Real-Time Water Quality Deployment Report

Lower Churchill River Network

August 8 to
September 14, 2013

Newfoundland Labrador

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

Contents

Real Time Water Quality Monitoring 1

Quality Assurance and Quality Control 1

Data Interpretation 4

- **Churchill River below Metchin River** 4
- **Churchill River below Grizzle Rapids** 11
- **Churchill River above Muskrat Falls** 18
- **Churchill River below Muskrat Falls** 26
- **Churchill River at English Point** 35

Conclusions 39

Appendix 1 – Weather Data – Environment Canada Historical Weather and Climate Database 40

Prepared by:
Grace de Beer – Environmental Scientist
Department of Environment and Conservation
Water Resources Management Division
Phone: 709.896.5542
Fax: 709.896.9566

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Real Time Water Quality Monitoring

- Department of Environment and Conservation staff monitors the real-time web pages regularly.
- This deployment report discusses water quality related events occurring at five stations on the Lower Churchill River: below Metchin River, below Grizzle Rapids, above and below Muskrat Falls and at English Point.
- There was no instrument deployed at the station on Lake Melville east of Little River. Instrument deployments at this station have been suspended for 2013 because of deployment issues in both 2011 and 2012 that caused significant damage to the instrument.
- On August 8, 9, and 13, 2013, real-time water quality monitoring instruments were deployed at the five Lower Churchill River Stations for periods of 30-37 days. Instruments were removed on September 12, and 14, 2013.

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 Instrument is temporarily deployed along side the Field Instrument. 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 Instrument and QAQC Instrument 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 (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 > 35µS/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 instrument 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 instrument the entire instrument 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 Lower Churchill River stations deployed from August 8, 9, & 13 to September 12 & 14 are summarized in Table 2.

Table 2: Comparison rankings for Lower Churchill River stations, August 8, 9, & 13 to September 10 & 11, 2013

Churchill River Station and Instrument Number	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Below Metchin River (45707)	Aug 8, 2013	Deployment	Good	Good	Excellent	Excellent	Excellent
	Sep 14, 2013	Removal	Good	Excellent	Excellent	Excellent	Excellent
Below Grizzle Rapids (45699)	Aug 8, 2013	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Sep 14, 2013	Removal	Excellent	n/a*	Excellent	Excellent	Excellent
Above Muskrat Falls (47590)	Aug 8, 2013	Deployment	Excellent	Good	Excellent	n/a†	n/a†
	Sep 12, 2013	Removal	Excellent	Good	Excellent	Excellent	n/a‡
Below Muskrat Falls (45700)	Aug 9, 2013	Deployment	Good	Excellent	Excellent	n/a†	n/a†
	Sep 12, 2013	Removal	Good	Excellent	Excellent	Excellent	Good
At English Point (45042)	Aug 13, 2013	Deployment	Good	Fair	Excellent	n/a†	n/a†
	Sep 12, 2013	Removal	Good	Excellent	Excellent	Excellent	Excellent

*Comparison ranking unavailable due to pH sensor malfunction on QAQC instrument 47592 on September 14, 2013.

†Comparison ranking unavailable due to dissolved oxygen sensor malfunction on QAQC instrument 47592 on August 8-9-13, 2013.

‡ Comparison ranking unavailable due to turbidity sensor error on field instrument 45042 on September 12, 2013.

- At the station below Metchin River, all parameters ranked 'good' or 'excellent' at deployment and removal.
- At the station below Grizzle Rapids, all parameters ranked either 'good' or 'excellent' at deployment.

  At removal, temperature, specific conductivity, dissolved oxygen and turbidity all ranked 'excellent'. pH was not ranked due to sensor failure on the QAQC instrument.

- At the station above Muskrat Falls, temperature, pH, and specific conductivity rank either 'good' or 'excellent' at deployment. Dissolved oxygen and turbidity are not ranked due to sensor malfunction.

  At removal, temperature, pH, specific conductivity and dissolved oxygen rank either 'good' or 'excellent'. Turbidity is not ranked due to sensor malfunction.

- At the station below Muskrat Falls, temperature, pH, and specific conductivity rank either 'good' or 'excellent' at deployment. Dissolved oxygen and turbidity are not ranked due to sensor malfunction.

  At removal, all parameters rank either 'good' or 'excellent'.

- At the station at English Point, temperature, and specific conductivity rank 'good' and 'excellent' at deployment while pH ranks 'fair'. For pH, the field instrument read a value of 6.86 and the QAQC instrument read a value of 7.39, a difference of 0.53. The discrepancy in the values may in part be due to the time the field instrument has to stabilize to the environment. At the time of the first transmission at 10:30am the field instrument read a value of 7.23 which when compared to the QAQC instrument value of 7.39 yields an 'excellent' ranking. Dissolved oxygen and turbidity are not ranked due to sensor malfunction.

  At removal, all parameters rank either 'good' or 'excellent'.

Data Interpretation

- The following graphs and discussion illustrate water quality related events occurring between August 8 and September 14 in the Lower Churchill River Network.
- 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 below Metchin River

- Water temperature ranges from 9.90°C to 17.90°C during the deployment period (Figure 1).
- Water temperature is decreasing throughout this part of the deployment period. This trend is expected due to the cooling air temperatures late in the summer season (Figure 2). Water temperature fluctuates diurnally.

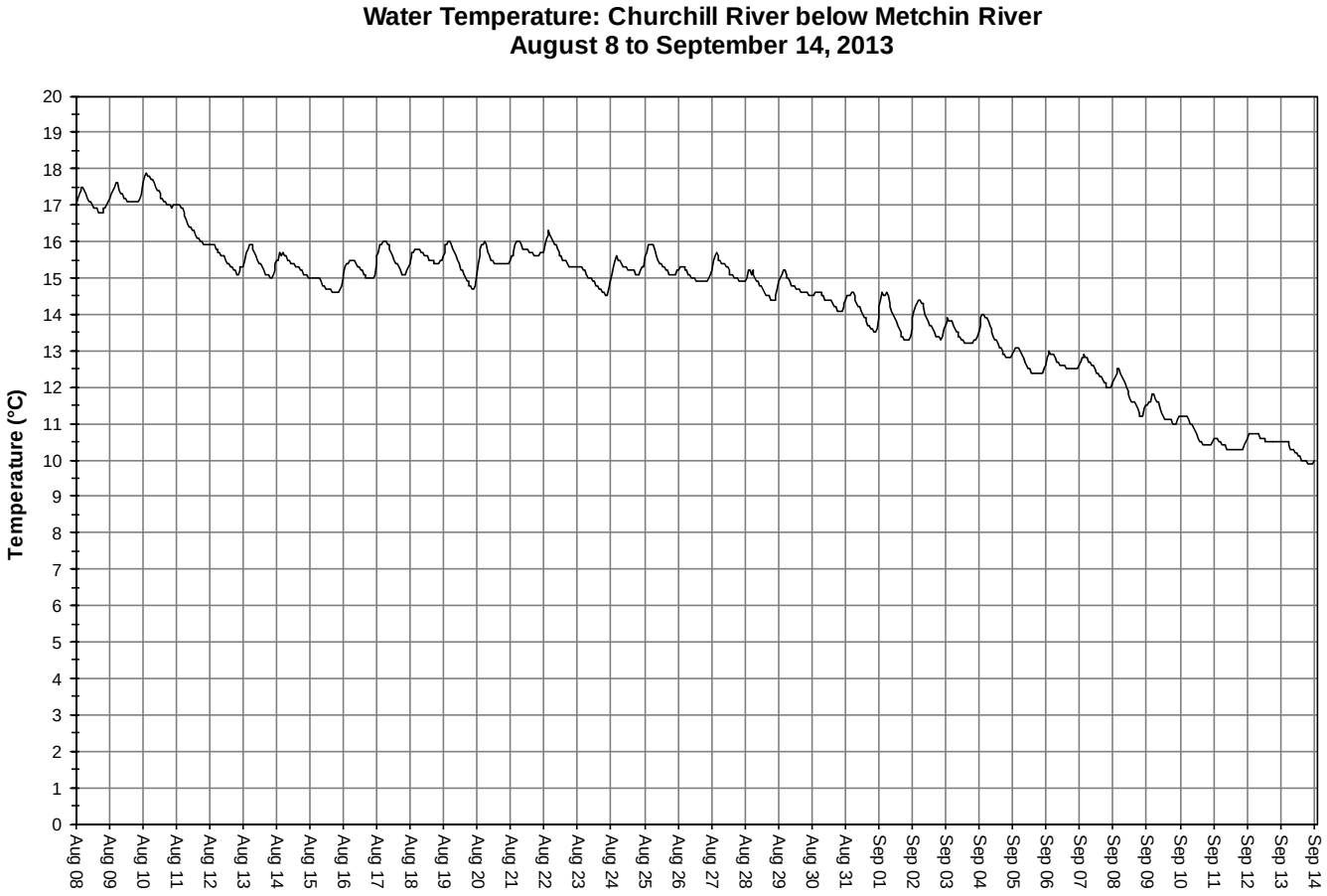


Figure 1: Water temperature at Churchill River below Metchin River

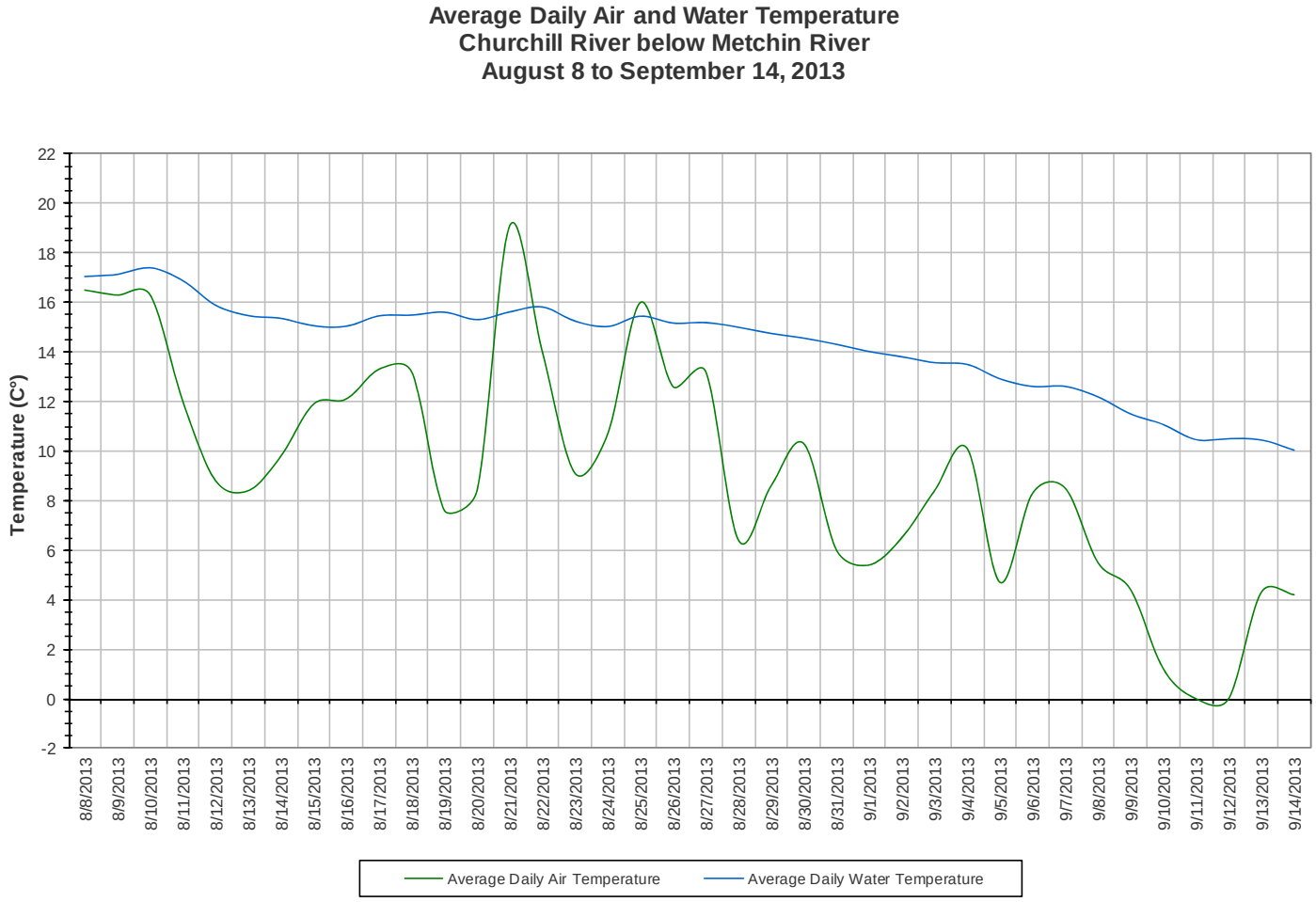


Figure 2: Average daily air and water temperature at Churchill River below Metchin River (weather data recorded at Churchill Falls, NL)

- pH ranges between 7.13 and 7.27 pH units and is very stable throughout the deployment period regardless of the changing stage levels (Figure 3). pH values fluctuate slightly on a daily basis.
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 3).

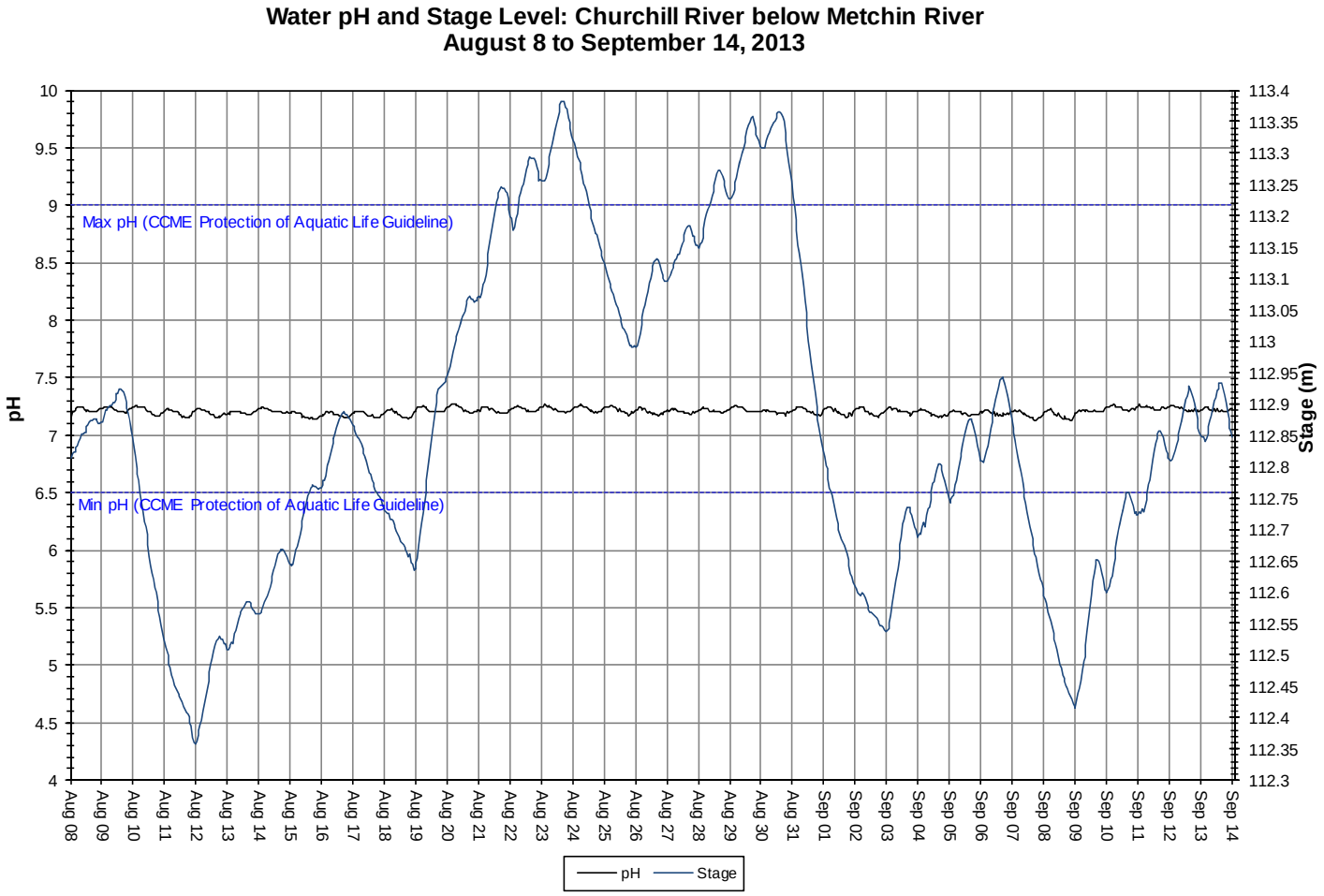


Figure 3: pH and stage level at Churchill River below Metchin River

- Specific conductivity ranges between 20.7µS/cm to 23.1µS/cm during the deployment period, averaging 21.6µS/cm (Figure 4).
- Stage is included in Figure 4 to illustrate the inverse relationship between conductivity and water level. Stage is fluctuating significantly throughout the deployment period. Generally, as stage levels decrease, specific conductivity generally increases due to the increasing concentration of dissolved solids in the water column. Inversely, when stage increases, specific conductivity usually decreases as the concentration of dissolved solids is diluted. This trend is not clearly visible in the data collected during the deployment period and that is typical of this station. Specific conductivity is very stable despite changing water levels.

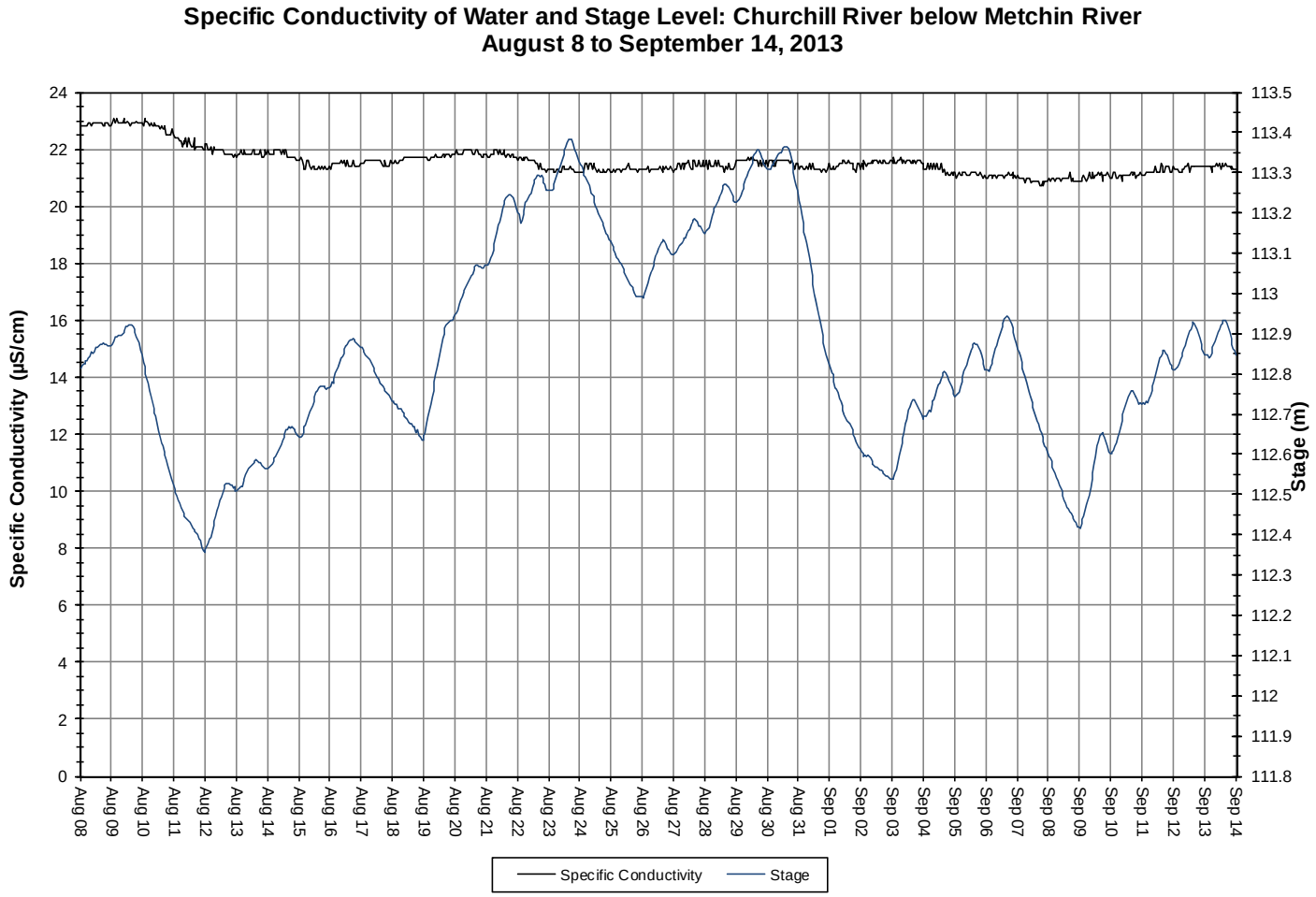


Figure 4: Specific conductivity and stage level at Churchill River below Metchin River

- Dissolved oxygen content ranges between 8.8mg/l and 10.36mg/l. The saturation of dissolved oxygen ranges from 90.3% to 96.8% (Figure 5).
- All values were above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l. For the first three weeks of the deployment period, dissolved oxygen values are just below the minimum CCME Guideline for the Protection of Cold Water Biota at Early Life Stages of 9.5mg/l. In the beginning of September, values increase to above 9.5mg/l. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content is increasing throughout the deployment period. This trend is expected given the cooling air and water temperatures (Figure 2).

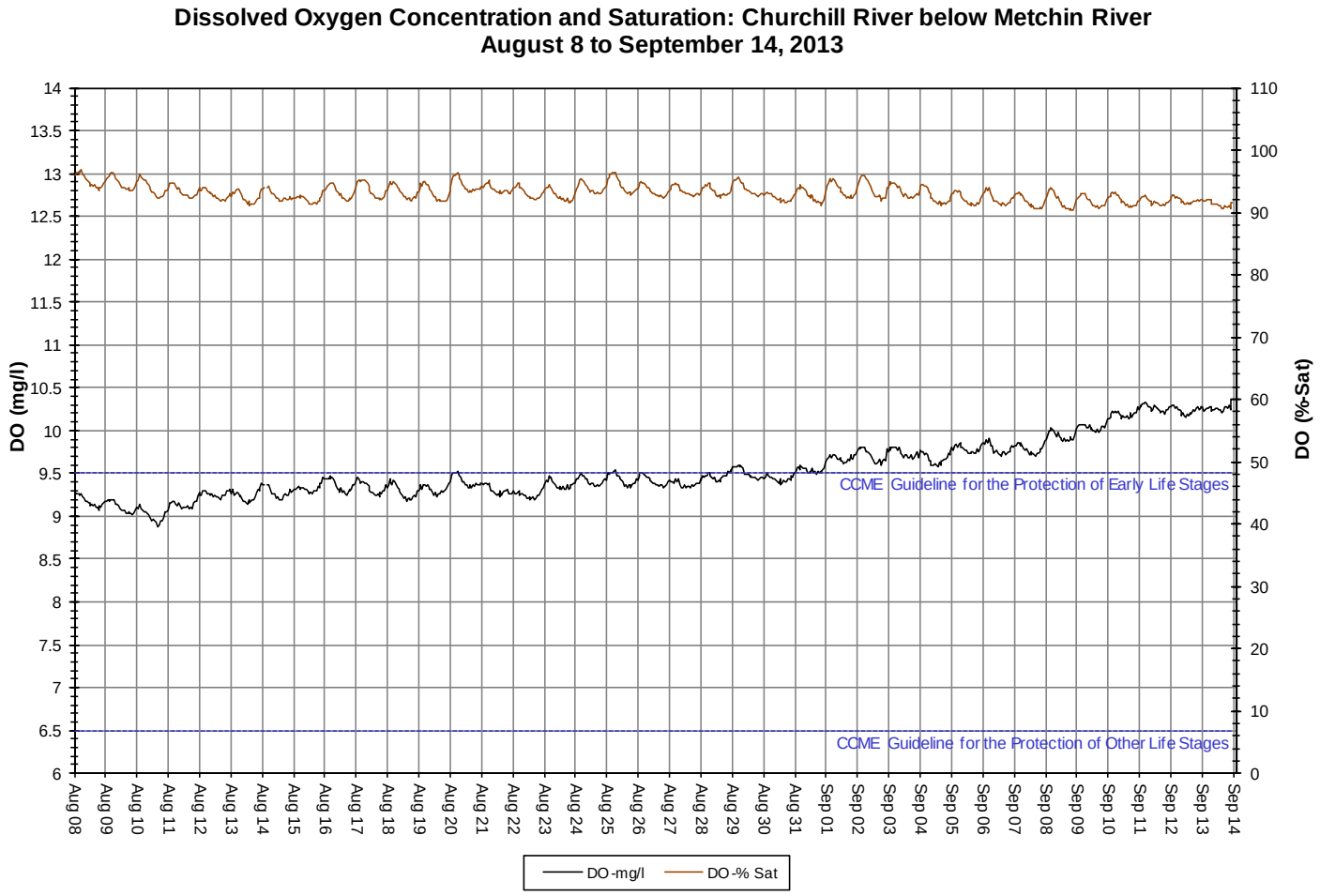


Figure 5: Dissolved oxygen and percent saturation at Churchill River below Metchin River

- Turbidity generally remains at 0NTU for the majority of the deployment period (Figure 6). A median value of 0NTU indicates there is no natural background turbidity value at this station.
- Turbidity increase to 8NTU for a period of 1 hour on September 3. This increase corresponds with low stage levels. On September 9, turbidity increases up to 1.5NTU for a period of 5 days. This turbidity event is not considered significant and can likely be attributed to silt build up near the sensor.

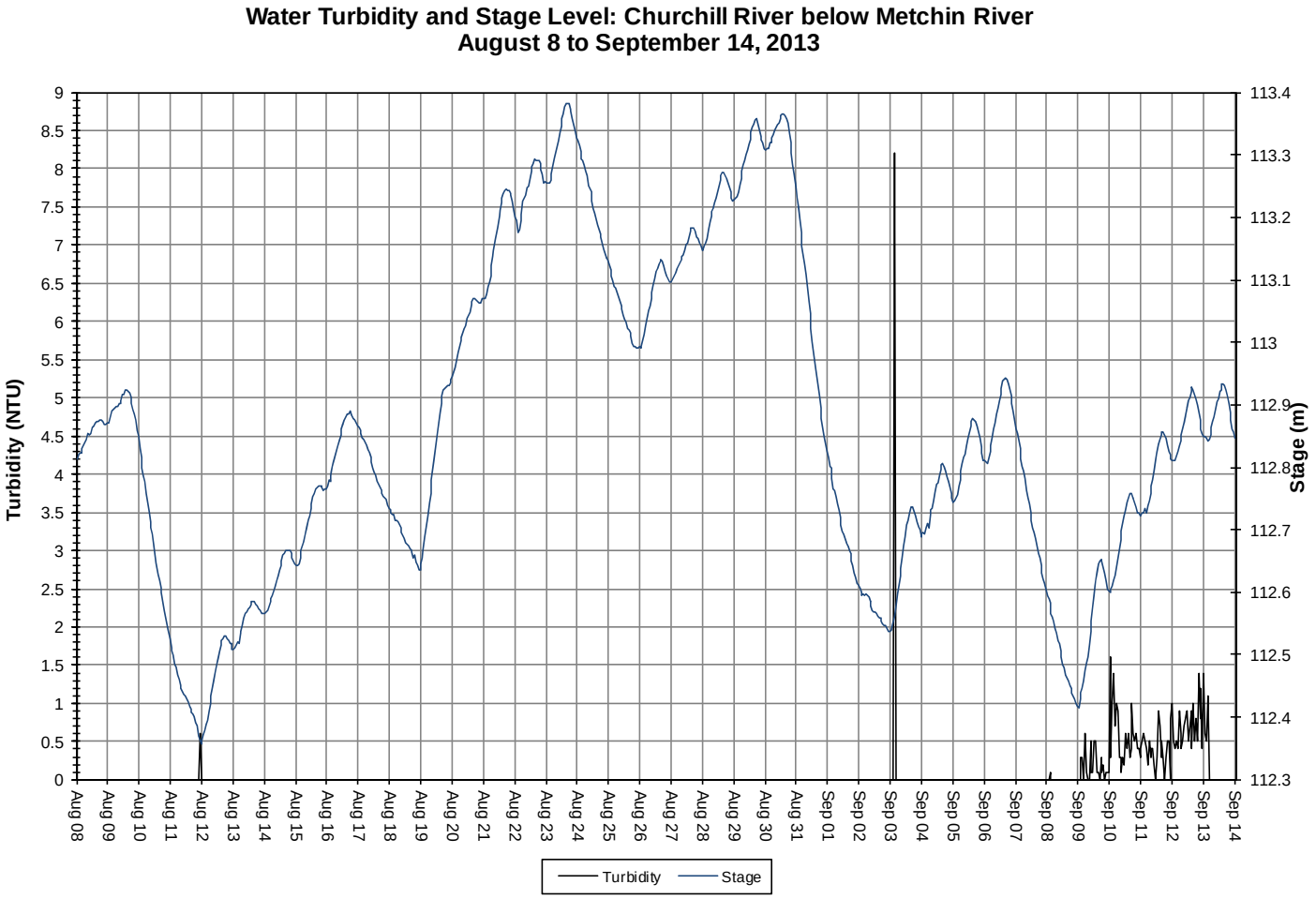


Figure 6: Turbidity and stage level at Churchill River below Metchin River

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 7). Stage is fluctuating throughout the deployment period. Precipitation records are frequent but low in magnitude except for one +40mm event on August 10. Stage ranges between 112.36m and 113.38m, a difference of 1.02m.

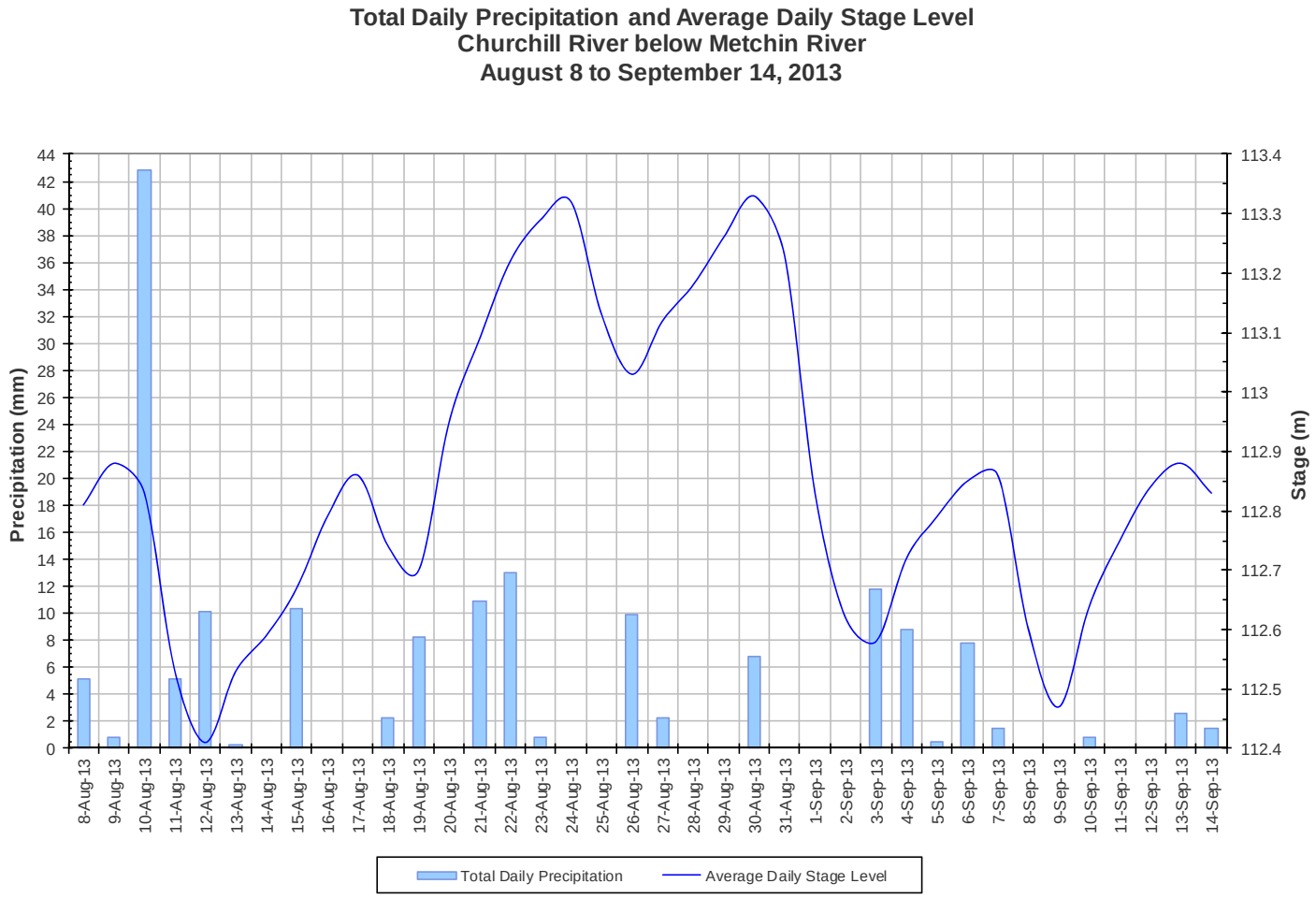


Figure 7: Daily precipitation and average daily stage level at Churchill River below Metchin River (weather data recorded at Churchill Falls)

Churchill River below Grizzle Rapids

- Water temperature ranges from 12.20°C to 18.40°C during the deployment period (Figure 8).
- Water temperature is decreasing throughout the deployment period. This trend is expected due to the cooling ambient air temperatures late in the summer season (Figure 9). Water temperature fluctuates diurnally.

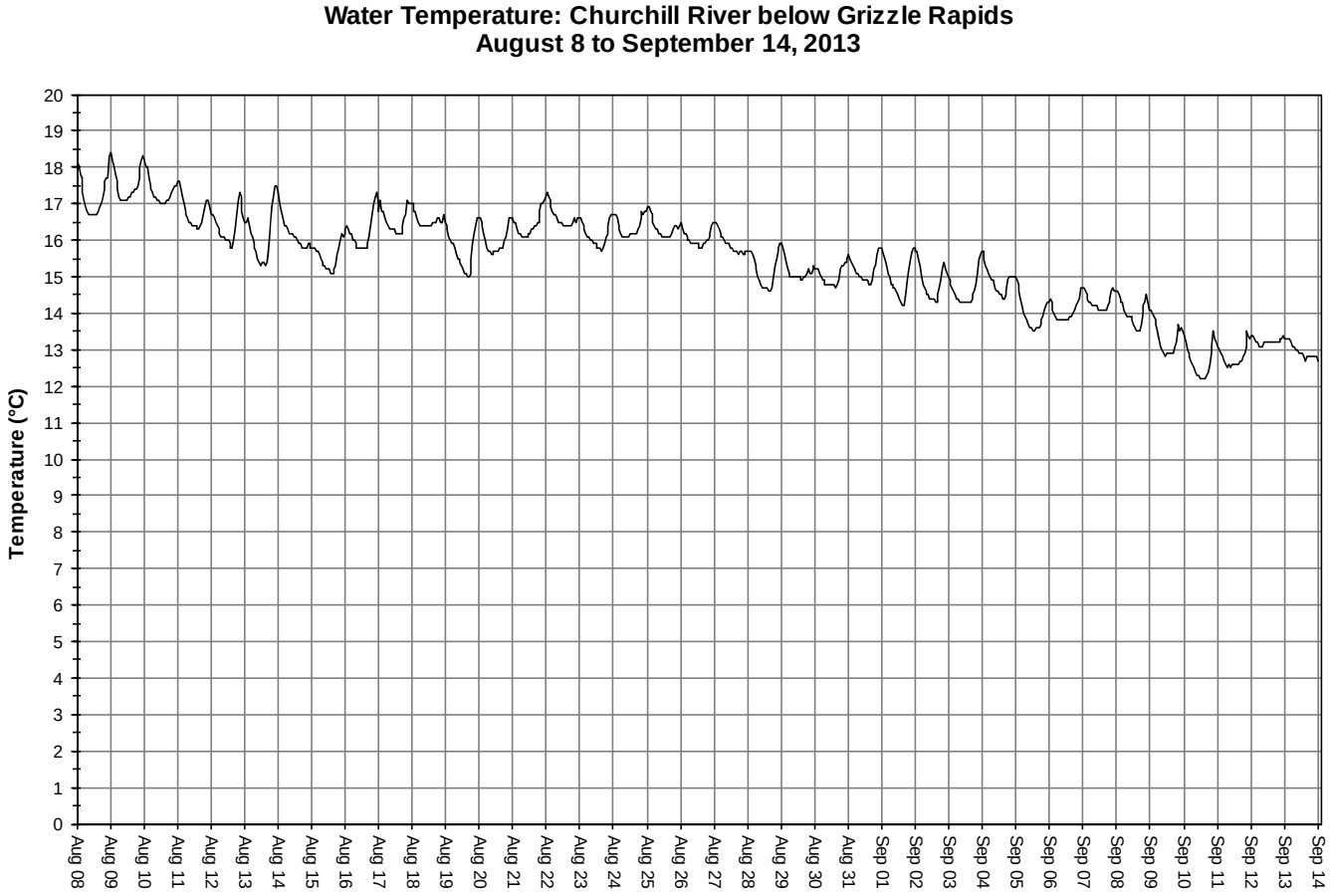


Figure 8: Water temperature at Churchill River below Grizzle Rapids

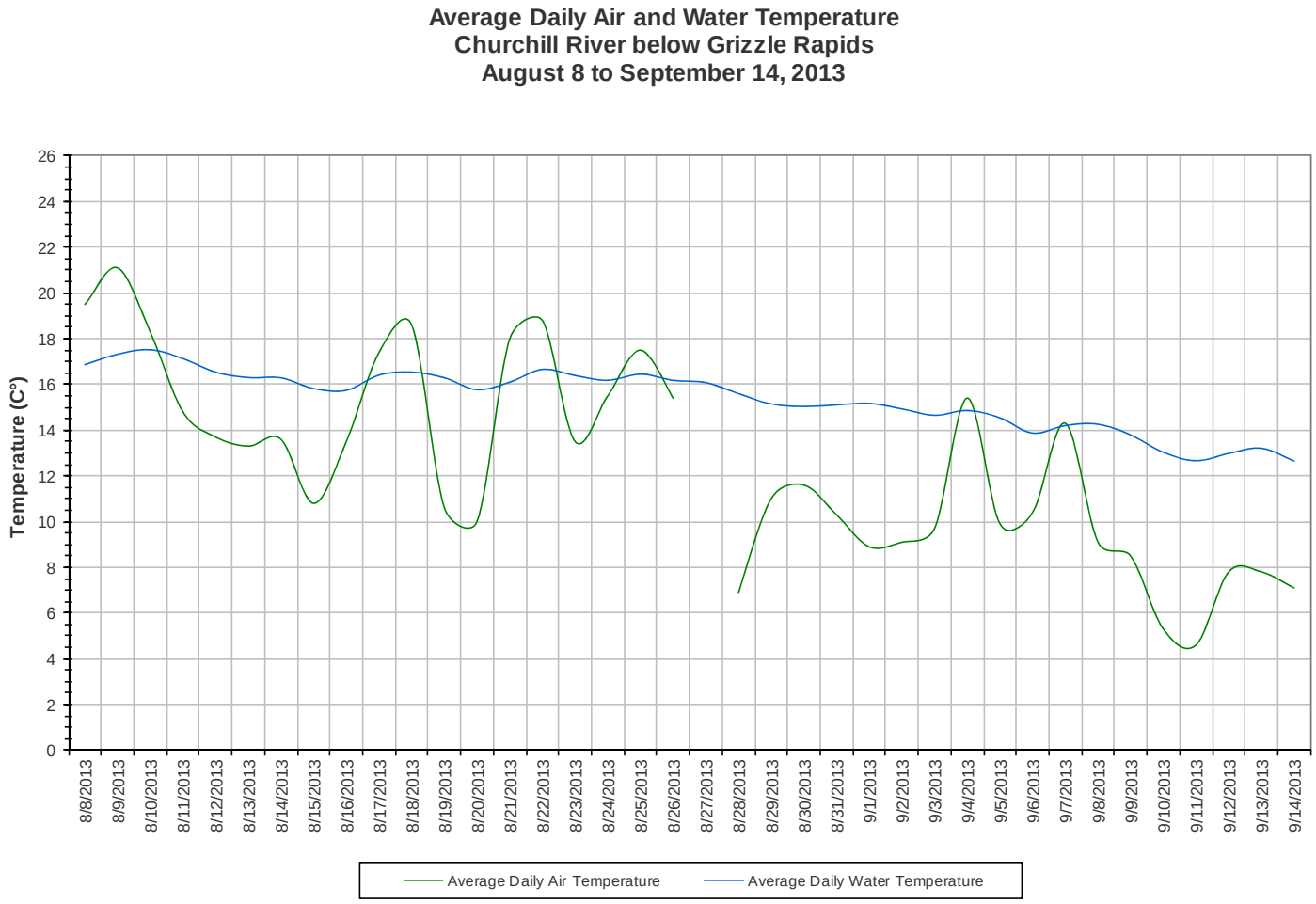


Figure 9: Average daily air and water temperature at Churchill River below Grizzle Rapids

(weather data recorded at Goose Bay)

- pH ranges between 7.10 and 7.39 pH units (Figure 10).
- pH values are very stable throughout the deployment period regardless of changing water levels. pH values fluctuate consistently on a daily basis.
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 10).

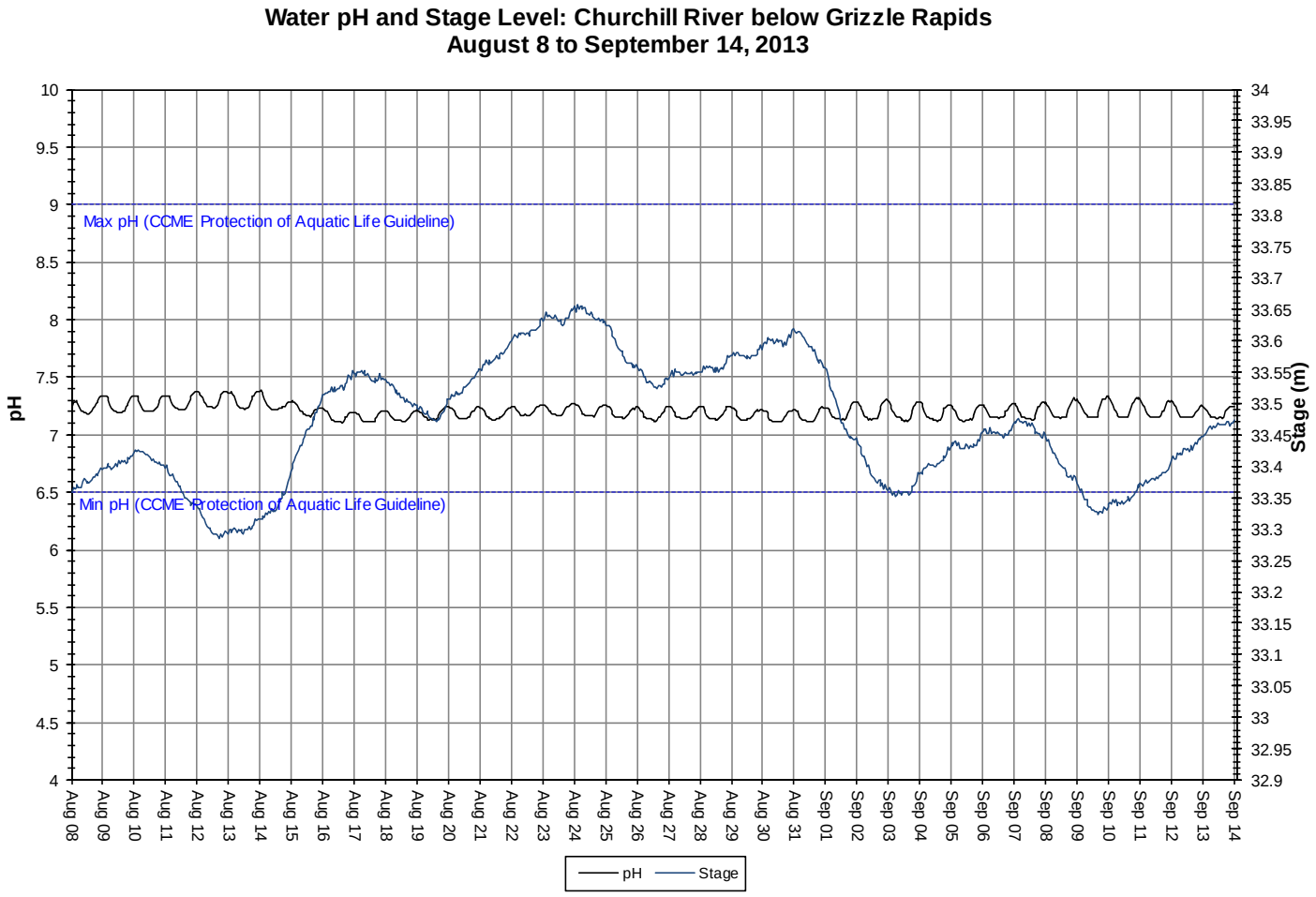


Figure 10: pH and stage level at Churchill River below Grizzle Rapids

- Specific conductivity ranges from 19.7µS/cm to 22.5µS/cm during the deployment period, averaging 20.7µS/cm (Figure 11).
- Specific conductance is decreasing slightly throughout the deployment period. There is one spike in specific conductivity on August 20 lasting 1 hour.
- Stage is included in Figure 11 to illustrate the inverse relationship between conductivity and water level. Typically, stage is increasing throughout the deployment period with minimal fluctuations. Generally, as stage levels increase, specific conductivity decreases due to the dilution of dissolved solids in the water column. Inversely, when stage decreases, specific conductivity usually increases as the concentration of dissolved solids is increased. This trend is not clearly visible in the data collected during the deployment period however, this is typical at this station.

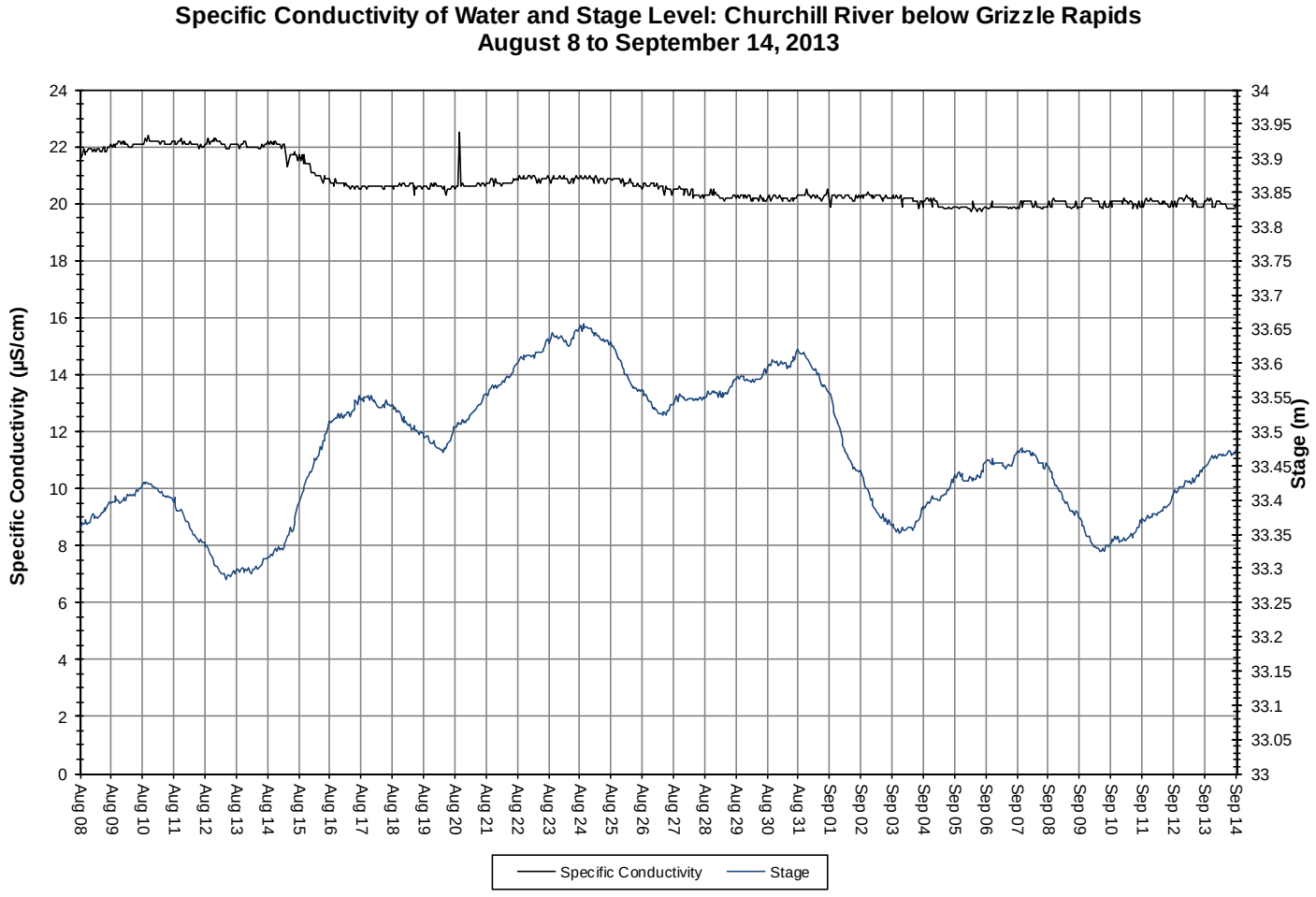


Figure 11: Specific conductivity and stage level at Churchill River below Grizzle Rapids

- Dissolved oxygen content ranges between 9.04mg/l and 10.32mg/l. The saturation of dissolved oxygen ranges from 92.6% to 100.8% (Figure 12).
- All values were above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l. For the first three weeks of the deployment period, dissolved oxygen values are just below the minimum CCME Guideline for the Protection of Cold Water Biota at Early Life Stages of 9.5mg/l. In late August, values increase to above 9.5mg/l. The guidelines are indicated in blue on Figure 9.
- Dissolved oxygen content is increasing throughout the deployment period. This trend is expected given the cooling air and water temperatures (Figure 9).

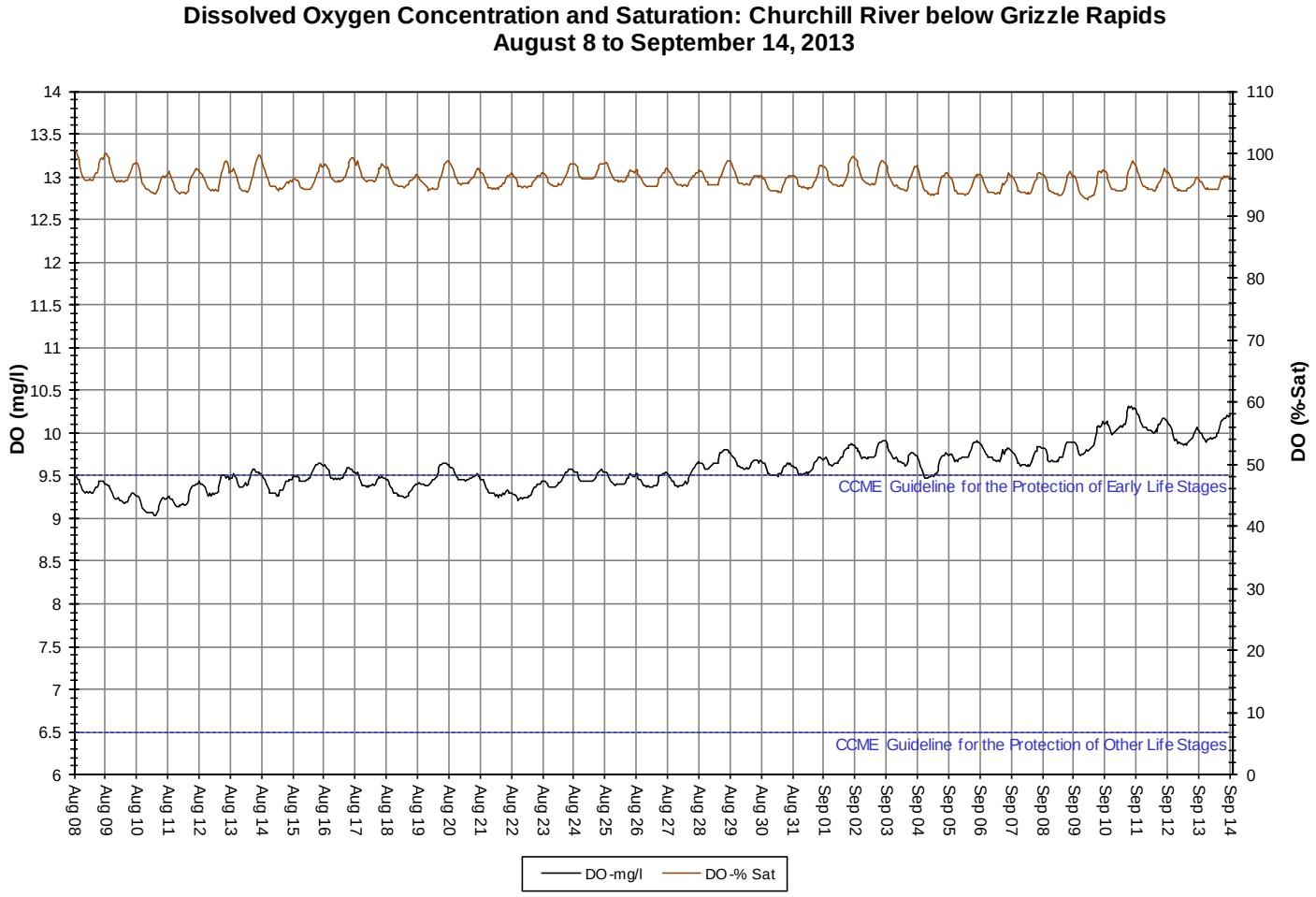


Figure 12: Dissolved oxygen and percent saturation at Churchill River below Grizzle Rapids

- Turbidity values generally remained at 0NTU for the majority of the deployment period (Figure 13). A median value of 0NTU at this station indicates there is no natural background turbidity.
- This trend is typical of this station as the river reach runs clearly and quickly though Grizzle Rapids. There is one instance when turbidity reaches 2.8NTU for a period of one hour.

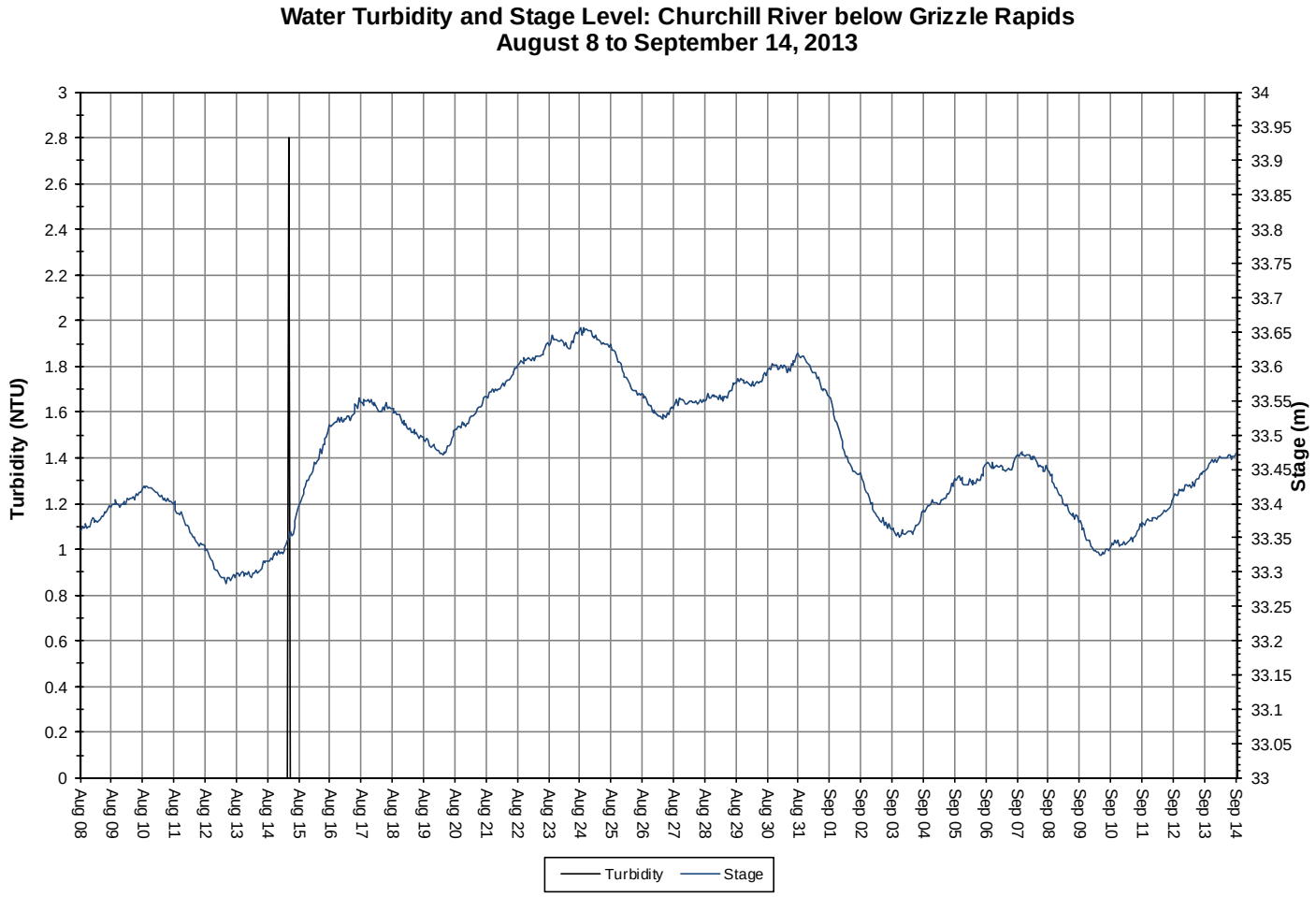


Figure 13: Turbidity and stage level at Churchill River below Grizzle Rapids

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 14). Stage is fluctuating throughout the deployment period. Precipitation events are frequent and range from low to high in magnitude. Stage ranges between 33.28m and 33.66m, a difference of 0.38m.

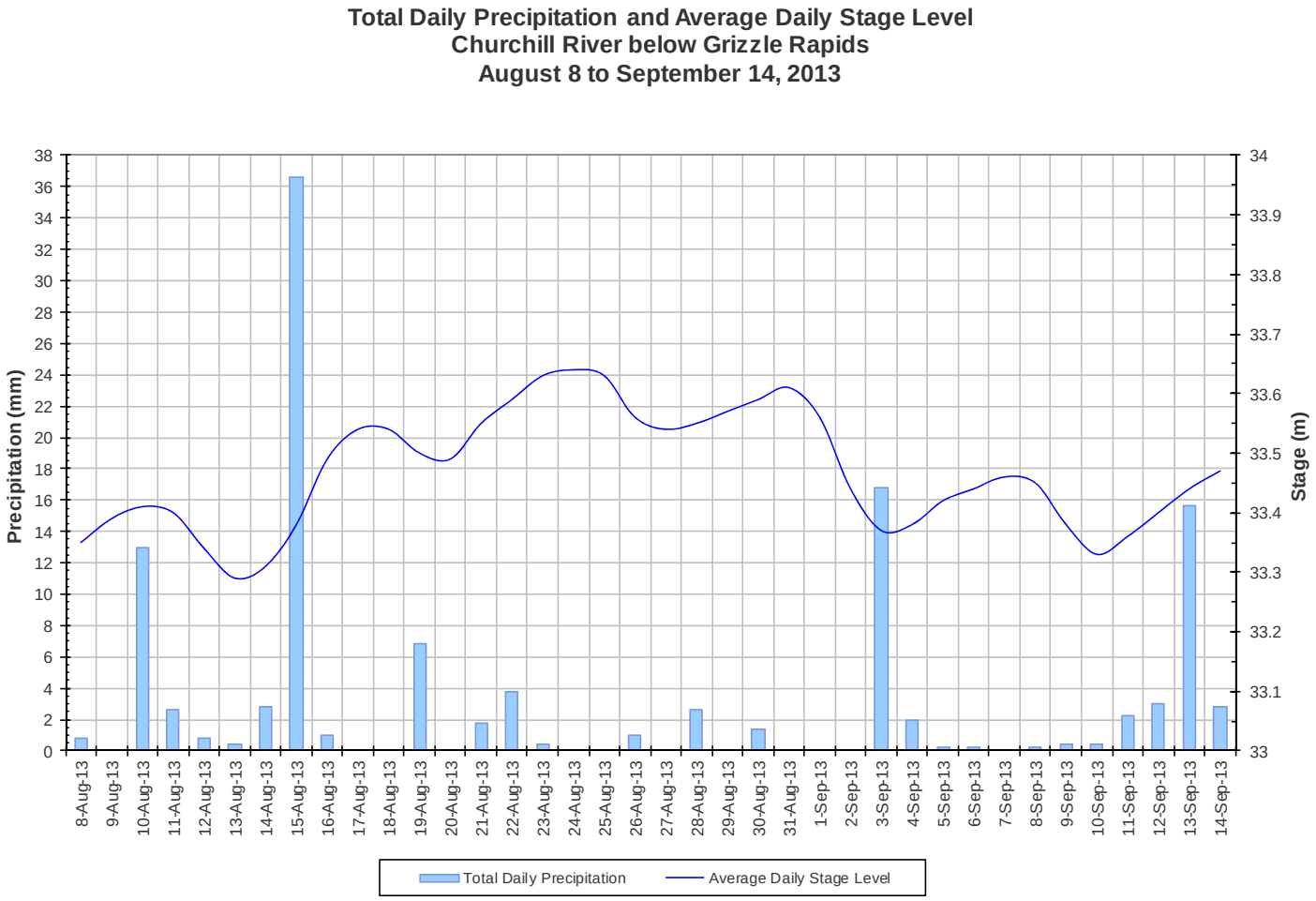


Figure 14: Daily precipitation and average daily stage level at Churchill River below Grizzle Rapids (weather data recorded at Goose Bay)

Churchill River above Muskrat Falls

- Water temperature ranges from 11.78°C to 18.28°C during the deployment period (Figure 15).
- Water temperature is decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures late in the summer season (Figure 16). Water temperature fluctuates diurnally.

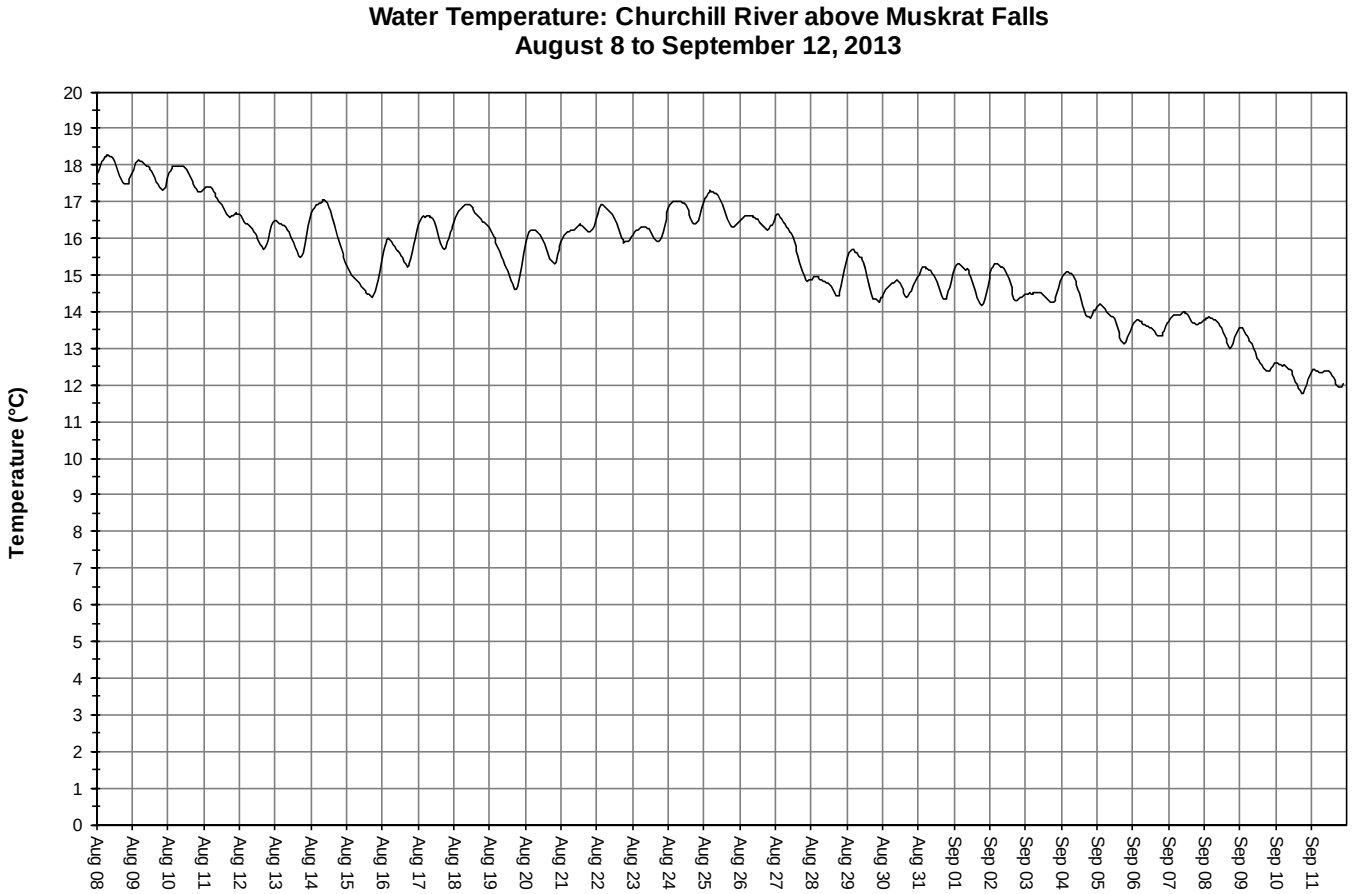


Figure 15: Water temperature at Churchill River above Muskrat Falls

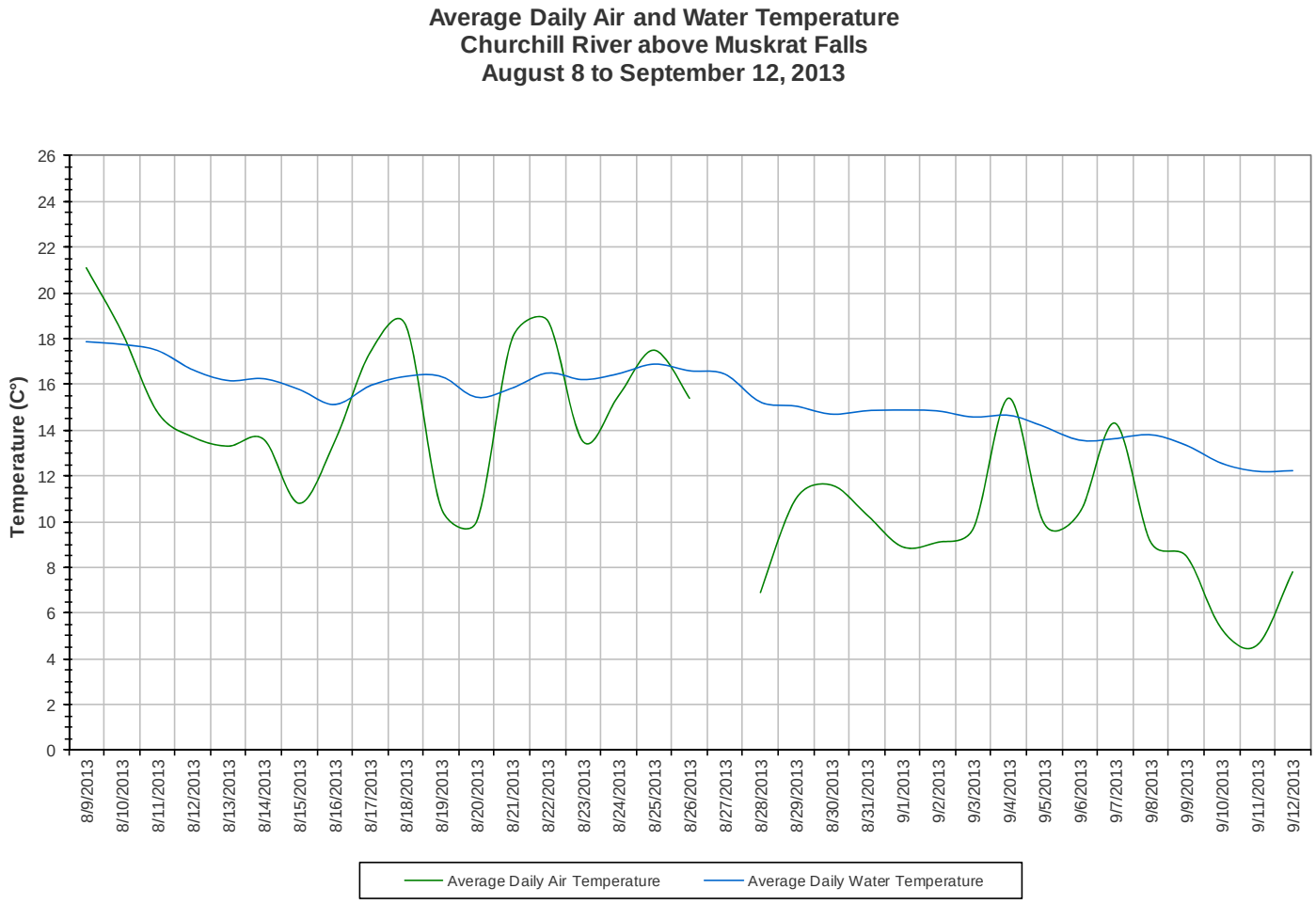


Figure 16: Average daily air and water temperature at Churchill River above Muskrat Falls (weather data recorded at Goose Bay)

- pH ranges between 7.01 and 7.26 pH units (Figure 17). pH values are relatively stable throughout the deployment period.
- There is a slight decrease in pH on August 15 during an increase in stage level. This event is highlighted in red on Figure 17.
- All pH values recorded are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 17).

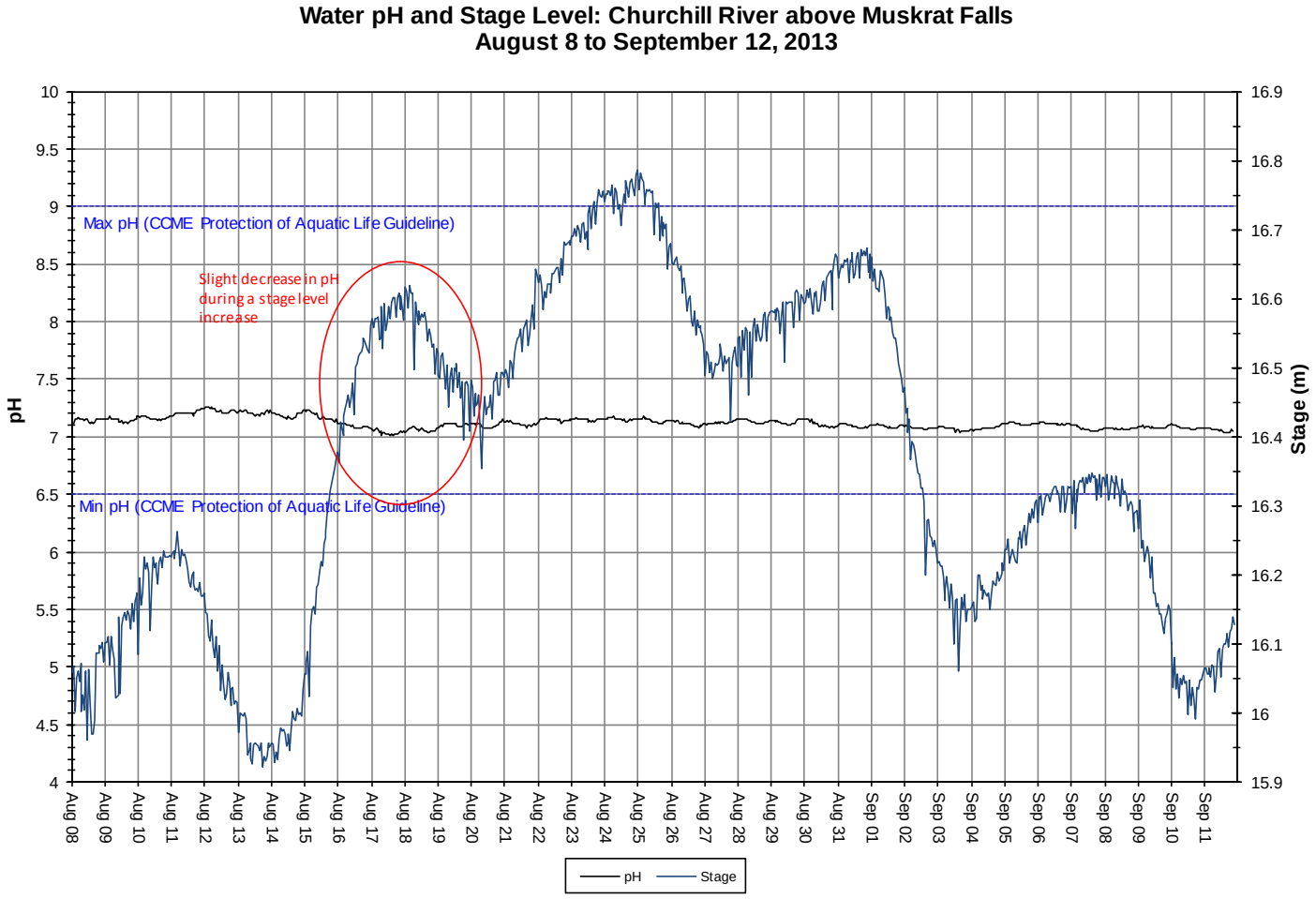


Figure 17: pH and stage at Churchill River above Muskrat Falls

- Specific conductivity ranges from 20.0µS/cm to 23.1µS/cm during the deployment period, averaging 21.3µS/cm. (Figure 18).
- Specific conductance decreases throughout the deployment period.
- Stage is included in Figure 18 to illustrate the inverse relationship between conductivity and water level. Generally, as stage levels increase, specific conductivity decreases due to the dilution of dissolved solids in the water column. Inversely, when stage decreases, specific conductivity usually increases as the concentration of dissolved solids is increased. This trend is not clearly visible in the data collected during the deployment period. There are slight decreases in specific conductivity on Aug 15-16 and September 4-5, both of which correspond with an changes in stage level. These events are highlighted in red on Figure 18.

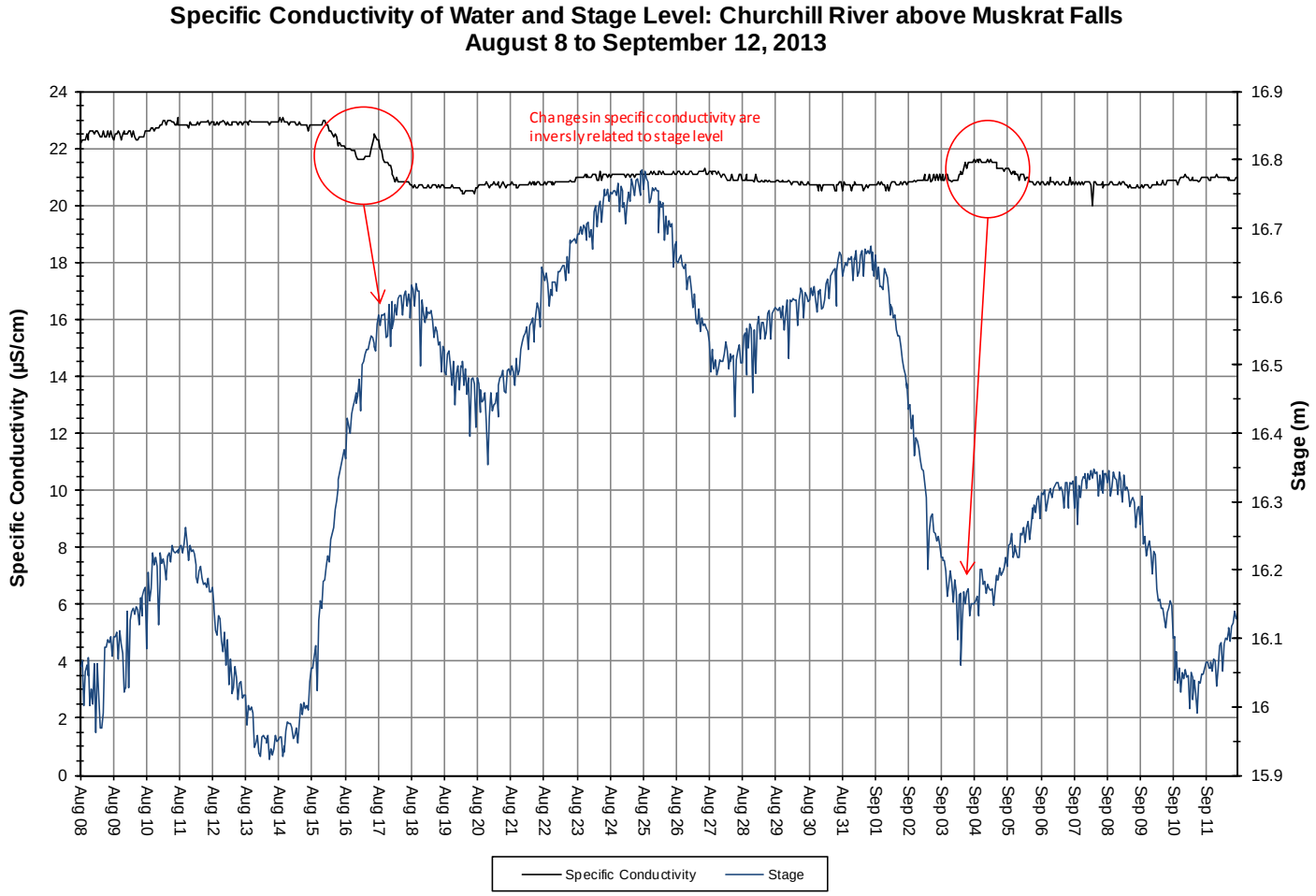


Figure 18: Specific conductivity and stage level at Churchill River above Muskrat Falls

- Dissolved oxygen content ranges between 9.06mg/l and 10.24mg/l. The saturation of dissolved oxygen ranges from 93.0% to 100.1% (Figure 19).
- All values were above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l. From August 8-28, most values were just below the minimum CCME Guideline for the Protection of Cold Water Biota at Early Life Stages of 9.5mg/l. From August 28 to September 12, dissolved oxygen content is just above the minimum guideline suggested by the CCME for Early Life Stages. The guidelines are indicated in blue on Figure 19.
- Dissolved oxygen content is increasing slightly throughout the deployment period. This trend is expected given the cooling air and water temperatures (Figure 16).

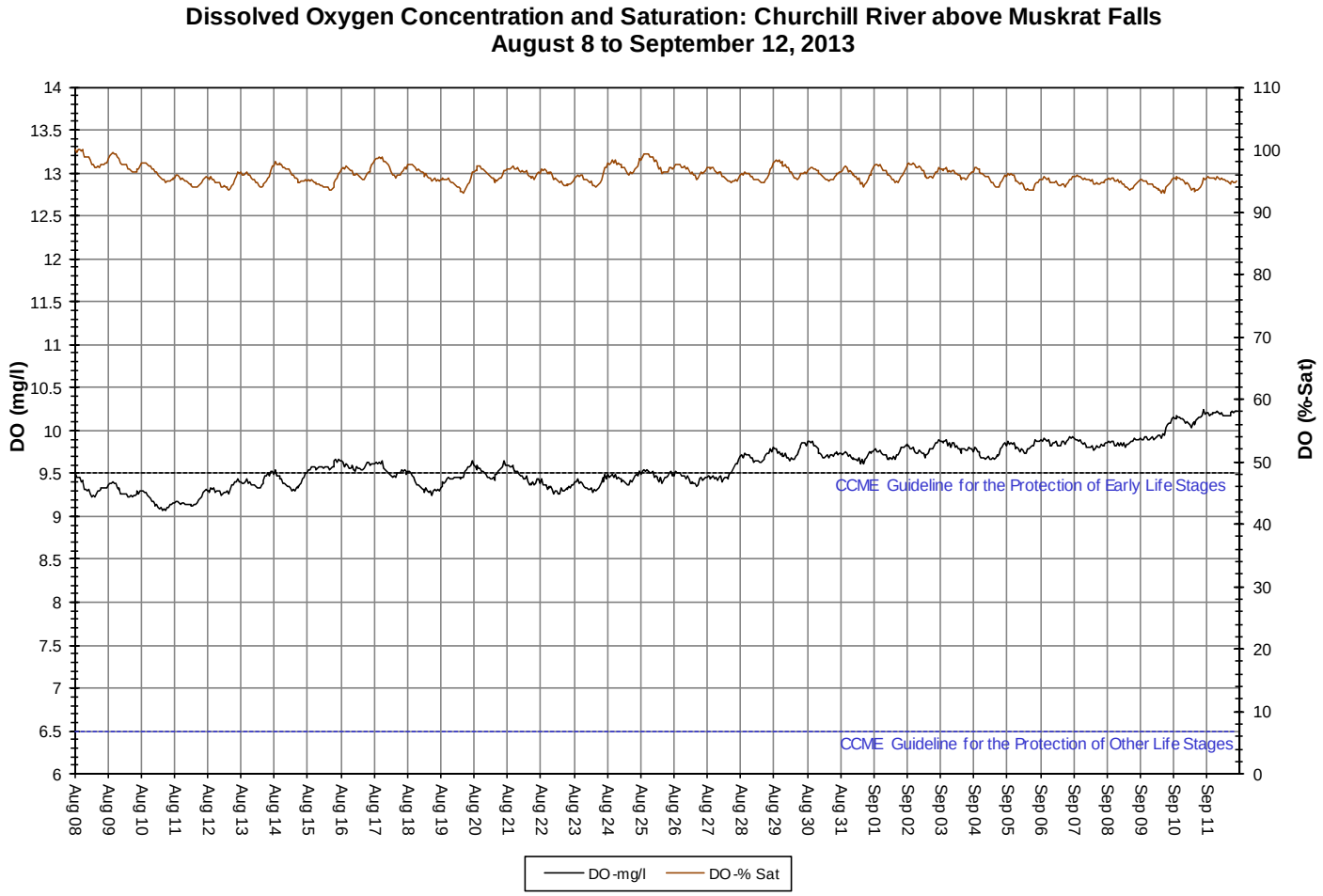


Figure 19: Dissolved oxygen and percent saturation at Churchill River above Muskrat Falls

- Turbidity ranges between 1.3NTU and 6.3NTU, averaging 3.1NTU during the first week of the deployment (Figure 20). A median value of 2.9NTU during the first week of the deployment period indicates there is a consistent natural background turbidity value. This trend is typical at this station.
- Turbidity data collected between August 15 and September 12 is invalid and has been removed from the data set. Values during this time often were reporting an error value of 3000NTU. It is unknown what caused this error.

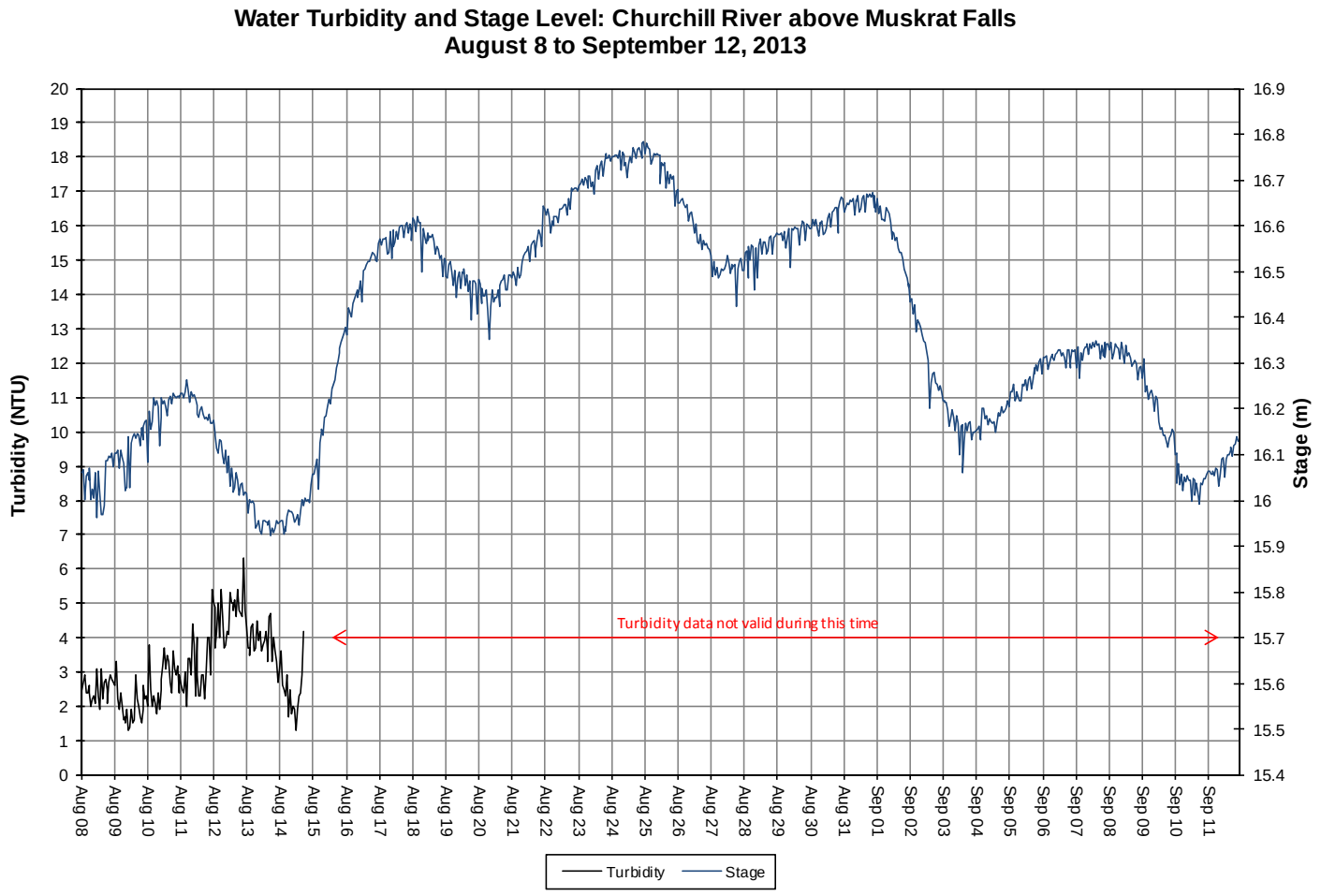


Figure 20: Turbidity and stage level at Churchill River above Muskrat Falls

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 22). Stage is fluctuating throughout the deployment period. Precipitation events are frequent and range from low to high in magnitude. Stage ranges between 15.92m and 16.79m, a difference of 0.87m. Discharge ranges from 1230m^3/s to 1720m^3/s.

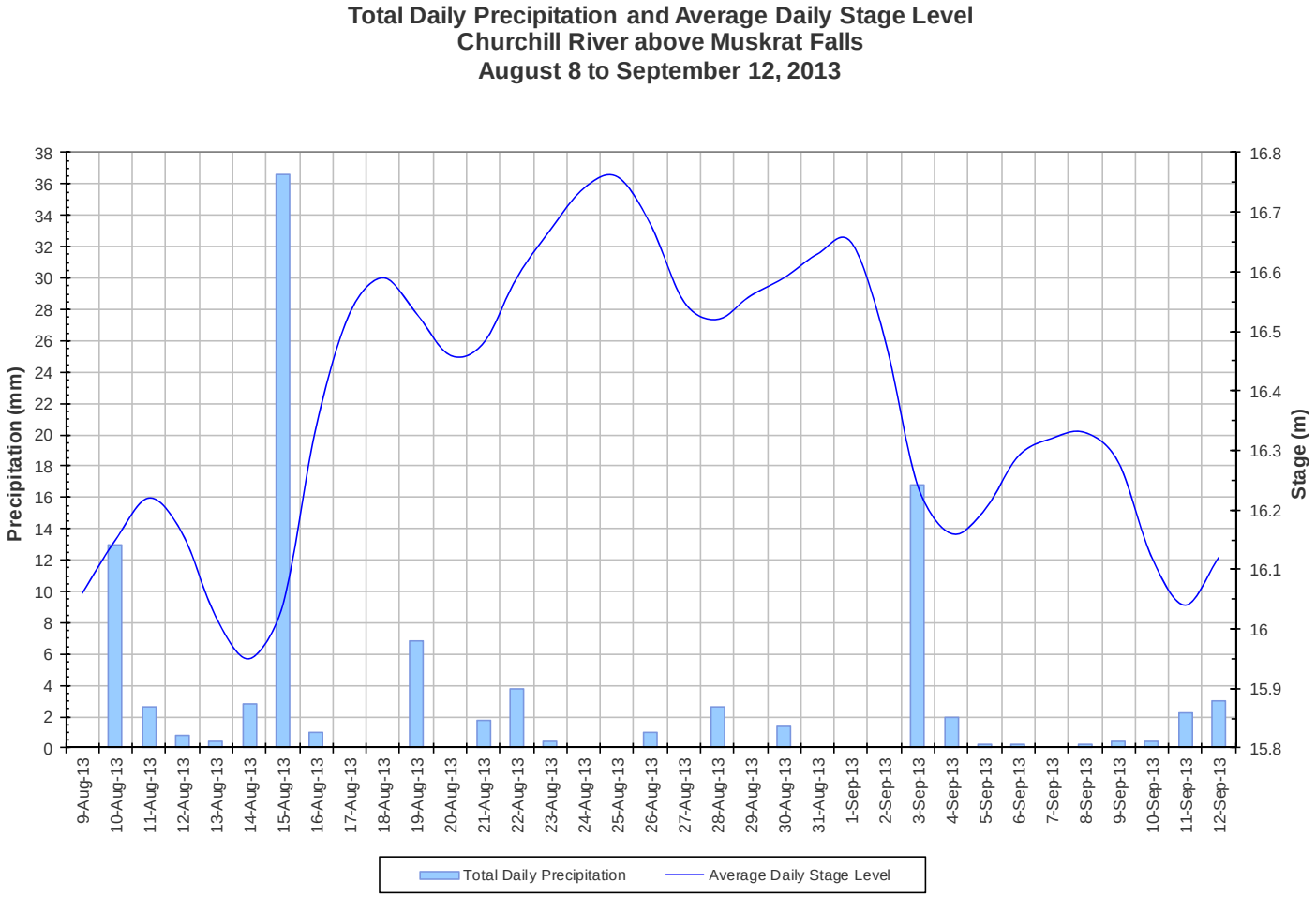


Figure 22: Daily precipitation and average daily stage level at Churchill River above Muskrat Falls (weather data recorded at Goose Bay)

Churchill River below Muskrat Falls

- Water temperature ranges from 12.10°C to 18.00°C during the deployment period (Figure 23).
- Water temperature is decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures late in the summer season (Figure 24). Water temperature fluctuates consistently each 24 hour period.

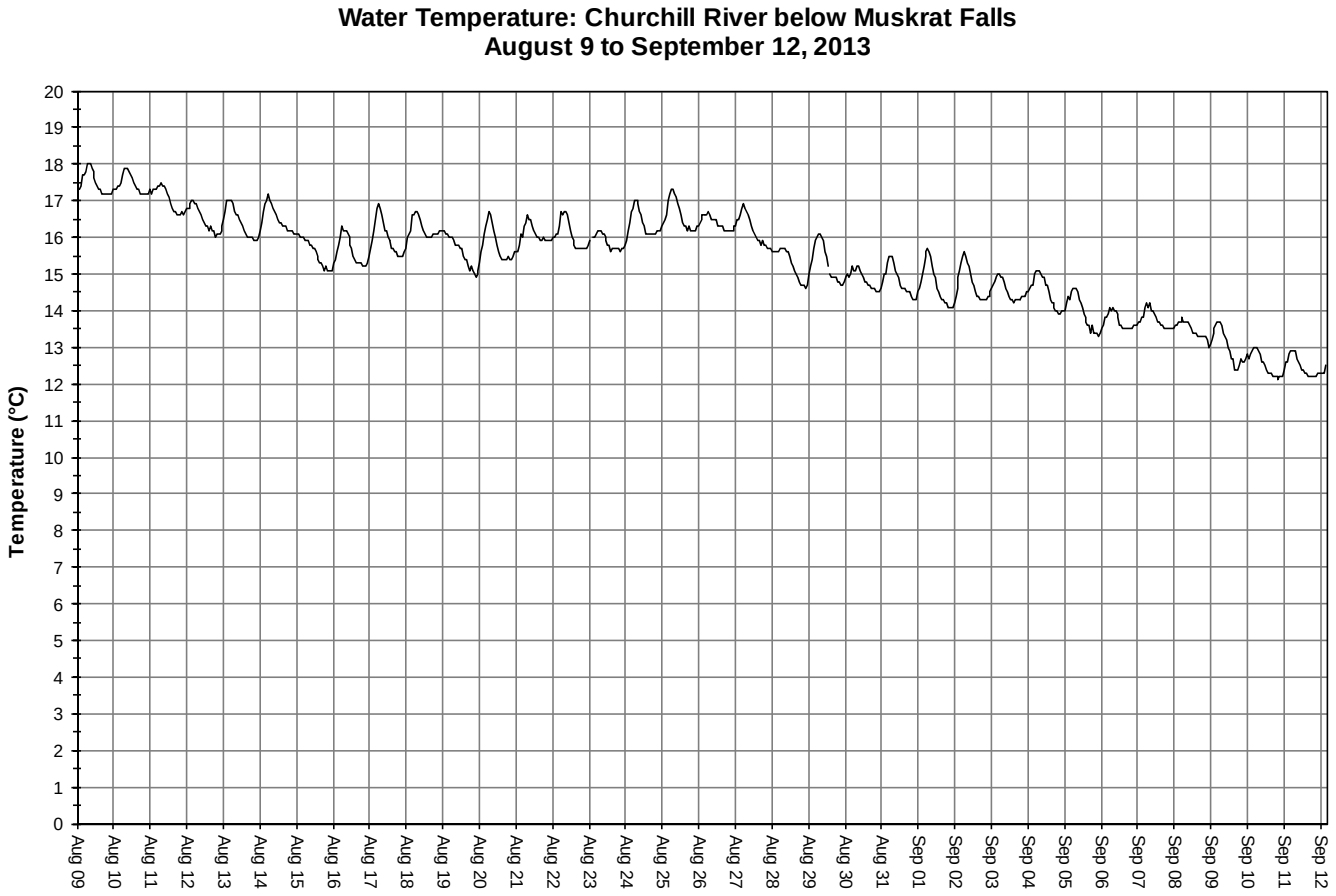


Figure 23: Water temperature at Churchill River below Muskrat Falls

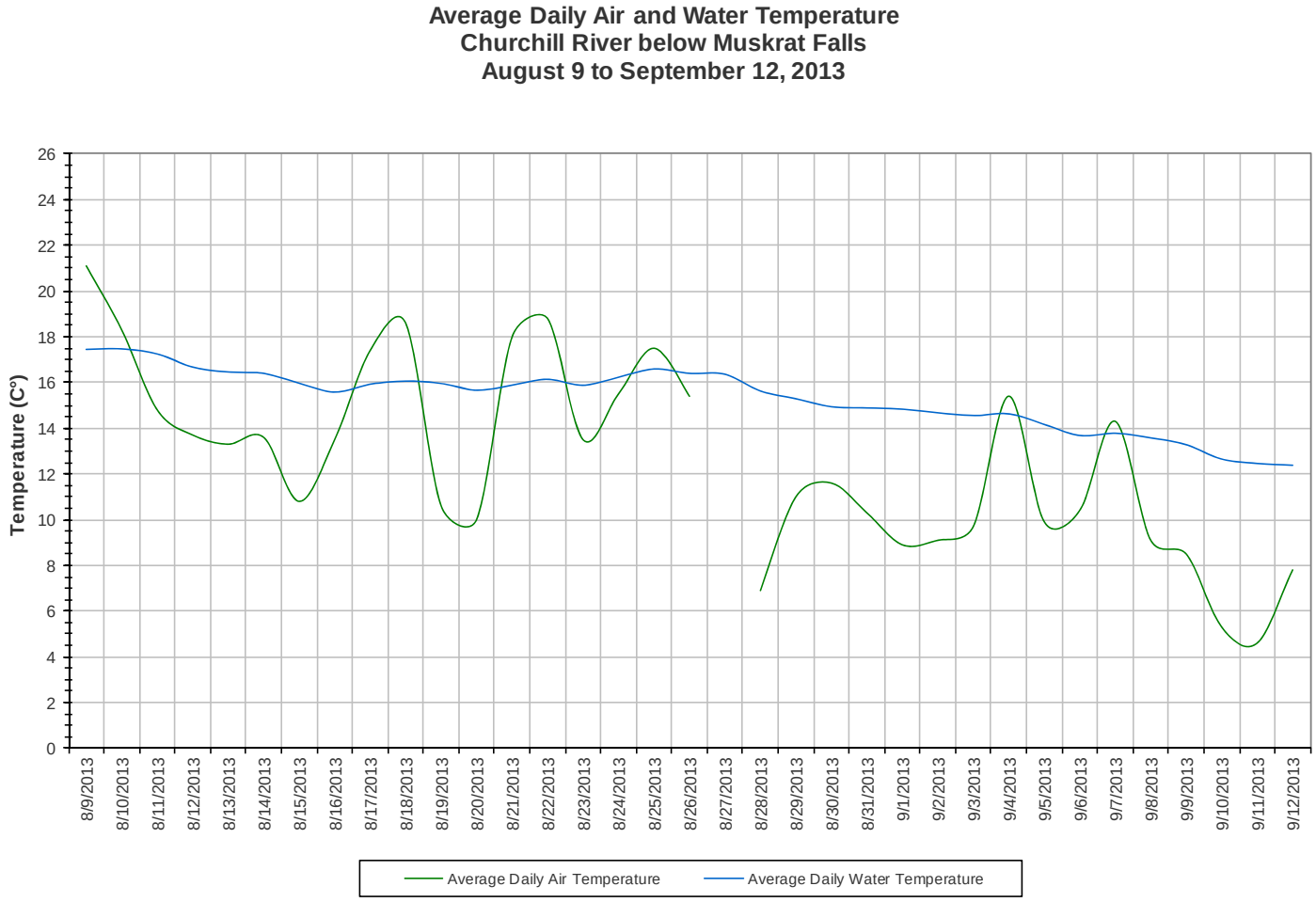


Figure 24: Average daily air and water temperature at Churchill River below Muskrat Falls

(weather data recorded at Goose Bay)

- pH ranges between 7.14 and 7.51 pH units (Figure 25). pH is relatively stable at this station.
- There is a decrease in pH on August 11 which corresponds with a stage increase. This event is highlighted in red on Figure 25.
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 25).

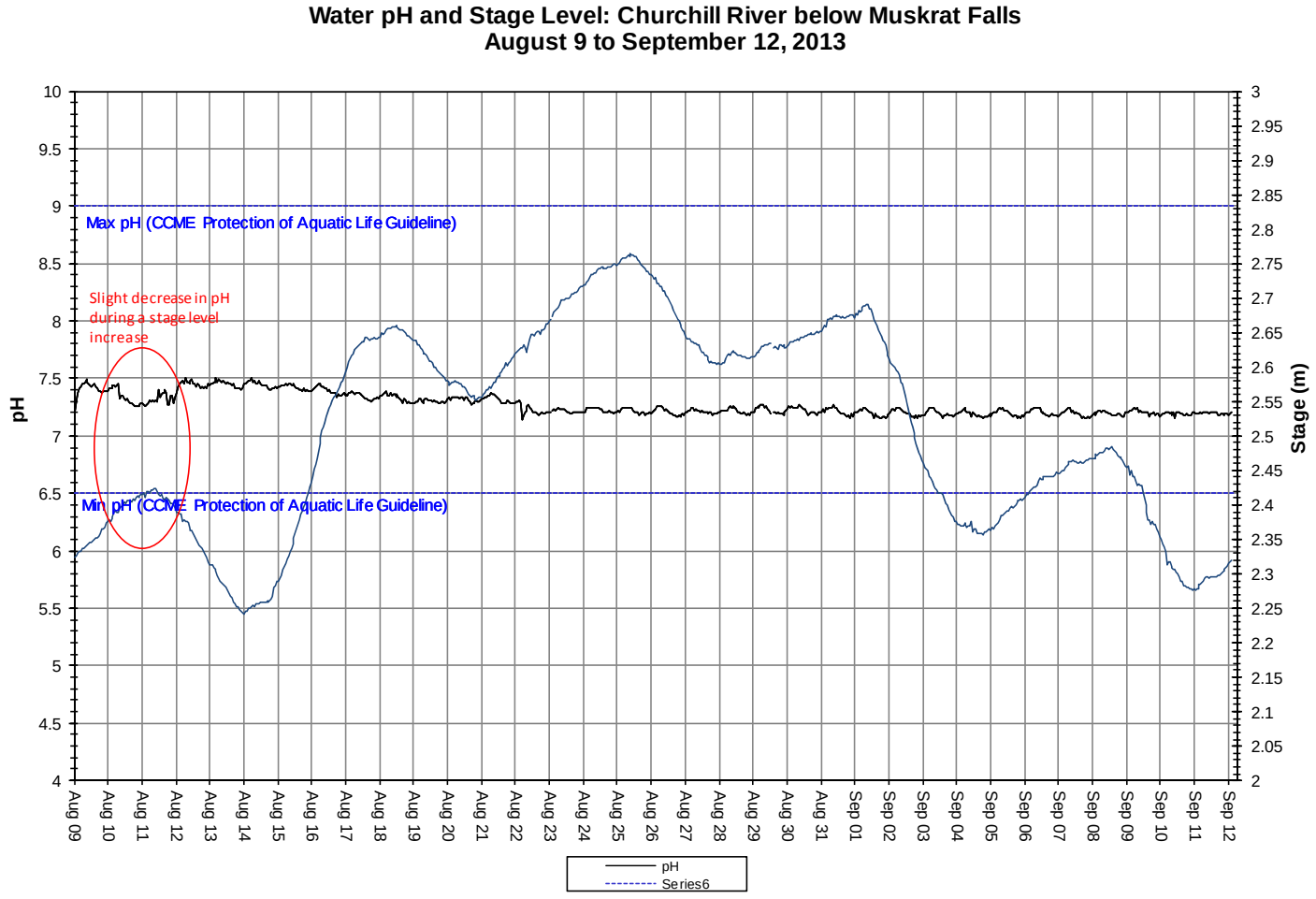


Figure 25: pH and stage level at Churchill River below Muskrat Falls

- Specific conductance ranges between 19.7µS/cm and 22.1µS/cm during the deployment period, averaging 20.7µS/cm (Figure 26).
- Specific conductivity is decreasing slightly throughout the deployment period.
- Stage is included in Figure 26 to illustrate the inverse relationship between conductivity and water level. Generally, as stage levels increase, specific conductivity decreases due to the dilution of dissolved solids in the water column. Inversely, when stage decreases, specific conductivity usually increases as the concentration of dissolved solids is increased. This trend is not clearly visible in the data collected during the deployment period. Specific conductivity is decreasing slightly during the changes in water level.

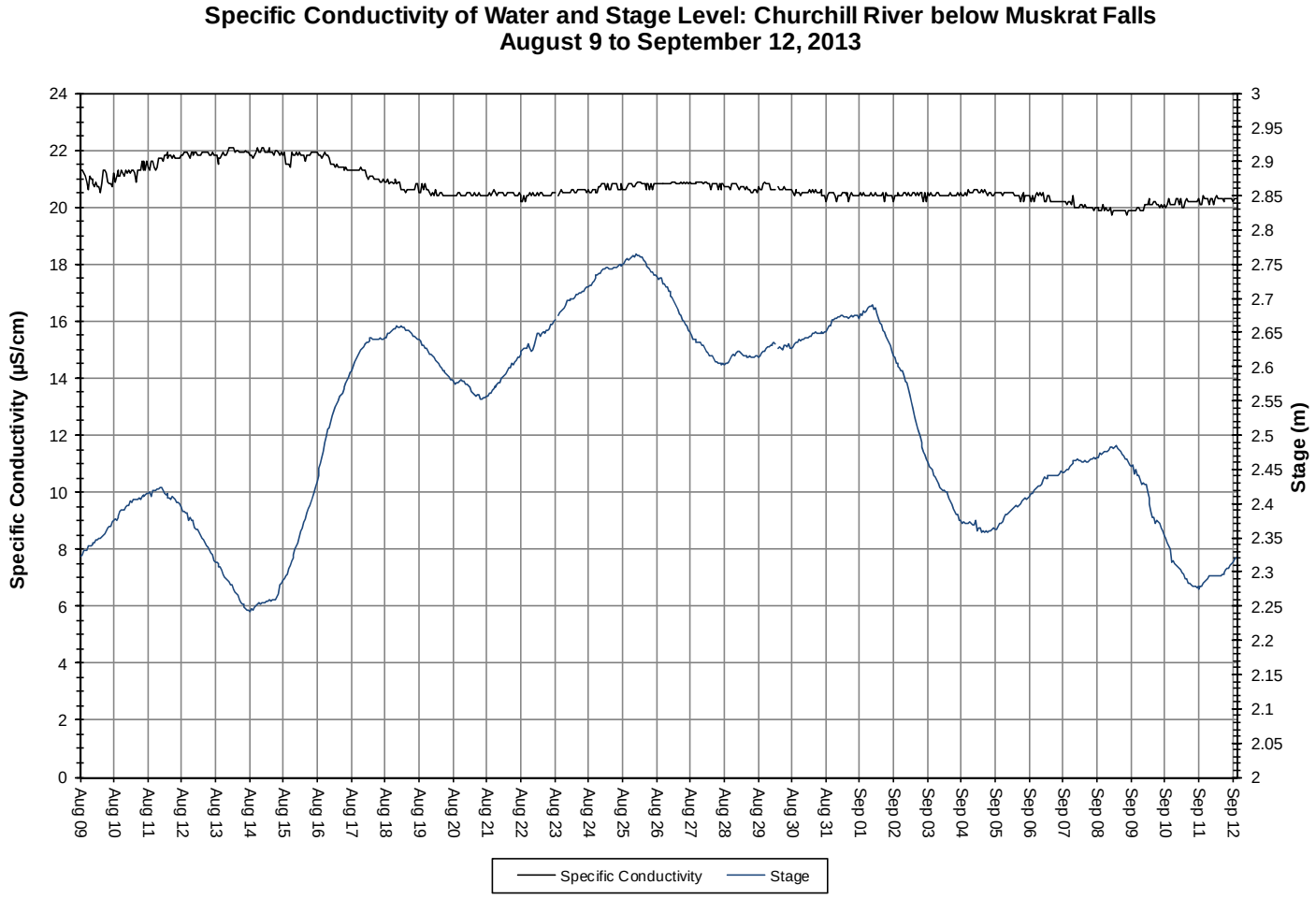


Figure 26: Specific conductivity and stage level at Churchill River below Muskrat Falls

- Dissolved oxygen content ranges between 10.00mg/l and 11.53mg/l. The saturation of dissolved oxygen ranges from 100.4% to 114.6% (Figure 27).
- All values were above both the minimum CCME Guidelines for the Protection of Cold Water Biota at Other Life Stage of 6.5mg/l and at Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 27.
- Dissolved oxygen content is increasing throughout the deployment period. This trend is expected given the cooling air and water temperatures (Figure 24). Dissolved oxygen is typically higher at this station compared to the other stations further upstream due to the addition of oxygen to the water at Muskrat Falls.

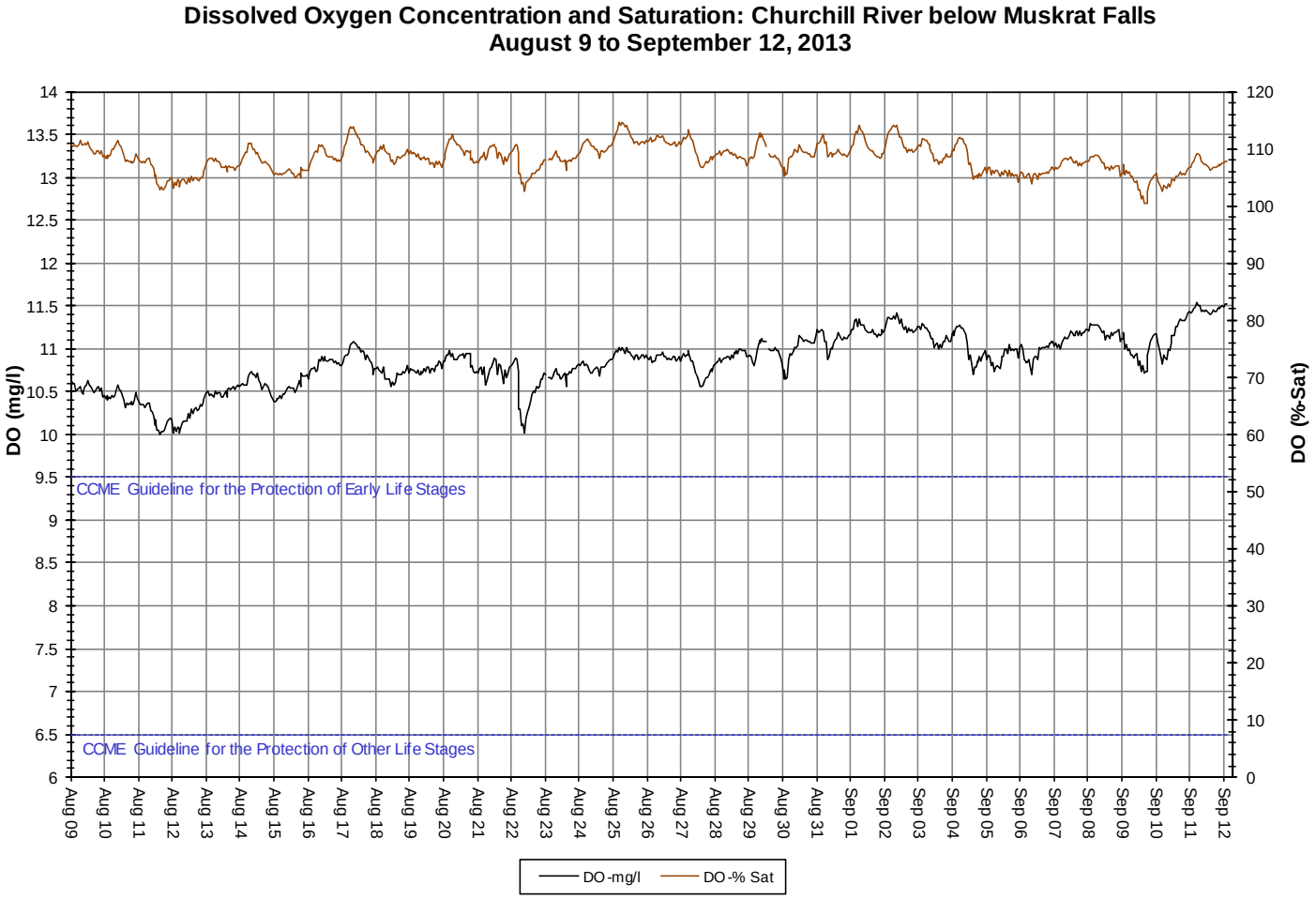


Figure 27: Dissolved oxygen and percent saturation at Churchill River below Muskrat Falls

- Turbidity ranges between 4.6NTU and 52.1NTU, averaging 7.7NTU between August 22 and September 12 (Figure 20). A median value of 7.4NTU during this time indicates there is a consistent natural background turbidity value. This trend is typical at this station.
- Turbidity data collected between August 8 and August 22 is invalid and has been removed from the data set. Values during this time often were consistently reporting 100NTU due to a calibration error. This error was rectified during a station visit in boat on August 22. The sensor was recalibrated in the field.

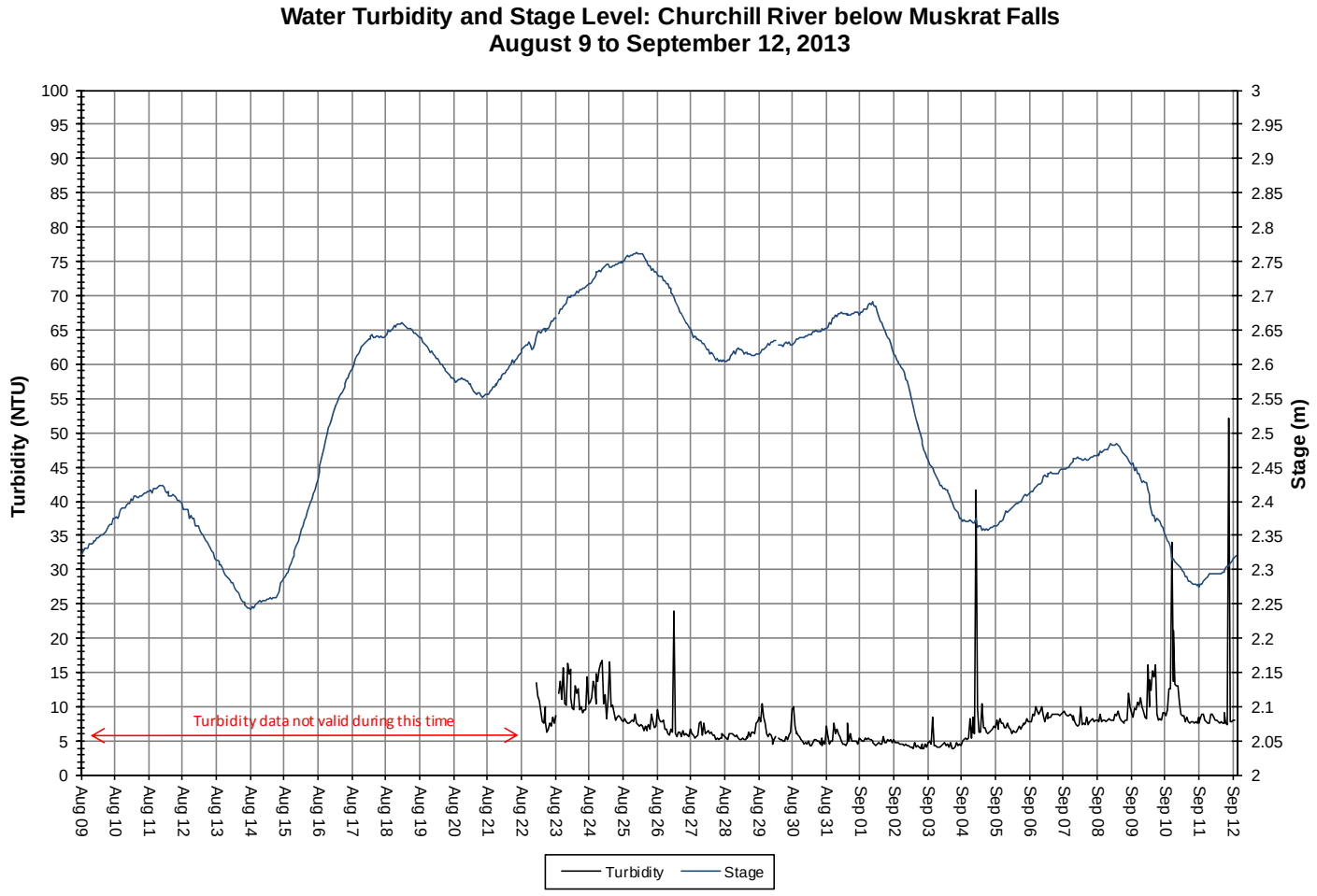


Figure 28a: Turbidity and stage level at Churchill River below Muskrat Falls

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 30). Stage is fluctuating throughout the deployment period. Precipitation events are frequent and range from low to high in magnitude. Stage ranges between 2.24m and 2.76m, a difference of 0.52m.

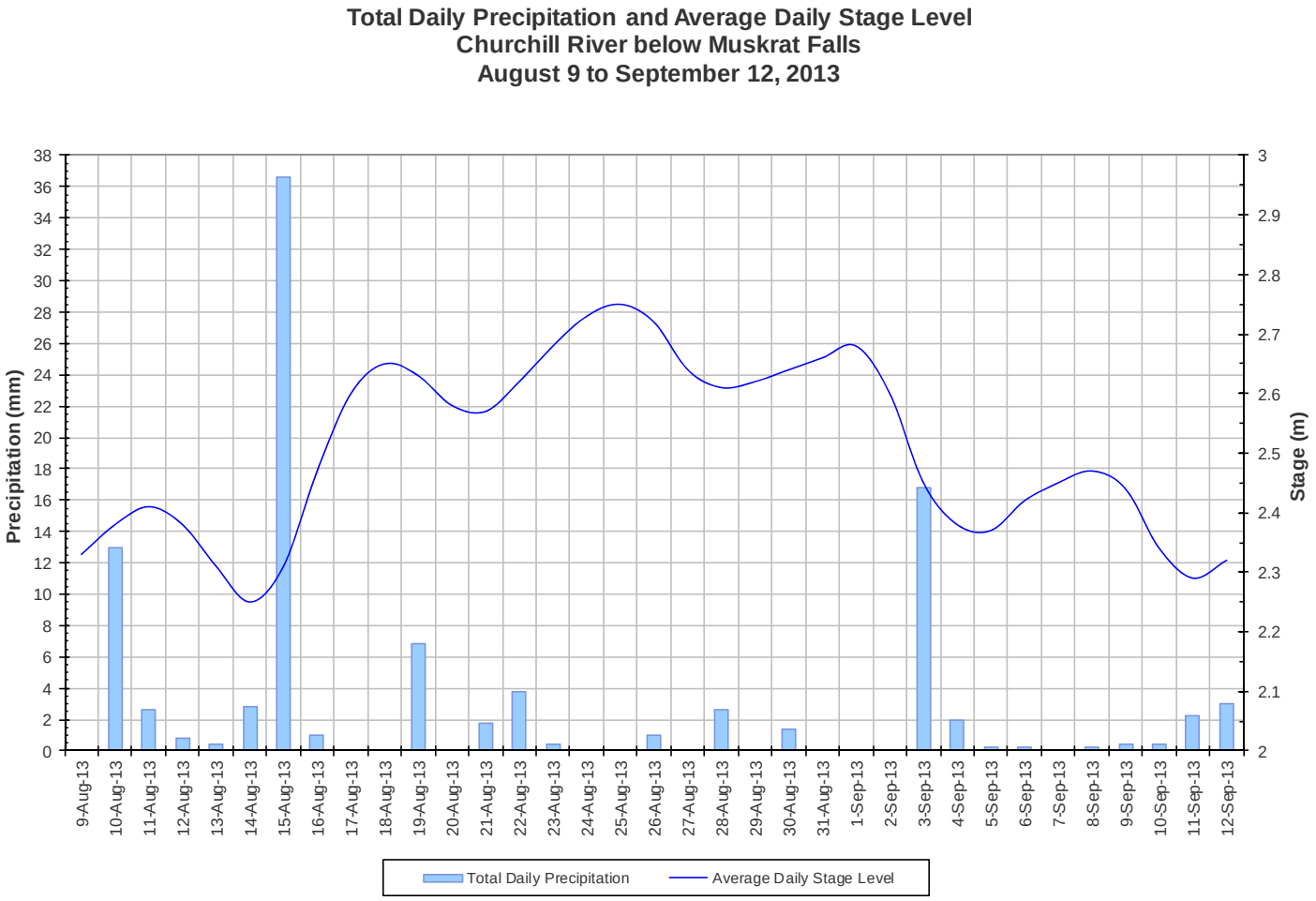


Figure 30: Daily precipitation and average daily stage level at Churchill River below Muskrat Falls (weather data recorded at Goose Bay)

Churchill River at English Point

- Water temperature ranges from 11.10°C to 19.10°C during the deployment period (Figure 31).
- Water temperature is decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures late in the summer season (Figure 32). Water temperature fluctuates diurnally.

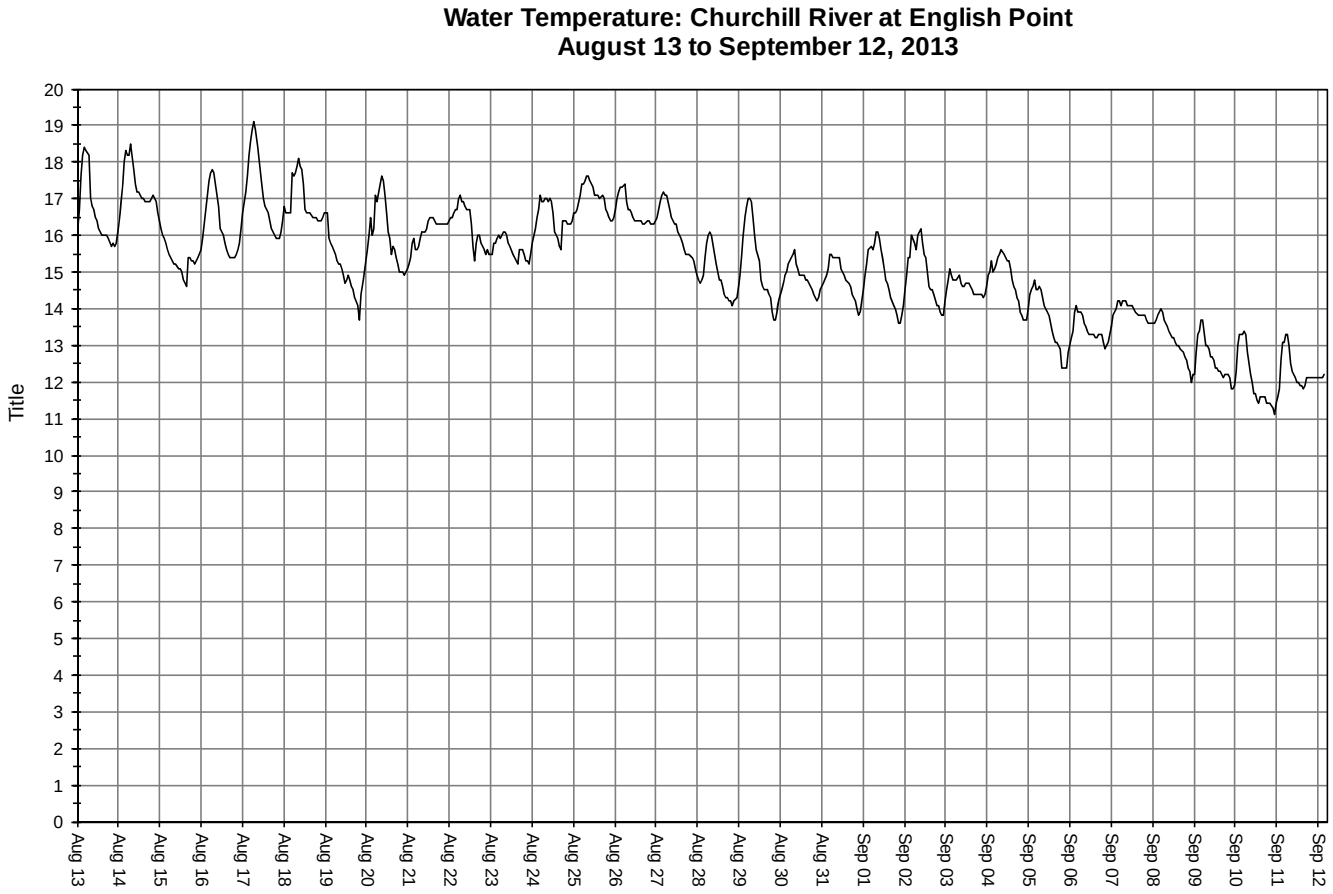


Figure 31: Water temperature at Churchill River at English Point

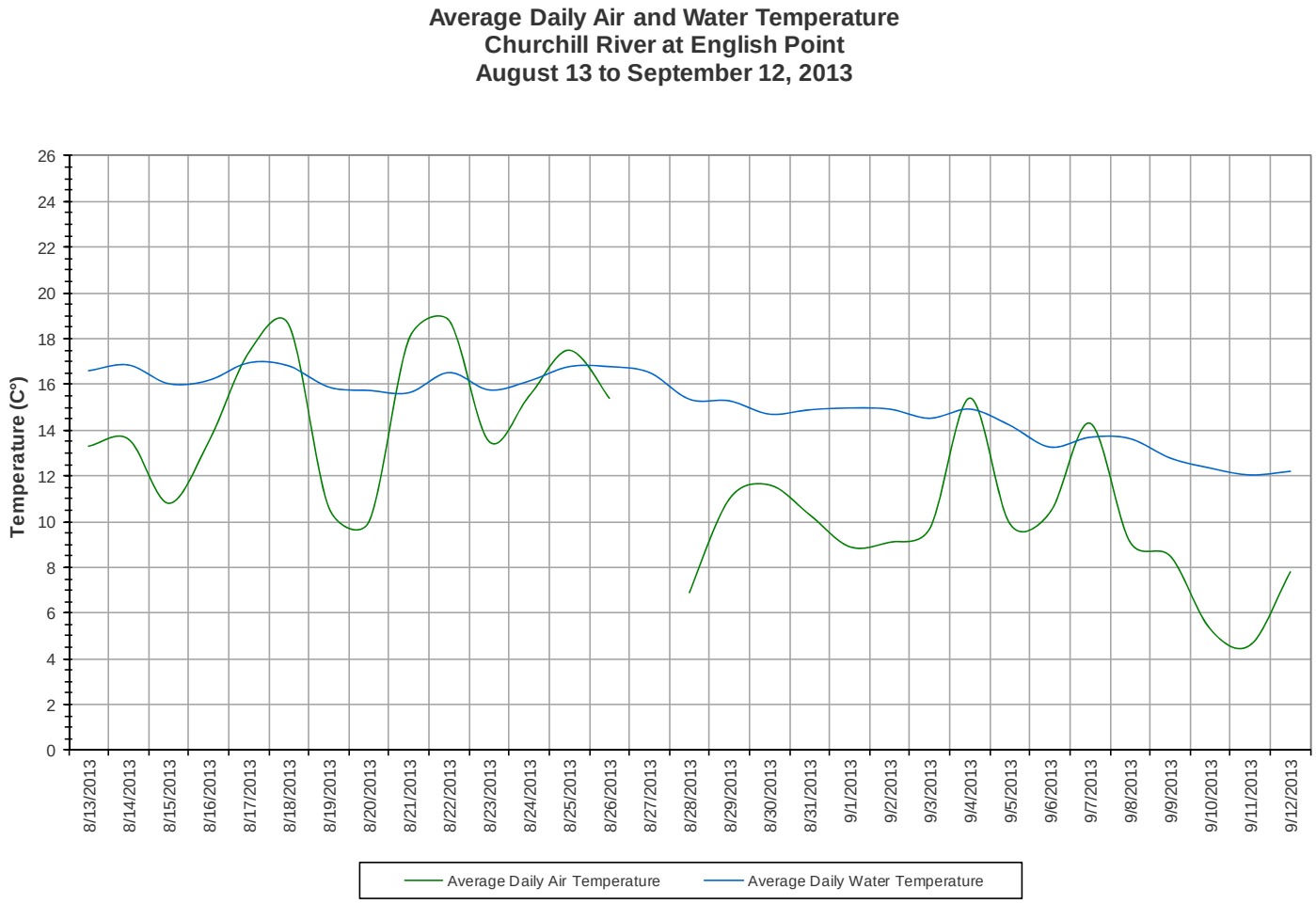


Figure 32: Average daily air and water temperature at Churchill River at English Point

(weather data recorded at Goose Bay)

- pH ranges between 6.92 and 7.56 pH units (Figure 33). pH fluctuates on a daily basis.
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 33).

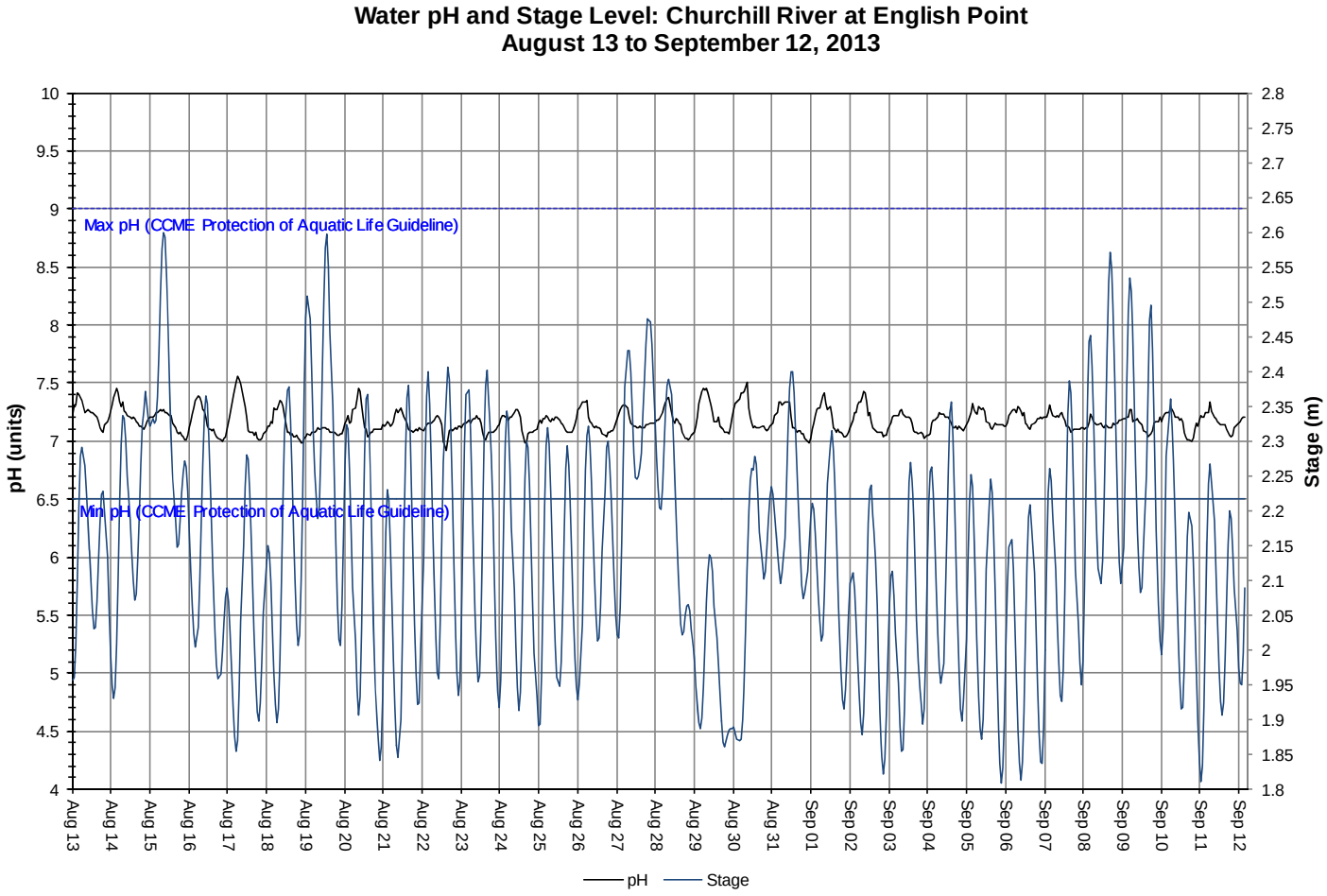


Figure 33: pH and stage level at Churchill River at English Point

- Specific conductance typically ranges between 21.4µS/cm and 57.2µS/cm during the deployment period, averaging 30.3µS/cm (Figure 34).
- 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.
- There is an increase in specific conductivity on August 29-30 which does correspond with a decrease in stage. This event is highlighted in red on Figure 34.

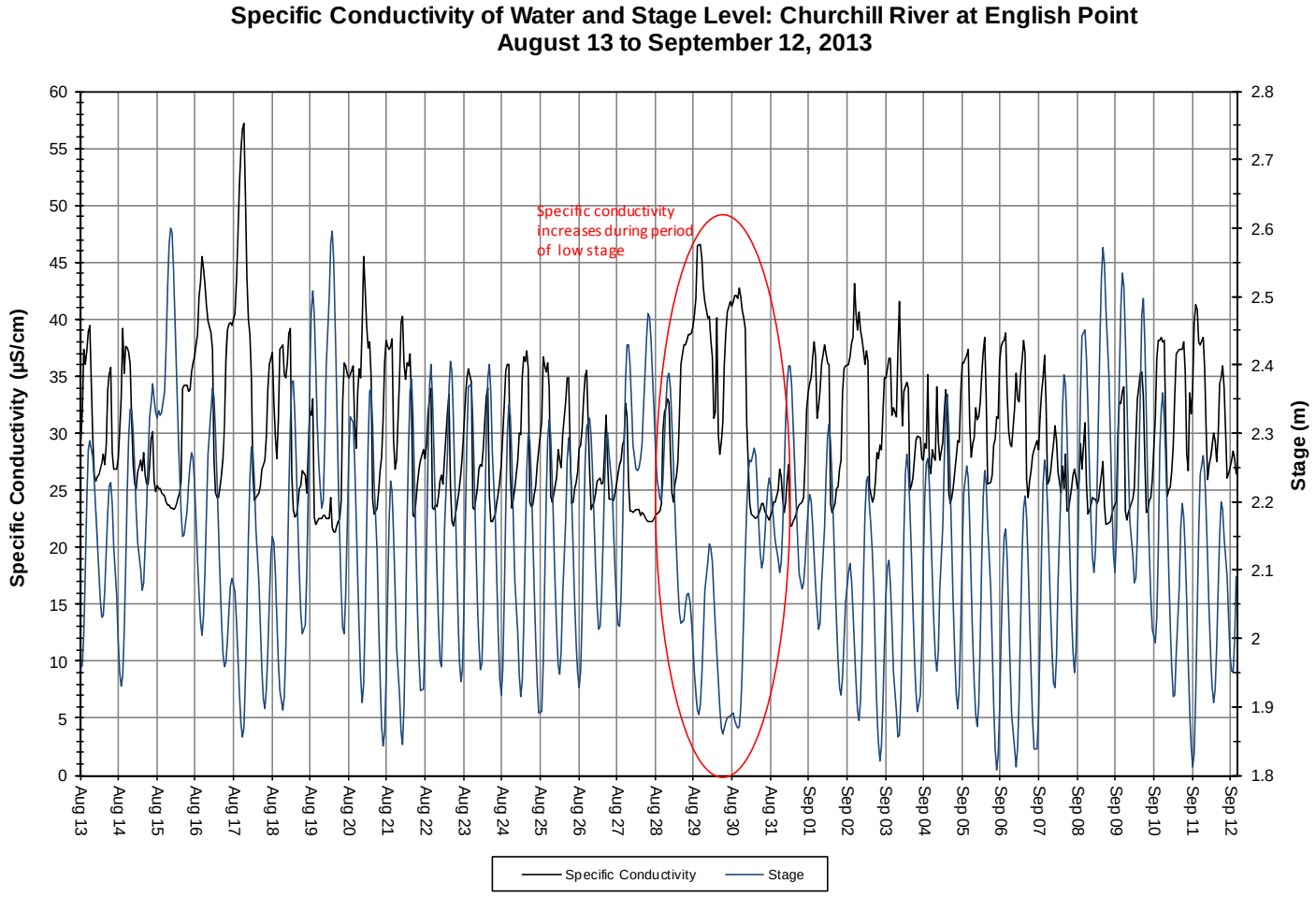


Figure 34: Specific conductivity and stage level at Churchill River at English Point

- Dissolved oxygen content ranges between 8.92mg/l and 10.89mg/l. The saturation of dissolved oxygen ranges from 87.6% to 109.4% (Figure 35).
- All values were above the minimum CCME Guidelines for the Protection of Cold Water Biota at Other Life Stage of 6.5mg/l. From August 13-30, most values are either just above or just below the minimum CCME Guideline for the Protection of Aquatic Life at Early Life Stages of 9.5mg/l. From August 30 to September 12, all values are above this guideline. The guidelines are indicated in blue on Figure 35.
- Dissolved oxygen content is increasing slightly throughout the deployment period. This trend is expected given the cooling air and water temperatures (Figure 32).

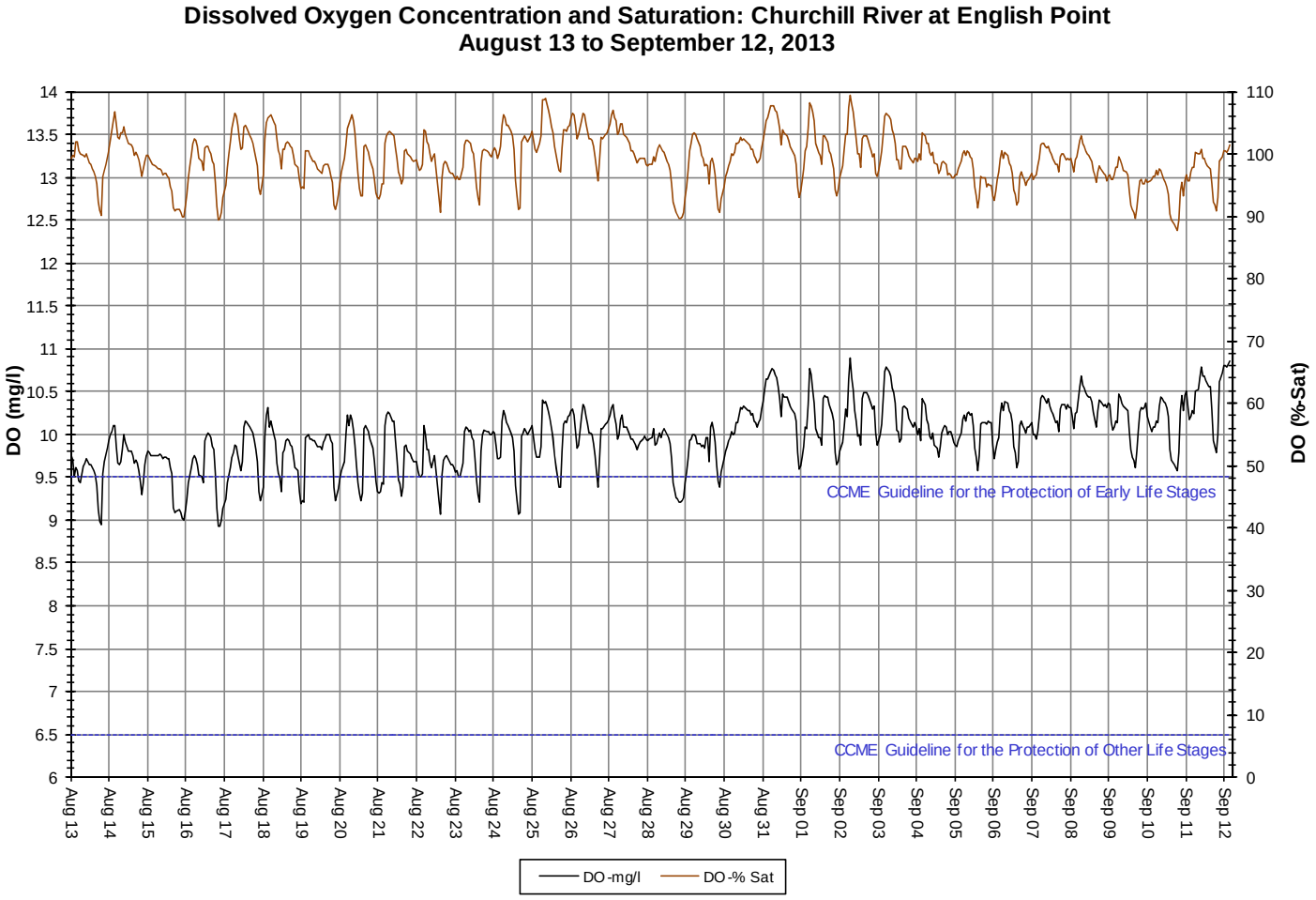


Figure 35: Dissolved oxygen and percent saturation at Churchill River at English Point

- Turbidity ranges between 0.0NTU and 62.3NTU throughout the deployment period (Figure 36). A median value of 1.5NTU indicates there is a consistent natural background turbidity value at this station. This trend is typical at this station.
- There are a number of instances when turbidity increases well above the background turbidity value. On August 22 and September 7, & 9 turbidity increases to >55NTU. None of these increases correspond with precipitation events.

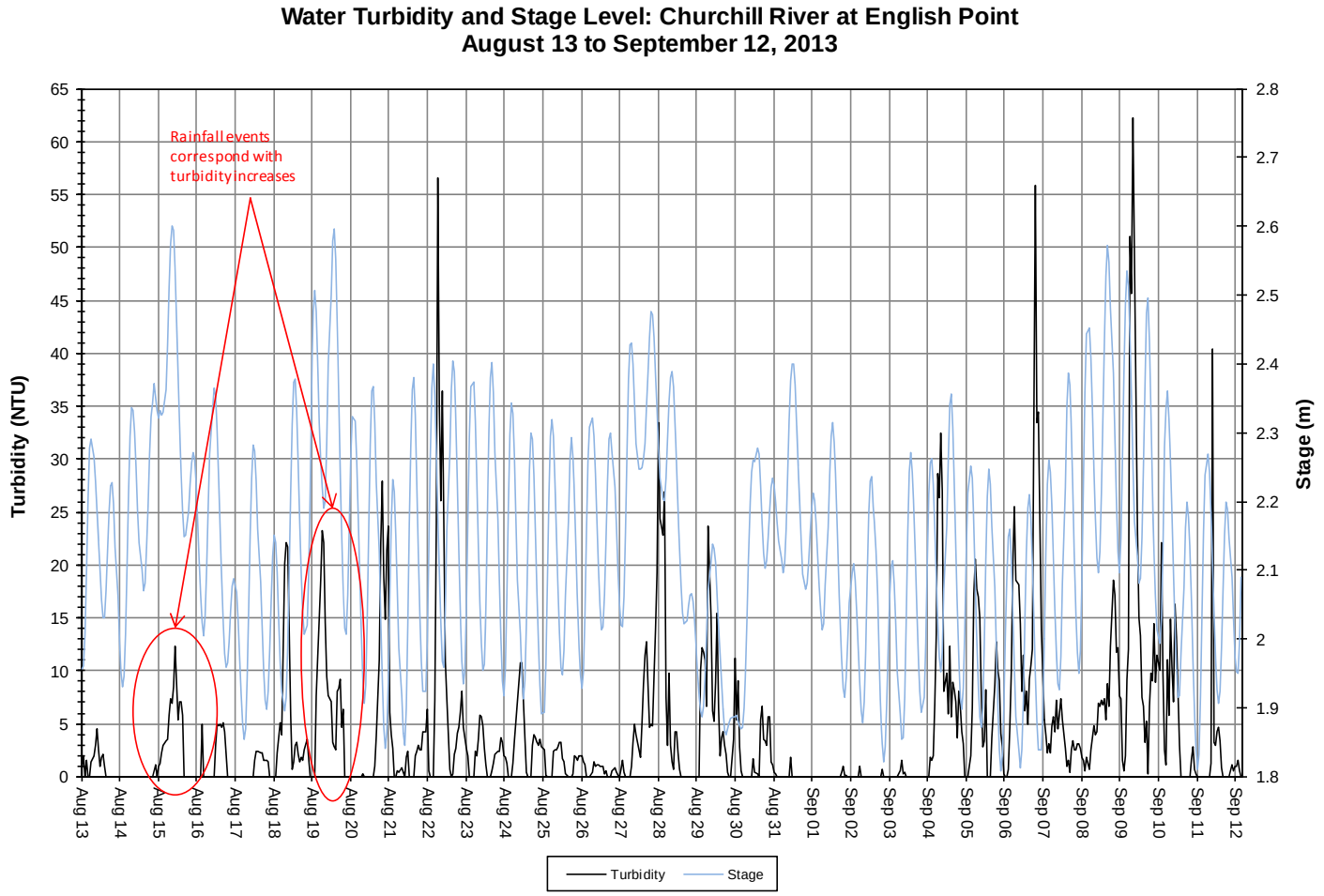


Figure 36: Turbidity and stage level at Churchill River at English Point

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 37). Stage is fluctuating throughout the deployment period. Precipitation events are frequent and range from high to low in magnitude. Stage ranges between 1.81m and 2.60m, a difference of 0.79m.

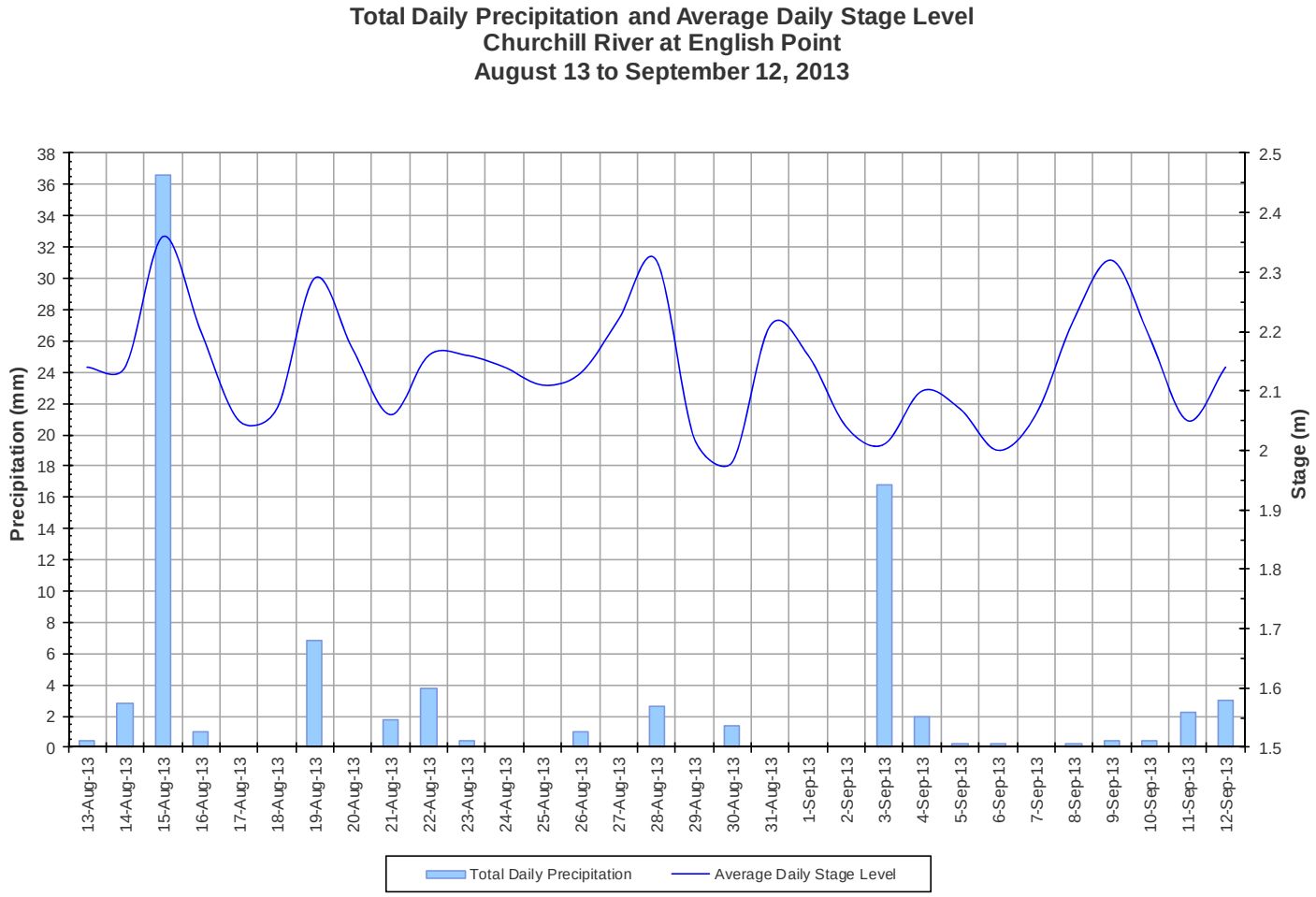
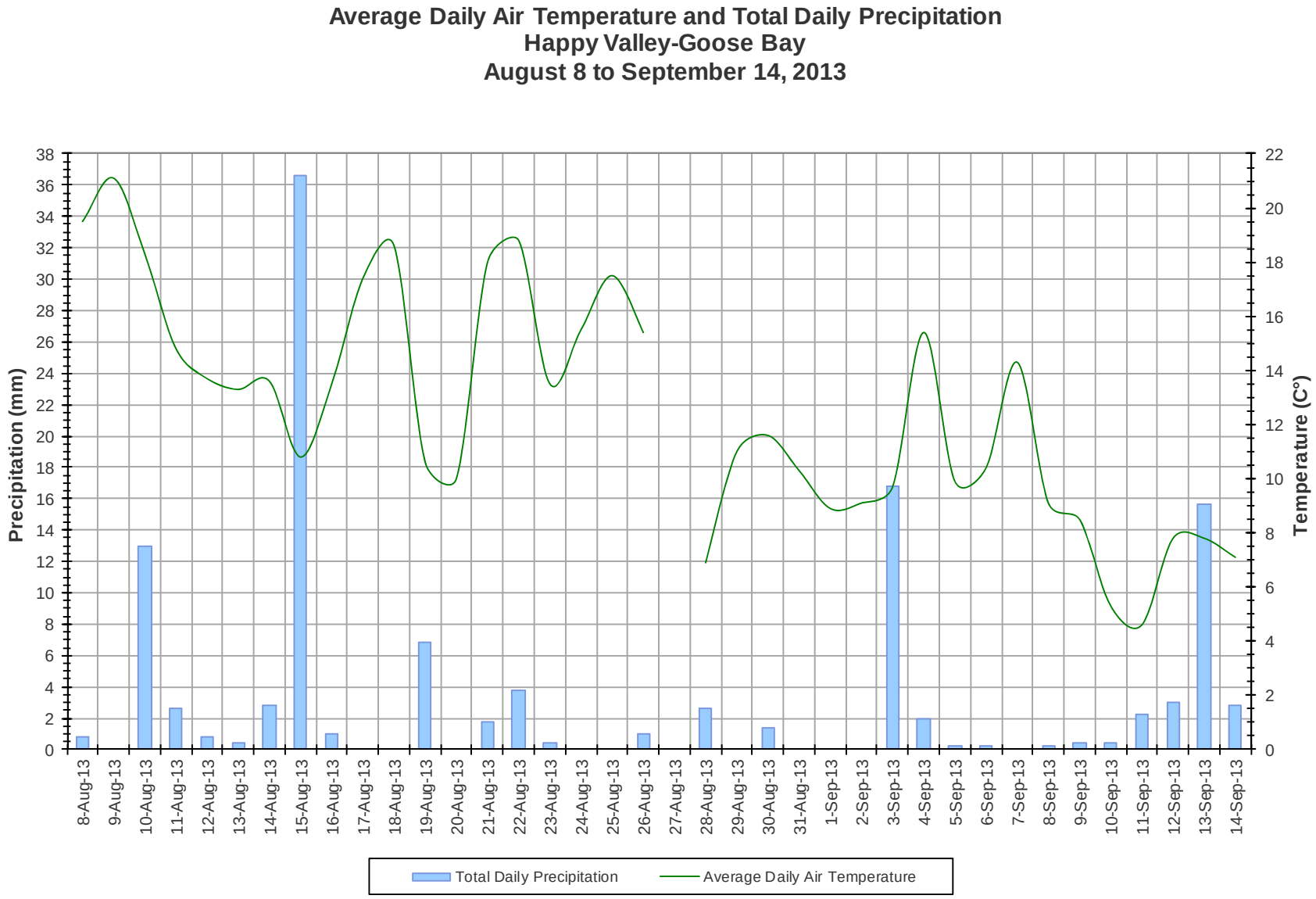


Figure 37: Daily precipitation and average daily stage level at Churchill River at English Point (weather data recorded at Goose Bay)

Conclusions

- Instruments at five water quality monitoring stations on the Lower Churchill River were deployed from August 8/9/13 to September 12/14, 2013.
- Stage levels fluctuated at all stations throughout the deployment period. Water level changes at the each of the stations ranged between 0.38m and 1.02m. F20.7
- Water temperature was decreasing at all stations throughout the deployment period due to the cooling ambient air temperatures in the region late in the summer season. Water temperature typically ranged between 10°C and 19°C.
- pH is generally neutral and stable at all stations along the Lower Churchill River ranging between 6.92 and 7.56 pH units. pH values were within the recommended CCME Guidelines for the Protection of Aquatic Life.
- Specific conductivity was relatively stable at all stations regardless of the fluctuating stage levels. While this trend is not normally experienced, for this deployment period, the trend was similar throughout the network with the exception of the station at English Point which is influenced by the tides in Lake Melville. Specific conductivity averaged between 20.7µS/cm and 21.6µS/cm at the stations below Metchin River, below Grizzle Rapids and above and below Muskrat Falls. Specific conductivity values at the station at English Point averaged higher at 30.3µS/cm.
- Dissolved oxygen content was increasing throughout the deployment period as it is inversely related to water temperature. Values ranged between 8.88mg/l and 11.53mg/l. All values were above the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages at 6.5mg/l. Most values for the first three weeks of the deployment period were just below the CCME Guideline for the Protection of Aquatic Life at Early Life Stages of 9.5mg/l. The station below Muskrat Falls consistently has high dissolved oxygen content due to the location of the Muskrat Falls, 6km upstream. All values recorded at this station were greater than 9.5mg/l.
- Turbidity values at the stations below Metchin River and below Grizzle Rapids remained mostly at 0NTU throughout the deployment period which is typical of these stations. Turbidity values at the station above Muskrat Falls were only accurate for the first week of the deployment period before sensor malfunction rendered the rest of the data in accurate. At the station below Muskrat Falls, the first two weeks of the deployment period, the instrument reported a value of 100NTU which was the result of a calibration error. Following an infield calibration on October 22, data collection resumed normally and data values were typical for the deployment period. Data collected at the station at English Point was typical for the deployment period with a background level at ~1.5NTU.

Appendix 1 – Weather Data – Environment Canada Historical Weather and Climate Database



Average Daily Air Temperature and Total Daily Precipitation
Churchill Falls
August 8 to September 14, 2013