Real-Time Water Quality Deployment Report

Voisey's Bay Network

September 28 to
October 28, 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 four stations in the Voisey's Bay Network; Upper Reid Brook, Tributary to Lower Reid Brook, Lower Reid Brook and Camp Pond Brook.
- On September 28, 2011, Vale Environment staff deployed real-time water quality monitoring instruments at the four real time stations in the Voisey's Bay network for a period of 30 days. Instruments were removed for cleaning and calibration by Vale Environment staff on October 28.

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 (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 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 Voisey's Bay Network stations deployed from September 28 to October 28, 2011 are summarized in Table 2.

Table 2: Comparison rankings for Voisey's Bay Network stations, September 28– October 28, 2011

Station Voisey's Bay	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Upper Reid Brook	Sep 28, 2011	Deployment	Good	Marginal	Excellent	Fair	n/a*
	Oct 28, 2011	Removal	Excellent	Excellent	Excellent	Fair	n/a*
Tributary to Lower Reid Brook	Sep 28, 2011	Deployment	Good	Good	Good	n/a†	n/a*
	Oct 28, 2011	Removal	Good	Good	Good	n/a†	n/a*
Lower Reid Brook	Sep 28, 2011	Deployment	Excellent	Excellent	Good	Excellent	n/a*
	Oct 28, 2011	Removal	Excellent	Good	Excellent	Fair	n/a*
Camp Pond Brook	Sep 28, 2011	Deployment	Excellent	Good	Excellent	Excellent	n/a*
	Oct 28, 2011	Removal	Excellent	Fair	Excellent	Fair	n/a*

* QAQC comparison rankings were not available due to the absence of a turbidity sensor on either the field or QAQC instrument.

† QAQC comparison readings were not available for dissolved oxygen because the display was not working on the handheld unit.

- At the station at Upper Reid Brook, temperature, specific conductivity ranked either 'good' and 'excellent' at deployment, while pH ranked 'marginal' and dissolved oxygen ranked 'fair'. For pH, the field instrument read a value of 5.72 while the QAQC instrument read a value of 6.59, a difference of 0.87. For dissolved oxygen, the field instrument read a value of 12.12mg/l while the QAQC instrument read a value of 11.35mg/l, a difference of 0.77mg/l. Both these disparities may in part be caused by the insufficient time for the instrument to stabilize or the difference between the positions of the field and QAQC instruments. No turbidity comparison rankings are available because the field instrument at this station is not equipped with a turbidity sensor.
- At removal, temperature, pH and specific conductivity all ranked 'excellent' while dissolved oxygen ranked 'fair'. The field instrument read 11.37mg/l while the QAQC instrument read a value of 11.90mg/l, a difference of 0.53mg/l. This disparity may in part be caused by the insufficient time for the instrument to stabilize or the difference between the positions of the field and QAQC instruments. No comparison rankings for turbidity are available because the field instrument was not equipped with a turbidity sensor.
- At the station on the Tributary to Lower Reid Brook, temperature, pH and specific conductivity all ranked 'good'. Dissolved oxygen was not ranked because a reading from the QAQC instrument was unavailable on the hand held field PC at the time of deployment. The dissolved oxygen sensor was in good working condition when deployed. The first transmission of data from the station after deployment reports a dissolved oxygen value of 11.96mg/l which when compared to the QAQC instrument reading of 12.41mg/l, also yields a 'good' ranking. No comparison rankings for turbidity are available because the QAQC instrument was not equipped with a turbidity sensor.

- At removal, temperature, pH and specific conductivity all ranked 'good'. Dissolved oxygen was not ranked because a reading from the QAQC instrument continued to be unavailable on the hand held field PC at the time of removal. The dissolved oxygen sensor was in good working condition when deployed and throughout the deployment period reported reasonable values. The last transmission of data from the station before removal reports a dissolved oxygen value of 13.39mg/l which when compared to the QAQC instrument reading of 13.64mg/l yields an 'excellent' ranking. No comparison rankings for turbidity are available because the QAQC instrument was not equipped with a turbidity sensor.
- At the station on Lower Reid Brook below the tributary, temperature, pH, specific conductivity, and dissolved oxygen all ranked either 'good' or 'excellent' at deployment. No comparison rankings for turbidity are available because the QAQC instrument was not equipped with a turbidity sensor.
- At removal, temperature, pH and specific conductivity all ranked either 'good' or 'excellent' while dissolved oxygen ranked 'fair'. The field instrument read a value of 13.03mg/l while the QAQC instrument read a value of 13.56mg/l, a difference of 0.53mg/l. This disparity may in part be caused by the insufficient time for the instrument to stabilize or the difference between the positions of the field and QAQC instruments. No comparison rankings for turbidity are available because the QAQC instrument was not equipped with a turbidity sensor.
- At the station on Camp Pond Brook, temperature, pH, specific conductivity and dissolved oxygen all ranked either 'good' or 'excellent' at deployment. No comparison rankings for turbidity are available because the QAQC instrument was not equipped with a turbidity sensor.
- At removal, temperature and specific conductivity both ranked 'excellent' while pH and dissolved oxygen both ranked 'fair'. For pH, the field instrument read a value of 6.73 while the QAQC instrument read a value of 6.07, a difference 0.66. The QAQC instrument read low pH values throughout the day at all stations, however most differences were not great enough to yield 'fair' or 'poor' readings. For dissolved oxygen, the field instrument read a value of 12.72mg/l and the QAQC instrument read a value of 13.43mg/l, a difference of 0.71mg/l. Both of these disparities may in part be caused by the insufficient time for the instrument to stabilize or the difference between the positions of the field and QAQC instruments. No comparison rankings for turbidity are available because the QAQC instrument was not equipped with a turbidity sensor.

Data Interpretation

- The following graphs and discussion illustrate significant water quality-related events from September 28 to October 28 in the Voisey's Bay Real Time Water Quality Monitoring 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.

Upper Reid Brook (Outlet from Reid Pond)

- Water temperature ranged from 4.93 ^{o}C to 8.97^{o}C during the deployment period (Figure 1).
- Water temperature is decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures in the fall season (Figure 2). Water temperature fluctuates diurnally.

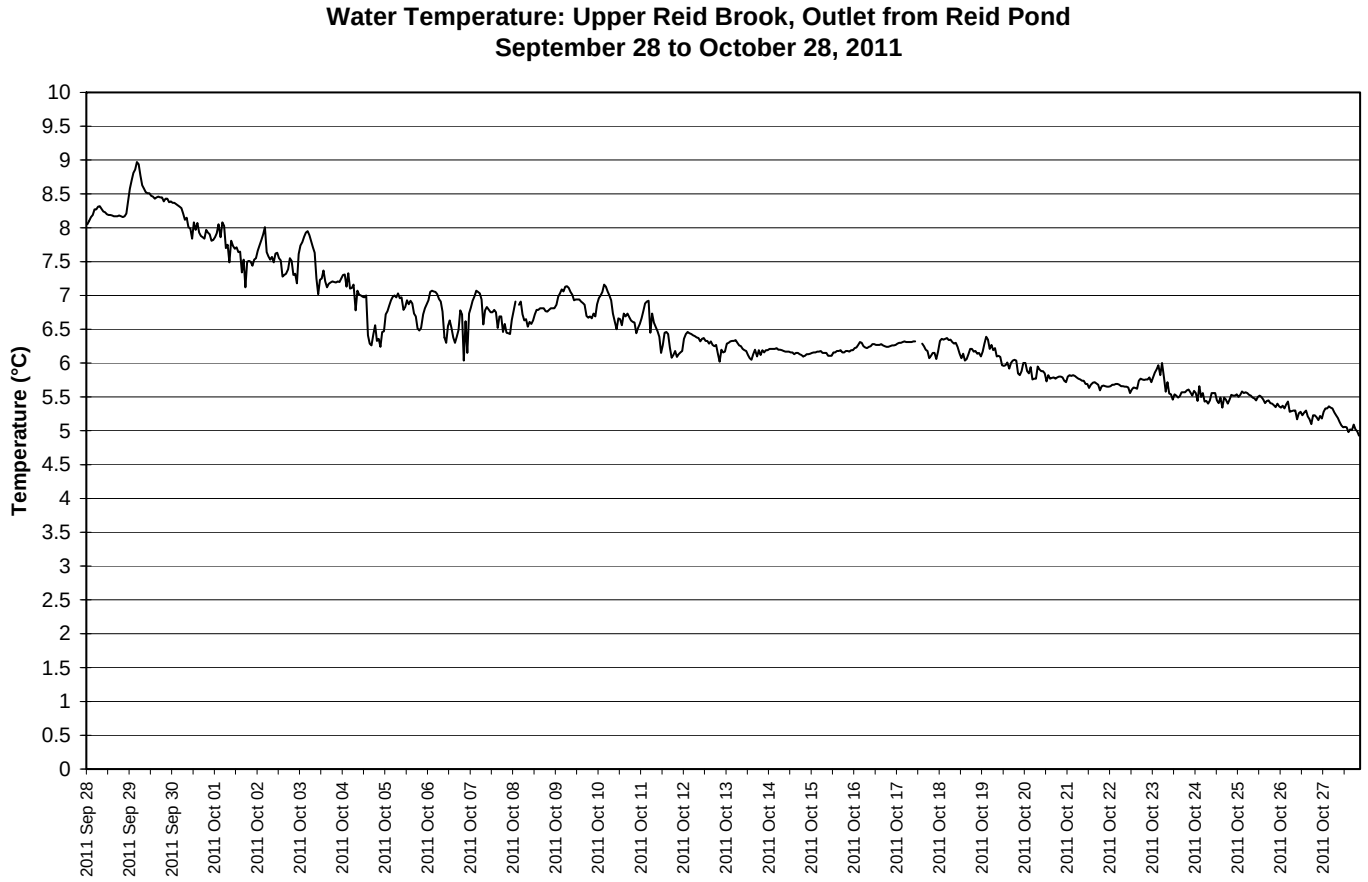

Figure 1: Water temperature at Upper Reid Brook

- Average daily air and water temperatures are decreasing throughout the deployment period (Figure 2). Average daily air temperatures do increase on occasion throughout the month of October but do not affect water temperature significantly. Water temperatures are on average warmer than the air temperatures at this time of year. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.

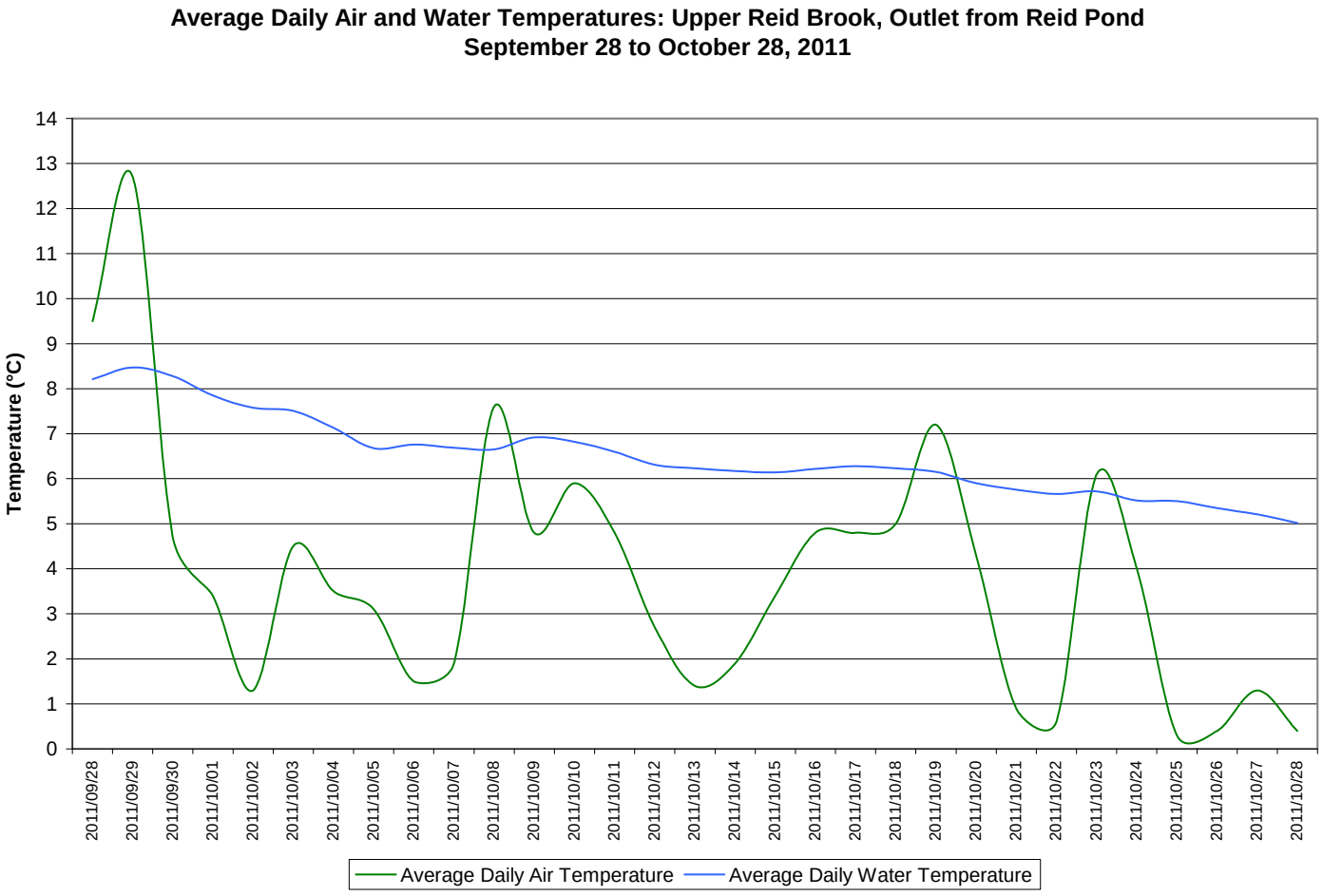

Figure 2: Average daily air and water temperatures at Upper Reid Brook

(weather data recorded at Nain)

- pH ranged between 6.51 and 6.73 pH units (Figure 3) and is stable throughout the deployment period.
- All values are above the minimum CCME Guideline for the Protection of Aquatic Life (> 6.5 pH units).

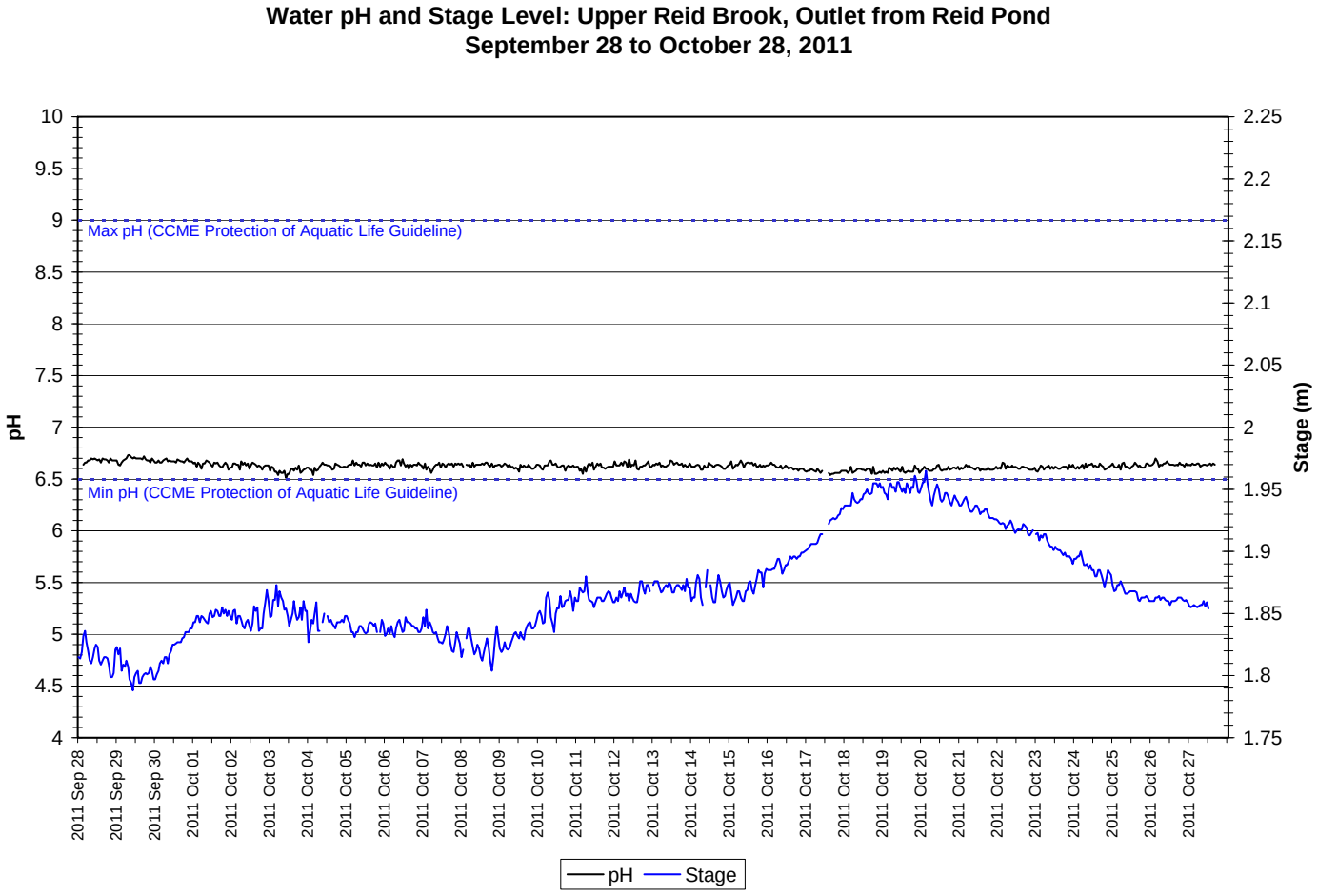

Figure 3: pH and stage level at Upper Reid Brook

- Specific conductivity ranged from 8.5µS/cm to 9.6µS/cm during the deployment period (Figure 4).
- Specific conductivity remains very low and extremely stable throughout the deployment period with minimal fluctuation (±0.9µS/cm) regardless of the changing water level. This trend is expected as the flow from this station is directly from a stable lake environment.

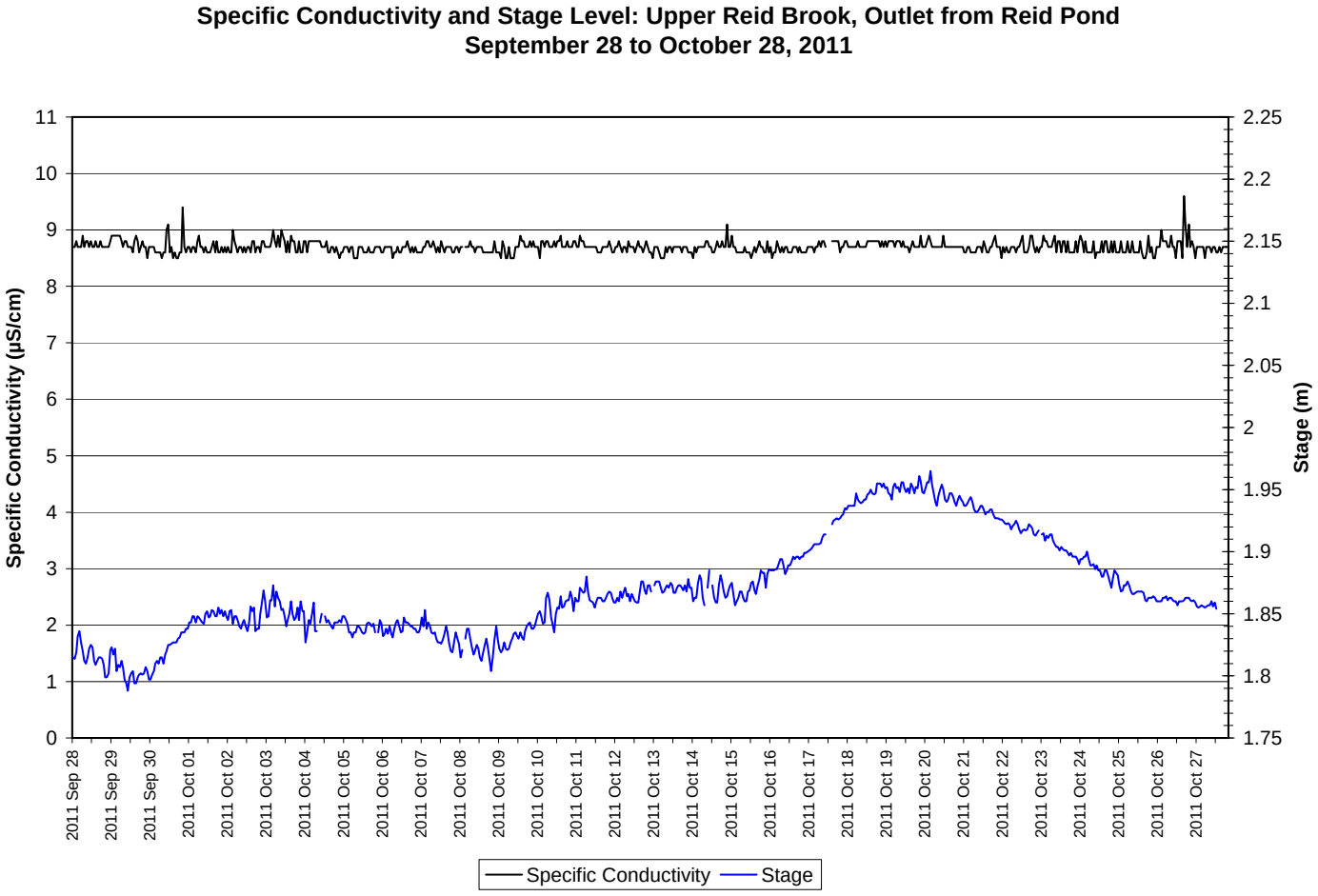

Figure 4: Specific conductivity and stage level at Upper Reid Brook

- Dissolved oxygen content ranged between 8.81mg/L and 11.48mg/L. The saturation of dissolved oxygen ranged from 96.0% to 105.7% (Figure 5).
- All values were above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l). Most values were above the minimum guideline for Early Life Stages (9.5mg/l) during the deployment period. The guidelines are indicated in blue on Figure 5. The average dissolved oxygen value was 10.01mg/l.
- Dissolved oxygen content is stable throughout the deployment period. It would be expected that dissolved oxygen would be increasing slightly over the deployment period in response to the cooling air and water temperatures (Figure 1 & 2) however this increase is not apparent in the data collected.

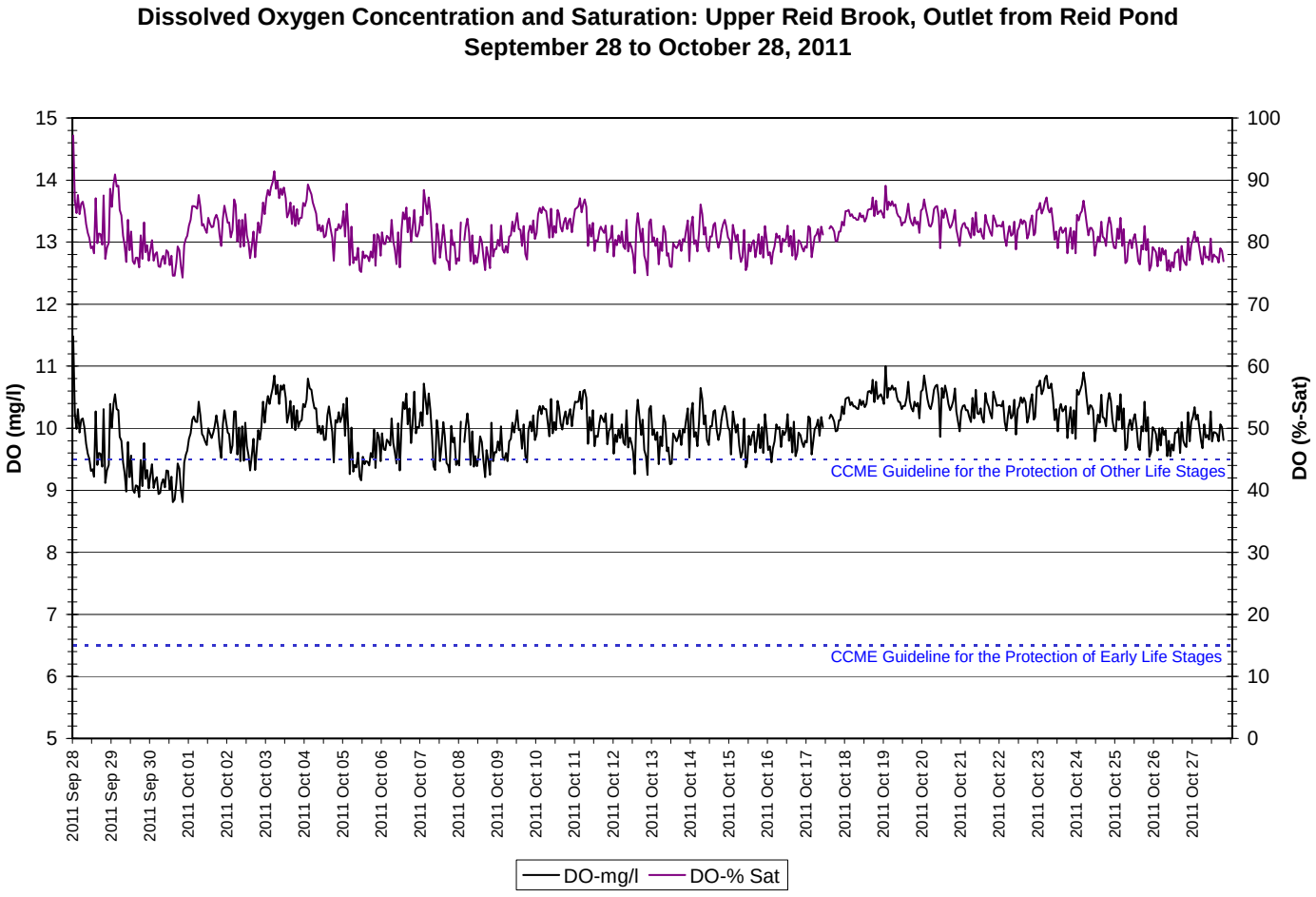

Figure 5: Dissolved oxygen and percent saturation at Upper Reid Brook

- The instrument deployed at Upper Reid Brook is a replacement instrument provided by the Department of Environment and Conservation. The Minisonde 4a, Special Edition, features a temperature, specific conductivity, Clark cell dissolved oxygen and pH sensors. This instrument is not equipped with a turbidity sensor therefore no turbidity data is available for discussion at this station.

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 6). Stage is generally increasing for the first three weeks of the deployment period. Stage level is decreasing in the final week of the deployment. Precipitation events are frequent and moderate in magnitude.

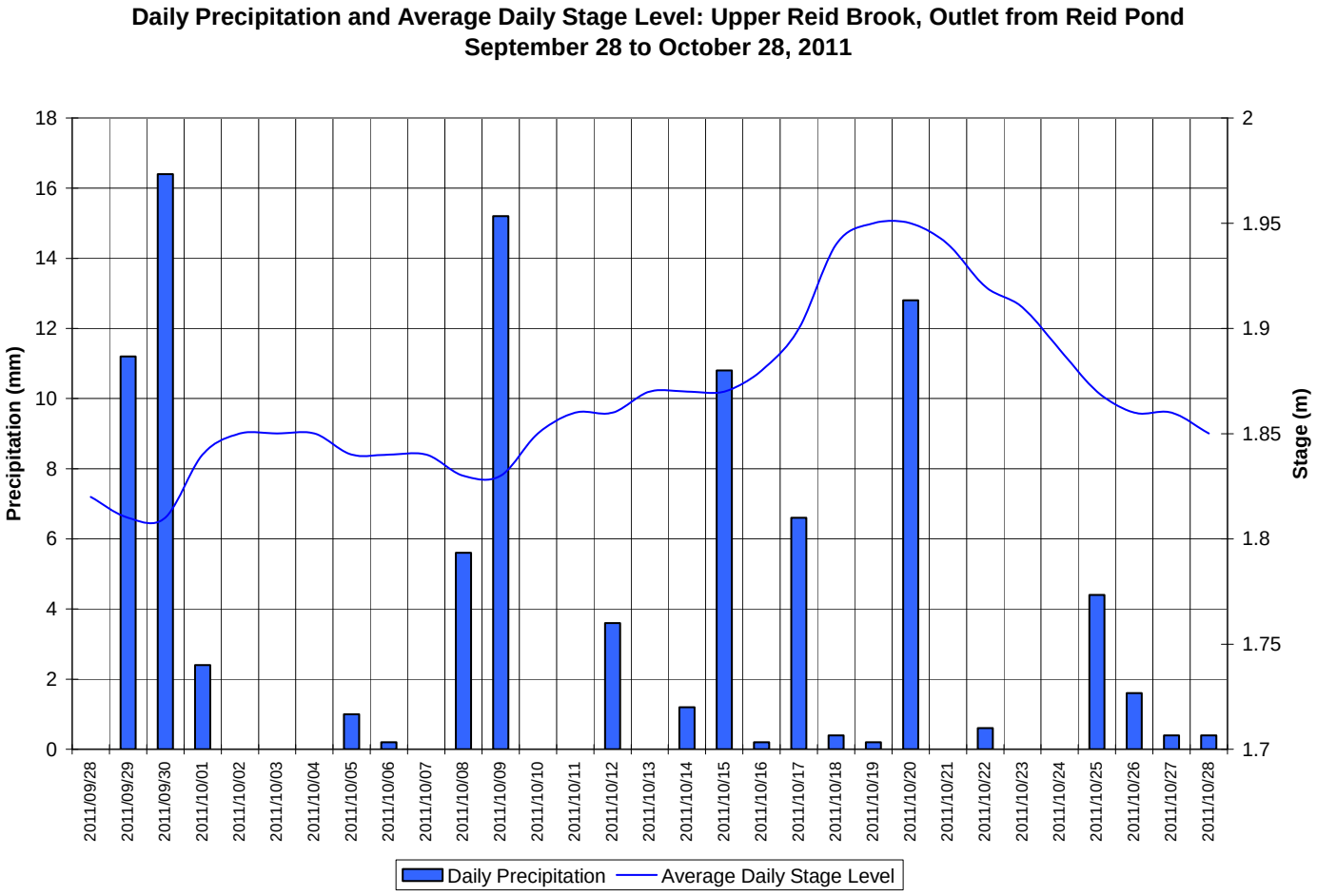

Figure 6: Daily precipitation and average daily stage level at Upper Reid Brook

(weather data recorded at Nain)

Tributary to Lower Reid Brook

- Water temperature ranged from 1.50 °C to 8.30°C during the deployment period (Figure 7).
- Water temperature is decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures in the fall season (Figure 8). Water temperature fluctuates diurnally.

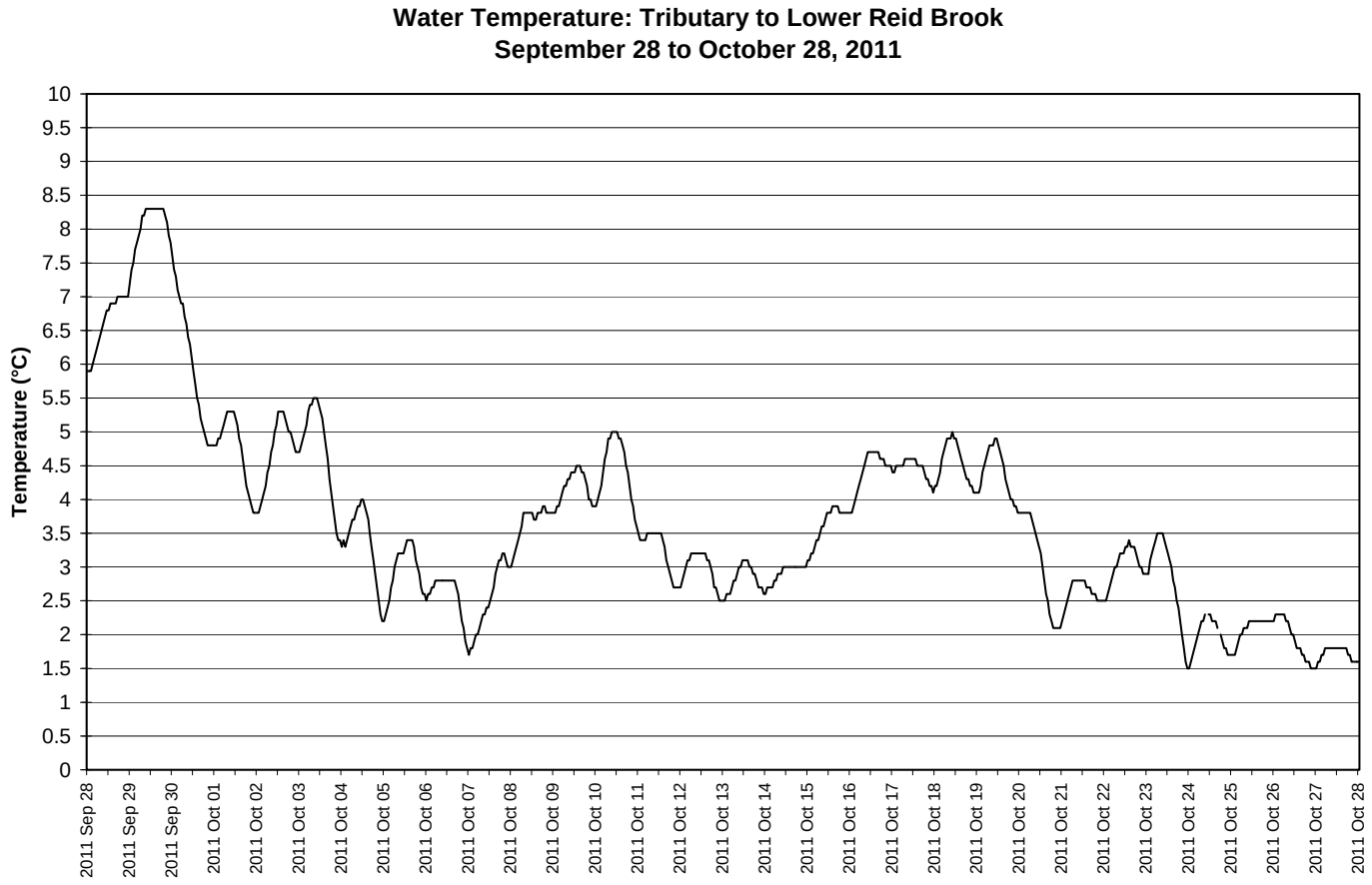

Figure 7: Water temperature at Tributary to Lower Reid Brook

- Average daily air and water temperatures are generally decreasing throughout the deployment period (Figure 8). Average daily air temperatures do increase on occasion throughout the month of October and each time are reflected in slight increases in water temperature. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.

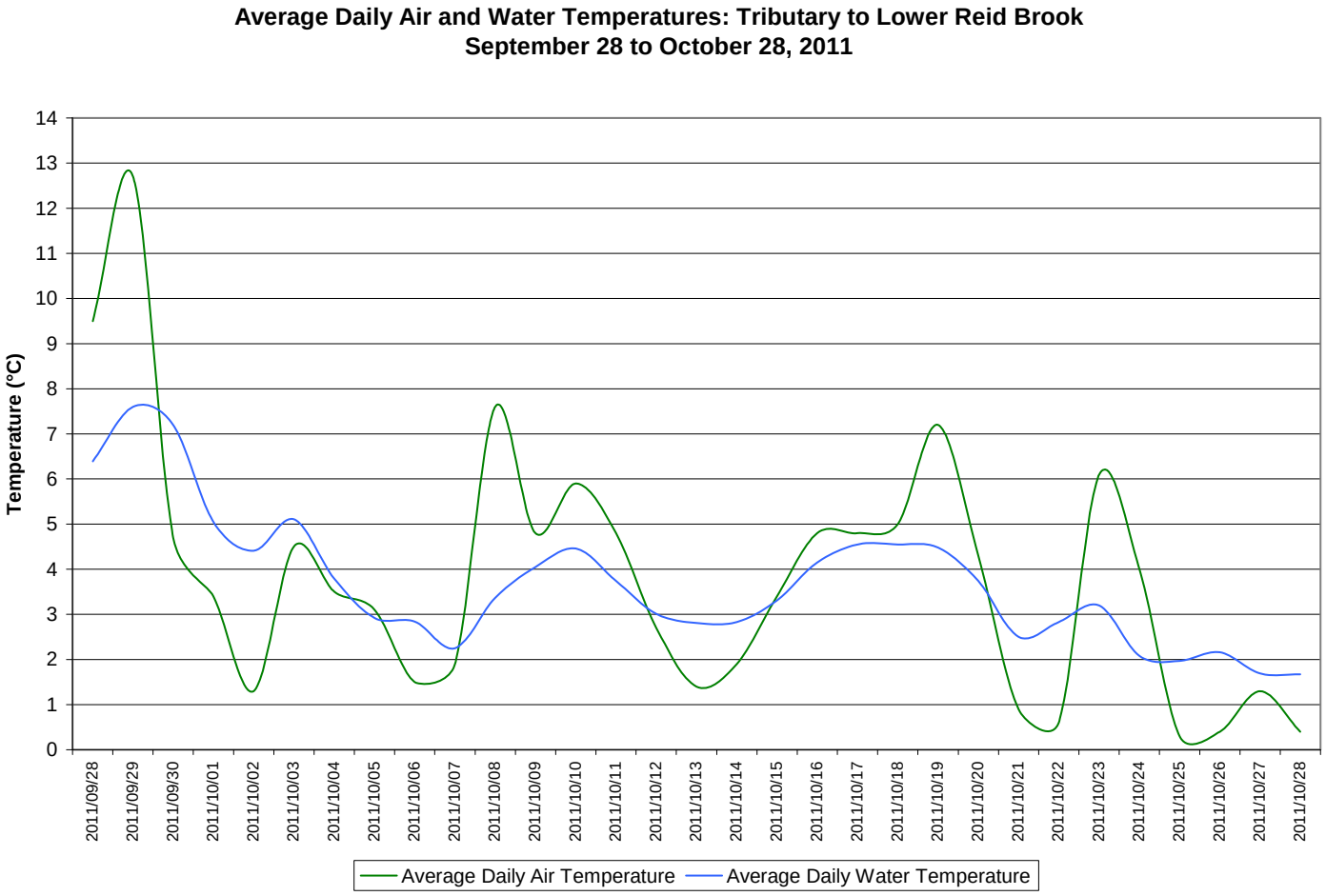

Figure 8: Average daily air and water temperatures at Tributary to Lower Reid Brook

(weather data recorded at Nain)

- pH ranged between 6.61 and 6.98 pH units (Figure 9).
- Stage is included on Figure 9 to show the relationship between water level and pH. Raw uncorrected stage data for this deployment period is depicted below. There is a jump in stage level from 0.330m to 0.512m on October 4. Corrected hydrometric data is available upon request from Environment Canada. pH values fluctuate throughout the deployment period with changing water levels. On a number of occasions, pH decreases as stage increases (indicated by red arrows on Figure 9).
- All values are within the recommended range for pH as suggested by the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 9).

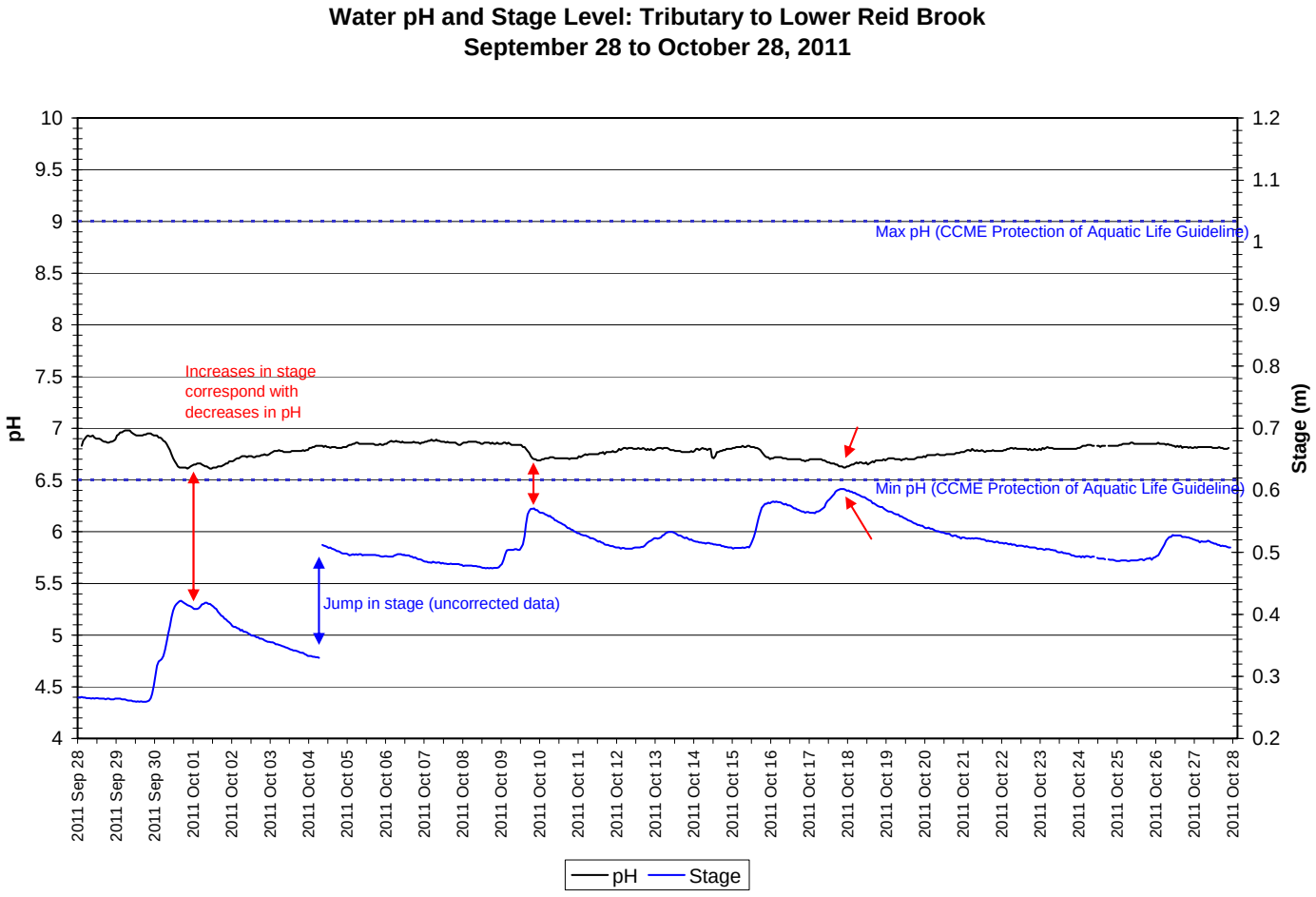

Figure 9: pH and stage level at Tributary to Lower Reid Brook

- Specific conductivity ranged between 27.1µS/cm and 35.6µS/cm and fluctuated throughout the deployment period (Figure 10).
- Stage is included in Figure 10 to illustrate the inverse relationship between conductivity and water level. Generally, stage is increasing throughout the first three weeks of the deployment period before decreasing in the final week. Specific conductivity changes with the varying water level (indicated by red arrows in Figure 10). As stage increases, specific conductivity generally decreases due to the dilution of dissolved solids in the water column. Inversely, as stage decreases, specific conductivity increases as the concentration of dissolved solids increases.

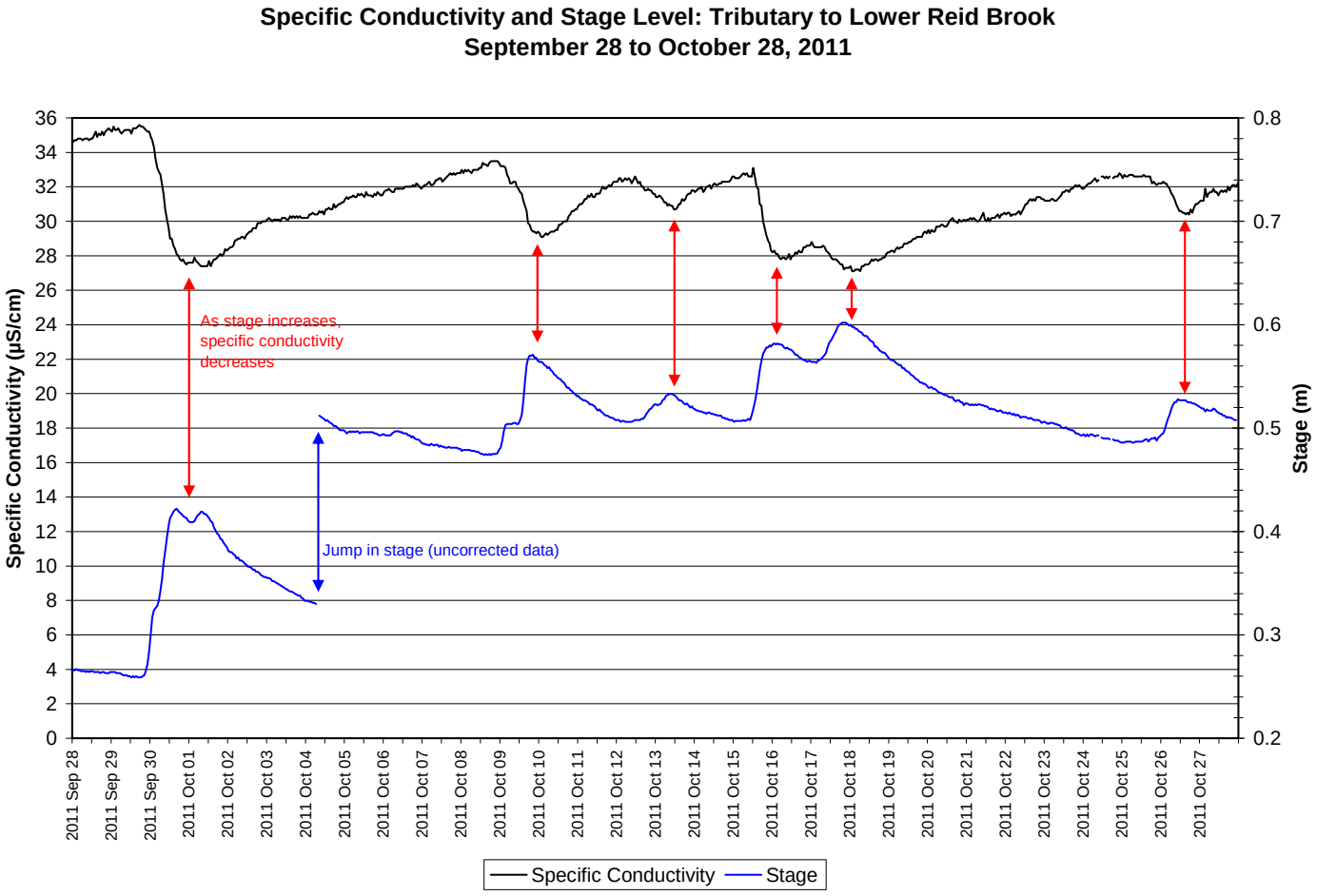

Figure 10: Specific conductivity and stage level at Tributary to Lower Reid Brook

- Dissolved oxygen content ranged between 10.99g/L and 13.58mg/L. The saturation of dissolved oxygen ranged from 93.2% to 97.6% (Figure 11).
- All values were above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l) and Early Life Stages (9.5mg/l). The guidelines are indicated in blue on Figure 11.
- Dissolved oxygen content is increasing slightly throughout the deployment period. This trend is expected given the cooling air and water temperatures in the fall season (Figure 7 & 8).

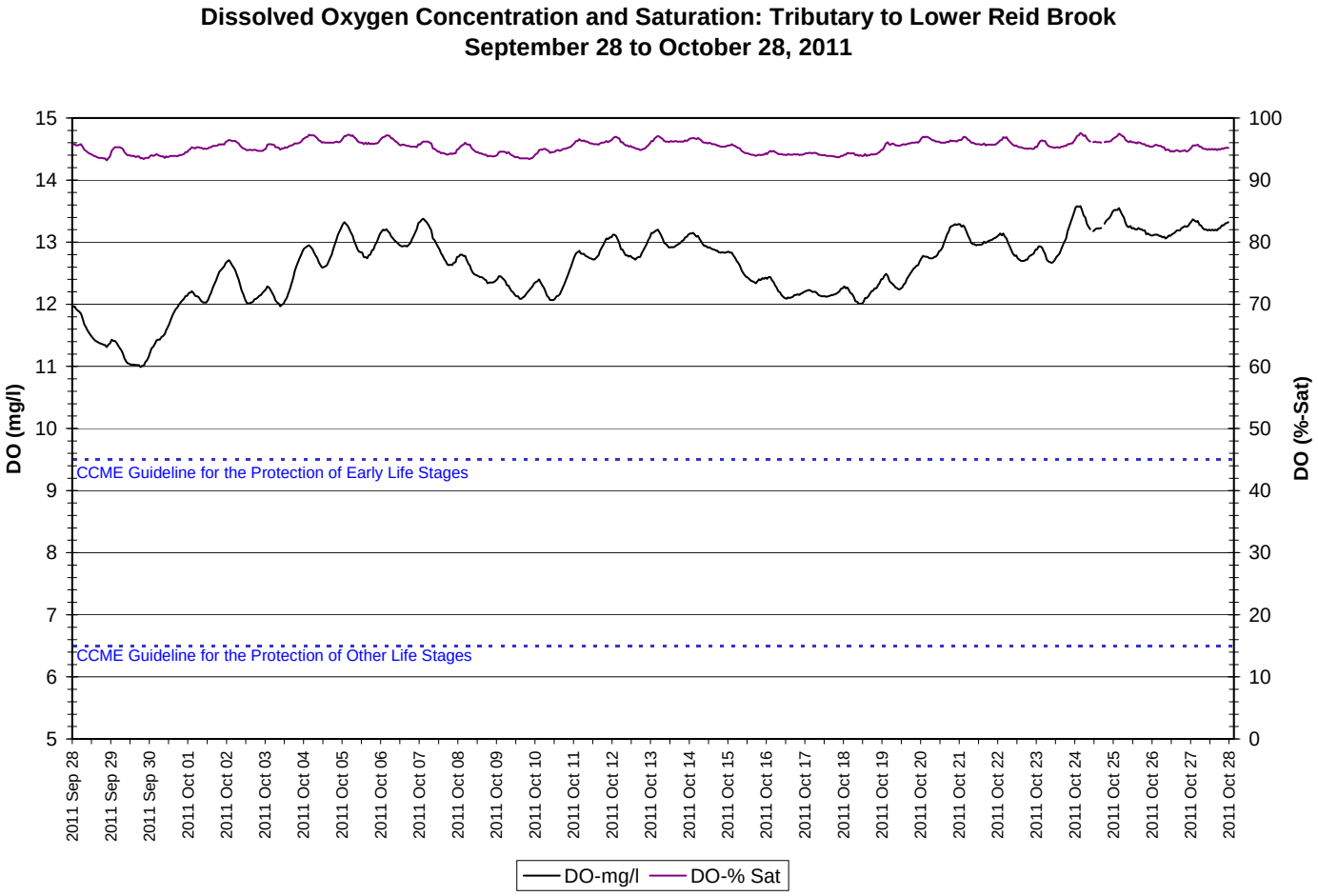

Figure 11: Dissolved oxygen and percent saturation at Tributary to Lower Reid Brook

- The turbidity sensor on the Tributary to Lower Reid Brook instrument (s/n 44175) has not functioned at full capacity since the beginning of the 2011 deployment season. The wiper on the instrument no longer completes the revolutions prior to the taking reading. The instrument was deployed at the station regardless and a note was placed on the online graph indicating the turbidity sensor was not functional.
- Throughout the 2011 deployment season, turbidity consistently recorded 0NTU. Oddly, on September 30, the turbidity sensor became active again and recorded turbidity values ranging from 0.1NTU to 78.6NTU for a period of seven days until October 6. Turbidity remained at 0NTU for the remainder of the deployment period (Figure 12). The sensor performance is highly unreliable at this point and the data values that were recorded are erratic. For QAQC purposes this data has been removed from the dataset for future use.

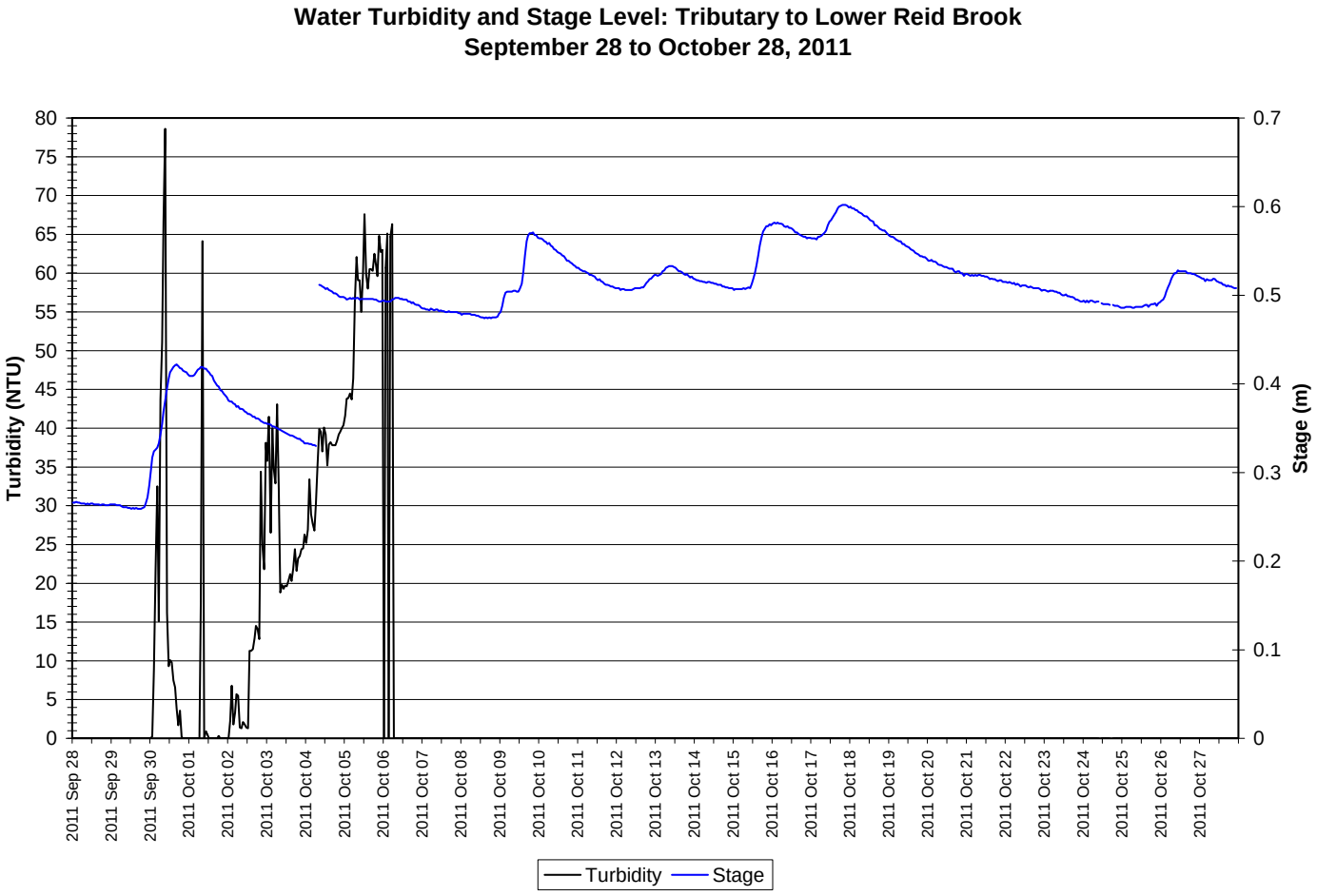

Figure 12: Turbidity and stage level at Tributary to Lower Reid Brook

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 13). Stage is generally increasing for the first three weeks of the deployment period. Stage level is decreasing in the final week of the deployment. Precipitation events are frequent and moderate in magnitude.

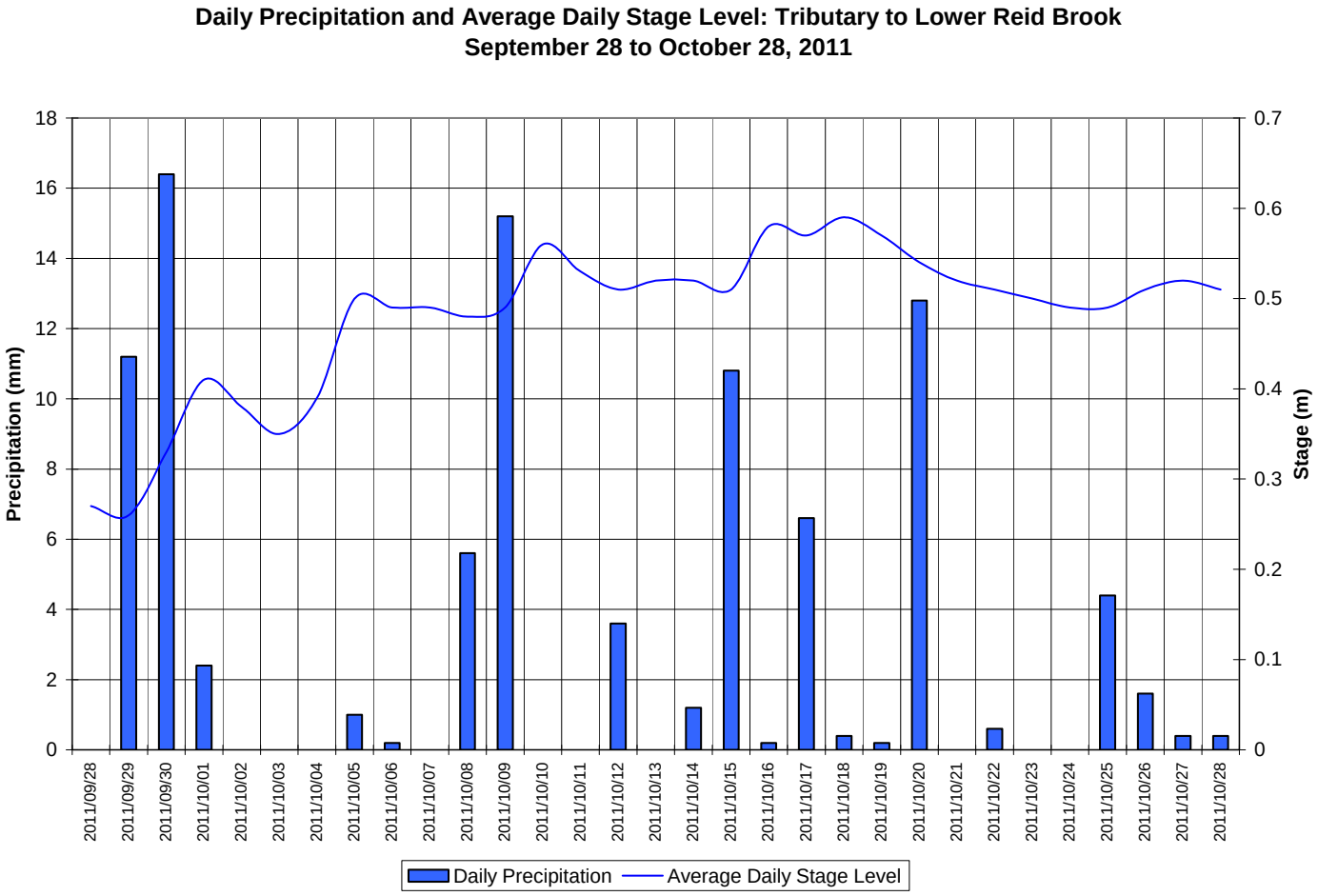

Figure 13: Average Daily Stage and Daily Precipitation at Tributary to Lower Reid Brook

Lower Reid Brook

- Water temperature ranged from 1.43 °C to 8.67°C during the deployment period (Figure 15).
- Water temperature is generally decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures in the fall season (Figure 16). Water temperature fluctuates diurnally.
- There is a significant increase in water temperature at the beginning of the deployment period. This event corresponds with very warm air temperatures (~13 °C) recorded in the region on that day (Appendix 1).

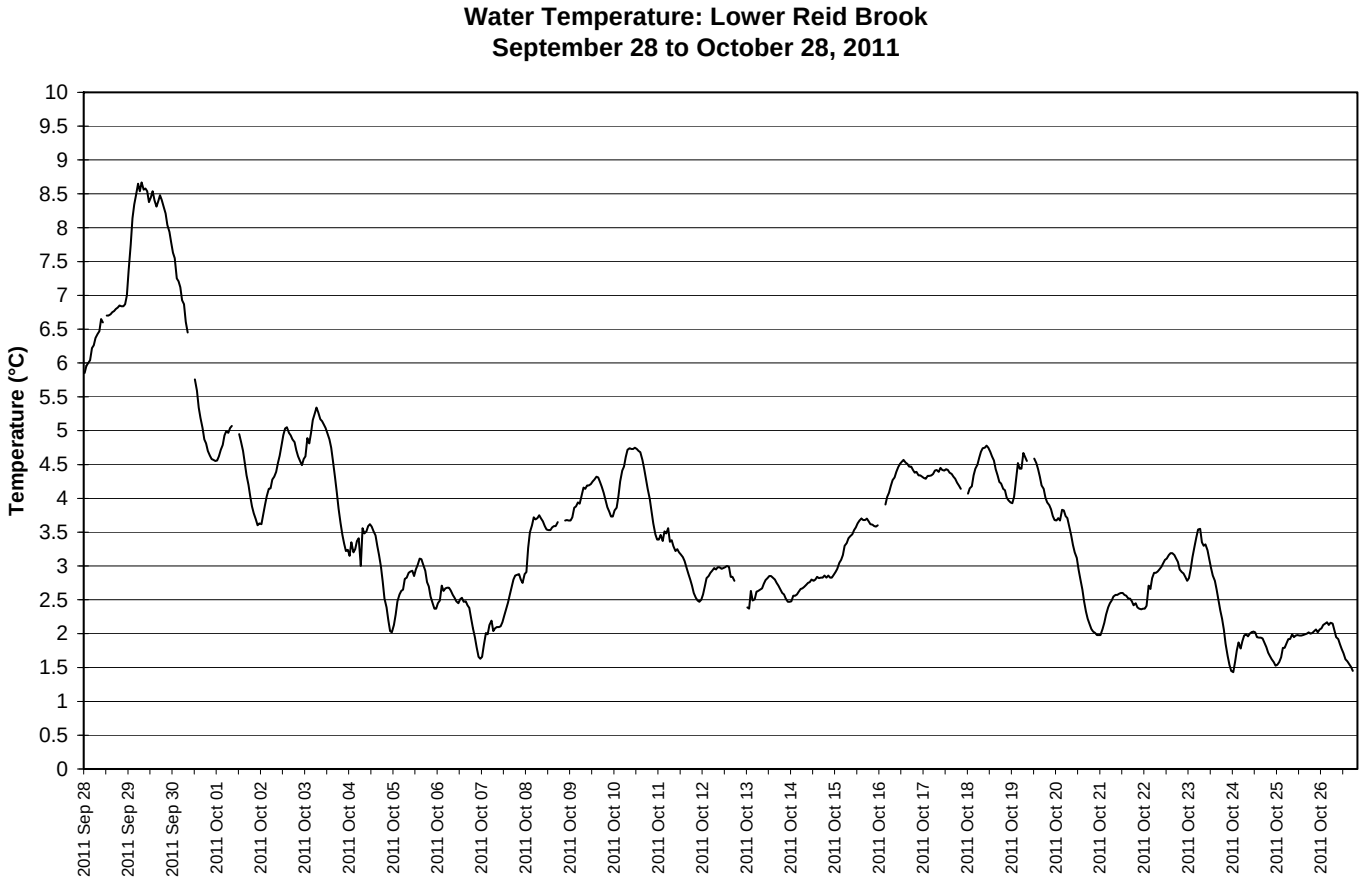

Figure 15: Water temperature at Lower Reid Brook

- Average daily air and water temperatures are generally decreasing throughout the deployment period (Figure 16). Average daily air temperatures do increase on occasion throughout the month of October and each time are reflected in slight increases in water temperature. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.

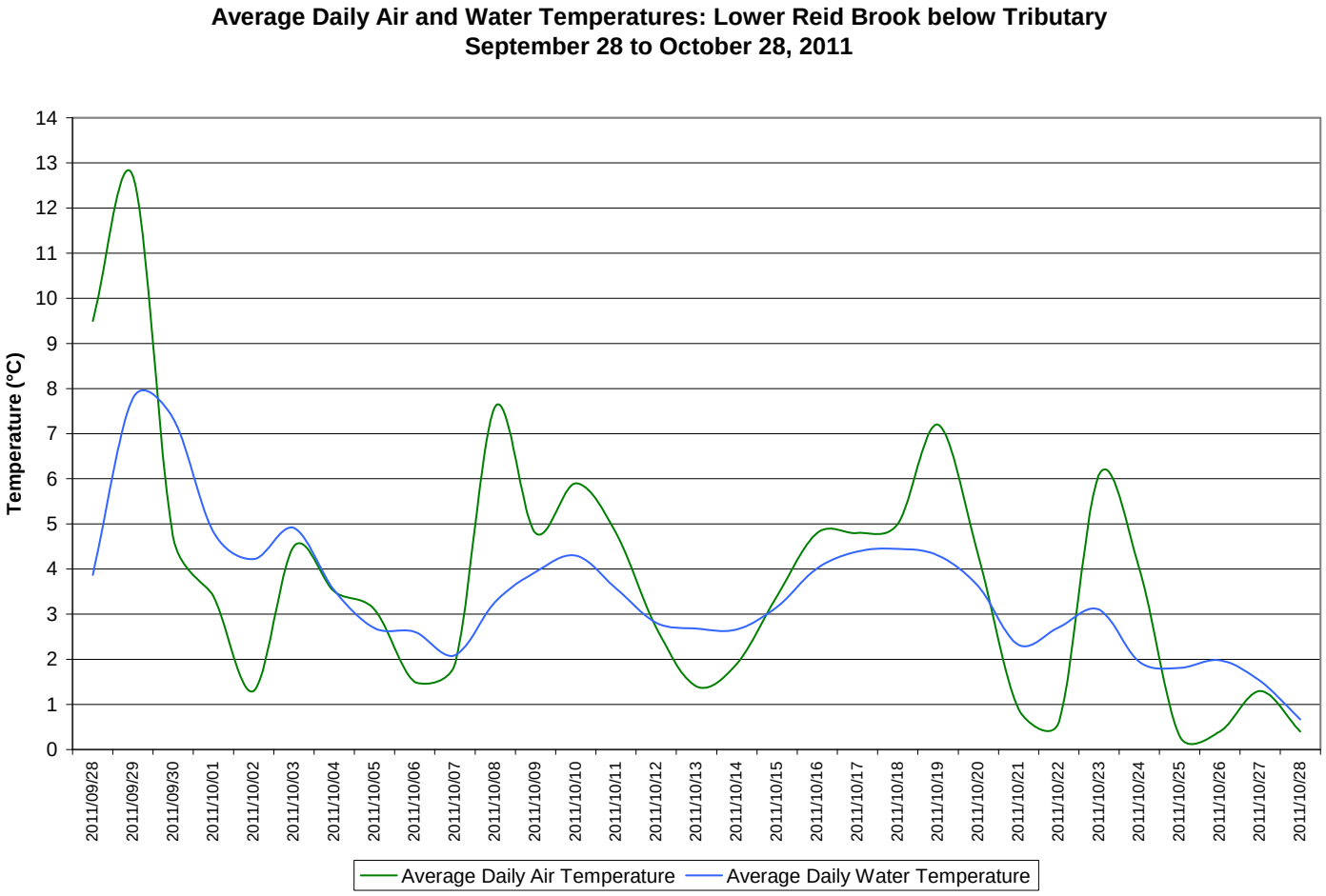

Figure 16: Average daily air and water temperatures at Lower Reid Brook

(weather data recorded at Nain)

- pH ranged between 6.70 and 7.08 pH units (Figure 17).
- Stage is included on Figure 9 to show the relationship between water level and pH. pH values fluctuate throughout the deployment period with changing water levels. On a number of occasions, pH decreases as stage increases (indicated by red arrows on Figure 9).
- All values are within the recommended range for pH as suggested by the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 9).

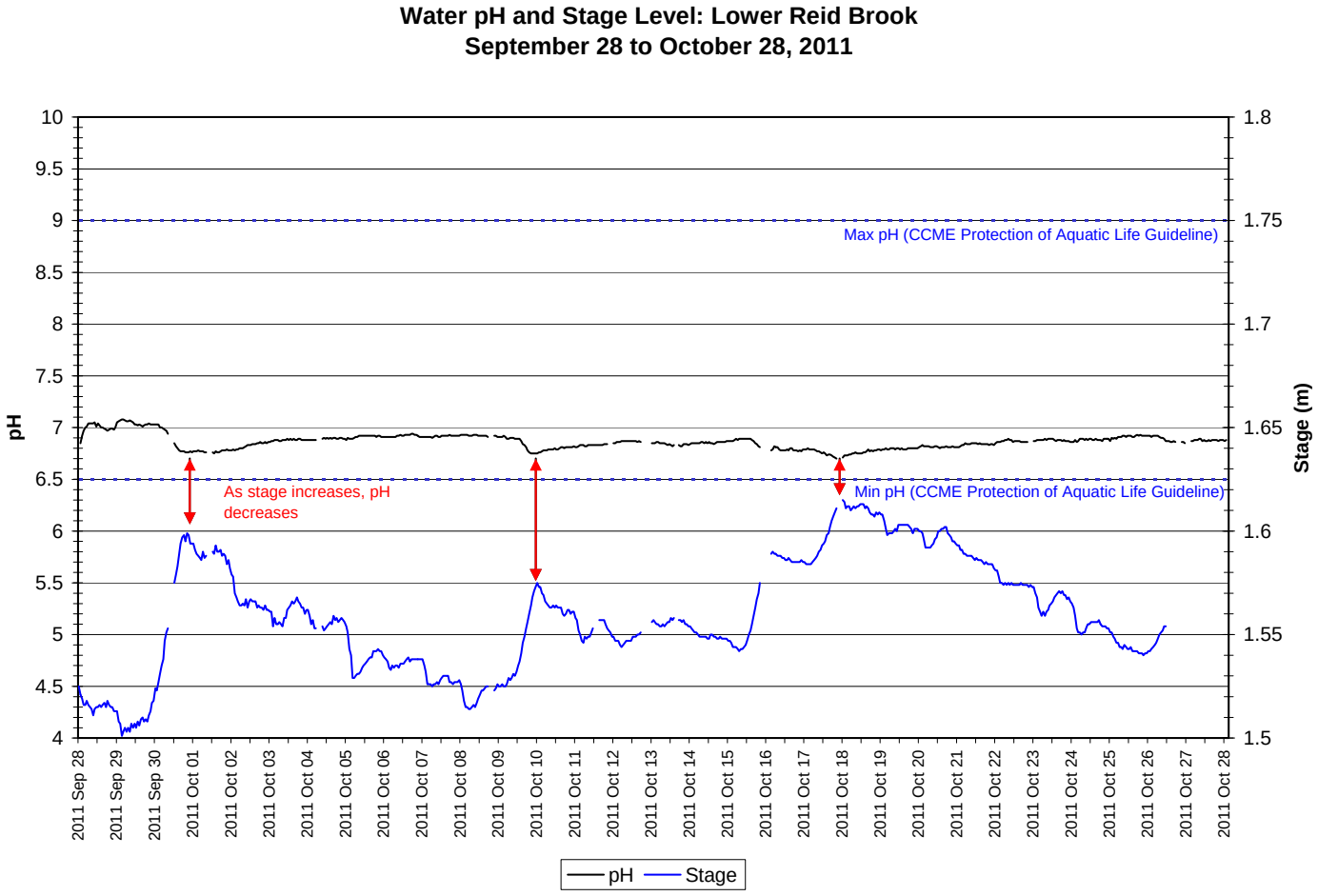

Figure 17: pH and stage level at Lower Reid Brook

- Specific conductivity ranged between 25.0µS/cm and 32.0µS/cm (Figure 18). Due to a programming error at this station, specific conductivity is only recorded to zero decimal places.
- Stage is included in Figure 18 to illustrate the inverse relationship between conductivity and water level. Stage is fluctuating throughout the deployment period. Specific conductivity changes with the varying water level (indicated by red arrows in Figure 18). As stage increases, specific conductivity generally decreases due to the dilution of dissolved solids in the water column. Inversely, as stage decreases, specific conductivity increases as the concentration of dissolved solids increases.

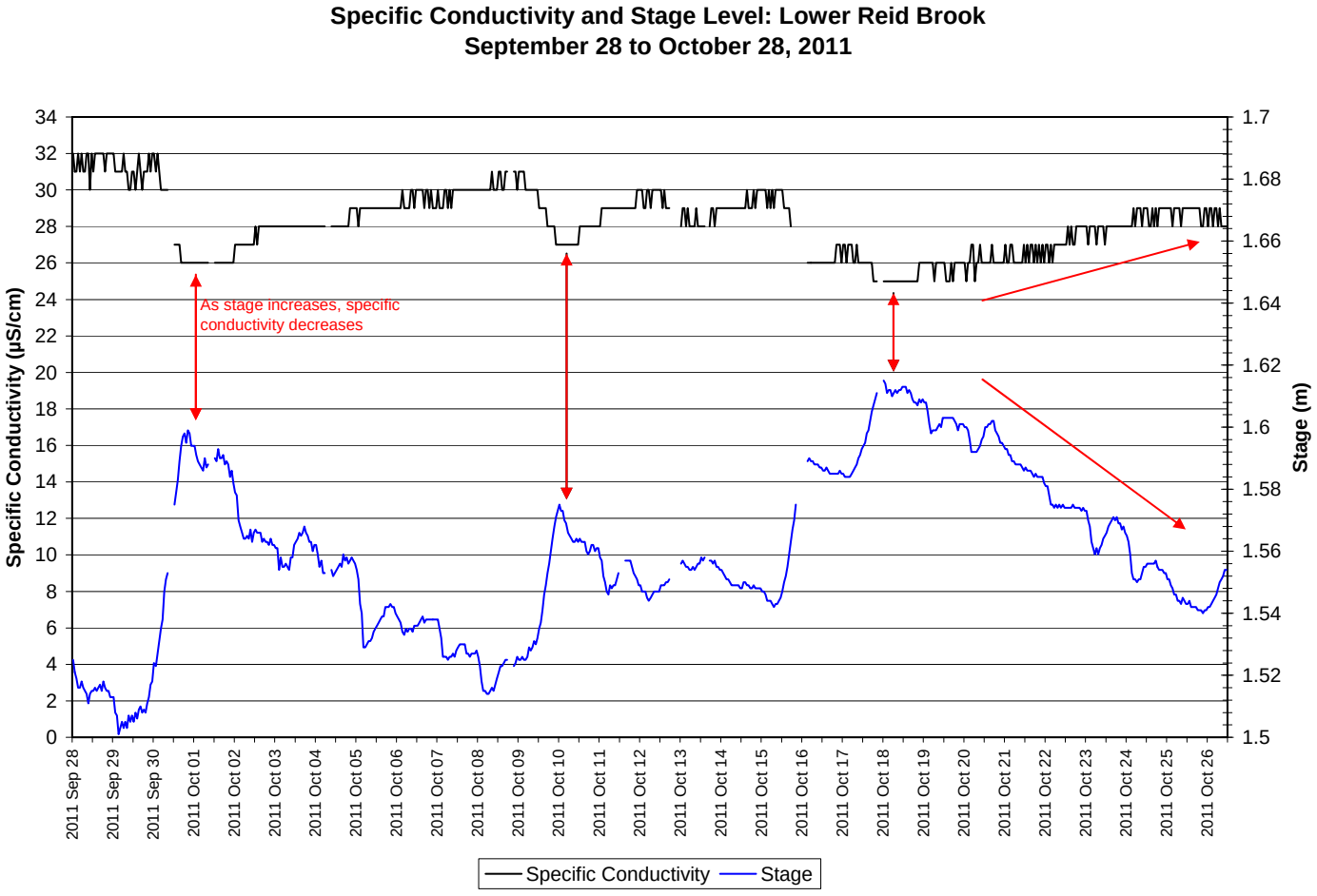

Figure 18: Specific conductivity and stage level at Lower Reid Brook

- Dissolved oxygen content ranged between 9.71g/L and 12.07mg/L. The saturation of dissolved oxygen ranged from 76.7% to 92.2% (Figure 19).
- All values were above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l) and Early Life Stages (9.5 mg/l). The guidelines are indicated in blue on Figure 19.
- Dissolved oxygen content is fluctuating throughout the deployment period. It would be expected that the dissolved oxygen content would be increasing slightly in response to the decreasing air and water temperatures (Figure 15 & 16) however this trend is not apparent in the data collected.

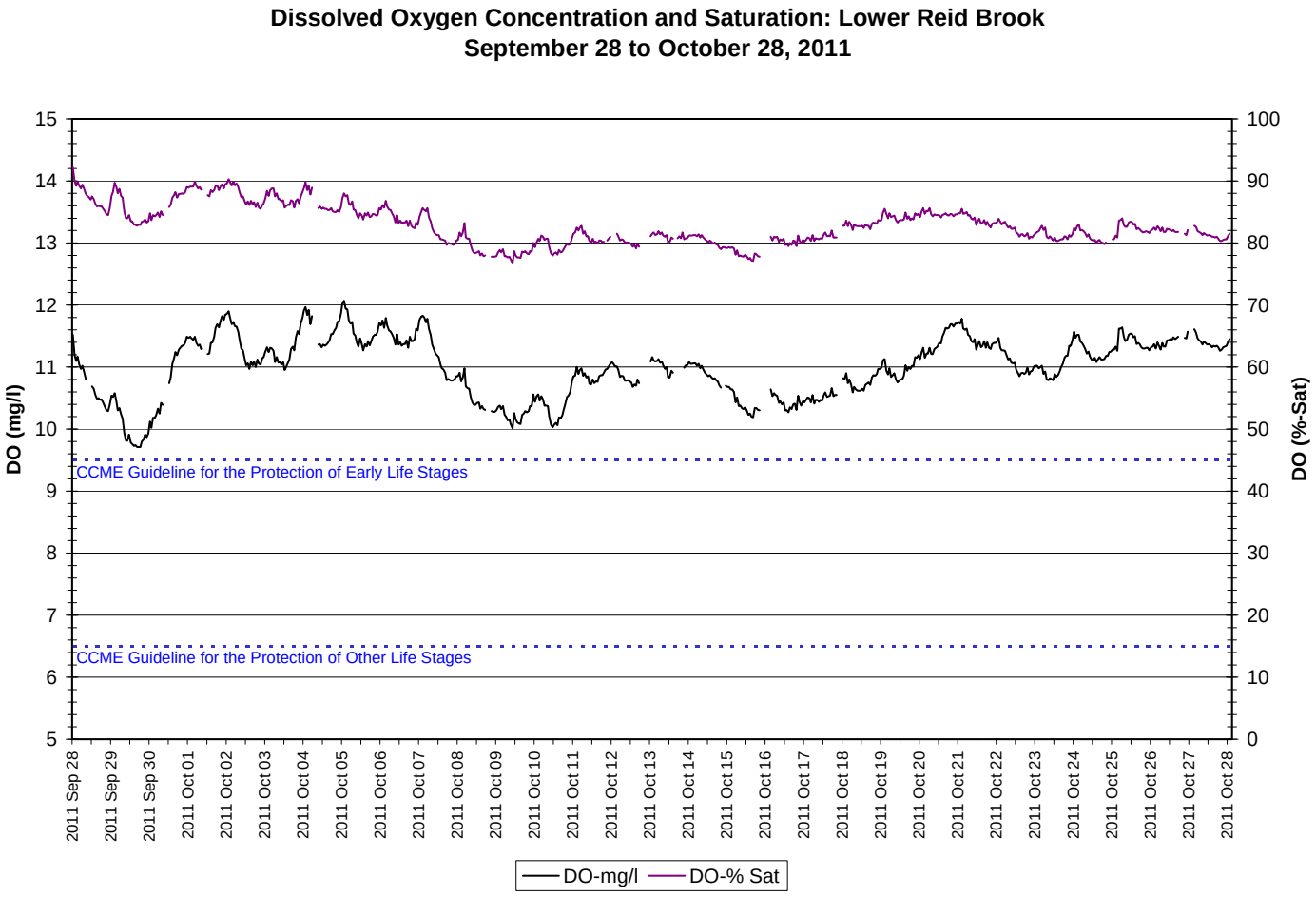

Figure 19: Dissolved oxygen and percent saturation at Lower Reid Brook

- The turbidity sensor on the Lower Reid Brook instrument (s/n 40643) has not functioned at full capacity since the August 2011. The wiper on the instrument no longer completes the revolutions prior to the taking reading. The instrument was deployed at the station regardless and a note was placed on the online graph indicating the turbidity sensor was not functional.
- Turbidity remained at 0NTU for the entire deployment period (Figure 20). These values are not typical for this station. For QAQC purposes, these values have been removed from the data set.

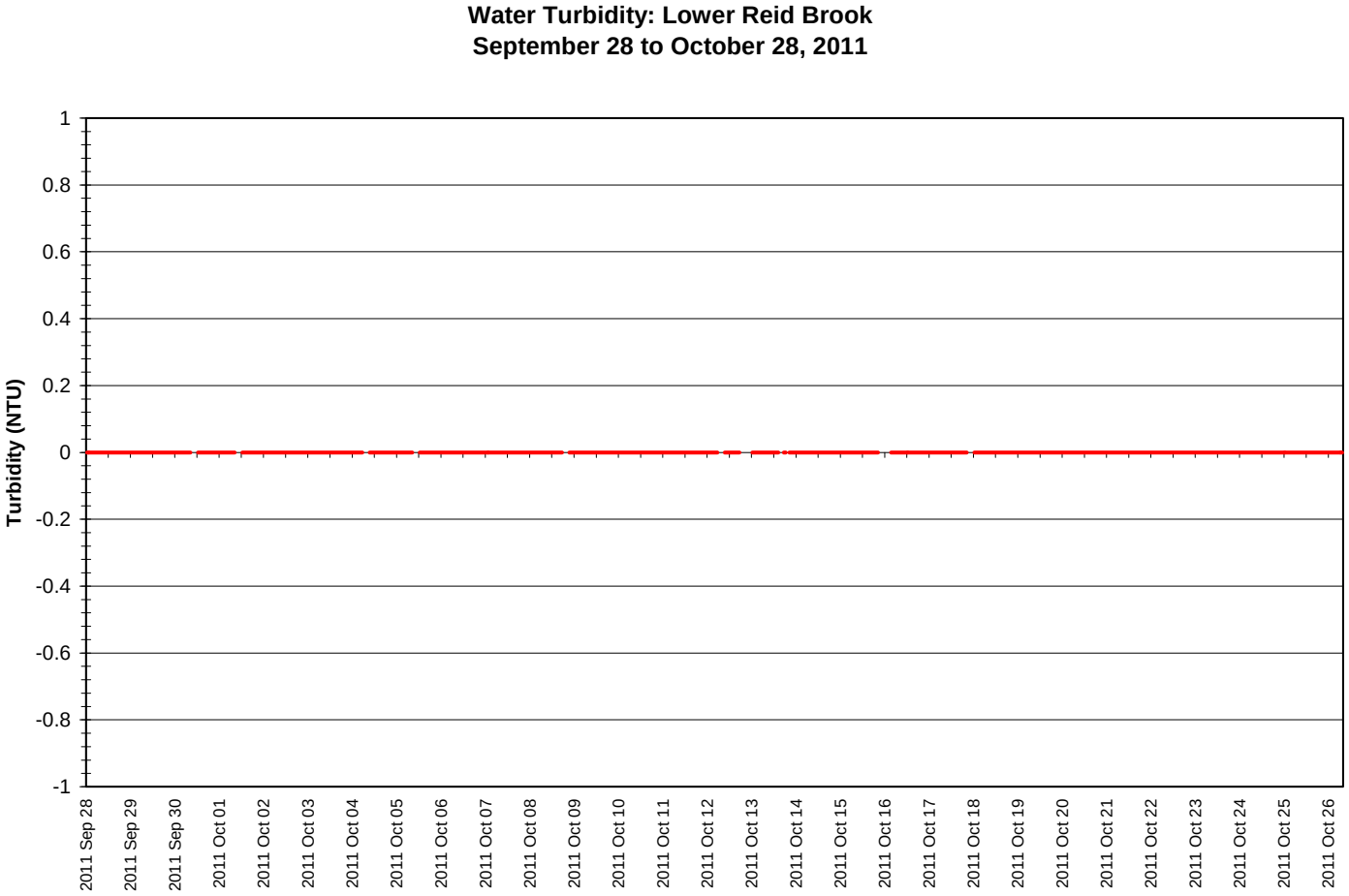

Figure 20: Turbidity and stage level at Lower Reid Brook

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 21). Stage is increasing and decreasing throughout the deployment period. Precipitation events are frequent and moderate in magnitude.

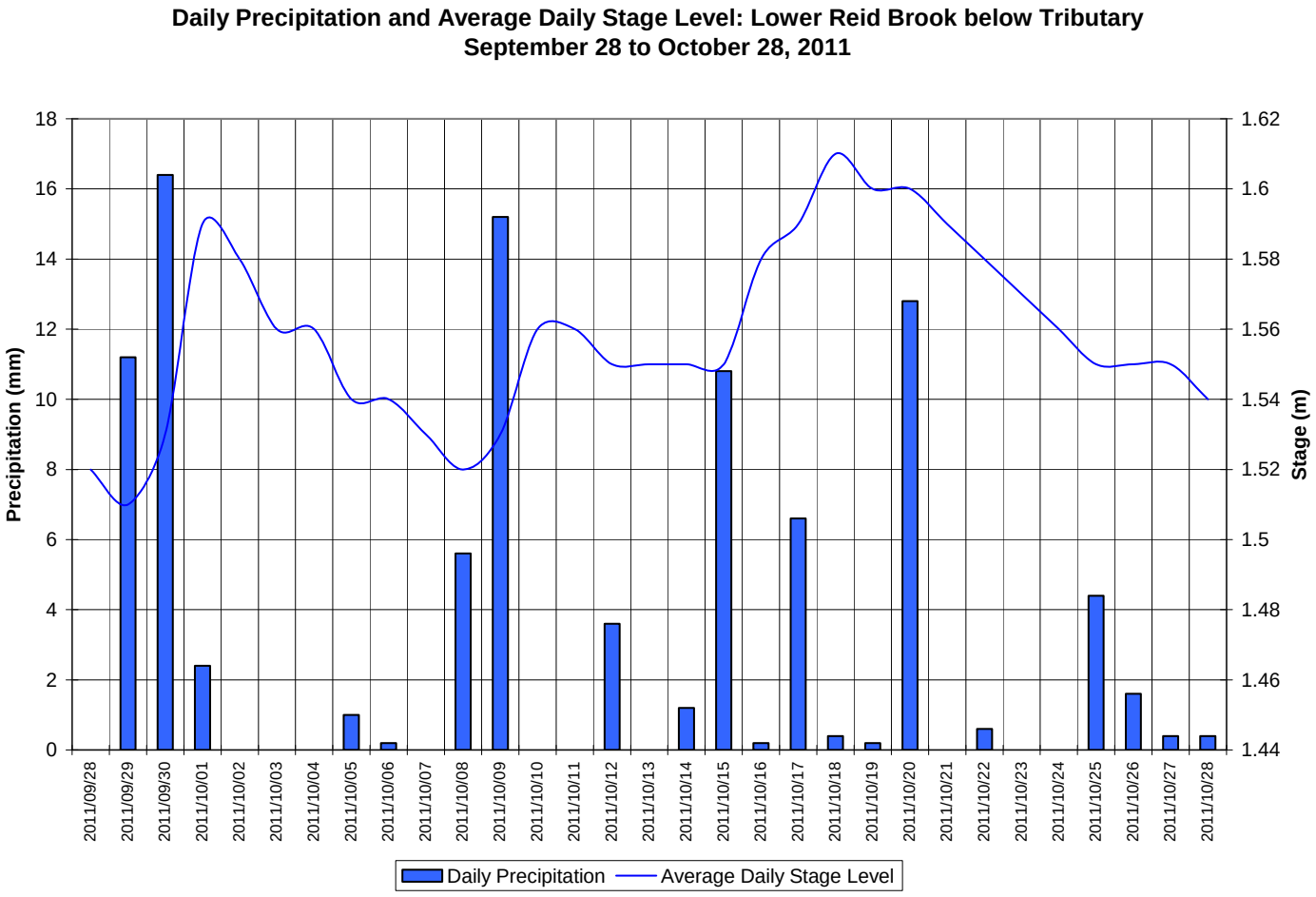

Figure 21: Daily precipitation and average daily stage level at Lower Reid Brook

(weather data recorded at Nain)

Camp Pond Brook

- Water temperature ranged from 0.90 °C to 11.00°C during the deployment period (Figure 22).
- Water temperature is generally decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures in the fall season (Figure 23). Water temperature fluctuates diurnally.
- There is a significant increase in water temperature at the beginning of the deployment period. This event corresponds with very warm air temperatures (~13 °C) recorded in the region on that day (Appendix 1).

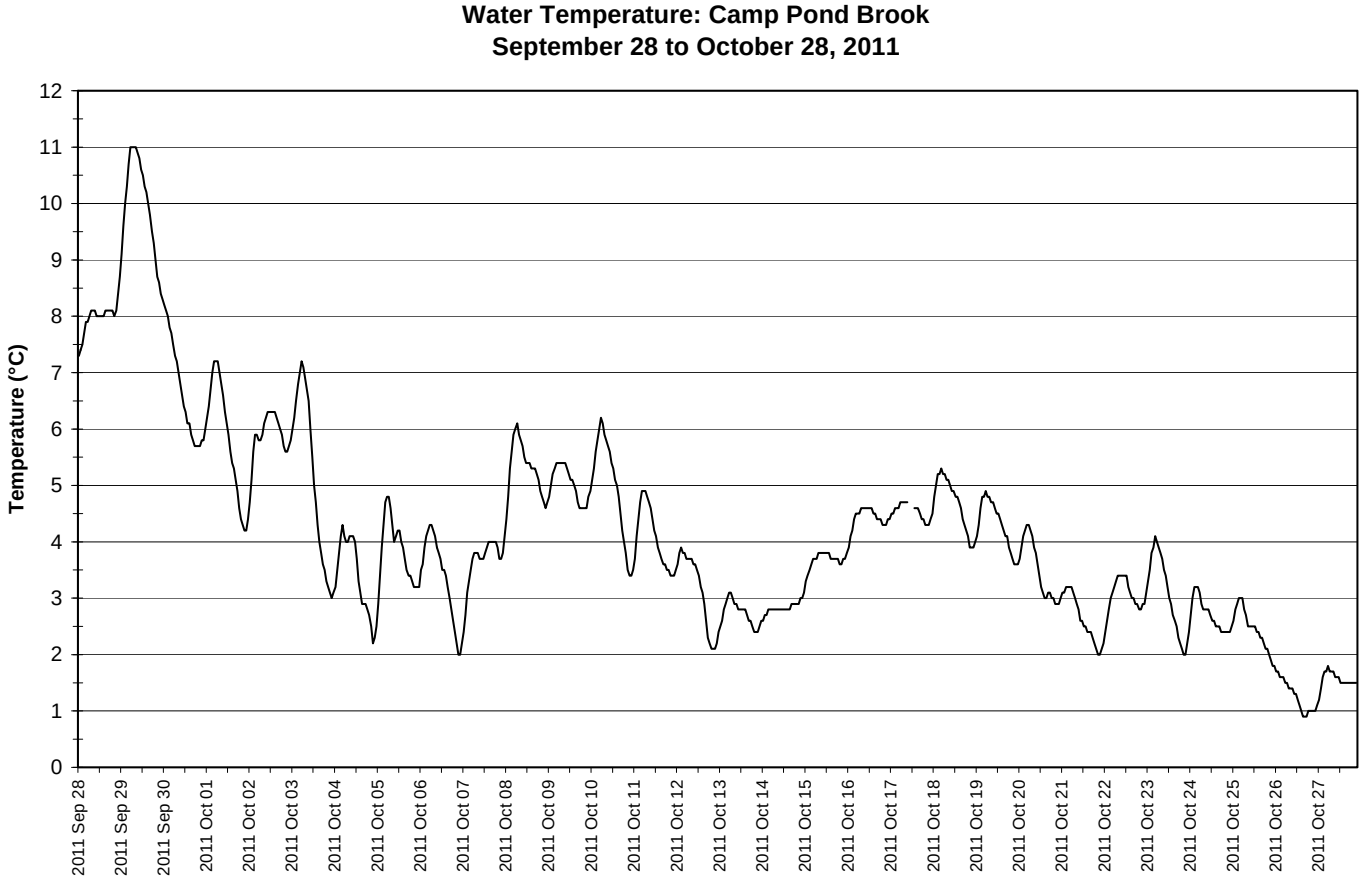

Figure 22: Water temperature at Camp Pond Brook

- Average daily air and water temperatures are generally decreasing throughout the deployment period (Figure 23). Average daily air temperatures do increase on occasion throughout the month of October and each time are reflected in slight increases in water temperature. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.

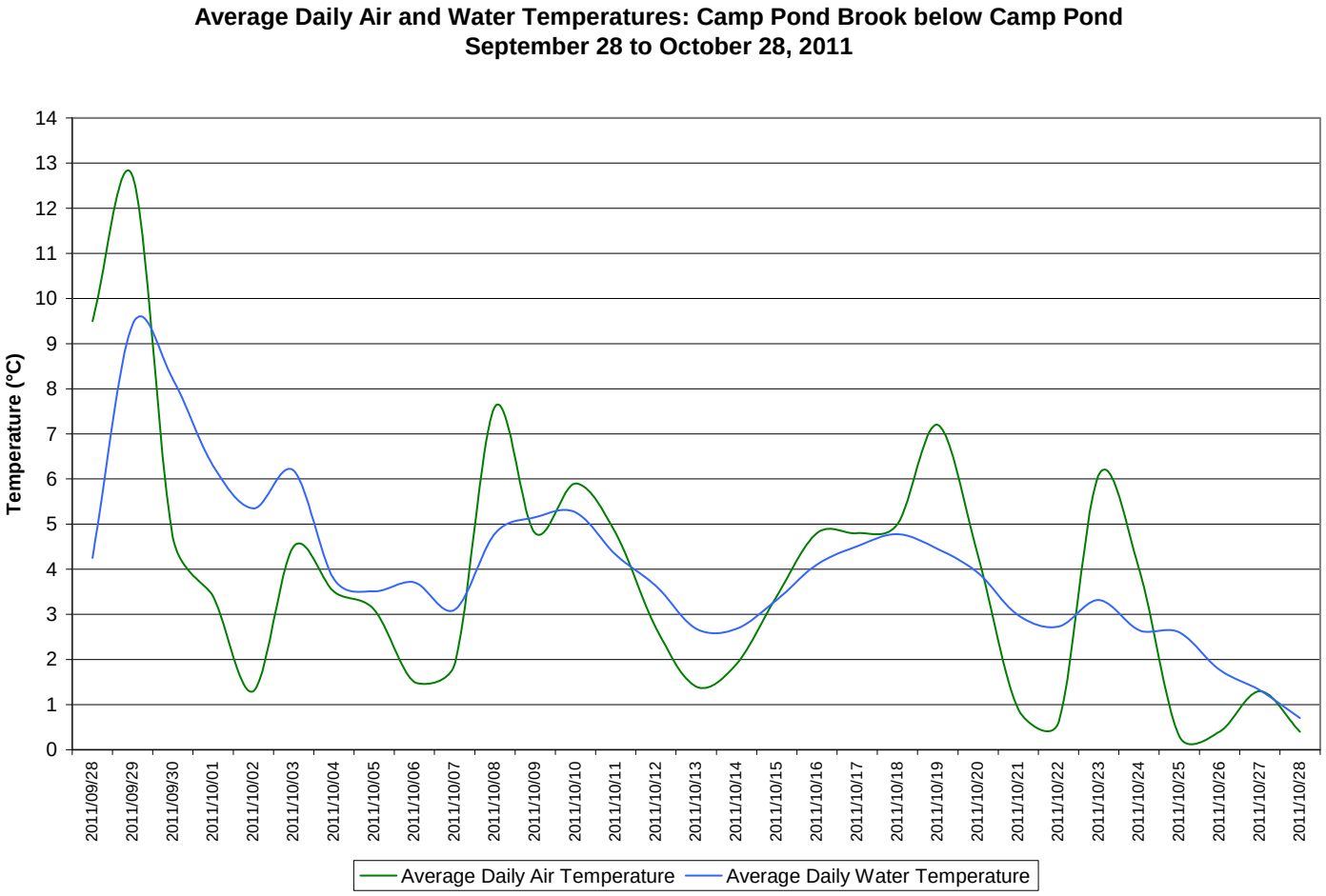

Figure 23: Average daily air and water temperatures at Camp Pond Brook

(weather data recorded at Nain)

- pH ranged between 6.50 and 6.97 pH units (Figure 24).
- pH values are stable with daily fluctuations throughout the deployment period.
- Stage is included on Figure 24 to show the relationship between water level and pH. As stage increases there are slight decreases in pH (indicated by red arrows on Figure 24).
- All values are within the recommended range for pH as suggested by the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 24).

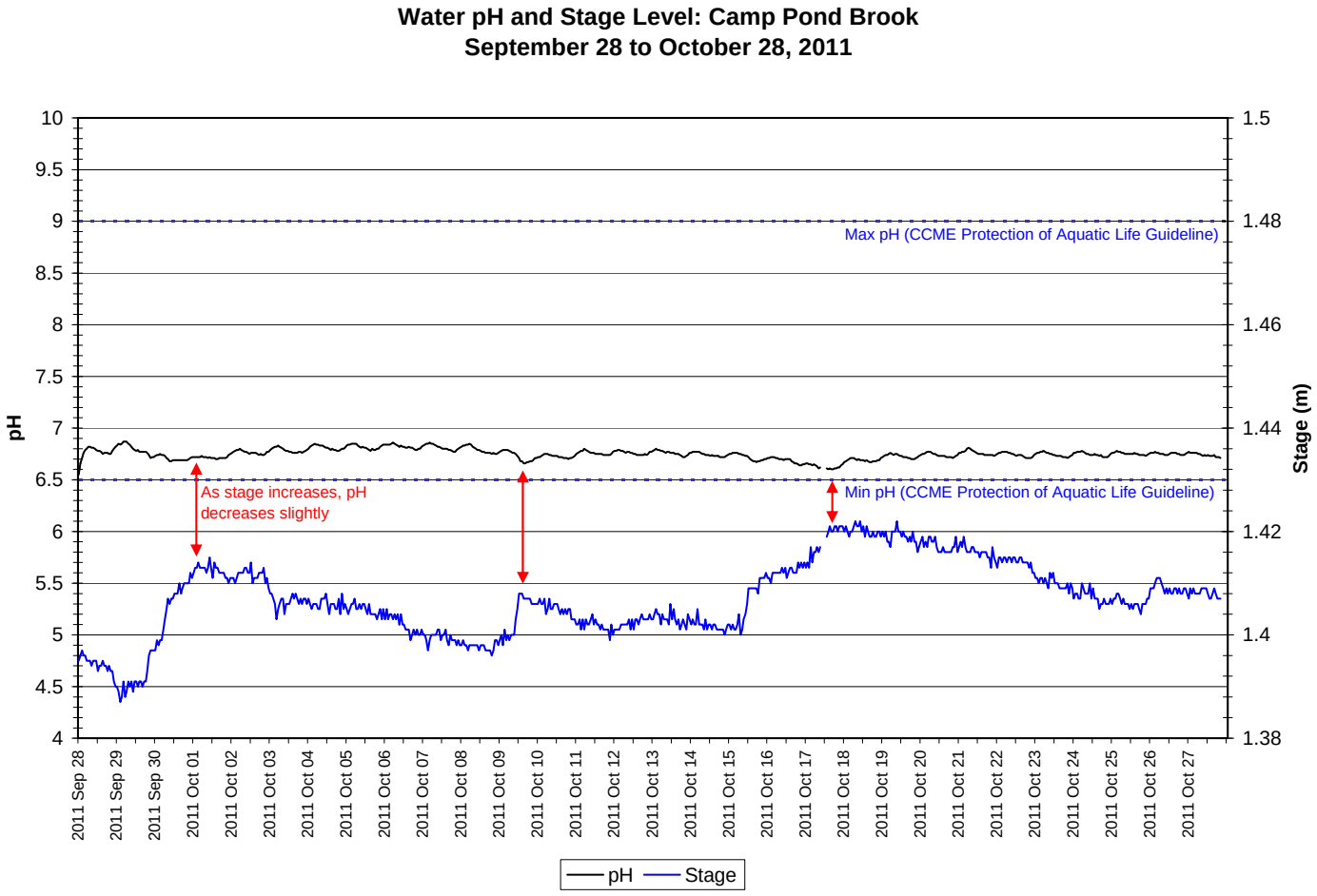

Figure 24: pH and stage level at Camp Pond Brook

- Specific conductivity ranged from 29.5µS/cm to 37.8µS/cm during the deployment period (Figure 25).
- Stage is included in Figure 25 to illustrate the inverse relationship between conductivity and water level. Stage is fluctuating throughout the deployment period. Precipitation input and stage level increase typically decreases the specific conductivity of the water by diluting the concentrations of dissolved solids present in the water column, however, in these instances, there is an increase in specific conductivity following the increase in stage (indicated by red arrows in Figure 25). This pattern has been experienced at this station in the past.

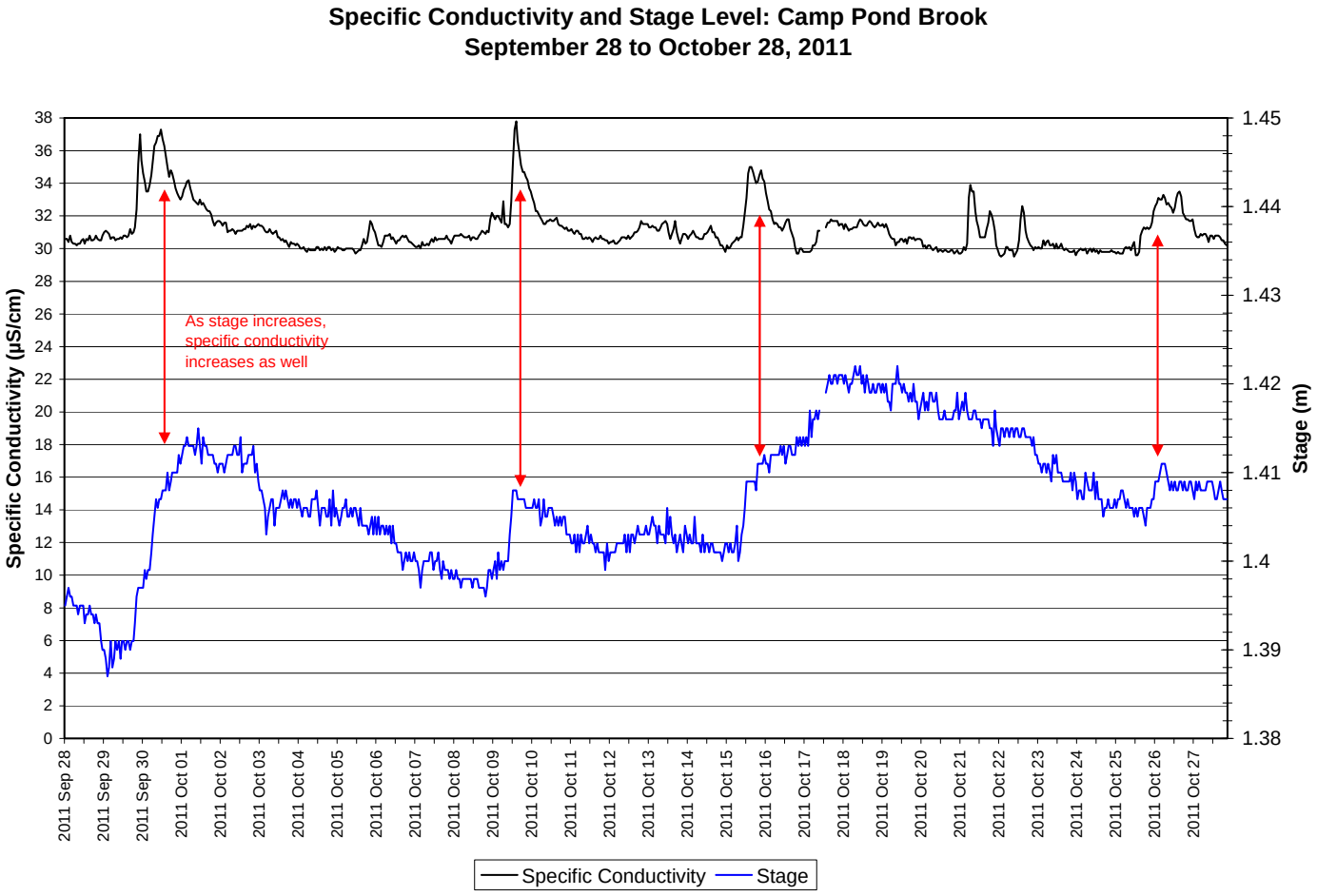

Figure 25: Specific conductivity and stage level at Camp Pond Brook

- Dissolved oxygen content ranged between 9.86mg/L and 14.63mg/L. The saturation of dissolved oxygen ranged from 78.0% to 109.3% (Figure 26).
- In several instances, DO and percent saturation dropped significantly to values as low as 20.0% and 3.00mg/L respectively. These outlying values are not included in the range and have been removed from the data set. The reason for the sporadic sensor readings is unknown at this time. The sensor will be examined carefully during the next calibration and will likely need to be replaced prior to the 2012 deployment season.
- All values were above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l) and Early Life Stages (9.5mg/l).
- Dissolved oxygen content is fluctuating slightly throughout the deployment period. It would be expected that the dissolved oxygen content would be increasing in response to the decreasing air and water temperatures (Figure 22 & 23) however this trend is not apparent in the data collected.

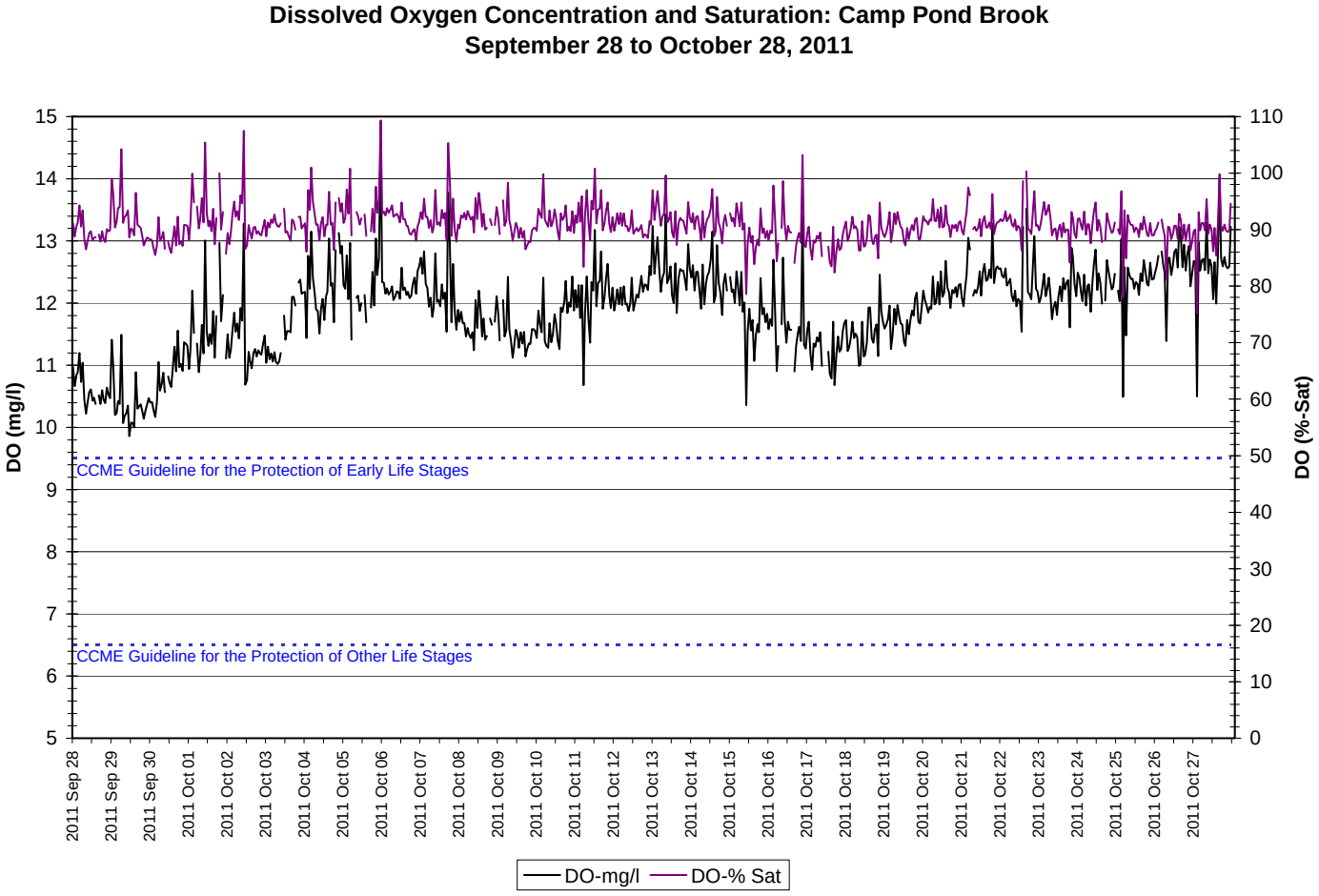

Figure 26: Dissolved oxygen and percent saturation at Camp Pond Brook

- Turbidity generally ranged between 3.4NTU to 10.0NTU (Figure 27). A median value of 5.9NTU indicates there is a consistent natural background turbidity value at this station.
- This trend is typical for turbidity at this station. There are a couple of instances when turbidity spikes to greater than the background level (>10NTU) however these events are short lived (1-2 hours) and not of significant magnitude (<27NTU).

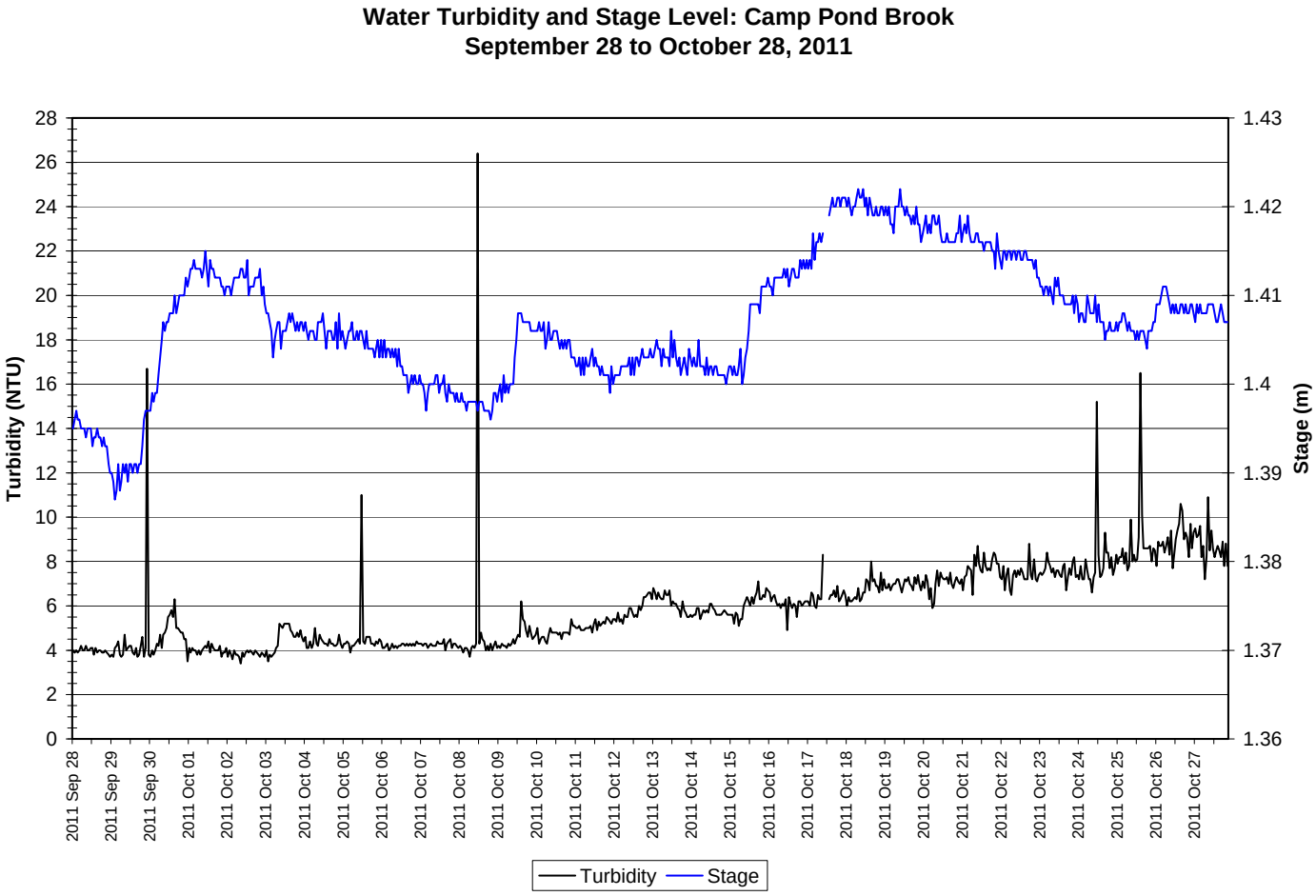

Figure 27: Turbidity and stage level at Camp Pond Brook

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 28). Stage is increasing and decreasing throughout the deployment period. Precipitation events are frequent and moderate in magnitude.

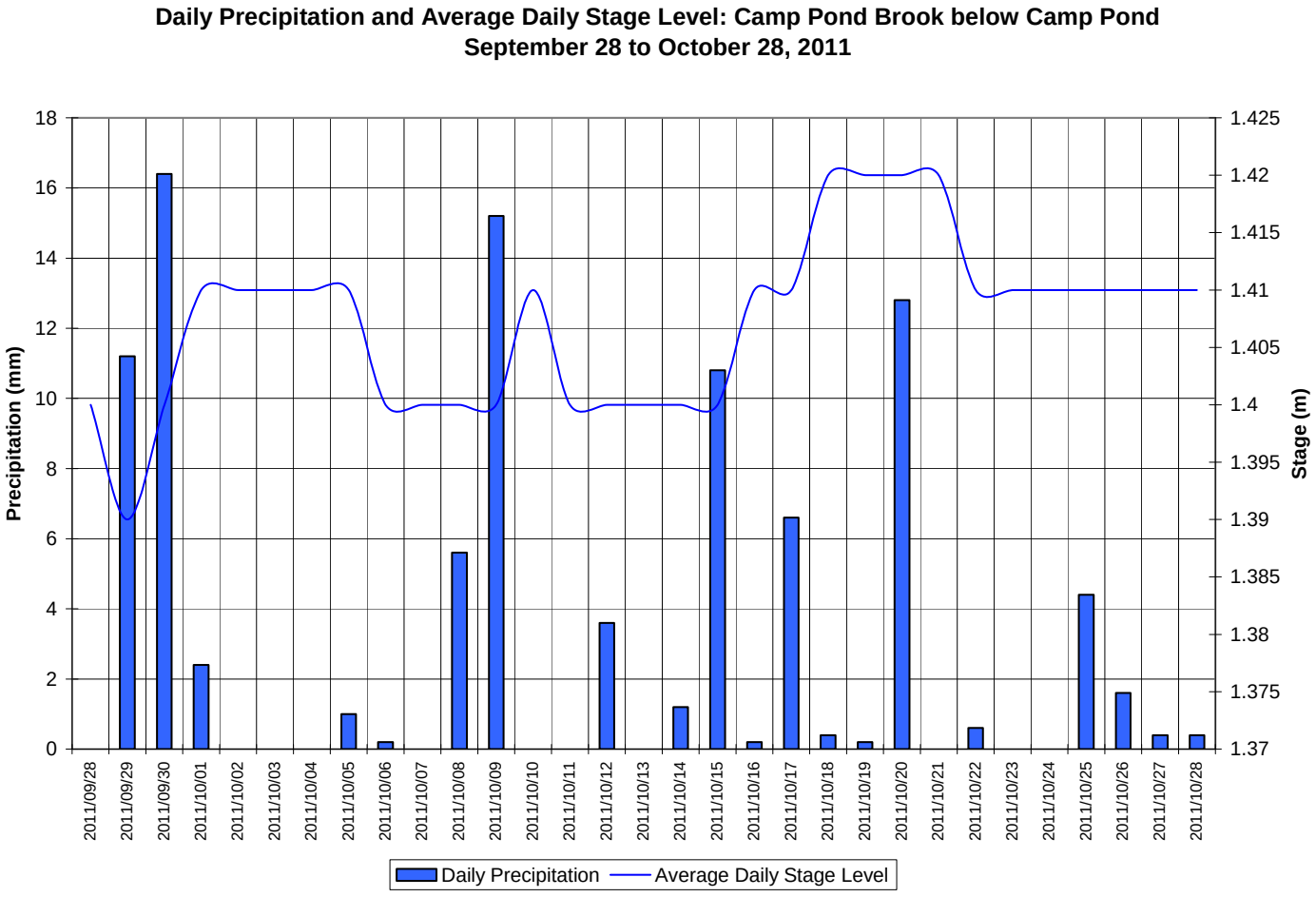

Figure 28: Daily precipitation and average daily stage level at Camp Pond Brook

(weather data recorded at Nain)

Conclusions

- Instruments at water quality monitoring stations in the Voisey's Bay Network were deployed from September 28 to October 28, 2011.

Summary by Station

- At Upper Reid Brook, a replacement instrument loaned to Vale by ENVC was deployed on September 28. This instrument features no turbidity sensor or battery pack therefore there is no turbidity data or option for a back up log file. Temperature decreased throughout the deployment period. pH and specific conductivity we both very stable. Dissolved oxygen increased in response to the cooling air and water temperatures. Stage levels increased for the first three weeks of the deployment before decreasing in the final week.
- At Tributary to Lower Reid Brook, the turbidity wiper and cleaning brush is not working. Oddly turbidity began recording values >0NTU for a period of one week however due to the unreliability of the sensor, values have been removed from the data set. Other parameters were satisfactory; temperature decreased steadily, pH and specific conductivity fluctuated in response to changing water levels. Dissolved oxygen increased in response to the cooling air and water temperatures. Stage levels increased for the first three weeks of the deployment before decreasing during the final week.
- At Lower Reid Brook, temperature also decreased throughout the deployment period. pH and specific conductivity fluctuated in response to changing water levels. Dissolved oxygen did not increase as expected with decreasing temperatures. The turbidity sensor on the instrument is not functional and reported 0NTU for the entire deployment period which is not usual for this station. The data collected for turbidity during this time is invalid and has been removed from the dataset for future use. Stage increased and decreased throughout the month of October.
- At Camp Pond Brook, water temperatures decreased while dissolved oxygen values remained stable throughout the deployment period. pH values were stable and fluctuated diurnally with minimal response to changing water levels. Specific conductivity did not portray a typical inverse relationship with stage level. Instead of seeing specific conductivity decrease with increasing stage, specific conductivity increased when stage increased. Turbidity averaged around 6NTU, which is typical for this station. Stage levels increased and decreased throughout the deployment period.

Summary by Parameter

- Temperature averaged 3.6°C at the stations on Tributary to Lower Reid Brook and Lower Reid Brook. At Camp Pond Brook, temperatures were slightly warmer averaging around 4.19°C. At Upper Reid Brook, water temperatures were the warmest across the network for this deployment period, averaging 6.51°C. Temperature decreased at all stations throughout the deployment period due to the cooling ambient air temperatures in the fall season. There was a significant increase in water temperature at the beginning of the deployment period noticeable at all stations that corresponded with above average air temperatures recorded that day.

- pH values averaged between 6.50 and 7.08 pH units across the network. All values recorded were within the recommended range as stated by the CCME Guideline for the Protection of Aquatic Life. At stations at Tributary to Lower Reid Brook, Lower Reid Brook, and Camp Pond Brook, increases in stage level caused noticeable decreases in pH.
- At Tributary to Lower Reid Brook, Lower Reid Brook and Camp Pond Brook stations, specific conductivity averaged between 28µS/cm and 31µS/cm. Values at Upper Reid Brook were considerably lower averaging 8.7µS/cm. These lower values are expected from this pristine station at the outflow from Reid Pond. Values at this station tend not to fluctuate a lot even with changing stage levels. At Tributary to Lower Reid and Lower Reid Stations, specific conductivity displayed a clear inverse relationship with stage level, with values decreasing when stage level increased. At Camp Pond Brook, specific conductivity increased sharply when the stage level increased which is a trend normally seen at this station.
- Dissolved oxygen levels were satisfactory across the network averaging between 10.01mg/l and 12.61mg/l. All values recorded were above the minimum CCME Guideline for the Protection of Aquatic Life at Other Life Stages (6.5mg/l). All values recorded at Tributary to Lower Reid Brook, Lower Reid Brook and Camp Pond Brook were above the minimum CCME Guideline for the Protection of Aquatic Life at Early Life Stages (9.5mg/l). At Upper Reid Brook, most values were greater than 9.5mg/l. At Upper Reid Brook, Lower Reid Brook and Camp Pond Brook, dissolved oxygen trends did not display a clear inverse relationship with water temperature and remained stable despite dropping water temperatures. Dissolved oxygen levels increased slightly throughout the deployment period at Tributary to Lower Reid Brook.
- Turbidity values are inaccurate for the station at Tributary to Lower Reid Brook and Lower Reid Brook due to sensor failure. Values recorded at Camp Pond Brook were typical for the station averaging around 6NTU. There is no turbidity sensor on the instrument at Upper Reid Brook.
- Stage increased for the first three weeks of the deployment period at the stations on Upper Reid Brook and Tributary to Lower Reid Brook before decreasing during the final week of deployment. At Lower Reid Brook and Camp Pond Brook, stage levels increased and decreased throughout the deployment period. Precipitation events were frequent and moderate in magnitude.

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Appendix 1

Daily Precipitation and Average Daily Air Temperature: Nain, NL
September 28 to October 28, 2011