Real-Time Water Quality Deployment Report

Voisey's Bay Network

June 19 to
July 20, 2011

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 June 19, 2011, a real-time water quality monitoring instrument was deployed at one of the real time stations in the Voisey's Bay network at Upper Reid Brook. Instruments at the three remaining stations, Tributary to Lower Reid Brook, Lower Reid Brook and Camp Pond Brook, were deployed on June 22. All instruments were removed for cleaning and calibration on July 20, a period of 28-31 days.

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 QA/QC 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 June 19/22 to July 20, 2011 are summarized in Table 2.

Table 2: Comparison rankings for Voisey's Bay Network stations, June 19/22 – July 20, 2011

Station Voisey's Bay	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Upper Reid Brook	Jun 19, 2011	Deployment	Poor	Good	Excellent	Poor	n/a*
	Jul 20, 2011	Removal	n/a†	n/a†	n/a†	n/a†	n/a†
Tributary to Lower Reid Brook	Jun 22, 2011	Deployment	Good	Good	Excellent	n/a‡	n/a*
	Jul 20, 2011	Removal	Excellent	Excellent	Fair	Fair	Excellent
Lower Reid Brook	Jun 22, 2011	Deployment	Good	Good	Good	Excellent	n/a*
	Jul 20, 2011	Removal	Good	Excellent	Excellent	Poor	Poor
Camp Pond Brook	Jun 22, 2011	Deployment	Excellent	Excellent	Excellent	Fair	n/a*
	Jul 20, 2011	Removal	Good	Good	Good	Poor	Fair

* QAQC comparison readings were not available at deployment for turbidity at all four stations station due to the absence of a turbidity sensor on the QAQC instrument.

† QAQC comparison rankings were not available at removal at the Upper Reid Brook station due to the absence of power to the field instrument.

‡ QAQC comparison rankings were not available at deployment at Tributary to Lower Reid Brook station for dissolved oxygen due to instrument error.

- At the station at Upper Reid Brook, pH and conductivity ranked 'good' and 'excellent' respectively. Temperature was ranked 'poor'. The field instrument read a value of 2.52°C while the QAQC instrument read 4.69°C. This is a significant temperature difference. The difference may have in part been due to placement of the instruments in the water body. Both temperature sensors will be tested against a lab grade thermometer during the next cleaning and calibration. Dissolved oxygen content also ranked 'poor' at deployment. The field instrument read 13.25mg/L while the QAQC instrument read 10.84mg/L. Both of these instruments feature a Clark cell DO sensor. The difference between the two instrument readings is in large part due to the disparity in temperatures as the DO measurement uses the temperature sensor reading to calculate DO content. Turbidity is not ranked because there is no turbidity sensor on either the field or QAQC instrument. No QAQC readings were available at the time of removal as there is no battery pack for the field instrument. Therefore, no values were read directly from the field sonde in the station shelter.
- At the station on the Tributary to Lower Reid Brook, temperature, pH and specific conductivity ranked 'good' or 'excellent' at deployment. Dissolved oxygen was not ranked due to an error with the instrument display unit (Surveyor). Limited power prevented the reading from being properly displayed. Turbidity comparison readings are unavailable for the deployment because there is no turbidity sensor on the QAQC instrument. At removal, temperature, pH and turbidity all ranked 'excellent' while specific conductivity and dissolved oxygen both ranked 'fair'. Specific conductance was measured on the field instrument at

17µS/cm while the QAQC instrument read 27.9µS/cm. When the field instrument was later calibrated in 100µS/cm solution, the initial reading was 62µS/cm indicated the field instrument values had drifted and were reporting lower than the true existing conditions in the water body. Dissolved oxygen was measured on the field instrument at a concentration of 10.09mg/L while the QAQC instrument reported 10.65mg/L. Both instruments feature a luminescent dissolved oxygen sensor. The difference between the measurements may have been in part due to placement of the instruments in the water body adjacent to one another or the amount of time required for readings to stabilize.

- At the station at Lower Reid Brook, temperature, pH, specific conductivity, and dissolved oxygen all ranked either 'good' or excellent'. Turbidity was not ranked because there was no turbidity sensor on the QAQC instrument. At removal, temperature, pH and specific conductivity all ranked 'good' or 'excellent' while dissolved oxygen and turbidity both ranked 'poor'. The power requirements for the dissolved oxygen and turbidity sensors are closely related. In previous experience when there is limited power for the turbidity sensor, the dissolved oxygen sensor accuracy is also compromised. Throughout the deployment period, a lot of sand and sediment had built up on the turbidity sensor and in the instrument casing. This build caused the turbidity sensor to fail for much of the deployment period, likely compromising the dissolved oxygen sensor readings as well. This will be discussed in further detail in the *Data Interpretation* section of this report.
- At the station on Camp Pond Brook, temperature, pH and specific conductivity all ranked excellent at deployment while dissolved oxygen ranked 'fair'. The field sonde reported a DO value of 11.57mg/L while the QAQC instrument read 12.08mg/L. Both of these instruments feature a Clark cell DO sensor. The difference between the measurements may have been in part due to placement of the instruments in the water body adjacent to one another or the amount of time required for readings to stabilize. Turbidity was not ranked because there was no turbidity sensor on the QAQC instrument. At removal, temperature, pH and specific conductivity all ranked 'good' while dissolved oxygen and turbidity ranked 'poor' and 'fair respectively. The dissolved oxygen read from the field sonde was 8.06mg/L while the QAQC instrument read 9.75mg/L. Dissolved oxygen is decreasing at the end of the deployment period and indicates that the sensor may have been failing and therefore reported a less than true value at the time of removal. This will be further discussed in the *Data Interpretation* section. Turbidity, which ranked 'poor', was recorded at 5.6NTU on the field sonde and 0NTU on the QAQC sonde. This difference may in part be due to placement of the instruments adjacent to one another in the water body or disturbance of the bottom material when placing the instruments in the water.

Data Interpretation

- The following graphs and discussion illustrate significant water quality-related events from June 19/22 to July 20 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 2.11 to 12.38°C during this deployment period (Figure 1).
- Water temperature is increasing throughout the deployment period. This trend is expected due to the increasing ambient air temperatures in the spring and summer seasons (Figure 2). Water temperature fluctuates diurnally.
- Near the end of the deployment period, greater fluctuations become more significant. These changes in temperature correspond with warm weather recorded in the area.

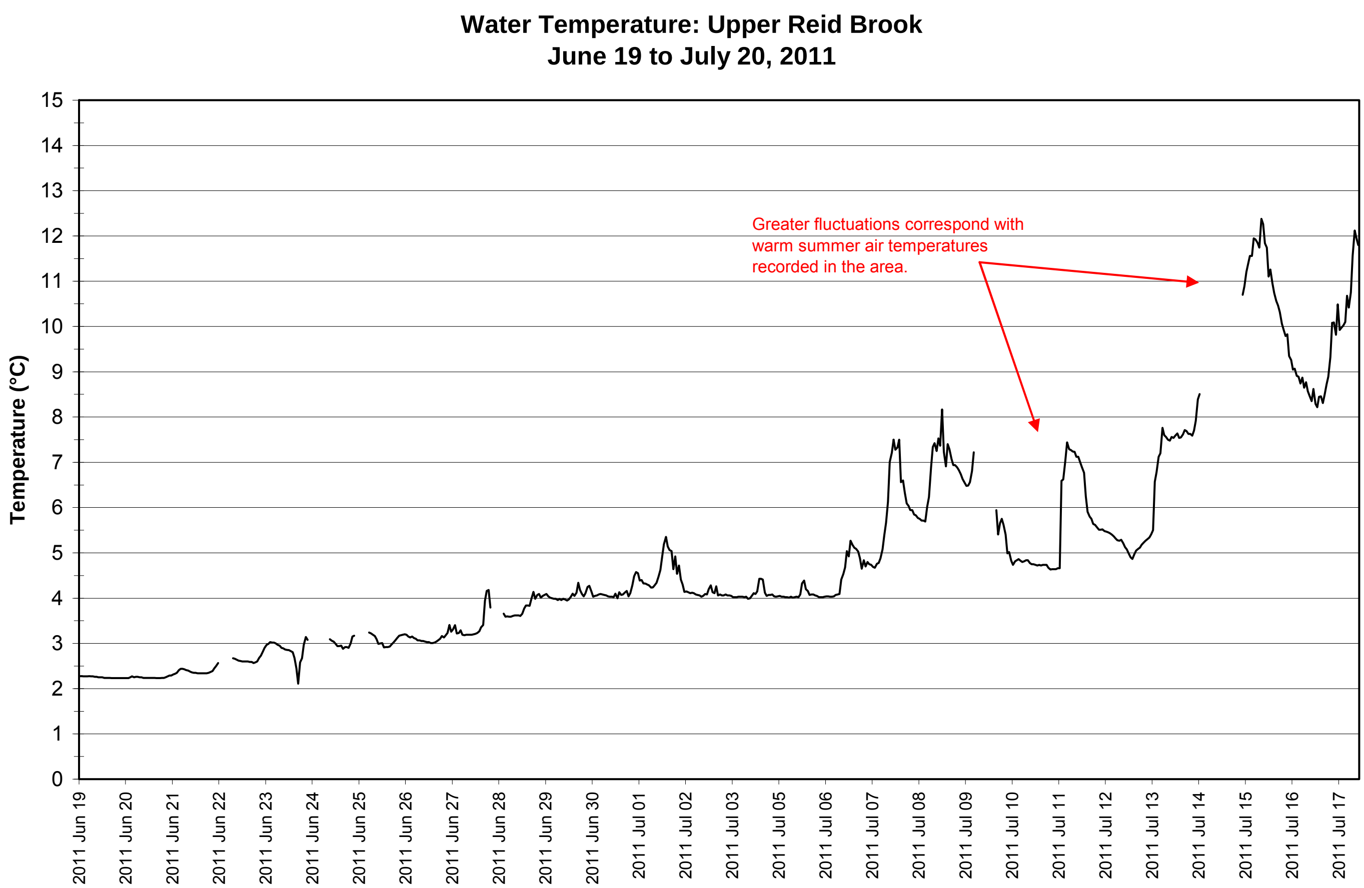

Figure 1: Water temperature at Upper Reid Brook

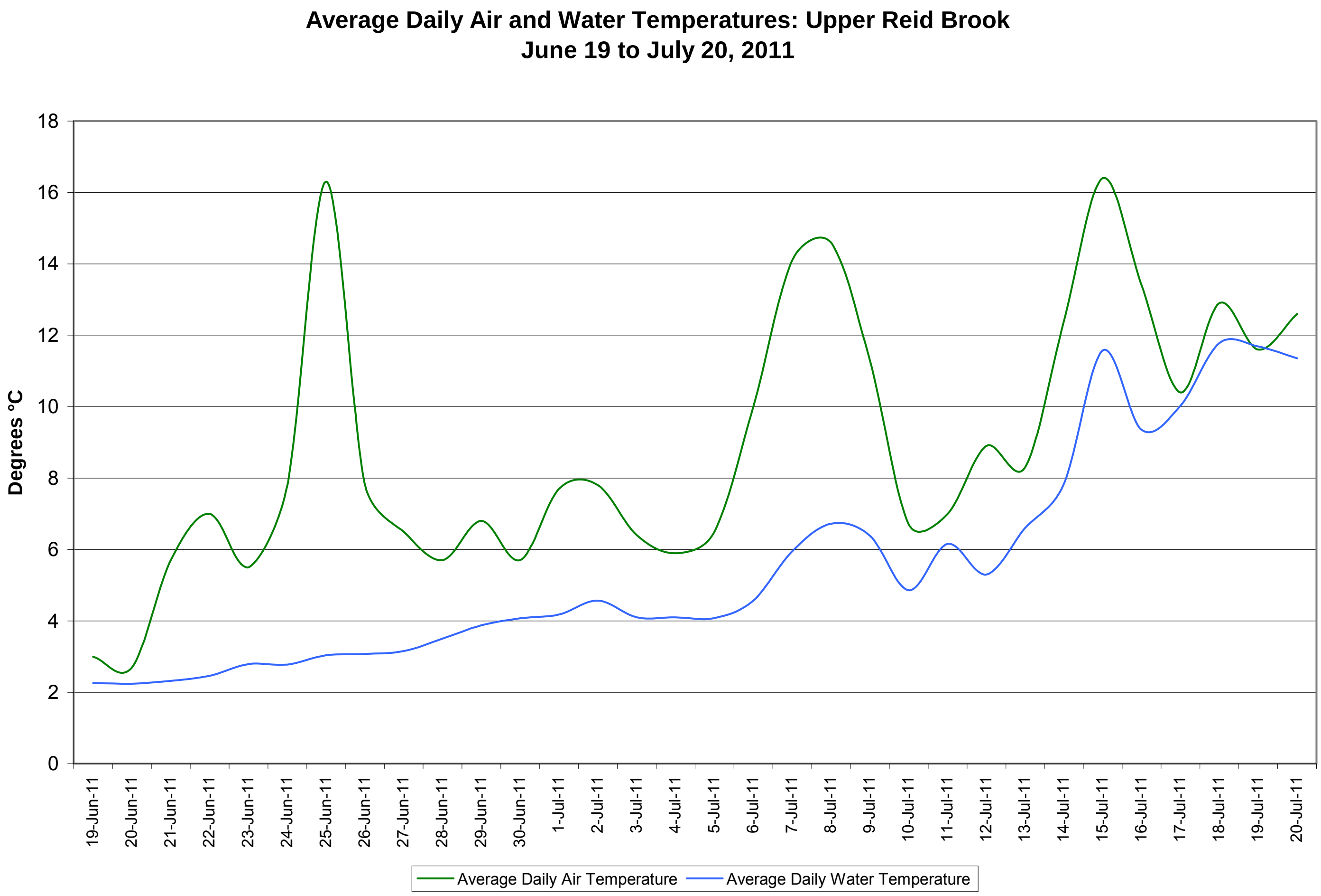

Figure 2: Average daily air and water temperatures at Upper Reid Brook

(weather data recorded at Nain)

- pH ranges between 6.35 and 6.66 pH units and generally remains stable throughout the deployment period (Figure 3).
- Most values during the deployment are just below the minimum CCME Guideline for the Protection of Aquatic Life (between 6.5 and 9.0 pH units). At the end of the deployment, pH values are just above the minimum guideline.

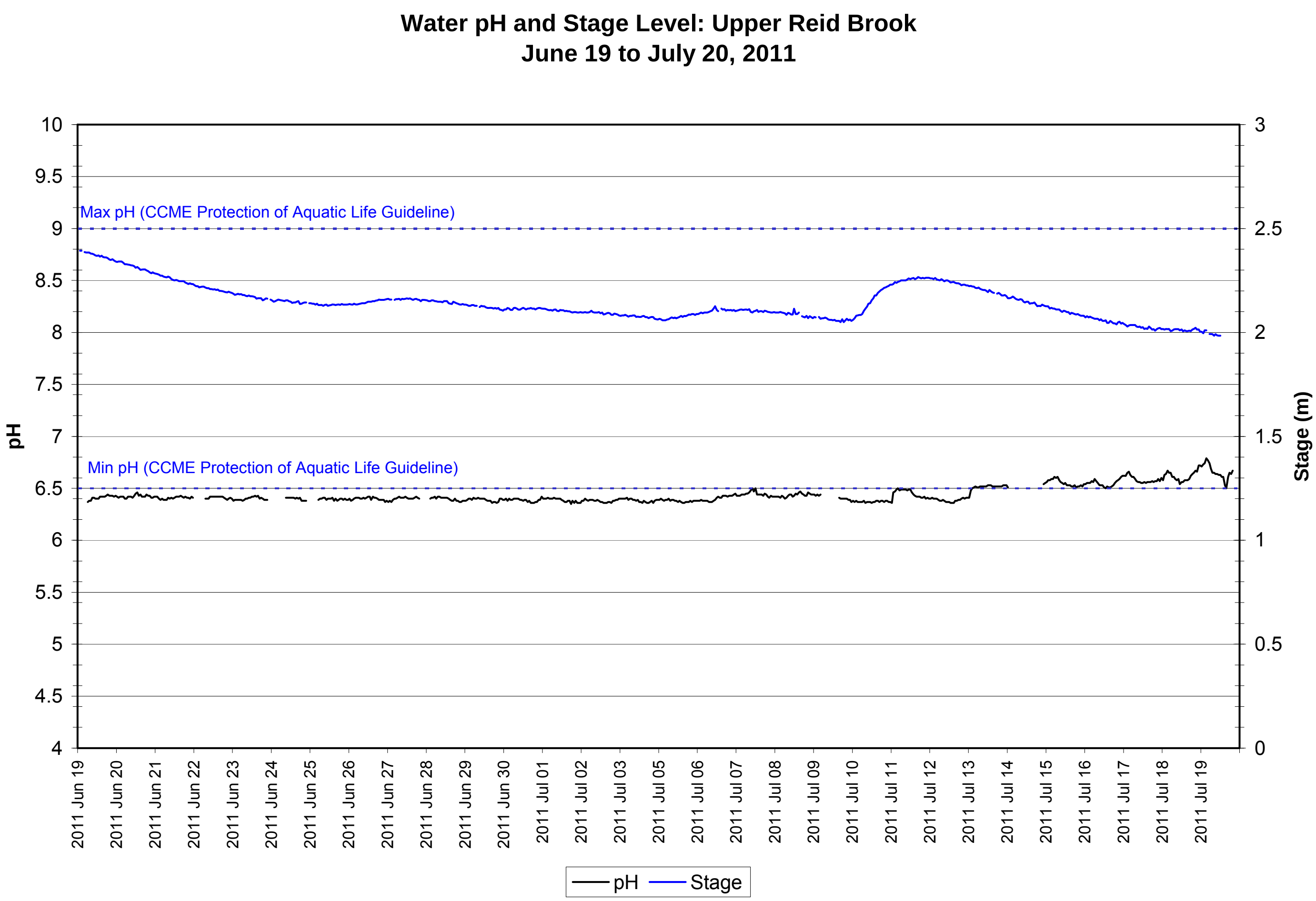

Figure 3: pH and stage level at Upper Reid Brook

- Specific conductivity ranges from 7.8 to 8.5µS/cm during the deployment period, averaging 8.1µS/cm (Figure 4).
- Specific conductance remains very low and stable throughout the deployment period with minimal fluctuation regardless of the changing water level.

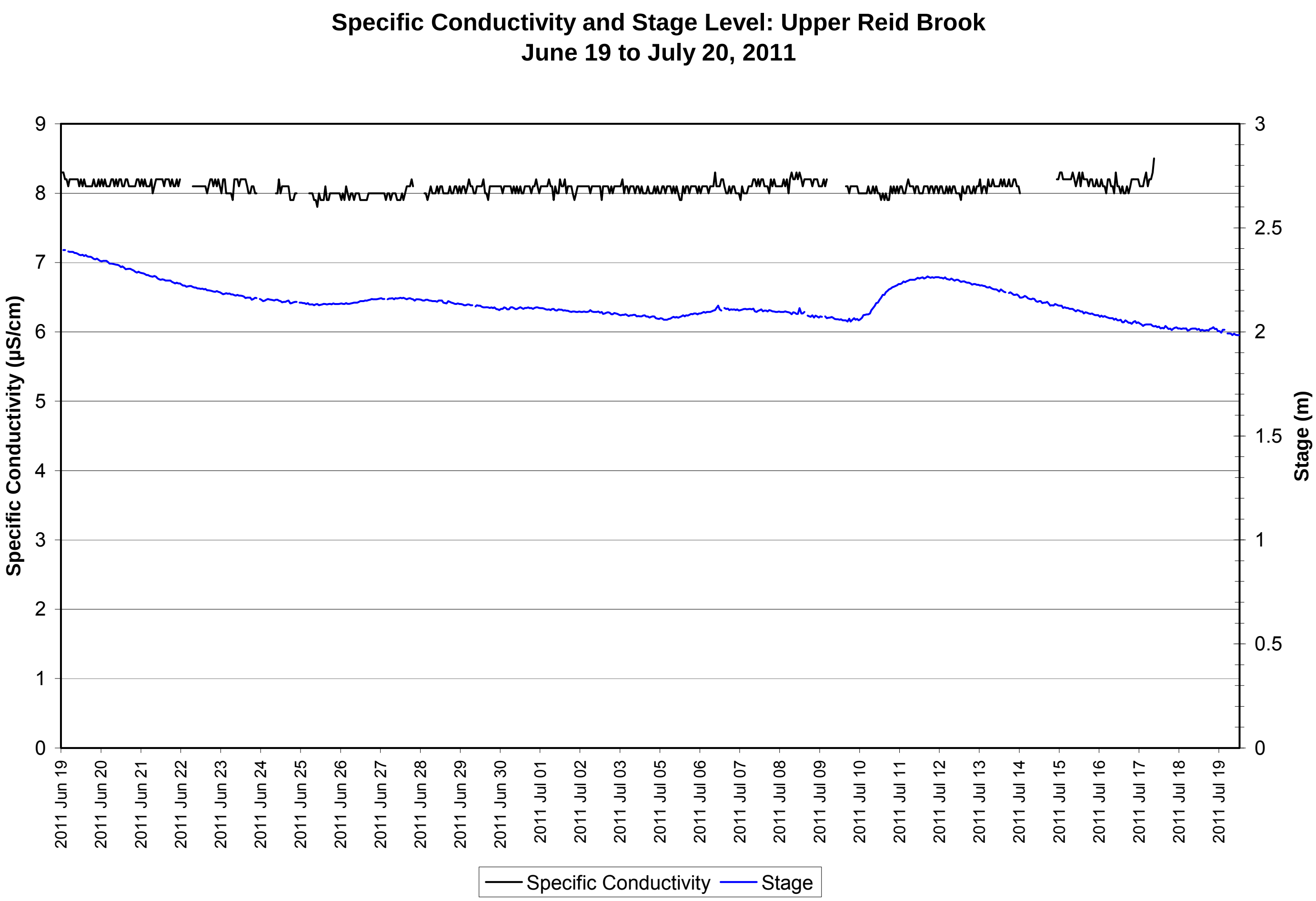

Figure 4: Specific conductivity and stage level at Upper Reid Brook

- A transmission error at the Upper Reid Brook station prevented dissolved oxygen concentration and percent saturation data from being collected in real time. Because the instrument deployed did not have a battery pack, a log file was unable to be set for this deployment period. No dissolved oxygen or percent saturation data is available between June 19 and July 15.
- On July 15, during Environment Canada's routine site visits, EC staff rectified the error and data transmission resumed successfully in real time.
- Between July 15 and July 20, dissolved oxygen content ranged between 11.43mg/L and 12.92mg/L. The saturation of dissolved oxygen ranged from 105.4% to 112.6% (Figure 5).
- All values recorded in this short 5 day period were above both the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l and the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 5.

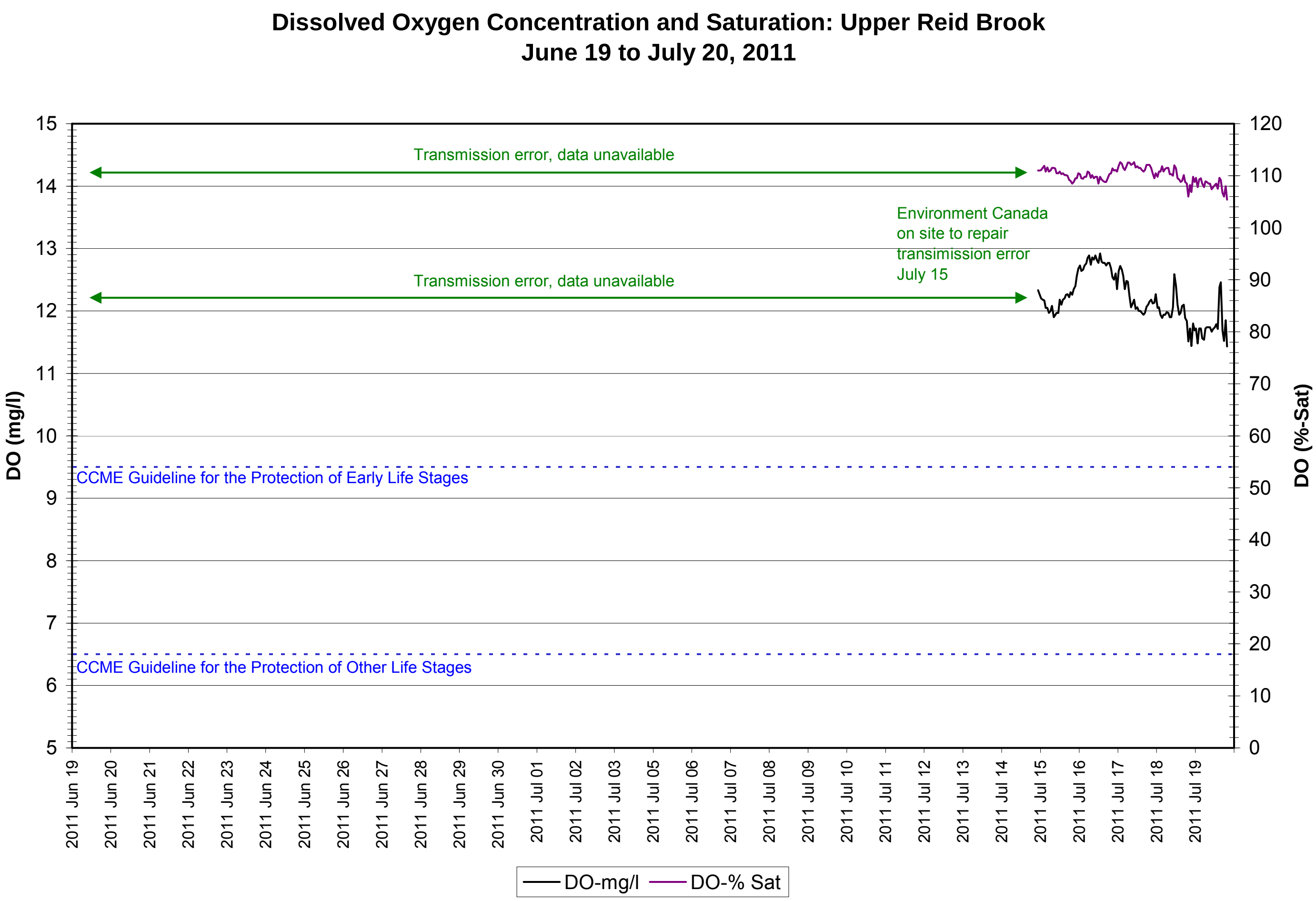

Figure 5: Dissolved oxygen and percent saturation at Upper Reid Brook

- 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 decreasing throughout the deployment period with varying precipitation records.
- In some instances, for example, the rainfall events on June 9 and 10, cause the water level in the river to rise in the days following.

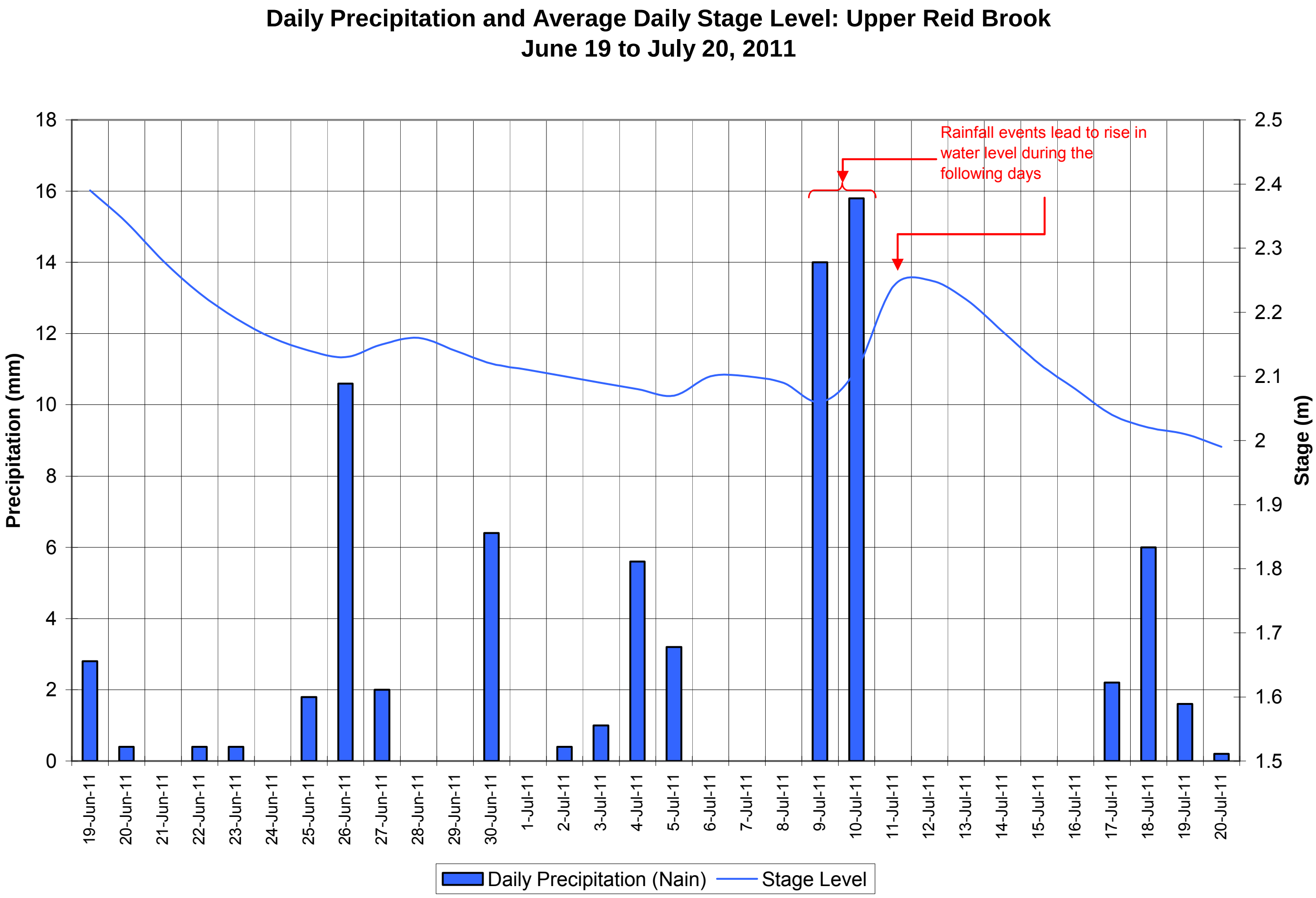

Figure 6: Daily precipitation and average daily stage level at Upper Reid Brook

(weather data recorded at Nain)

Tributary to Lower Reid Brook Lower Reid Brook

- Water temperature ranges from 5.40 to 16.10^{o}C during this deployment period (Figure 7).
- Water temperature is generally increasing throughout the deployment period. This trend is expected given the increasing ambient air temperature in the spring (Figure 8). Water temperature fluctuates diurnally.

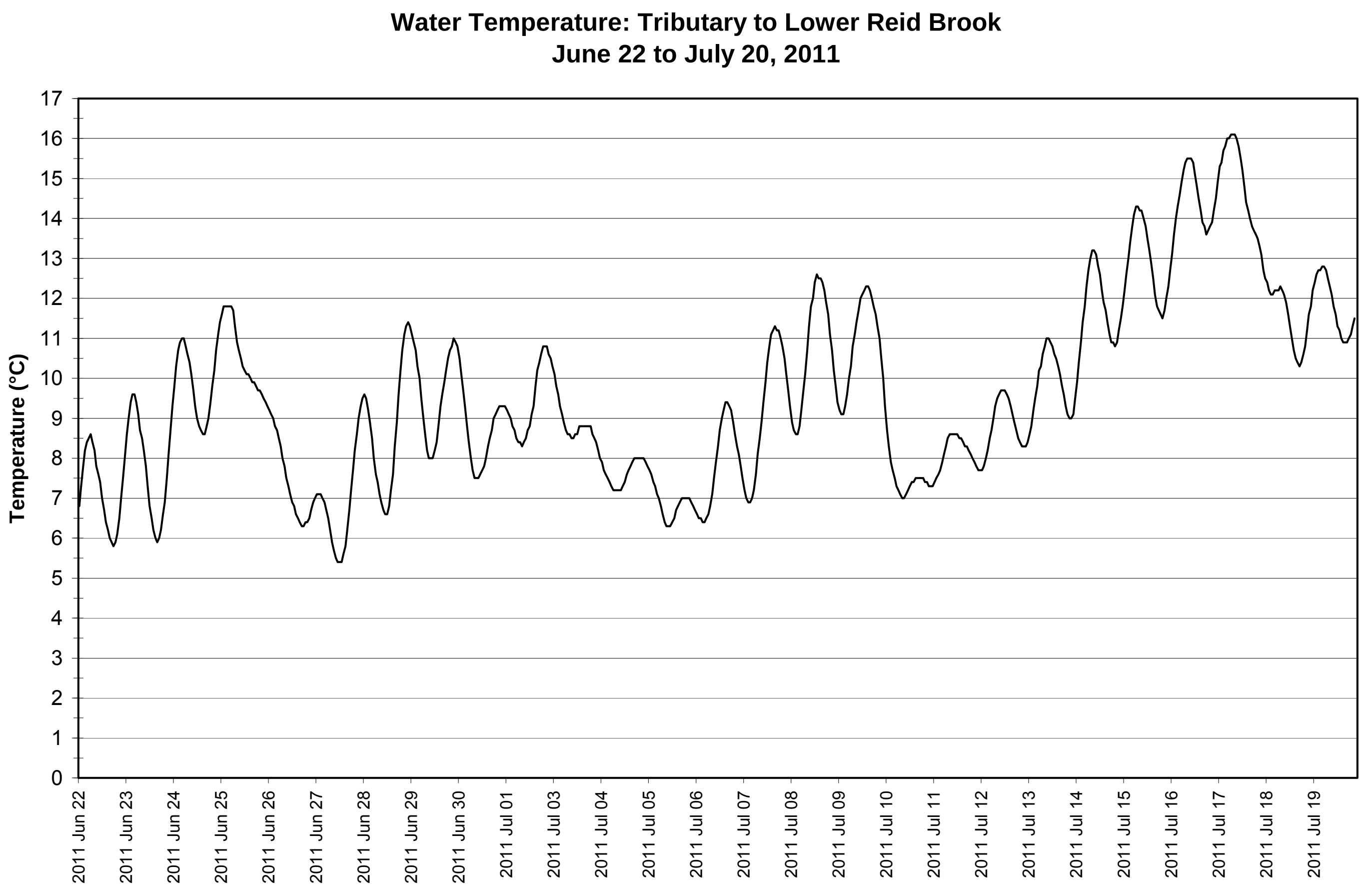

Figure 7: Water temperature at Tributary to Lower Reid Brook

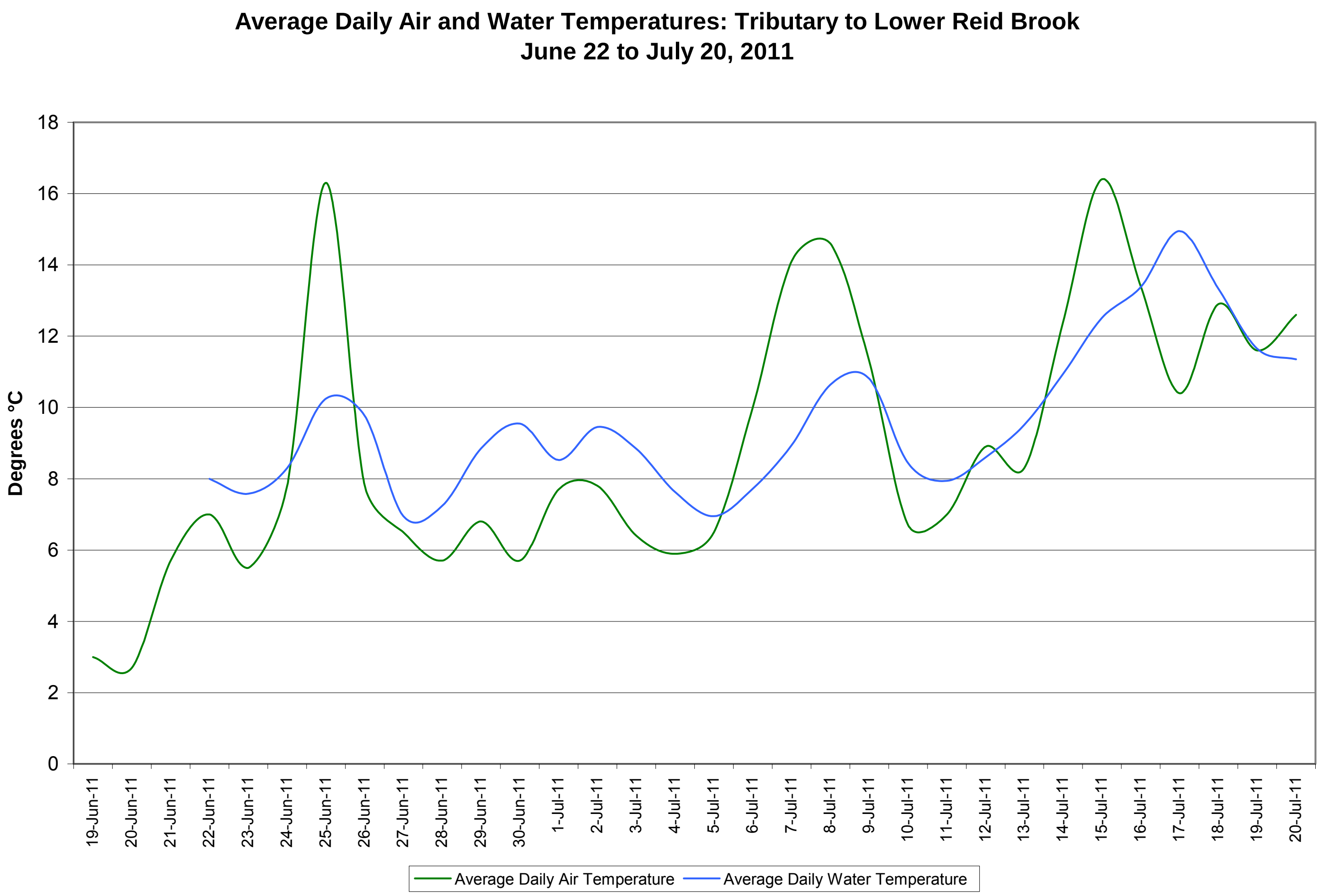

Figure 8: Average daily air and water temperatures at Tributary to Lower Reid Brook

(weather data recorded at Nain)

- pH ranges between 6.31 and 6.78 pH units (Figure 9). pH values rise and fall throughout the deployment period, averaging 6.66 pH units.
- Most 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). Between June 10 and 12, during a significant increase in stage level, pH drops below the minimum guideline. The inverse relationship between stage and pH is clearly evident during the deployment period with many occurrences of pH decreases during stage increases (indicated by red arrows on Figure 9).

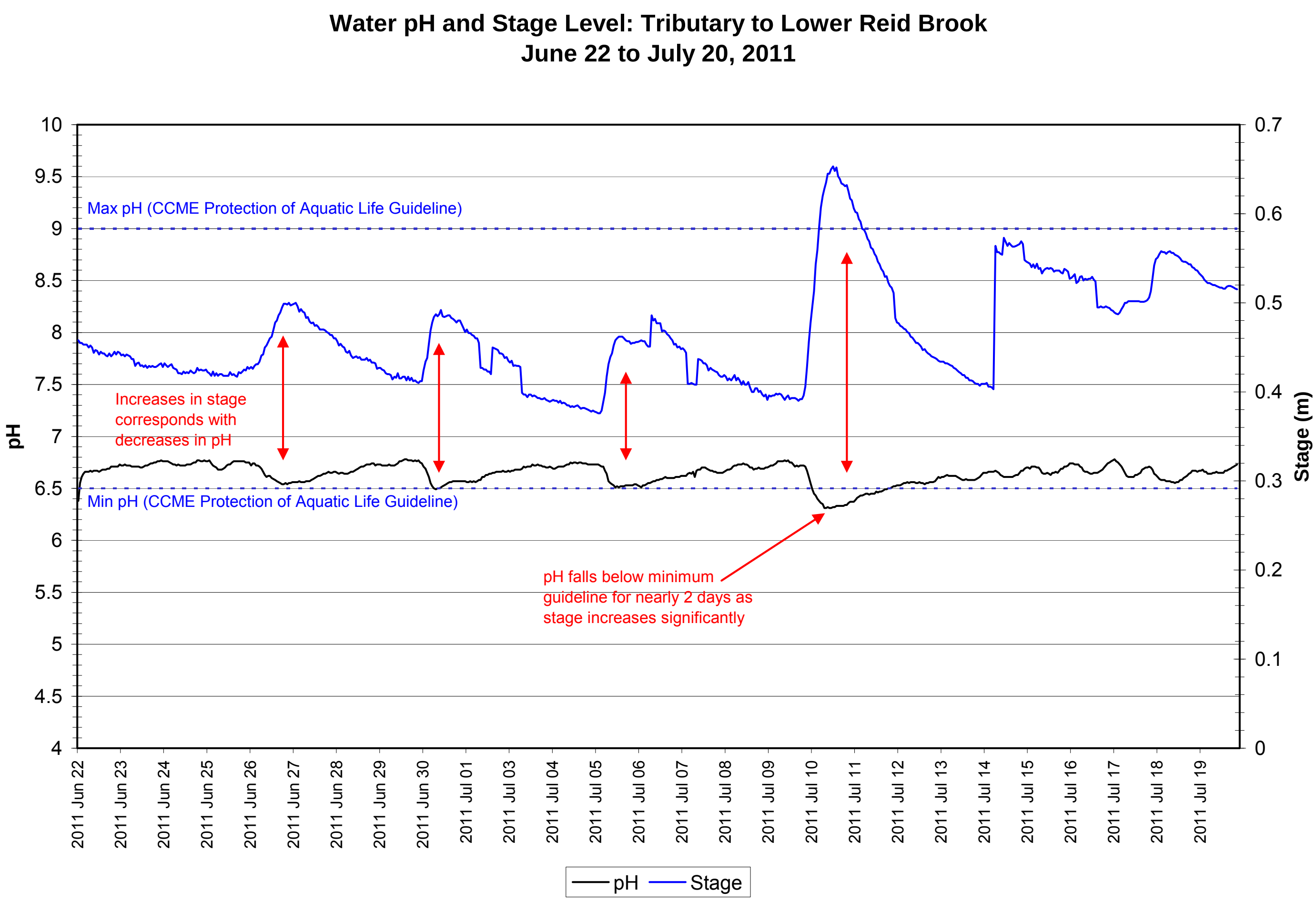

Figure 9: pH and stage level at Tributary to Lower Reid Brook

- Specific conductivity ranges between 12.0 and 17.6µS/cm and is fluctuating throughout the deployment period (Figure 10).
- Stage is included in Figure 10 to illustrate the inverse relationship between conductivity and water level. Stage is generally increasing throughout the deployment period with significant increases and decreases. As stage increases, specific conductivity decreases (indicated by red arrows on Figure 10). Precipitation input can decrease the specific conductivity of the water by diluting the concentrations of dissolved solids present in the water column. As water level decreases, the concentration of total dissolved solids increases, hence increasing specific conductivity.

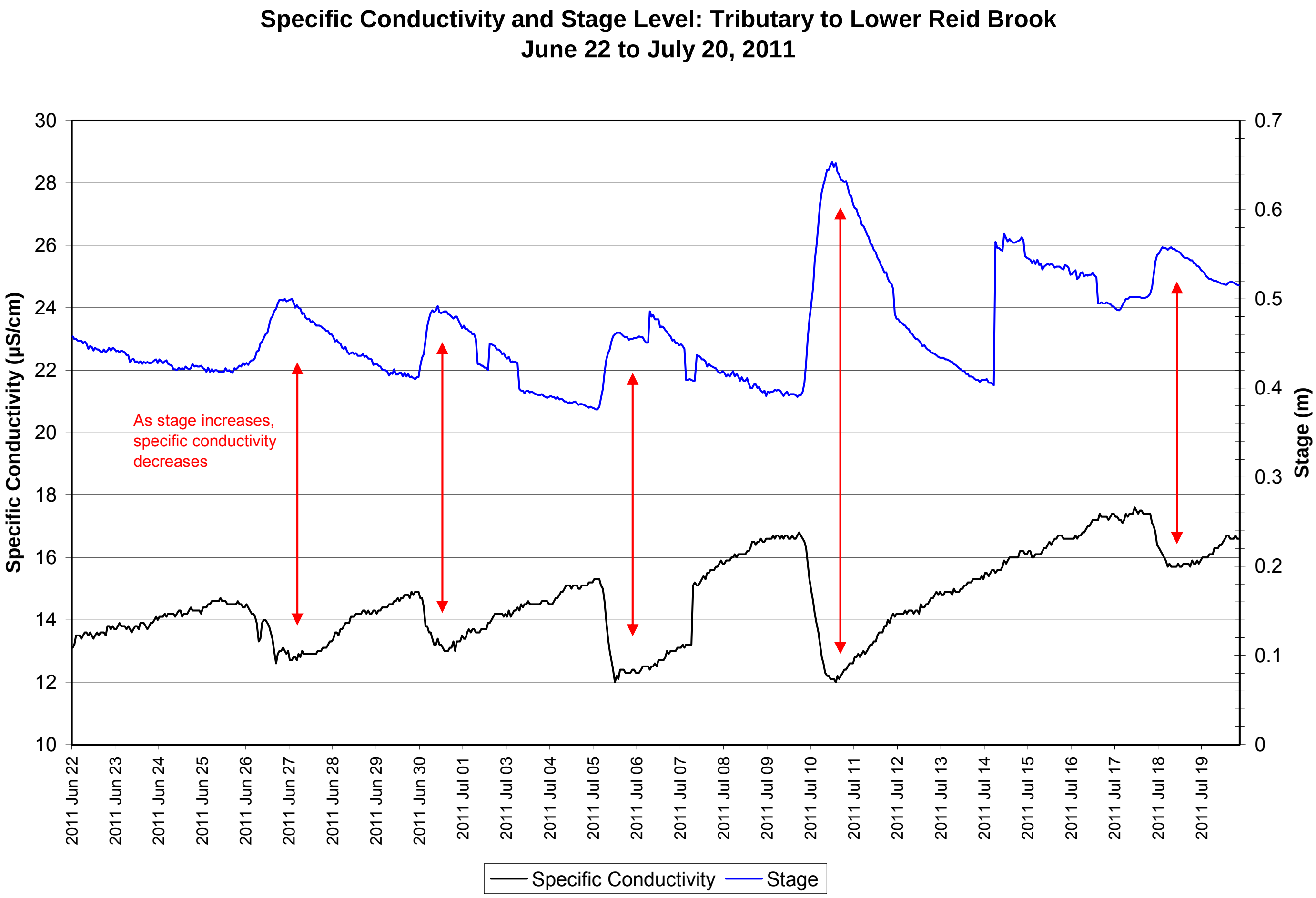

Figure 10: Specific conductivity and stage level at Tributary to Lower Reid Brook

- The saturation of dissolved oxygen ranged from 91.5% to 95.5% and a range of 9.04 to 11.88mg/l was found in the concentration of dissolved oxygen with a median value of 10.75mg/l (Figure 11).
- Most values were above both the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l and the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 11.
- DO content falls just below the minimum guideline during the day time hours on July 16 and 17. These low DO values correspond with the warmest water and air temperatures (Figure 8), clearly displaying the inverse relationship between water temperature and DO concentration. In addition to warm temperatures, a significant amount of biofouling was found on the instrument at removal (Figure 13). This is due to the failure of the wiper and cleaning brush to rotate once per hour to clean the sensor tips prior to taking a reading. It is very likely that the build up of biofouling on the DO sensor caused the instrument to report less than true values for dissolved oxygen and percent saturation.

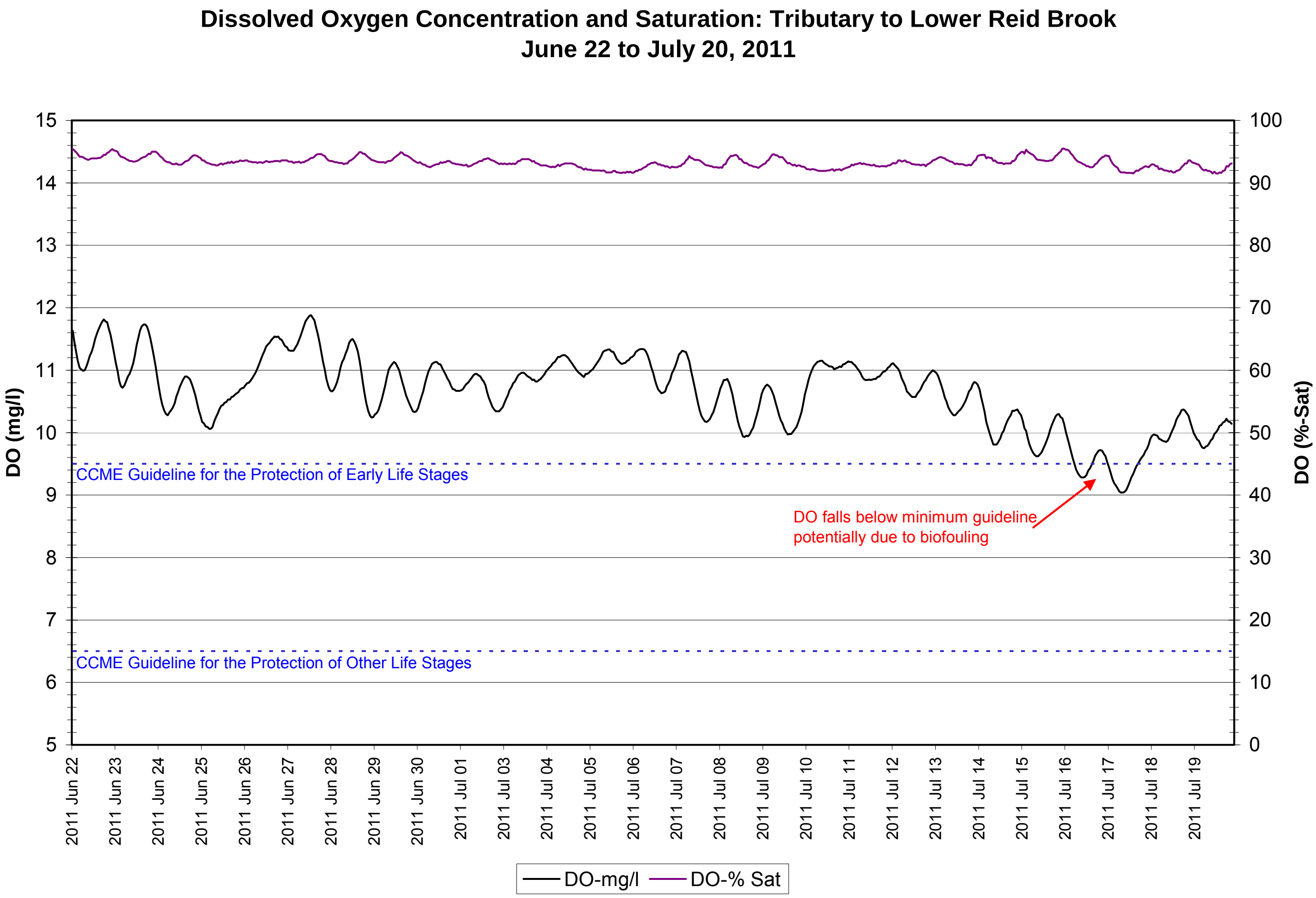

Figure 11: Dissolved oxygen and percent saturation at Tributary to Lower Reid Brook

- Turbidity remains at 0NTU for the entire deployment period (Figure 12).
- The turbidity sensor on the Lower Reid Brook instrument (s/n 44175) was not functioning at full capacity during the deployment period. The wiper on the instrument will no longer complete the revolutions prior to the taking reading. The sensor will still read turbidity values and calibrated correctly to 0NTU and 100NTU in the laboratory prior to deployment.
- While making a site visit mid deployment period on July 7 to Lower Reid Brook station, Vale Environment staff checked on the instrument at the Tributary to Lower Reid Station. No factors were visibly present that would indicate the sensor was not working properly. Vale Environment staff cleaned the instrument in the field (cleared some debris and small leaves from casing) and replaced the instrument in the water body. The instrument continued to read 0NTU for turbidity for the remainder of the deployment period.
- Upon retrieval, the turbidity sensor read 0NTU and 101.5NTU in the laboratory when place in 0NTU and 100NTU solutions indicating the sensor was still functioning properly regardless of the wiper failure.
- There was a significant amount of bio fouling on the instrument at the time of removal because the wiper and brush no longer function properly (Figure 13).

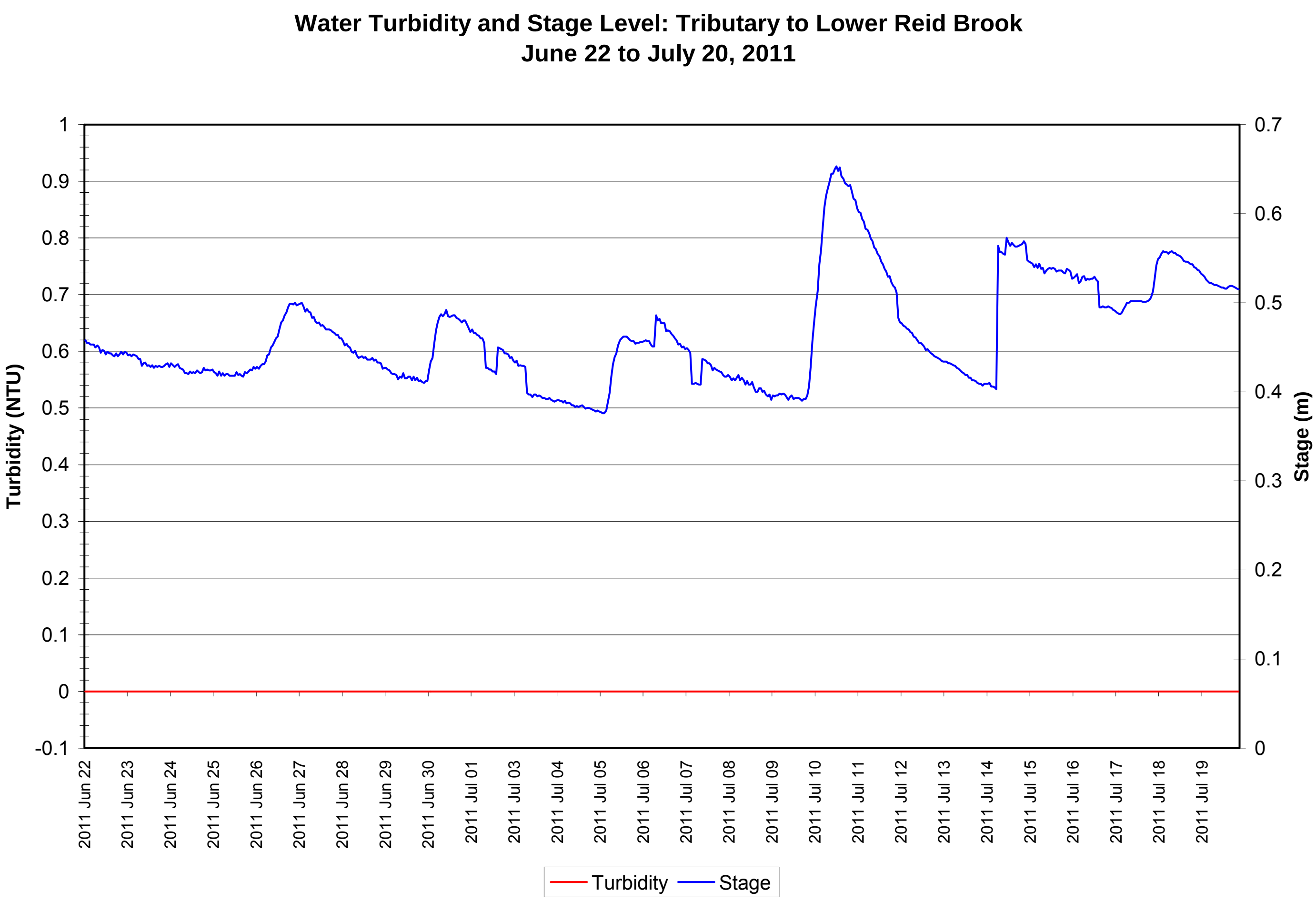

Figure 12: Turbidity and stage level at Tributary to Lower Reid Brook

Figure 13: Bio-fouling residue on instrument at Tributary to Lower Reid Brook after wiper and brush failure

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 14).
- Stage is generally stable throughout the deployment period with varying precipitation records.
- In some instances, for example, the rainfall events from June 9 to 10 cause the water level in the river to rise in the days following.

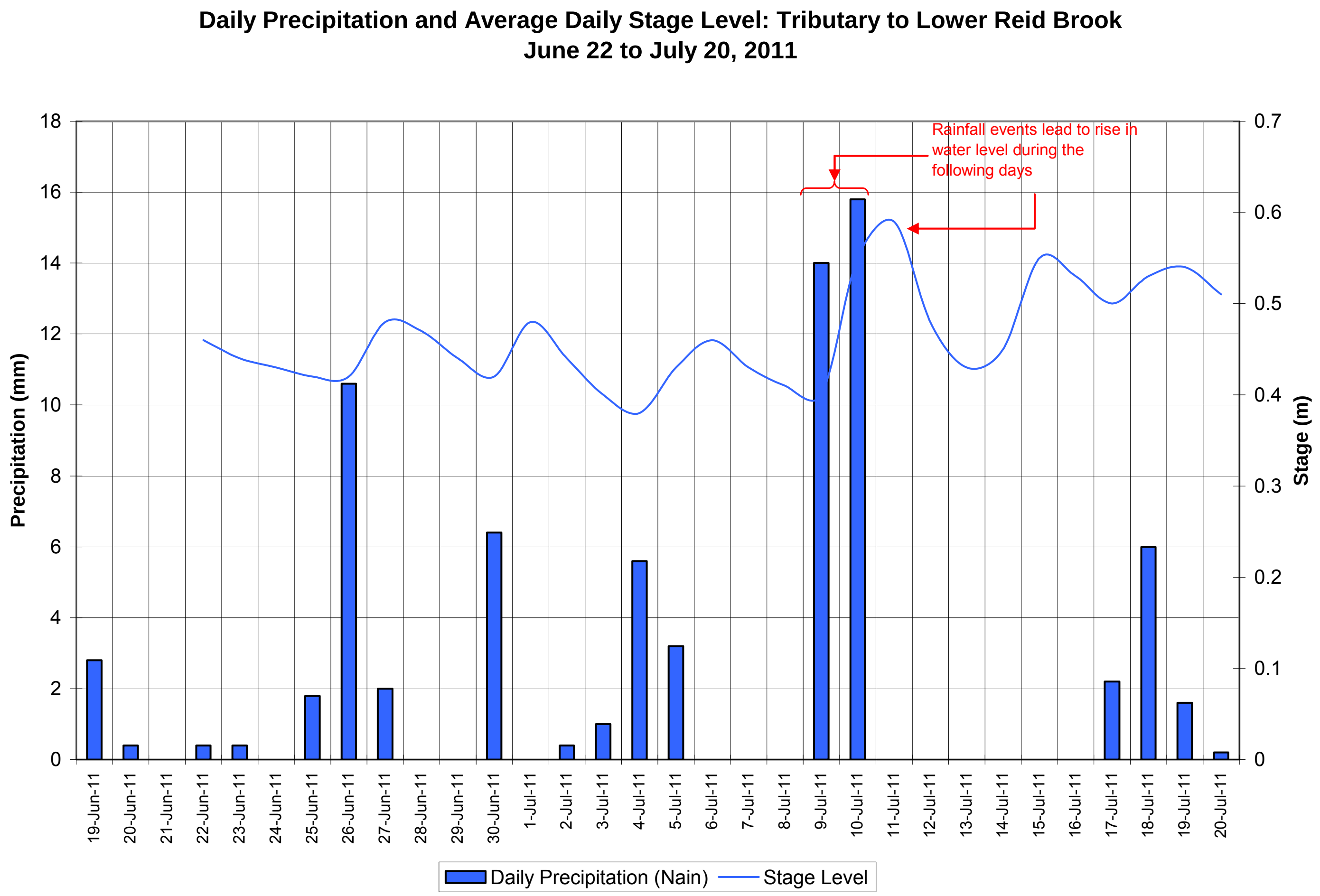

Figure 14: Daily precipitation and average daily stage level at Tributary to Lower Reid Brook (weather data collected at Nain)

Lower Reid Brook

- Water temperature ranges from 4.36 to 15.69°C during this deployment period (Figure 15).
- Water temperature is generally increasing throughout the deployment period. This trend is expected given the increasing ambient air temperature in the spring (Figure 16). Water temperature fluctuates diurnally.

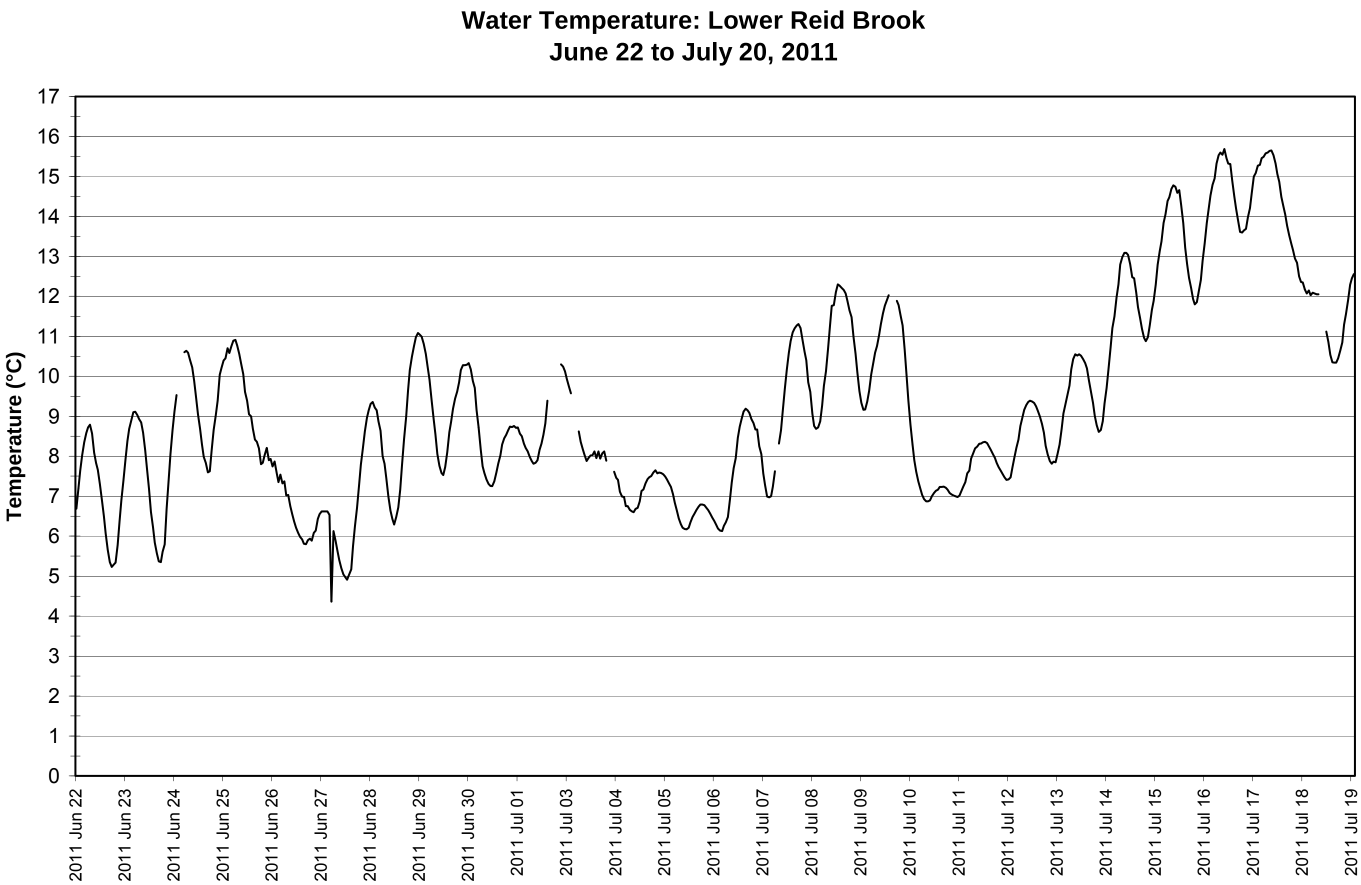

Figure 15: Water temperature at Lower Reid Brook

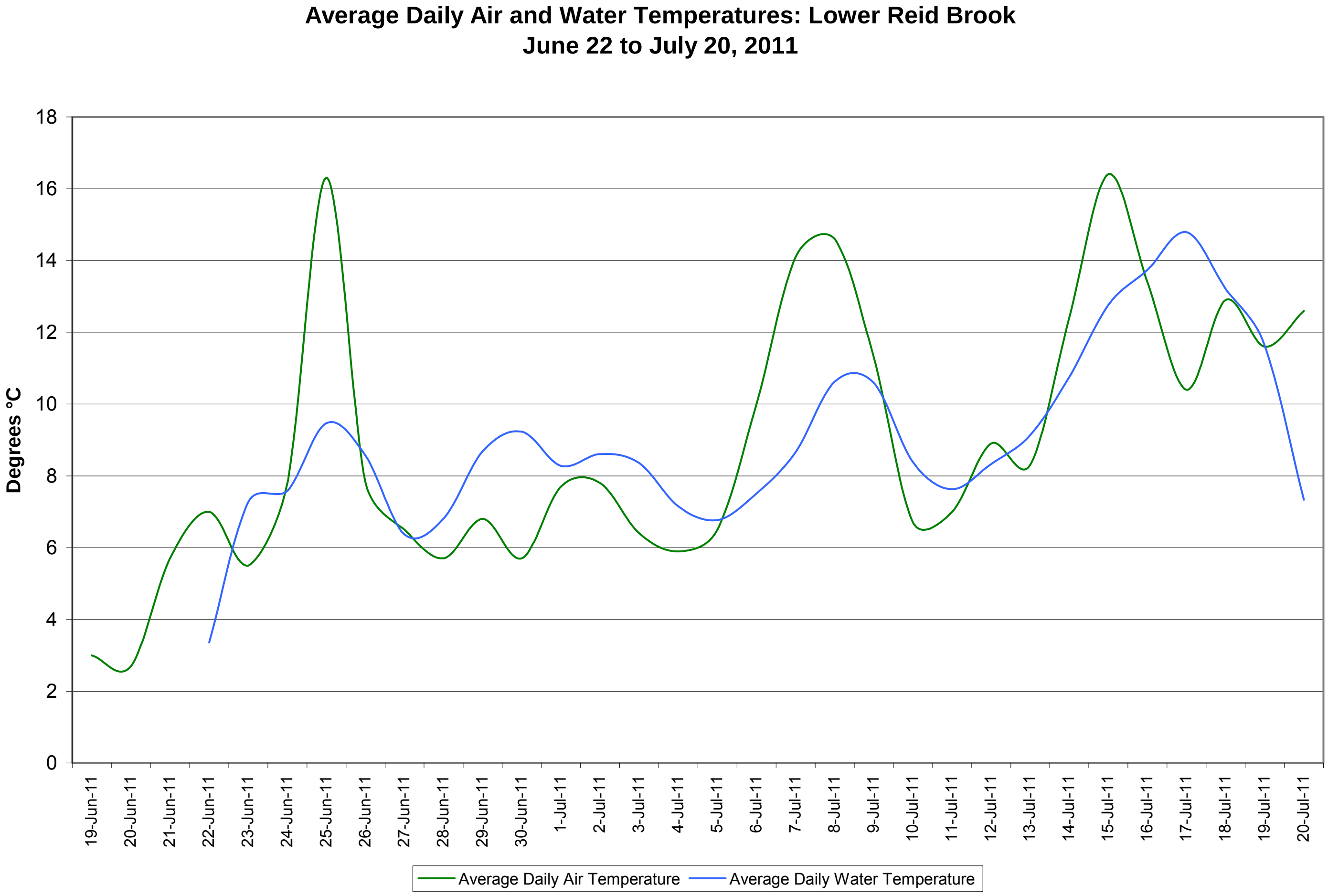

Figure 16: Average daily air and water temperatures at Lower Reid Brook

(weather data recorded at Nain)

- pH ranges between 6.60 and 7.18 pH units (Figure 17). pH values fluctuate slightly throughout the deployment period.
- 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 17).
- Stage is included on Figure 17 to show the inverse relationship between water level and pH. As stage increases, pH values decrease. This is clearly evident on July 10 when stage level increases significantly, resulting in a decrease in pH (indicated by red arrows on Figure 17).

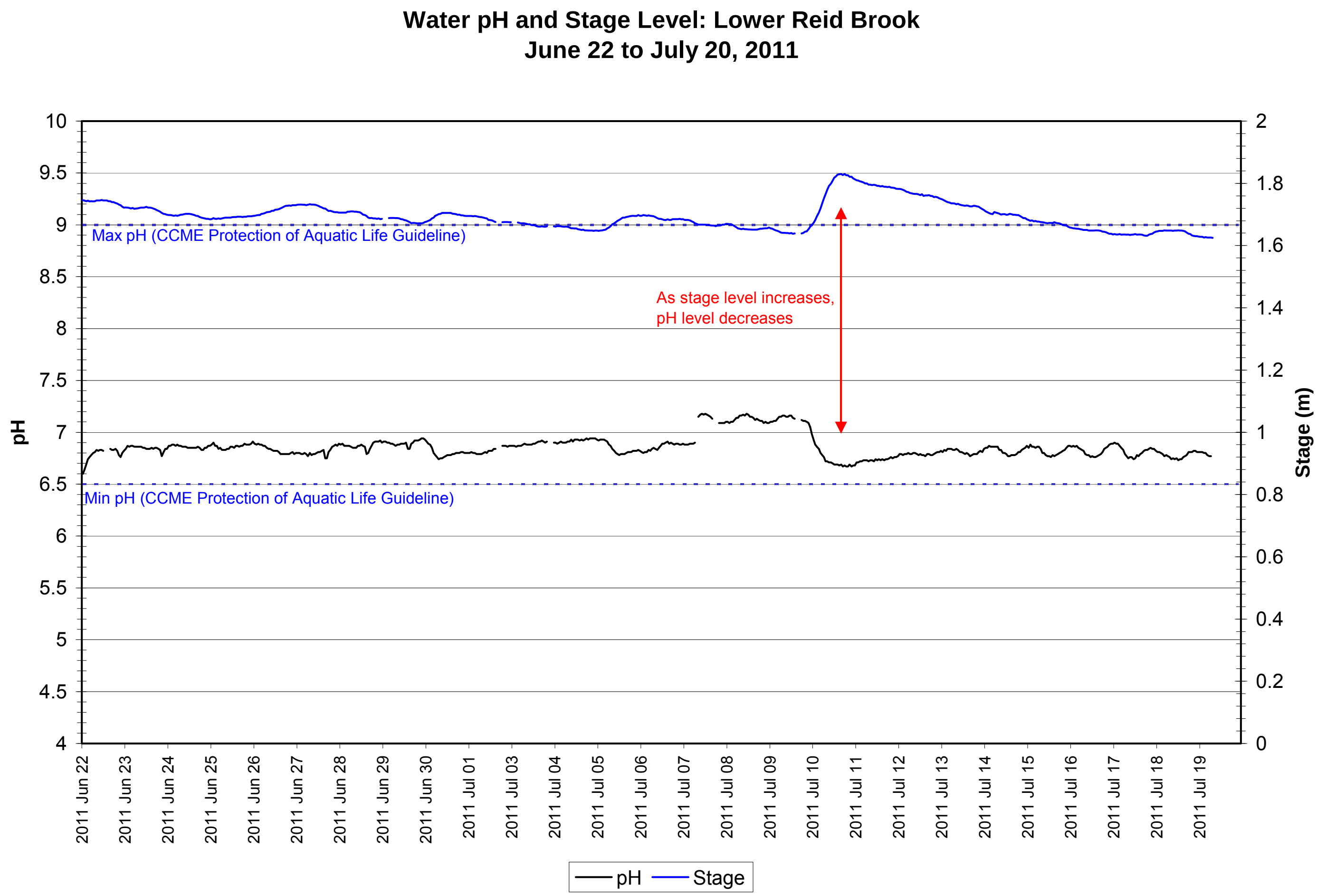

Figure 17: pH and stage level at Lower Reid Brook

- Specific conductivity ranges between 17.0 and 26.0µS/cm and is generally increasing throughout the deployment period (Figure 18).
- There is one instance where specific conductivity spikes to 190µS/cm for a period of one hour. This increase is likely related to something affecting the sensor (debris or air bubble) and is not considered a water quality event.
- Stage is included in Figure 18 to illustrate the inverse relationship between conductivity and water level. Stage is generally decreasing throughout the first three weeks of the deployment period while specific conductivity is increasing. Stage increases significantly on July 10 which corresponds with a decrease in specific conductivity (indicated by red arrows on Figure 18). Precipitation input can decrease the specific conductivity of the water by diluting the concentration of dissolved solids present in the water column. Following this event, stage slowly decreases again for the remainder of the deployment period while specific conductivity increases.

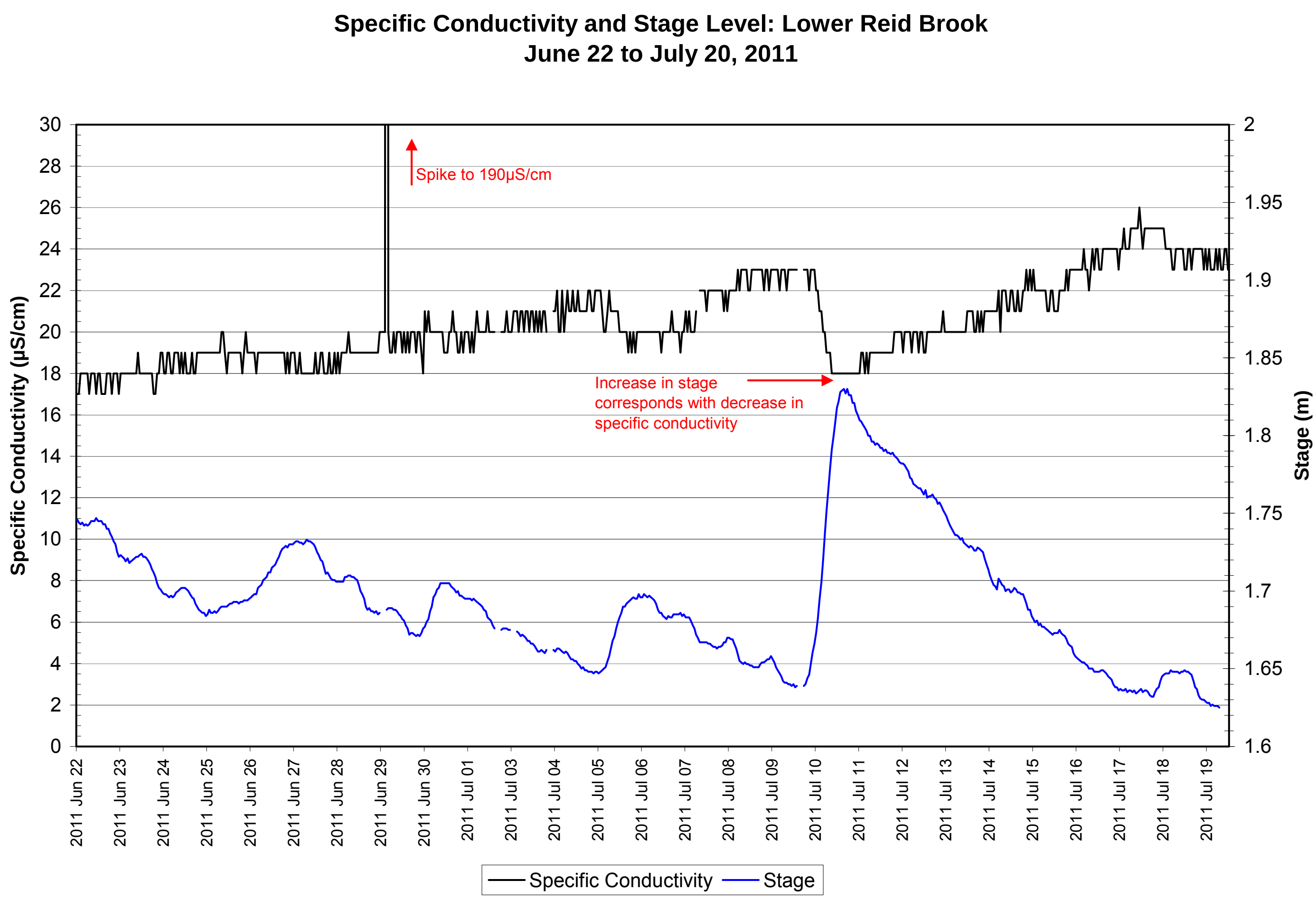

Figure 18: Specific conductivity and stage level at Lower Reid Brook

- The saturation of dissolved oxygen ranged from 80.0% to 101.1% and a range of 7.97 to 12.56mg/l was found in the concentration of dissolved oxygen with a median value of 10.54mg/l (Figure 19).
- For the first three weeks of the deployment period, all values were above both the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l and the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 19. After July 14, DO and percent saturation levels begin to drop off steadily and is likely a sign of sensor failure. When the instrument was retrieved and calibrated in the lab, the DO sensor failed completely to calibrate indicating the sensor was no longer functional. DO and percent saturation data collected in the last week of the deployment is subject to error and is not accurate.

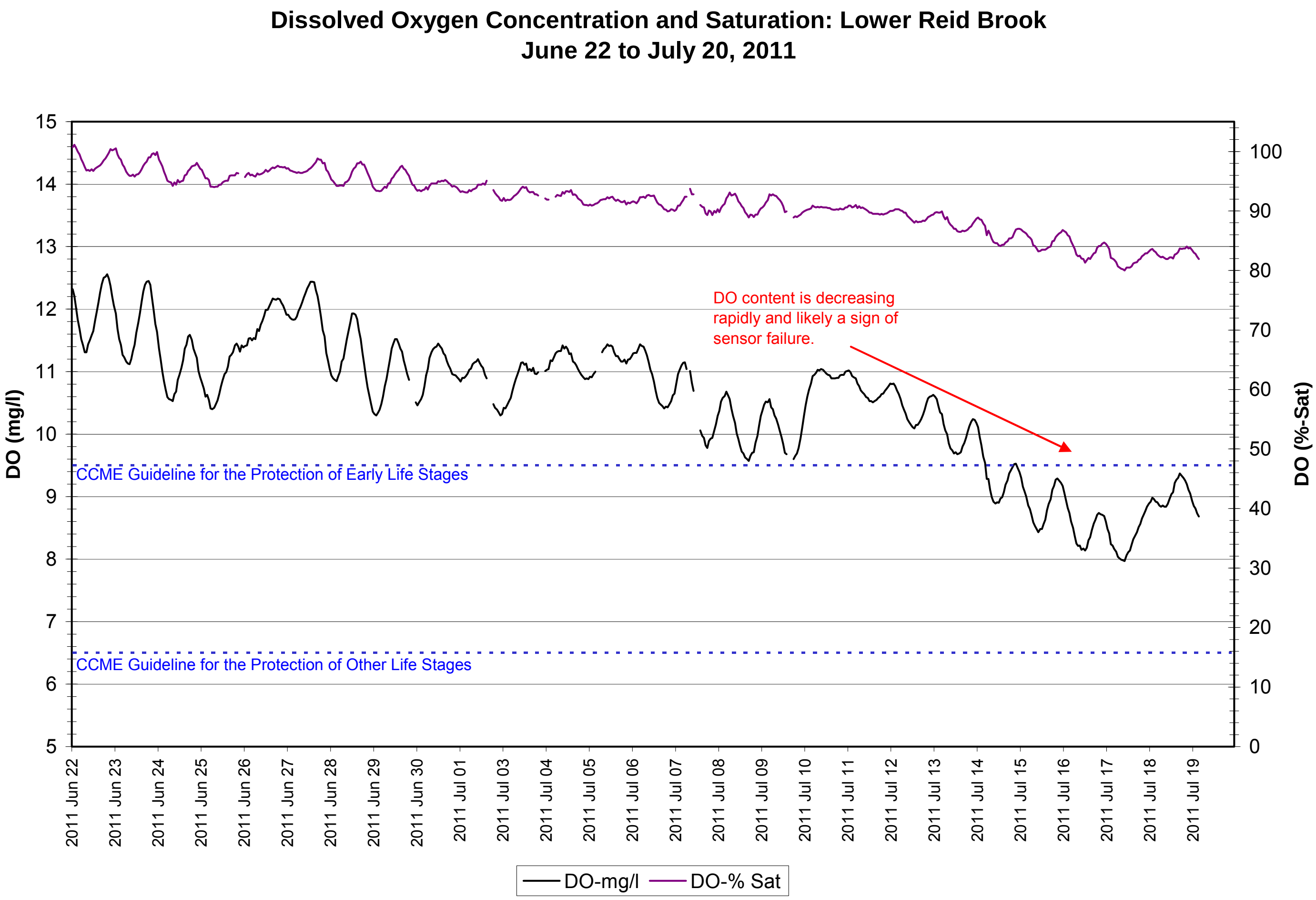

Figure 19: Dissolved oxygen and percent saturation at Lower Reid Brook

- A range of 5.5 to 2668.0NTU was recorded for turbidity for this deployment period (Figure 20).
- Soon after the initial deployment on June 22, turbidity values began to steadily increase to as high as 300NTU. During a turbidity event, values typically increase for a period of time which is then followed by a recovery period where values decrease slowly again to baseline levels. In this instance, turbidity values just continued to increase indicating that there may have been something affecting the sensor (sand, debris, etc.). When it was clear the turbidity values were not likely to recover naturally, Vale Environment staff visited the site to determine if something was affecting the sensor (debris, sand etc.). During the site visit, the instrument was removed and rocks and sand, which had accumulated around the sensors inside the sensor guard and instrument casing, were cleared (Figure 21a). The instrument was placed back in the river and propped up on a rock to avoid future accumulation of sand from the river bed. However, with in a few days, a large increase in stage level and flow caused a similar situation and turbidity values began to increase significantly to over 2600NTU. A stand for this instrument has since been fabricated and place in the river in an attempt to avoid this problem in the future. The stand was put in place on July 21 at redeployment for the July period (Figure 21d).

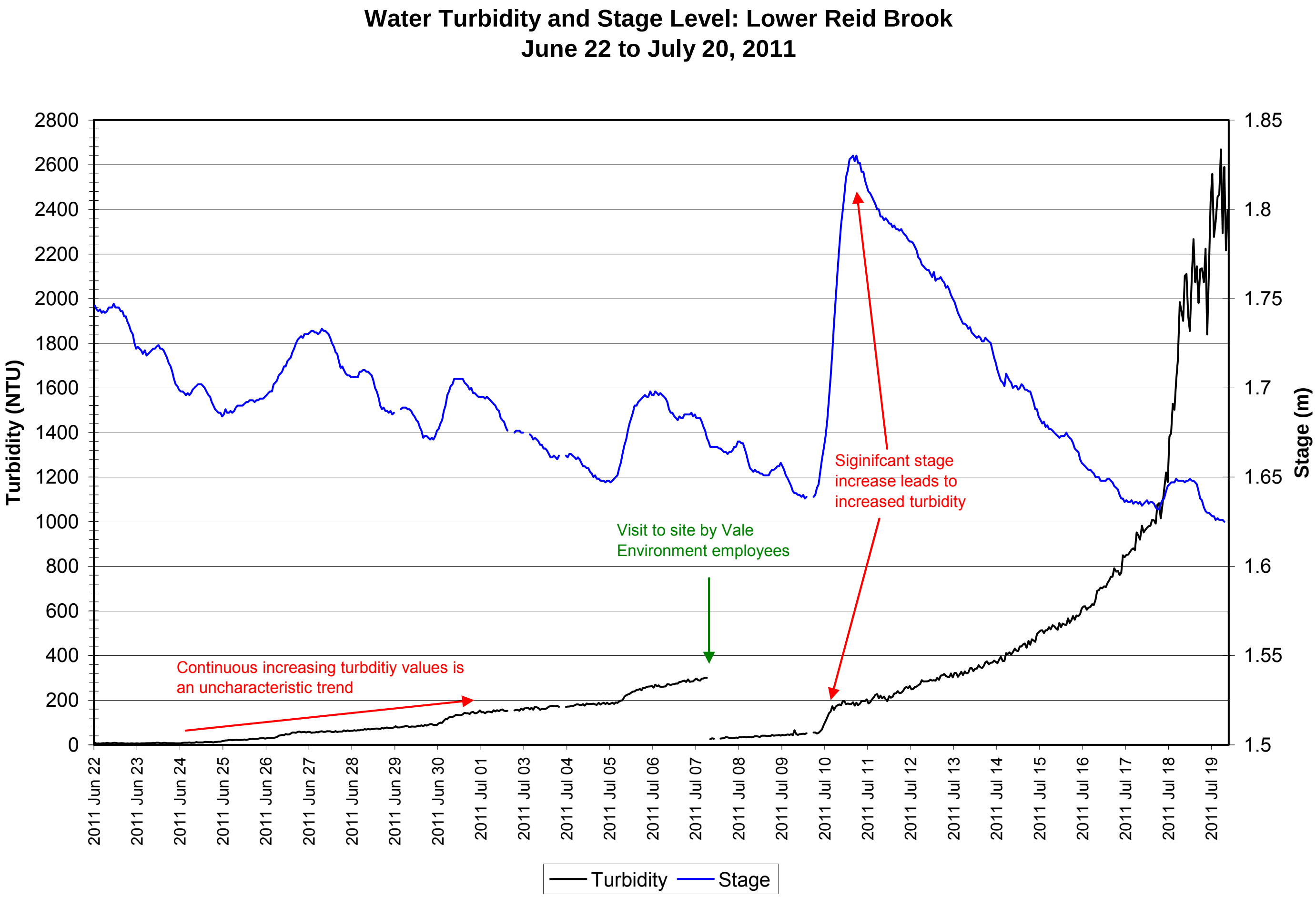

Figure 20: Turbidity and stage level at Lower Reid Brook

a. 
b. 

c. 
d. 

Figure 21: (a) Lower Reid Brook instrument as found by Vale Environment staff during site visit on July 7. (b) Lower Reid Brook instrument as found by ENVC and Vale Environment staff during site visit on July 20. (c) Vale Environment staff installing stand for instrument to prevent rock and debris build up around the instrument sensors. (d) Lower Reid Brook instrument deployed on stand on July 21 (QAQC sonde temporarily deployed for comparison readings).

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 22). Stage is generally decreasing throughout the deployment period with varying precipitation records.
- In some instances, for example, the rainfall events on July 9 and 10 cause the water level in the river to rise in the days following.

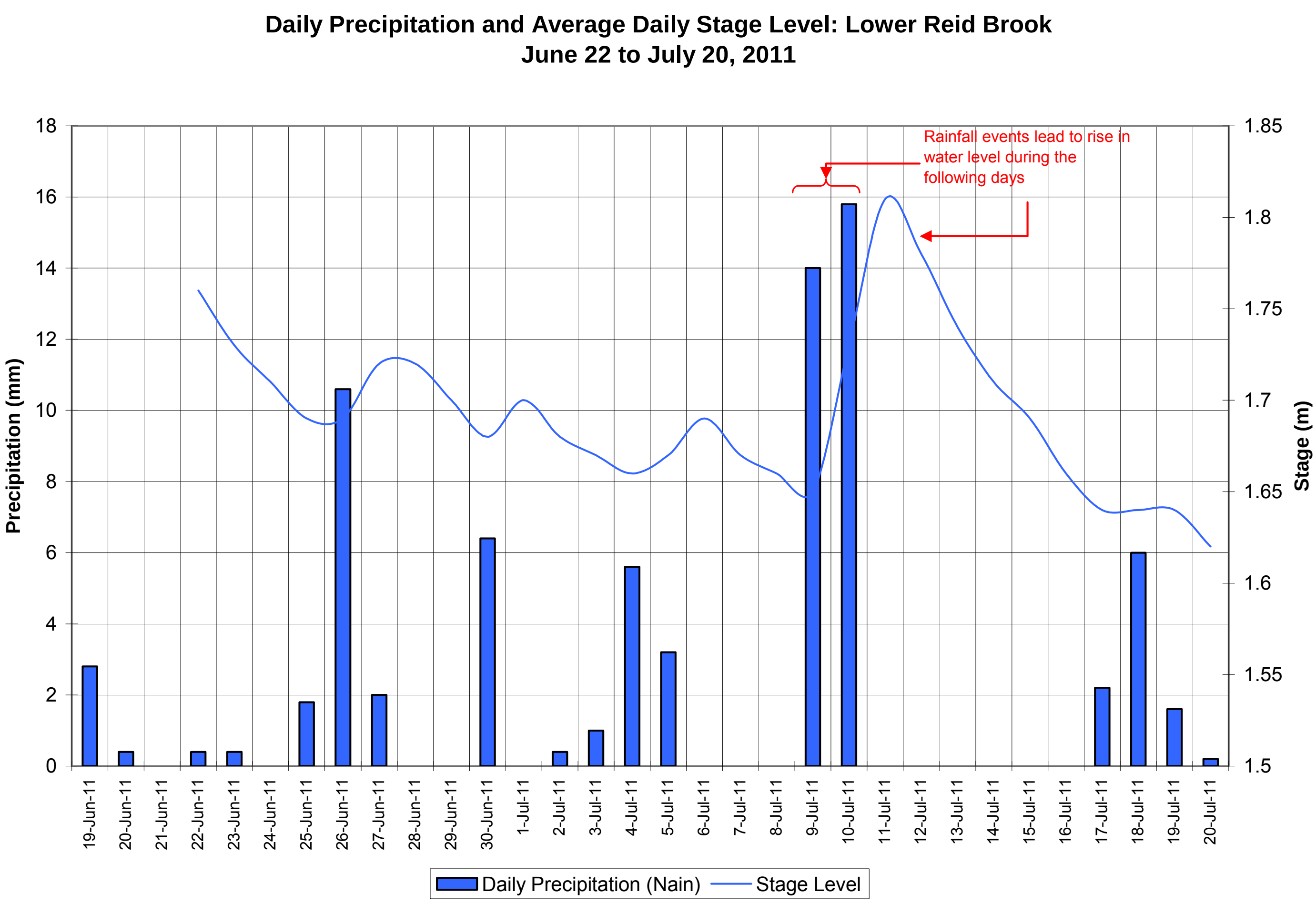

Figure 22: Daily precipitation and average daily stage level at Lower Reid Brook

(weather data recorded at Nain)

Camp Pond Brook

- Water temperature ranges from 7.50 to 21.00°C during this deployment period (Figure 23).
- Water temperature is increasing throughout the deployment period. This trend is expected given increasing ambient air temperatures in the spring and summer seasons (Figure 24). Water temperature fluctuates diurnally.

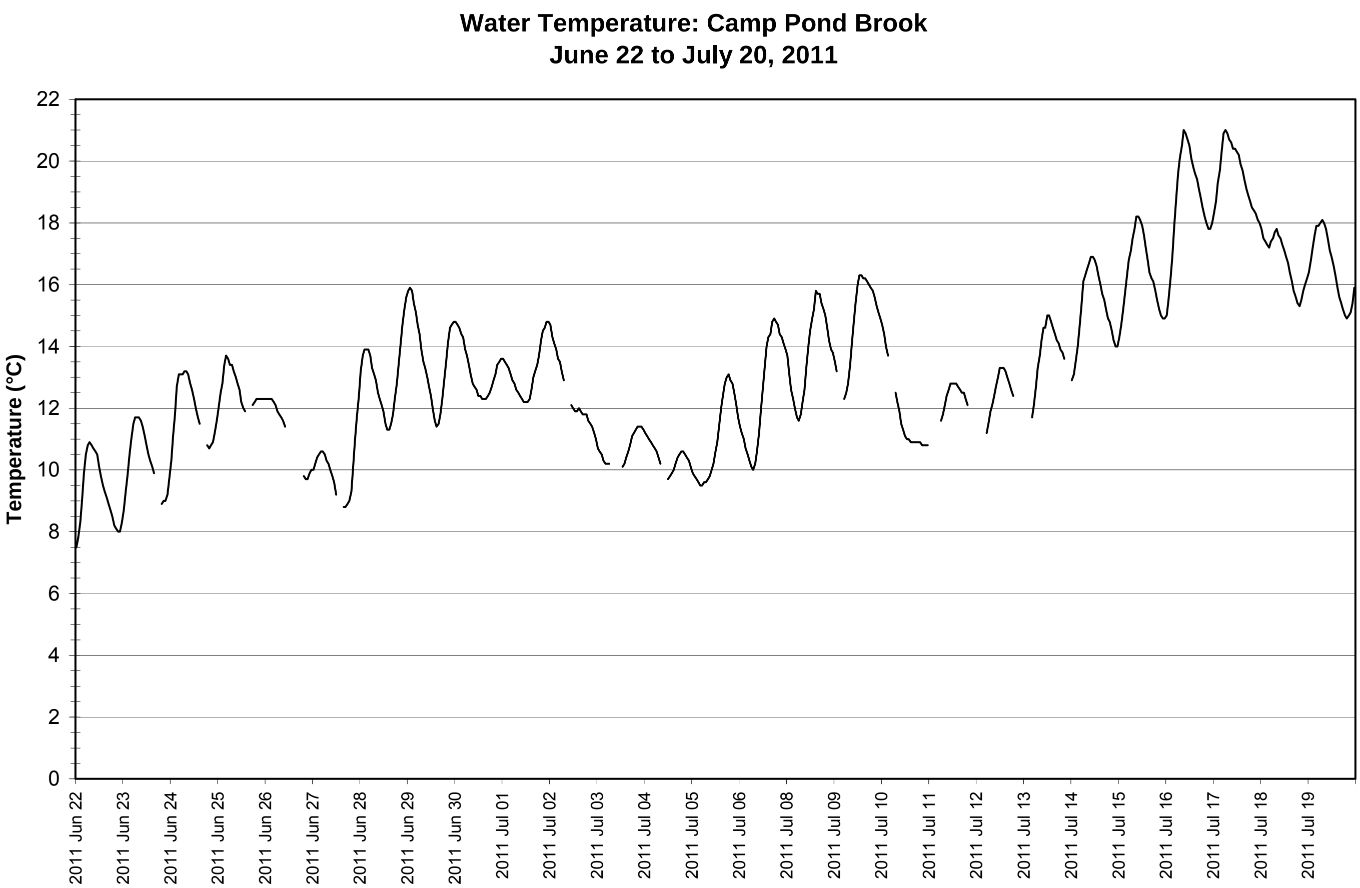

Figure 23: Water temperature at Camp Pond Brook

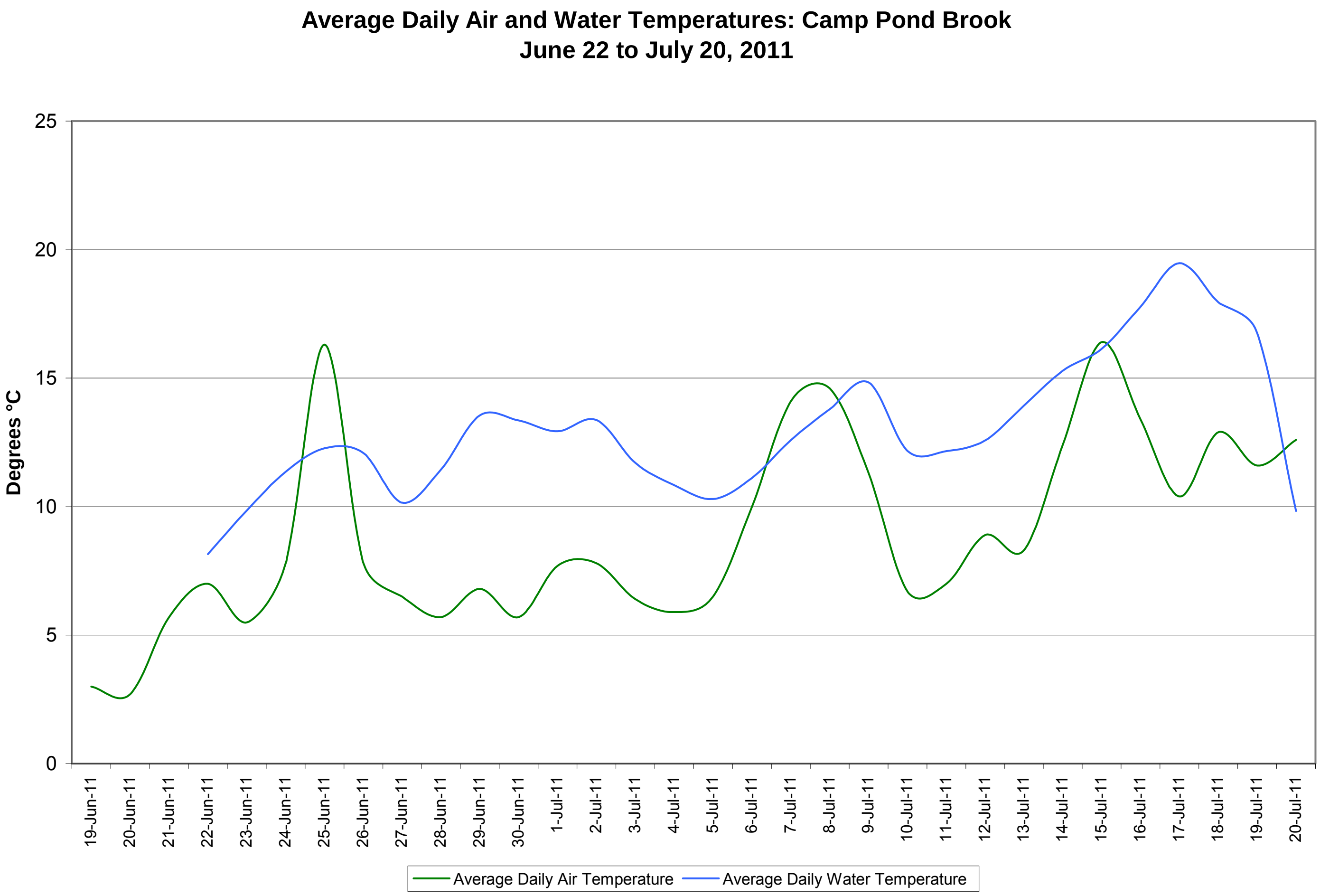

Figure 24: Average daily air and water temperatures at Camp Pond Brook (weather data recorded at Nain)

- pH ranges between 6.57 and 7.30 pH units (Figure 25). pH values increase just slightly over the deployment period while continuing to fluctuate diurnally.
- All values during the deployment are within the recommended range as suggested by the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 25).

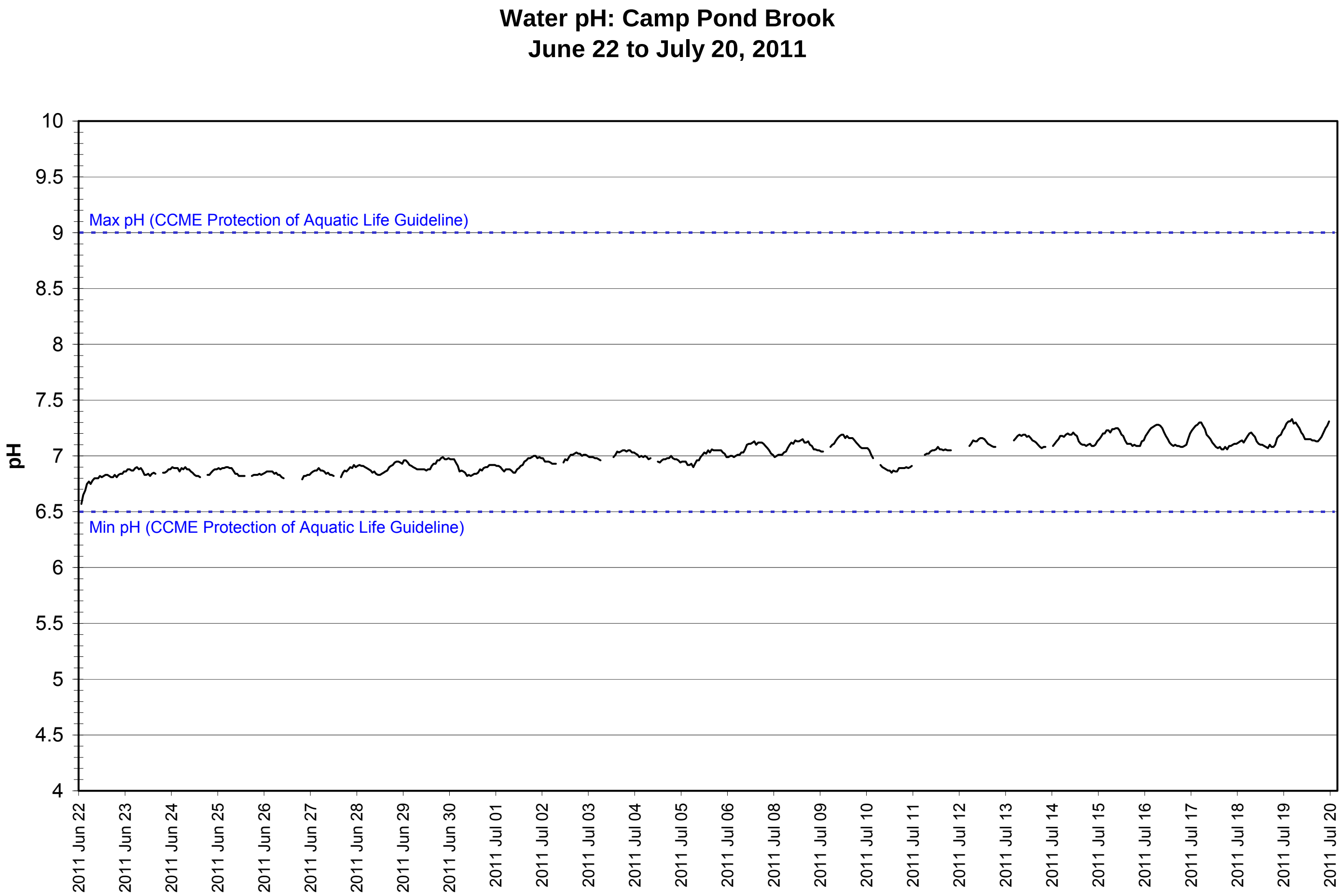

Figure 25: pH at Camp Pond Brook

- Specific conductivity ranged from 20.5 to 30.5µS/cm during the deployment period (Figure 26). Specific conductance is generally increasing throughout the deployment period.
- Stage is included in Figure 26 to illustrate the inverse relationship between conductivity and water level. Stage is decreasing significantly throughout the deployment period with daily increases and decreases. As stage decreases, specific conductivity increases (indicated by red arrows on Figure 26). Precipitation input can decrease the specific conductivity of the water by diluting the concentrations of dissolved solids present in the water column. As the water level drops, the concentration of total dissolved solids in the water column is increased, hence increasing the specific conductivity.
- Stage data is inaccurate between July 6 and 14 due to instrument error. Values recorded during this time have been removed from the data presented in this report.

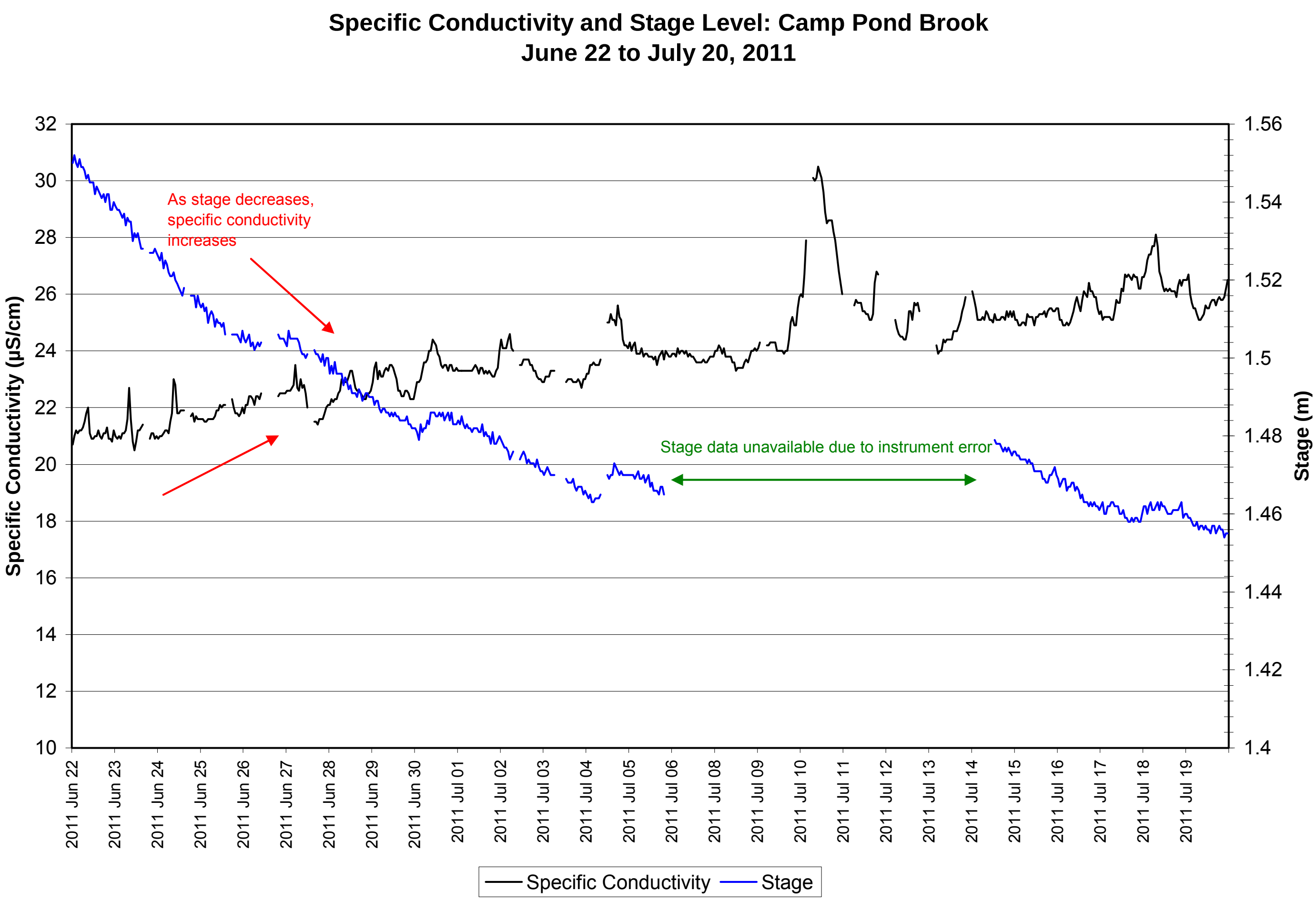

Figure 26: Specific conductivity and stage level at Camp Pond Brook

- The saturation of dissolved oxygen generally ranged from 71.2% to 100.0% and a range of 6.93 to 11.13mg/l was found in the concentration of dissolved oxygen (Figure 27). In several instances, DO and percent saturation dropped significantly to values as low as 21.0% and 2.36mg/L. These outlying values are not included in the range but are however illustrated in Figure 27. The reason for all of 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.
- When the instrument was removed, the QAQC instrument read a DO value of 9.75mg/L while the field sonde was reading 8.06mg/L. During calibration, the field instrument read 81% saturation during the water-air saturation calibration procedure. These readings indicate that the DO sensor on the field sonde may have been reading a less than true value for DO content throughout the deployment period.
- All values were above the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l while most of the values were below the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l.

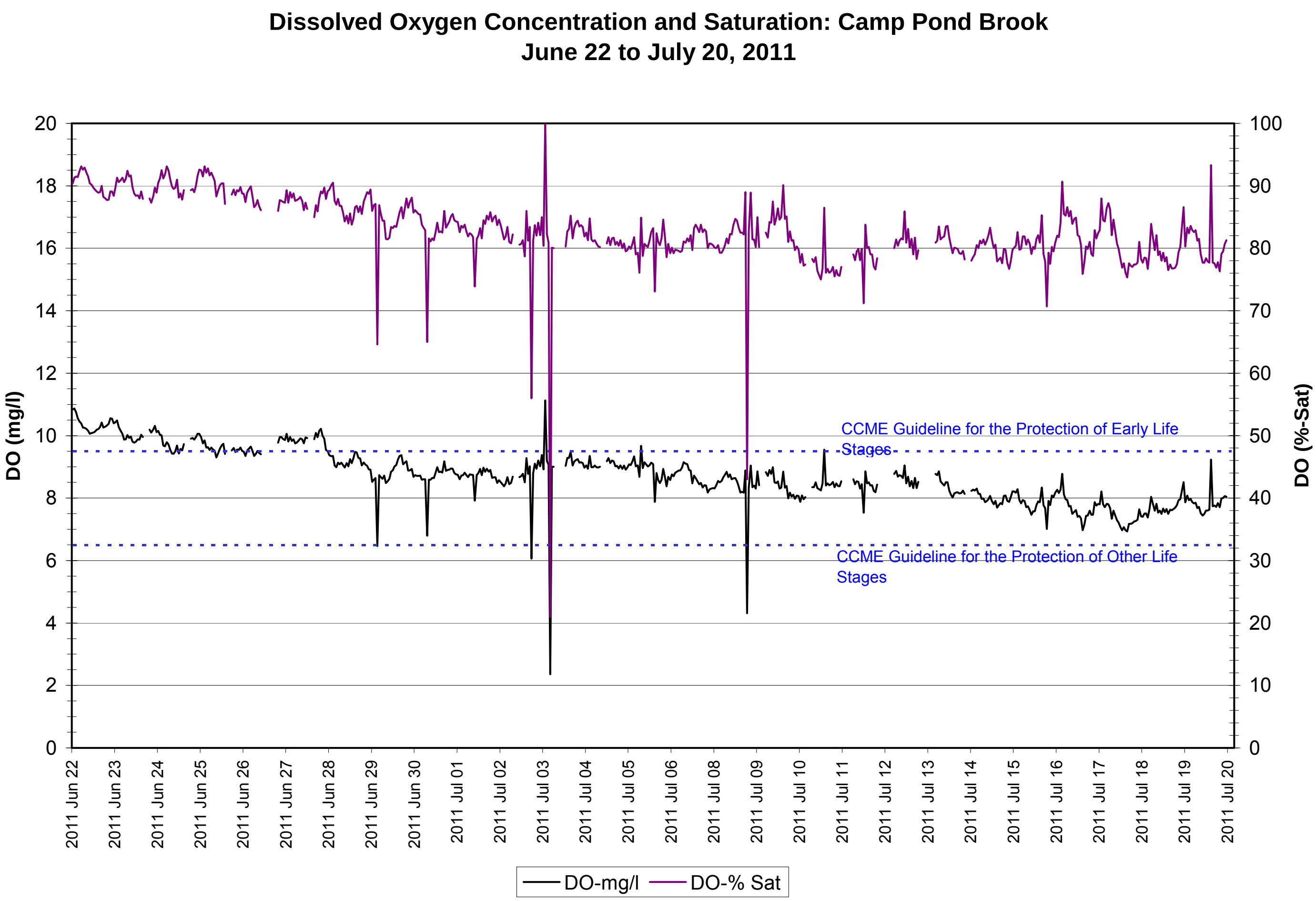

Figure 27: Dissolved oxygen and percent saturation at Camp Pond Brook

- A range of 1.6 to 15.3NTU was recorded for turbidity for this deployment period (Figure 28). A median value of 4.2 NTU indicates there is a consistent natural background turbidity value at this station.
- This trend is typical for turbidity at this station and there are no significant outlying values or large spikes.

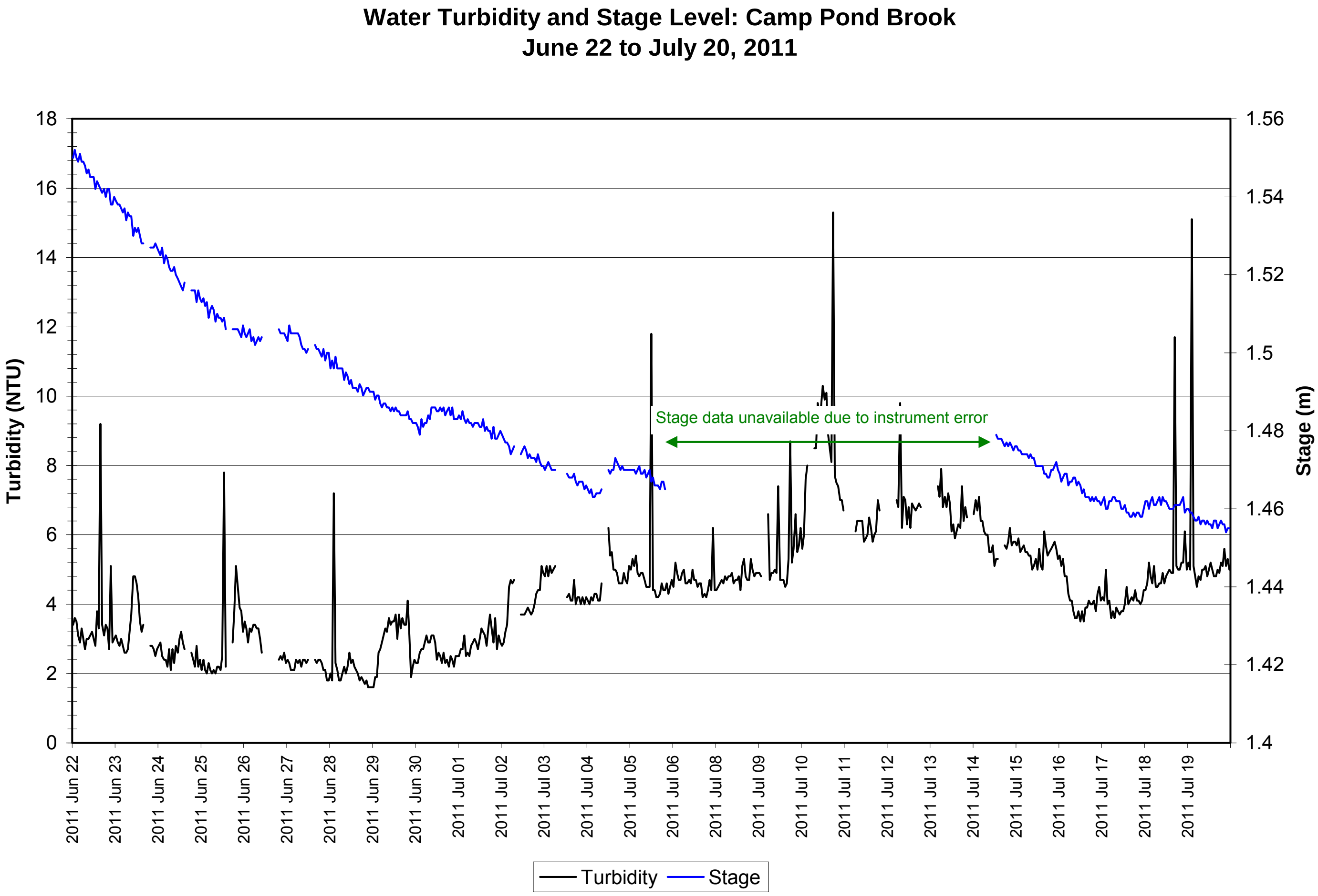

Figure 28: Turbidity and stage level at Camp Pond Brook

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 29). Stage is generally decreasing throughout the deployment period with varying precipitation records.
- Stage values recorded between July 5 and 14 have been removed from the data illustrated in Figure 29. Values recorded during this time were inaccurate due to sensor error.

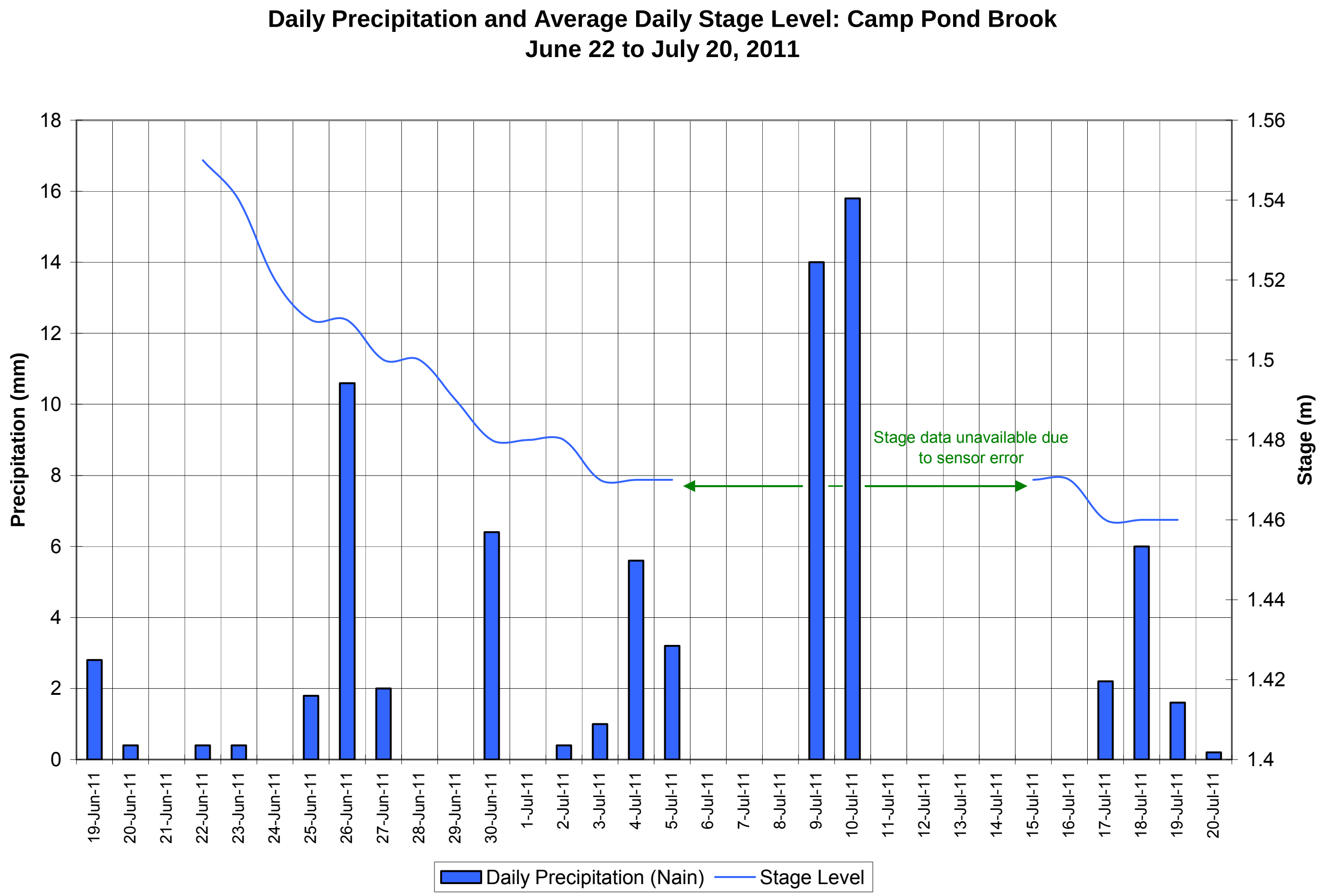

Figure 29: Daily precipitation and average daily stage level at Camp Pond Brook

(weather data recorded at Nain)

Conclusions

- Instruments at water quality monitoring stations in the Voisey's Bay Network were deployed at four water quality monitoring stations from June 19/22 to July 20, 2011.
- At Upper Reid Brook, a replacement instrument loaned to Vale by ENVC was deployed on June 19. This instrument features no turbidity sensor or battery pack therefore there is no turbidity data or option for a back up log file. A Data transmission error prevented DO and percent saturation data from being transmitted in real time until EC visited the station on July 14. pH values were generally just below the minimum CCME guideline. DO values that were recorded between July 14 and 20 were above the recommended guidelines.
- At Tributary to Lower Reid Brook, the turbidity wiper and cleaning brush is not working. This resulted in significant biofouling growth accumulating on the sensor tips and is the potential cause for DO values to decrease rapidly near the end of the deployment period in warm water conditions. DO is generally above the minimum guideline as recommended by the CCME Guidelines for the Protection of Aquatic Life. pH values are also mostly above the minimum guideline. Vale Environmental staff checked on the instrument to inspect the turbidity sensor on July 7. Turbidity recorded 0NTU consistently throughout the deployment period.
- At Lower Reid Brook, pH values remained within the recommended range as recommended by the CCME Guidelines for the Protection of Aquatic Life. DO generally remained above the minimum guideline as well until the end of the deployment period where the DO sensor failed. The DO sensor was not repairable and will need to be replaced for the 2012 season. Turbidity at this station was a consistent issue throughout the deployment period. Vale Environment staff cleared away sand and sediment impacting the sensor during a site visit on July 7. A stand has been fabricated for the instrument to avoid future false turbidity readings.
- At Camp Pond Brook, pH values remained within the recommended range as recommended by the CCME Guidelines for the Protection of Aquatic Life. DO values typically remained below the minimum guideline for the protection of aquatic life in early life stages and above the minimum guideline for other life stages. The DO sensor did not rank well when compared to the QAQC instrument at removal nor did the calibration values match indicating the sensor functionality may have been compromised during the deployment period.

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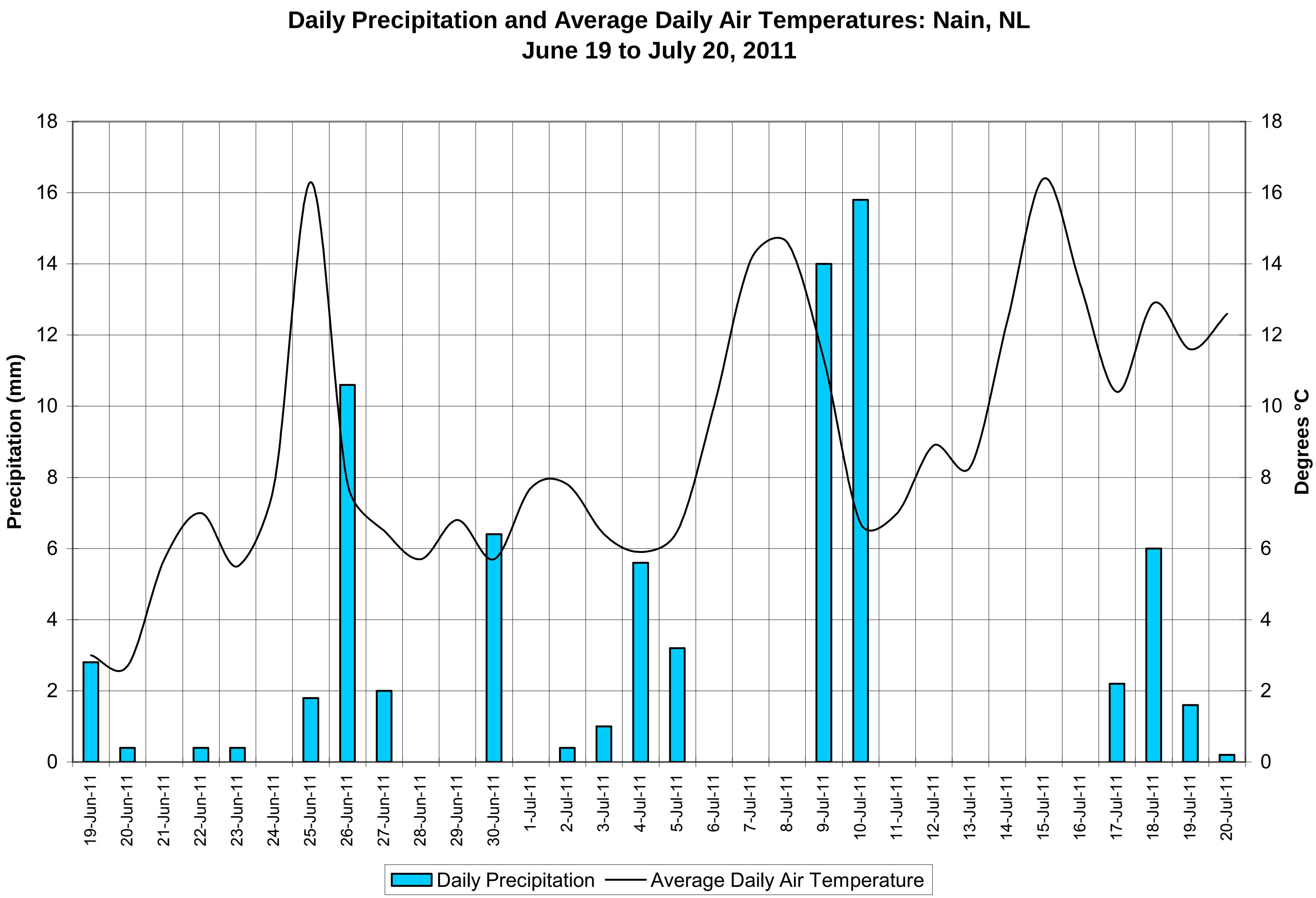
Appendix 1


Daily Precipitation and Average Daily Air Temperatures: Nain, NL
June 19 to July 20, 2011
Precipitation (mm)
Degrees °C
0
2
4
6
8
10
12
14
16
18
19-Jun-11
20-Jun-11
21-Jun-11
22-Jun-11
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20-Jul-11
Daily Precipitation
Average Daily Air Temperature