Real-Time Water Quality Deployment Report

Lower Churchill River and Lake Melville Stations

October 5 to November 2, 2011

Newfoundland Labrador

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

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Contents

General

- Department of Environment and Conservation staff monitors the real-time web pages regularly.
- This deployment report discusses water quality related events occurring at the station on the Lower Churchill River at English Point.
- On October 5, 2011, a real-time water quality monitoring instruments was deployed at the station on the Lower Churchill River at English Point. The instrument was deployed for a period of 29 days. The instrument was removed on November 2.
- At the station on Lake Melville east of Little River, upon removal of the instrument deployed in August 2011, the casing which encloses and protects the instrument had been lost. The instrument had been heavily damaged in high surf conditions. No replacement instrument was deployed in September or October 2011.

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 along side 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 parameters recorded by 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: Ranking classifications for deployment and removal

	Rank				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (oC)	<=+/-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 broken down into three groups: temperature dependant, temperature compensated and temperature independent. Because the temperature sensor is not isolated from the rest of the sonde the entire sonde must be at the same temperature before the 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 comparison rankings for the English Point station deployed between October 5 and November 2, 2011 are summarized in Table 2.

Table 2: Comparison rankings for Churchill River at English Point station, October 5- November 2, 2011

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
English Point	Aug 3, 2011	Deployment	Good	Good	Good	Excellent	Poor
	Sep 1, 2011	Removal	Good	Good	Marginal	Good	Excellent

- At Churchill River at English Point, temperature, pH, specific conductivity, and dissolved oxygen all ranked either 'good' or excellent' while turbidity ranked 'poor'. The field instrument read a value of 9.1NTU and the QA/QC instrument read a value of 19.1NTU. The average turbidity at this station for the deployment period was 10.7NTU indicating that the field instrument was most likely correct. This discrepancy may have been caused by a calibration error with the QA/QC instrument which resulted in higher than expected values or due to the positioning of the instruments side by side in the river and the amount of time allowed for stabilization. At removal, temperature, pH, dissolved oxygen and turbidity all ranked either 'good' or 'excellent' while specific conductivity ranked 'marginal'. The field instrument read a value of 41.0µS/cm while the QA/QC instrument read a value of 48.3µS/cm, a difference >20%. When specific conductivity is >35uS/cm, the ranking criteria dictate a percentage difference be used to classify data. If data is examined with on a numerical difference, the difference is 7.3uS/cm, which yields a ranking of 'good'. Considering the values in comparison are just above 35uS/cm, the 'poor' ranking should be judged with caution.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from October 5 to November 2 at the station on the Churchill River at English Point.
- 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.

Churchill River at English Point

- Water temperature ranged from 3.20 to 9.30^{o}C during this deployment period (Figure 1).
- Water temperature is decreasing throughout the deployment period. This trend is expected due to the cooling ambient air temperatures in the fall season (Figure 2). Water temperature fluctuates diurnally and with tidal influences.

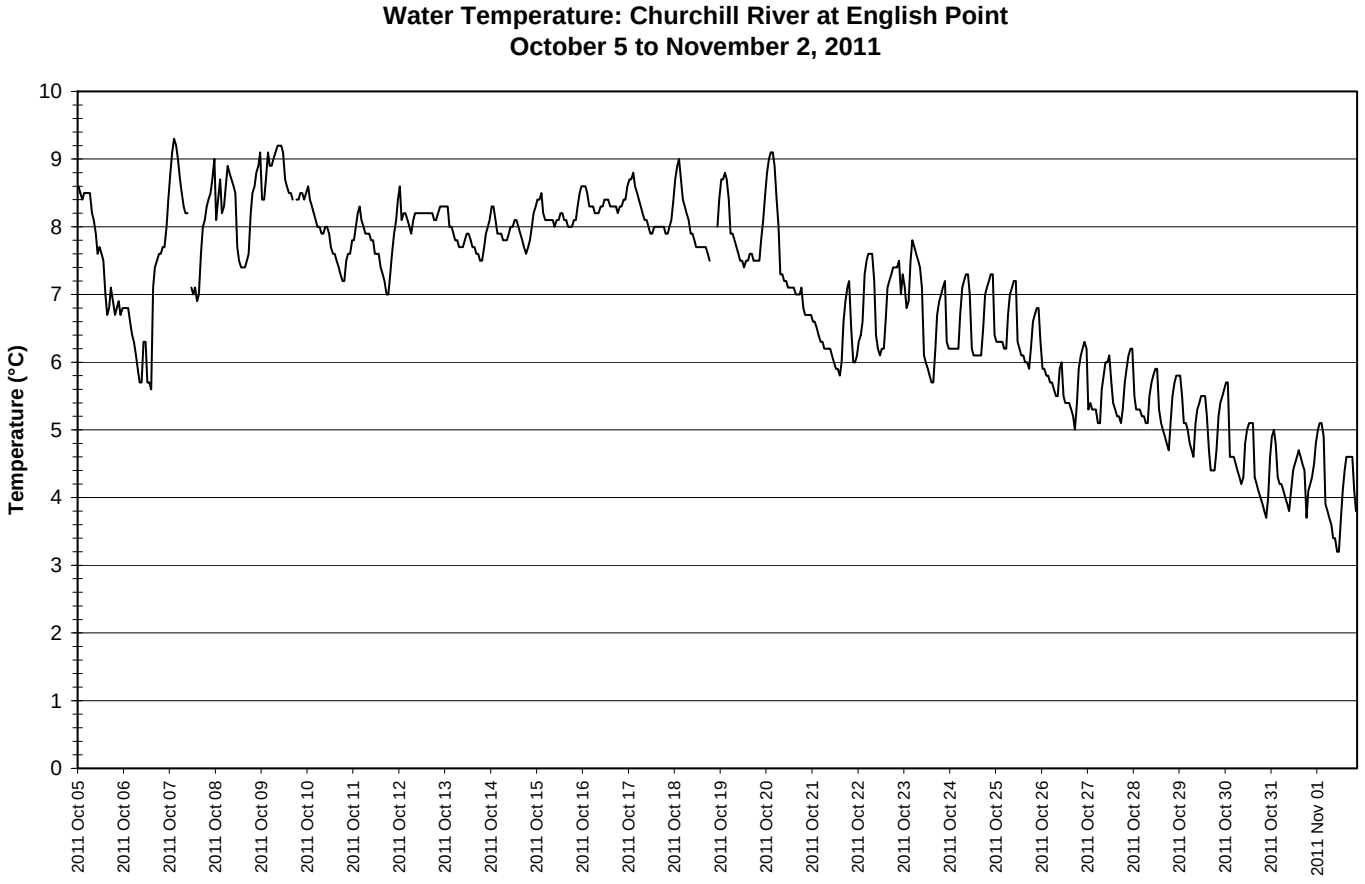


Figure 1: Water temperature at Churchill River at English Point

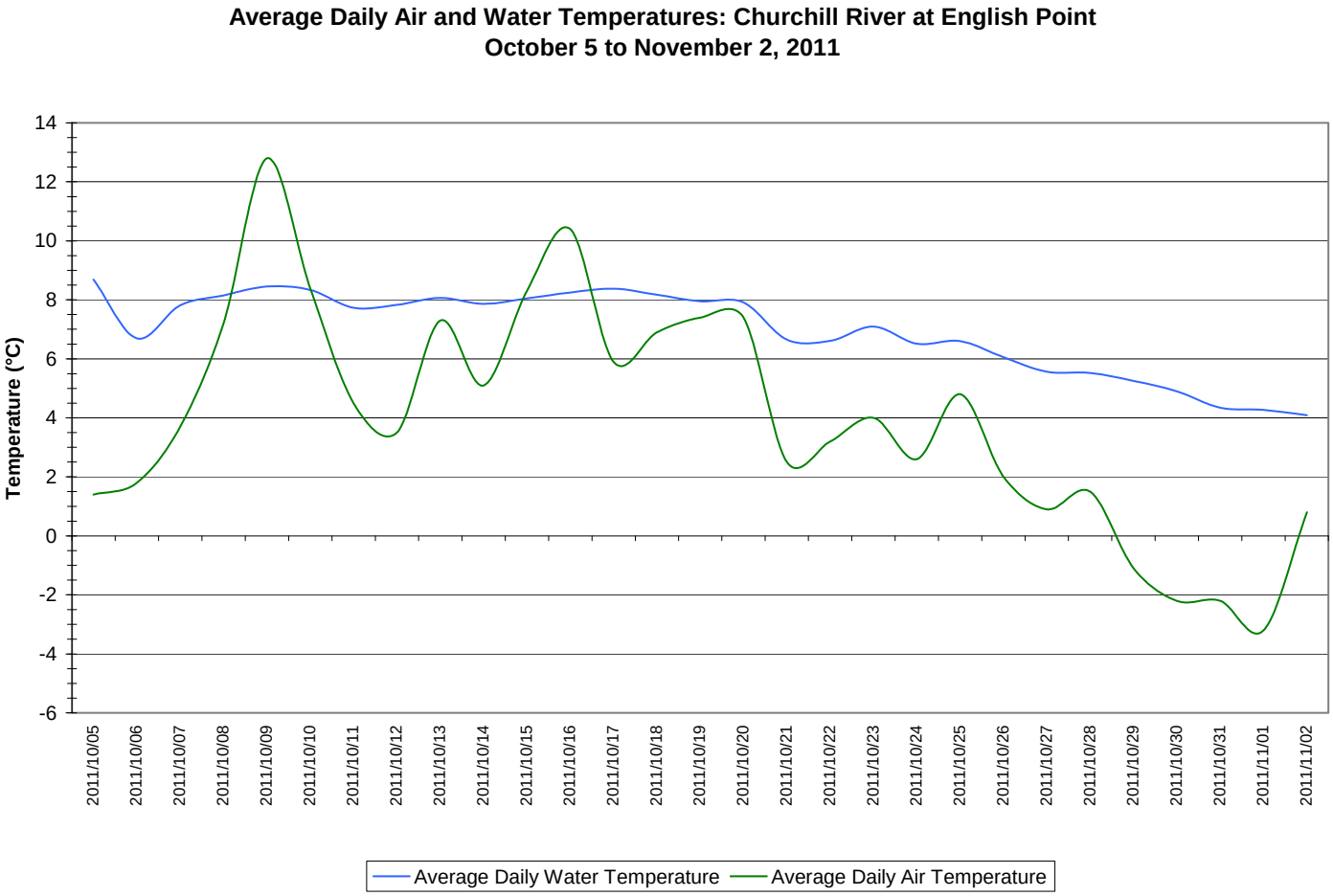


Figure 2: Average daily air and water temperatures at Churchill River at English Point (weather data collected at Goose Bay)

- pH ranges between 6.36 and 7.11 pH units (Figure 3). pH values are generally stable and fluctuate diurnally and with tidal influences.
- Most values during the deployment are within the minimum and maximum CCME Guidelines for the Protection of Aquatic Life (>6.5 and <9.5). pH values drop below the minimum guideline near the very end of the deployment period however this trend can likely be attributed to sensor drift.

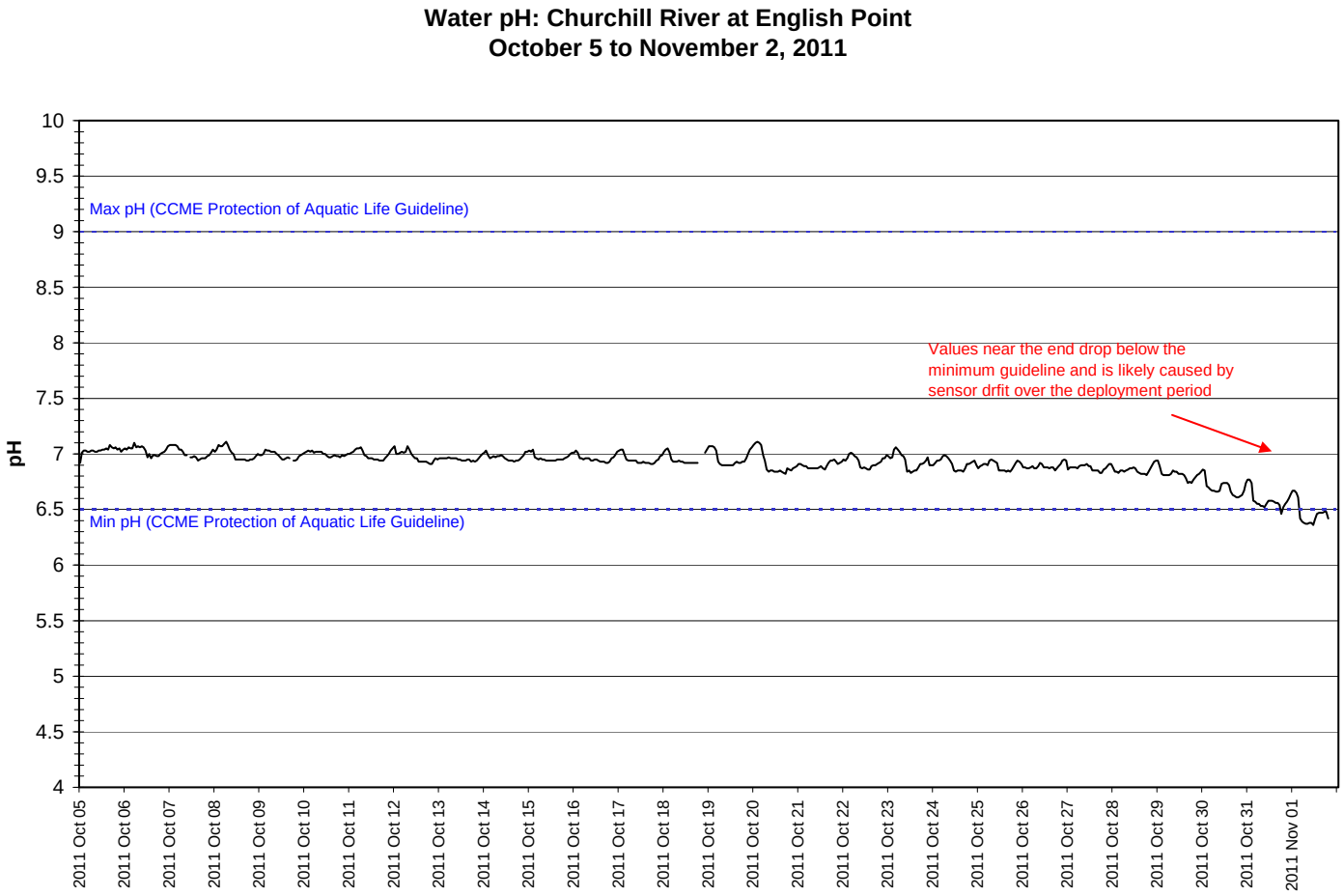


Figure 3: pH at Churchill River at English Point

- Specific conductivity typically ranges between 23.0 to 56.3µS/cm during the deployment period, averaging 36.1µS/cm (Figure 4).
- Specific conductivity fluctuates considerably at this location due to the tidal influences of the Atlantic Ocean. As the tide comes in, the specific conductivity increases as the dissolved solids and salinity increase, and vice versa as the tide goes out. This increase and decrease in specific conductivity and stage occurs twice daily. This pattern is generally consistent throughout the deployment period.
- On October 21, specific conductivity does not fluctuate regularly as seen throughout the deployment period. This event corresponds with a significant rainfall event recorded in the area over October 21-22 and a stage level increase, which decreases the specific conductivity during that time.

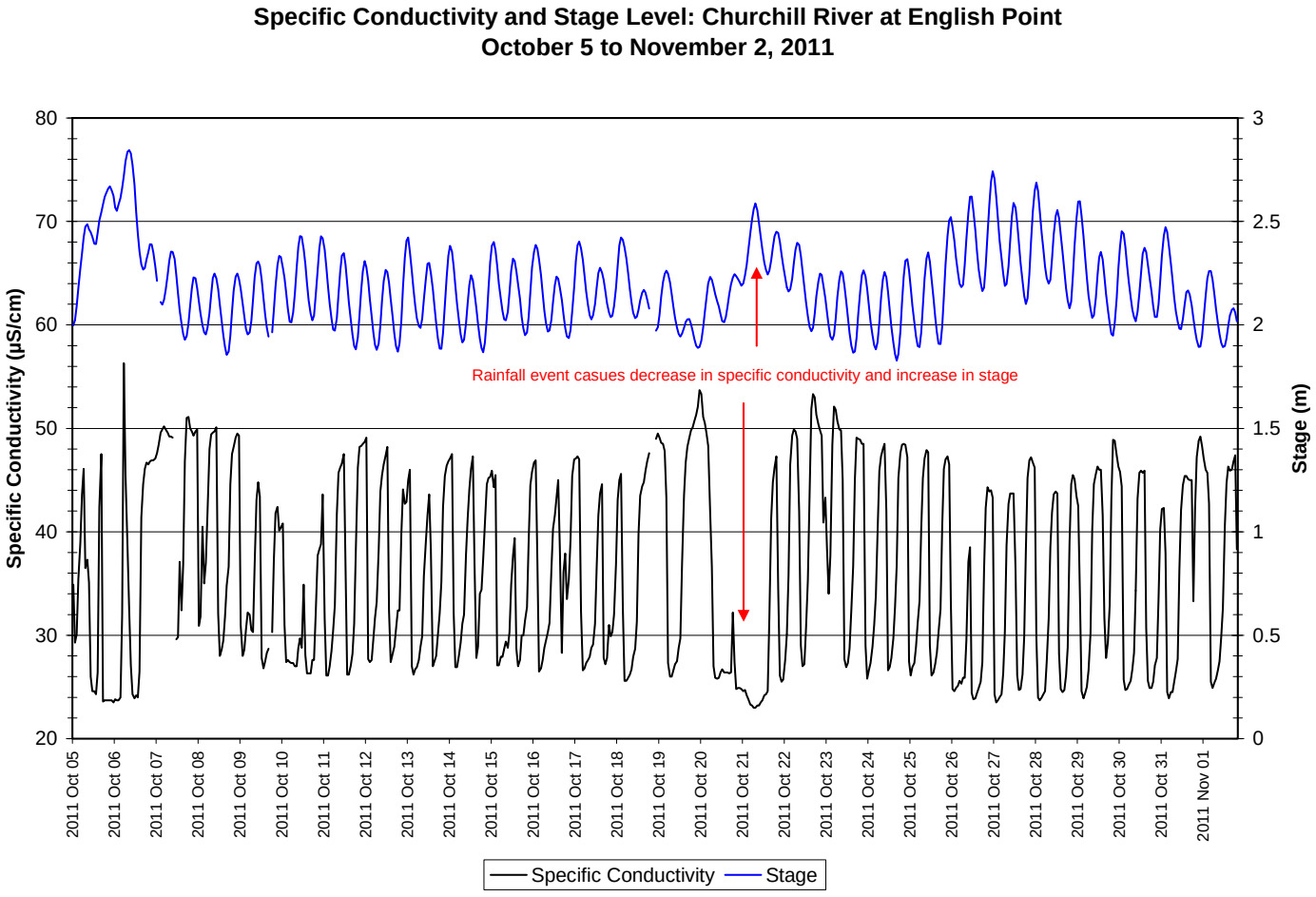


Figure 4: Specific conductivity and stage level at Churchill River at English Point

- The saturation of dissolved oxygen ranged from 88.2 to 101.7% and a range of 10.41 to 13.05mg/l was found in the concentration of dissolved oxygen with a median value of 11.52mg/l (Figure 5).
- All values were above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stage of 6.5 mg/l and at Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content is increasing slightly throughout the deployment period and clearly fluctuates diurnally, displaying the inverse relationship to water temperature during the day and night. This trend is expected given increasingly colder air and water temperatures in the fall season (Figure 2).
- There are a couple of instances when the diurnal fluctuation patterns are disrupted throughout the deployment period. These changes typically correspond with rainfall events and increases in stage level. From October 5-8, stage is increasing while dissolved oxygen content is inconsistent. From October 20-22, dissolved oxygen trends are disrupted during a significant rainfall event recorded on October 21-22.

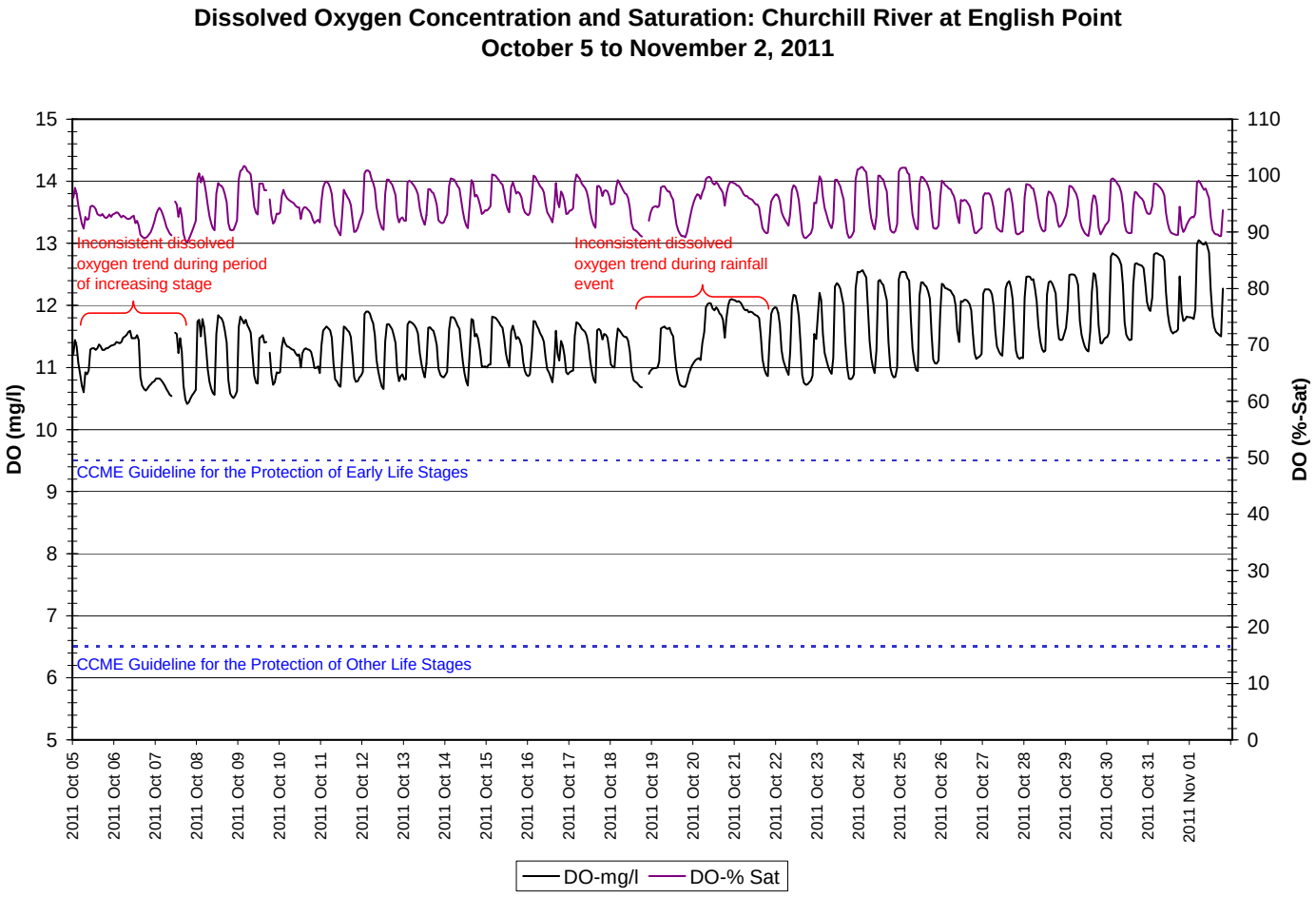


Figure 5: Dissolved oxygen and percent saturation at Churchill River at English Point

- Turbidity values generally ranged between 0.0 and 60.0NTU (Figure 6a & b). A median value of 0.0 NTU indicates there no apparent natural background turbidity value at this station however this station is susceptible to frequent turbidity increases. Average turbidity at this station is about 5.0NTU after extreme outliers have been removed from the dataset.
- Turbidity values are displayed in Figures 6 a & b. The two graphs show the turbidity event on 2 different scales. In Figure 6a, all turbidity events are included to show the magnitude of the turbidity increases throughout the deployment period. There are several instances when turbidity increases above average values to as high at 1700NTU. At the beginning of the deployment on October 5-6, turbidity increases correspond with increasing stage levels and changes in other water quality parameters such as specific conductivity (Figure 4), and dissolved oxygen (Figure 5). Other significant increases in turbidity occur on October 8 however it is unknown what caused these spikes.

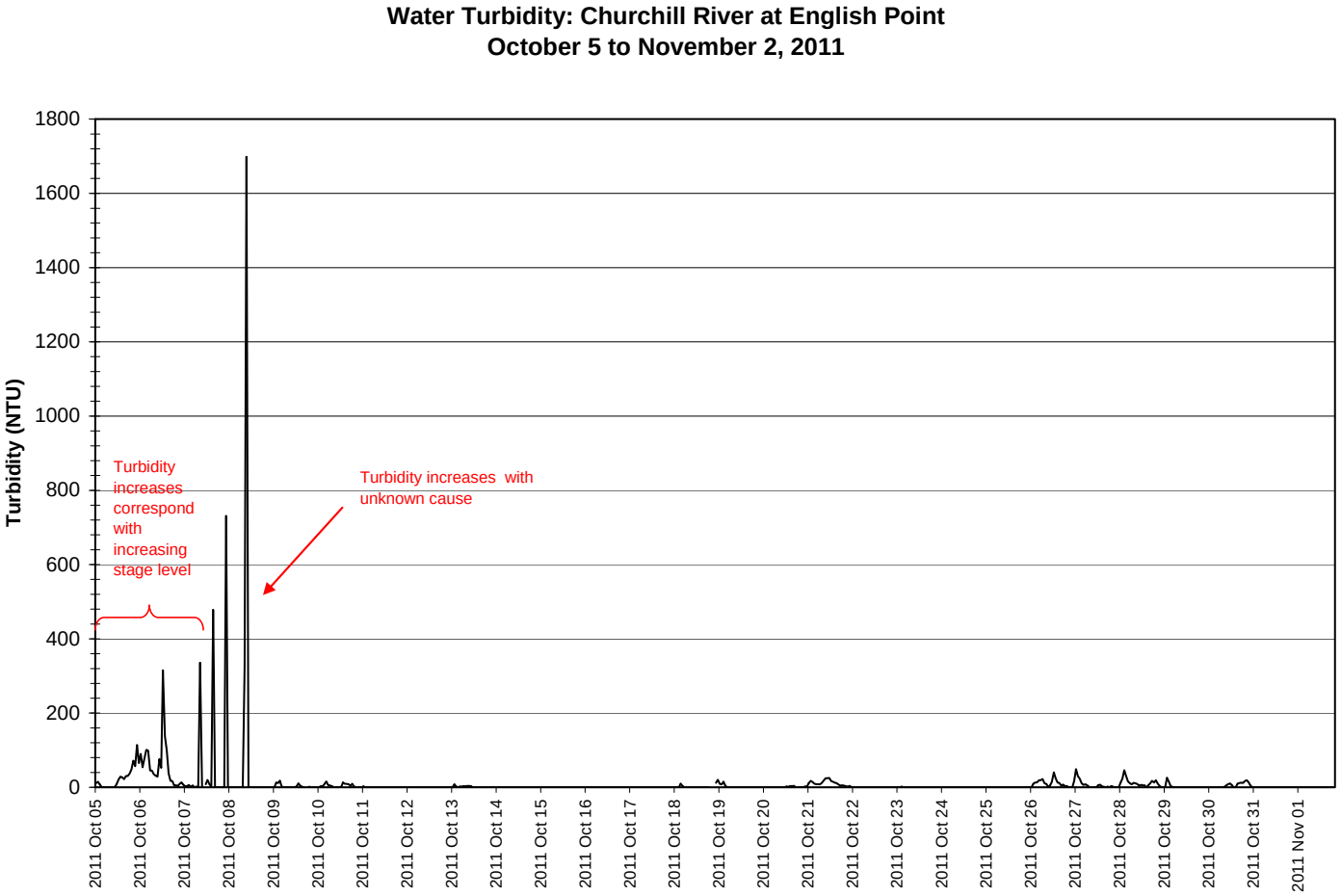


Figure 6a: Turbidity (0 to 1800NTU) at Churchill River at English Point

- In Figure 6b, all turbidity events are depicted on a smaller scale (0 to 100NTU) to show the detail of the lower magnitude increases throughout the deployment period. On October 20-21, turbidity increases correspond with a rainfall event recorded in the area over 2 days. This event is also noticeable in with changes in other water quality parameters such as specific conductivity (Figure 4) and dissolved oxygen (Figure 5). Turbidity spikes near the end of the deployment period from October 26 to 31 correspond with a period of increasing stage.

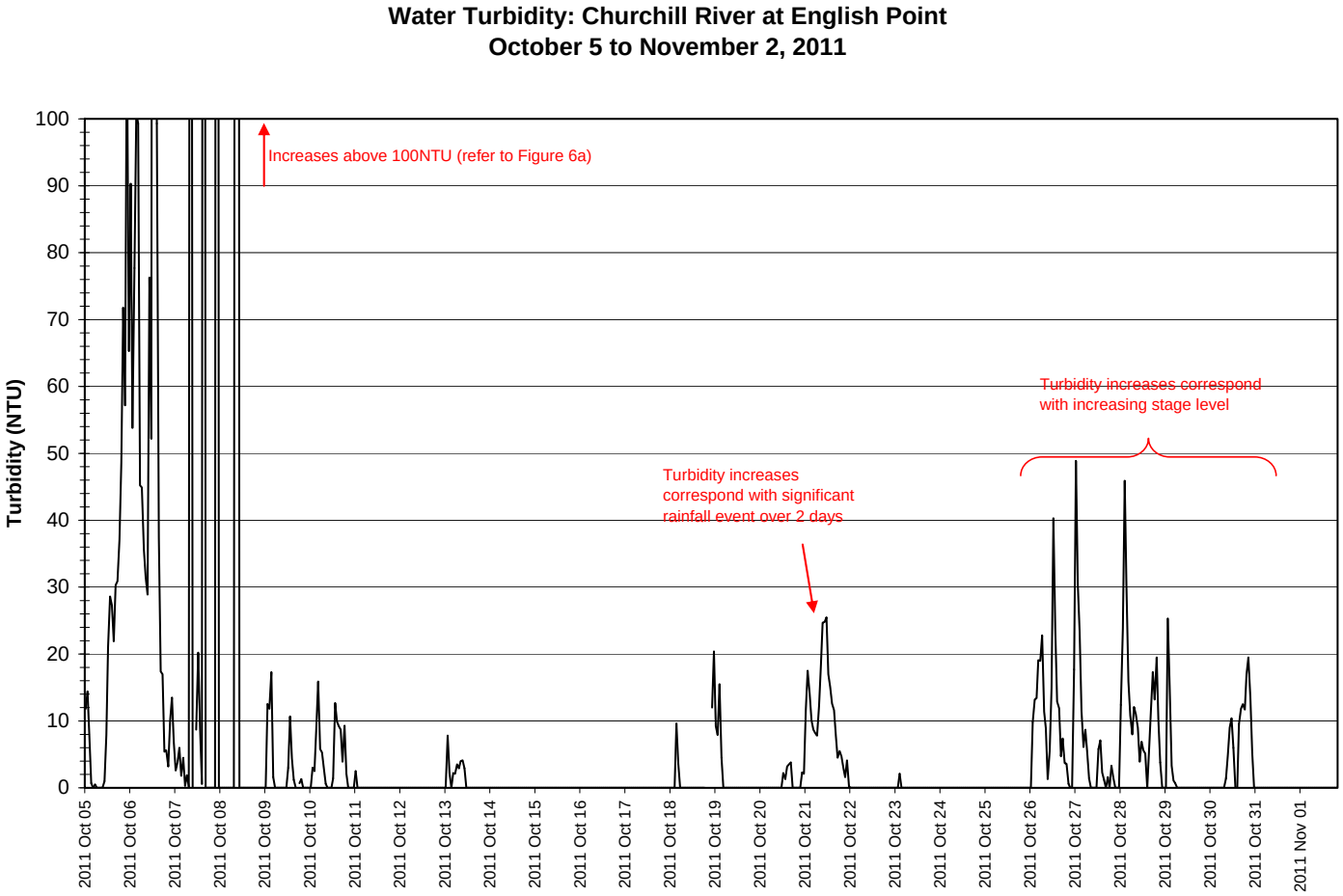


Figure 6b: Turbidity (0 to 100NTU) at Churchill River at English Point

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 7). Stage remains relatively stable fluctuating throughout the deployment period with varying precipitation records. Averaging stage over 24 hour period reduces the appearance of diurnal variability caused by the tides in the hourly data.

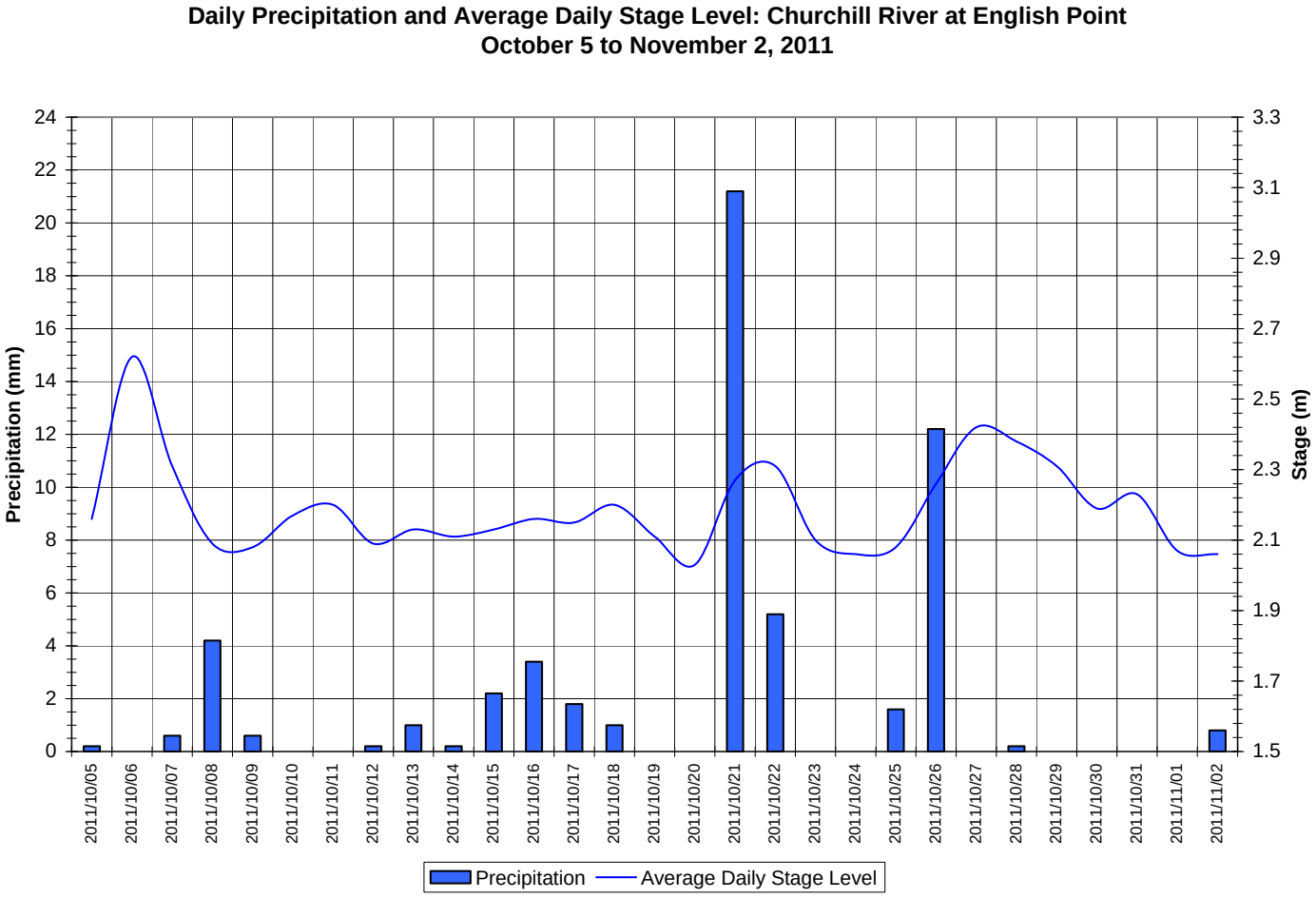


Figure 7: Stage and precipitation at Churchill River at English Point

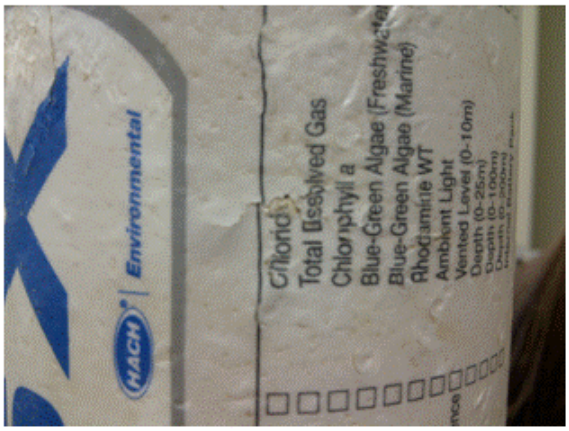
Lake Melville East of Little River

- No instrument was deployed at this station for the months of September or October 2011. Upon removal of the instrument deployed on August 3, the protective casing that protects the instrument had been lost. The instrument was heavily damaged by rocky bottom at the lake shore station. No replacement instrument was deployed. A new heavy duty casing is being fabricated for this station.

Protective casing for instrument

Instrument upon removal without protective casing

High surf conditions on at Lake Melville east of Little River on September 2, 2011



Damage resulting after instrument casing was lost. Hydrolab casing was cracked and dented potentially compromising future use.

Conclusions

- A water quality monitoring instrument at the station on the Lower Churchill River at English Point was deployed on October 5 and removed on November 2, a period of 29 days. No instrument was deployed during this time at the station on Lake Melville east of Little River.
- These stations are an extension of the existing RTWQ Network on the Lower Churchill River, established to protect ambient water resources and catch emerging water quality issues. The data from these two stations augment the data collected from the existing stations on the Lower Churchill River.
- At Churchill River at English Point, in most cases, weather related events or increase/decreases in water level could be used to explain the fluctuations. In some cases, the cause of the disturbance remains unknown. Water temperature was decreasing throughout the period while dissolved oxygen was generally increasing. Specific conductivity fluctuated regularly with changes in stage level and is highly influenced by the tides in the Atlantic Ocean. pH is very stable throughout the deployment period and may have been subject to sensor drift at the end of the deployment when values were decreasing. Turbidity fluctuated throughout the deployment period. Stage was relatively consistent while precipitation records varied.
- All values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen.
- At the station on Lake Melville at Little River, no instrument was deployed for the months of September or October 2011 due to the loss of the protective casing in high surf conditions. The instrument removed on September 2 was heavily damaged.

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Appendix 1

Average Daily Air Temperature and Daily Precipitation: Happy Valley Goose Bay, NL
October 5 to November 2, 2011