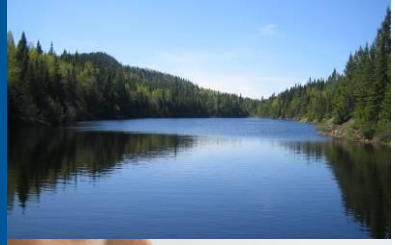




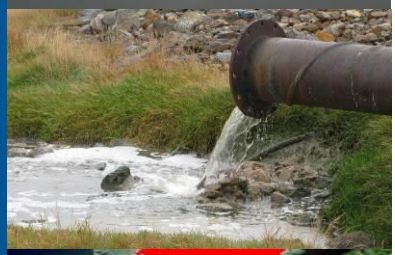


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2014-06-25 to 2014-07-23

2014-08-25

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 planned discharge of effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) from the beginning of the deployment until July 1, 2014, and no discharge from then until the end of the deployment period.

Maintenance and Calibration of Instrumentation

- **DataSonde®**(s/n 43245) was deployed in Tributary to Gills Pond Brook on June 25, 2014 after being cleaned and freshly calibrated. The unit ceased to work on July 1, 2014, and was removed from service on July, 9, 2014. A spare unit having the same technical specifications (s/n 60394) was deployed after being cleaned and freshly calibrated for the remainder of the 28 day deployment period. The period from July 1, 2014 to July 9, 2014 has no data available for this site. As the **DataSonde®** failed completely, no data for this period was logged internally.
- **DataSonde®**(s/n 43794) was deployed in East Pond Brook on June 25, 2014 after being cleaned and freshly calibrated, and remained deployed continuously until July 23, 2014; a 28 day period.
- **MiniSonde®** (s/n 47591) was used for QA/QC purposes during the installation and removal of the instruments. This unit, having the same technical specifications as the **DataSondes®**, was cleaned and freshly calibrated prior to each use.
- **Quanta G®** (s/n 00353) was deployed on June 3, 2014 and remains deployed continuously in Monitoring Well After Tailings Dam Station (MW1). This report covers the period from June 25, 2014 through July 23, 2014, a 28 day 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 usually 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 QA/QC **MiniSonde®** a qualitative statement (Ranking) is usually made on the data.
- The ranking at the beginning and at the end of the deployment period is shown in **Table 2** for Tributary to Gill's Pond Brook and **Table 3** for East Pond Brook.
- A 'Marginal' ranking was determined for Dissolved Oxygen (mg/L) for Tributary to Gills Pond Brook upon removal on July 23, 2014. The Field **DataSonde®** read 7.28 mg/L while the QA/QC **MiniSonde®** read 8.17 mg/L. It should be noted that there was a considerable amount of fouling of the probe due to biofilm and algae accumulation, along with bottom sediments that became liberated in the water column once disturbed during the removal process.
- 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 Conductivity based upon live data and laboratory data.
- As the instrument deployed in well was not installed or removed during this deployment period, no ranking could be calculated.
- 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 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**
2014-06-25 Installation	Temp (^{o}C)	Good
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2014-07-23 Removal	Temp (^{o}C)	Good
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Marginal
	Turbidity (NTU)	Excellent

Table 2

Note: As discussed above, the instrument installed on June 25, 2014 failed and was replaced with a different instrument on July 9, 2014

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2014-06-25 Installation	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2014-07-23 Removal	Temp (^{o}C)	Good
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Good

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 13.28˚C to a maximum of 27.34˚C.
- The temperatures throughout the deployment period are higher than typical for this time of year.
- There does not appear to be any correlation with stage.

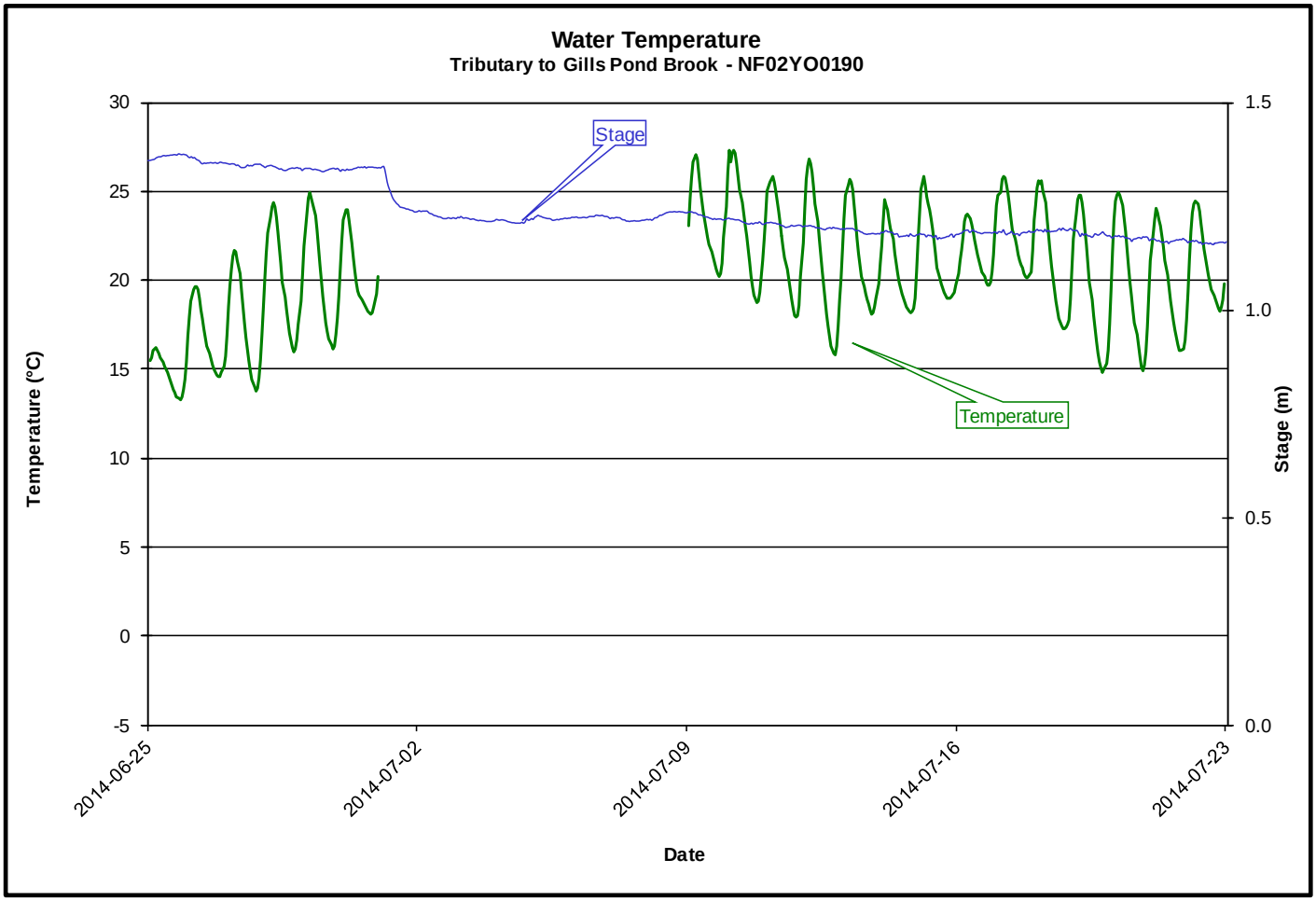

Figure 1

- Throughout the deployment period, pH values (**Figure 2**) ranged from a minimum of 6.00 to a maximum of 6.98 with most values lower than 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, and is usually higher during periods of discharge from the Polishing Pond. However, during this deployment, the pH was slightly lower than normal background levels during the first 6 days, when there was discharge from the Polishing Pond.

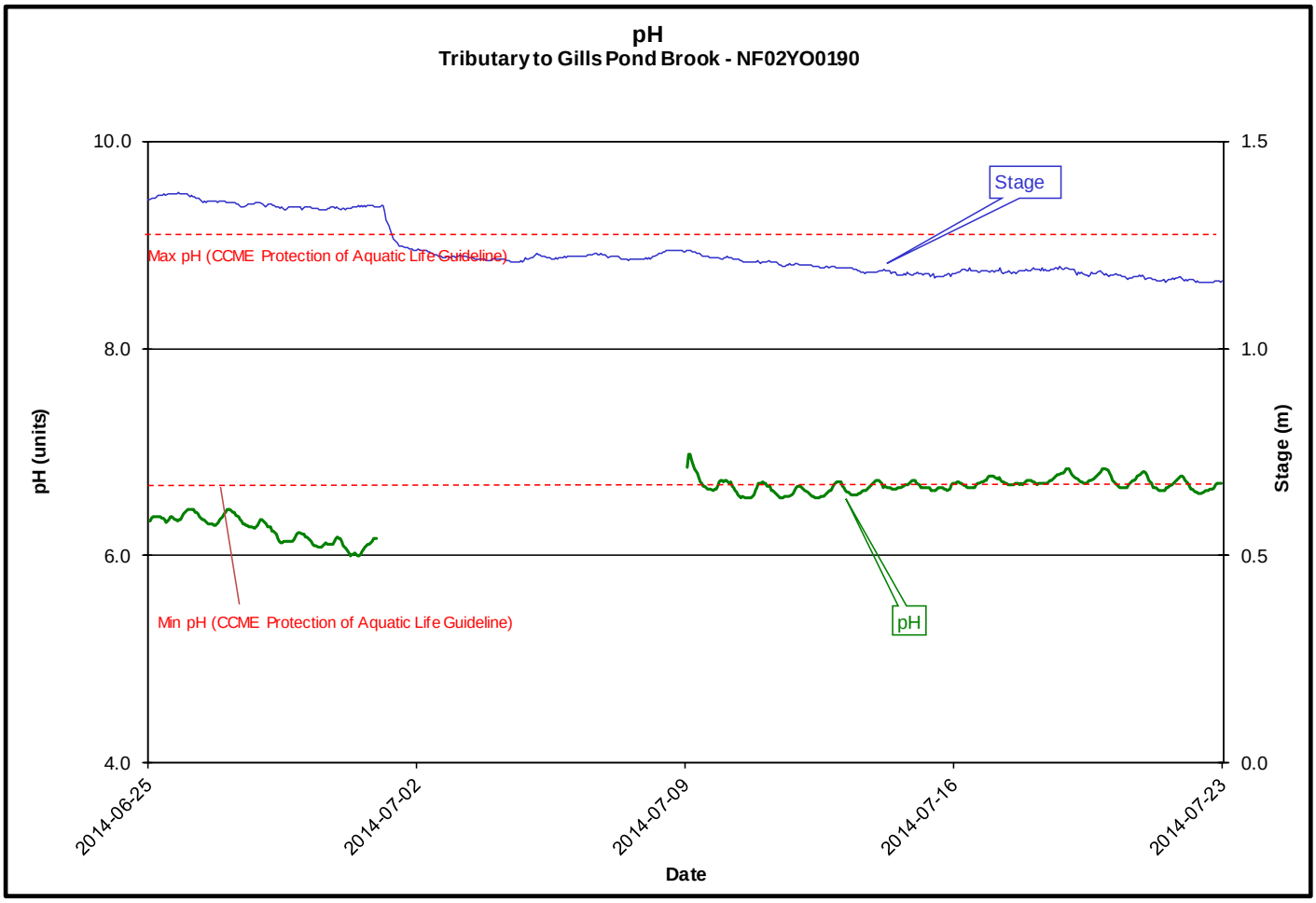

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 94.7 µS/cm to a maximum of 939.0 µS/cm over the deployment period.
- Specific conductance was significantly higher during the first six days when there was discharge from Polishing Pond. Values for the last part of the deployment period approach typical background levels.

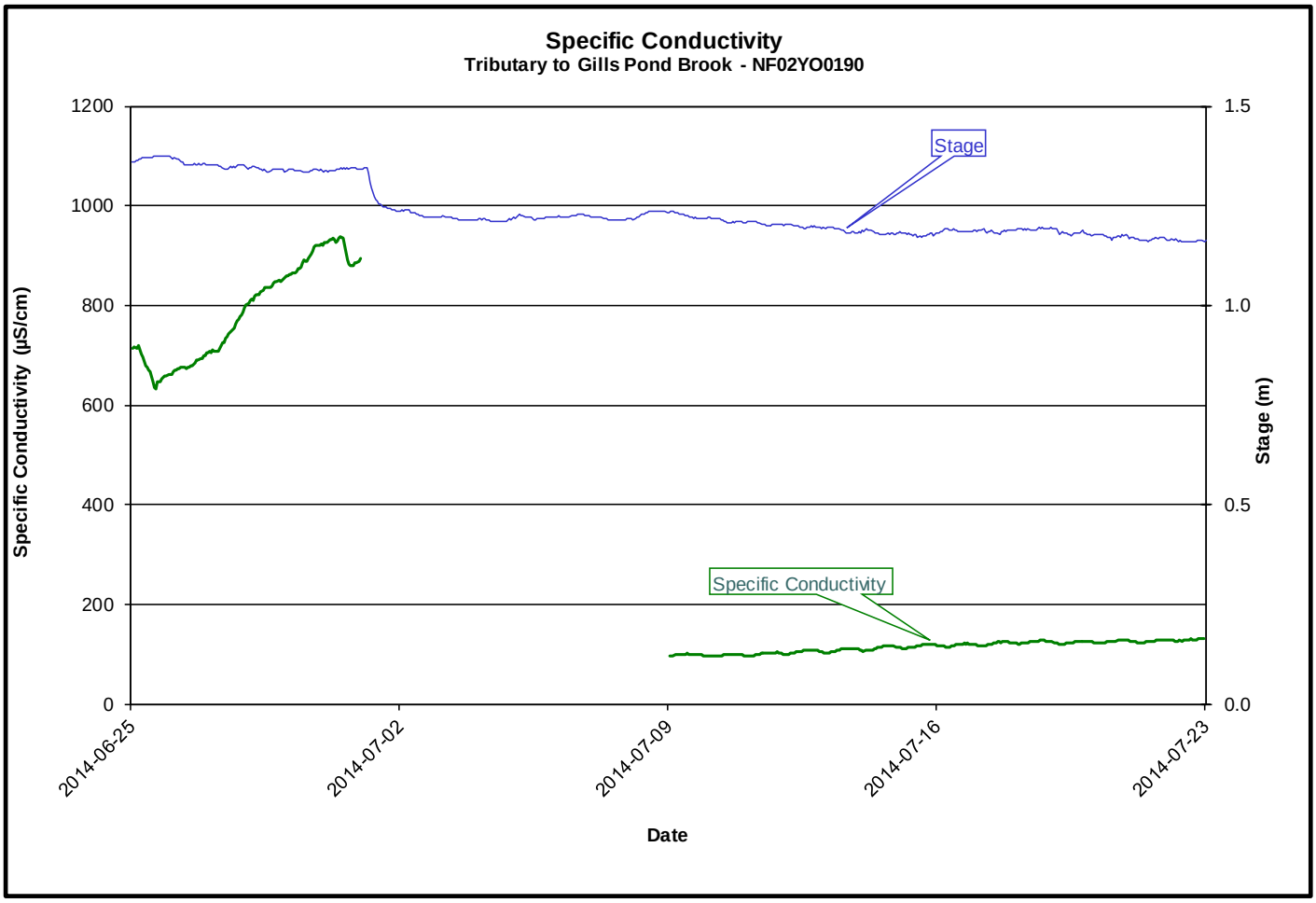

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 6.41 mg/L to a maximum of 9.65 mg/L over the deployment period, with the percent saturation ranging between 72.4 and 98.2.
- Dissolved oxygen (mg/L) decreased slightly over the deployment period. Some of this decrease may have resulted from biofilm and algae accumulations, and an accumulation of sediment on the instrument. There was an atypical discrepancy between the deployed unit and the QA/QC unit upon removal.
- Nearly all of the dissolved oxygen values fell above the minimum for Other Life Stages (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). This range is typical based upon water temperatures.

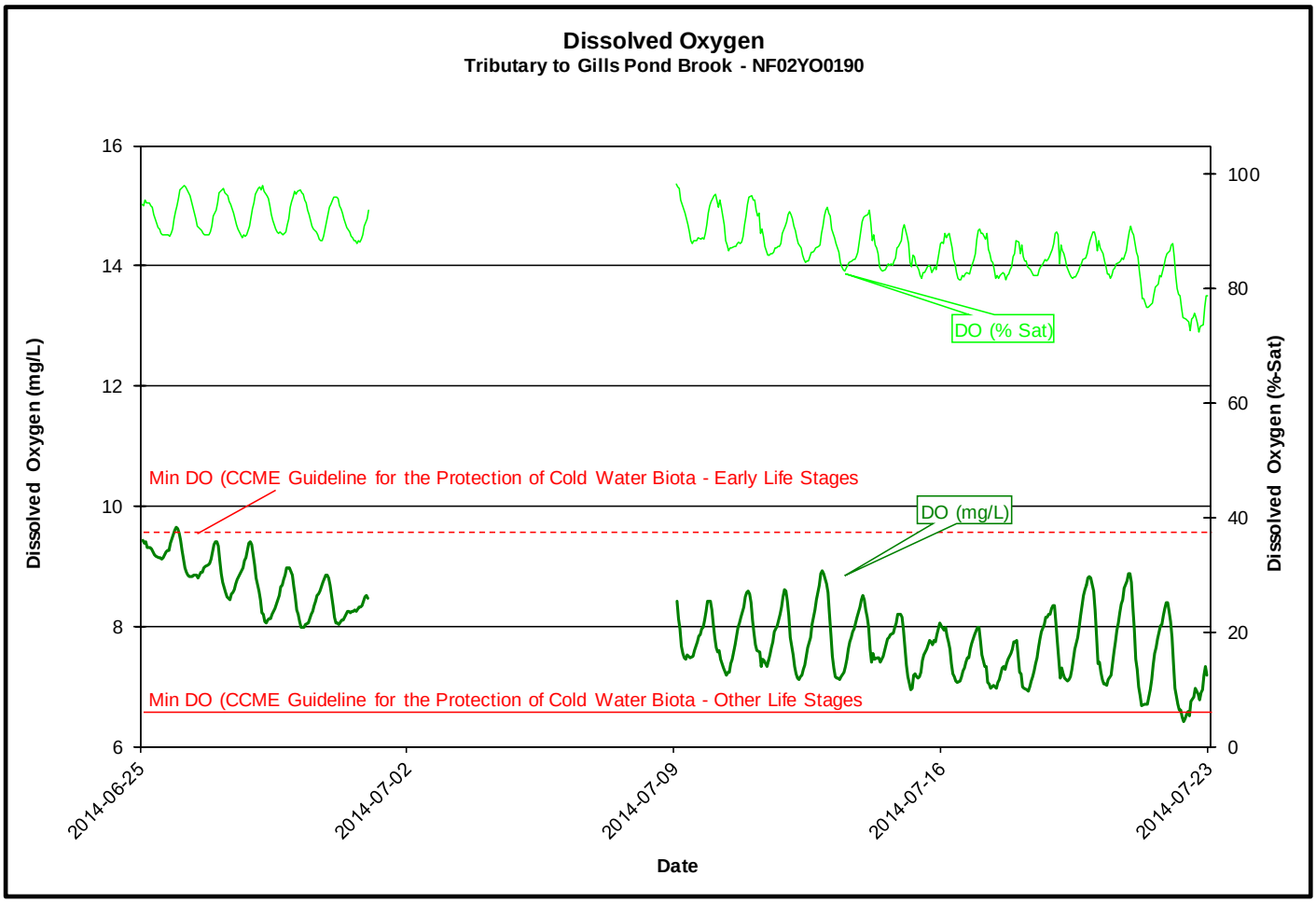

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 30.0 NTU.
- Some of the highest peaks in turbidity were recorded during increased stage, when there was discharge from the Polishing Pond.

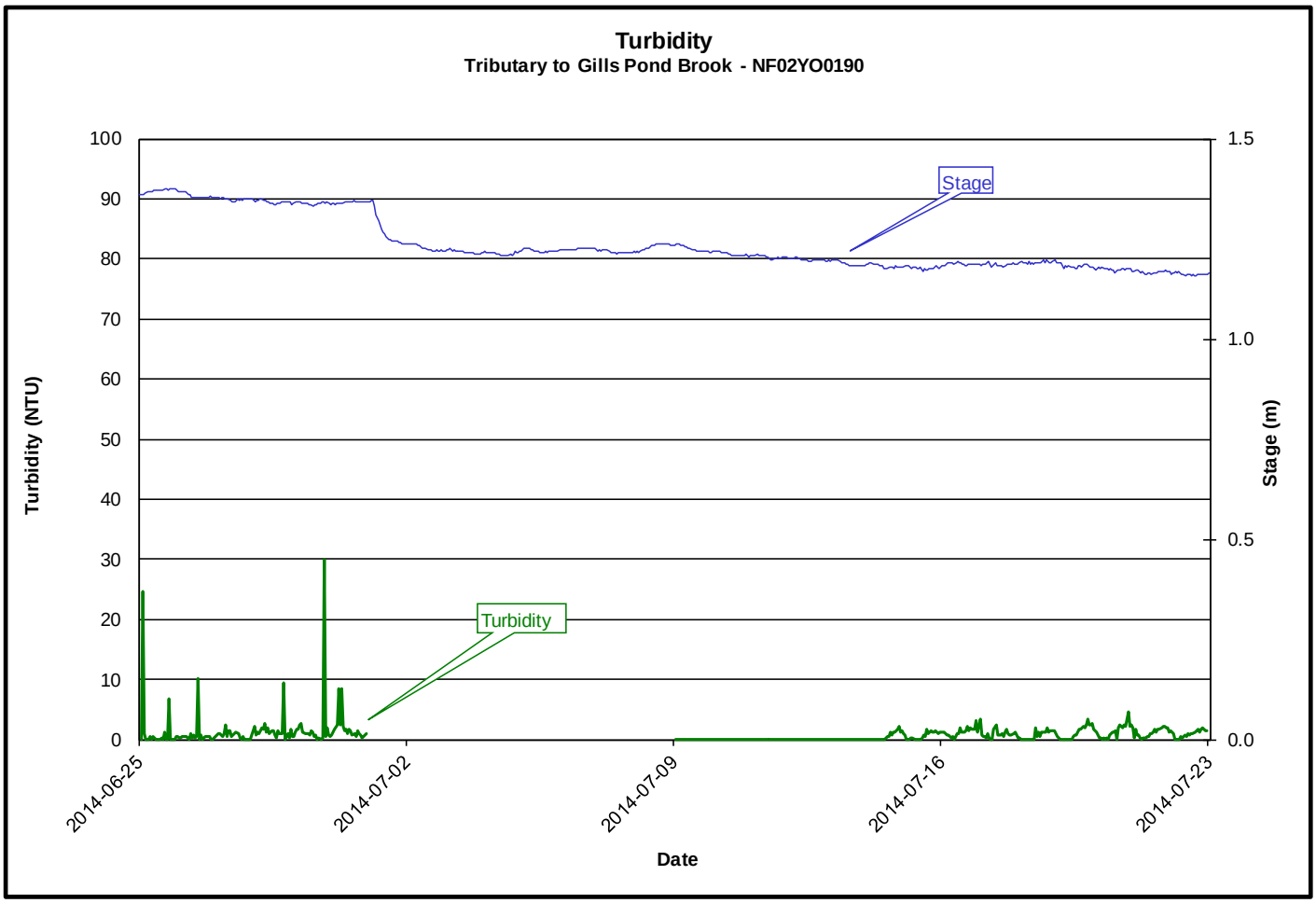

Figure 5

- The stage or water level ranged from a minimum of 1.16 m to a maximum of 1.38 m. The flow or discharge ranged from a minimum of 0.01 m^3/s to a maximum of 0.33 m^3/s (**Figure 6)**.
- The decrease in stage and flow following cessation of discharge from Polishing Pond on July 1, 2014 is obvious.
- Both stage and flow were extremely low after July 1, 2014 following cessation of discharge. In fact flow could not be calculated for the latter part of the deployment, as stage was below the minimum level of the existing stage-flow table.
- Given the extremely dry weather conditions there was barely enough water in the stream to cover the instrument. Similar hydrologic conditions were experienced throughout the Island during this period.

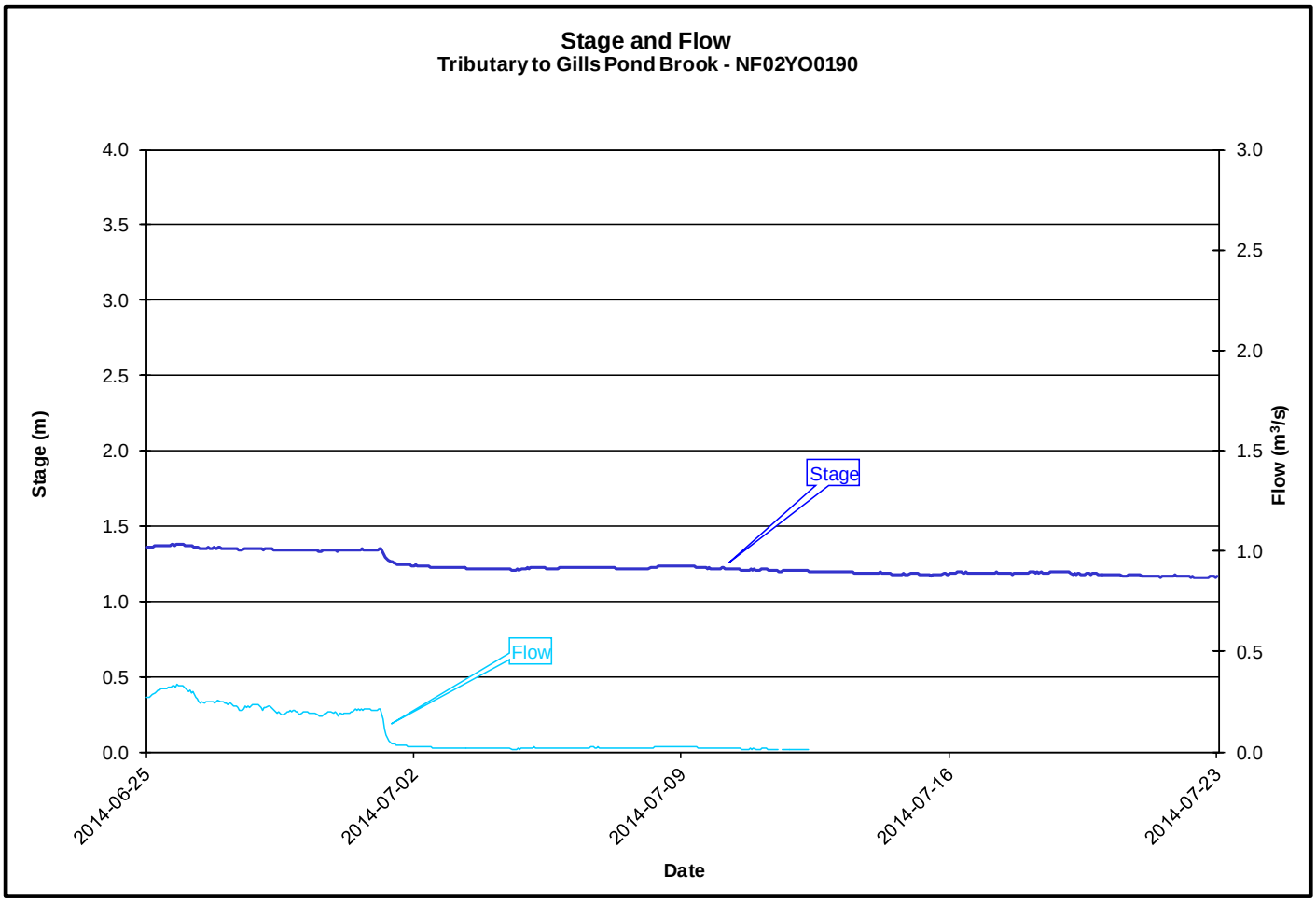

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 13.65 ˚C to a maximum of 27.94 ˚C.
- The temperatures throughout the deployment period are higher than typical for this time of year.
- There does not appear to be any correlation with stage during this reporting period.

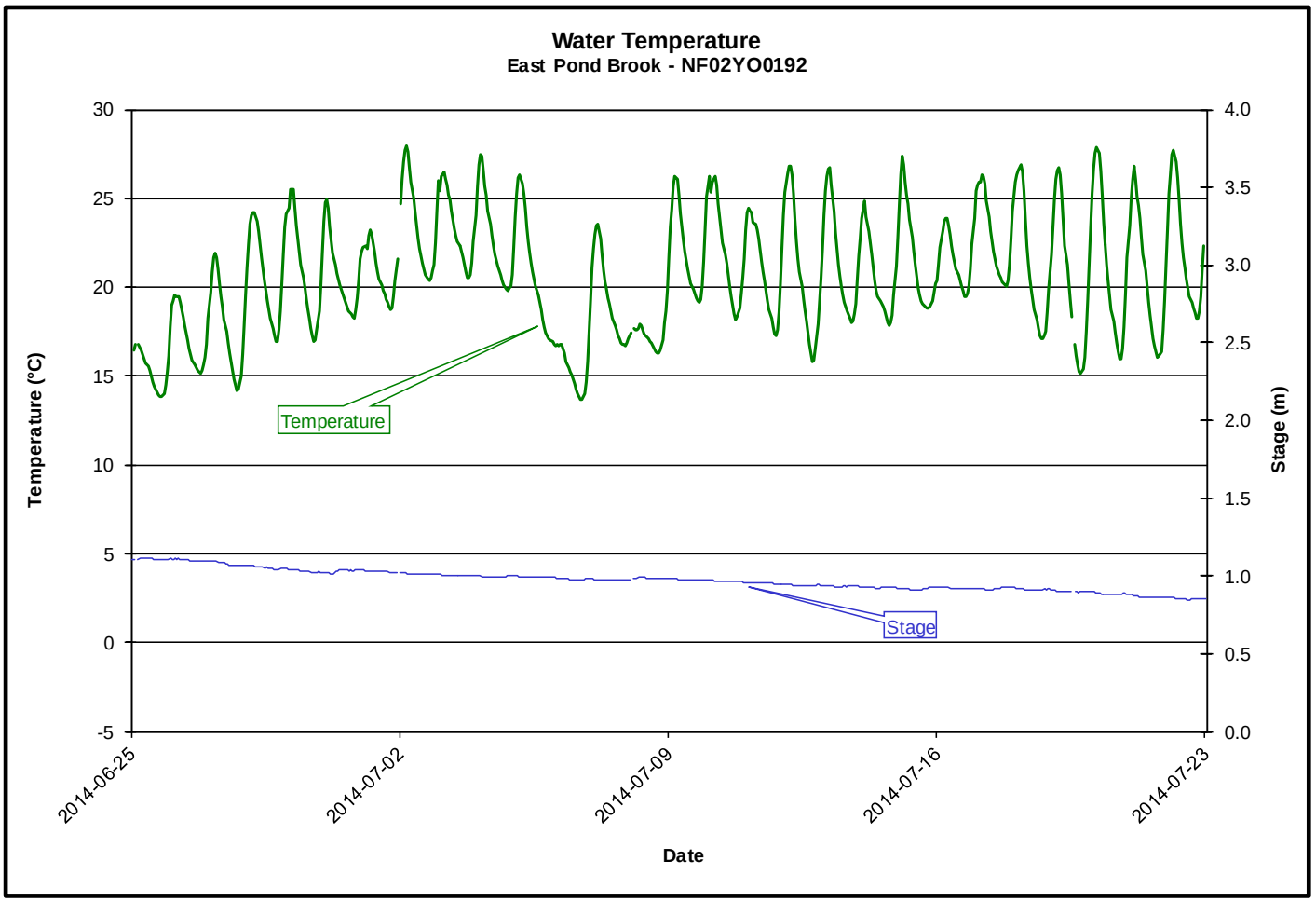

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.63 to a maximum of 6.97, and remained very constant over the deployment period, with only diurnal variation.
- For the entire deployment period, pH values were near the lower limit of 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 lower limit are not unusual.

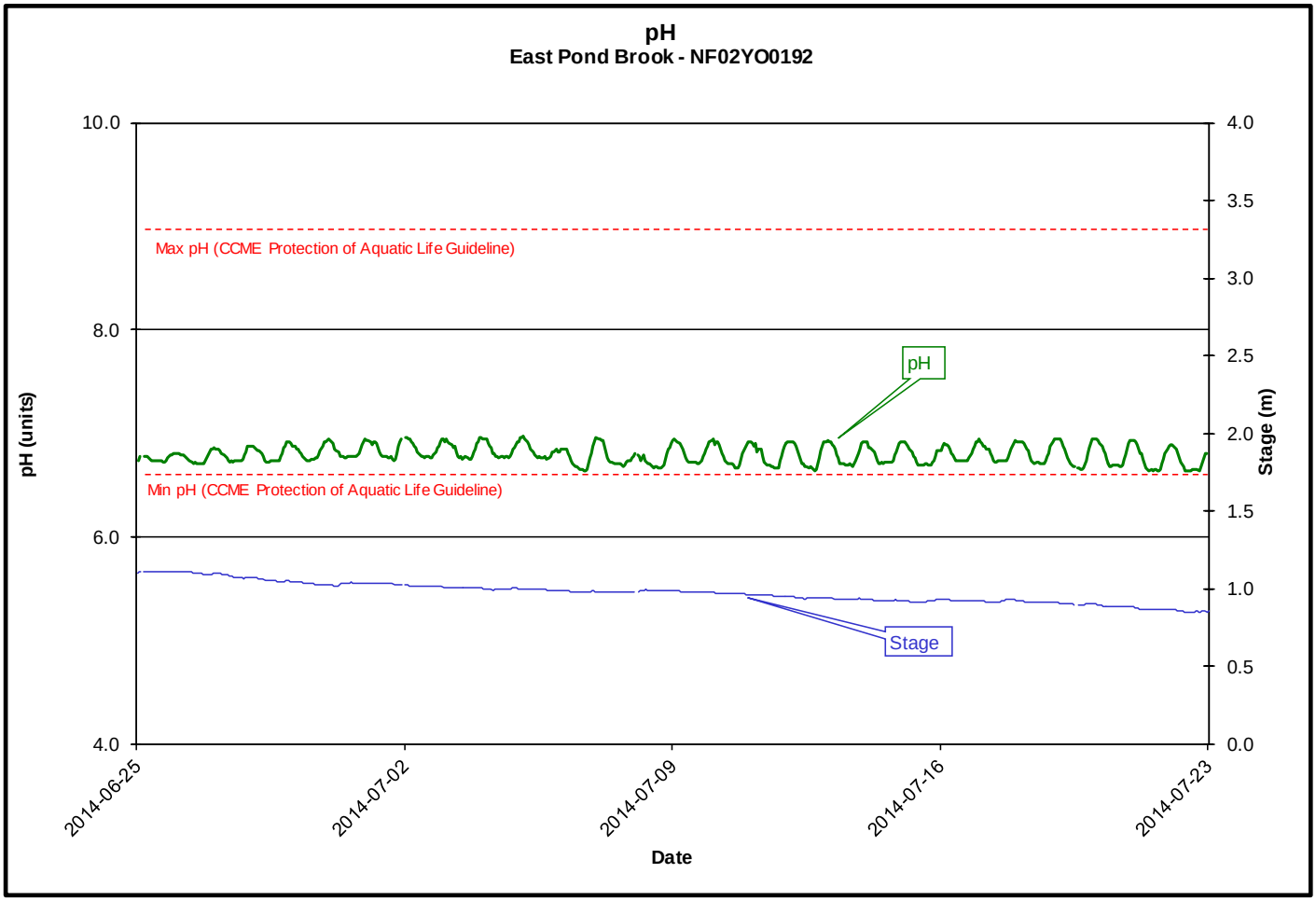

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 20.0 µS/cm to a maximum of 42.3 µS/cm.
- There was a constant increase in specific conductance over the entire deployment period, which appears to correspond with a steady decrease in stage. This would be expected as there was little surface runoff, and stream flow would have increasingly been comprised of groundwater inputs.
- All values are within the normal range.

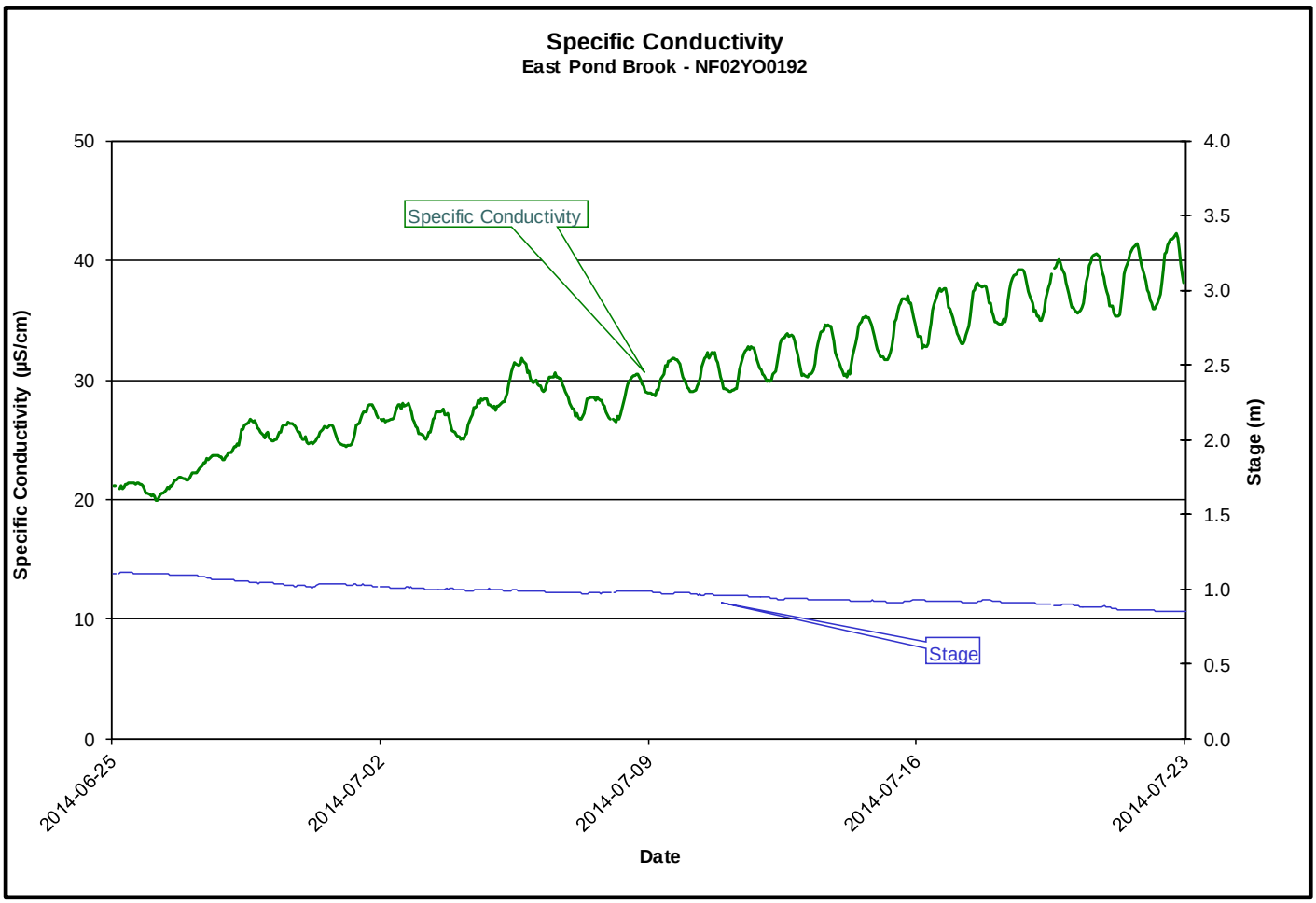

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 6.95 mg/L to a maximum of 9.71 mg/L over the deployment period, with the percent saturation ranging between 79.0 and 99.0.
- Dissolved oxygen (mg/L) tended to decrease toward the end of the deployment period.
- All of the dissolved oxygen values fell above the minimum for Other Life Stages (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). This range is typical based upon water temperatures.
- Based upon the fact that Dissolved Oxygen % Saturation had minimal and predictable change over the, we can be confident that the Dissolved Oxygen mg/L values are accurate.

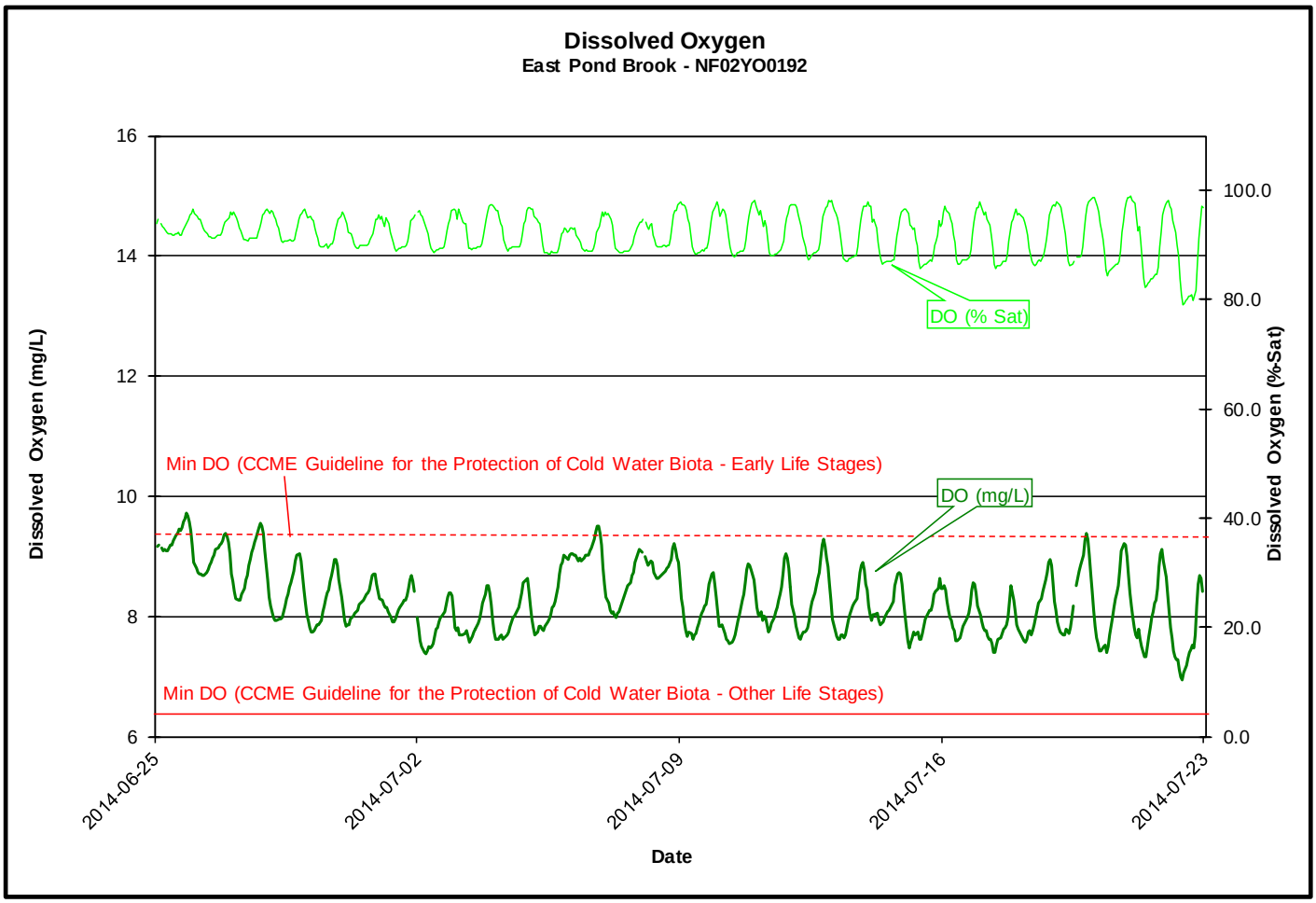

Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.0 NTU to a maximum of 32.5 NTU.
- It was noted upon removal, that there was some accumulation of algae on the sensor, which may have contributed to the turbidity measurements towards the end of the deployment period.

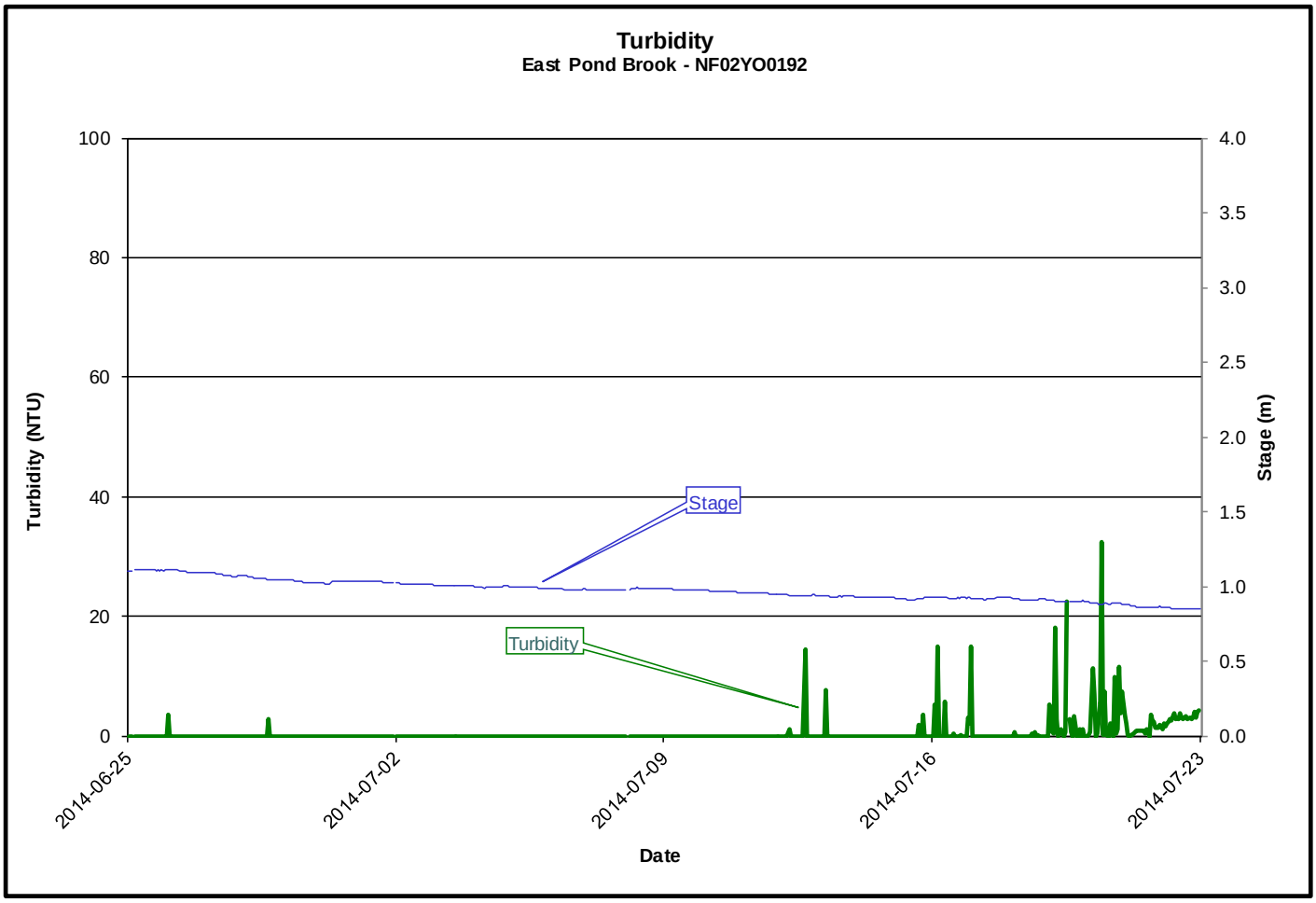

Figure 11

- The stage or water level ranged from a minimum of 0.85 m to a maximum of 1.11 m. The flow or discharge ranged from a minimum of 0.11 m^3/s to a maximum of 1.03 m^3/s **(Figure 12)**.
- Flow could not be calculated for the latter part of the deployment, as stage was below the minimum level of the existing stage-flow table.
- Given the extremely dry weather conditions there was barely enough water in the stream to cover the instrument. Similar hydrologic conditions were experienced throughout the Island during this period.

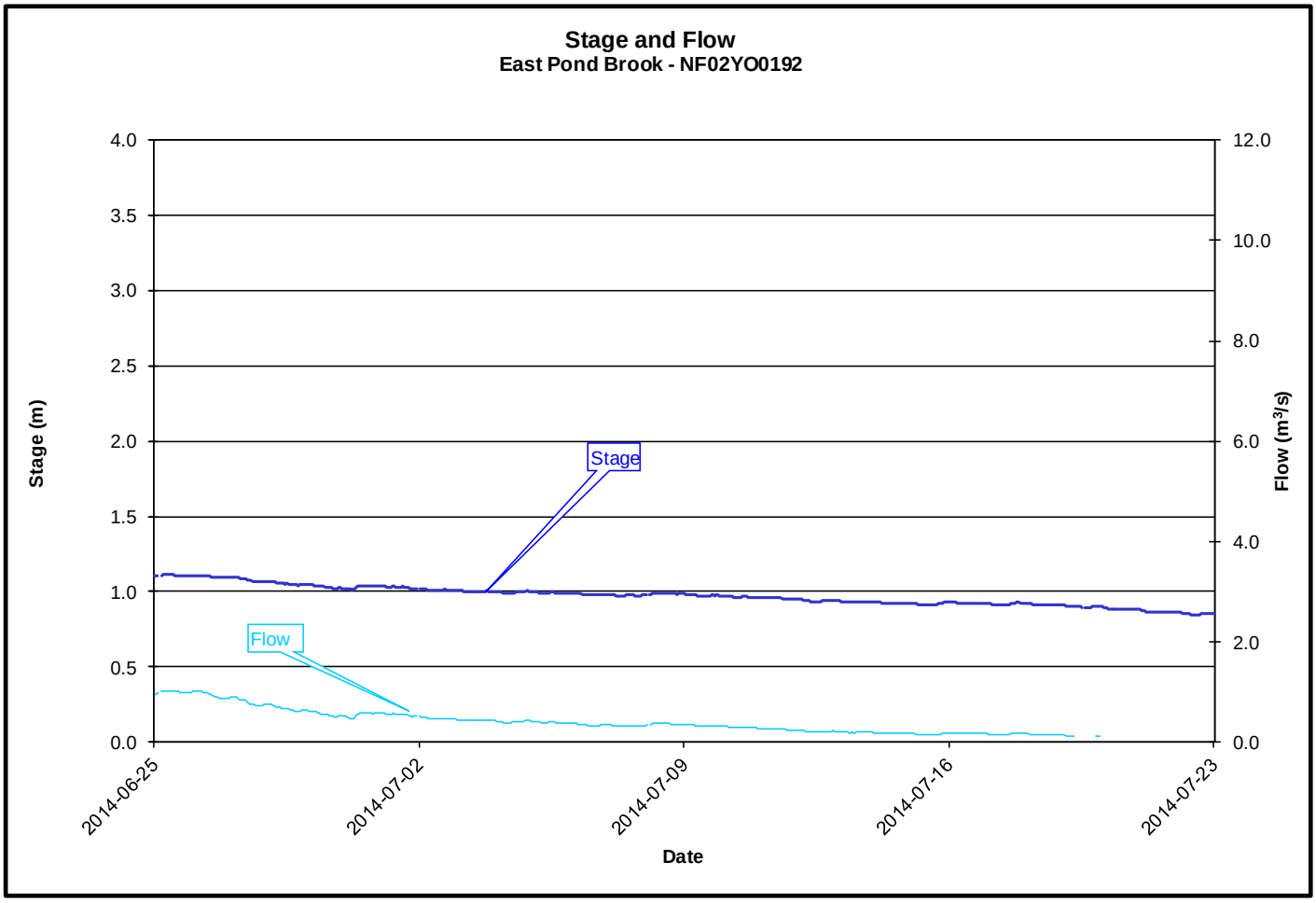

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.00 ˚C to a maximum of 5.04 ˚C with little change over the deployment period.
- There appears to be no correlation with water elevation.

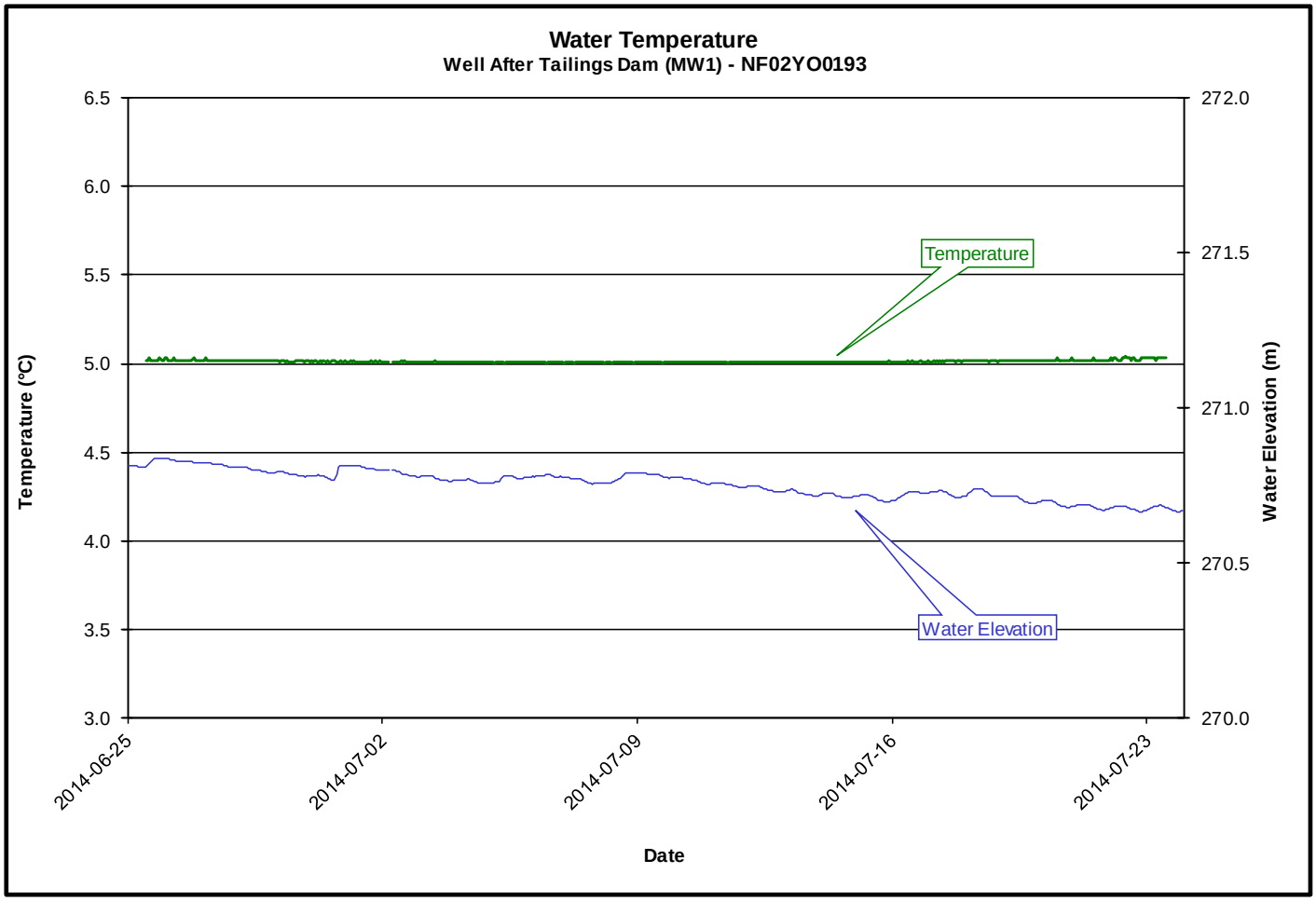

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.49 to a maximum of 8.56, with little change over the deployment period.
- There does not appear to be any correlation with water elevation.

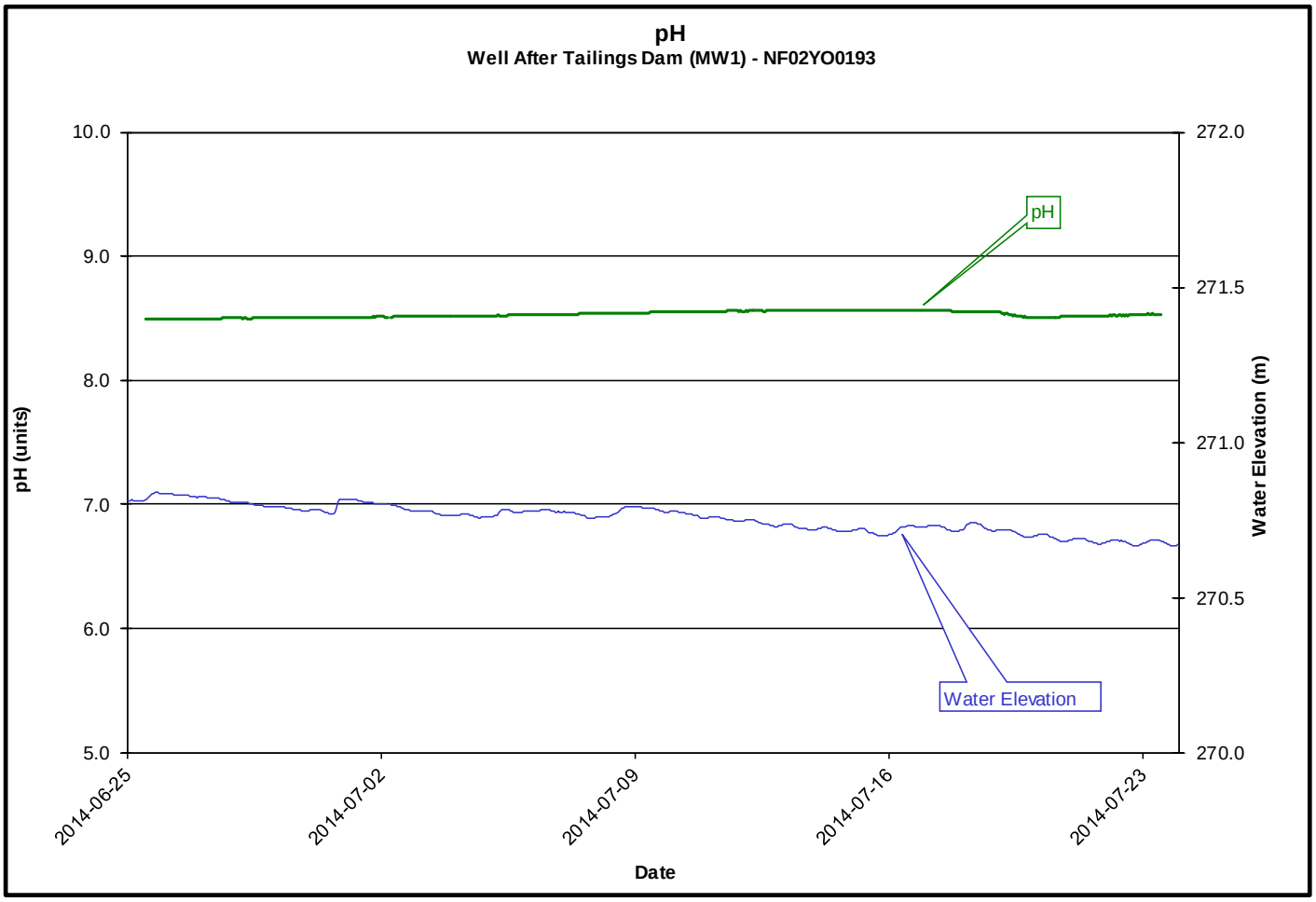

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.779 mS/cm to a maximum of 0.796 mS/cm.
- There was a slight decrease evident over the deployment period. This may be correlated with the slight decrease in water elevation.

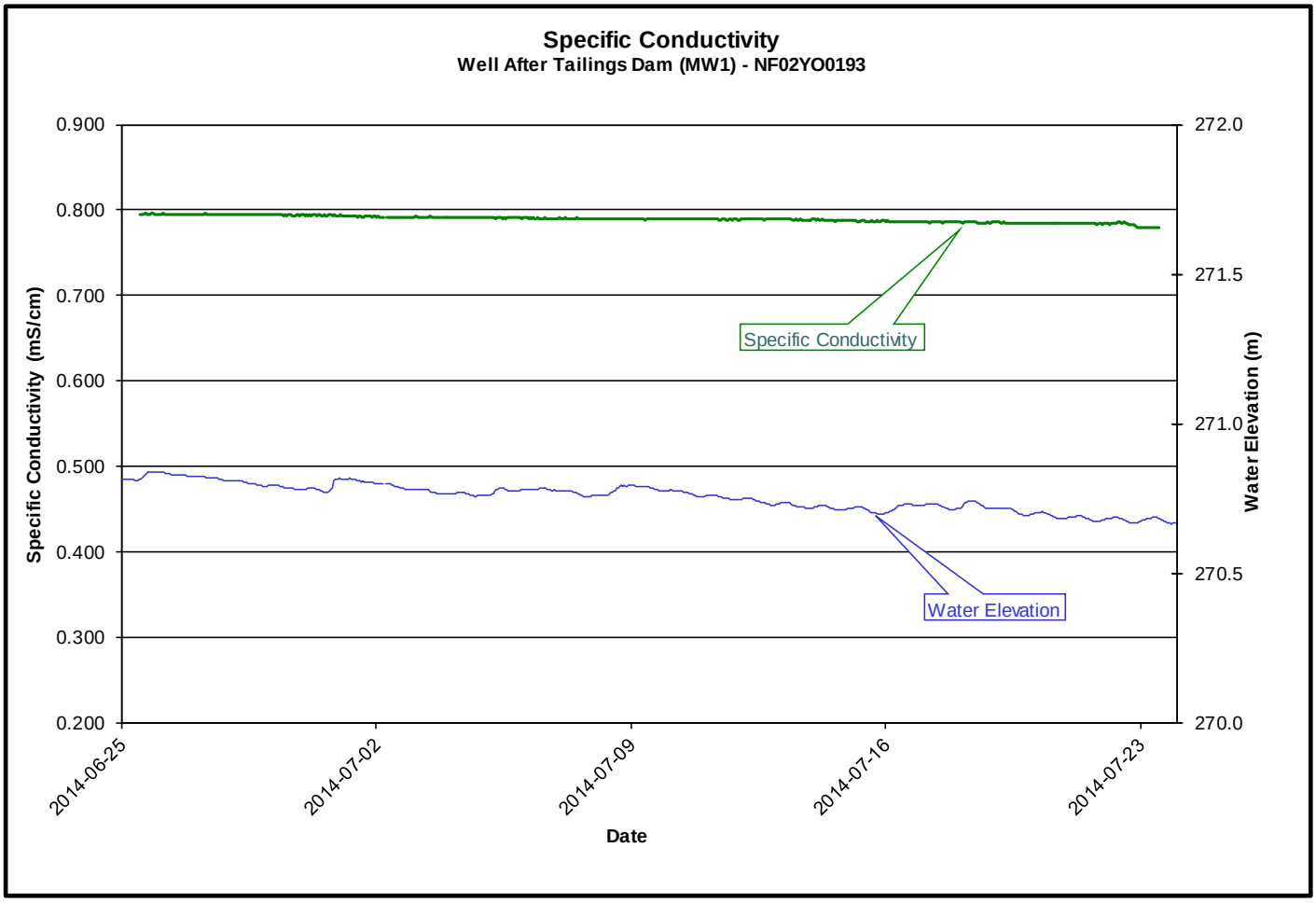

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.67 m to a maximum of 270.84 m, with a slight decrease over the deployment period.
- Water elevation in this well corresponds to increased water level in an adjacent stream, and is influenced by runoff from precipitation.

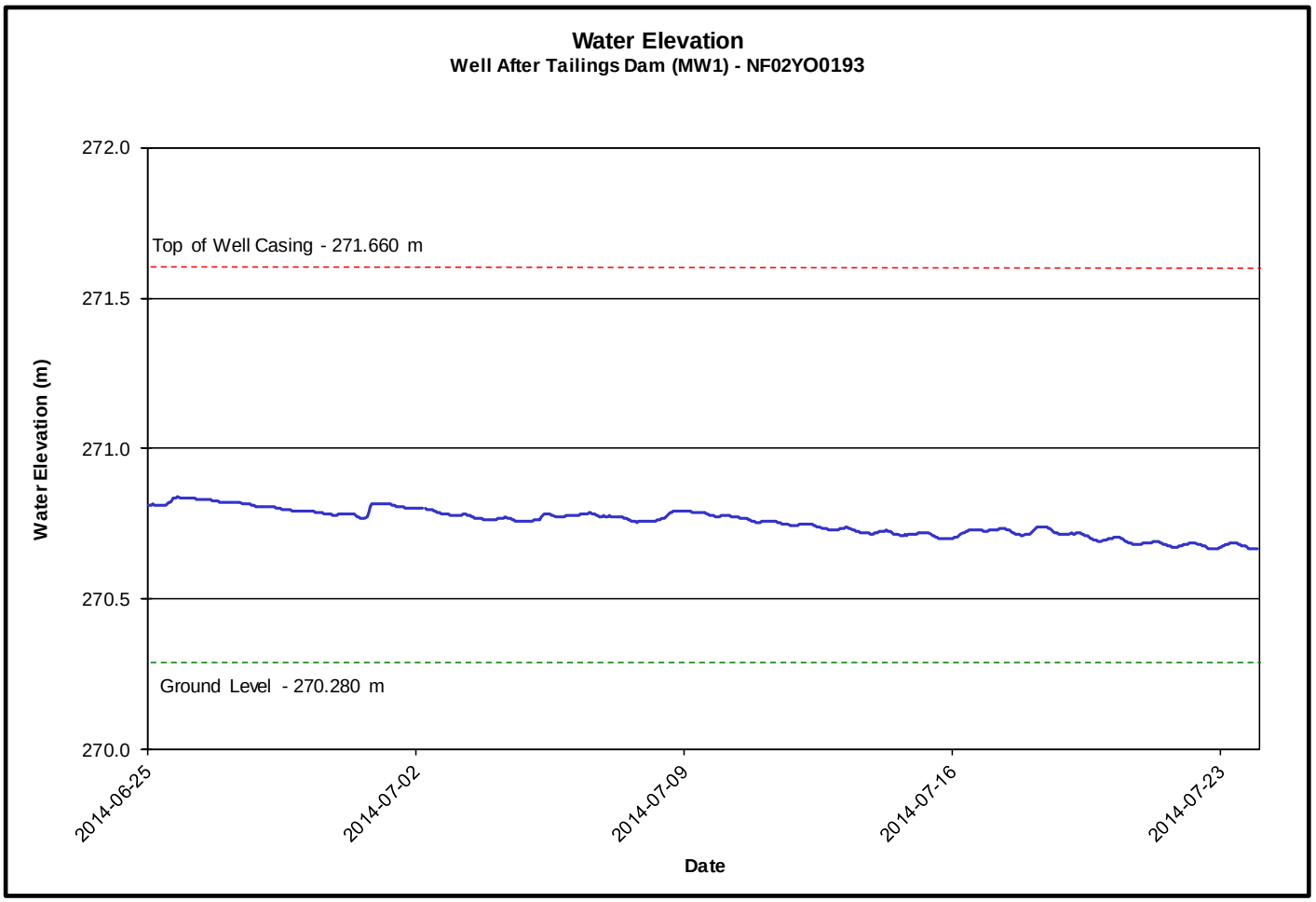

Figure 16

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