



Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
June 4, 2019 to July 24, 2019



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

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General

- The Water Resources Management Division (WRMD), 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 Parkway.
- 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 real-time station. Leary's Brook is an urban stream that flows through industrial and commercial areas and adjacent to a major roadway.
- This report covers the period between the deployment on June 4, 2019 and removal on July 24, 2019.

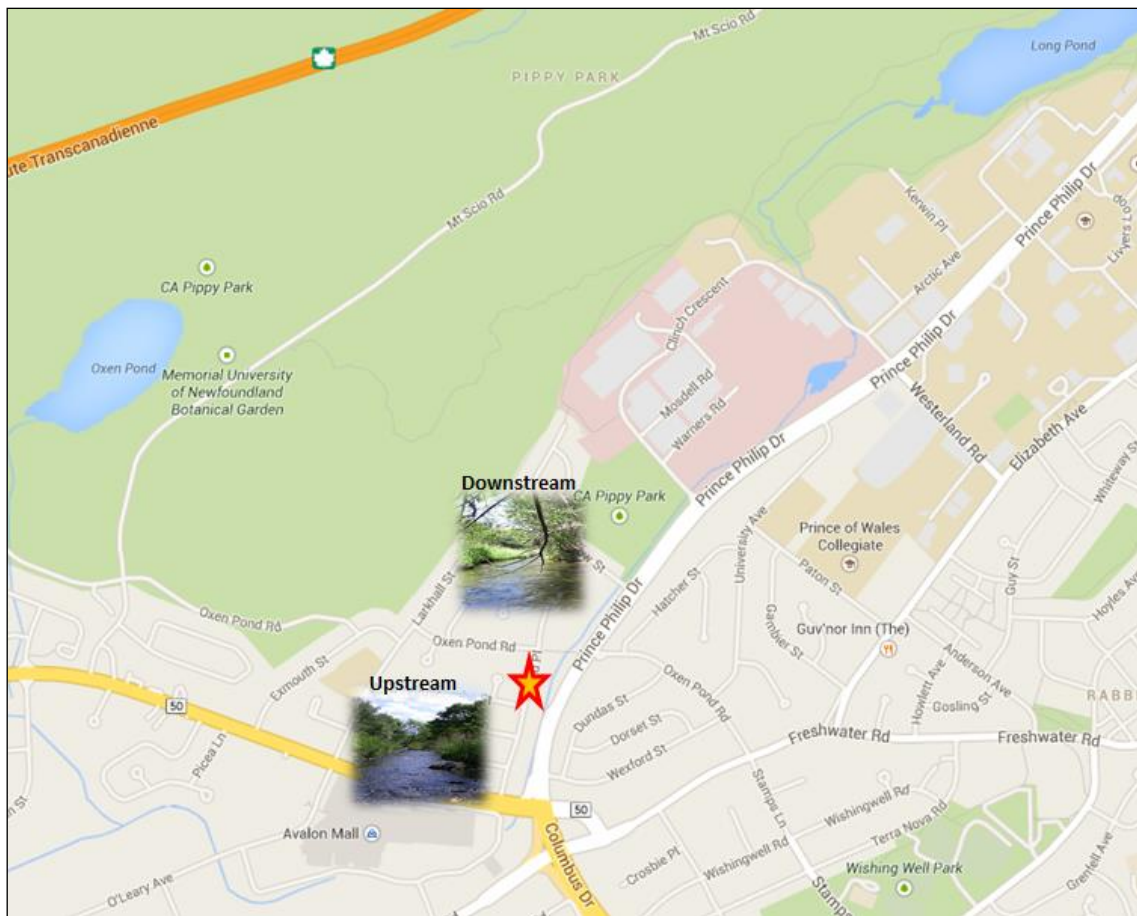


Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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 alongside 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

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

- The temperature sensor on any sonde is the most important. 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 sonde 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.
- 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	June 4, 2019	Deployment	Excellent	Good	Excellent	Good	Good
	July 24, 2019	Removal	Excellent	Good	Fair	Excellent	Excellent

- At the Leary's Brook station at the time of deployment, temperature and conductivity ranked as "Excellent", while pH, dissolved oxygen and turbidity ranked as "Good".

- At the time of removal, temperature, dissolved oxygen and turbidity ranked as “Excellent”, pH ranked as “Good” and Conductivity ranked as “Fair”.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from June 4, 2019 to July 24, 2019 at the Leary's Brook station.
- 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 (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.

Leary's Brook

Water Temperature

- Water temperature ranged from 7.59 to 18.30 °C during this deployment period (Figure 2).
- Water temperature at Leary's Brook displayed a typical variation over the deployment period. Water temperature is influenced by air temperature.
- The water temperature data displayed on Figure 2 is typical of shallow streams and ponds. Shallow water bodies are highly influenced by variations in ambient air temperatures. Water temperature often falls overnight and rises during daylight hours.
- 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.

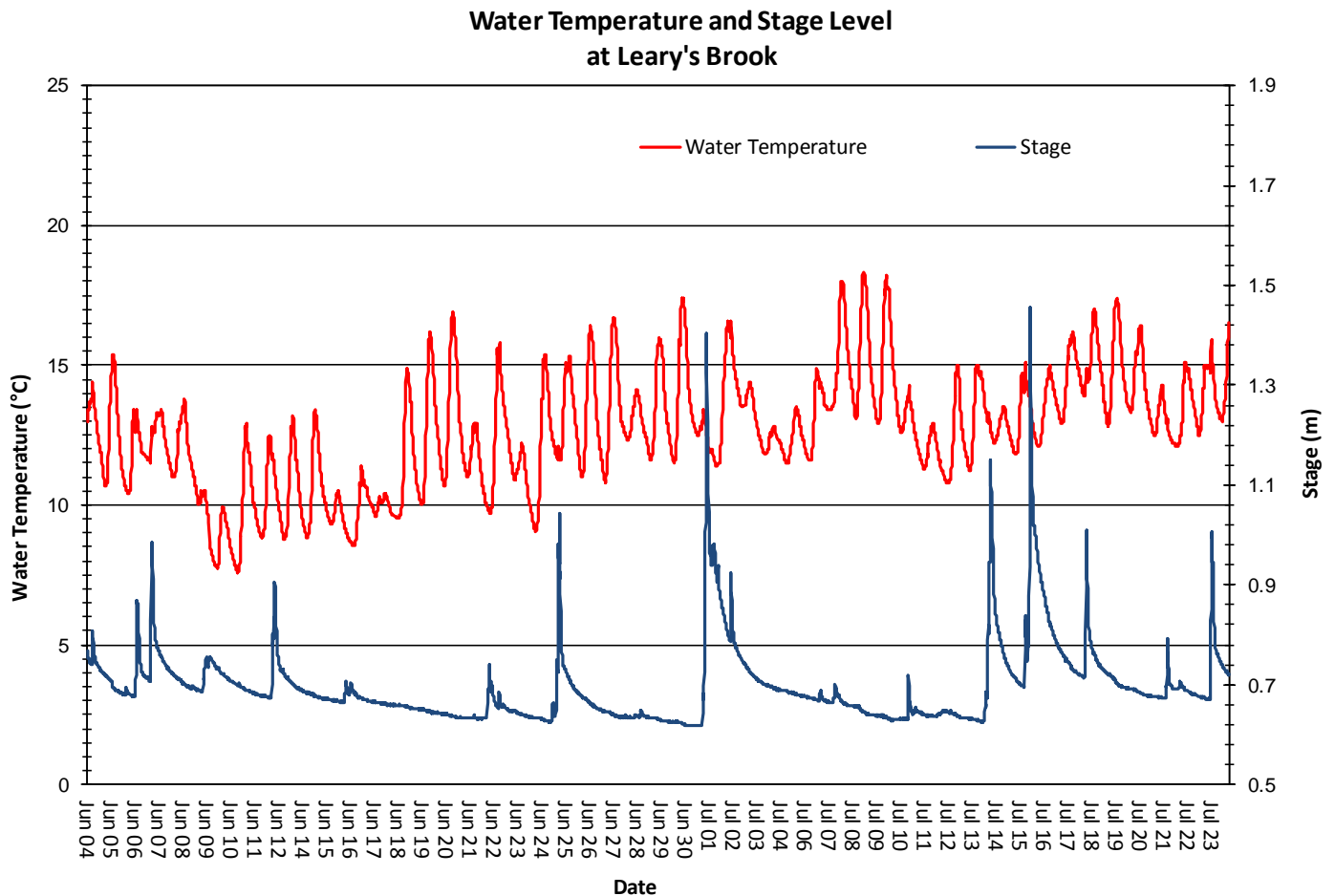


Figure 2: Water Temperature and Stage Level at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 5.89 pH units and 7.05 pH units (Figure 3).
- The CCME guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. Leary's Brook pH median was 6.65 (pH units) for this deployment period.
- pH typically falls slightly in Leary's Brook (the water becomes more acidic) at the same time as stage and flow are increasing. 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.
- For a large portion of this deployment period, the pH sensor appears to have been malfunctioning. This is discussed later in this report.

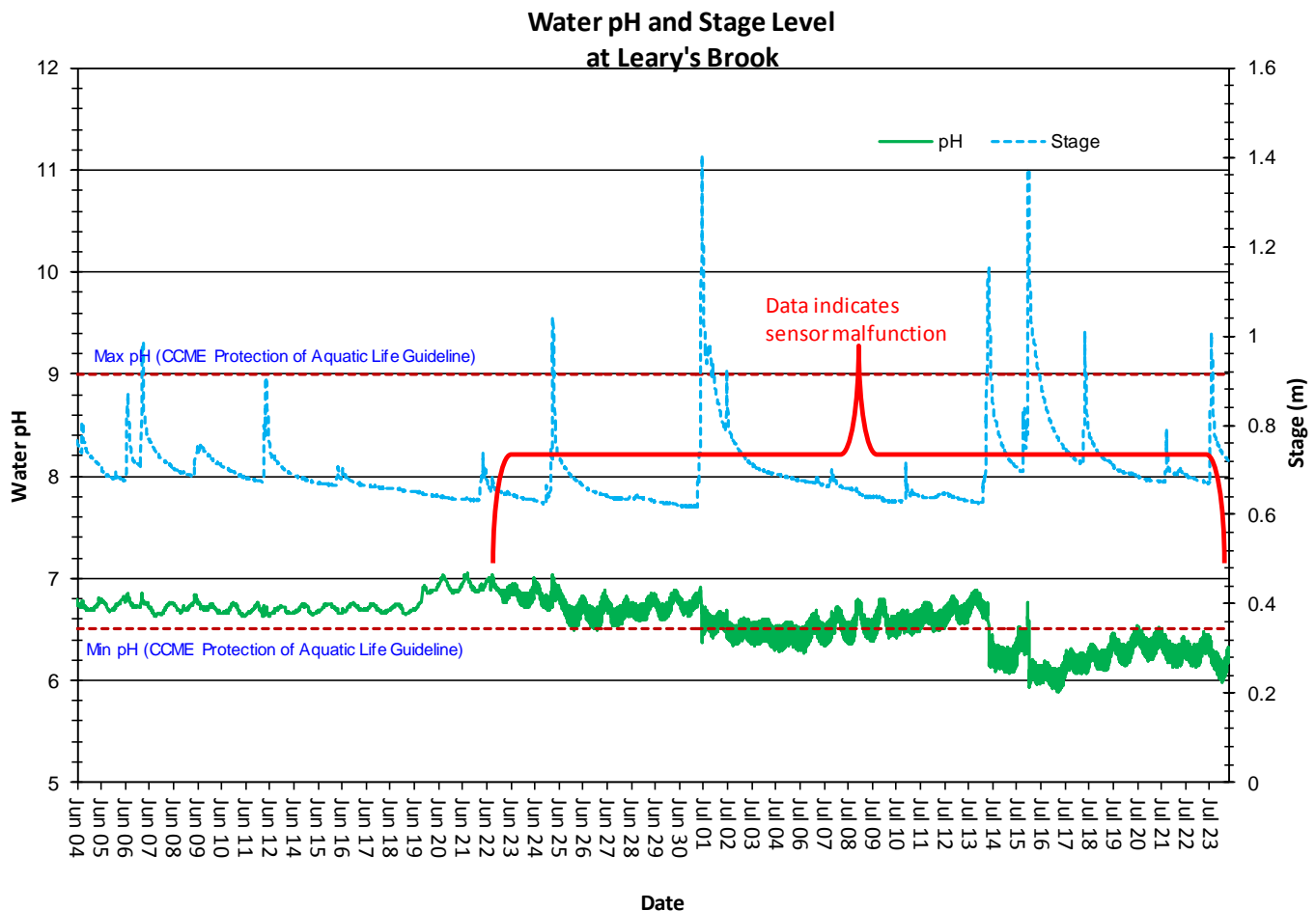


Figure 3: Water pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 156.5 $\mu\text{S}/\text{cm}$ and 971.0 $\mu\text{S}/\text{cm}$ during this deployment period. The median was 742.0 $\mu\text{S}/\text{cm}$. TDS ranged from 0.1001 g/ml to 0.6220 g/ml (Figure 4).
- Road salt was not applied during this deployment period and precipitation runoff tends to dilute ions in Leary's Brook causing specific conductivity to drop rapidly as water levels increase.

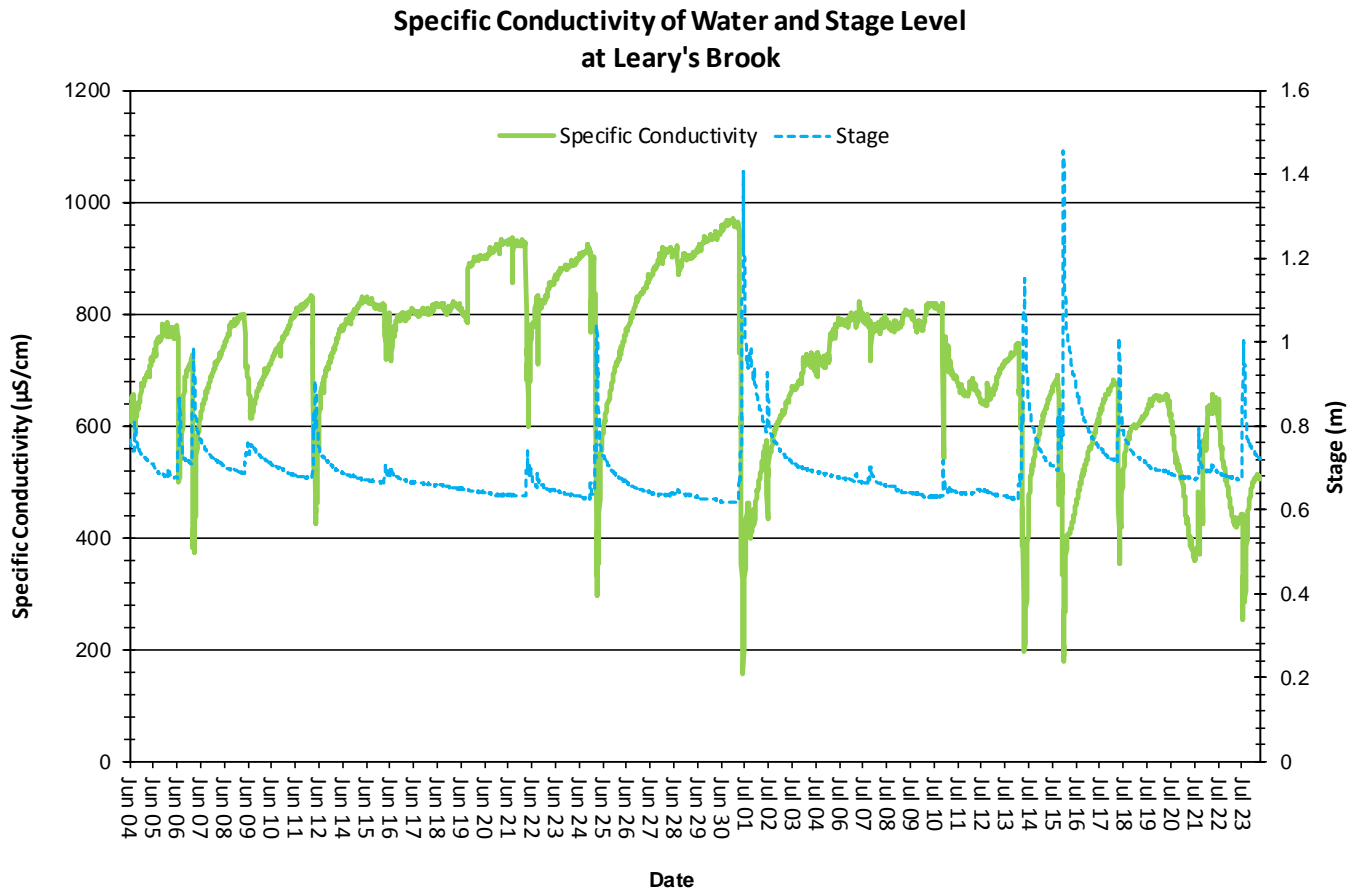


Figure 4: Specific conductivity values at Leary's Brook Station

Dissolved Oxygen

- The instrument measures dissolved oxygen (mg/L) and then calculates the percent saturation (% Sat.).
- The Dissolved Oxygen % Sat levels within this deployment period were between 89.3 % Sat and 99.7 % Sat. Dissolved Oxygen (mg/L) measured between 8.76 mg/L and 11.48 mg/L (Figure 5).
- The DO mg/L values were above the minimum DO CCME guidelines for the protection of early life stages and other life stages for the majority of the deployment period (Figure 5).
- Small decreases in available oxygen are associated with increases in water temperature, as warm water can hold less dissolved oxygen than cooler water.

**Dissolved Oxygen Concentration and Saturation
at Leary's Brook**

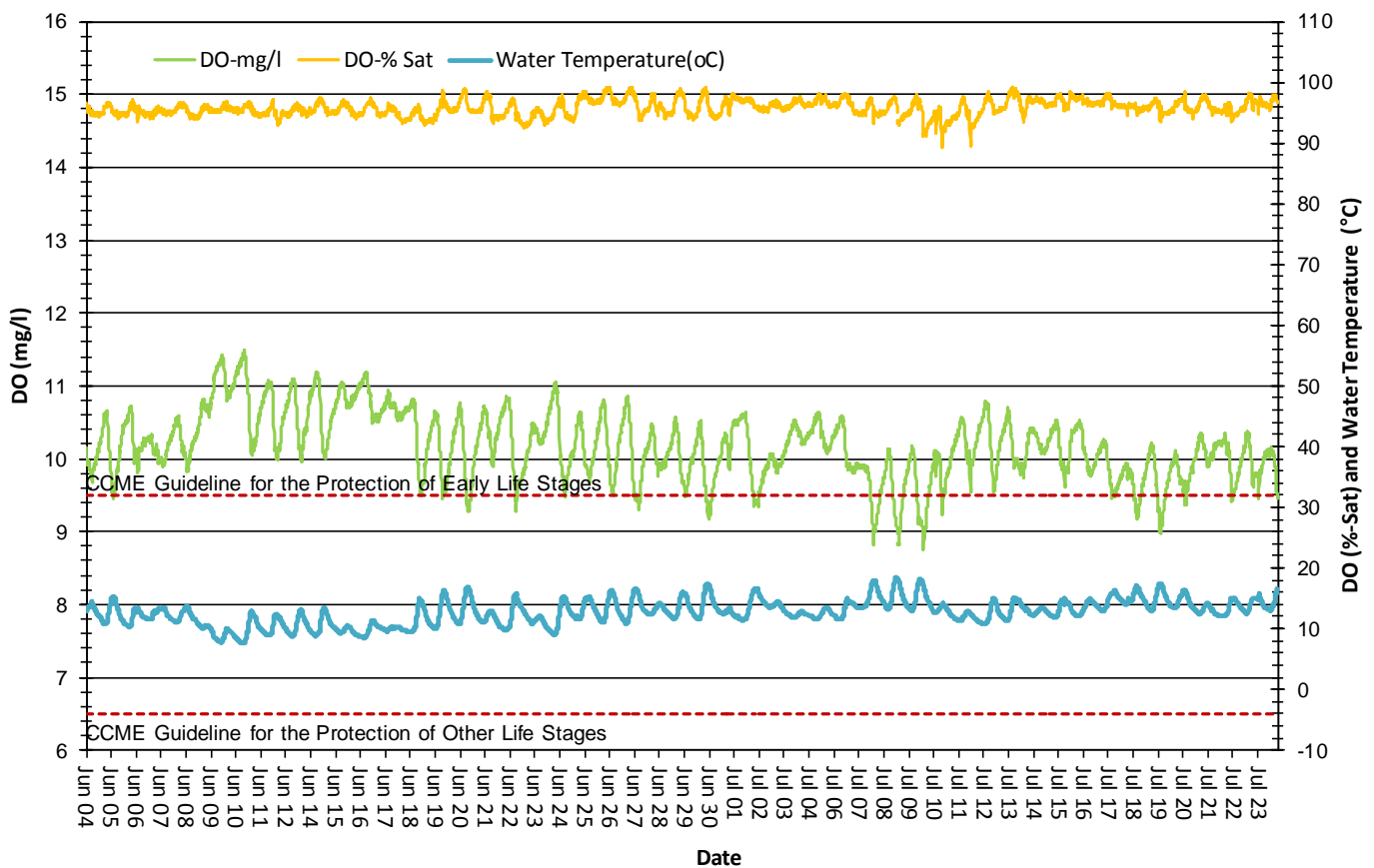


Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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 any statistical analysis.
- The turbidity readings during this deployment ranged between 0.0 NTU to 132.5 NTU (Figure 6).
- 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 will also cause turbidity to increase.
- In many instances during this deployment period the deterioration in Leary's Brook water quality (indicated by an increase in turbidity) is likely associated with upstream construction activity rather than with precipitation runoff.

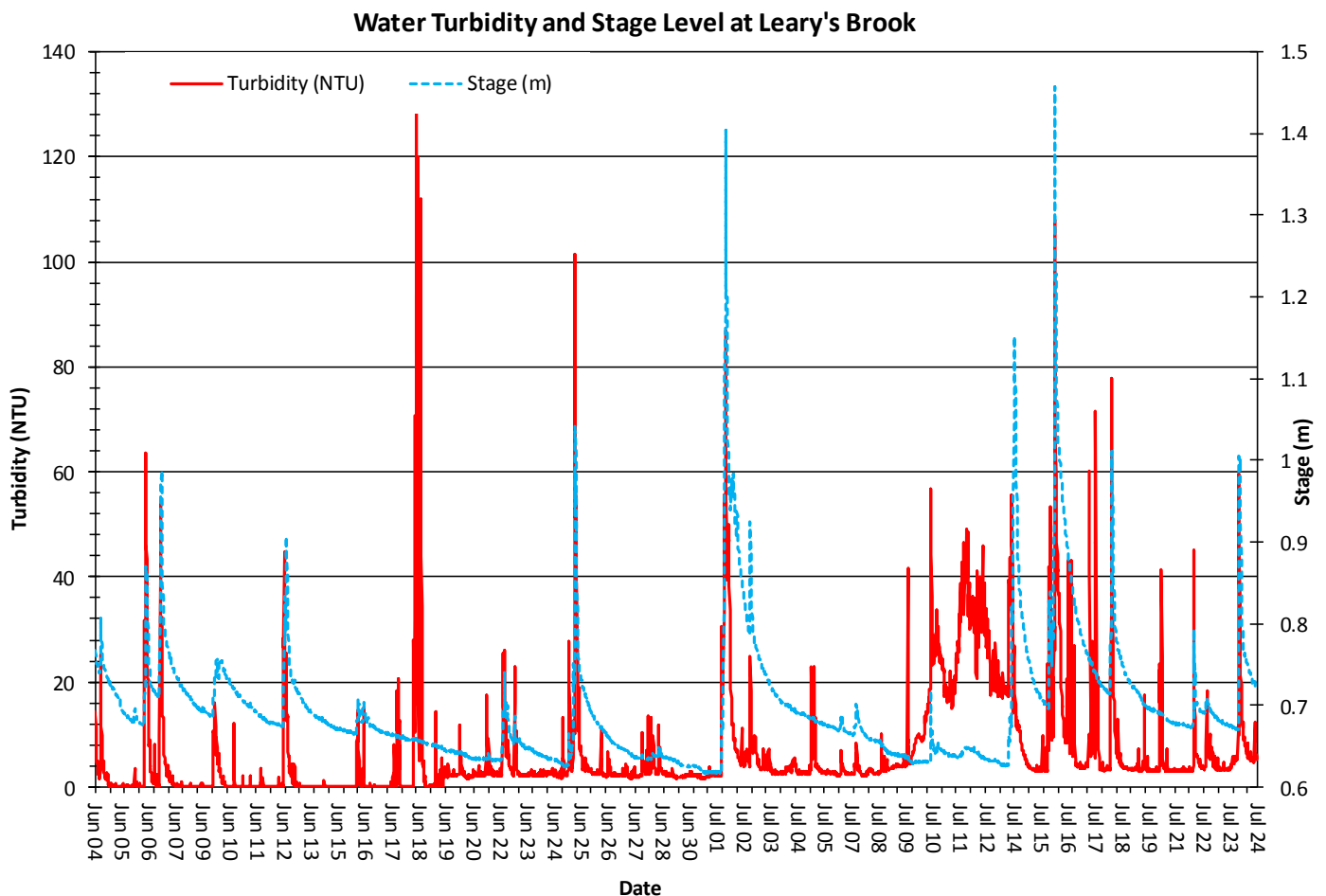


Figure 6: Turbidity (NTU) values at Leary's Brook Station

Stage and Total Precipitation

- The graph below shows daily total precipitation data from St. John's International Airport weather station and the daily average stage (Figure 7). 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.

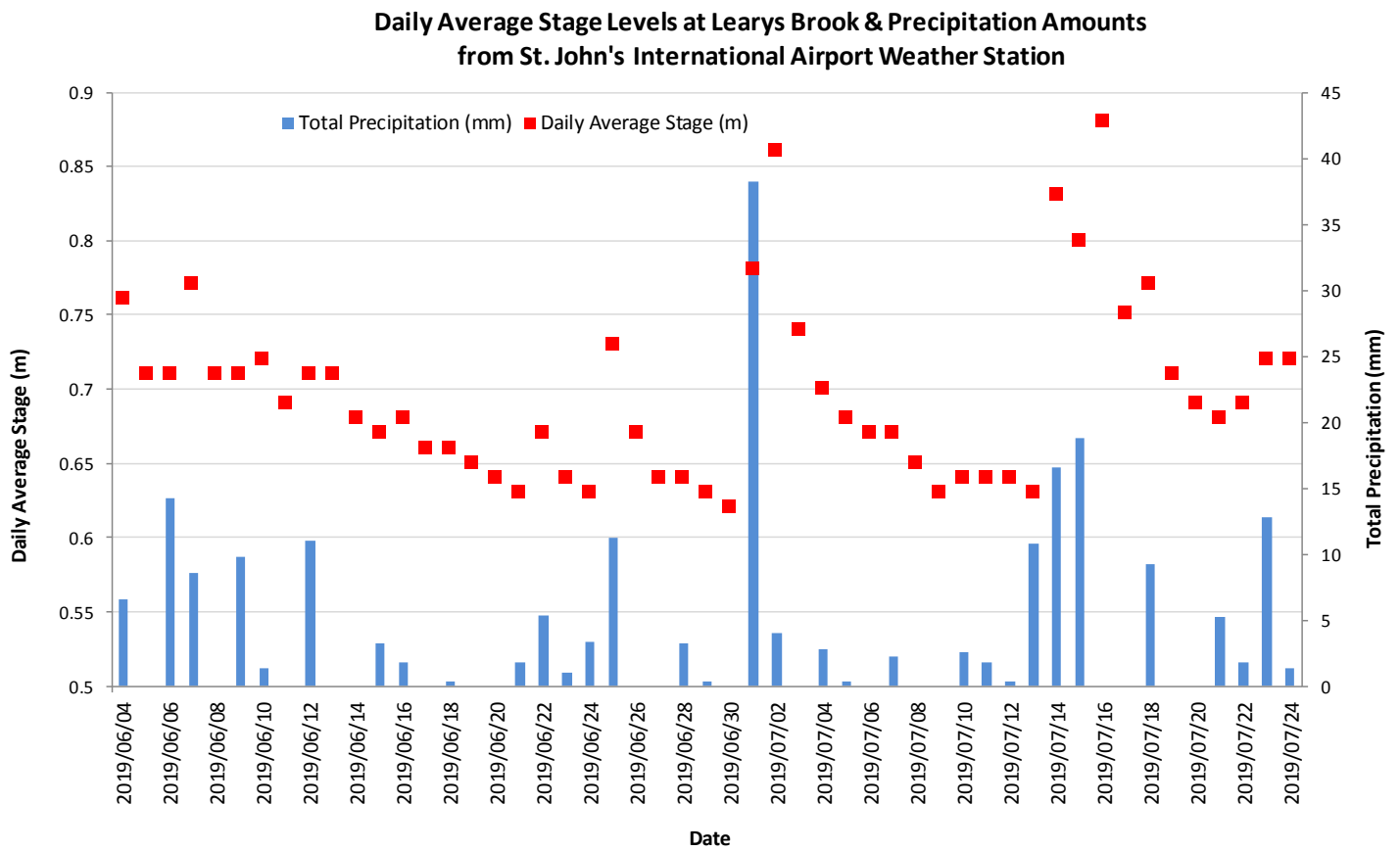


Figure 7: Daily average stage values (m) from Leary's Brook and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

In both natural and urban environments, climate and weather conditions can contribute in large part to variations in water quality. Being an urban stream surrounded by developed land however, it is usually the case 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, which thus influenced the values of turbidity, pH, specific conductance, and TDS. When ambient air temperatures increased there were correspondingly warmer water temperatures, which in turn decreased the amount of dissolved oxygen in the water.

During this deployment period the median water temperature at the Leary's Brook station was 12.70°C.

The median pH value for Leary's Brook Station was 6.72 (pH units). The pH level usually decreases slightly at this station during rainfall events and increases during dry periods.

It is evident from the data collected from June 22, 2019 to the end of the deployment period that the pH sensor was malfunctioning. This can be seen in both the increasing variability of the measurements and in the general downward trend of the recorded pH values. This data has been removed from the dataset and it has been used in this report for illustrative purposes only.

Conductivity had a median value of 742.0 $\mu\text{S}/\text{cm}$. The maximum conductivity was 971.0 $\mu\text{S}/\text{cm}$. At this time of year, conductivity reaches its highest values during times of low flow and drops rapidly during a precipitation event.

Dissolved Oxygen at Leary's Brook had a median of 95.7 %Sat and 10.16 mg/L during the deployment period. Small reductions in DO (mg/L and % Sat) correspond with increases in water temperatures. DO levels were above the "CCME Guideline for the Protection of Early Life Stages" throughout the deployment period.