



Real-Time Water Quality Deployment Report

Flora Creek below TLH

June 7 to
July 13, 2023



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

Contents

General	2
Quality Assurance and Quality Control.....	2
Data Interpretation	4
Flora Creek below TLH	4
Conclusions	10
Appendix 1 - Air Temperature & Precipitation.....	11
Appendix 2 - QA/QC Grab Sample Results	12

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 7th, 2023, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 36 days and was removed on July 13th, 2023. This was the first deployment for 2023.

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 June 7 and July 13, 2023 are summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station June 7 – July 13, 2023.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	June 7, 2023	Deployment	Excellent	Good	Good	Excellent	Good
	July 13, 2023	Removal	Excellent	Fair	Excellent	Excellent	Fair

- At deployment, all parameters ranked either ‘good’ or ‘excellent’.
- At removal, pH ranked ‘fair’. The field sonde read a value of 8.21, while the QA/QC sonde read a value of 7.47. Turbidity ranked ‘fair’. The field sonde read a value of -2.9 NTU, while the QA/QC sonde read a value of 3.6 NTU. All other parameters ranked ‘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 June 7 to July 13 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 8.86 to 25.66°C during this deployment period (Figure 1).
- Water temperature increased during this deployment period, corresponding with increasing seasonal ambient air temperature (Figure 1). This is expected due to temperatures increasing into the summer.

**Water and Air Temperature : Flora Creek below TLH
June 7 to July 13, 2023**

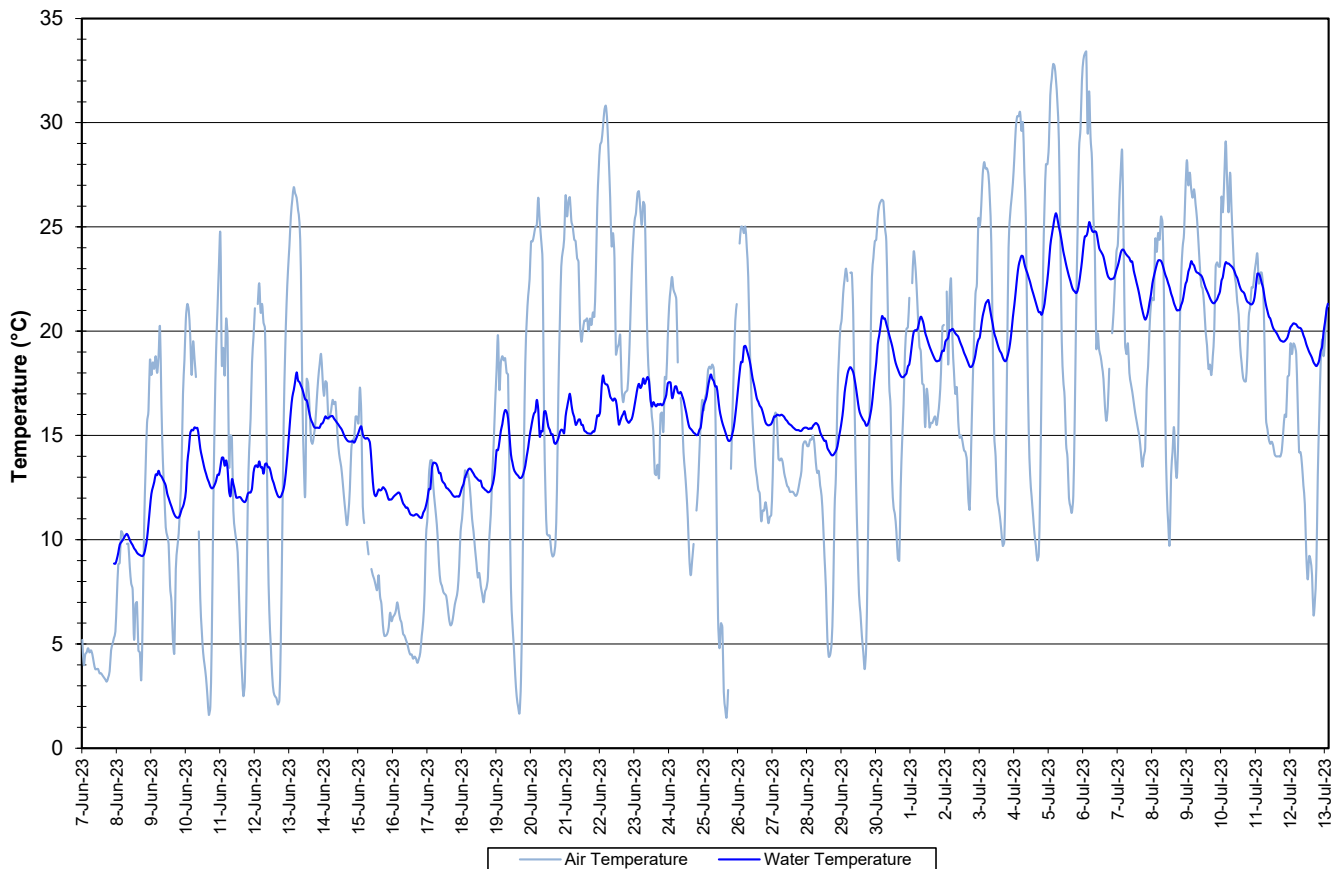


Figure 1: Water and Air Temperature - Flora Creek below TLH

(Weather data collected at Moosehead Lake)

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.94 and 8.48 pH units throughout the deployment period, with a median value of 8.10 units (Figure 2).
- pH decreased slightly during the end of June when stage increased. It then was relatively stable for the remainder of the deployment.
- 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
June 7 to July 13, 2023**

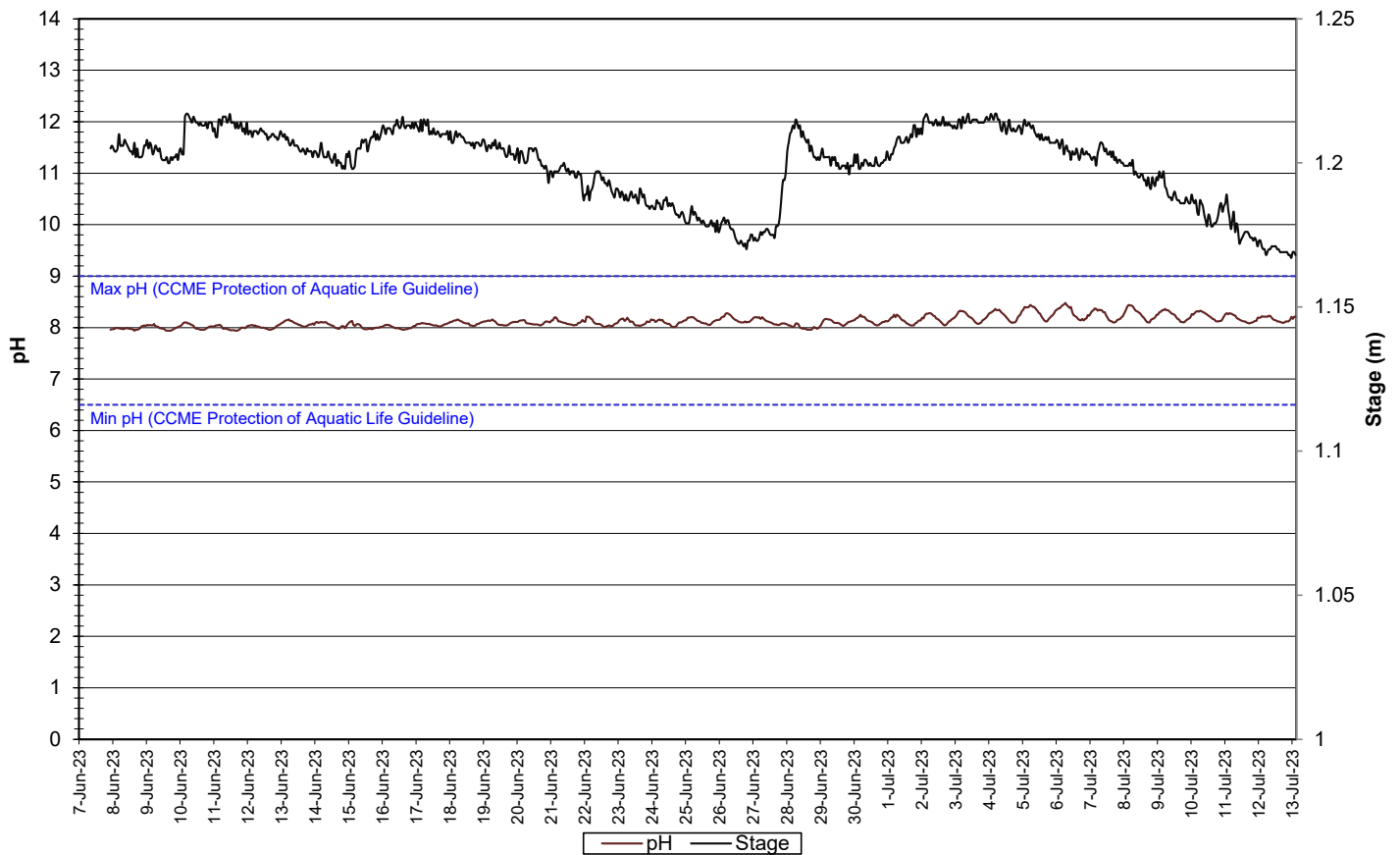


Figure 2: Water pH and Stage - Flora Creek below TLH

- Specific conductivity ranged from 65.2 to 69.0 $\mu\text{S}/\text{cm}$ (Figure 3).
- Specific conductivity increased gradually over the course of the deployment period with a noticeable decrease at the end of June, which corresponds with a sudden increase in stage due to a high precipitation event. As the amount of water in the creek increases, this dilutes the solids that are present, decreasing the conductivity. Some of these events are identified on the graph in red (Figure 3).
- 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 7 to July 13, 2023**

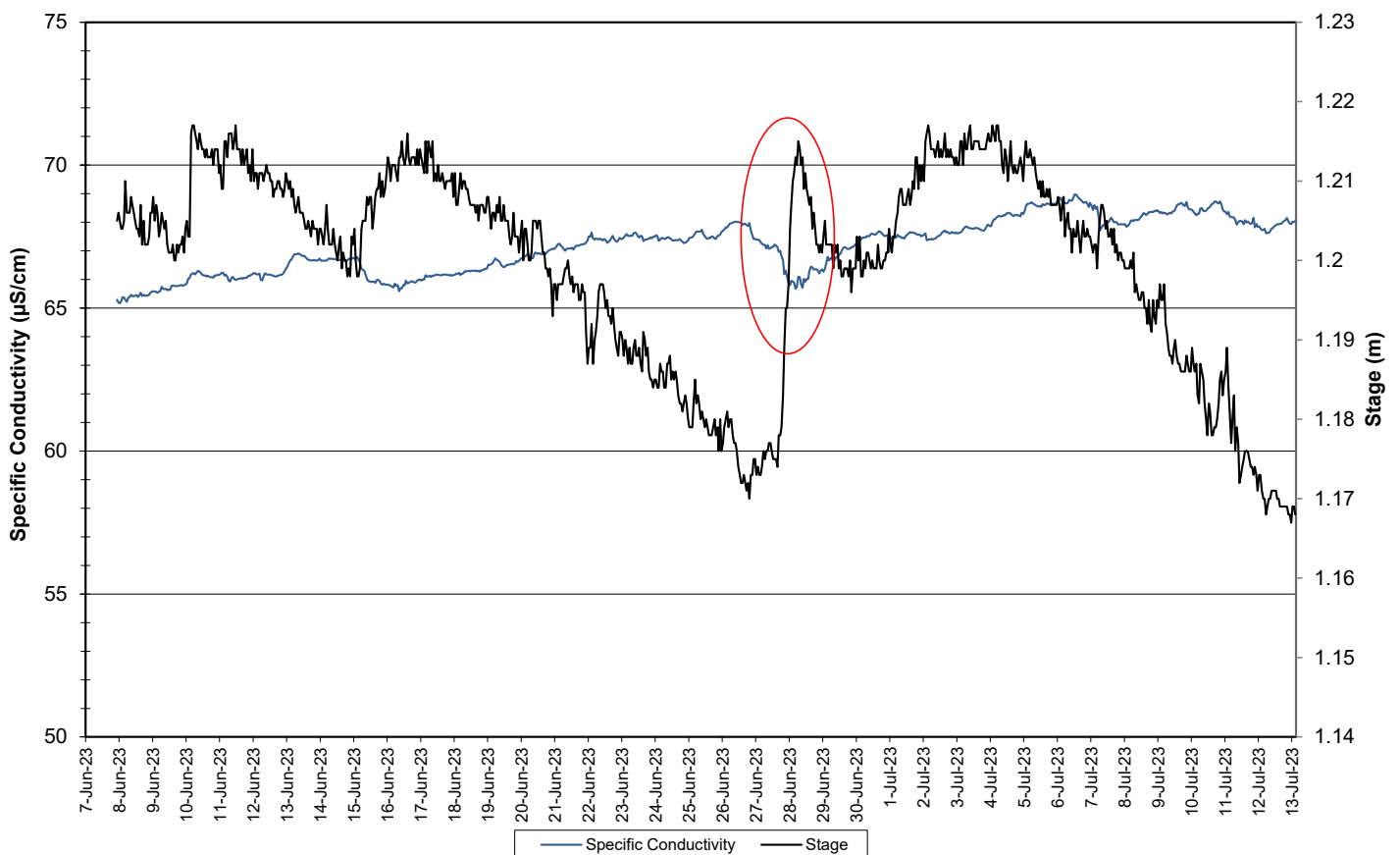


Figure 3: Specific Conductivity of Water and Stage - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- The saturation of dissolved oxygen ranged from 88.0 to 106.7% and a range of 7.95 to 10.57 mg/l was found for the concentration of dissolved oxygen with a median value of 9.32 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. The majority of values were above 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 decreased during this deployment period, as water temperature warms into the summer.

**Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH
June 7 to July 13, 2023**

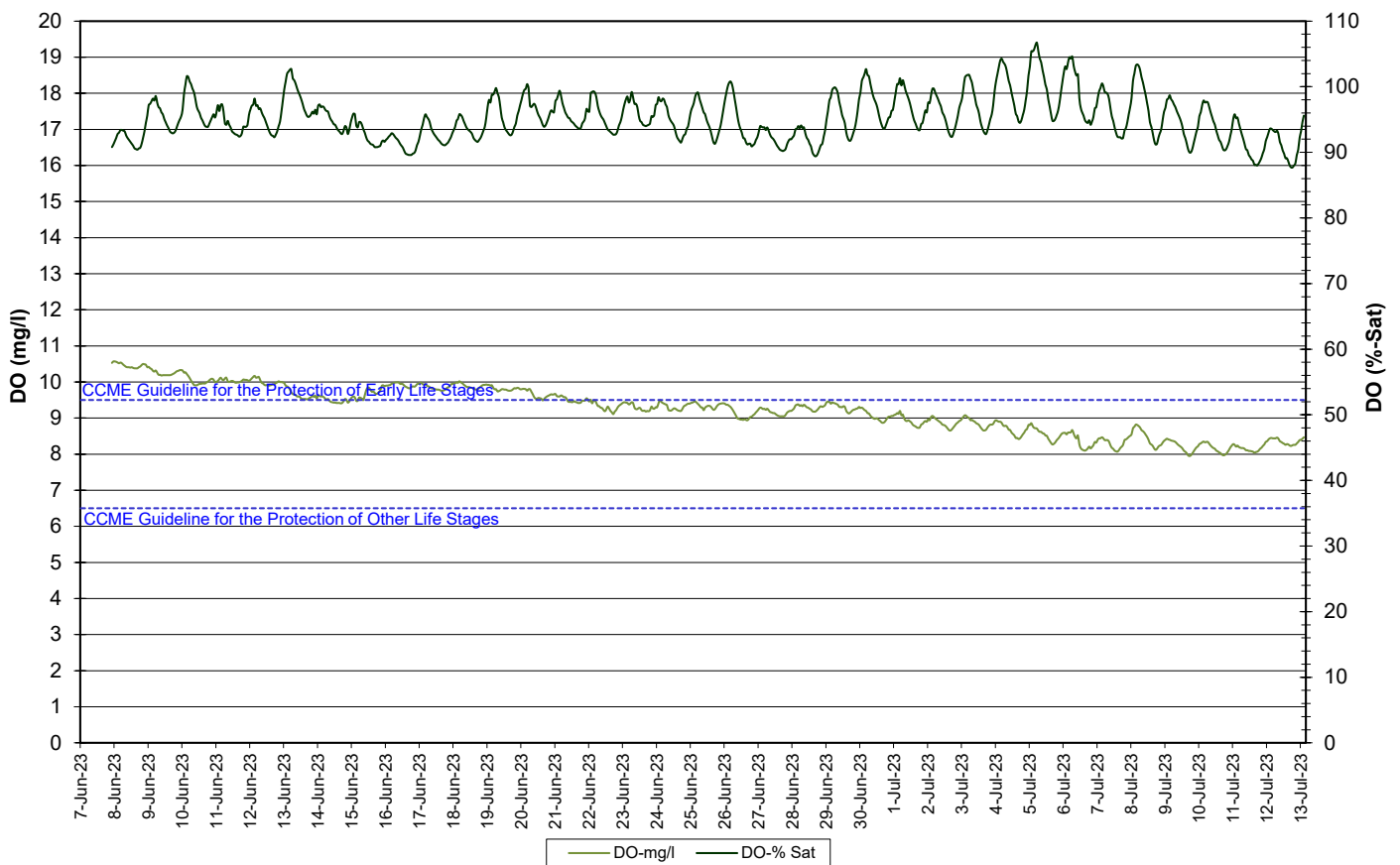


Figure 4: Dissolved Oxygen and Saturation - Flora Creek below TLH

- Turbidity values range from 0.0 NTU to 60.4 NTU (Figure 5).
- This site has very turbid water at times. Turbidity steadily decreased after the late spring melt/freshet. Turbidity increased after a prolonged precipitation event. Temporary spikes are noted following short term precipitation.

**Water Turbidity and Precipitation : Flora Creek below TLH
June 7 to July 13, 2023**

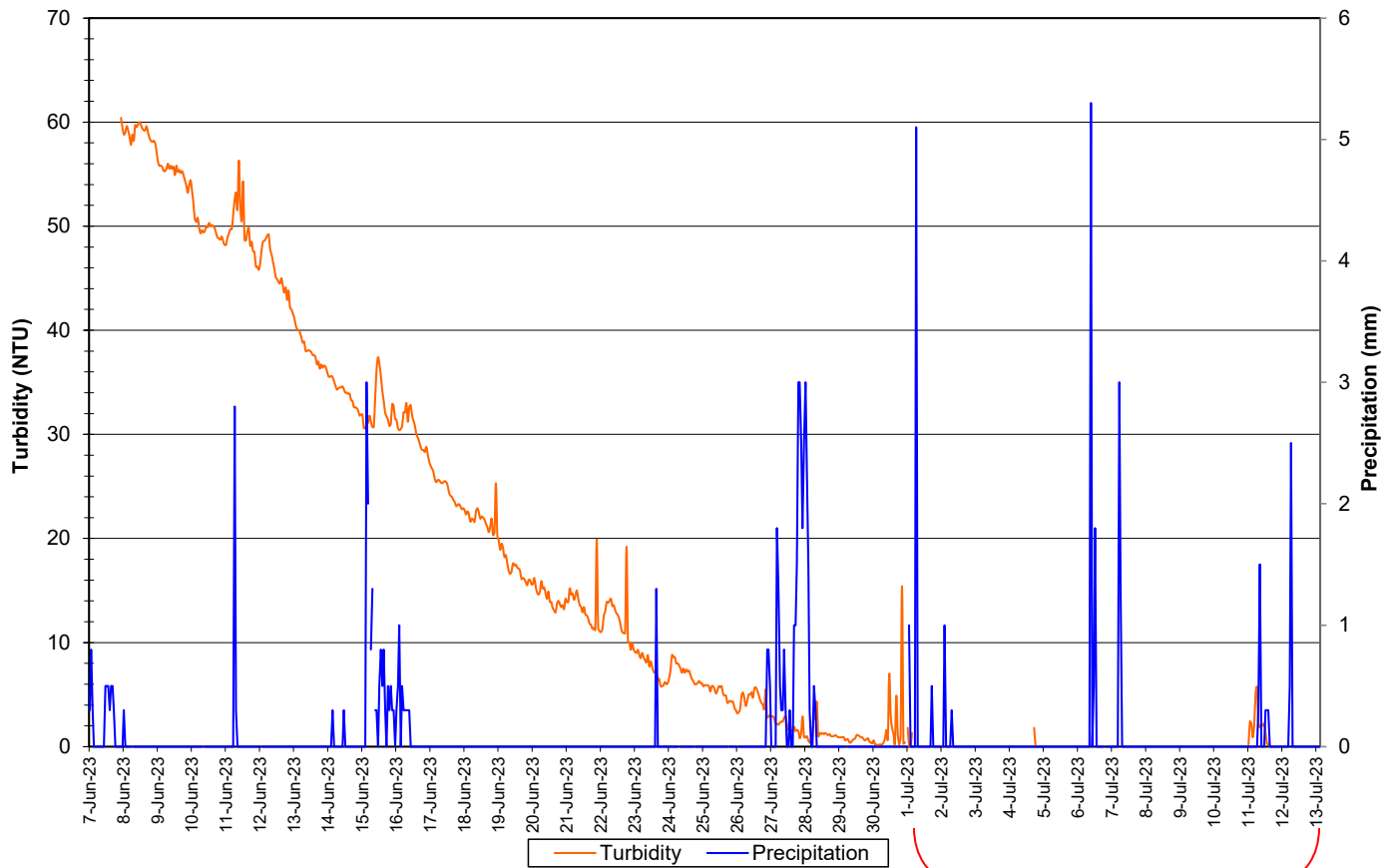


Figure 5: Turbidity - Flora Creek below TLH

A large portion of data was removed during these dates due to inaccurate readings.

- Precipitation and stage during the deployment period are graphed below (Figure 6). Stage increased after prolonged precipitation events, followed by gradual decreases.
- 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 7 to July 13, 2023**

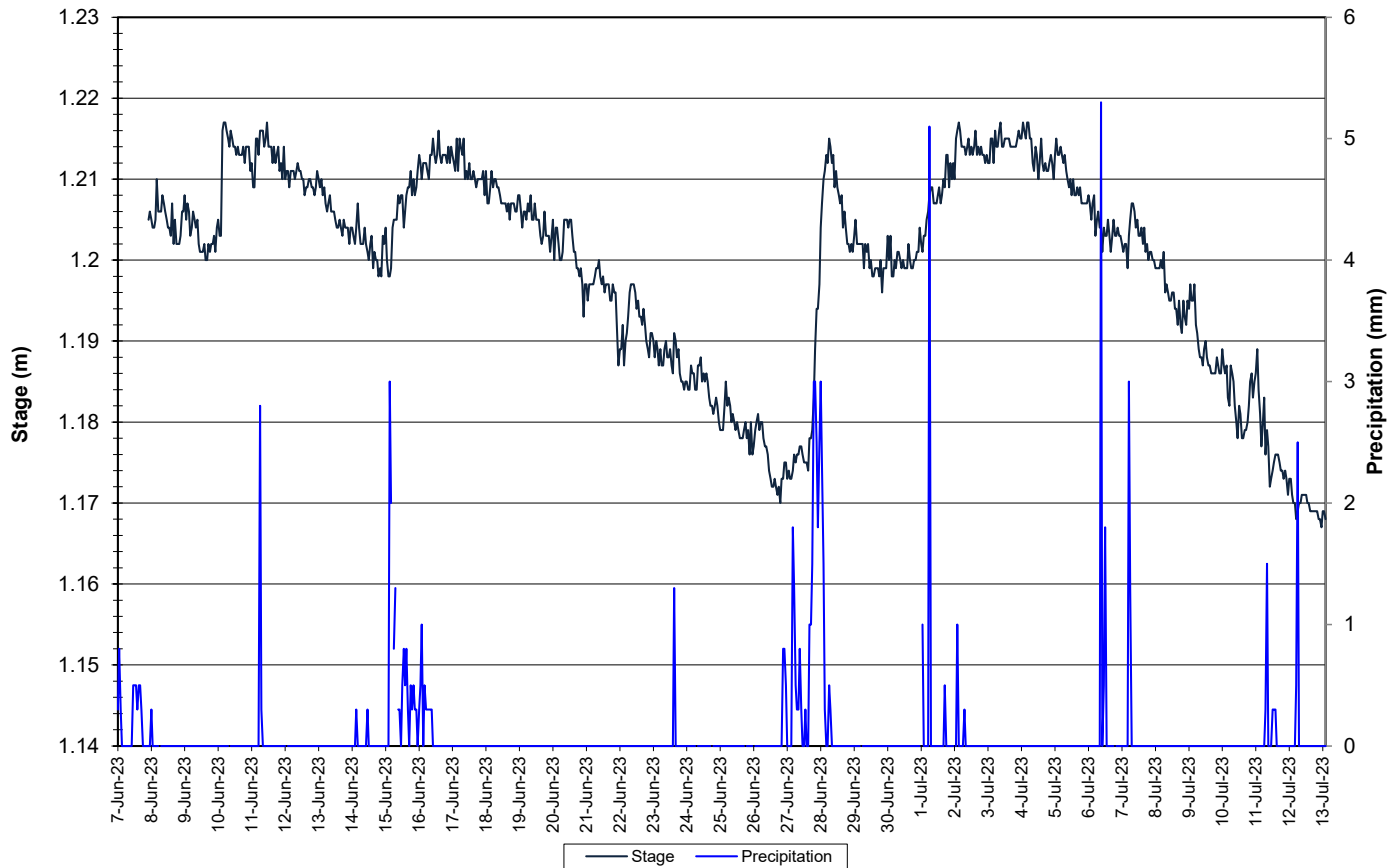


Figure 6: Precipitation and Stage – Flora Creek below TLH

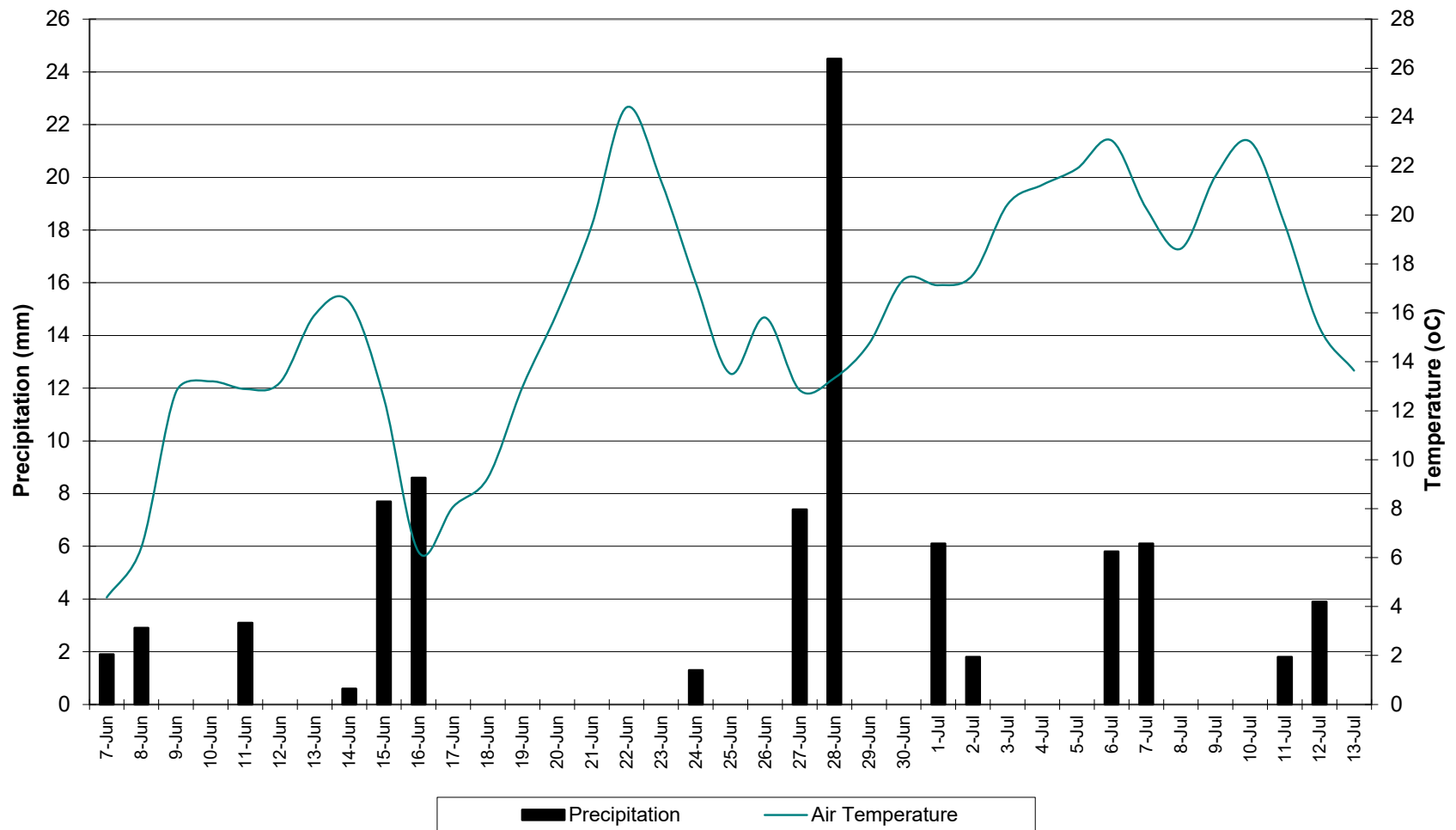
Conclusions

- A clean and calibrated instrument was deployed at the Flora Creek below TLH water quality monitoring station on June 7, 2023 and removed on July 13, 2023. This was the first deployment for 2023.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations. Most values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen.
- Water temperature corresponded with ambient air temperature, ranging between 8.86 and 25.66°C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.94 and 8.48.
- Specific conductivity increased gradually over the course of the deployment period. There was a decrease during a significant precipitation event. Values ranged from 65.2 to 69.0 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 the 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 is high at this site during this time of year, due to late spring runoff/freshet. Values decreased over the course of this deployment period. Turbidity ranged from 0.0 to 64.0 NTU.
- Stage fluctuated during this deployment period, showing decreases during periods of little to no precipitation. Stage increases were noted after precipitation events.
- 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.

Prepared by:
Maria Murphy
Department of Environment & Climate Change
Water Resources Management Division
Phone: 709.896.7981

Appendix 1

Air Temperature and Precipitation: Moosehead Lake June 7 to July 13, 2023



Appendix 2
QA/QC Grab Sample Results



BUREAU VERITAS

Bureau Veritas Job #: C3H0137
Report Date: 2023/06/28

NL Department of Environment, Climate Change and
Municipalities
Site Location: LABRADOR
Your P.O. #: 220028978-9
Sampler Initials: MM

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
WBS584 FLORA CREEK								
Sampling Date		2023/06/07 12:30						
Matrix		W						
Sample #		2023-6306-00-SI-SP						
Registration #		SA-0000						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	31	1.0	mg/L	N/A	2023/06/26		8722303
Nitrate (N)	-	0.38	0.050	mg/L	N/A	2023/06/21		8722227
Total dissolved solids (calc., EC)	-	39	1.0	mg/L	N/A	2023/06/16		8722338
Inorganics								
Conductivity	-	70	1.0	uS/cm	N/A	2023/06/15	NGI	8727590
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2023/06/19	LKH	8732150
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2023/06/19	LKH	8732150
Sulphate (SO4)	-	3.6	1.0	mg/L	N/A	2023/06/19	LKH	8732150
Total Alkalinity (Total as CaCO3)	-	28	2.0	mg/L	N/A	2023/06/15	NGI	8727593
Colour	-	16	5.0	TCU	N/A	2023/06/20	TGO	8737879
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2023/06/15	NGI	8727594
Total Kjeldahl Nitrogen (TKN)	-	0.21	0.10	mg/L	2023/06/22	2023/06/23	RTY	8746431
Nitrate + Nitrite (N)	-	0.38	0.050	mg/L	N/A	2023/06/21	TGO	8737875
Nitrite (N)	-	ND	0.010	mg/L	N/A	2023/06/20	TGO	8736712
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2023/06/22	TGO	8745758
Dissolved Organic Carbon (C)	-	2.0	0.50	mg/L	N/A	2023/06/15	CPP	8729203
Total Organic Carbon (C)	-	2.0	0.50	mg/L	N/A	2023/06/15	CPP	8727523
pH	-	7.67		pH	N/A	2023/06/15	NGI	8727592
Total Phosphorus	-	0.012	0.004	mg/L	2023/06/22	2023/06/23	SPC	8746738
Total Suspended Solids	-	2.6	1.0	mg/L	2023/06/13	2023/06/15	RMK	8721816
Turbidity	-	23	0.10	NTU	N/A	2023/06/21	NGI	8737994
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2023/06/19	2023/06/20	SGK	8736613
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.014	0.0050	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Antimony (Sb)	-	ND	0.0010	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Arsenic (As)	-	ND	0.0010	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Barium (Ba)	-	0.013	0.0010	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Boron (B)	-	ND	0.050	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Calcium (Ca)	-	6.8	0.10	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Chromium (Cr)	-	ND	0.0010	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Copper (Cu)	-	ND	0.00050	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Iron (Fe)	-	0.11	0.050	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Lead (Pb)	-	ND	0.00050	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Magnesium (Mg)	-	3.4	0.10	mg/L	2023/06/23	2023/06/23	BCZ	8747406



BUREAU
VERITAS

Bureau Veritas Job #: C3H0137
Report Date: 2023/06/28

NL Department of Environment, Climate Change and
Municipalities
Site Location: LABRADOR
Your P.O. #: 220028978-9
Sampler Initials: MM

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
WBS584 FLORA CREEK								
Sampling Date		2023/06/07 12:30						
Matrix		W						
Sample #		2023-6306-00-SI-SP						
Registration #		SA-0000						
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.29	0.0020	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Nickel (Ni)	-	ND	0.0020	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Phosphorus (P)	-	ND	0.10	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Potassium (K)	-	0.77	0.10	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Selenium (Se)	-	ND	0.00050	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Sodium (Na)	-	0.79	0.10	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Strontium (Sr)	-	0.0068	0.0020	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Uranium (U)	-	ND	0.00010	mg/L	2023/06/23	2023/06/23	BCZ	8747406
Total Zinc (Zn)	-	ND	0.0050	mg/L	2023/06/23	2023/06/23	BCZ	8747406