Real-Time Water Quality Deployment Report

Flora Creek below TLH

June 12 to
July 25, 2018

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Municipal Affairs and Environment
Water Resources Management Division

Contents

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 monitors the real-time webpages regularly.
- On June 12, 2018, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. Normally an instrument is deployed for a period of 35-40 days; due to logistical issues, this instrument was deployed for a period of 91 days. For the purpose of this report, data from June 12th to July 25th will be used. This was the first deployment period for this 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

	Rank				
Parameter	**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 September 11, 2018 are summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station June 12 –September 11, 2018.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	June 12, 2018	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Sept 11, 2018	Removal	Excellent	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 25 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 4.47 to 22.05°C during this deployment period (Figure 1).
- Water temperature generally increased throughout the deployment period. This corresponds with increasing ambient air temperature (Figure 2). It is important to note that weather data was collected from a climate station approximately 95 kilometers away.

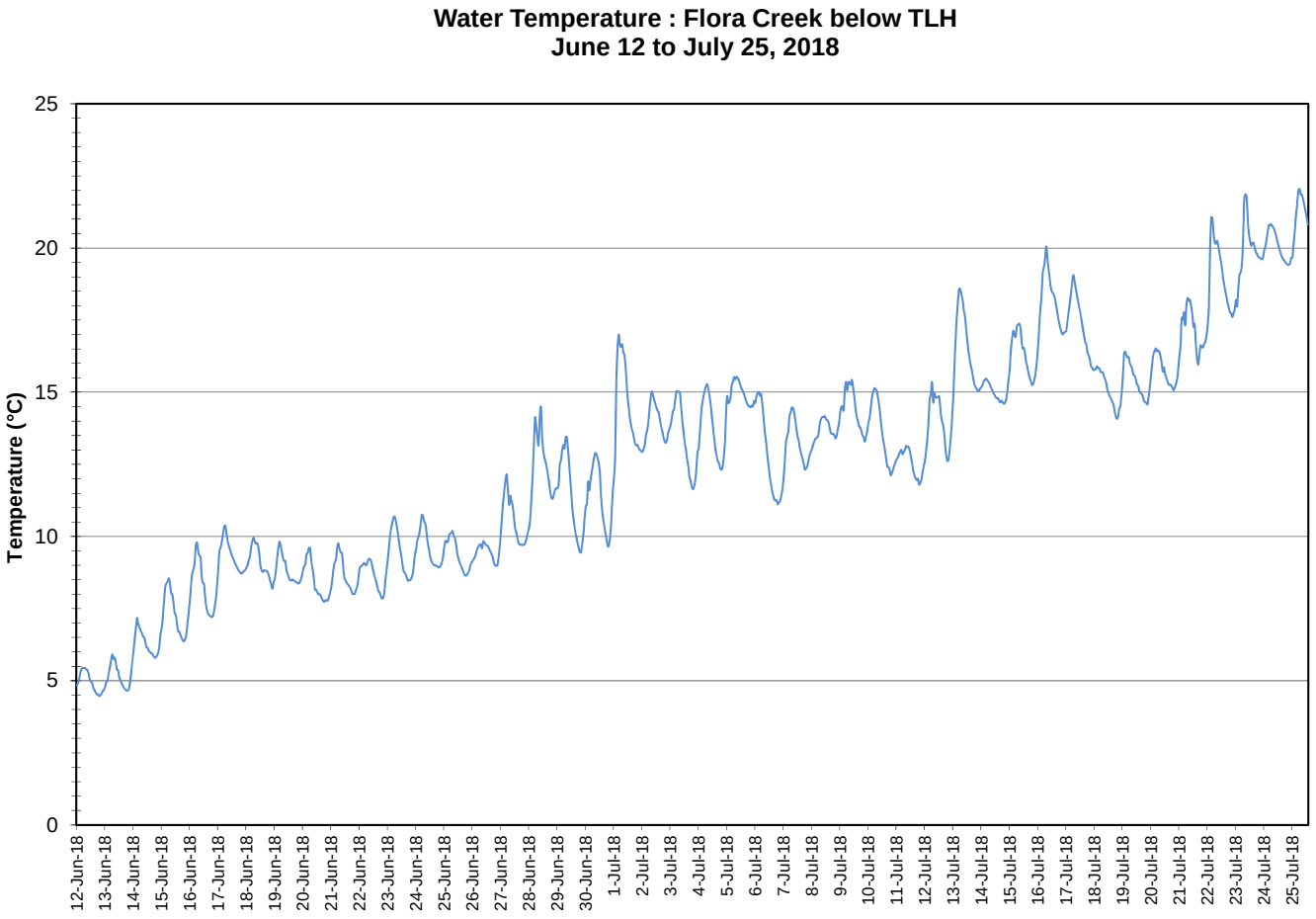

Figure 1: Water temperature - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

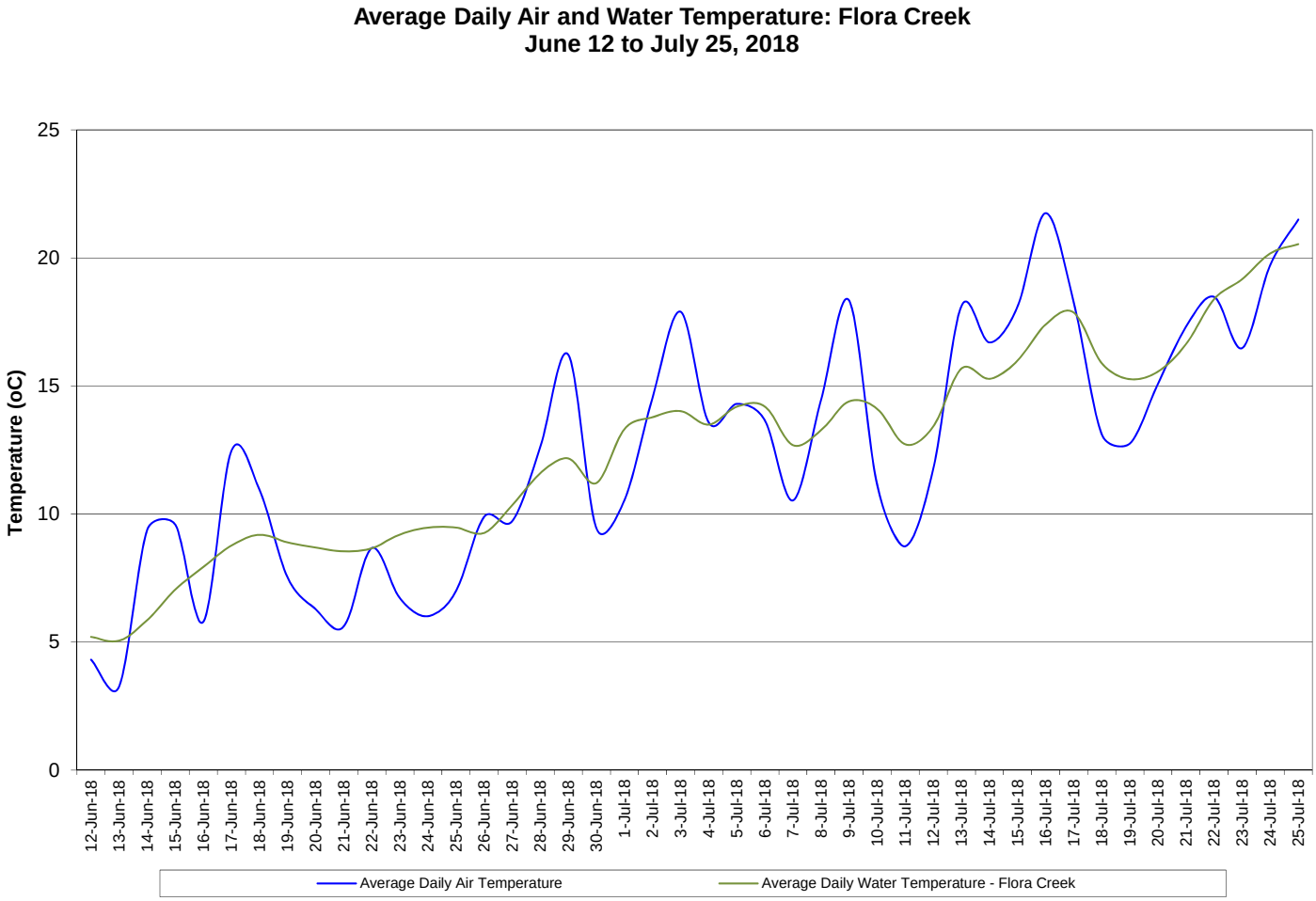

Figure 2: Average daily air and water temperatures - Flora Creek below TLH

(Weather data collected from climate station on TLH between Churchill Falls and Labrador City, ~95km away)

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.21 and 7.76 pH units throughout the deployment period, with a median value of 7.53 units (Figure 3).
- 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.

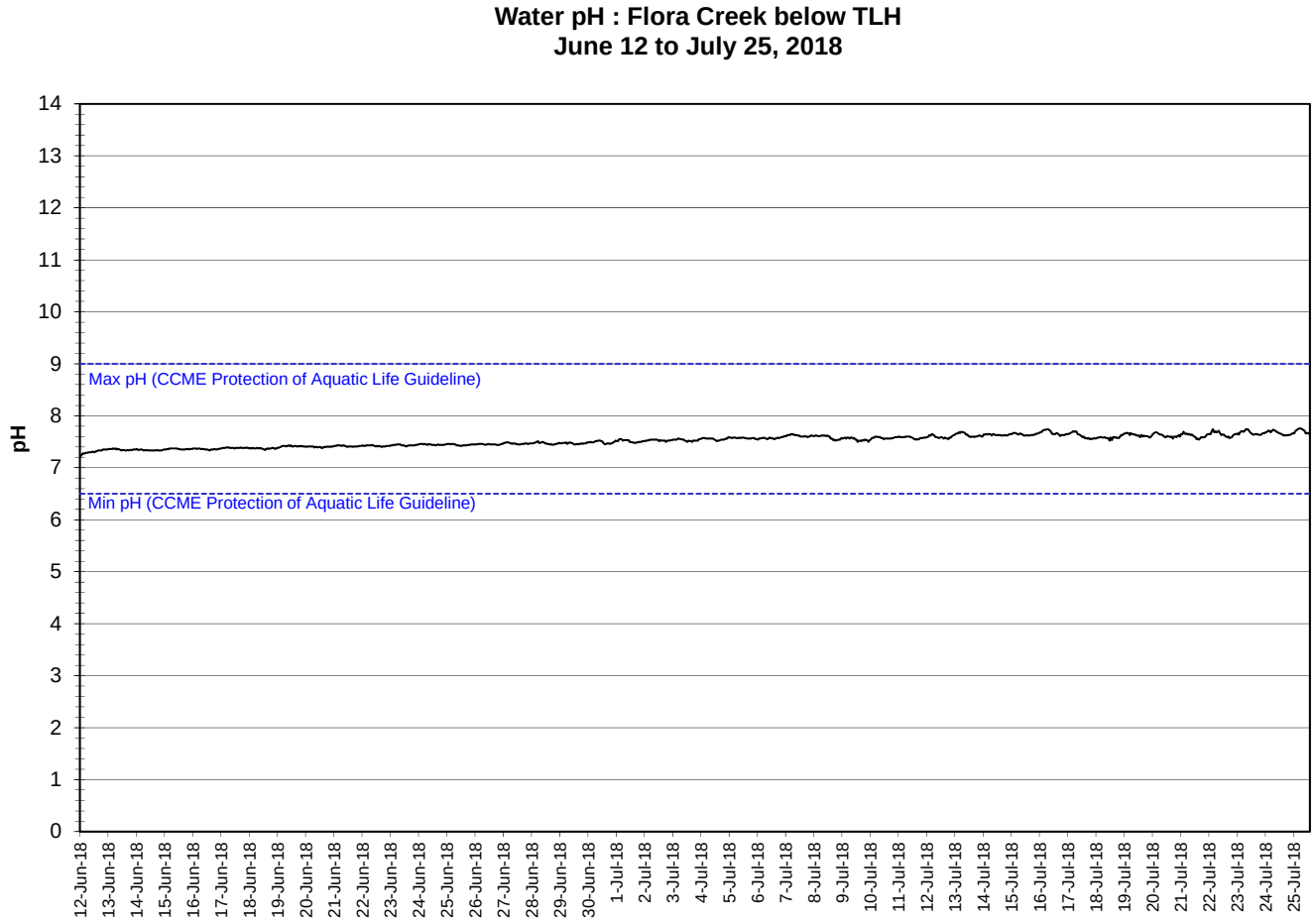

Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 56.3 to 60.8 µs/cm (Figure 4).
- Specific conductivity decreased slightly during June, increasing into July.
- 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.

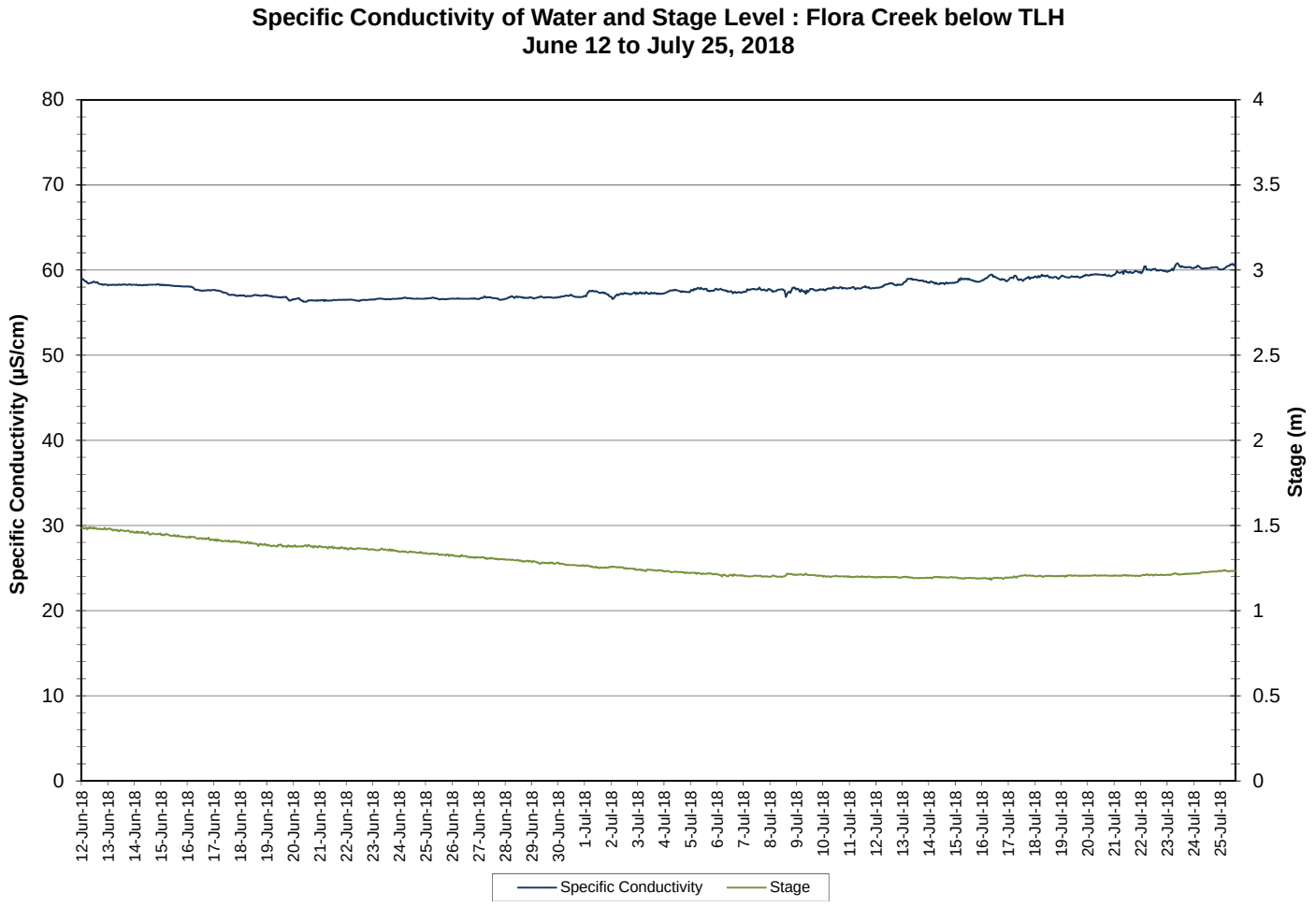

Figure 4: Specific conductivity and stage level - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- The saturation of dissolved oxygen ranged from 89.3 to 103.6%. The concentration of dissolved oxygen ranged from 8.38 to 11.84 mg/l with a median value of 9.90 mg/l (Figure 5).
- 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 concentration values were above the minimum CCME Guideline for the Protection of Early Life Stages Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. DO decreases during the later portion of the deployment period; due to an increase in water temperature at this time.

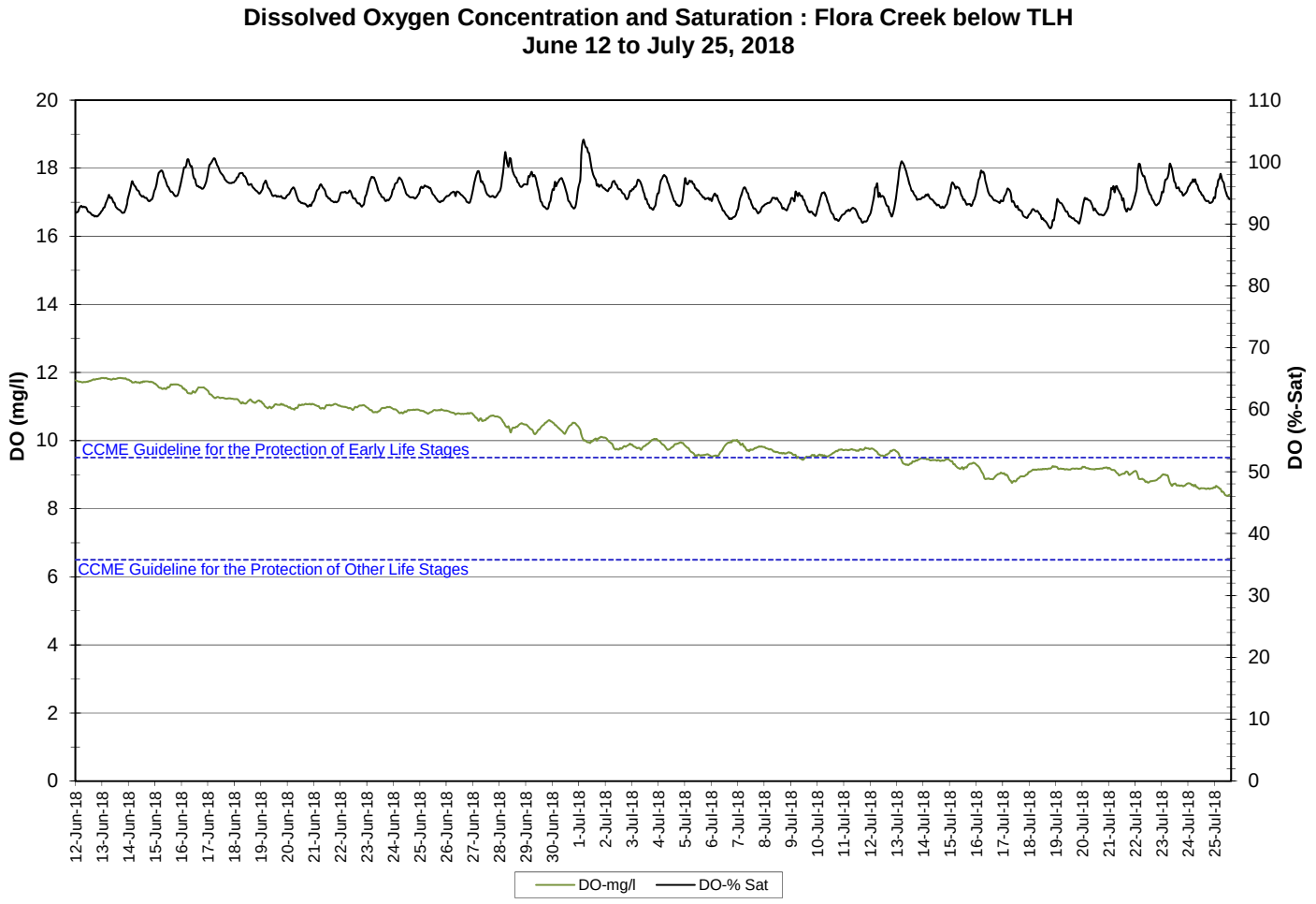

Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- Turbidity values range from 58.9 NTU to 619.7 NTU, the highest readings being recorded at the beginning of the deployment period. Turbidity gradually decreases over the course of the deployment period (Figure 6).
- 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.

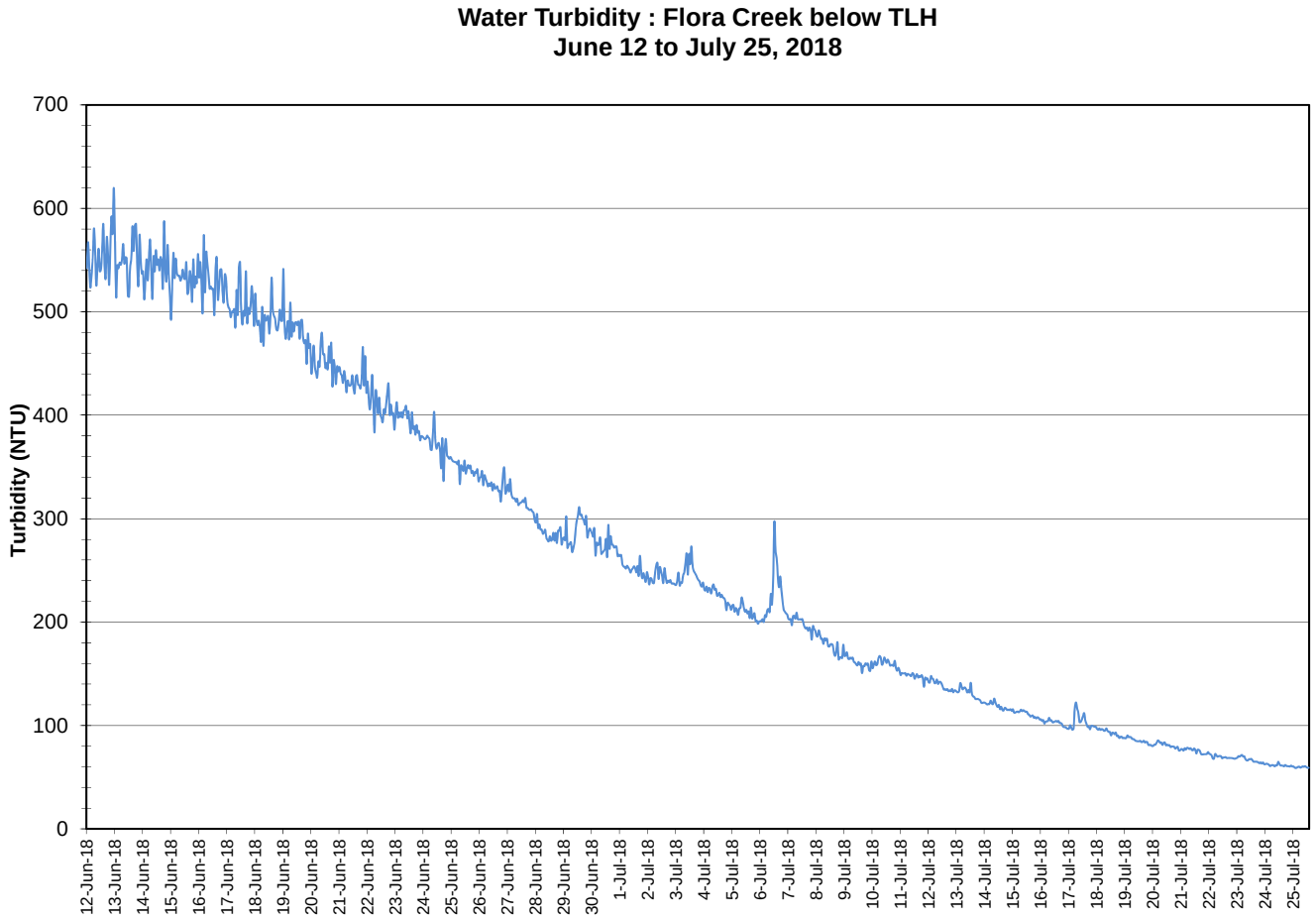

Figure 6: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period is graphed below (Figure 7). Stage gradually decreased over the course of this deployment period with varying precipitation records.
- 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.

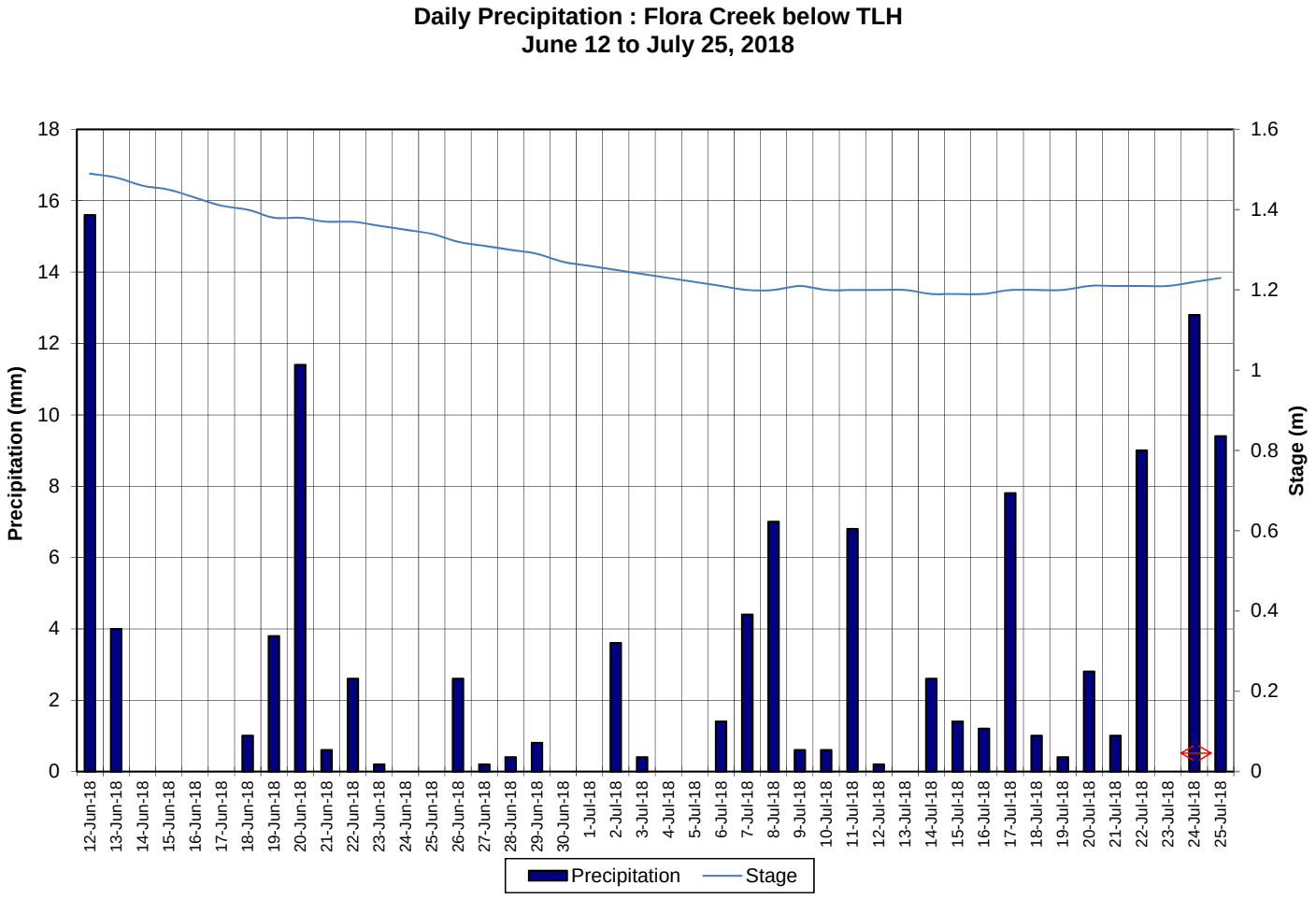

Figure 7: Precipitation and Stage – Flora Creek below TLH

(Weather data collected from climate station on TLH between Churchill Falls and Labrador City, ~95km away)

Conclusions

- An instrument at the water quality monitoring station on Flora Creek below TLH station was deployed on June 12 and removed on September 11, 2018. This was the first deployment period for this season. Data from June 12 to July 25, 2018 was analyzed in this report.
- In most cases, weather related events or increases/decreases in water level could be used to explain the 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. The temperature typically ranged between 4.47 and 22.05^{o}C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.21 and 7.76.
- Specific conductivity was relatively stable throughout the deployment period, raning from 56.3 to 60.8 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 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 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.

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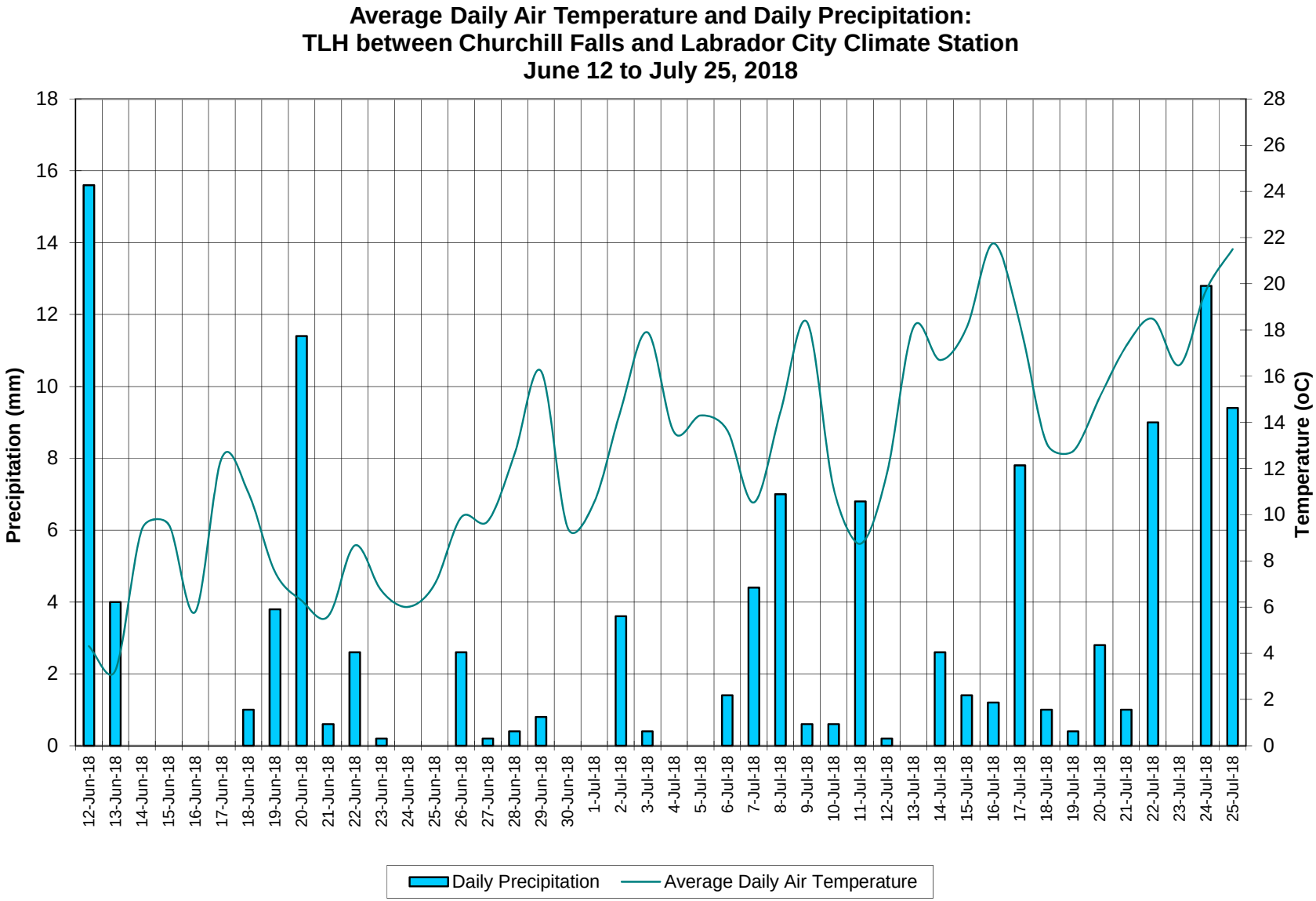
Appendix 1


Average Daily Air Temperature and Daily Precipitation:
TLH between Churchill Falls and Labrador City Climate Station
June 12 to July 25, 2018
Precipitation (mm)
Temperature (oC)
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
14
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Daily Precipitation
Average Daily Air Temperature