Real-Time Water Quality Deployment Report

Lower Churchill River and Lake Melville Stations

July 25 to
August 22, 2012

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 stations on the Lower Churchill River at English Point and Lake Melville east of Little River.
- On July 25, 2012, real-time water quality monitoring instruments were deployed at the stations on the Lower Churchill River at English Point and Lake Melville east of Little River. The instruments were deployed for a period of 28 days. The instruments were removed on August 22.

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QAQC), 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 QAQC 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 QAQC 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 and Lake Melville stations deployed between July 25 and August 22, 2012 are summarized in Table 2.

Table 2: Comparison rankings for Churchill River and Lake Melville stations, July 25- August 22, 2012

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Churchill R. at English Point	Jul 25, 2012	Deployment	Excellent	Good	Good	Excellent	Good
	Aug 22, 2012	Removal	Excellent	Good	Good	n/a*	n/a*
Lake Melville east of Little R.	Jul 25, 2012	Deployment	Excellent	Excellent	Excellent	n/a**	Good
	Aug 22, 2012	Removal	Excellent	Good	Excellent	n/a**	n/a**

* QAQC instrument dissolved oxygen sensor not functioning correctly. Values unavailable.

**Field instrument dissolved oxygen and turbidity sensors not functioning correctly. Values unavailable.

- At Churchill River at English Point, all parameters ranked either 'good' or 'excellent' at deployment. At removal, temperature, pH, specific conductivity all ranked either 'good' or 'excellent' while turbidity and dissolved oxygen were not ranked. Dissolved oxygen and turbidity were not ranked due to an error with the QAQC instrument. No QAQC comparisons values are available.
- At the station on Lake Melville east of Little River, temperature, pH, specific conductivity and turbidity all ranked either 'good' or 'excellent' at deployment. Dissolved oxygen was not ranked due to an error with the field instrument sensor. The dissolved oxygen sensor did not function for the entirety of the deployment period and all values have been removed from the dataset. At removal, temperature, pH, and specific conductivity all ranked either 'good' or 'excellent'. Dissolved oxygen was not ranked because the sensor was not functioning correctly. Turbidity was not ranked due to operation issues related to the failure of the dissolved oxygen sensor.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from July 25 to August 22 at the stations on the Churchill River at English Point and Lake Melville east of Little River.

- 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 QAQC protocol. Water Survey of Canada is responsible for QAQC of water quantity data. Corrected data can be obtained upon request.

Churchill River at English Point

- Water temperature ranges from 17.40 to 22.10^{o}C during the deployment period (Figure 1).
- Water temperature is increasing slightly for the first half of the deployment period and then decreases slightly in the latter half. Daily average air temperature is very closely related to daily average water temperature (Figure 2).
- Water temperature fluctuates diurnally and with tidal influences.

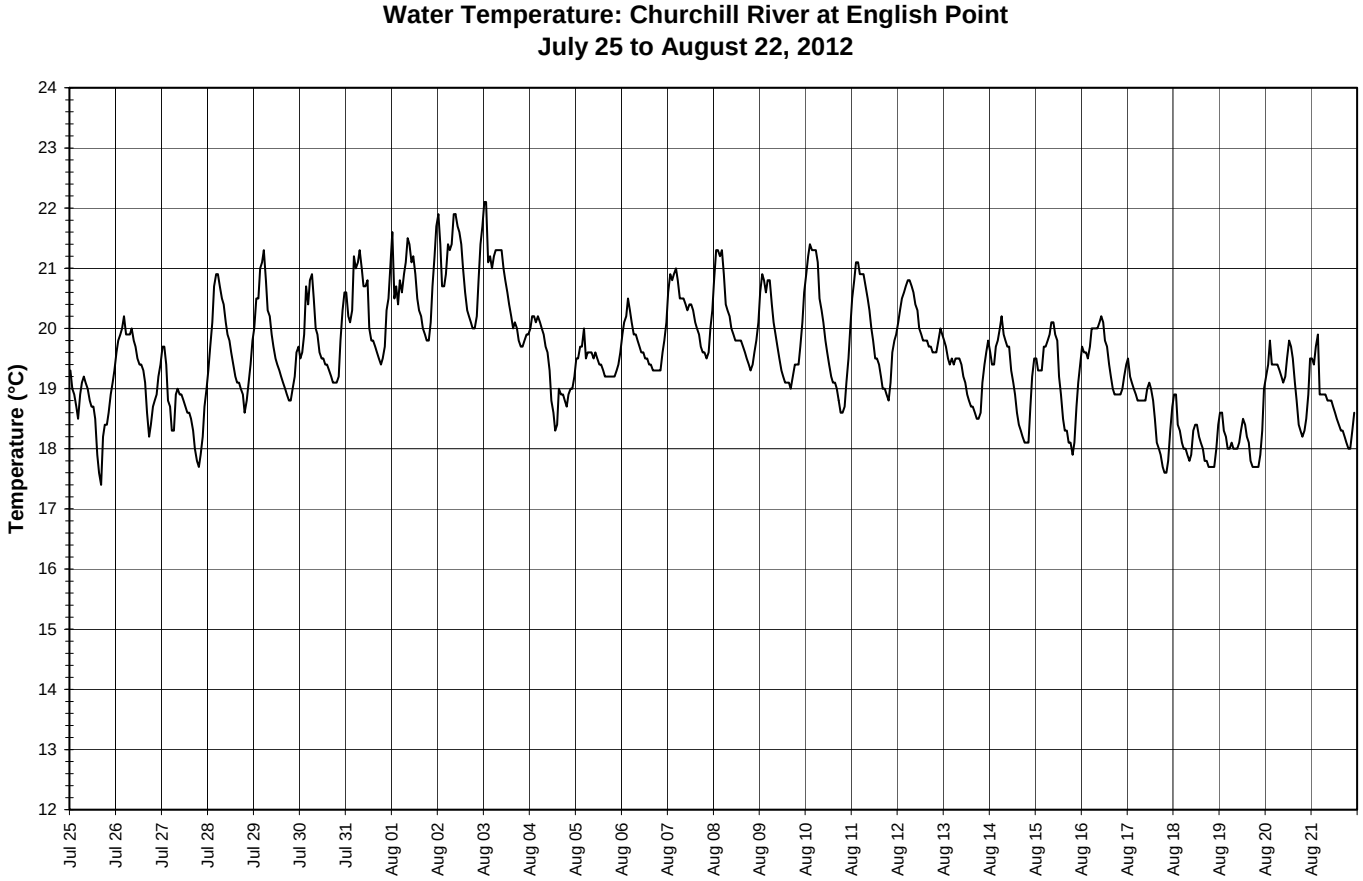

Figure 1: Water temperature at Churchill River at English Point

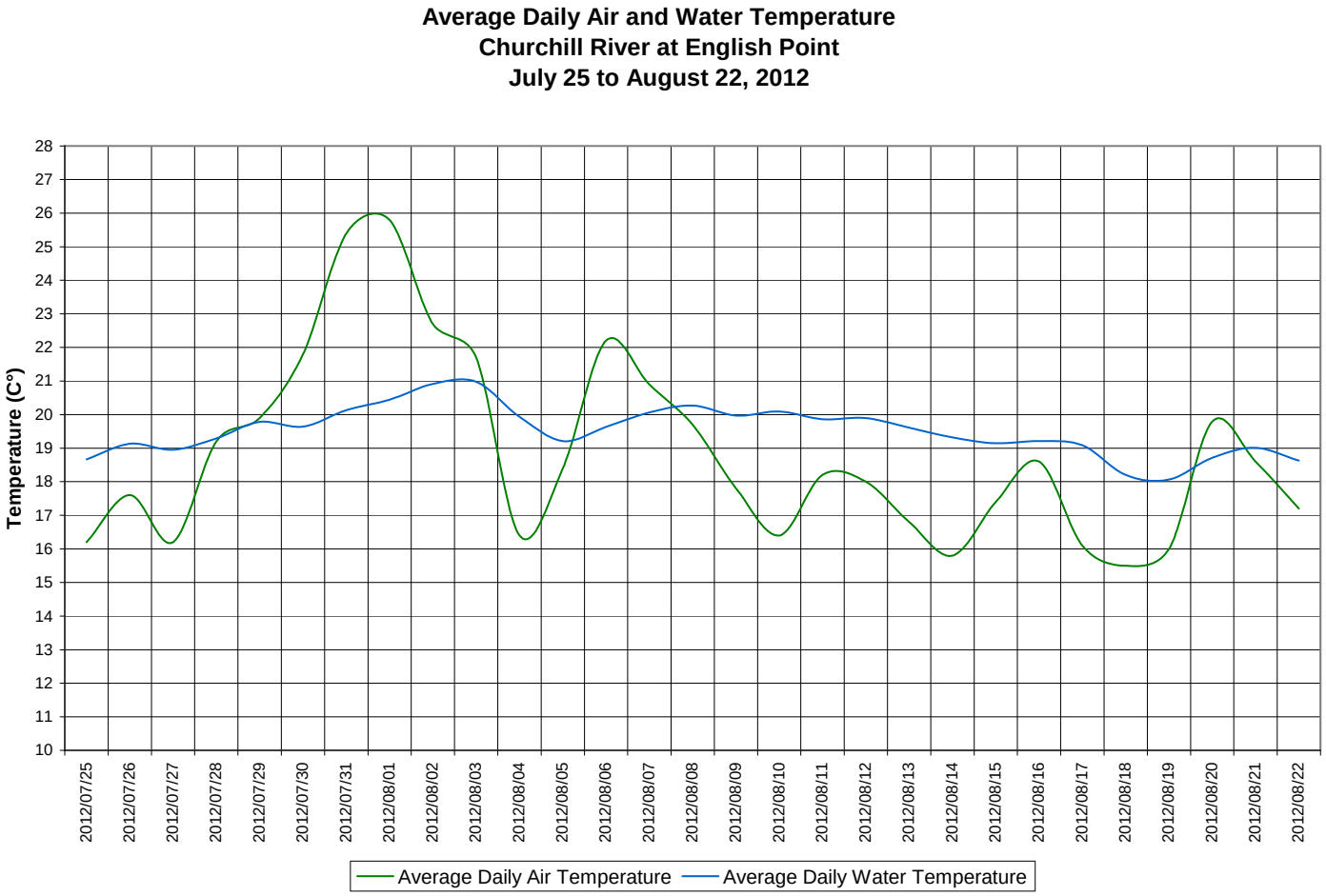

Figure 2: Average daily air and water temperatures at Churchill River at English Point

(weather data collected at Goose Bay)

- pH ranges between 6.74 and 7.29 pH units (Figure 3). pH values are generally stable and fluctuate diurnally and with tidal influences.
- All values during the deployment are within the minimum and maximum CCME Guidelines for the Protection of Aquatic Life of 6.5 and 9.0 respectively. Guidelines are indicated on Figure 3 in blue.

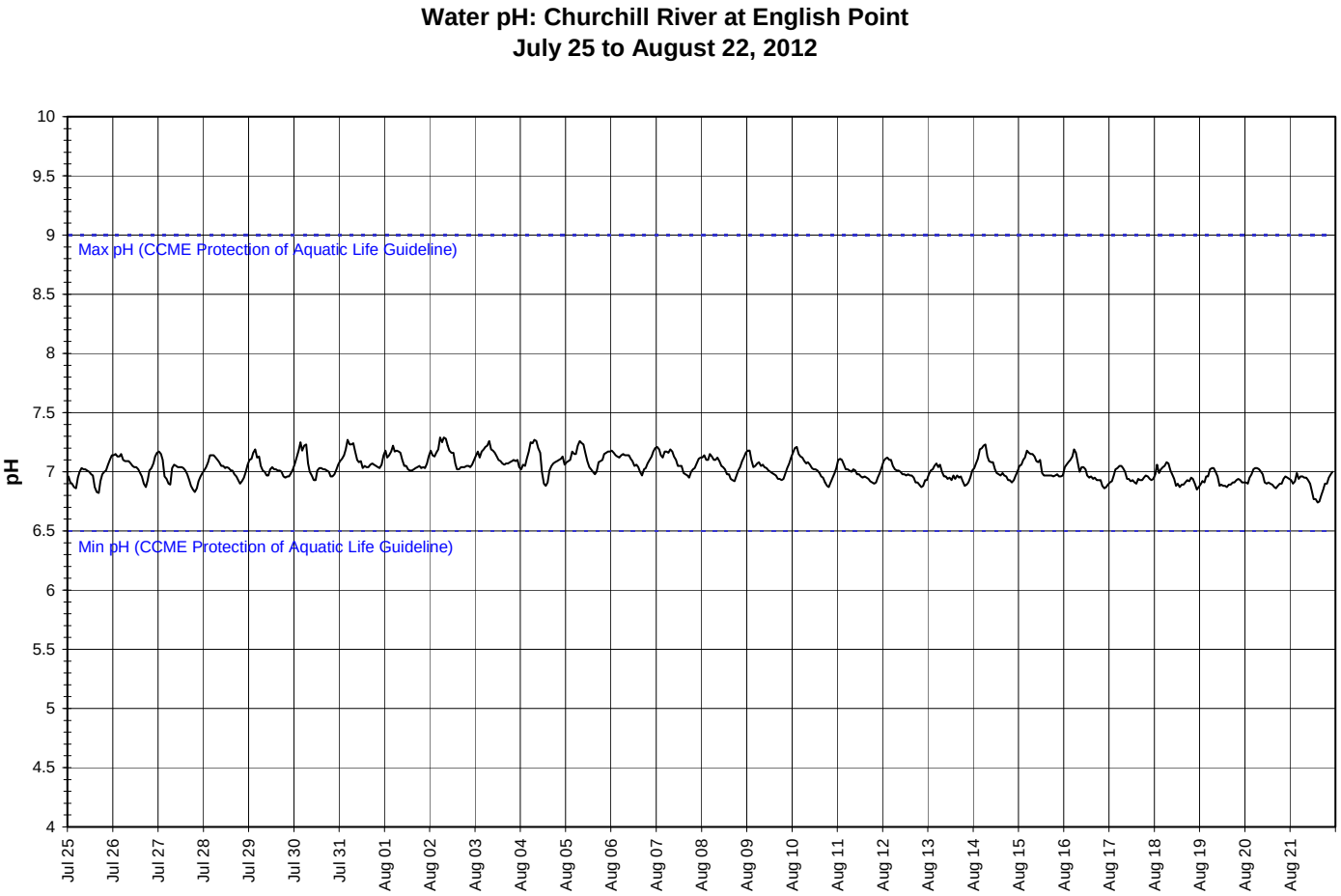

Figure 3: pH at Churchill River at English Point

- Specific conductivity ranges between 24.6 to 61.1µS/cm during the deployment period, averaging 34.6µS/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.

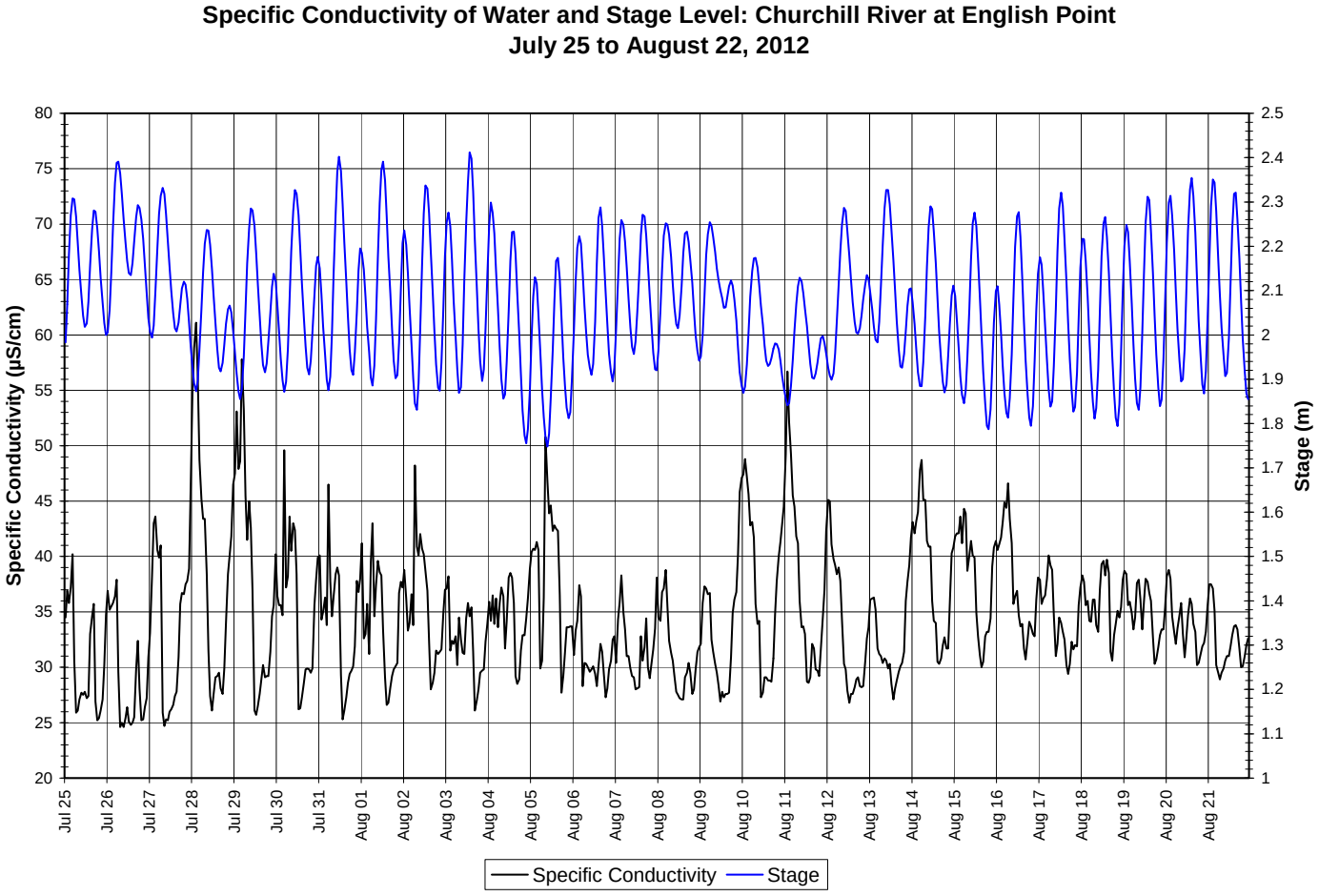

Figure 4: Specific conductivity and stage level at Churchill River at English Point

- The saturation of dissolved oxygen ranged from 95.0 to 112.2% and a range of 8.91 to 10.33mg/l was found in the concentration of dissolved oxygen with a median value of 9.56mg/l (Figure 5).
- All values were above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stage of 6.5 mg/l. About half of the values recorded during the deployment period are above the CCME Guideline for the Protection of Cold Water Biota at Early Life Stage of 9.5 mg/l. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content is decreasing slightly throughout the first half of the deployment period and increasing slightly in the latter half. This trend is expected given the inverse pattern in water temperature. Dissolve oxygen clearly fluctuates diurnally, displaying the inverse relationship with water temperature during day, night and tidal changes.

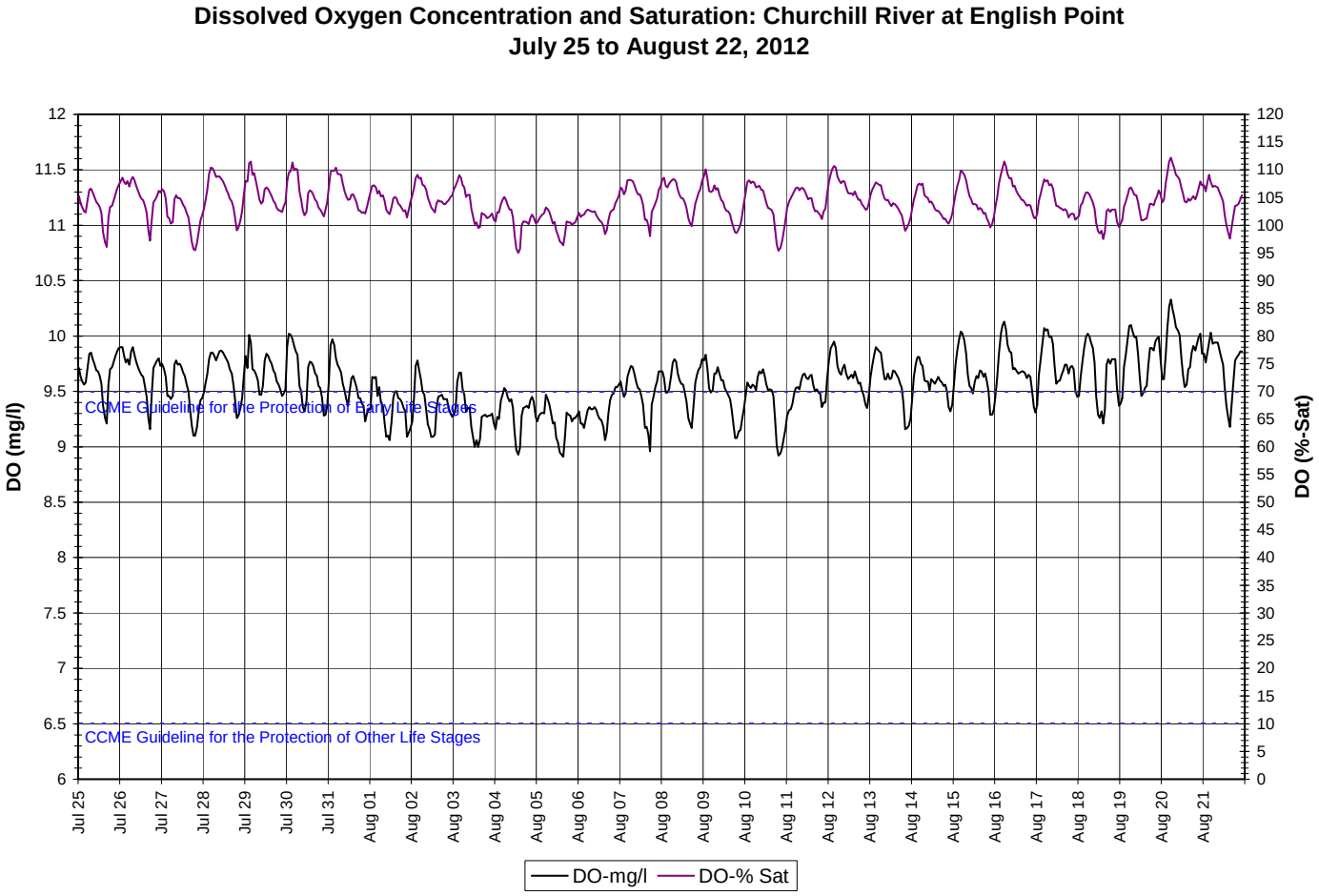

Figure 5: Dissolved oxygen and percent saturation at Churchill River at English Point

- Turbidity values generally remained below 65.0NTU (Figure 6). A median value of 6.1NTU indicates there is a natural background turbidity value at this station. Average turbidity at this station is 9.1NTU.
- There is are a couple significant increases in turbidity to >65.0NTU throughout the deployment period. On August 5, turbidity increase to 112NTU for a short period of time. On August 19, turbidity increase to 225NTU for a one hour period. These increases in turbidity do not correspond with any weather related events recorded in the area. Precipitation events vary throughout the deployment period and may or may not cause turbidity increases (Figure 7).

Water Turbidity: Churchill River at English Point
July 25 to August 22, 2012

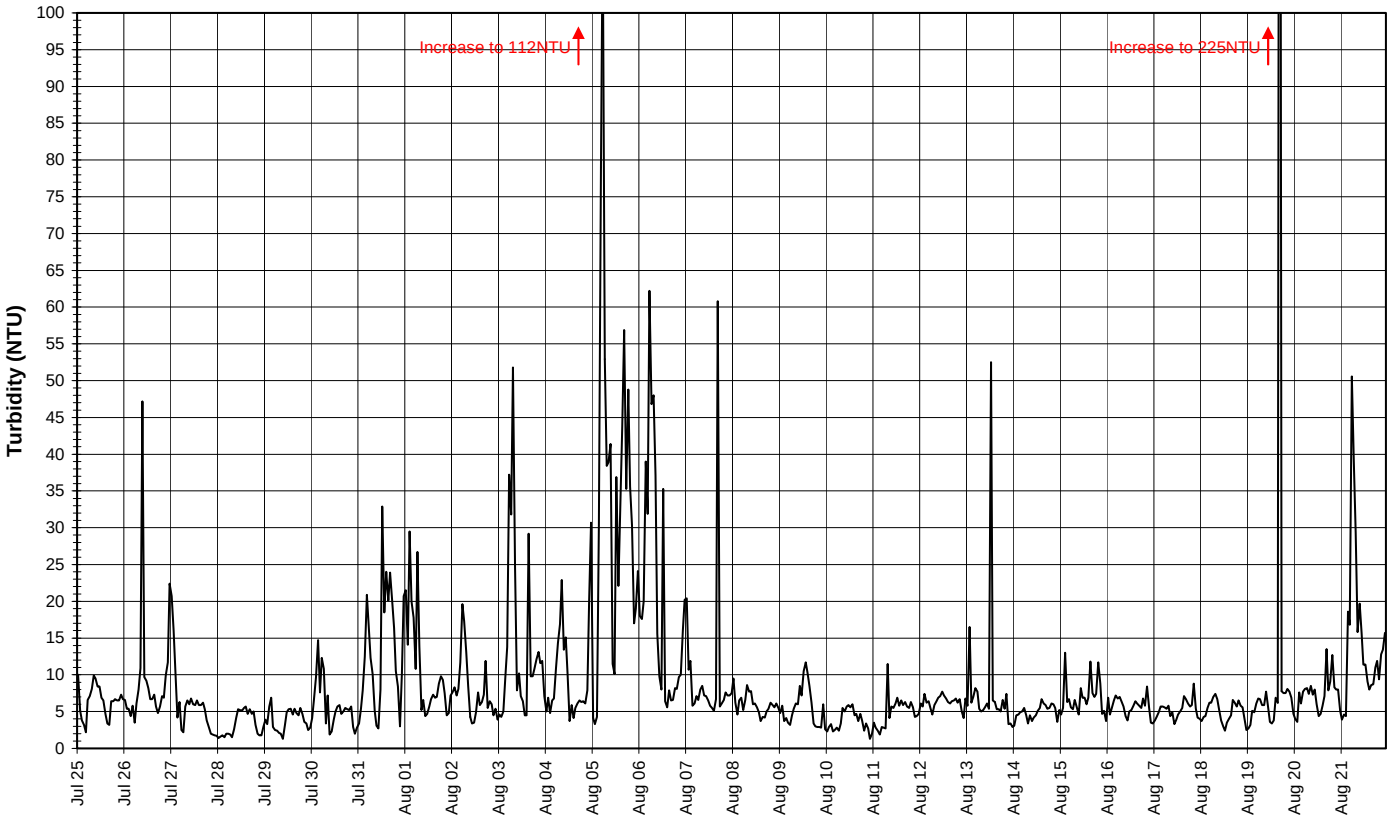

Figure 6: Turbidity at Churchill River at English Point

- 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.

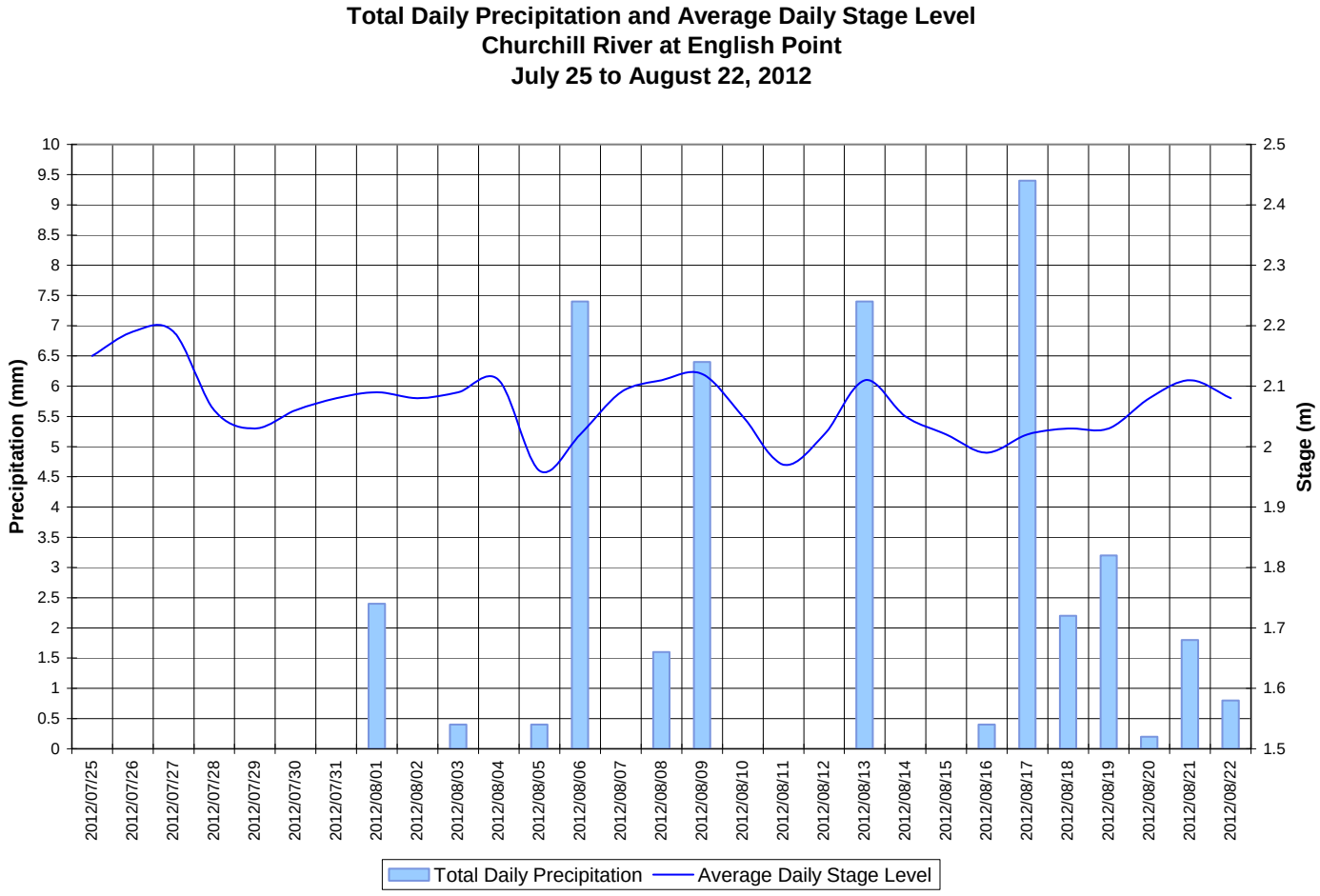

Figure 7: Stage and precipitation at Churchill River at English Point

Lake Melville East of Little River

- Water temperature ranges from 16.10 to 23.10^{o}C during the deployment period (Figure 8).
- Water temperature is increasing slightly in the beginning of the deployment period and decreases slightly in the latter half.
- Water temperature fluctuates diurnally and with tidal influences.

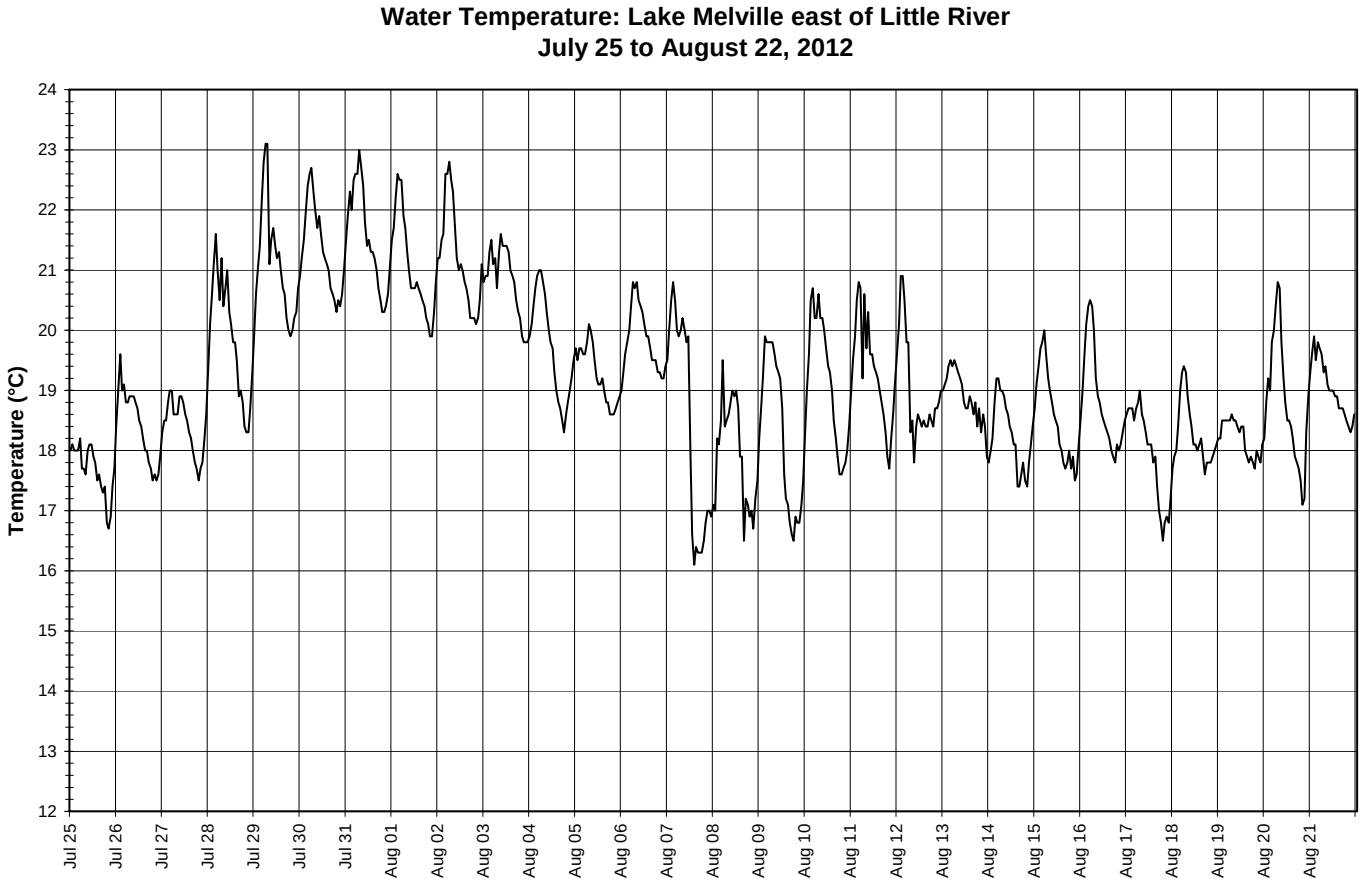

Figure 8: Water temperature at Lake Melville east of Little River

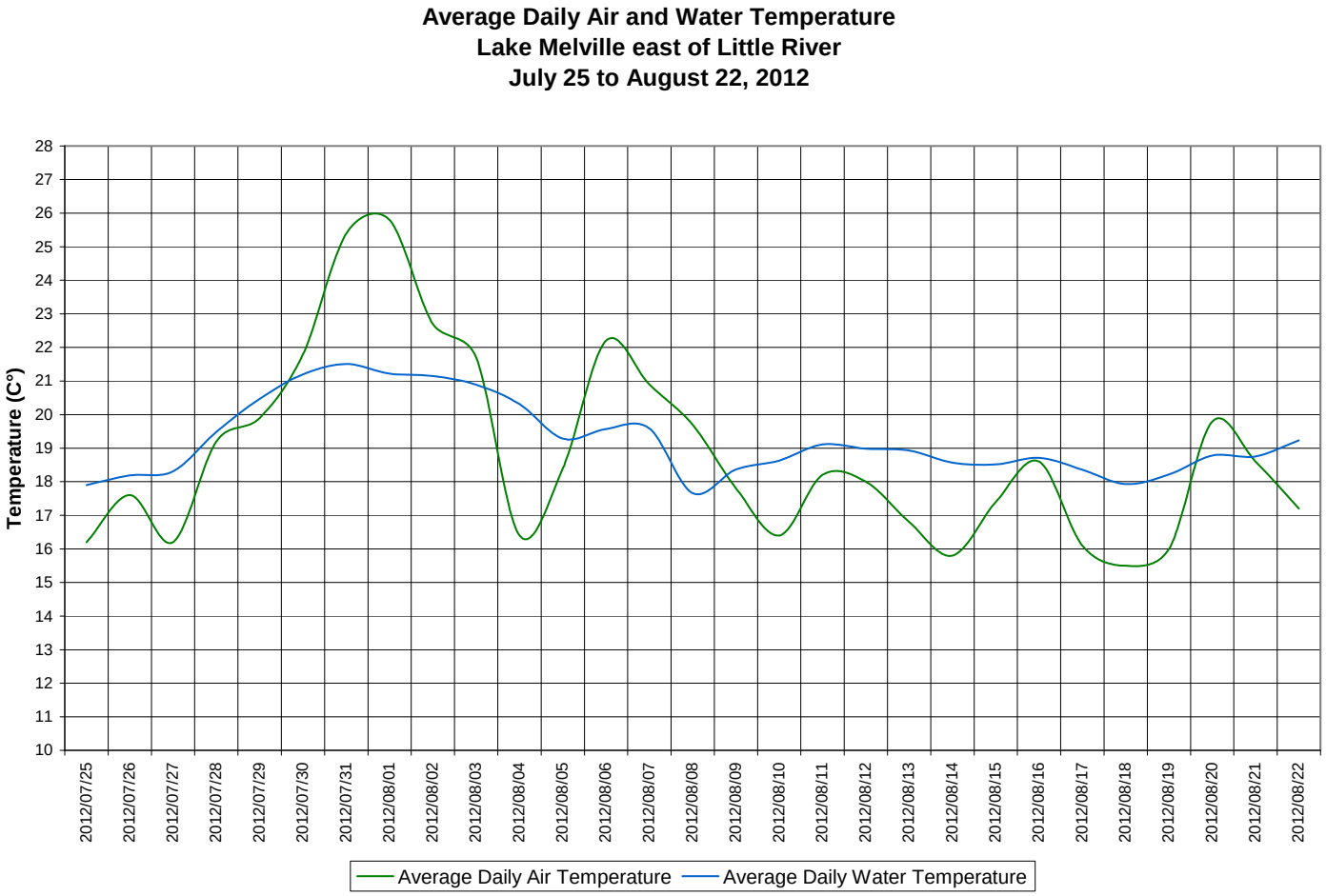

Figure 9: Average daily air and water temperatures at Lake Melville east of Little River (weather data collected at Goose Bay)

- pH ranges between 7.17 and 8.69 pH units (Figure 10). pH values are generally stable and fluctuate diurnally and with tidal influences.
- A rainfall event on August 6 corresponds with changes in the regular pH fluctuation on the same day (indicated in red on Figure 10).
- All values during the deployment are within the minimum and maximum CCME Guidelines for the Protection of Aquatic Life of 6.5 and 9.0 (Guidelines are indicated in blue on Figure 10).

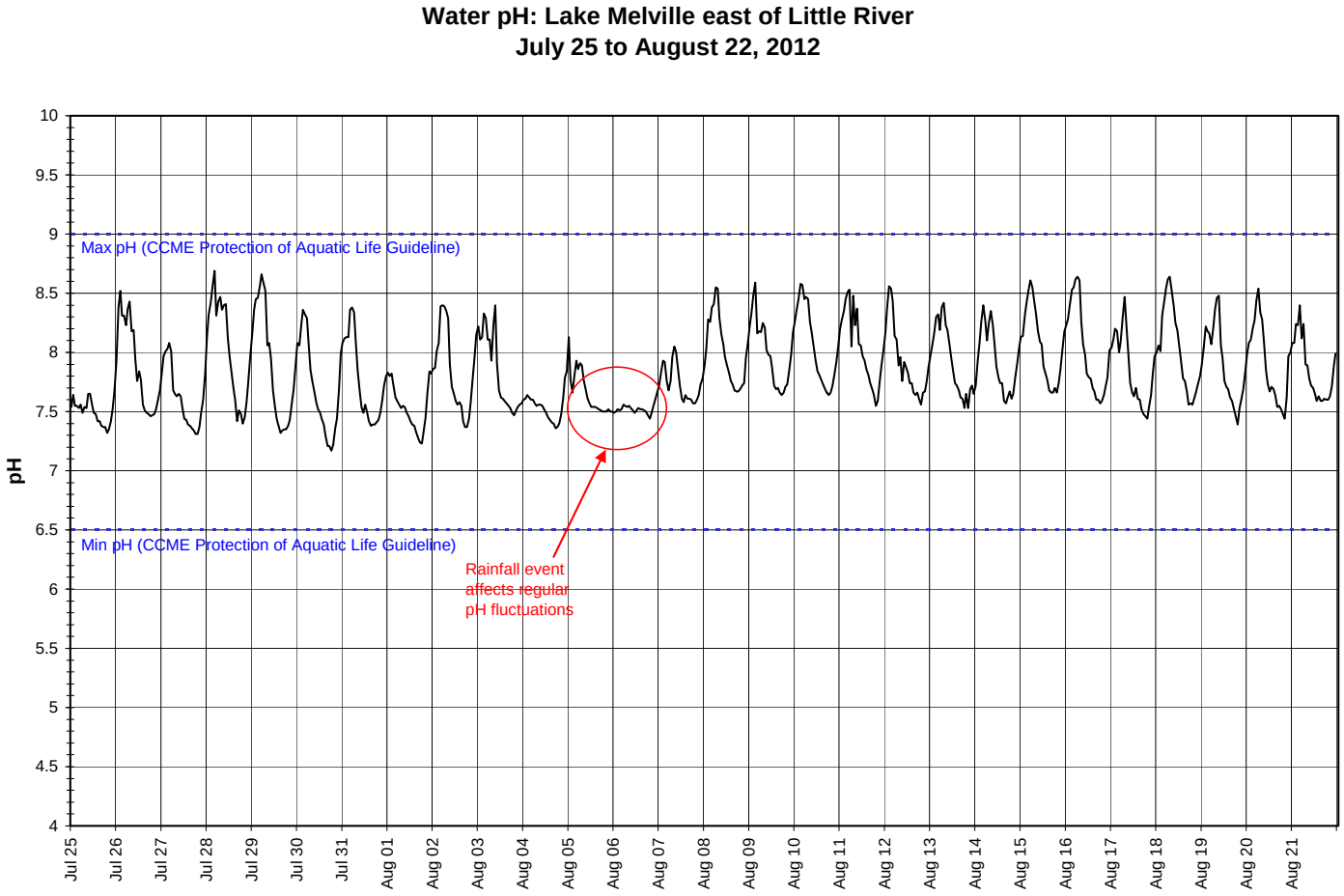

Figure 10: pH at Lake Melville east of Little River

- Specific conductivity ranges between 4600 to 15000µS/cm during the deployment period, averaging ~8750µS/cm (Figure 11).
- Specific conductivity averages ~5700uS/cm during the first half of the deployment period from July 25 to August 7. On August 7, following a rainfall event on August 6, specific conductivity increases to over 14000uS/cm and remains high for the rest of the deployment period, averaging ~11500uS/cm.
- 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.

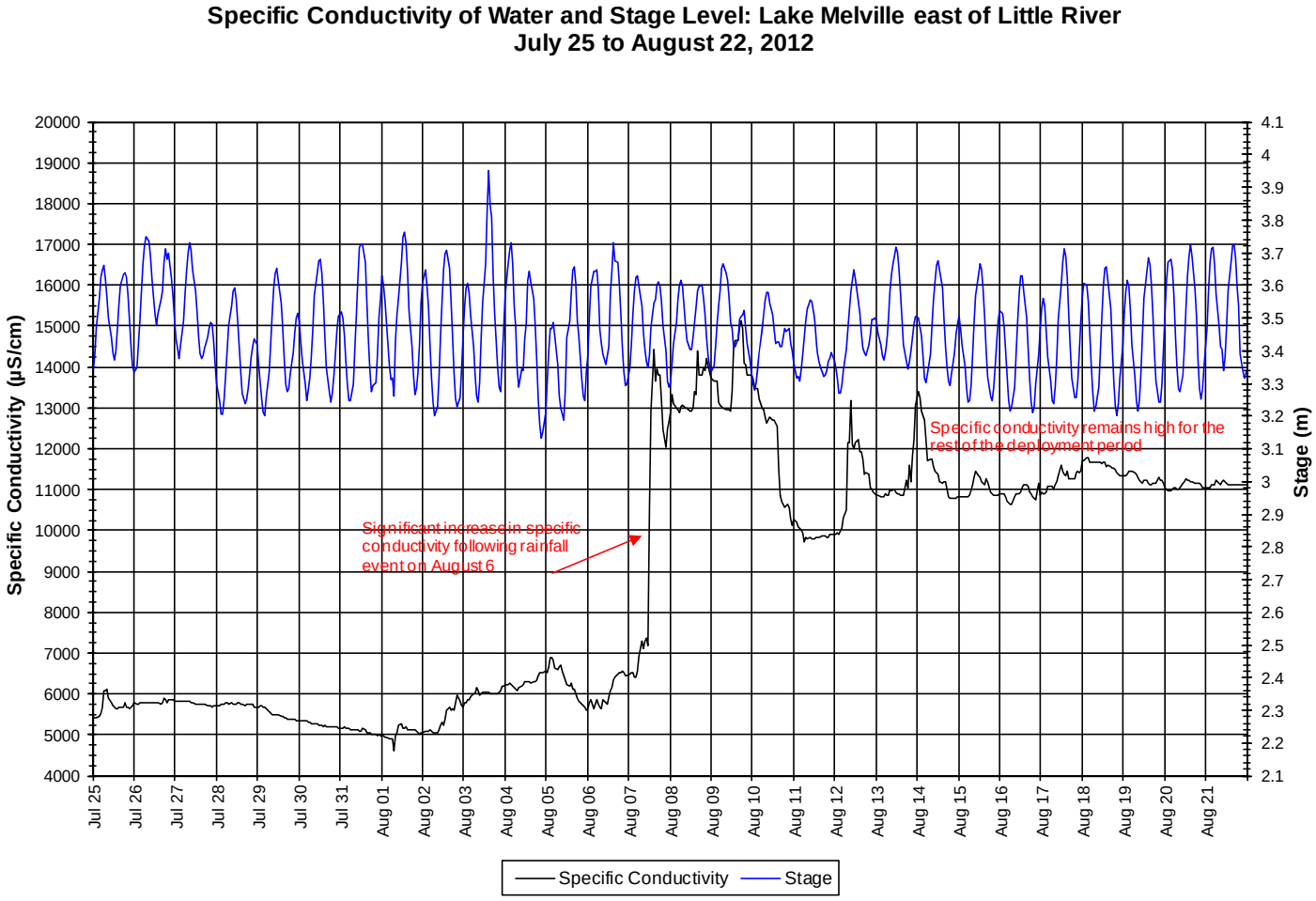

Figure 11: Specific conductivity and stage level at Lake Melville east of Little River

- Dissolved oxygen and percent saturation values are not available for the deployment period. Data collected by the instrument was inaccurate due to sensor failure. This data has been removed from the data set.
- The turbidity sensor operation is closely related to the dissolved oxygen sensor. The dissolved oxygen sensor failed for the entire deployment period. Subsequently, the turbidity data is also compromised. This data cannot be confirmed accurate and has therefore been removed from the data set.

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 12). 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.

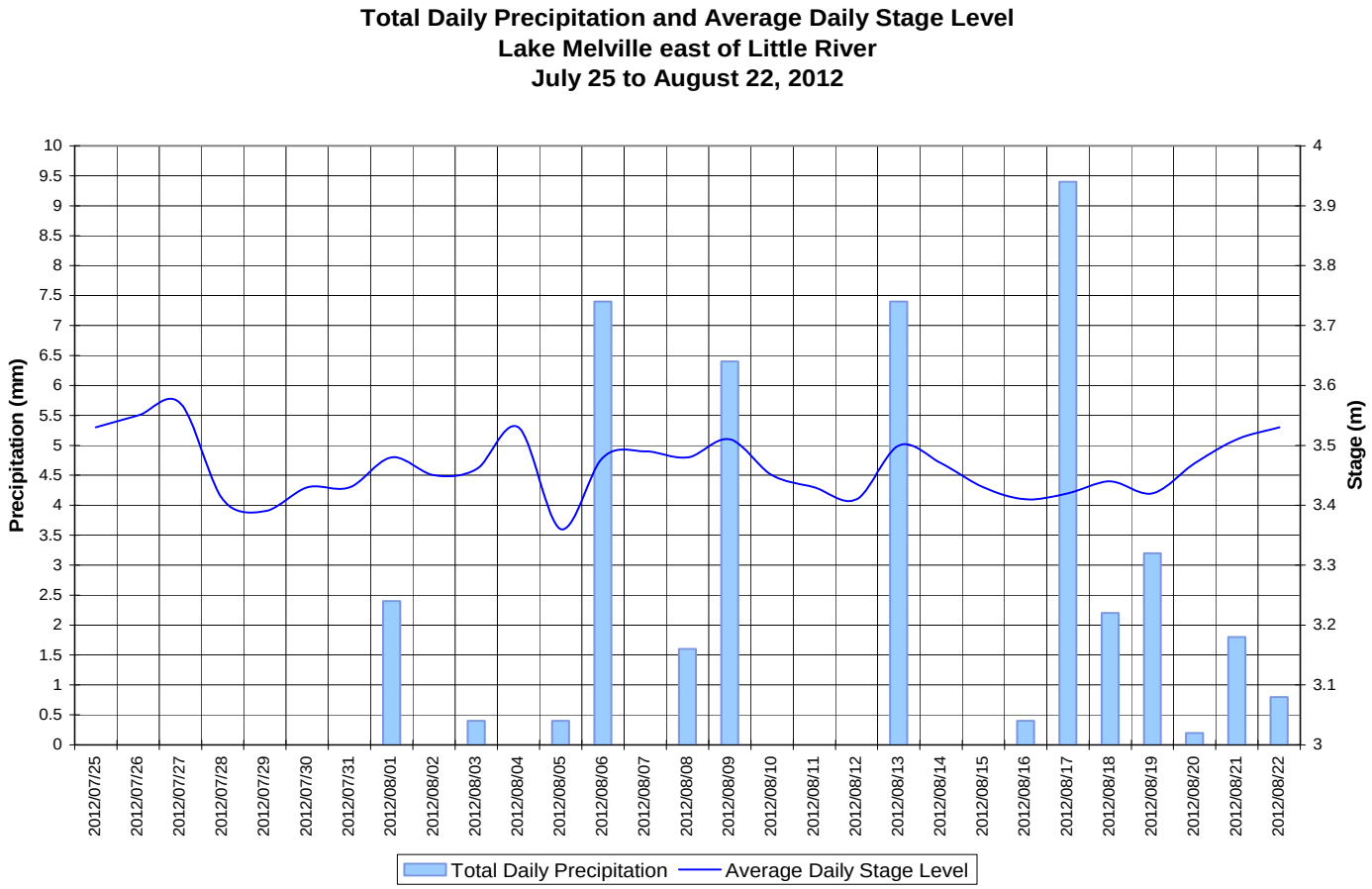

Figure 12: Stage and precipitation at Lake Melville east of Little River

Conclusions

- Water quality monitoring instruments at the stations on the Lower Churchill River at English Point and Lake Melville east of Little River were deployed on July 25 and removed on August 22, a period of 28 days.
- 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, water temperature was found to be closely related to air temperature, increasing slightly in the beginning of the deployment period and decreasing slightly in the latter half. Dissolved oxygen content showed a typical inverse relationship to water temperature. pH values were generally stable. Specific conductivity and stage were generally stable and typical for historical station values. Turbidity generally remained below 65NTU but increase a few times above this level however, showed no corresponding weather event to propose an explanation.
- At Lake Melville east of Little River, water temperature also increased slightly in the beginning of the deployment period and decreased slightly in the latter half. pH values were generally stable with some irregularity in pattern following a rainfall event on August 6. Specific conductivity was lower in the first half of the deployment period before a significant increase on August 7 following a rainfall event. Specific conductivity remained high for the rest of the deployment period. The dissolved oxygen and turbidity sensors on the field instrument both failed to collect accurate reliable data. The instrument has since been sent for repair. Inaccurate data has been removed from the data set.
- All values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH (>6.5 and <9.0). For dissolved oxygen at English Point, all values recorded were above the minimum CCME Guideline for the Protection of Aquatic Life in Freshwater Environments at Other Life Stages (6.5mg/l) and most values were above the minimum CCME Guideline for the Protection of Aquatic Life in Freshwater Environments at Early Life Stages (9.5mg/l).

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Appendix 1 – Weather Data, Environment Canada Historical Climate Database

Average Daily Air Temperature and Total Daily Precipitation
Happy Valley-Goose Bay
July 25 to August 22, 2012