



# Real-Time Water Quality Deployment Report

Flora Creek below TLH

July 20 to  
September 8, 2022



Government of Newfoundland & Labrador  
Department of Environment & Climate Change  
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 July 20, 2022, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 50 days and was removed on September 8<sup>th</sup>, 2022. This was the second deployment for 2022.
- This station did not transmit data in real time during the deployment. Data was recorded internally and retrieved once the instrument was removed on September 8<sup>th</sup>, 2022. There is missing data during the last week of the deployment period.

## 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 July 20 and September 8, 2022 are summarized in Table 2.

**Table 2: Comparison rankings for Flora Creek below TLH station July 20 – September 8, 2022.**

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	July 20, 2022	Deployment	Excellent	Excellent	Excellent	Excellent	Good
	Sept 8, 2022	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 7.76, while the QA/QC sonde read a value of 7.12. When the field sonde value was compared to a QA/QC grab sample collected at the time, the comparison ranking is ‘excellent’. Turbidity also ranked ‘fair’, with the field instrument reading a value of 13.8 NTU, while the QA/QC instrument read a value of 8.4 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 July 20 to September 8 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 13.97 to 21.81°C during this deployment period (Figure 1).
- Water temperature corresponded with increases and decreases in ambient air temperature (Figure 1).

Water and Air Temperature : Flora Creek below TLH  
July 20 to September 8, 2022

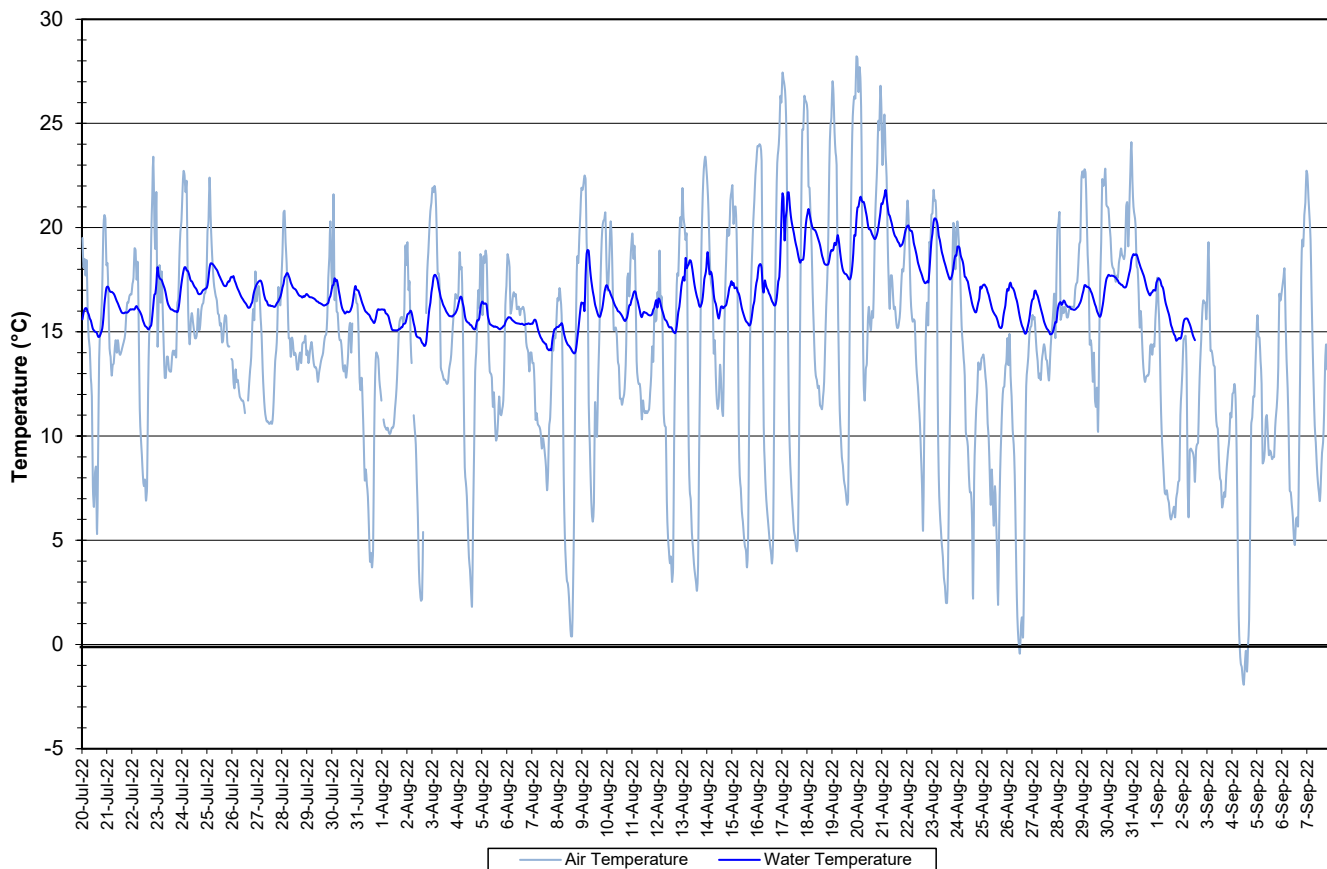


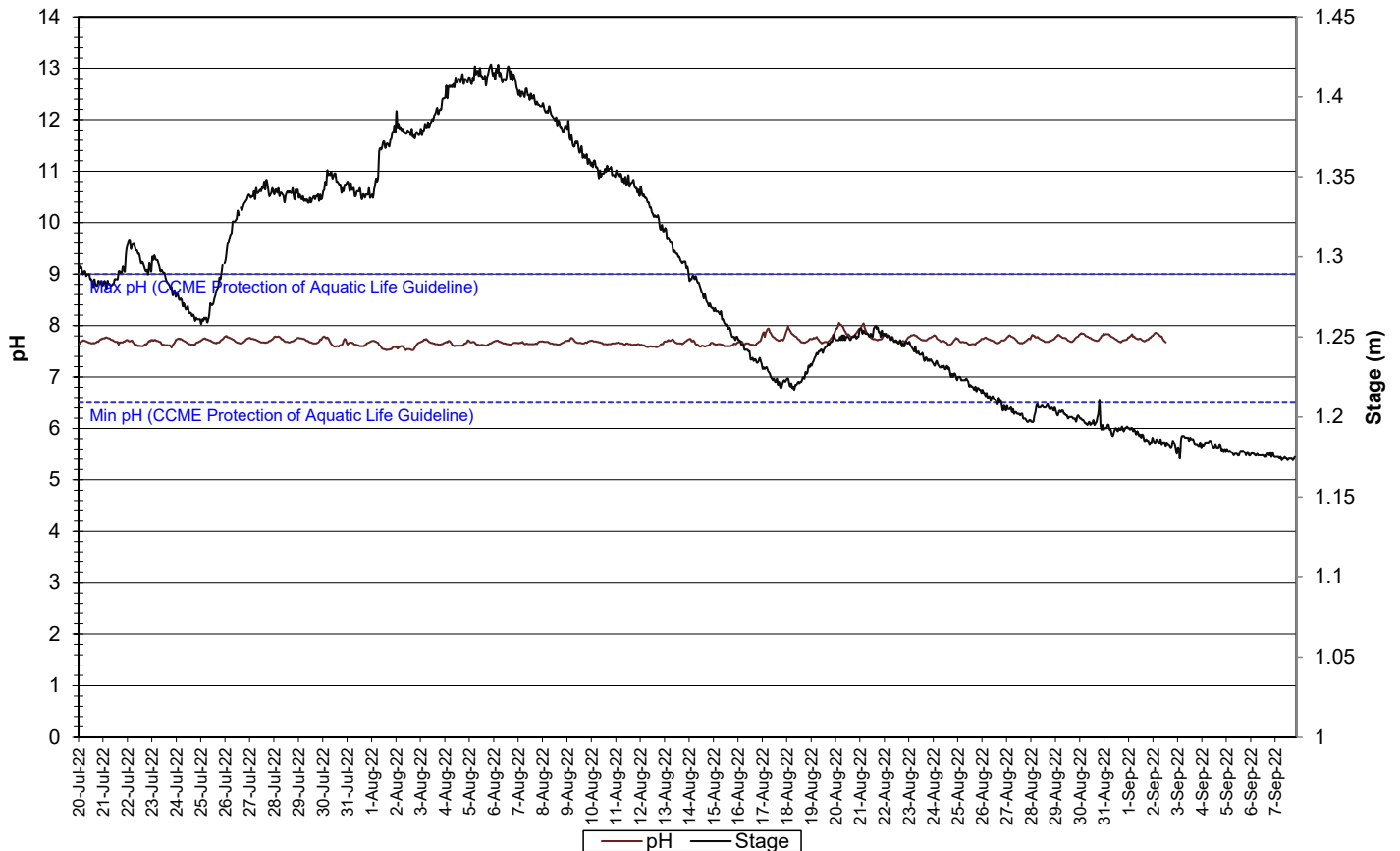
Figure 1: Water and Air Temperature - Flora Creek below TLH

(Weather data collected at Moosehead Lake)

*Flora Creek below TLH, Newfoundland and Labrador*

- pH ranged between 7.52 and 8.05 pH units throughout the deployment period, with a median value of 7.68 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  
July 20 to September 8, 2022**



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

- Specific conductivity ranged from 62.1 to 65.9  $\mu\text{S}/\text{cm}$  (Figure 3).
- Specific conductivity decreased during the first two weeks of August. It then started to increase and fluctuated within a small range for the remainder of the deployment period.
- There are a few noticeable decreases in conductivity that correspond with precipitation events. This can be expected after rainfall. As the amount of water in the creek increases, this dilutes the solids that are present, decreasing the conductivity. 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  
July 20 to September 8, 2022

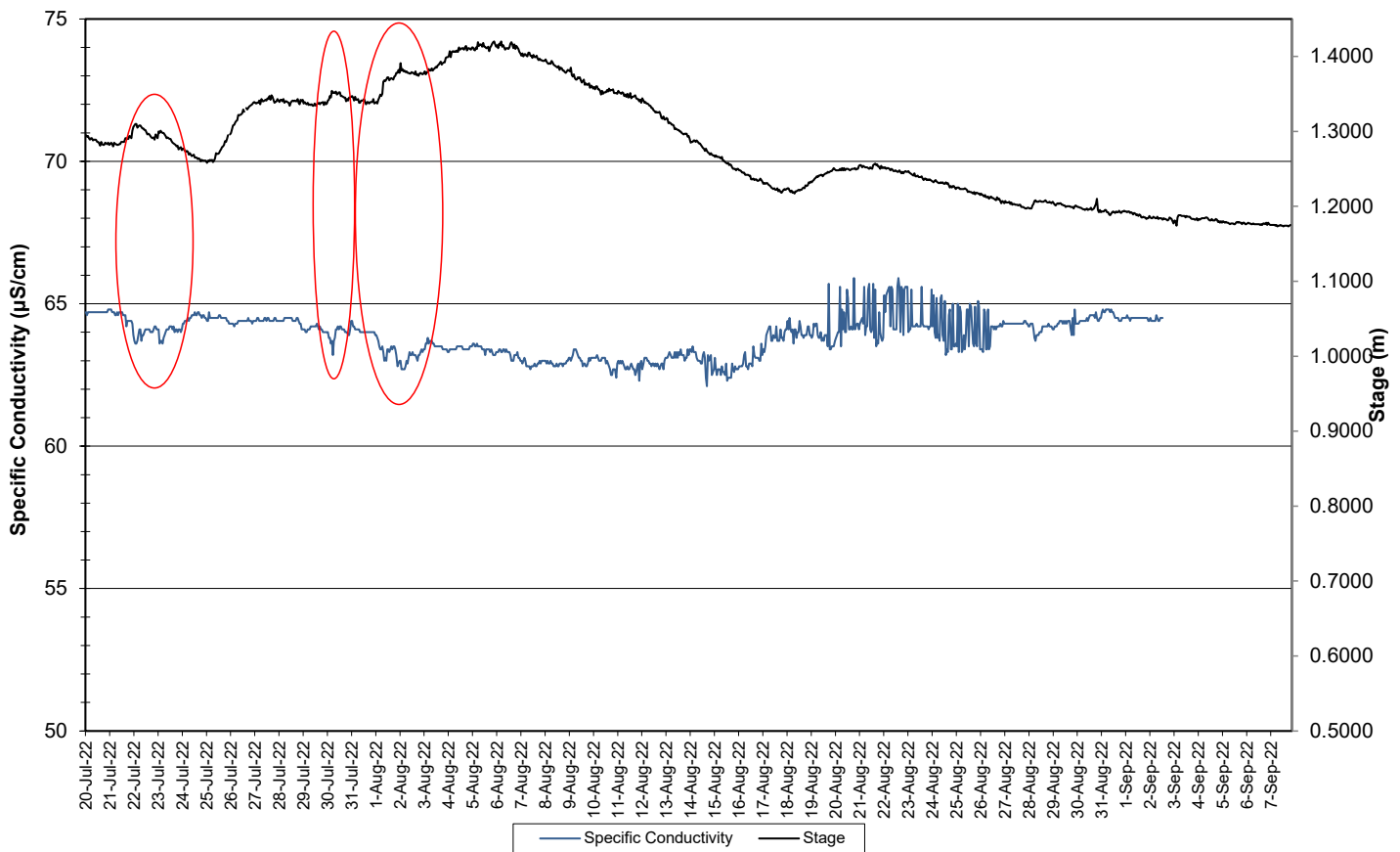
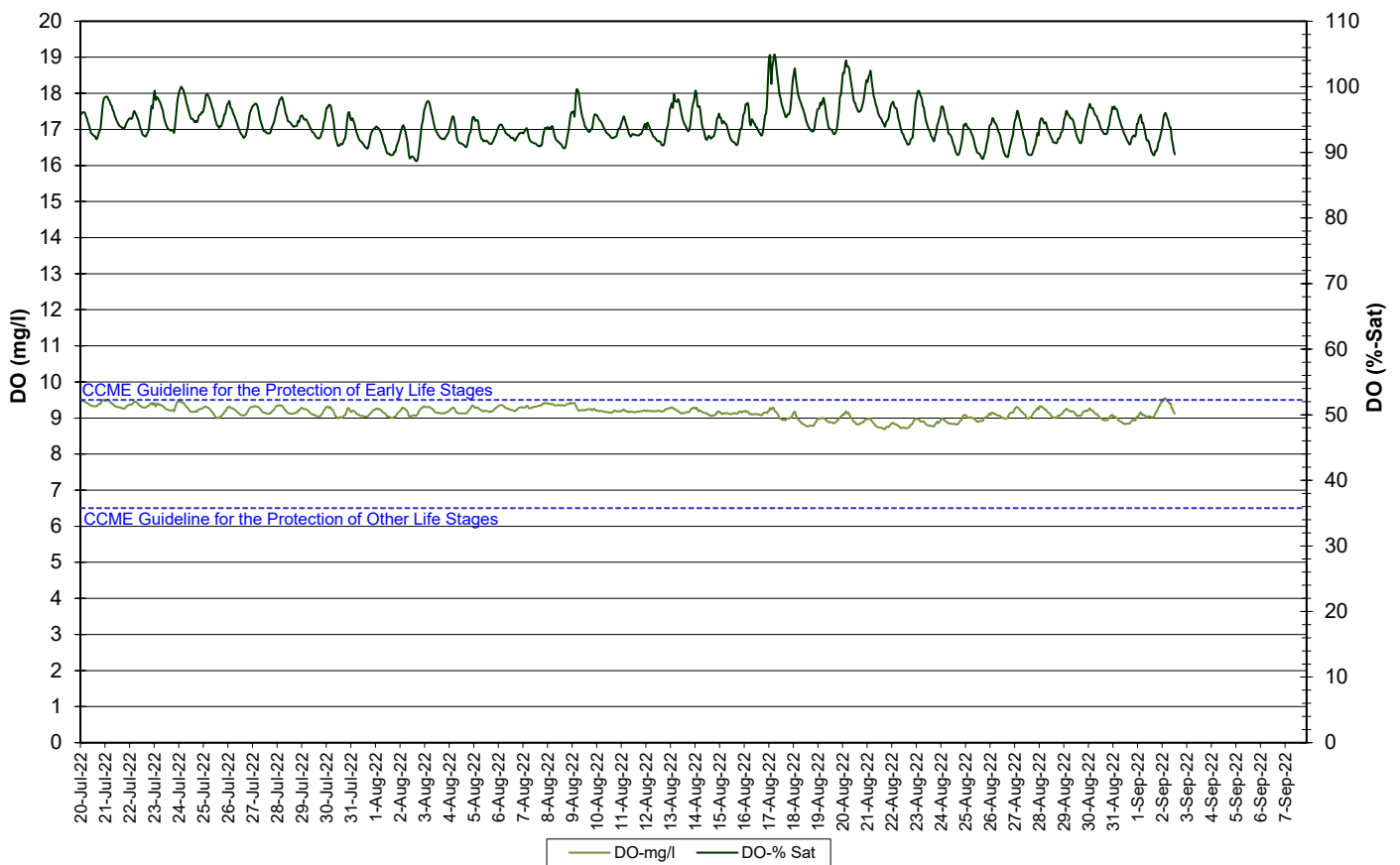


Figure 3: Specific Conductivity of Water and Stage - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 88.7% to 104.9% and a range of 8.69 to 9.55 mg/l was found for the concentration of dissolved oxygen with a median value of 9.17 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 below 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 decreases during August as water temperature is highest at this time.

**Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH  
July 20 to September 8, 2022**

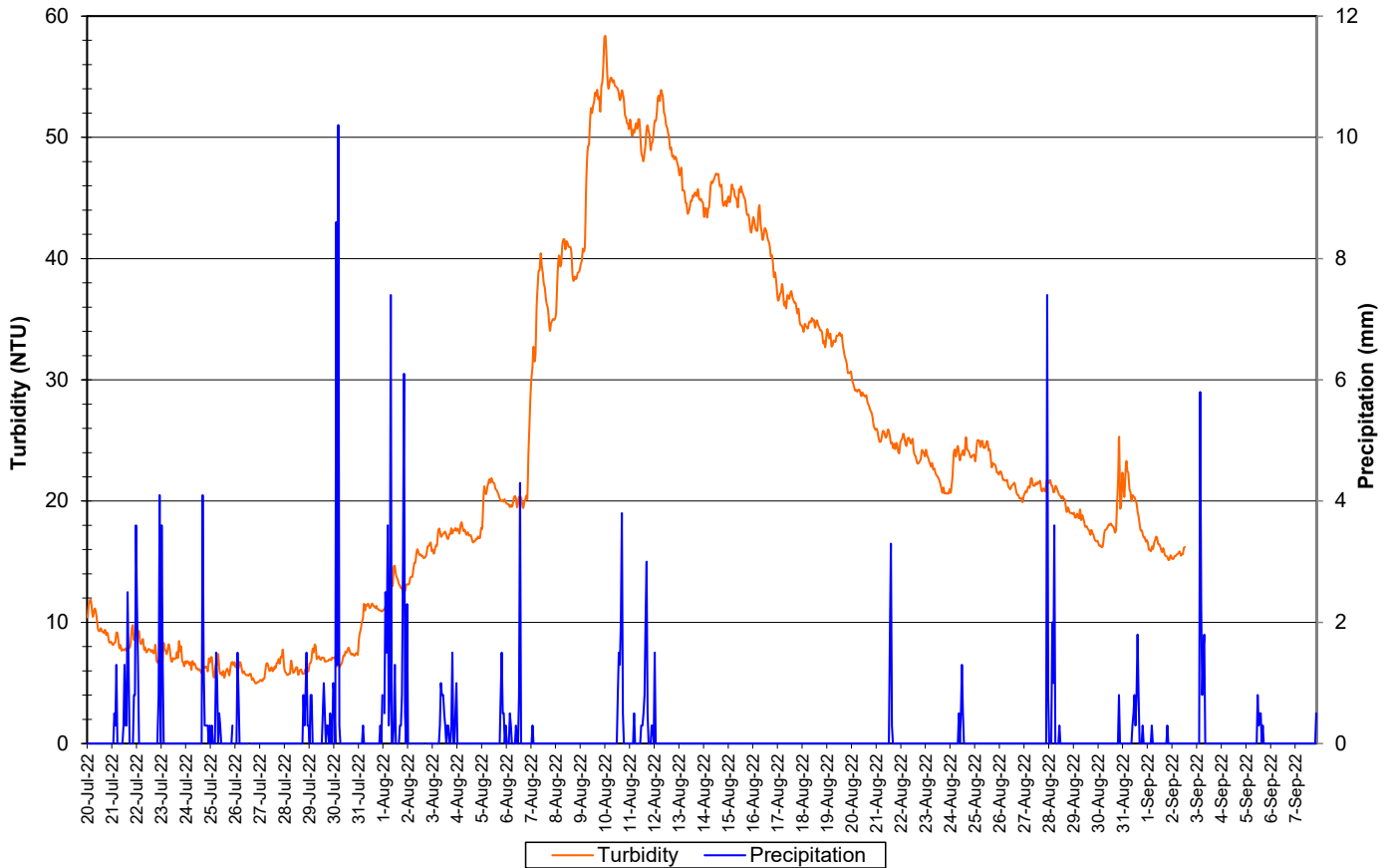


**Figure 4: Dissolved Oxygen and Saturation - Flora Creek below TLH**



- Turbidity values range from 5.0 NTU to 58.4 NTU (Figure 5).
- This site has very turbid water at times. Turbidity steadily increased until the second week of August. It then gradually decreased until the end of the deployment period.

**Water Turbidity and Precipitation : Flora Creek below TLH  
July 20 to September 8, 2022**



**Figure 5: Turbidity - Flora Creek below TLH**

- Precipitation and stage during the deployment period are graphed below (Figure 6). Stage increased slightly until the second week of August. It then decreased gradually until the end 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  
July 20 to September 8, 2022

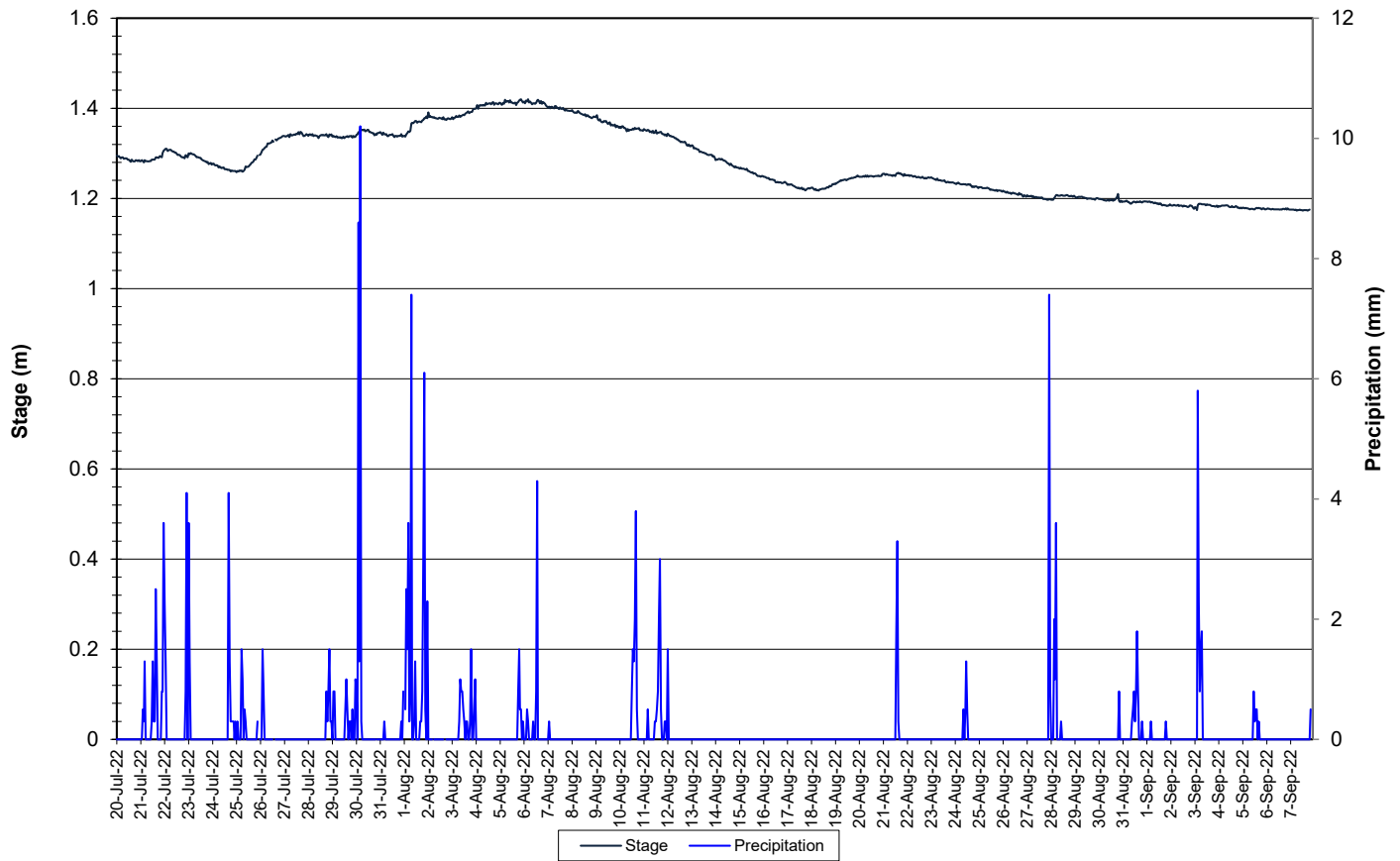


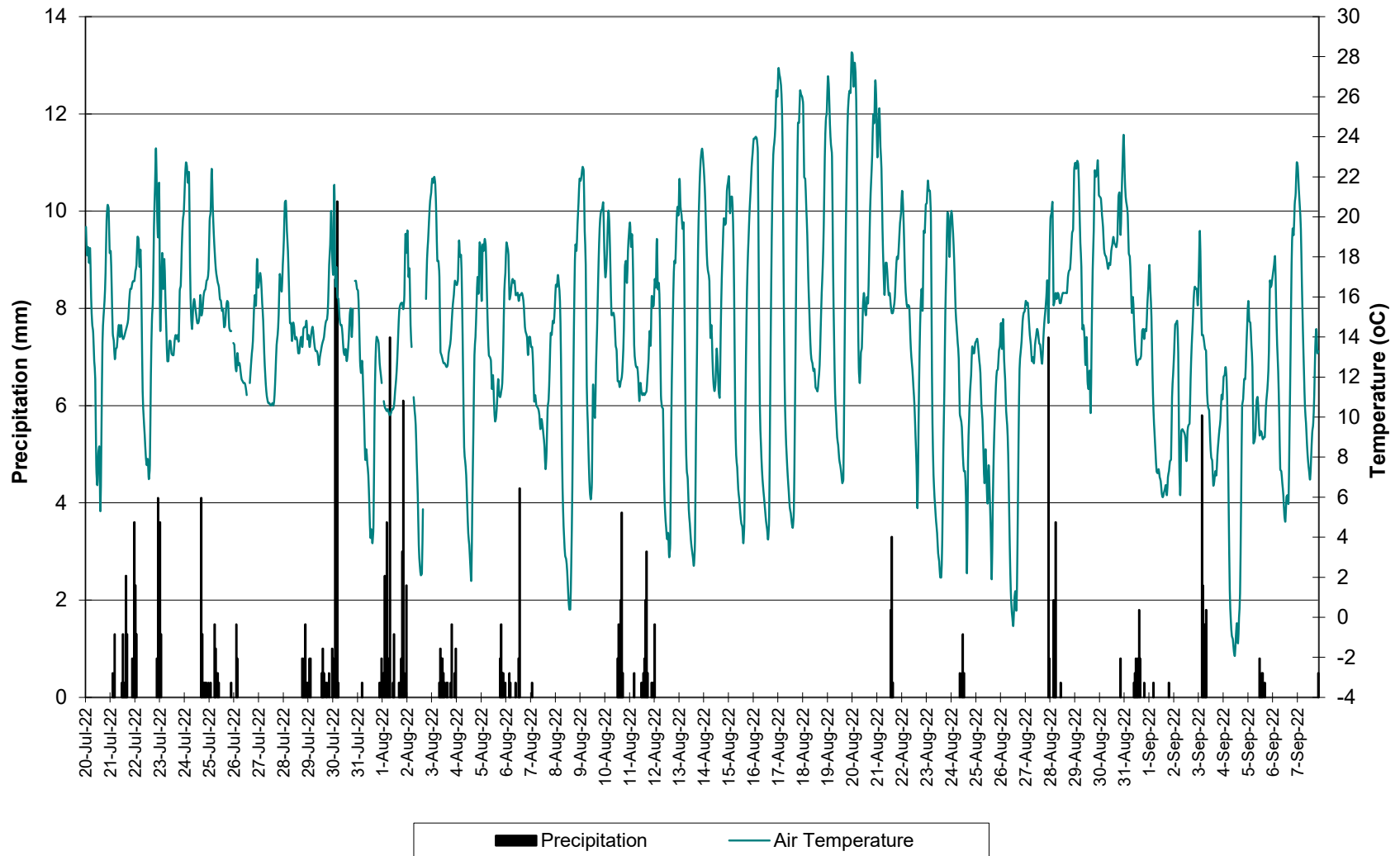
Figure 6: Precipitation and Stage – Flora Creek below TLH

## Conclusions

- A clean and calibrated instrument was deployed at the Flora Creek below TLH water quality monitoring station on July 20<sup>th</sup> and removed on September 8<sup>th</sup>, 2022. This was the second deployment for 2022.
- 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 13.97 and 21.81°C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.52 and 8.05.
- Specific conductivity decreased during the first two weeks of August. It then started to increase again and fluctuated in a small range for the remainder of the period, ranging from 62.1 to 65.9 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. Almost all 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 steadily increased until the second week of August. It then gradually decreased until the end of the deployment period. Turbidity ranged from 5.0 to 58.4 NTU.
- Stage increased slightly during the later portion of July before decreasing gradually over 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 July 20 to September 8, 2022



**Appendix 2**  
**QA/QC Grab Sample Results**



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Bureau Veritas Job #: C2L3227  
Report Date: 2023/01/17

NL Department of Environment, Climate Change and  
Municipalities  
Client Project #: RTWQ  
Site Location: LABRADOR  
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
THQ457 FLORA CREEK								
Sampling Date		2022/07/20 12:50						
Matrix		W						
Sample #		2022-6316-00-SI-SP						
Registration #		WS-0-0000						
<b>RESULTS OF ANALYSES OF WATER</b>								
<b>Calculated Parameters</b>								
Hardness (CaCO3)	-	28	1.0	mg/L	N/A	2022/08/10		8137781
Nitrate (N)	-	0.29	0.050	mg/L	N/A	2022/08/04		8137785
Total dissolved solids (calc., EC)	-	35	1.0	mg/L	N/A	2022/08/03		8137821
<b>Inorganics</b>								
Conductivity	-	63	1.0	uS/cm	N/A	2022/08/02	NGI	8141682
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2022/08/03	LKH	8144160
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/08/03	LKH	8144160
Sulphate (SO4)	-	3.7	1.0	mg/L	N/A	2022/08/03	LKH	8144160
Total Alkalinity (Total as CaCO3)	-	26	2.0	mg/L	N/A	2022/08/02	NGI	8141684
Colour	-	ND	5.0	TCU	N/A	2022/08/04	TGO	8143902
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/08/03	NGI	8141685
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/08/09	2022/08/10	RTY	8155159
Nitrate + Nitrite (N)	-	0.29	0.050	mg/L	N/A	2022/08/03	TGO	8143904
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/08/03	TGO	8143905
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/08/02	TGO	8141634
Dissolved Organic Carbon (C)	-	2.1	0.50	mg/L	N/A	2022/08/02	KMC	8138119
Total Organic Carbon (C)	-	2.0	0.50	mg/L	N/A	2022/08/02	KMC	8138114
pH	-	7.55		pH	N/A	2022/08/02	NGI	8141683
Total Phosphorus	-	ND	0.004	mg/L	2022/08/03	2022/08/05	SSV	8145071
Total Suspended Solids	-	1.0	1.0	mg/L	2022/07/29	2022/07/29	RMK	8137996
Turbidity	-	3.8	0.10	NTU	N/A	2022/08/03	NGI	8143950
<b>MERCURY BY COLD VAPOUR AA (WATER)</b>								
<b>Metals</b>								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/07/29	2022/08/02	FJO	8138417
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Aluminum (Al)	-	0.010	0.0050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Barium (Ba)	-	0.0035	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Boron (B)	-	ND	0.050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Calcium (Ca)	-	6.3	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Copper (Cu)	-	0.00067	0.00050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Iron (Fe)	-	ND	0.050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Magnesium (Mg)	-	3.1	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038



BUREAU  
VERITAS

Bureau Veritas Job #: C2L3227  
Report Date: 2023/01/17

NL Department of Environment, Climate Change and  
Municipalities  
Client Project #: RTWQ  
Site Location: LABRADOR  
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
THQ457 FLORA CREEK								
Sampling Date		2022/07/20 12:50						
Matrix		W						
Sample #		2022-6316-00-SI-SP						
Registration #		WS-0-0000						
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Manganese (Mn)	-	0.093	0.0020	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Potassium (K)	-	0.80	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Sodium (Na)	-	0.74	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Strontium (Sr)	-	0.0054	0.0020	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Uranium (U)	-	ND	0.00010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/08/08	2022/08/09	JHY	8153038