1) Stage

- Stage ranged between 1.43 m and 3.39 m with an average stage height of 2.38 m
- Flow ranged from 138.121 m³/s to 480.660 m³/s with an average speed of 287.709 m³/s.
- Fluctuations of stage height were frequent throughout this deployment period with most peaks correlating to the weather data with events of high precipitation (See Appendix C) very near or on the same day the stage and flow values rose.
- This behaviour is anticipated as the fall transitions into winter, where the combination of varied precipitation and the freeze/thaw cycle affects waterbodies in the watershed, creating fluctuations in both stage and flow related to the weather.



Stage & Flow

Figure 1: Stage & Flow at Humber River from November 5, 2021, to February 2, 2022



2) Temperature

- Throughout the deployment period, the water temperature ranged between 0.97 °C and 9.39 °C, with an average temperature of 5.06 °C.
- Temperatures steadily decreased for the entire deployment period; typical as the climate transitioned from fall to winter and continued decreasing throughout.

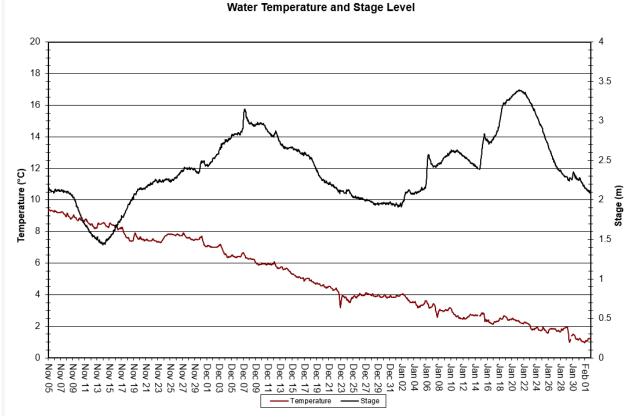
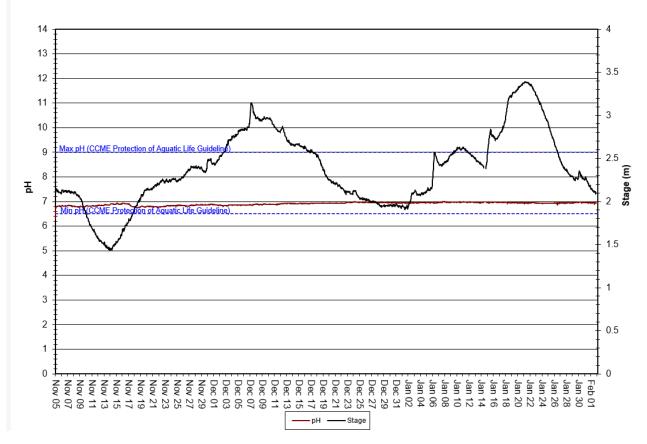


Figure 2: Temperature (°C) at Humber River from November 5, 2021, to February 2, 2022



3) pH

- pH ranged between 6.27 and 7.00 during the deployment period, with an average of 6.91 pH units.
- This parameter was generally stable throughout the course of the deployment period, with one slight decrease on November 17 that correlated to a stage increase that started on November 14. Precipitation data was unavailable for this time period due to a loose connection at the Humber Village weather station. Precipitation data was also not available from nearby ECCC weather stations.
- 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).



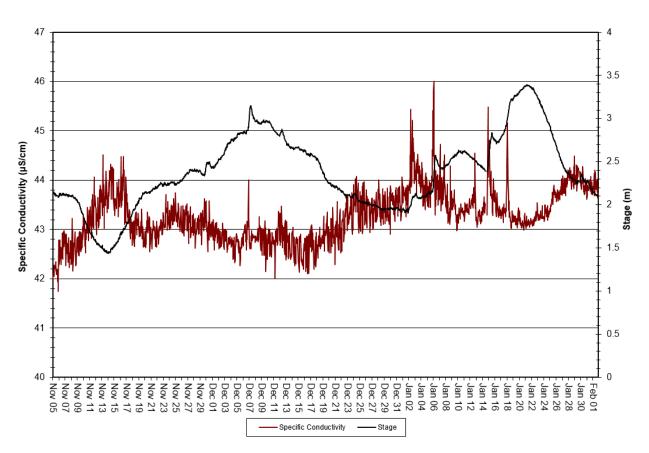
Water pH and Stage Level

Figure 3: pH values recorded at Humber River from November 5, 2021, to February 2, 2022



4) Specific Conductivity

- Throughout the deployment period, specific conductivity ranged between 41.75 μS/cm and 46.01 μS/cm, with an average of 43.26 μS/cm.
- Data was generally stable throughout the deployment, with occasional spikes correlating to stage increases and precipitative events.



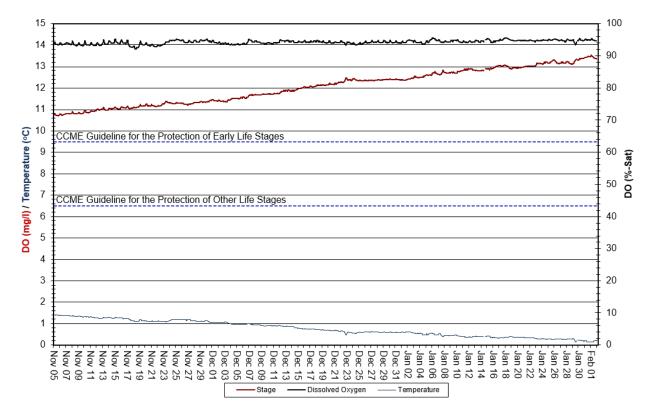
Specific Conductivity of Water and Stage Level

Figure 4: Specific conductivity (μ s/cm) at Humber River from November 5, 2021, to February 2, 2022



5) Dissolved Oxygen

- During the deployment period, dissolved oxygen concentrations ranged from 10.70 mg/L to 13.53 mg/L, with an average of 12.06 mg/L. Dissolved oxygen percent-saturation ranged from 92.1% to 95.6%, with an average of 94.2%.
- Dissolved oxygen has a tendency to increase when water temperature decreases (and vice versa).
 This can be seen in Figure 5 as oxygen concentrations increased throughout the course of the deployment.
- This is a normal trend as fall transitions into the winter months, bringing with it a cooler climate.
- Values remained above the thresholds of the CCME guidelines for the protection of both early and other life stages (CCME, 2007).



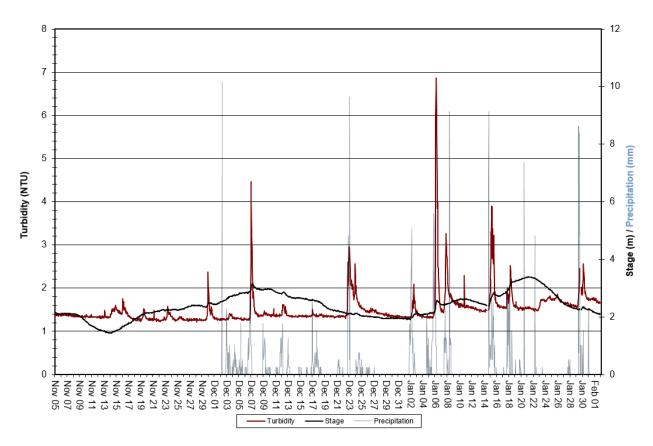
Dissolved Oxygen Concentration, Saturation, and Water Temperature

Figure 5: DO (mg/L & % saturation) with Water Temperature (°C) at Humber River November 5, 2021, to February 2, 2022



6) Turbidity

- Throughout the deployment period, turbidity ranged from 1.2 NTU to 6.9 NTU, with an average turbidity of 1.5 NTU.
- Turbidity was relatively stable throughout deployment, with several spikes corresponding to precipitative events and subsequent stage increases. High volumes of rain over a few hours likely disturbed the water column and stirred the sediments.



Water Turbidity, Stage Level, and Precipitation

Figure 6: Turbidity (NTU) at Humber River from November 5, 2021, to February 2, 2022



Conclusions

- This deployment report outlines the findings of water quality and water quantity data recorded over a period of 90 days at the Humber River at Humber Village November 5, 2021, to February 2, 2022.
- QA/QC rankings at the start of the deployment duration were satisfactory, with 3/5 sensors ranking "Excellent", and 2/5 sensors ranking "Good". At removal, the QA/QC ranking for specific conductivity was the only sensor that fell to a "Fair" ranking. There were no QA/QC changes among the other sensors.
- The following are summarized statements regarding the findings at Humber River:
 - <u>Stage & Flow:</u> Stage ranged from 1.43 m to 3.39 m, averaging at 2.38 m. Flow ranged from 138.121 m³/s to 480.660 m³/s, averaging 287.709 m³/s. The increases in the data are likely attributed to precipitative events that occurred throughout the deployment period.
 - <u>Water Temperature:</u> Ranged from 0.97 °C to 9.39 °C, averaging 5.06 °C, steadily decreased throughout in response to the cooling climate of fall then winter.
 - <u>pH:</u> Ranged from 6.27 to 7.00, averaging 6.91 pH units. Remained mostly stable, only notable decrease occurred during an increase in stage between November 14 and 17. Data was within the threshold of acceptance for the protection of aquatic life as outlined by the CCME.
 - Specific Conductivity: Ranged from 41.75 μS/cm to 46.01 μS/cm, averaging at 43.26 μS/cm. Stable overall with occasional responses corresponding to stage decreases (peaked) and precipitation causing stage increases (spiked due to initial precipitation with gradual dips thereafter as stage rose).
 - <u>Dissolved Oxygen:</u> Concentration ranged from 10.70 mg/L to 13.53 mg/L, averaging at 12.06 mg/L; percent-saturation ranged from 92.1% to 95.6%, averaging at 94.2%. Concentrations increased steadily in response to consistently cooling temperatures. Data met the acceptance thresholds of the CCME's guidelines for the protection of both early and other life stages.
 - <u>Turbidity</u>: Ranged from 1.2 NTU to 6.9 NTU, averaging 1.5 NTU. Was relatively stable throughout deployment, with several spikes corresponding to precipitative events and subsequent stage increases.



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: <u>http://ceqg-rcqe.ccme.ca/download/en/222/</u>)



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.

	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

Performance ratings are based on differences listed in the table below.

¹ Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous waterquality 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)
November 5, 2021	4.286	2.869	6.150	0.00
November 6, 2021	4.929	2.718	8.310	0.00
November 7, 2021	9.472	7.678	10.430	0.00
November 8, 2021	8.180	4.041	11.660	0.00
November 9, 2021	7.416	2.077	11.170	0.00
November 10, 2021	7.460	5.154	8.810	0.00
November 11, 2021	3.308	0.932	5.013	0.00
November 12, 2021	0.229	-2.683	1.245	0.00
November 13, 2021	4.918	-2.697	11.140	0.00
November 14, 2021	6.187	3.973	10.170	0.00
November 15, 2021	5.745	3.934	7.858	0.00
November 16, 2021	6.179	3.789	7.901	0.00
November 17, 2021	3.266	1.763	4.334	0.00
November 18, 2021	2.433	1.723	5.321	0.00
November 19, 2021	10.054	5.313	15.870	0.00
November 20, 2021	3.049	1.590	5.341	0.00
November 21, 2021	2.853	0.178	5.146	0.00
November 22, 2021	6.425	3.623	9.130	0.00
November 23, 2021	8.998	7.770	11.190	0.00
November 24, 2021	13.340	11.090	14.810	0.00
November 25, 2021	10.565	8.700	15.360	0.00
November 26, 2021	10.211	9.020	12.230	0.00
November 27, 2021	9.622	7.338	13.490	0.00
November 28, 2021	5.051	2.981	8.340	0.00
November 29, 2021	3.949	2.213	5.864	0.00
November 30, 2021	8.435	1.802	13.790	0.00
December 1, 2021	1.481	0.308	2.213	0.00
December 2, 2021	2.860	1.186	4.592	0.87
December 3, 2021	8.373	2.418	12.320	0.44
December 4, 2021	-2.131	-3.632	1.638	0.28
December 5, 2021	-1.236	-2.922	0.574	0.21
December 6, 2021	-0.313	-1.968	3.274	0.79
December 7, 2021	7.345	0.490	14.980	0.12
December 8, 2021	-1.074	-2.291	0.556	0.13
December 9, 2021	-3.249	-4.091	-1.620	0.34
December 10, 2021	-3.859	-6.070	-2.407	0.02



Humber River at Humber Village – Provincial RTWQ Network Real-Time Water Quality Deployment Report November 5, 2021, to February 2, 2022

December 11, 2021	-0.657	-4.416	1.886	0.28
December 12, 2021	5.002	1.005	13.910	0.26
December 13, 2021	2.034	0.546	2.918	0.20
December 14, 2021	-0.738	-3.796	0.514	0.04
December 15, 2021	-5.171	-6.030	-4.169	0.01
December 16, 2021	-4.884	-6.222	-2.155	0.17
December 17, 2021	1.532	-4.959	4.241	0.61
December 18, 2021	0.461	-2.930	3.397	0.06
December 19, 2021	-4.162	-4.832	-3.287	0.00
December 20, 2021	-5.713	-10.120	-2.542	0.00
December 21, 2021	-2.299	-4.768	0.673	0.13
December 22, 2021	-3.114	-4.532	-0.904	0.87
December 23, 2021	-1.602	-4.922	1.840	0.49
December 24, 2021	-4.888	-6.299	-3.595	0.26
December 25, 2021	-1.494	-3.731	0.088	0.06
December 26, 2021	2.266	-0.434	3.767	0.04
December 27, 2021	2.971	-0.323	4.696	0.01
December 28, 2021	1.033	-2.806	3.141	0.00
December 29, 2021	-0.422	-3.037	2.880	0.00
December 30, 2021	-2.214	-5.583	1.726	0.00
December 31, 2021	-2.693	-5.481	-0.263	0.00
January 1, 2022	0.713	-1.662	4.453	0.23
January 2, 2022	4.988	2.974	7.143	1.15
January 3, 2022	-3.428	-6.358	1.814	0.00
January 4, 2022	-8.489	-9.890	-6.551	0.26
January 5, 2022	-3.069	-8.130	3.023	1.40
January 6, 2022	4.614	-4.159	9.740	0.80
January 7, 2022	-4.361	-5.681	-3.168	0.59
January 8, 2022	-3.631	-6.978	-1.312	0.90
January 9, 2022	-3.587	-7.353	2.502	0.00
January 10, 2022	-1.350	-8.200	3.022	0.00
January 11, 2022	-9.653	-11.260	-8.340	0.00
January 12, 2022	-7.783	-10.300	-4.366	0.00
January 13, 2022	-0.700	-3.097	0.552	0.00
January 14, 2022	-2.387	-6.631	0.597	1.24
January 15, 2022	3.336	-2.929	8.170	0.91
January 16, 2022	-6.799	-7.848	-4.847	0.00
January 17, 2022	-3.424	-6.013	0.017	0.61
January 18, 2022	5.068	0.640	8.640	0.62
January 19, 2022	-3.477	-6.910	2.598	0.11
January 20, 2022	-2.521	-7.539	3.088	0.44



January 21, 2022	-7.039	-10.050	-4.252	0.00
January 22, 2022	-6.293	-9.970	-3.440	0.29
January 23, 2022	-5.529	-10.050	-2.030	0.01
January 24, 2022	-1.523	-4.558	-0.221	0.00
January 25, 2022	-3.358	-5.475	-2.141	0.00
January 26, 2022	-1.568	-6.369	4.081	0.00
January 27, 2022	-9.586	-13.560	-6.437	0.05
January 28, 2022	-4.681	-12.680	-0.903	0.03
January 29, 2022	-1.685	-2.913	1.160	1.69
January 30, 2022	1.091	-2.789	6.925	0.10
January 31, 2022	-3.427	-5.175	-2.432	0.12
February 1, 2022	-7.218	-8.920	-4.925	0.00
February 2, 2022	-10.824	-13.500	-3.486	0.00

Note: Precipitation data from November to the start of December was unavailable due to a loose connection with the monitoring equipment. Appropriate repairs were made on December 2 and precipitation monitoring was re-established.

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