Real-Time Water Quality Deployment Report

Lower Churchill River Network

May 26/June 6 to
July 6/7/19, 2022

Newfoundland Labrador

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

Contents

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Real Time Water Quality Monitoring

- Staff with the Department of Environment and Climate Change monitor real-time water quality data on a regular basis.
- This deployment report discusses water quality related events occurring at three stations on the Lower Churchill River: Churchill River below Metchin River, Churchill River below Muskrat Falls and Churchill River at English Point.
- Real-time water quality monitoring instruments were deployed at Churchill River below Muskrat Falls and Churchill River at English Point on May 26th. An instrument was deployed at Churchill River below Metchin River on June 6th.
- An instrument was not deployed at Churchill River above Grizzle Rapids due to the presence of an ice wall, which prohibited access to that site.
- The instrument at Churchill River at English Point was removed on June 15th due to suspected issues with the pH sensor, for a deployment period of 20 days. Another instrument was deployed at English Point on June 15th and removed on July 7th, for a deployment period of 22 days. Both of these deployment periods are included in this report.
- The instrument at Churchill River below Muskrat Falls was removed on July 6th for a deployment period of 41 days. The instrument at Churchill River below Metchin River was removed on July 19th for a deployment period of 43 days.

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. This procedure is based on the approach used by the United States Geological Survey.
- At deployment and removal, a QA/QC instrument is temporarily deployed alongside the field instrument. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments**.** Based on the degree of difference between parameters recorded by the field instrument and QA/QC instrument at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

Table 1: Instrument Performance Ranking classifications for deployment and removal

	Rank				
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 > 35µS/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

- It should be noted that the temperature sensor on any instrument is the most important. All other parameters can be broken down into three groups: temperature dependent, temperature compensated and temperature independent. Because the temperature sensor is not isolated from the rest of the instrument, the entire instrument must be at the same temperature before the sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is taken too soon it may not accurately portray the water body.

- Deployment and removal comparison rankings for the Lower Churchill River stations deployed from May 26/June 6 to July 6/7/19, 2022 are summarized in Table 2.

Table 2: Comparison rankings for Lower Churchill River stations May 26/June 6 to July 6/7/19, 2022

Churchill River Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Below Metchin River	June 6, 2022	Deployment	Excellent	Excellent	Excellent	Excellent	Poor
	July 19, 2022	Removal	Excellent	Excellent	Excellent	Excellent	Fair
Above Grizzle Rapids	N/A	Deployment	N/A	N/A	N/A	N/A	N/A
	N/A	Removal	N/A	N/A	N/A	N/A	N/A
Below Muskrat Falls	May 26, 2022	Deployment	Excellent	Good	Excellent	Excellent	Poor
	July 6, 2022	Removal	Excellent	Good	Excellent	Excellent	Good
At English Point	May 26, 2022	Deployment	Good	Fair	Excellent	Excellent	Poor
	June 15, 2022	Removal	Excellent	Poor	Excellent	Excellent	Excellent
At English Point	June 15, 2022	Deployment	Good	Excellent	Excellent	Good	Excellent
	July 7, 2022	Removal	Good	Excellent	Excellent	Excellent	Good

- **Churchill River below Metchin River**
  - At deployment, all parameters ranked as 'excellent', with the exception of turbidity. A 'poor' ranking for turbidity is likely due to the QA/QC sonde not being placed in close enough proximity to the field sonde or not being given sufficient time to acclimate; this is supported by a 'good' ranking for turbidity between the field sonde and the grab sample.
  - At removal, all parameters ranked as 'excellent', with the exception of turbidity which was 'fair'.

- **Churchill River above Grizzle Rapids**
  - An instrument could not be deployed at this station due to unfavourable site conditions.

- **Churchill River below Muskrat Falls**
    - At deployment, all parameters ranked as either 'excellent' or 'good', with the exception of turbidity. A 'poor' ranking for turbidity is likely due to the QA/QC sonde not being placed in close enough proximity to the field sonde or given sufficient time to acclimate; this is supported by an 'excellent' ranking for turbidity between the field sonde and the grab sample.
    - At removal, all parameters again ranked as either 'excellent' or 'good'.

- **Churchill River at English Point (May 26 – June 15)**
    - At deployment, conductivity and dissolved oxygen were 'excellent', temperature was 'good', pH was 'fair', while turbidity was 'poor'. This discrepancy is likely due to the QA/QC sonde not being placed in close enough proximity to the field sonde or given sufficient time to acclimate; this is supported by a better ranking between the field sonde and grab sample.
    - At removal, all parameters ranked as 'excellent', with the exception of pH. This discrepancy is being attributed to an issue with the pH sensor on the field sonde, hence why the instrument was switched out partway through the deployment period.
- **Churchill River at English Point (June 15 – July 7)**
    - At deployment, all parameters ranked as either 'excellent' or 'good'.
    - At removal, all parameters ranked as either 'excellent' or 'good'.

Data Interpretation

- The following graphs and discussion illustrate water quality related events occurring from May 26/June 6 to July 6/7/19, 2022 on the Lower Churchill River Network.
- With the exception of water quantity data (stage & flow), all data used in the preparation of the graphs and subsequent discussion below adhere to stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

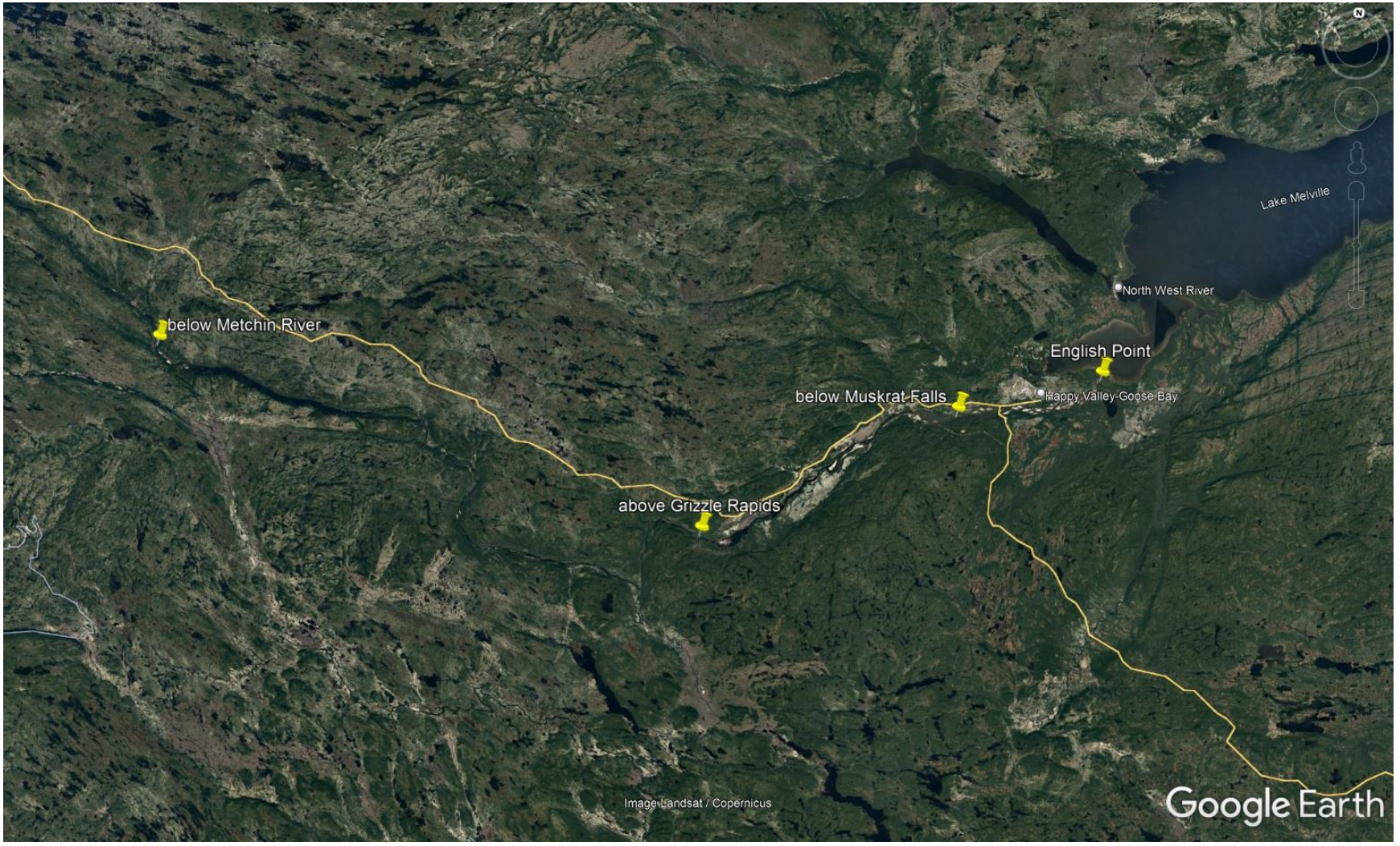

Figure 1: Lower Churchill Network of Real-Time Water Quality Stations

Churchill River below Metchin River

Water Temperature

- Over the deployment period, water temperature ranged from 6.4°C to 15.1°C, with a median value of 12.4°C (Figure 2). Air temperature data was obtained from the Metchin River near TLH Weather Station.
- Water temperature was gradually increasing over the course of deployment, which is to be expected as air temperatures were also increasing through the spring and summer. Water temperature data exhibits a diurnal pattern as expected, and closely correlates with ambient air temperatures.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

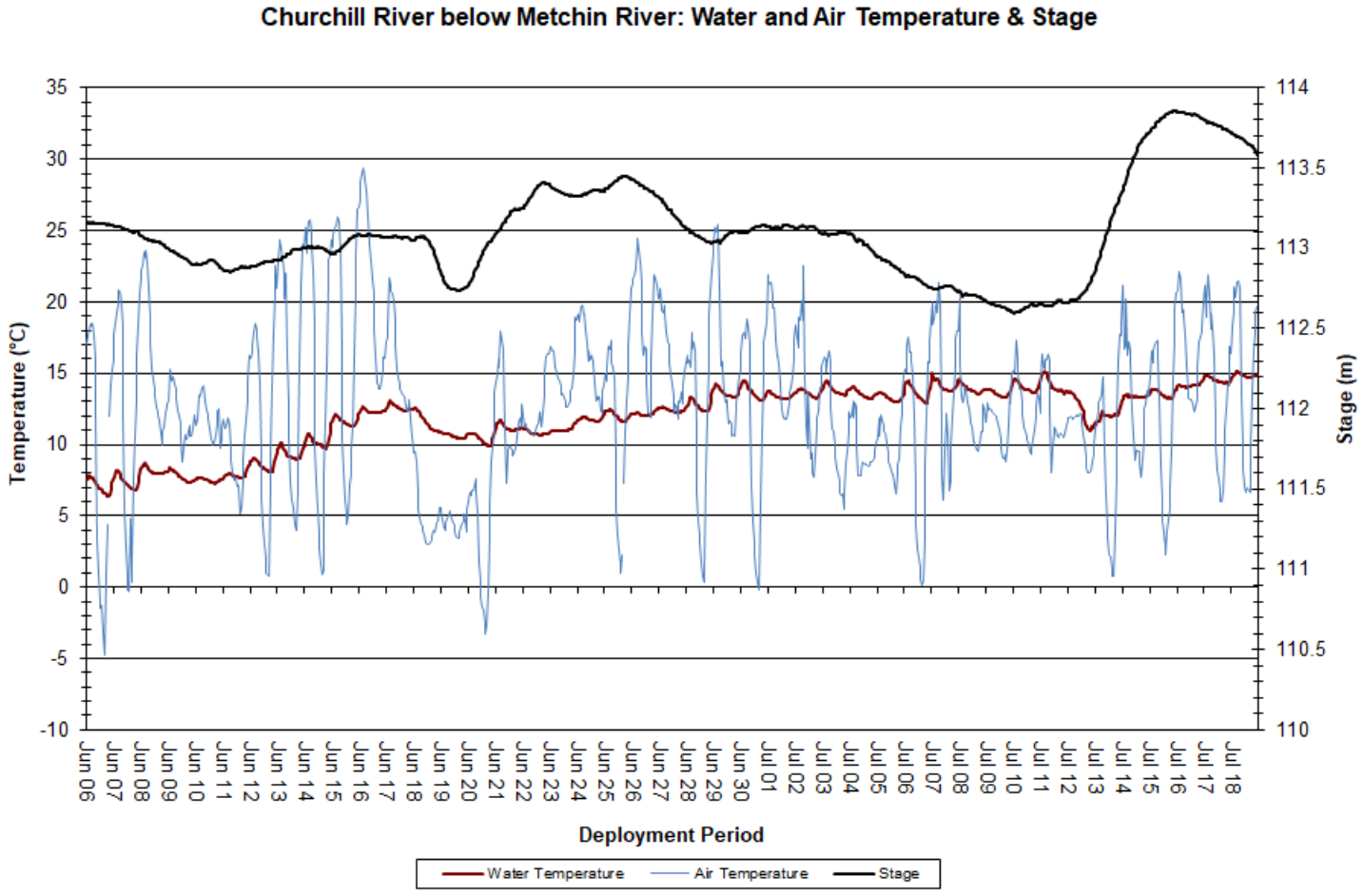

Figure 2: Water and Air Temperature & Stage at Churchill River below Metchin River

pH

- Over the deployment period, pH values ranged from 5.63 to 6.91 pH units, with a median value of 6.48 (Figure 3).
- pH values were relatively stable over the course of deployment; however, several marked decreases occurred in conjunction with increases in stage. pH levels were within the CCME's Guidelines for the Protection of Aquatic Life until June 27, after which they fell and remained below the minimum guideline for the rest of the deployment period.
- Photosynthesis uses up hydrogen molecules; this causes the concentration of hydrogen ions to decrease, which in turn causes pH to increase. For this reason, pH may be higher during daylight hours and during the growing season when photosynthesis is at a maximum. This is illustrated by the diurnal fluctuations in pH values (Figure 3).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

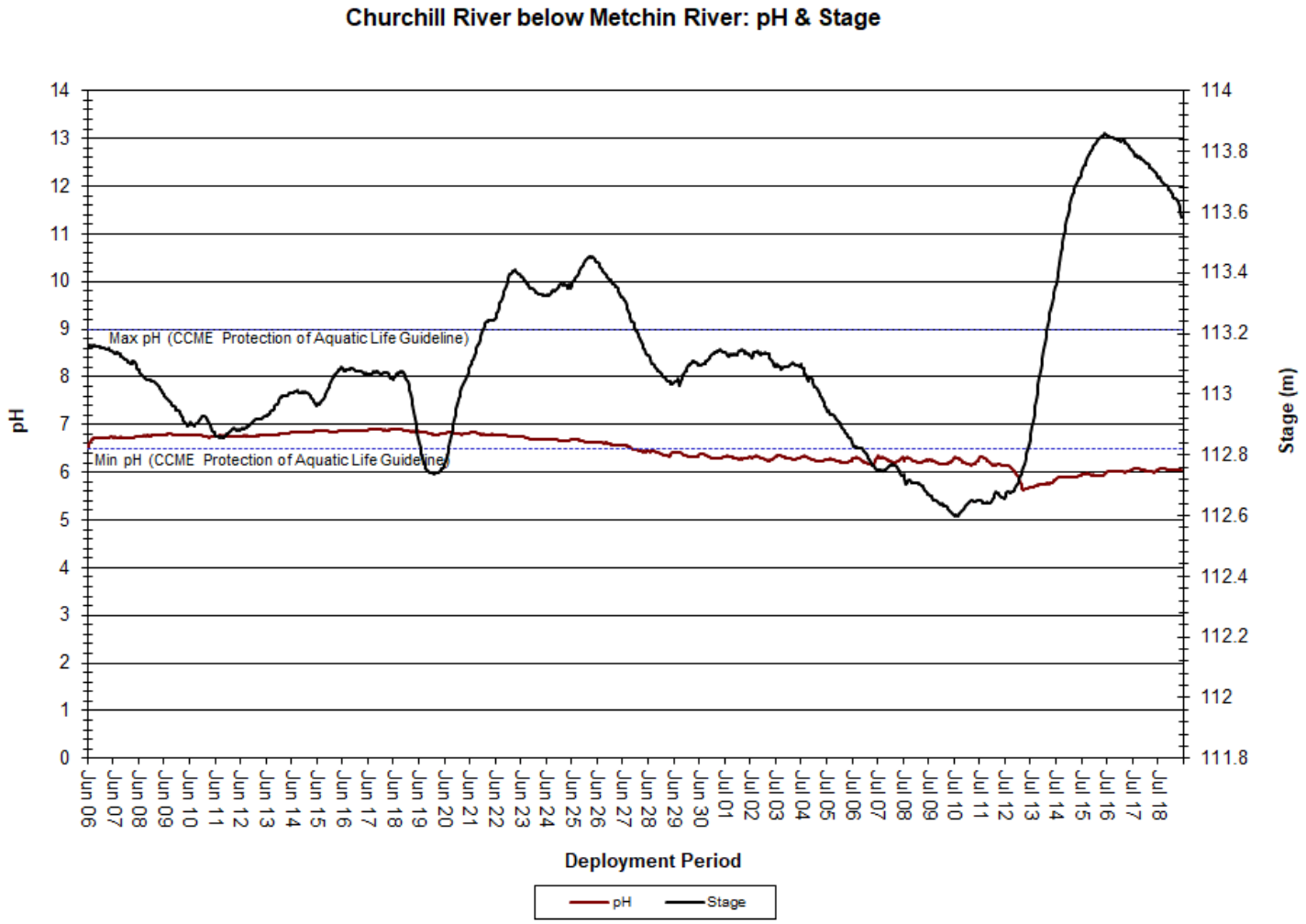

Figure 3: pH & Stage at Churchill River below Metchin River

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 14.5µS/cm to 19.1µS/cm, with a median value of 17.1µS/cm (Figure 4).
- The relationship between conductivity and stage is generally inversed. When stage levels increase, specific conductivity levels decrease as the increased amount of water in the river system dilutes solids that are present. This relationship is somewhat evident in the graph below (Figure 4).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

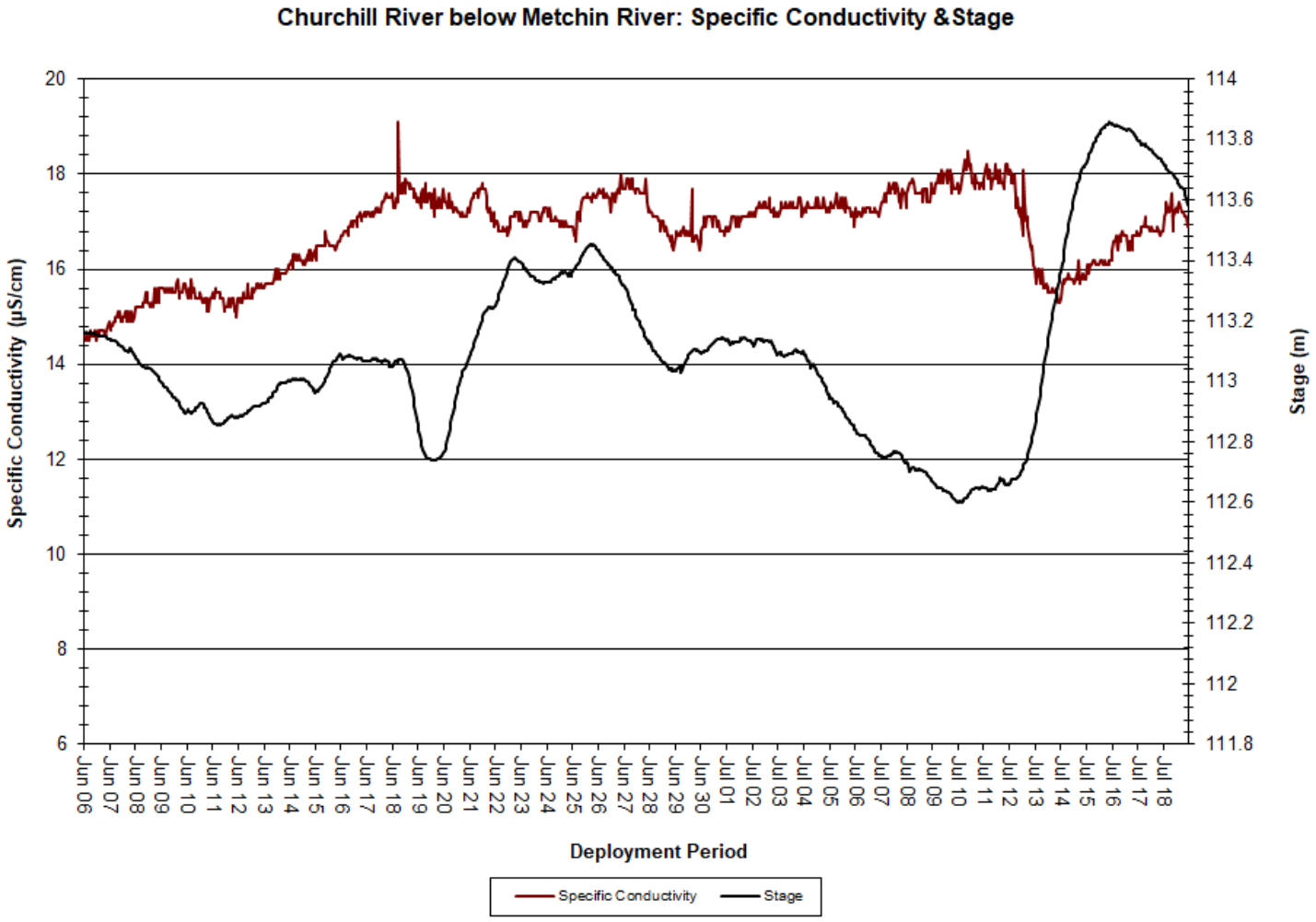

Figure 4: Specific Conductivity & Stage at Churchill River below Metchin River

Dissolved Oxygen

- Over the deployment period, dissolved oxygen content ranged from 9.6mg/L to 12.24mg/L, with a median value of 10.32mg/L. Saturation of dissolved oxygen ranged from 92.9% to 104.6%, with a median value of 96.8% (Figure 5).
- There is an evident relationship between water temperature and dissolved oxygen. Over the deployment period, dissolved oxygen levels were steadily decreasing, as water temperatures were steadily increasing. Dissolved oxygen also follows a diurnal pattern as water temperatures rise and fall under the influence of ambient air temperatures. Generally, dissolved oxygen levels are higher in a waterbody during cooler temperatures.
- Dissolved oxygen levels remained above the CCME's Guidelines for the Protection of Early and Other Life Stages for the duration of deployment.

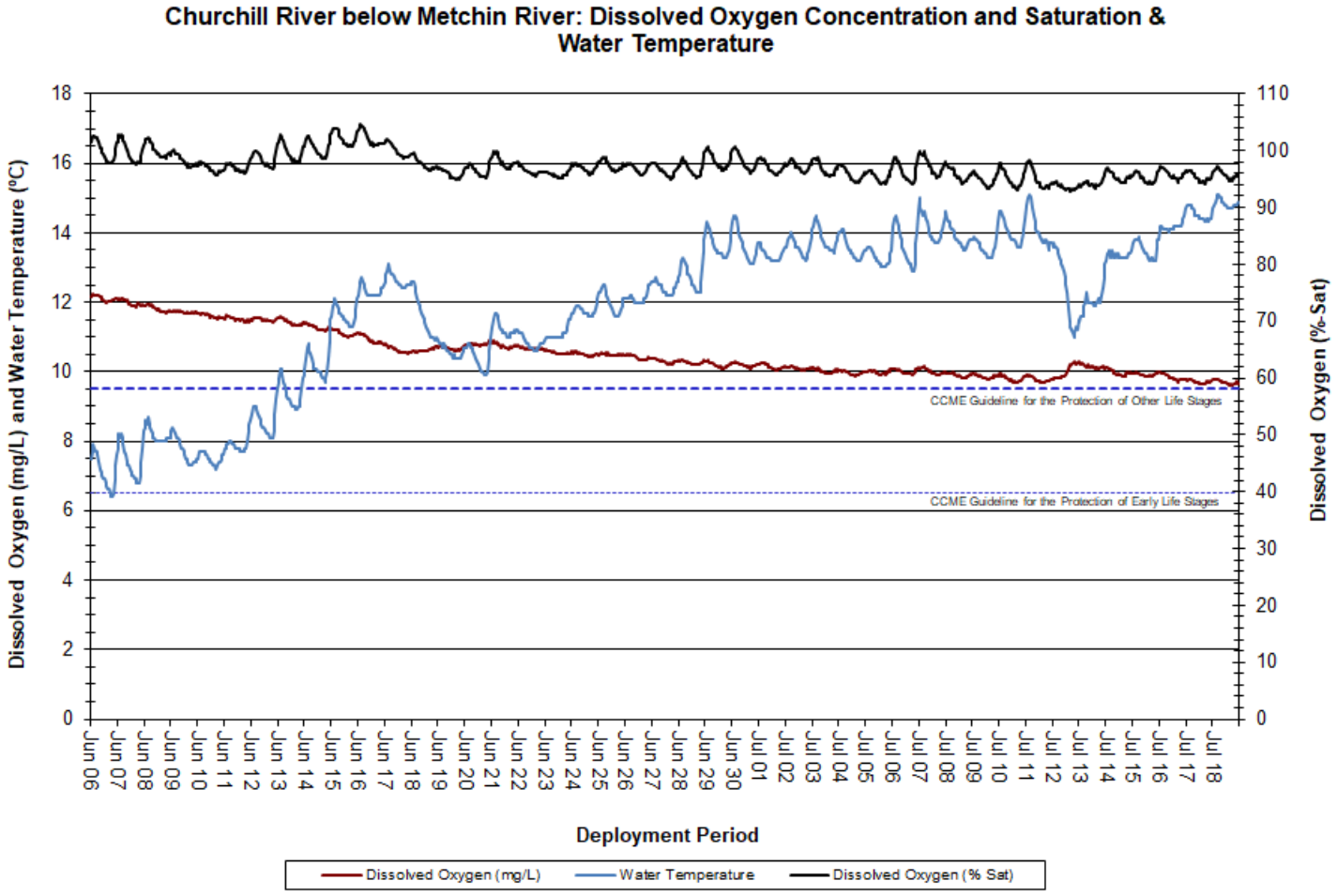

Figure 5: Dissolved Oxygen & Water Temperature at Churchill River below Metchin River

Turbidity

- Over the deployment period, turbidity ranged from 0.0NTU to 45.9NTU, with a median value of 0.0NTU (Figure 6). A median value of 0.0NTU indicates a very low level of natural background turbidity in the waterbody. Precipitation data was obtained from the Metchin River near TLH Weather Station.
- Many of the turbidity spikes observed throughout the deployment period correlate closely with precipitation events (Figure 6); however, some turbidity events do not coincide with any precipitation. This station is located at a wide and deep section of the Churchill River and therefore turbidity levels are likely less susceptible to precipitation events as compared to other areas.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

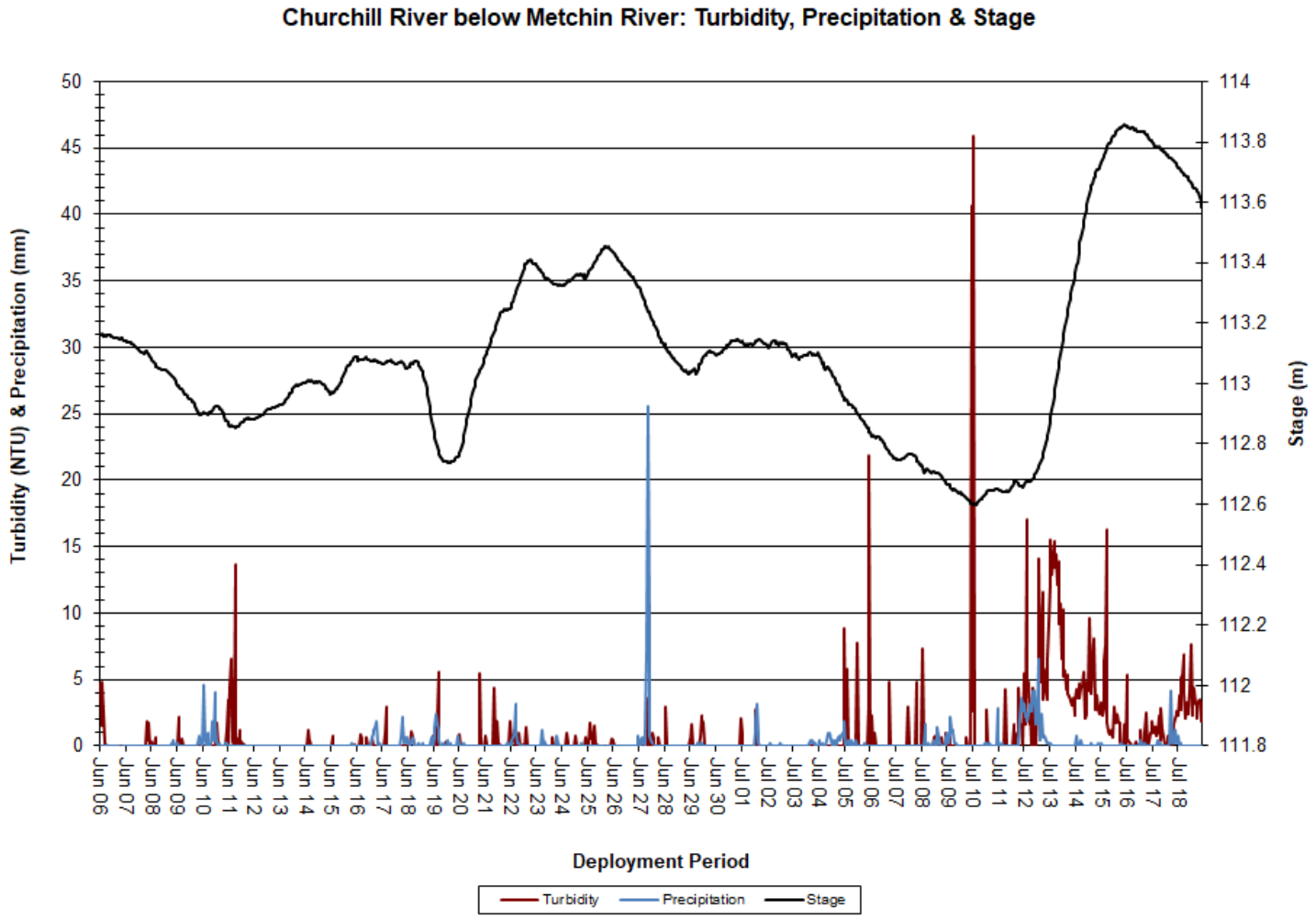

Figure 6: Turbidity, Precipitation & Stage at Churchill River below Metchin River

Stage and Flow

- Over the deployment period, stage levels ranged from 112.599m to 113.858m, with a median value of 113.07m. Flow ranged from 1137.703m^3/s to 1481.064m^3/s, with a median value of 1284.596m^3/s (Figure 7). Precipitation data was obtained from the Metchin River near TLH Weather Station.
- Stage and flow were variable but relatively stable over the course of deployment. Precipitation amounts across the same period generally correlated with increases in both stage and flow (Figure 8).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

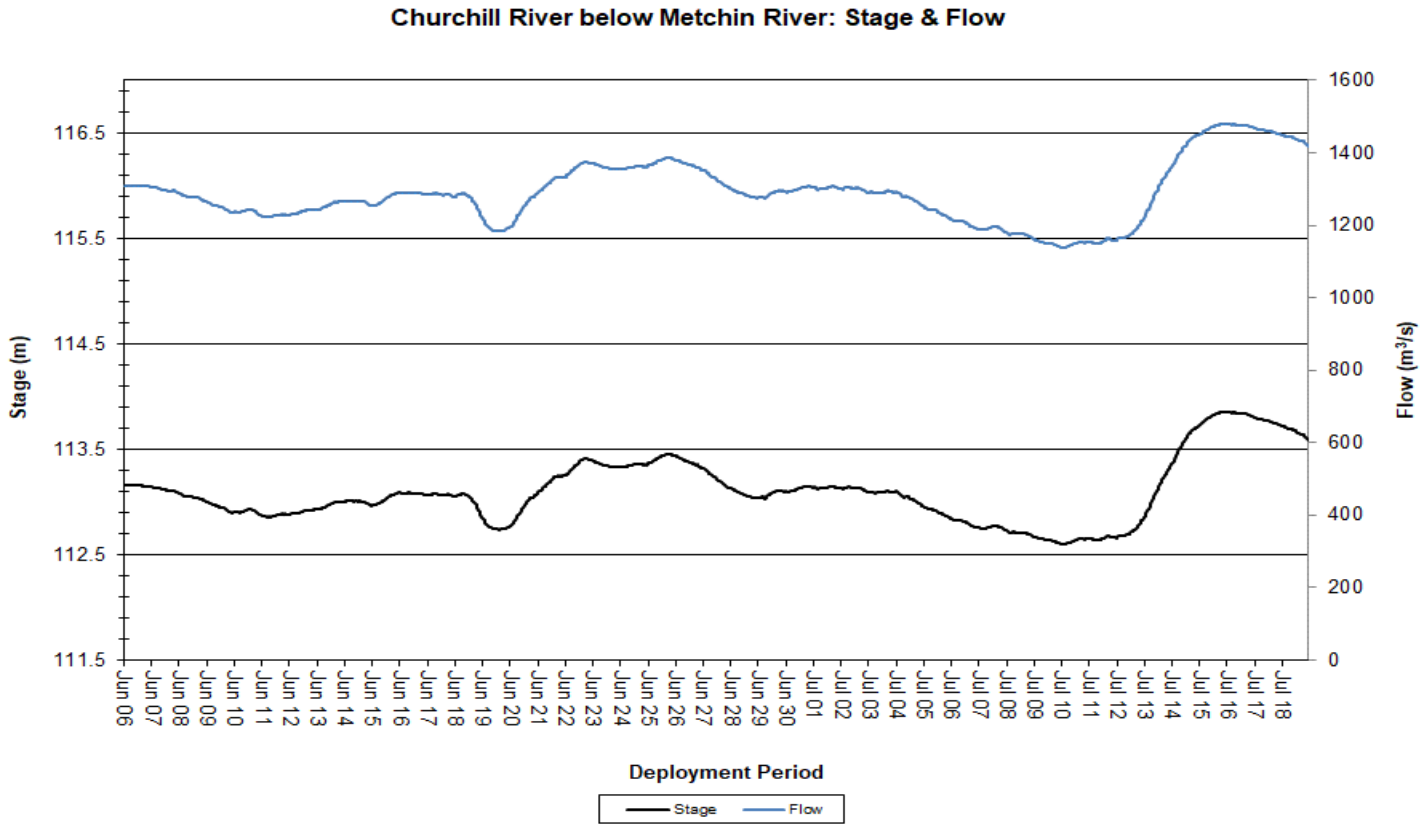

Figure 7: Stage & Flow at Churchill River below Metchin River

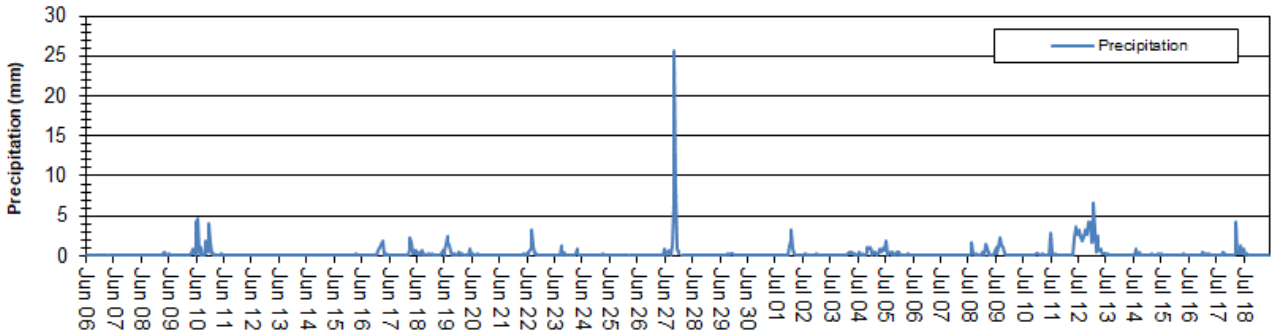

Figure 8: Precipitation at Churchill River below Metchin River

Churchill River below Muskrat Falls

Water Temperature

- Over the deployment period, water temperature ranged from 0.1°C to 28.6°C, with a median value of 9.1°C (Figure 9). Air temperature data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Water temperature slowly increased over the course of the deployment period. This is to be expected as ambient air temperatures also increased through June and July. Water temperatures closely correlate with ambient air temperatures.
- The period through early June where water temperatures almost match air temperatures indicates that the instrument was out of water due to decreased stage levels. The instrument was placed back into the water on June 15.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

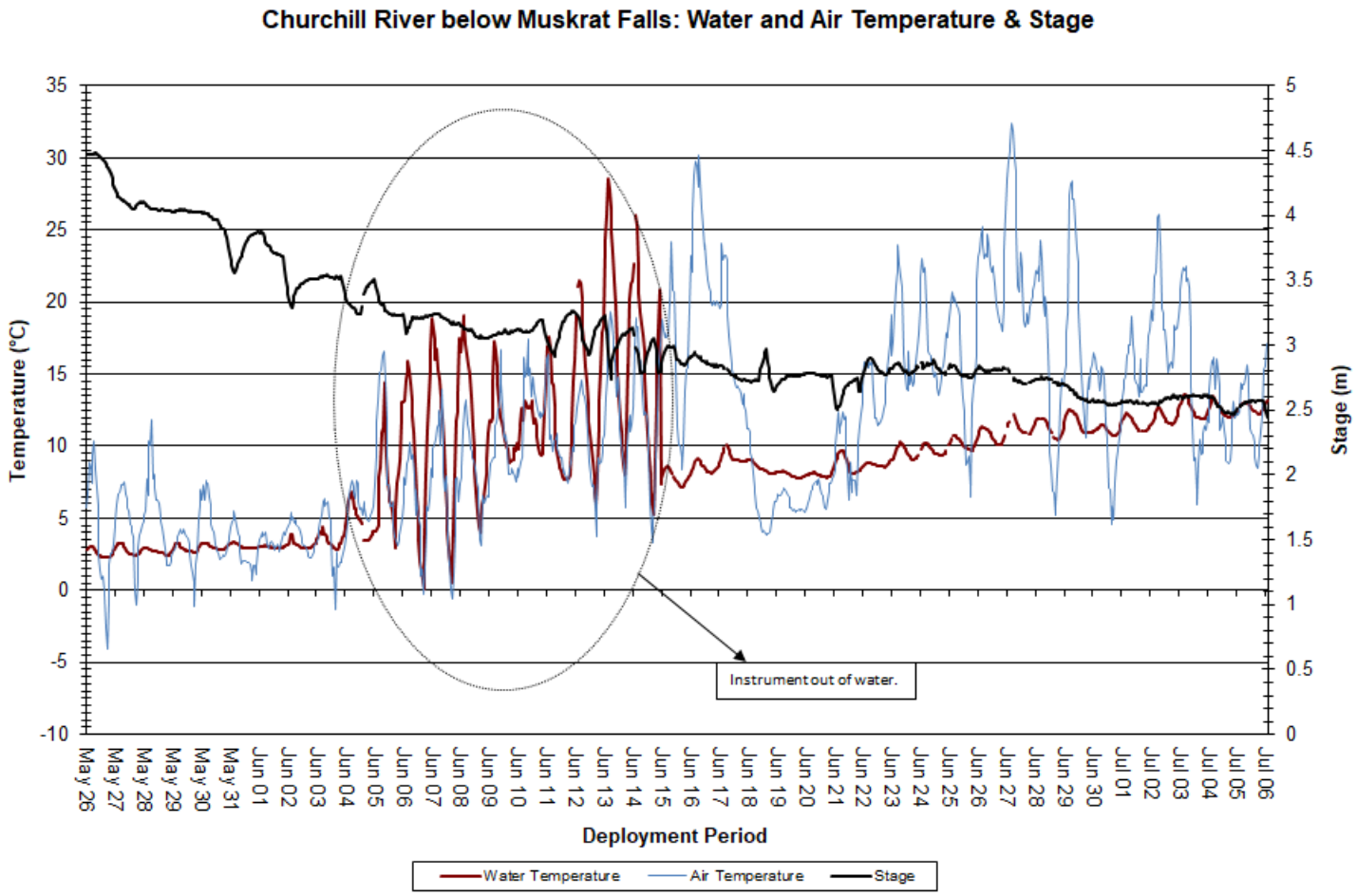

Figure 9: Water and Air Temperature & Stage at Churchill River below Muskrat Falls

pH

- Over the deployment period, pH ranged from 0 pH units to 13.29 pH units, with a median value of 6.61 (Figure 10).
- pH values were relatively stable over the course of deployment, and remained within the CCME's Guidelines for the Protection of Aquatic Life for the majority of deployment (Figure 10). Exceptions occurred through the first half of June while the instrument was out of water due to decreased stage levels. The instrument was placed back into the water on June 15.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

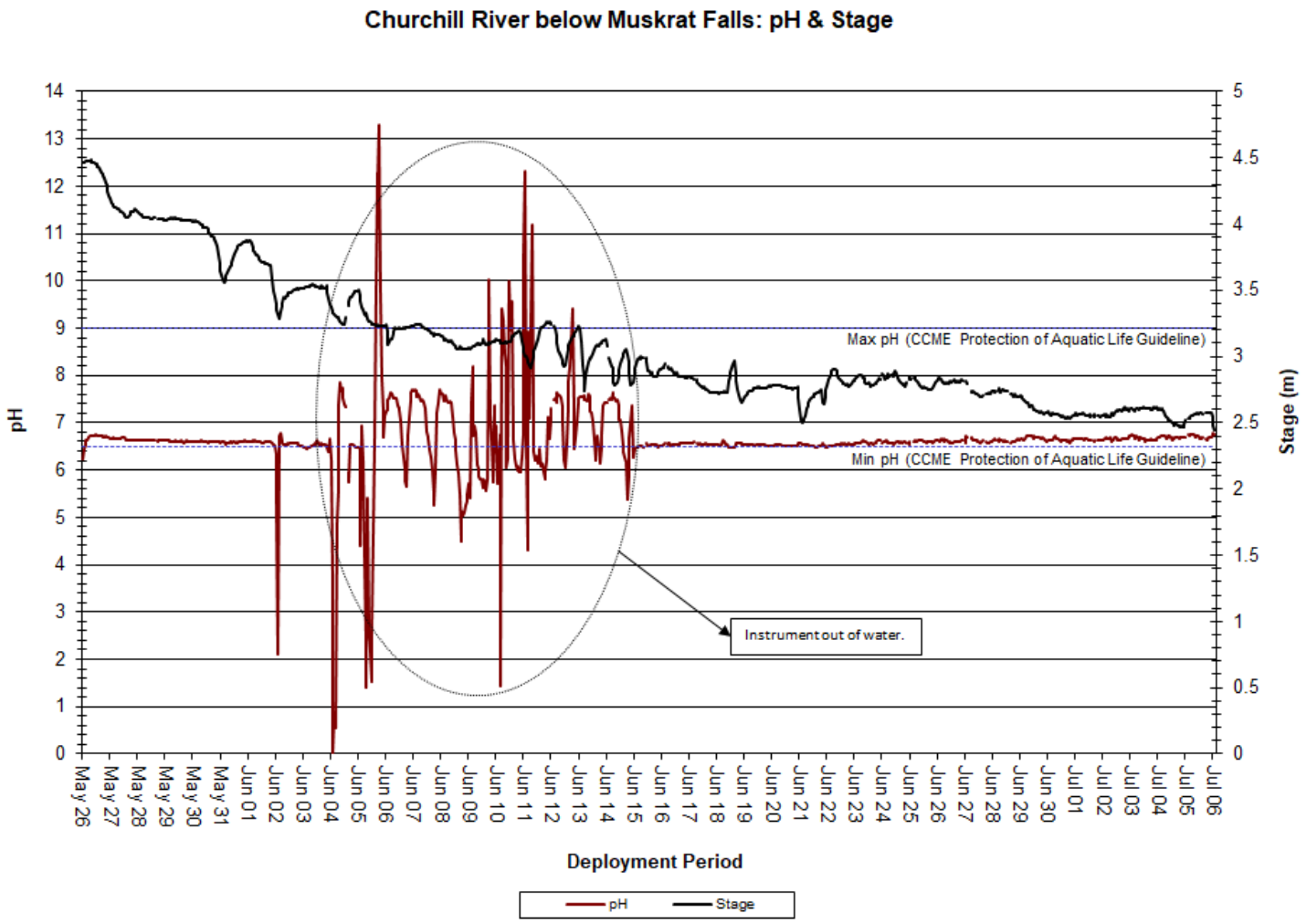

Figure 10: pH & Stage at Churchill River below Muskrat Falls

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 0µS/cm to 15.1µS/cm, with a median value of 12.6µS/cm (Figure 11).
- The relationship between conductivity and stage is generally inversed. When stage decreases, specific conductivity increases as the decreased amount of water in the river system concentrates solids that are present, and vice versa. This relationship is only somewhat evident in the graph below, likely because this station is located at a deep and wide section of the Churchill River and other factors in the water column influence conductivity levels (Figure 11).
- Zero readings for conductivity occurred through the first half of June while the instrument was out of water due to decreased stage levels. The instrument was placed back into the water on June 15.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

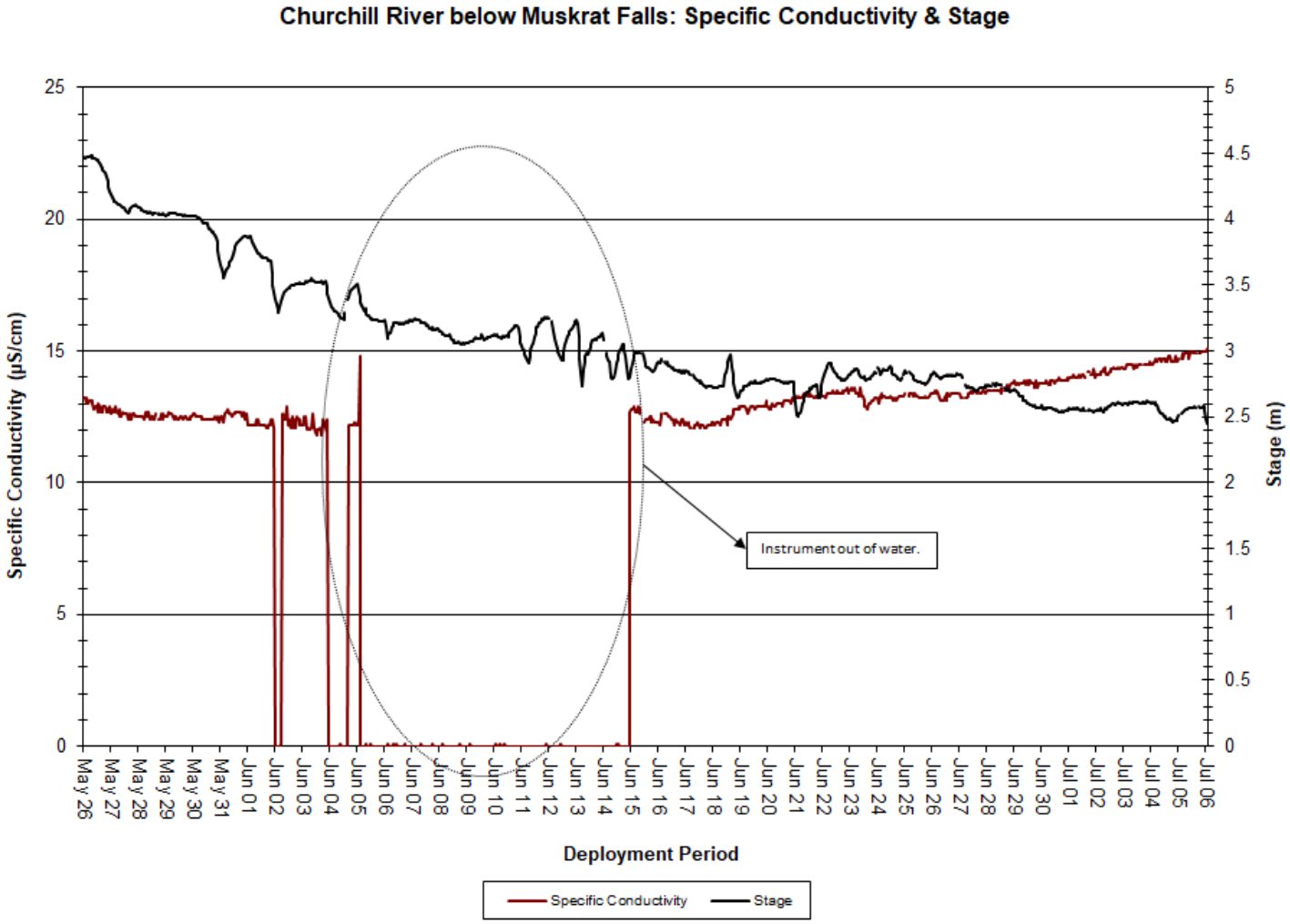

Figure 11: Specific Conductivity & Stage at Churchill River below Muskrat Falls

Dissolved Oxygen

- Over the deployment period, dissolved oxygen concentration ranged from 0mg/L to 16.26mg/L, with a median value of 10.53mg/L. Saturation of dissolved oxygen ranged from 0% to 144.2%, with a median value of 96.0% (Figure 12).
- Dissolved oxygen and water temperature exhibit an inverse relationship: as one parameter increases, the other decreases, and vice versa. Dissolved oxygen levels slowly decreased over the course of deployment. This is to be expected since water temperatures were slowly increasing over the same period. Dissolved oxygen also follows a diurnal pattern as water temperatures rise and fall under the influence of ambient air temperatures.
- Zero readings for dissolved oxygen occurred through the first half of June while the instrument was out of the water due to decreased stage levels. The instrument was placed back into the water on June 15.
- Dissolved oxygen levels were above the CCME's Guidelines for the Protection of Early and Other Life Stages for the period of deployment while the instrument was in the water.

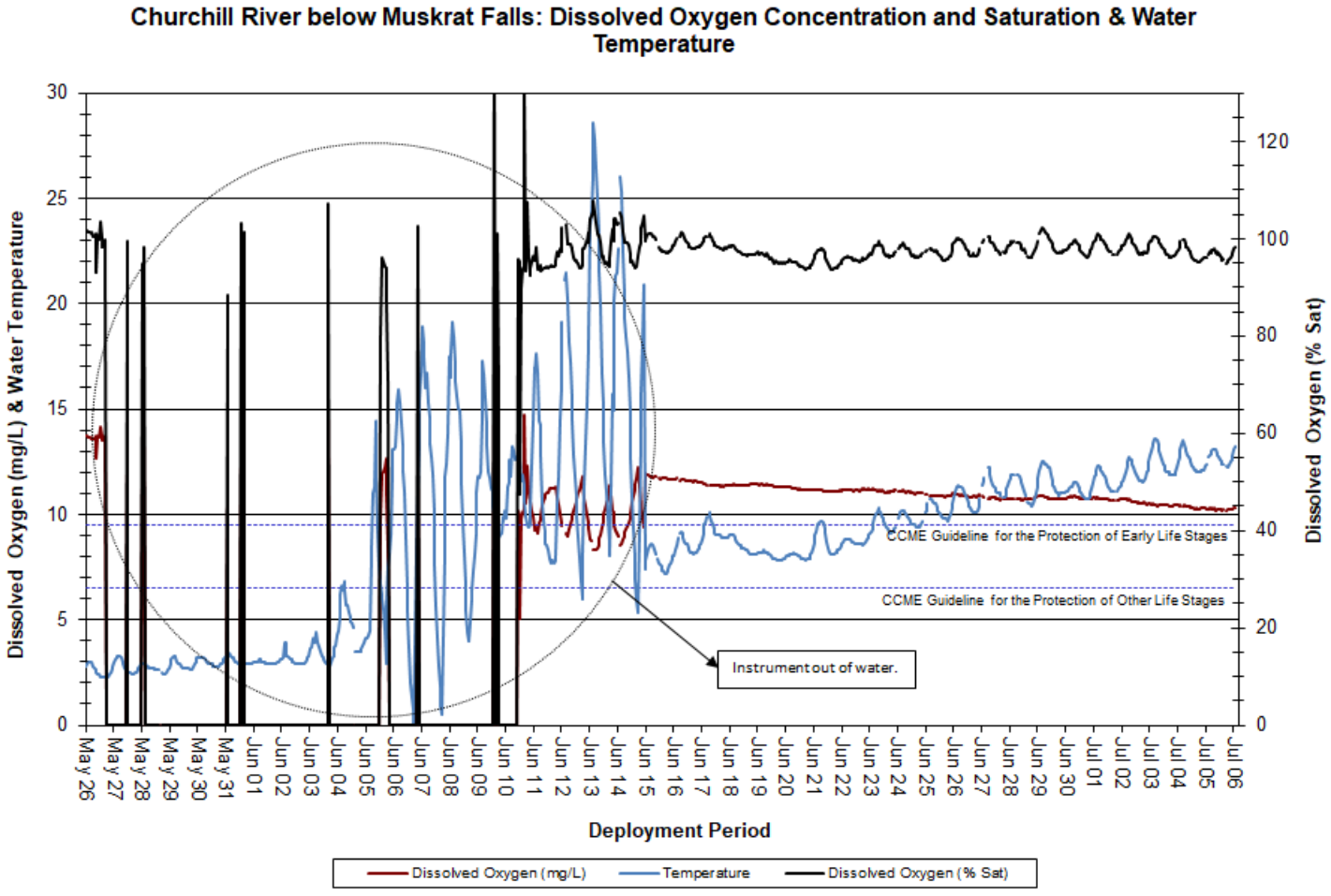

Figure 12: Dissolved Oxygen & Water Temperature at Churchill River below Muskrat Falls

Turbidity

- Over the deployment period, turbidity ranged from 0.0NTU to 21.7NTU, with a median value of 0.0NTU. A median value of 0.0NTU indicates a very low level of natural background turbidity in the waterbody. Precipitation data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- There was good correlation between turbidity events and precipitation events across most the deployment period (Figure 13).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

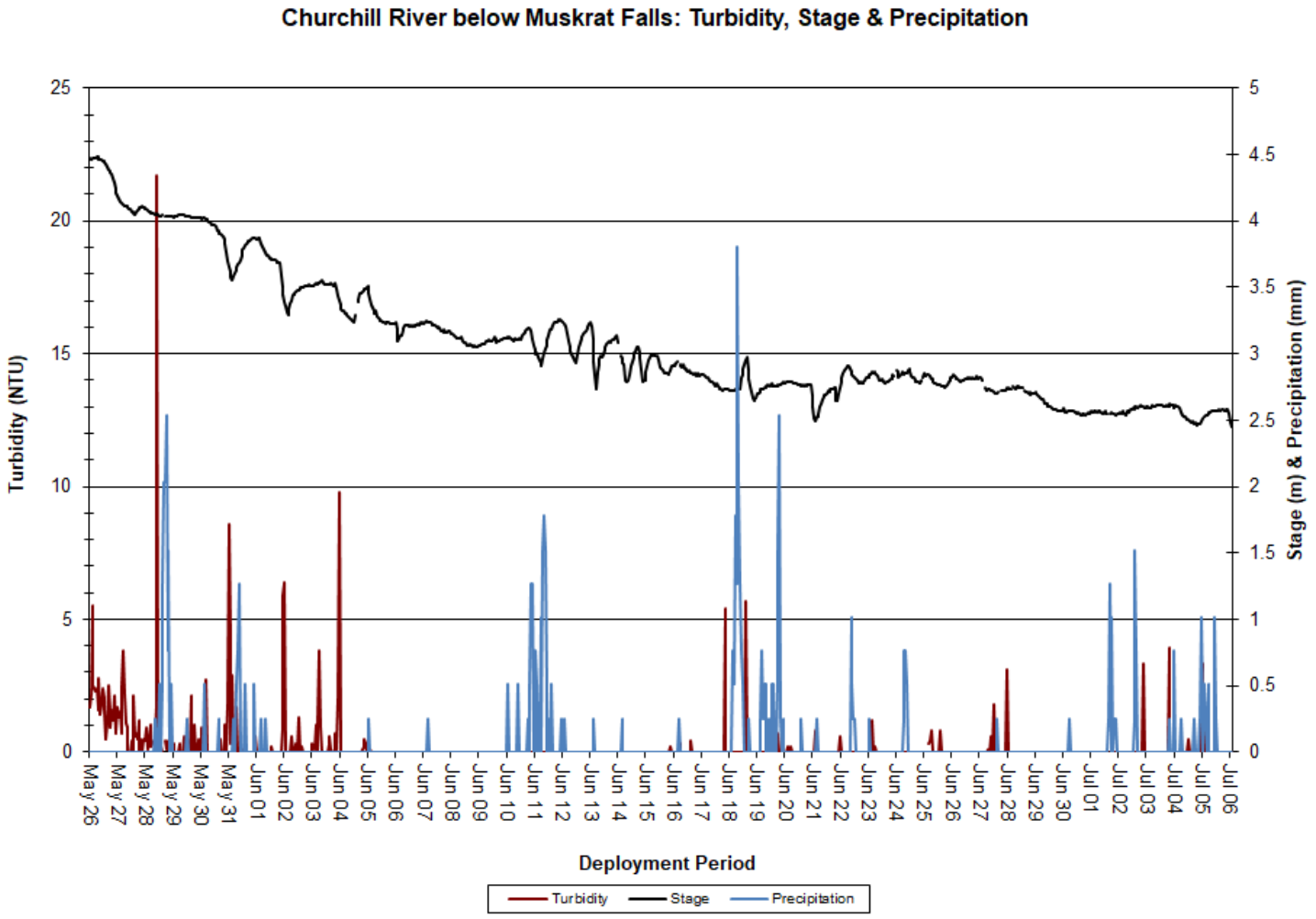

Figure 13: Turbidity, Precipitation & Stage at Churchill River below Muskrat Falls

Stage & Flow

- Over the deployment period, stage ranged from 2.448m to 4.488m, with a median value of 2.908m. Flow ranged from 1436.507m^3/s to 3862.343m^3/s, with a median value of 1902.47m^3/s (Figure 14). Precipitation data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Stage and flow were variable but steadily decreasing over the course of deployment, and correlated somewhat with precipitation events. This is partly related to the fact that this station is located on a very wide section of the Churchill River and therefore not as easily influenced by smaller precipitation events. Stage and flow at this station are also influenced by upstream activities at the Muskrat Falls hydroelectric project.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

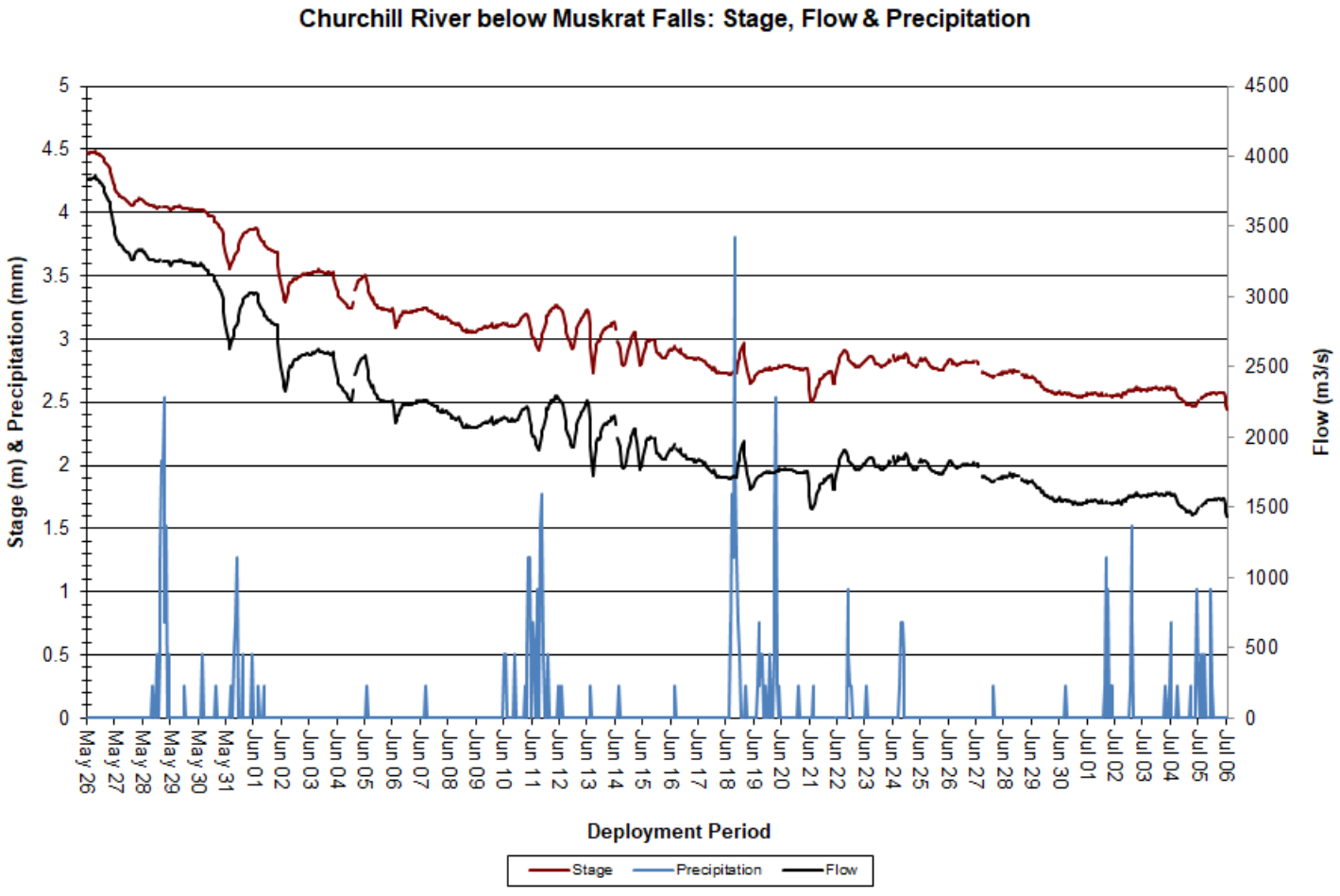

Figure 14: Stage, Flow & Precipitation at Churchill River below Muskrat Falls

Chlorophyll

- Over the deployment period, chlorophyll ranged from 0ug/L to 3.91ug/L, with a median value of 2.23ug/L (Figure 15).
- Chlorophyll is found within living cells of photosynthetic organisms like phytoplankton and cyanobacteria. The amount of chlorophyll found in water can be used to understand the general biological health of an ecosystem. Chlorophyll can also be used to identify algal bloom events and is an indicator of nutrient loading in ecosystems.
- Zero readings for chlorophyll occurred during the first half of June while the instrument was out of water due to decreased stage levels. The instrument was placed back into the water on June 15.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

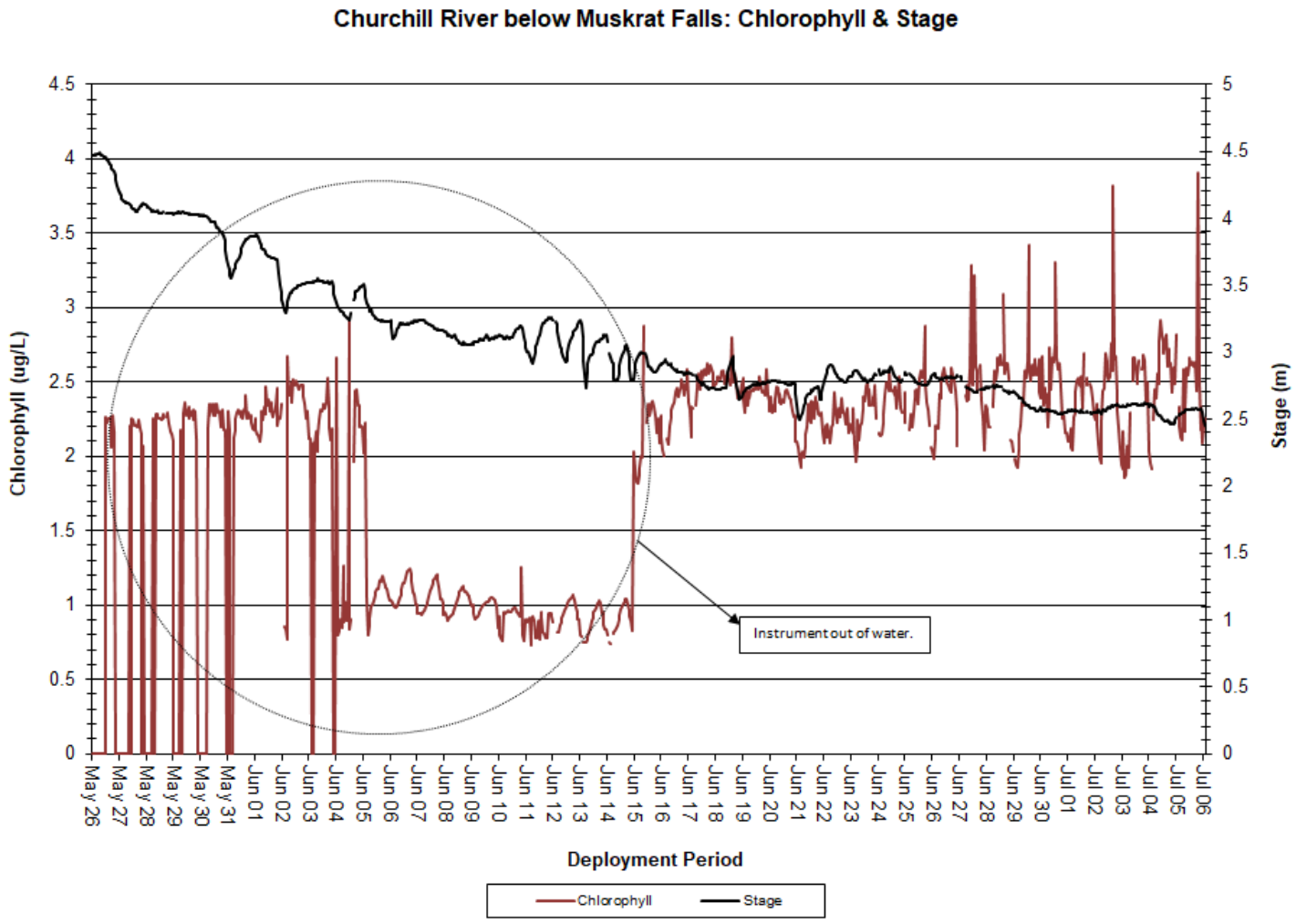

Figure 15: Chlorophyll & Stage at Churchill River below Muskrat Falls

Churchill River at English Point

Water Temperature

- Water temperature ranged from 2.3°C to 16.5°C, with a median value of 9.2°C (Figure 16). Air temperature data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Water temperature increased steadily across the deployment period. Water temperatures closely correlated with ambient air temperatures, which followed a similar trend across the same period.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

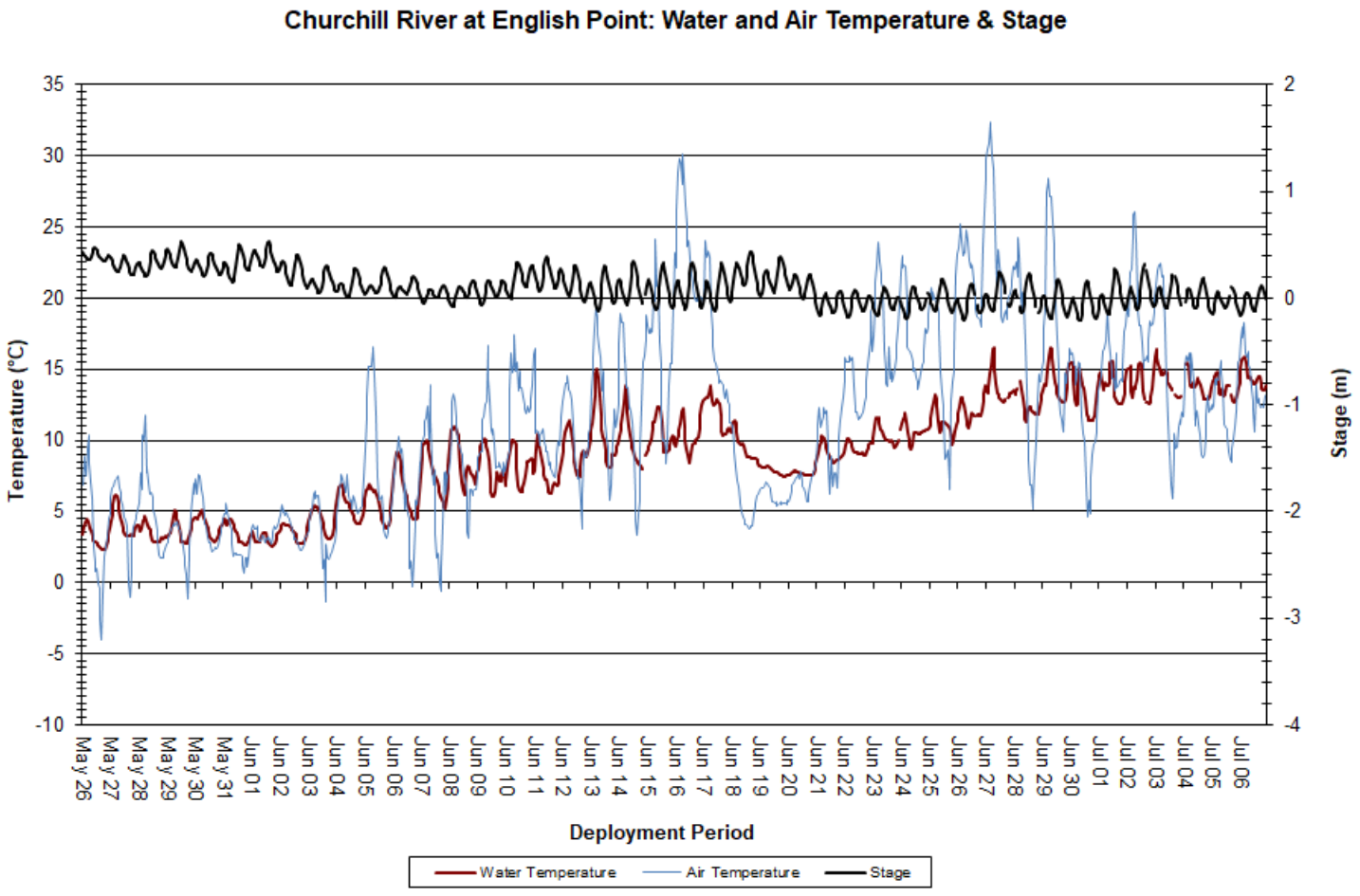

Figure 16: Water and Air Temperature & Stage at Churchill River at English Point

pH

- Over the deployment period, pH ranged from 6.42 pH units to 14.0 pH units, with a median value of 6.80 (Figure 17).
- pH values were unusually high during the first half of deployment. It was determined that this was likely due to a sensor failure, and the instrument was replaced on June 15. pH values remained within the CCME's Guidelines for the Protection of Aquatic Life for the remainder of deployment.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

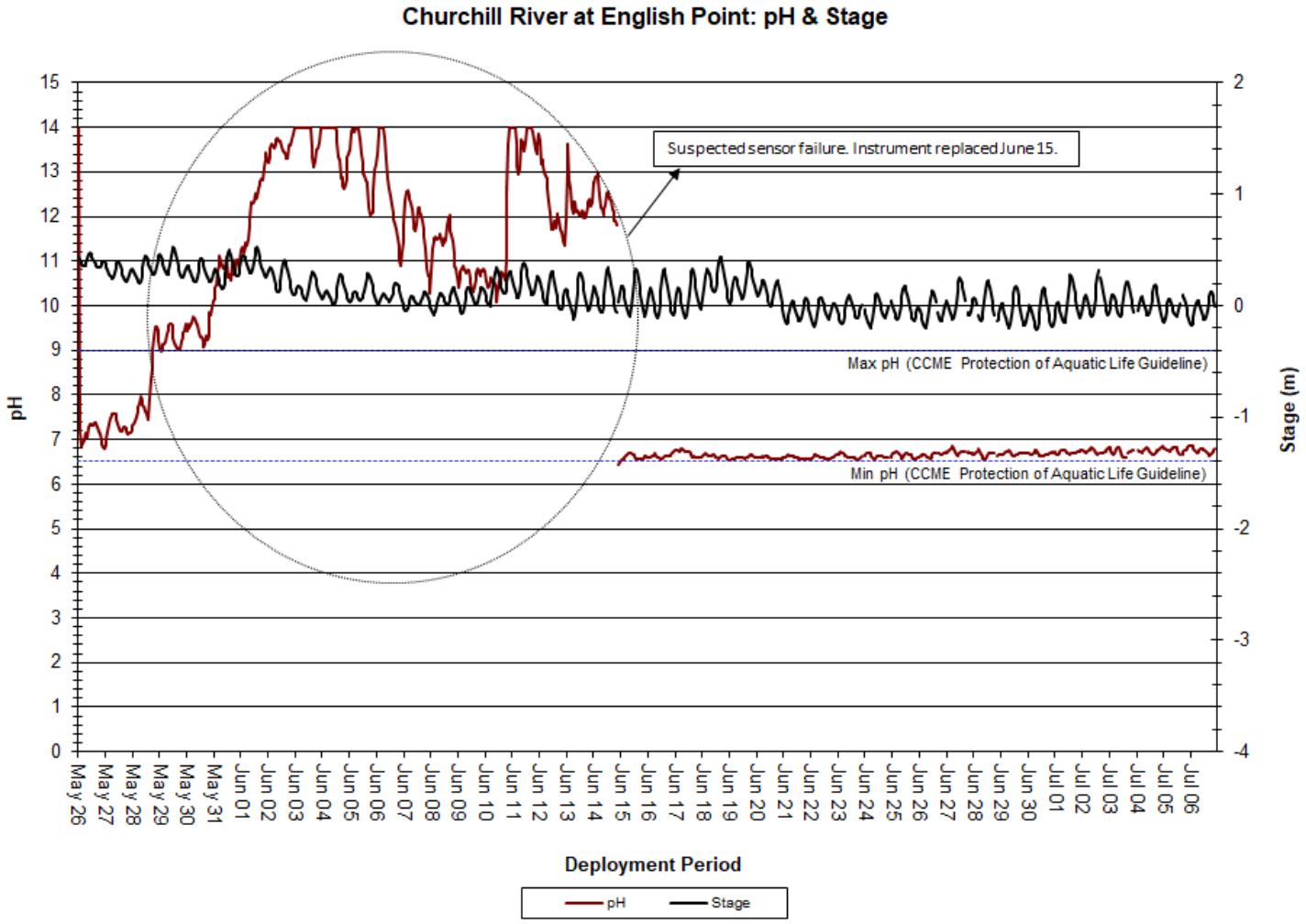

Figure 17: pH & Stage at Churchill River at English Point

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 12.8µS/cm to 41.3µs/cm, with a median value of 24.7µS/cm (Figure 18).
- Specific conductivity fluctuates considerably at this location due to the tidal influences of the Atlantic Ocean on Lake Melville. As the tide comes in, specific conductivity increases as dissolved solids and salinity increase, and vice versa as the tide goes out. This increase and decrease in specific conductivity and stage occurs twice daily. This pattern is generally consistent throughout the deployment period (Figure 18).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

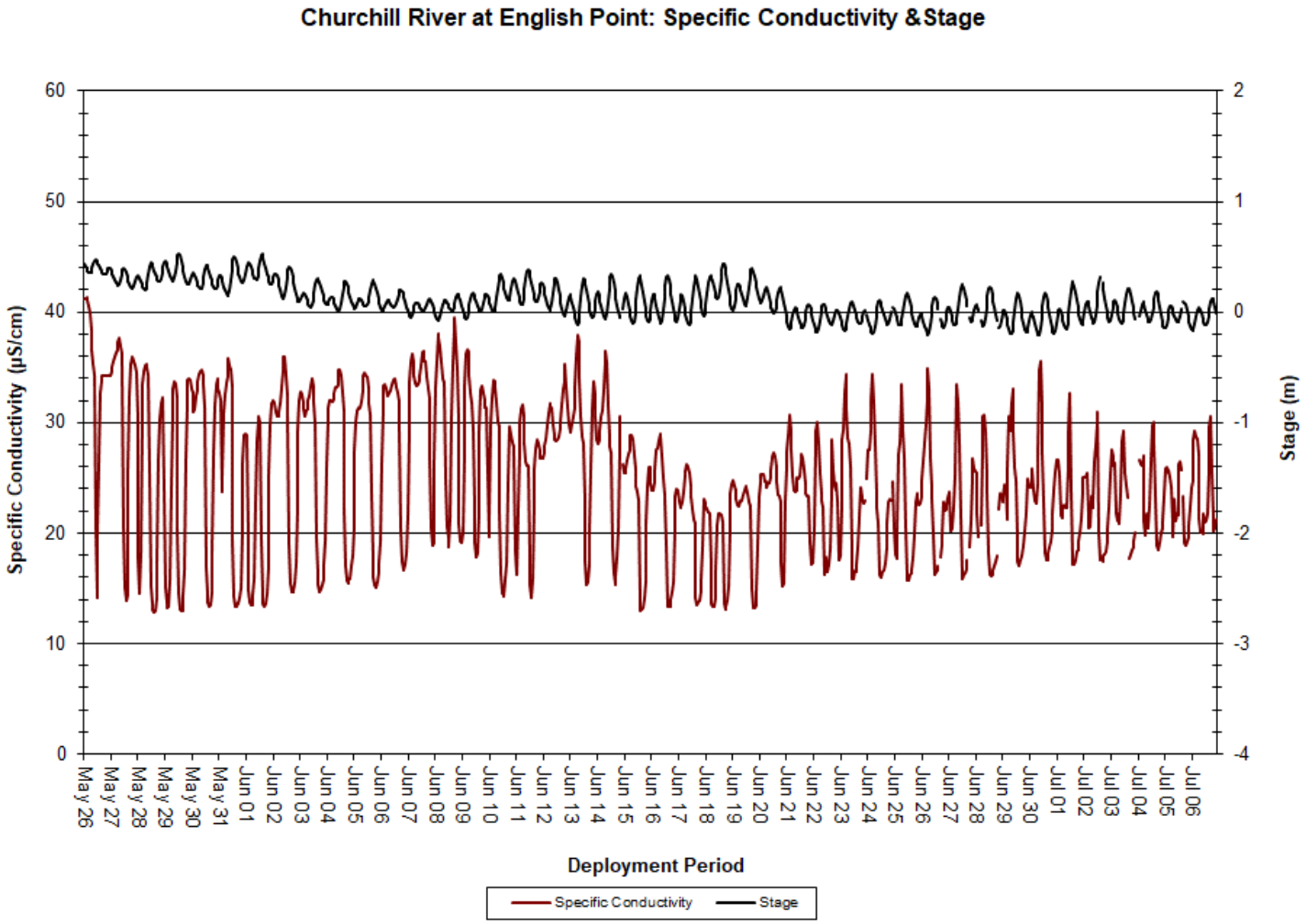

Figure 18: Specific Conductivity & Stage at Churchill River at English Point

Dissolved Oxygen

- Over the deployment period, dissolved oxygen concentration ranged from 9.78mg/L to 13.57mg/L, with a median value of 11.37mg/L. Saturation of dissolved oxygen ranged from 82.3% to 115.8% saturation, with a median value of 98.3% (Figure 19).
- There is an evident relationship between water temperature and dissolved oxygen. As water temperatures increased over the deployment period, dissolved oxygen levels decreased. Dissolved oxygen levels also follow a diurnal pattern as water temperatures rise and fall under the influence of ambient air temperatures. Generally, dissolved oxygen levels are higher in a waterbody during cooler temperatures.
- Dissolved oxygen levels remained above the CCME's Guidelines for the Protection of Early and Other Life Stages for the duration of deployment (Figure 19).

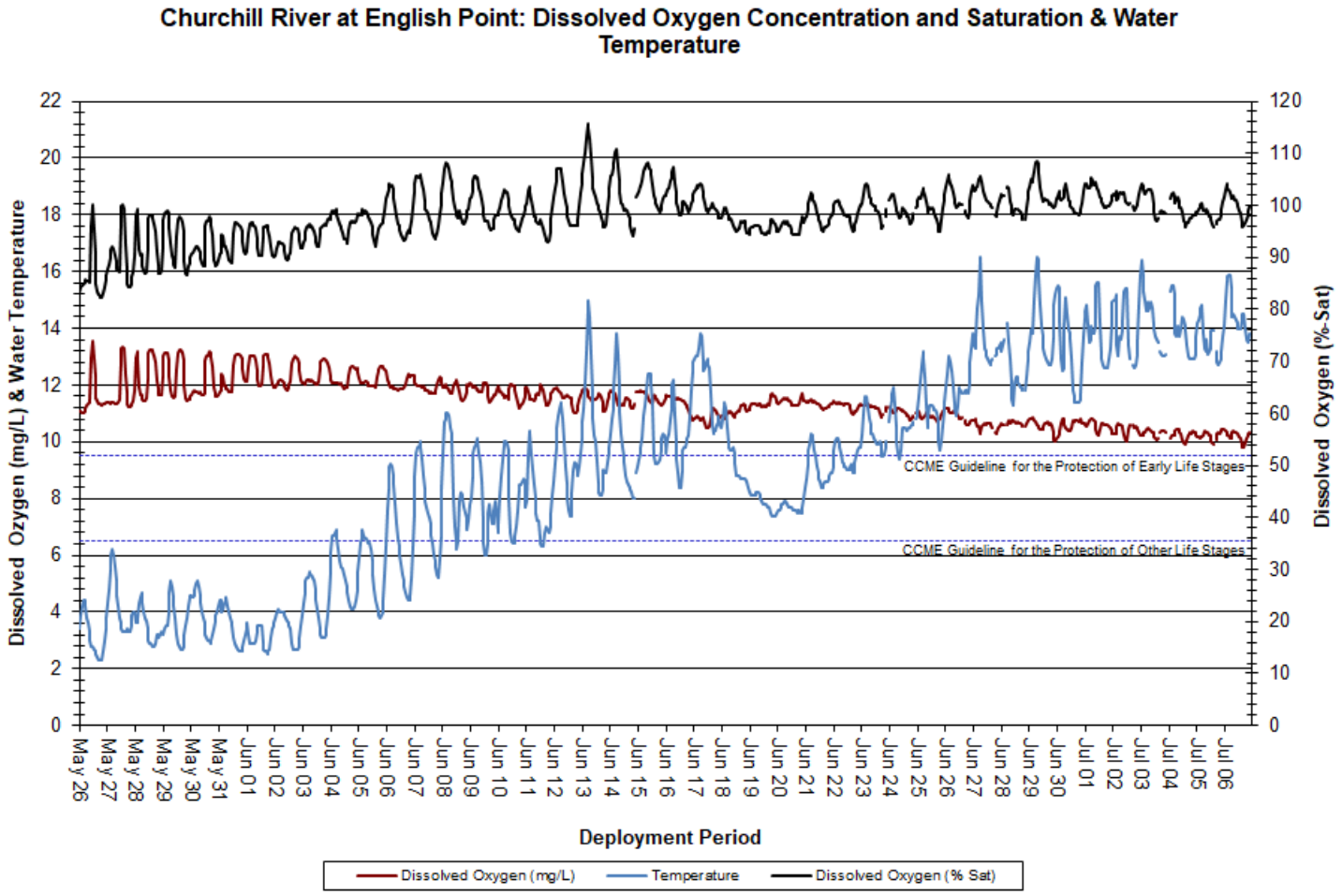

Figure 19: Dissolved Oxygen & Water Temperature at Churchill River at English Point

Turbidity

- Over the deployment period, turbidity ranged from 0 NTU to 198.5 NTU, with a median value of 18.1 NTU (Figure 20). A median value of 18.1 NTU indicates a significant level of background turbidity; this is to be expected considering the sandy river bed and tidal influences present at this station. Precipitation data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Turbidity events generally correlate with precipitation events, as these can increase the presence of suspended material in water. High winds and tidal influences can also contribute to turbidity events at this station by disturbing sediment from the river bed (Figure 20). Wind speed data was also obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

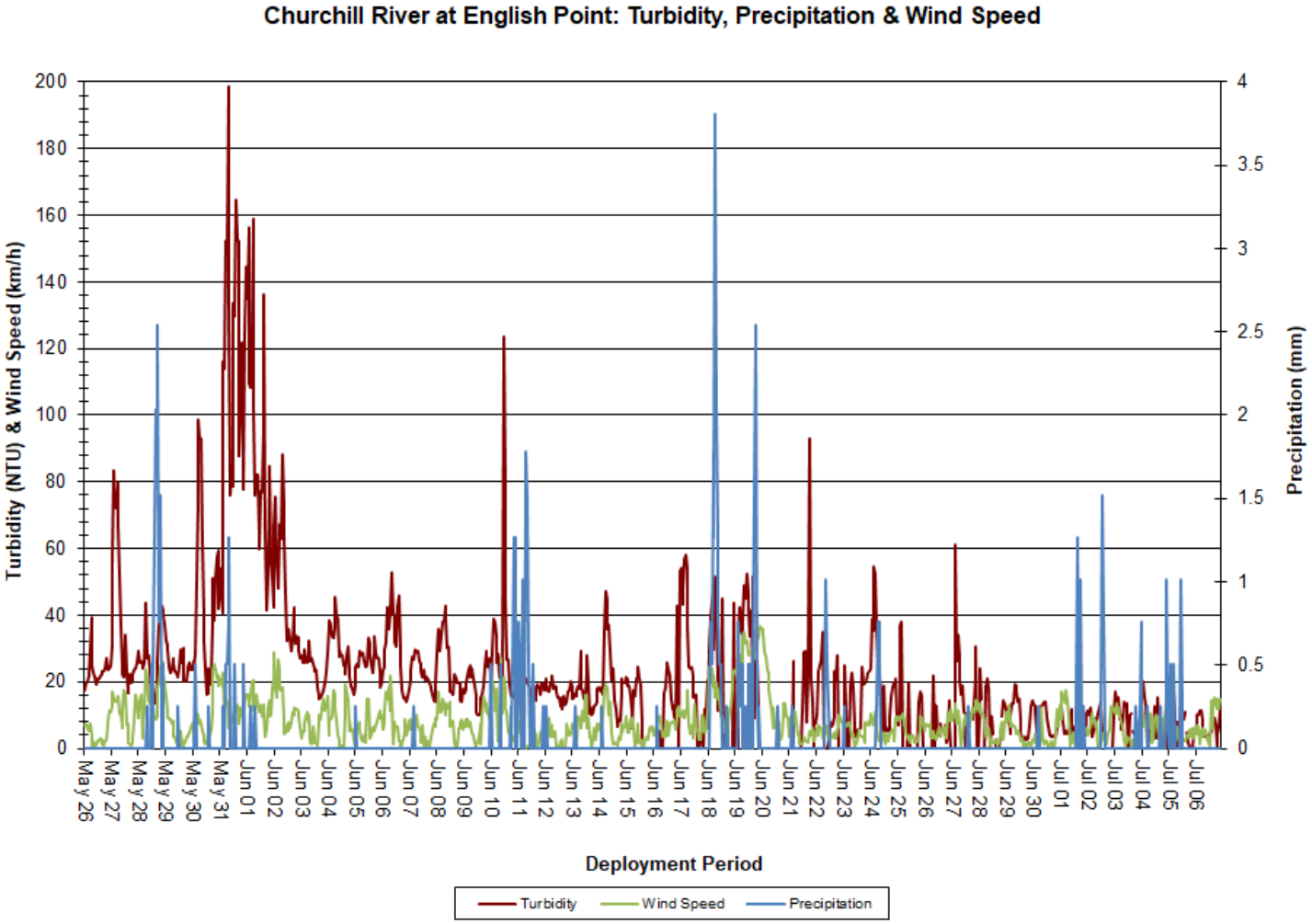

Figure 20: Turbidity, Precipitation & Wind Speed at Churchill River at English Point

Stage

- Over the deployment period, stage ranged from -0.214m to 0.532m, with a median value of 0.089m (Figure 21). Precipitation data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Stage fluctuates considerably at this location due to the tidal influences of the Atlantic Ocean. This pattern is consistent over the deployment period. Increases in stage often correlate with precipitation events.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

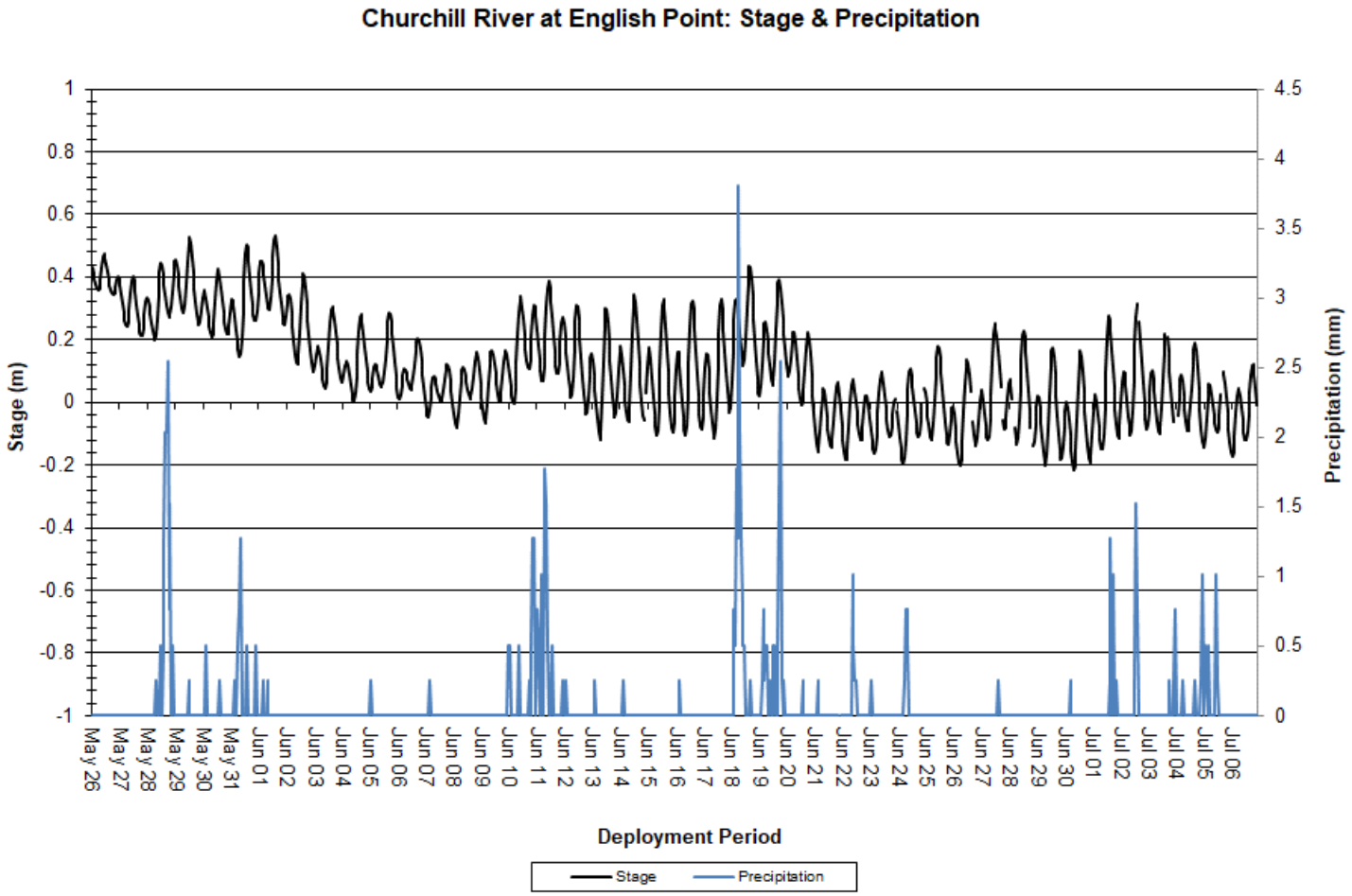

Figure 21: Stage & Precipitation at Churchill River at English Point

Conclusions

- Instruments at three water quality monitoring stations on the Lower Churchill River were deployed from May 26/June 6 through July 6/7/19, 2022.
- Water temperature increased steadily at all stations over the course of deployment. This is to be expected based on ambient air temperature trends during the same period through July and August.
- pH was relatively stable at all stations, and was within the CCME's Guidelines for the Protection of Aquatic Life for the majority of deployment. Instances where pH was outside of the CCME's Guidelines can be attributed to the increased stage levels at Churchill River below Metchin River, the instrument being out of the water at Churchill River below Muskrat Falls, and a sensor failure at Churchill River at English Point.
- Specific conductivity generally increased over the course of deployment at all stations. Since English Point is influenced by tides in Lake Melville, specific conductivity values at the Churchill River at English Point station had a much wider range, which is comparable to other deployments at this location.
- Dissolved oxygen levels slowly decreased over the course of deployment at all stations as water temperatures increased through the summer. Dissolved oxygen levels are generally higher in water at cooler temperatures. Dissolved oxygen levels were above the CCME's Guidelines for the Protection of Early and Other Life Stages for the duration of deployment at all stations, with the exception of when the instrument was out of water at Churchill River below Muskrat Falls.
- Turbidity events occurred at all stations and were generally related to precipitation, wind or tidal events. Turbidity values returned to background levels following each observed event.

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. Available at: http://st-ts.ccme.ca/en/index.html?chems=154,162&chapters=1 [Accessed November 23, 2022].

Fondriest Environmental Inc. (2016a). Fundamentals of Environmental Measurements [Online]. Available at: http://www.fondriest.com/environmental-measurements/parameters/water-quality/conductivity-salinity-tds/#cond15 [Accessed November 23, 2022].

Fondriest Environmental Inc. (2016b). Fundamentals of Environmental Measurements [Online]. Available at: http://www.fondriest.com/environmental-measurements/parameters/water-quality/water-temperature/#watertemp1 [Accessed November 23, 2022].

Swenson, H.A., and Baldwin, H.L. (1965). A Primer on Water Quality, U.S. Geological Survey. Available at: https://pubs.usgs.gov/gip/7000057/report.pdf [Accessed November 23, 2022].

United States Geological Survey. (2017). Water properties: Dissolved oxygen [Online]. Available at: https://water.usgs.gov/edu/dissolvedoxygen.html [Accessed November 23, 2022].

APPENDIX A

Water Parameter Description

Water Parameter Description

Dissolved Oxygen - The amount of Dissolved Oxygen (DO) (mg/l or % saturation) in the water is vital to aquatic organisms for their survival. The concentration of DO is affected by such things as water temperature, water depth and flow (e.g., aeration by rapids, riffles etc.), consumption by aerobic organisms, consumption by inorganic chemical reactions, consumption by plants during darkness, and production by plants during the daylight (USGS, 2017).

Flow - Flow (m3/s) is a measure of how quickly a volume of water is displaced in streams, rivers, and other channels.

pH - pH is a measure of the relative amount of free hydrogen and hydroxyl ions in water. pH is an important indicator of chemically changing water, and determines the solubility and biological availability of nutrients and heavy metals in the water (USGS, 2017).

Specific conductivity - Specific conductivity (µs/cm) is a measure of water's ability to conduct electricity, with values normalized to a water temperature of 25°C. Specific conductance indicates the concentration of dissolved solids (such as salts) in the water, which can affect the growth and reproduction of aquatic life. Specific conductivity is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Fondriest Environmental Inc, 2016).

Stage - Stage (m) is the elevation of the water surface and is often used as a surrogate for the more difficult to measure flow.

Temperature - Essential to the measurement of most water quality parameters, temperature (°C) controls most aquatic processes. Water temperature is influenced by such things as ambient air temperature, solar radiation, meteorological events, industrial effluence, wastewater, inflowing tributaries, as well as water body size and depth. In turn, water temperature has an influence on the metabolic rates and biological activity of aquatic organisms (Fondriest Environmental Inc, 2016b).

Total Dissolved Solids - Total Dissolved Solids (TDS) (g/l) is a measure of alkaline salts dissolved in water or in fine suspension and can affect the growth and reproduction of aquatic life. It is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Swenson and Baldwin, 1965).

Turbidity - Turbidity (NTU) is a measure of the translucence of water and indicates the amount of suspended material in the water. Turbidity is caused by any substance that makes water cloudy (e.g., soil erosion, micro-organisms, vegetation, chemicals, etc.) and can correspond to precipitation events, high stage, and floating debris near the sensor (Swenson and Baldwin 1965).

APPENDIX B

Grab Sample Results

Bureau Veritas Job #: C2G1158
Report Date: 2022/06/27

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SWM541 CR BELOW MR								
Sampling Date 2022/06/06 13:15								
Matrix W								
Sample # 2022-6302-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	7.6	1.0	mg/L	N/A	2022/06/21		8048416
Nitrate (N)	-	ND	0.050	mg/L	N/A	2022/06/22		8048419
Total dissolved solids (calc., EC)	-	8.8	1.0	mg/L	N/A	2022/06/21		8048524
Inorganics								
Conductivity	-	16	1.0	uS/cm	N/A	2022/06/21	NGI	8064561
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2022/06/17	SUR	8058222
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/06/17	SUR	8058222
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2022/06/17	SUR	8058222
Total Alkalinity (Total as CaCO3)	-	7.4	2.0	mg/L	N/A	2022/06/21	NGI	8064567
Colour	-	31	5.0	TCU	N/A	2022/06/21	MCN	8064431
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/06/21	NGI	8064568
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/06/20	2022/06/21	MJ1	8064190
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2022/06/21	MCN	8064436
Nitrite (N)	-	0.012	0.010	mg/L	N/A	2022/06/21	MCN	8064438
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/06/20	MCN	8062357
Dissolved Organic Carbon (C)	-	4.4	0.50	mg/L	N/A	2022/06/26	JHH	8073391
Total Organic Carbon (C)	-	4.4	0.50	mg/L	N/A	2022/06/25	JHH	8073390
pH	-	6.95		pH	N/A	2022/06/21	NGI	8064565
Total Phosphorus	-	0.049	0.004	mg/L	2022/06/22	2022/06/24	SSV	8065190
Total Suspended Solids	-	17	1.0	mg/L	2022/06/13	2022/06/15	A1M	8049123
Turbidity	-	2.5	0.10	NTU	N/A	2022/06/21	NGI	8064653
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/06/20	2022/06/21	EPU	8062383
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.14	0.0050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Barium (Ba)	-	0.0081	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Boron (B)	-	ND	0.050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Calcium (Ca)	-	2.0	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Copper (Cu)	-	0.00075	0.00050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Iron (Fe)	-	0.30	0.050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Magnesium (Mg)	-	0.67	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Manganese (Mn)	-	0.017	0.0020	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/06/20	2022/06/21	JHY	8062905

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Bureau Veritas Job #: C2G1158
Report Date: 2022/06/27

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SWM541 CR BELOW MR Sampling Date 2022/06/06 13:15 Matrix W Sample # 2022-6302-00-SI-SP Registration # WS-S-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Potassium (K)	-	0.33	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Sodium (Na)	-	0.53	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Strontium (Sr)	-	0.010	0.0020	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Uranium (U)	-	ND	0.00010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/06/20	2022/06/21	JHY	8062905

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Bureau Veritas Job #: C2E8469
Report Date: 2022/06/09

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
STS351 CR BELOW MF								
Sampling Date 2022/05/26 11:30								
Matrix W								
Sample # 2022-6300-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	7.6	1.0	mg/L	N/A	2022/06/08		8026313
Nitrate (N)	-	0.051	0.050	mg/L	N/A	2022/06/07		8026316
Total dissolved solids (calc., EC)	-	8.8	1.0	mg/L	N/A	2022/06/09		8026957
Inorganics								
Conductivity	-	16	1.0	uS/cm	N/A	2022/06/08	NGI	8039626
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2022/06/06	LKH	8033343
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/06/06	LKH	8033343
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2022/06/06	LKH	8033343
Total Alkalinity (Total as CaCO3)	-	6.7	2.0	mg/L	N/A	2022/06/08	NGI	8039629
Colour	-	46(1)	10	TCU	N/A	2022/06/07	MCN	8034975
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/06/08	NGI	8039630
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/06/06	2022/06/07	MJ1	8035662
Nitrate + Nitrite (N)	-	0.051	0.050	mg/L	N/A	2022/06/07	MCN	8034979
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/06/07	MCN	8034981
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/06/07	MCN	8036866
Dissolved Organic Carbon (C)	-	5.6	0.50	mg/L	N/A	2022/06/08	SSI	8039676
Total Organic Carbon (C)	-	5.6	0.50	mg/L	N/A	2022/06/09	SSI	8039693
pH	-	6.84		pH	N/A	2022/06/08	NGI	8039628
Total Phosphorus	-	0.011	0.004	mg/L	2022/06/07	2022/06/09	SSV	8037079
Total Suspended Solids	-	6.4	1.0	mg/L	2022/06/02	2022/06/03	A1M	8028887
Turbidity	-	7.1	0.10	NTU	N/A	2022/06/08	NGI	8040089
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/06/07	2022/06/08	EPU	8037202
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.41	0.0050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Barium (Ba)	-	0.010	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Boron (B)	-	ND	0.050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Calcium (Ca)	-	1.9	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Chromium (Cr)	-	0.0011	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Copper (Cu)	-	0.0022	0.00050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Iron (Fe)	-	0.58	0.050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Magnesium (Mg)	-	0.71	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Manganese (Mn)	-	0.017	0.0020	mg/L	2022/06/06	2022/06/07	EPU	8035148

(1) Elevate reporting limit due to sample matrix.

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Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
STS351 CR BELOW MF Sampling Date 2022/05/26 11:30 Matrix W Sample # 2022-6300-00-SI-SP Registration # WS-S-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Potassium (K)	-	0.38	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Sodium (Na)	-	0.58	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Strontium (Sr)	-	0.011	0.0020	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Uranium (U)	-	ND	0.00010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Zinc (Zn)	-	0.0059	0.0050	mg/L	2022/06/06	2022/06/07	EPU	8035148

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Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
STS352 CR @ EP								
Sampling Date 2022/05/26 12:45								
Matrix W								
Sample # 2022-6301-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	11	1.0	mg/L	N/A	2022/06/08		8026313
Nitrate (N)	-	0.070	0.050	mg/L	N/A	2022/06/07		8026316
Total dissolved solids (calc., EC)	-	24	1.0	mg/L	N/A	2022/06/09		8026957
Inorganics								
Conductivity	-	43	1.0	uS/cm	N/A	2022/06/08	NGI	8039626
Chloride (Cl-)	-	6.1	1.0	mg/L	N/A	2022/06/06	LKH	8033343
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/06/06	LKH	8033343
Sulphate (SO4)	-	1.1	1.0	mg/L	N/A	2022/06/06	LKH	8033343
Total Alkalinity (Total as CaCO3)	-	8.4	2.0	mg/L	N/A	2022/06/08	NGI	8039629
Colour	-	82	25	TCU	N/A	2022/06/07	MCN	8034975
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/06/08	NGI	8039630
Total Kjeldahl Nitrogen (TKN)	-	0.10	0.10	mg/L	2022/06/06	2022/06/07	MJ1	8035662
Nitrate + Nitrite (N)	-	0.070	0.050	mg/L	N/A	2022/06/07	MCN	8034979
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/06/07	MCN	8034981
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/06/07	MCN	8036866
Dissolved Organic Carbon (C)	-	7.4	0.50	mg/L	N/A	2022/06/08	SSI	8039676
Total Organic Carbon (C)	-	7.5	0.50	mg/L	N/A	2022/06/09	SSI	8039693
pH	-	6.73		pH	N/A	2022/06/08	NGI	8039628
Total Phosphorus	-	0.036	0.004	mg/L	2022/06/07	2022/06/09	SSV	8037079
Total Suspended Solids	-	13	1.0	mg/L	2022/06/02	2022/06/03	A1M	8028887
Turbidity	-	18	0.10	NTU	N/A	2022/06/08	NGI	8040089
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/06/07	2022/06/08	EPU	8037202
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.38	0.0050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Barium (Ba)	-	0.012	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Boron (B)	-	ND	0.050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Calcium (Ca)	-	2.2	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Chromium (Cr)	-	0.0012	0.0010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Copper (Cu)	-	0.0013	0.00050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Iron (Fe)	-	1.1	0.050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Magnesium (Mg)	-	1.2	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Manganese (Mn)	-	0.11	0.0020	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/06/06	2022/06/07	EPU	8035148

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Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
STS352 CR @ EP Sampling Date 2022/05/26 12:45 Matrix W Sample # 2022-6301-00-SI-SP Registration # WS-S-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Potassium (K)	-	0.64	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Sodium (Na)	-	4.6	0.10	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Strontium (Sr)	-	0.018	0.0020	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Uranium (U)	-	ND	0.00010	mg/L	2022/06/06	2022/06/07	EPU	8035148
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/06/06	2022/06/07	EPU	8035148

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Bureau Veritas Job #: C2H1143
Report Date: 2022/07/08

NL Department of Environment, Climate Change and Municipalities
Client Project #: INORGANICS AND TSS
Your P.O. #: 220028978-6

Sample Details/Parameters	MAC	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SYP535 2022-6308-00-SI-SP								
Sampling Date 2022/06/15 09:55								
Matrix W								
Sample # 2022-6308-00-SI-SP								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	8.4	1.0	mg/L	N/A	2022/06/28		8065438
Nitrate (N)	**10**	ND	0.050	mg/L	N/A	2022/06/27		8065160
Total dissolved solids (calc., EC)	-	17	1.0	mg/L	N/A	2022/06/27		8065631
Inorganics								
Conductivity	-	30	1.0	uS/cm	N/A	2022/06/26	KMC	8075544
Chloride (Cl-)	-	3.7	1.0	mg/L	N/A	2022/06/24	LKH	8072234
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/06/24	LKH	8072234
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2022/06/24	LKH	8072234
Total Alkalinity (Total as CaCO3)	-	6.1	2.0	mg/L	N/A	2022/06/26	KMC	8075545
Colour	-	91	25	TCU	N/A	2022/06/27	MCN	8075307
Dissolved Fluoride (F-)	**1.5**	ND	0.10	mg/L	N/A	2022/06/26	KMC	8075547
Total Kjeldahl Nitrogen (TKN)	-	0.12	0.10	mg/L	2022/06/24	2022/06/27	RTY	8074128
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2022/06/27	MCN	8075308
Nitrite (N)	**1**	ND	0.010	mg/L	N/A	2022/06/27	MCN	8075309
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/06/27	MCN	8076172
Dissolved Organic Carbon (C)	-	6.5	0.50	mg/L	N/A	2022/07/07	JHH	8094997
Total Organic Carbon (C)	-	6.8	0.50	mg/L	N/A	2022/07/06	JHH	8090609
pH		6.72		pH	N/A	2022/06/26	KMC	8075541
Total Phosphorus	-	0.028	0.004	mg/L	2022/06/27	2022/06/27	SSV	8076244
Total Suspended Solids	-	14	1.0	mg/L	2022/06/22	2022/06/24	RMK	8067101
Turbidity	-	21	0.10	NTU	N/A	2022/06/26	KMC	8073910

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Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminum guideline value of 0.1 mg/L is for treatment plants using aluminum-based coagulants, 0.2mg/L applies to other types of treatment systems.

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Sample Details/Parameters	MAC	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SYP535 2022-6308-00-SI-SP								
Sampling Date 2022/06/15 09:55								
Matrix W								
Sample # 2022-6308-00-SI-SP								
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	**0.001**	ND	0.000013	mg/L	2022/06/23	2022/06/23	EPU	8068017
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	**2.9**	0.78	0.0050	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Antimony (Sb)	**0.006**	ND	0.0010	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Arsenic (As)	**0.010**	ND	0.0010	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Barium (Ba)	**2.0**	0.014	0.0010	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Boron (B)	**5**	ND	0.050	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Cadmium (Cd)	**0.007**	ND	0.000010	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Calcium (Ca)	-	1.6	0.10	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Chromium (Cr)	**0.05**	0.0017	0.0010	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Copper (Cu)	**2**	0.0016	0.00050	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Iron (Fe)	-	1.2	0.050	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Lead (Pb)	**0.005**	ND	0.00050	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Magnesium (Mg)	-	1.0	0.10	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Manganese (Mn)	**0.12**	0.039	0.0020	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Potassium (K)	-	0.62	0.10	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Selenium (Se)	**0.05**	ND	0.00050	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Sodium (Na)	-	2.9	0.10	mg/L	2022/06/24	2022/06/27	JHY	8073642

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Matrix W								
Sample # 2022-6308-00-SI-SP								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Strontium (Sr)	**7.0**	0.014	0.0020	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Uranium (U)	**0.02**	ND	0.00010	mg/L	2022/06/24	2022/06/27	JHY	8073642
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/06/24	2022/06/27	JHY	8073642

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