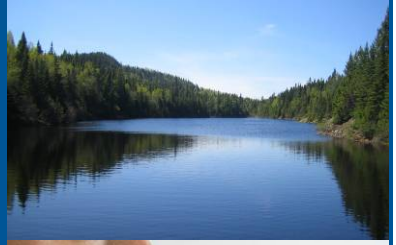
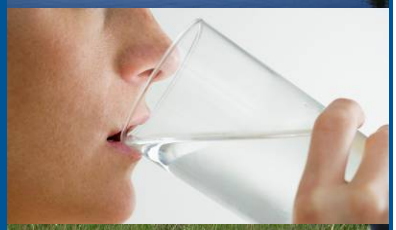






Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
May 12, 2016 to June 15, 2016

Newfoundland Labrador

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

Leary's Brook, Newfoundland and Labrador

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General

- The Water Resources Management Division (WRMD), in partnership with Environment and Climate Change Canada (ECC), 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 May 12, 2016 and removal on June 15, 2016.

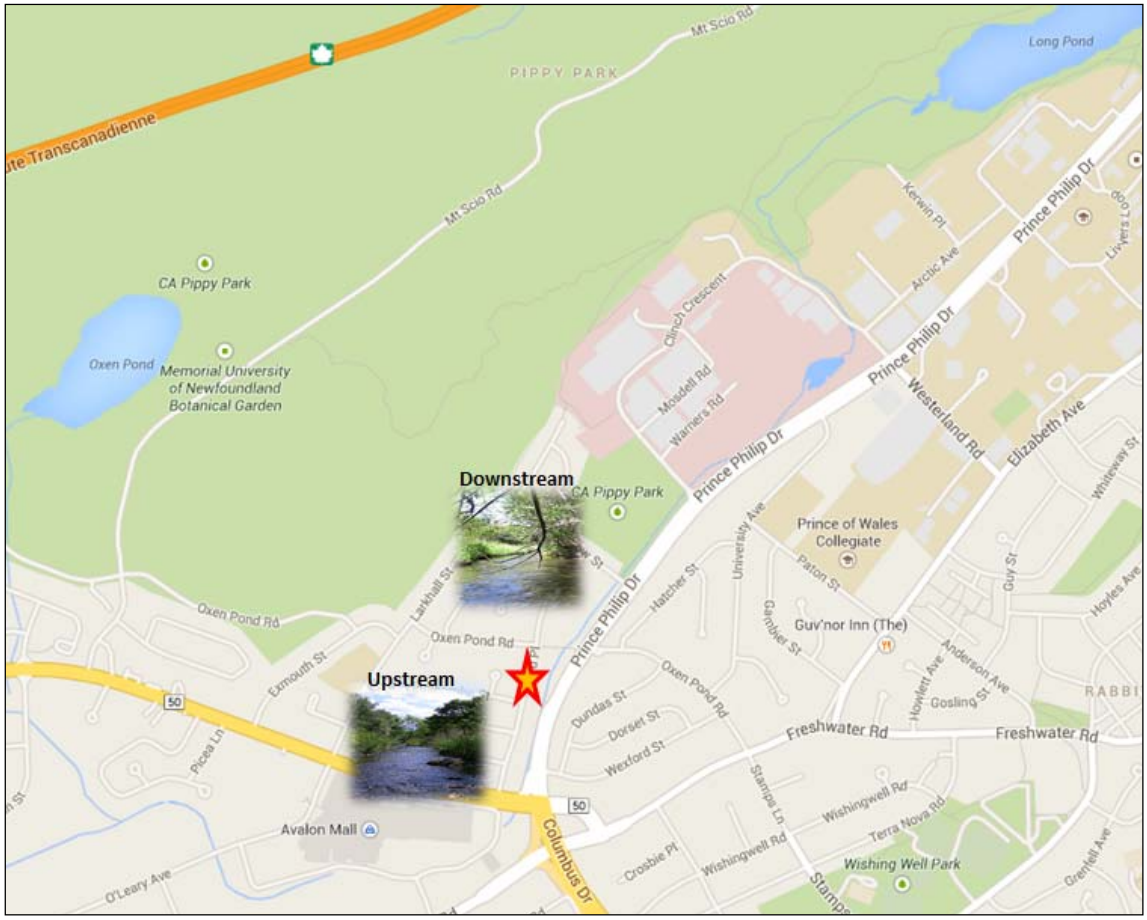

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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

	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 May 12, 2016 to June 15, 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	**May 12, 2016**	**Deployment**	Good	Good	Excellent	Good	Excellent
	June 15, 2016	**Removal**	Excellent	Good	Good	Excellent	Good

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

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

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from May 12, 2016 to June 15, 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 ECC weather station at St. John's International Airport.

Leary's Brook

Water Temperature

- Water temperature ranged from 4.72°C to 17.40°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.

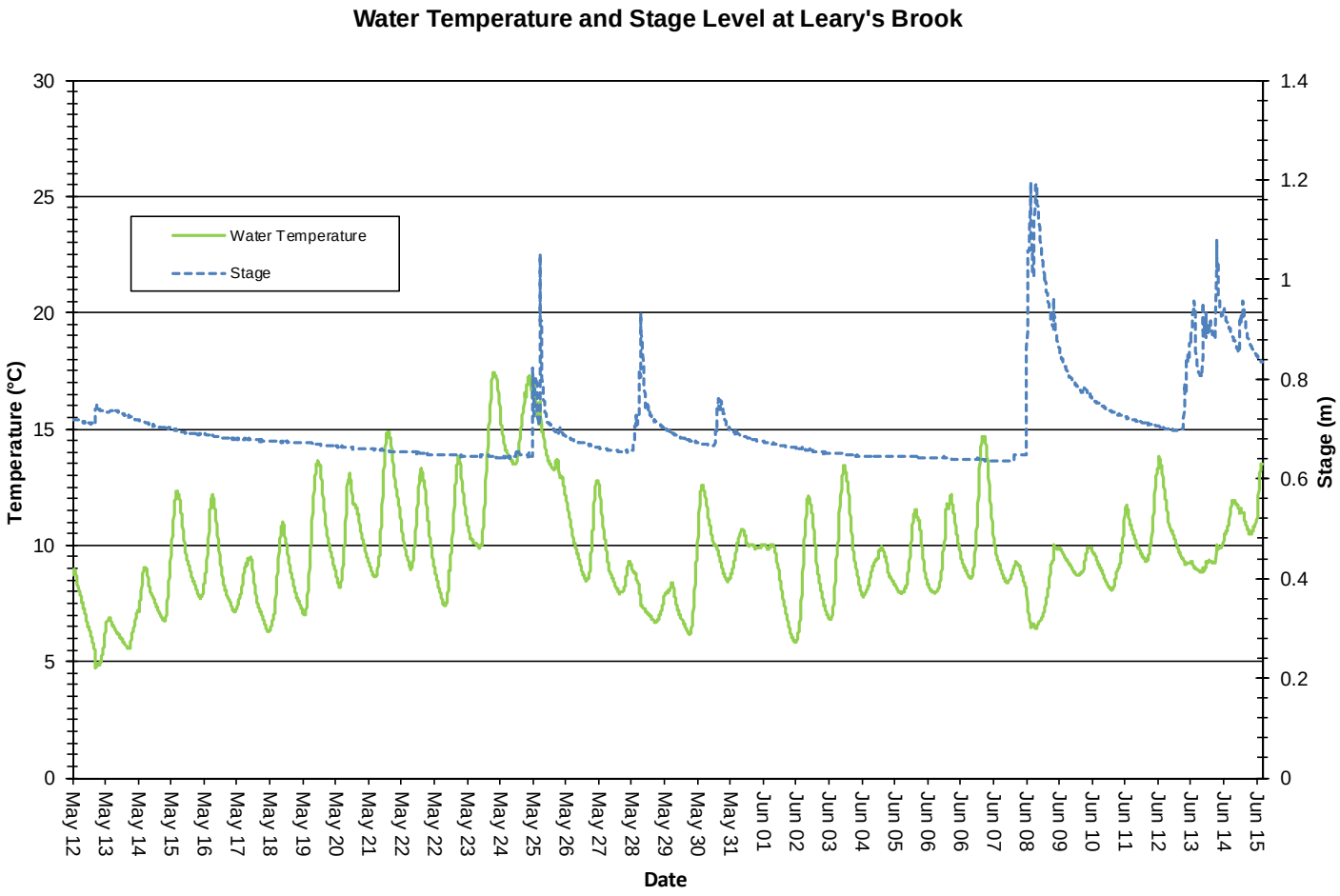

Figure 2: Water Temperature and Stage Level at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.13 pH units and 6.94 pH units (Figure 3).
- For most of the deployment, pH values were near the minimum CCME Guidelines for the Protection of Aquatic Life (6.5 pH units).
- 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 (see inside oval). 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.

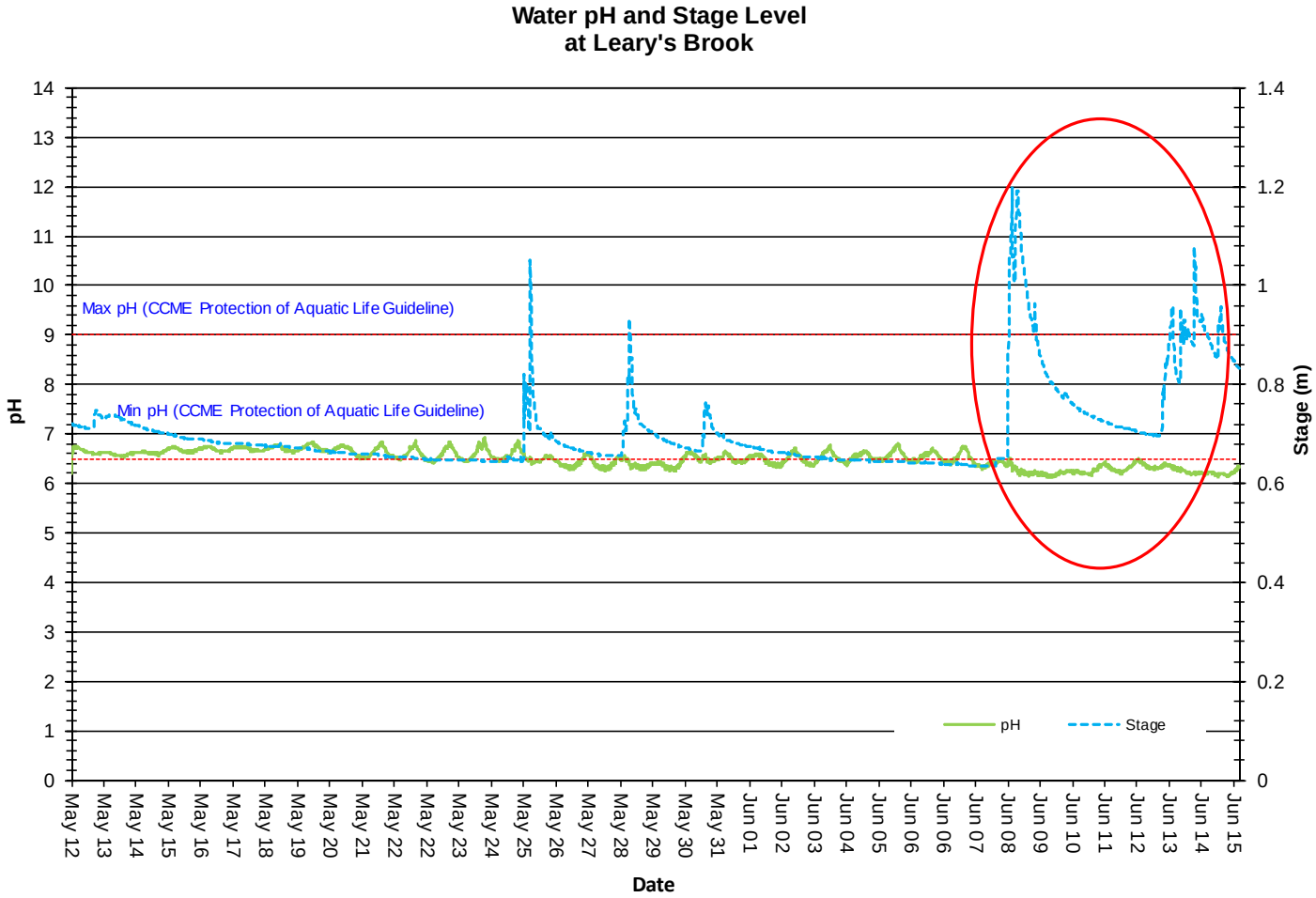

Figure 3: pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 177.1 µS/cm and 942.0 µS/cm during this deployment period. The median was 669.0 µS/cm. TDS ranged from 0.1134 g/ml to 0.6030 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.
- A rapid increase in conductivity was recorded by the instrument on June 6, 2016 as it rose from about 480 to 900 uS/cm. Conductivity remained at or near this level until June 8, when heavy precipitation and runoff caused conductivity to fall again (See inside oval on Figure 4). The increase in conductivity on June 6 was associated with a period of relatively high turbidity at the Leary's Brook station. The data indicates that instream disturbances upstream may have been causing turbidity and conductivity levels to rise at this time.
- 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.

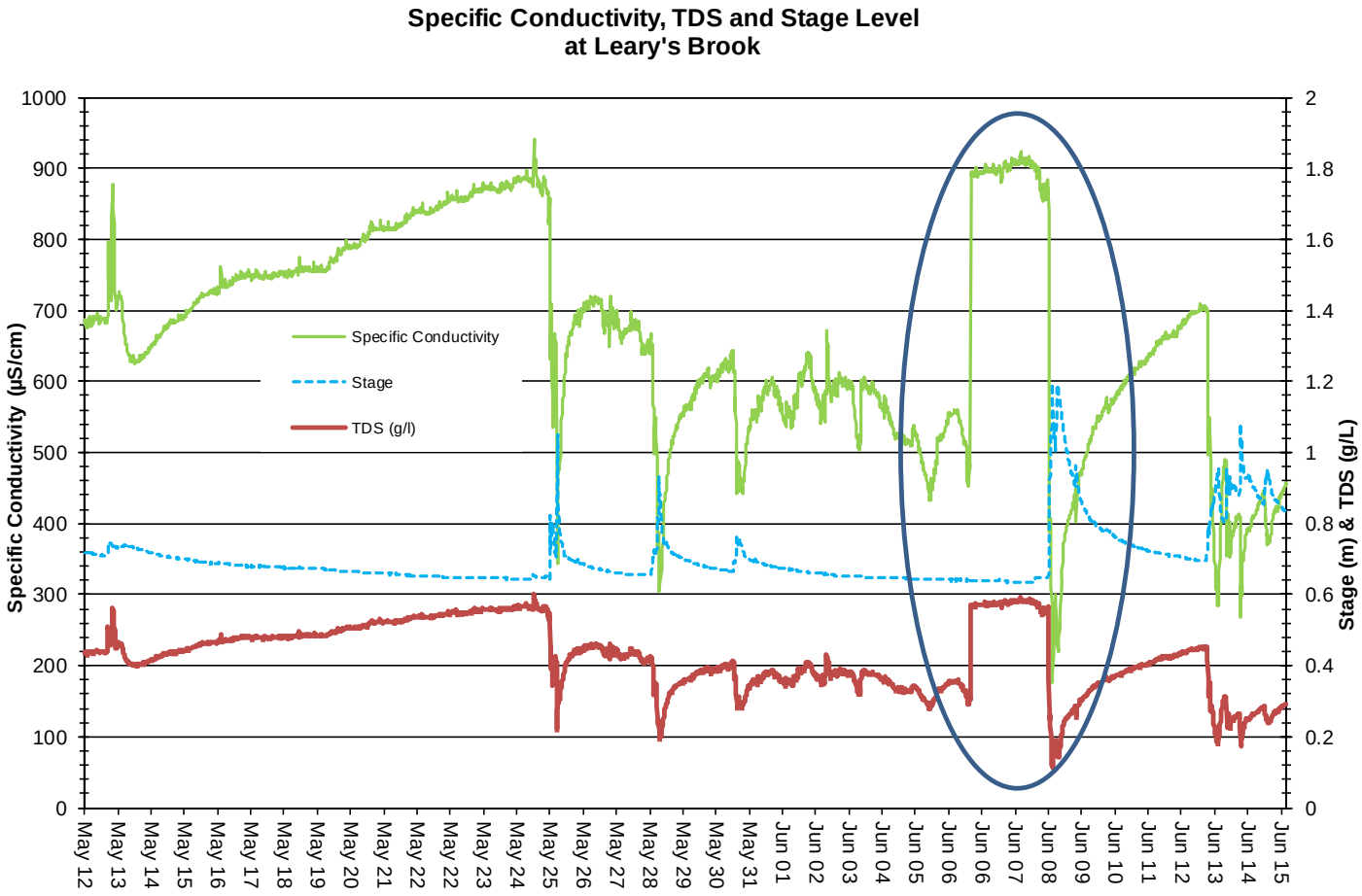

Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Leary's Brook Station

Dissolved Oxygen

- The instrument measures dissolved oxygen (mg/L) directly then calculates percent saturation (% Sat.).
- The Dissolved Oxygen % Sat levels within this deployment period were between 94.1 % Sat and 105.0 % Sat. Dissolved Oxygen (mg/L) measured between 9.16 mg/L and 12.66 mg/L. (Figure 5)
- Dissolved oxygen is often above 100% saturation in natural systems as pure oxygen is produced by photosynthesizing aquatic plants and because equilibrium between air and water is not instantaneous.
- The DO mg/L values were above the minimum DO CCME guideline for early life stages for 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.

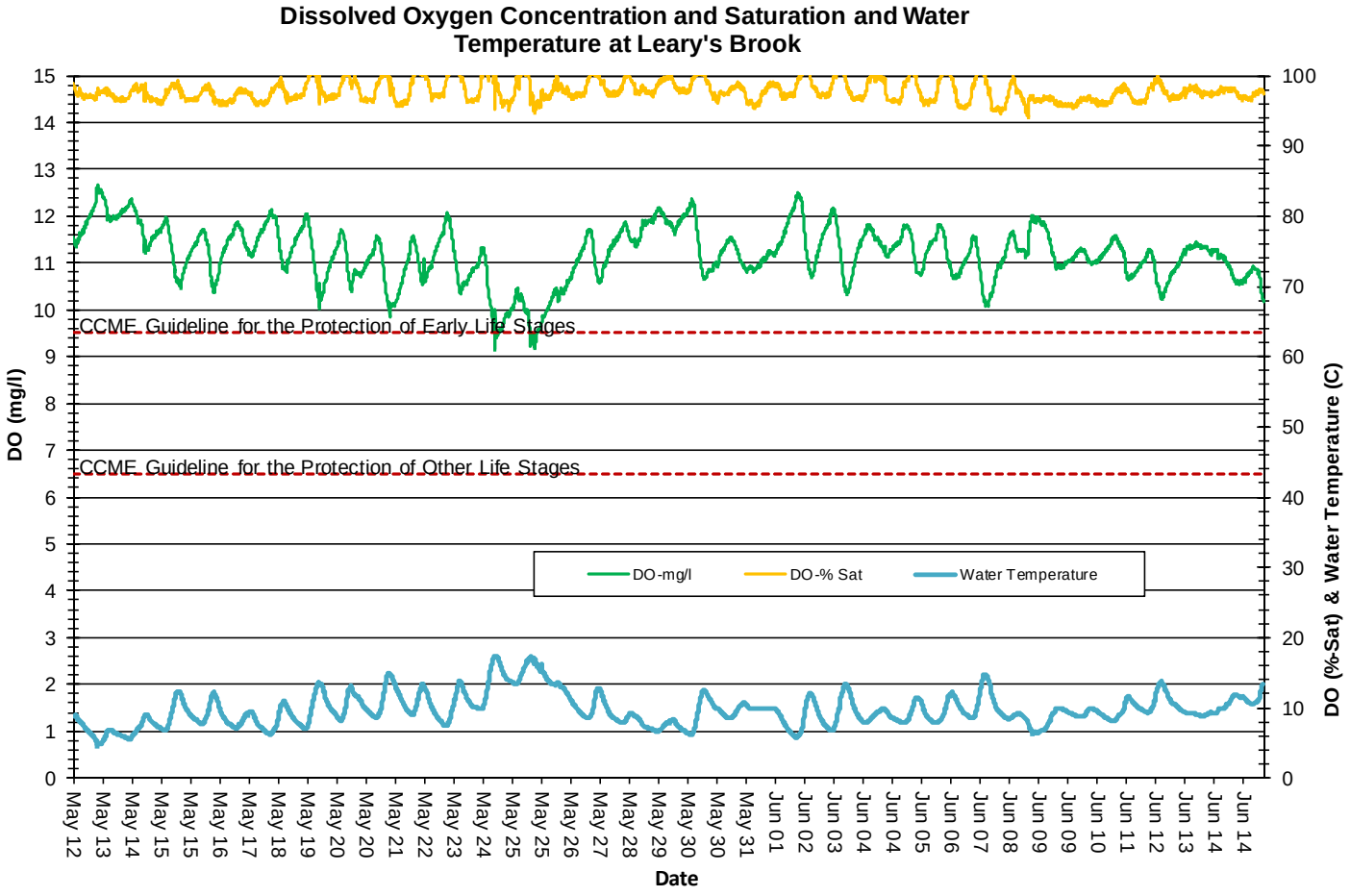

Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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 410.0 NTU (Figure 6).
- Higher turbidity values closely correspond with precipitation events and elevated river stage and runoff (Figure 7). 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.
- 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.

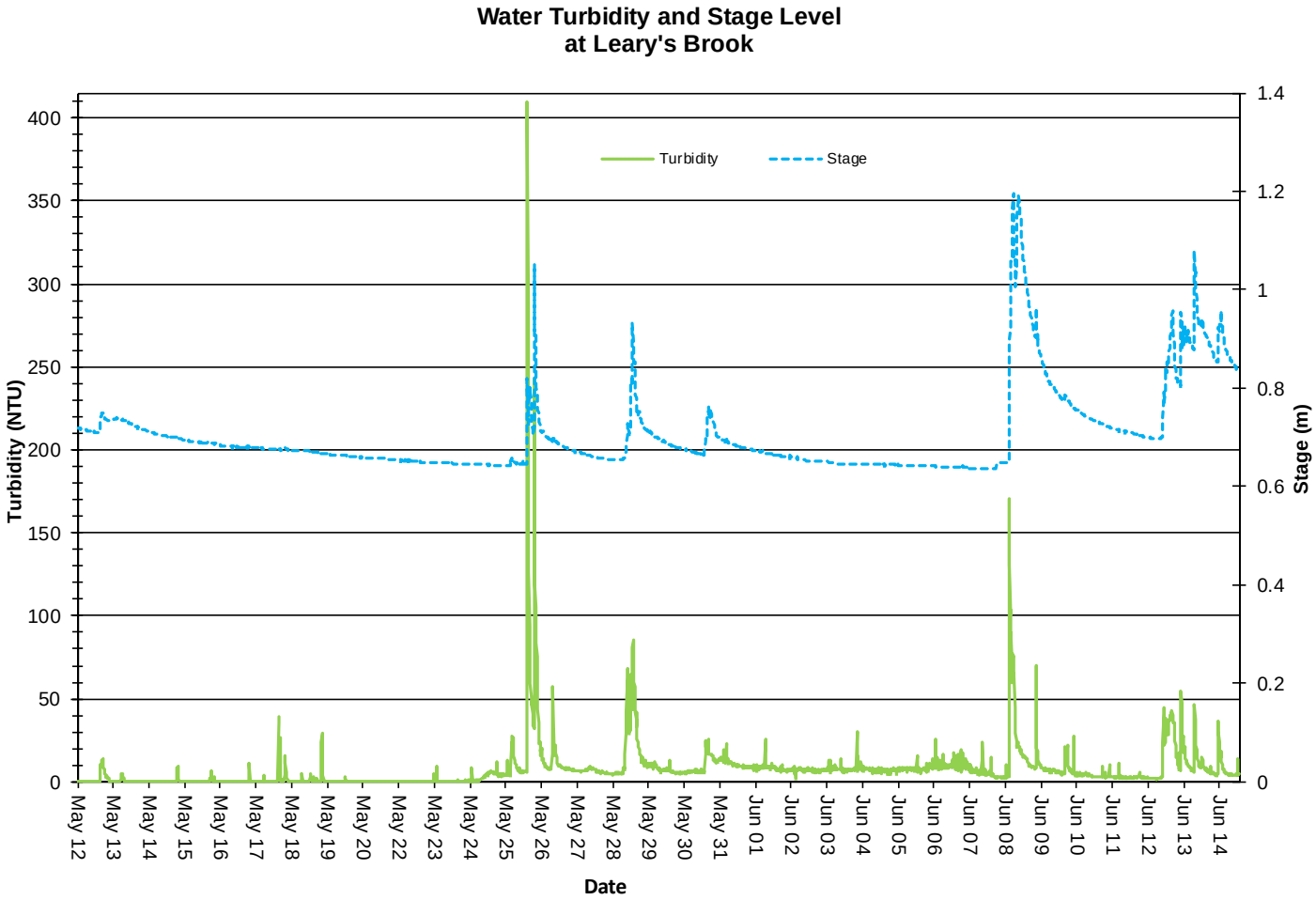

Figure 6: Turbidity (NTU) values at Leary's Brook Station

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.

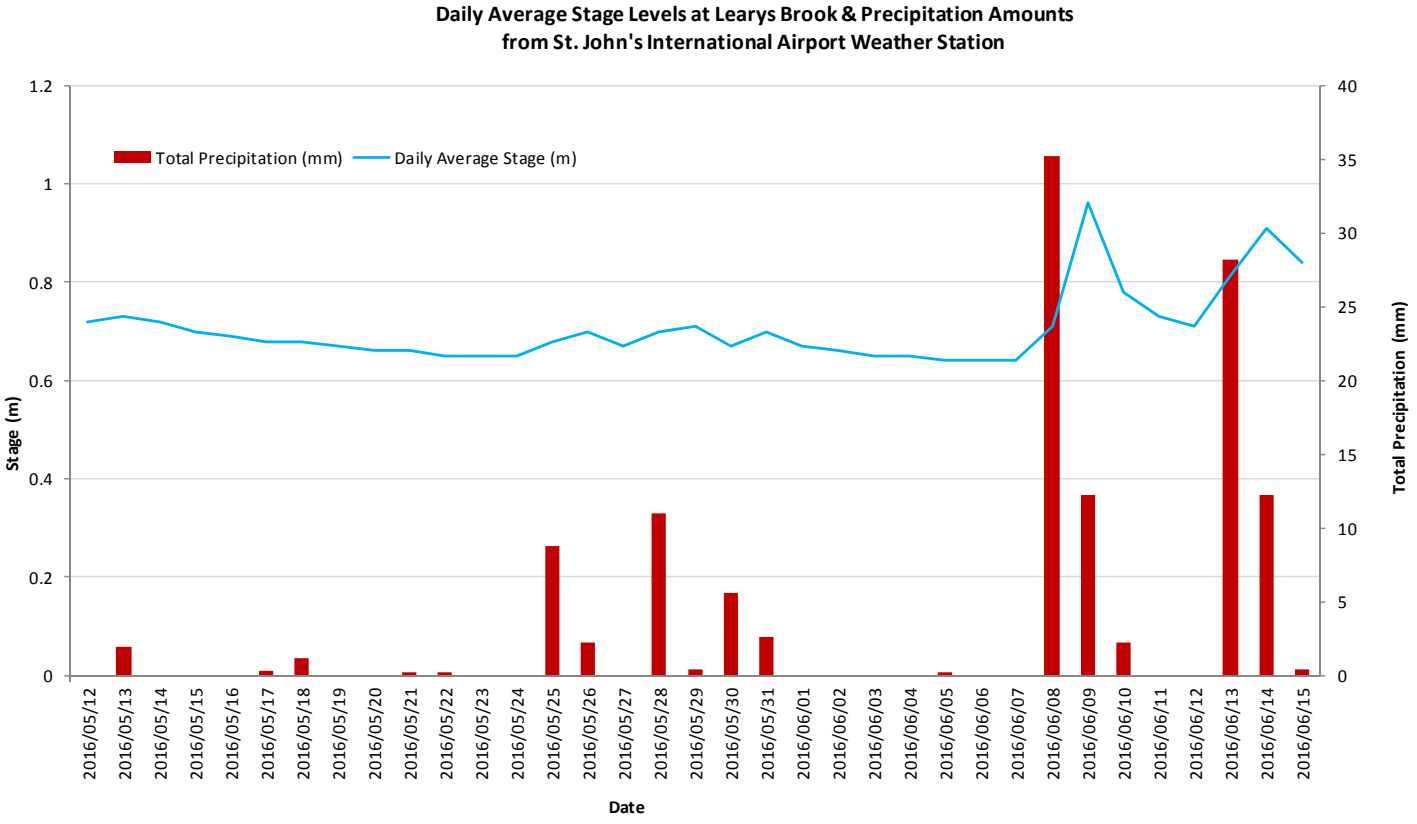

Figure 7: Daily average stage values (m) from Leary's Brook Station and daily total precipitation values (mm) from St. John's International Airport.

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 slightly decreased the amount of dissolved oxygen in the water.

During this deployment period the median water temperature at the Leary's Brook station was 9.31°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 of water in Leary's Brook ranged from 177.1 µS/cm to 942.0 µS/cm with a mean value of 663.2 µS/cm. Conductivity is lower in Leary's Brook at this time of year during periods of high runoff and elevated stage.

Dissolved Oxygen at Leary's Brook had a median of 97.5 %Sat and 11.24 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 5.4 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.