

Real-Time Water Quality Deployment Report

Flora Creek below TLH

September 2 to
October 28, 2020



Government of Newfoundland & Labrador
Department of Environment, Climate Change and
Municipalities
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 September 2, 2020, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 56 days. This was the second and final deployment for 2020

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 September 2 and October 28, 2020 are summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station September 2 – October 28, 2020.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	Sept 2, 2020	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	Oct 28, 2020	Removal	Excellent	Excellent	Marginal	Good	Fair

- At deployment, all parameters ranked ‘excellent’.
- At removal, temperature, pH and dissolved oxygen ranked either ‘good’ or ‘excellent’. Conductivity ranked ‘marginal’. The field instrument read a value of 70.3 $\mu\text{s/cm}$, while the QA/QC instrument read a value of 58.5 $\mu\text{s/cm}$. Turbidity ranked ‘fair’. The field instrument read a value of 85.8 NTU, while the QA/QC instrument read a value of 74.1 NTU.
- 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 September 2 to October 28 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 0.83 to 13.60°C during this deployment period (Figure 1).
- Water temperature decreased over this deployment period, corresponding with decreasing ambient air temperature (Figure 1).

**Water and Air Temperature : Flora Creek below TLH
September 2 to October 28, 2020**

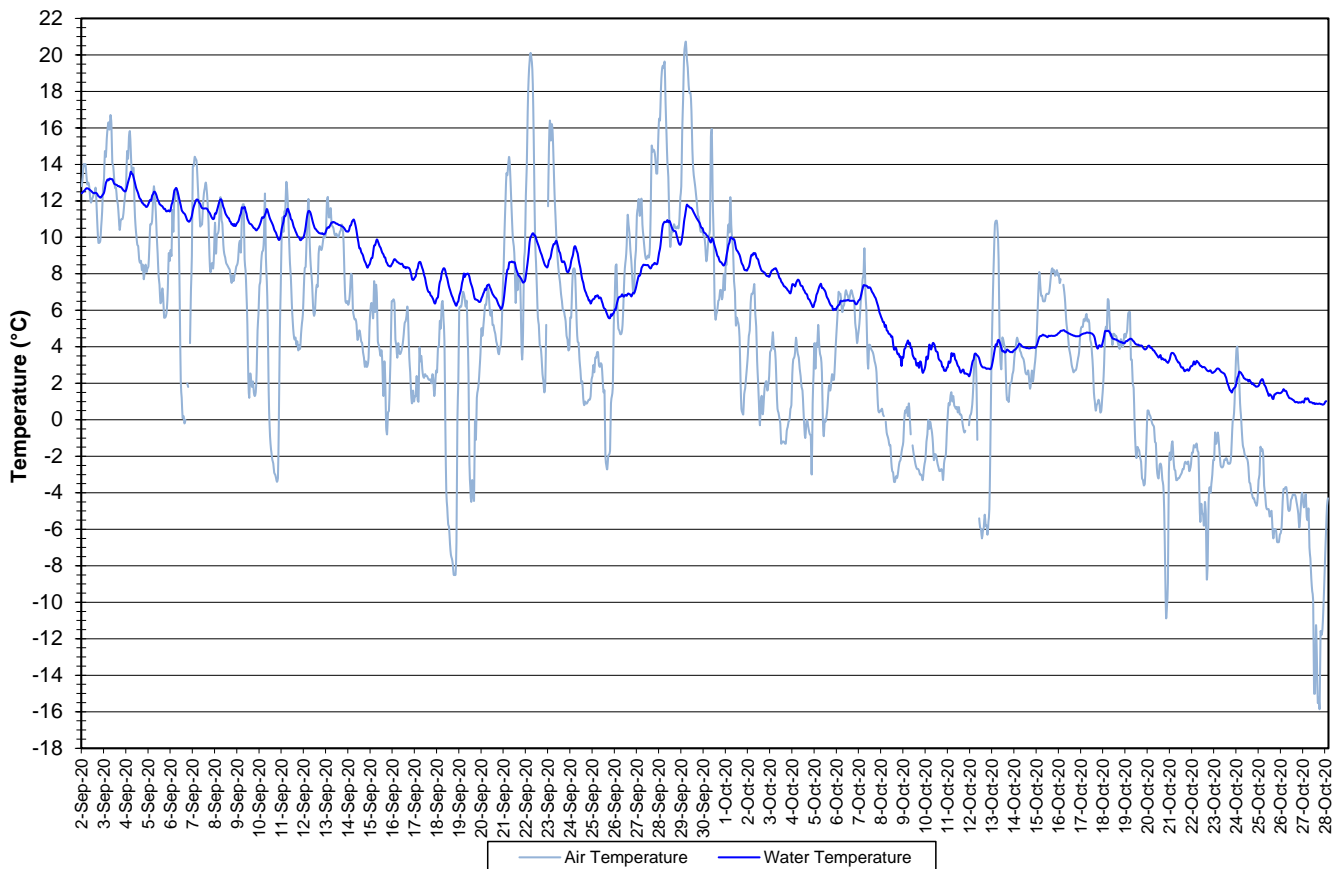


Figure 1: Water and Air Temperature - Flora Creek below TLH

(Weather data collected at Moosehead Lake)

- pH ranged between 7.47 and 7.71 pH units throughout the deployment period, with a median value of 7.61 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
September 2 to October 28, 2020**

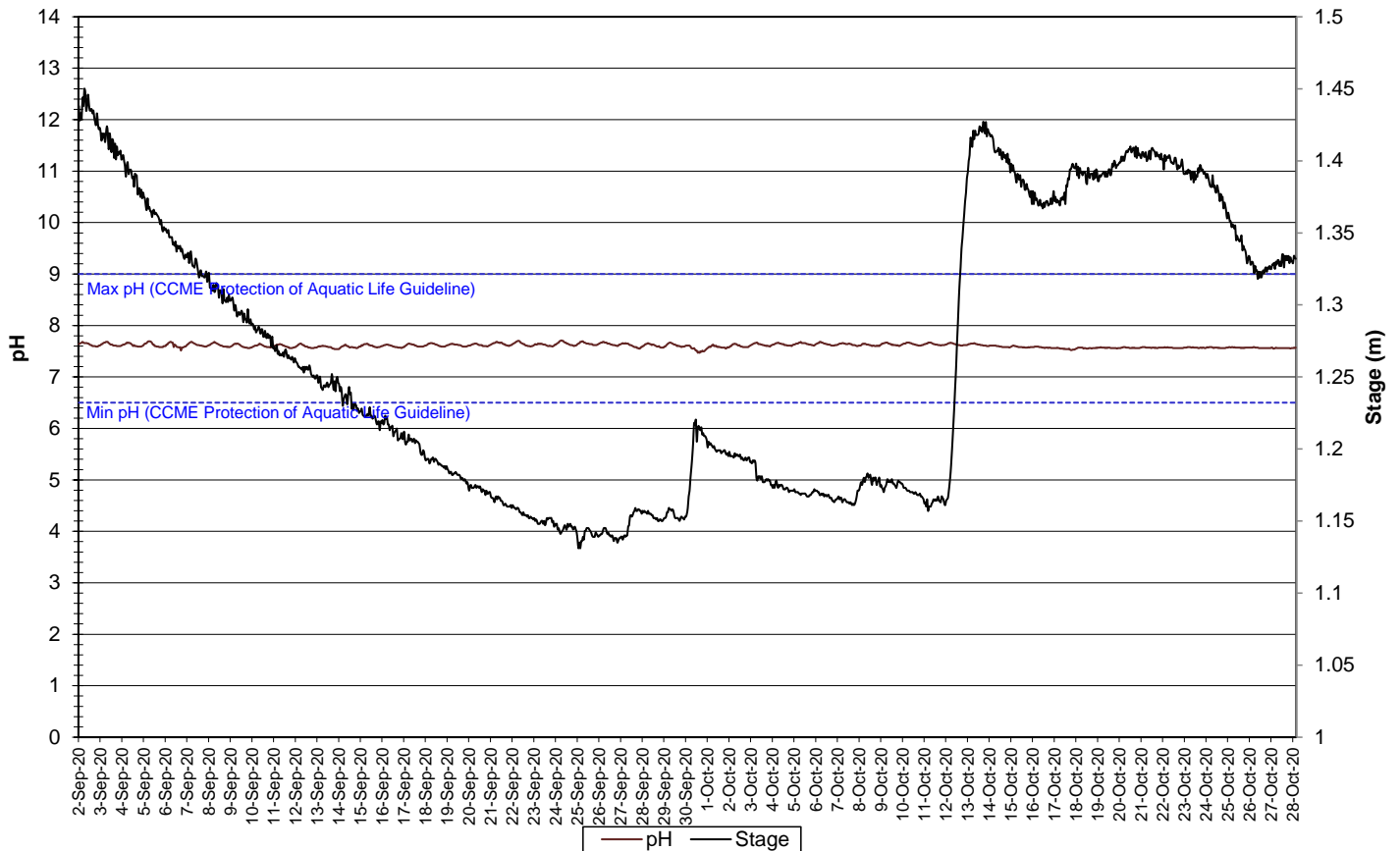


Figure 2: Water pH and Stage - Flora Creek below TLH

- Specific conductivity ranged from 68.9 to 72.4 $\mu\text{S}/\text{cm}$ (Figure 3).
- Specific conductivity was relatively stable over the deployment period.
- There is a noticeable decrease in conductivity at the end of the Septmeber occurring after a couple of days with precipitation events. 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
September 2 to October 28, 2020**

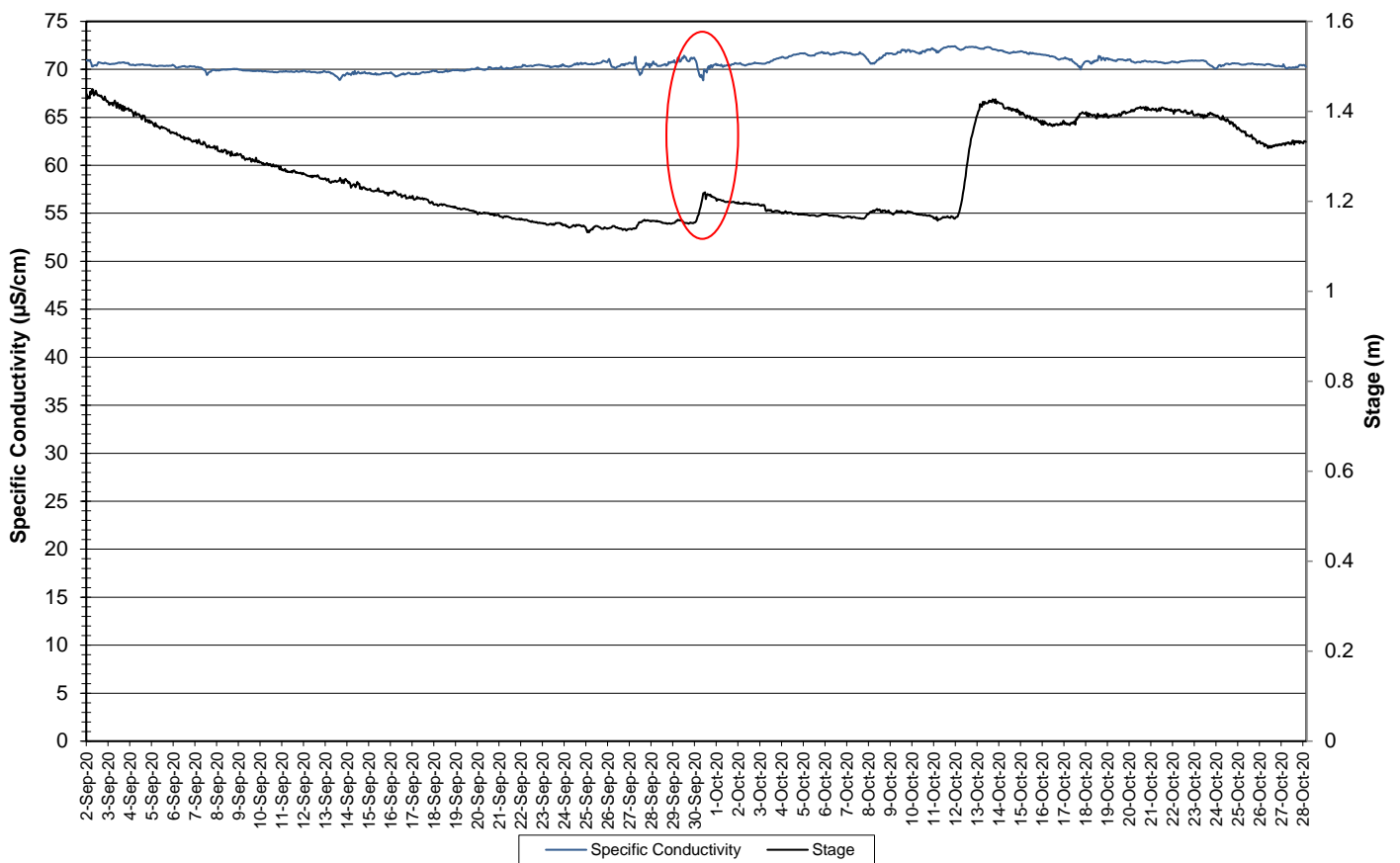


Figure 3: Specific Conductivity of Water and Stage - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 91.5 to 101.6% and a range of 9.95 to 13.36 mg/l was found for the concentration of dissolved oxygen with a median value of 11.46 mg/l (Figure 4).
- All values were above the minimum CCME Guideline for the Protection of Other Life Stages for Cold Water Biota of 6.5 mg/l and the minimum CCME Guideline for the Protection of Early Life Stage for Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 4.
- Dissolved oxygen content fluctuates diurnally and displays an inverse relationship to water temperature. DO increases over the course of the deployment period due to decreasing water temperatures in the fall.

**Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH
September 2 to October 28, 2020**

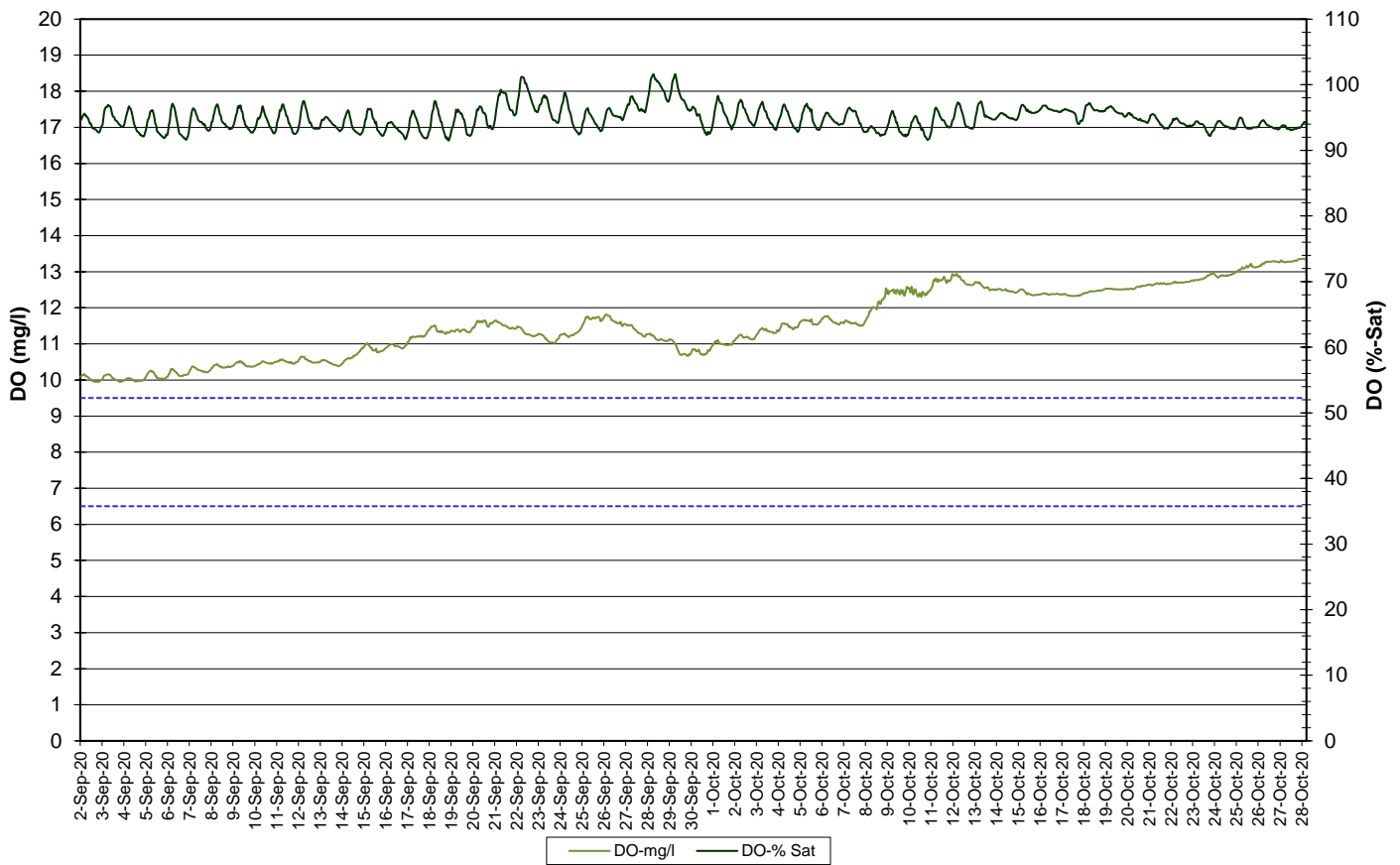


Figure 4: Dissolved Oxygen and Saturation - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- Turbidity values range from 5.7 NTU to 87.6 NTU with the highest readings recorded at the end of the deployment period. Turbidity increases during the middle of September and again at the end of October. Increases attributed to precipitation events are identified on the graph in red. (Figure 5).
- This site has very turbid water at times.

**Water Turbidity and Precipitation : Flora Creek below TLH
September 2 to October 28, 2020**

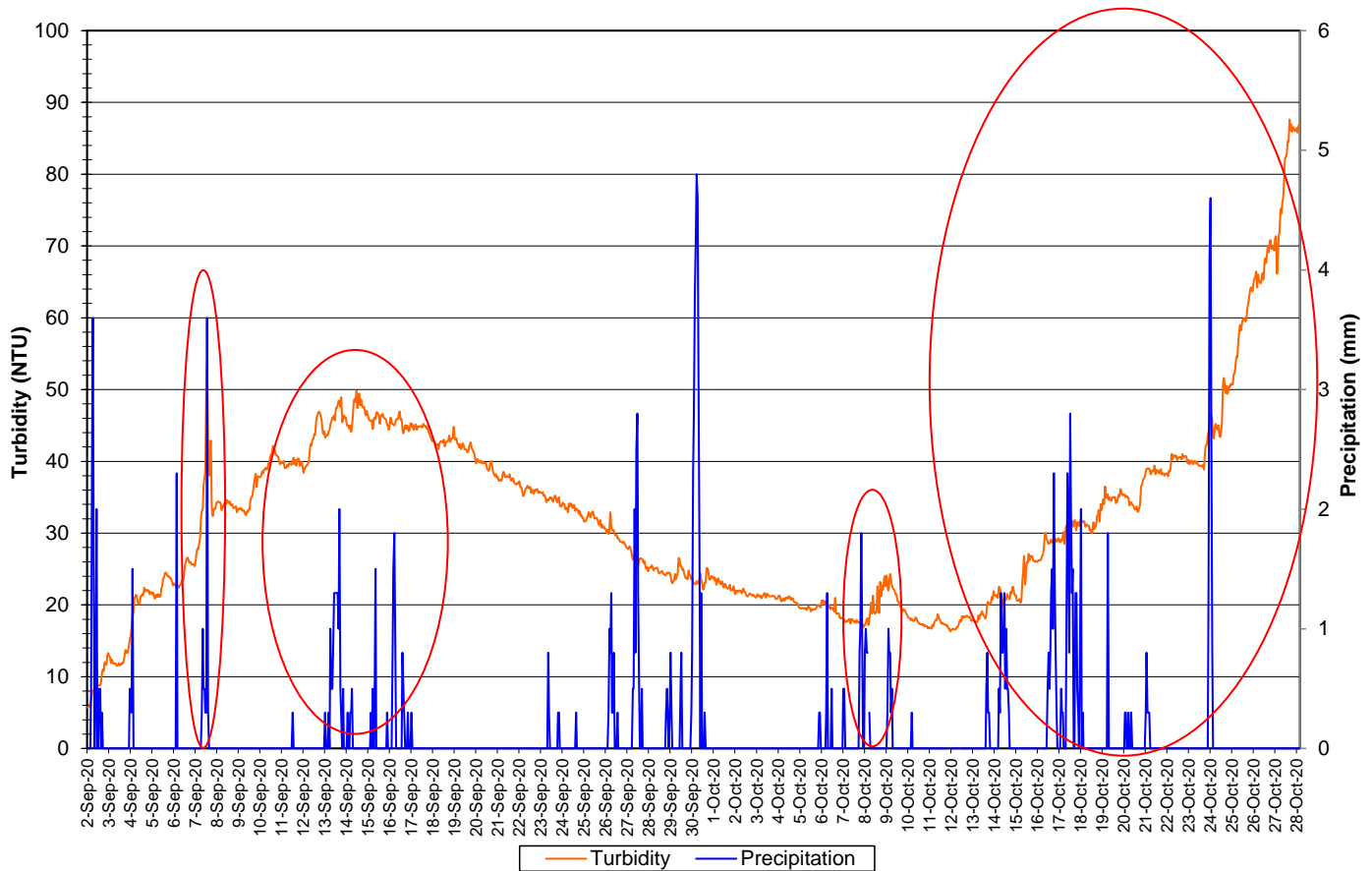


Figure 5: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period are graphed below (Figure 6). Stage decreased during September and then increased over the course of the remainder of the deployment period.
- 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
September 2 to October 28, 2020**

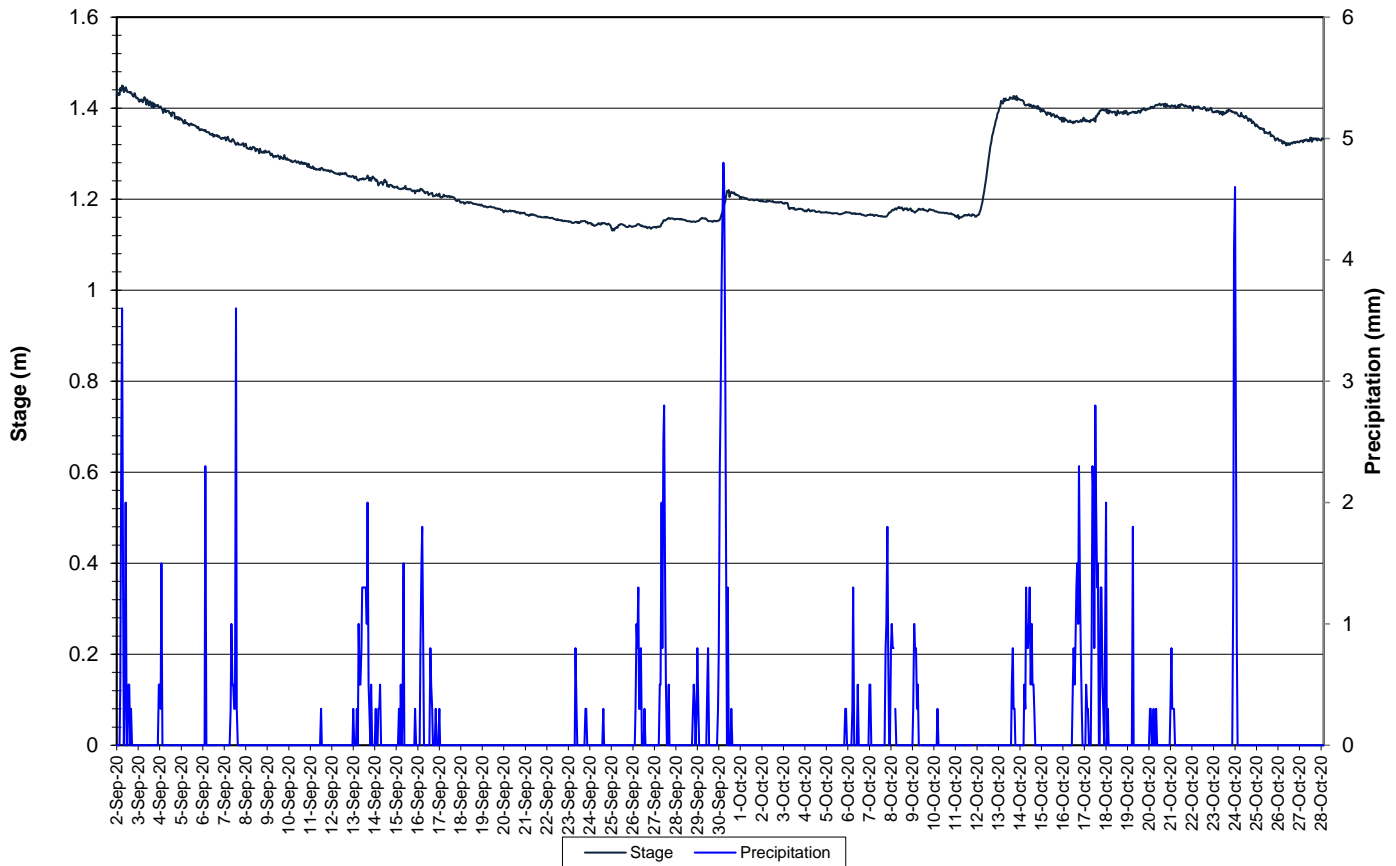


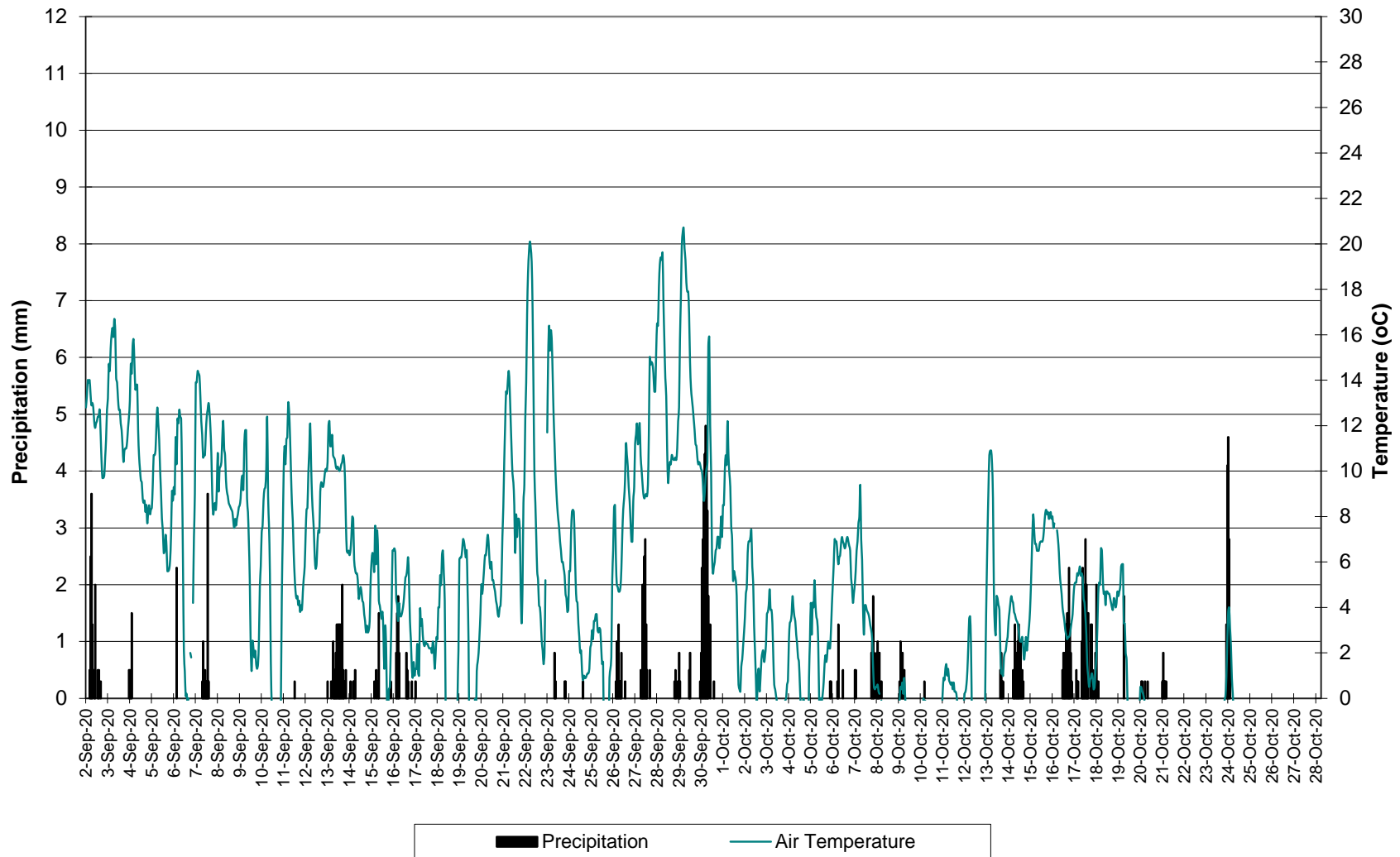
Figure 6: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument was deployed at the Flora Creek below TLH water quality monitoring station on September 2nd and removed on October 28th, 2020. This was the second and final deployment for 2020. The instrument was removed for the winter season and will be re-deployed in the spring when winter/ice conditions permit.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations. All values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen.
- Water temperature increased during the deployment period, ranging between 0.83 and 13.60°C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.47 and 7.71.
- Specific conductivity ranged from 68.9 to 72.4 µs/cm.
- Dissolved oxygen values were above the minimum CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages of 6.5 mg/l and the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l.
- Turbidity values increased during the middle of September and then decreased before increasing again in the middle of October. They continued to increase throughout the remainder of the deployment period.
- Stage gradually decreased during September. It increased for the remainder of the deployment period.
- 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 September 2 to October 28, 2020



Appendix 2
QA/QC Grab Sample Results

Client: Department of Environment
Attention: Ms. Leona Hyde
Client Project:
Purchase Order: 219034377-5

COC Number:
Date Reported: 2020-09-24
Date Submitted: 2020-09-09
Sample Matrix: Water

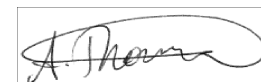
LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1515490	WS-S-0000 Flora Creek	2020-6316-00-SI-SP	2020-09-02	Alkalinity as CaCO3	mg/L	5	24
				Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	1
				Colour	TCU	2	4
				Conductivity	uS/cm	5	78
				Dissolved Organic Carbon	mg/L	0.5	2.0
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	36
				N-NH3 (Ammonia)	mg/L	0.05	0.06
				N-NO2 (Nitrite)	mg/L	0.10	<0.10
				N-NO3 (Nitrate)	mg/L	0.10	0.19
				pH		1.00	7.29
				Sulphate	mg/L	1	4
				Total Dissolved Solids (COND - CALC)	mg/L	1	51
				Total Kjeldahl Nitrogen	mg/L	0.8	<0.8
				Total Organic Carbon	mg/L	0.5	2.3
				Turbidity	NTU	0.1	2.5
				Aluminum	mg/L	0.01	<0.01

Sample comment:

Holding time for turbidity 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

Client: Department of Environment
Attention: Ms. Leona Hyde
Client Project:
Purchase Order: 219034377-5

COC Number:
Date Reported: 2020-09-24
Date Submitted: 2020-09-09
Sample Matrix: Water

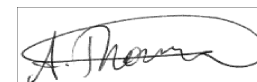
<u>LAB ID</u>	<u>Supply / Description</u>	<u>Client Sample ID</u>	<u>Sample Date</u>	<u>ANALYTE</u>	<u>UNIT</u>	<u>MRL</u>	<u>RESULT</u>
1515490	WS-S-0000 Flora Creek	2020-6316-00-SI-SP	2020-09-02	Antimony	mg/L	0.0005	<0.0005
				Arsenic	mg/L	0.001	<0.001
				Barium	mg/L	0.01	<0.01
				Boron	mg/L	0.01	<0.01
				Calcium	mg/L	1	8
				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	<0.03
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	4
				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	0.008

Sample comment:

Holding time for turbidity analysis was exceeded.

Report comment:

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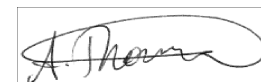
<u>LAB ID</u>	<u>Supply / Description</u>	<u>Client Sample ID</u>	<u>Sample Date</u>	<u>ANALYTE</u>	<u>UNIT</u>	<u>MRL</u>	<u>RESULT</u>
1515490	WS-S-0000 Flora Creek	2020-6316-00-SI-SP	2020-09-02	Uranium	mg/L	0.001	<0.001
				Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	<0.002
				Total Suspended Solids	mg/L	2	<2

Sample comment:

Holding time for turbidity analysis was exceeded.

Report comment:

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 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: 219034377-


COC Number:
Date Reported: 2020-11-11
Date Submitted: 2020-11-04
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>
1526560	WS-S-0000 Flora Creek	2020-6325-00-SI-SP	2020-10-28	Alkalinity as CaCO ₃	mg/L	5	32
				Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	<1
				Colour	TCU	2	37
				Conductivity	uS/cm	5	70
				Dissolved Organic Carbon	mg/L	0.5	2.3
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO ₃	mg/L	1	36
				N-NH ₃ (Ammonia)	mg/L	0.010	0.029
				N-NO ₂ (Nitrite)	mg/L	0.10	<0.10
				N-NO ₃ (Nitrate)	mg/L	0.10	0.19
				pH		1.00	7.64
				Sulphate	mg/L	1	4
				Total Dissolved Solids (COND - CALC)	mg/L	1	46
				Total Kjeldahl Nitrogen	mg/L	0.100	0.121
				Total Organic Carbon	mg/L	0.5	2.4
				Turbidity	NTU	0.1	31.2
				Aluminum	mg/L	0.01	<0.01

Sample comment:

Report comment:

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APPROVAL: 
 Sarah Horner

Client: Department of Environment
Attention: Ms. Leona Hyde
Client Project:
Purchase Order: 219034377-


COC Number:
Date Reported: 2020-11-11
Date Submitted: 2020-11-04
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>
1526560	WS-S-0000 Flora Creek	2020-6325-00-SI-SP	2020-10-28	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	8
				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	4
				Manganese	mg/L	0.01	0.09
				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: 2020-11-11
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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>
1526560	WS-S-0000 Flora Creek	2020-6325-00-SI-SP	2020-10-28	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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