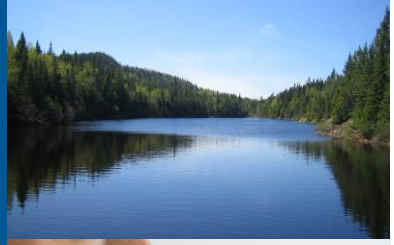
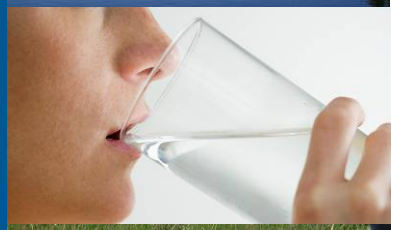



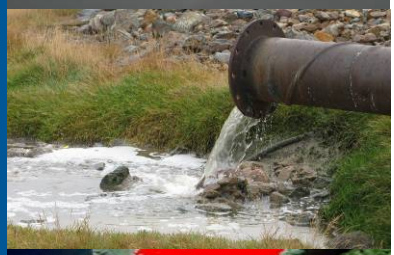


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2010-07-07 to 2010-08-31

2010-09-24

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.
- The graphs below may sometimes show vertical lines from the data string to zero or the bottom of the graph. These lines should be ignored, as they are an artefact of individual missing data points. We are working to resolve this issue.
- There was effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) throughout the deployment period, except for three brief periods in August.

Maintenance and Calibration of Instrumentation

- After being cleaned and freshly calibrated the **DataSondes®** for Tributary to Gills Pond Brook and East Pond Brook were installed on July 7, 2010, and remained deployed continuously until August 31, 2010, a 55 day period.
- After being removed from service for the winter and sent to the vendor for its bi-annual service, the **Quanta G®** was replaced in Monitoring Well After Tailings Dam Station (MW1) on April 28, 2010 and will remain in service until the fall of 2010, provided there are no operational issues.

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

- Upon deployment, a QA/QC **MiniSonde®** is temporarily deployed along side the Field **DataSonde®**. Values for temperature and dissolved oxygen are compared between the two instruments. A grab sample is taken to compare with the Field **DataSonde®** for specific conductivity, pH and turbidity parameters. Based on the difference between parameters recorded by the Field **DataSonde®**, QAQC **MiniSonde®** and grab sample a qualitative statement is made on the data quality upon deployment.

- At the end of a deployment period, readings are taken in the water body from the Field **DataSonde®** before and after a thorough cleaning in order to assess the degree of biofouling. During calibration in the laboratory, an assessment of calibration drift is made and the two error values are combined to give Total Error (T_e). If T_e exceeds a predetermined data correction criterion, a correction based on T_e is applied to the dataset using linear interpolation. Based on the value for T_e, a qualitative statement is also made on the data quality upon removal.
- 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.
- The 'Poor' ranking for Specific Conductivity at Tributary to Gills Pond Brook at the end of the Deployment period is attributed to instrument drift. See Page 7.
- Because the deployment set-up for Well After Tailings Dam (MW1) is different, comparison with another instrument is not possible, thus Total Error cannot be calculated. In this case, since no grab sample was collected, there data cannot be ranked against laboratory data.
- 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 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. Where appropriate, corrected data for water quality parameters are indicated.

Tributary to Gills Pond Brook Station (NF02YO0190)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2009-07-07 Deployment	Temp (°C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2010-08-31 Removal	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Poor
	Dissolved Oxygen (%)	Excellent
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2009-07-07 Deployment	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2010-08-31 Removal	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Excellent
	Turbidity (NTU)	Excellent

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 13.74 ˚C to a maximum of 25.31 ˚C.
- There appears to be little correlation with stage for the most part, although when stage increased on July 11, 2010 and July 23, 2010, there is a noticeable decrease in water temperature. Presumably, this is due to the onset of precipitation events.
- As fouling and instrument drift were negligible, no data corrections were required for temperature.

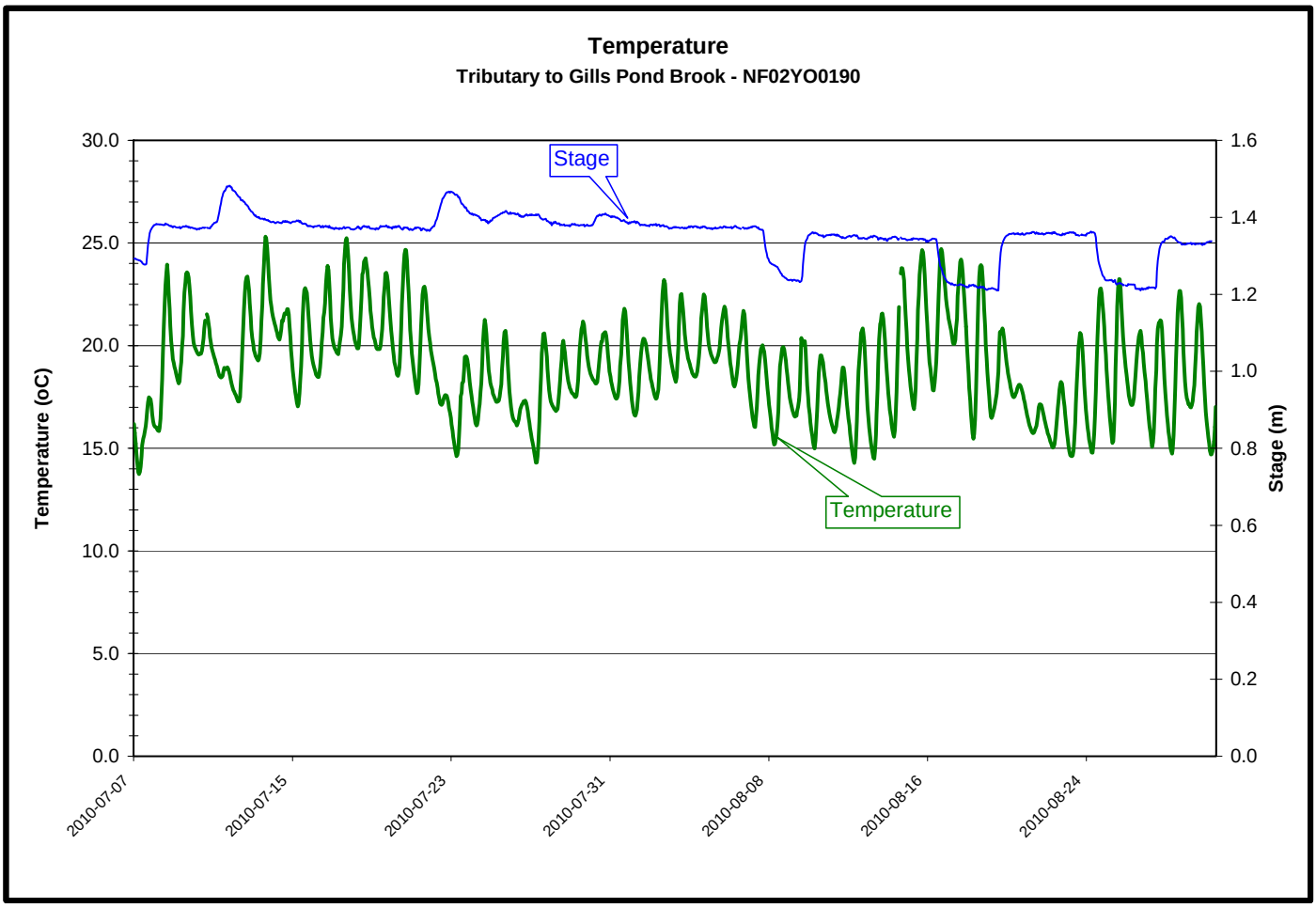

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 6.20 to a maximum of 7.34 with some of the values falling below 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. pH varies with periods of discharge from Polishing Pond, as discharge water has a slightly higher pH than the background water quality.
- An inverse correlation with discharge is obvious particularly during increases in stage on July 11, 2010 and July 23, 2010, when there is a noticeable decrease in pH. Presumably, this is due to the onset of precipitation events.
- As fouling and instrument drift were negligible, no data corrections were required for pH.

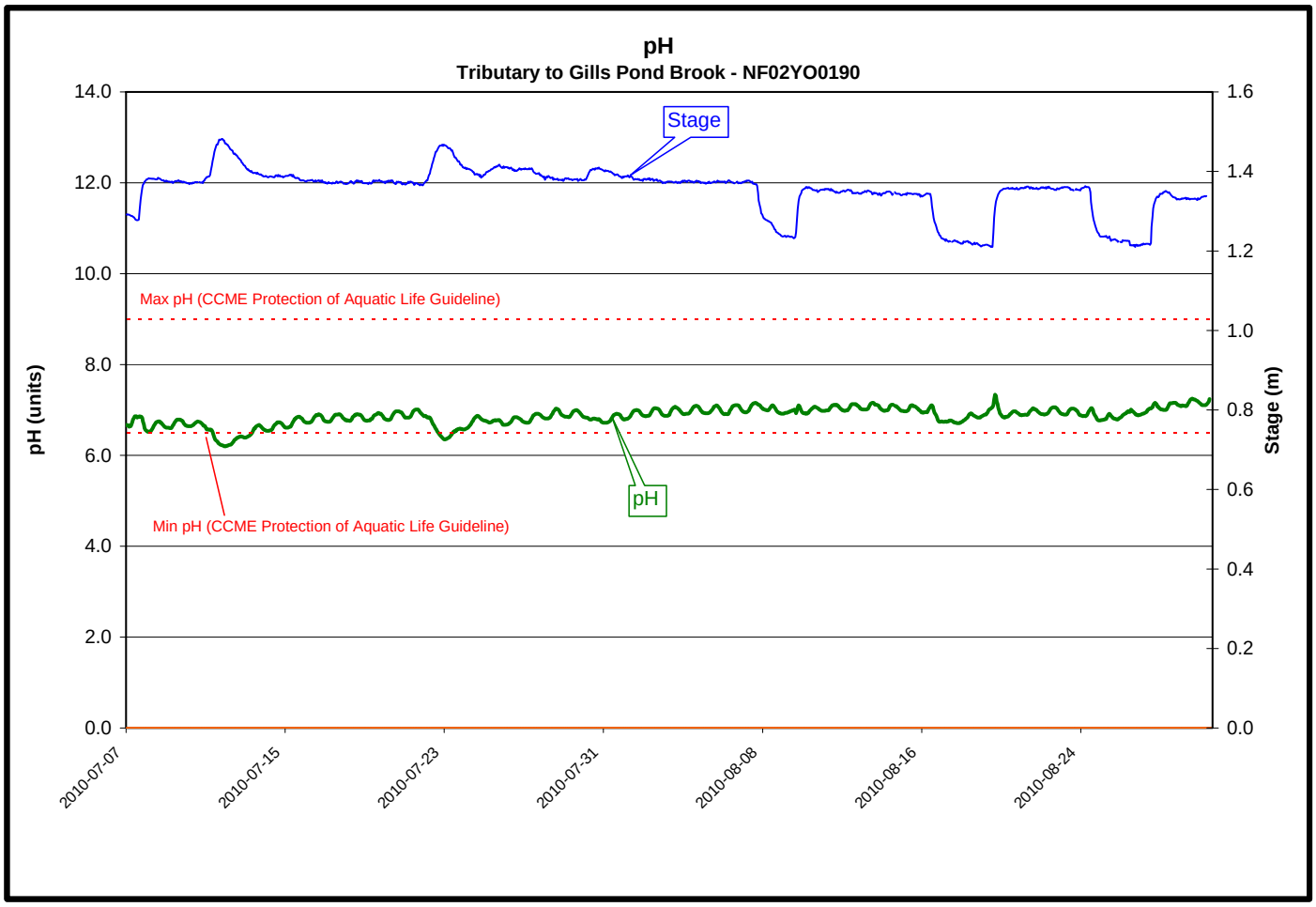

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 39.4 µS/cm to a maximum of 1065.3 µS/cm over the deployment period.
- Specific Conductance increased markedly on July 8, 2010 once discharge from Polishing Pond began, and remained above 300 µS/cm throughout the deployment period. The several 'V' shaped dips are the result of dilution caused by precipitation events, indicated by peaks in the stage, and by brief interruptions in discharge indicated by dips in the stage (three events in August).
- The QA/QC protocol revealed a net increase of 56.5 µS/cm (4.0 %) over the 55 day deployment period. All of this increase was due to instrument drift. Accordingly the correction factor has been applied to the raw data.

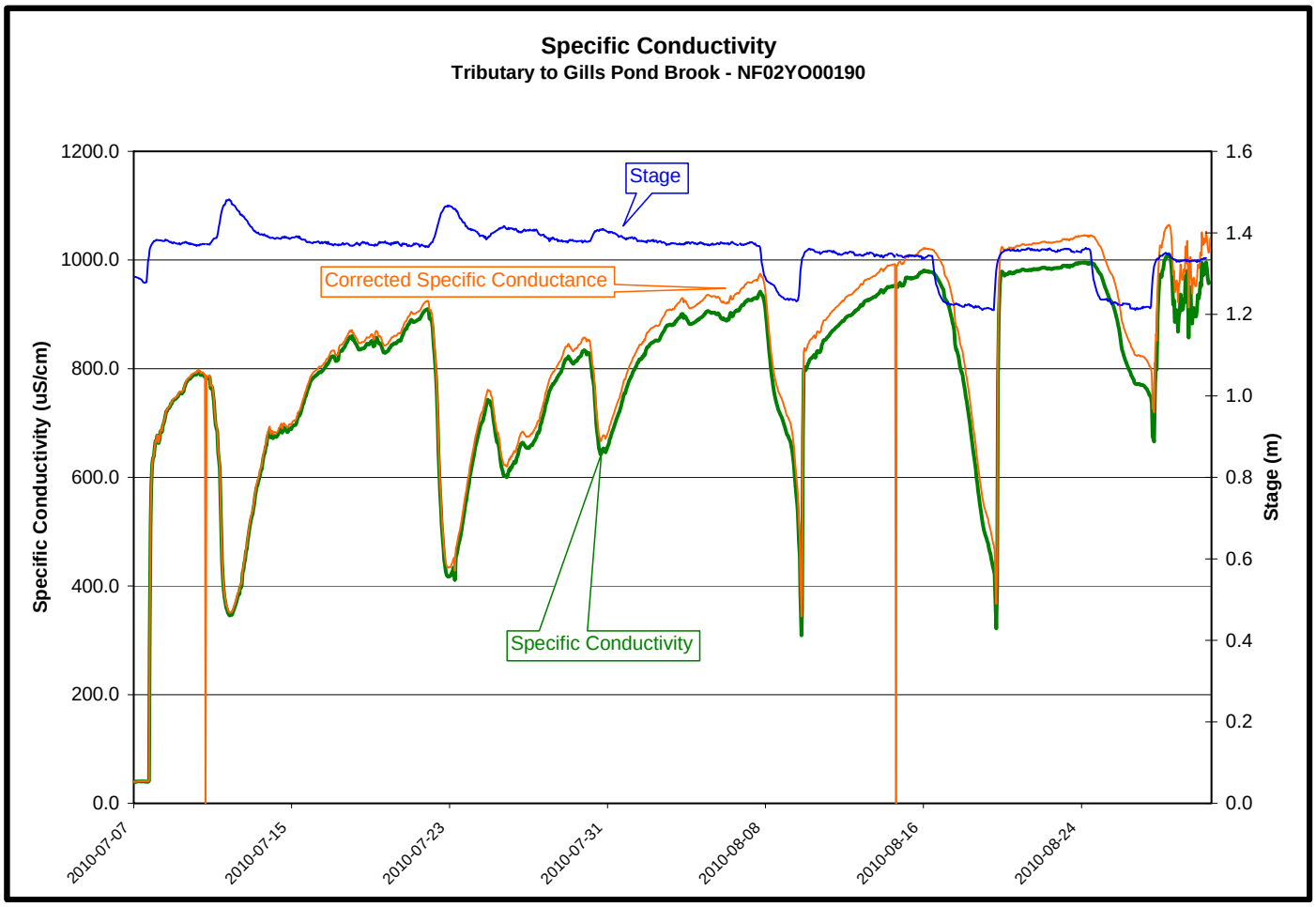

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 7.21 mg/L to a maximum of 9.68 mg/L over the deployment period.
- Dissolved oxygen is inversely proportional to water temperature.
- For nearly 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). Lower dissolved oxygen values are considered to be solely a function of the naturally increasing temperatures during this period.
- The QA/QC protocol revealed a net increase of 1.9 % in the Dissolved Oxygen (% Sat) over the 55 day deployment period. The majority of this increase was due to instrument drift. Accordingly the correction factor has been applied to the raw data.
- Based upon the fact that Dissolved Oxygen % Saturation had minimal drift, we can be confident that the Dissolved Oxygen mg/L values are accurate.

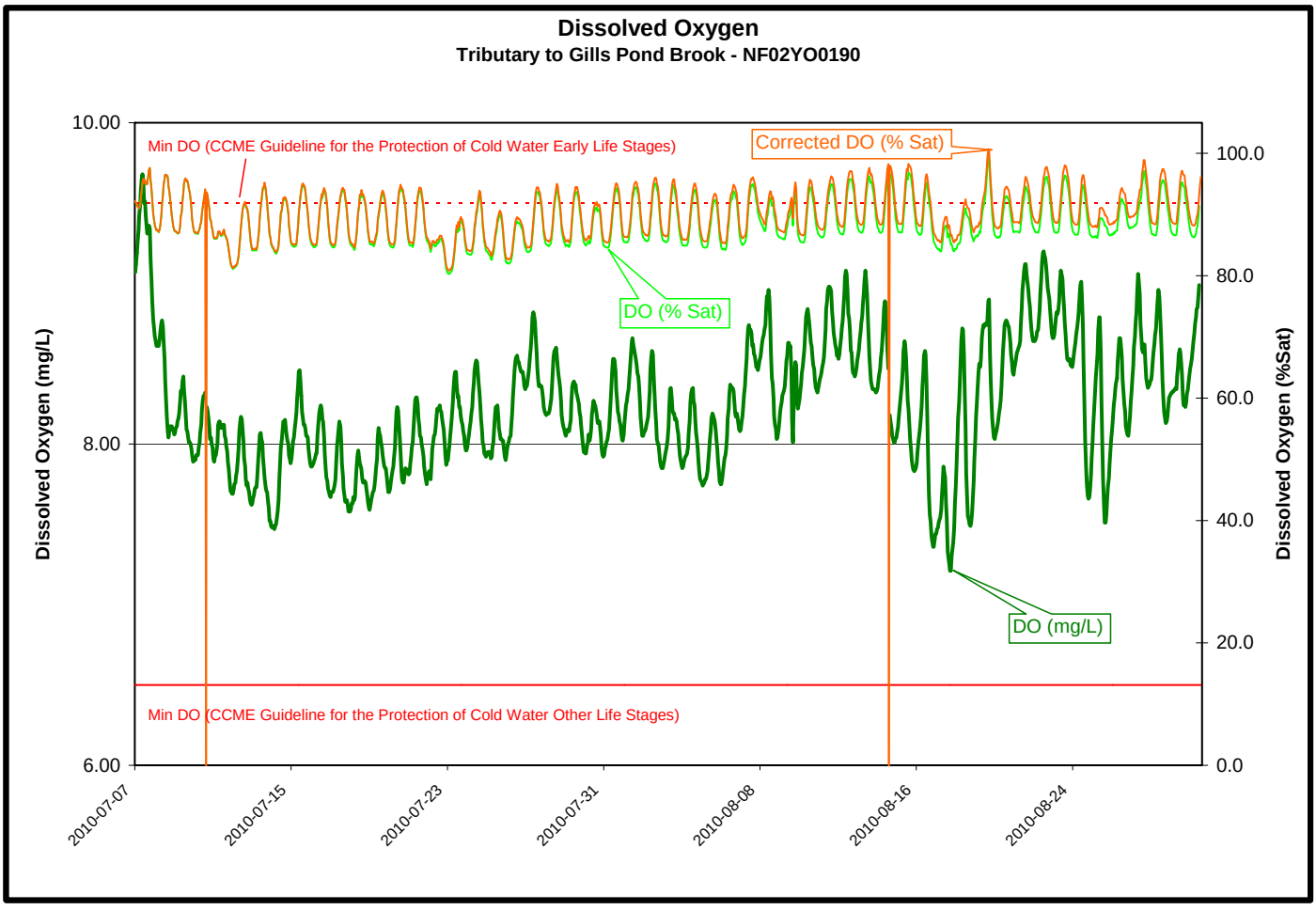

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 392.6 NTU.
- Highest turbidity values correspond to precipitation events and high stage.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during high flows.
- Neither *in situ* nor grab sample measurements nor visual observations indicated turbidity issues.
- The QA/QC protocol revealed a net decrease of 2.7 NTU over the 55 day deployment period. Accordingly the correction factor has been applied to the raw data.
- Because the spread (correction factor) is so small, the corrected data obscure the raw data.

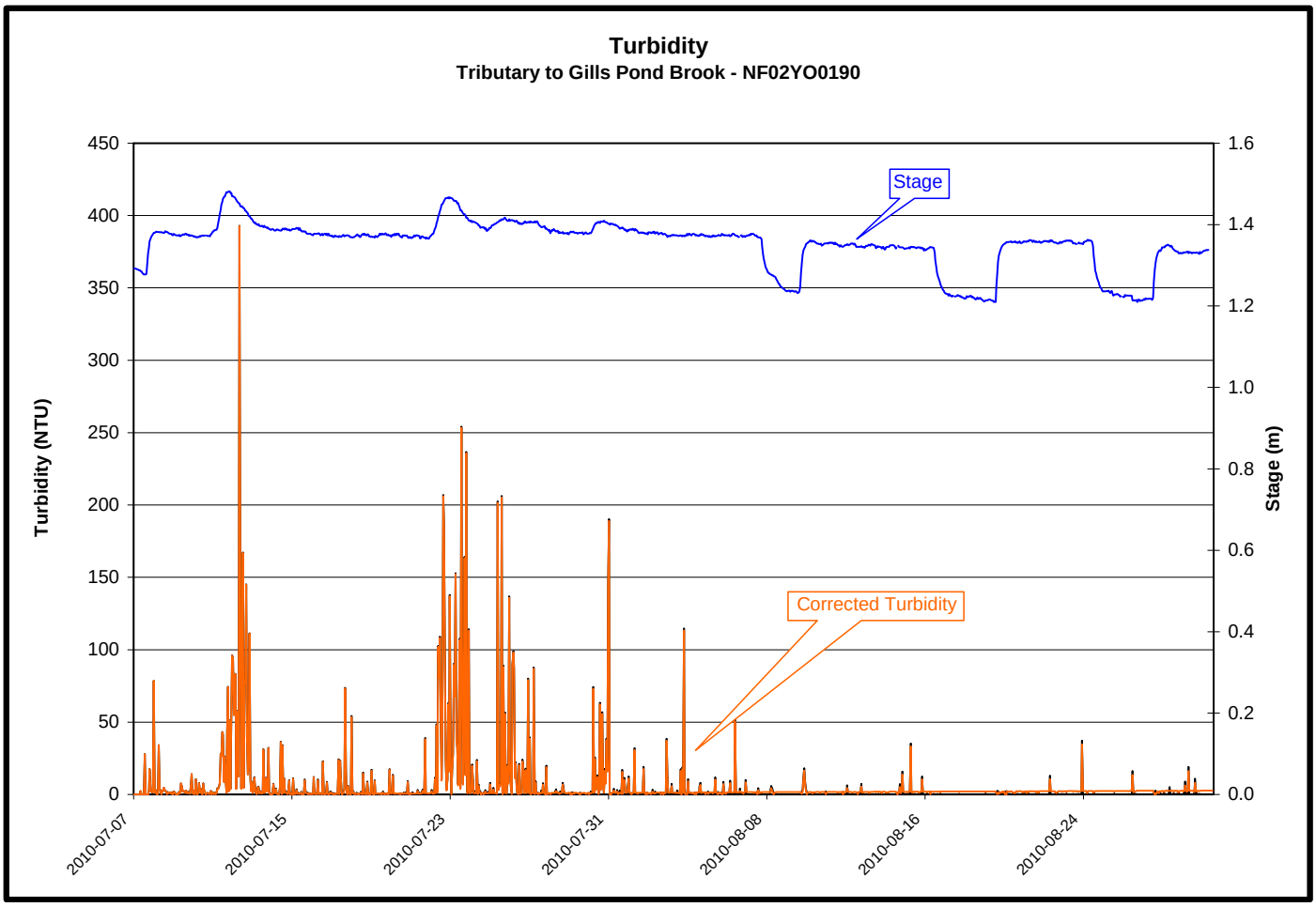

Figure 5

- The stage (**Figure 6)** or water level ranged from a minimum of 1.21 m to a maximum of 1.48 m with the peaks in July corresponding to precipitation events, and the dips in August corresponding to short terms cessation of discharge from Polishing Pond.
- All values are within the normal range.

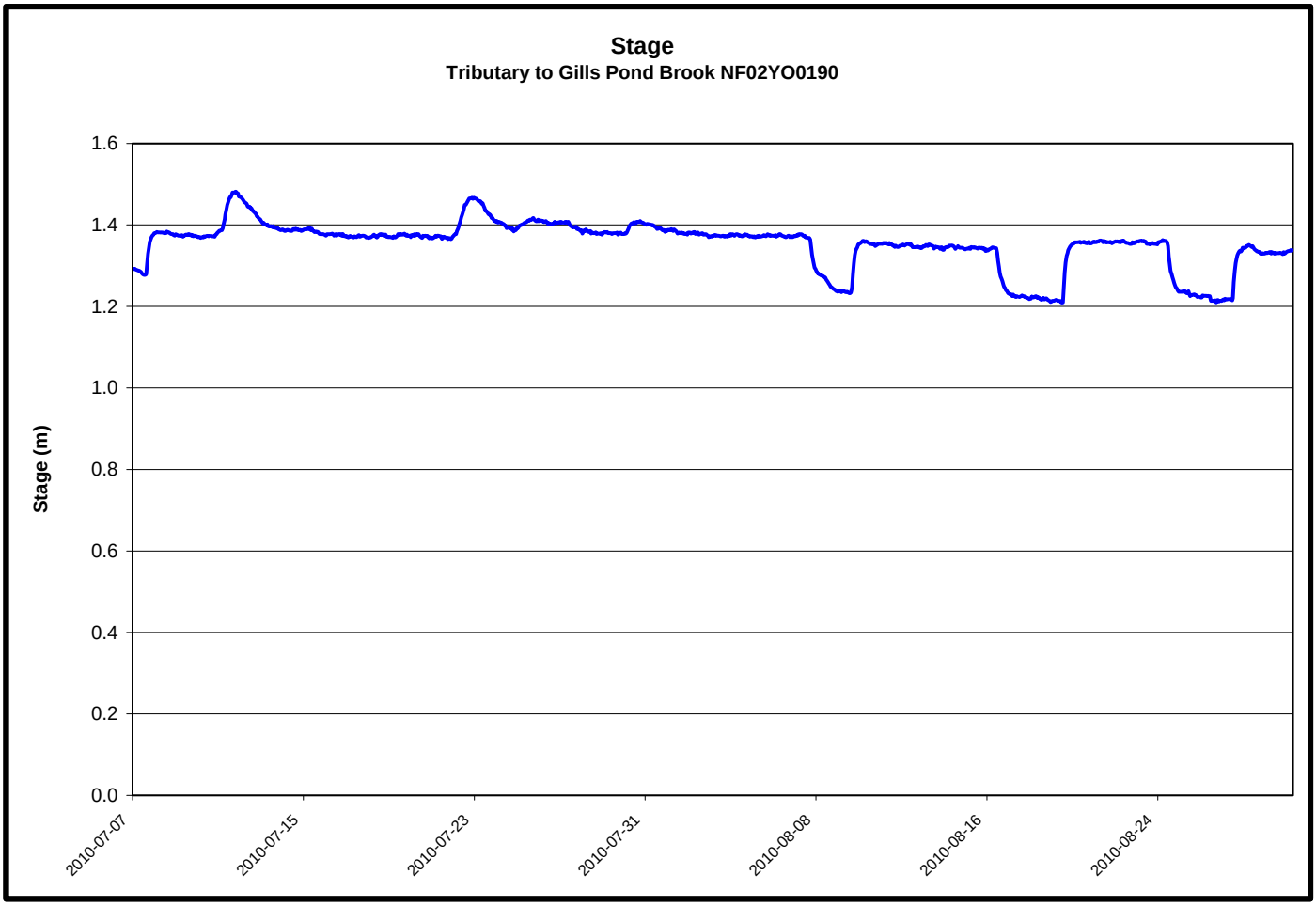

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 11.88 ˚C to a maximum of 26.34 ˚C.
- There appears to be little correlation with stage for the most part, although when stage increased on July 11, 2010 and July 23, 2010, there is a noticeable decrease in water temperature. Presumably, this is due to the onset of precipitation events, and subsequent runoff.
- As fouling and instrument drift were negligible, no data corrections were required for temperature.

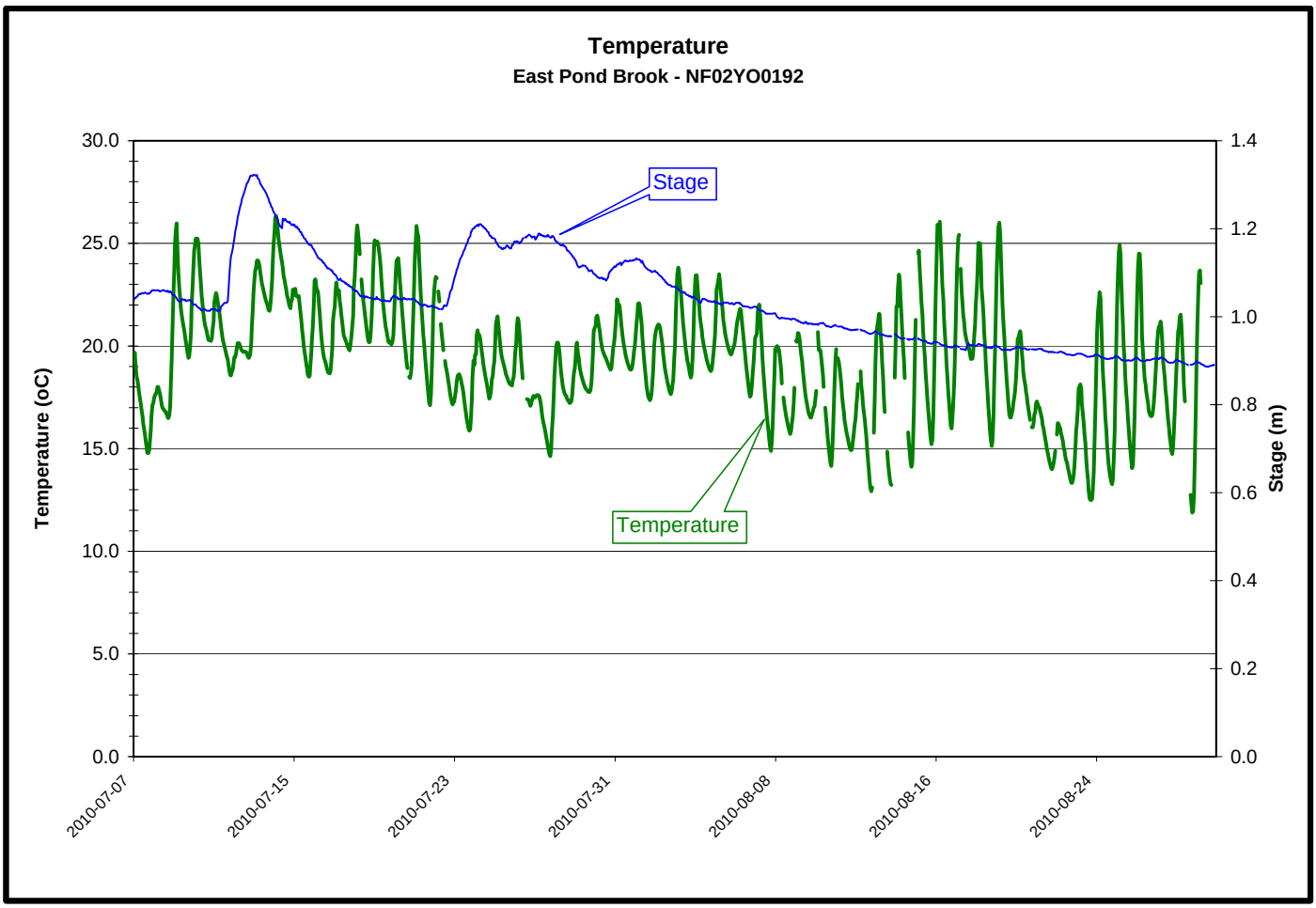

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.27 to a maximum of 7.07 with some of the values falling below 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 quite low, and values near and below the limit are not unusual.
- As fouling and instrument drift were negligible, no data corrections were required for pH.

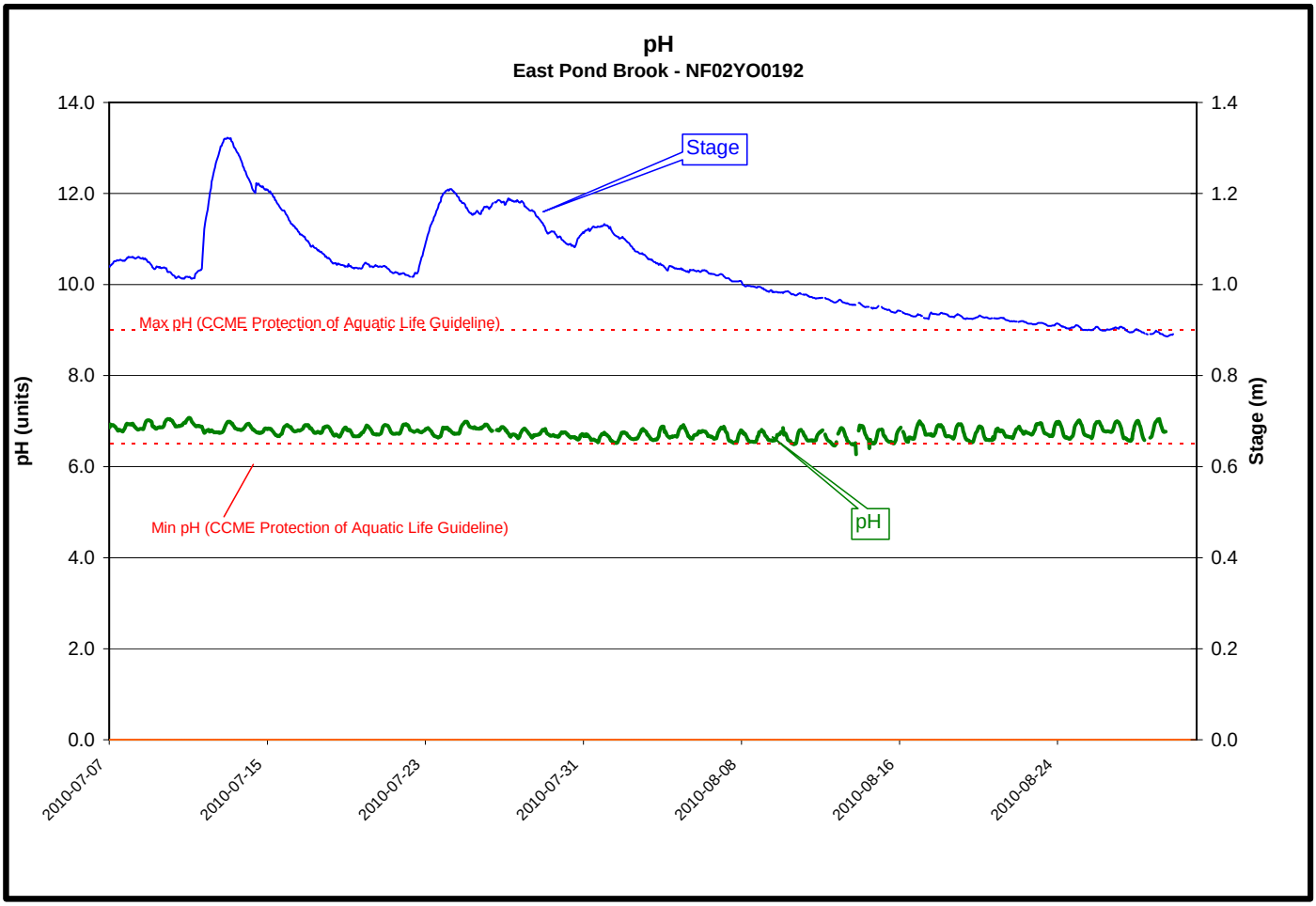

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 23.2 µS/cm to a maximum of 38.7 µS/cm.
- Highest specific conductivity values are reported when stage is low and flow in this stream is minimal. There are some peaks in specific conductivity which correspond to periods of precipitation and high stage.
- The QA/QC protocol revealed a net decrease of 2.0 µS/cm over the 55 day deployment period. The majority (1.5 µS/cm) of this decrease was due to instrument fouling. Accordingly the correction factor has been applied to the raw data.

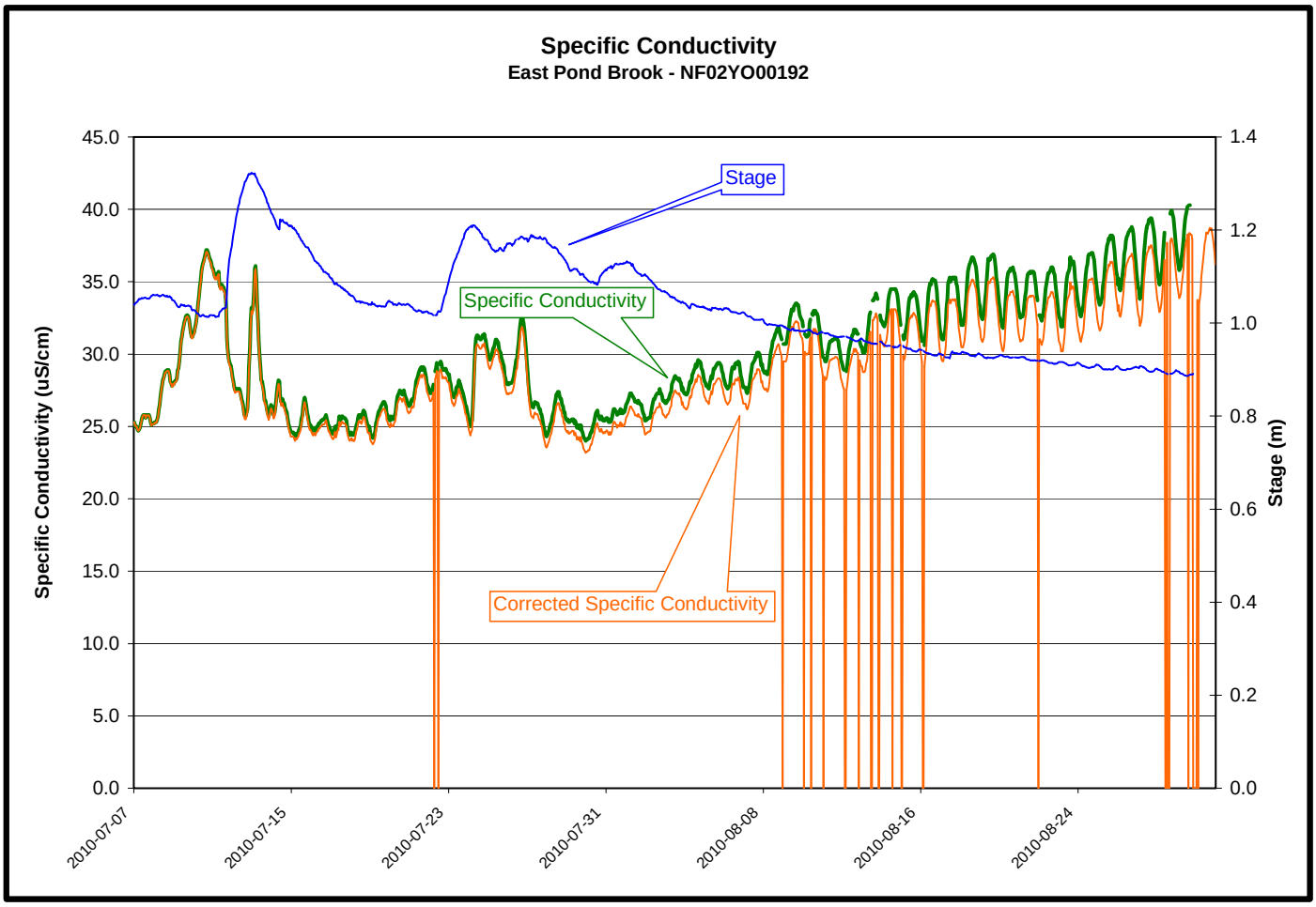

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 7.72 mg/L to a maximum of 10.09 mg/L over the deployment period.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout most of the deployment period, dissolved oxygen values often 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). Lower dissolved oxygen values are considered to be solely a function of the naturally increasing temperatures during this period.
- The QA/QC protocol revealed an increase of 1.5 % in the Dissolved Oxygen (% Sat) over the 55 day deployment period. The majority (1.4%) of this increase was due to instrument drift. Accordingly the correction factor has been applied to the raw data.
- Based upon the fact that Dissolved Oxygen % Saturation had minimal drift, we can be confident that the Dissolved Oxygen mg/L values are accurate.

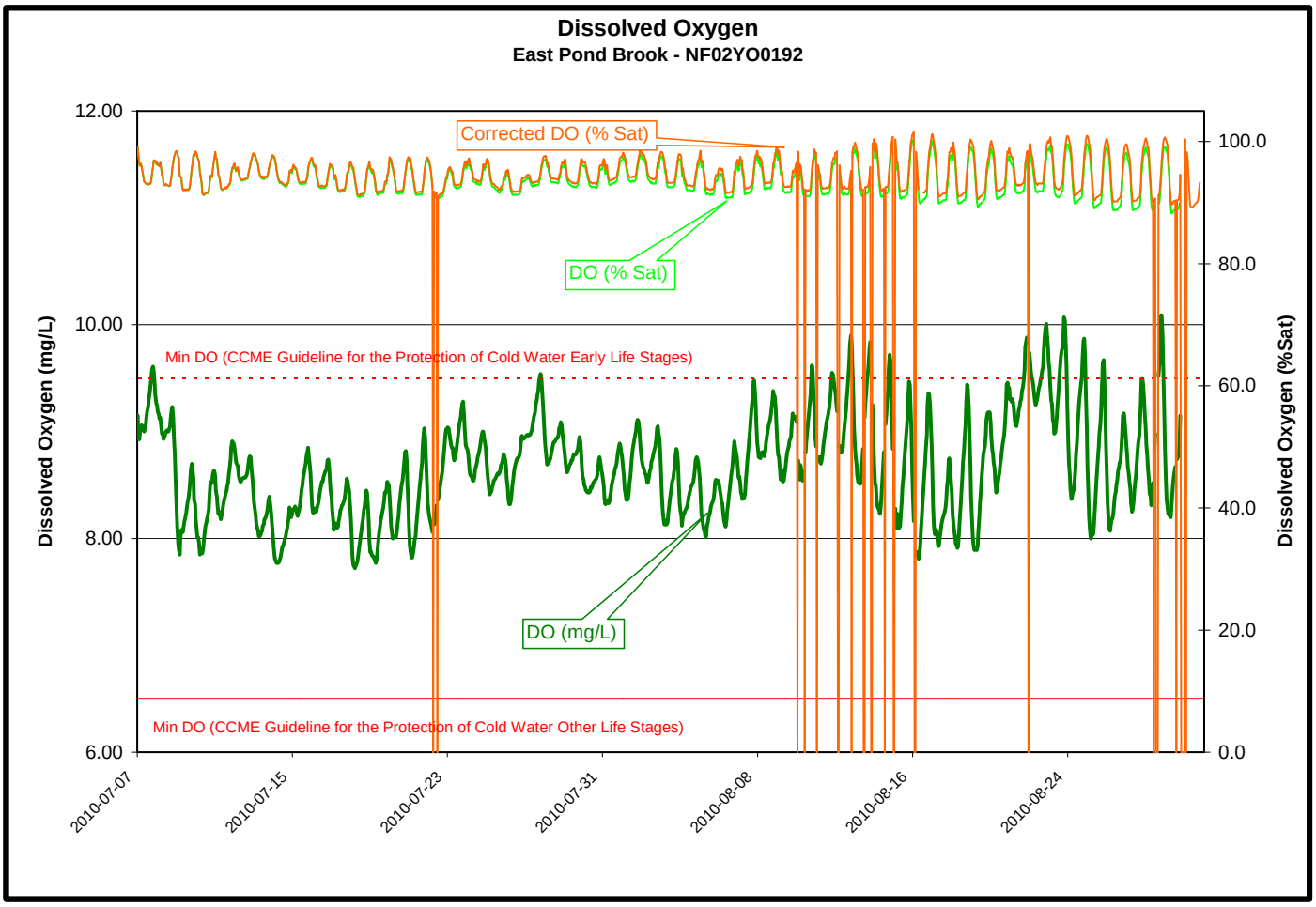

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 16.1 NTU.
- Typically, turbidity values in this stream are near zero; the higher peaks being insignificant events when natural stream debris passed near the sensor. These peaks are observed during a period of increased discharge, presumably resultant from precipitation events and subsequent runoff.
- Neither *in situ* nor grab sample measurements nor visual observations indicated turbidity issues.
- The QA/QC protocol revealed an increase of 0.25 NTU over the 55 day deployment period. All of this change was due to instrument drift. Accordingly the correction factor has been applied to the raw data.
- Because the spread (correction factor) is so small, the corrected data obscure the raw data.

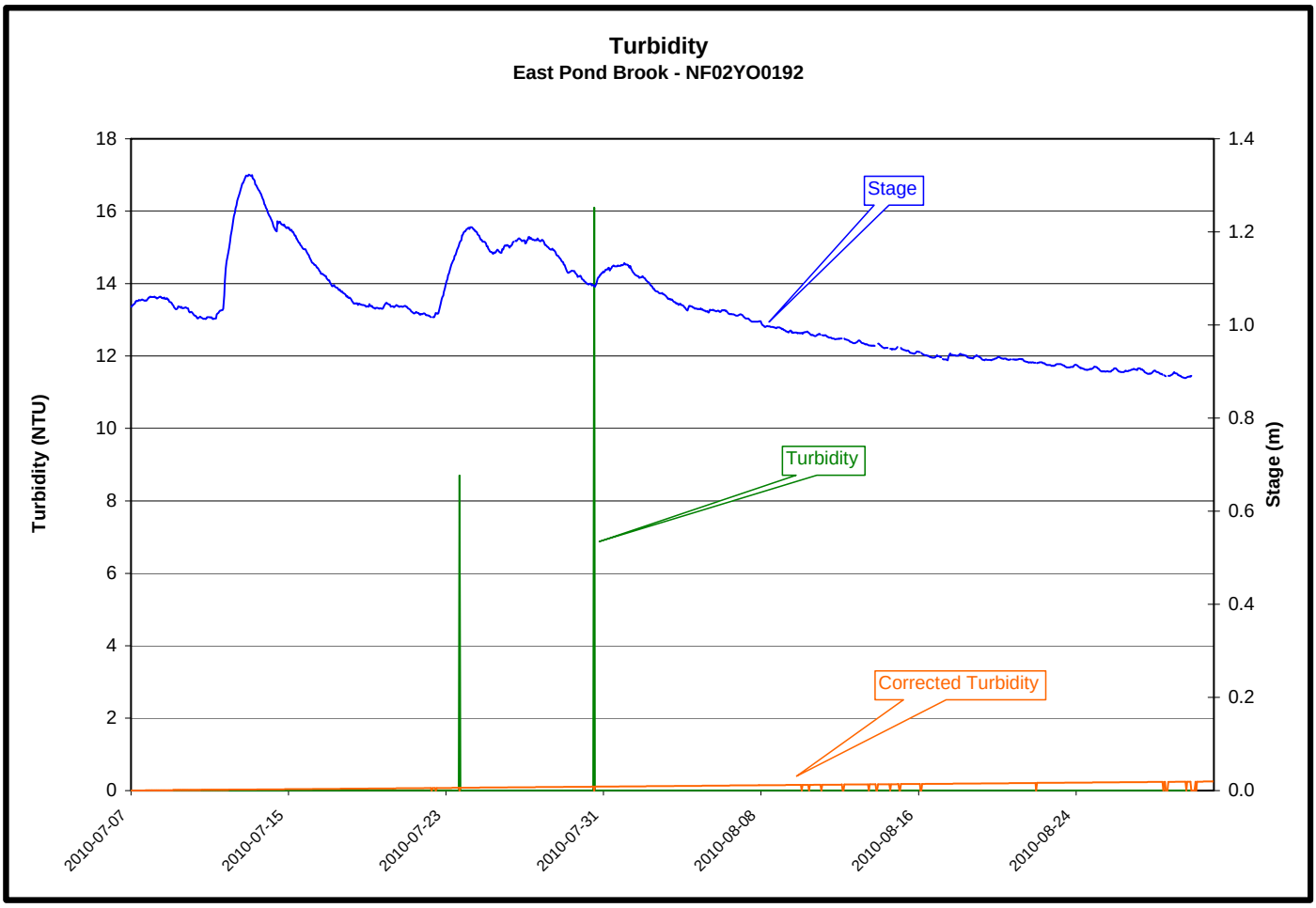

Figure 11

- The stage **(Figure 12)** or water level ranged from a minimum of 0.89 m to a maximum of 1.32 m.
- Peaks correspond to precipitation and runoff events, with basal flow only during the latter half of the deployment period.

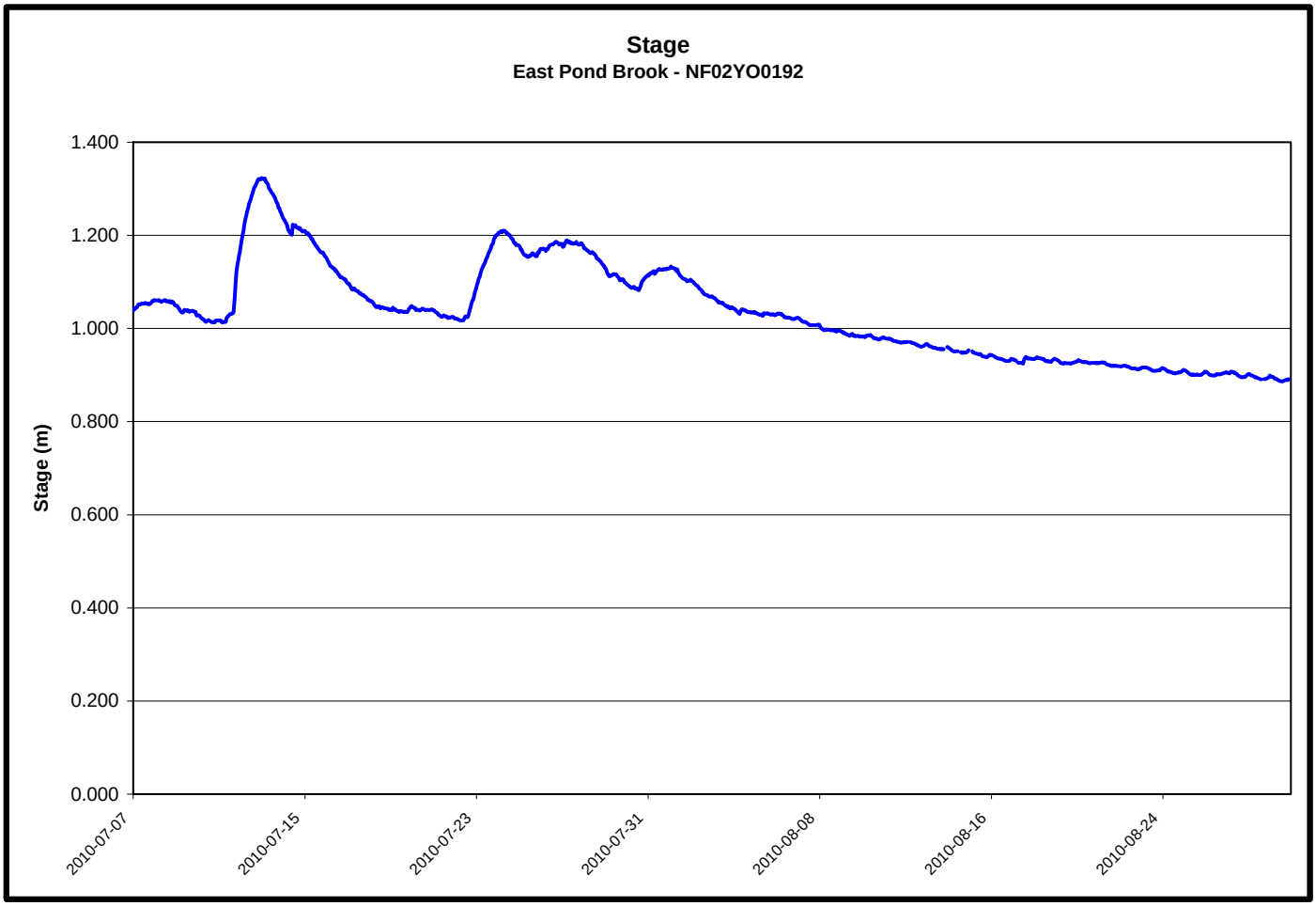

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 4.80 ˚C to a maximum of 5.03 ˚C; generally increasing over the deployment period.
- There appears to be little correlation with water elevation.

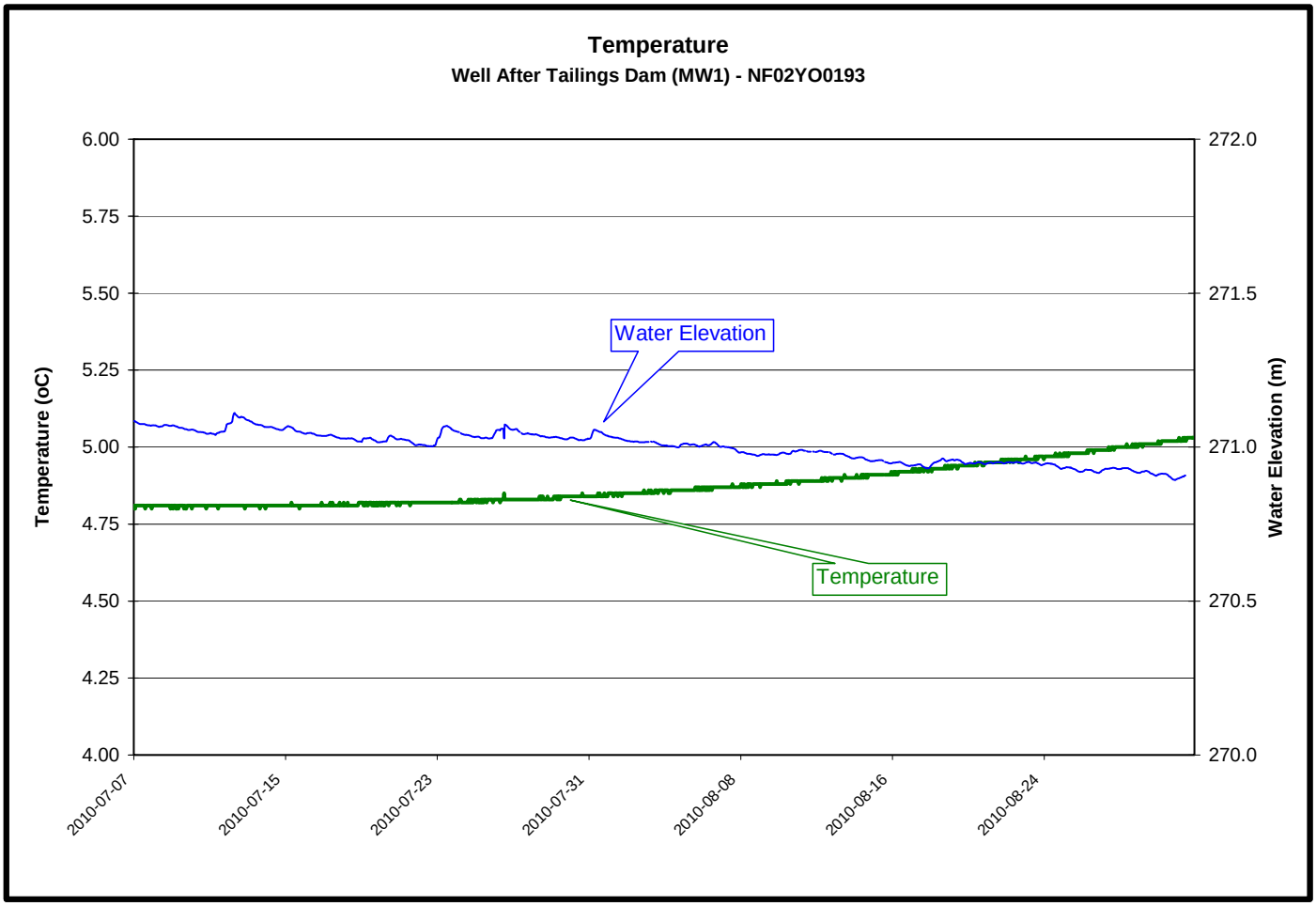

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.86 to a maximum of 8.92 over the deployment period
- There was very little variability.

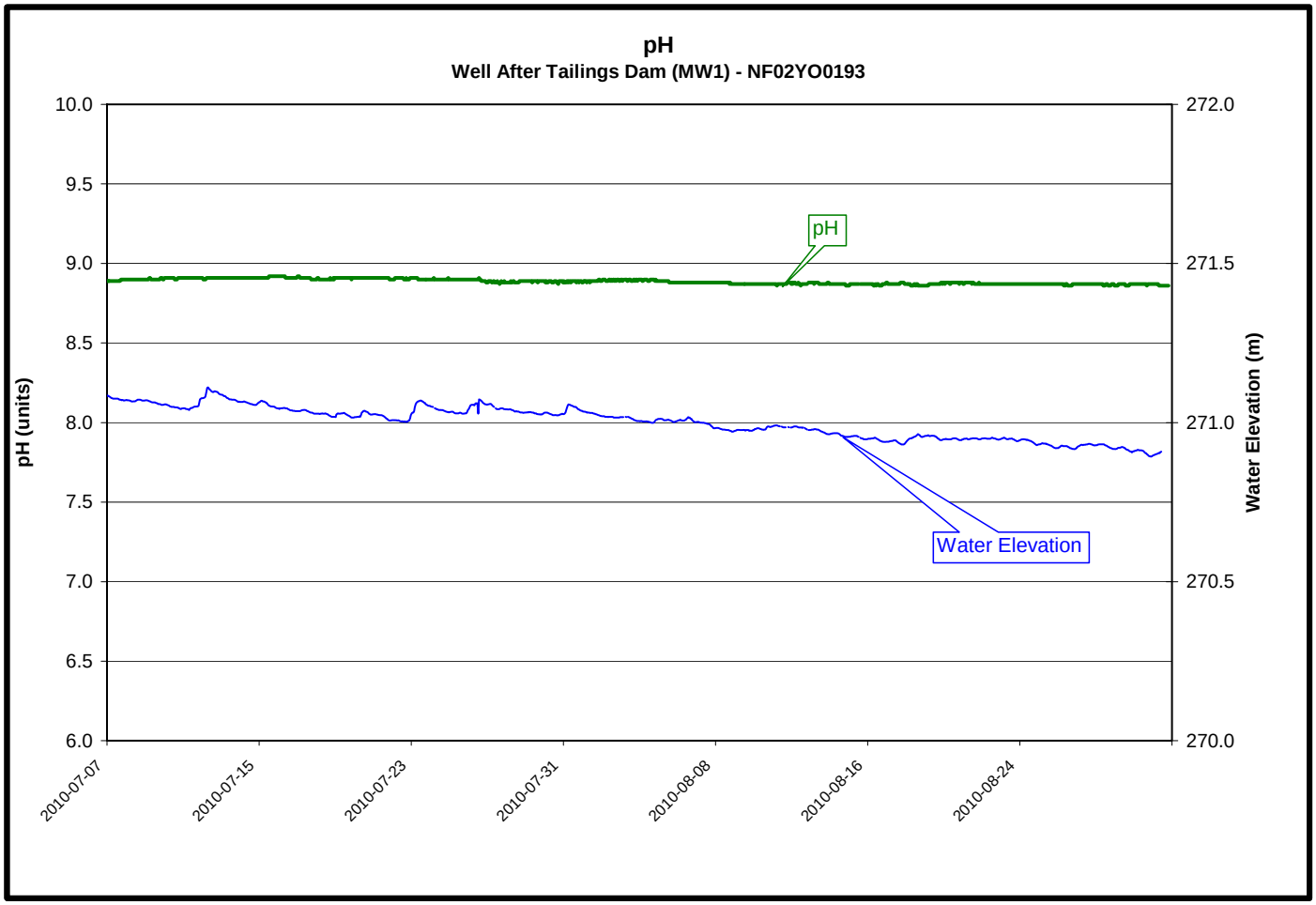

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.521 mS/cm to a maximum of 0.545 mS/cm.
- There was a slight increase throughout the deployment period.

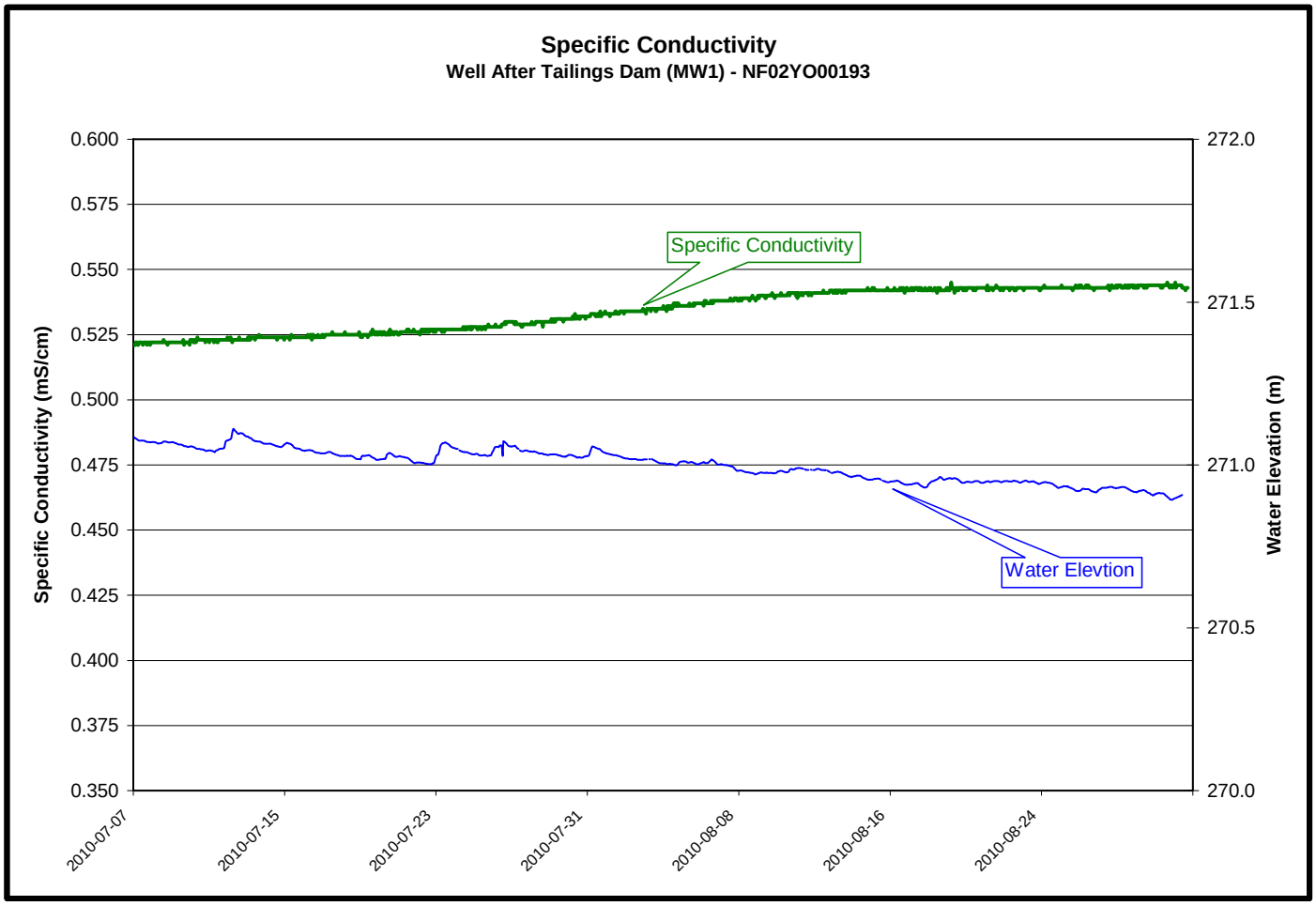

Figure 15

- The Water Elevation ranged from a minimum of 270.89 m to 271.11 m, through the deployment period with a slight decrease over the 55 days.

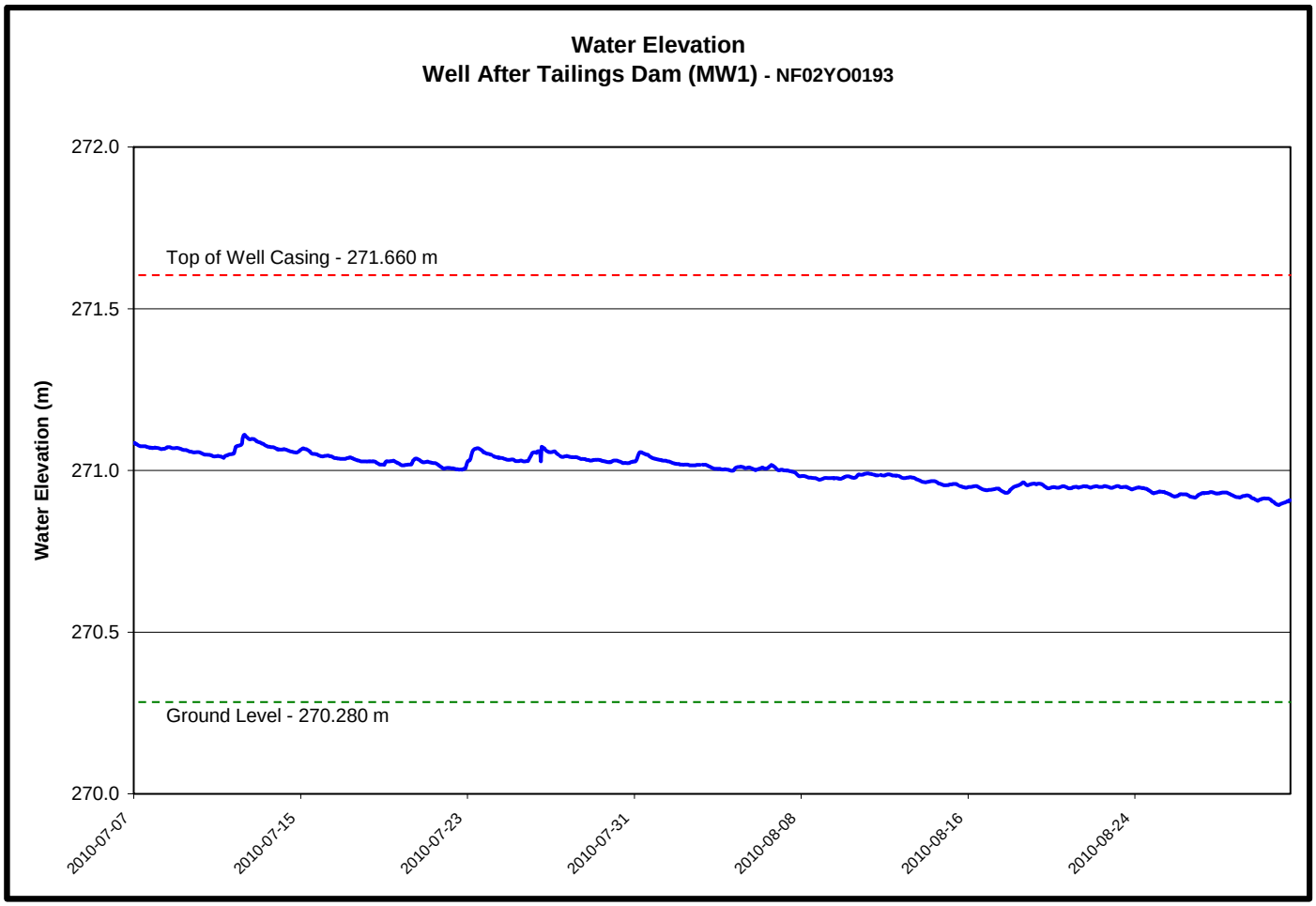

Figure 16

Prepared by:

Robert Wight
Environmental Scientist
Water Resources Management Division
Department of Environment and Conservation
Tel: 709-292-4280
Fax: 709-292-4365
e-mail: robertwight@gov.nl.ca