

Real-Time Water Quality Deployment Report

Flora Creek below TLH

June 12 to
July 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 June 12, 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 34 days. This was the first deployment for the 2019 season.

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.

Flora Creek below TLH, Newfoundland and Labrador

- Deployment and removal comparison rankings for the station on Flora Creek deployed between June 12 and July 16, 2019 are summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station June 12 – July 16, 2019.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	June 12, 2019	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	July 16, 2019	Removal	Good	Good	Excellent	Excellent	Excellent

- At deployment and removal, all parameters ranked either 'excellent' or 'good'.

Data Interpretation

- The following graphs and discussion illustrate water quality related events from June 12 to July 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 8.29 to 22.52°C during this deployment period (Figure 1).
- Water temperature increased throughout the deployment period, which corresponds with increasing ambient air temperature (Figure 1).

**Water and Air Temperature : Flora Creek below TLH
June 12 to July 16, 2019**

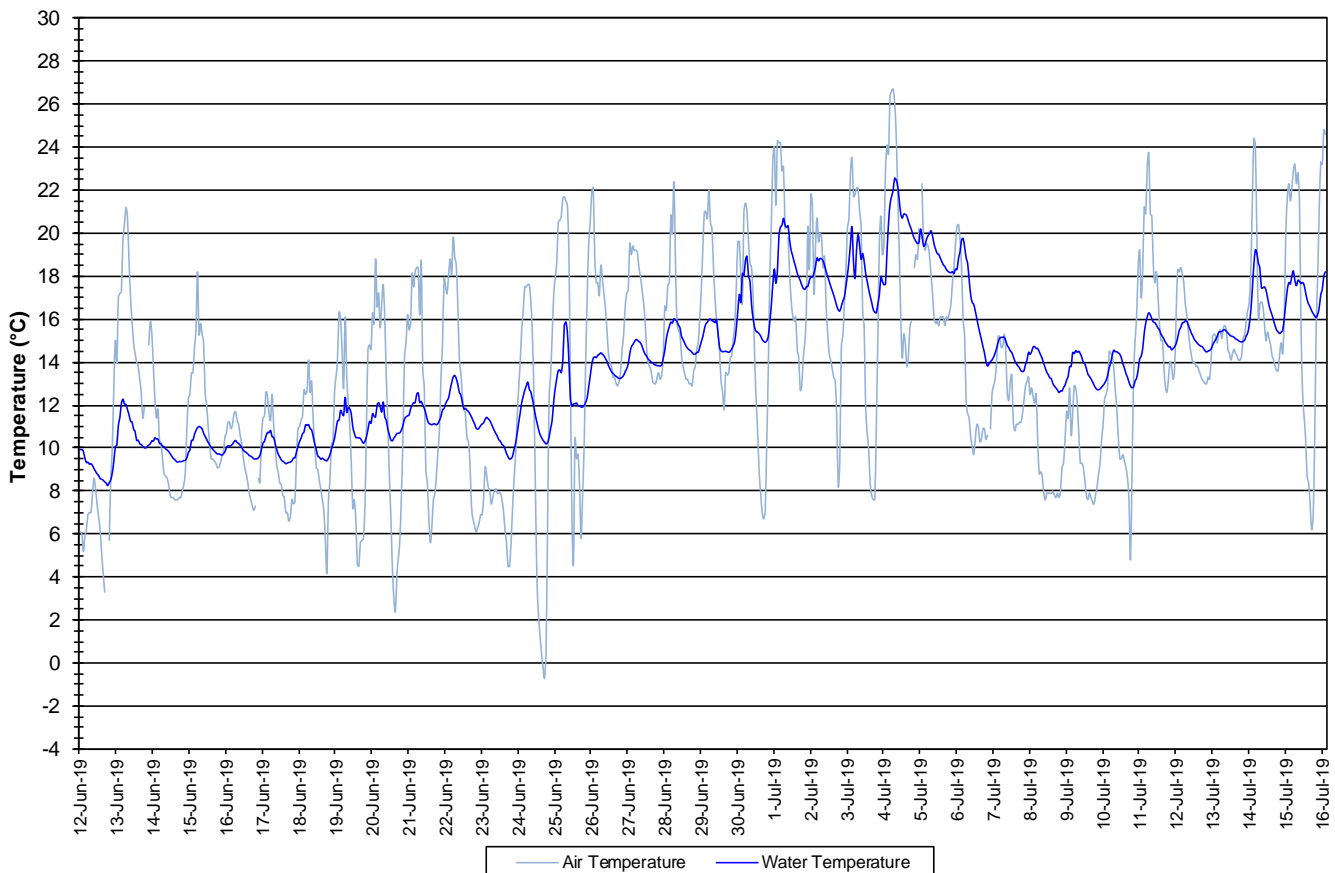


Figure 1: Water and Air Temperature - Flora Creek below TLH

(Weather data collected at Moosehead Lake)

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.02 and 7.71 pH units throughout the deployment period, with a median value of 7.18 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.
- There is a noticeable rise in pH during the first few days of this deployment, for unknown reasons. pH values did return to normal. This event is identified on the graph (Figure 2) in red.

**Water pH and Stage : Flora Creek below TLH
June 12 to July 16, 2019**

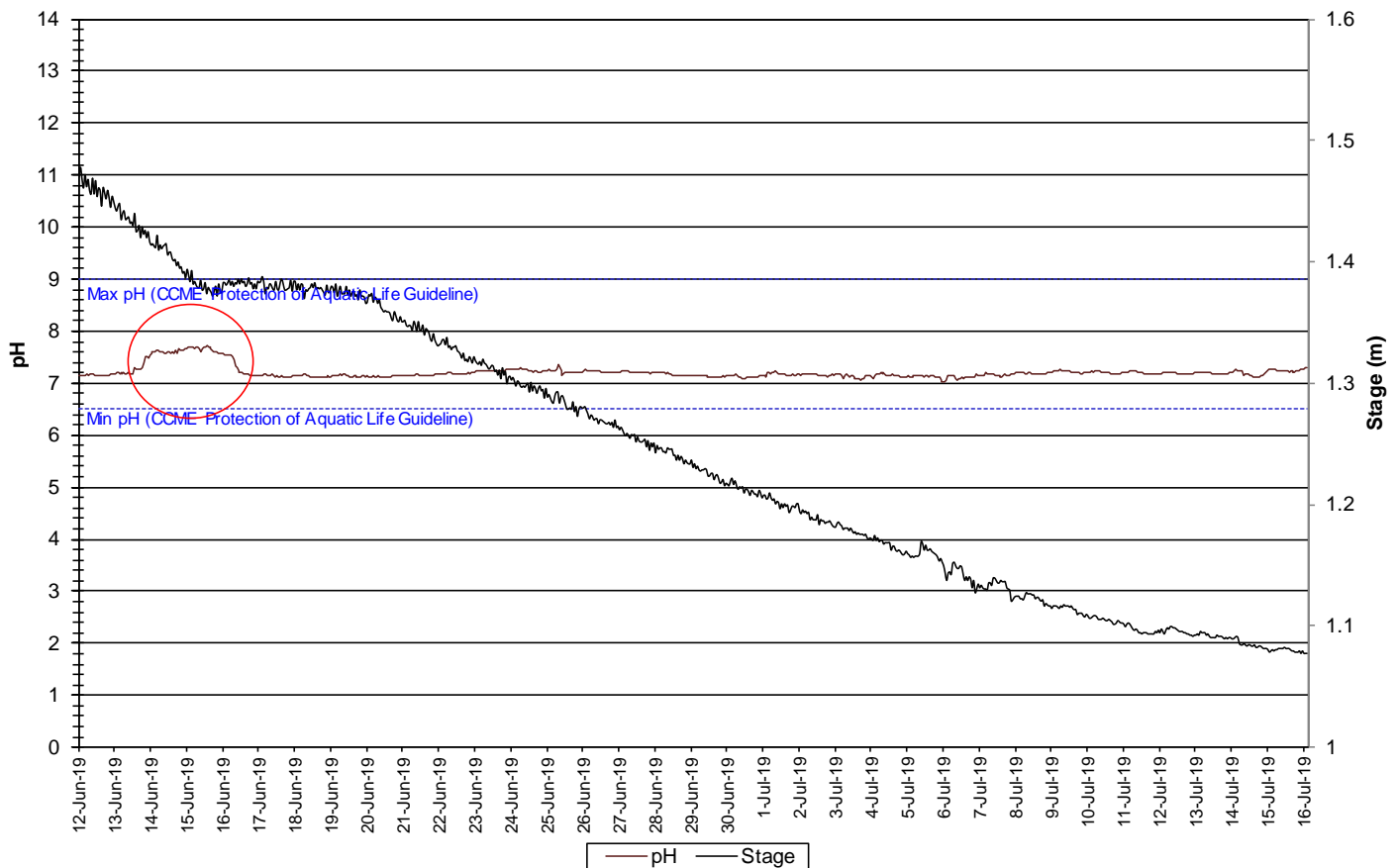


Figure 2: Water pH and Stage - Flora Creek below TLH

- Specific conductivity ranged from 52.6 to 58.1 $\mu\text{S}/\text{cm}$ (Figure 3).
- Specific conductivity increased slightly over the course of this deployment period.
- There is a noticeable decrease in conductivity corresponding with a rainfall event 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
June 12 to July 16, 2019**

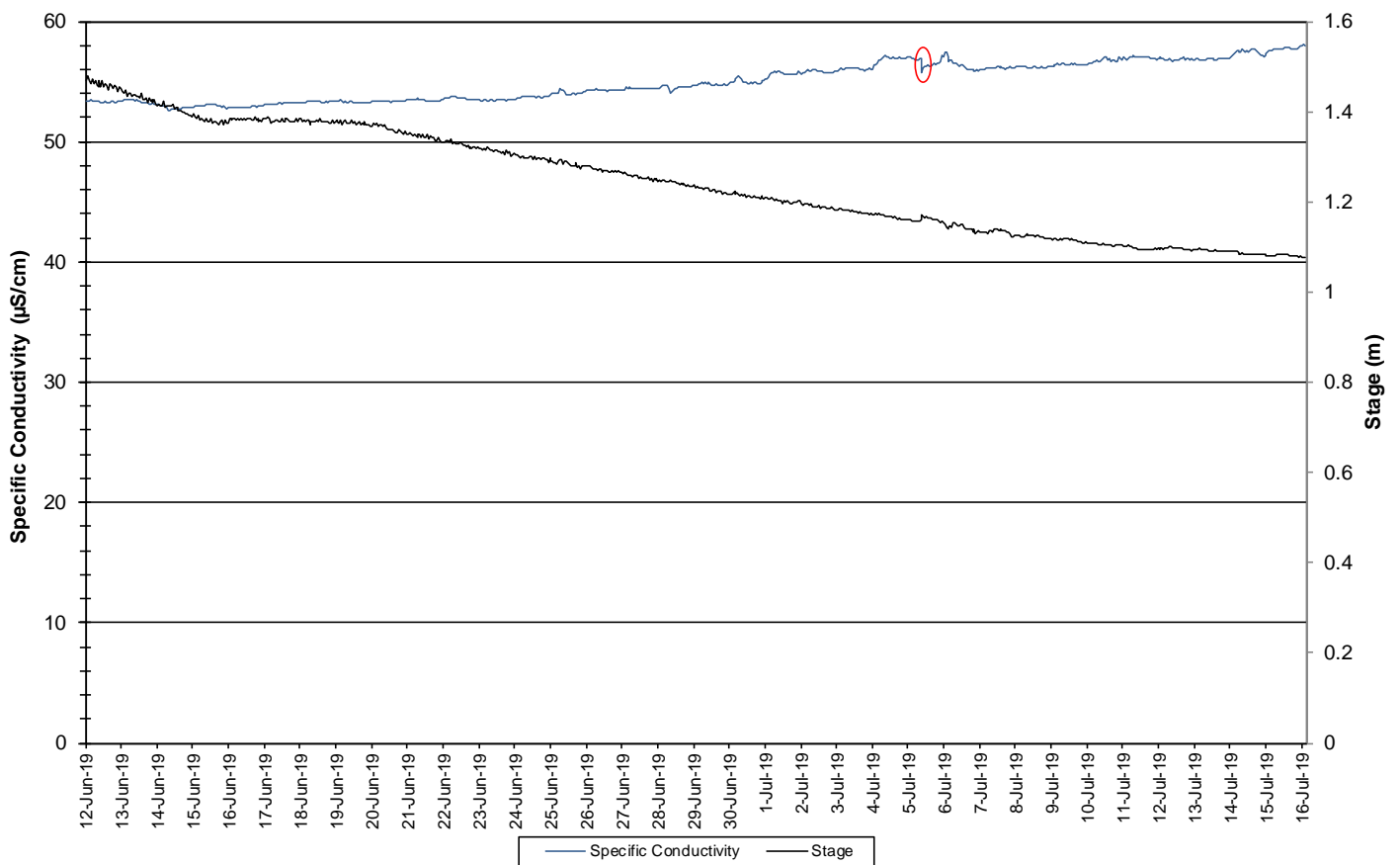


Figure 3: Specific Conductivity of Water and Stage - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- The saturation of dissolved oxygen ranged from 88.0 to 99.4% and a range of 8.28 to 10.88 mg/l was found for the concentration of dissolved oxygen with a median value of 9.53 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 below 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. Overall, DO decreases during this deployment period due to an increase in water temperature at this time.

**Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH
June 12 to July 16, 2019**

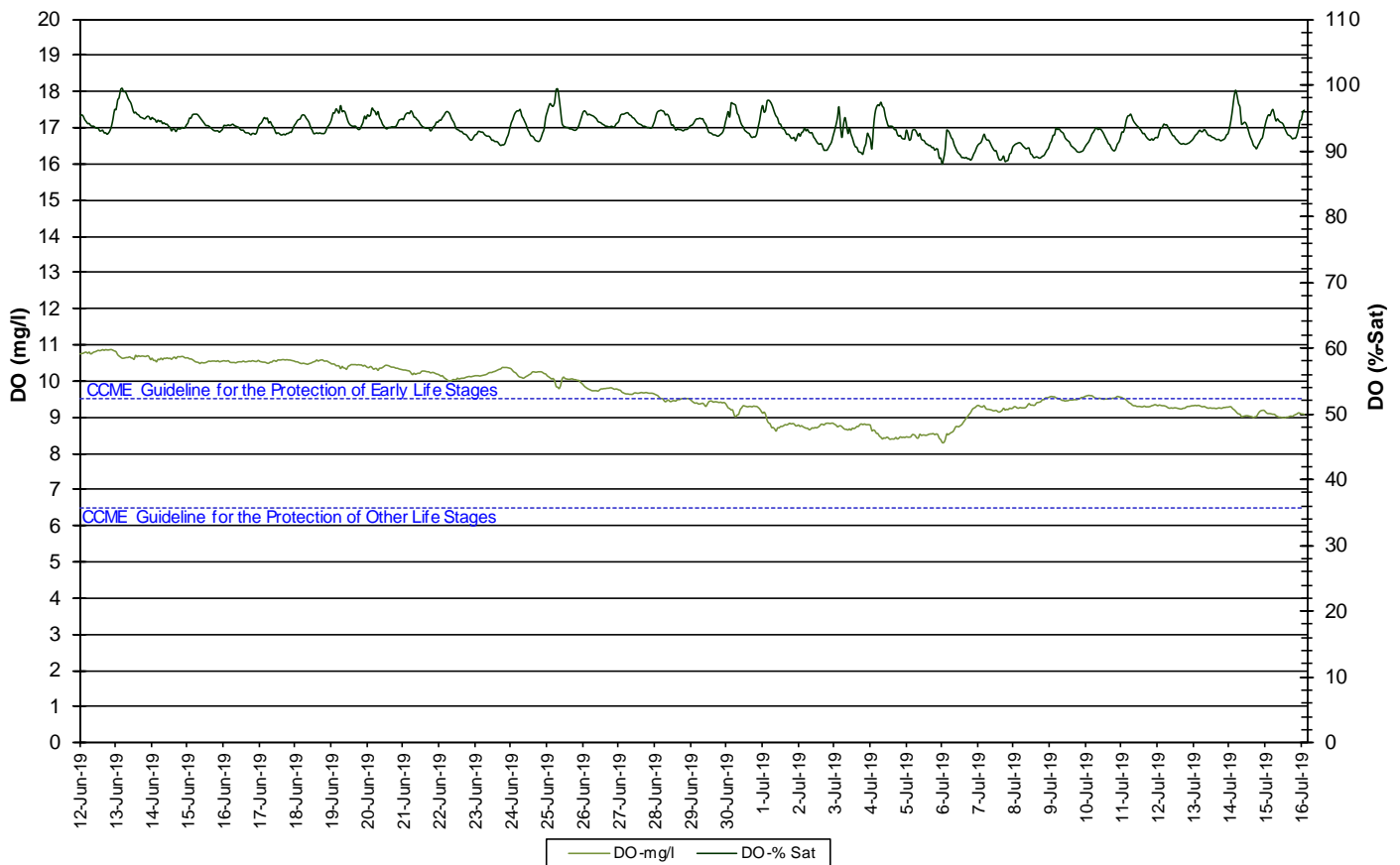


Figure 4: Dissolved Oxygen and Saturation - Flora Creek below TLH

- Turbidity values range from 41.9 NTU to 440.0 NTU, the highest readings being recorded at the beginning of the deployment period. Turbidity gradually decreases over the course of the deployment period. An increase in early July corresponds with high precipitation at the time, it is identified on the graph in red (Figure 5).
- This site has very turbid water at times. It is likely that the high turbidity in June can be attributed to late snow melt/spring freshet. This trend has been noticed each year since the station was commissioned.

**Water Turbidity and Precipitation : Flora Creek below TLH
June 12 to July 16, 2019**

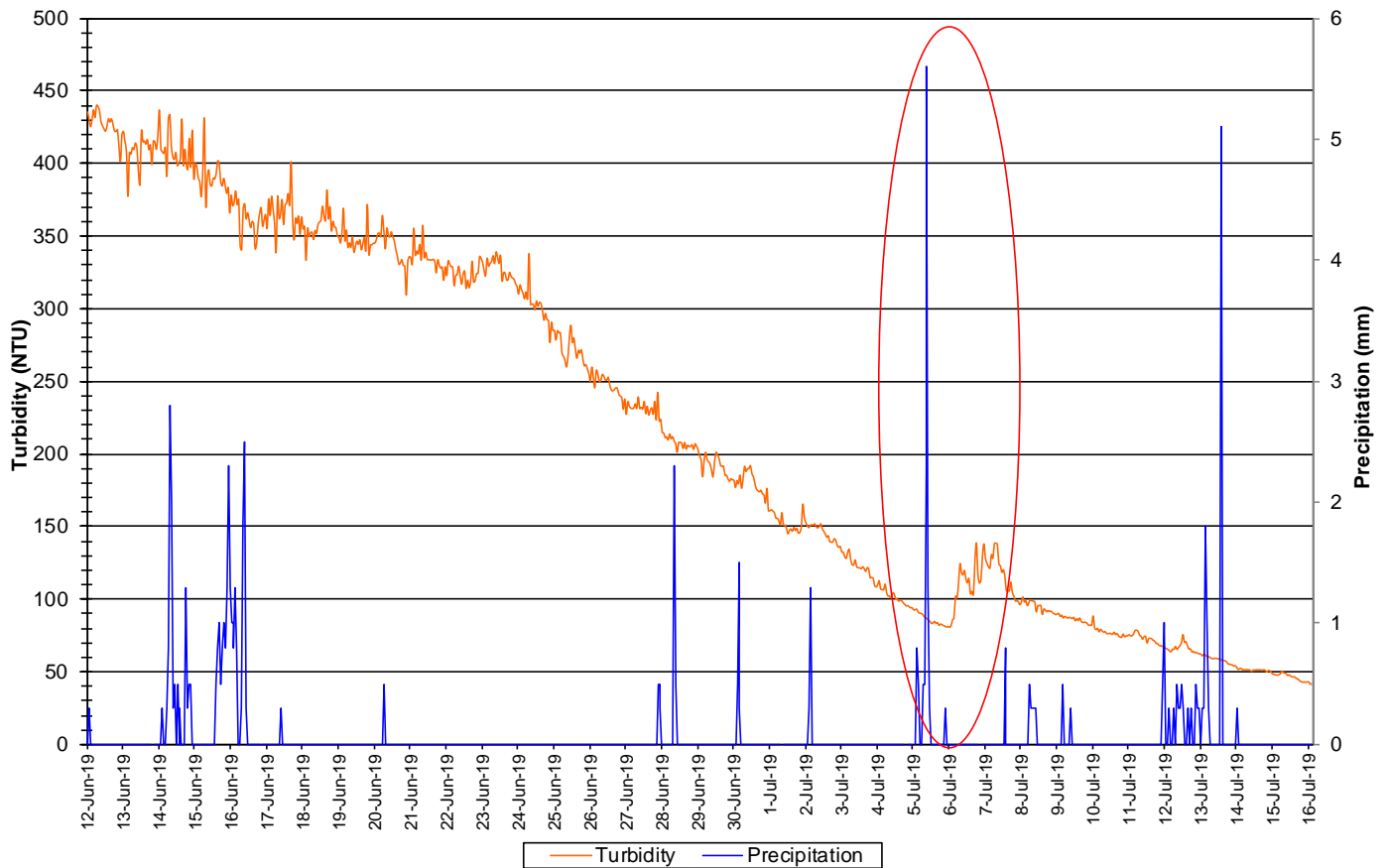


Figure 5: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period are graphed below (Figure 6). Overall, stage decreased during this 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
June 12 to July 16, 2019**

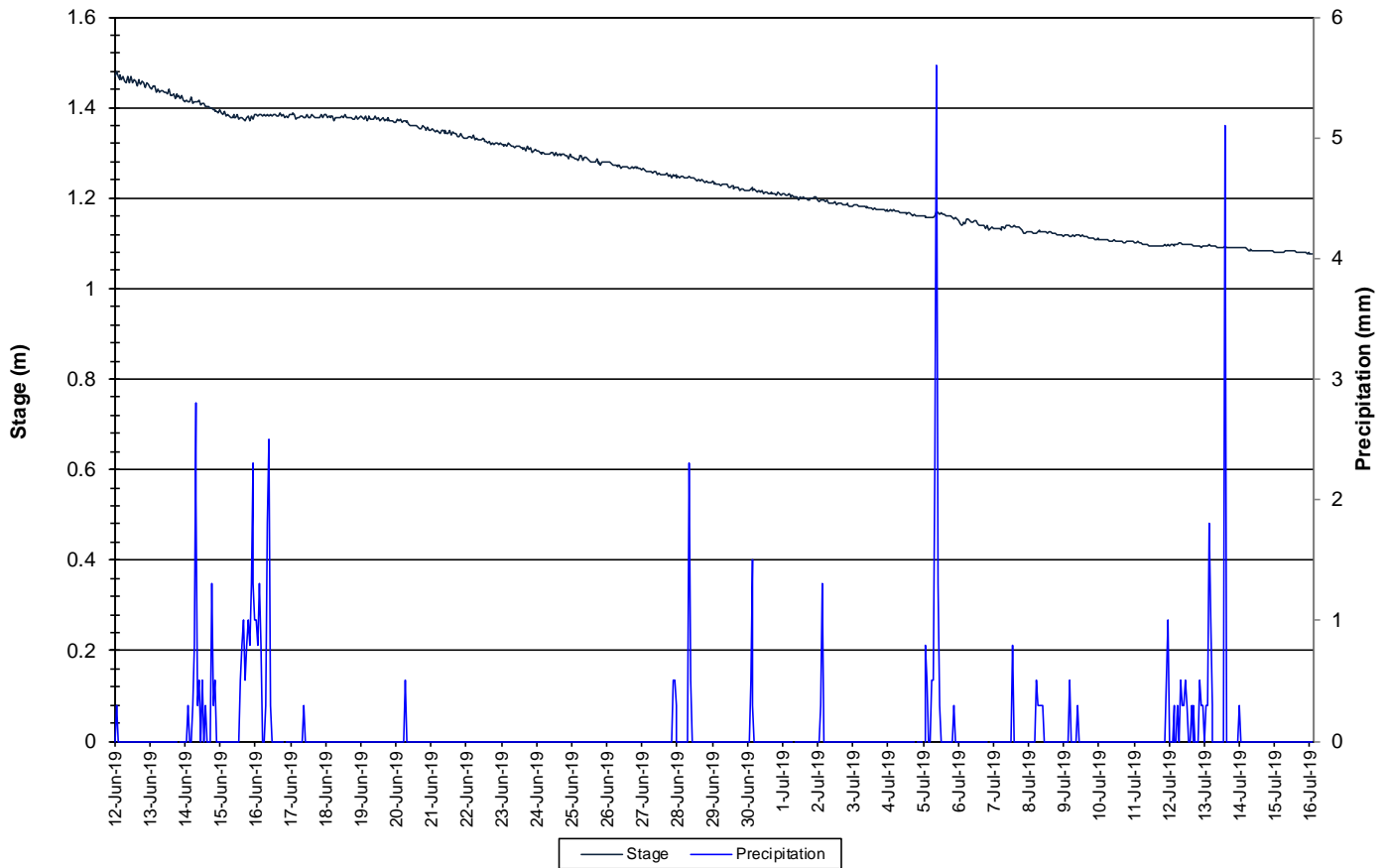


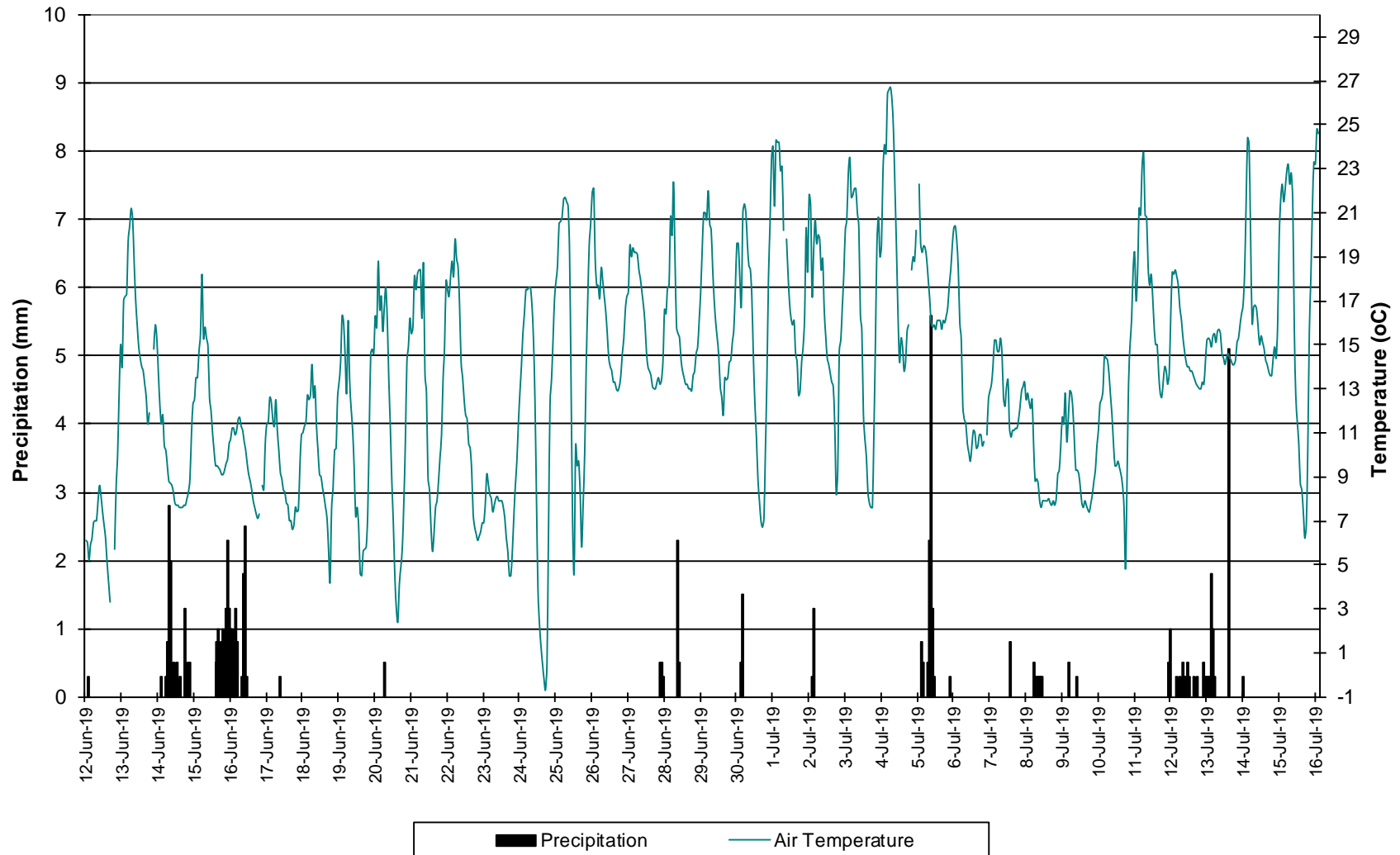
Figure 6: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument was deployed at the Flora Creek below TLH water quality monitoring station on June 12 and removed on July 16, 2019. This was the first deployment for the 2019 field season.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations. Almost 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 8.29 and 22.52°C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.02 and 7.71.
- Specific conductivity ranged from 52.6 to 58.1 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. The majority of values were below the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l.
- Turbidity values decreased significantly over the deployment period.
- Stage gradually decreased during the deployment period as spring runoff decreased.
- 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 June 12 to July 16, 2019



Appendix 2
QA/QC Grab Sample Results

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

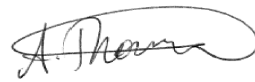
COC Number: 844849
Date Reported: 2019-06-28
Date Submitted: 2019-06-17
Sample Matrix: Water

<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>
1433466	WS-S-0000 Flora Creek	2019-6305-00-SI-SP	2019-06-12	Alkalinity as CaCO3	mg/L	5	24
				Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	3
				Colour	TCU	2	68
				Conductivity	uS/cm	5	53
				Dissolved Organic Carbon	mg/L	0.5	4.6
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	23
				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	7.44
				Sulphate	mg/L	1	2
				Total Dissolved Solids (COND - CALC)	mg/L	1	34
				Total Kjeldahl Nitrogen	mg/L	0.15	<0.15
				Total Organic Carbon	mg/L	0.5	4.5
				Turbidity	NTU	0.1	>100
				Aluminum	mg/L	0.01	0.05

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

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Attention: Ms. Leona Hyde
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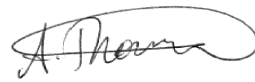
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1433466	WS-S-0000 Flora Creek	2019-6305-00-SI-SP	2019-06-12	Antimony	mg/L	0.0005	<0.0005
				Arsenic	mg/L	0.001	<0.001
				Barium	mg/L	0.01	0.04
				Boron	mg/L	0.01	<0.01
				Calcium	mg/L	1	6
				Cadmium	mg/L	0.0001	<0.0001
				Chromium	mg/L	0.001	<0.001
				Copper	mg/L	0.001	<0.001
				Iron	mg/L	0.03	0.34
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	2
				Manganese	mg/L	0.01	0.94
				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	0.010

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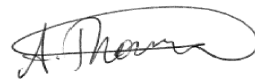
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1433466	WS-S-0000 Flora Creek	2019-6305-00-SI-SP	2019-06-12	Uranium	mg/L	0.001	<0.001
				Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	0.005
				Total Suspended Solids	mg/L	2	41

Sample comment:

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