Real-Time Water Quality Report
Leary's Brook at Prince Philip Drive

Deployment Period
February 3rd, 2022 to March 16th, 2022

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Climate Change
Water Resources Management Division

Prepared by:
Adrian Rogers
Environmental Scientist
Water Resources Management Division
Department of Environment and Climate Change
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
Ph. No: (709) 729 - 0351
adrianrogers@gov.nl.ca

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General

The Water Resources Management Division, in partnership with Environment and Climate Change Canada (ECCC), maintains a real-time water quality and water quantity monitoring station at Leary's Brook, adjacent to Prince Phillip Drive.

The real-time station allows for assessment and management of the water body. This deployment report discusses water quality related events occurring at the Leary's Brook station.

The purpose of this real-time station is to monitor, process, and publish hydrometric (water quantity) and real-time water quality data at the station. Leary's Brook is an urban stream which flows through industrial and commercial areas and is adjacent to a major roadway.

This report covers the period between the February 2, 2022 deployment and the March 16, 2022 removal.

Figure 1 Leary's Brook Real-Time Water Quality and Quantity Station

Quality Assurance and Quality Control

To ensure the effectiveness and reliability of the real time water quality monitoring program, quality assurance, quality control, and quality assessment procedures have been implemented. 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 adjacent to 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 the parameters on 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 Instrument Performance 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

The most important sensor on any sonde is the temperature sensor. All other parameters can be divided into subgroups of temperature dependent, temperature compensated, and temperature independent. Due to the temperature sensor's location on the sonde, the entire device must be at a constant temperature before the temperature 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.

The deployment and removal instrument performance rankings for **Leary's Brook** for this period are summarized in Table 2.

Table 2 Instrument performance rankings for Leary's Brook

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Leary's Brook	February 3, 2022	Deployment	Good	Good	Good	Good	Excellent
	March 16, 2022	Removal	Excellent	Good	Good	Fair	Poor

At the time of deployment, turbidity ranked "Excellent," while temperature, pH, conductivity, and dissolved oxygen ranked "Good."

At the time of removal, temperature ranked "Excellent," pH and specific conductivity ranked "Good," dissolved oxygen ranked "Fair," and turbidity ranked as "Poor."

The "Poor" and "Fair" ranking for turbidity and dissolved oxygen respectively, was caused by fine sediment build-up around the sonde near the end of this deployment.

Data Interpretation

The following graphs and discussion illustrate water quality-related events from February 3, 2022 to March 16, 2022 at the Leary's Brook station.

With the exception of water quantity data (stage) and precipitation data, all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Water Survey of Canada (WSC) is responsible for QA/QC of water quantity data. Corrected and finalized data may be retrieved from the WSC website (http://www.ec.gc.ca/rhc-wsc/). Precipitation data from the deployment period was retrieved from the ECCC weather station at St. John's International Airport.

Results

Water Temperature

- Water temperature ranged from 0.23°C to 6.29°C during this deployment period, with a median value of 1.14°C and a mean value of 1.67°C.
- The water temperature data displayed below, on figure 2, is typical of shallow streams and ponds. Water temperatures in shallow streams respond quickly to changes in air temperature. Water temperature usually falls overnight and rises during daylight hours. As seen in figure 2, water temperature is also impacted by stage. Temperatures in Leary's Brook rise when warmer runoff enters the system.
- Please note, the stage data is raw data that is published on the ECCC web page. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

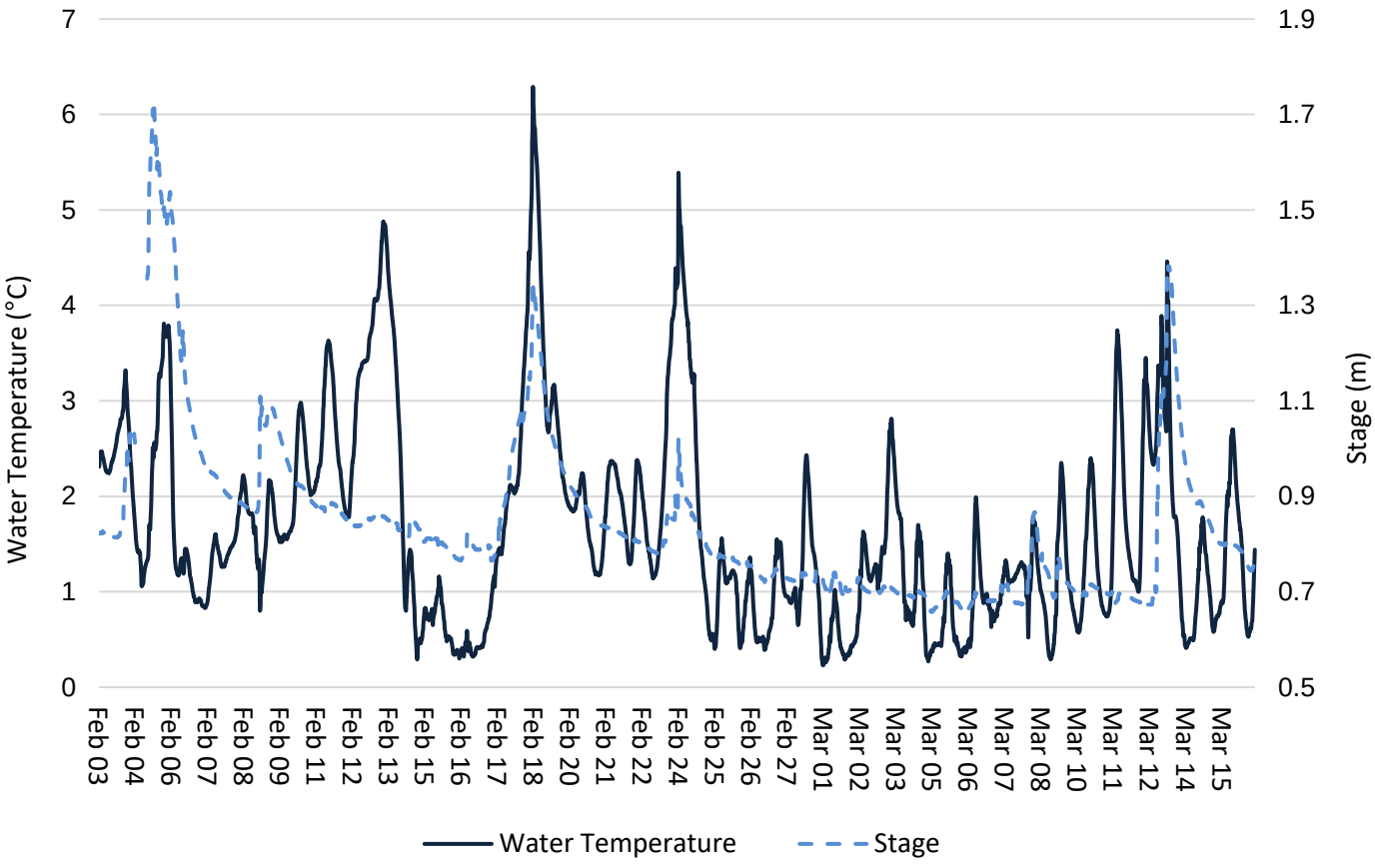

Figure 2 Water Temperature and Stage Level at Leary's Brook

pH

- Throughout the deployment period, the pH at Leary's Brook Station ranged from 6.29 to 6.98.
- The CCME (Canadian Council of Ministers of the Environment) Freshwater Aquatic Life guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. The median and mean pH at Leary's Brook were 6.71 and 6.70 respectively for this deployment period.
- Figure 3, below, illustrates how pH typically falls in Leary's Brook (the water becomes more acidic) when stage increases. In general, precipitation entering Leary's Brook has a lower pH than local surface water causing a small reduction in the pH of the brook.

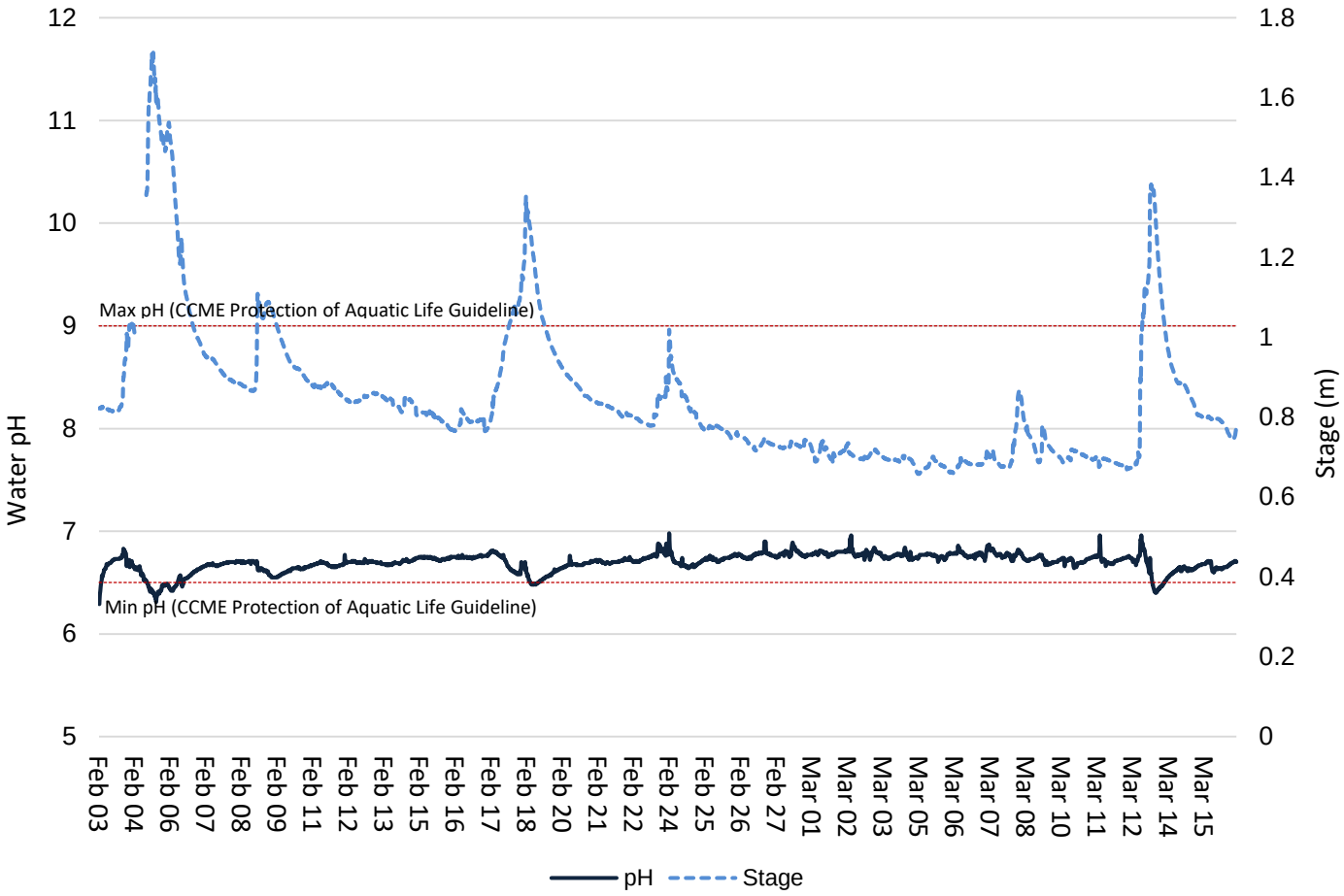

Figure 3 Water pH and Stage at Leary's Brook

Specific Conductivity

- The conductivity levels ranged from 178.8 µS/cm to 14510.0 µS/cm during this deployment period. The median and mean specific conductivities were 997.0 µS/cm and 1429.8 µS/cm respectively.
- Figure 4 illustrates how specific conductivity increases during winter months when water levels increase as a result of precipitation; increased precipitation introduces road salts from runoff. Warm temperatures can melt snow and ice and introduce road salts to the system.

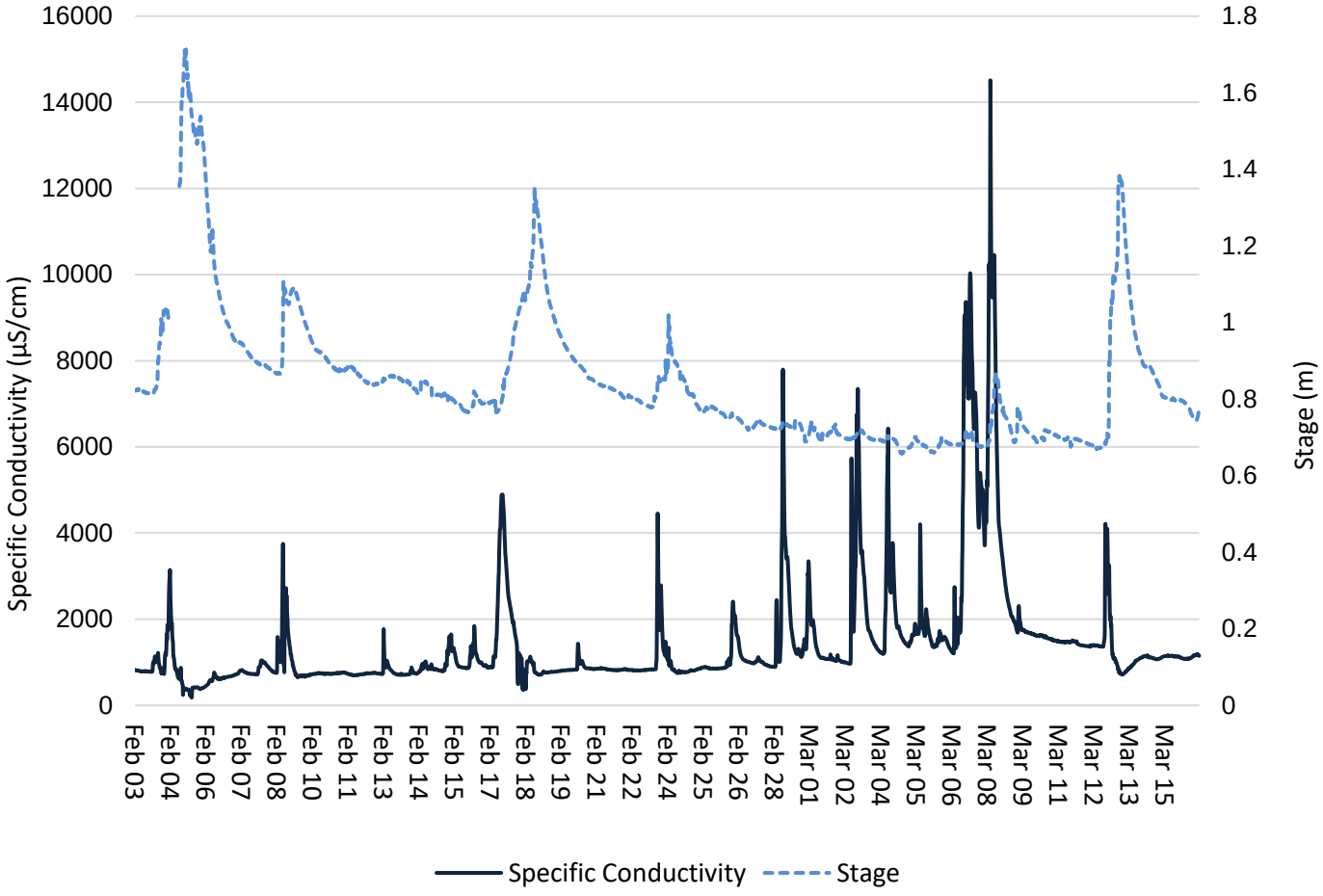

Figure 4 Specific conductivity values at Leary's Brook Station.

Total Dissolved Solids

- The values for total dissolved solids (TDS) ranged from 9.29 g/mL to 0.1144 g/mL during this deployment period. The median and mean for TDS were 0.638 g/mL and 0.915 g/mL respectively.
- Like specific conductivity, TDS is calculated from the conductivity and temperate probes. Pure water has low conductivity. Electrical currents are conducted by ions in solution, so increases in TDS will result in an increase in conductivity. Figure 5, below, illustrates how an increase to stage can lead to an increase in TDS during the winter months.

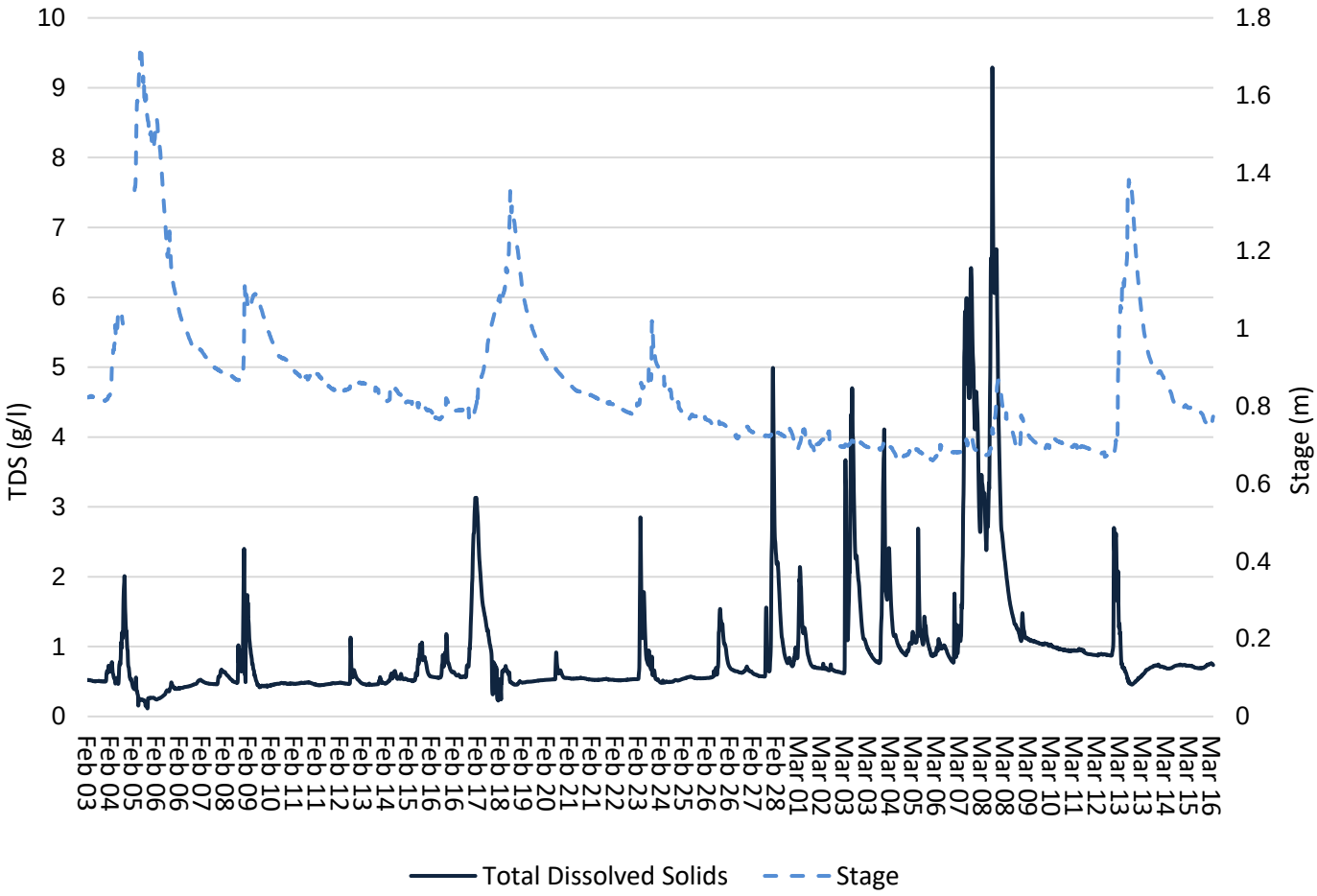

Figure 5 Total Dissolved Solids in Water and Stage Level at Leary's Brook.

Dissolved Oxygen

- The sonde measures dissolved oxygen (DO) (mg/L) and then calculates the percent saturation (% Sat) using the dissolved oxygen and temperature sensors.
- The dissolved oxygen percent saturation levels within during the deployment period ranged from 85.0 % to 97.2 %, with a median and mean value of 93.2 % and 93.0 % respectively. Dissolved oxygen (mg/L) measured from 11.35 mg/L to 13.89 mg/L, with a median and mean value of 13.14 mg/L and 13.06 mg/L respectively.
- Figure 6, below, shows all dissolved oxygen (mg/L) values were above the minimum dissolved oxygen CCME Guideline for the protection of other life stages and early life stages throughout the deployment period.
- Small decreases in available oxygen are associated with increases in water temperature, because warm water can hold less dissolved oxygen than cold water.

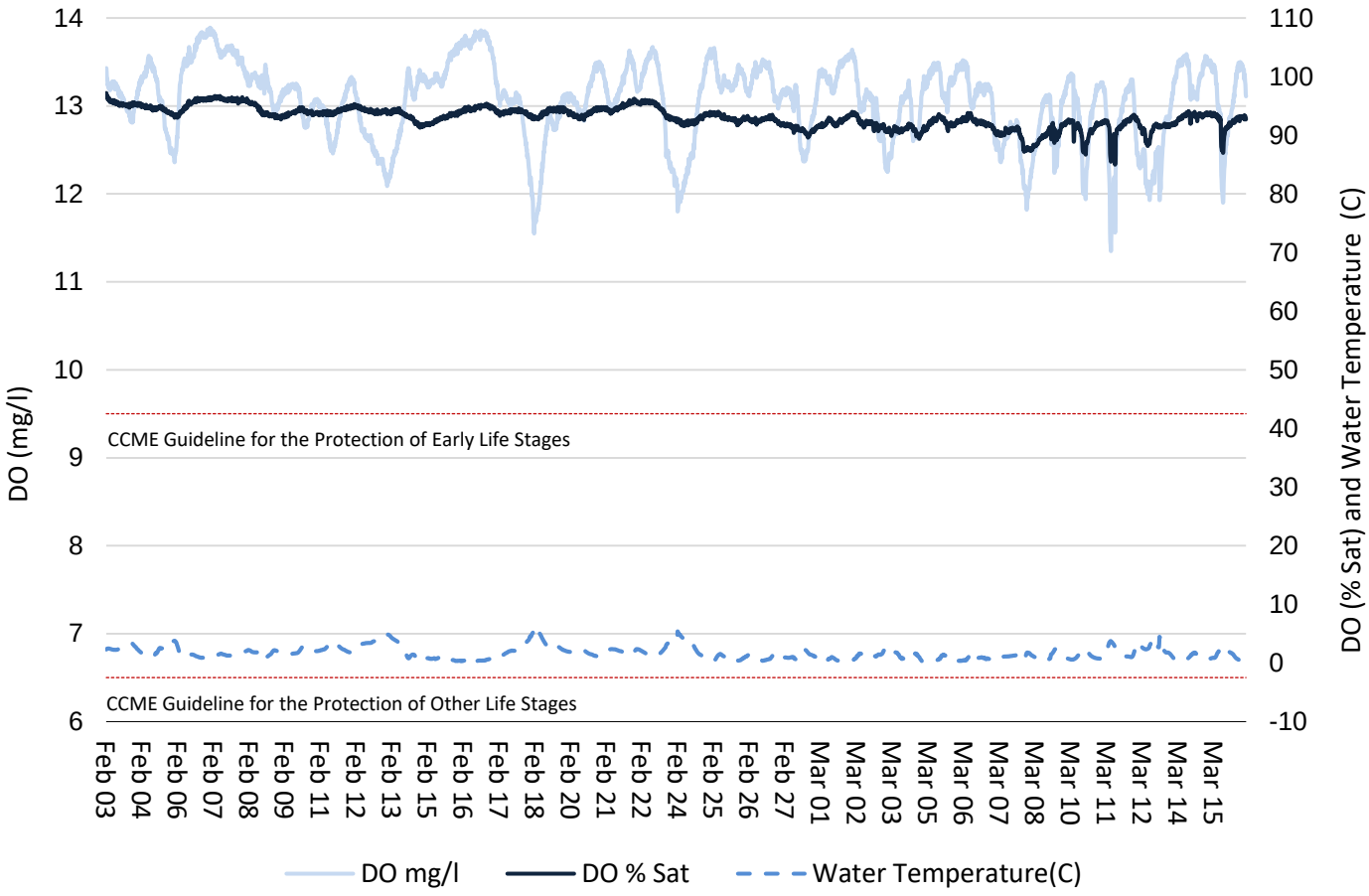

Figure 6 Dissolved oxygen (mg/L & % Sat) and water temperature (°C) values at Leary's Brook Station.

Turbidity

- The turbidity sensor records values between 0 NTU and 3000 NTU. A turbidity reading of 3000 NTU is identified as an error and is not a true value. Readings of 3000 NTU should not be included in statistical analysis.
- The turbidity readings during this deployment ranged between 0.0 NTU to 427.0 NTU with median and mean values of 10.4 NTU and 36.8 NTU respectively.
- Increases in turbidity (cloudiness) are usually caused by increased runoff during precipitation events. Runoff carries silt and other debris into Leary's Brook. Upstream construction and the inadequate control of silt-laden runoff can also cause turbidity to increase. As shown in figure 7, most turbidity increases during this period are clearly associated with runoff from precipitation events.
- There is an increasing trend in turbidity throughout March as a result of sediment accumulation. Upon removal, the instrument was partially covered with silt and pebbles obstructing some of the sensors. As noted in QAQC, the secondary instrument provided a result with a statistically significantly which was most likely caused by debris.

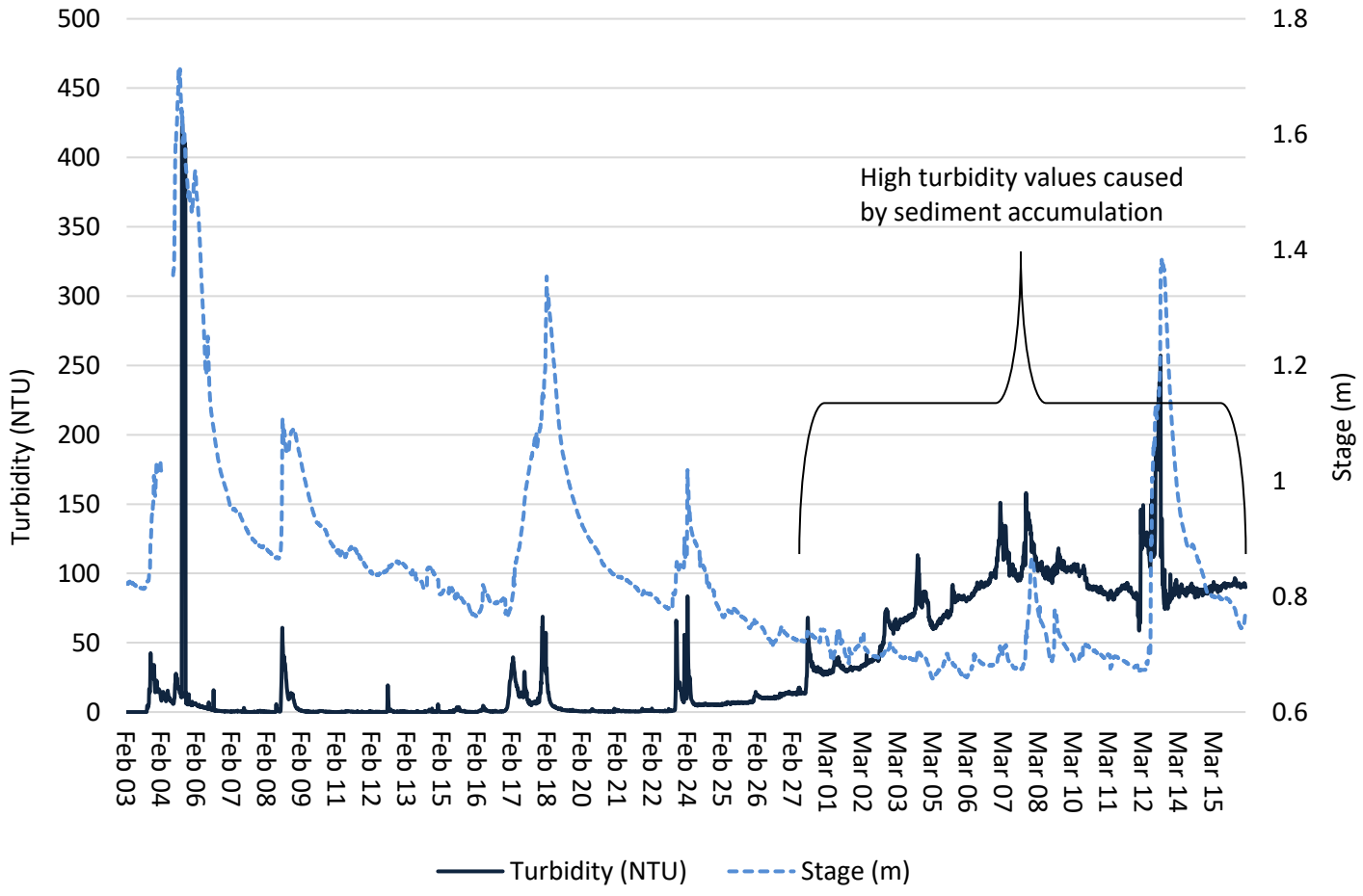

Figure 7 Turbidity (NTU) values at Leary's Brook Station

Stage and Total Precipitation

- Figure 8, below, shows daily total precipitation data from St. John's International Airport weather station and the daily average stage.
- Please note that the stage data in this report is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.
- Stage (and streamflow) usually varies significantly throughout a deployment period in Leary's Brook.

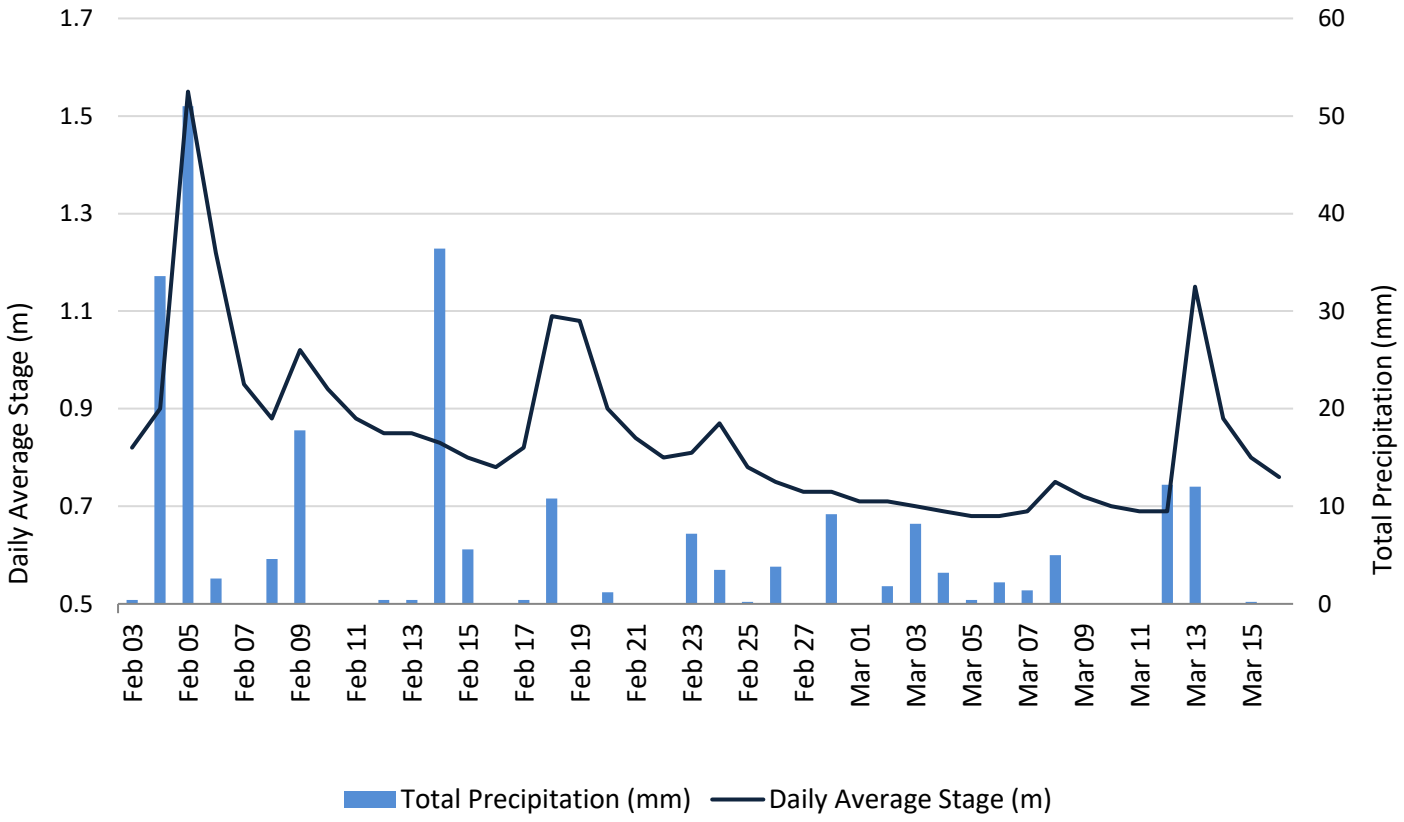

Figure 8 Daily average stage values (m) from Leary's Brook and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

In both natural and developed environments, climate and weather conditions can contribute to variations in water quality. Leary's Brook is an urban stream surrounded by heavily developed land, so it is expected that observed and recorded changes in Leary's Brook water quality are related to anthropogenic disturbances or effects.

Precipitation and runoff events during the deployment period led to expected increases in stage, thus influencing the water temperature, DO, turbidity, pH, specific conductance, and TDS. During this deployment period, the median water temperature at the Leary's Brook station was 1.41°C. The median pH for Leary's Brook Station was 6.71. The pH level generally decreases slightly at this station during rainfall events and increases during dry periods. Increased turbidity levels can be associated with upstream disturbances and construction, although most often they are caused by precipitation runoff. Runoff can carry sediments into the brook overland and via storm drains. Specific conductivity had a median value of 997.0 µS/cm. The maximum specific conductivity was 14510.0.0 µS/cm, which is very high for fresh water systems; however, it is not unexpected at Leary's Brook. During winter months, conductivity usually reaches its highest values during periods of high flow. Conductivity rapidly increases as precipitation runoff introduces road salts. TDS had a median value of 0.638 during the deployment period. Dissolved Oxygen at Leary's Brook had a median of 93.2 % saturation and 13.14 mg/L during the deployment period. Small decreases in DO (mg/L and % Sat) correspond with increases in water temperatures. Dissolved oxygen levels were above the CCME Aquatic Life guidelines for the protection of early and other life stages during this deployment period.