Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
September 14, 2017 to October 19, 2017

Newfoundland Labrador

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

Leary's Brook, Newfoundland and Labrador

Prepared by:

Paul Rideout
Environmental Scientist
Water Resources Management Division
Department of Municipal Affairs and Environment
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
Ph. No.: (709) 729 - 0351
Fax No.: (709) 729 - 0320
paulrideout@gov.nl.ca

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 September 14, 2017 and removal on October 19, 2017.

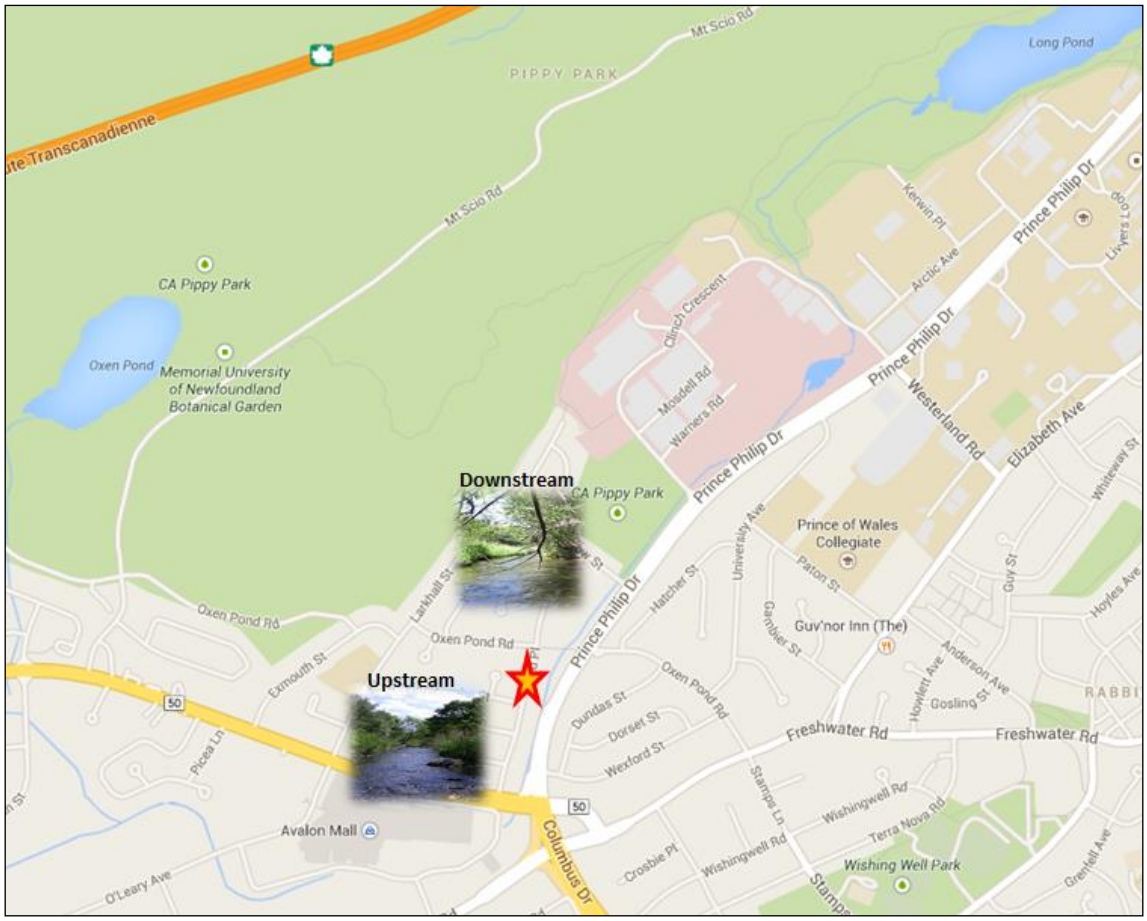

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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

	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 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 September 14, 2017 to October 19, 2017 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	**September 14, 2017**	**Deployment**	Excellent	Good	Good	Excellent	Excellent
	October 19, 2017	**Removal**	Good	Good	Good	Excellent	Poor

- At the Leary's Brook station at the time of deployment, temperature, dissolved oxygen and turbidity readings ranked as "Excellent", while pH and conductivity temperature ranked as "Good".
- At the time of removal, temperature, pH conductivity ranked as "Good", dissolved oxygen readings ranked as "Excellent" and turbidity ranked as "Poor".
- It is likely that the turbidity readings near the end of this deployment period are inaccurate because of excessive sedimentation and/or biofouling.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from September 14, 2017 to October 19, 2017 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.
- A number of interruptions in data transmission occurred during this deployment period, likely the result of transmission equipment failures.

Leary's Brook

Water Temperature

- Water temperature ranged from 7.63 ^{o}C to 15.70 ^{o}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 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.

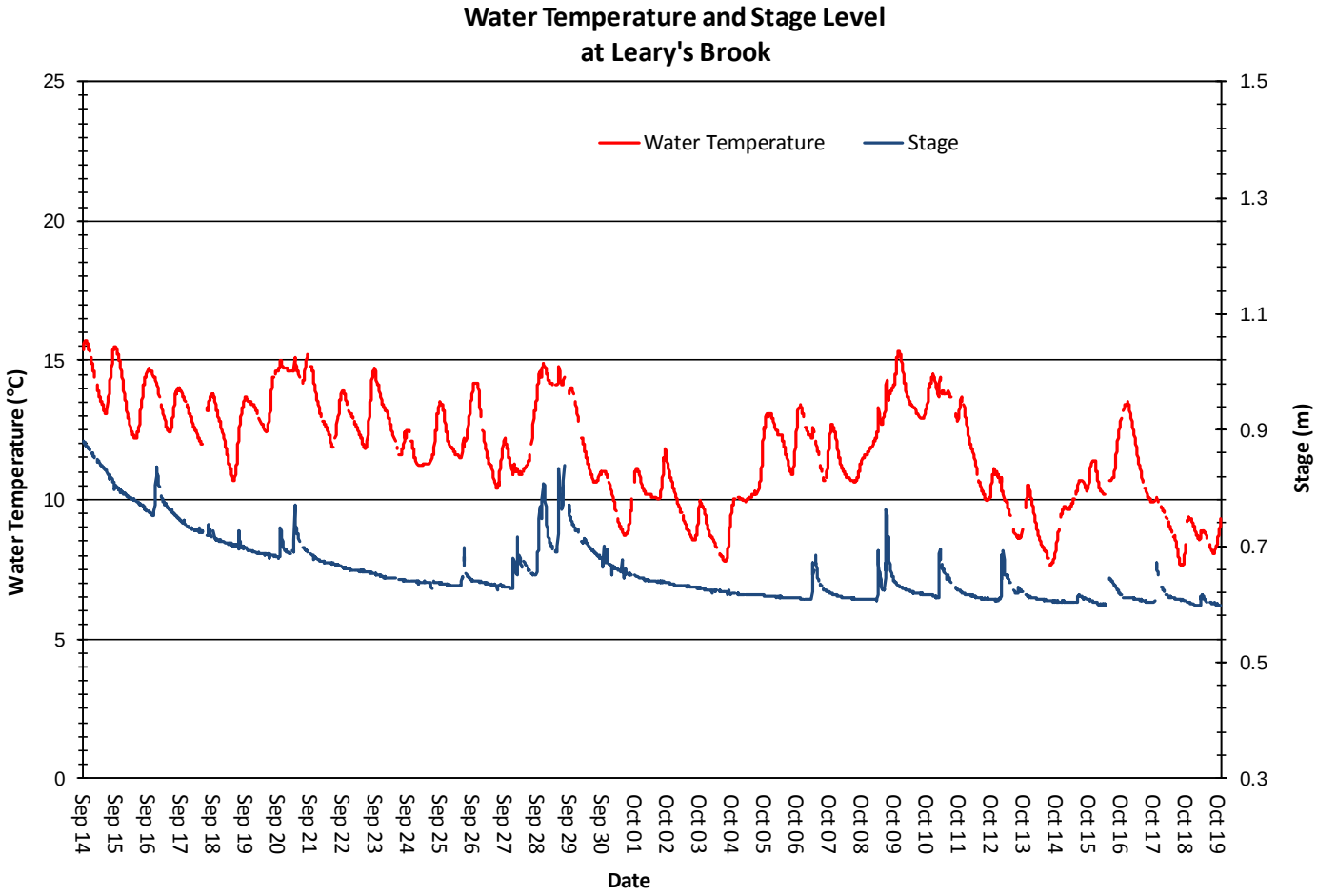

Figure 2: Water Temperature and Stage Level at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.66 pH units and 9.63 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 7.04 (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 and this causes a reduction in the pH of the brook.
- On a number of occasions, and most obviously on September 22nd, pH increased quickly in Leary's Brook. On September 22nd, pH increased to 9.63.

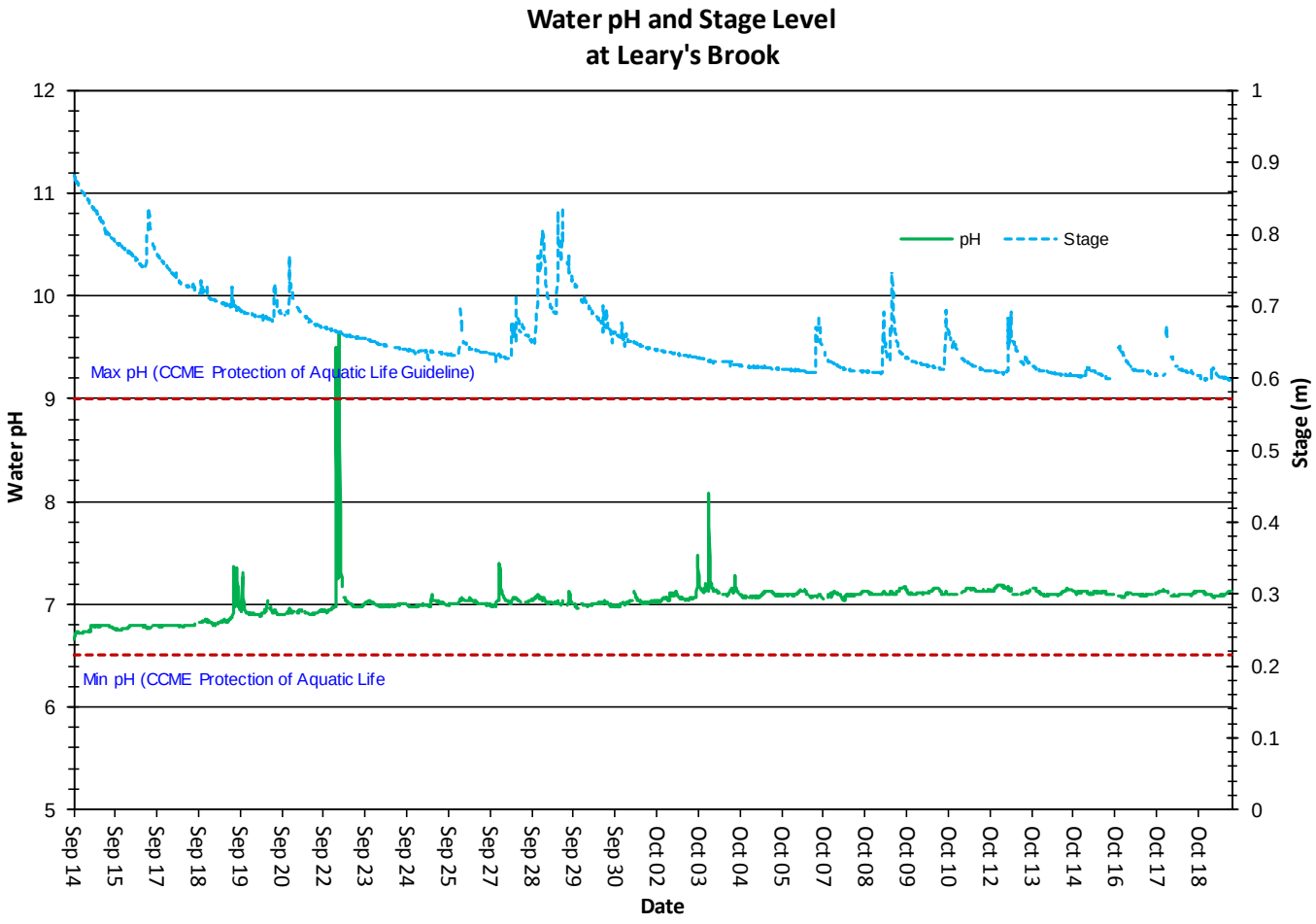

Figure 3: Water pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 263.0 µS/cm and 639.0 µS/cm during this deployment period. The median was 546.0 µS/cm. TDS ranged from 0.1680 g/ml to 0.4090 g/ml. (Figure 4)
- Decreases in conductivity seen during this deployment period are associated with precipitation runoff and increasing stage. This is typical for this time of the year as runoff from precipitation dilutes salts carried into the brook from urban environments.

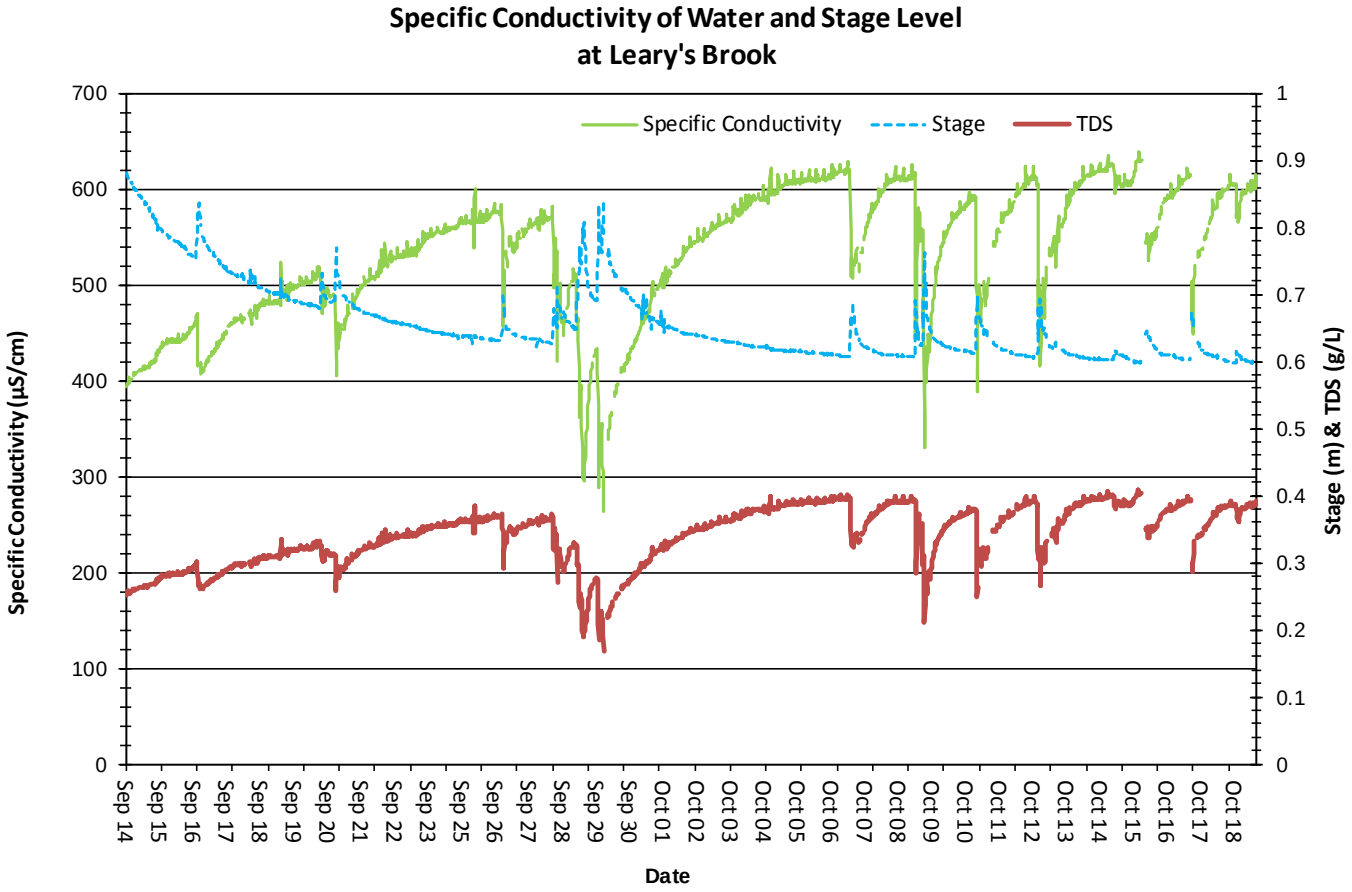

Figure 4: Specific conductivity values at Leary's Brook Station

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 92.8 % Sat and 99.3 % Sat. Dissolved Oxygen (mg/L) measured between 9.52 mg/L and 11.58 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 during this deployment period (Figure 5).
- Small decreases in available oxygen are associated with increases in water temperature. Warm water can hold less dissolved oxygen than cooler water.
- The lowest levels of DO correspond with the highest water temperatures recorded during this deployment period.

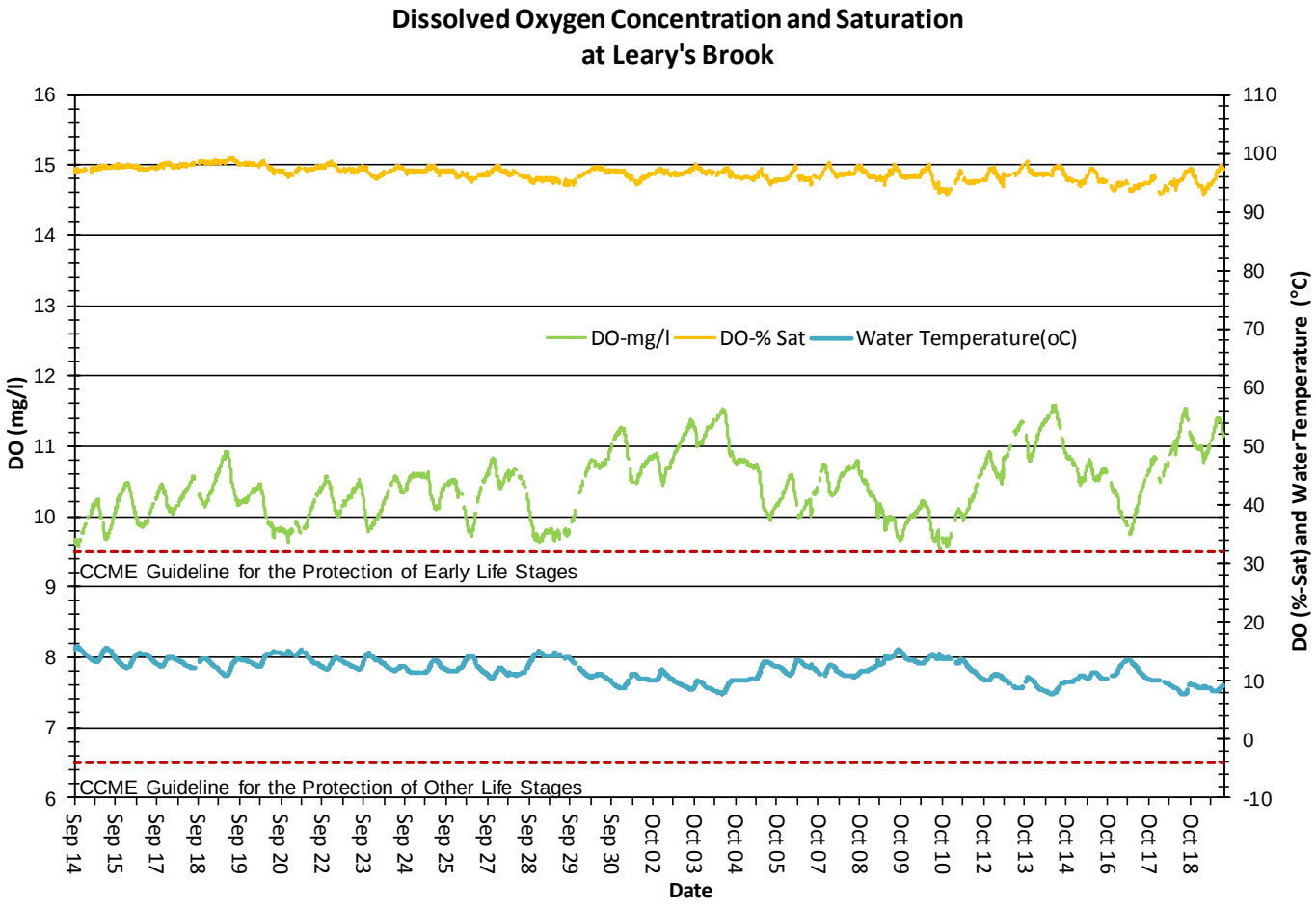

Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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.
- Leary's Brook experienced prolonged periods of high turbidity (cloudy, muddy water) during this deployment period. Many of these events were not caused by increased runoff, which, under natural conditions, is usually the reason that turbidity rises and water becomes cloudy.
- The turbidity readings during this deployment ranged between 0.0 NTU to 2348.0 NTU (Figure 6).
- Turbidity readings from 4 pm on October 16 to the end of the deployment period have been removed from the dataset as it is believed that the sensor was recording erroneous readings as a result of biofouling during this period.

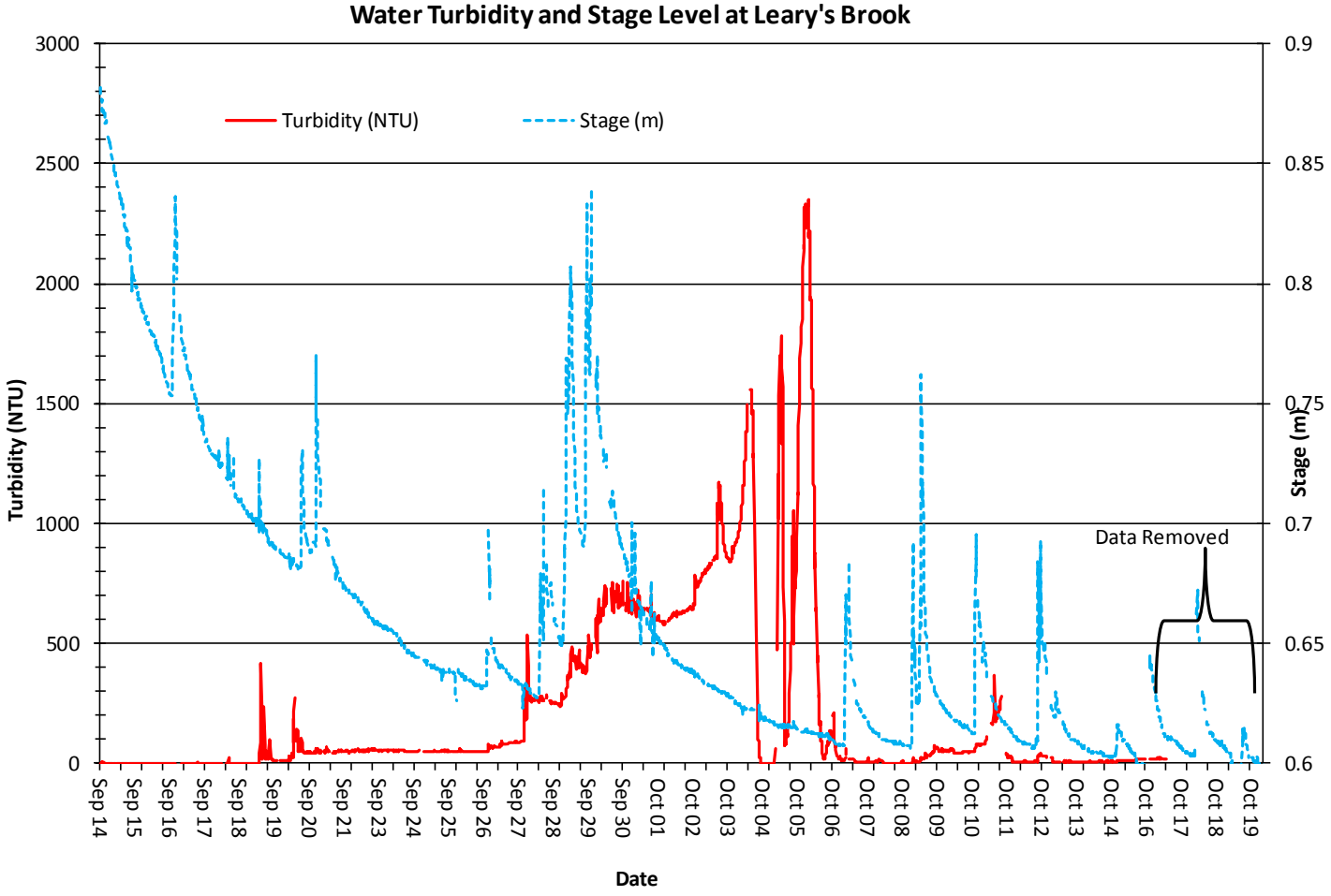

Figure 6: Turbidity (NTU) values at Leary's Brook Station

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(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.

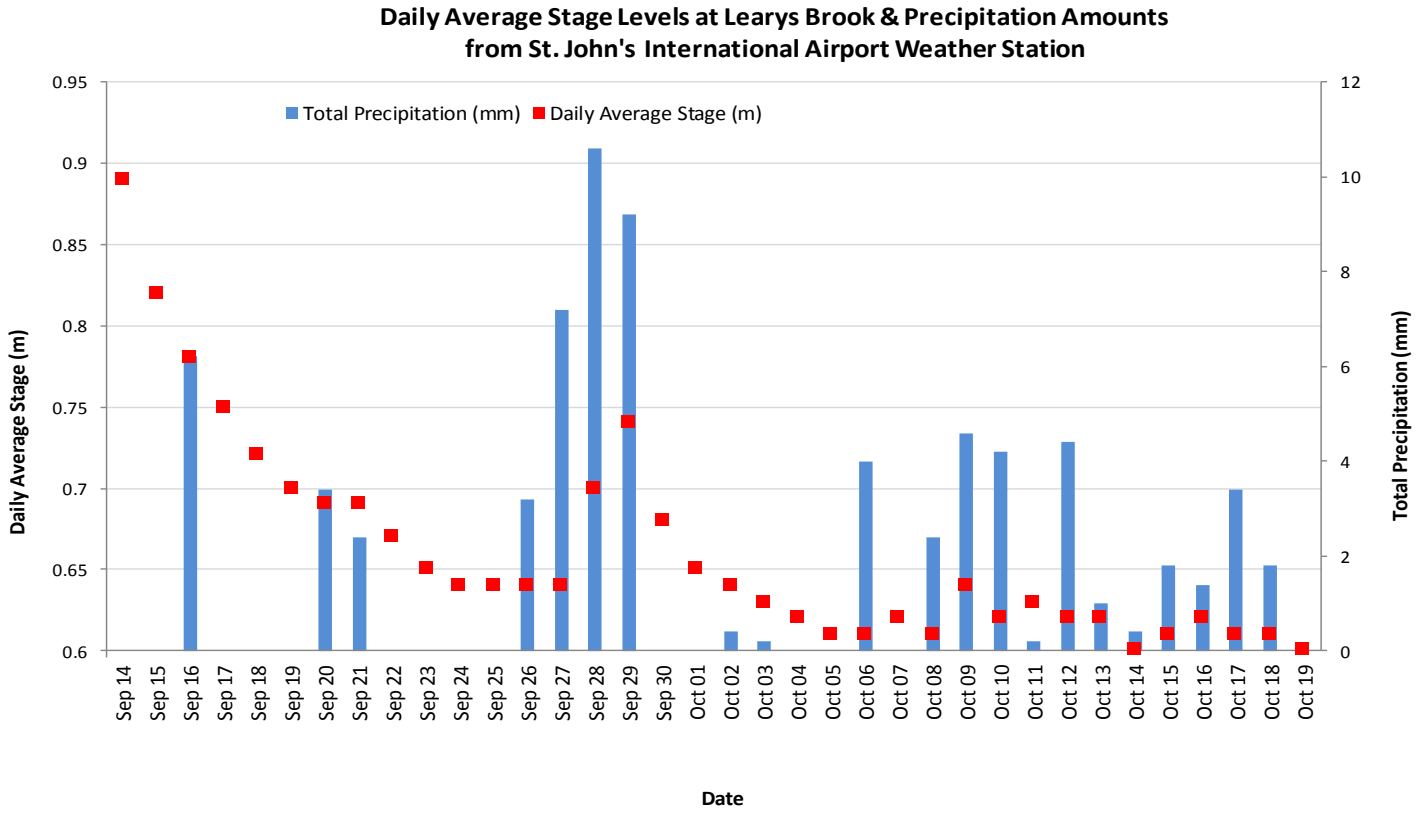

Figure 7: Daily average stage values (m) from Leary's Brook and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

In both natural and urban environments, climate and weather conditions can contribute in large part to variations in water quality. 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 and runoff 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.

It was also obvious during this deployment period that water quality in Leary's Brook was degraded by circumstances that are not related to precipitation events. Significantly high turbidity was recorded by the water quality sonde and verified by observation on a number of occasions. There were also periods (most notably on September 22) when the pH in Leary's Brook increased significantly. The data indicates that Leary's Brook water quality, as measured by turbidity and pH, was adversely affected by human activity, most likely the ongoing construction of a new parking facility in the Avalon Mall area.

During this deployment period the median water temperature at the Leary's Brook station was 12.10°C.

The median pH value for Leary's Brook Station was 7.04 (pH units). The pH level usually decreases at this station during rainfall events and increases during dry periods.

Conductivity had a median value of 546.0 µS/cm. The maximum conductivity was 639.0 µS/cm. At this time of year, conductivity increases in Leary's Brook as water levels decline and dissolved salts become more concentrated.

Dissolved Oxygen at Leary's Brook had a median of 96.7 %Sat and 10.39 mg/L during the deployment period. Reductions in DO (mg/L and % Sat) correspond with increases in water temperatures. DO levels remained above the "CCME Guideline for the Protection of Early Life Stages" throughout the deployment period.