



# Real-Time Water Quality Deployment Report

Flora Creek below TLH

June 7 to  
July 20, 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 June 7, 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 43 days and was removed on July 20<sup>th</sup>, 2022. This was the first 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 July 20<sup>th</sup>, 2022.

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

**Table 2: Comparison rankings for Flora Creek below TLH station June 7 – July 20, 2022.**

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	June 7, 2022	Deployment	Good	Good	Excellent	Excellent	N/A
	July 20, 2022	Removal	Excellent	Good	Excellent	Excellent	Excellent

- At deployment and removal, all parameters except turbidity ranked either ‘good’ or ‘excellent’.
- At deployment, turbidity could not be ranked when compared to the QA/QC sonde, due to a failed sensor on this sonde. When compared to the QA/QC grab sample collected at deployment, the turbidity ranking is ‘poor’.
- 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.

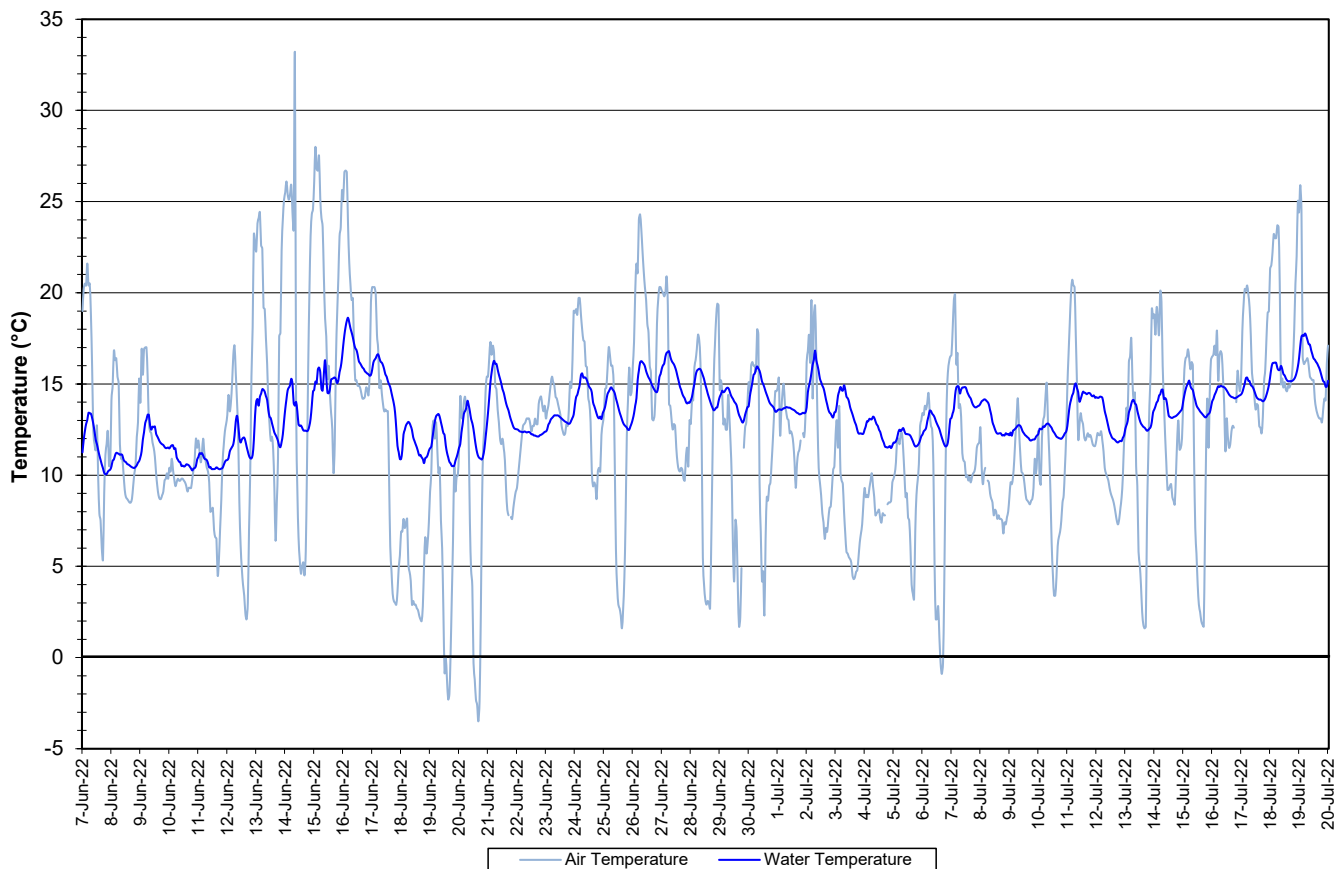
## Data Interpretation

- The following graphs and discussion illustrate water quality related events from June 7 to July 20 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 10.05 to 18.63°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  
June 7 to July 20, 2022**



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

(Weather data collected at Moosehead Lake)

- pH ranged between 7.58 and 8.00 pH units throughout the deployment period, with a median value of 7.83 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  
June 7 to July 20, 2022

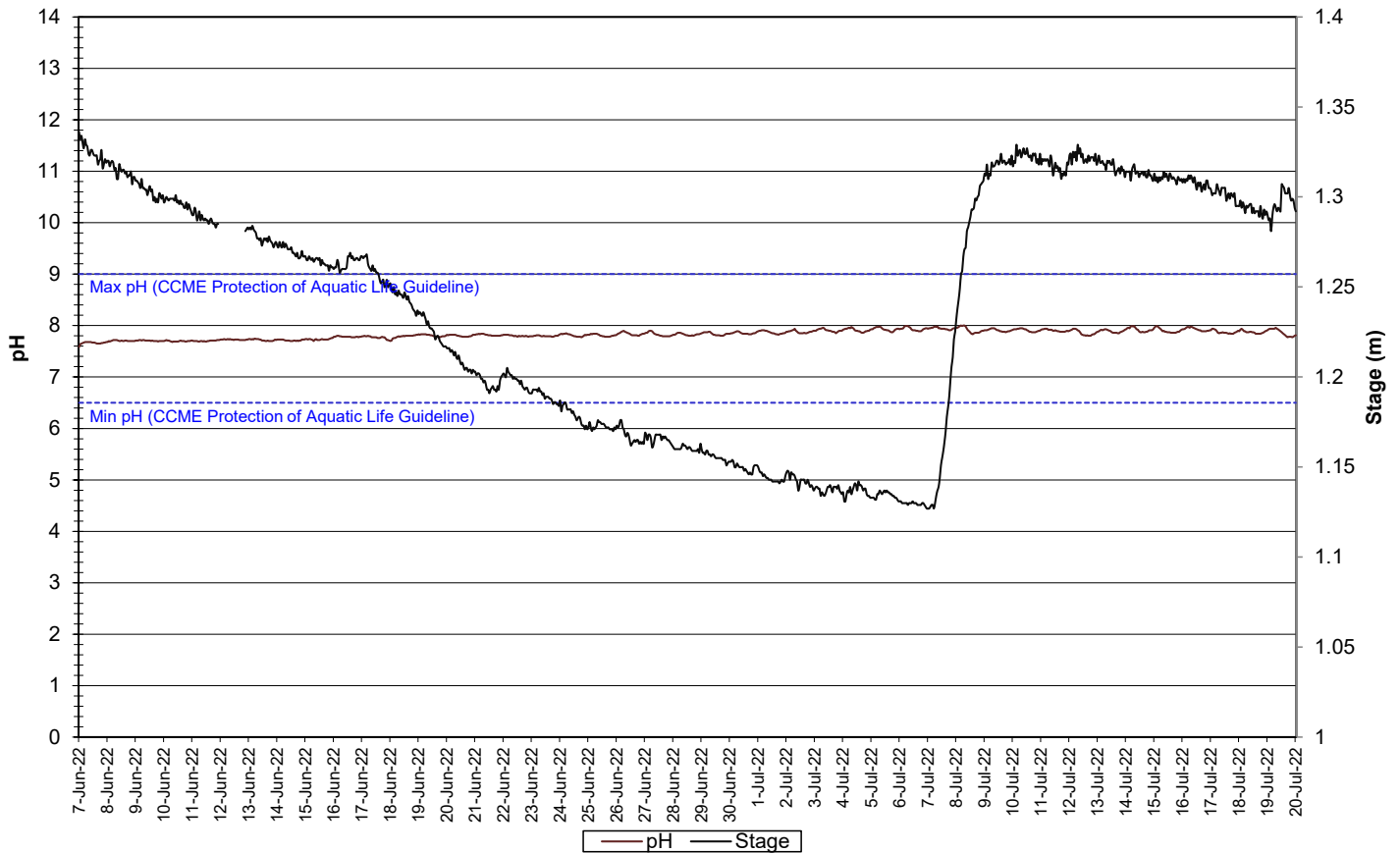
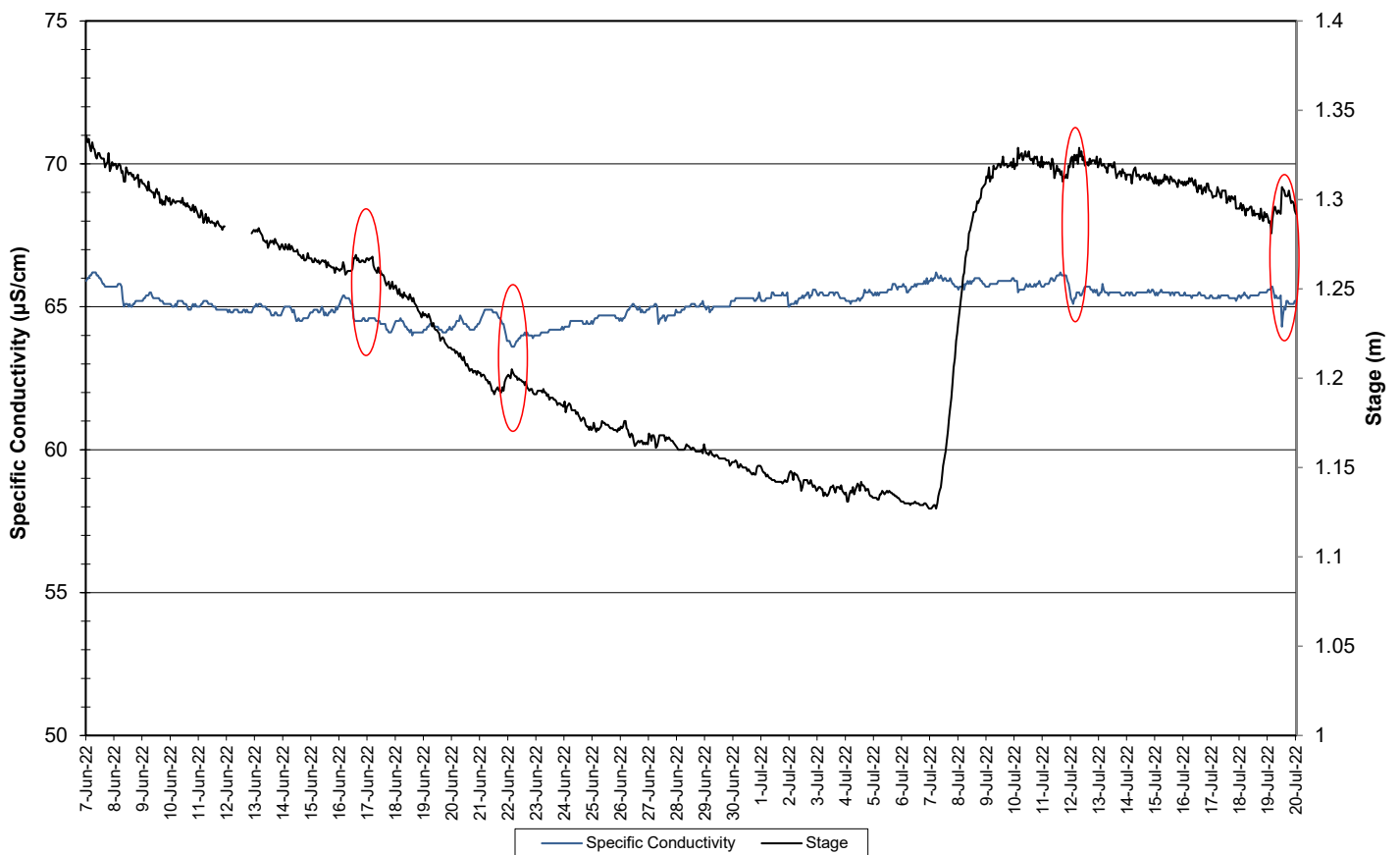


Figure 2: Water pH and Stage - Flora Creek below TLH

- Specific conductivity ranged from 63.6 to 66.2  $\mu\text{S}/\text{cm}$  (Figure 3).
- Specific conductivity increased over 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  
June 7 to July 20, 2022**

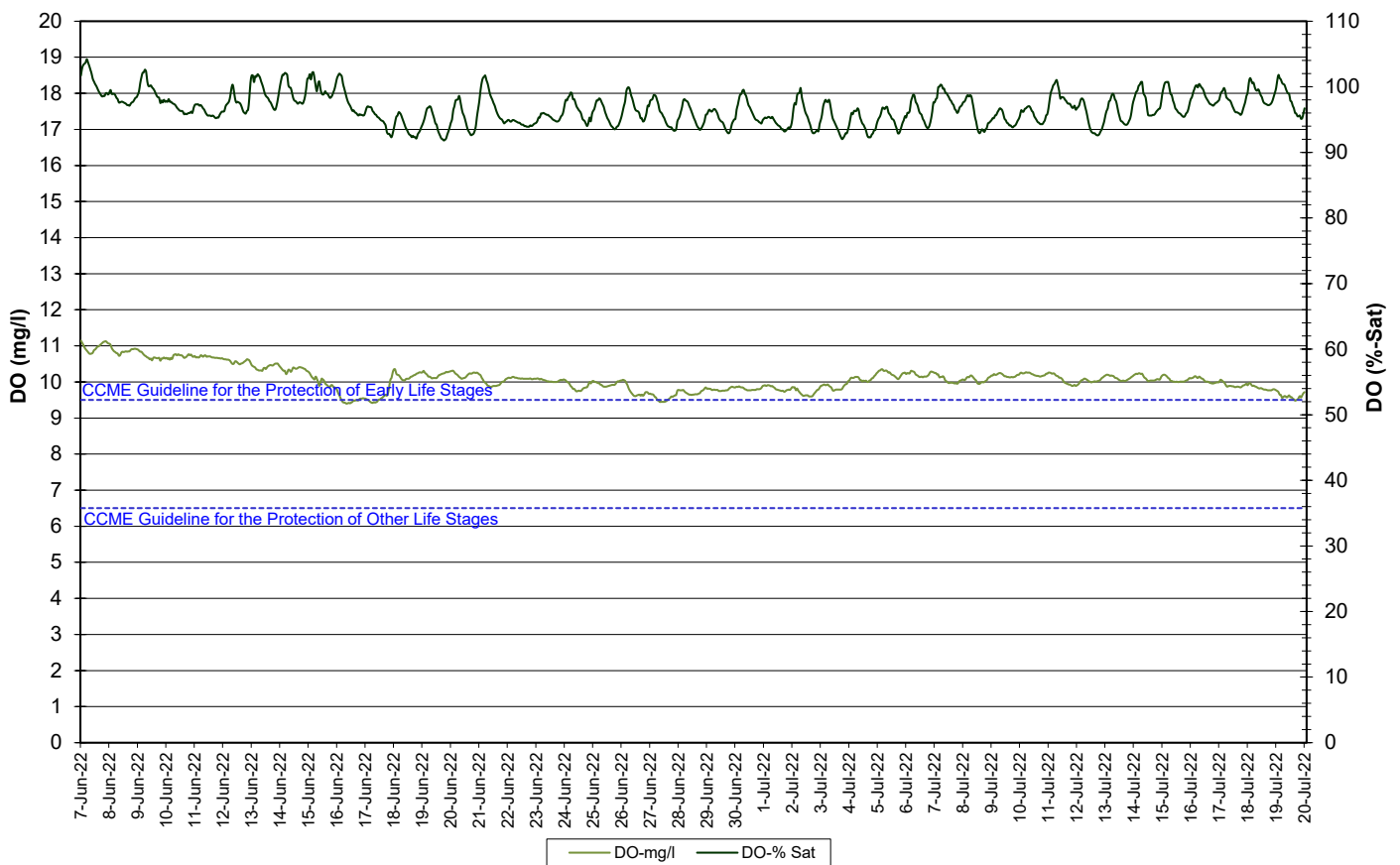


**Figure 3: Specific Conductivity of Water and Stage - Flora Creek below TLH**

Flora Creek below TLH, Newfoundland and Labrador

- The saturation of dissolved oxygen ranged from 91.8% to 104.2%. A range of 9.40 to 11.15 mg/l was found for the concentration of dissolved oxygen with a median value of 10.06 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 decreases in this deployment period, as water temperature increases into the summer.

**Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH  
June 7 to July 20, 2022**

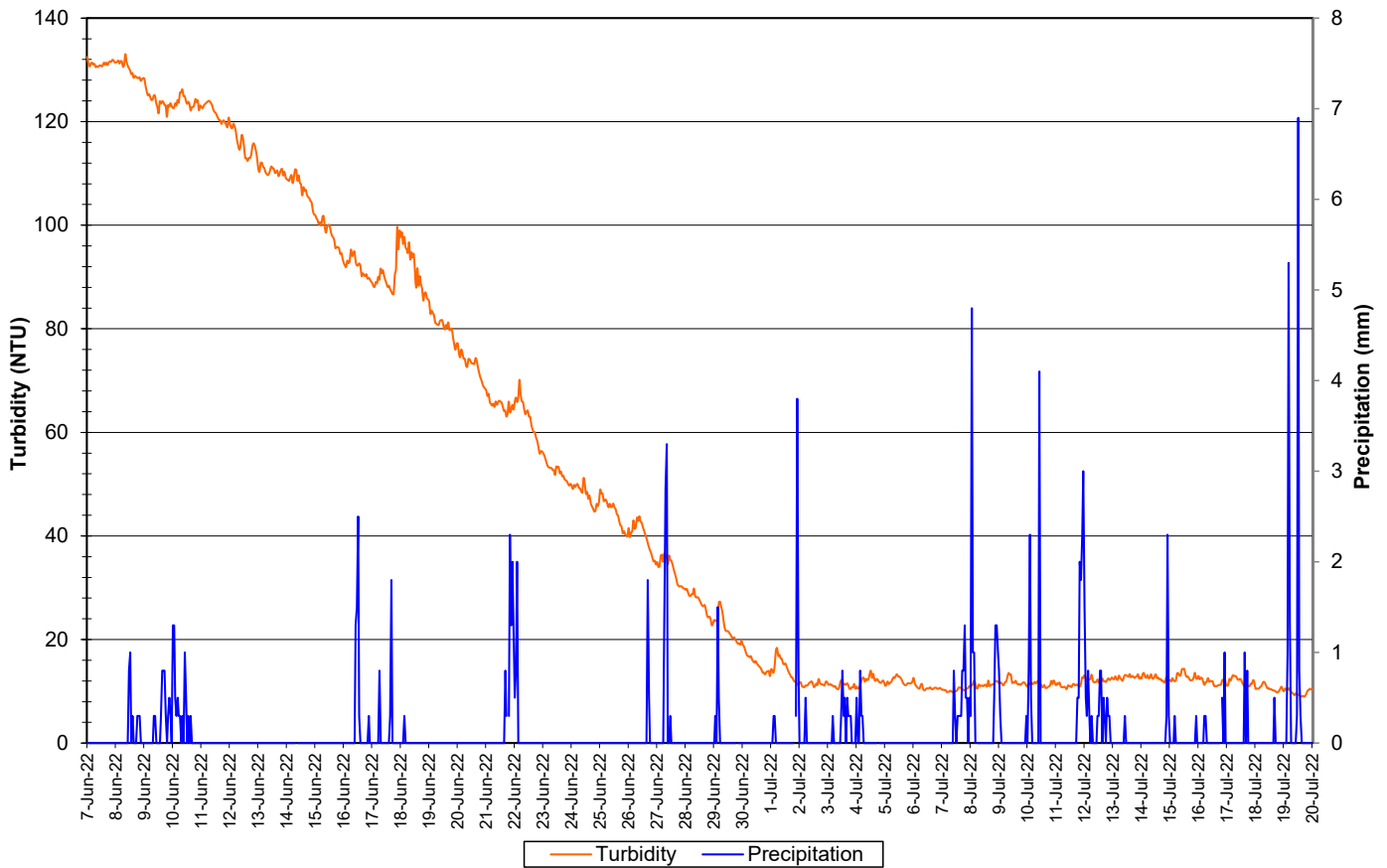


**Figure 4: Dissolved Oxygen and Saturation - Flora Creek below TLH**



- Turbidity values range from 8.9 NTU to 133.0 NTU (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, when data was available.

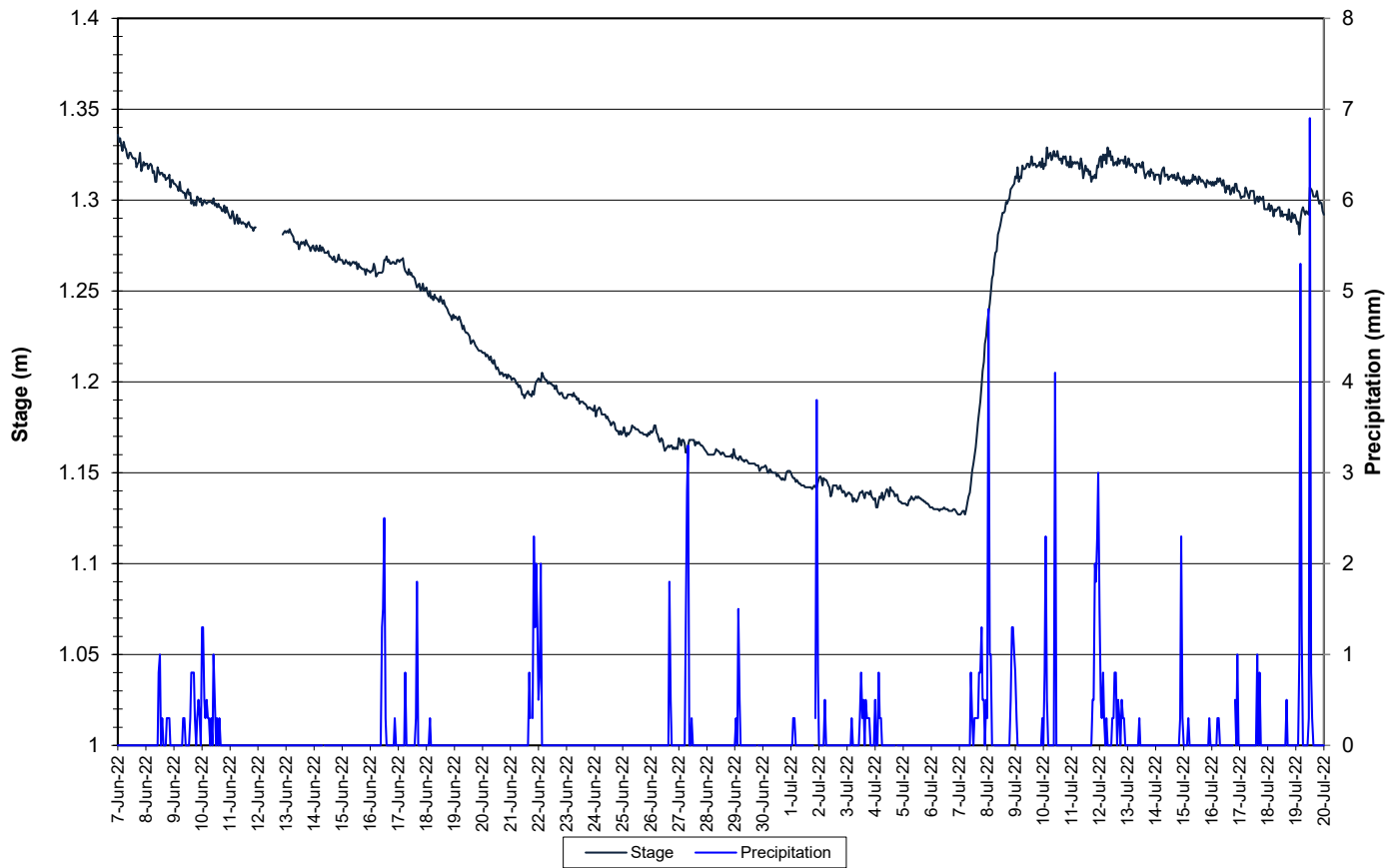
**Water Turbidity and Precipitation : Flora Creek below TLH  
June 7 to July 20, 2022**



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

- Precipitation and stage during the deployment period are graphed below (Figure 6). Stage decreased until the second week of July. Stage then increased and remained elevated with due to frequent precipitation events.
- 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 20, 2022**



**Figure 6: Precipitation and Stage – Flora Creek below TLH**

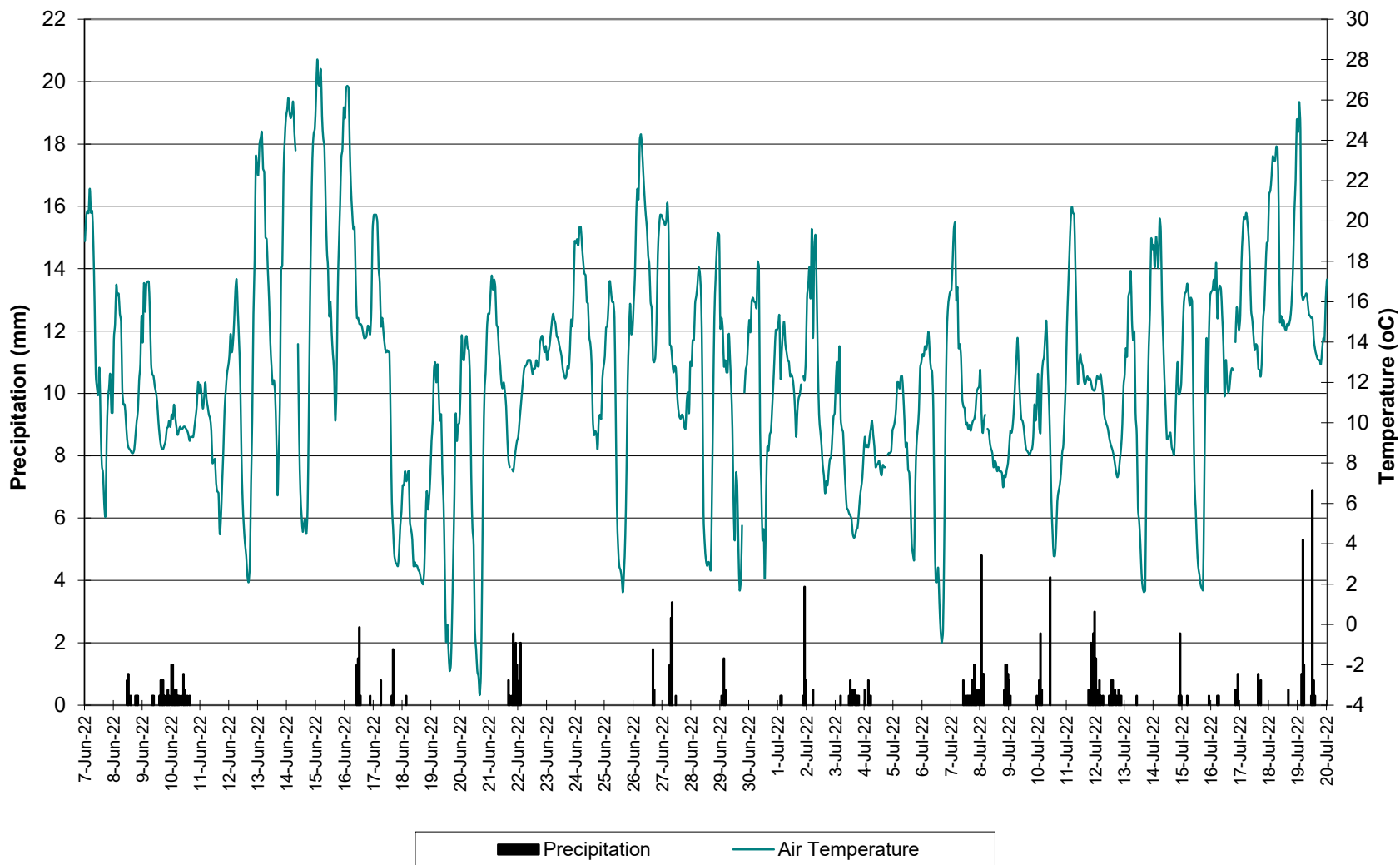
## Conclusions

- A clean and calibrated instrument was deployed at the Flora Creek below TLH water quality monitoring station on June 7<sup>th</sup> and removed on July 20<sup>th</sup>, 2022. This was the first 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 10.05 and 18.63°C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.58 and 8.00.
- Specific conductivity increased slightly and ranged from 63.6 to 66.2 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 above the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l.
- Turbidity decreased over the course of this deployment period. Highest values were recorded at the beginning of the deployment, likely due to late snow melt/spring freshet.
- Stage decreased until the second week of July. It remained elevated for the rest of the deployment. This was driven by precipitation over several days.
- 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:  
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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 20, 2022



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



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Bureau Veritas Job #: C2G1158  
Report Date: 2022/06/27

NL Department of Environment, Climate Change and  
Municipalities  
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SWM543 FLORA CREEK								
Sampling Date		2022/06/07 11:00						
Matrix		W						
Sample #		2022-6304-00-SI-SP						
Registration #		WS-S-0000						
<b>RESULTS OF ANALYSES OF WATER</b>								
<b>Calculated Parameters</b>								
Hardness (CaCO3)	-	30	1.0	mg/L	N/A	2022/06/21		8048416
Nitrate (N)	-	0.30	0.050	mg/L	N/A	2022/06/22		8048419
Total dissolved solids (calc., EC)	-	36	1.0	mg/L	N/A	2022/06/21		8048524
<b>Inorganics</b>								
Conductivity	-	65	1.0	uS/cm	N/A	2022/06/21	NGI	8064561
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2022/06/20	SRU	8060546
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/06/20	SRU	8060546
Sulphate (SO4)	-	3.7	1.0	mg/L	N/A	2022/06/20	SRU	8060546
Total Alkalinity (Total as CaCO3)	-	29	2.0	mg/L	N/A	2022/06/21	NGI	8064567
Colour	-	58	25	TCU	N/A	2022/06/21	MCN	8064431
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/06/21	NGI	8064568
Total Kjeldahl Nitrogen (TKN)	-	0.18	0.10	mg/L	2022/06/20	2022/06/21	RTY	8063386
Nitrate + Nitrite (N)	-	0.31	0.050	mg/L	N/A	2022/06/21	MCN	8064436
Nitrite (N)	-	0.011	0.010	mg/L	N/A	2022/06/21	MCN	8064438
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/06/20	MCN	8062357
Dissolved Organic Carbon (C)	-	2.2	0.50	mg/L	N/A	2022/06/23	JHH	8069833
Total Organic Carbon (C)	-	2.2	0.50	mg/L	N/A	2022/06/24	JHH	8072887
pH	-	7.59		pH	N/A	2022/06/21	NGI	8064565
Total Phosphorus	-	0.007	0.004	mg/L	2022/06/22	2022/06/24	SSV	8065190
Total Suspended Solids	-	5.0	5.0	mg/L	2022/06/13	2022/06/15	A1M	8049123
Turbidity	-	87	0.10	NTU	N/A	2022/06/21	NGI	8064653
<b>MERCURY BY COLD VAPOUR AA (WATER)</b>								
<b>Metals</b>								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/06/20	2022/06/21	EPU	8062383
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Aluminum (Al)	-	0.034	0.0050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Antimony (Sb)	-	0.0013	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Barium (Ba)	-	0.026	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Boron (B)	-	ND	0.050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Calcium (Ca)	-	6.8	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Copper (Cu)	-	ND	0.00050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Iron (Fe)	-	0.42	0.050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Magnesium (Mg)	-	3.2	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Manganese (Mn)	-	0.55	0.0020	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/06/20	2022/06/21	JHY	8062905



BUREAU  
VERITAS

Bureau Veritas Job #: C2G1158  
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NL Department of Environment, Climate Change and  
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Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SWM543 FLORA CREEK								
Sampling Date		2022/06/07 11:00						
Matrix		W						
Sample #		2022-6304-00-SI-SP						
Registration #		WS-S-0000						
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Potassium (K)	-	0.83	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Sodium (Na)	-	0.72	0.10	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Strontium (Sr)	-	0.0077	0.0020	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Uranium (U)	-	ND	0.00010	mg/L	2022/06/20	2022/06/21	JHY	8062905
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/06/20	2022/06/21	JHY	8062905