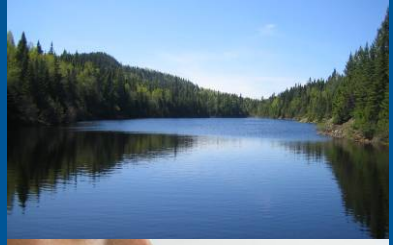







# Real-Time Water Quality Report

# Leary's Brook Network

**Deployment Period**
**January 14, 2014 to March 12, 2014**

Newfoundland Labrador

**Government of Newfoundland & Labrador**
**Department of Environment and Conservation**
**Water Resources Management Division**

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## General

- The Water Resources Management Division (WRMD), in partnership with Environment Canada, maintain a real-time water quality and water quantity monitoring station along 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 in the vicinity of the Avalon Mall, a highly developed urban area and an extremely busy roadway.
- This report covers the 57-day period from deployment on January 14, 2014 until removal on March 12, 2014.

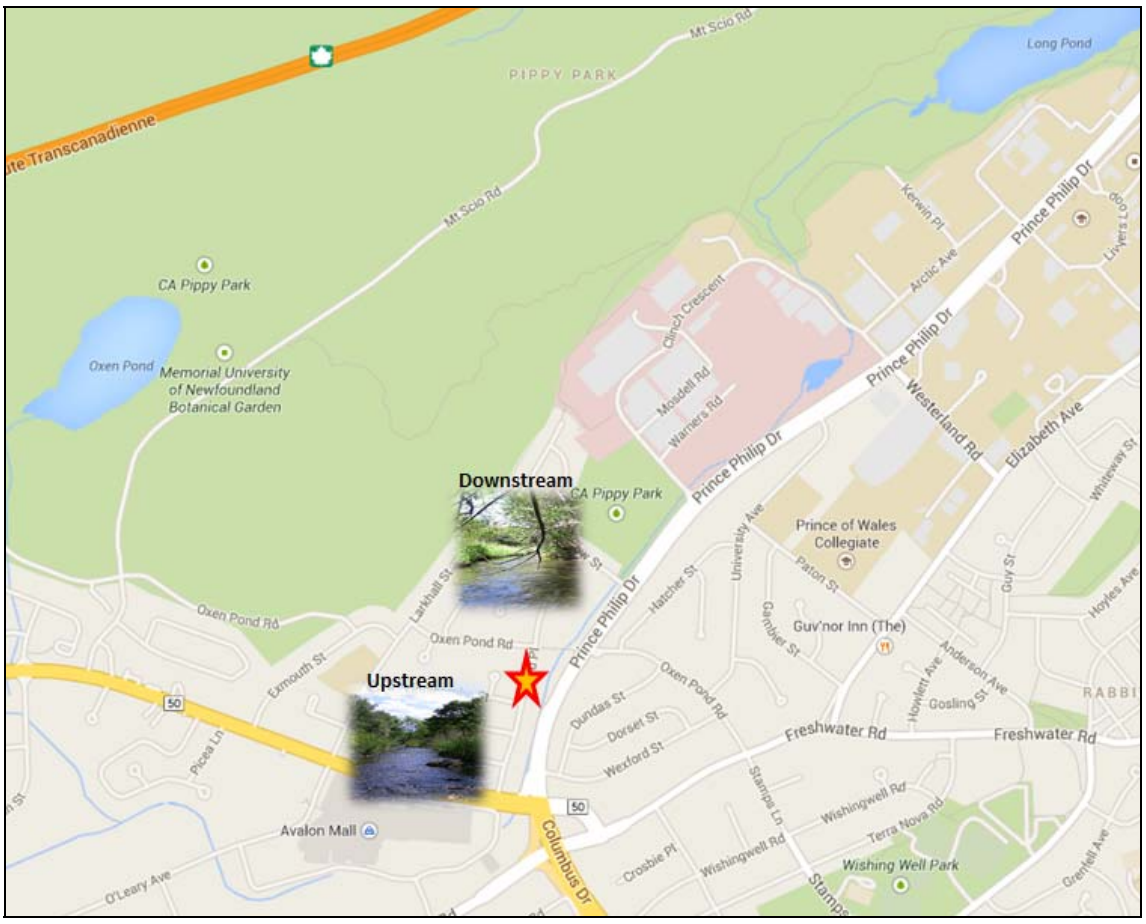


**Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.**

## 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 |

- It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependant, 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 January 14, 2014 through to March 12, 2014 are summarized in Table 2.

**Table 2: Instrument performance rankings for Leary's Brook Jan 14, 2014 – March 12, 2014**

| **Station** | **Date** | **Action** | **Comparison Ranking** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **Temperature** | **pH** | **Conductivity** | **Dissolved Oxygen** | **Turbidity** |
| **Leary's Brook** | **Jan 14 2014** | **Deployment** | Poor | Excellent | Marginal | Fair | Marginal |
| | **Mar 12 2014** | **Removal** | Excellent | Excellent | Excellent | Good | Good |

- At the Leary's Brook station at the point of deployment, the water temperature reading ranked as poor. This is very unusual to see as the temperature probe is one of the more accurate sensors on the water quality instrument. It was determined that the temperature probe on the QAQC instrument had failed and the instrument needed to be returned to the manufacturer for servicing. The pH reading for deployment

ranked as 'excellent', the conductivity and turbidity sensor ranking as 'marginal' while the dissolved oxygen data ranked 'fair'. The 'fair' ranking may be due to the failure of the temperature probe on the QAQC instrument, the dissolved oxygen probe relies on the temperature reading to provide an accurate DO reading.

- At removal, the temperature, pH, and conductivity data all ranked 'excellent'. The dissolved oxygen and turbidity data ranked 'good'. At removal, due to technical issues with the original QAQC, a new QAQC instrument was used to rank the sensor data therefore the data rankings were better than at deployment.

## Deployment Notes

- There were several transmission errors during this deployment period at Leary's Brook. Due to the nature of the data transmission it is not uncommon to have data drop out of transmission. This deployment period however, had persistent transmission errors so it was decided that the daily averages for all water quality and water quantity data would be used for this deployment report.
- As a result of a power outage at this station, there is a gap in data from January 14$^{th}$, 2014 through to January 21$^{st}$, 2014 in all the water quality parameters. This data was lost when the power outage caused the station to shut down and stop transmitting data.

## Data Interpretation

- The following graphs and discussion illustrate water quality-related events from January 14, 2014 through to March 12, 2014 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 is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request from Water Survey of Canada.
- Precipitation data from the deployment period was retrieved from the Environment Canada's weather station at St. John's International Airport.

## Leary's Brook

### Water Temperature

- Water temperature ranged from 0.08°C to 2.25°C during this deployment period (Figure 2).
- Water temperature at this brook displays a typical variation in pattern over the deployment period. Water temperature is influenced by air temperature. Over the course of the deployment period the water temperature drops to almost 0°C. For the most part, the temperatures remain just above 0°C.
- The water temperature 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 is an important parameter and it influences the other parameters that are measured by the water quality instrument.

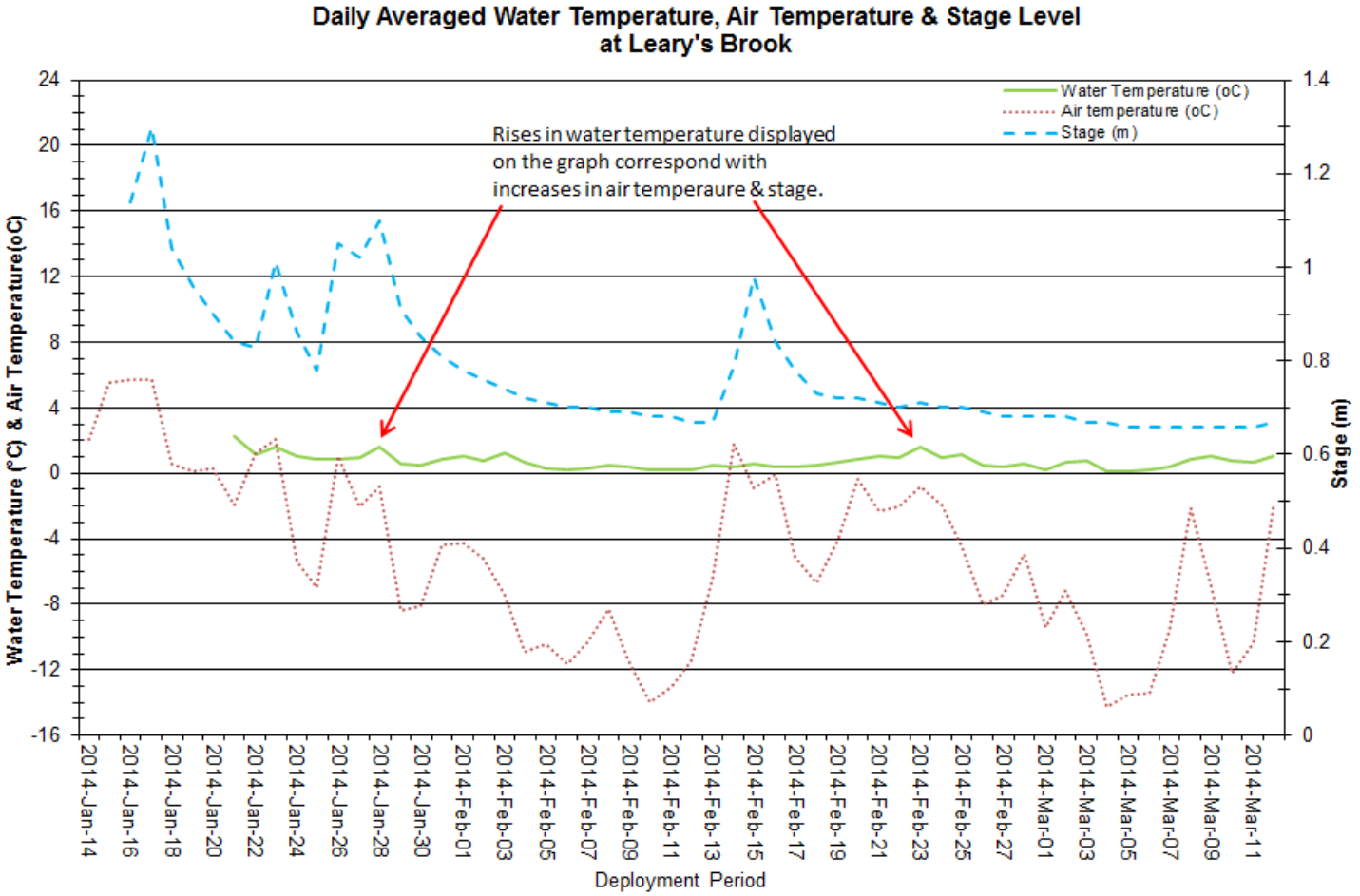


**Figure 2: Daily Averaged water temperature (°C) and stage level (m) values at Leary's Brook**

**pH**

- Throughout this deployment period pH values ranged between 6.48 pH units and 7.11 pH units (Figure 3).
- During the deployment, the pH values were between the CCME Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units). During high stage periods the pH values drop slightly lower than the guideline. This is evident on the graph on February 15 through to February 17 (Figure 3). This is a natural occurrence between rainfall and pH levels.
- 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 6.97 (pH units) for this deployment period.

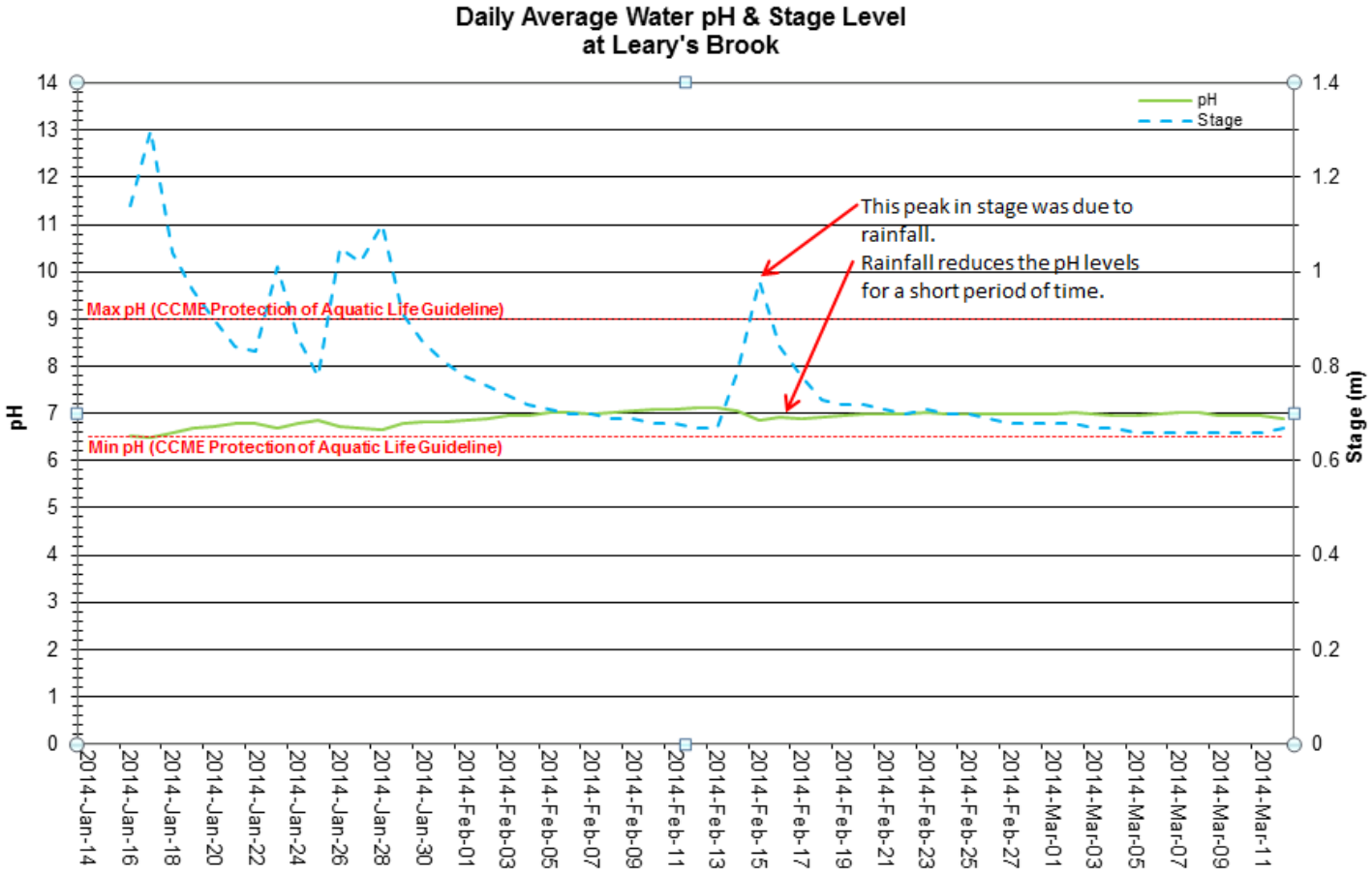


**Figure 3: Daily Averaged pH (pH units) and stage level (m) values at Leary's Brook Station**

**Specific Conductivity**

- The conductivity levels were within 513 µS/cm and 4473.6 µS/cm during this deployment period. TDS ranged from 0.3300 g/L to 2.8600 g/L.
- The peaks in conductivity correspond with the higher stage levels on Figure 4. Peaks in stage result in conductivity increases, indicating that the runoff flowing into the brook is increasing the material present in the water column.
- During winter storms the roads are heavily salted and as the ice and snow thaws it flows into the surrounding urban rivers and brooks.

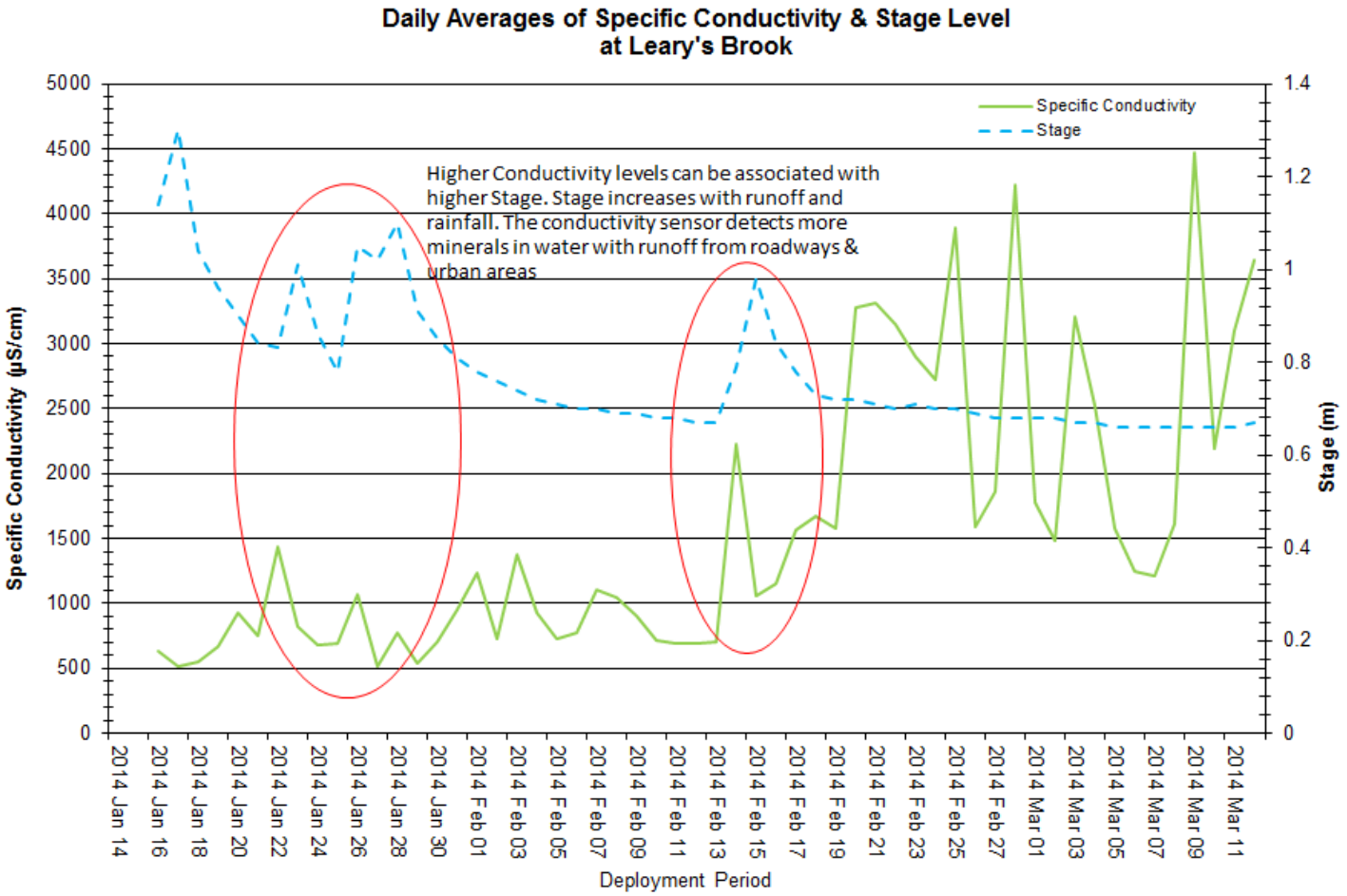


**Figure 4: Daily Averaged specific conductivity (µS/cm) and stage (m) values at Leary's Brook Station**

**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 within 93.3% Sat and 97.4% Sat. Dissolved Oxygen (mg/L) measured 12.82 mg/L to 13.92 mg/L.
- The DO mg/L values are well above the minimum DO CCME guideline for early life stages throughout this deployment period (Figure 5).
- The small dip in dissolved oxygen (mg/L) on January 28th, corresponds with an increase in water temperature. Water temperature influences the amount of oxygen present in a water body. Small decreases in dissolved oxygen values are inversely related to increases in water temperature as warmer water can hold less oxygen.
- The Dissolved Oxygen percent saturation remains constant throughout the deployment period.

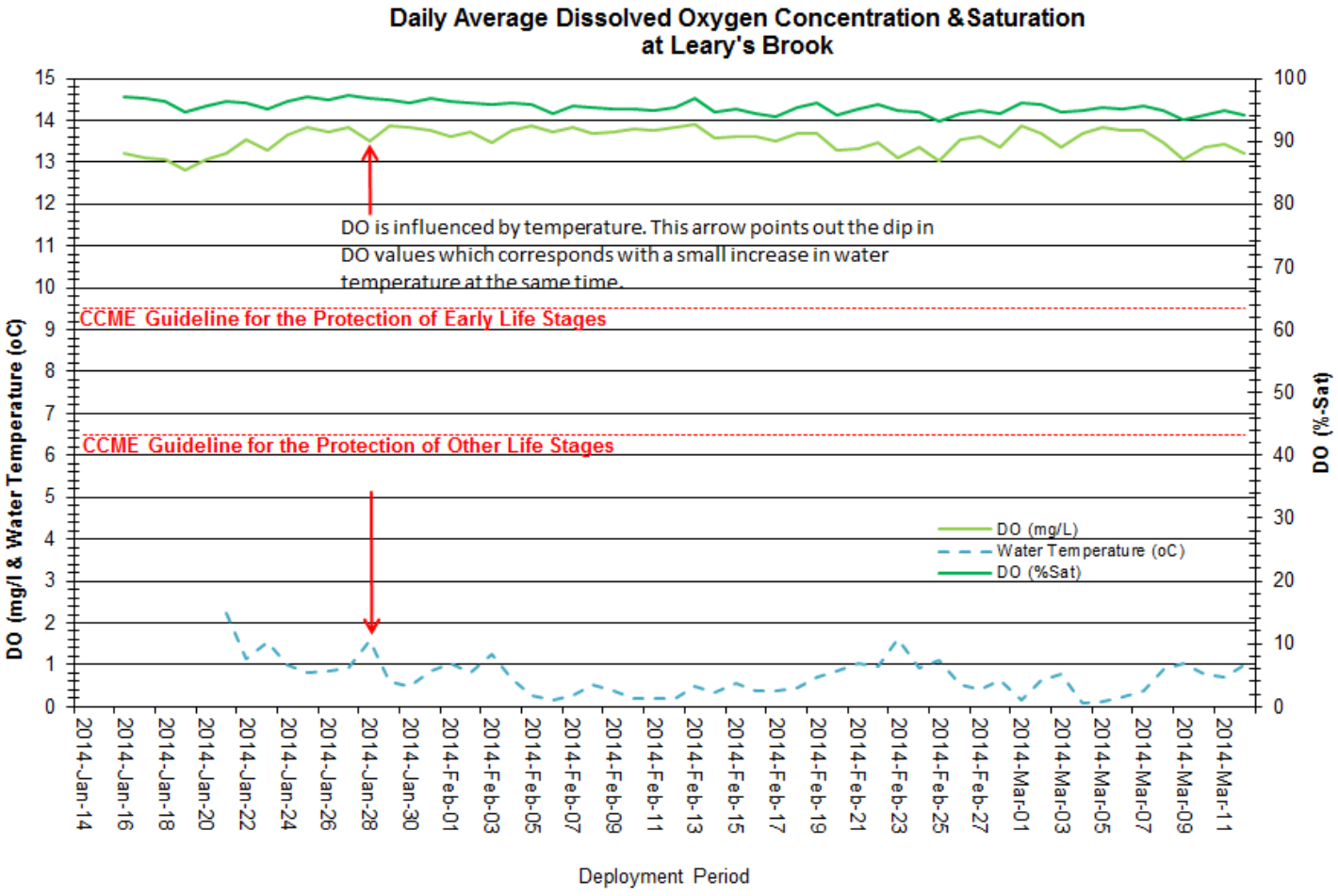


**Figure 5: Daily Averaged dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station**

**Turbidity**

- The turbidity sensor records values between 0 NTU and 3000 NTU. However a turbidity reading of 3000NTU is identified as an error and is not a true turbidity value. Readings of 3000 NTU should not be included in any statistical analysis.
- The turbidity readings during this deployment ranged within 0.0 NTU to 151.0 NTU (Figure 6).
- The turbidity events evident on the graph in Figure 6 correspond with the higher stage levels at those times. With rainfall and runoff comes an increase in sediment and material flowing into the brook and this is what is captured by the turbidity sensor.

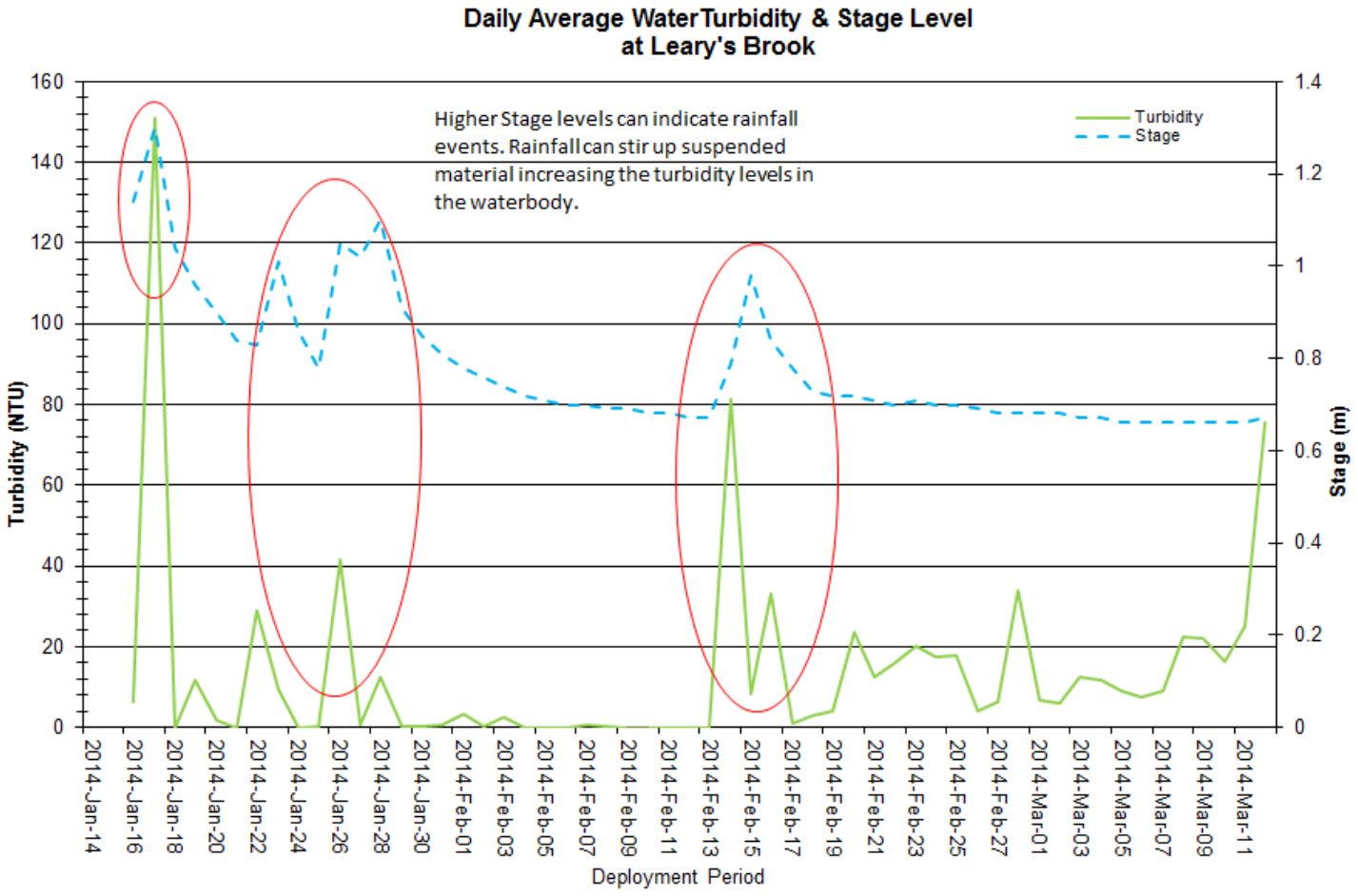


**Figure 6: Daily Averaged turbidity (NTU) and stage level (m) values at Leary's Brook Station**

**Stage**

- The below graph includes precipitation data from St. John's International Airport weather station.
- Stage can be defined as the height or elevation of the stream's water surface above a reference elevation (sea level, gage level)**.** Stage is important to display as it provides an estimation of water level at the station and can explain some of the events that are occurring with other parameters (i.e. Specific Conductivity, DO, turbidity).
- It is not unusual to see Stage vary throughout the deployment period (Figure 7). Stage is directly influenced by rainfall and subsequent runoff from the surrounding environment.
- The peaks in Stage in Figure 7 were a response to the rainfall events that occurred during this deployment period. Please note the stage data is raw data that is published on our 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.

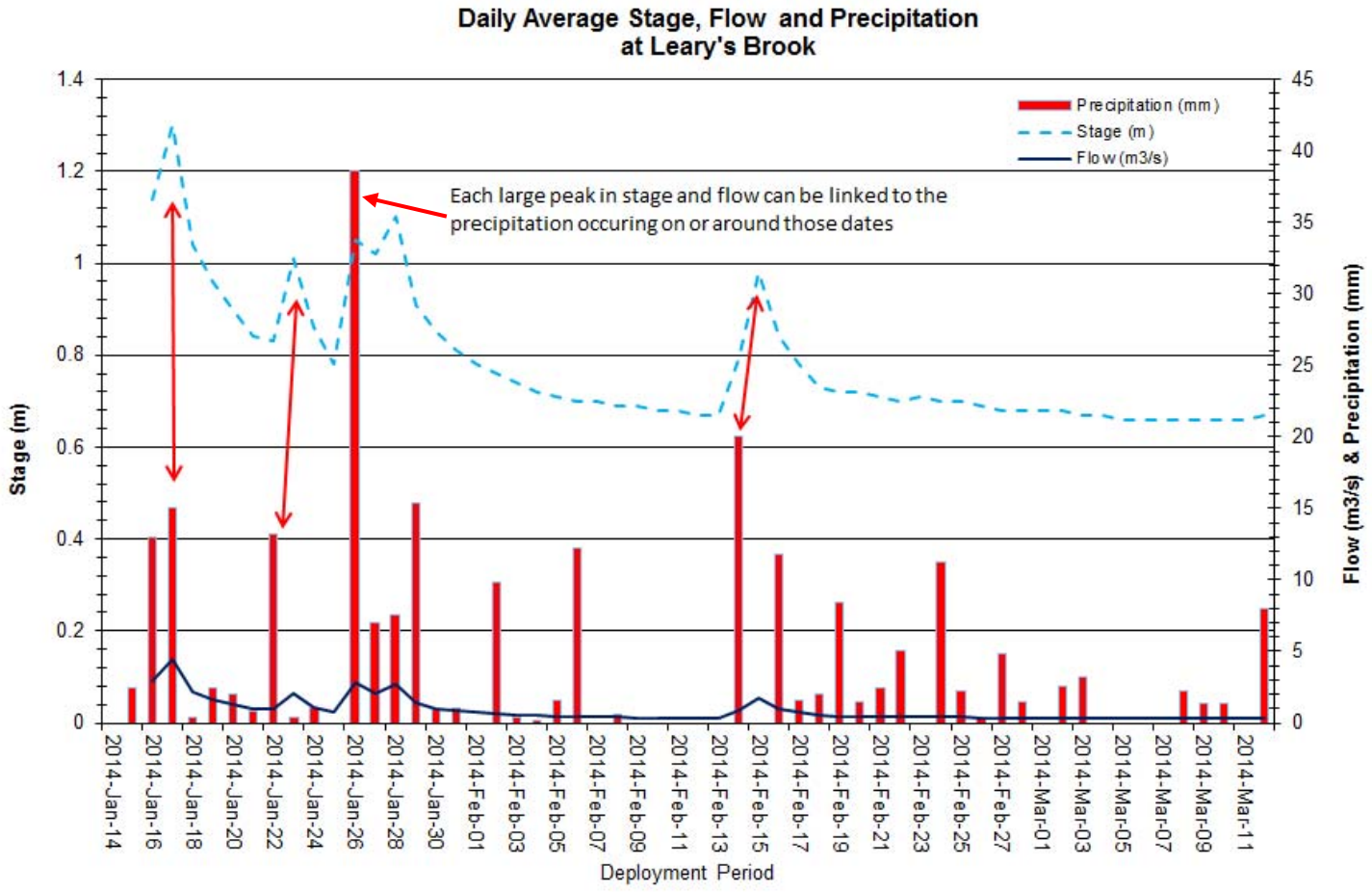


**Figure 7: Daily average stage values (m), flow (m3/s) and daily total precipitation values (mm) for Leary's Brook**

## Conclusions

- Generally in natural environments, climate and weather conditions contribute in large part to the variation in water quality parameters. During this deployment it was evident that many of the changes in the parameter data displayed on the graphs, was related to the intermittent precipitation events and small climatic changes of the seasons (i.e. temperature decreases).
- Precipitation events during the deployment period led to related fluctuations in stage, which thus influenced the values of turbidity, pH, specific conductance, and TDS. As ambient air temperatures decreased, there were correspondingly cooler water temperatures, which in turn increased the amount of dissolved oxygen in the water.
- The addition of road salt to roadways during periods of snowfall and low ambient air temperatures led to increases in specific conductance and TDS as the salts were washed into the river system. This indicates that this river is influenced by runoff upstream of the station. These salts can also briefly decrease dissolved oxygen values.
- During this deployment period the median water temperature at the Leary's Brook station was 0.62°C. Water Temperature will continue to fluctuate and be influenced by the surrounding winter air temperature, this is to be expected with the colder temperatures at night and slightly warmer temperatures during the day.
- The median pH value for Leary's Brook Station was 6.97 (pH units). The pH level for the most part is steady at this station.
- The Specific Conductivity median at Leary's Brook was 1128.4µS/cm. The Specific Conductivity graph for this station display several intermittent peaks in conductivity over the deployment period, this can be attributed to road salting of the roadways within the brooks vicinity.
- Dissolved Oxygen at Leary's Brook had a median of 95.4 %Sat during the deployment period. The small dips in DO (mg/L and % Sat) correspond with water temperatures. The larger dips in DO (mg/L and %Sat) at Leary's Brook correspond with rainfall events.
- The turbidity median value at Leary's Brook during deployment was 6.2 NTU. Generally in the colder months of the year, with everything frozen there is little or no change in the turbidity of the brooks. Once the spring thaw starts then the turbidity readings start to fluctuate. The majority of turbidity events correlated with increases in stage likely a result of precipitation events.
- Increases in stage level can explain the peaks in the turbidity values during the deployment period. As organic matter and natural minerals are washed into the brook, the suspended matter in the water column will increase and the turbidity sensor and the specific conductivity sensor will pick up these additional changes in the water body.