Real-Time Water Quality Deployment Report

Lower Churchill River Network

May 28/June 11 to July 9/16, 2019

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Municipal Affairs & Environment
Water Resources Management Division

Contents

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Real Time Water Quality Monitoring

- Staff members with the Department of Municipal Affairs & Environment 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.
- On May 28, 2019, real-time water quality monitoring instruments were deployed at the Churchill River below Muskrat Falls and Churchill River at English Point stations for a period of 42 days.
- On June 11, 2019, a real-time water quality monitoring instrument was deployed at the Churchill River below Metchin River station for a period of 35 days.
- The station above Grizzle Rapids was not deployed due to inaccessibility. This site consistently experiences heavy ice build-up that does not abate until late spring.
- The station at above Muskrat Falls was not able to be deployed during this deployment period. This station was relocated in October 2016 as it was situated in the flood zone of the Muskrat Falls Reservoir and needed to be moved back to ensure the station did not flood as the reservoir water levels were raised (as was planned in the fall of 2016). However, due to unforeseen issues, water levels were raised and decreased again. As a result, the newly located above Muskrat Falls station is now situated approximately 650 feet from the edge of the reservoir (i.e. at current water levels) making it impractical to install monitoring equipment. Additionally, safety requirements with regards to working in and around the reservoir for the Muskrat Falls project further hindered the ability to deploy the instrument at this station.

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. The 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 dependant, 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 28 through July 16, 2019 are summarized in Table 2.

Table 2: Comparison rankings for Lower Churchill River stations, May 29 to July 10, 2018

Churchill River Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Below Metchin River	June 11, 2019	Deployment	Excellent	Good	Excellent	Excellent	Good
	July 16, 2019	Removal	Fair	Good	Poor	Poor	Excellent
Below Muskrat Falls	May 28, 2019	Deployment	Good	Excellent	Excellent	Fair	Excellent
	July 9, 2019	Removal	Good	Good	Excellent	Excellent	Excellent
English Point	May 28, 2019	Deployment	Good	Excellent	Excellent	Excellent	Excellent
	July 9, 2019	Removal	Excellent	Excellent	Excellent	Excellent	Fair
Above Grizzle Rapids	Not deployed	Deployment	N/A	N/A	N/A	N/A	N/A
	Not deployed	Removal	N/A	N/A	N/A	N/A	N/A
Above Muskrat Falls	Not deployed	Deployment	N/A	N/A	N/A	N/A	N/A
	Not deployed	Removal	N/A	N/A	N/A	N/A	N/A

- **Churchill River below Metchin River**
  - At deployment, all parameters ranked as either 'excellent' or 'good'.
  - At removal, turbidity was 'excellent', pH was 'good', temperature was 'fair', while both conductivity and dissolved oxygen were 'poor'. These observed discrepancies are a result of the water quality instrument no longer being in the water; water levels dropped significantly compared to when the instrument was deployed and upon removal, the instrument was found completely out of the water. Data from the latter part of deployment has been removed.
- **Churchill River below Muskrat Falls**
  - At deployment, pH, conductivity, and turbidity were all 'excellent', temperature was 'good', and dissolved oxygen was 'fair'.
  - At removal, all parameters ranked as either 'excellent' or 'good'.
- **Churchill River at English Point**
  - At deployment, all parameters ranked as either 'excellent' or 'good'.
  - At removal, all parameters were 'excellent' except for turbidity, which was 'fair'.

Data Interpretation

- The following graphs and discussion illustrate water quality related events occurring from May 28 to July 16, 2019 at the Churchill River below Metchin River, Churchill River below Muskrat Falls, and Churchill River at English Point sites.
- With the exception of water quantity data (stage & flow), all data used in the preparation of graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- The above Grizzle Rapids station was inaccessible due to spring ice.
- The above Muskrat Falls station was inaccessible due to having been moved a significant distance from the water (i.e. outside of flood zone) and due to safety concerns associated with working in and around the reservoir.

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

Churchill River below Metchin River

Water Temperature

- Over the start of deployment, water temperature ranged from 6.20°C to 10.90°C, with a median value of 7.90°C (Figure 2). Air temperature data was obtained from the Metchin River near TLH Weather Station.
- Water temperature slowly increased over the course of deployment. This is to be expected as air temperatures also increased through spring and summer (Figure 2).
- Water temperature data was removed from June 23rd onwards because the water quality instrument was out of the water.
- 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.

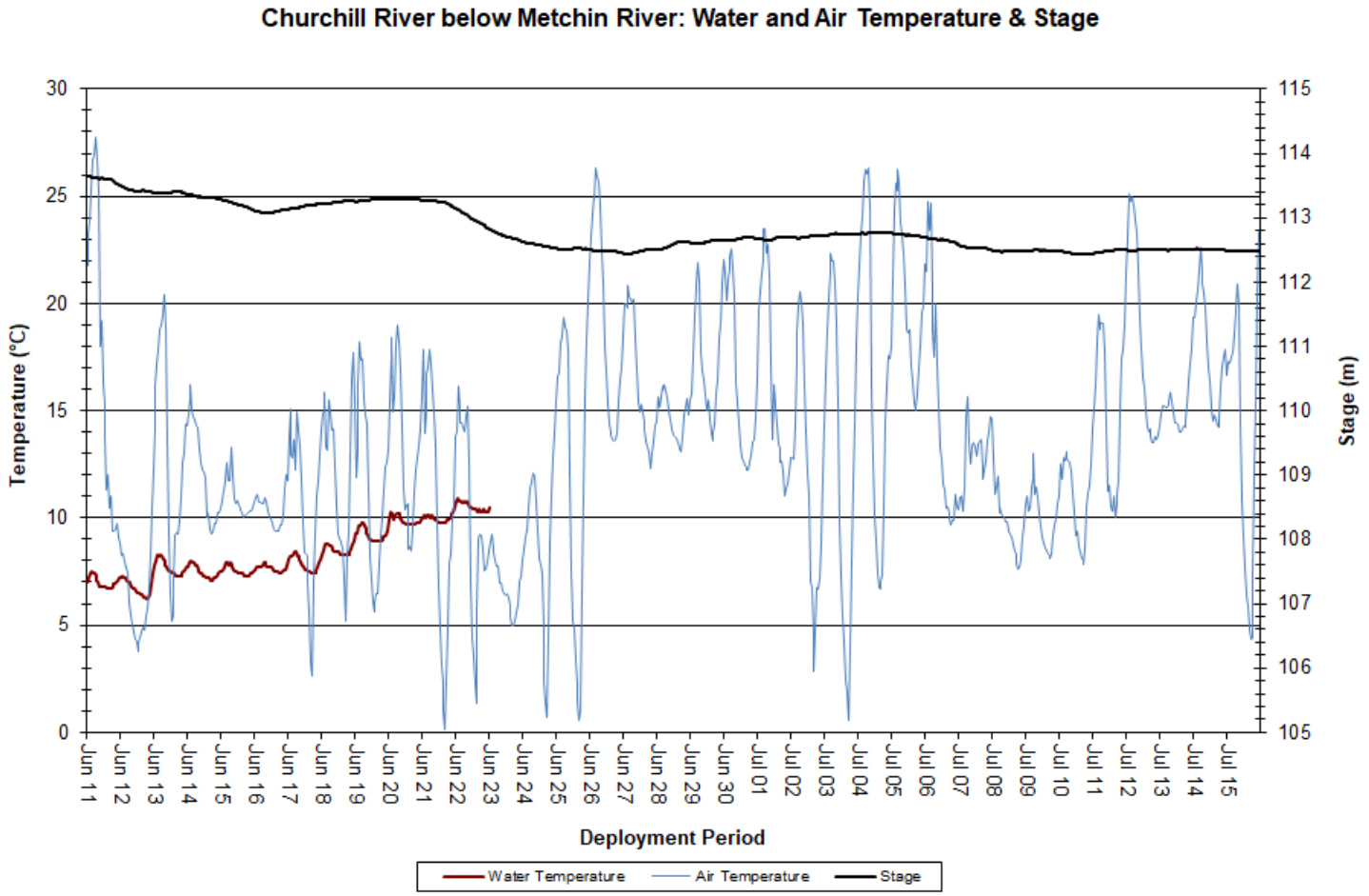

Figure 2: Water and Air Temperature & Stage at Churchill River below Metchin River

pH

- Over the start of deployment, pH values ranged from 5.92 to 6.30 pH units, with a median value of 6.23 (Figure 3).
- pH values were stable but fell below the CCME's Guidelines for the Protection of Aquatic Life.
- pH data was removed from June 23rd onwards because the water quality instrument was out of the water.
- 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.

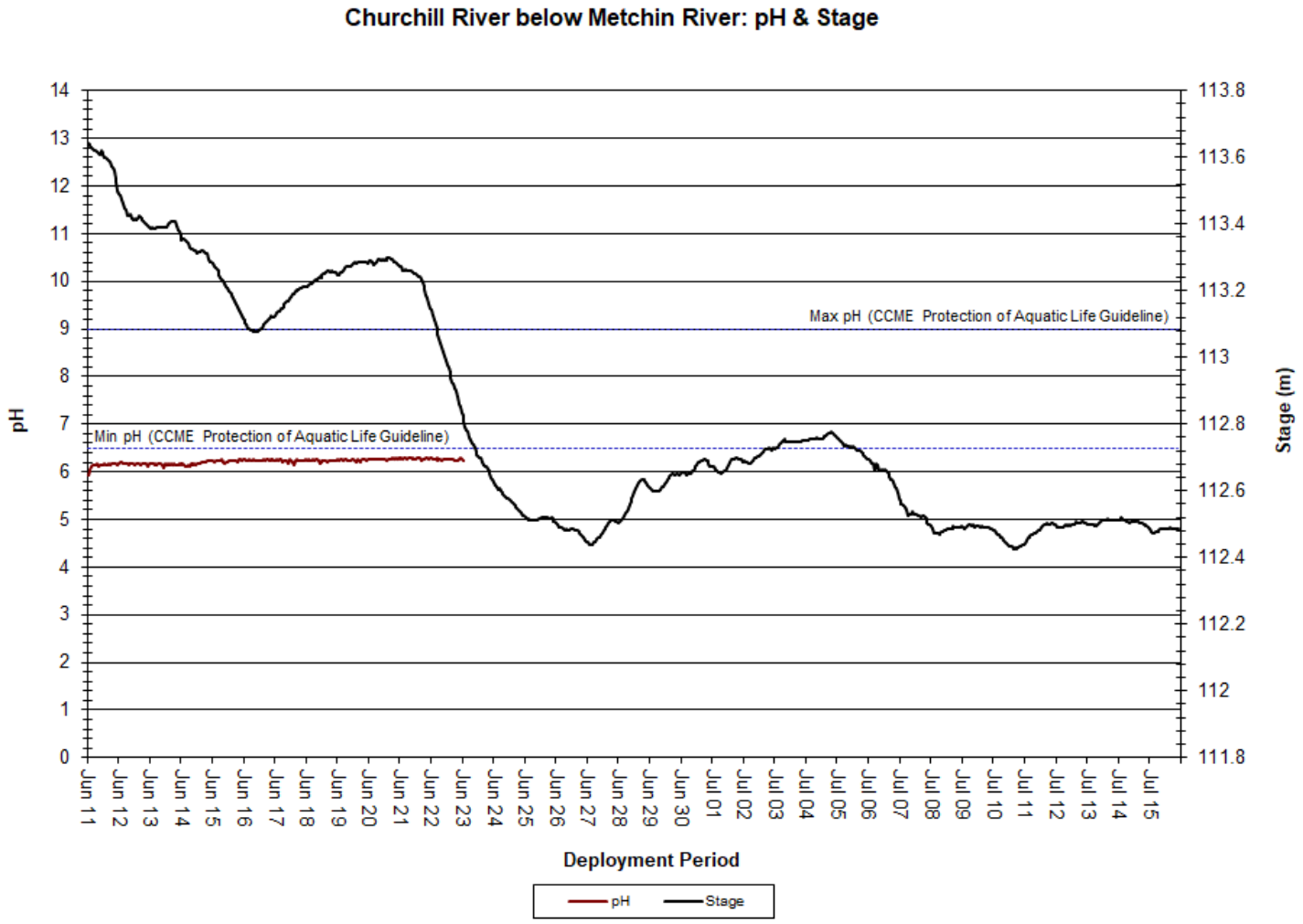

Figure 3: pH & Stage at Churchill River below Metchin River

Specific Conductivity

- Over the start of deployment, specific conductivity ranged from 11.8µS/cm to 14.5µS/cm, with a median value of 12.7µS/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 difficult to observe in the graph below due to limited data.
- Specific conductivity data was removed from June 23rd onwards because the water quality instrument was out of the water.
- 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.

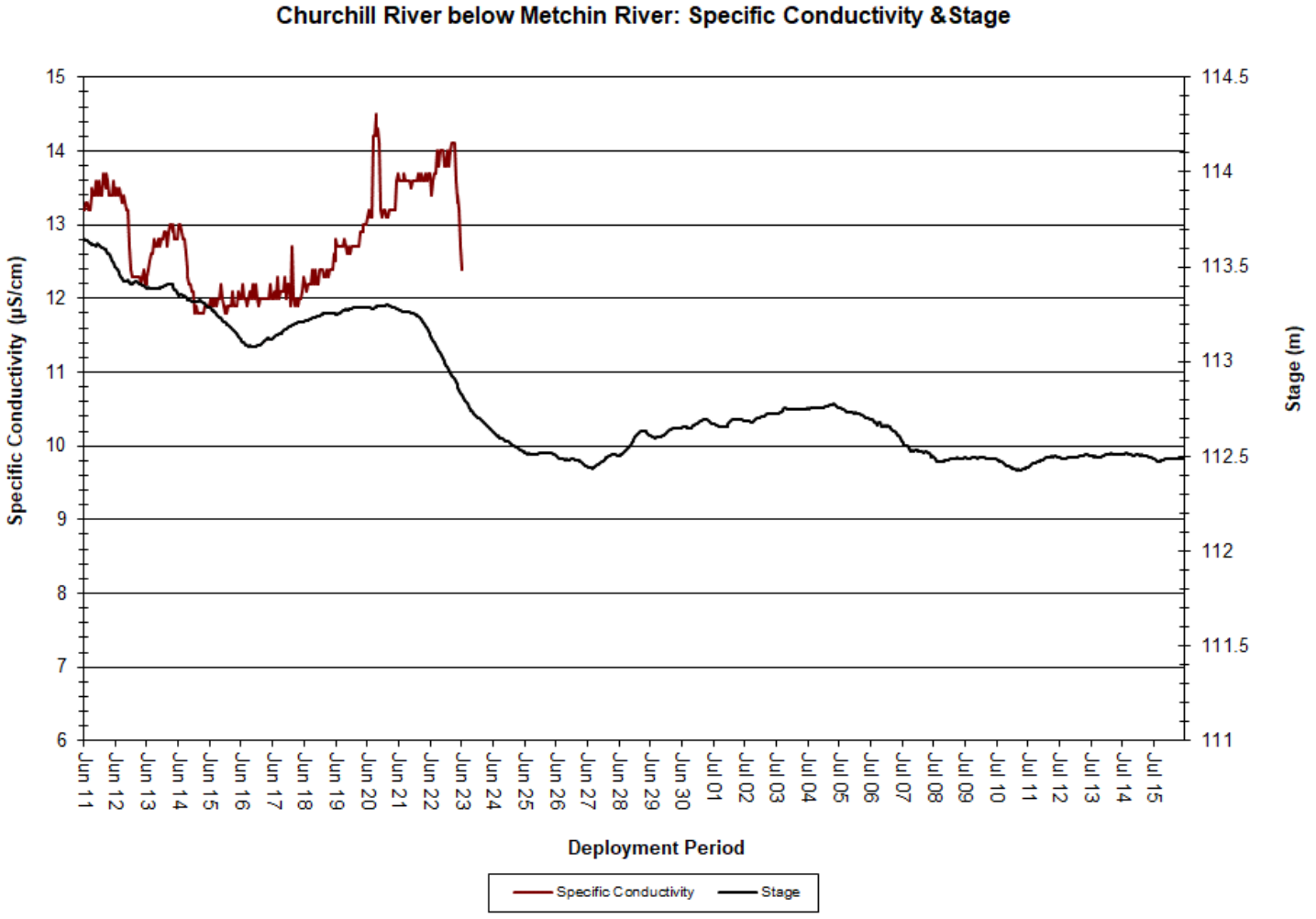

Figure 4: Specific Conductivity & Stage at Churchill River below Metchin River

Dissolved Oxygen

- Over the start of deployment, dissolved oxygen content ranged from 10.09mg/L to 11.85mg/L, with a median value of 11.25mg/L. Saturation of dissolved oxygen ranged from 90.4% to 98.5%, with a median value of 94.9% (Figure 5).
- There is an evident relationship between water temperature and dissolved oxygen. Over the start of deployment, dissolved oxygen levels gradually decreased as water temperatures increased through the spring. 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 were above the CCME's Guidelines for the Protection of Early and Other Life Stages for the start of deployment.
- Dissolved oxygen data was removed from June 23rd onwards because the water quality instrument as out of the water.

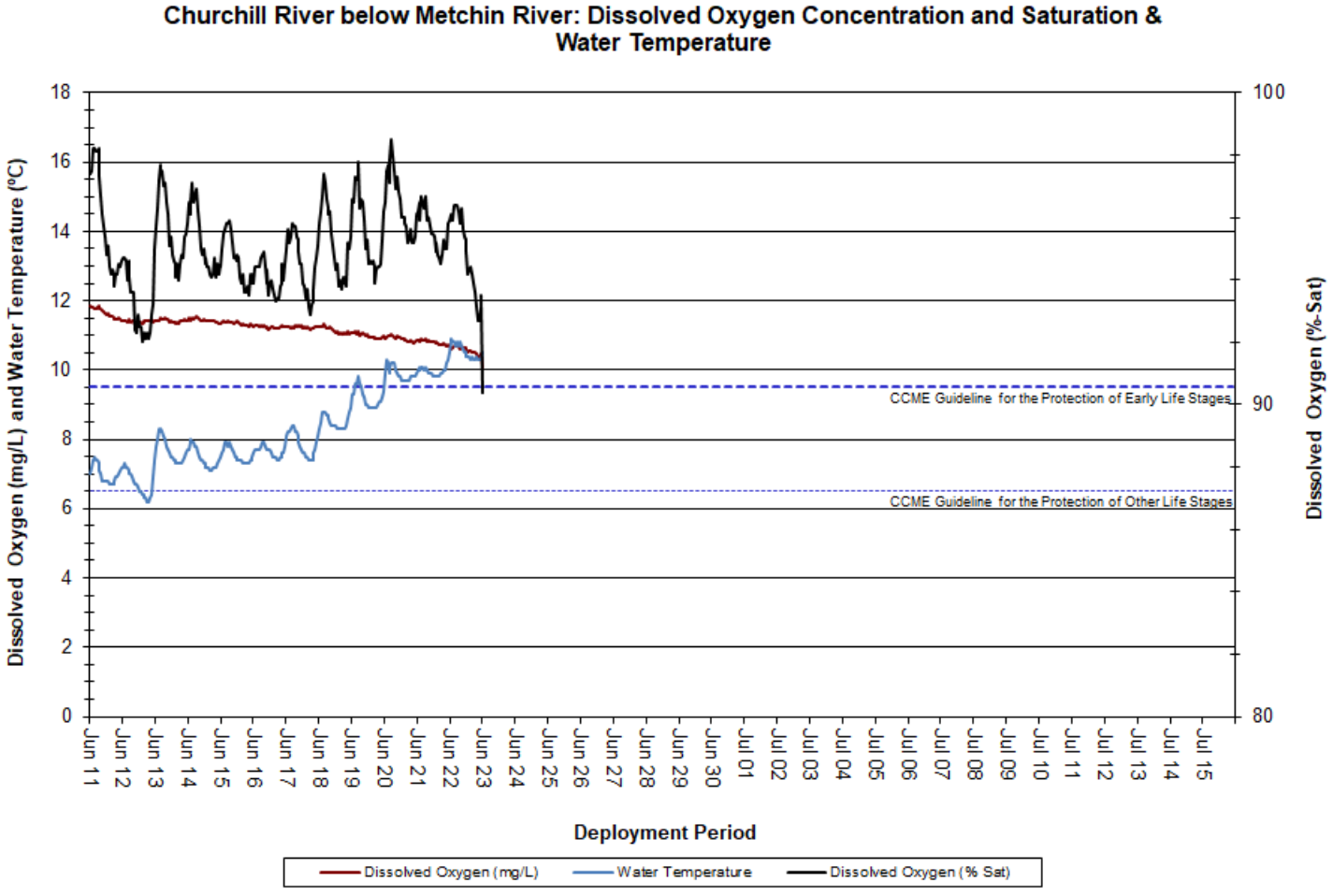

Figure 5: Dissolved Oxygen & Water Temperature at Churchill River below Metchin River

Turbidity

- Over the start of deployment, turbidity ranged from 0.0NTU to 116.2NTU, with a median value of 0.1NTU (Figure 6). A median value of 0.1NTU 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 correlate 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. Turbidity levels returned to background levels following each observed increase.
- Turbidity data was removed from June 23rd onwards because the water quality instrument was out of the water.
- 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.

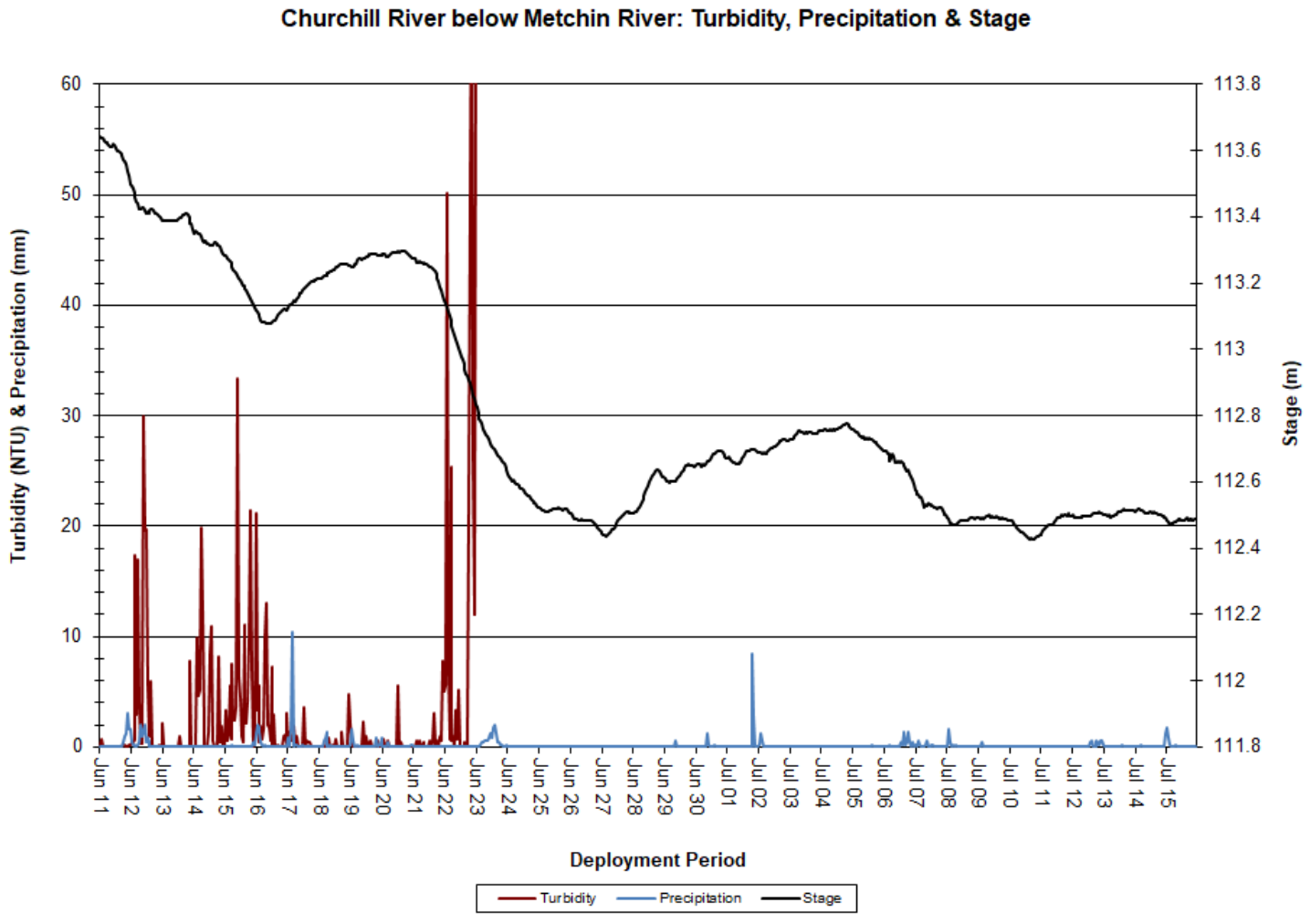

Figure 6: Turbidity, Precipitation & Stage at Churchill River below Metchin River

Stage and Flow

- Over the deployment period, stage levels ranged from 112.43m to 113.64m, with a median value of 112.68m. Flow ranged from 1028.73m^3/s to 1426.99m^3/s, with a median value of 1128.28m^3/s (Figure 7). Precipitation data was obtained from the Metchin River near TLH Weather Station.
- Stage was slightly variable across the deployment period, with flow following a similar trend. Precipitation amounts across the same period are graphed below (Figure 8) to show that precipitation events often correlate with increases in both stage and flow.
- 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.

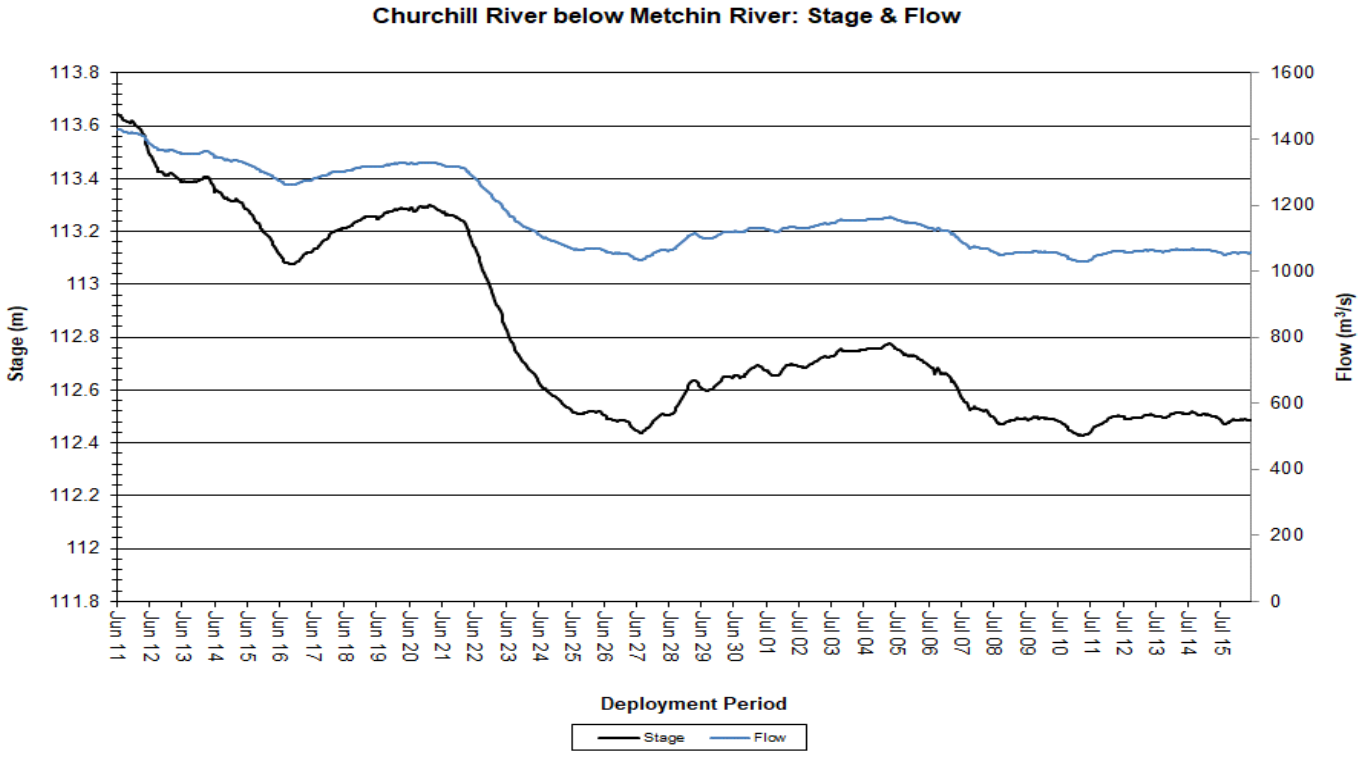

Figure 7: Stage & Flow at Churchill River below Metchin River

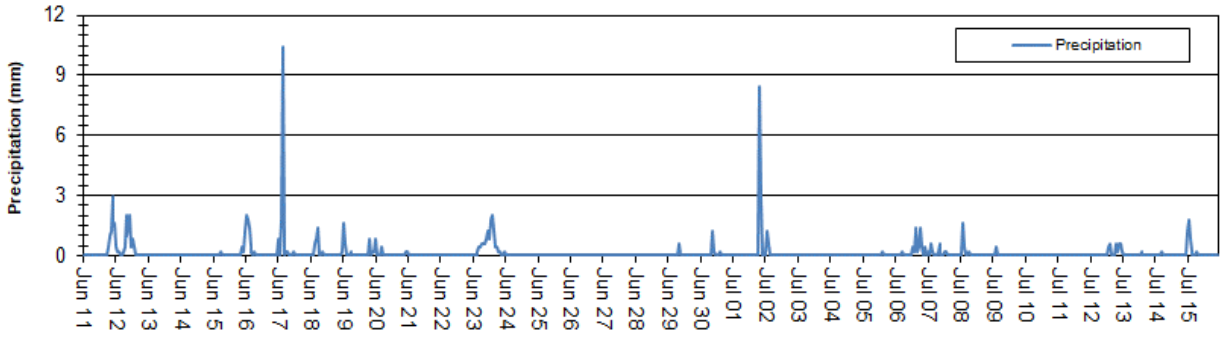

Figure 8: Precipitation at Churchill River below Metchin River

Churchill River below Muskrat Falls

Water Temperature

- Over the deployment period, water temperature ranged from 1.60°C to 12.70°C, with a median value of 4.50°C (Figure 9).
- Water temperature gradually increased over the course of the deployment period. This warming trend is to be expected as air temperatures warmed into the spring and summer months. Air temperature data was obtained from the Muskrat Falls MET Station.
- Water temperature data was removed from June 12th through July 3rd, during which time the water quality instrument was out of the water.
- 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.

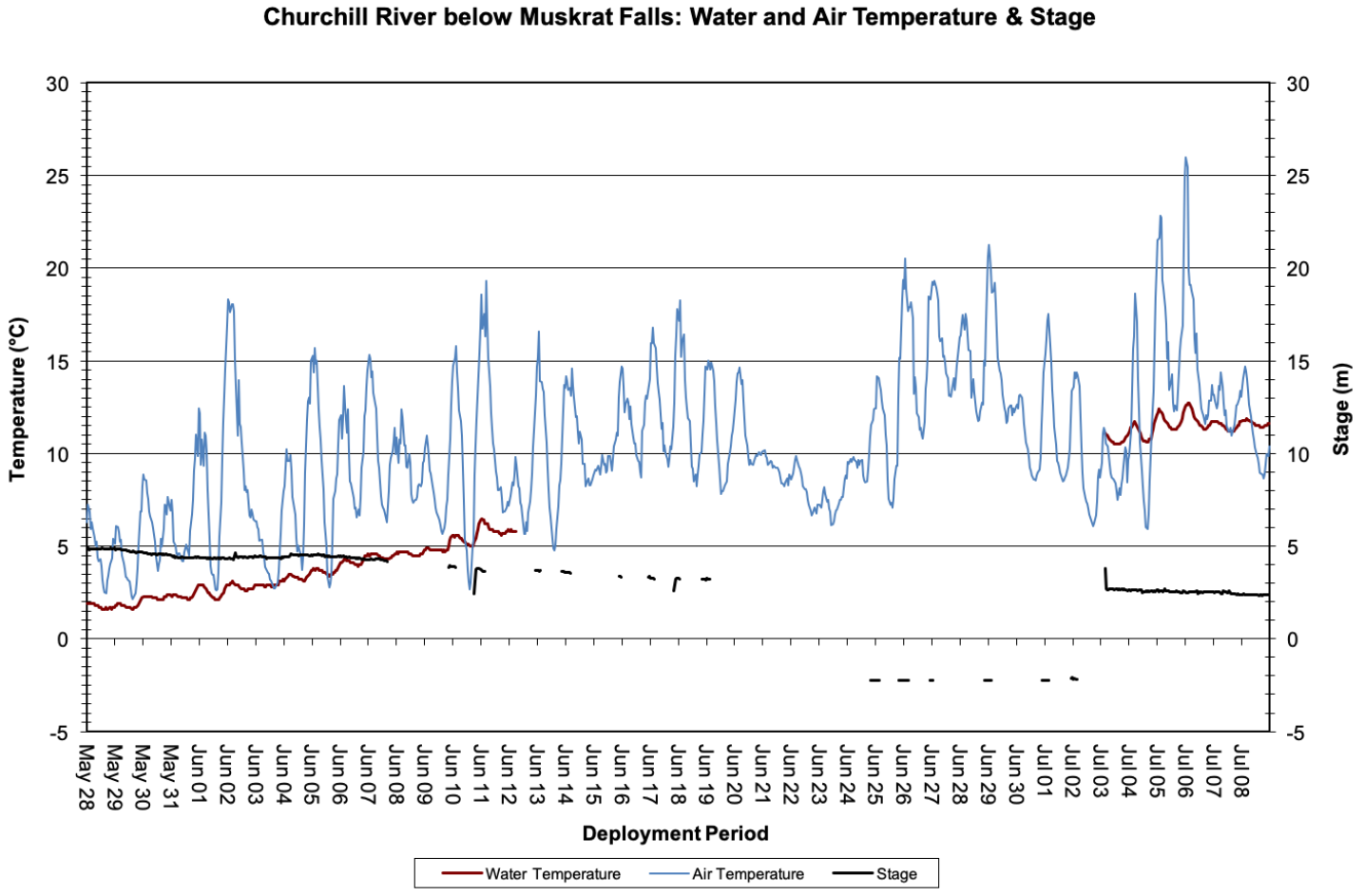

Figure 9: Water and Air Temperature & Stage at Churchill River below Muskrat Falls

pH

- Over the deployment period, pH ranged from 5.98 pH units to 6.37 pH units, with a median value of 6.10 (Figure 10).
- pH values were relatively stable and remained below the CCME's Minimum Guideline for the Protection of Aquatic Life for the period that the instrument was in the water.
- pH data was removed from June 12th through July 3rd, during which time the water quality instrument was out of the water.
- 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.

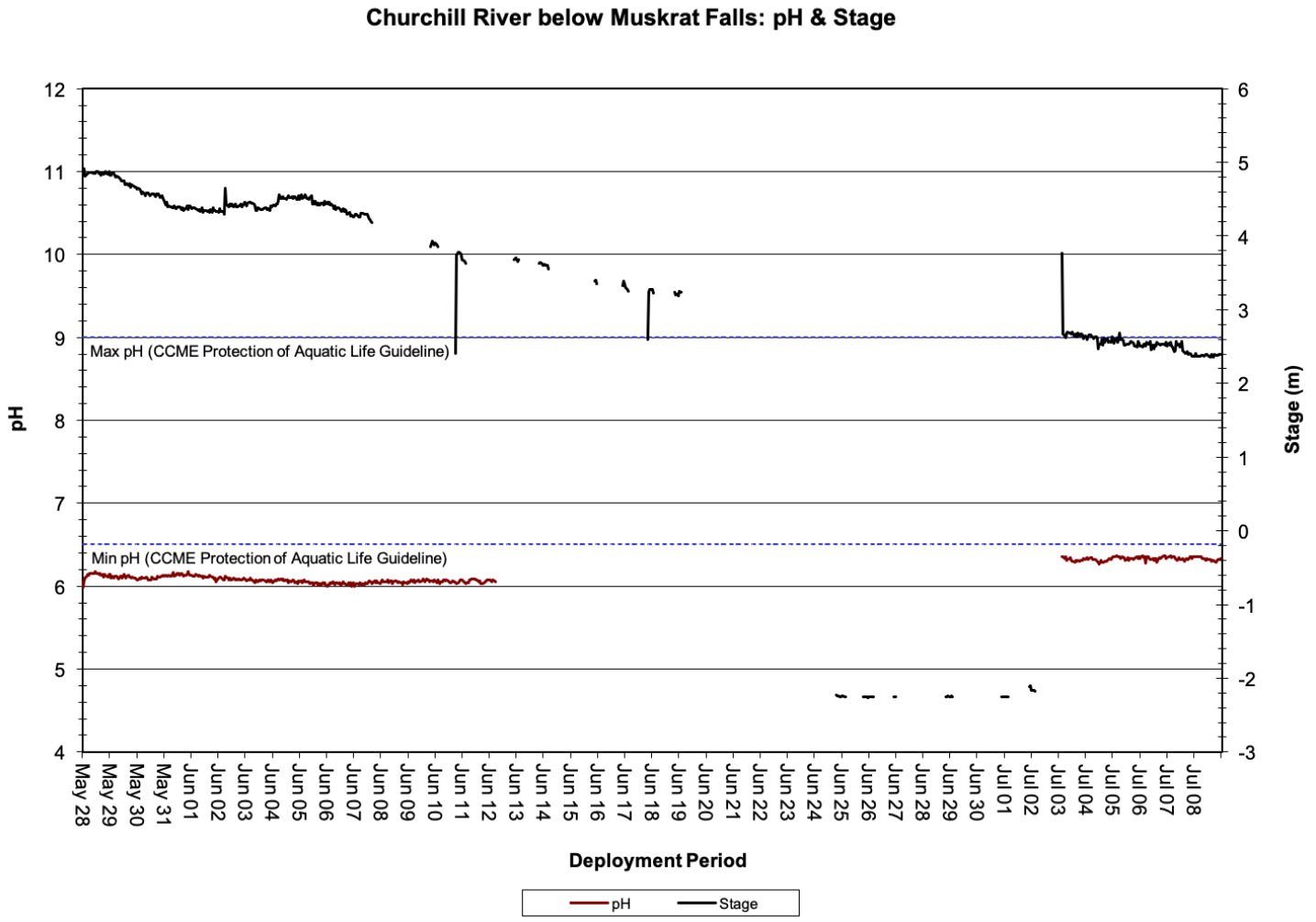

Figure 10: pH & Stage at Churchill River below Muskrat Falls

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 8.3µS/cm to 13.0µS/cm, with a median value of 10.1µS/cm (Figure 11).
- The relationship between conductivity and stage is generally inversed. When stage level rises, specific conductivity levels drop in response as increased amounts of water in the river system dilute solids that are present. This relationship is not as evident in the graph below due to missing data.
- Specific conductivity data was removed from June 12th through July 3rd, during which time the water quality instrument was out of the water.
- 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.

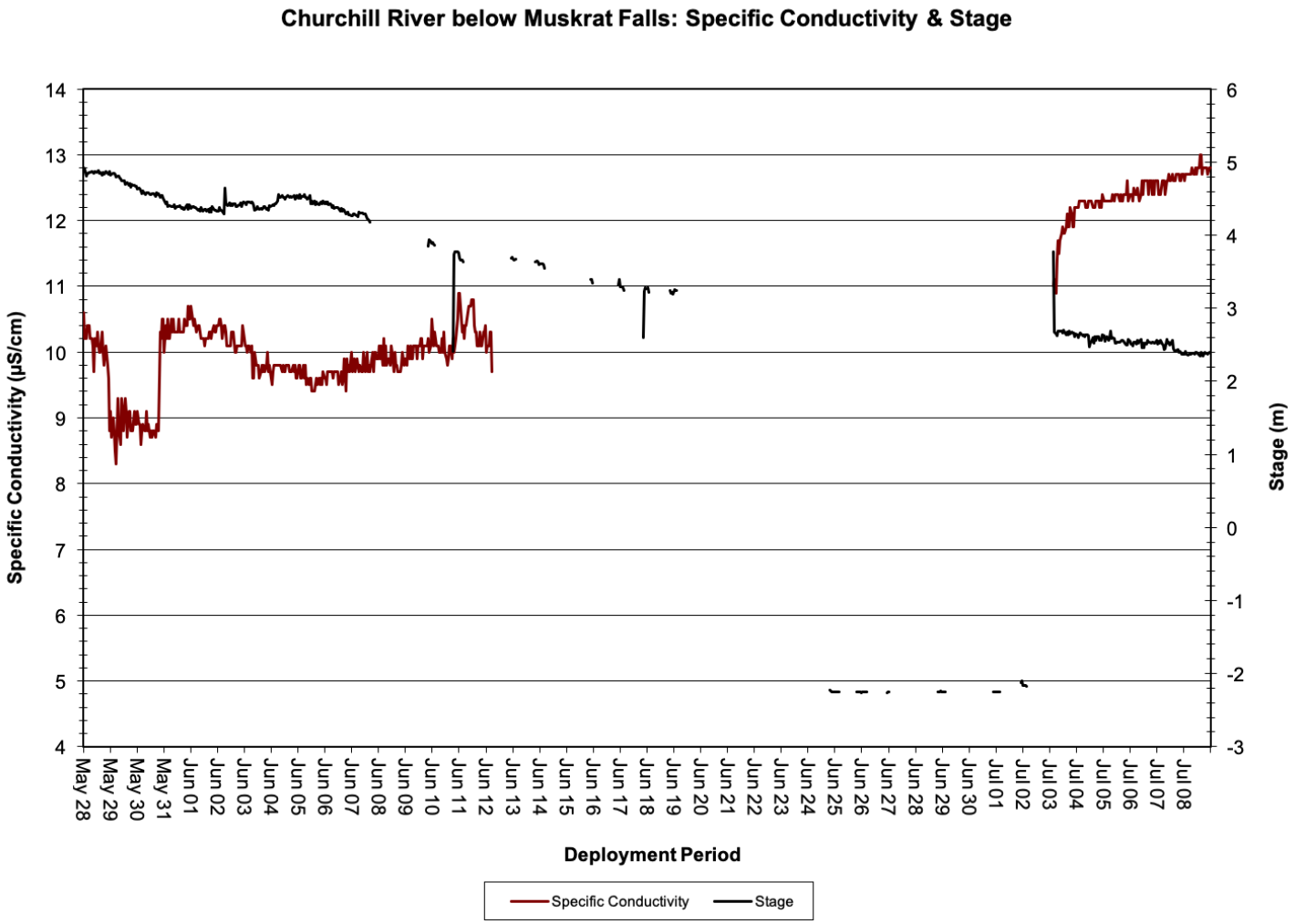

Figure 11: Specific Conductivity & Stage at Churchill River below Muskrat Falls

Dissolved Oxygen

- Over the deployment period, dissolved oxygen content ranged from 11.44mg/L to 16.82mg/L, with a median value of 15.71mg/L. Saturation of dissolved oxygen ranged from 104.5% saturation to 121.0% saturation, with a median value of 118.0% (Figure 12).
- Water temperature and dissolved oxygen generally exhibit an inverse relationship: as one parameter increases, the other decreases. Over the deployment period, dissolved oxygen levels slowly decreased as water temperatures increased through the spring season.
- Dissolved oxygen data was removed from June 12th through July 3rd, during which time the water quality instrument was out of the water.
- Dissolved oxygen levels remained above the CCME's Guidelines for the Protection of Early and Other Life Stages for the period that the instrument was in the water.

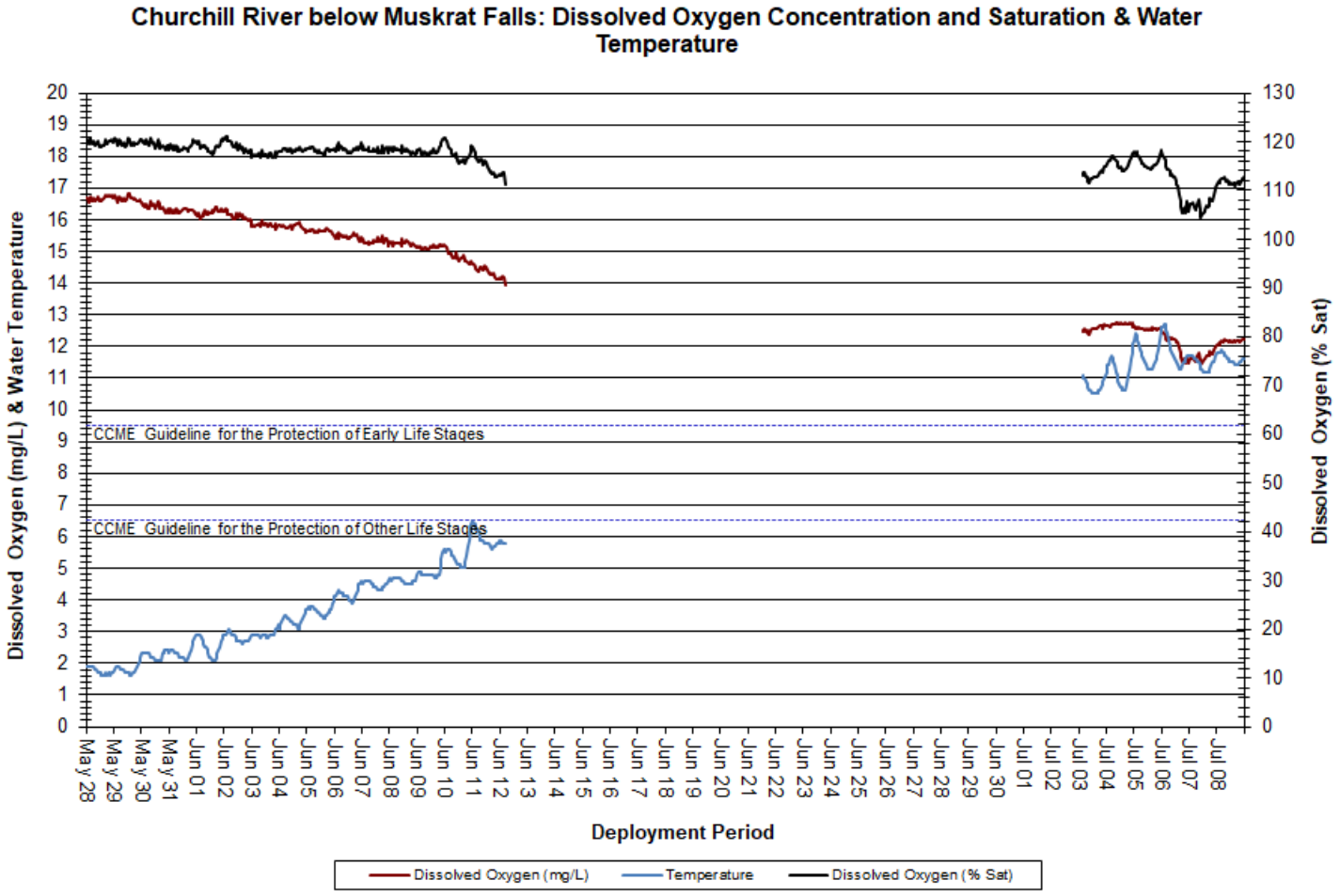

Figure 12: Dissolved Oxygen & Water Temperature at Churchill River below Muskrat Falls

Turbidity

- Over the deployment period, turbidity ranged from 4.6NTU to 26.6NTU, with a median value of 8.5NTU (Figure 13). A median value of 8.5NTU indicates that there was a small level of background turbidity at this station.
- The majority of turbidity events during deployment correlated with precipitation events (Figure 13), as precipitation can increase the presence of suspended material in the water. Turbidity levels at this station can also be increased by high winds, which serve to stir up sediment from the river bed.
- Turbidity data was removed from June 12th through July 3rd, during which time the water quality instrument was out of the water.

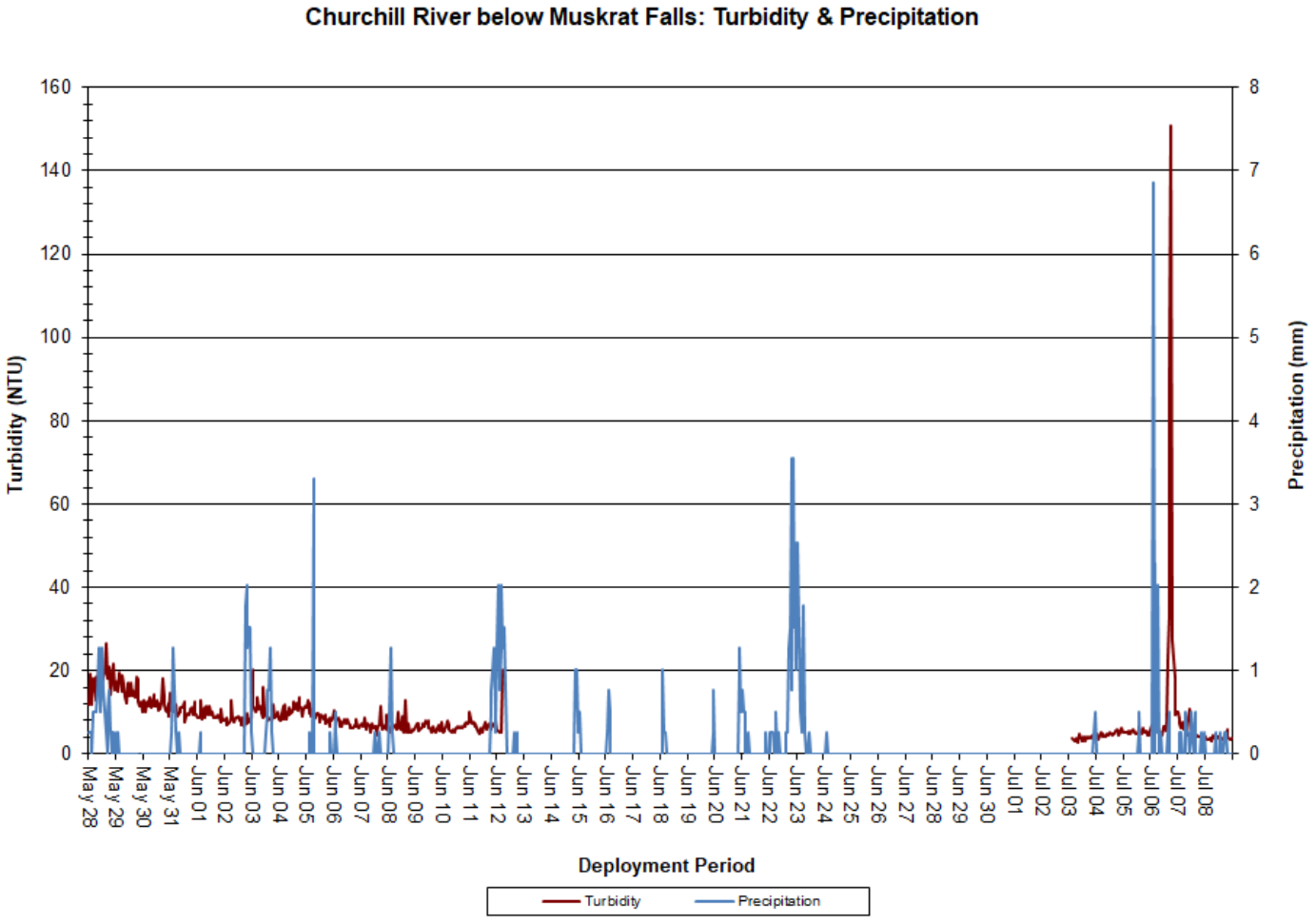

Figure 13: Turbidity & Precipitation at Churchill River below Muskrat Falls

Stage and Precipitation

- Over the deployment period, stage levels ranged from -2.26m to 4.92m, with a median value of 4.27m (Figure 14). Precipitation data was obtained from the Muskrat Falls Weather Station.
- Stage was quite variable across the deployment period. Precipitation events correlated with some increases in stage; however, there were issues with the power supply at this station during the deployment period. Negative stage values are likely inaccurate and therefore not included on this graph.
- 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.

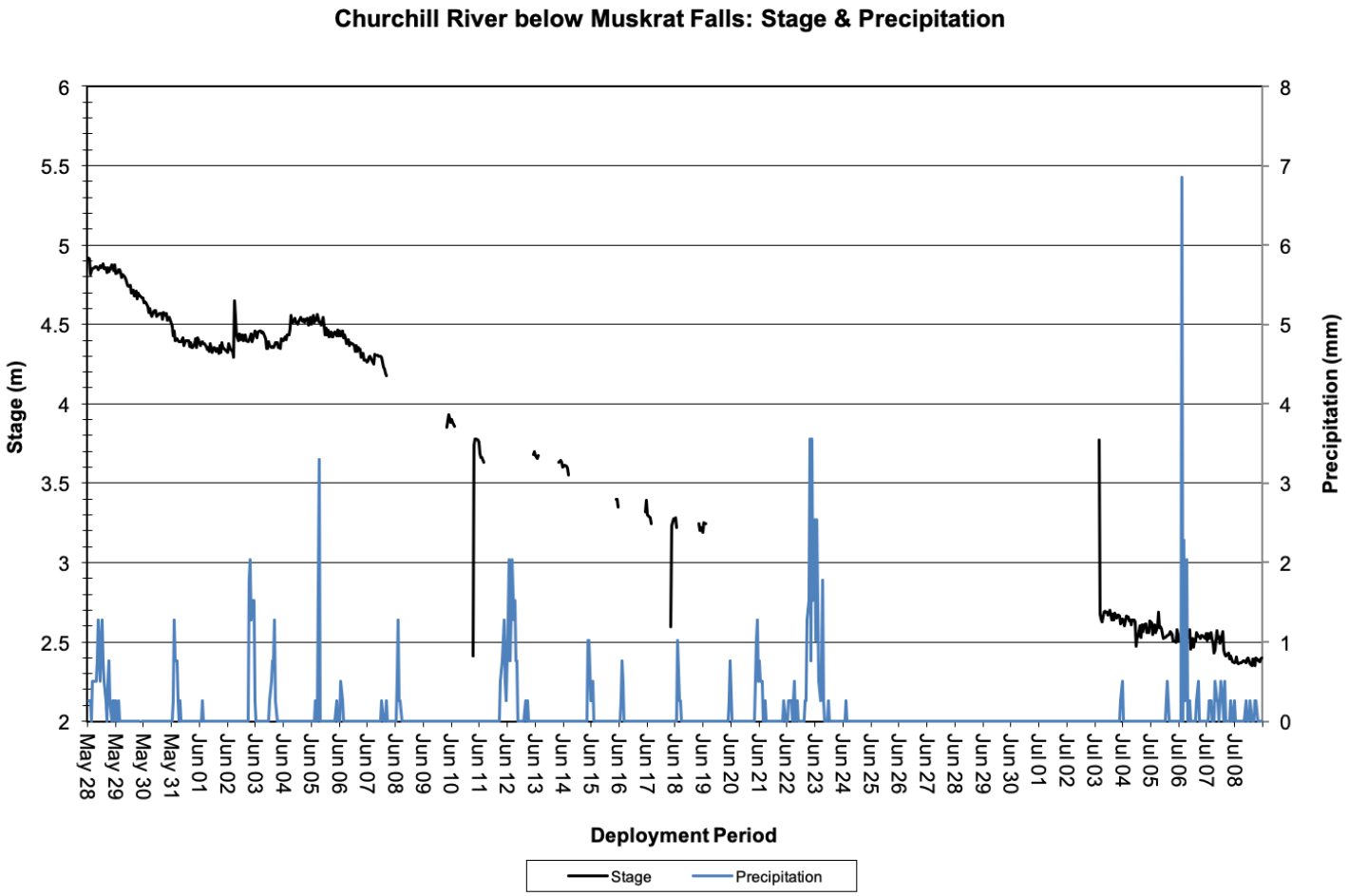

Figure 14: Stage & Precipitation (Muskrat Falls Weather Station) at Churchill River below Muskrat Falls

Chlorophyll

- Over the deployment period, chlorophyll ranged from 1.81ug/L to 4.76ug/L, with a median value of 2.15ug/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.
- Chlorophyll data was removed from June 12th through July 3rd, during which time the water quality instrument was out of the water.
- 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.

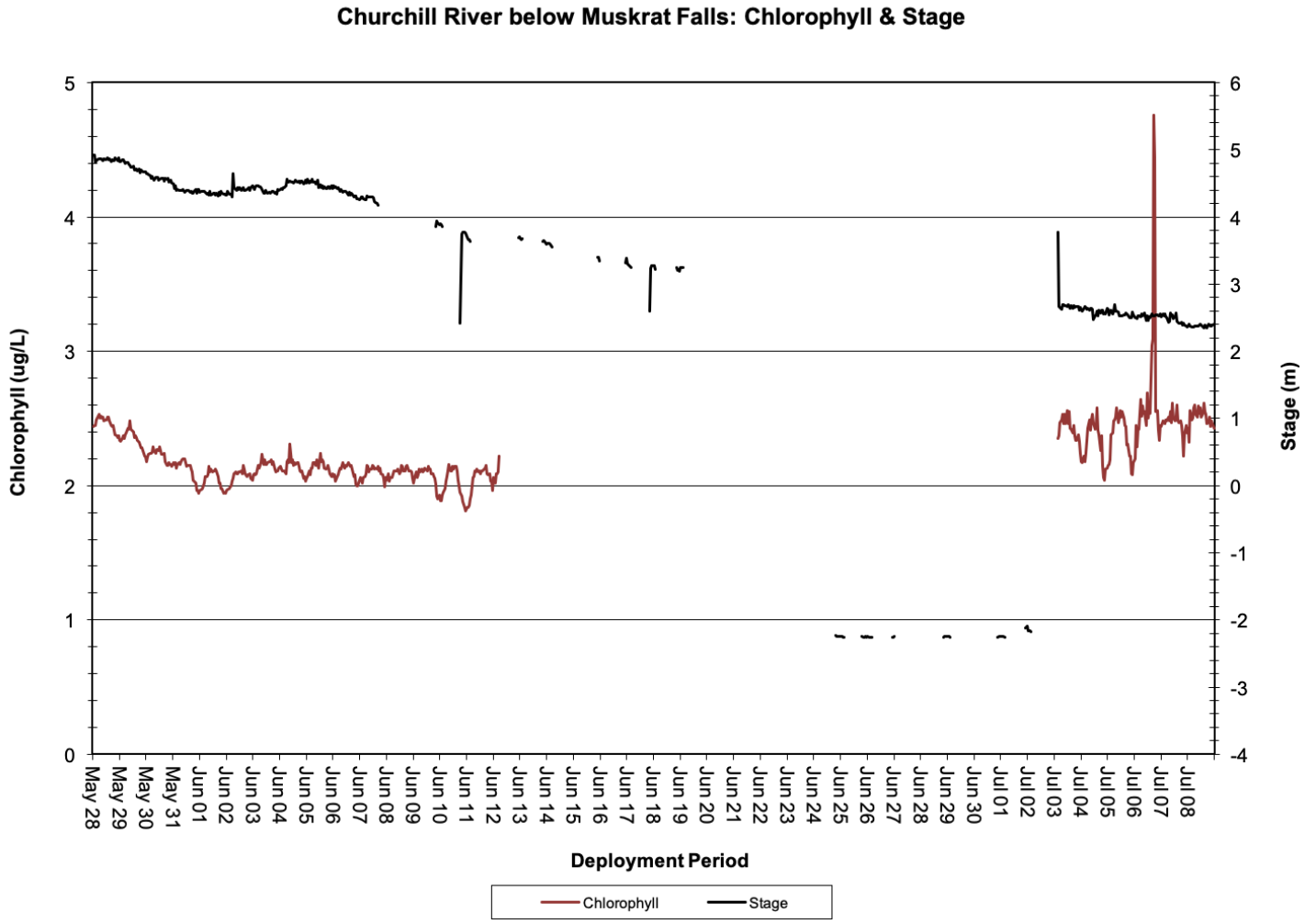

Figure 15: Chlorophyll & Stage at Churchill River below Muskrat Falls

Churchill River at English Point

Water Temperature

- Over the deployment period, water temperature ranged from 2.50°C to 15.10°C, with a median value of 8.15°C (Figure 16). Air temperature data was obtained from the Muskrat Falls Weather Station.
- Water temperature gradually increased over the course of deployment, a trend that is expected as air temperatures also increased into the summer months. Water temperatures closely correlate 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.

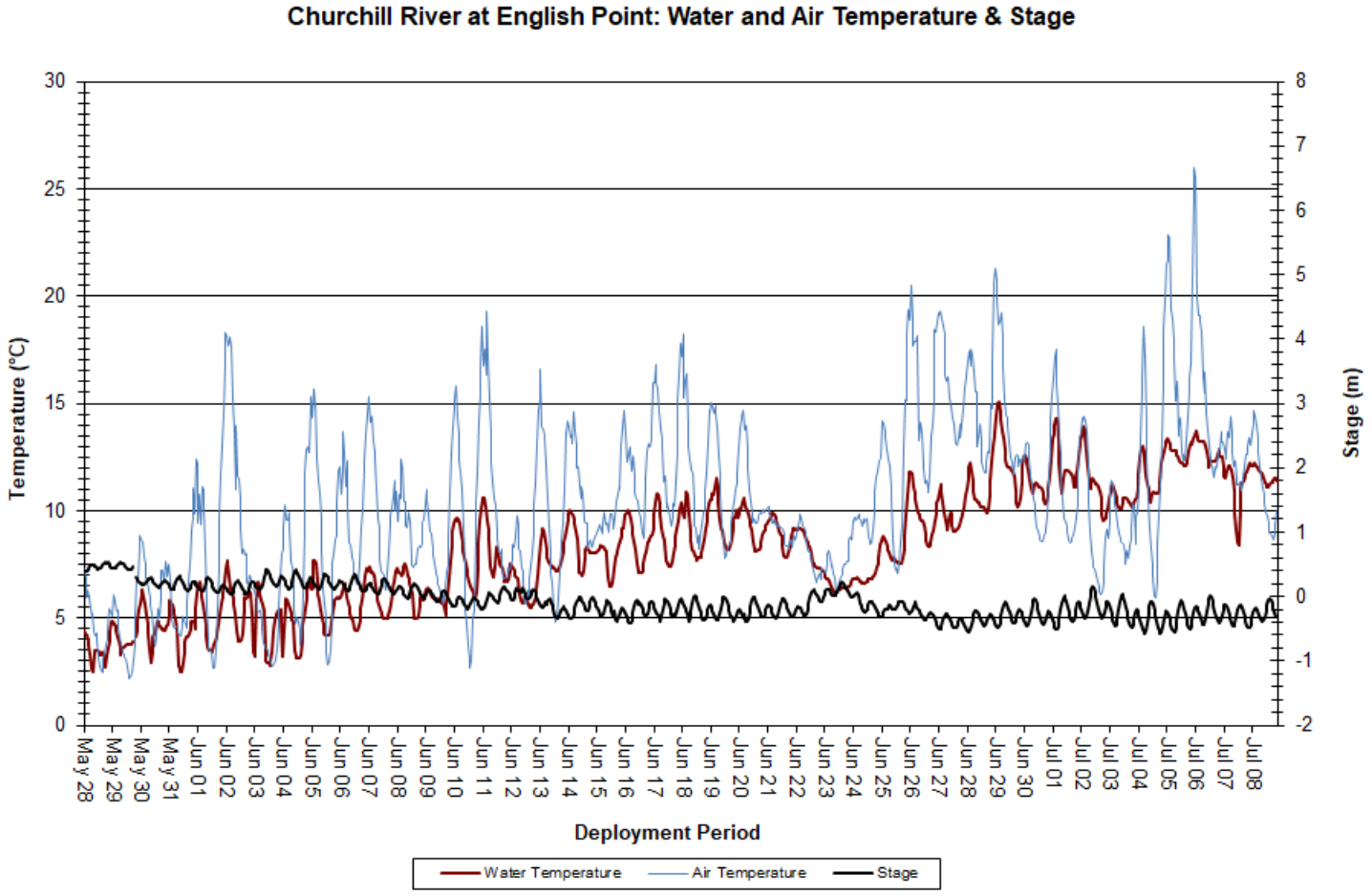

Figure 16: Water and Air Temperature & Stage at Churchill River at English Point

pH

- Over the deployment period, pH ranged from 6.20 pH units to 6.65 pH units, with a median value of 6.46 (Figure 17).
- pH values hovered around the CCME's Minimum Guideline for the Protection of Aquatic Life for the duration of deployment. This may be due to large influxes of freshwater from spring melt.
- 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.

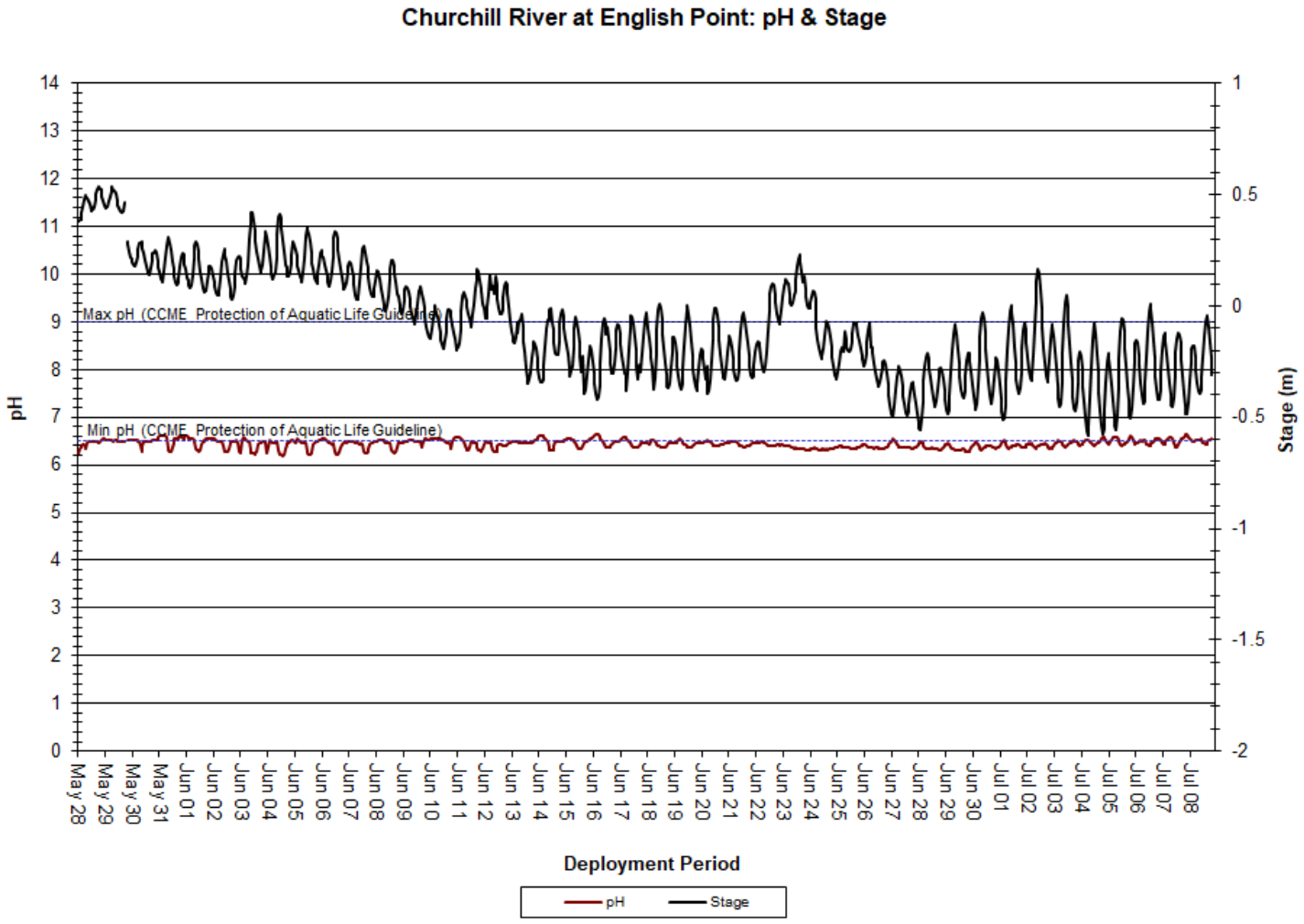

Figure 17: pH & Stage at Churchill River at English Point

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 9.7µS/cm to 44.0µs/cm, with a median value of 27.4µS/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 was 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.

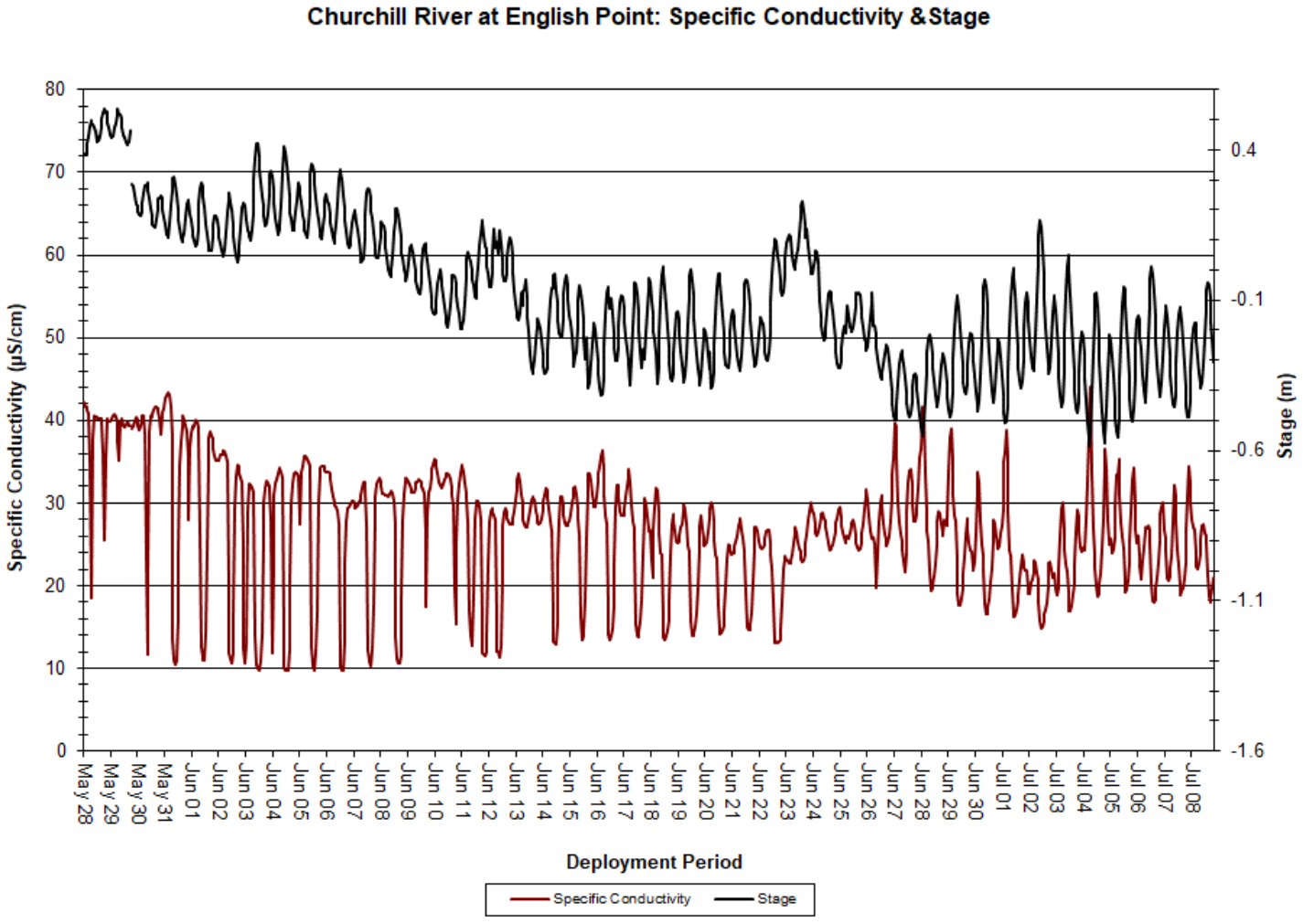

Figure 18: Specific Conductivity & Stage at Churchill River at English Point

Dissolved Oxygen

- Over the deployment period, dissolved oxygen concentration ranged from 10.16mg/L to 14.40mg/L, with a median value of 11.51mg/L. Saturation of dissolved oxygen ranged from 84.1% to 110.60%, with a median value of 98.1% (Figure 19).
- There is an evident relationship between water temperature and dissolved oxygen. As water temperatures increased over the deployment period, dissolved oxygen levels slowly decreased. Dissolved oxygen levels also follow a diurnal pattern as water temperature rises and falls under the influence of ambient air temperature. Generally, dissolved oxygen levels are higher in a waterbody during cooler temperatures.
- Dissolved oxygen levels remained above the CCME's Guideline for the Protection of Early and Other Life Stages for the duration of deployment (Figure 19). This is to be expected considering the cooler water temperatures observed over the deployment period.

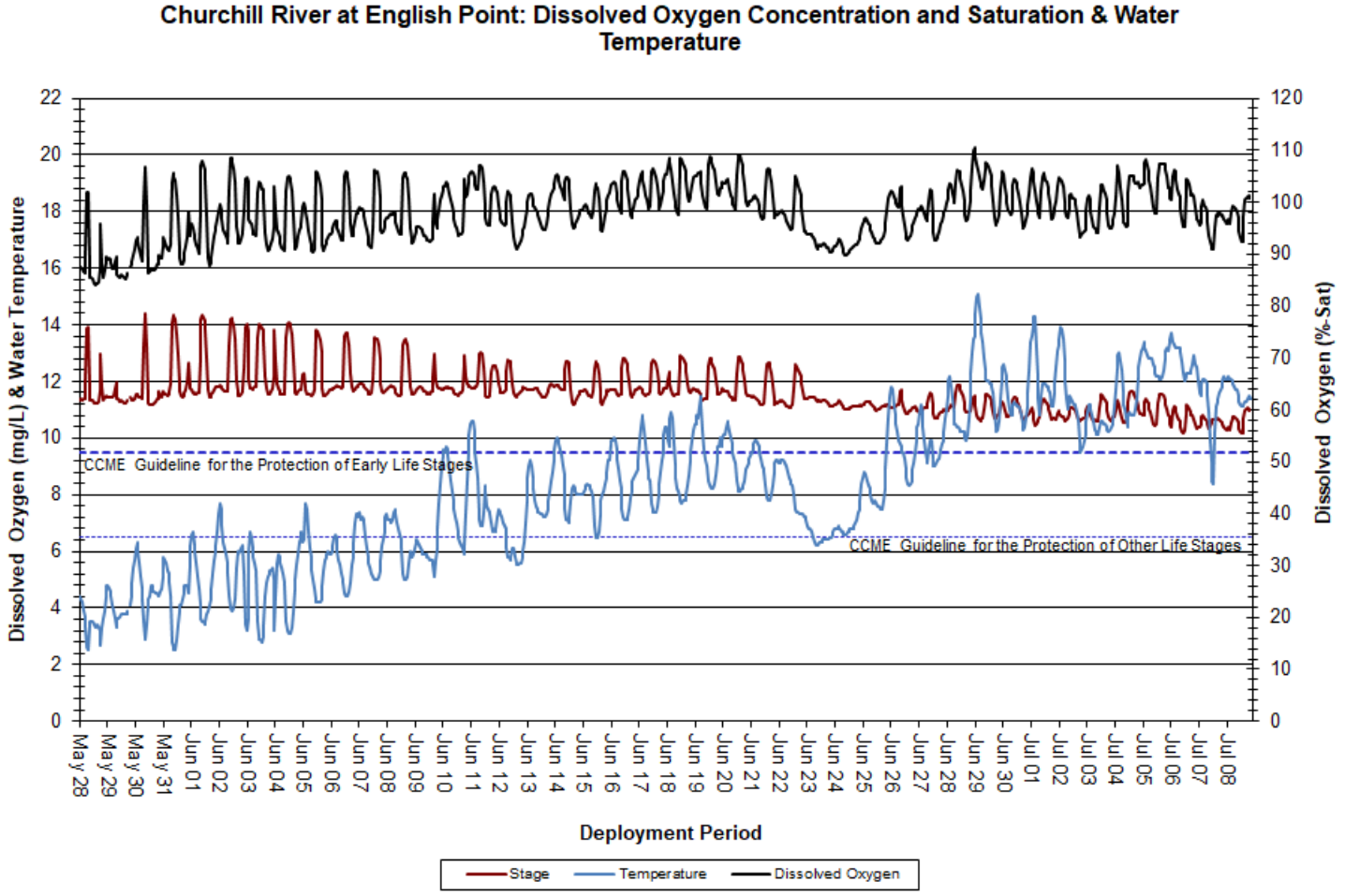

Figure 19: Dissolved Oxygen & Water Temperature at Churchill River at English Point

Turbidity

- Over the deployment period, turbidity ranged from 4.7NTU to 1314.0NTU, with a median value of 15.6NTU (Figure 20).
- A median value of 15.6NTU indicates a significant level of background turbidity; while this is not unusual at this site, there may have been sediment build-up around the field sonde from June 22nd onwards that attributed to higher-than-expected turbidity levels. This is further supported by the observation that after June 22nd, turbidity levels failed to return to baseline levels as they did during the first half of deployment.
- Turbidity events often correlate with precipitation events, as precipitation can increase the presence of suspended material in the water column. High winds and tidal influences can also increase turbidity levels at this station by stirring up sediment from the river bed (Figure 20). Wind speed data was obtained from the Churchill River at End of Mud Lake Road weather station.

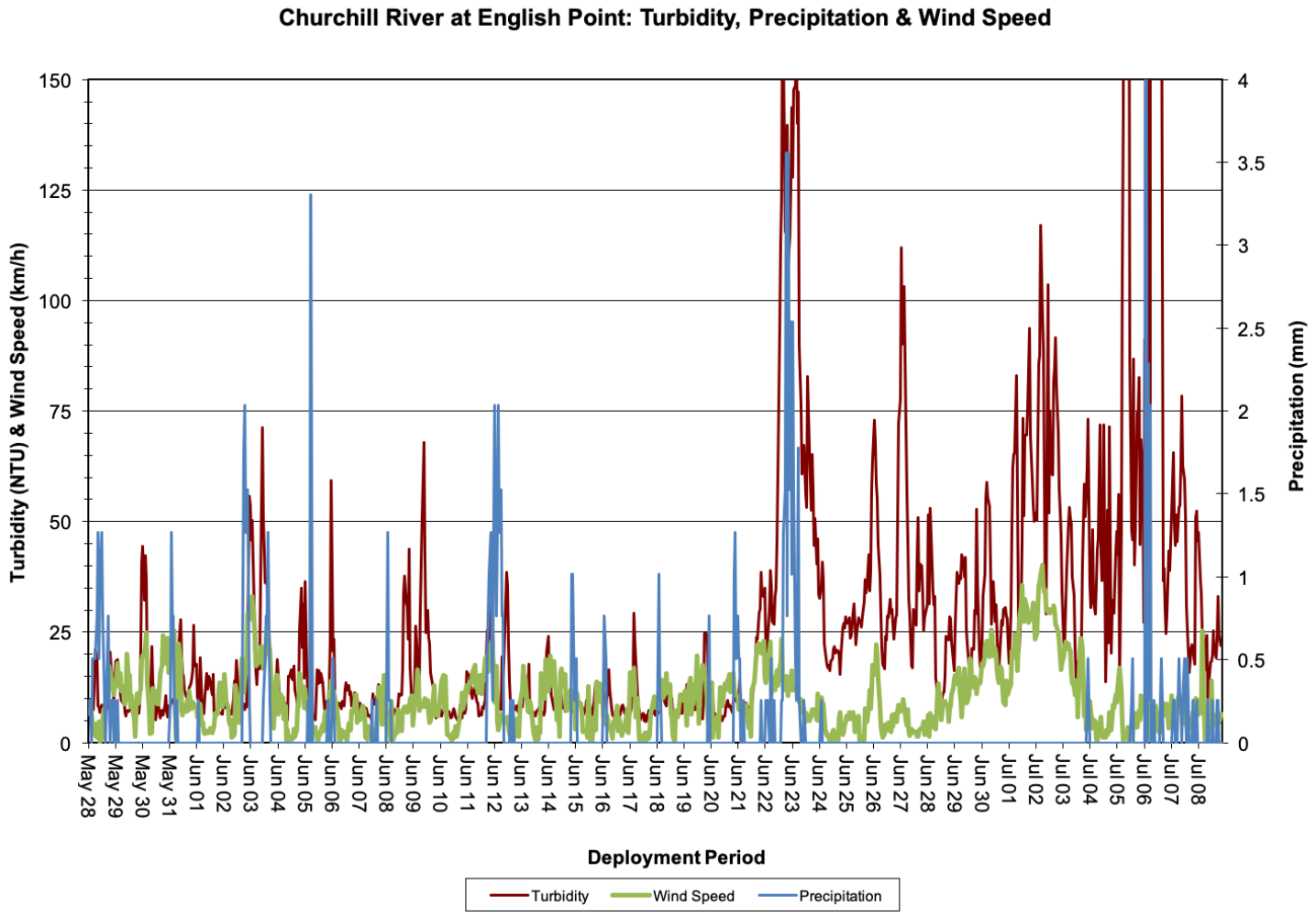

Figure 20: Turbidity, Precipitation & Wind Speed at Churchill River at English Point

Stage

- Over the deployment period, stage ranged from -0.59m to 0.54m, with a median value of -0.10m (Figure 21). Precipitation data was obtained from the Muskrat Falls Weather Station.
- Stage fluctuates at this location due to the tidal influences of the Atlantic Ocean. As such, precipitation events are less easily correlated with increases in stage; however, the relationship between the two still exists and is evident in the graph below, particularly on June 22nd (Figure 21).
- 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.

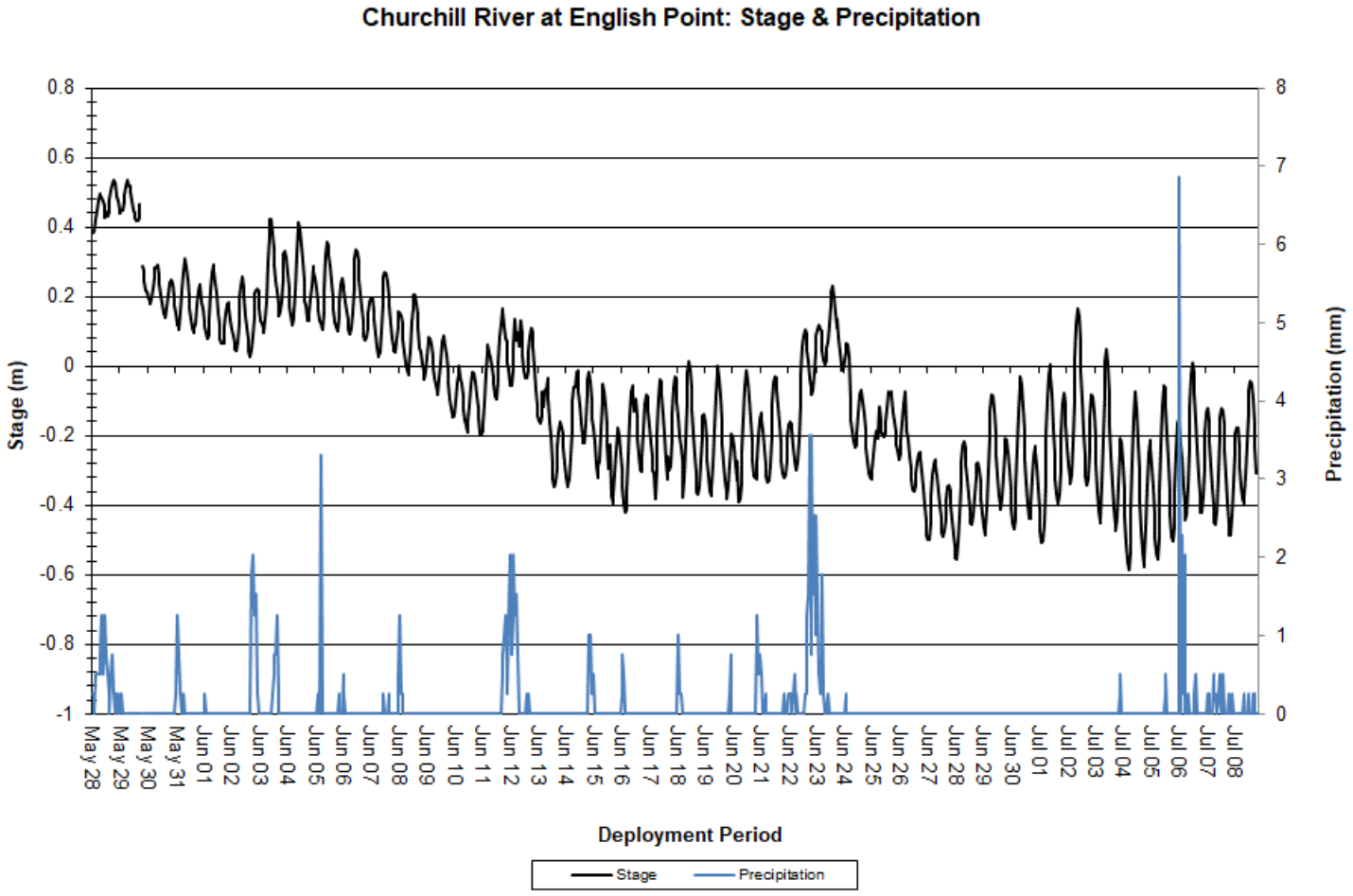

Figure 21: Stage & Precipitation at Churchill River at English Point

Conclusions

- Instruments were deployed at the Churchill River below Metchin River, Churchill River below Muskrat Falls, and Churchill River at English Point water quality monitoring stations on the Lower Churchill River from May 28th through July 16th, 2019. The station above Grizzle Rapids could not be deployed due to seasonal conditions. The station above Muskrat Falls could not be deployed due to location and accessibility concerns.
- Water levels dropped significantly at both Churchill River below Metchin River and Churchill River below Muskrat Falls after deployment, resulting in the water quality instruments being out of the water for extended periods. Data from these periods was deemed inaccurate and removed from the datasets.
- Water temperature was increasing at all stations throughout the deployment period due to the increasing ambient air temperatures in the region over the same period.
- pH was stable at all stations; however, pH levels remained below the CCME's Minimum Guideline for the Protection of Aquatic Life for the majority of deployment.
- Specific conductivity levels showed some variation at Churchill River below Metchin River and Churchill River below Muskrat Falls, demonstrating an expected inverse relationship with stage. This relationship was less evident at Churchill River at English Point due to tidal influences from the Atlantic Ocean, which cause significant fluctuation in conductivity levels.
- Dissolved oxygen concentrations were generally decreasing at all stations throughout the deployment period. This is to be expected as water temperatures were increasing over the same period with the change from spring to summer. 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.
- Turbidity data at all stations showed several turbidity events related to precipitation. There is known consistent background turbidity at these stations due to high levels of sediment.

References

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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

REPORT OF ANALYSIS

Lab Report Number: 1909867

Cient:	Department of Environment	**COC Number:**	844849
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-28
Client Project:		**Date Submitted:**	2019-06-17
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1433463	WS-S-0000 CR below MR	2019-6301-00-SI-SP	2019-06-11	Alkalinity as CaCO3	mg/L	5	10
				Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	2
				Colour	TCU	2	34
				Conductivity	uS/cm	5	25
				Dissolved Organic Carbon	mg/L	0.5	4.4
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	2
				N-NH3 (Ammonia)	mg/L	0.010	<0.010
				N-NO2 (Nitrite)	mg/L	0.10	<0.10
				N-NO3 (Nitrate)	mg/L	0.10	<0.10
				pH		1.00	7.38
				Sulphate	mg/L	1	<1
				Total Dissolved Solids (COND - CALC)	mg/L	1	16
				Total Kjeldahl Nitrogen	mg/L	0.15	<0.15
				Total Organic Carbon	mg/L	0.5	4.1
				Turbidity	NTU	0.1	2.0
				Aluminum	mg/L	0.01	0.31

Sample comment:

Holding time for N-NO2, N-NO3 analysis was exceeded.

Report comment:

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

APPROVAL: A. Thomas

Addrine Thomas

REPORT OF ANALYSIS

Lab Report Number: **1909867**

Cient:	Department of Environment	**COC Number:**	844849
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-28
Client Project:		**Date Submitted:**	2019-06-17
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1433463	WS-S-0000	2019-6301-00-SI-SP	2019-06-11	Antimony	mg/L	0.0005	<0.0005
	CR below MR			Arsenic	mg/L	0.001	<0.001
				Barium	mg/L	0.01	0.01
				Boron	mg/L	0.01	<0.01
				Calcium	mg/L	1	1
				Cadmium	mg/L	0.0001	<0.0001
				Chromium	mg/L	0.001	<0.001
				Copper	mg/L	0.001	0.001
				Iron	mg/L	0.03	0.65
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	<1
				Manganese	mg/L	0.01	0.03
				Mercury	mg/L	0.0001	<0.0001
				Nickel	mg/L	0.005	<0.005
				Potassium	mg/L	1	<1
				Selenium	mg/L	0.001	<0.001
				Sodium	mg/L	2	<2
				Strontium	mg/L	0.001	0.009

Sample comment:

Holding time for N-NO2, N-NO3 analysis was exceeded.

Report comment:

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

APPROVAL: A. Thomas

Addrine Thomas

REPORT OF ANALYSIS

Lab Report Number: 1909867

Cient:	Department of Environment	**COC Number:**	844849
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-28
Client Project:		**Date Submitted:**	2019-06-17
Purchase Order:	2180014303	**Sample Matrix:**	Water

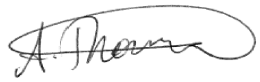
LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1433463	WS-S-0000	2019-6301-00-SI-SP	2019-06-11	Uranium	mg/L	0.001	<0.001
	CR below MR			Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	0.072
				Total Suspended Solids	mg/L	2	92

Sample comment:

Holding time for N-NO2, N-NO3 analysis was exceeded.

Report comment:

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

APPROVAL: 

Addrine Thomas

REPORT OF ANALYSIS

Lab Report Number: 1908611

Cient:	Department of Environment	**COC Number:**	
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-11
Client Project:		**Date Submitted:**	2019-05-31
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1429821	Cr below lower MF	2019-6300-00-SI-SP	2019-05-28	Alkalinity as CaCO3	mg/L	5	7
	Cr below lower MF			Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	4
				Colour	TCU	2	60
				Conductivity	uS/cm	5	15
				Dissolved Organic Carbon	mg/L	0.5	5.3
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	2
				N-NH3 (Ammonia)	mg/L	0.01	0.03
				N-NO2 (Nitrite)	mg/L	0.10	<0.10
				N-NO3 (Nitrate)	mg/L	0.10	<0.10
				pH		1.00	7.27
				Sulphate	mg/L	1	2
				Total Dissolved Solids (COND - CALC)	mg/L	1	10
				Total Kjeldahl Nitrogen	mg/L	0.15	0.20
				Total Organic Carbon	mg/L	0.5	5.4
				Turbidity	NTU	0.1	8.4
				Aluminum	mg/L	0.01	0.43

Sample comment:

Report comment:

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

APPROVAL: A. Thomas

Addrine Thomas

REPORT OF ANALYSIS

Lab Report Number: 1908611

Cient:	Department of Environment	**COC Number:**	
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-11
Client Project:		**Date Submitted:**	2019-05-31
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1429821	Cr below lower MF	2019-6300-00-SI-SP	2019-05-28	Antimony	mg/L	0.0005	<0.0005
	Cr below lower MF			Arsenic	mg/L	0.001	<0.001
				Barium	mg/L	0.01	0.01
Sample comment:				Boron	mg/L	0.01	<0.01
				Calcium	mg/L	1	1
				Cadmium	mg/L	0.0001	<0.0001
Report comment:				Chromium	mg/L	0.001	<0.001
				Copper	mg/L	0.001	0.001
				Iron	mg/L	0.03	0.54
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	<1
				Manganese	mg/L	0.01	0.02
				Mercury	mg/L	0.0001	<0.0001
				Nickel	mg/L	0.005	<0.005
				Potassium	mg/L	1	<1
				Selenium	mg/L	0.001	<0.001
				Sodium	mg/L	2	<2
				Strontium	mg/L	0.001	0.009

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
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Methods references and/or additional QA/QC information available on request.

APPROVAL: A. Thomas

Addrine Thomas

REPORT OF ANALYSIS

Lab Report Number: **1908611**

Cient:	Department of Environment	**COC Number:**	
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-11
Client Project:		**Date Submitted:**	2019-05-31
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1429821	Cr below lower MF	2019-6300-00-SI-SP	2019-05-28	Uranium	mg/L	0.001	<0.001
	Cr below lower MF			Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	0.042
Sample comment:				Total Suspended Solids	mg/L	2	17

Report comment:

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
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APPROVAL: A. Thomas

Addrine Thomas

REPORT OF ANALYSIS

Lab Report Number: 1908611

Cient:	Department of Environment	**COC Number:**	
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-11
Client Project:		**Date Submitted:**	2019-05-31
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1429822	CR at EP	2019-6303-00-SI-SP	2019-05-28	Alkalinity as CaCO3	mg/L	5	23
	CR at EP			Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	10
Sample comment:				Colour	TCU	2	77
				Conductivity	uS/cm	5	40
				Dissolved Organic Carbon	mg/L	0.5	6.2
Report comment:				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	9
				N-NH3 (Ammonia)	mg/L	0.01	0.06
				N-NO2 (Nitrite)	mg/L	0.10	<0.10
				N-NO3 (Nitrate)	mg/L	0.10	<0.10
				pH		1.00	7.85
				Sulphate	mg/L	1	1
				Total Dissolved Solids (COND - CALC)	mg/L	1	26
				Total Kjeldahl Nitrogen	mg/L	0.15	0.23
				Total Organic Carbon	mg/L	0.5	6.5
				Turbidity	NTU	0.1	6.6
				Aluminum	mg/L	0.01	0.22

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
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Methods references and/or additional QA/QC information available on request.

APPROVAL: Addrine Thomas

REPORT OF ANALYSIS

Lab Report Number: 1908611

Cient:	Department of Environment	**COC Number:**	
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-11
Client Project:		**Date Submitted:**	2019-05-31
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1429822	CR at EP	2019-6303-00-SI-SP	2019-05-28	Antimony	mg/L	0.0005	<0.0005
	CR at EP			Arsenic	mg/L	0.001	<0.001
				Barium	mg/L	0.01	0.01
Sample comment:				Boron	mg/L	0.01	<0.01
				Calcium	mg/L	1	2
				Cadmium	mg/L	0.0001	<0.0001
Report comment:				Chromium	mg/L	0.001	<0.001
				Copper	mg/L	0.001	<0.001
				Iron	mg/L	0.03	0.70
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	1
				Manganese	mg/L	0.01	0.04
				Mercury	mg/L	0.0001	<0.0001
				Nickel	mg/L	0.005	<0.005
				Potassium	mg/L	1	<1
				Selenium	mg/L	0.001	<0.001
				Sodium	mg/L	2	4
				Strontium	mg/L	0.001	0.018

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
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Methods references and/or additional QA/QC information available on request.

APPROVAL: A. Thomas

Addrine Thomas

REPORT OF ANALYSIS

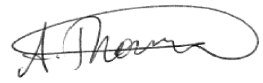
Lab Report Number: **1908611**

Cient:	Department of Environment	**COC Number:**	
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-06-11
Client Project:		**Date Submitted:**	2019-05-31
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1429822	CR at EP	2019-6303-00-SI-SP	2019-05-28	Uranium	mg/L	0.001	<0.001
	CR at EP			Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	0.019
Sample comment:				Total Suspended Solids	mg/L	2	6

Report comment:

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

APPROVAL: 

Addrine Thomas