

Real Time Water Quality Monthly Report for Vale Inco Newfoundland and Labrador Ltd. June & July 2009

General

- In January 2009 all four Datasondes were taken out of winter storage and sent to Campbell Scientific Canada Corp for annual performance testing and evaluation. It was decided not to send the Minisonde in for servicing since it was serviced in August 2008.
- The instruments were received by the Department of Environment and Conservation (DOEC) in February 2009 (after full testing and servicing by the supplier).
- In May 2009, all instruments underwent a series of cleaning/calibration and setup by DOEC staff prior to shipment to Voisey's Bay, Labrador.
- Throughout the month of June, DOEC staff communicated with Vale Inco staff (on-site) to determine when the ice conditions would be suitable enough to deploy the real-time instruments.
- On June 19th, the Vale Inco staff was equipped with a helicopter and installed three of the four Datasondes (Upper Reid Brook; Lower Reid Brook and Tributary to Lower Reid Brook). The final Datasonde was deployed on June 20th at Camp Pond Brook.
- The real-time data (and subsequently the water quality graphs) logged, transmitted and graphed successfully for all four stations over the deployment period.
- This report interprets the real-time data collected over the deployment period from June 19th/20th until the instruments were removed for cleaning /calibration on August 5th/6th.

Maintenance and Calibration of Instrumentation

- Vale Inco staff on-site removed instruments from Upper Reid Brook, Lower Reid Brook and Tributary to Lower Reid Brook for cleaning/calibration on August 6th (after 49 day deployment period). The Camp Pond Brook instrument was removed for cleaning/calibration on August 5th (after 47 day deployment period). Vale Inco staff cleaned and calibrated the instruments and returned them to all four stations on August 8th and 9th.
- As part of the removal and reinstallation process, parameters are recorded from both the field sonde (in situ) and a similar, newly-calibrated QA sonde (placed side by side). The parameters from both instruments are compared and their variability is ranked as part of the QA/QC protocol (see Table 1).
- Upon installation of the Datasondes at the end of June, all parameters at all stations were ranked as either "Excellent" or "Good" with the exception of "Fair" rankings for dissolved oxygen at both the Camp Pond Brook and Tributary to Lower Reid Brook stations.
- Upon removal of the Datasondes in early August, all parameters with the exception of dissolved oxygen ranked as either "Excellent" or "Good" at all stations. The dissolved oxygen rankings were "Poor" at the Lower Reid Brook and Camp Pond Brook stations; it was "Fair" at the Tributary to Lower Reid Brook station. The deployment periods were slightly extended past the recommended 30-day cycle (due to helicopter and staff availability). Therefore it is expected that the dissolved oxygen membrane-based technology sensor drifted overtime.

Table 1: QA/QC Data Comparison Rankings upon installation on June 19th/20th, 2009 to August 5th/6th, 2009.

Station	Date	Action	Instrument Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Upper Reid Brook	June 19/09	Installation	Excellent	Good	Excellent	Good	NA
	Aug 6/09	Removal	Excellent	Good	Excellent	Excellent	NA
Lower Reid Brook	June 19/09	Installation	Excellent	Excellent	Excellent	Excellent	NA
	Aug 6/09	Removal	Excellent	Excellent	Good	Poor	NA
Camp Pond Brook	June 20/09	Installation	Good	Good	Good	Fair	NA
	Aug 5/09	Removal	Excellent	Excellent	Excellent	Poor	NA
Tributary to Lower Reid Brook	June 19/09	Installation	Good	Good	Good	Fair	NA
	Aug 6/09	Removal	Excellent	Excellent	Excellent	Fair	NA

Data Interpretation

REID BROOK AT OUTLET OF REID POND (UPPER REID BROOK)

- The water temperature (**Figure 1**) increased gradually throughout the deployment period. The values remained relatively consistent throughout the beginning of the deployment period. It appears as though the sensor lost some of its stability in early July leading to variability in the data. This increasing trend is expected as the average daily temperature is also increasing during this period (see **Appendix**). The water temperatures ranged from 1.72°C to 16.08°C.

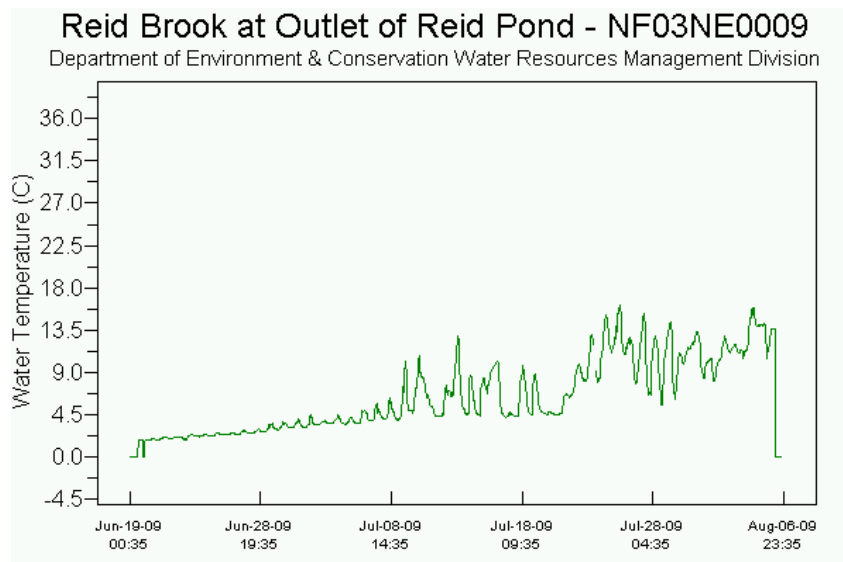
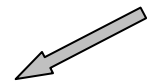


Figure 1



- The dissolved oxygen values (**Figure 2**) decreased throughout the deployment period corresponding to the above mentioned increase in water temperature. The dissolved oxygen sensor also lost stability in early July leading to more variable readings. The dissolved oxygen values ranged from 9.65 mg/L to 13.52 mg/L. All values recorded are within the acceptable range for dissolved oxygen concentration as stated by the CCME Guidelines for the Protection of Aquatic Life. The Guidelines state dissolved oxygen (for cold water) must be at least 9.5 mg/L for early life stages.

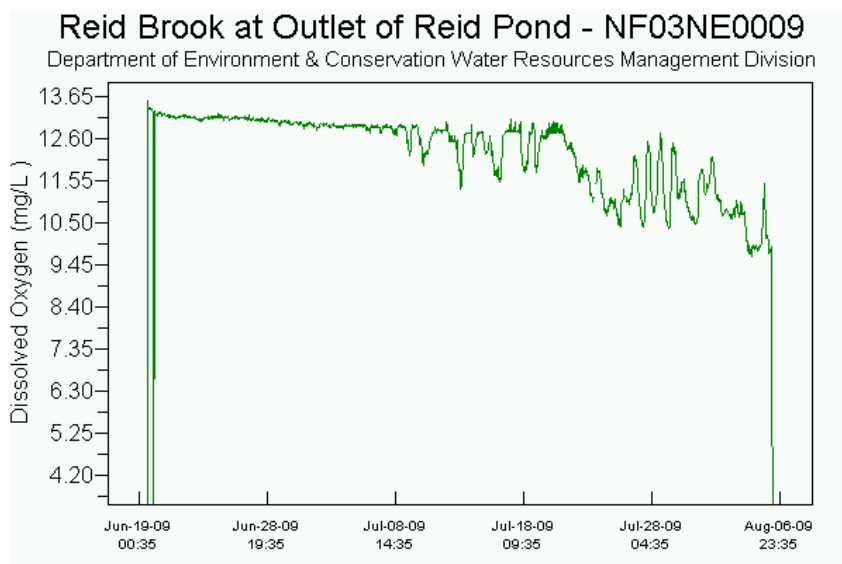
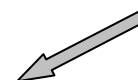


Figure 2



- The conductivity values (**Figure 3**) remained consistent throughout the deployment period at a very low background level ranging from 8.6 uS/cm to 10 uS/cm. The Upper Reid station is fairly pristine with very little development as seen by the naturally low specific conductivity values. There were no significant water quality events captured.

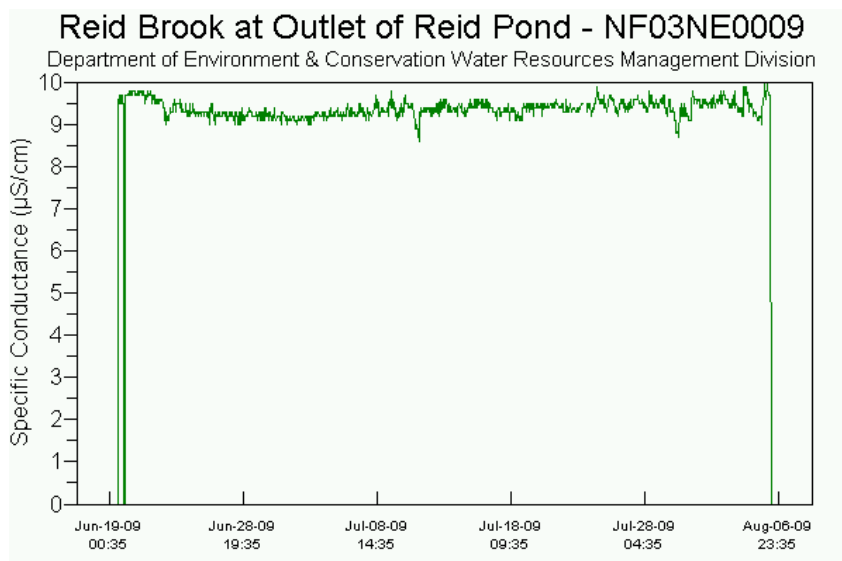
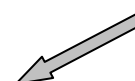


Figure 3



- The pH values (**Figure 4**) remained consistent throughout the first part of the deployment period. Again the sensor demonstrated instability from early July onward. The pH values ranged from 5.75 to 7.25. This is a greater amount of variability in the data than is normally seen. The majority of the pH values were around or slightly below the minimum recommended pH guideline (6.5) for the CCME Water Quality Guidelines for Aquatic Life.

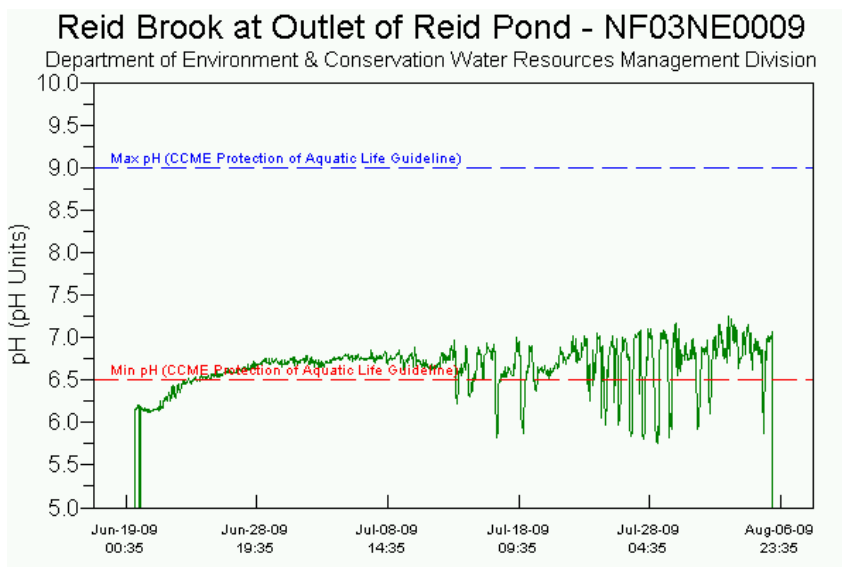


Figure 4

- Turbidity values (**Figure 5**) were slightly variable but remained at very low background levels ranging from 0.3 NTU to 4.599 NTU throughout the deployment period. The maximum reading of 4.599 NTU on July 24th was sporadic in nature and not sustained (only one elevated reading then returned to very low background) therefore this should not be considered a water quality event.

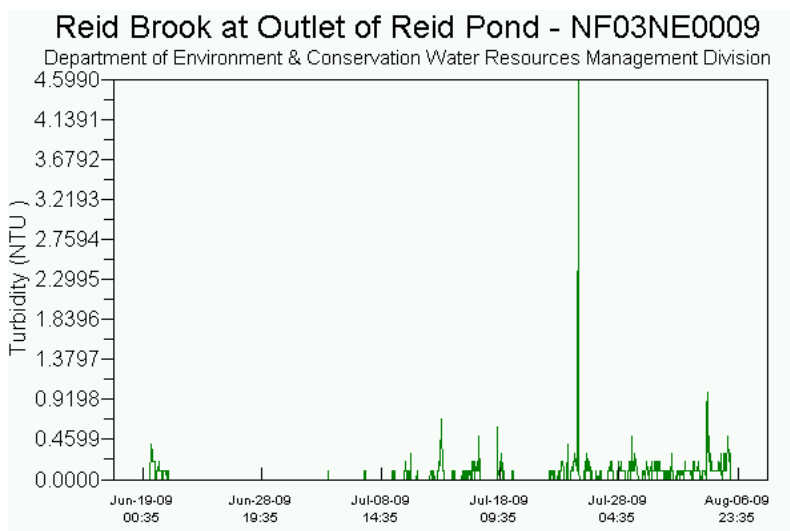


Figure 5

CAMP POND BROOK BELOW CAMP POND

- The water temperature (**Figure 6**) increased slightly throughout the deployment period with clear diurnal patterns. This increasing trend is expected as the average daily temperature is also increasing during this period (see **Appendix**). The water temperatures ranged from 6.07°C to 21.98°C.

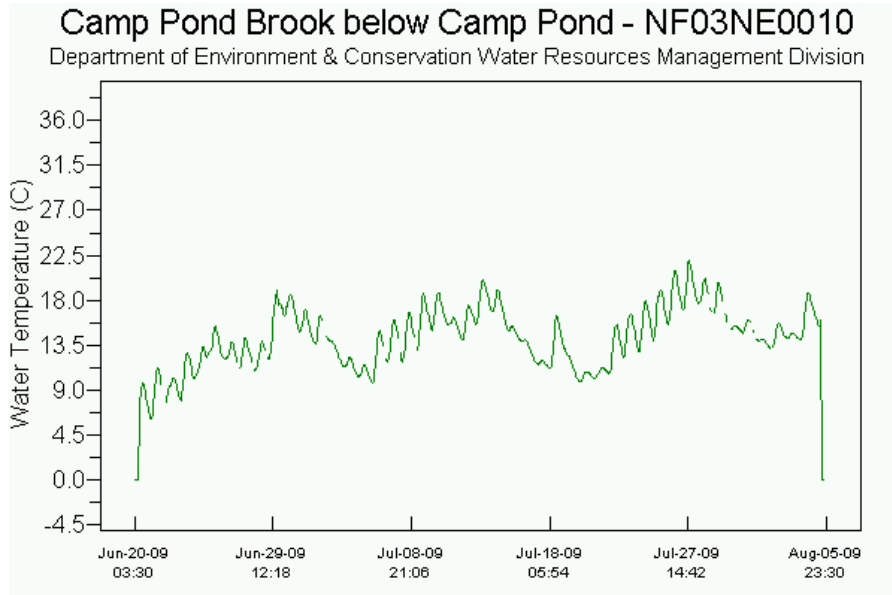


Figure 6

- The dissolved oxygen values (**Figure 7**) decreased throughout the deployment period corresponding to the above mentioned increase in water temperature. The minimum dissolved oxygen value recorded was 7.04 mg/L.

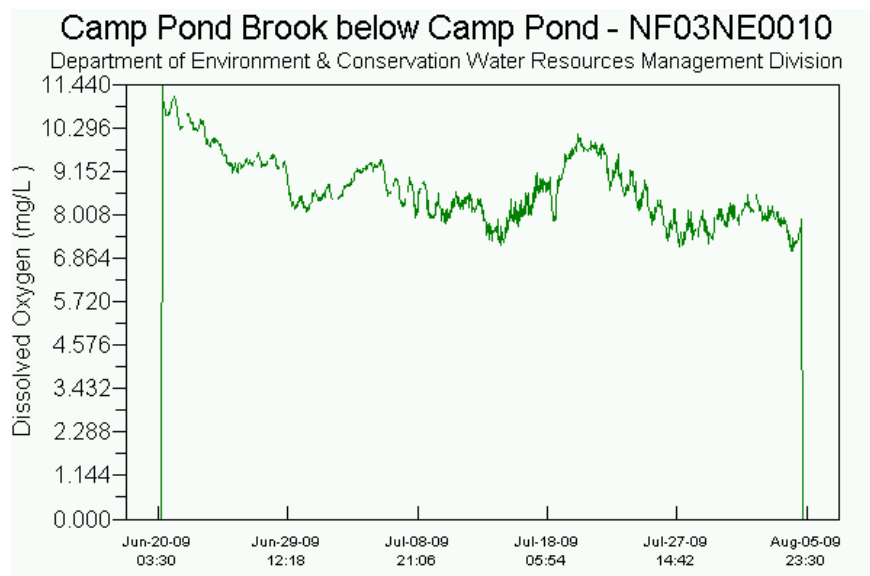


Figure 7

- The conductivity values (**Figure 8**) demonstrated an increasing trend throughout the deployment period. The conductivity values ranged from 20.1 uS/cm to 36.1 uS/cm. There are some minor fluctuations throughout the deployment period but no significant water quality events were captured.

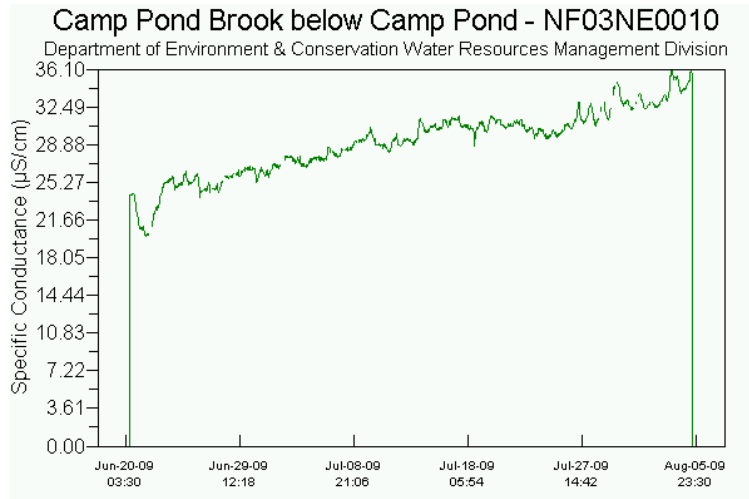
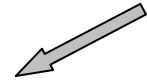


Figure 8



- The pH values (**Figure 9**) remained very consistent throughout the deployment period. The pH values ranged from 6.51 to 7.08. All the pH values fell within the recommended CCME Water Quality Guidelines for the Protection of Aquatic Life.

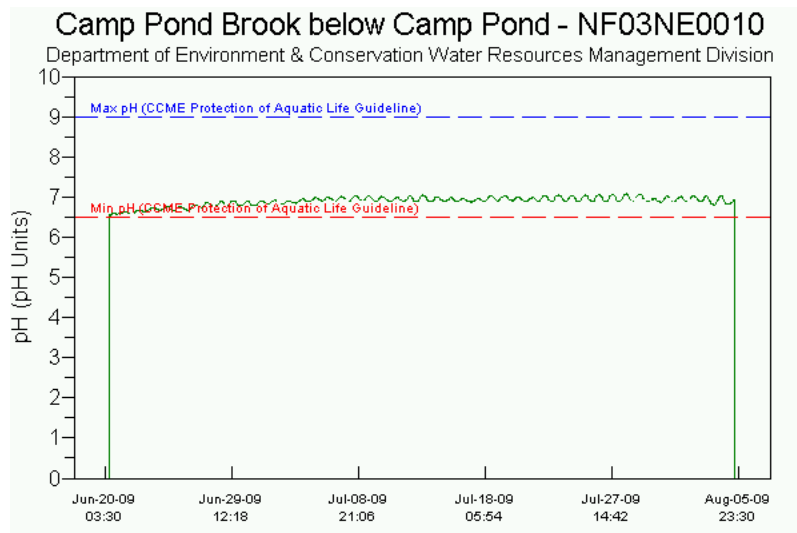
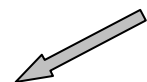


Figure 9



- Turbidity values (**Figure 10**) were variable over the deployment period ranging from 1.1 NTU to 166.9 NTU. There were two periods when the turbidity increased significantly: a) around June 25th reaching a value of 72.6 NTU; b) around July 16th reaching a maximum value of 166.9 NTU. The first instance appears to be related to a rainfall event (see **Appendix**), however, this event is not clearly captured on the stage graph (**Figure 11**). The second instance is more likely due to debris interfering with the sensor during the reading since it was sporadic in nature and not sustained (only one elevated reading then returned to background) therefore this should not be considered a water quality event.

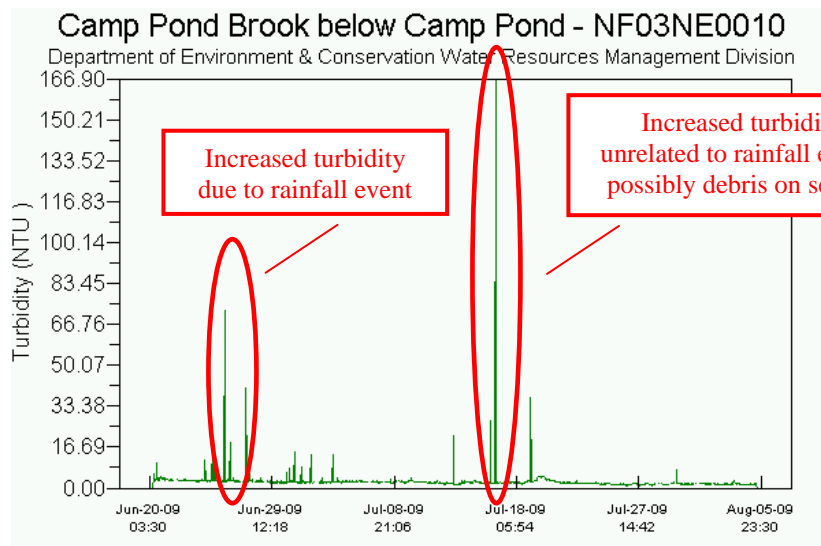


Figure 10

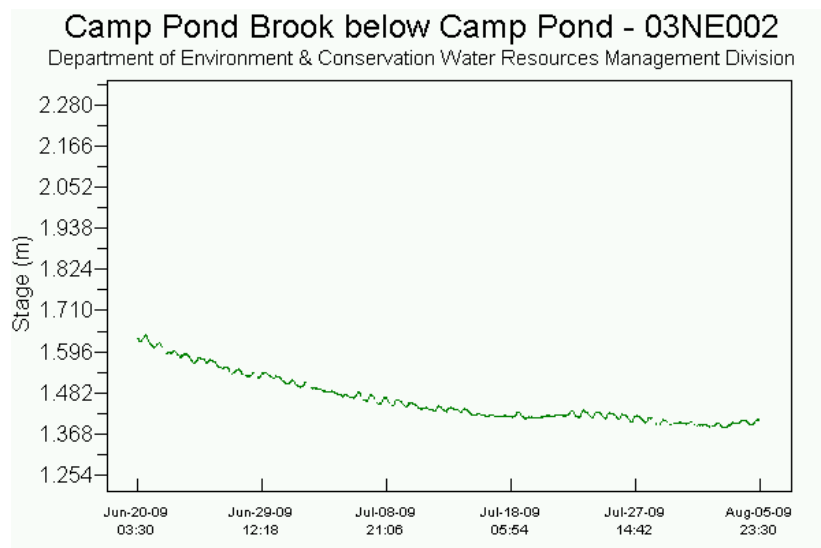


Figure 11

LOWER REID BROOK BELOW TRIBUTARY

- The water temperature (**Figure 12**) increased slightly throughout the deployment period with clear diurnal patterns. This increasing trend is expected as the average daily temperature is also increasing during this period (see **Appendix**). The water temperatures ranged from 2.8°C to 15.41°C.

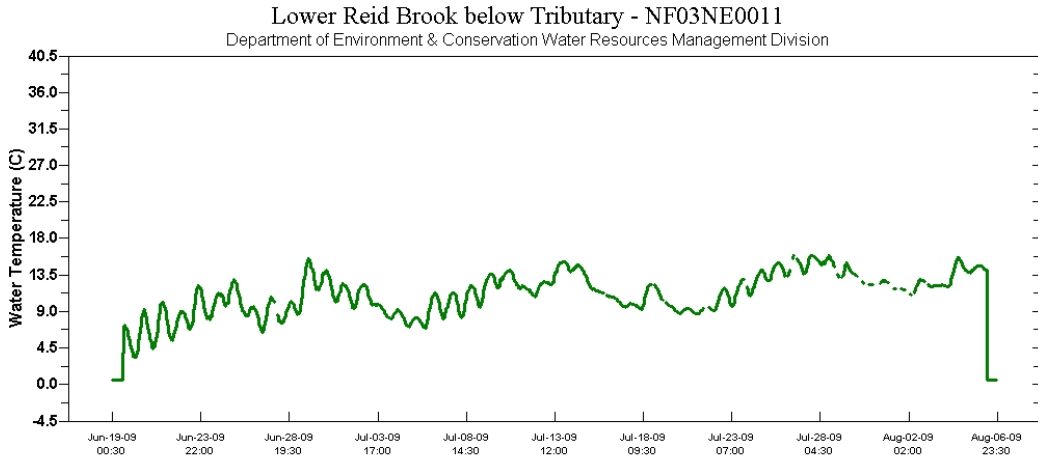
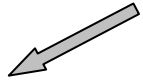


Figure 12



- The dissolved oxygen values (**Figure 13**) decreased throughout the deployment period corresponding to the above mentioned increase in water temperature. The minimum dissolved oxygen value recorded was 7.98 mg/L.

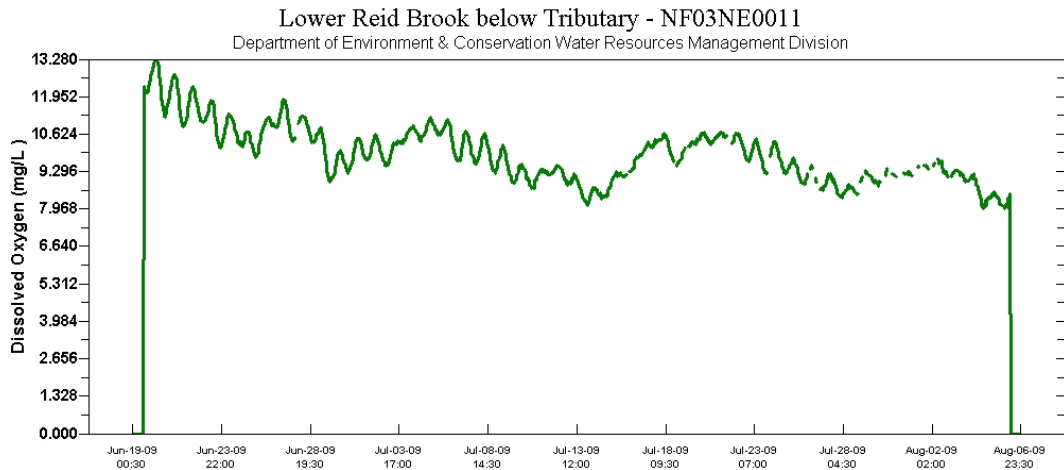
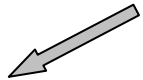


Figure 13



- The conductivity values (**Figure 14**) demonstrated an increasing trend throughout the deployment period. The conductivity values ranged from 14.0 uS/cm to 32.0 uS/cm. There are some minor fluctuations throughout the deployment period but no significant water quality events were captured.

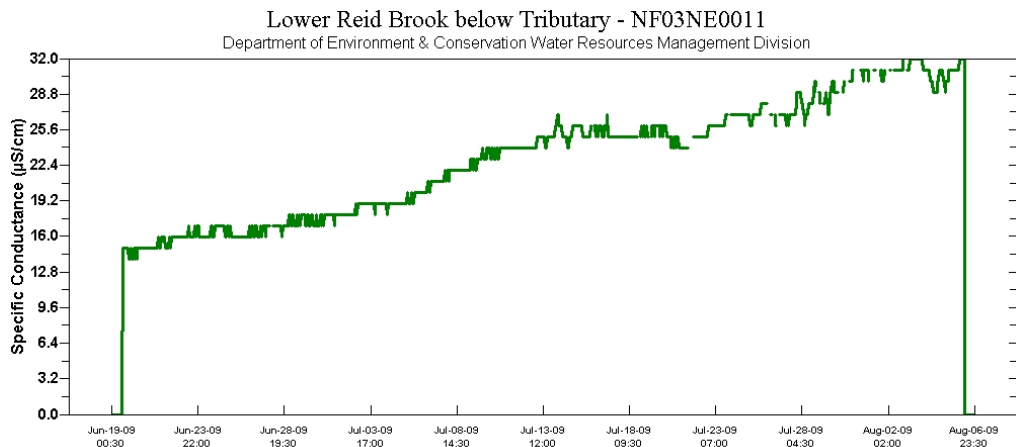
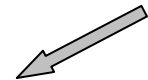


Figure 13



- The pH values (**Figure 14**) remained very consistent throughout the deployment period. The pH values ranged from 6.19 to 7.04. All the pH values fell within the recommended CCME Water Quality Guidelines for the Protection of Aquatic Life.

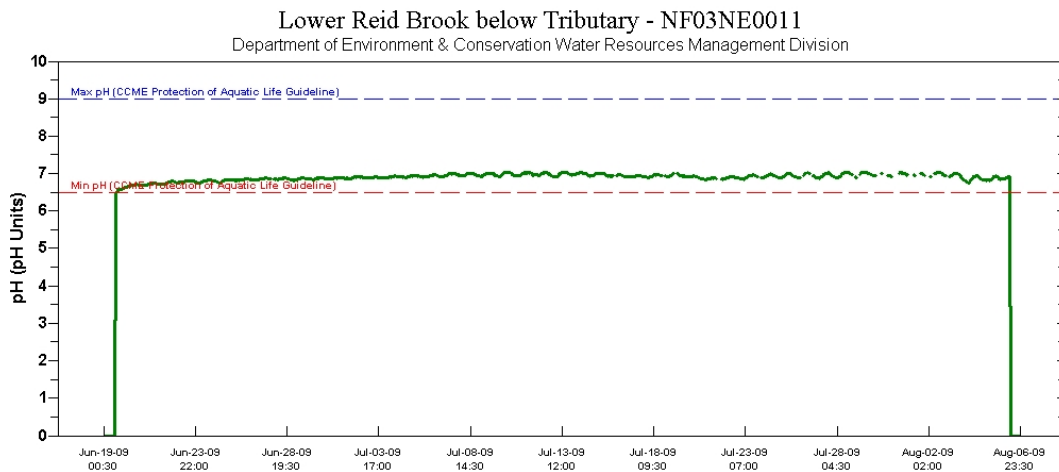
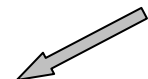


Figure 14



- Turbidity values (**Figure 15**) were variable over the deployment period at low levels ranging from 1.9 NTU to 13.9 NTU. The most significant increases occurred around July 16th and 17th which can be attributed to rainfall events from July 13th-16th (see **Appendix**). The sustained rainfall amounts at this time are not clearly captured on the stage graph (**Figure 16**). Many of the smaller turbidity increases can be attributed to other rainfall events as well.

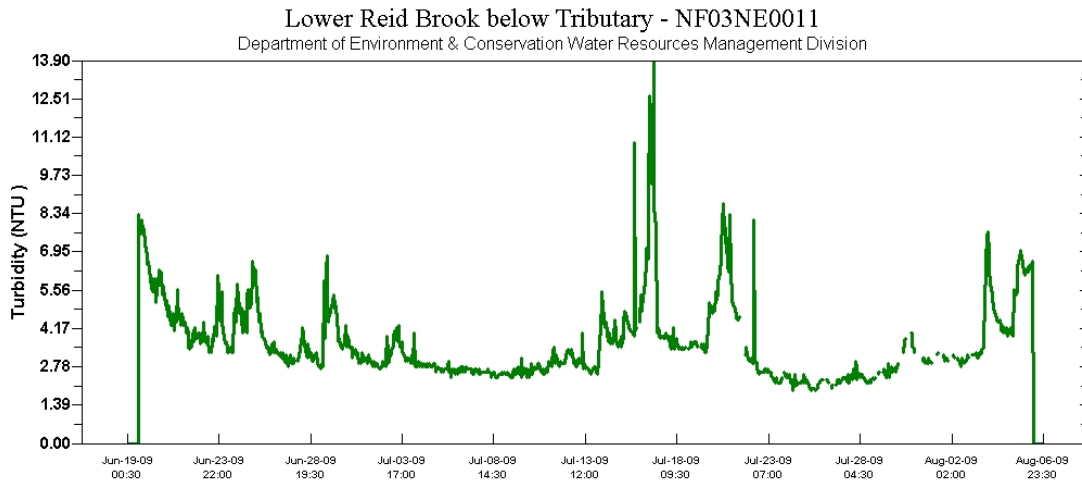


Figure 15

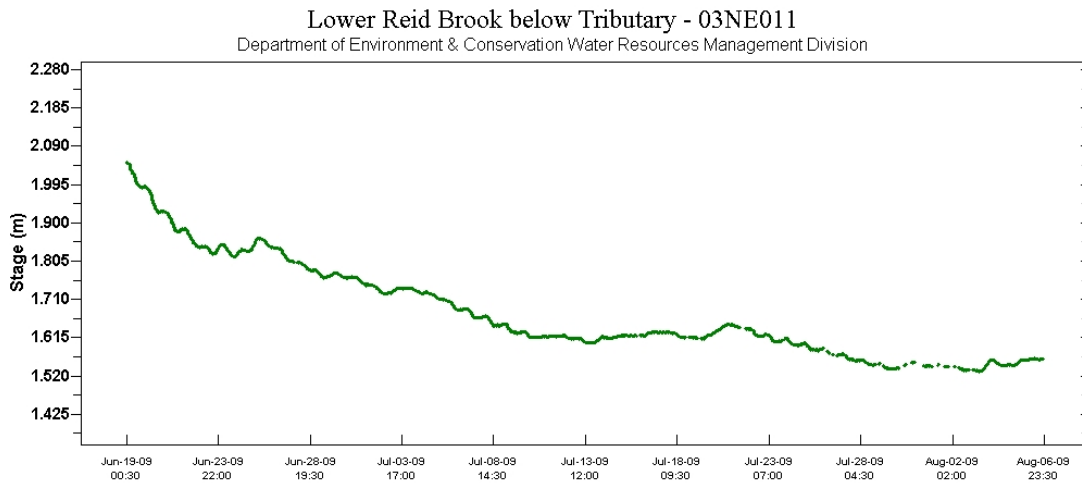
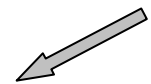
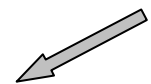


Figure 16



TRIBUTARY TO REID BROOK

- The water temperature (**Figure 17**) increased slightly throughout the deployment period with clear diurnal patterns. This increasing trend is expected as the average daily temperature is also increasing during this period (see **Appendix**). The water temperatures ranged from 3.58°C to 16.3°C.

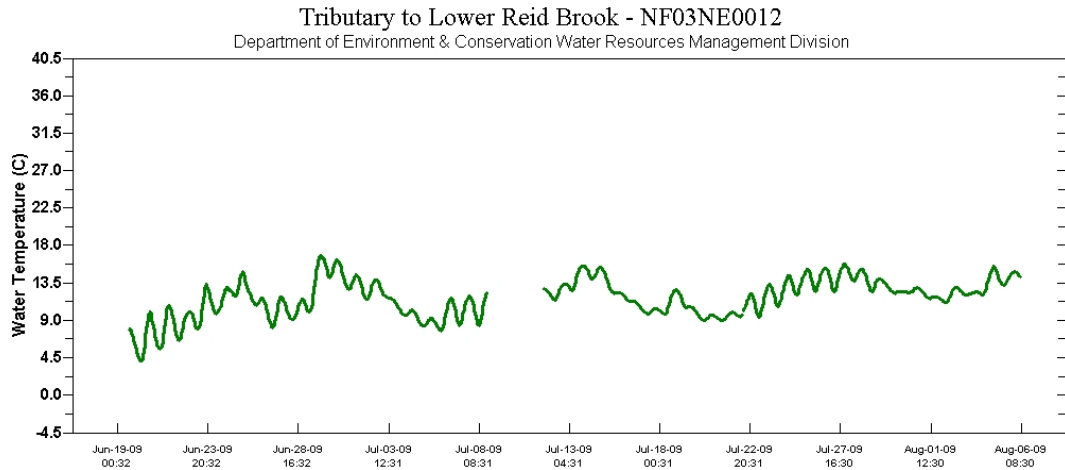
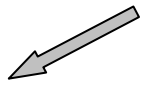


Figure 17



- The dissolved oxygen values (**Figure 18**) decreased slightly throughout the deployment period corresponding to the above mentioned increase in water temperature. The minimum dissolved oxygen value recorded was 9.88 mg/L. All values recorded are within the acceptable range for dissolved oxygen concentration as stated by the CCME Guidelines for the Protection of Aquatic Life. The Guidelines state dissolved oxygen (for cold water) must be at least 9.5 mg/L for early life stages.

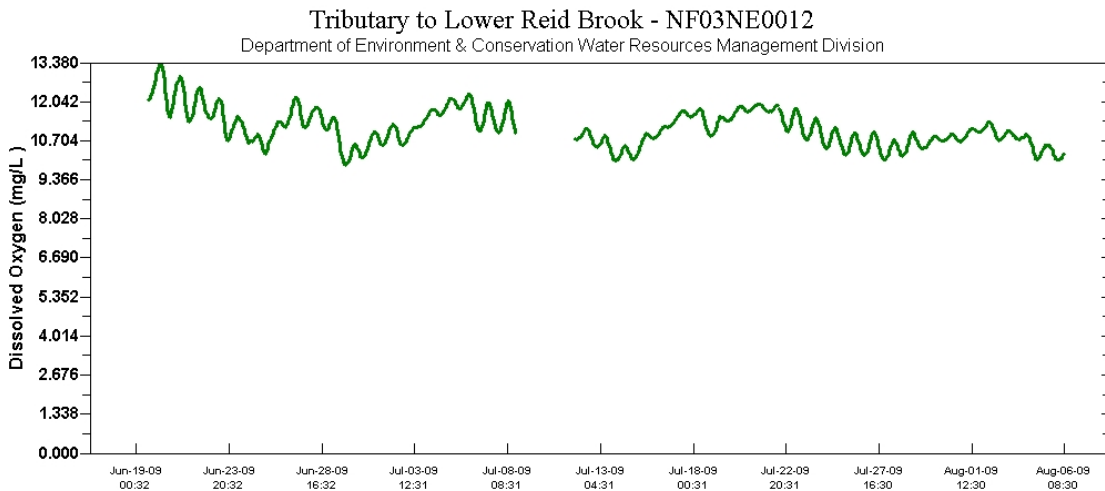
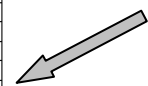


Figure 18



- The conductivity values (**Figure 18**) demonstrated an increasing trend throughout the deployment period. The conductivity values ranged from 17.0 uS/cm to 33.4 uS/cm. Around July 20th, a rainfall event lead to a significant decrease in conductivity values (due to a diluting effect). This event is clearly indicated on the stage graph (Figure 21 below).

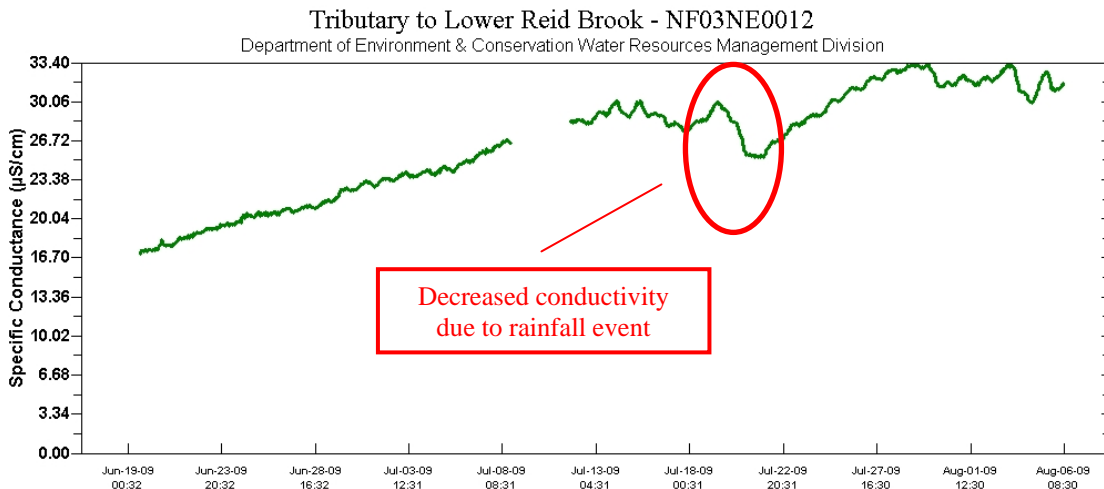


Figure 18

- The pH values (**Figure 19**) remained very consistent throughout the deployment period. The pH values ranged from 6.4 to 7.08. All the pH values fell at or within the recommended CCME Water Quality Guidelines for the Protection of Aquatic Life.

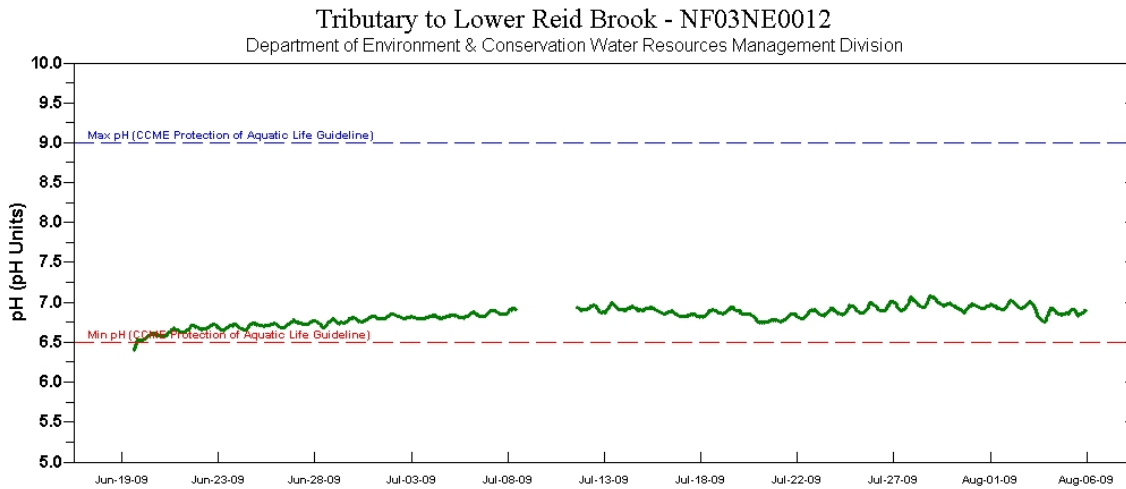


Figure 19

- Turbidity values (**Figure 20**) were only slightly variable over the deployment period ranging from 0.0 NTU to 230.7 NTU. The maximum increase (230.7 NTU) occurred on July 20th and may have been associated with increased rainfall amounts (see **Appendix**) and associated increases in the stage graph (**Figure 21**). Many of the smaller turbidity increases may be attributed to other rainfall events as well.

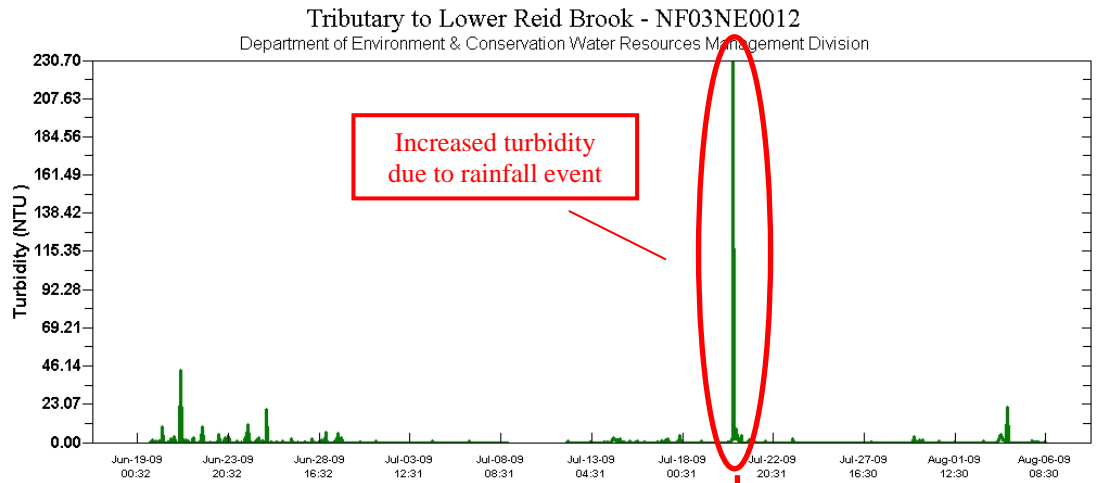


Figure 20

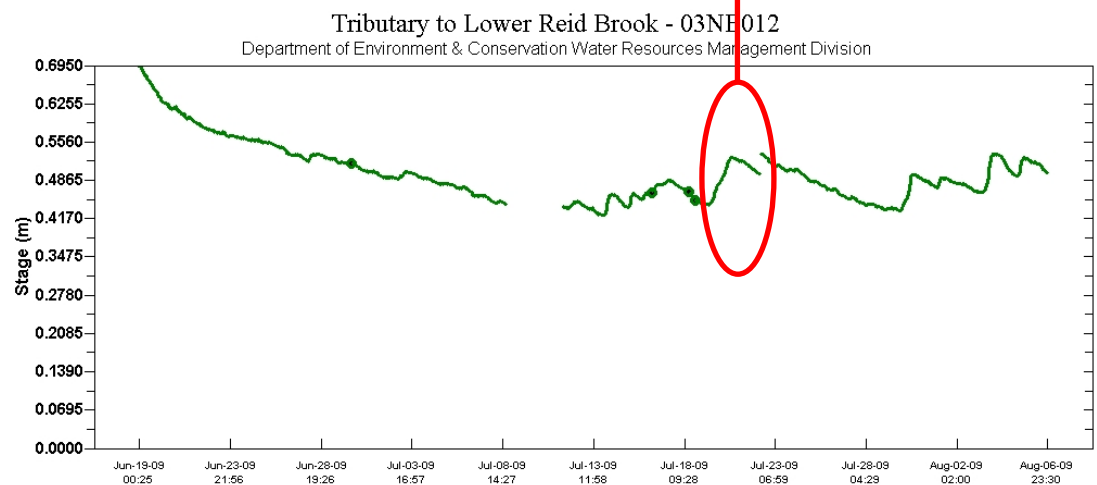
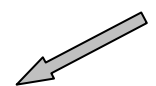
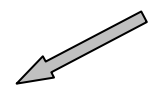


Figure 21



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