# Real-Time Water Quality Deployment Report

## Flora Creek below TLH

**September 5 to**
**October 15, 2014**

Newfoundland Labrador

**Government of Newfoundland & Labrador**
**Department of Environment and Conservation**
**Water Resources Management Division**

# Contents

## General

- The Water Resources Management Division, in partnership with Cliffs Natural Resources – Wabush Mines, maintains one real-time water quality and water quantity station at Flora Creek.
- This station is situated downstream of the Wabush Mines tailings disposal area, in Flora Lake.
- Water Resources Management Division staff monitors the real-time web pages regularly.
- On September 5, 2014, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 40 days. The instrument was removed on October 15, for the winter 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.

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- Deployment and removal comparison rankings for the station on Flora Creek deployed between September 5 and October 15, 2014 is summarized in Table 2.

**Table 2: Comparison rankings for Flora Creek below TLH station September 5 – October 15, 2014.**

| Station | Date | Action | Comparison Ranking | | | | |
|---|---|---|---|---|---|---|---|
| | | | Temperature | pH | Conductivity | Dissolved Oxygen | Turbidity |
| Flora Creek below TLH | Sept 5, 2014 | Deployment | Excellent | Fair | Poor | Good | Excellent |
| | Oct 15, 2014 | Removal | N/A | N/A | N/A | N/A | N/A |

- At deployment, temperature, dissolved oxygen and turbidity ranked either 'excellent' or 'good'. pH ranked 'fair', the field sonde read a value of 7.21, while the QA/QC sonde read a value of 7.79. Conductivity ranked 'poor', the field sonde read a value of 100.5 µs/cm and the QA/QC sonde read a value of 76.0 µs/cm, this is due to the fact that the conductivity sensor needs hours to stabilize. These 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.

- Comparison rankings are not available at removal due to the EXO2 QA/QC sonde not functioning properly.

## Data Interpretation

- The following graphs and discussion illustrate water quality-related events from September 5 to October 15 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 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.

### Flora Creek below TLH

- Water temperature ranged from 5.74 to 15.39°C during this deployment period (Figure 1).
- Water temperature decreased throughout the deployment period and corresponded with decreasing ambient air temperature (Figure 2).

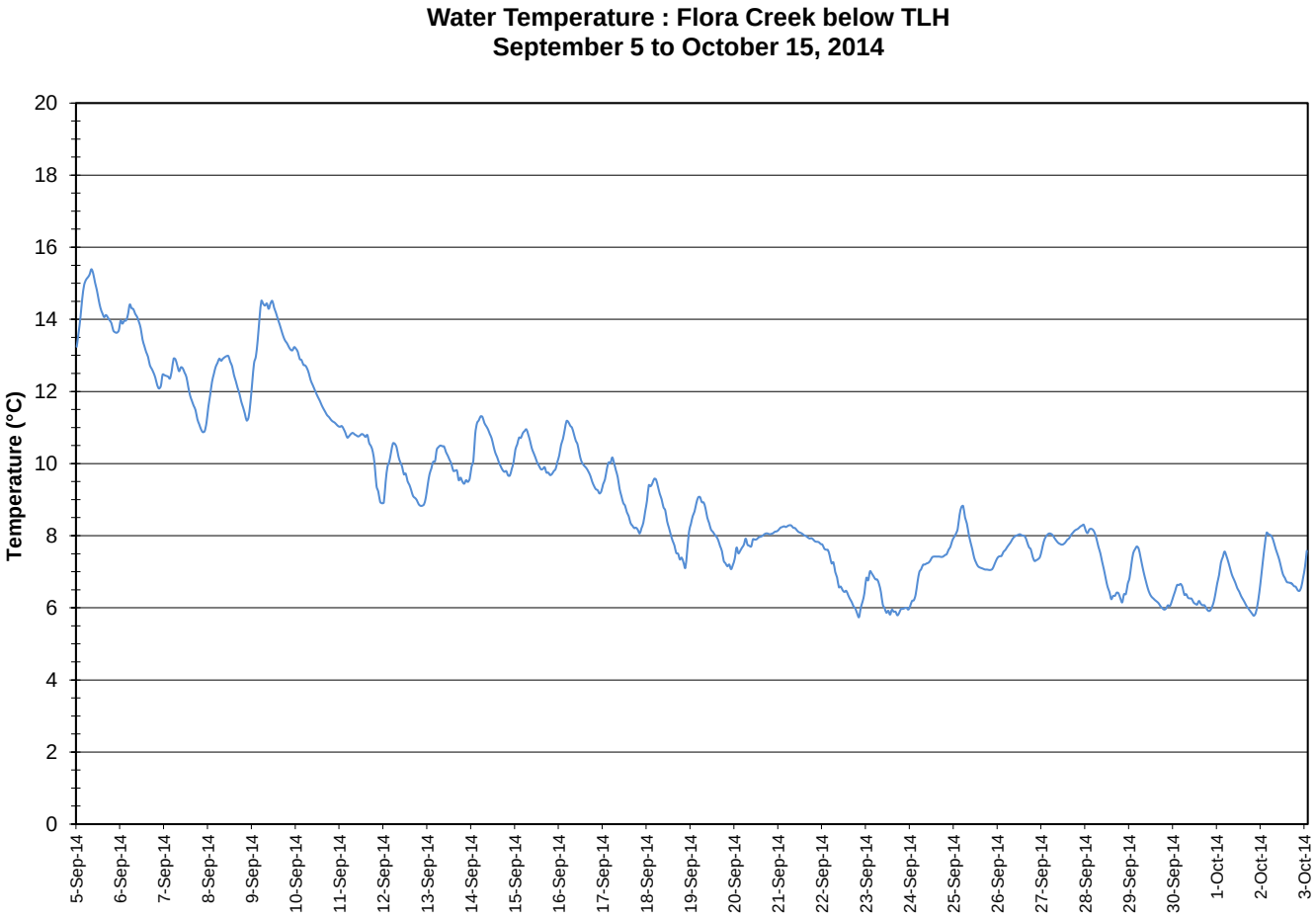


**Figure 1: Water temperature at Flora Creek below TLH**

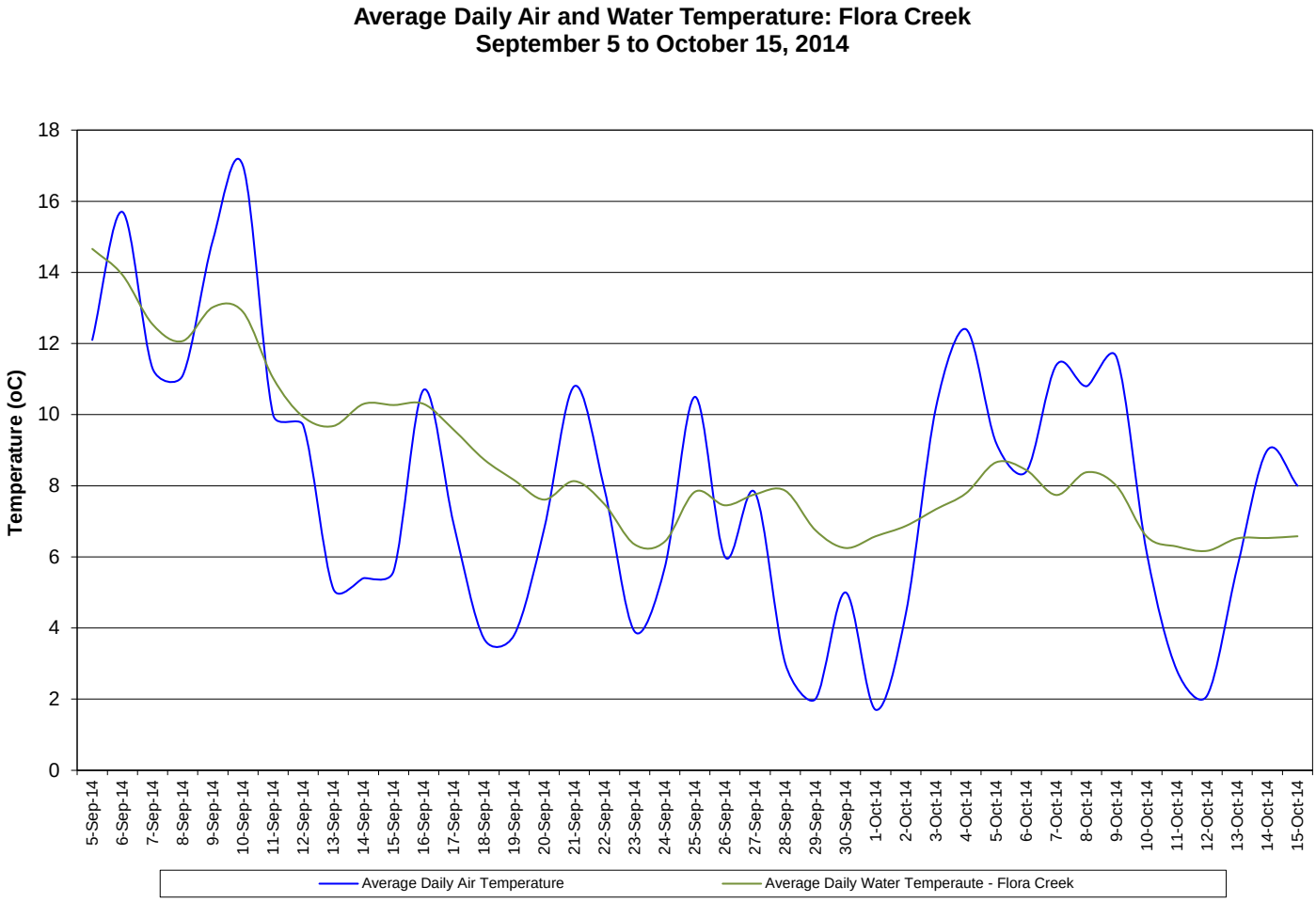


**Figure 2: Average daily air and water temperatures at Flora Creek below TLH**

**(weather data collected at Happy Valley – Goose Bay, NL)**

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- pH ranges between 7.51 and 8.09 pH units throughout the deployment period, with a median value of 7.74 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.

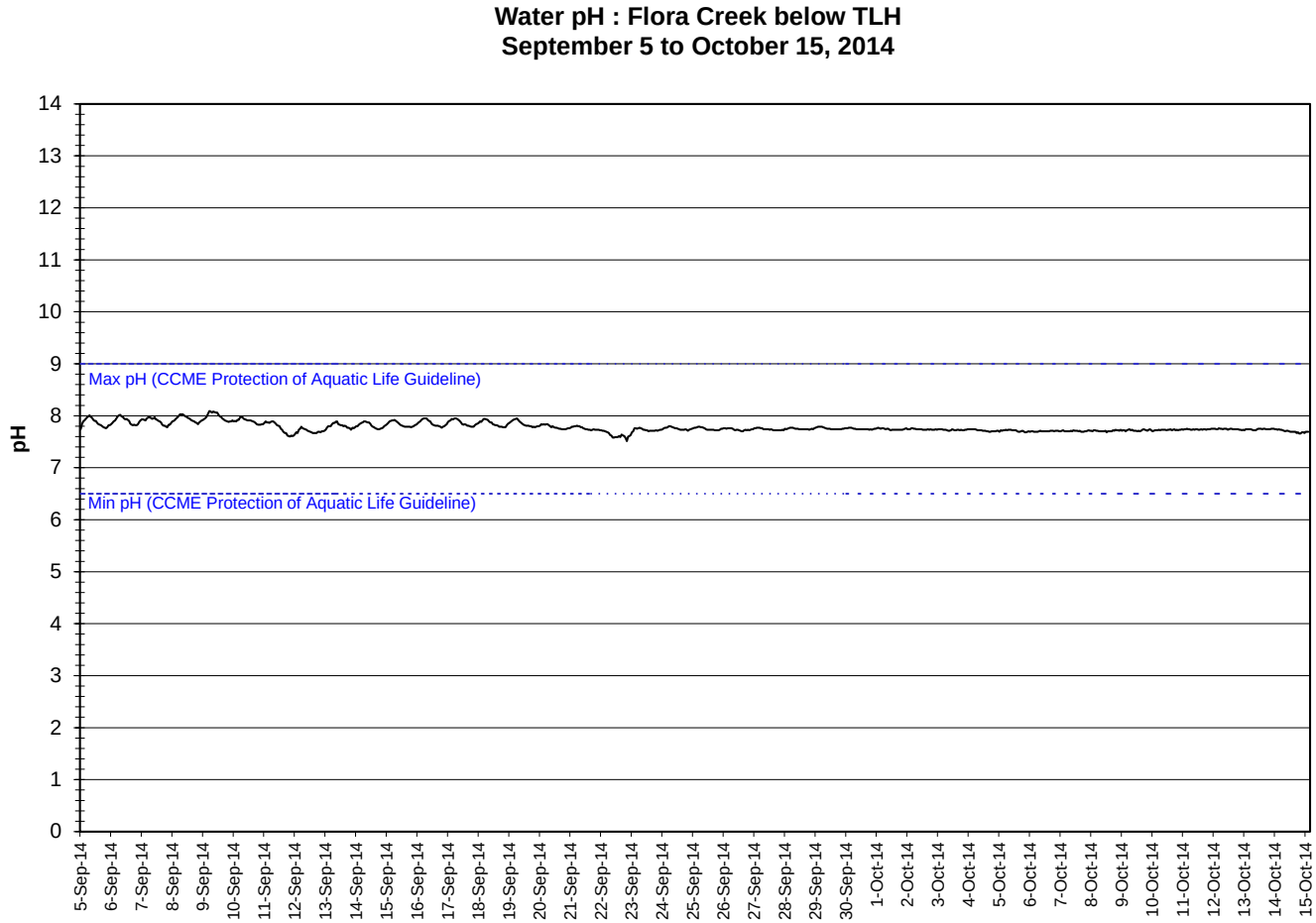


**Figure 3: pH at Flora Creek below TLH**

- Specific conductivity ranges from 69.0 to 90.9 µs/cm (Figure 4).
- Specific conductivity decreased the first day of deployment and then was relatively stable for the reminder of the deployment period. Stage data increased during the deployment period.

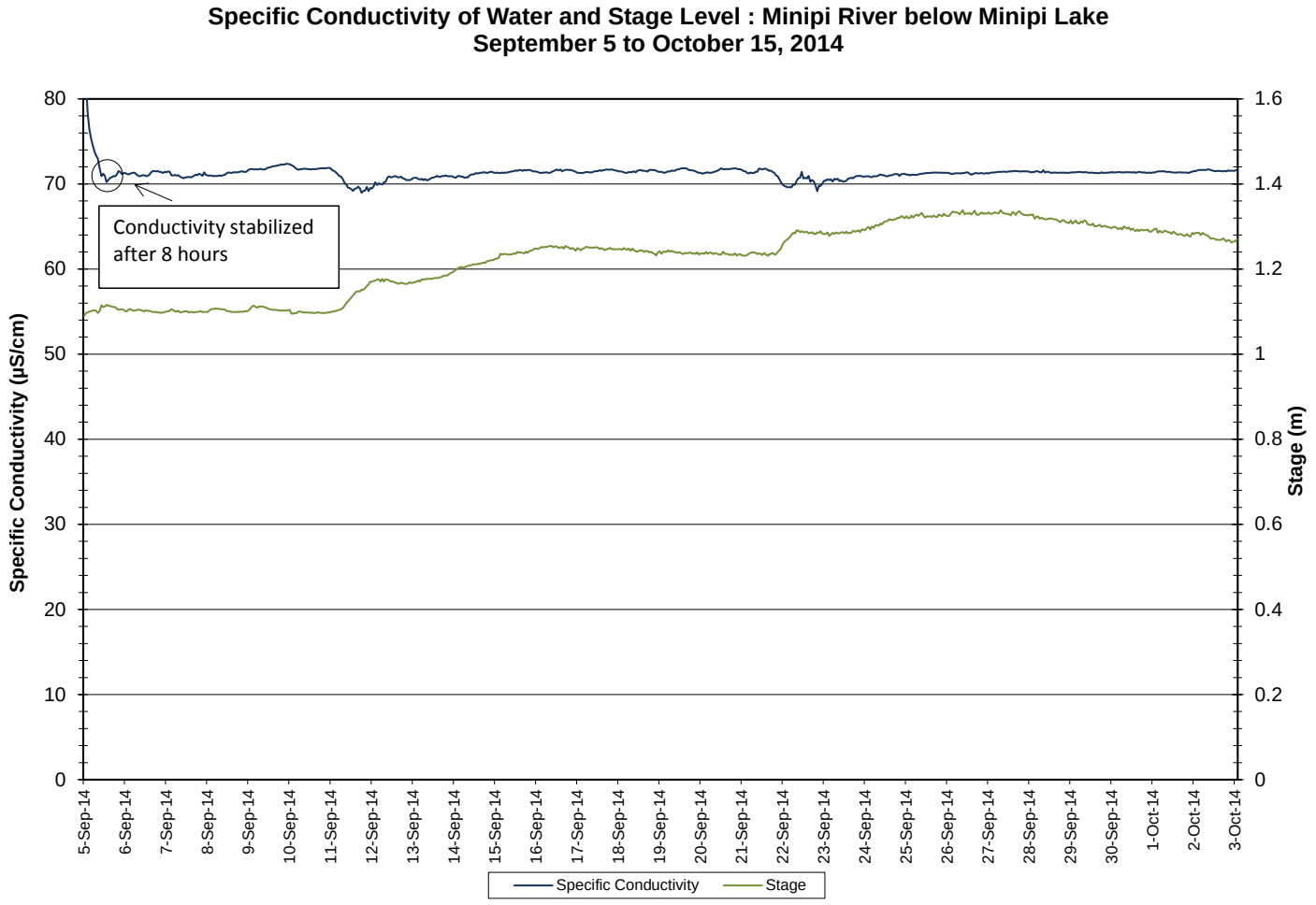


**Figure 4: Specific conductivity and stage at Flora Creek below TLH**

- The saturation of dissolved oxygen ranged from 92.2 to 106.4% and a range of 9.84 to 12.00 mg/l was found in the concentration of dissolved oxygen with a median value of 11.55 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 increases throughout the majority of the deployment period, showing the inverse relationship to water temperature.

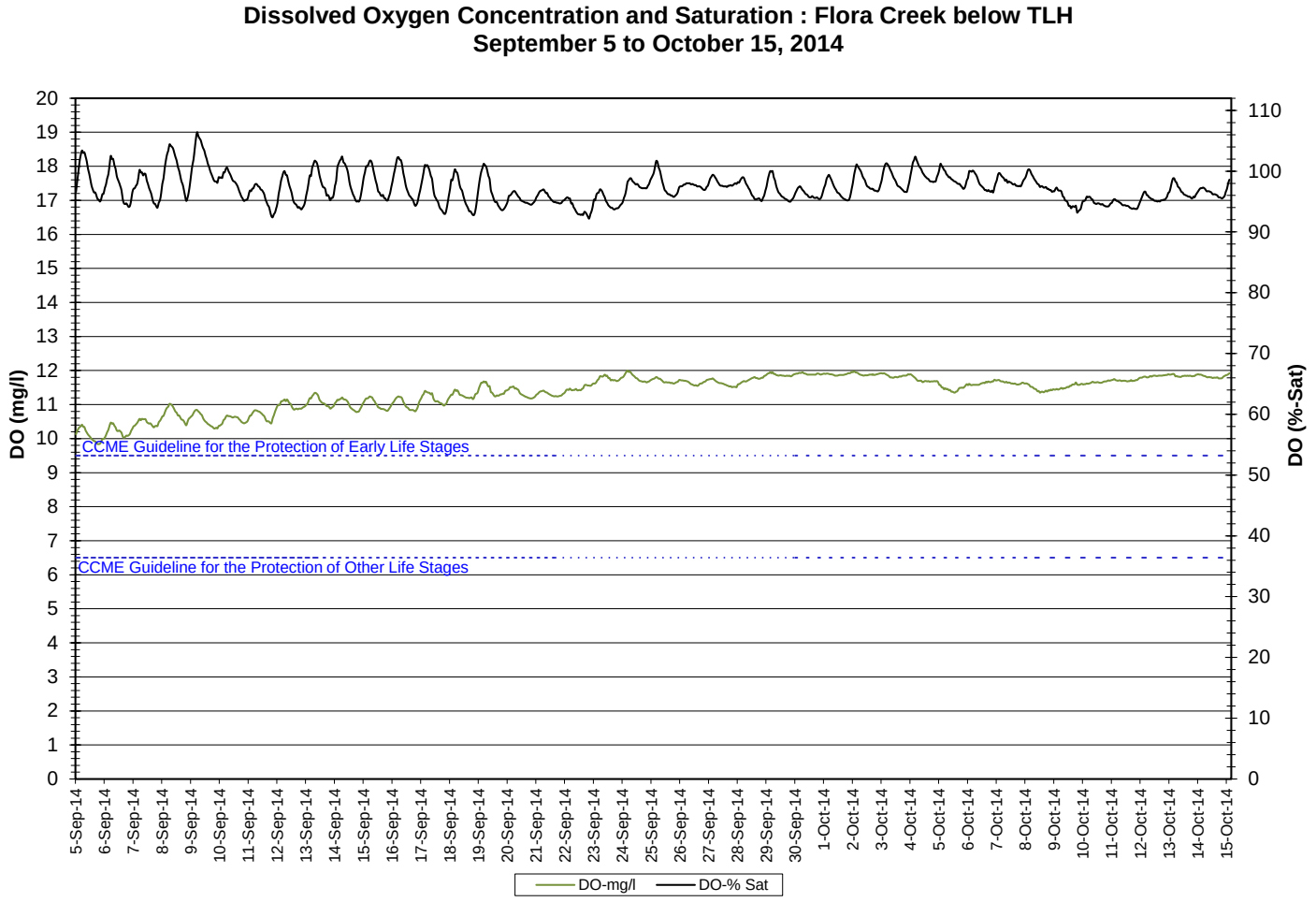


**Figure 5: Dissolved oxygen and percent saturation at Flora Creek below TLH**

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- Turbidity values range from 3.6 NTU to 218.5 NTU. Turbidity is low for the first portion of the deployment period; it then increases for the remainder of the period (Figure 6). There is also a high spike on the 29th of September, for a short period of time.

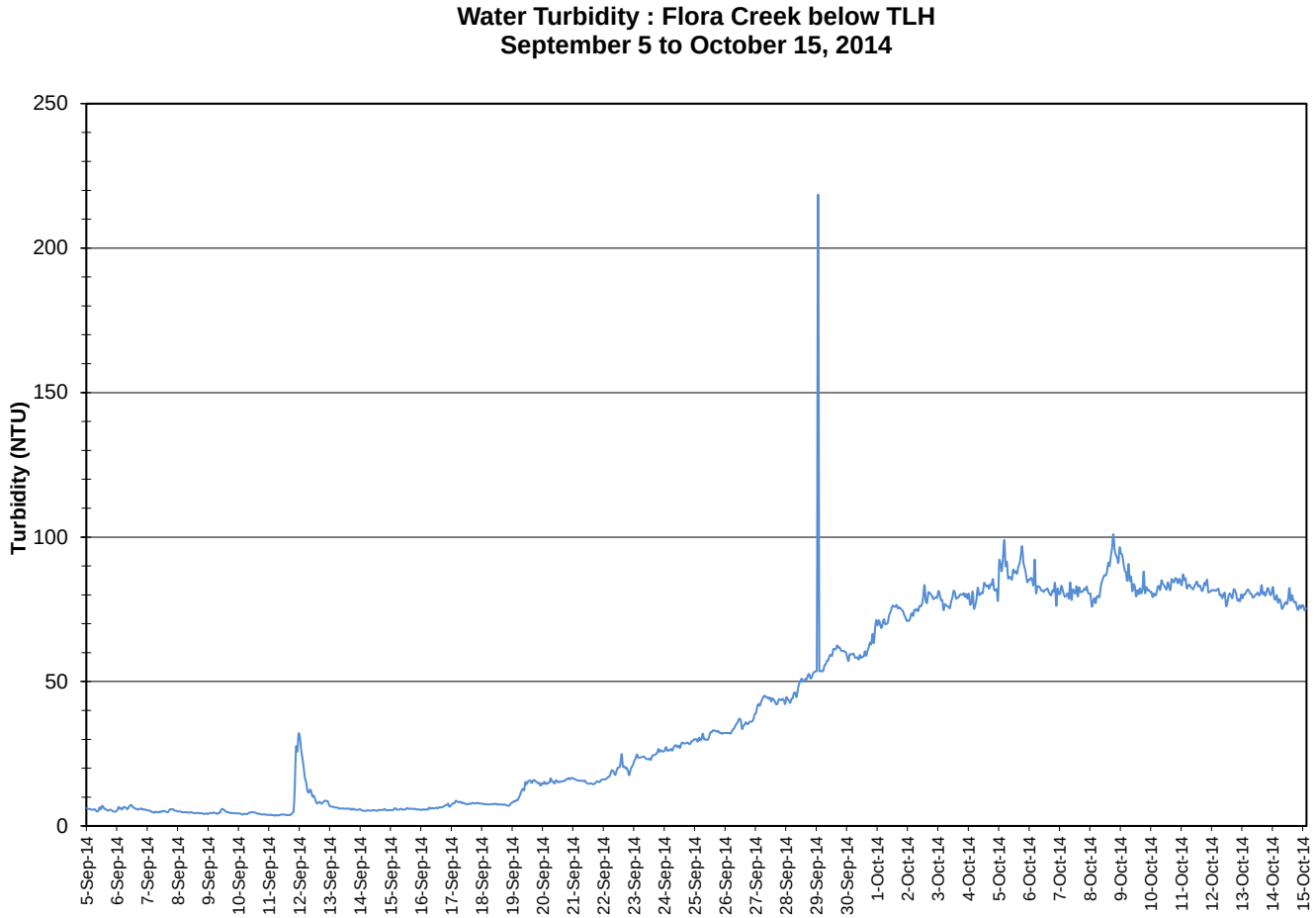


**Figure 6: Turbidity at Flora Creek below TLH**

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- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Flora Creek (Figure 7).
- Stage is relatively stable over the course of the deployment period.
- It is important to note that weather data was collected from Happy Valley – Goose Bay, ~500 km away. Data from the local area was not available for this period.

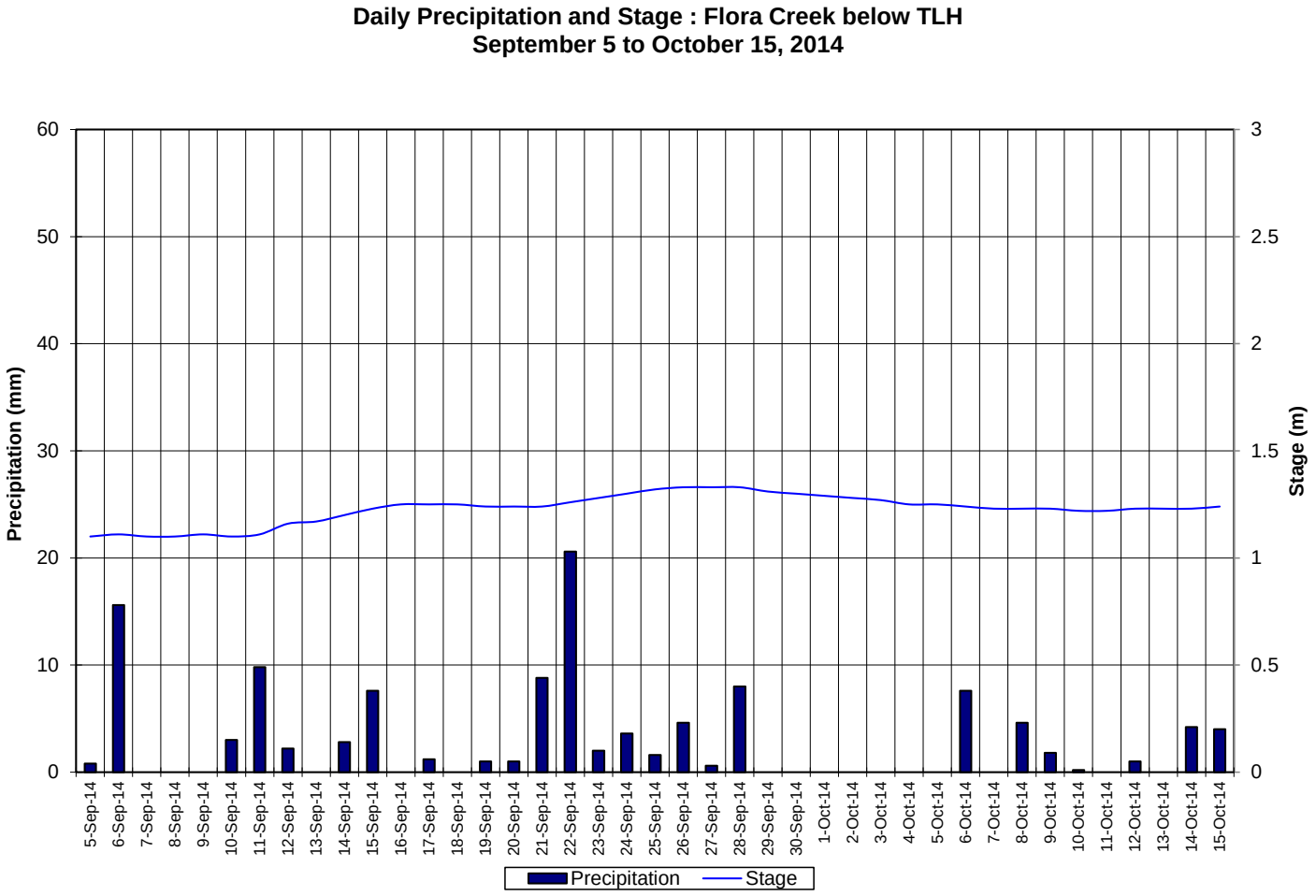


**Figure 7: Precipitation and Stage – Flora Creek**

## Conclusions

- An instrument at the water quality monitoring station on the Flora Creek below TLH station was deployed on September 5 and removed on October 15, 2014 for the winter season.
- 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 throughout the deployment period, corresponding with decreasing ambient air temperature. The temperature typically ranged between 5.74 and 15.39$^{o}$C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.51 and 8.09.
- Specific conductivity ranged from 69.0 to 90.9 µs/cm. It was noted that the conductivity sensor on this instrument requires a substantial amount time to stabilize. The sensor stabilized after 8 hours of being in the water.
- 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. Dissolved Oxygen increased throughout the deployment period.
- Turbidity values were low for the majority of the deployment period; they then began to increase for the remainder of the period.
- Stage was relatively stable for the entire deployment period.

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## Appendix 1

**Average Daily Air Temperature and Daily Precipitation: Happy Valley - Goose Bay, NL**
**September 5 to October 15, 2014**