

Real-Time Water Quality Deployment Report

Flora Creek below TLH

August 28 to
October 16, 2019



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

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General

- The Water Resources Management Division, in partnership with Tacora Resources Inc. – Wabush Mines, maintains one real-time water quality and water quantity station at Flora Creek.
- This station is situated downstream of the former Wabush Mines tailings disposal area in Flora Lake.
- Water Resources Management Division staff monitor the real-time web pages regularly.
- On August 28, 2019, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 49 days. This was the third and final deployment for this station in 2019. The instrument was removed on October 16th and will be redeployed in the spring of 2020 when conditions permit.

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 Sonde is temporarily deployed along side the Field Sonde. 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 Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

Table 1: Ranking classifications for deployment and removal

Parameter	Rank				
	Excellent	Good	Fair	Marginal	Poor
Temperature (°C)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35 µS/cm (%)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Dissolved Oxygen (mg/L) (% Sat)	<=+/-0.3	>+/-0.3 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Turbidity <40 NTU (NTU)	<=+/-2	>+/-2 to 5	>+/-5 to 8	>+/-8 to 10	>+/-10
Turbidity > 40 NTU (%)	<=+/-5	>+/-5 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20

- It should be noted that the temperature sensor on any sonde 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 sonde the entire sonde 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 station on Flora Creek deployed between August 28 and October 16, 2019 are summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station July 16 – August 28, 2019.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	Aug 28, 2019	Deployment	Excellent	Fair	Excellent	Excellent	Poor
	Oct 16, 2019	Removal	Excellent	Good	Excellent	Excellent	Excellent

- At deployment, all parameters except pH and turbidity ranked ‘excellent’. pH ranked ‘fair’. The field instrument read a value of 7.63, while the QA/QC instrument read a value of 8.29 mg/l. Turbidity ranked ‘poor’. The field instrument read a value of 78.5 NTU, while the QA/QC instrument read a value of 61.7 NTU.
- At removal, all parameters ranked either ‘good’ or ‘excellent’.

There are few circumstances which may cause less than ideal QA/QC rankings to be obtained. These include: the placement of the QA/QC sonde in relation to the field sonde, the amount of time each sonde was given to stabilize before readings were recorded; and deteriorating performance of one of the sensors.

Data Interpretation

- The following graphs and discussion illustrate water quality related events from August 28 to October 16 at the station Flora Creek below TLH.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion 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.

Flora Creek below TLH

- Water temperature ranged from 4.53 to 20.05°C during this deployment period (Figure 1).
- Water temperature increased after the end of July, and then fluctuated in a small range, before decreasing again during the later portion of August. Water temperature corresponds with ambient air temperature (Figure 1).

Water and Air Temperature : Flora Creek below TLH
August 28 to October 16, 2019

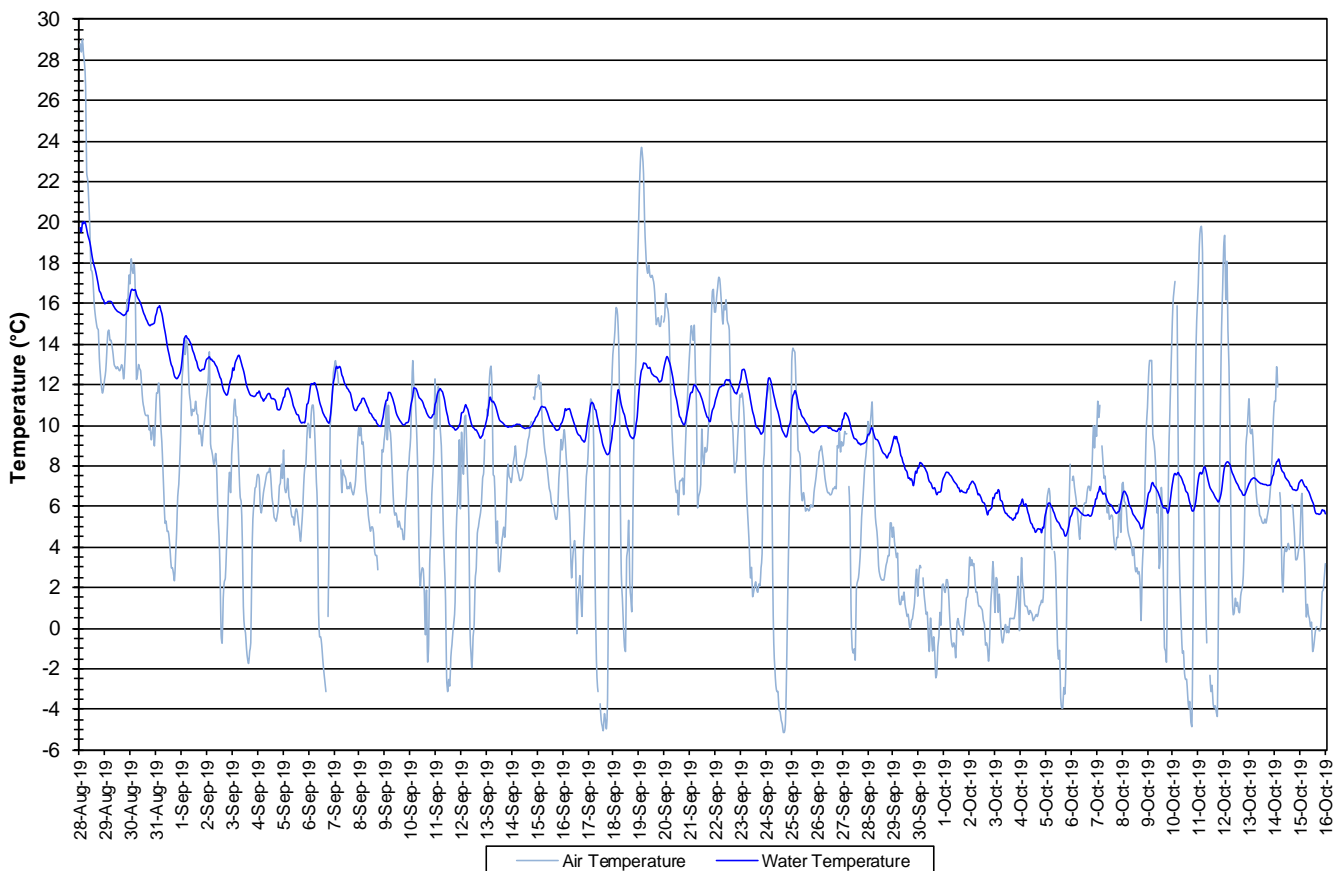


Figure 1: Water and Air Temperature - Flora Creek below TLH

(Weather data collected at Moosehead Lake)

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.41 and 7.81 pH units throughout the deployment period, with a median value of 7.64 units (Figure 2).
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units). pH fluctuates slightly during the day and night.

**Water pH and Stage : Flora Creek below TLH
August 28 to October 16, 2019**

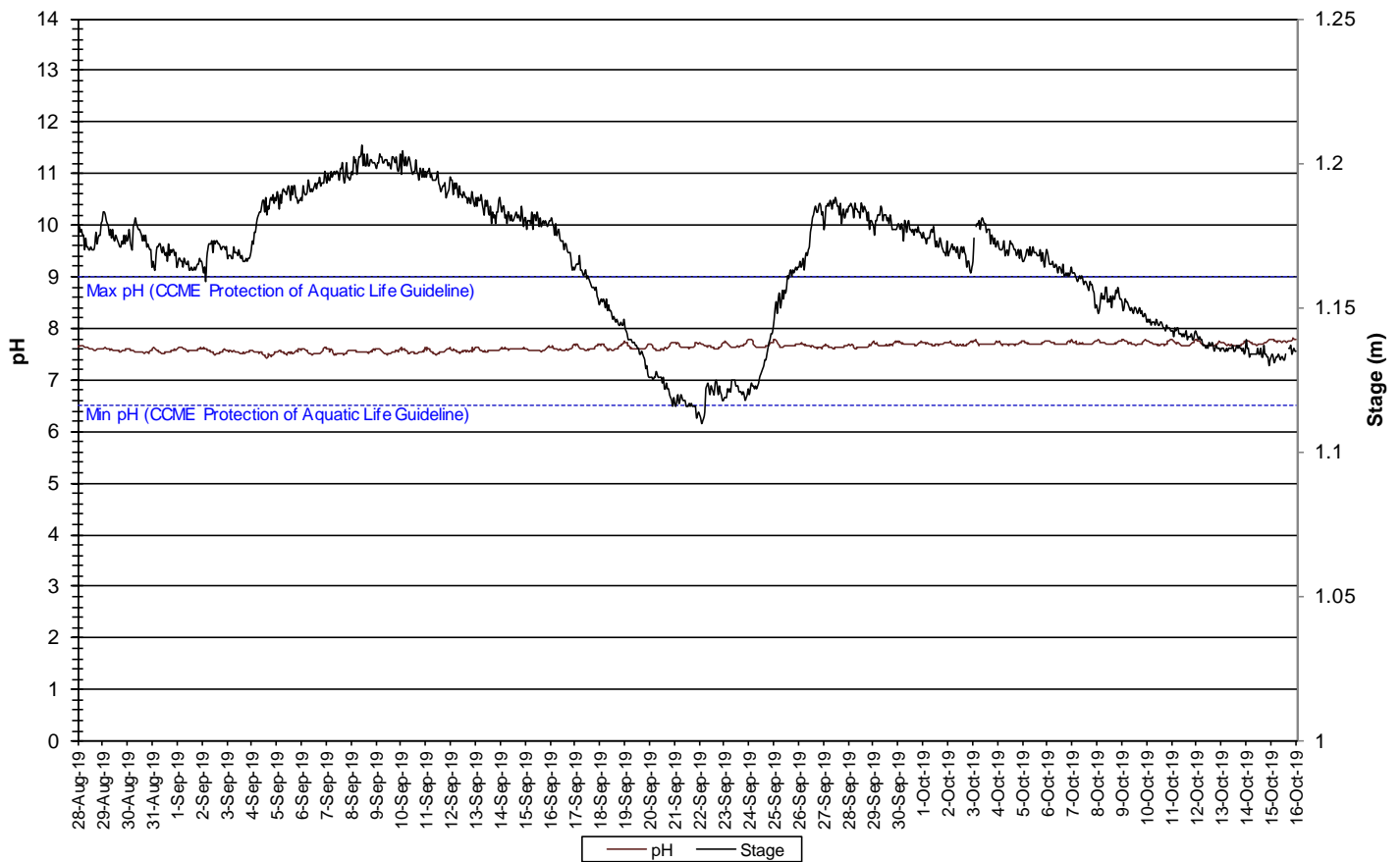


Figure 2: Water pH and Stage - Flora Creek below TLH

- Specific conductivity ranged from 59.5 to 64.6 $\mu\text{S}/\text{cm}$ (Figure 3).
- Specific conductivity increased over the course of this deployment period.
- There are a couple noticeable decreases in conductivity corresponding with rainfall events and identified on the graph below. This is to be expected after rainfall as the increase in the amount of water in the creek dilutes the solids that are present, decreasing the conductivity.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion 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.

**Specific Conductivity of Water and Stage : Flora Creek below TLH
August 28 to October 16, 2019**

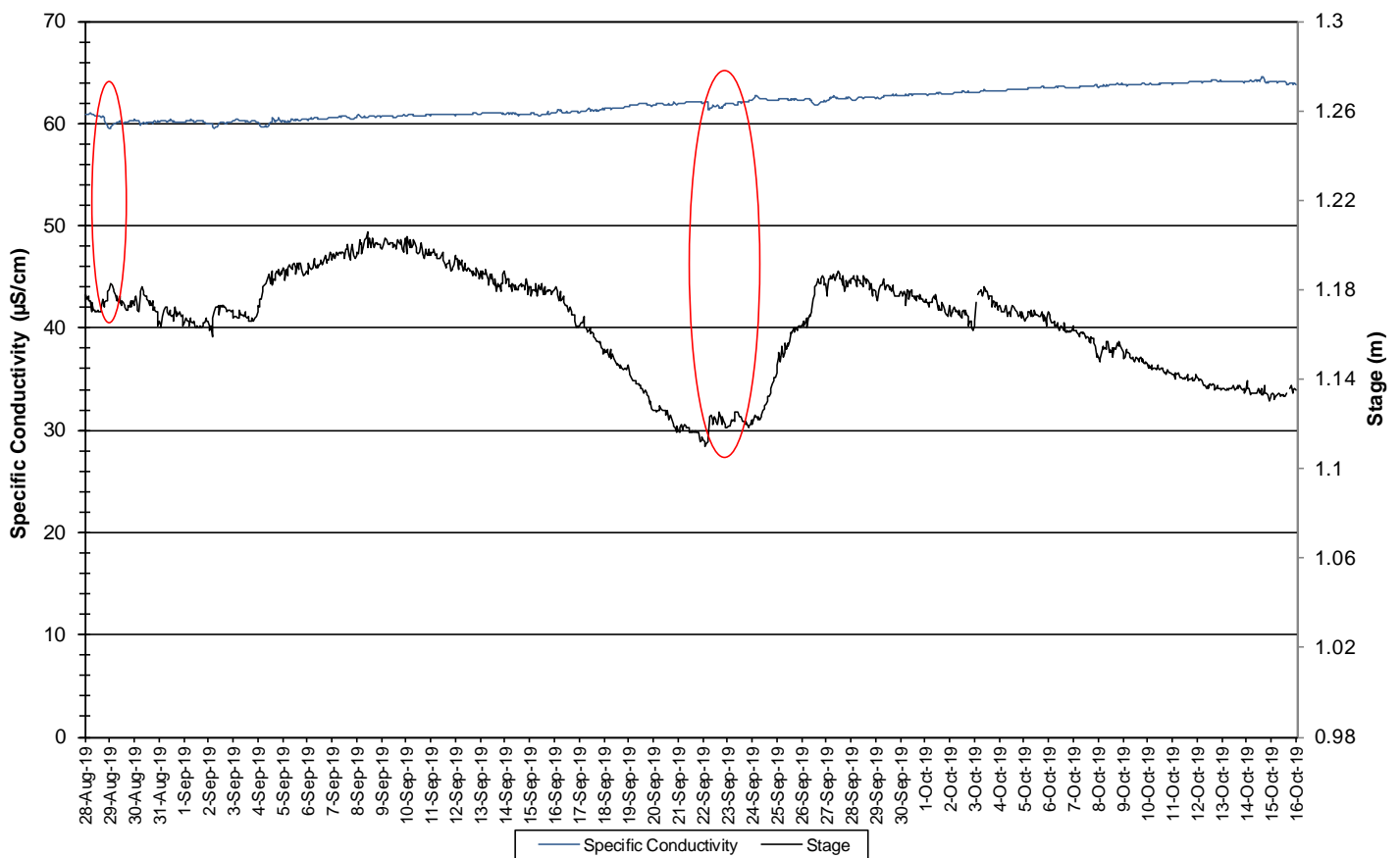


Figure 3: Specific Conductivity of Water and Stage - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- The saturation of dissolved oxygen ranged from 87.6 to 98.5% and a range of 8.71 to 11.87 mg/l was found for the concentration of dissolved oxygen with a median value of 10.34 mg/l (Figure 4).
- All values were above the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l. The majority of values were above the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 4.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. DO increased during this deployment period due to a decrease in water temperature at this time.

**Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH
August 28 to October 16, 2019**

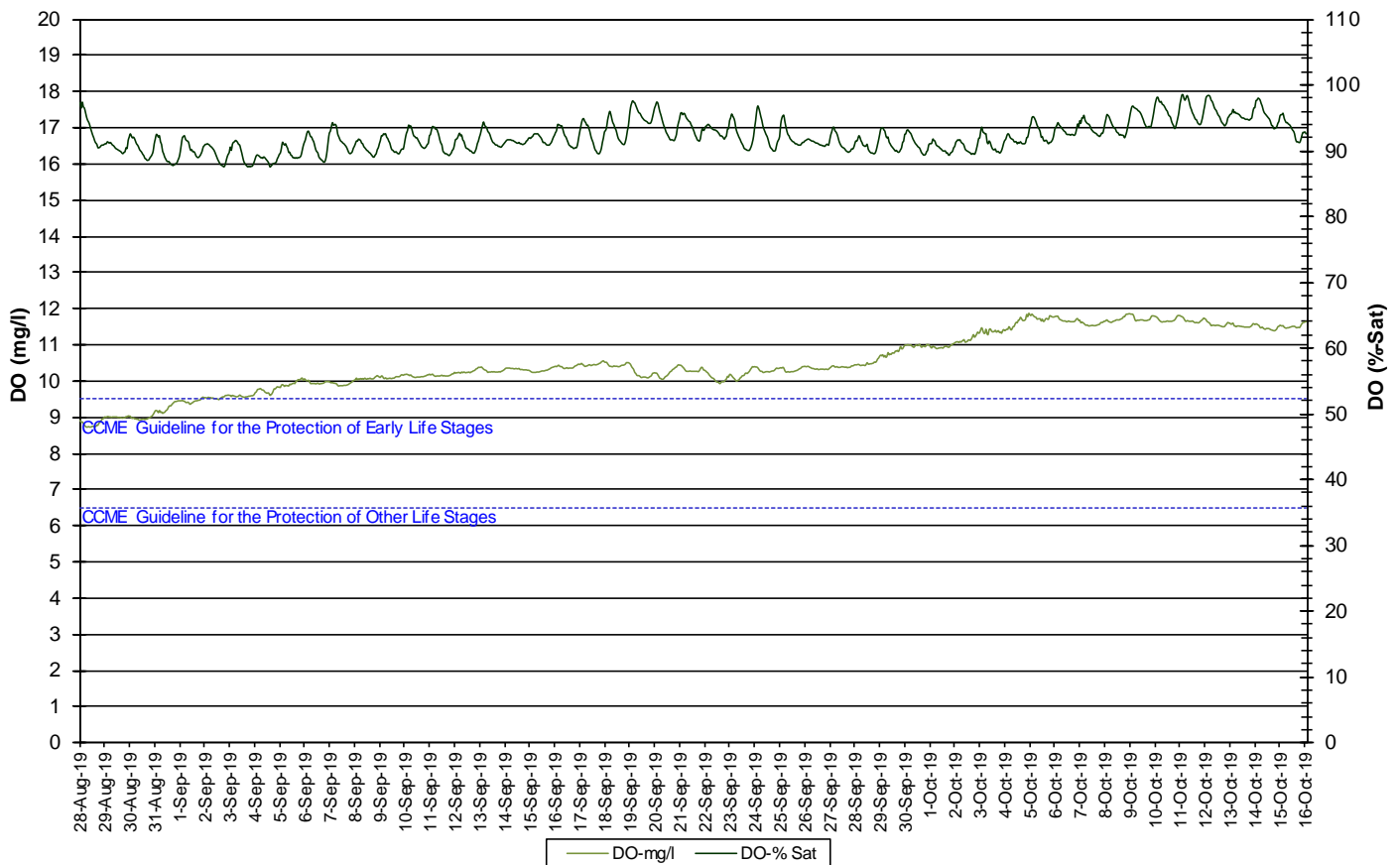


Figure 4: Dissolved Oxygen and Saturation - Flora Creek below TLH

- Turbidity values range from 37.7 NTU to 97.6 NTU. Overall, turbidity decreased during this deployment period with a few small spikes (Figure 5).
- This site has very turbid water at times.

**Water Turbidity and Precipitation : Flora Creek below TLH
August 28 to October 16, 2019**

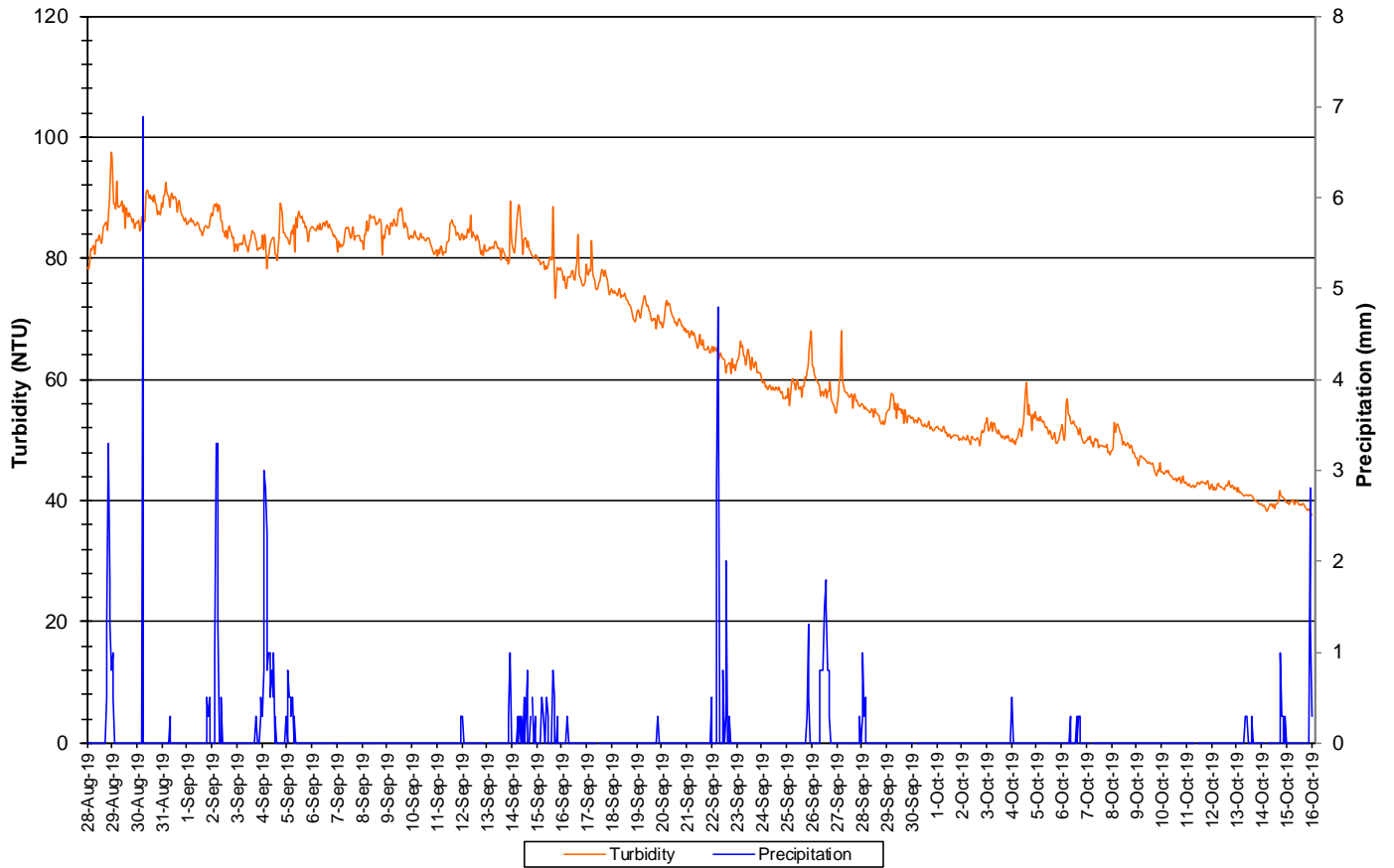


Figure 5: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period are graphed below (Figure 6). Stage decreased after the first half of the deployment period, before increasing again and then decreasing into the fall season.
- With the exception of water quantity data (stage), all data used in the preparation of the 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.

**Stage & Precipitation: Flora Creek below TLH
August 28 to October 16, 2019**

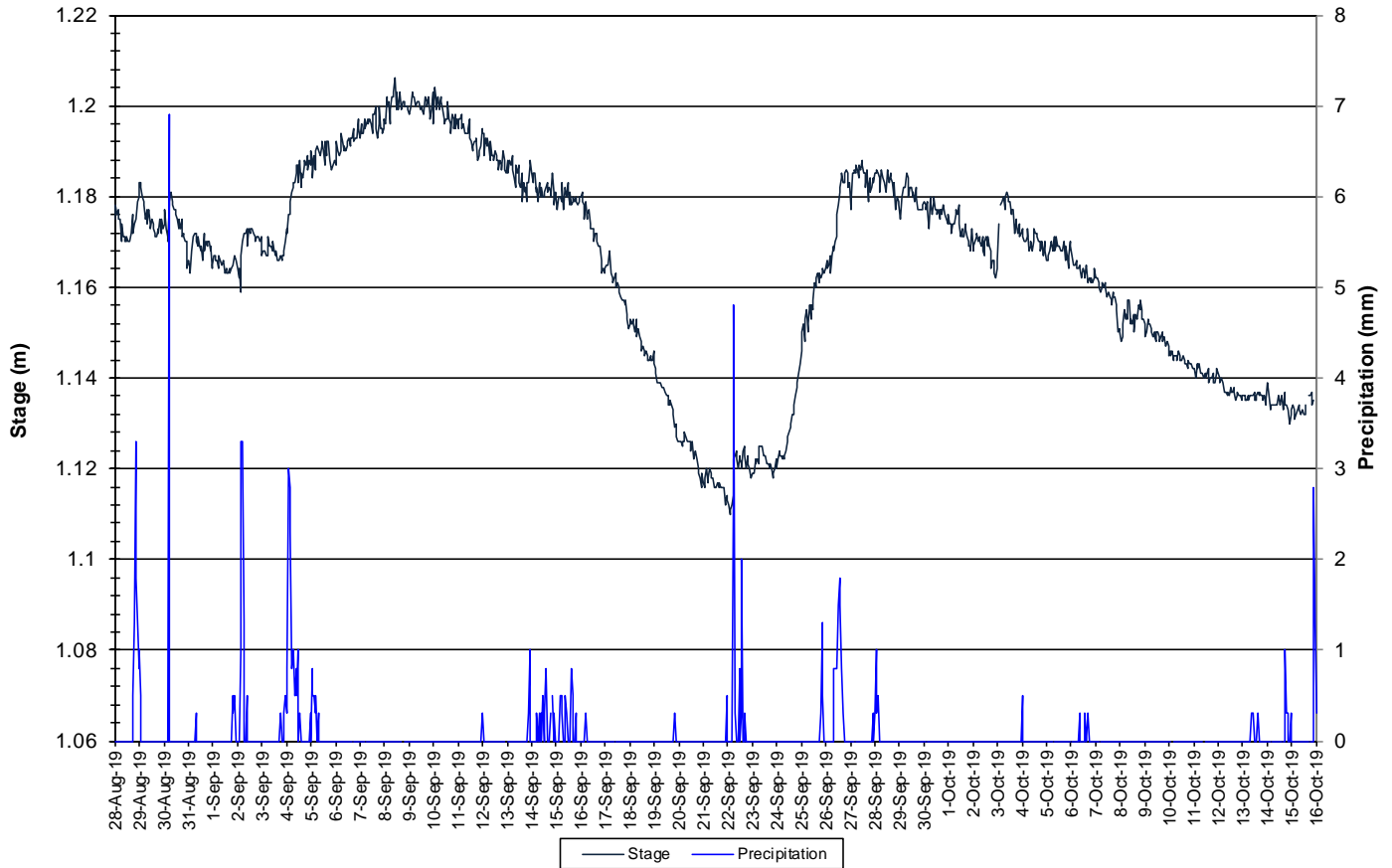


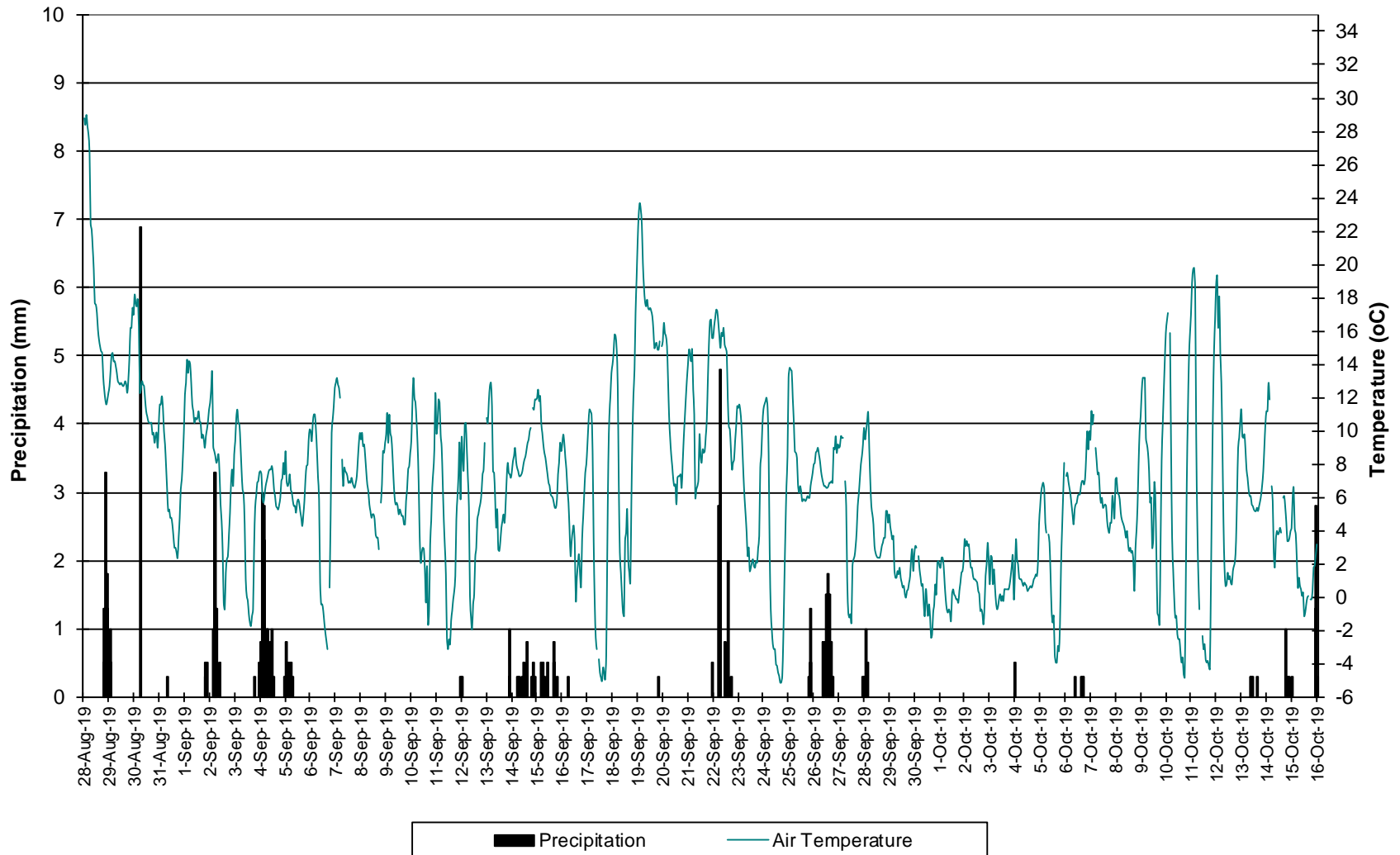
Figure 6: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument was deployed at the Flora Creek below TLH water quality monitoring station on August 28 and removed on October 16, 2019. This was the third and final deployment of the 2019 season.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations.
- Water temperature decreased during this deployment period, ranging from 20.05 down to 4.53^oC. This is expected due to the decreasing ambient air temperature.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.41 and 7.81.
- Specific conductivity ranged from 59.5 to 64.6 μ s/cm, showing little variation during the deployment.
- Dissolved oxygen values were above the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l. The majority of values were above the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l.
- Turbidity values decreased over the deployment period.
- Stage fluctuated during this deployment period, decreasing during the first half, before increasing and then decreasing again during the fall, as precipitation records varied.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion 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.

Appendix 1

Air Temperature and Precipitation: Moosehead Lake August 28 to October 16, 2019



Appendix 2
QA/QC Grab Sample Results

Client: Department of Environment
Attention: Ms. Leona Hyde
Client Project:
Purchase Order: 2180014303

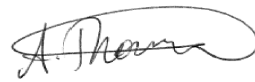
COC Number:
Date Reported: 2019-09-10
Date Submitted: 2019-09-04
Sample Matrix: Water

<u>LAB ID</u>	<u>Supply / Description</u>	<u>Client Sample ID</u>	<u>Sample Date</u>	<u>ANALYTE</u>	<u>UNIT</u>	<u>MRL</u>	<u>RESULT</u>
1451610	WS-S-0000 Flora Creek	2019-6323-00-SI-SP	2019-08-28	Alkalinity as CaCO3	mg/L	5	35
				Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	<1
				Colour	TCU	2	31
				Conductivity	uS/cm	5	70
				Dissolved Organic Carbon	mg/L	0.5	3.4
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	30
				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	8.42
				Sulphate	mg/L	1	2
				Total Dissolved Solids (COND - CALC)	mg/L	1	46
				Total Kjeldahl Nitrogen	mg/L	0.1	<0.1
				Total Organic Carbon	mg/L	0.5	3.8
				Turbidity	NTU	0.1	44.7
				Aluminum	mg/L	0.01	<0.01

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: 
 Addrine Thomas

Client: Department of Environment
Attention: Ms. Leona Hyde
Client Project:
Purchase Order: 2180014303

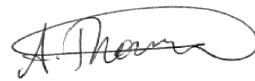
COC Number:
Date Reported: 2019-09-10
Date Submitted: 2019-09-04
Sample Matrix: Water

<u>LAB ID</u>	<u>Supply / Description</u>	<u>Client Sample ID</u>	<u>Sample Date</u>	<u>ANALYTE</u>	<u>UNIT</u>	<u>MRL</u>	<u>RESULT</u>
1451610	WS-S-0000 Flora Creek	2019-6323-00-SI-SP	2019-08-28	Antimony	mg/L	0.0005	<0.0005
				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	7
				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	0.16
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	3
				Manganese	mg/L	0.01	0.24
				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

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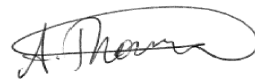
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1451610	WS-S-0000 Flora Creek	2019-6323-00-SI-SP	2019-08-28	Uranium	mg/L	0.001	<0.001
				Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	0.002
				Total Suspended Solids	mg/L	2	3

Sample comment:

Report comment:

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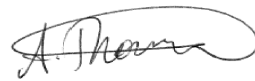
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Date Reported: 2019-10-30
Date Submitted: 2019-10-21
Sample Matrix: Water

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1461319	WS-S-0000 Flora Creek below TLH	2019-6337-00-SI-SP	2019-10-16	Alkalinity as CaCO3	mg/L	5	35
				Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	<1
				Colour	TCU	2	34
				Conductivity	uS/cm	5	74
				Dissolved Organic Carbon	mg/L	0.5	3.1
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	30
				N-NH3 (Ammonia)	mg/L	0.01	0.08
				N-NO2 (Nitrite)	mg/L	0.10	<0.10
				N-NO3 (Nitrate)	mg/L	0.10	0.12
				pH		1.00	7.94
				Sulphate	mg/L	1	2
				Total Dissolved Solids (COND - CALC)	mg/L	1	48
				Total Kjeldahl Nitrogen	mg/L	0.1	<0.1
				Total Organic Carbon	mg/L	0.5	3.1
				Turbidity	NTU	0.1	17.3
				Aluminum	mg/L	0.01	<0.01

Sample comment:

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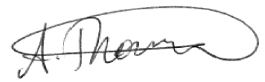
COC Number: 850423
Date Reported: 2019-10-30
Date Submitted: 2019-10-21
Sample Matrix: Water

<u>LAB ID</u>	<u>Supply / Description</u>	<u>Client Sample ID</u>	<u>Sample Date</u>	<u>ANALYTE</u>	<u>UNIT</u>	<u>MRL</u>	<u>RESULT</u>
1461319	WS-S-0000 Flora Creek below TLH	2019-6337-00-SI-SP	2019-10-16	Antimony	mg/L	0.0005	<0.0005
				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	7
				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	0.07
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	3
				Manganese	mg/L	0.01	0.08
				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	0.007

Sample comment:

Report comment:

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Date Reported: 2019-10-30

Date Submitted: 2019-10-21

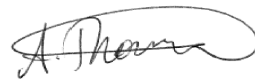
Sample Matrix: Water

<u>LAB ID</u>	<u>Supply / Description</u>	<u>Client Sample ID</u>	<u>Sample Date</u>	<u>ANALYTE</u>	<u>UNIT</u>	<u>MRL</u>	<u>RESULT</u>
1461319	WS-S-0000 Flora Creek below TLH	2019-6337-00-SI-SP	2019-10-16	Uranium	mg/L	0.001	<0.001
				Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	<0.002
				Total Suspended Solids	mg/L	2	4

Sample comment:

Report comment:

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