Real-Time Water Quality Deployment Report

Flora Creek below TLH

July 20 to
September 12, 2017

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 web pages regularly.
- On July 20, 2017, a clean and calibrated real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH, for the second deployment of the season. The instrument was deployed for a period of 54 days; it was removed for cleaning and calibration on September 12th, 2017.

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 July 20 and September 12, 2017 is summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station July 20 – September 12, 2017.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	July 20, 2017	Deployment	Excellent	Good	Good	Fair	Excellent
	Sept 12, 2017	Removal	Excellent	Excellent	Good	Fair	Excellent

- At deployment, all parameters besides dissolved oxygen ranked either 'good' or 'excellent'. Dissolved oxygen ranked 'fair', the field instrument read a value of 9.89 mg/l, while the QA/QC instrument read a value of 9.17 mg/l.

- At removal, all parameters besides dissolved oxygen ranked either 'good' or 'excellent'. Dissolved oxygen ranked 'fair', the field instrument read a value of 10.41 mg/l, while the QA/QC instrument read a value of 9.65.

- These 'fair' rankings could be due to the placement of the QA/QC instrument in relation to the field sonde, or the amount of time the instrument was given to stabilize.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from July 20 to September 12 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 10.97 to 20.25°C during this deployment period (Figure 1).
- Water temperature fluctuated between a small range for the majority of the deployment period, it then decreased during the last 2 weeks. Corresponding with ambient air temperature (Figure 2).

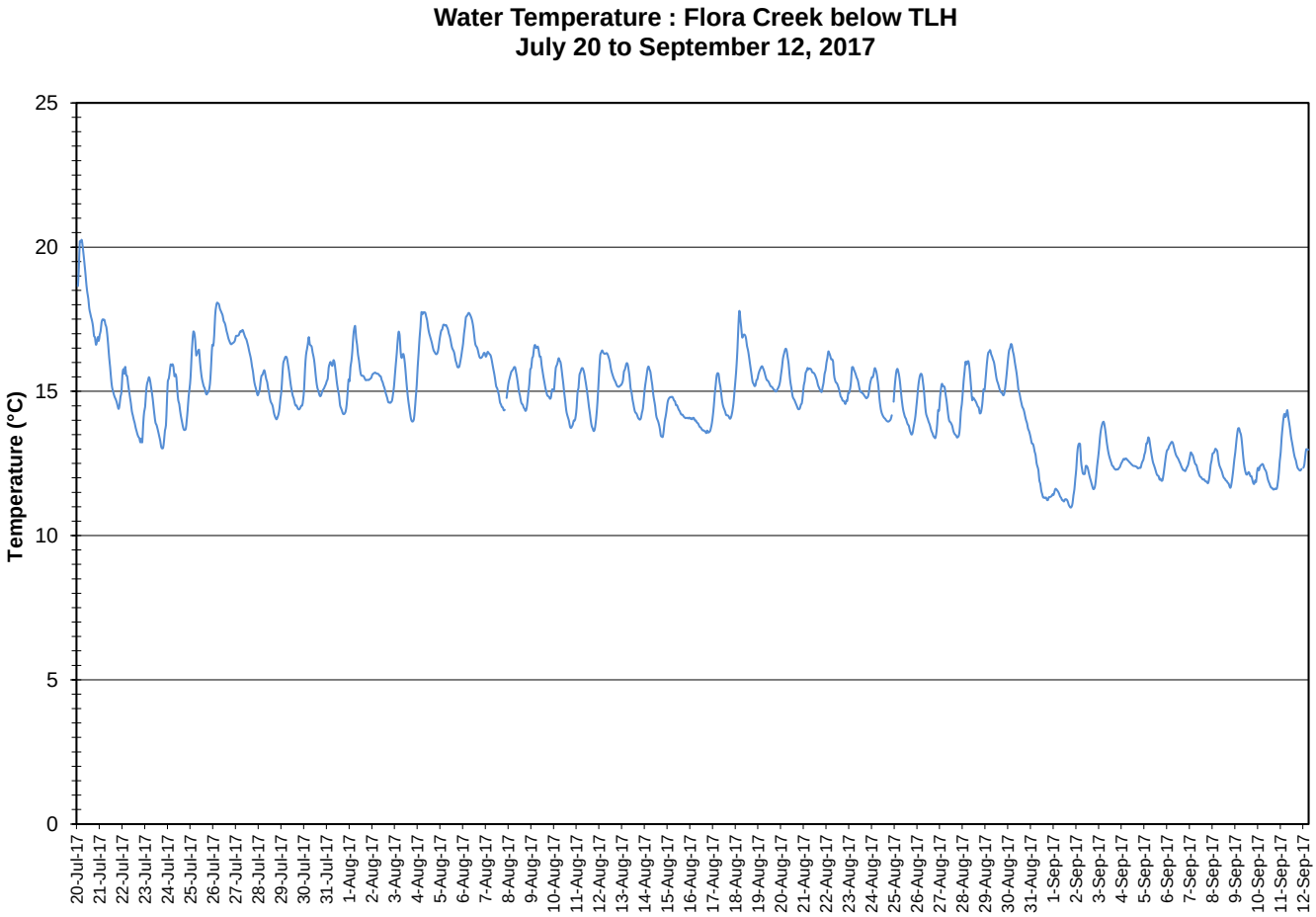


Figure 1: Water temperature - Flora Creek below TLH

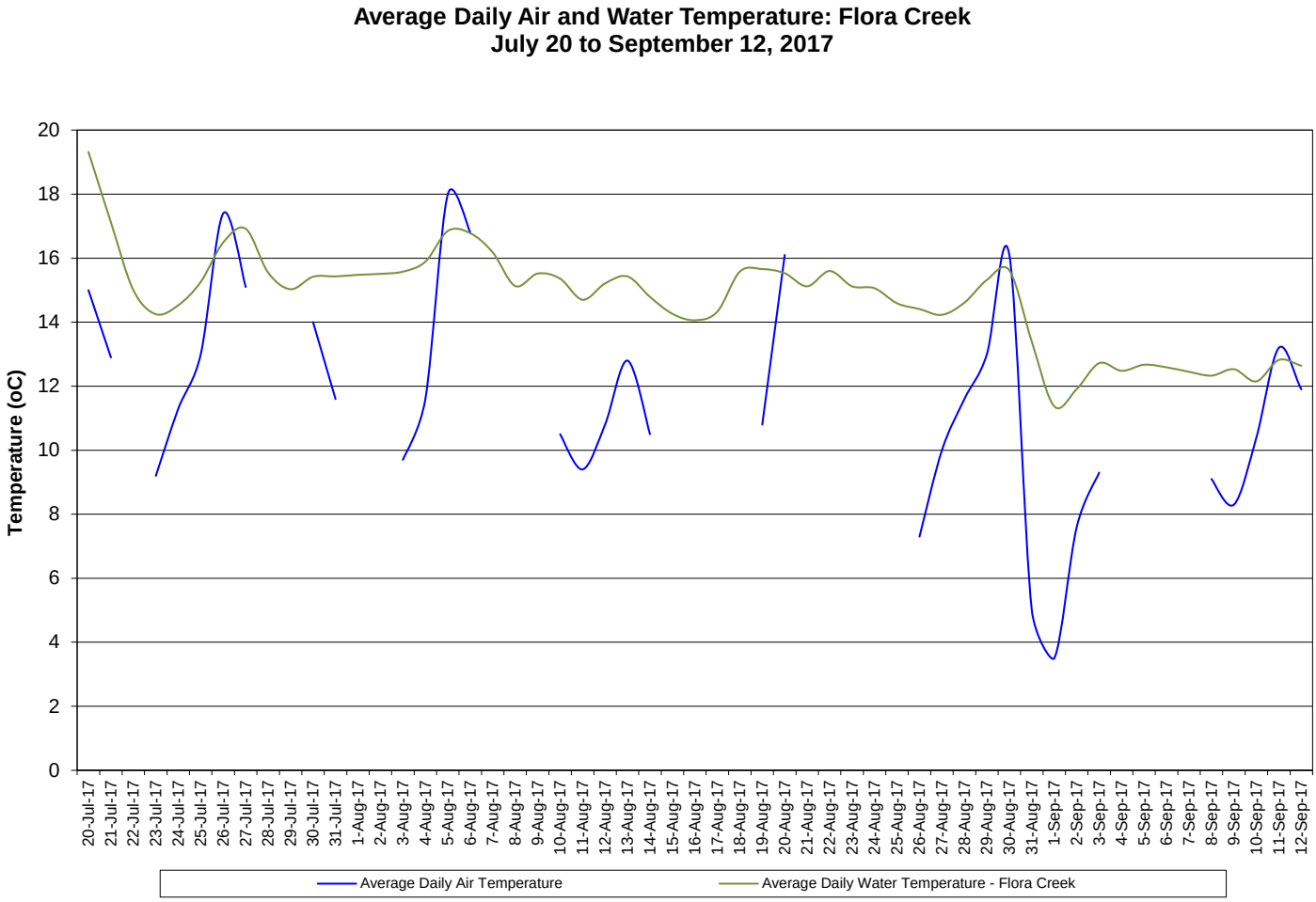


Figure 2: Average daily air and water temperatures - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.60 and 8.92 pH units throughout the deployment period, with a median value of 7.72 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.

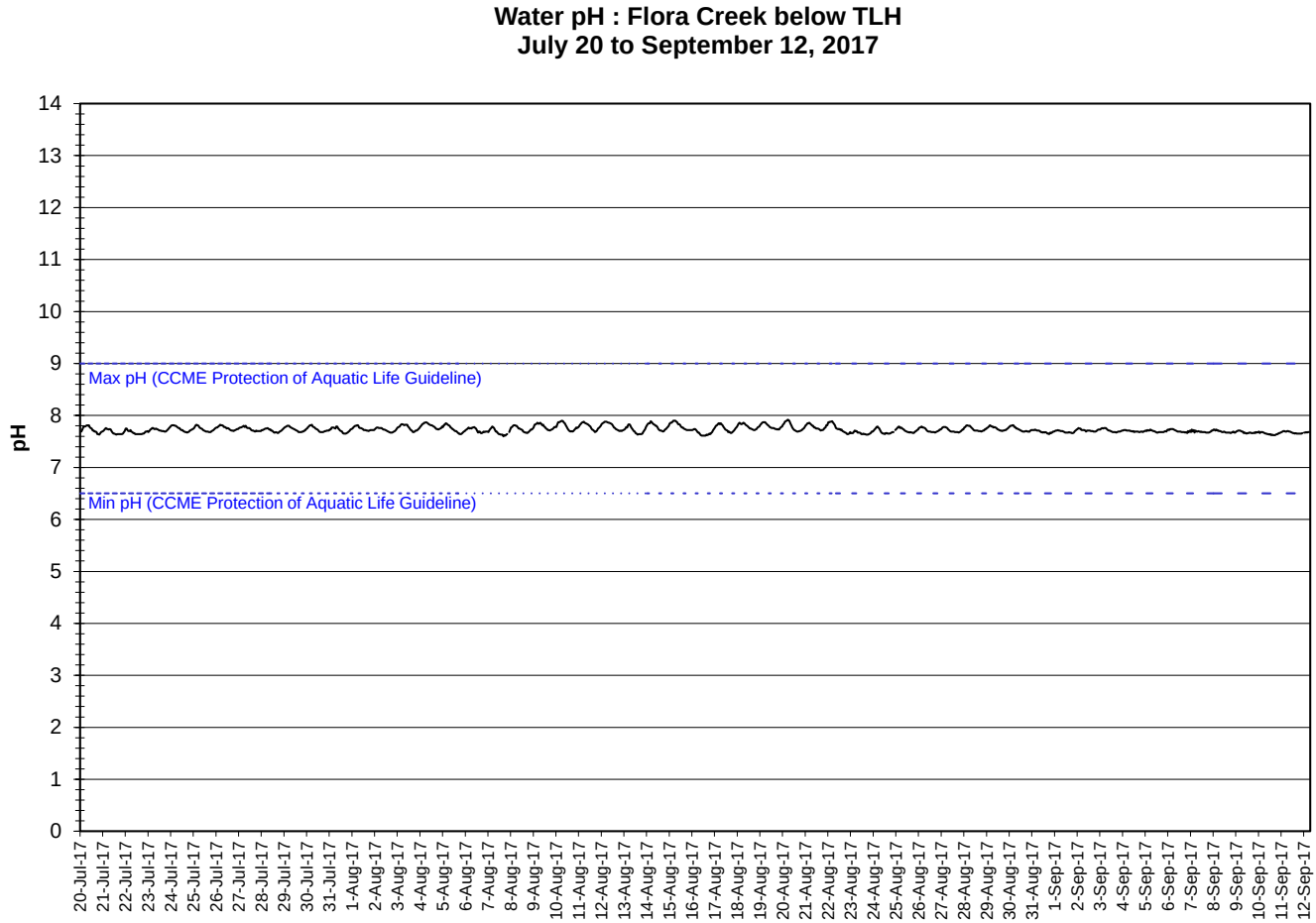


Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 65.8 to 69.5 µs/cm (Figure 4).
- Specific conductivity increased slightly over the course of this deployment period with an evident decrease in September. This decrease displays an inverse relationship to the increase in stage. This is to be expected due to the increased amount of water in the creek, diluting the solids that are present. Thus, decreasing the conductivity. Decreases after high precipitation events are identified on the graph in red.
- 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.

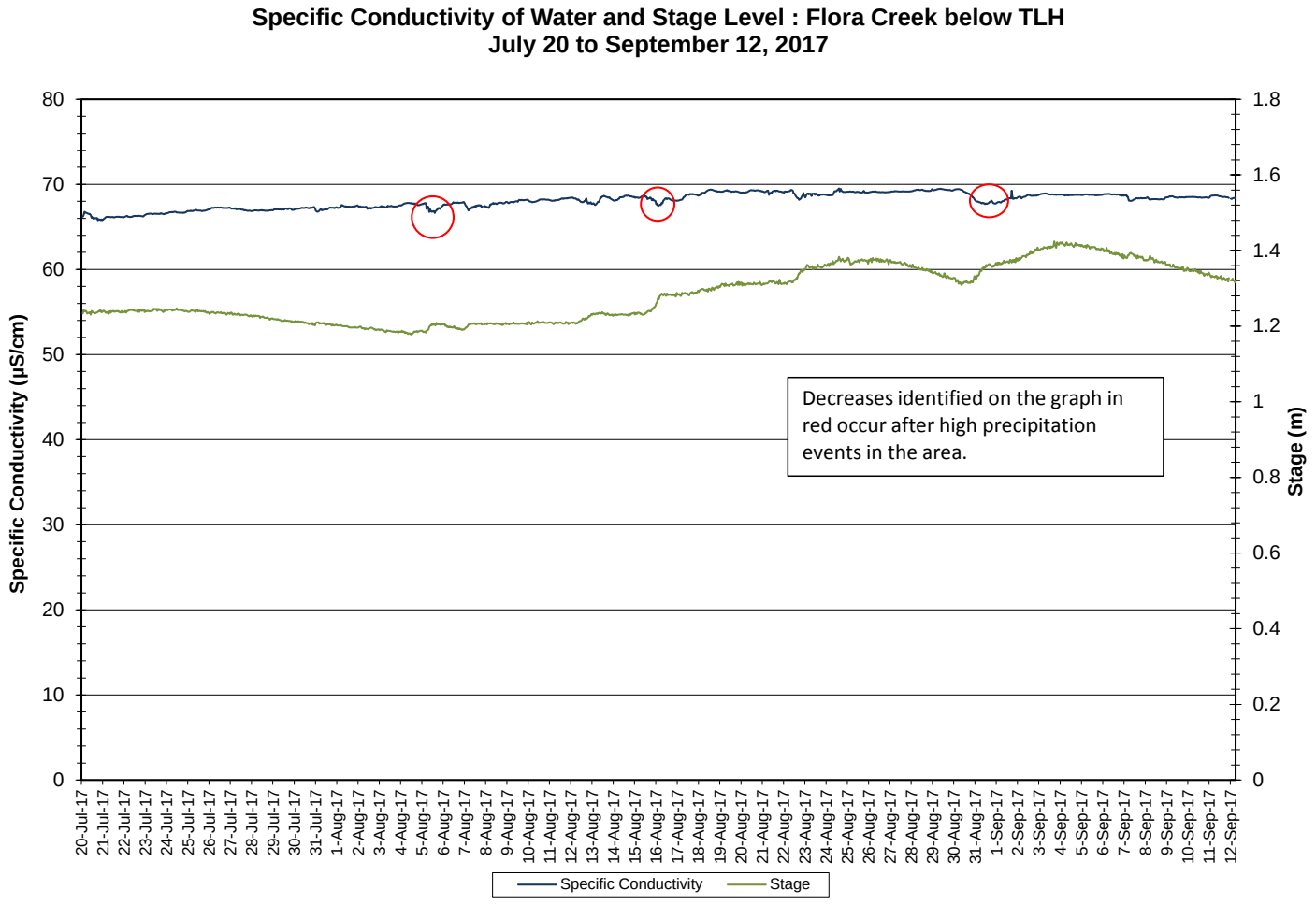


Figure 4: Specific conductivity and stage level - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 94.4 to 109.1% and a range of 9.59 to 10.63 mg/l was found in the concentration of dissolved oxygen with a median value of 10.01 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 and 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 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. DO increases slightly during the later portion of the deployment period; this is due to a decrease in water temperature at this time.

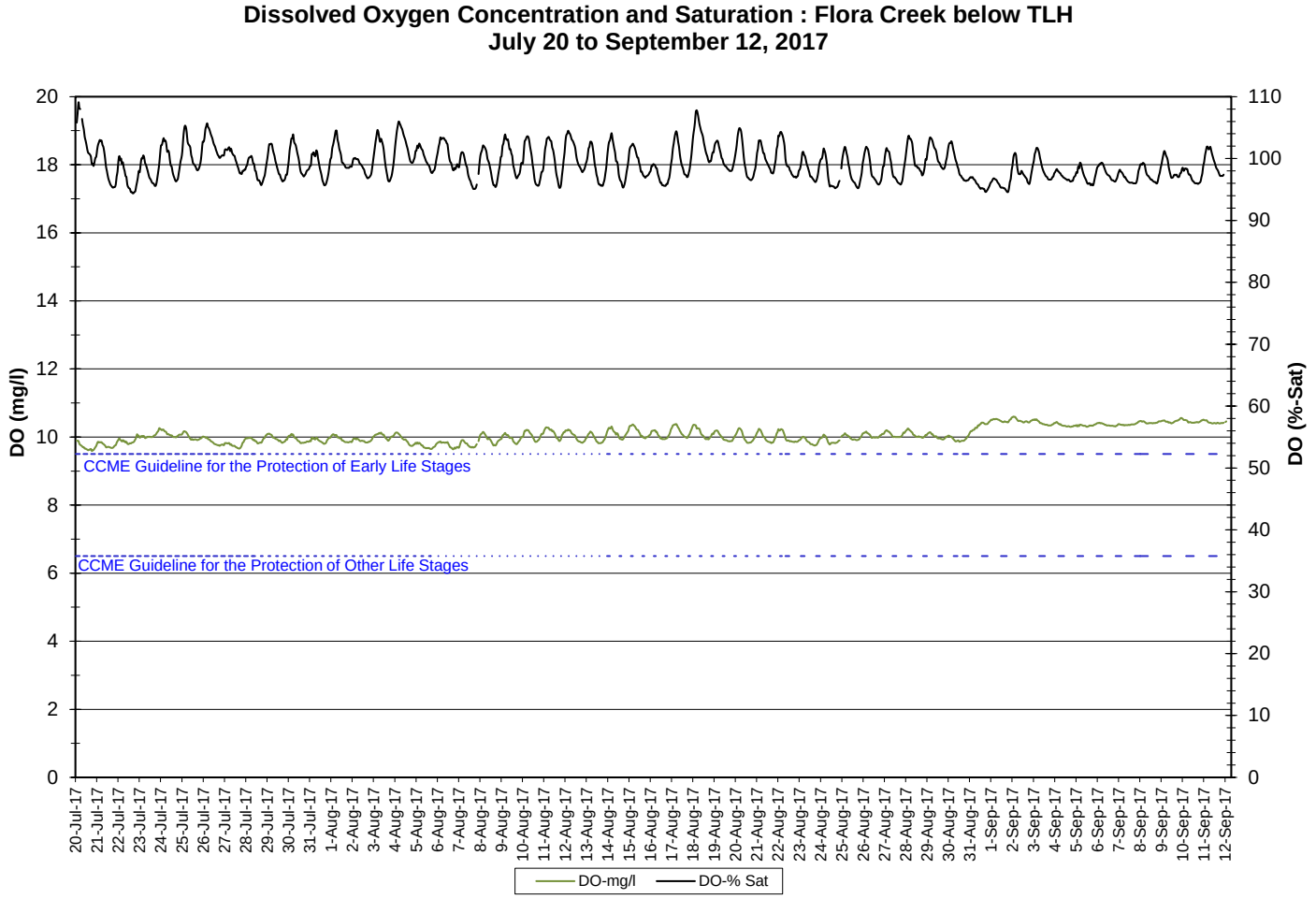


Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

- Turbidity values range from 9.6 NTU to 78.0 NTU, the highest readings being recorded at the end of the deployment period. (Figure 6).
- This site has very turbid water at times. Turbidity increased during this deployment period, this may be attributed to some heavy rainfall events in the area, as stage increased as well. These instances are identified on the graph in red.

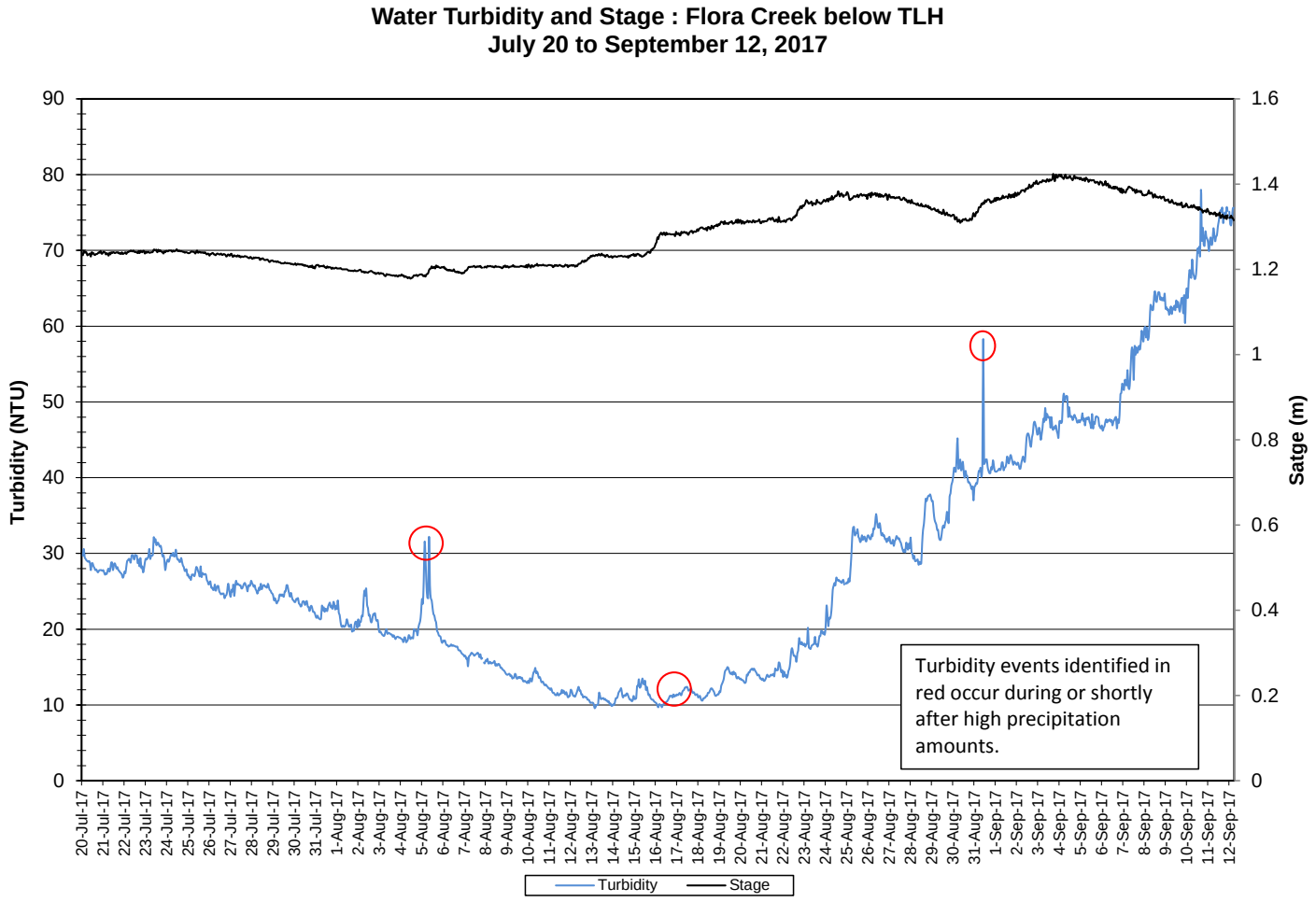


Figure 6: Turbidity and Stage - Flora Creek below TLH

- Precipitation and stage during the deployment period is graphed below (Figure 7). Stage increased during the later portion of this deployment period after some significant rainfall 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.

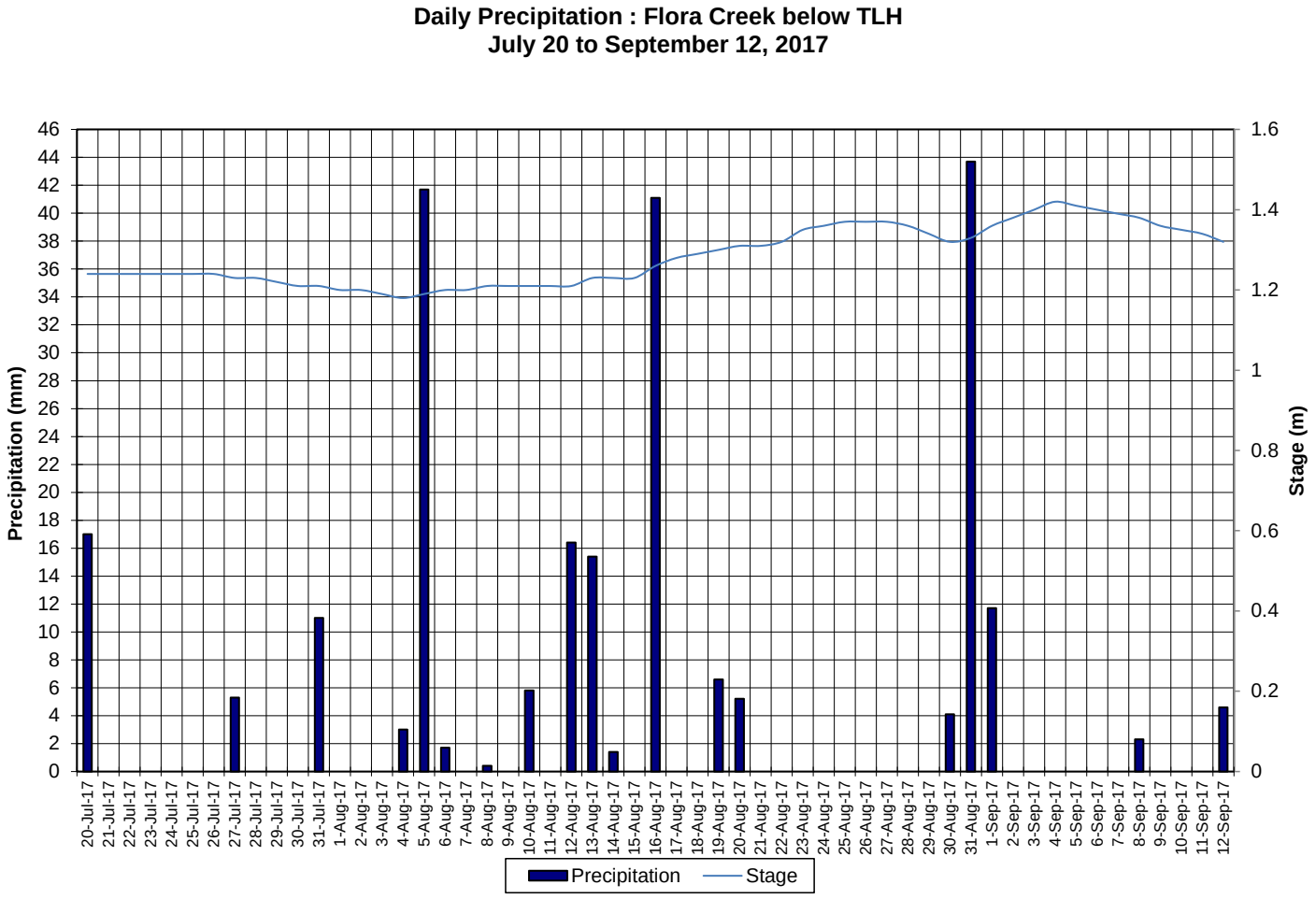


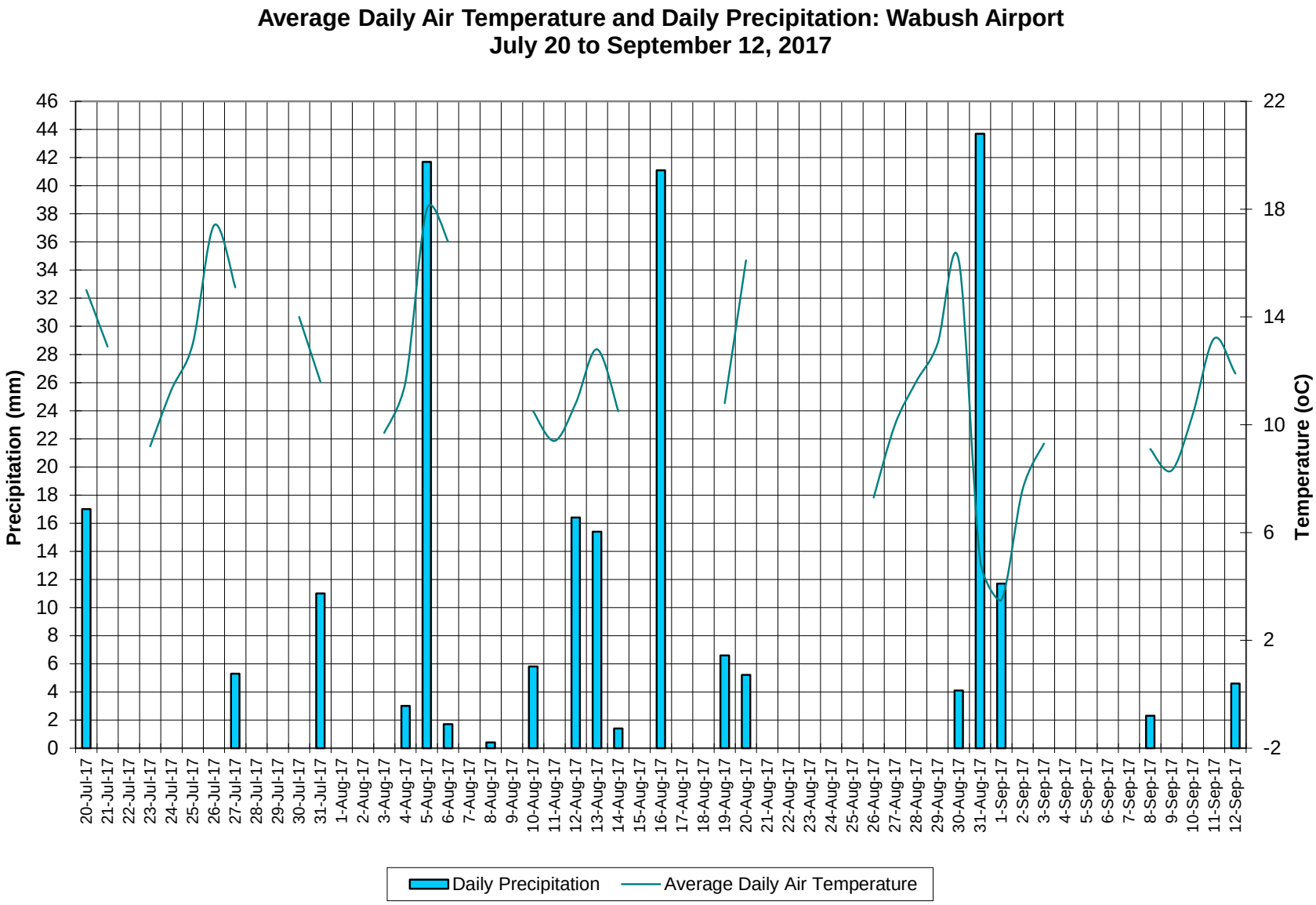
Figure 7: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument at the water quality monitoring station on the Flora Creek below TLH station was deployed on July 20 and removed on September 12, 2017.
- In most cases, weather related events or increases/decreases in water level could be used to explain the fluctuations. 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 decreased during the later portion of the deployment period. Water temperature corresponded with air temperature. The temperature typically ranged between 10.97 and 20.25^{o}C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.60 and 8.92.
- Specific conductivity ranged from 65.8 to 69.5 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 CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l.
- Turbidity values increased during the deployment period.
- Stage increased during 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.

Prepared by:
Maria Murphy
Department of Municipal Affairs and Environment
Water Resources Management Division
Phone: 709.896.7981
Fax: 709.896.9566

Appendix 1


Average Daily Air Temperature and Daily Precipitation: Wabush Airport
July 20 to September 12, 2017
Precipitation (mm)
Temperature (oC)
Daily Precipitation
Average Daily Air Temperature