

Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
October 17, 2016 to November 29, 2016



Government of Newfoundland & Labrador
Department of Environment and Climate Change
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 October 17, 2016 and removal on November 29, 2016.

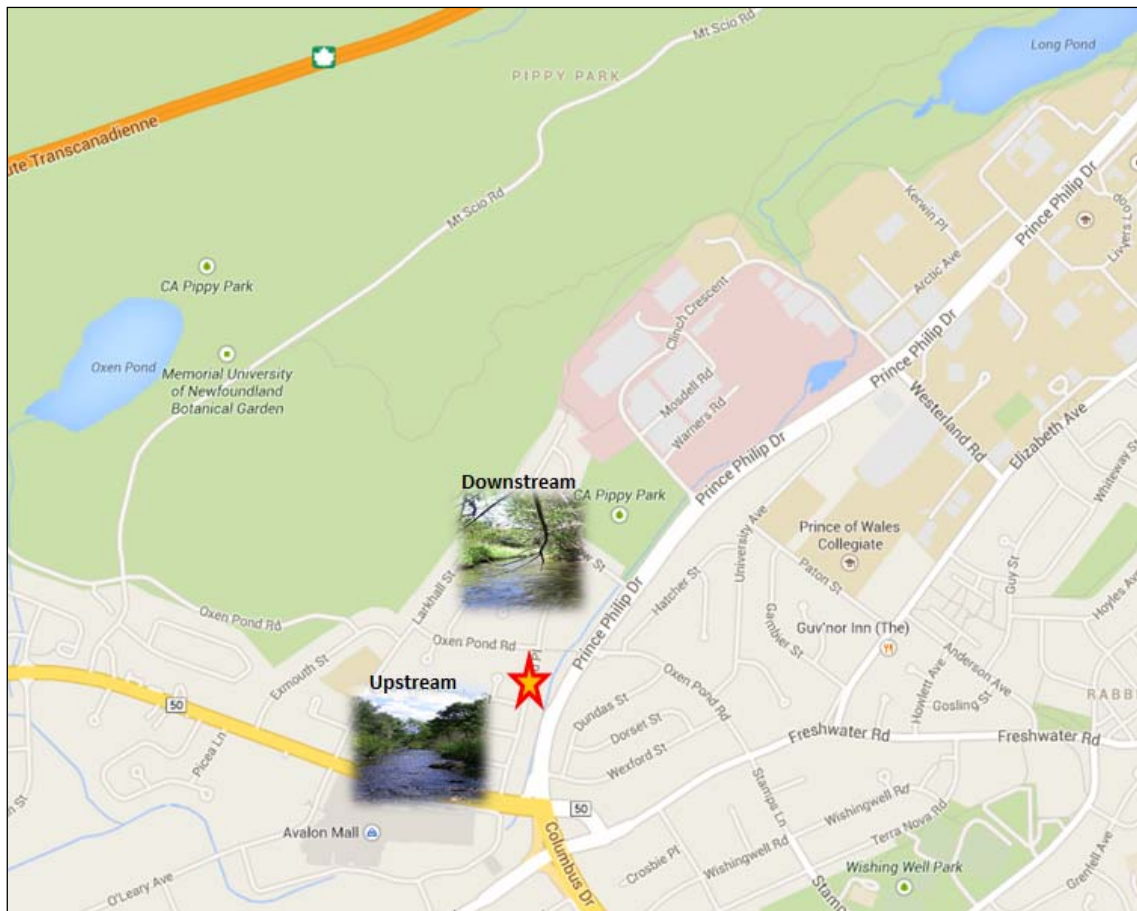


Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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)	$\leq \pm 0.2$	$> \pm 0.2$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$< \pm 1$
pH (unit)	$\leq \pm 0.2$	$> \pm 0.2$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$> \pm 1$
Sp. Conductance ($\mu\text{S}/\text{cm}$)	$\leq \pm 3$	$> \pm 3$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$
Sp. Conductance $> 35 \mu\text{S}/\text{cm}$ (%)	$\leq \pm 3$	$> \pm 3$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$
Dissolved Oxygen (mg/L) (% Sat)	$\leq \pm 0.3$	$> \pm 0.3$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$> \pm 1$
Turbidity < 40 NTU (NTU)	$\leq \pm 2$	$> \pm 2$ to 5	$> \pm 5$ to 8	$> \pm 8$ to 10	$> \pm 10$
Turbidity > 40 NTU (%)	$\leq \pm 5$	$> \pm 5$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$

- 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 the period of October 17, 2016 to November 29, 2016 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	October 17, 2016	Deployment	Excellent	Poor	Excellent	Good	Excellent
	November 29, 2016	Removal	Good	Good	Excellent	Fair	Excellent

- At the Leary's Brook station at the time of deployment, the temperature, conductivity and turbidity readings all ranked as "Excellent". The dissolved oxygen readings ranked as "Good" and the pH readings ranked as "Poor". The pH readings often take some time to stabilize at this location.
- At the time of removal, conductivity and turbidity readings ranked as "Excellent", temperature and pH ranked as "Good" and dissolved oxygen ranked as "Fair".

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from October 17, 2016 to November 29, 2016 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 4.45 °C to 16.30 °C during this deployment period (Figure 2).
- Water temperature at Leary's Brook displays 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 also falls overnight and rises during daylight hours.
- Please note the stage data is raw data that is published on the ECC 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.

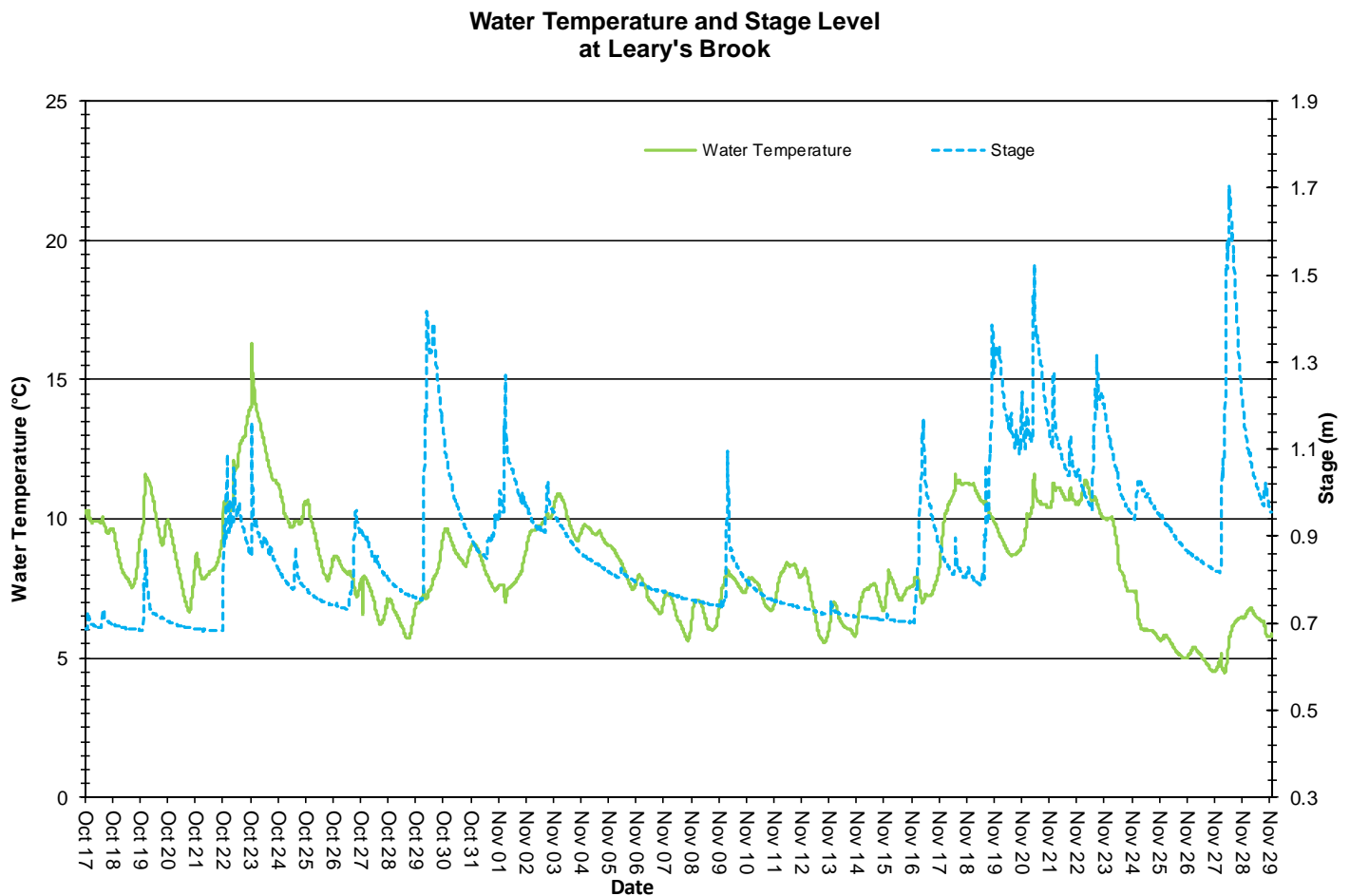


Figure 2: Water Temperature and Stage Level at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 5.20 pH units and 7.40 pH units (Figure 3).
- The pH values recorded for most of this deployment period are suspect. As noted above, at deployment the pH instrument performance, compared to the QA/QC sonde rated as "Poor". On October 19 the field sonde was removed from Leary's Brook and temporarily replaced with another sonde. The field sonde was performance tested and evaluated, including replacement of the KCl solution, and placed back in Leary's Brook on October 27. It performed relatively well for a period of time but began returning widely variable readings and steadily dropping pH until the end of the deployment period on November 29.
- 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 6.51 (pH units) for this deployment period.
- As illustrated below, 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 and this causes a reduction in the pH of the brook.
- Please note the stage data is raw data that is published on the ECC 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.

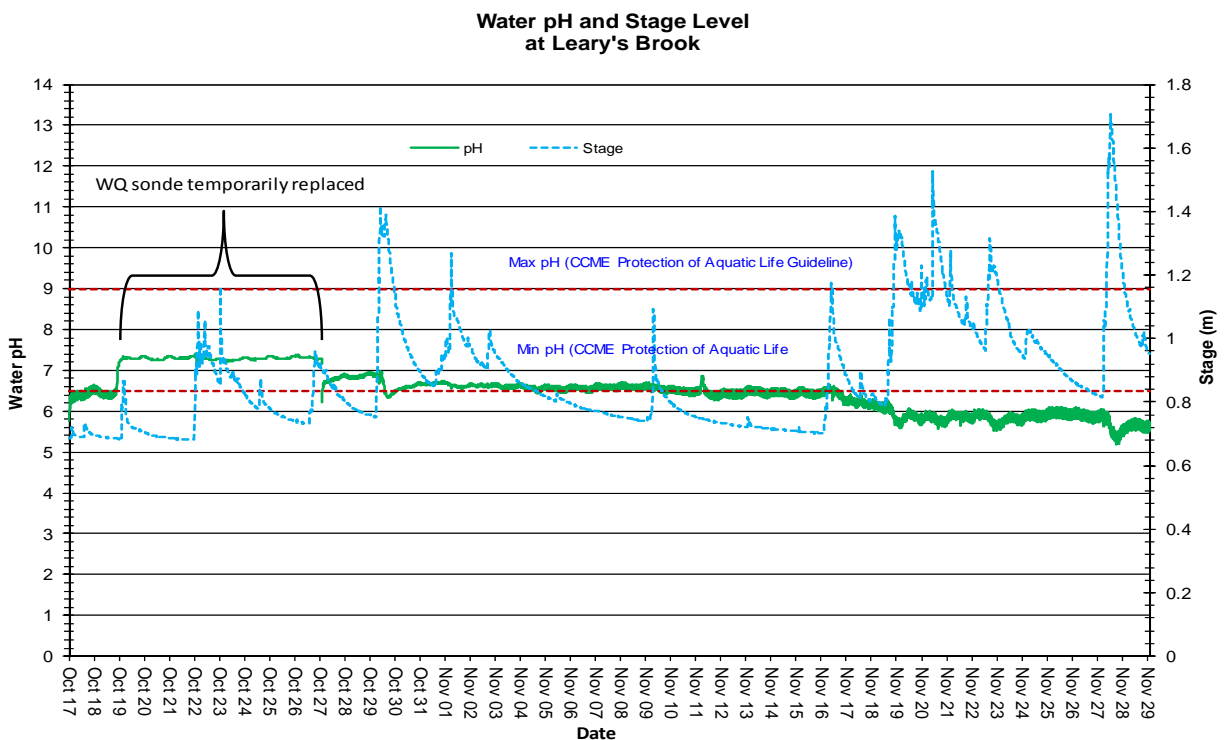


Figure 3: Water pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 107.3 $\mu\text{S}/\text{cm}$ and 929.0 $\mu\text{S}/\text{cm}$ during this deployment period. The median was 324.0 $\mu\text{S}/\text{cm}$. TDS ranged from 0.0687 g/ml to 0.5940 g/ml. (Figure 4)
- In general, decreases in conductivity seen during this deployment period are associated with precipitation runoff and rising stage. This is typical for this time of the year as runoff from precipitation dilutes the dissolved solids present in the brook.
- During frosty weather salt is applied to nearby roads and subsequent runoff often results in a peak in conductivity as the salt is flushed into the system. (see highlighted area in graph below)
- Please note the stage data is raw data that is published on the ECC 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.

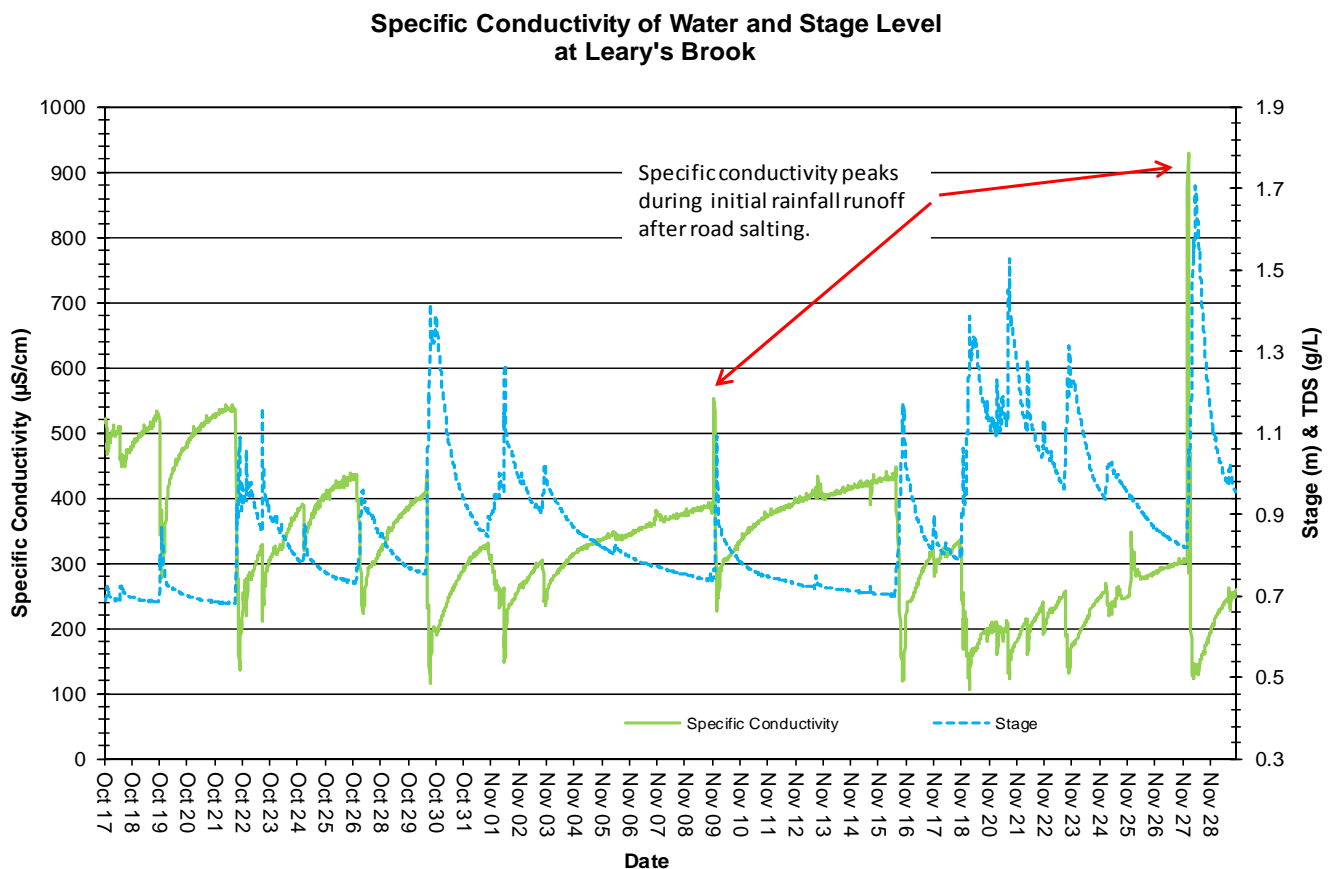


Figure 4: Specific conductivity ($\mu\text{S}/\text{cm}$), TDS (g/L) and stage (m) values at Leary's Brook Station

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 94.1 % Sat and 100.4 % Sat. Dissolved Oxygen (mg/L) measured between 9.39 mg/L and 12.78 mg/L. (Figure 5)
- The DO mg/L values were above the minimum DO CCME guideline for the protection of early life stages during most of this deployment period (Figure 5).
- Small dips in mg/L values are associated with increases in water temperature. Cool water can hold more dissolved oxygen than warmer water.
- Water temperature rose significantly on October 23 to a peak of 16.3 degrees Celsius and dissolved oxygen showed a corresponding decline. (see highlighted area in graph below),

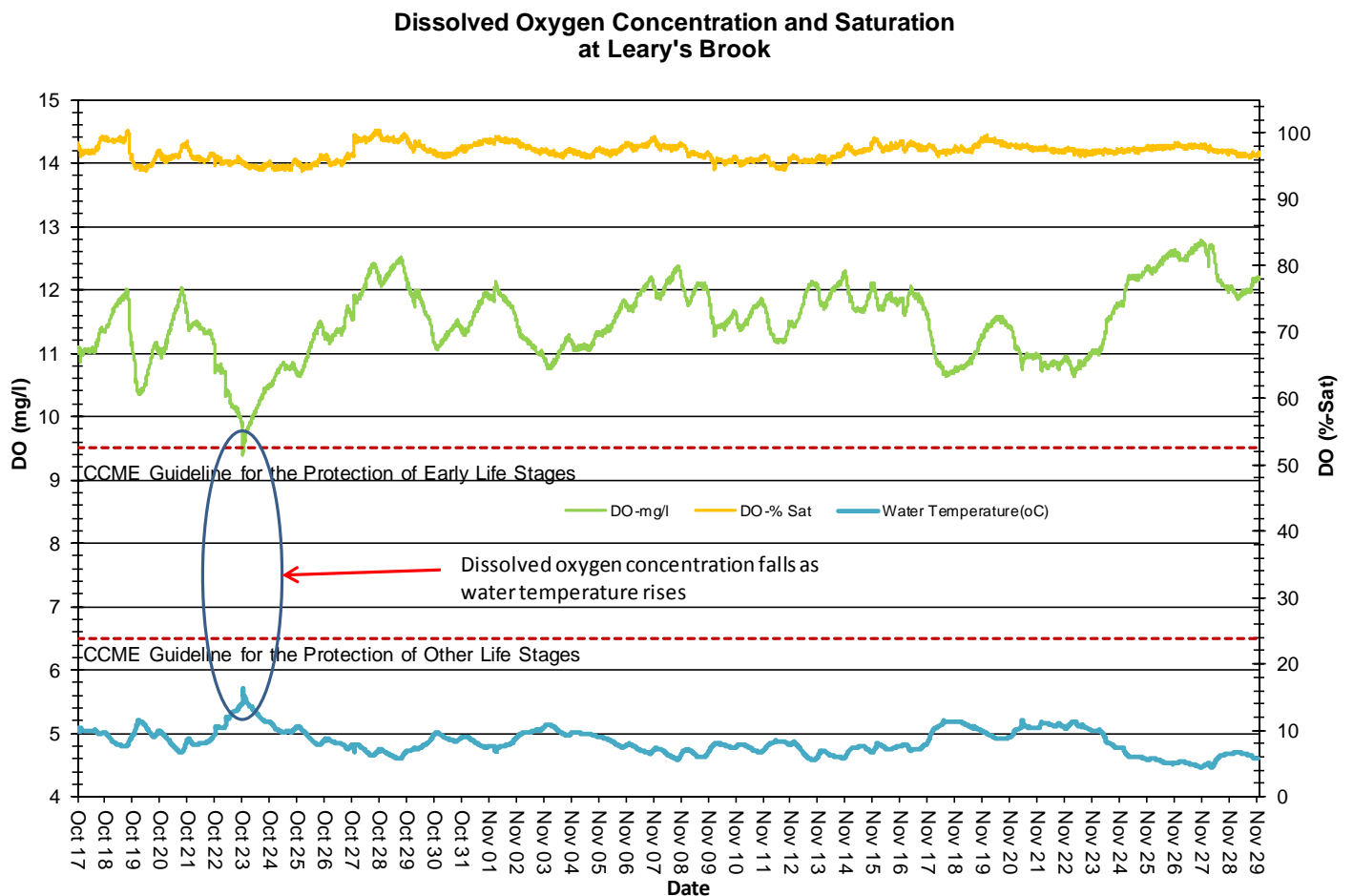


Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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 503.0 NTU (Figure 6).
- Higher turbidity values usually correspond with precipitation events and elevated river stage and runoff. Rainfall and subsequent runoff along with increased flow carries road and bank sediment and other material into the brook which is captured by the turbidity sensor. This is typical of an urban stream where significant sediment loading is associated with even minor precipitation events.
- Not all higher turbidity values can be attributed to increased runoff. Turbidity was elevated on the afternoon of October 31 for a few hours though stage and flow were not increasing at this time (See inside oval). Some instream disturbance upstream of the monitoring station likely caused this to occur.
- Please note the stage data is raw data that is published on the ECC 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.

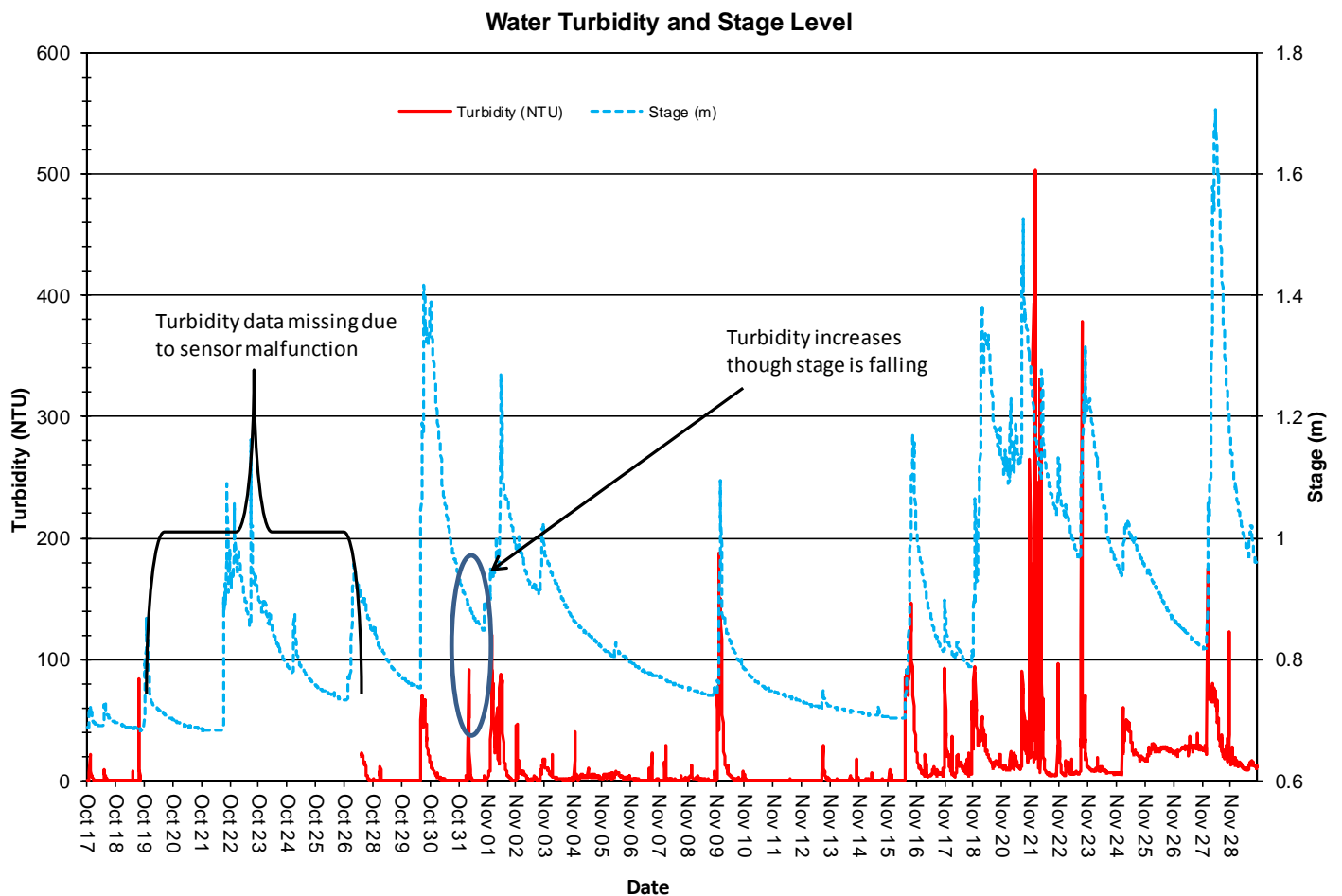


Figure 6: Turbidity (NTU) values at Leary's Brook Station

Stage and Total Precipitation

- The below graph includes 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. Stage is directly influenced by rainfall and subsequent runoff from the surrounding environment. Precipitation runoff impacts urban streams relatively quickly as rainfall flows across impervious surfaces such as roads and parking lots and then into storm drains.

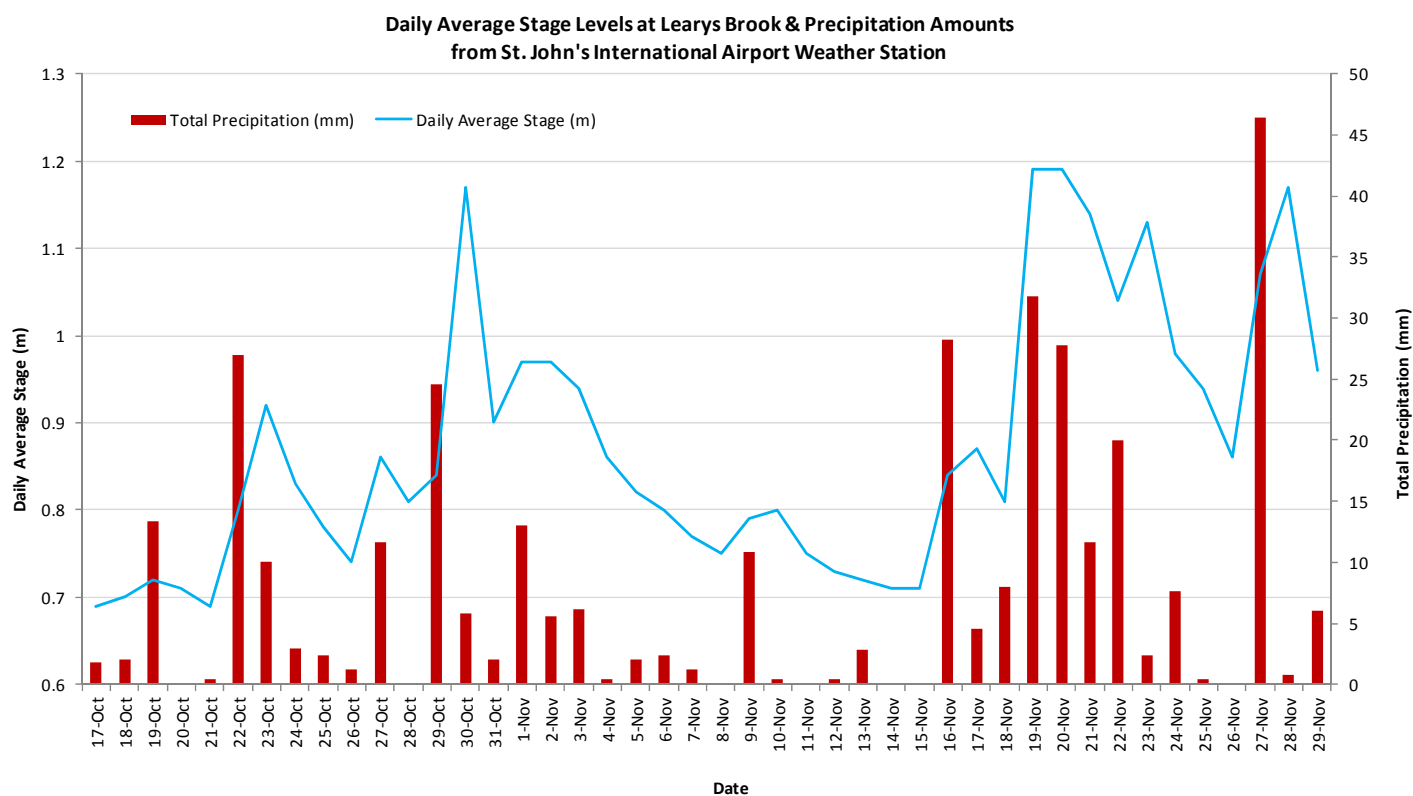


Figure 7: Daily average stage values (m) from Leary's Brook Station and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

Generally in both natural and urban environments, climate and weather conditions can contribute in large part to variations in water quality. During this deployment it was evident that many of the changes in Leary's Brook water quality are related to intermittent precipitation events and small climatic changes of the seasons.

Precipitation events during the deployment period led to related increases in stage, which thus influenced the values of turbidity, pH, specific conductance, and TDS. Also, 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 8.0°C.

The median pH value for Leary's Brook Station was 6.51 (pH units). The pH level for the most part, falls at this station during rainfall events and increases during dry periods.

Conductivity had a median value of 324.0 µS/cm. The maximum conductivity was 929.0 µS/cm. Conductivity peaked during the early stages of increased runoff as road salts were flushed into the brook. This is typical at this time of year.

Dissolved Oxygen at Leary's Brook had a median of 97.3 %Sat and 11.50 mg/L during the deployment period. Small reductions in DO (mg/L and % Sat) correspond with increases in water temperatures.

The turbidity median value at Leary's Brook during deployment was 1.3 NTU. Increases in stage level can explain most of the peaks in the turbidity values during the deployment period. As organic matter and sediments are washed into the brook, the suspended matter in the water column will increase and the turbidity sensor will detect an increase in water cloudiness.