Real-Time Water Quality Deployment Report

Lower Churchill River Network

October 10 to
November 8, 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

Newfoundland Labrador

Real-Time Water Quality Deployment Report

Lower Churchill River Network

October 10 to November 8, 2013

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 October 10 & 11, 2013, real-time water quality monitoring instruments were deployed at the five Lower Churchill River Stations for periods of 27-28 days. Instruments were removed on November 6 & 8, 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 October 10 & 11 to November 6 & 8 are summarized in Table 2.

Table 2: Comparison rankings for Lower Churchill River stations, October 10 & 11 to November 6 & 8, 2013

Churchill River Station and Instrument Number	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Below Metchin River (45707)	Oct 10, 2013	Deployment	Good	n/a*	Excellent	Excellent	Excellent
	Nov 6, 2013	Removal	Marginal	n/a*	Excellent	Fair	Excellent
Below Grizzle Rapids (45700)	Oct 10, 2013	Deployment	Good	n/a*	Excellent	Good	Excellent
	Nov 6, 2013	Removal	Fair	n/a*	Excellent	Excellent	Excellent
Above Muskrat Falls (47590)	Oct 11, 2013	Deployment	Excellent	n/a*	Excellent	Excellent	Excellent
	Nov 6, 2013	Removal	Excellent	n/a*	Excellent	Poor	Excellent
Below Muskrat Falls (45701)	Oct 11, 2013	Deployment	Good	n/a*	Excellent	Excellent	Good
	Nov 8, 2013	Removal	Good	n/a*	Excellent	n/a†	Good
At English Point (45042)	Oct 11, 2013	Deployment	Good	n/a*	Excellent	Excellent	Excellent
	Nov 8, 2013	Removal	Good	n/a*	Excellent	n/a†	Excellent

* Comparison ranking unavailable due to pH sensor malfunction on QAQC instrument 47592.

† Comparison ranking unavailable due to dissolved oxygen sensor malfunction on QAQC instrument 47592.

- At the station below Metchin River, temperature, specific conductivity, dissolved oxygen and turbidity all rank either 'good' or 'excellent' at deployment. pH is not ranked due to sensor malfunction.

  At removal, specific conductivity, and turbidity all rank 'excellent' while temperature ranks 'marginal' and dissolved oxygen ranks 'fair'. These two parameters are closely related therefore it is not unusual to see them both rank poorly during the same reading. For temperature, the field instrument read a value of 0.29°C while the QAQC instrument read a value of 1.20°C. Dissolved oxygen was reading 13.08mg/l on the field instrument and 13.62mg/l on the QAQC instrument. The discrepancy in the values is likely due to the extremely cold water temperatures at the station. If the instruments were not in the exact same location

adjacent to one another, the readings could have varied as much as 1°C. pH was not ranked due to sensor malfunction.

- At the station below Grizzle Rapids, temperature, specific conductivity, dissolved oxygen and turbidity all rank either 'good' or 'excellent' at deployment. pH is not ranked due to sensor malfunction.

  At removal, specific conductivity, dissolved oxygen and turbidity rank 'excellent' while temperature is ranks 'fair'. For temperature, the field instrument read a value of 4.12°C and the QAQC instrument read a value of 4.76°C. This discrepancy is likely due to the positioning of the instruments in the river adjacent to one another. pH is not ranked due to sensor malfunction.

- At the station above Muskrat Falls, temperature, specific conductivity, dissolved oxygen and turbidity all rank 'excellent' at deployment. pH is not ranked due to sensor malfunction.

  At removal, temperature, specific conductivity, and turbidity all rank 'excellent' while dissolved oxygen ranks 'poor'. For dissolved oxygen, the field instrument read a value of 12.28mg/l and the QAQC instrument read a value of 14.06mg/l. The QAQC instrument is reading unusually high and is likely incorrect. The dissolved oxygen sensor failed on the QAQC instrument soon after this reading was taken. pH is not ranked due to sensor malfunction.

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

  At removal, temperature, specific conductivity and turbidity all rank either 'good' or 'excellent'. Dissolved oxygen and pH are not ranked due to sensor malfunction.

- At the station at English Point, temperature, specific conductivity, dissolved oxygen and turbidity all rank either 'good' or 'excellent' at deployment. pH is not ranked due to sensor malfunction.

  At removal, temperature, specific conductivity and turbidity all rank either 'good' or 'excellent'. Dissolved oxygen and pH are not ranked due to sensor malfunction.

Data Interpretation

- The following graphs and discussion illustrate water quality related events occurring between October 10 and November 8 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 0.30°C to 7.70°C during the deployment period (Figure 1).
- Water temperature is decreasing throughout the deployment period. This trend is expected due to the cooling air temperatures in the fall season (Figure 2).

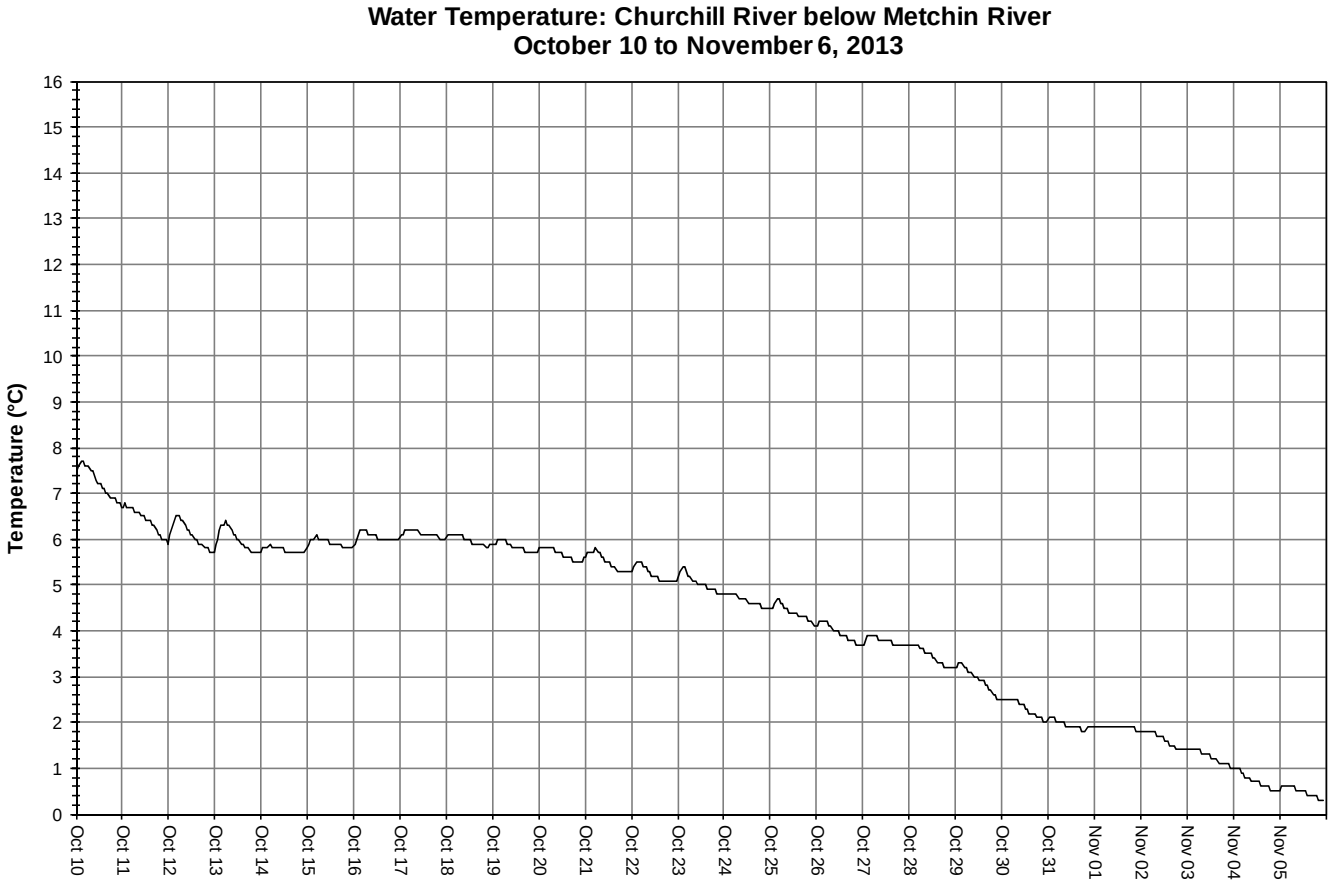


Figure 1: Water temperature at Churchill River below Metchin River

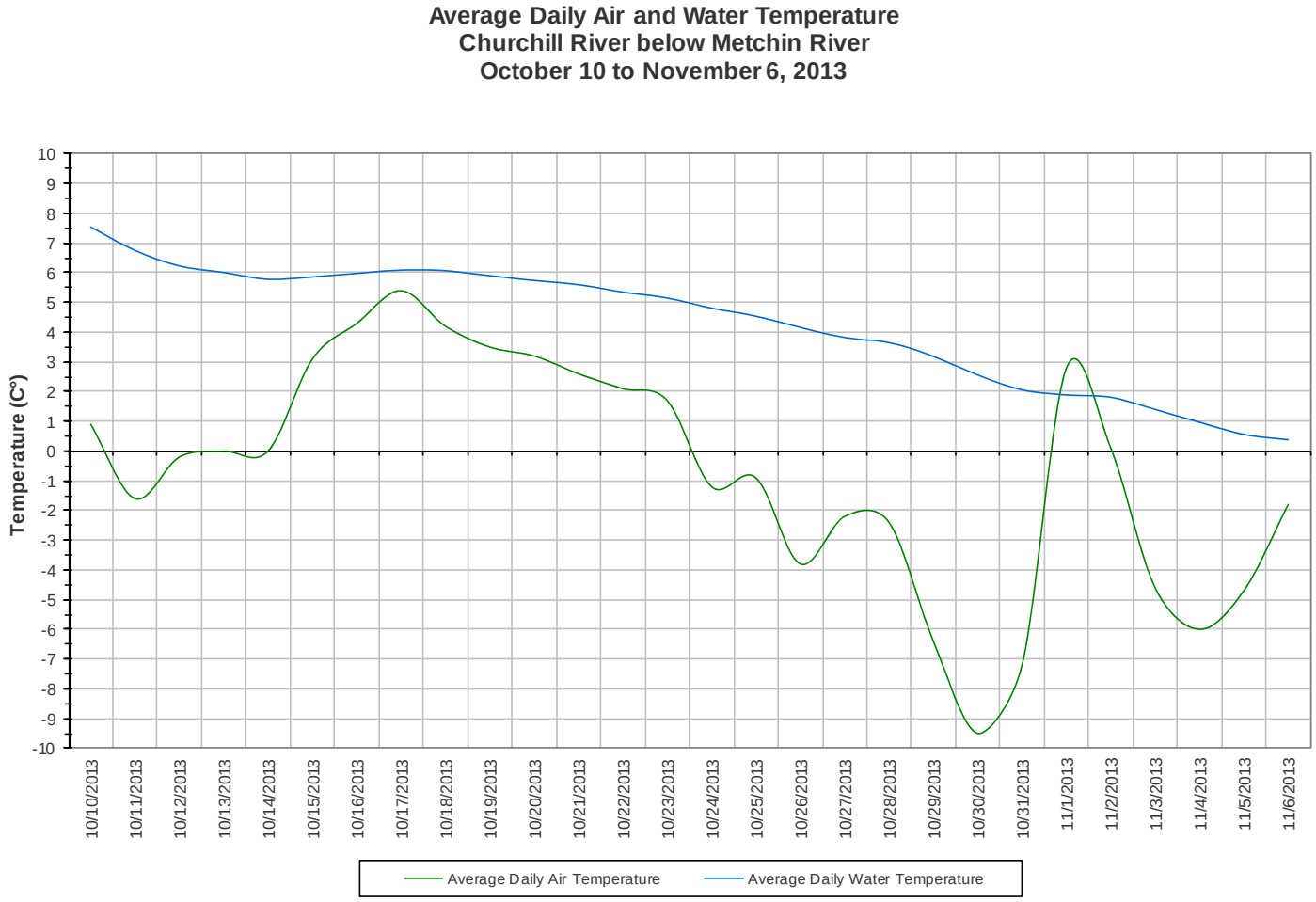


Figure 2: Average daily air and water temperature at Churchill River below Metchin River

(weather data recorded at Churchill Falls, NL)

- pH ranges between 7.06 and 7.35 pH units and is very stable throughout the deployment period regardless of the changing stage levels (Figure 3).
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 3).

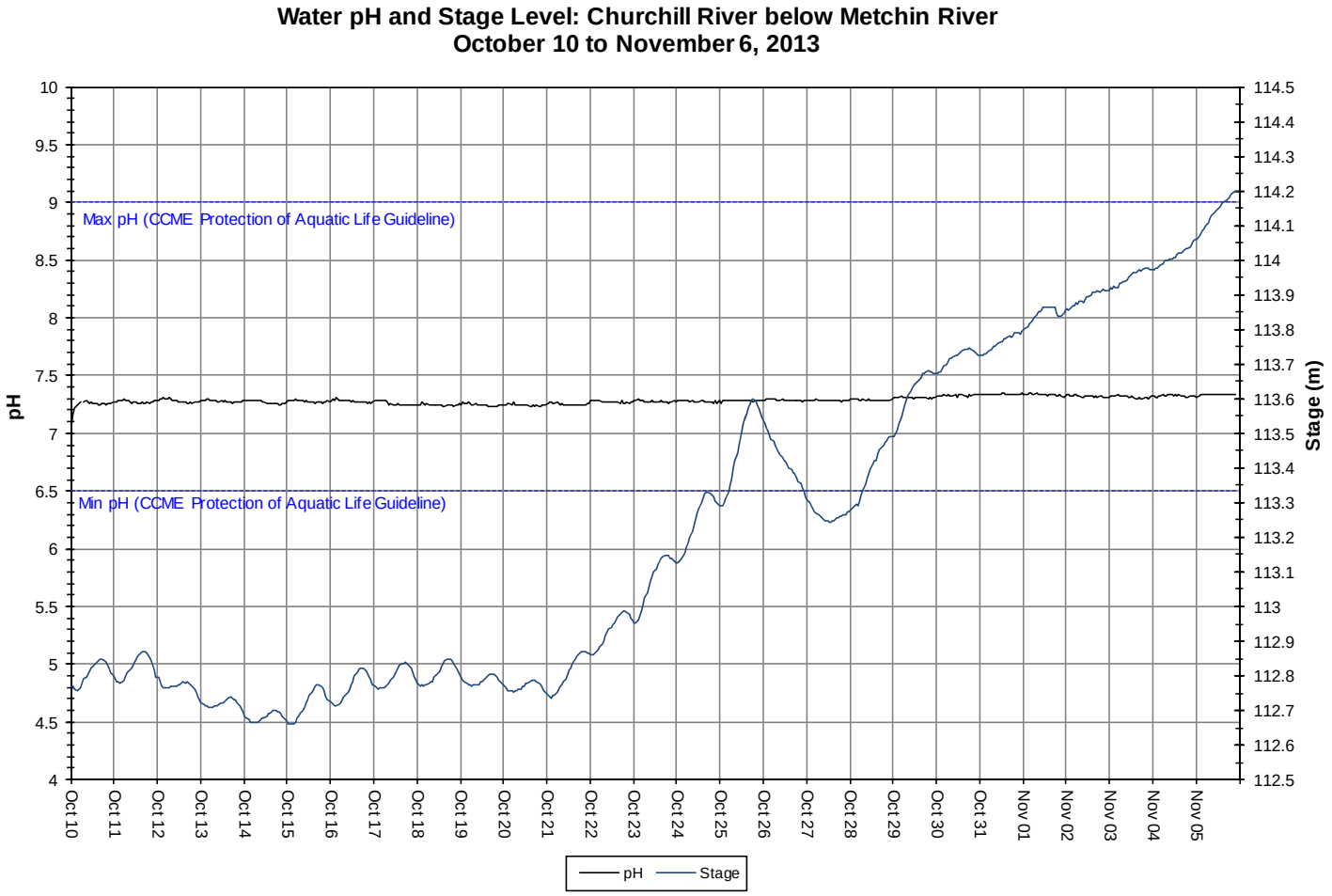


Figure 3: pH and stage level at Churchill River below Metchin River

- Specific conductivity ranges between 19.6µS/cm to 21.6µS/cm during the deployment period, averaging 20.5µS/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.

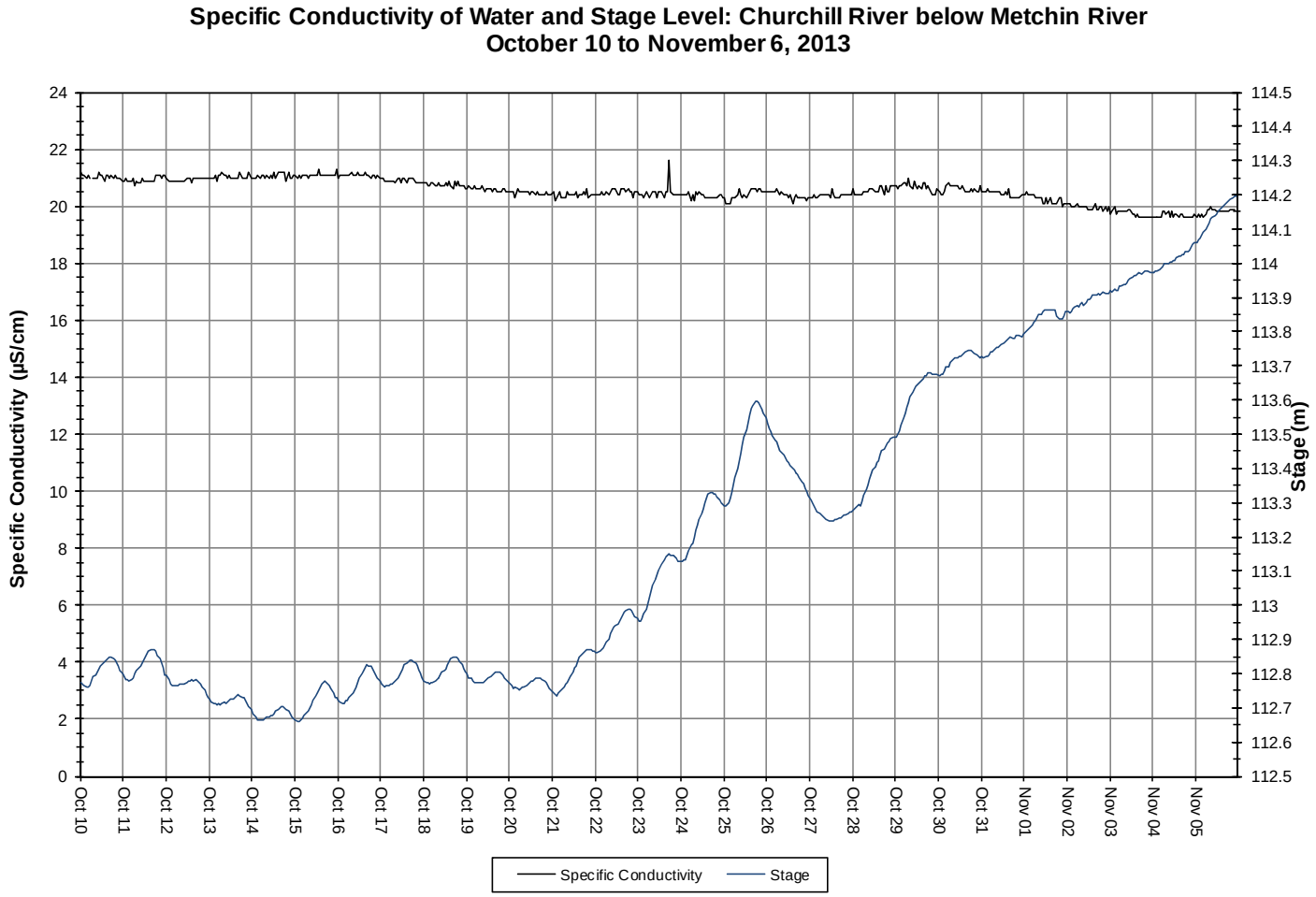


Figure 4: Specific conductivity and stage level at Churchill River below Metchin River

- Dissolved oxygen content ranges between 11.24mg/l and 13.17mg/l. The saturation of dissolved oxygen ranges from 89.3% to 95.3% (Figure 5).
- All values are above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l and at Early Life Stages of 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).

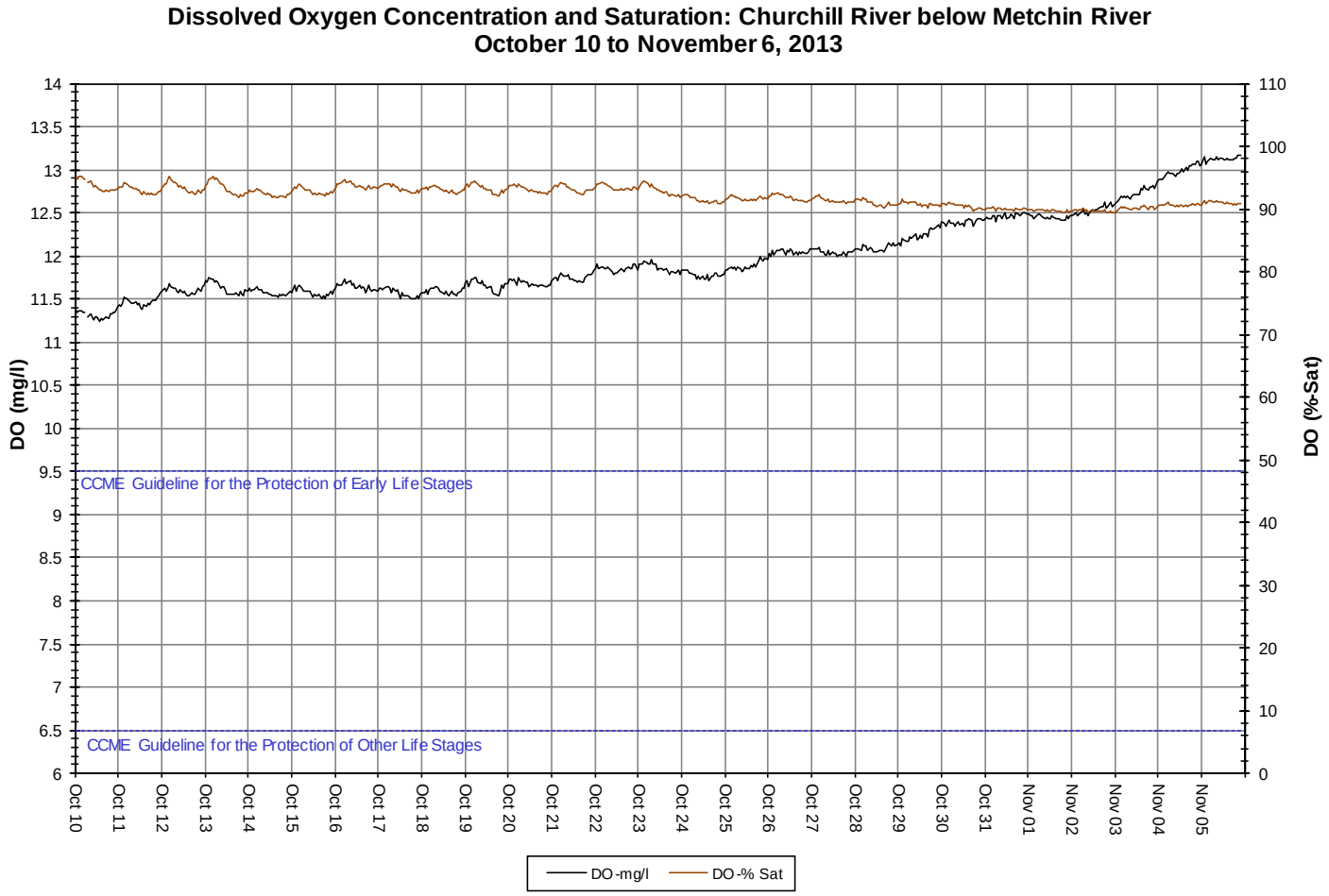


Figure 5: Dissolved oxygen and percent saturation at Churchill River below Metchin River

- 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.
- There are a few instances when turbidity increase to values >0NTU. These events are low in magnitude and not significant.

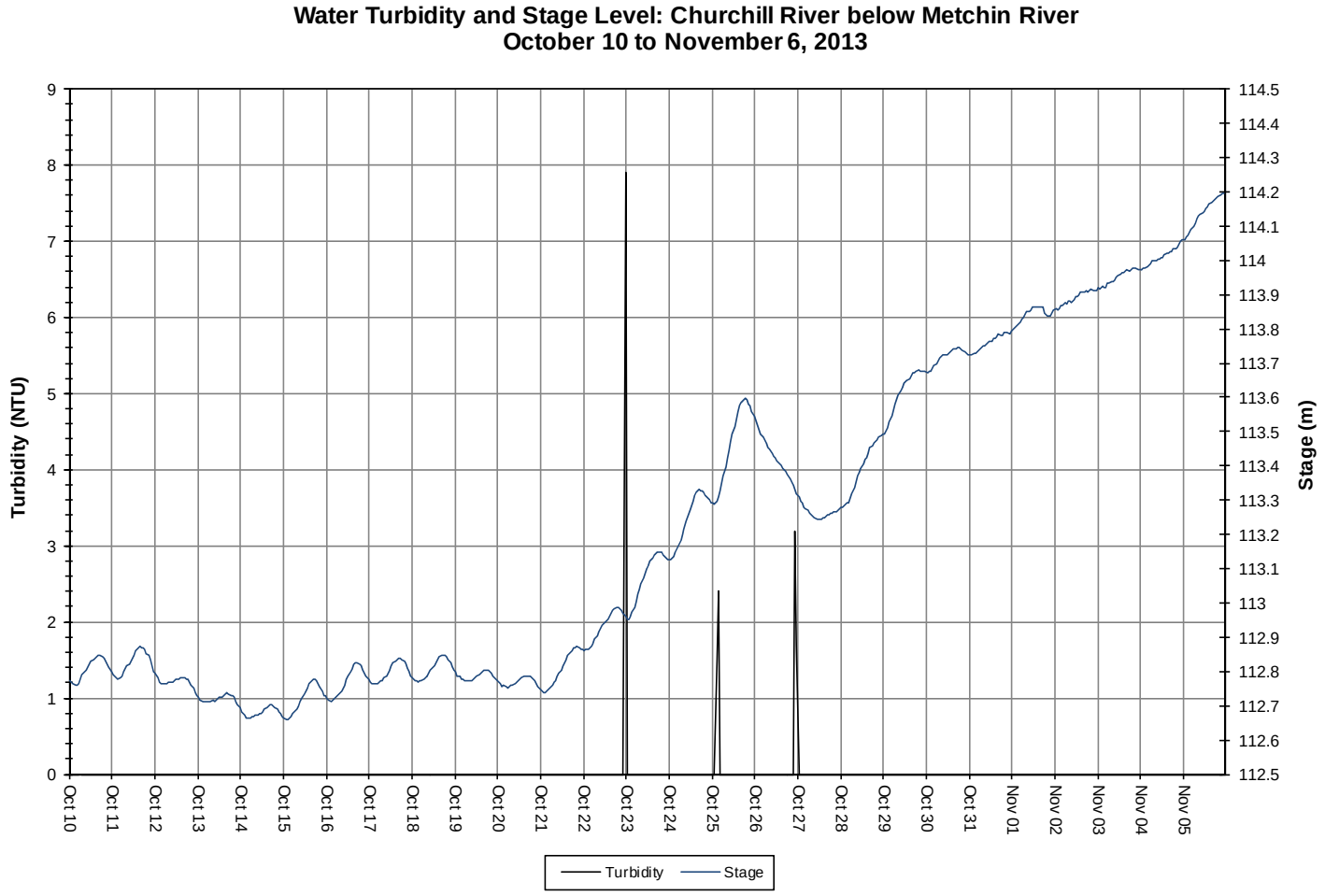


Figure 6: Turbidity and stage level at Churchill River below Metchin River

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 7). Stage is mostly increasing throughout the deployment period. Precipitation occurs on >50% of the days in the deployment period however amounts are generally low except for one +23mm event on November 1 . Stage ranges between 112.66m and 114.20m, a difference of 1.54m.

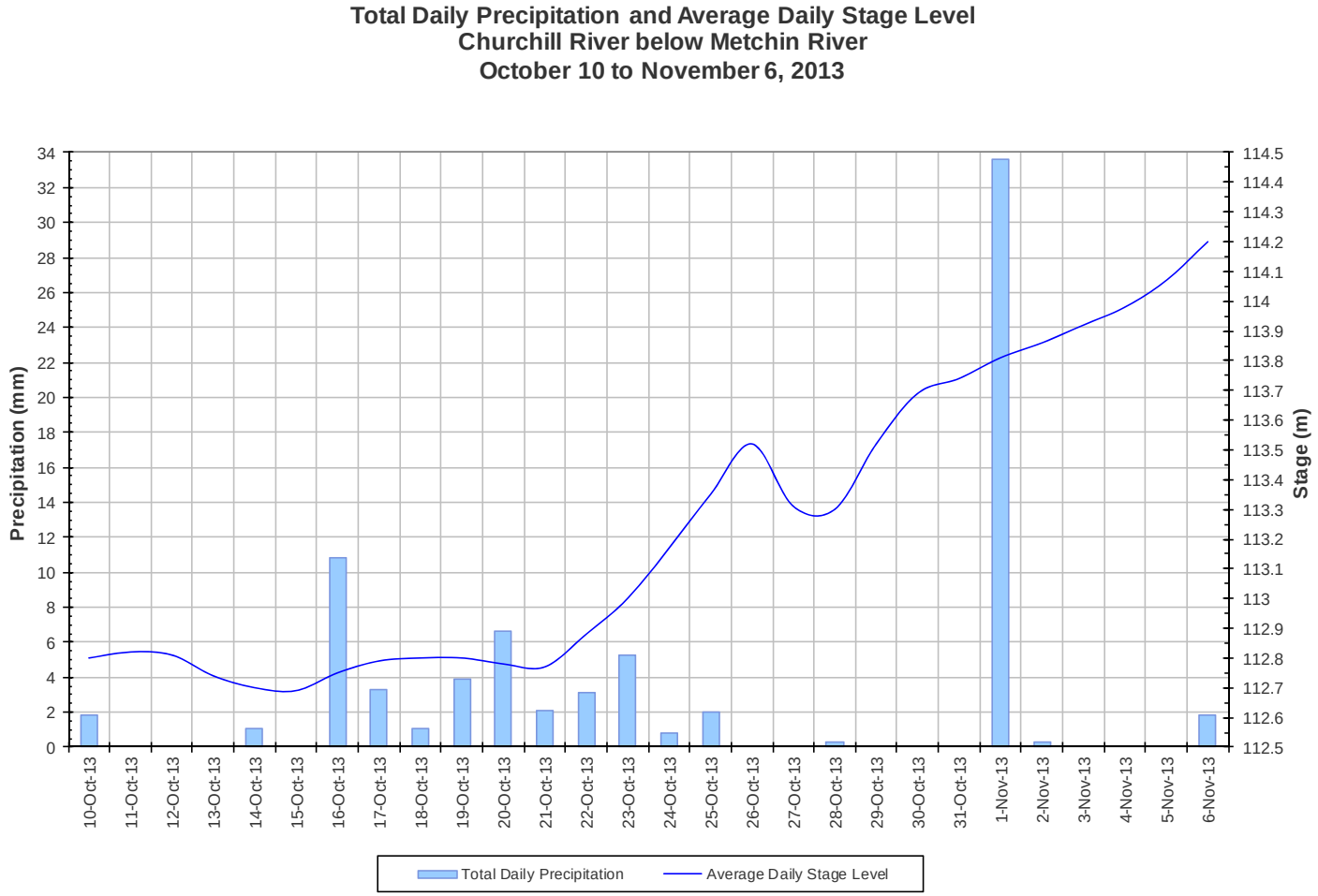


Figure 7: Daily precipitation and average daily stage level at Churchill River below Metchin River (weather data recorded at Churchill Falls)

Churchill River below Grizzle Rapids

- Water temperature ranges from 3.90°C to 8.50°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 in the fall season (Figure 9).

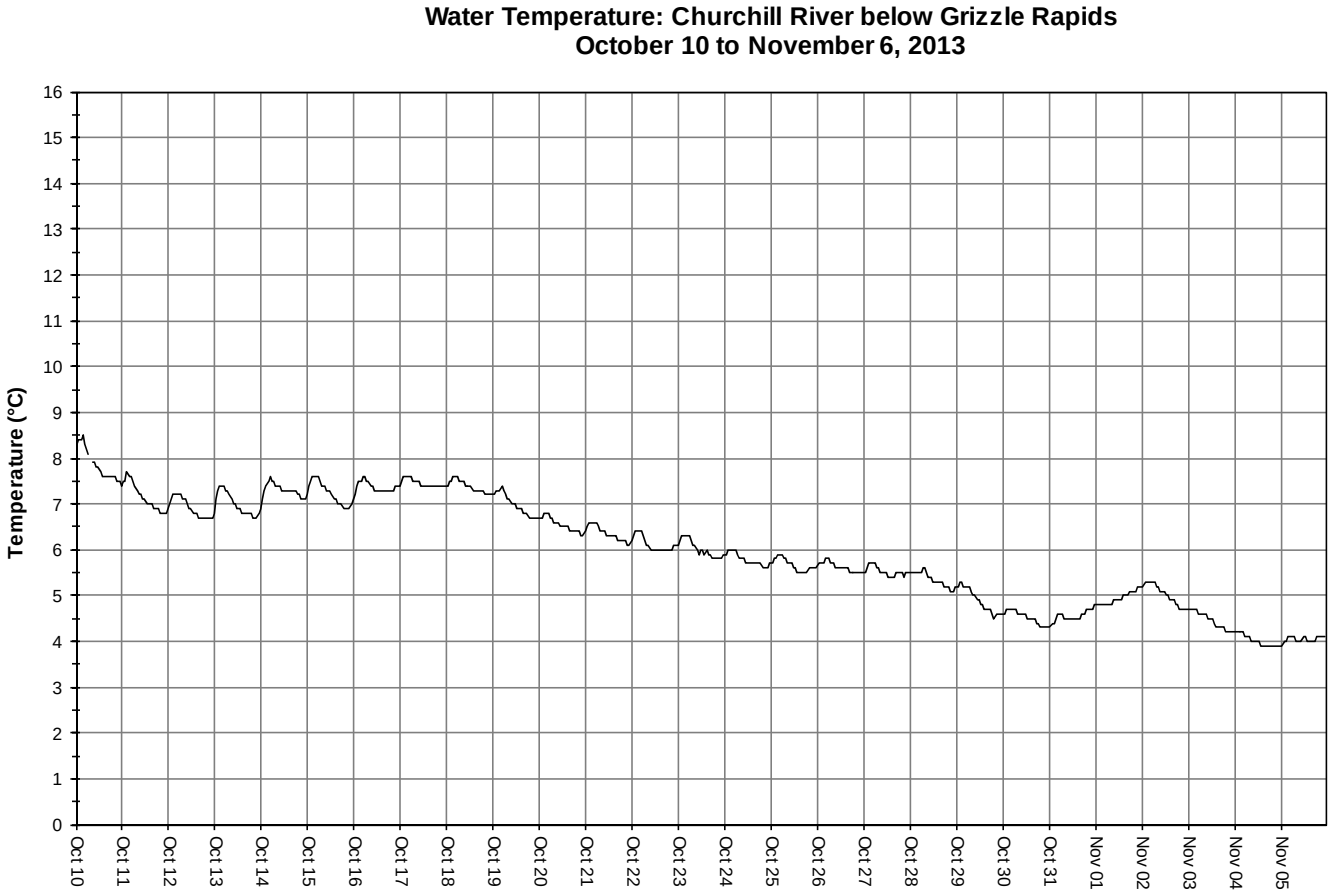


Figure 8: Water temperature at Churchill River below Grizzle Rapids

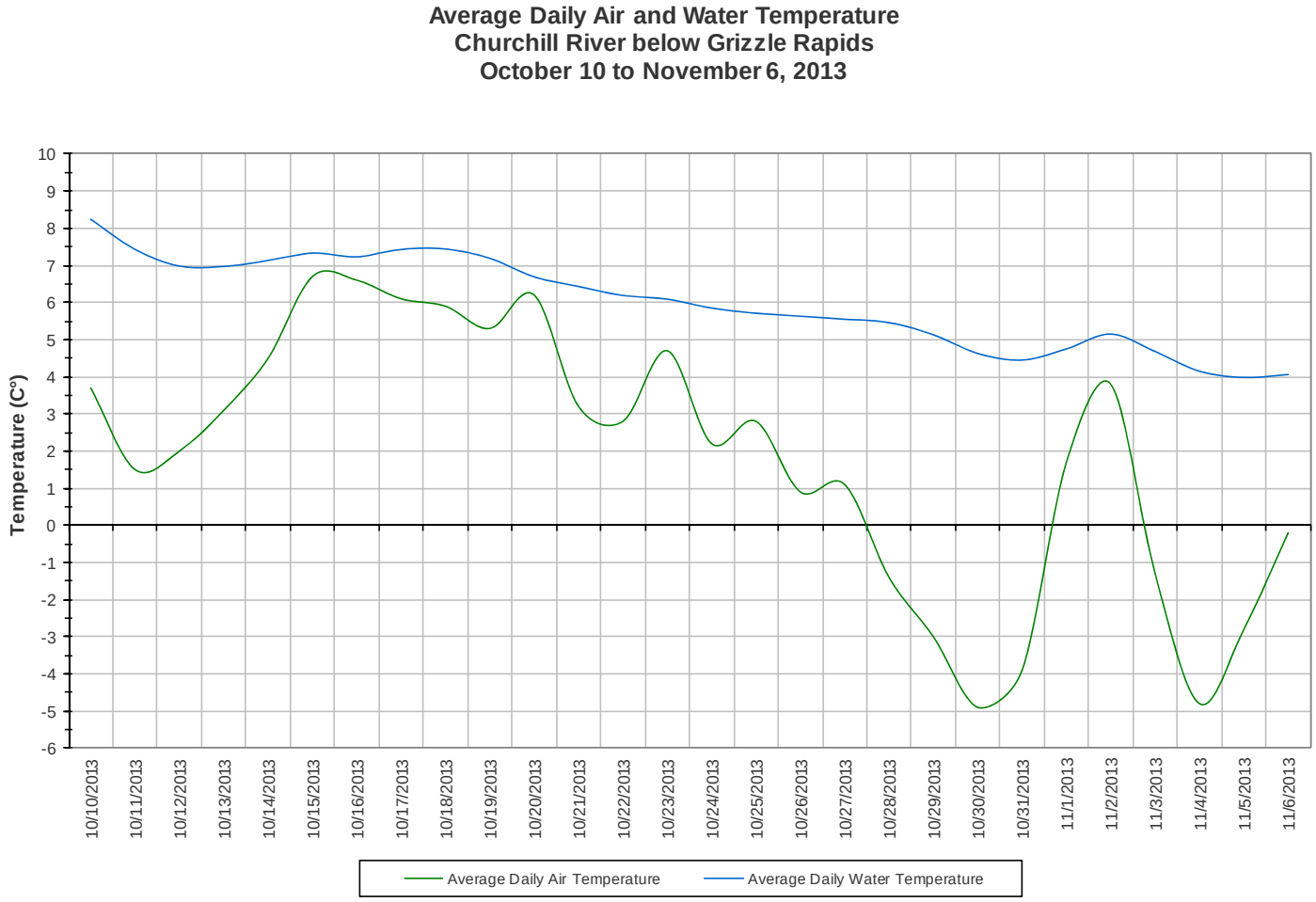


Figure 9: Average daily air and water temperature at Churchill River below Grizzle Rapids (weather data recorded at Goose Bay)

- pH ranges between 6.93 and 7.18 pH units (Figure 10).
- pH values are very stable throughout the deployment period regardless of changing water levels. pH values generally fluctuate on a daily basis. Towards the end of the deployment period, this daily fluctuation is decreasing.
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 10).

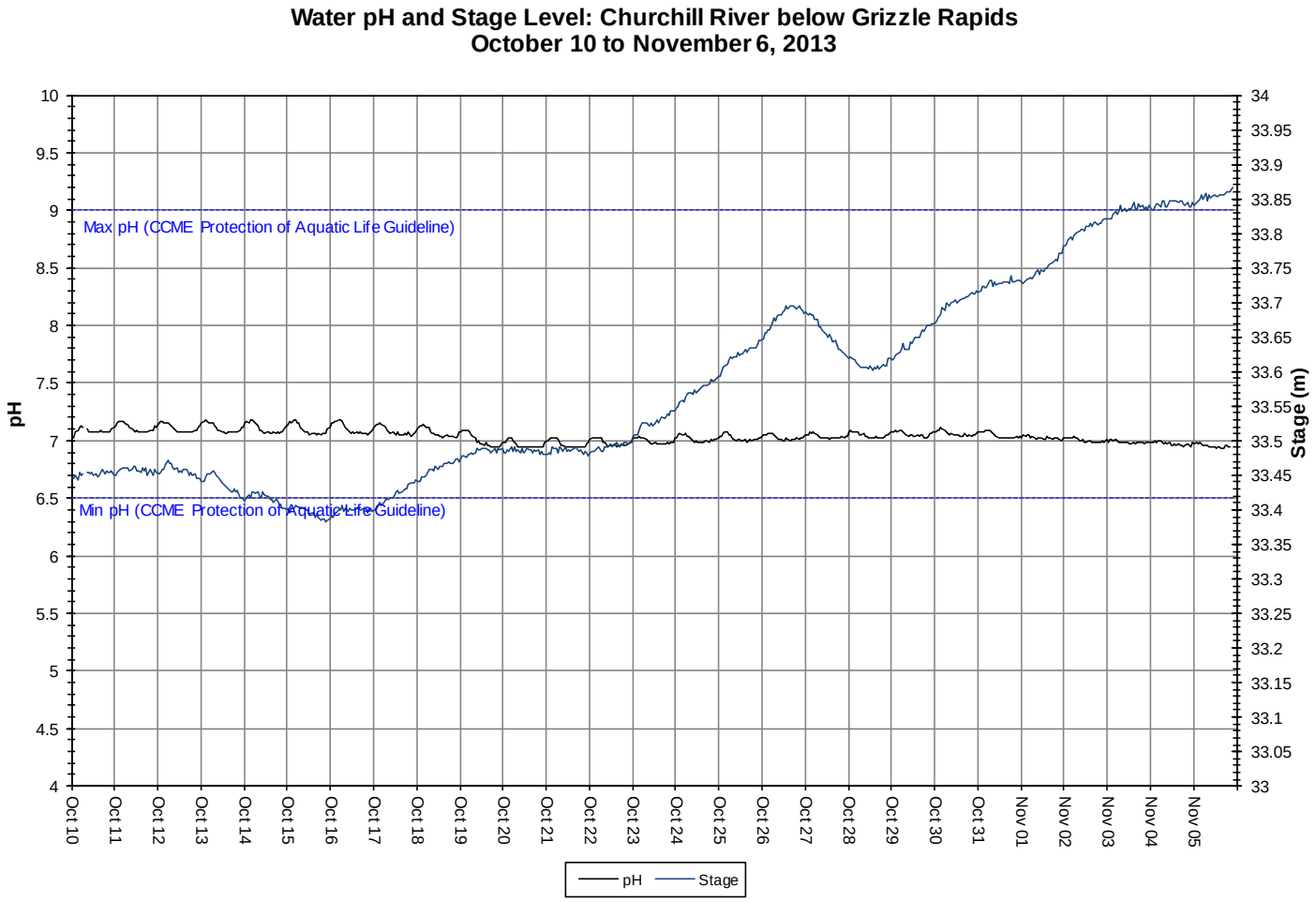


Figure 10: pH and stage level at Churchill River below Grizzle Rapids

- Specific conductivity ranges from 17.6µS/cm to 19.1µS/cm during the deployment period, averaging 18.5µS/cm (Figure 11).
- 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 and that is typical of this station. Specific conductivity is very stable despite changing water levels.

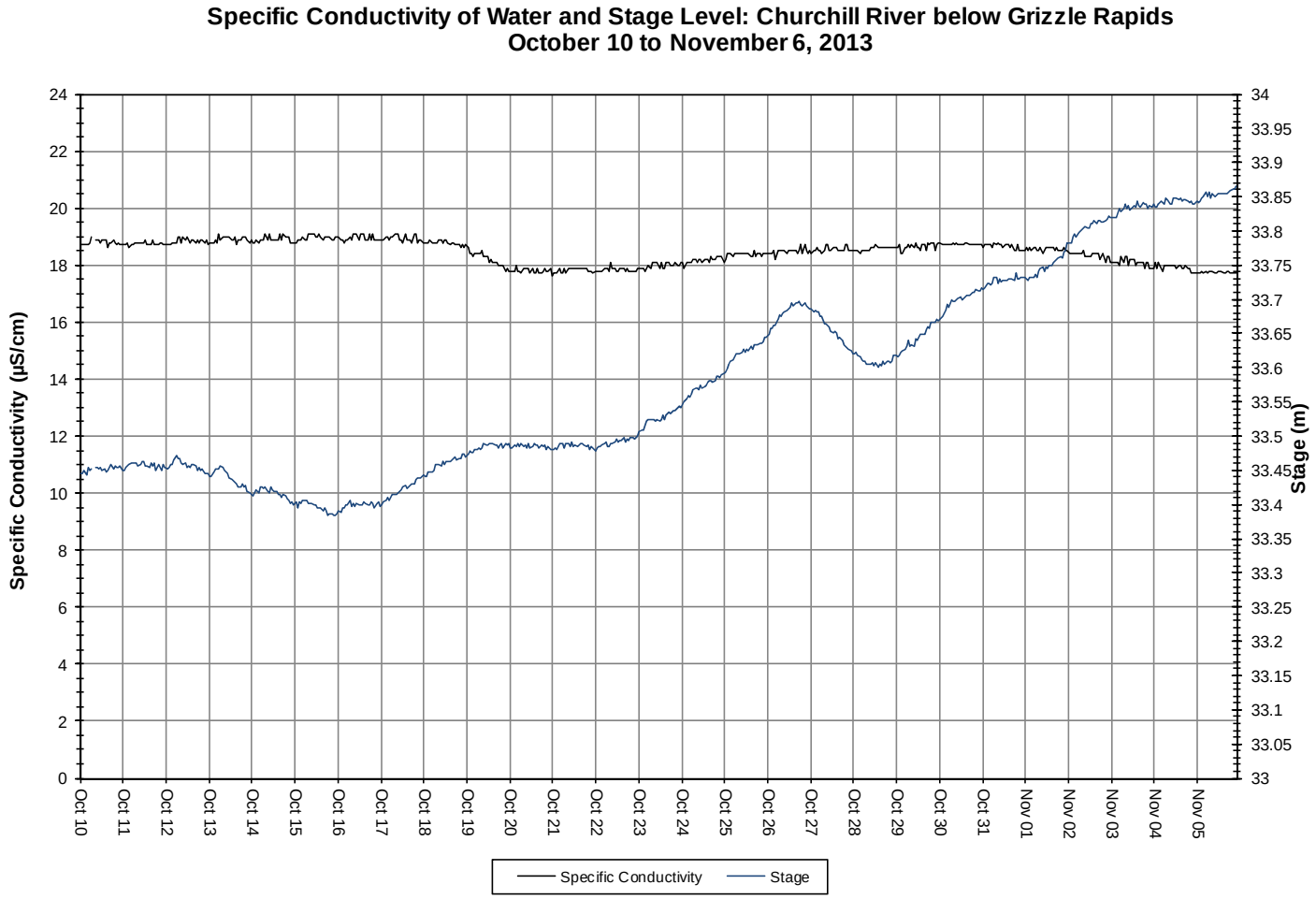


Figure 11: Specific conductivity and stage level at Churchill River below Grizzle Rapids

- Dissolved oxygen content ranges between 11.33mg/l and 12.46mg/l. The saturation of dissolved oxygen ranges from 95.1% to 100.8% (Figure 12).
- All values were above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l and at Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 12.
- Dissolved oxygen content is increasing slightly throughout the deployment period. This trend is expected given the cooling air and water temperatures (Figure 9).

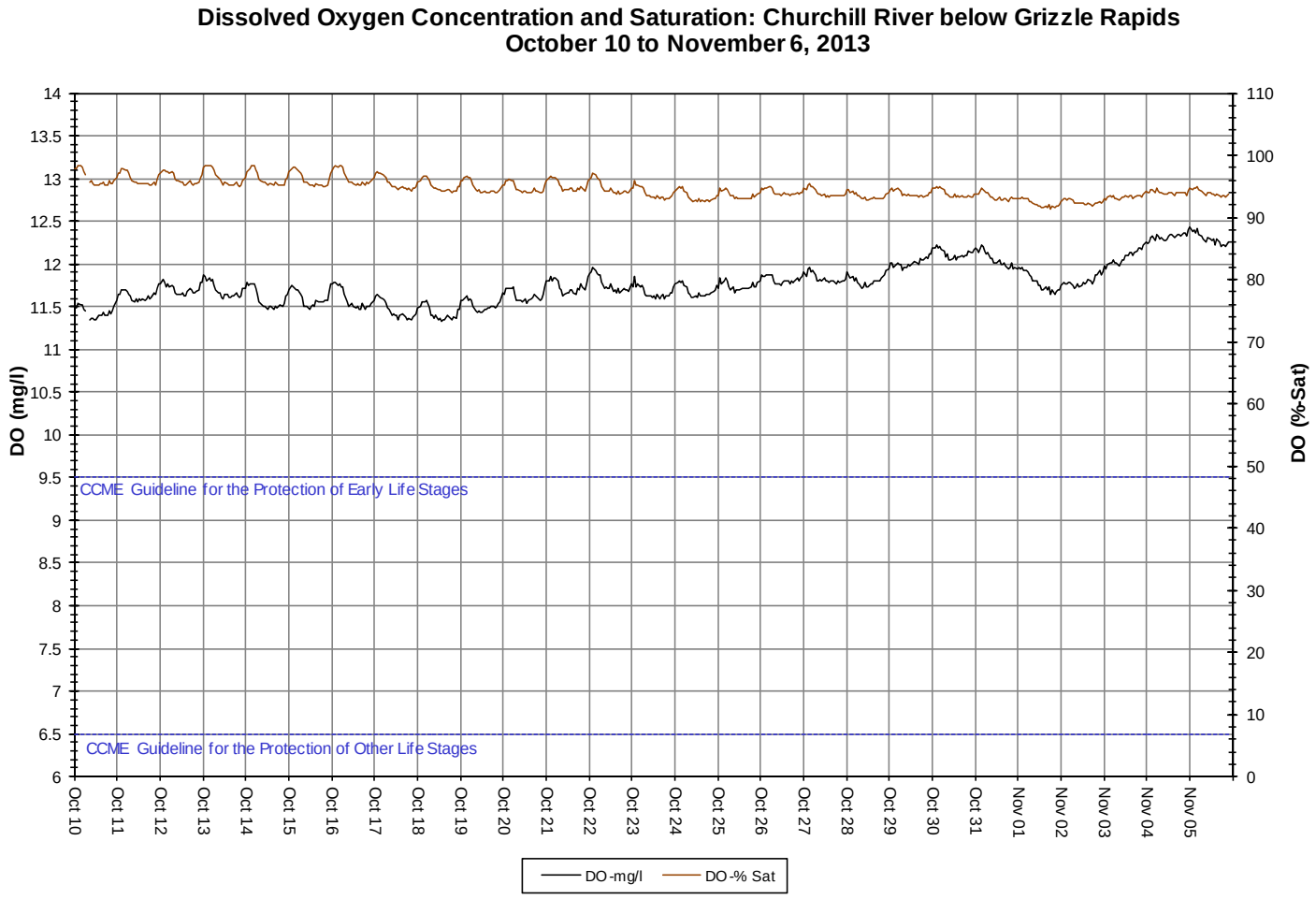


Figure 12: Dissolved oxygen and percent saturation at Churchill River below Grizzle Rapids

- Turbidity values remain at 0NTU for most 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.
- Turbidity increases up to 259NTU near the end of the deployment period on November 4. This event follows a large precipitation (rain and snow) event on November 1. It is unknown whether or not the precipitation could have caused this increase in turbidity as it is rare for this station to see turbidity values at this magnitude for any length of time greater than 1-2 hours.

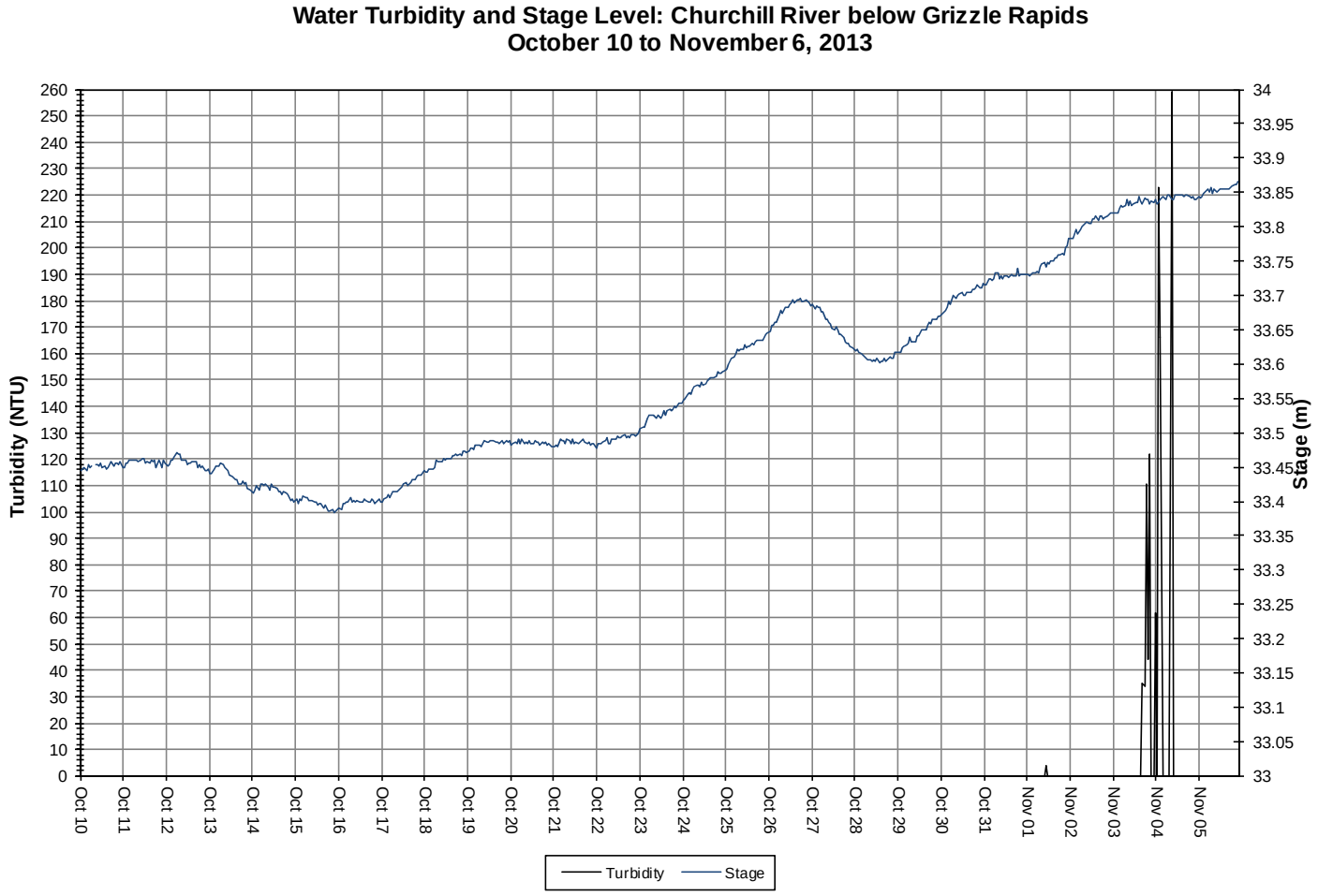


Figure 13: Turbidity and stage level at Churchill River below Grizzle Rapids

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 14). Stage is mostly increasing throughout the deployment period. Precipitation occurs on >50% of the days in the deployment period and amounts are moderate in magnitude. Stage ranges between 33.38m and 33.87m, a difference of 0.49m.

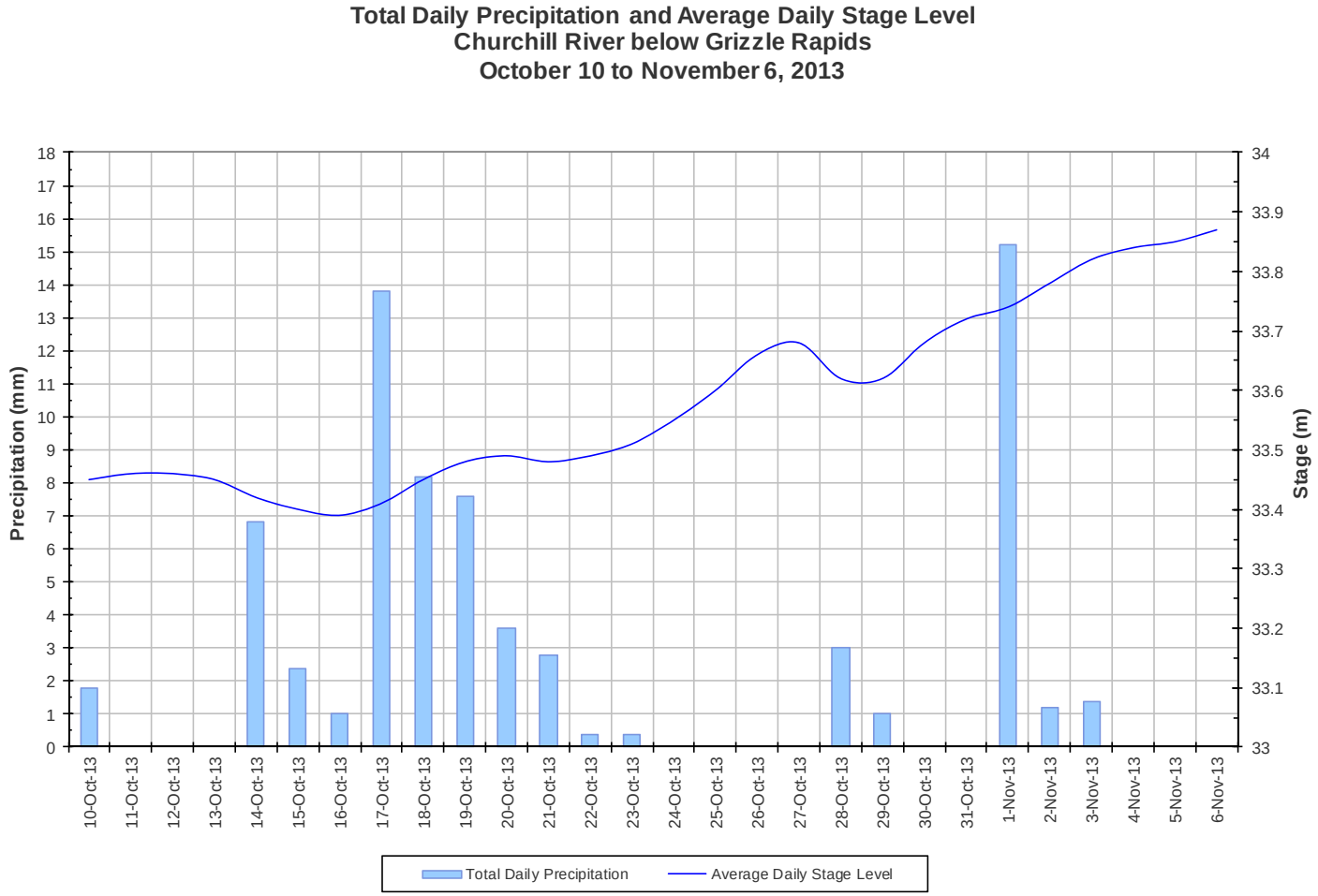


Figure 14: Daily precipitation and average daily stage level at Churchill River below Grizzle Rapids (weather data recorded at Goose Bay)

Churchill River above Muskrat Falls

- Water temperature ranges from 3.11°C to 7.73°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 in the fall season (Figure 16).

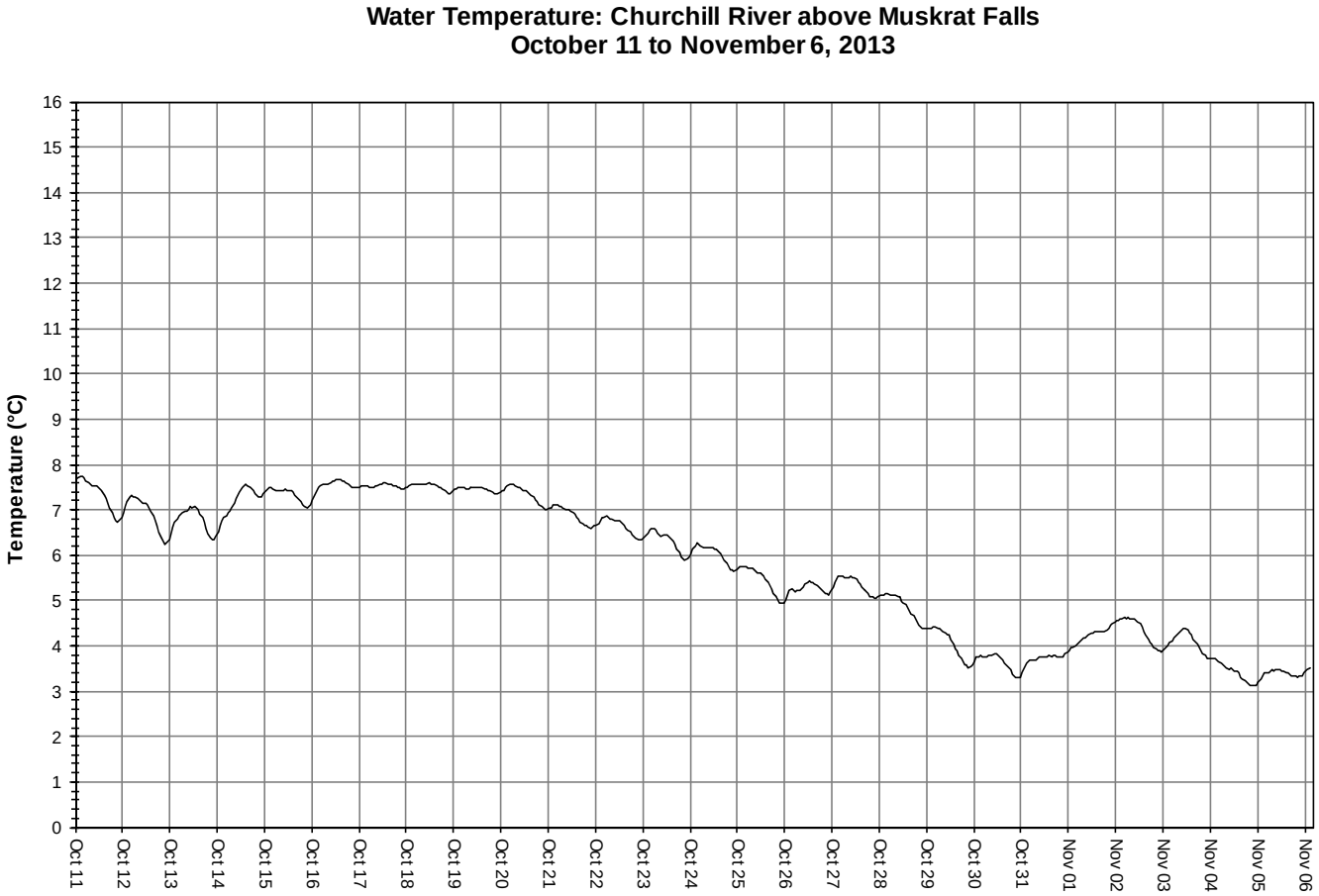


Figure 15: Water temperature at Churchill River above Muskrat Falls

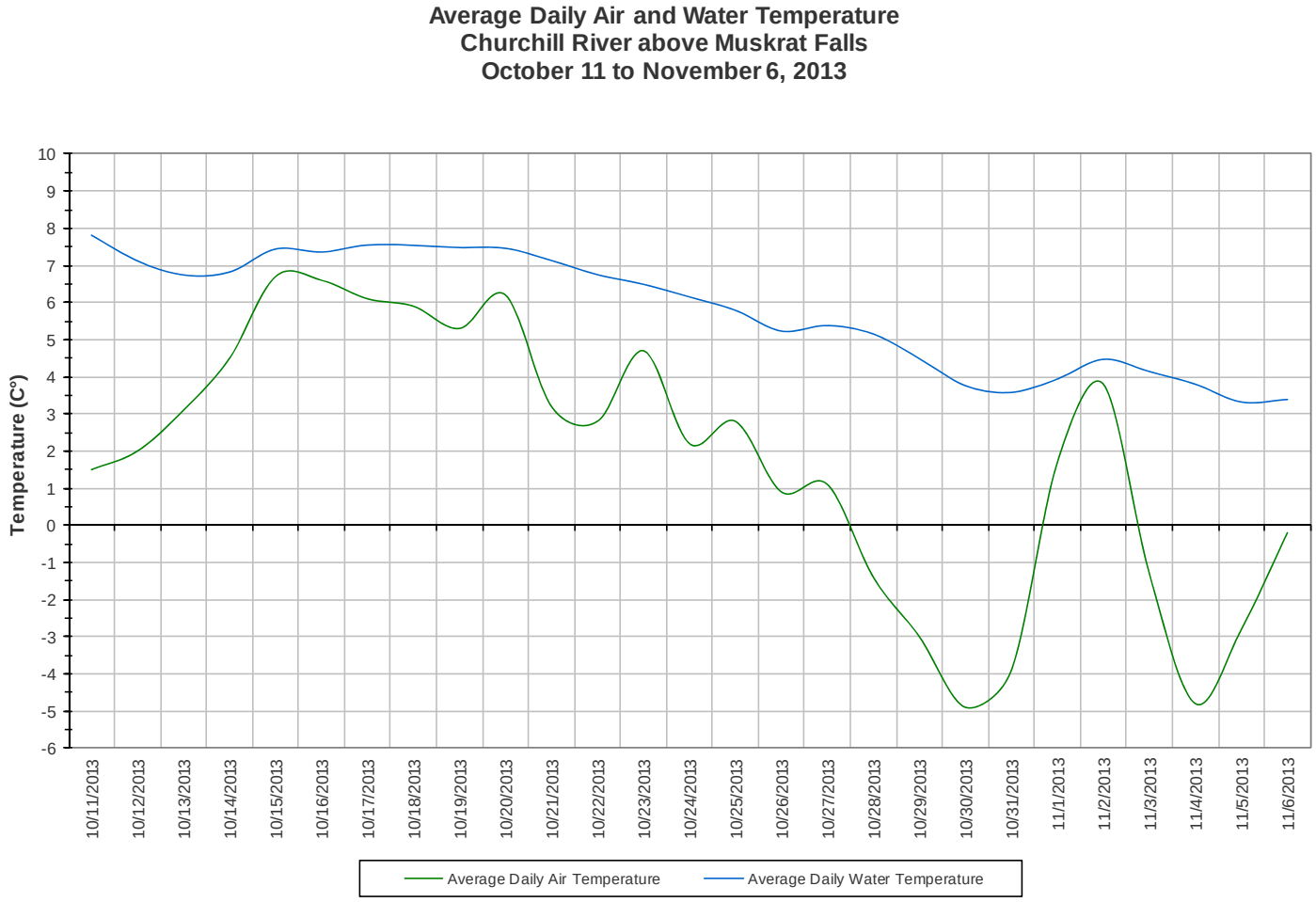


Figure 16: Average daily air and water temperature at Churchill River above Muskrat Falls (weather data recorded at Goose Bay)

- pH ranges between 6.83 and 7.02 pH units (Figure 17). pH values are very stable throughout the deployment period despite the changing water levels.
- All pH values recorded are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 17).

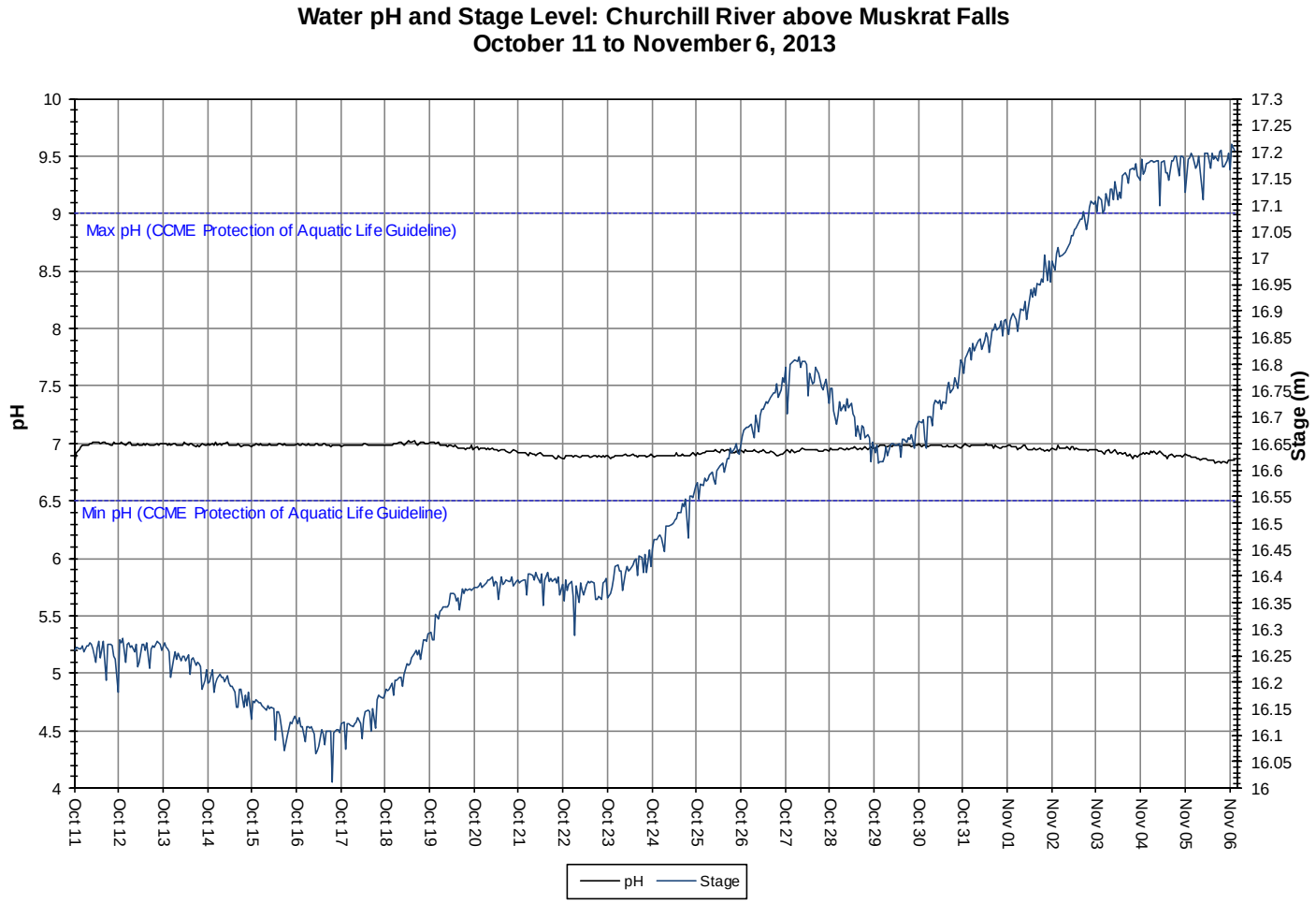


Figure 17: pH and stage at Churchill River above Muskrat Falls

- Specific conductivity ranges from 18.1µS/cm to 20.4µS/cm during the deployment period, averaging 19.0µS/cm. (Figure 18).
- 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 and that is typical of this station. Specific conductivity is relatively stable despite changing water levels.

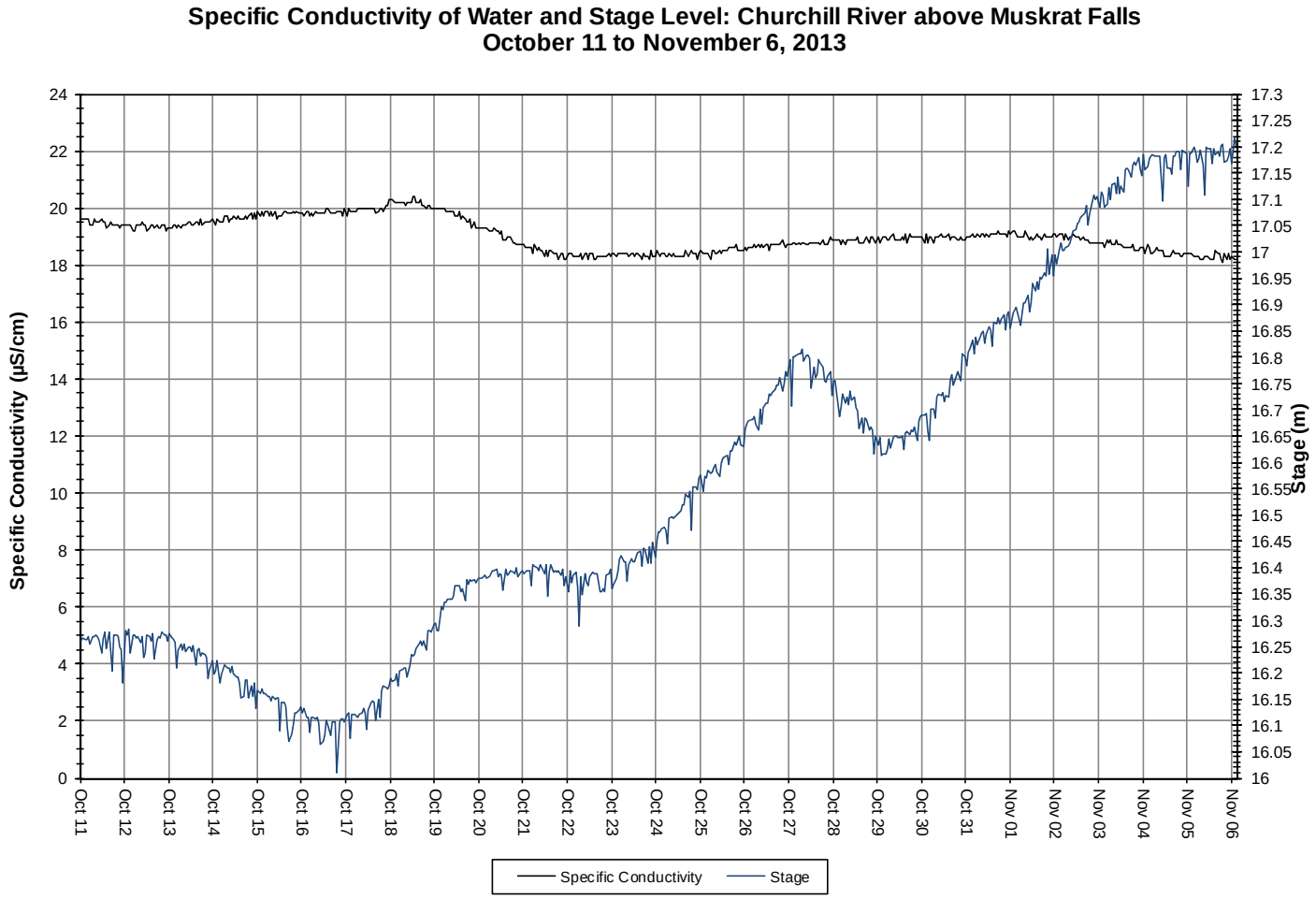


Figure 18: Specific conductivity and stage level at Churchill River above Muskrat Falls

- Dissolved oxygen content ranges between 11.21mg/l and 12.33mg/l. The saturation of dissolved oxygen ranges from 90.0% to 95.7% (Figure 19).
- All values were above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l and at Early Life Stages of 9.5mg/l. 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).

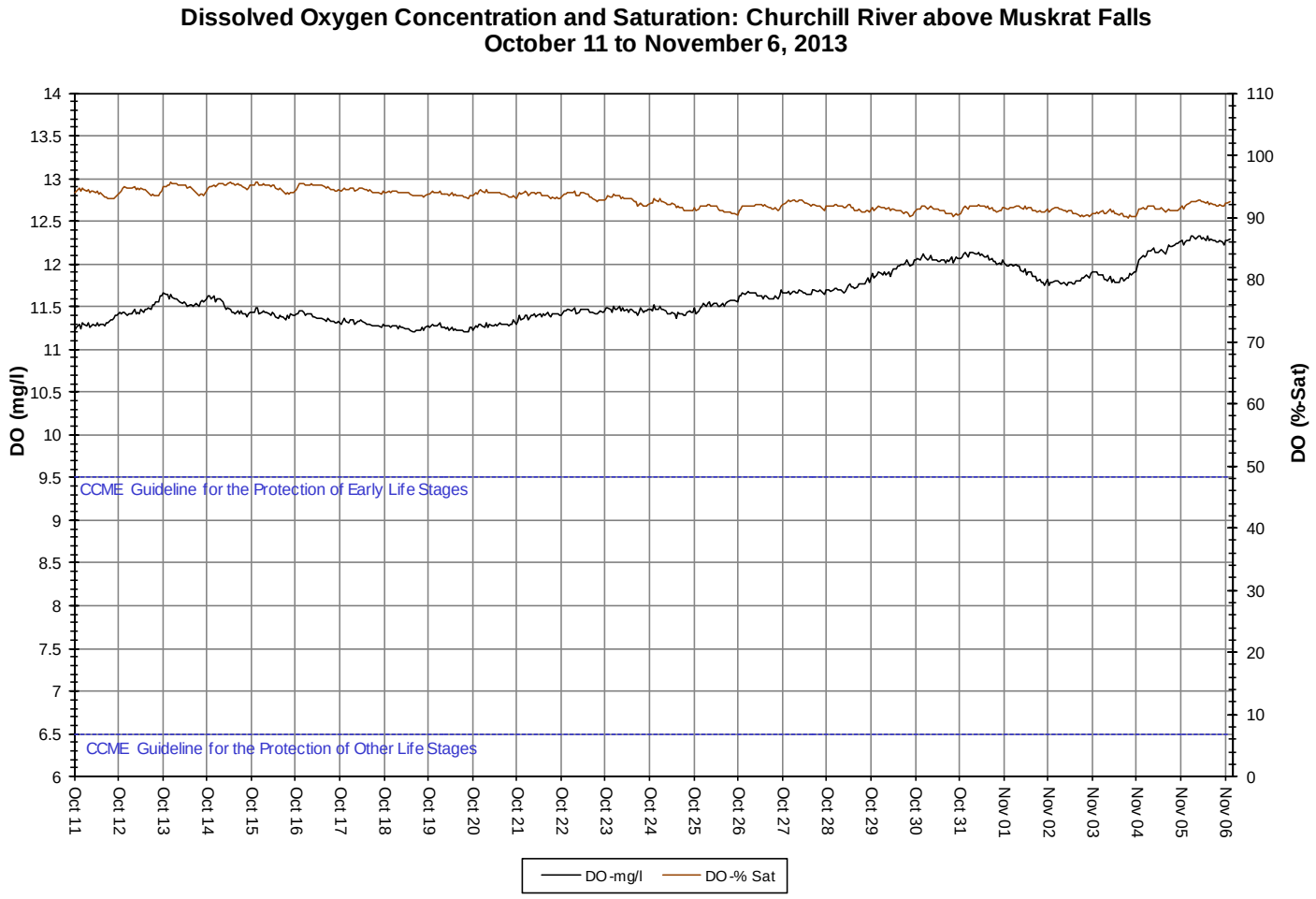


Figure 19: Dissolved oxygen and percent saturation at Churchill River above Muskrat Falls

- Turbidity ranges between 0.0NTU and 25.3NTU, averaging 2.9 NTU during the first week of the deployment (Figure 20). A median value of 1.4NTU suggests there is consistent natural background turbidity value. This trend is typical at this station.
- Turbidity increases on October 18-20, October 28 and November 2-5 each correspond with precipitation events. These events are highlighted in red on Figure 20.

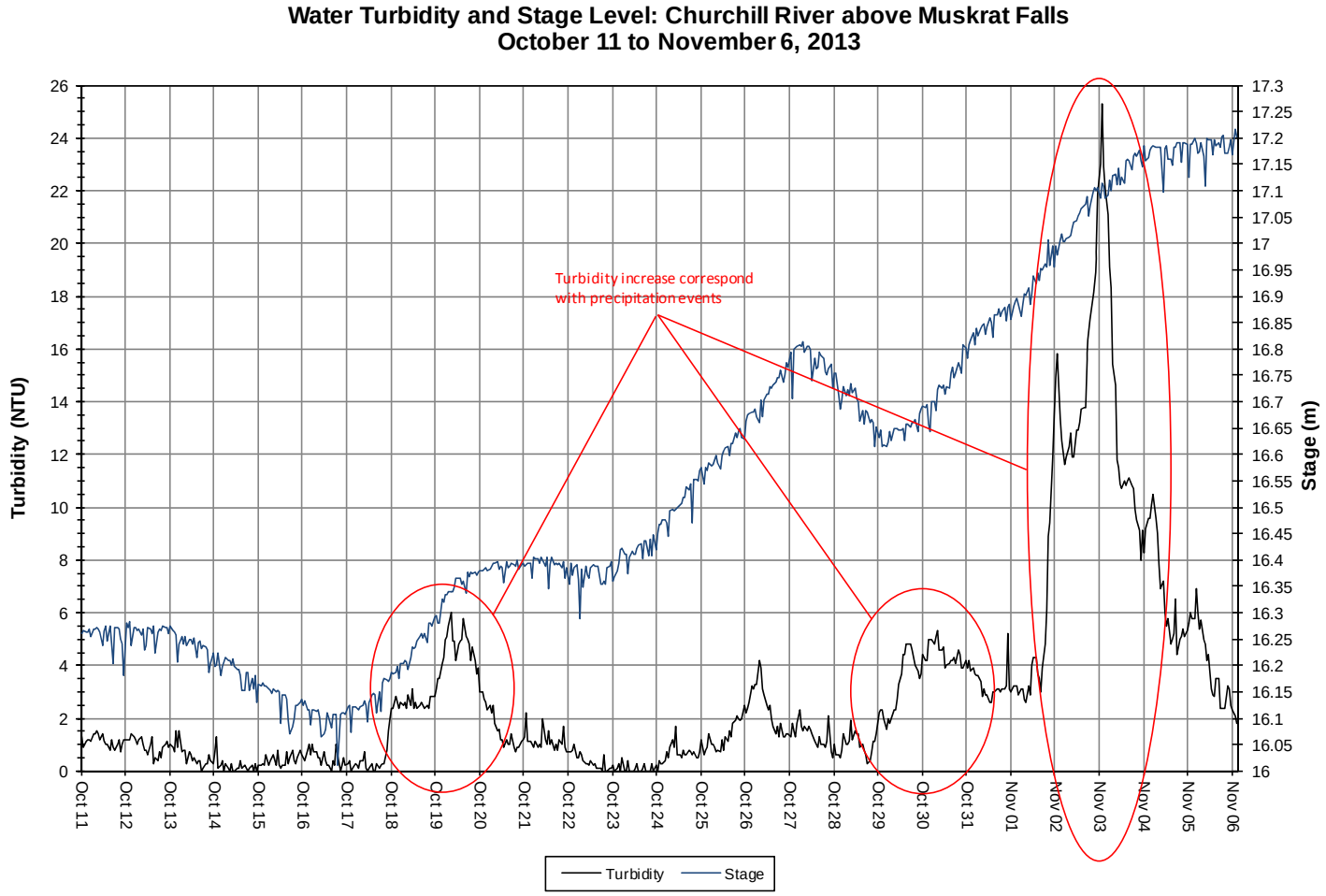


Figure 20: Turbidity and stage level at Churchill River above Muskrat Falls

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 22). Stage is mostly increasing throughout the deployment period. Precipitation occurs on >50% of the days in the deployment period and amounts are moderate in magnitude. Stage ranges between 16.01m and 17.22m, a difference of 1.21m. Discharge ranges from 1280m^3/s to 1990m^3/s.

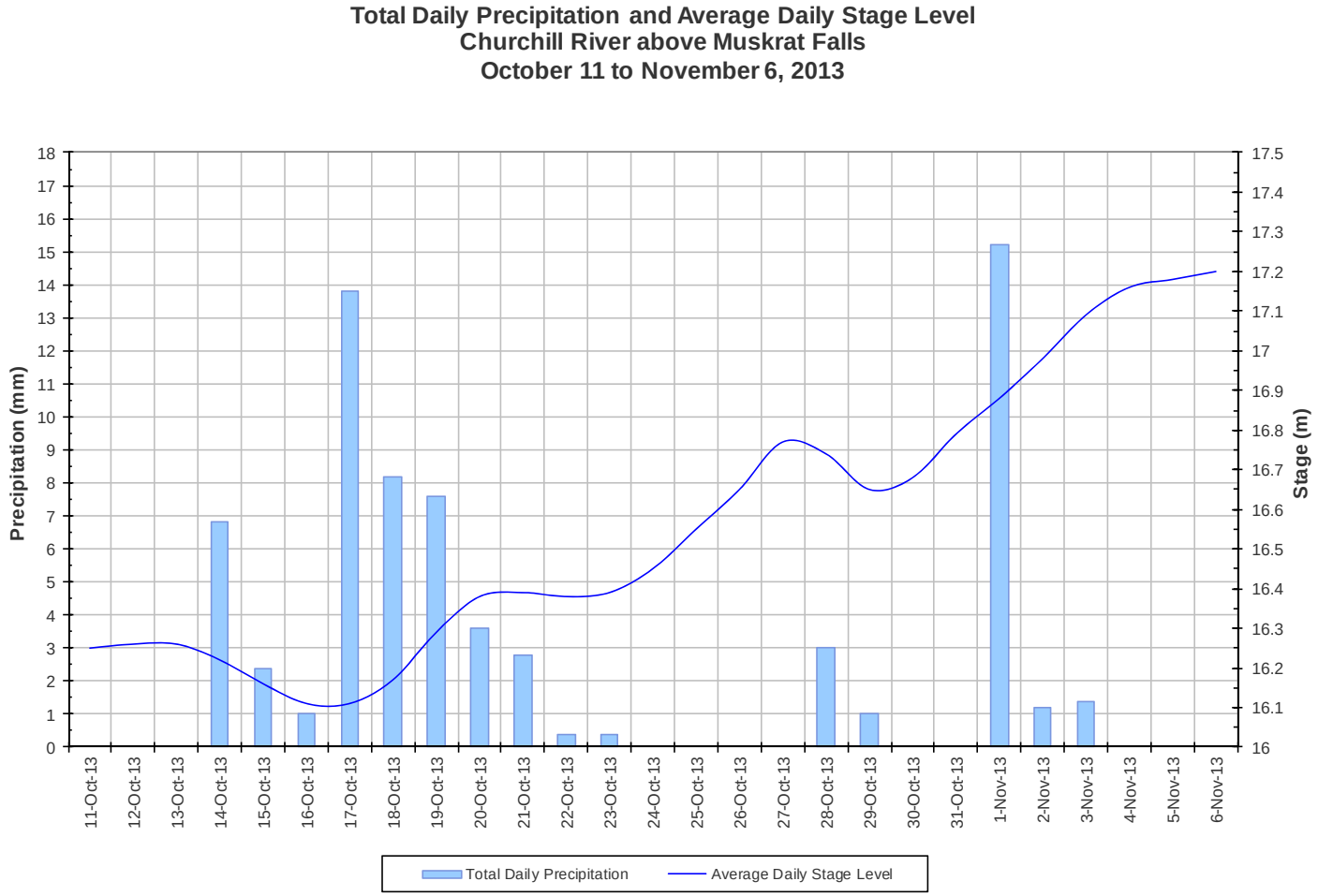


Figure 22: Daily precipitation and average daily stage level at Churchill River above Muskrat Falls (weather data recorded at Goose Bay)

Churchill River below Muskrat Falls

- Water temperature ranges from 3.40°C to 8.30°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 in the fall season (Figure 24).

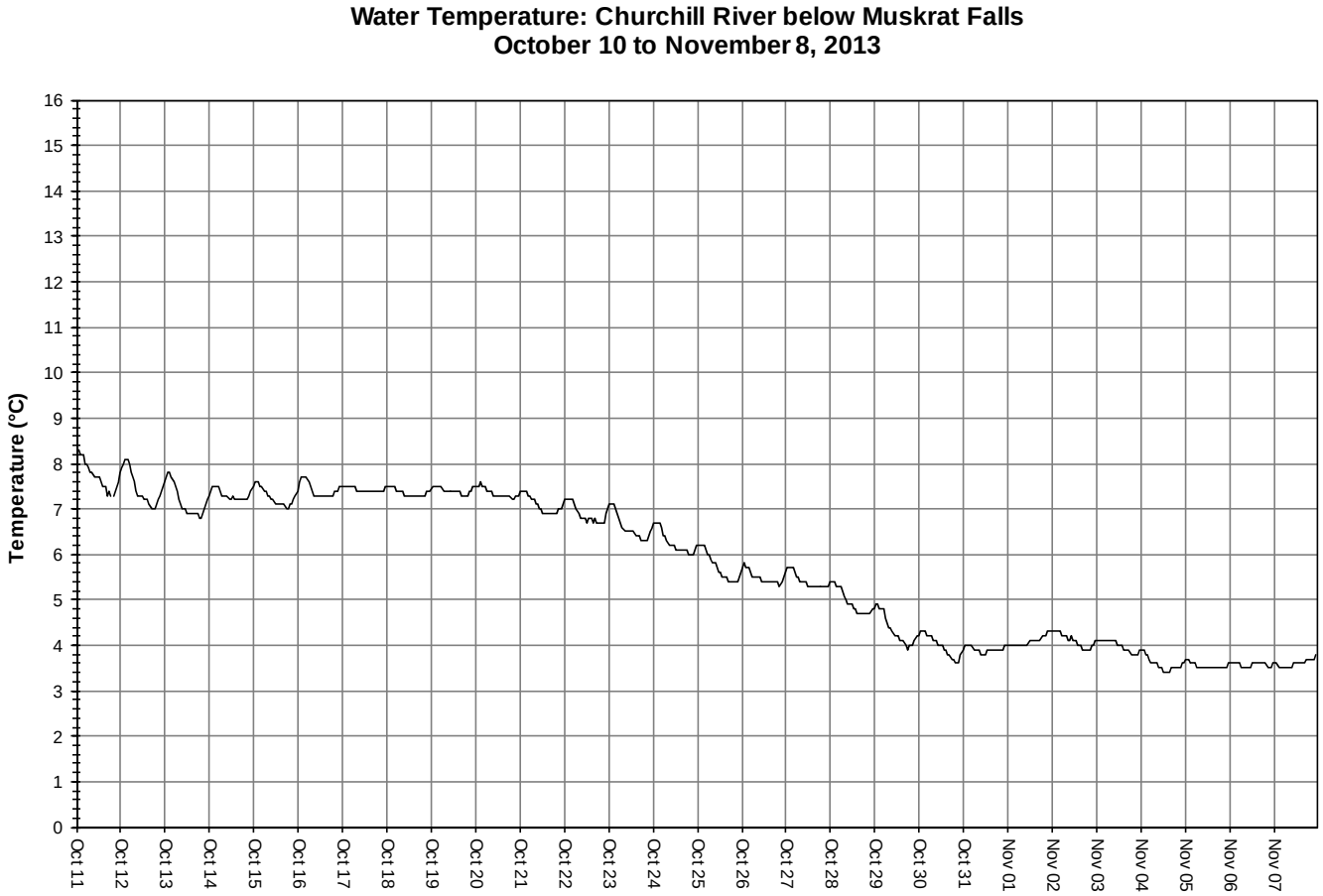


Figure 23: Water temperature at Churchill River below Muskrat Falls

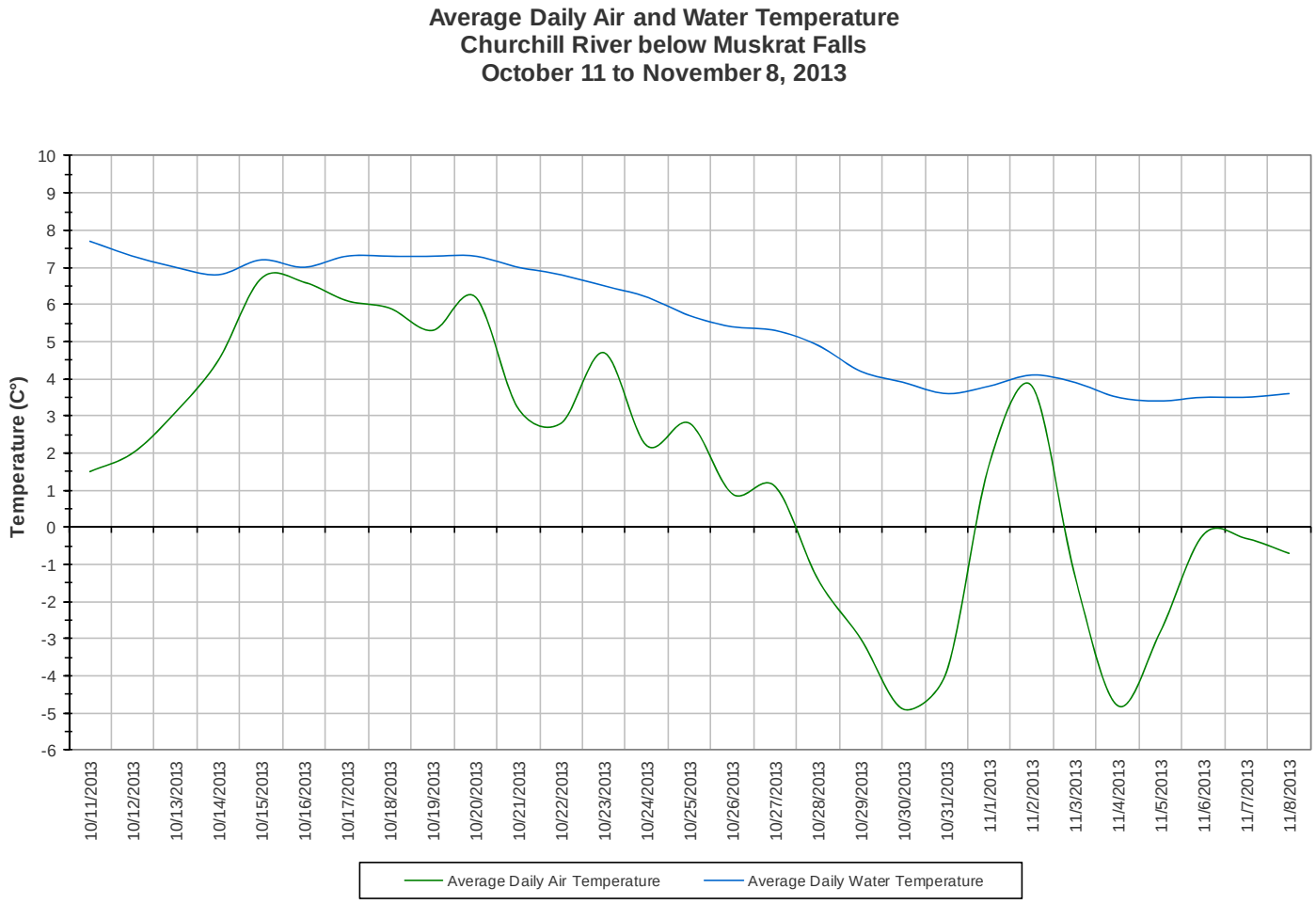


Figure 24: Average daily air and water temperature at Churchill River below Muskrat Falls

(weather data recorded at Goose Bay)

- pH ranges between 7.04 and 7.28 pH units (Figure 25). pH is very stable at this station despite the changing water level.
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 25).

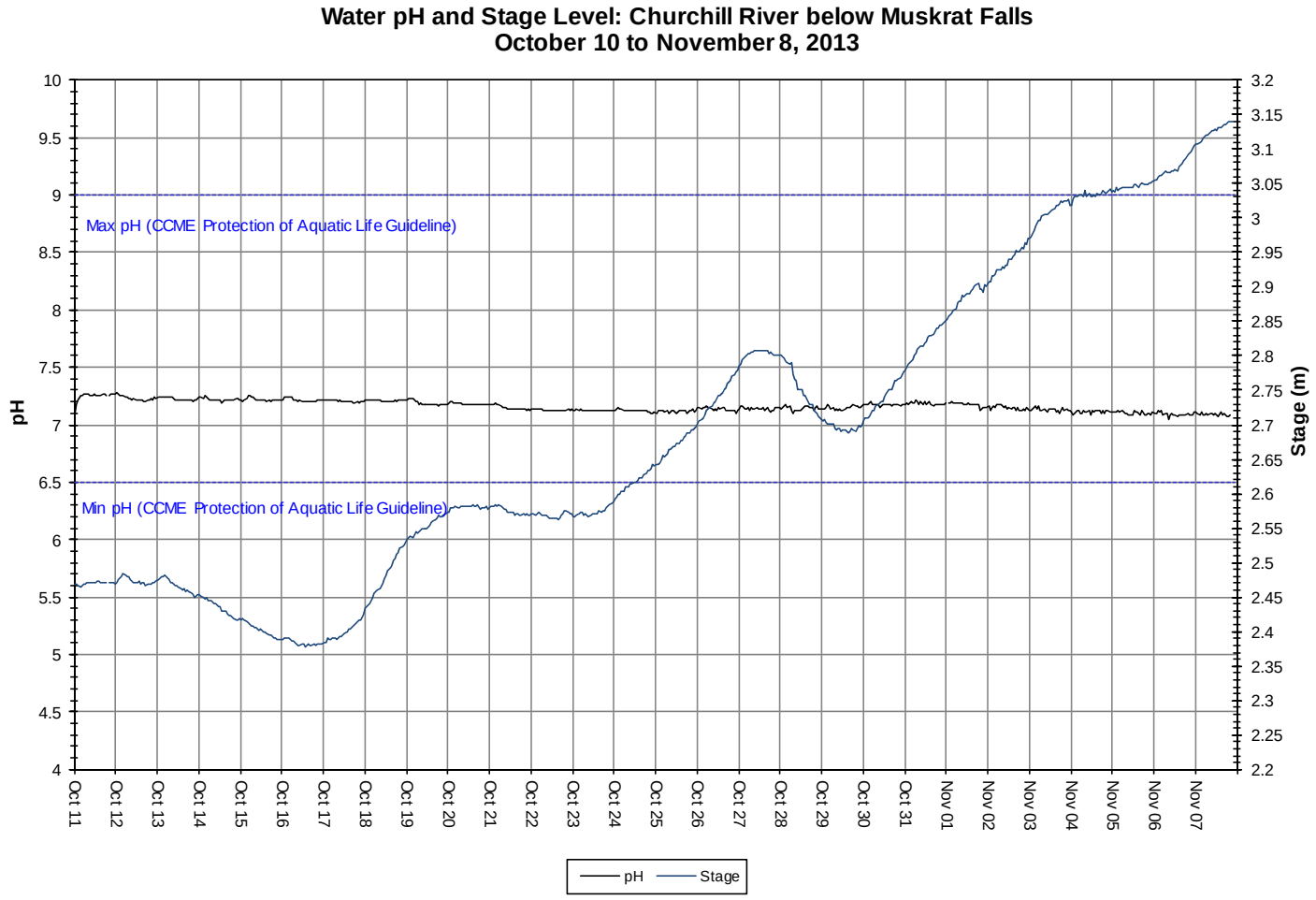


Figure 25: pH and stage level at Churchill River below Muskrat Falls

- Specific conductance ranges between 16.8µS/cm and 19.4µS/cm during the deployment period, averaging 18.2µS/cm (Figure 26).
- 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 remains stable during the changes in water level.

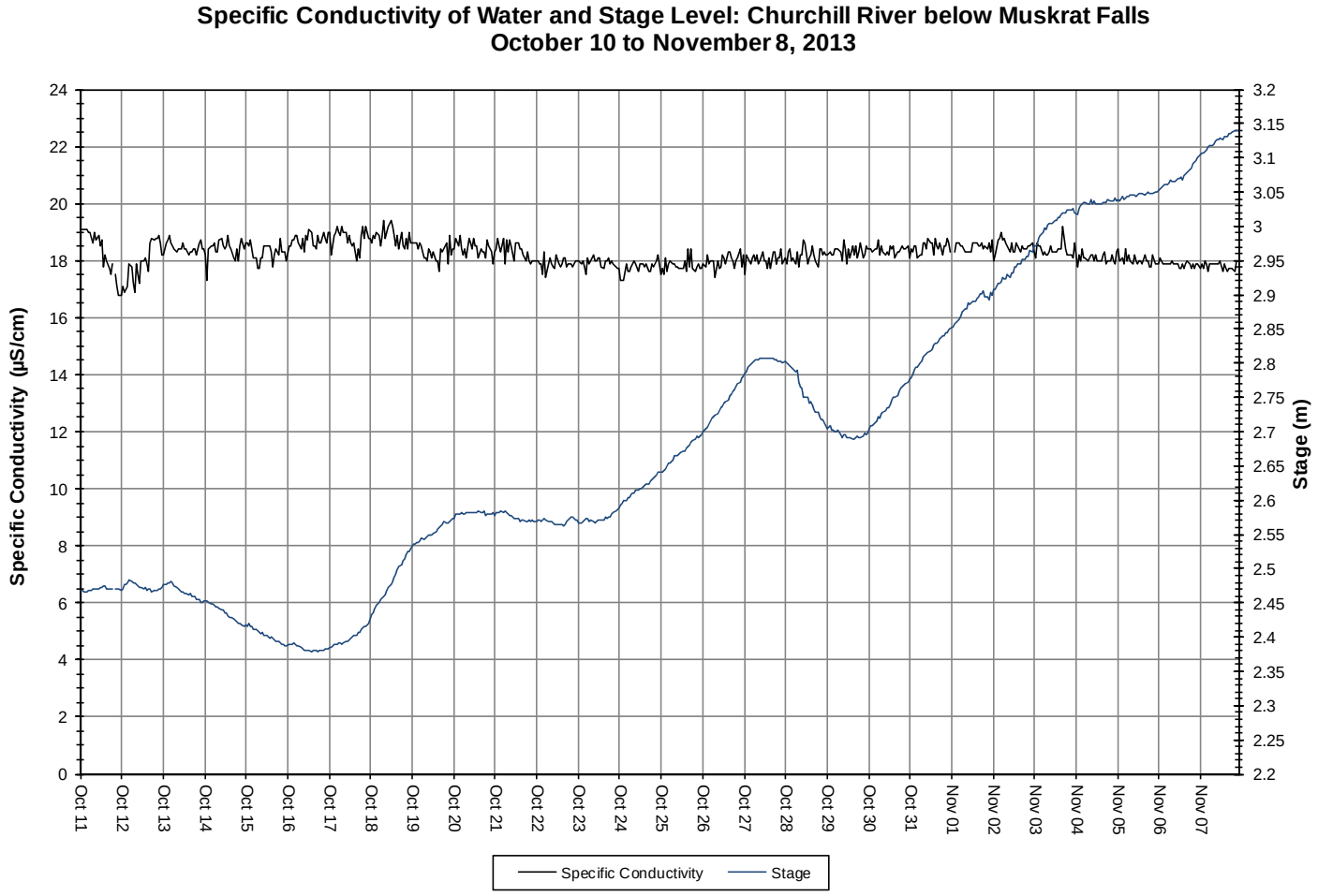


Figure 26: Specific conductivity and stage level at Churchill River below Muskrat Falls

- Dissolved oxygen content ranges between 12.46mg/l and 14.20mg/l. The saturation of dissolved oxygen ranges from 100.9% to 109.3% (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.

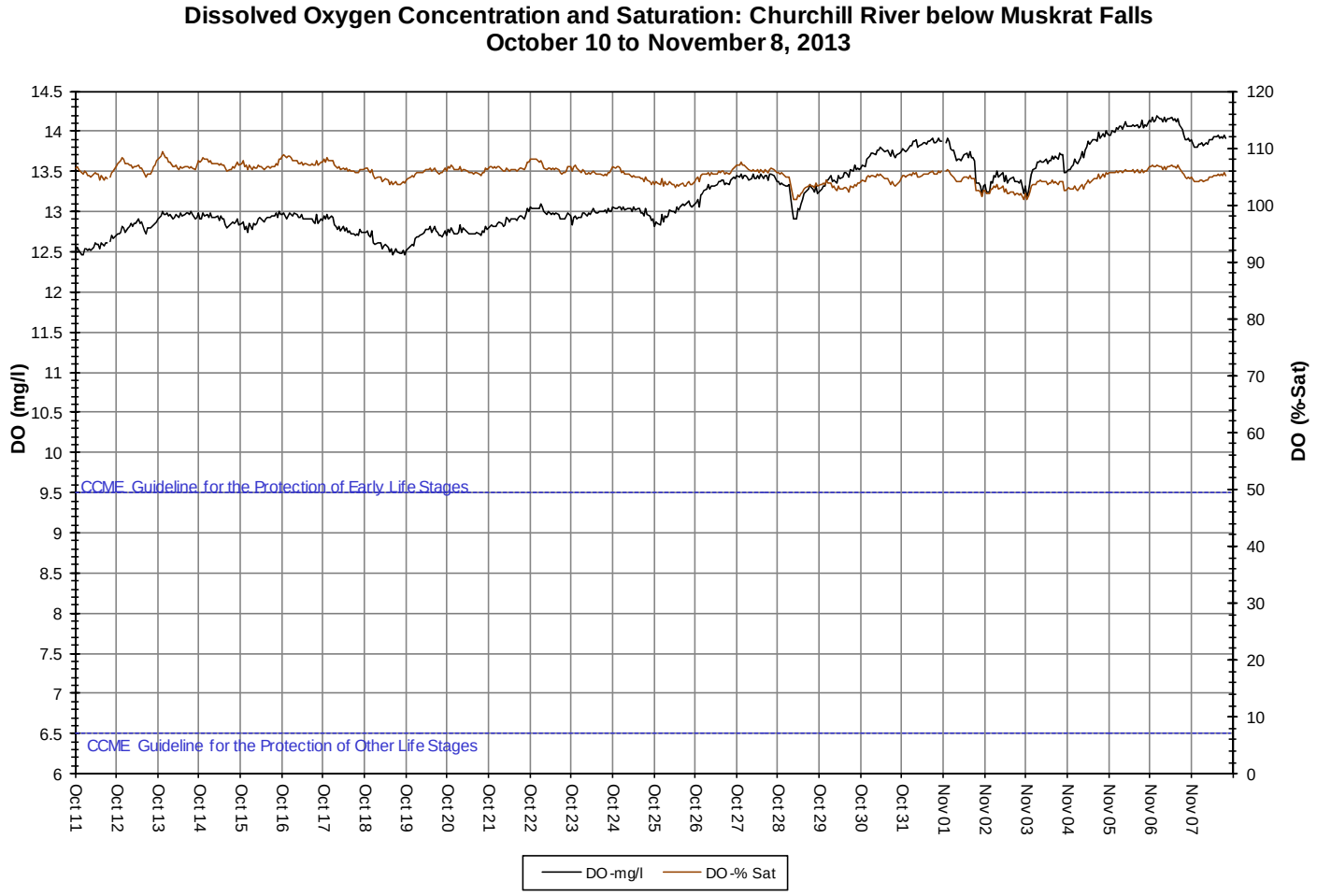


Figure 27: Dissolved oxygen and percent saturation at Churchill River below Muskrat Falls

- Turbidity ranges between 0.0NTU and 255NTU, averaging 9.6NTU (Figure 20). A median value of 4.3NTU during this time indicates there is a consistent natural background turbidity value. This trend is typical at this station.
- Turbidity values increase above background levels on a number of occasions. Turbidity increases on October 14, 17-18, 28 and November 1-5 each correspond with precipitation events. These events are highlighted in red on Figure 28.

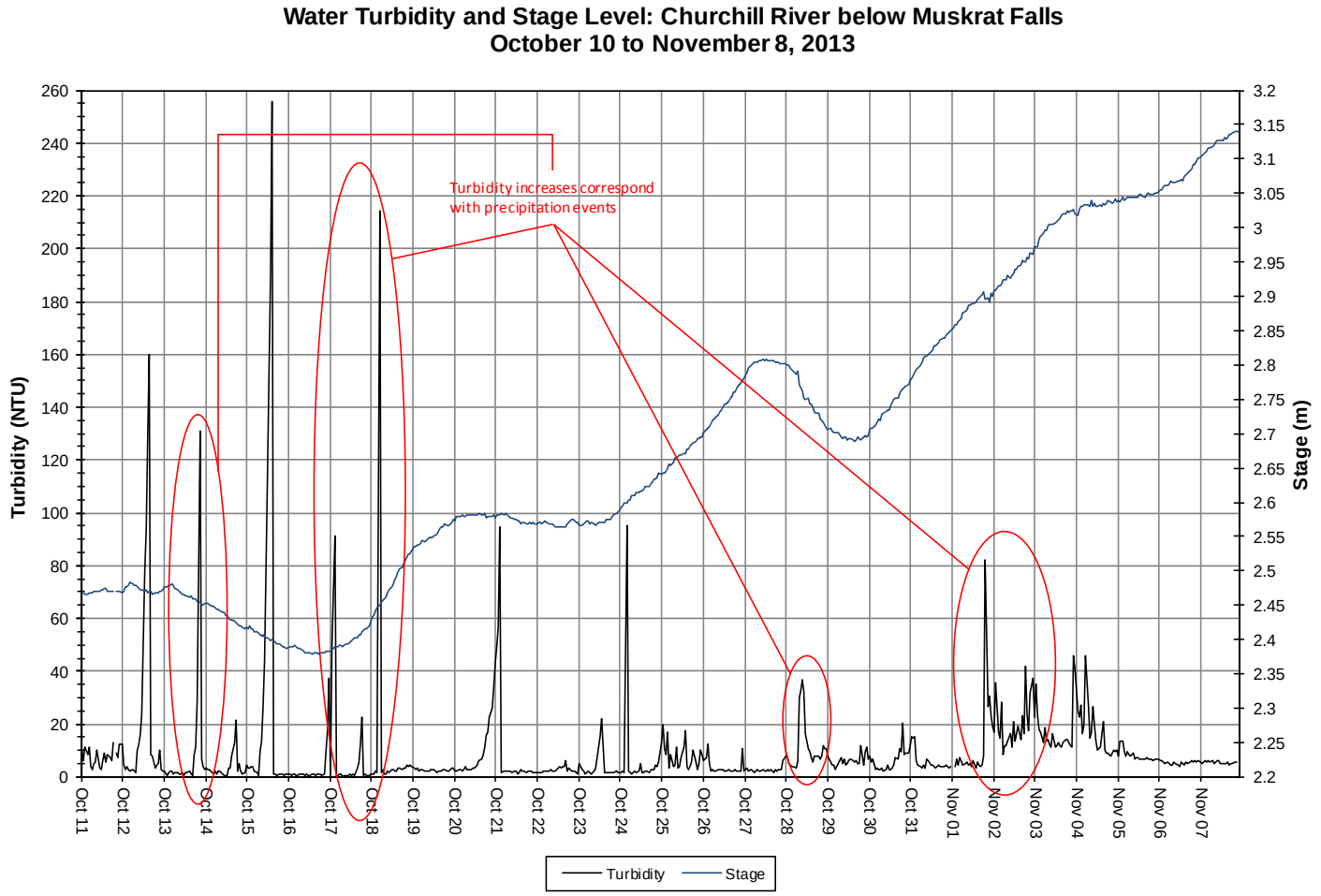


Figure 28: Turbidity and stage level at Churchill River below Muskrat Falls

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 30). Stage is mostly increasing throughout the deployment period. Precipitation occurs on >50% of the days in the deployment period and amounts are moderate in magnitude. Stage ranges between 2.38m and 3.14m, a difference of 0.76m.

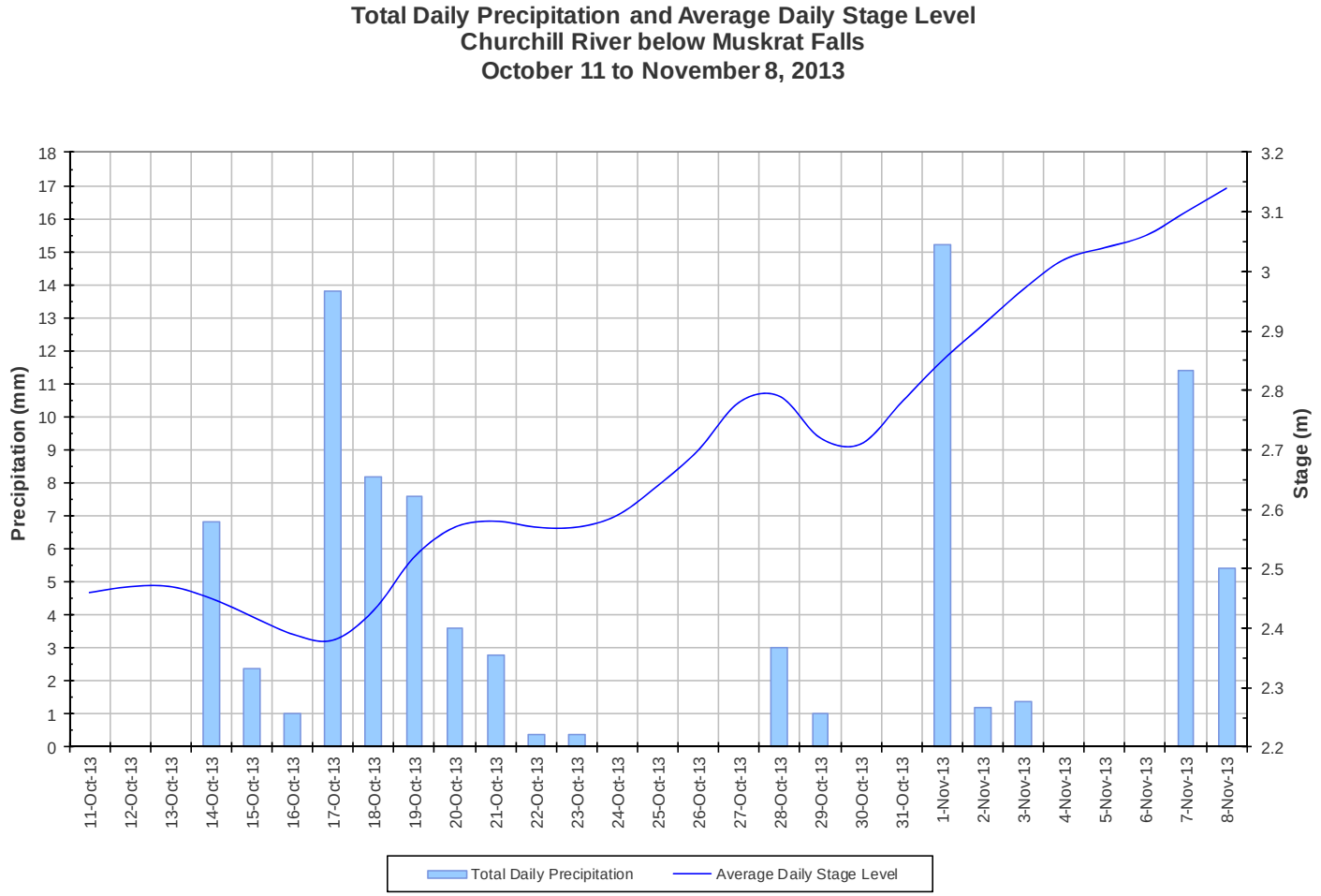


Figure 30: Daily precipitation and average daily stage level at Churchill River below Muskrat Falls (weather data recorded at Goose Bay)

Churchill River at English Point

- This station experienced a transmission error from September 19 to October 20. Log file data from the instrument internal memory is not available due to a problem with the file. Valid data is only available from October 20 to November 8.

- Water temperature ranges from 2.90°C to 8.30°C from October 20 to November 8 (Figure 31).
- Water temperature is decreasing throughout this period. This trend is expected given the cooling ambient air temperatures in the fall season (Figure 32). Water temperature fluctuates diurnally.

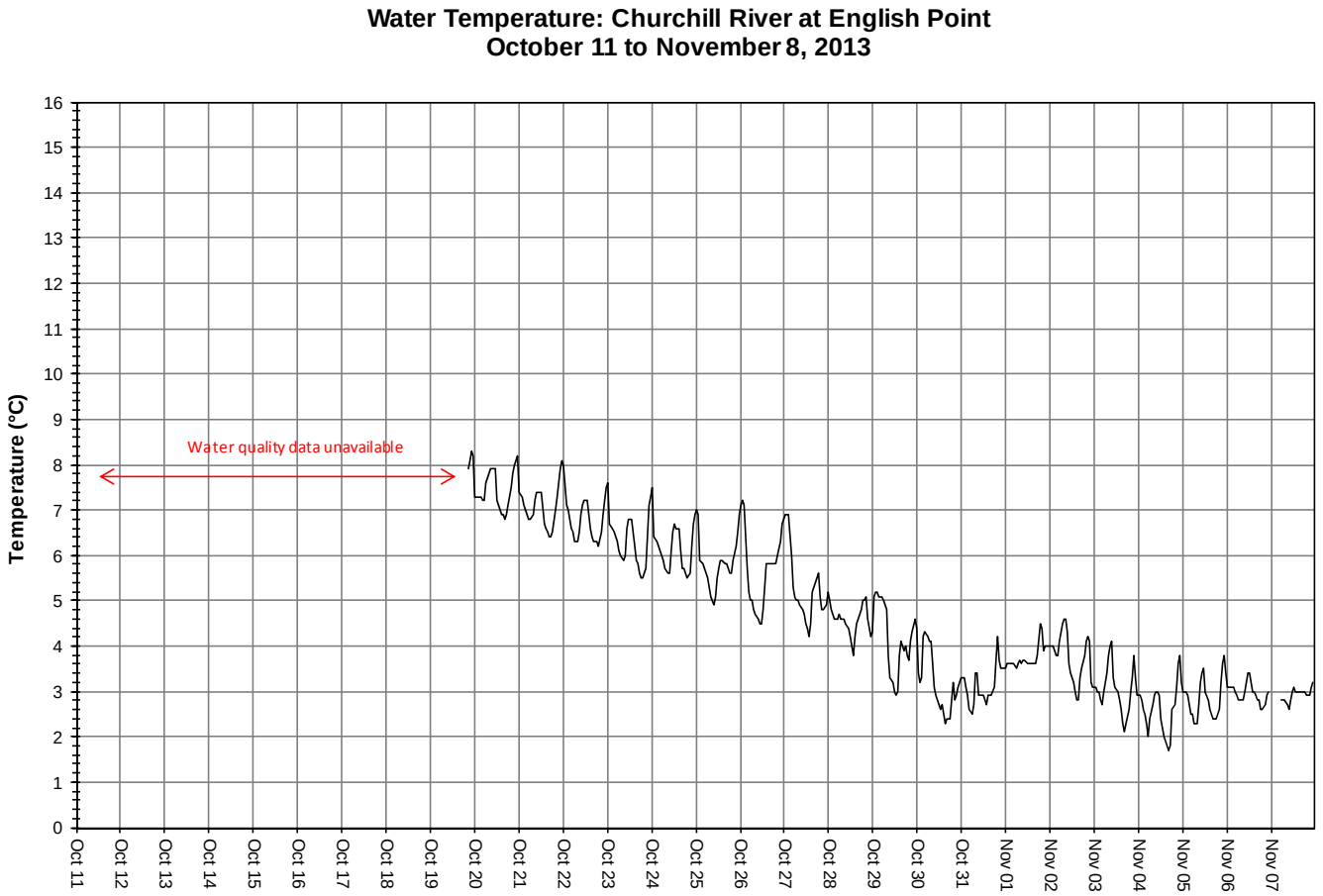


Figure 31: Water temperature at Churchill River at English Point

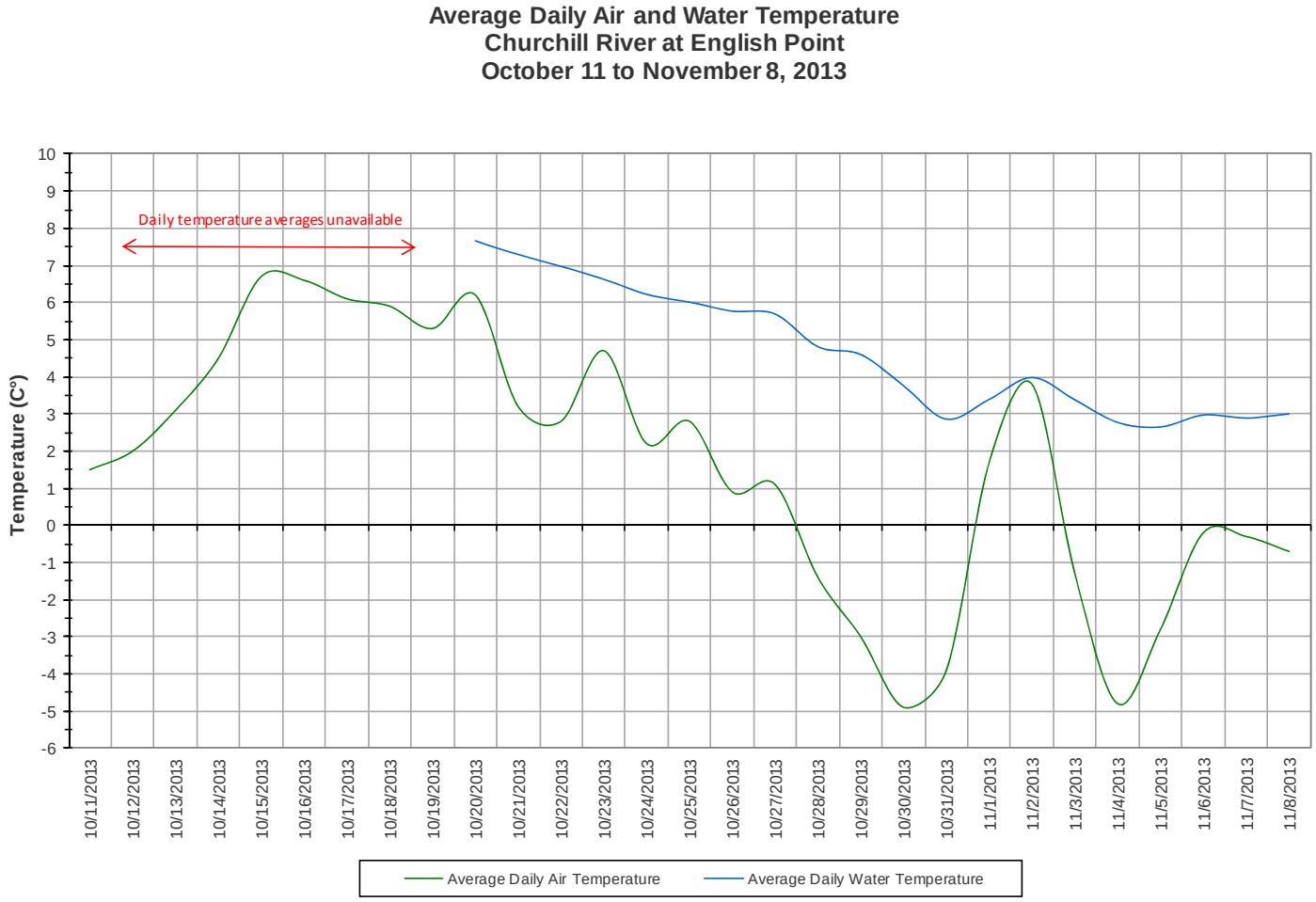


Figure 32: Average daily air and water temperature at Churchill River at English Point

(weather data recorded at Goose Bay)

- pH ranges between 6.91 and 7.24 pH units between October 20 and November 8 (Figure 33).
- All values during this period are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 33).

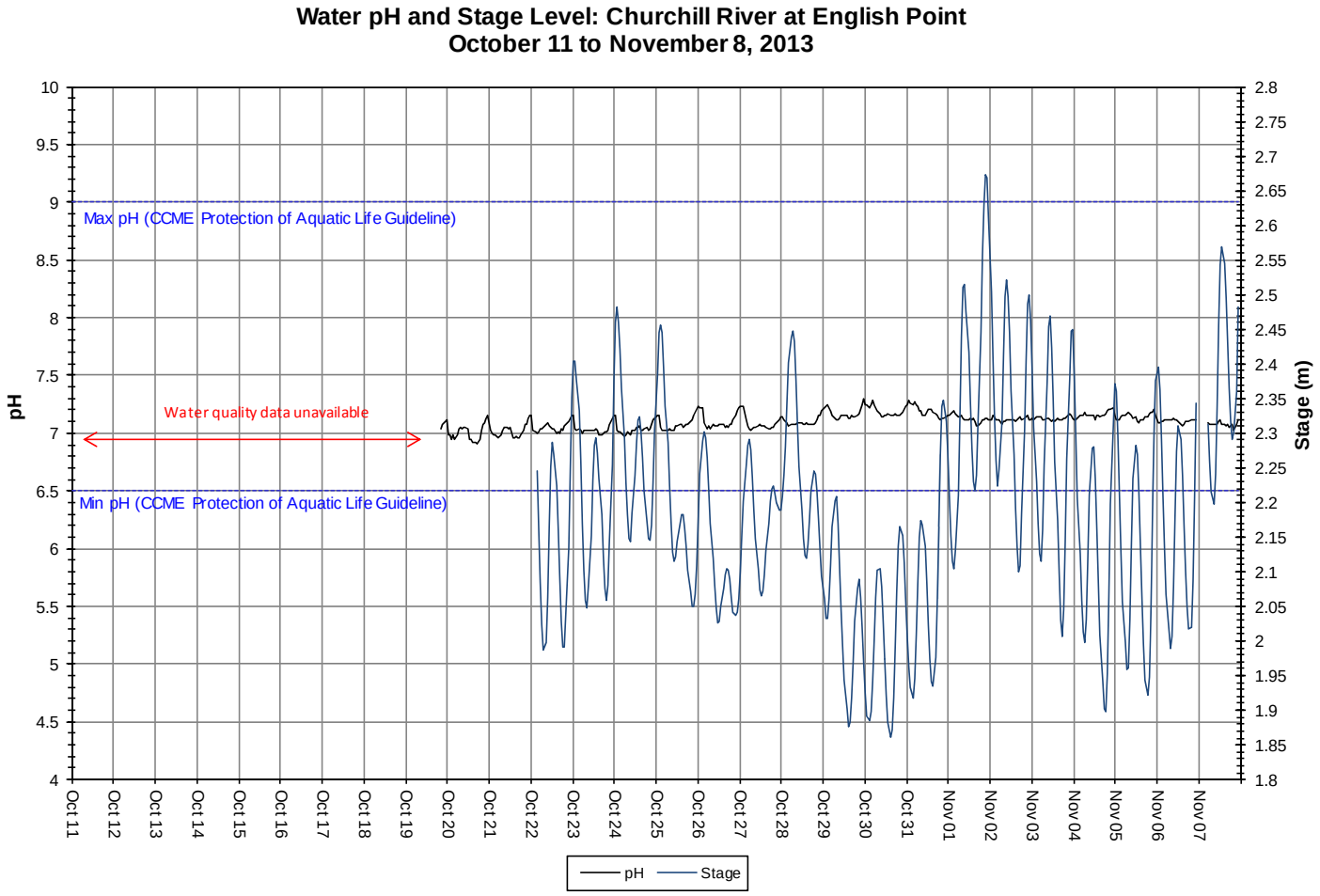


Figure 33: pH and stage level at Churchill River at English Point

- Specific conductance typically ranges between 19.7µS/cm and 42.9µS/cm between October 20 and November 8, averaging 30.4µS/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 during a period of low stage level from October 28 to November 1. This increase is highlighted in red on Figure 34.

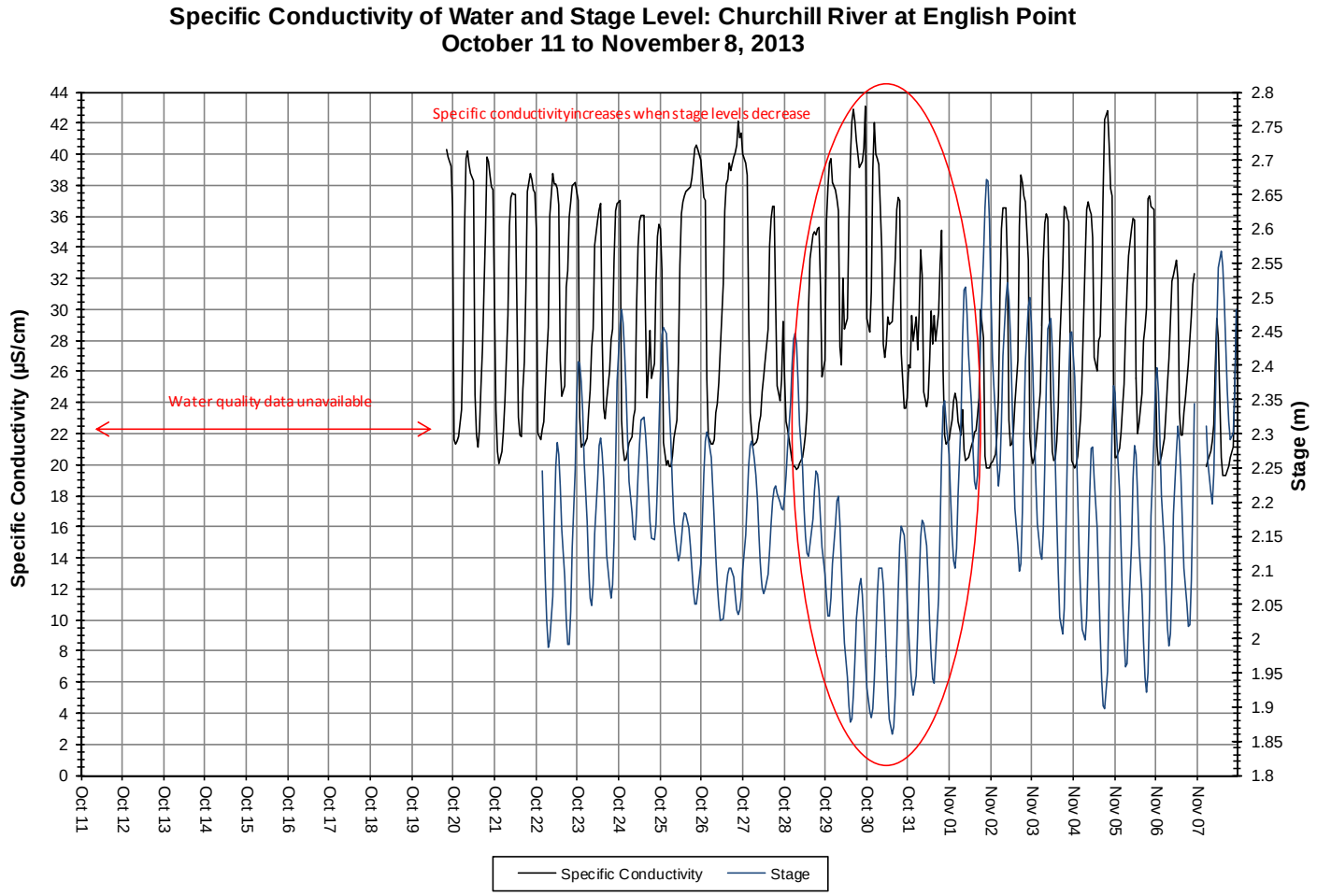


Figure 34: Specific conductivity and stage level at Churchill River at English Point

- Dissolved oxygen content ranges between 10.91mg/l and 13.01mg/l between October 20 and November 8. The saturation of dissolved oxygen ranges from 87.6% to 102.7% (Figure 35).
- 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 35.
- Dissolved oxygen content is increasing slightly throughout the deployment period. This trend is expected given the cooling air and water temperatures (Figure 32).

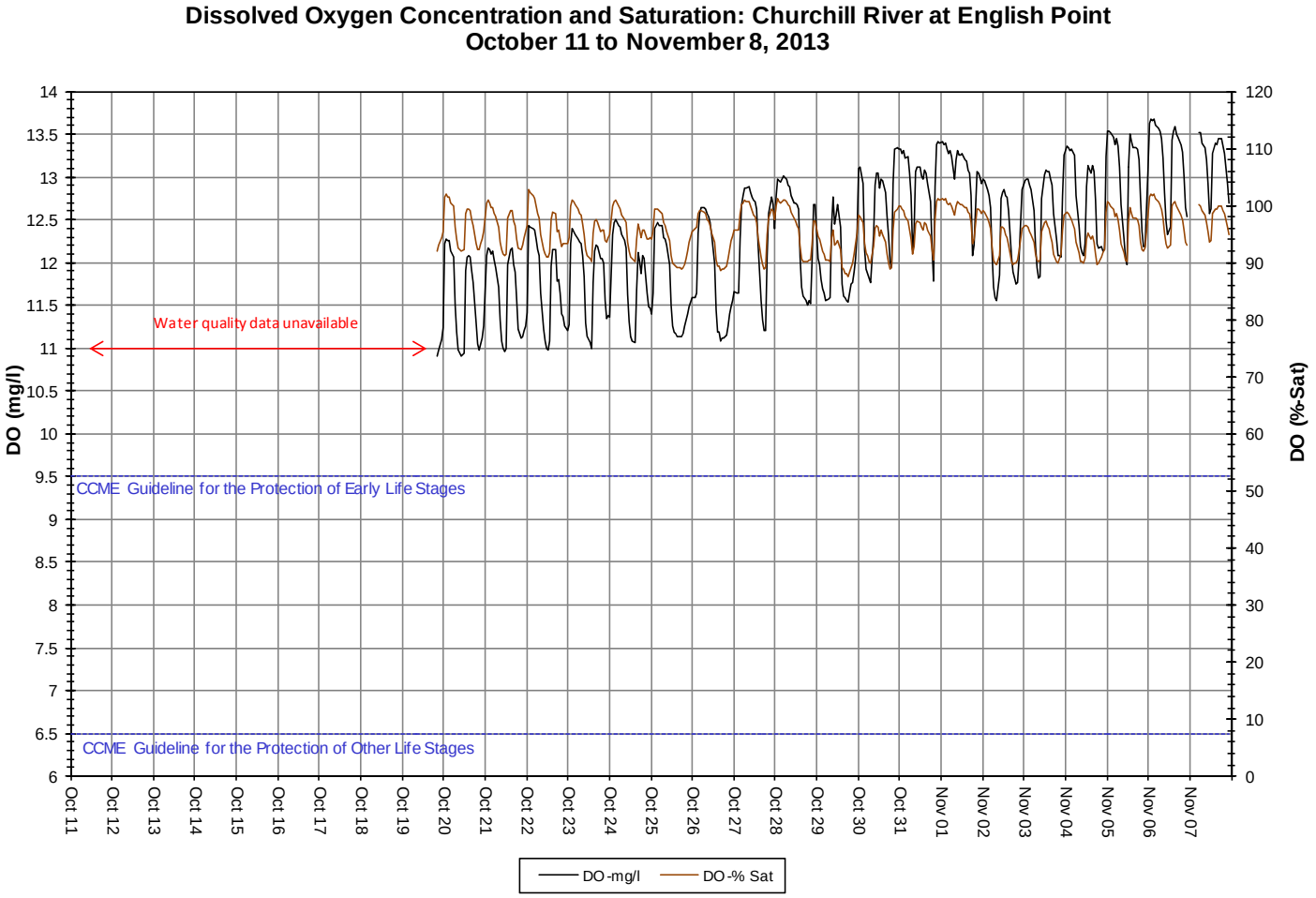


Figure 35: Dissolved oxygen and percent saturation at Churchill River at English Point

- Turbidity ranges from 0.0NTU to 108.7NTU between October 20 and November 8 (Figure 36).
- Turbidity increase on October 28 and November 1-5 each correspond with precipitation events recorded in the region. These events are highlighted in red on Figure 36.

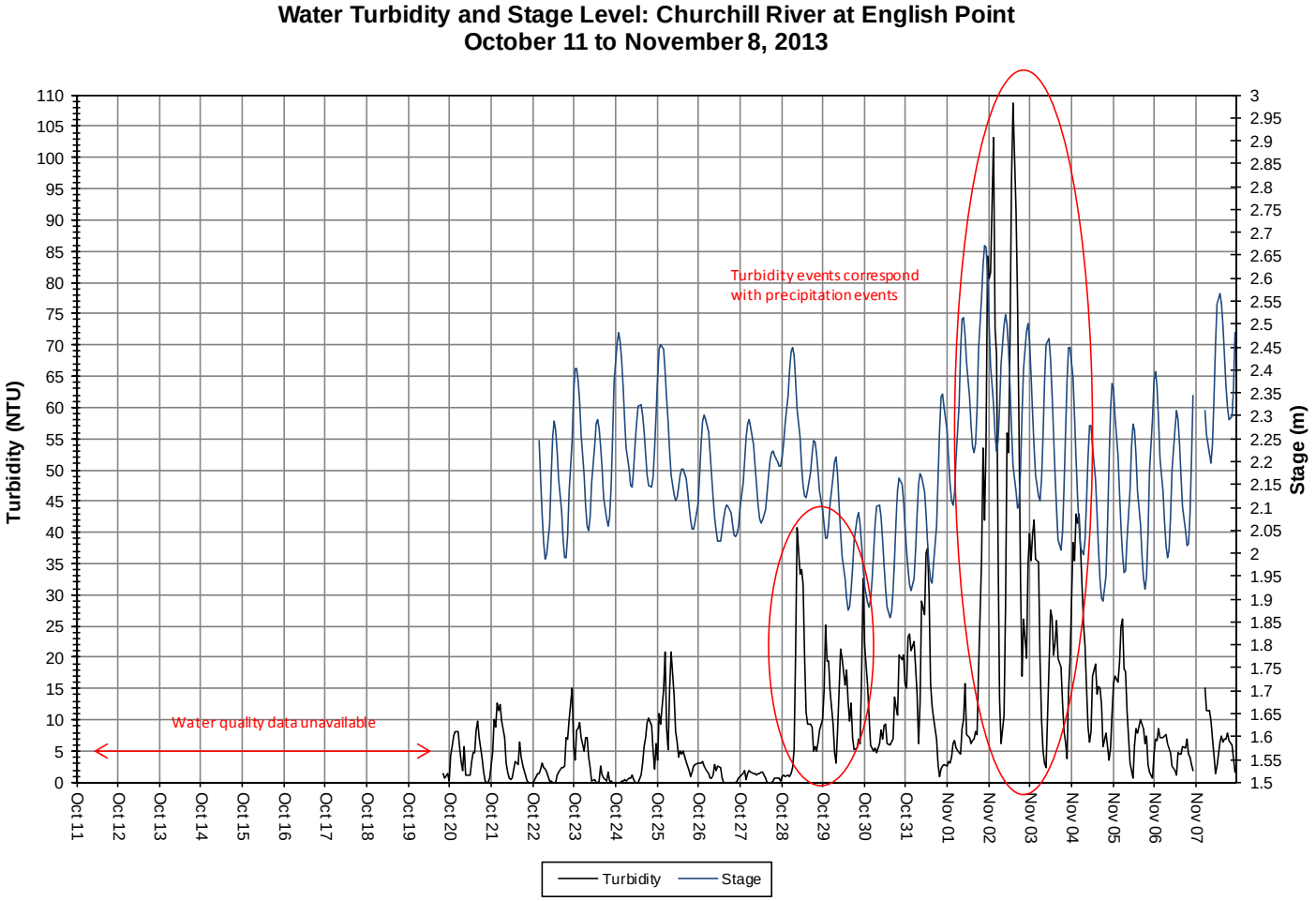


Figure 36: Turbidity and stage level at Churchill River at English Point

- 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 occurs on >50% of the days in the deployment period and amounts are moderate in magnitude. Stage ranges between 1.99m and 2.48m, a difference of 0.49m.

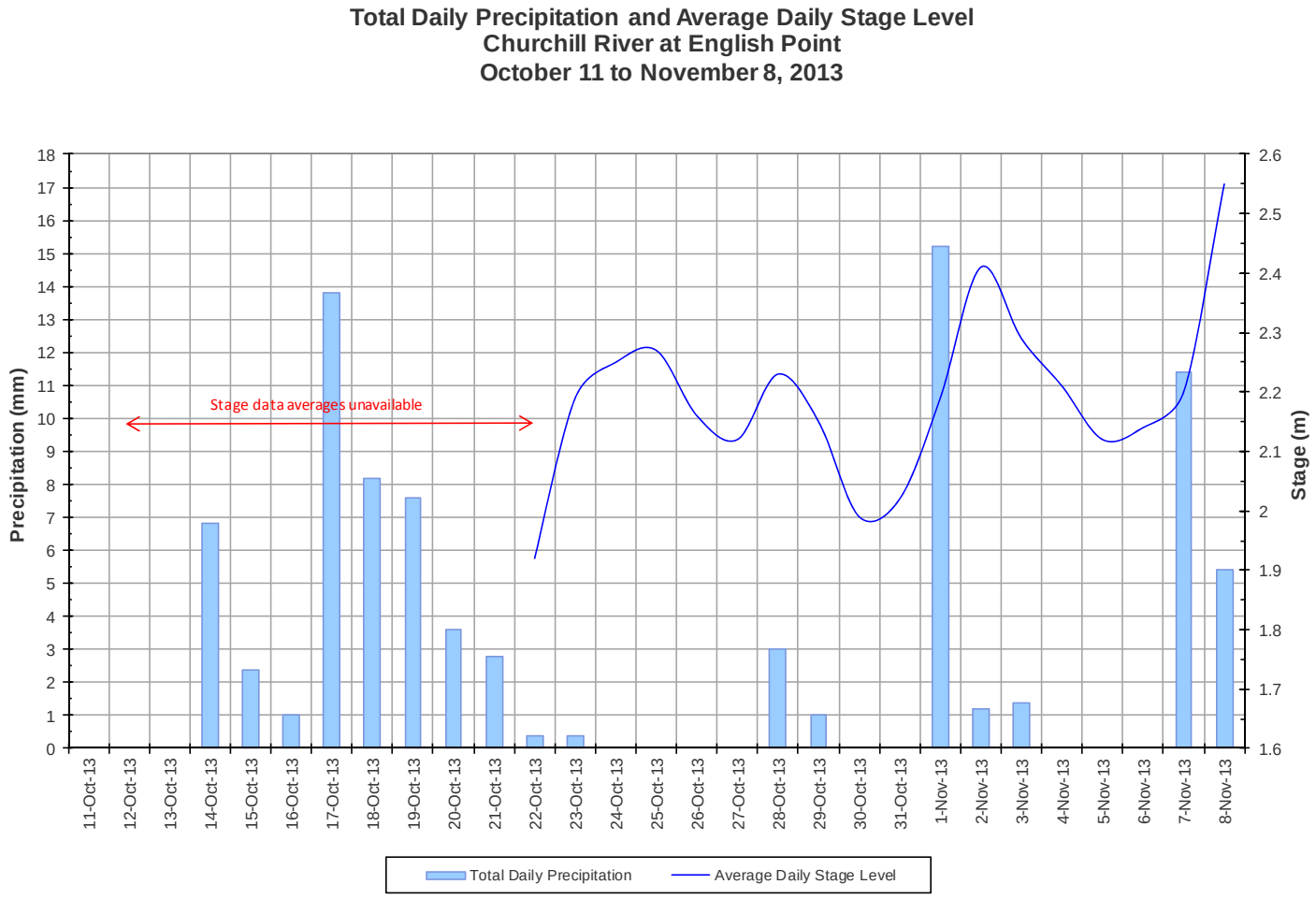
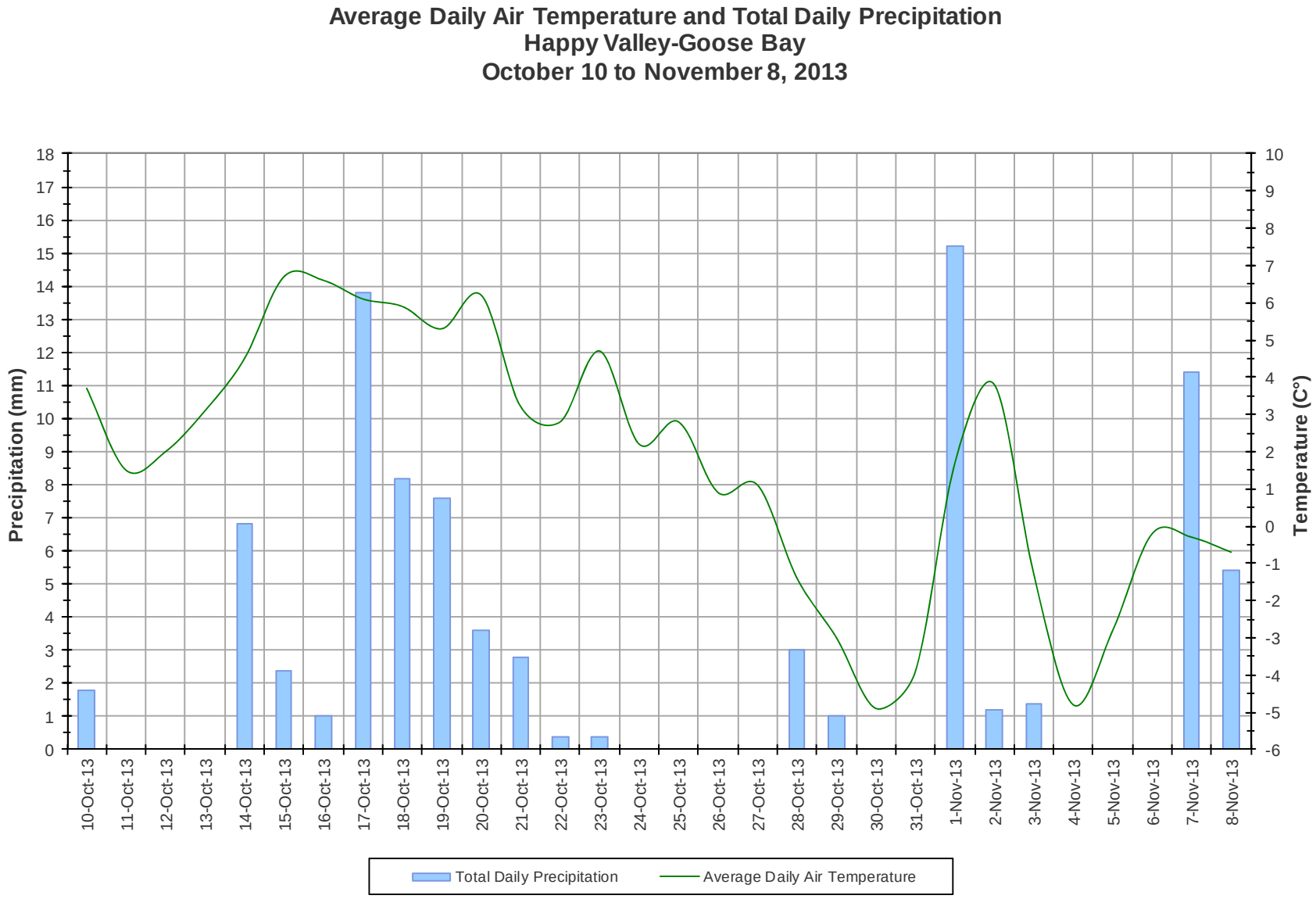


Figure 37: Daily precipitation and average daily stage level at Churchill River at English Point (weather data recorded at Goose Bay)

Conclusions

- Instruments at five water quality monitoring stations on the Lower Churchill River were deployed from October 10/11 to November 6/8, 2013.
- Stage levels mostly increase at all stations throughout the deployment period. Water level changes at the each of the stations ranged between 0.49m and 1.54m.
- Water temperature was decreasing at all stations throughout the deployment period due to the cooling ambient air temperatures in the region in the fall season. Water temperature typically ranged between 3°C and 8°C. Water temperatures at the station below Metchin River were on average colder, reaching as low as 0.30°C.
- pH is generally neutral and stable at stations along the Lower Churchill River ranging between 6.83 and 7.35 pH units. All pH values at all stations 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 18.2µS/cm and 20.5µS/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 30.4µS/cm.
- Dissolved oxygen content was increasing throughout the deployment period as it is inversely related to water temperature. Values ranged between 10.91mg/l and 14.20mg/l. All values were above both the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages at 6.5mg/l and 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.
- Turbidity data 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 stations above and below Muskrat Falls and at English Point were typical for the stations, reporting background values of 1.4NTU, 4.3NTU, and 2.4NTU respectively.

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



Average Daily Air Temperature and Total Daily Precipitation
Churchill Falls
October 10 to November 8, 2013