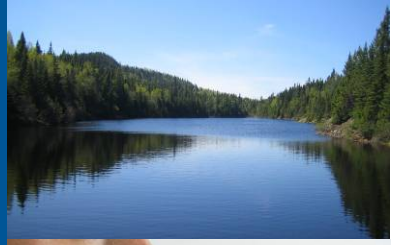
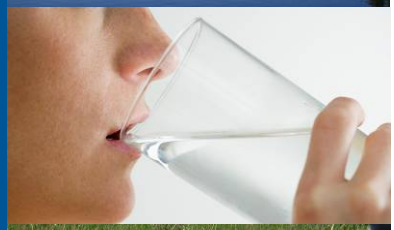



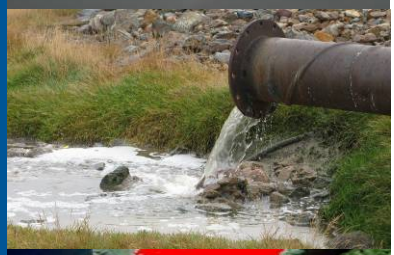


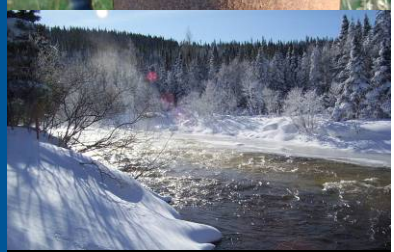

Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2011-08-10 to 2011-09-16

2011-09-22

Newfoundland Labrador

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

General

- Water Resources Management Division (WRMD) staff monitors the real-time web page on a daily basis. Any unusual observations are investigated, with site visits being carried out as warranted.
- Management at Teck Duck Pond Operations are informed of any significant water quality events or instrumentation problems by WRMD.
- There was effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) episodically throughout the deployment period.

Maintenance and Calibration of Instrumentation

- After being cleaned and freshly calibrated the regular **DataSondes®**(s/n 43245) for Tributary to Gills Pond Brook and (s/n 43794) for East Pond Brook were installed on August 10, 2011, and remained deployed continuously until September 16, 2011 a 36 day period.

- The regular **Quanta G®** (s/n 00035) was returned from the factory after servicing during this period, and was deployed on September 7, 2011, however, no data were transmitted until September 9, 2011. Thus there is data for Monitoring Well After Tailings Dam Station (MW1) for only the last seven days of this reporting period.

Quality Assurance / Quality Control (QA/QC) Measures

- As part of the QA/QC protocol, 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. See **Table 1**.

	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

Table 1

- For the Surface Water Stations, upon deployment and removal, a QA/QC **MiniSonde®** is temporarily deployed along side the Field **DataSonde®**. Values for each recorded parameter are compared between the two instruments. Based upon the difference between the parameters recorded by the Field **DataSonde®** and QAQC **MiniSonde®** a qualitative statement (Ranking) is usually made on the data.

- The ranking at the beginning and end of the deployment period are shown in **Table 2** for Tributary to Gill's Pond Brook and **Table 3** for East Pond Brook.

- It was noted during the removal of the Field **DataSonde®** from East Pond Brook, that there was some fouling (leafy debris) of the Turbidity sensor. That is the cause of the 'Fair' comparison ranking.

- Because the deployment set-up for Well After Tailings Dam (MW1) is different, comparison with another instrument is not possible. In this case, a grab sample is usually collected at the beginning and end of the deployment period, and the ranking is calculated for pH and Specific Conductance based upon live data and laboratory data. However, during this deployment period, no comparisons or rankings are possible.

- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent Quality Assurance and Quality Control (QA/QC) protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Tributary to Gills Pond Brook Station (NF02YO0190)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2011-08-10 Deployment	Temp (°C)	Good
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2011-09-16 Removal	Temp (°C)	Good
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Excellent
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2011-08-10 Deployment	Temp (°C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2011-09-16 Removal	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Excellent
	Turbidity (NTU)	Fair

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 10.40 ˚C to a maximum of 24.35 ˚C.
- There appears to be little correlation with stage.

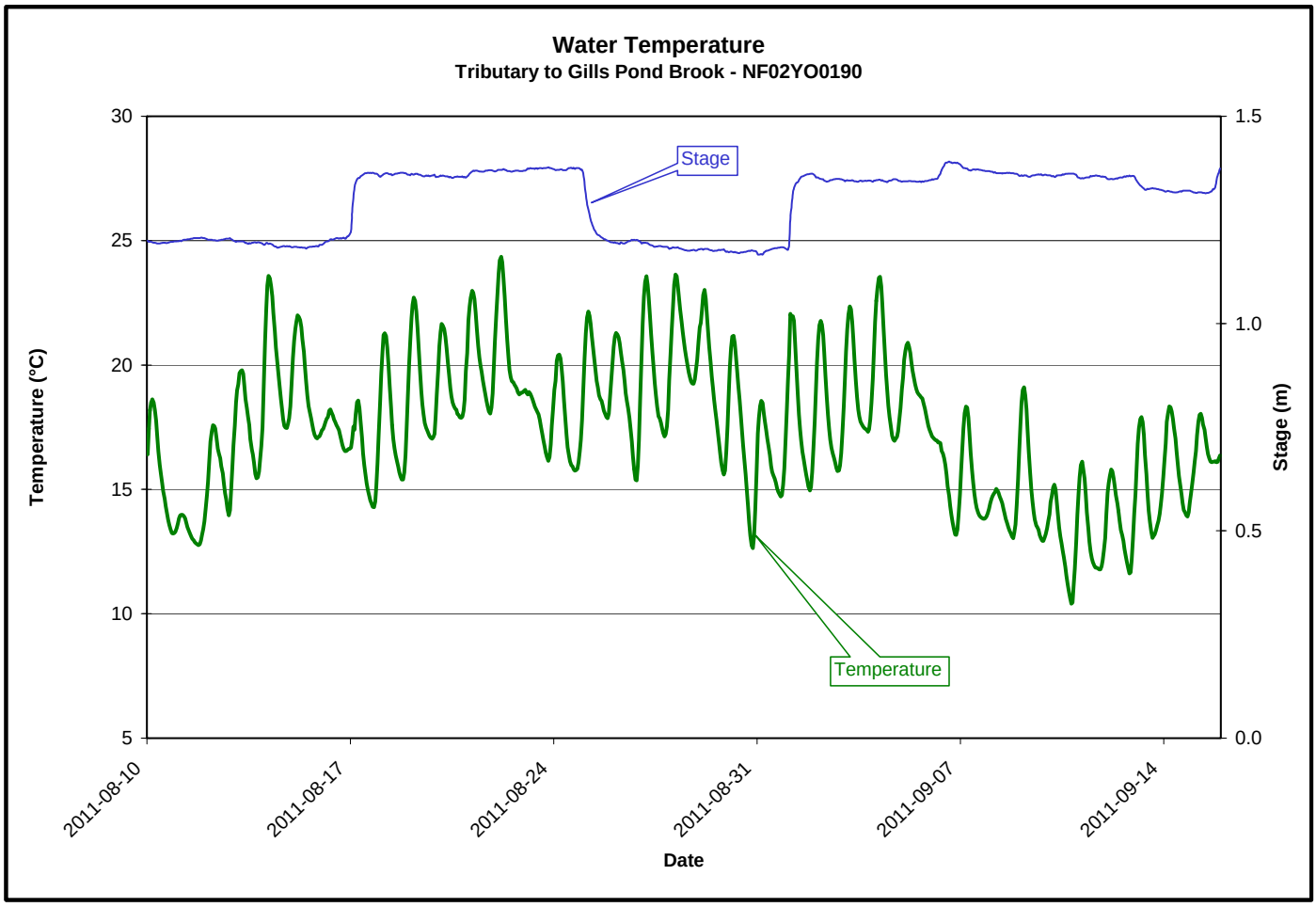

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 6.84 to a maximum of 7.46 with all of the values falling within the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- The background pH of this stream is normally around the lower limit of the recommended range.

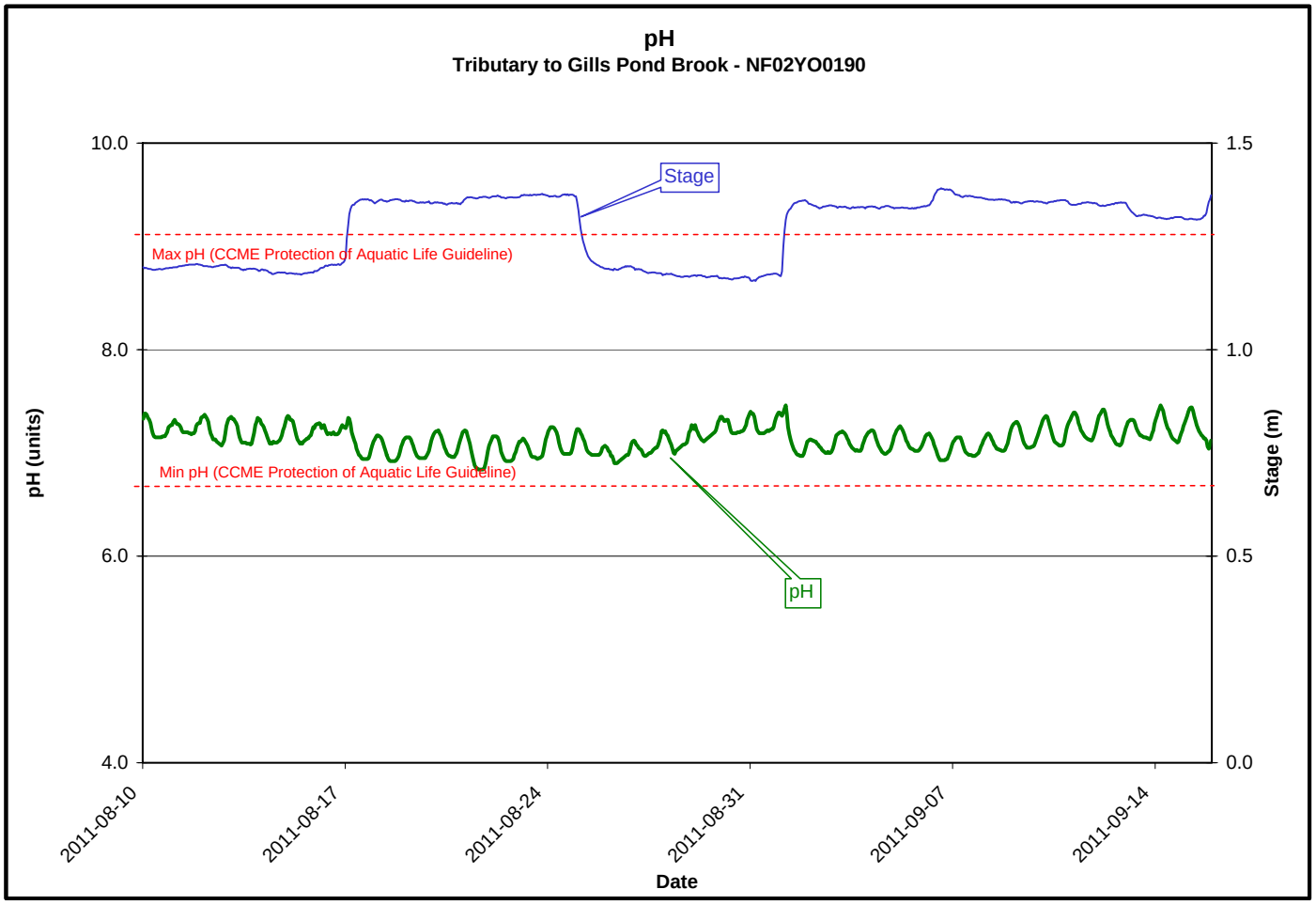

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 89.6 µS/cm to a maximum of 1186.0 µS/cm over the deployment period.
- The highest specific conductance readings correspond with periods of discharge from the Polishing Pond.
- The 'V' shaped dip following September 7, 2011 is the result of dilution caused by precipitation events, indicated by a slight peak in the stage.

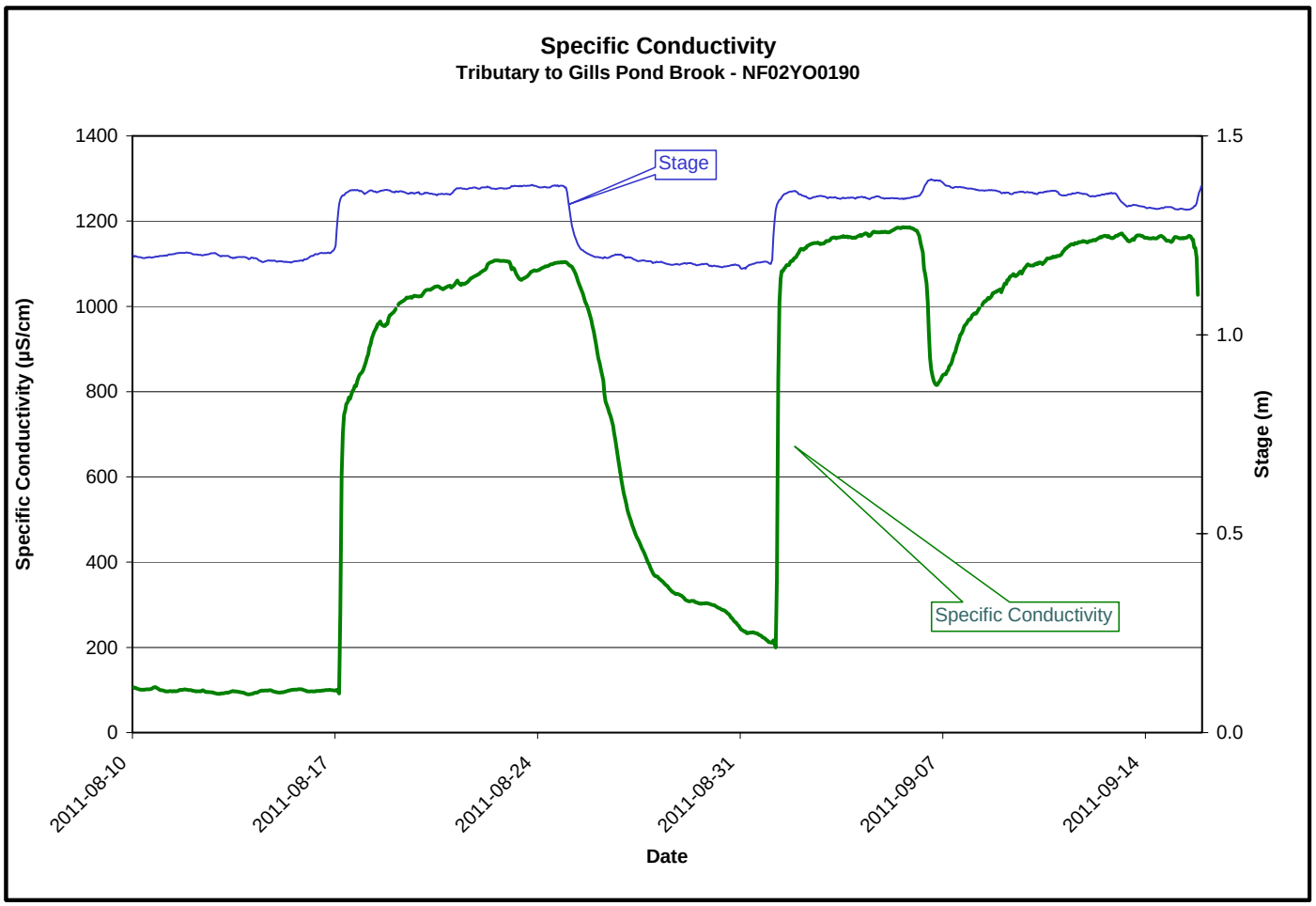

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 7.70 mg/L to a maximum of 10.24 mg/L over the deployment period, with the percent saturation ranging between 86.2 and 100.6.
- Dissolved oxygen is generally inversely proportional to water temperature.
- Many of the dissolved oxygen values fell below the upper limit recommended by CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (cold water/other life stages – above 6.5 mg/L; cold water/early life stages – above 9.5 mg/L).
- Based upon the fact that Dissolved Oxygen % saturation had minimal change over the deployment period, we can be confident that the Dissolved Oxygen mg/L values are accurate.

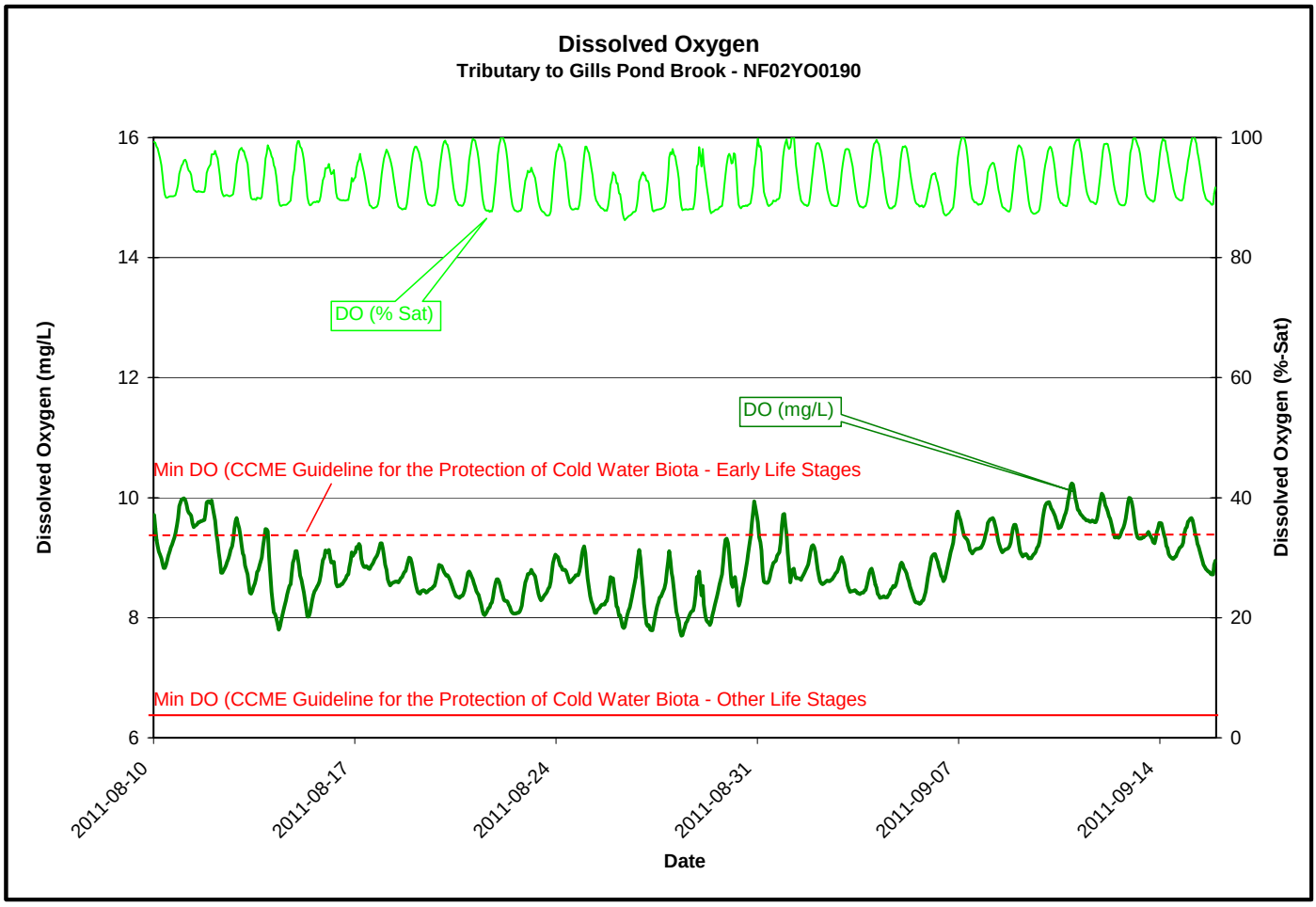

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 54.4 NTU.
- The peak in turbidity on September 7, 2011 appears to be correlated with an increase in stage which is the result of heavy precipitation.
- Turbidity values were recorded above zero only during periods of discharge from Polishing Pond.
- *In-situ* and grab sample data indicate turbidity values of less than 2.0 NTU.
- Upon removal, the water appeared to be slightly turbid.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during higher flows.
- The higher turbidity spikes likely correspond to natural in-stream debris and/or air bubbles from turbulent flow passing over the sensor.

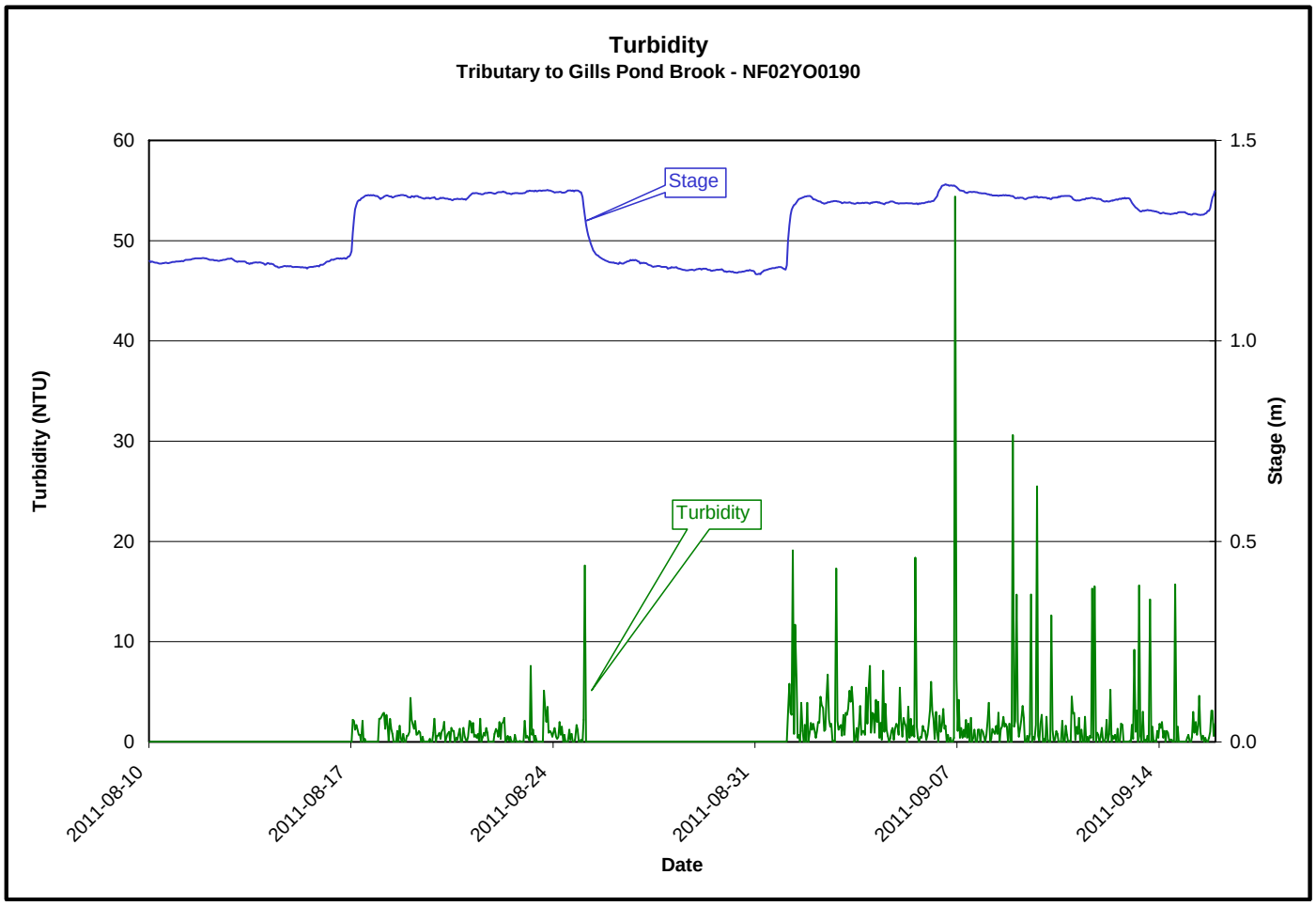

Figure 5

- The stage or water level ranged from a minimum of 1.17 m to a maximum of 1.39 m. The flow or discharge ranged from a minimum of 0.01 m^3/s to a maximum of 0.34 m^3/s (**Figure 6)**.
- The higher levels correspond to periods of discharge from Polishing Pond, while the peaks correspond to precipitation events.
- All values are within the normal range.
- The flow values for the lowest water levels could not be displayed as the stage-flow curve for these extremely low levels has yet to be calculated.

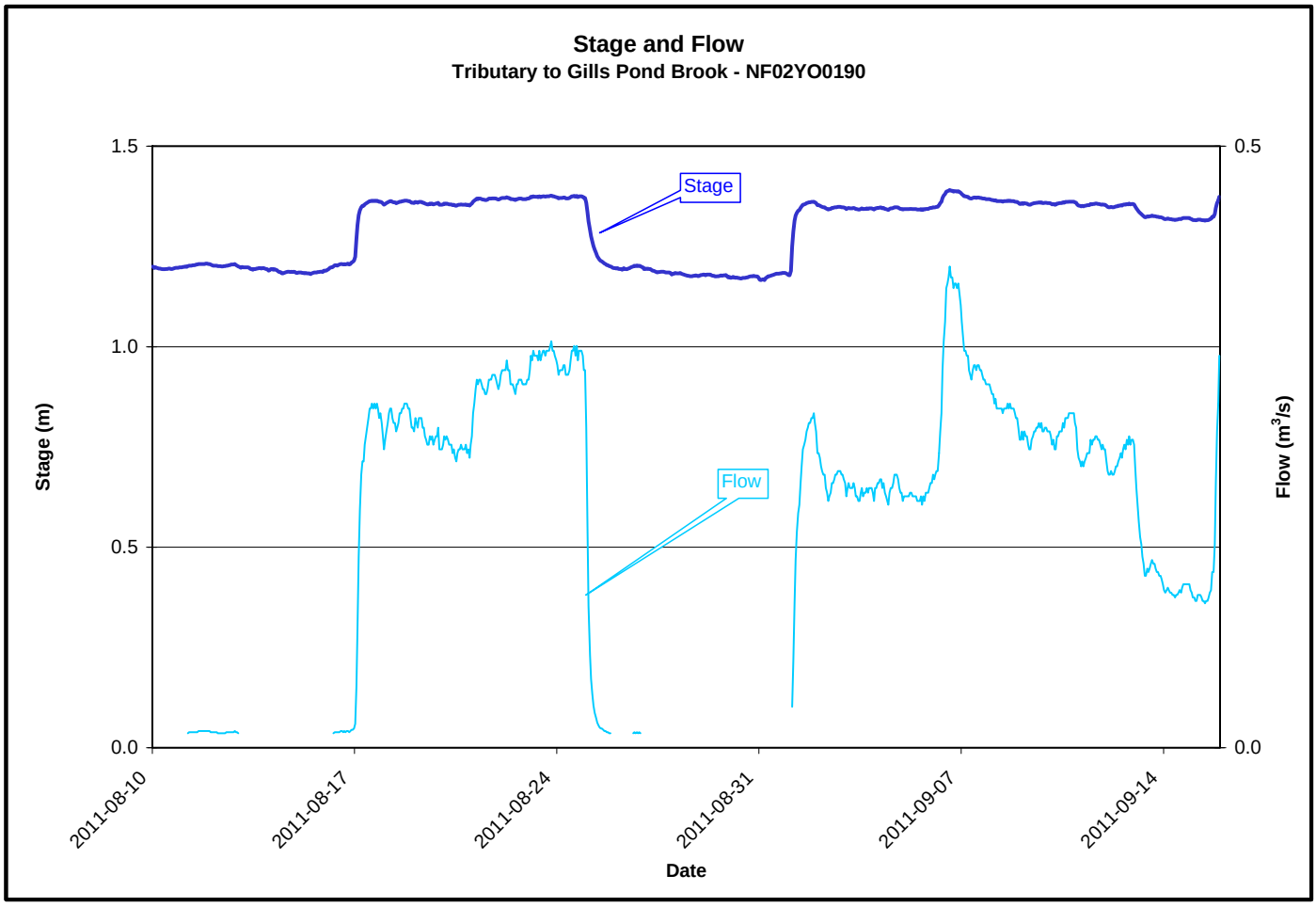

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 8.98 ˚C to a maximum of 25.54 ˚C.
- There appears to be little correlation with stage.

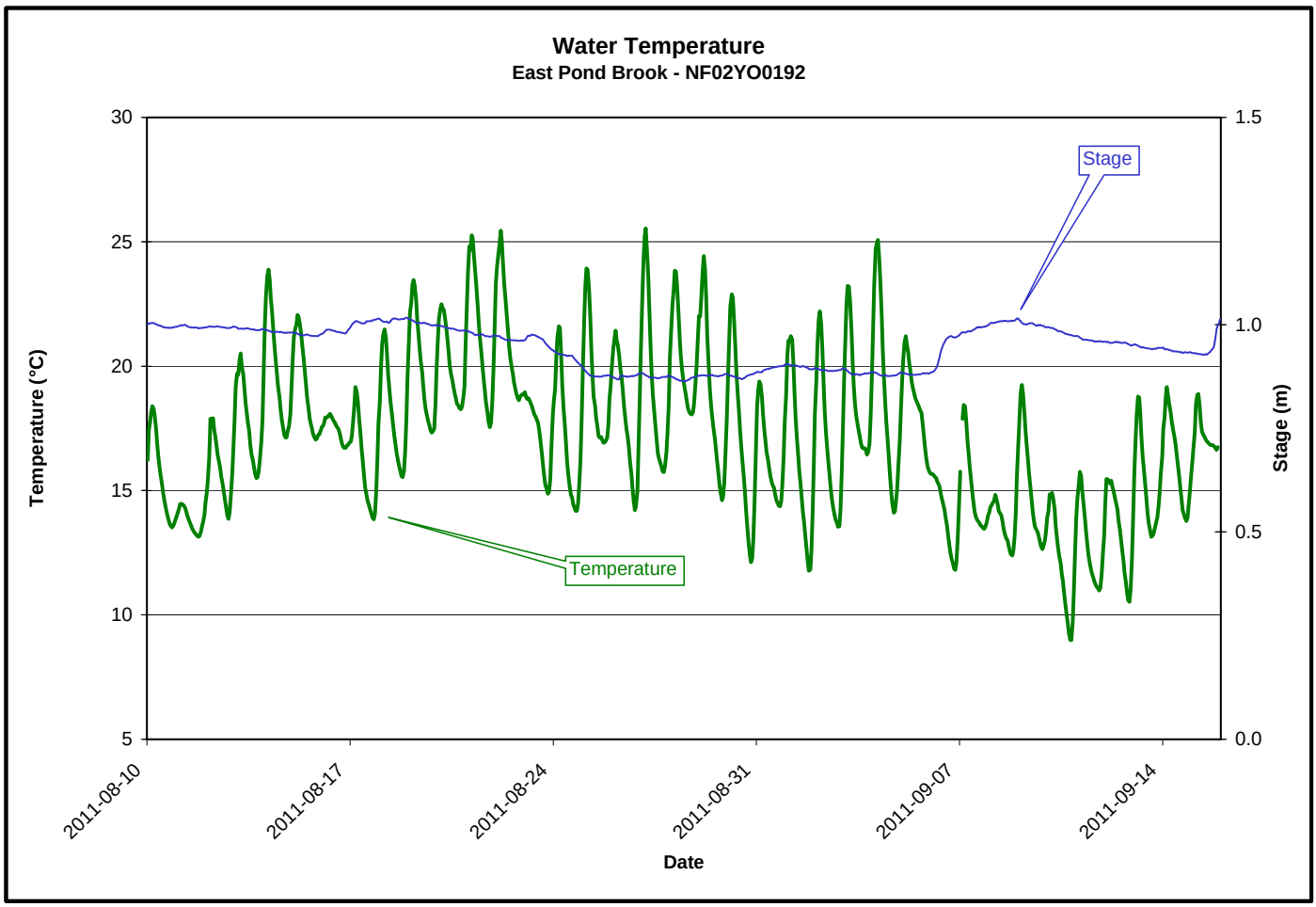

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.03 to a maximum of 7.02 with pH decreasing throughout the deployment period.
- In the latter third of the deployment period, some of the values fell below the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- It is interesting to note that this decrease corresponds to increase stage beginning on September 7, 2011, following a significant precipitation event.
- The background pH of this stream is normally quite low, and values near and below the limit are not unusual.

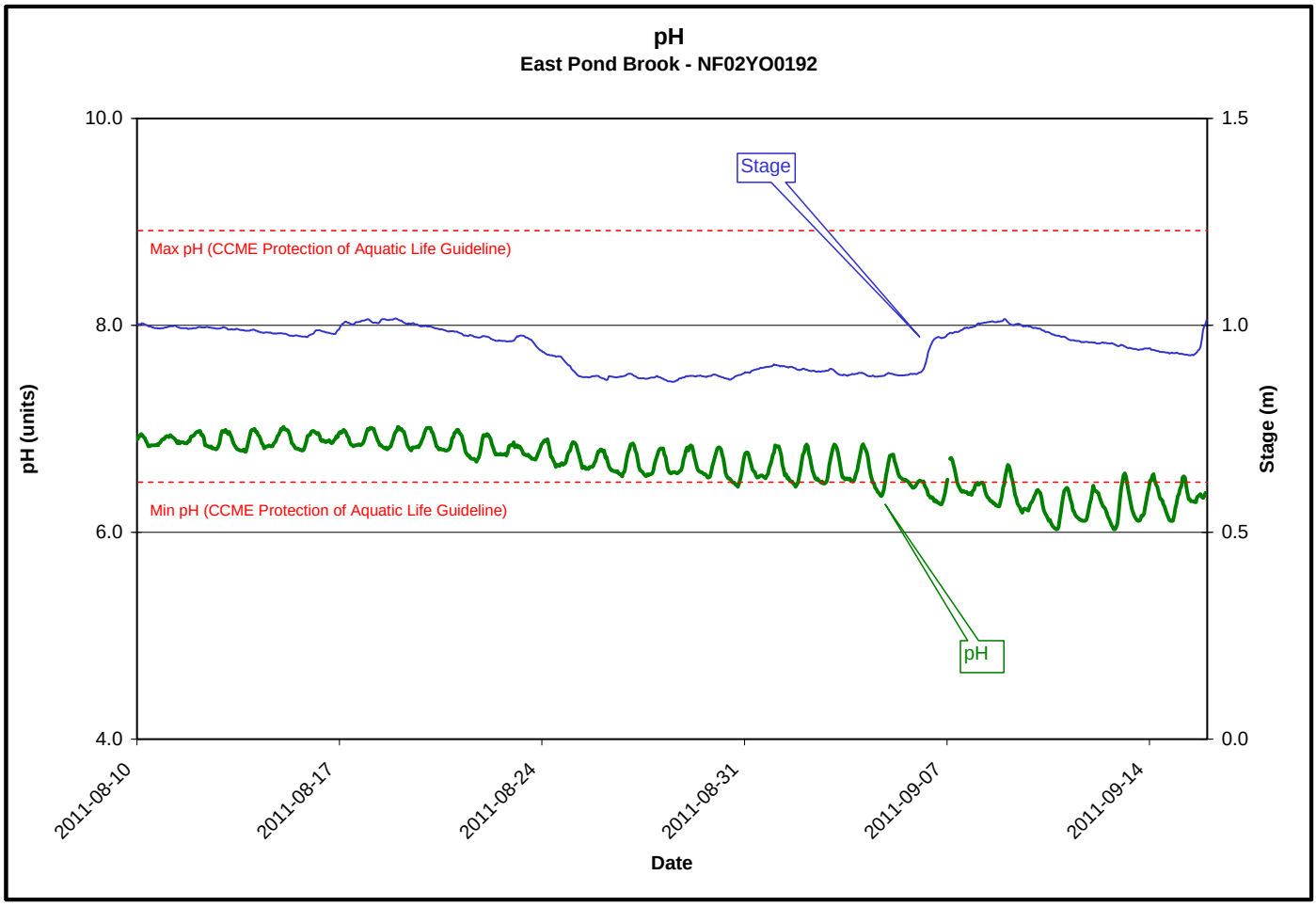

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 25.3 µS/cm to a maximum of 47.6 µS/cm, with a slight increase over the deployment period.

- All values are within the normal range.

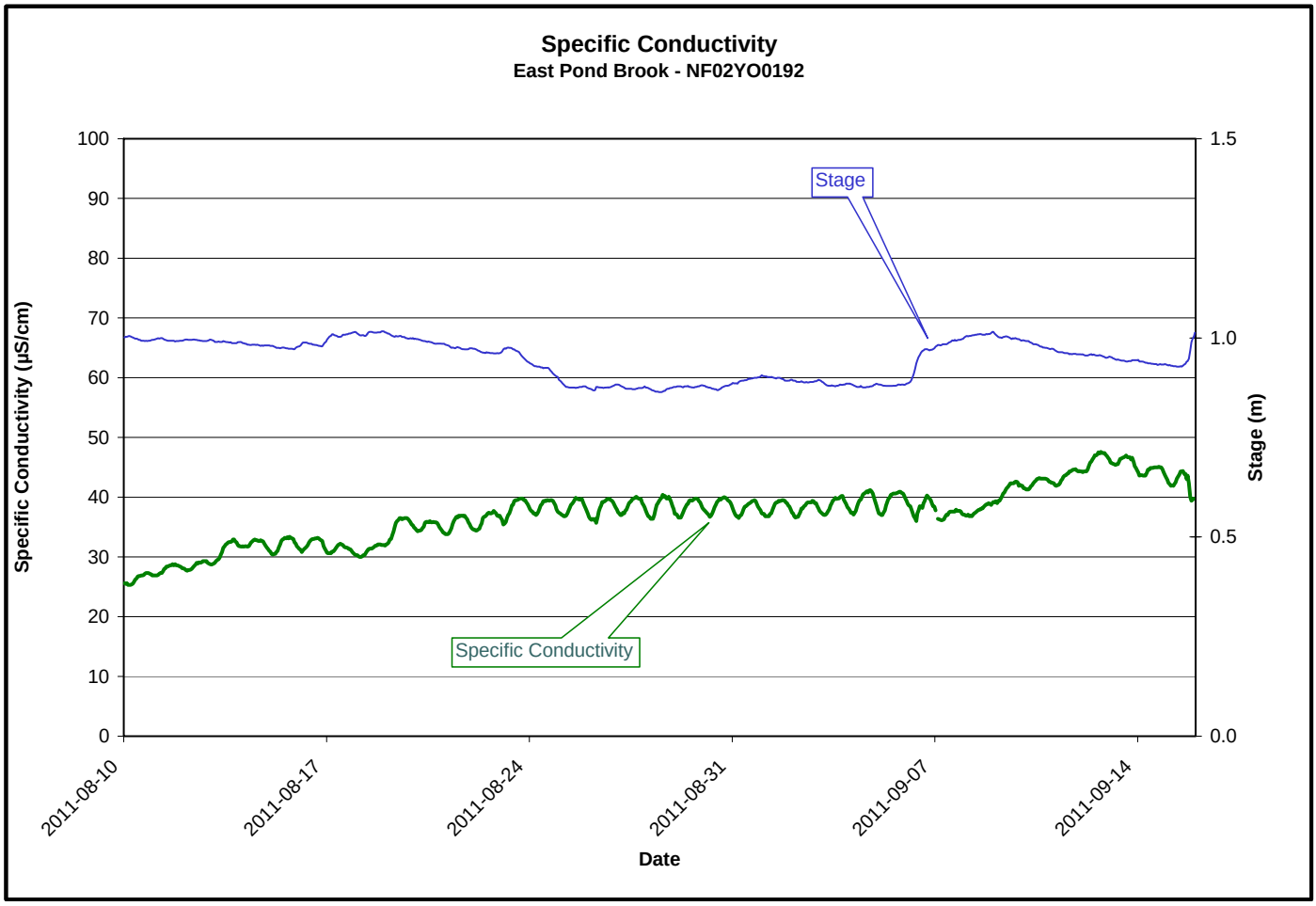

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 7.63 mg/L to a maximum of 10.66 mg/L over the deployment period, with the percent saturation ranging between 85.4 and 99.0.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout all of the deployment period, dissolved oxygen values fell below the upper limit recommended by CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (cold water/other life stages – above 6.5 mg/L; cold water/early life stages – above 9.5 mg/L).
- Based upon the fact that Dissolved Oxygen % Saturation had limited drift, we can be confident that the Dissolved Oxygen mg/L values are accurate.

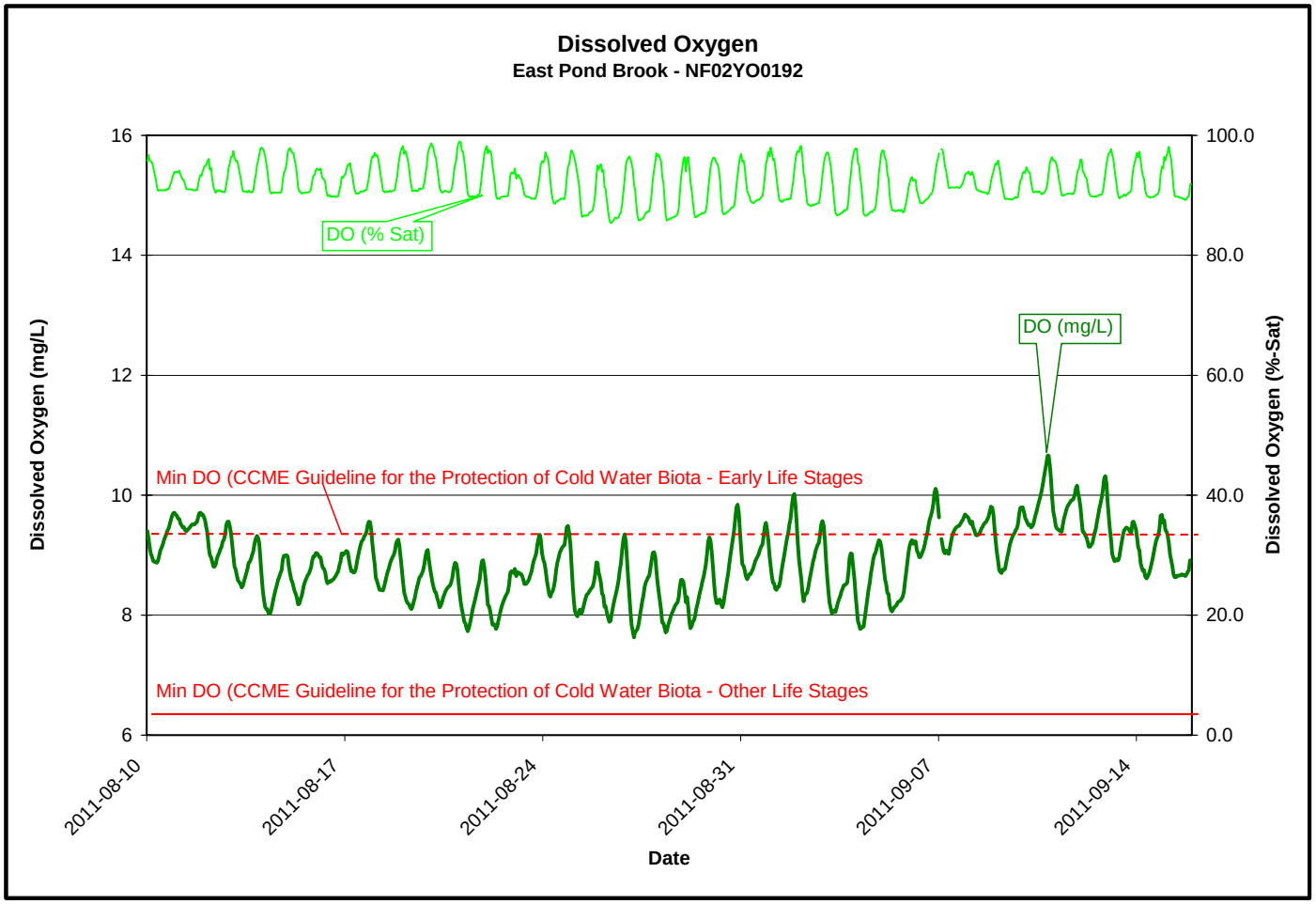

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 1753.0 NTU.
- Beginning on August 20, 2011 leafy debris became caught on the turbidity sensor, causing false positive vales to be recorded until the debris was removed on September 7, 2011.
- Again on September 16, 2011, upon removal of the sensor, turbidity was recorded at 5.5. More leafy debris was caught in the sensor.
- Turbidity values in this stream are typically near zero; the peaks typically being insignificant events when natural in-stream debris and/or air bubbles passed near the sensor.
- Neither *in situ* nor grab sample measurements nor visual observations indicated turbidity issues.

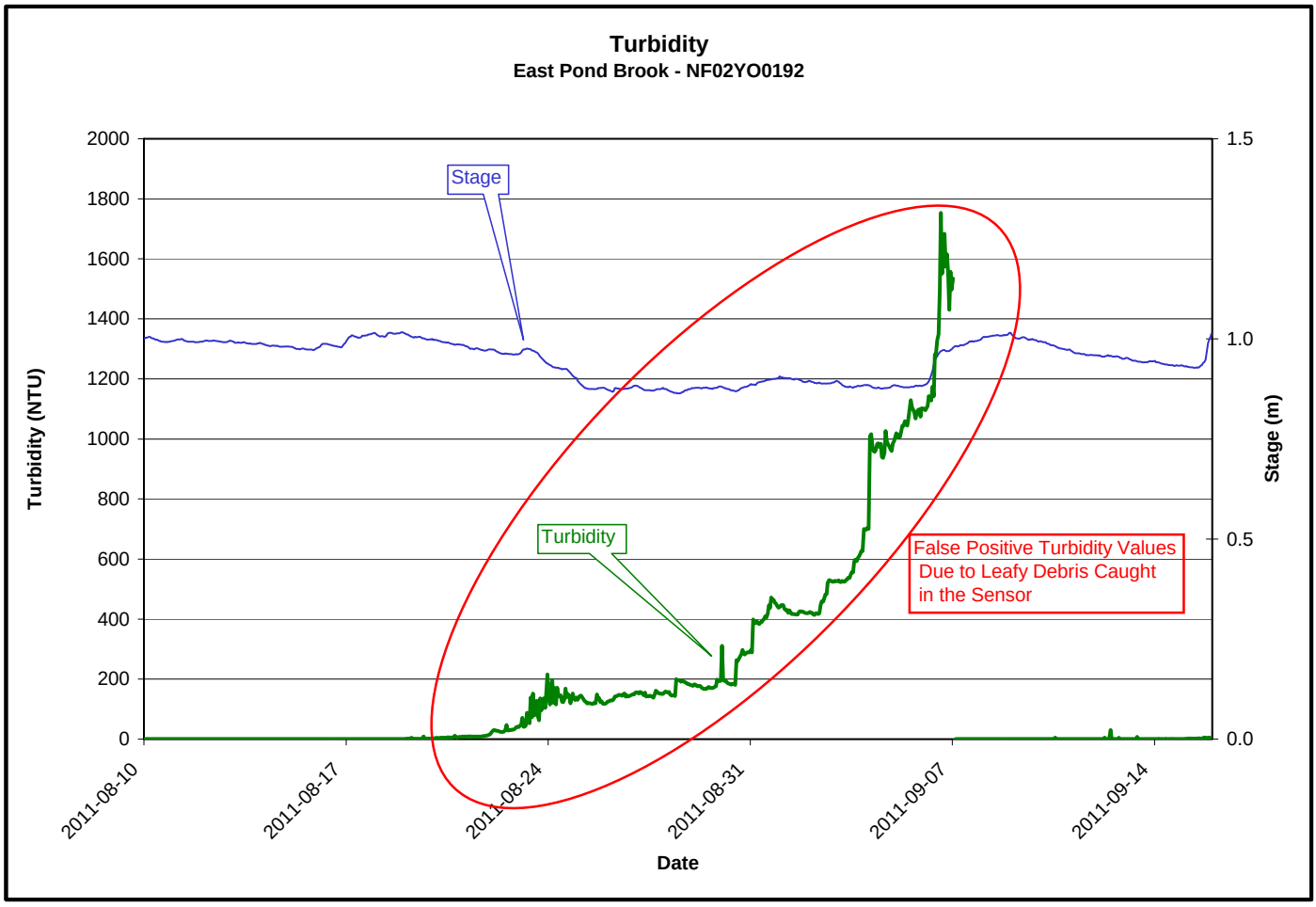

Figure 11

- The stage or water level ranged from a minimum of 0.86 m to a maximum of 1.02 m. The flow or discharge ranged from a minimum of 0.12 m^3/s to a maximum of 0.49 m^3/s **(Figure 12)**.
- Peaks are the result of precipitation/runoff events.
- Both stage and flow are within normal ranges.
- The flow values for the lowest water levels could not be displayed as the stage-flow curve for these extremely low levels has yet to be calculated.

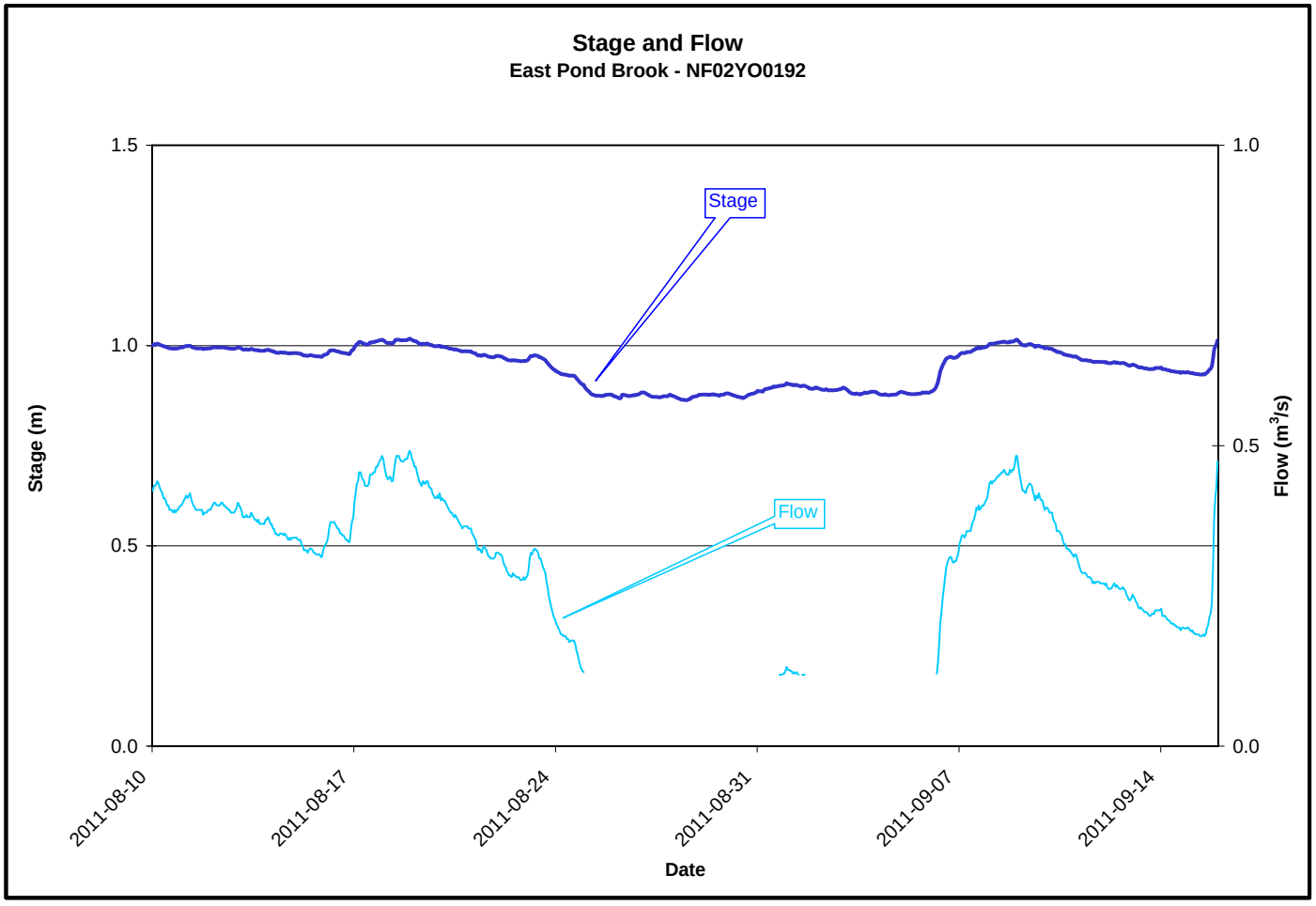

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.37 ˚C to a maximum of 5.43 ˚C with a slight increase over the deployment period.
- There appears to be little correlation with water elevation.

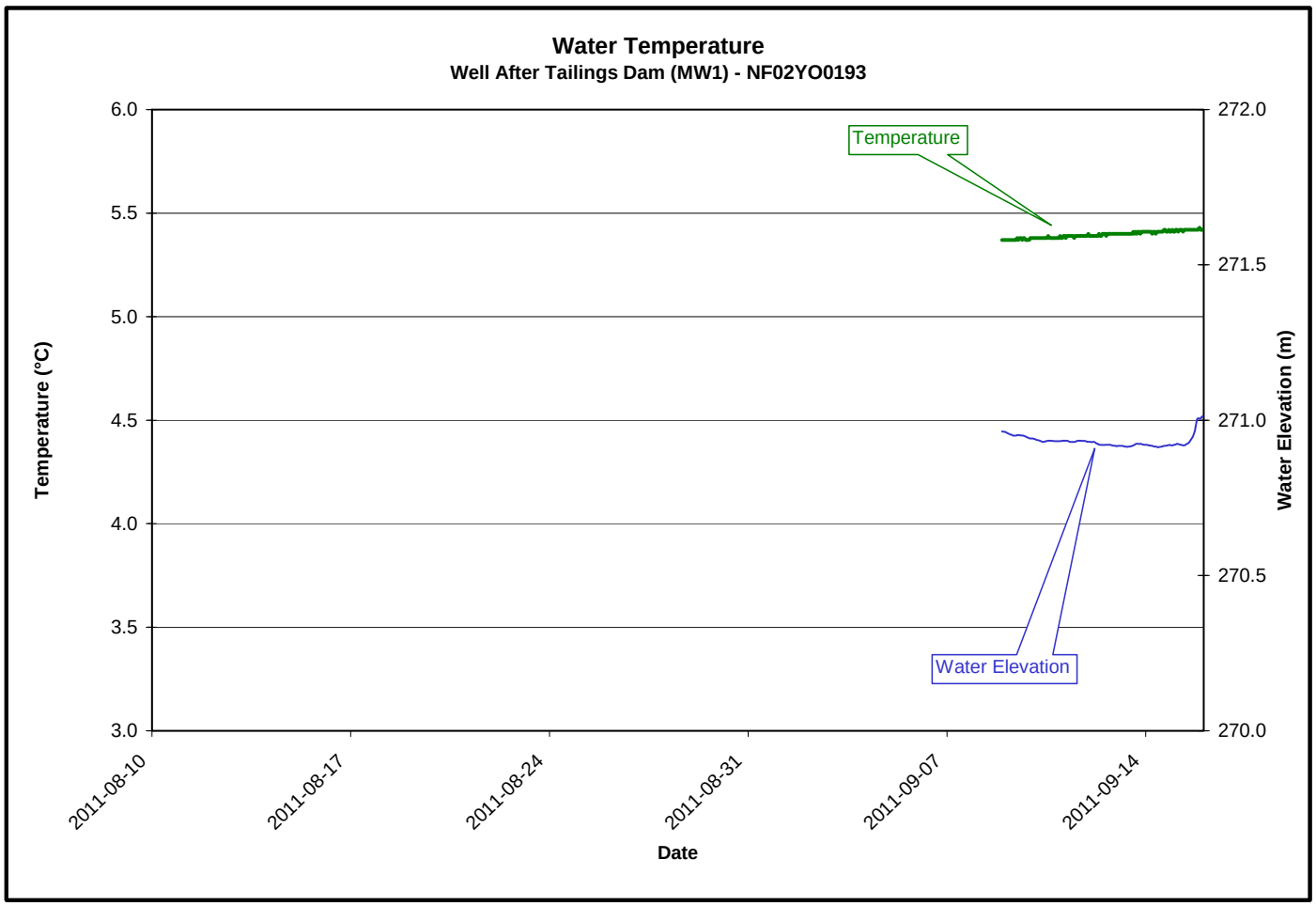

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 7.86 to a maximum of 8.30.
- Following the initial readings on September 9, 2011, there was an increase in pH to the end of the deployment period. This swing in pH is typical following each instrument deployment and continues to be the subject of investigation.
- There does not appear to be any correlation with water elevation.

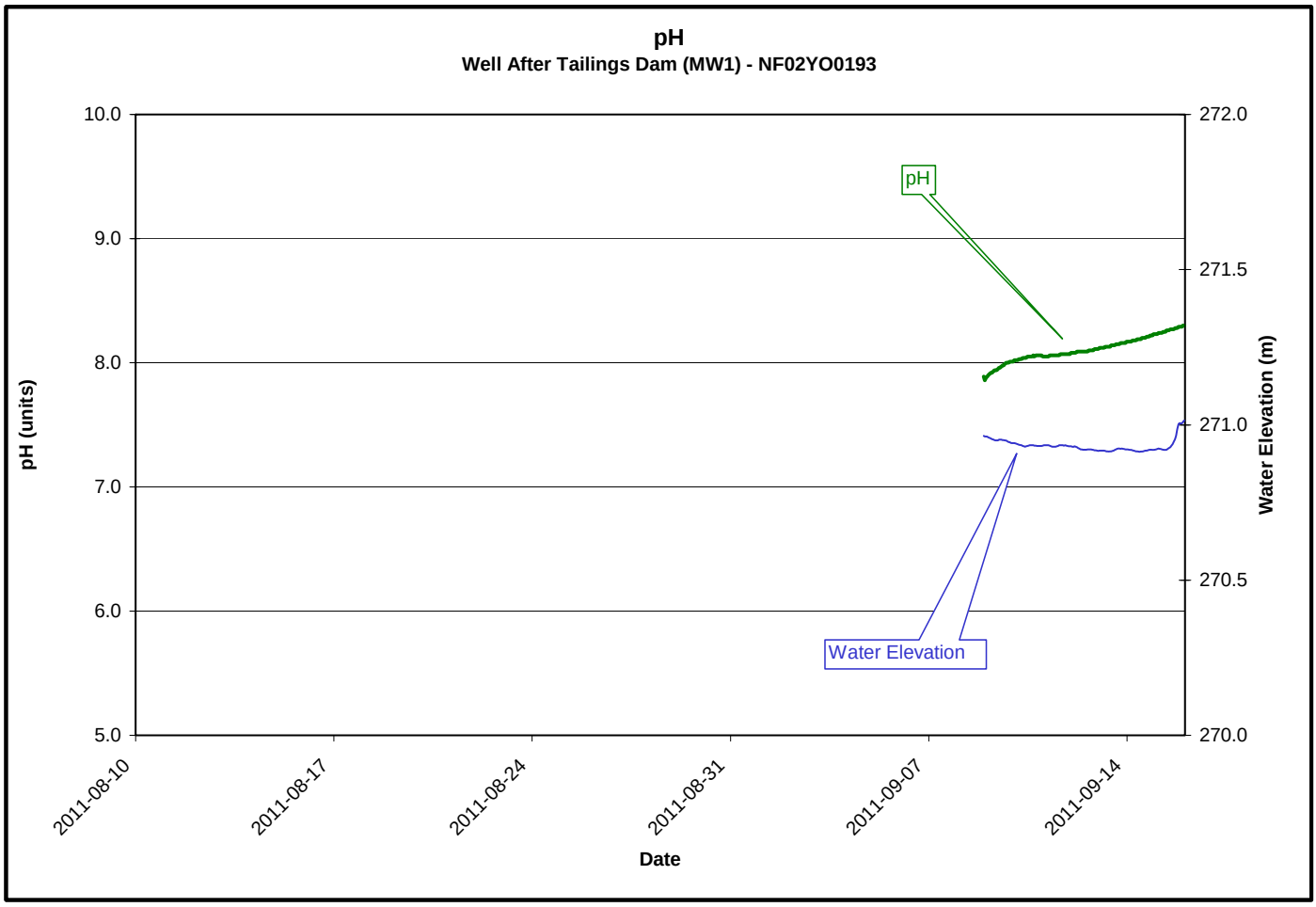

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.617 mS/cm to a maximum of 0.621 mS/cm over the deployment period.
- There was very little variation in the Specific Conductivity during the reporting period.

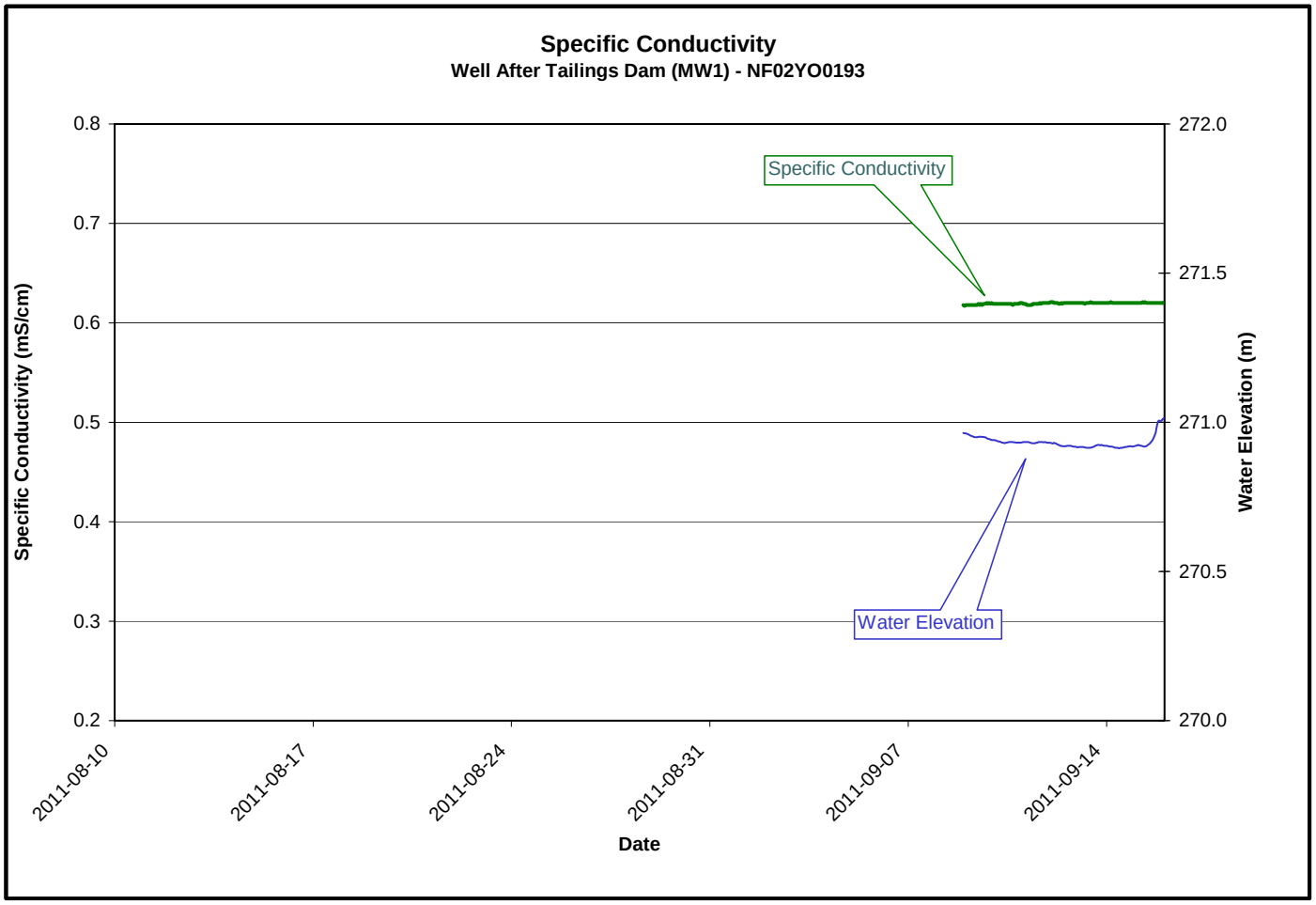

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.91 m to 271.01 m, with a slight increase during the last day of the deployment period.
- The well was purged during the initial installation on September 7, 2011.
- Water elevation recovered to original static water level within 60 minutes.
- There was minimal change in Temperature, pH, or Specific Conductance, during the well purge and subsequent recovery.
- Water elevation in this well corresponds to increased water level in an adjacent stream, and is influenced by runoff from precipitation.

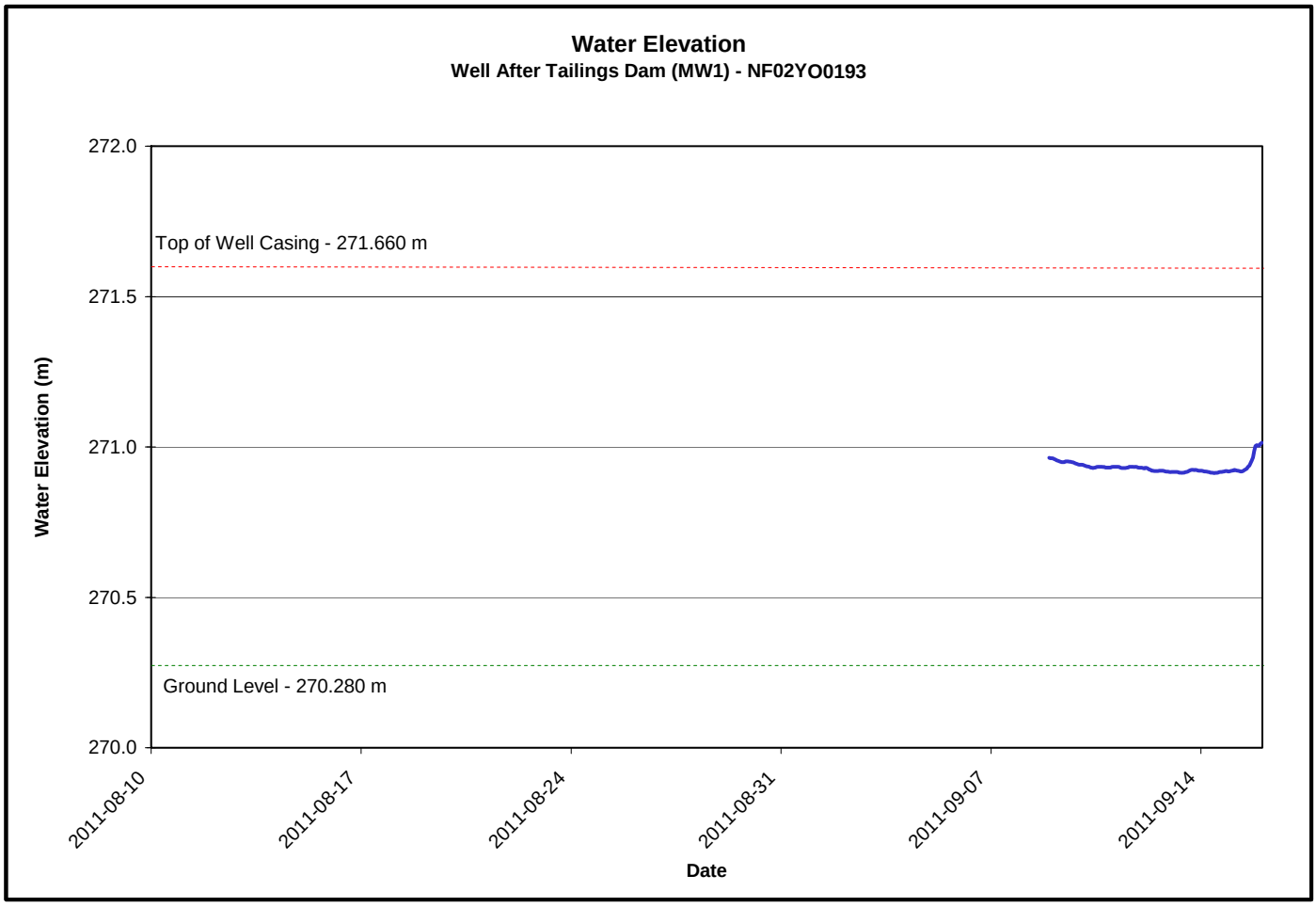

Figure 16

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