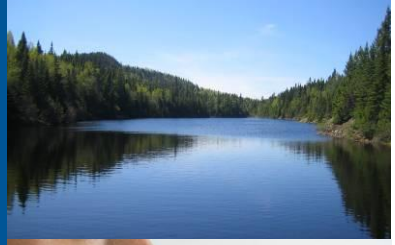




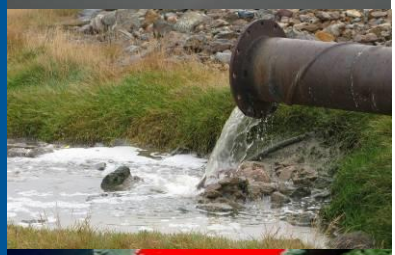


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2014-01-01 to 2014-05-13

2014-05-30

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.
- Again this winter for the Well After Tailings Dam (MW1) station, there was a loss of data transmission during the coldest period. Transmissions were episodic throughout January, then ceased completely from January 28, 2014 through April 12, 2014. Once again, efforts were made to investigate and re-establish data transmissions, however unsuccessfully. Prior to the next winter season, a bigger power source will be deployed in an attempt to resolve this ongoing issue.
- There was planned discharge of effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) for 5 separate events over the deployment period:
    - 2014-01-23 to 2014-03-14
    - 2014-03-18 to 2014-03-19
    - 2014-03-24 to 2014-03-26
    - 2014-03-31 to 2014-04-02
    - 2014-05-05 to the end of the deployment period

Maintenance and Calibration of Instrumentation

- **DataSonde®**(s/n 43245) was deployed in Tributary to Gills Pond Brook on November 14, 2013 after being cleaned and freshly calibrated, and remained deployed continuously until ice and water level conditions allowed for its removal on May 13, 2014. This report covers the period from January 1, 2014 to May 13, 2014; a 132 day period.
- **DataSonde®**(s/n 43794) was deployed in East Pond Brook on November 14, 2013 after being cleaned and freshly calibrated, and remained deployed continuously until ice and water level conditions allowed for its removal on May 13, 2014. This report covers the period from January 1, 2014 to May 13, 2014; a 132 day period.
- The regular **MiniSonde®** (s/n 47591) was used for QA/QC purposes during the installation of the instruments, and **MiniSonde®** (s/n 44998) a spare, was used during removal. Both instruments were cleaned and freshly calibrated prior to each use.
- **Quanta G®** (s/n 00653) was deployed on November 13, 2013 and remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1), until after the current reporting period This report covers the period from January 1, 2014 to May 13, 2014; a 132 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 removal 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. As the instruments were deployed prior to this reporting period, the rankings during installation are provided in the previous report.
- A 'Fair' ranking was determined for Dissolved Oxygen (mg/L) for East Pond Brook upon removal. A difference of only 0.56 mg/L was determined after the over-winter deployment.
- 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. Ranking data for the beginning of the deployment period is documented in a previous report. As the instrument remains deployed, no ranking can yet be determined for the removal.
- 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**
2014-05-13 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Good
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2014-05-13 Removal	Temp (^{o}C)	Good
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Fair
	Turbidity (NTU)	Excellent

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of -0.45˚C to a maximum of 9.10˚C.
- The temperature remained constant near freezing for all of January, then gradually increased over the remainder of the deployment period.
- There does not appear to be any correlation with stage.

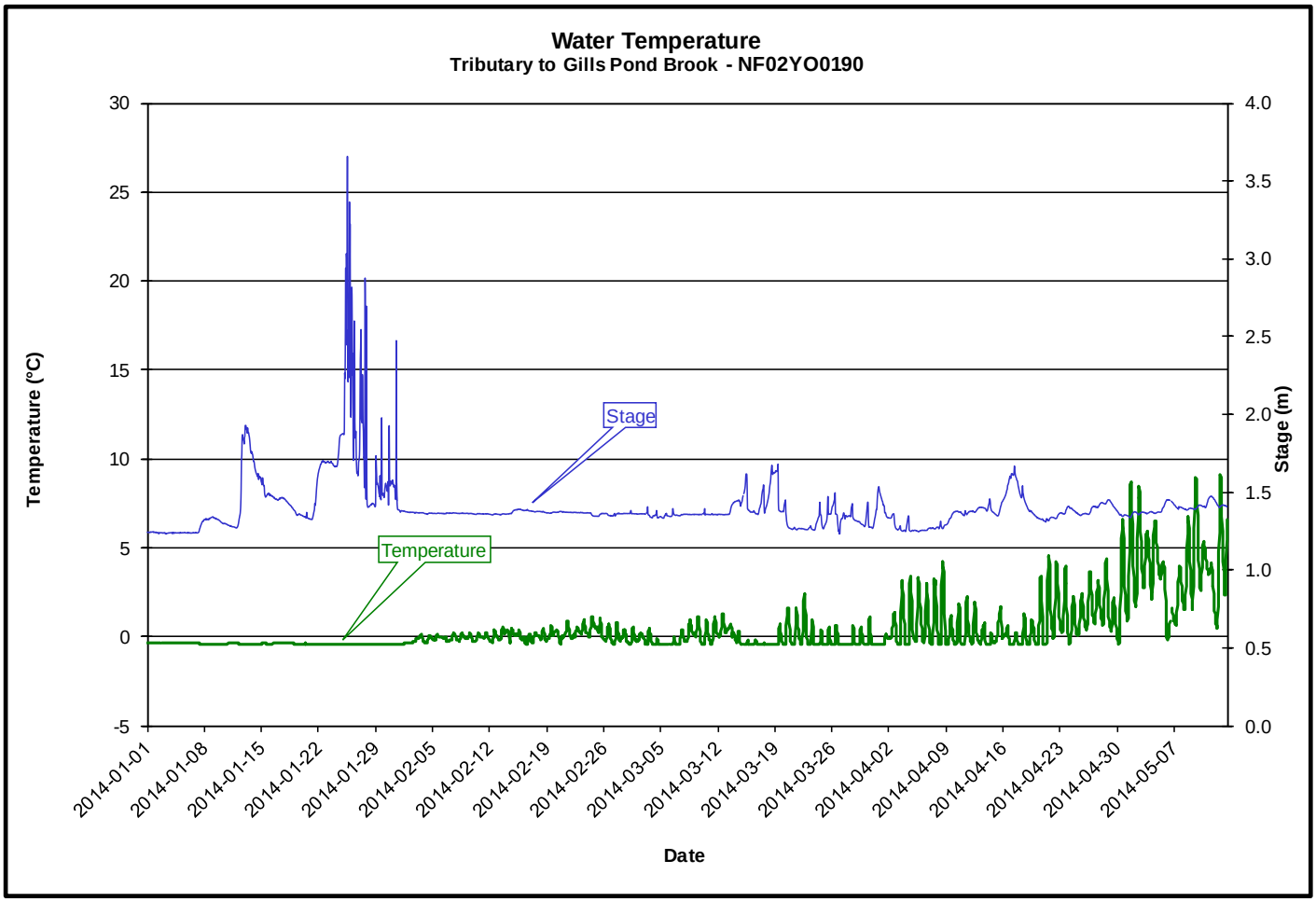

Figure 1

- Throughout the deployment period, pH values (**Figure 2**) ranged from a minimum of 5.62 to a maximum of 7.40 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*.
- pH increased slightly during periods when there was discharge from Polishing Pond.
- An inverse relationship with stage is obvious over several events during the deployment period.
- The background pH of this stream is normally around the lower limit of the recommended range, and is generally higher during periods of discharge from Polishing Pond.

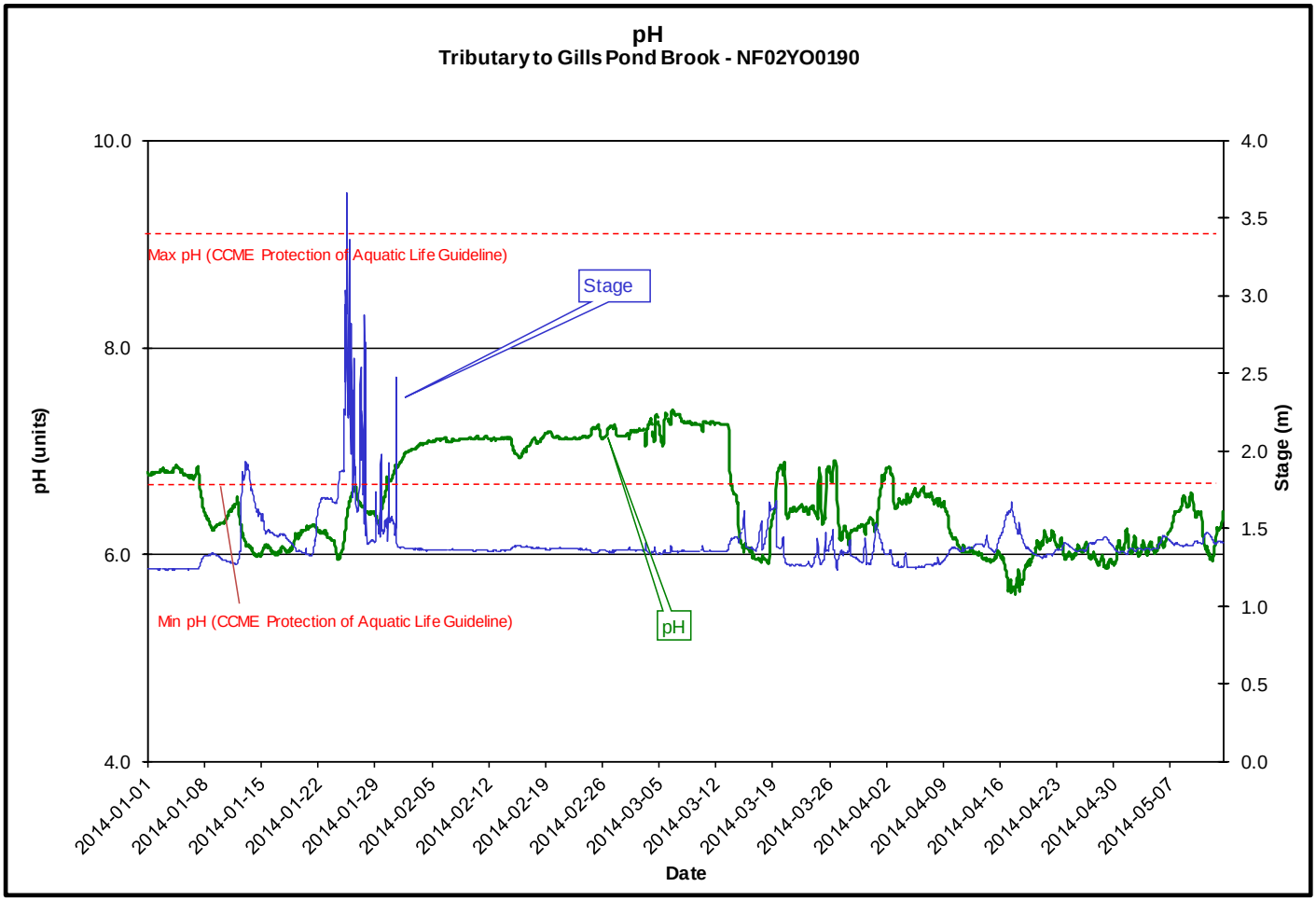

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 7.4 µS/cm to a maximum of 1184.0 µS/cm over the deployment period.
- Similar to pH above, specific conductance increased during periods when there was discharge from Polishing Pond.
- An inverse relationship with stage is obvious over several events during the deployment period, when precipitation events effectively caused a dilution effect in the stream's specific conductivity, which was elevated from natural background levels due to discharge from the Polishing Pond.

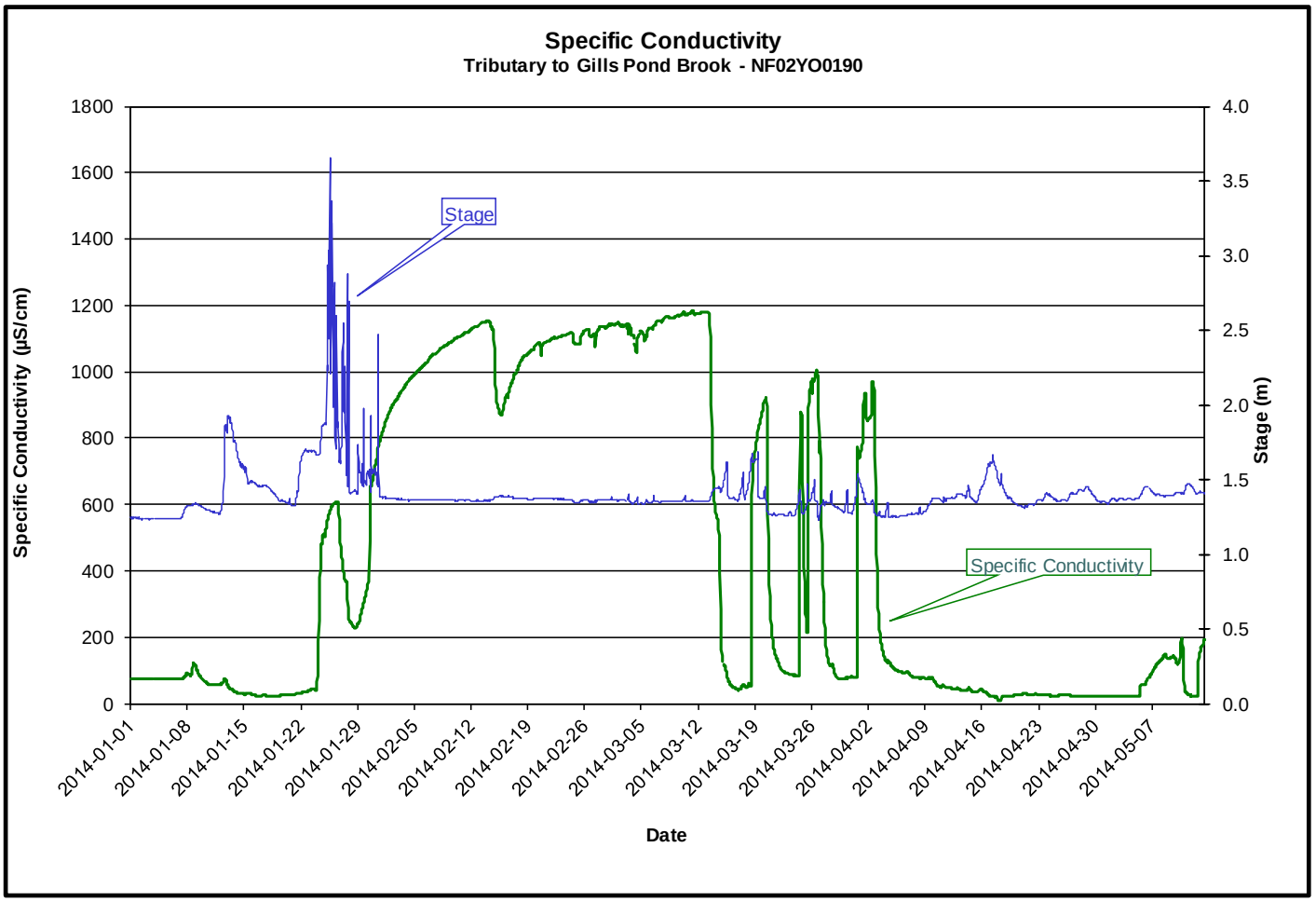

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 10.92 mg/L to a maximum of 13.78 mg/L over the deployment period, with the percent saturation ranging between 75.4 and 96.8.
- Dissolved oxygen (mg/L) decreased slightly over the deployment period.
- All of the dissolved oxygen values fell above the minimum for Early 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 change over the deployment period, we can be confident that the Dissolved Oxygen mg/L values are accurate.

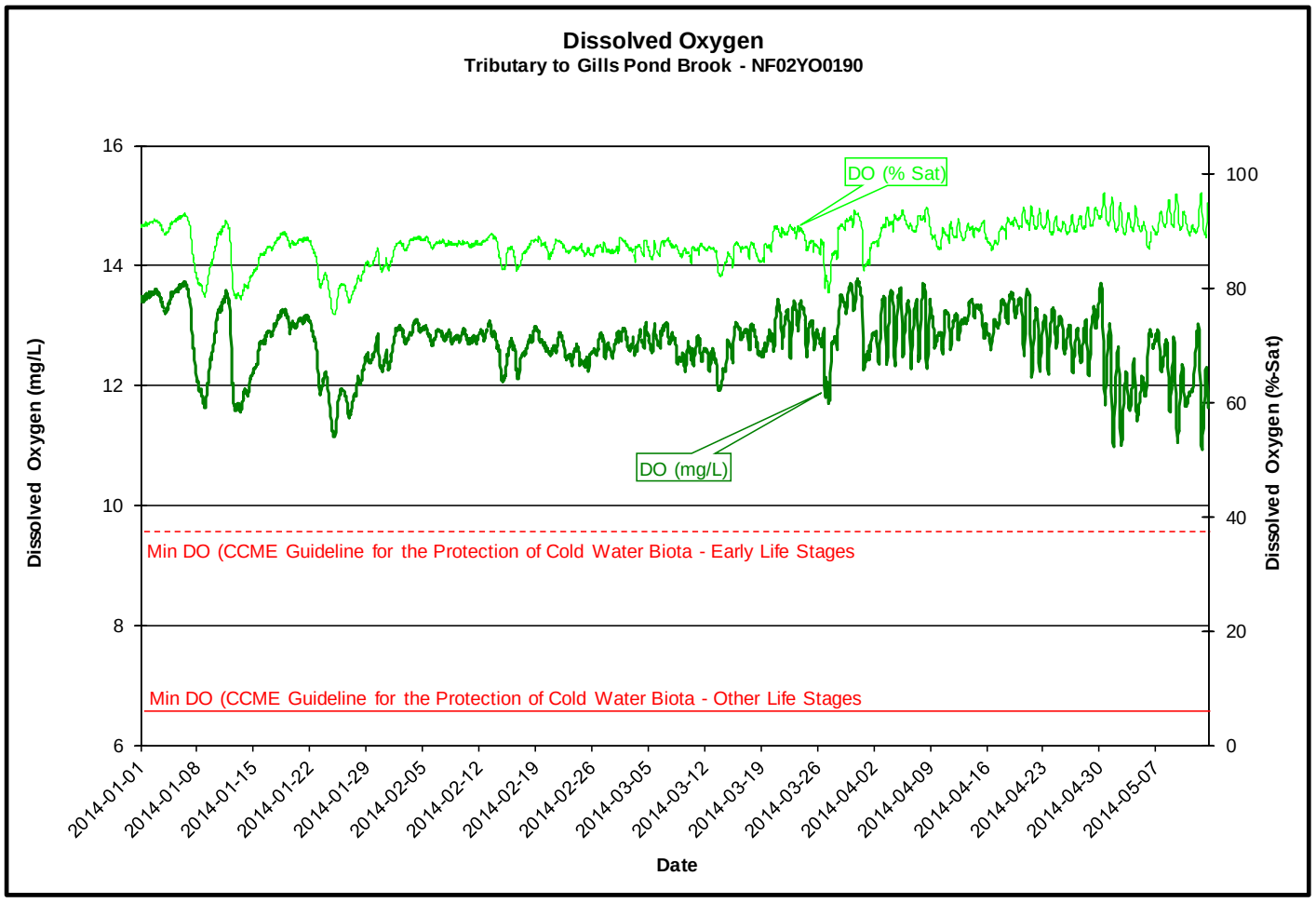

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 382.4 NTU.
- Some of the highest peaks in turbidity were recorded during peaks in stage.

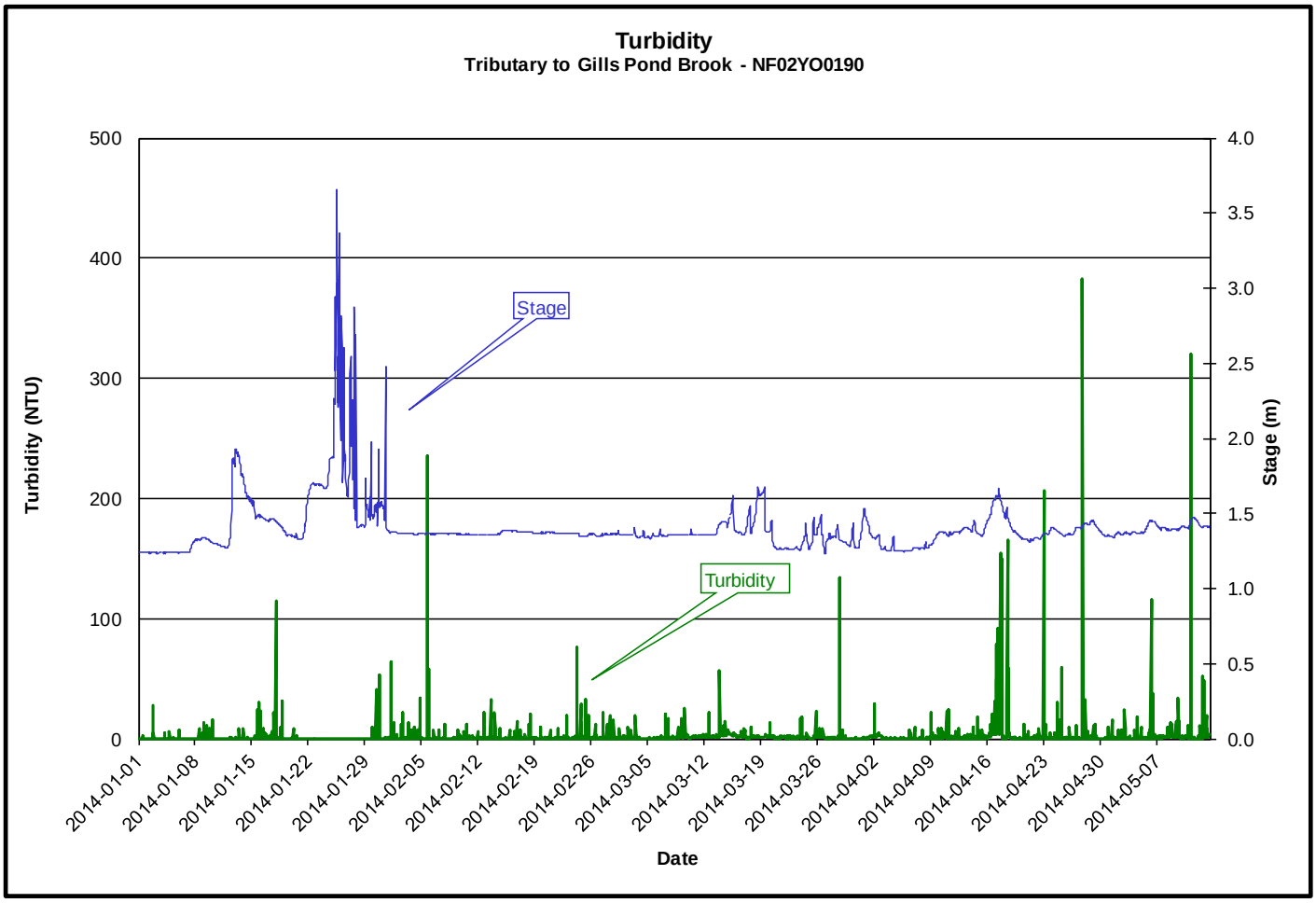

Figure 5

- The stage or water level ranged from a minimum of 1.23 m to a maximum of 3.66 m. The flow or discharge ranged from a minimum of 0.02 m^3/s to a maximum of 2.49 m^3/s (**Figure 6)**.
- The increase in stage and flow during the periods of discharge from Polishing Pond is obvious. The highest peaks in late January correspond with the initial release of discharge from Polishing Pond after the winter freeze-up and are likely partially due to a backwater effect from ice making its way down the brook. Other changes in stage and flow are resultant from precipitation/runoff events.
- All values are within the normal range.

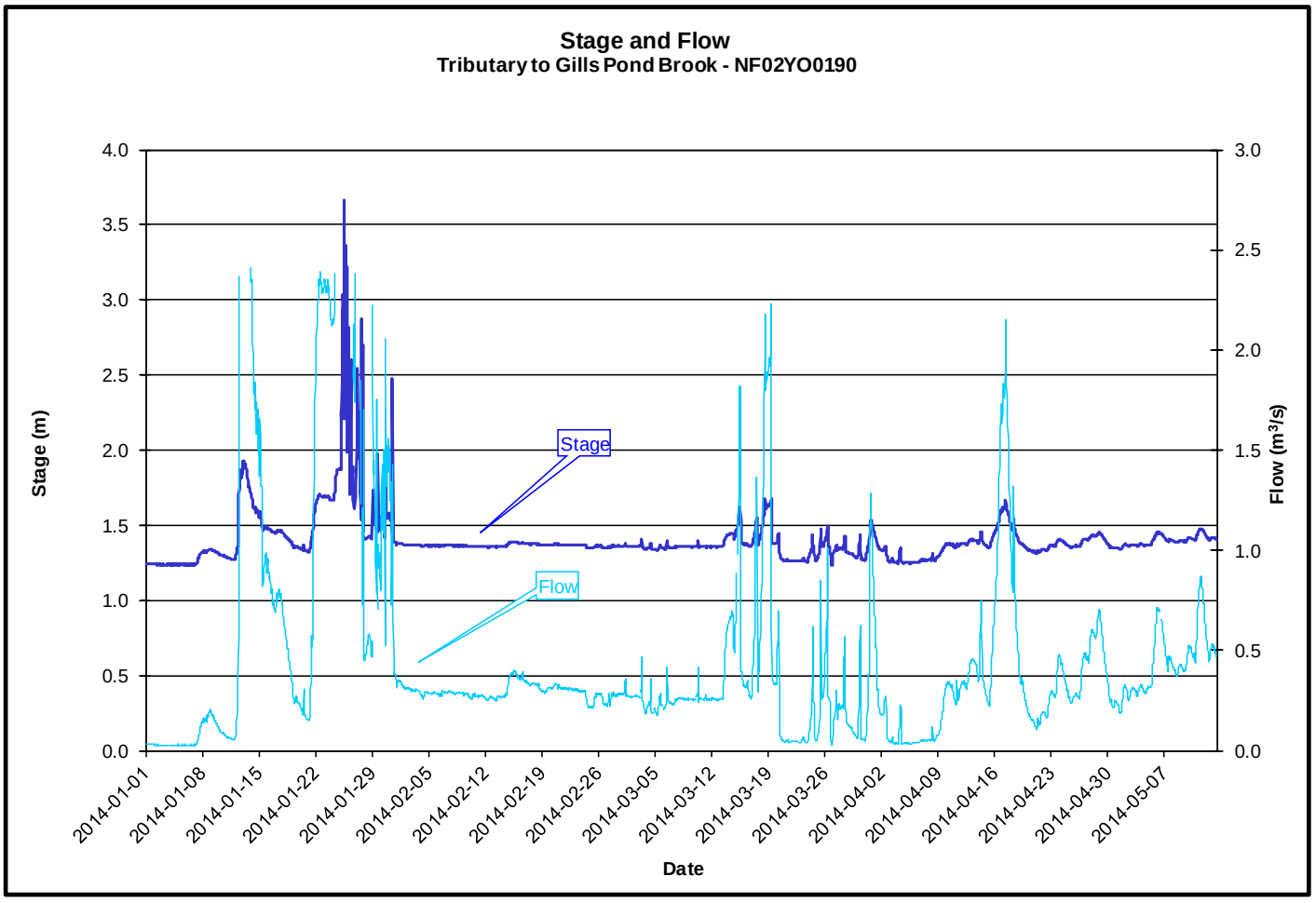

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 0.01 ˚C to a maximum of 8.63 ˚C.
- The temperature remained constant near zero from the beginning of the deployment period through mid-April then increased to the end of the deployment period.
- There does not appear to be any correlation with stage during this reporting period.

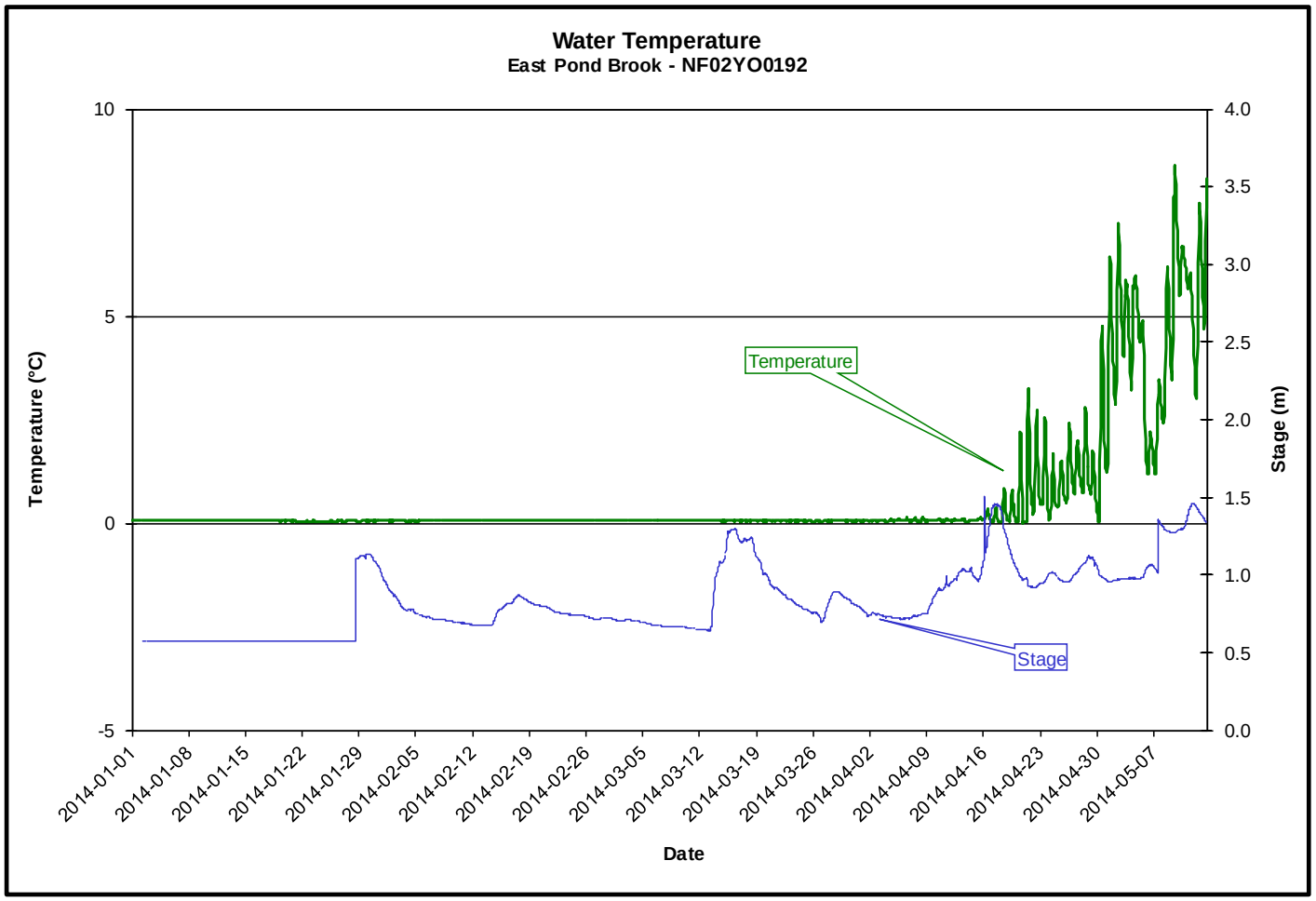

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 5.02 to a maximum of 6.74, with a slight decrease over the deployment period.
- An inverse relationship with stage is obvious over several events during the deployment period.
- For most of the deployment period, pH values were below 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.

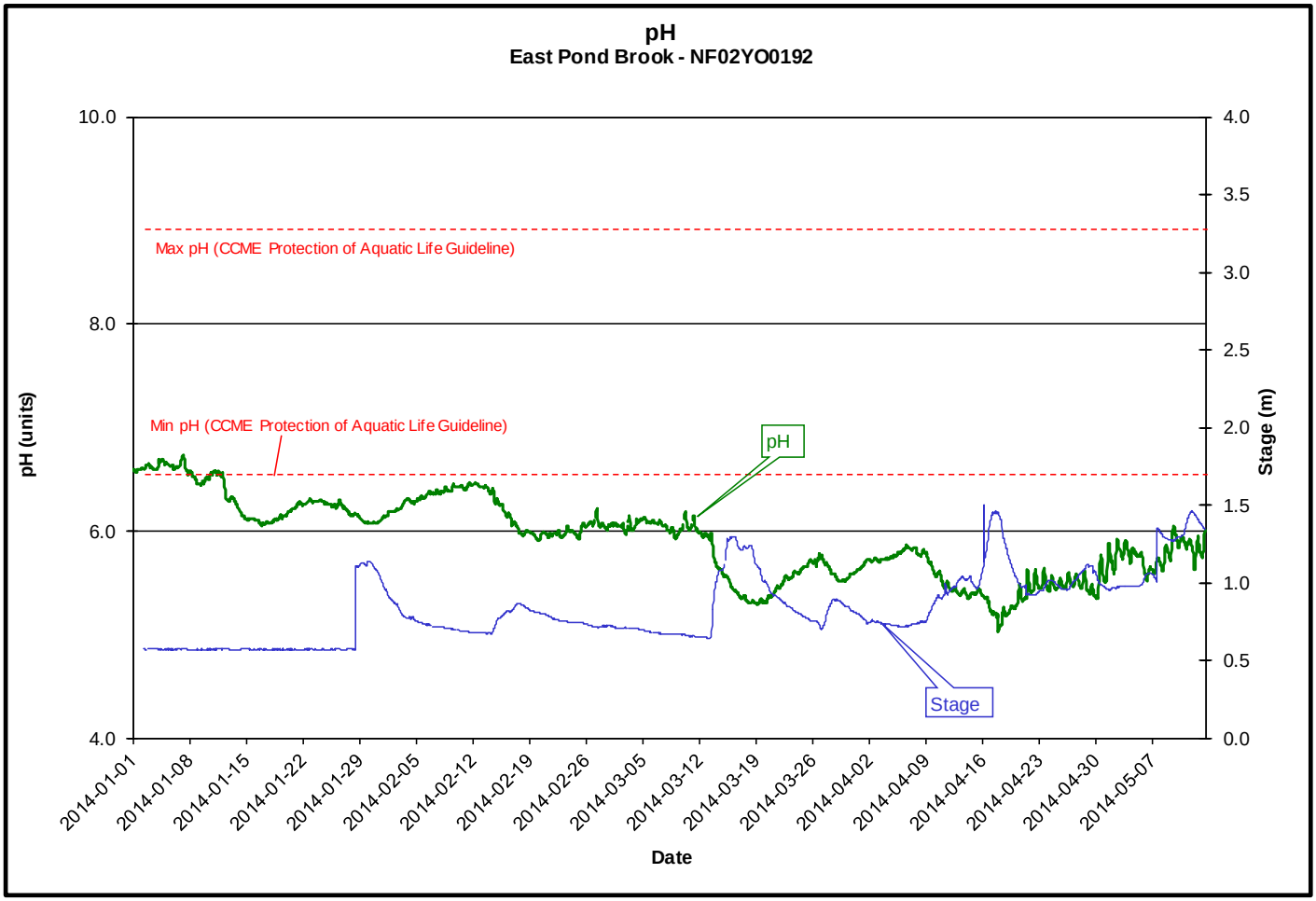

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 12.6 µS/cm to a maximum of 40.9 µS/cm.
- There was significant variation throughout the deployment period.
- All values are within the normal range.

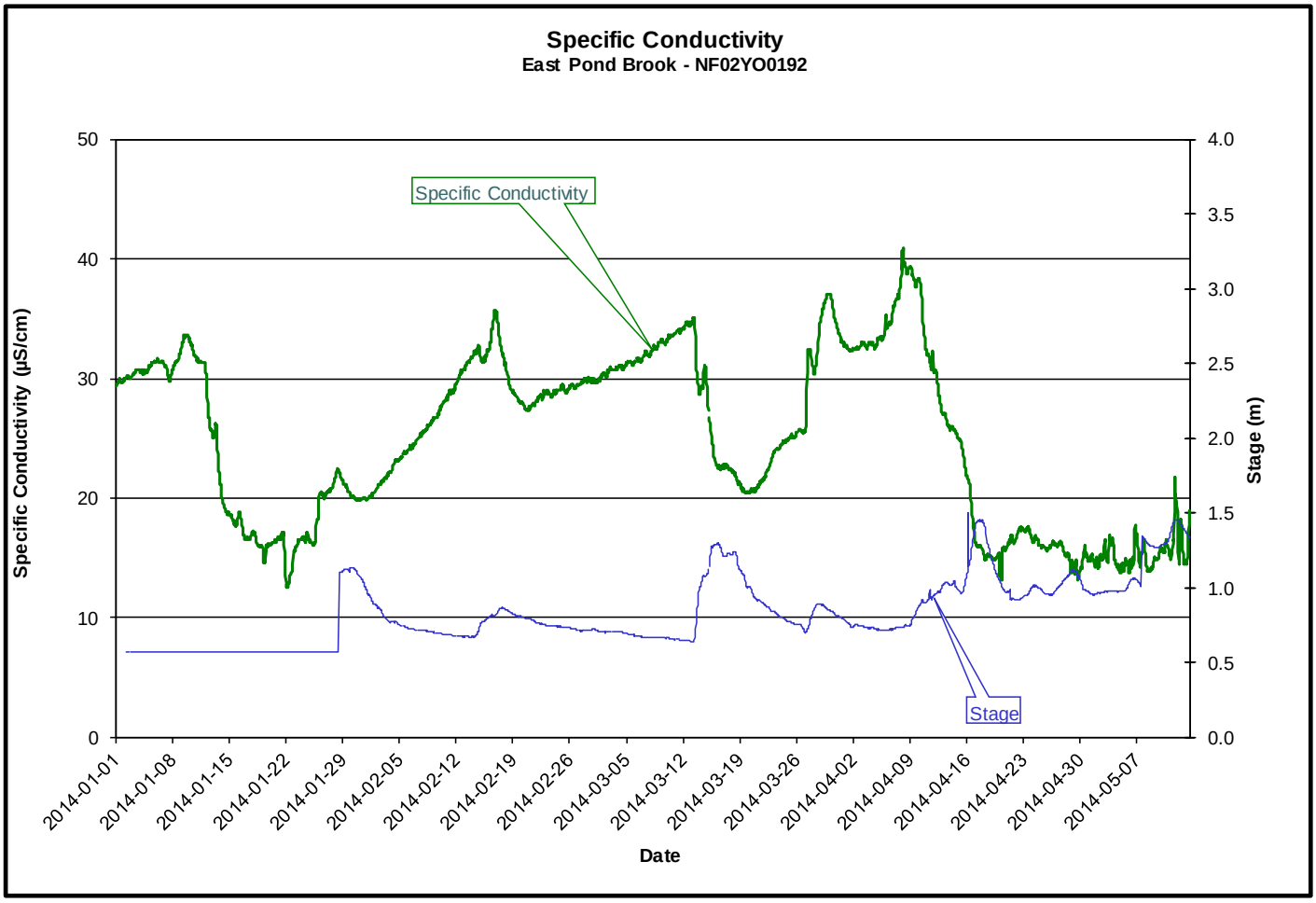

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 10.85 mg/L to a maximum of 13.84 mg/L over the deployment period, with the percent saturation ranging between 74.4 and 96.9.
- Dissolved oxygen (mg/L) tended to decrease toward the end of the deployment period, which corresponds to increasing water temperatures.
- A significant drop in dissolved oxygen (mg/L) and (%) is obvious around March 18, 2014. This corresponds with a rapid increase in stage, which would have resulted from a precipitation-snowmelt-runoff event.
- All of the dissolved oxygen values fell above the minimum for Early 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 limited drift, we can be confident that the Dissolved Oxygen mg/L values are accurate.

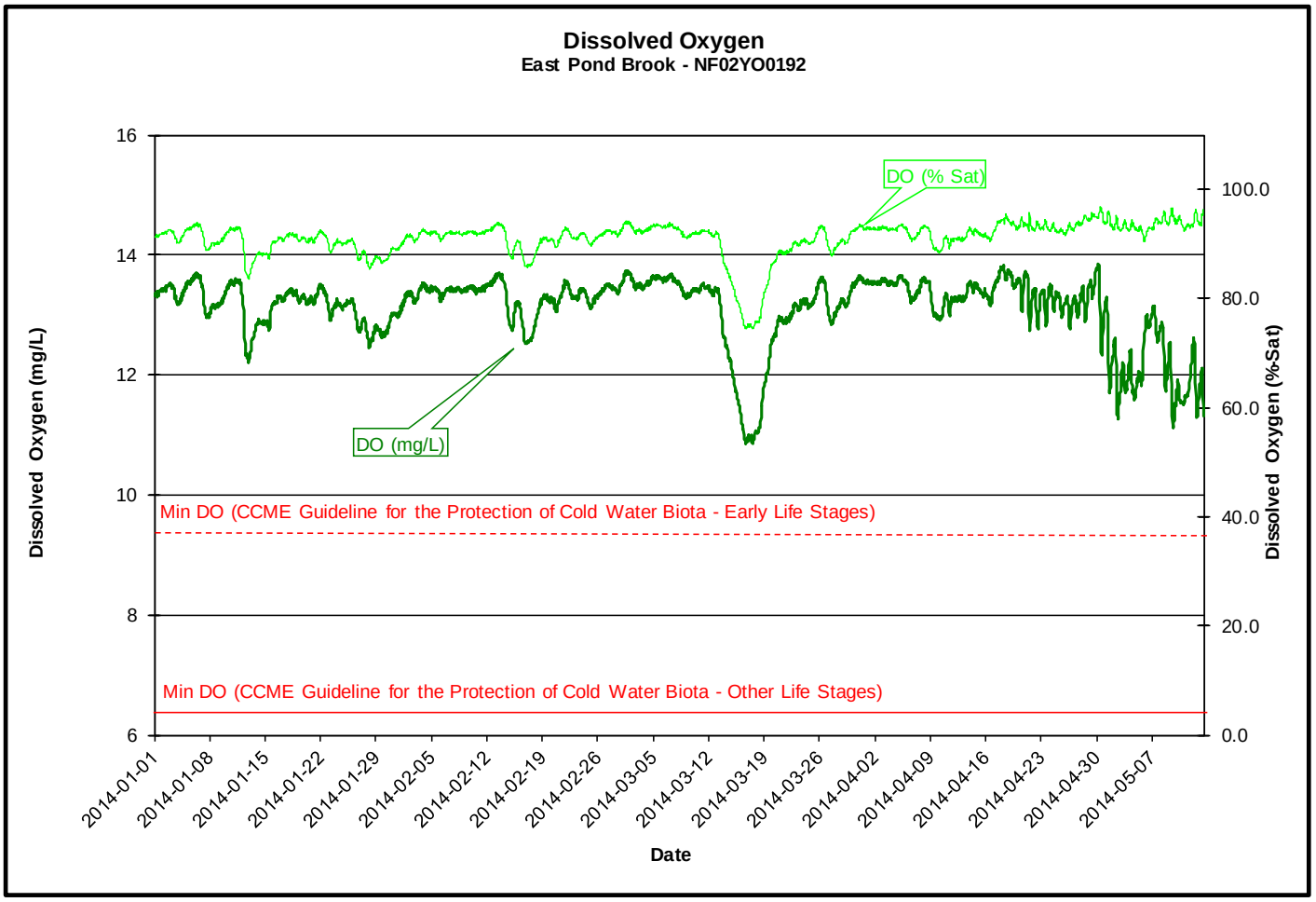

Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.0 NTU to a maximum of 123.6 NTU.
- Some of the peaks in turbidity corresponded to increased stage, for others, there is no obvious explanation.

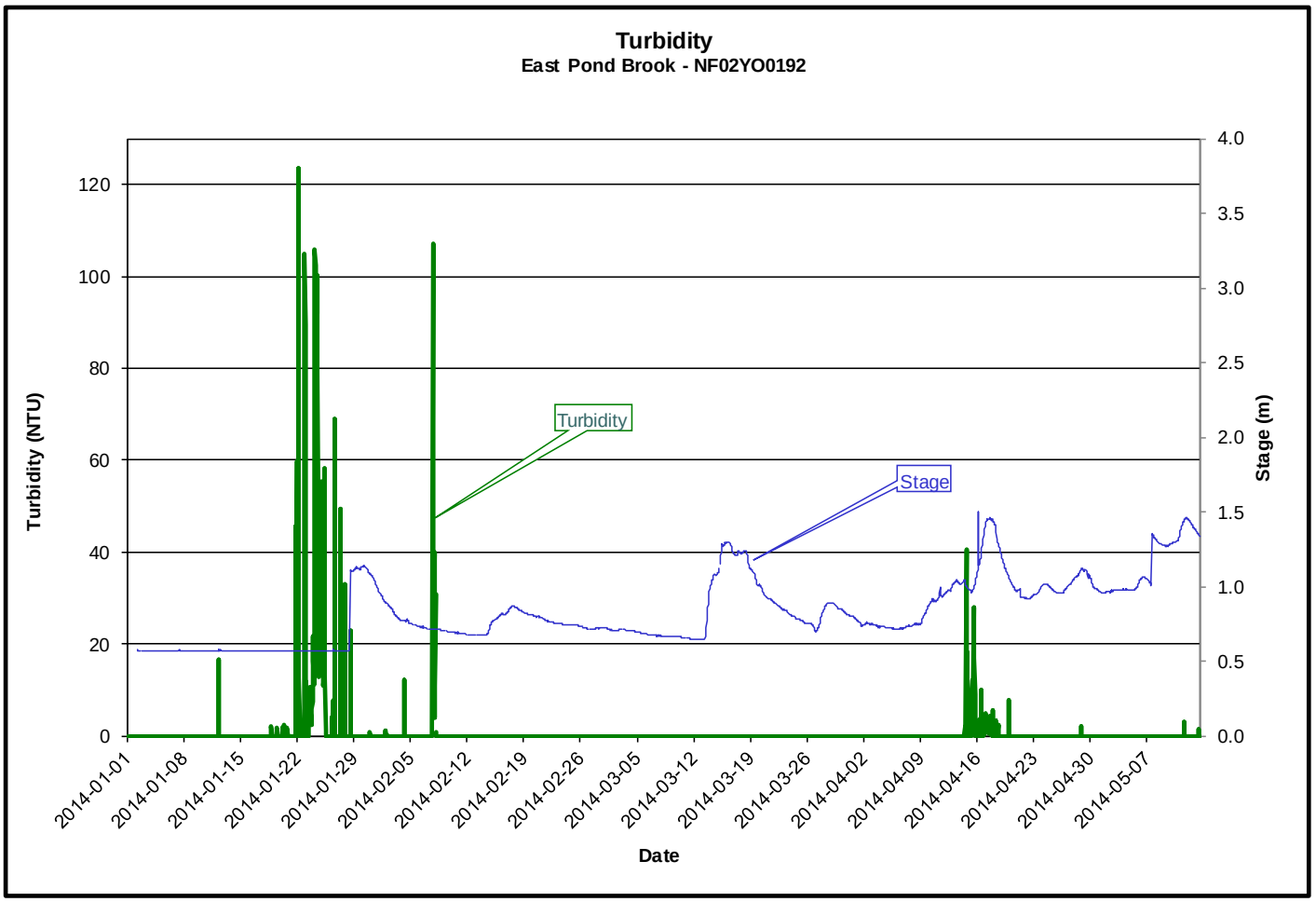

Figure 11

- The stage or water level ranged from a minimum of 0.57 m to a maximum of 1.50 m. The flow or discharge ranged from a minimum of 0.12 m^3/s to a maximum of 5.91 m^3/s **(Figure 12)**.
- For the period shown in the red ellipse, it is suspected that the stage levels were not recording properly. This data has not yet undergone QA/QC by our partners at Water Survey of Canada.
- There were several periods when the low flows could not be calculated as they were outside the range of the existing curves.
- Increases in stage and flow are attributed to precipitation/runoff events.
- All values for stage and flow are within the normal range.

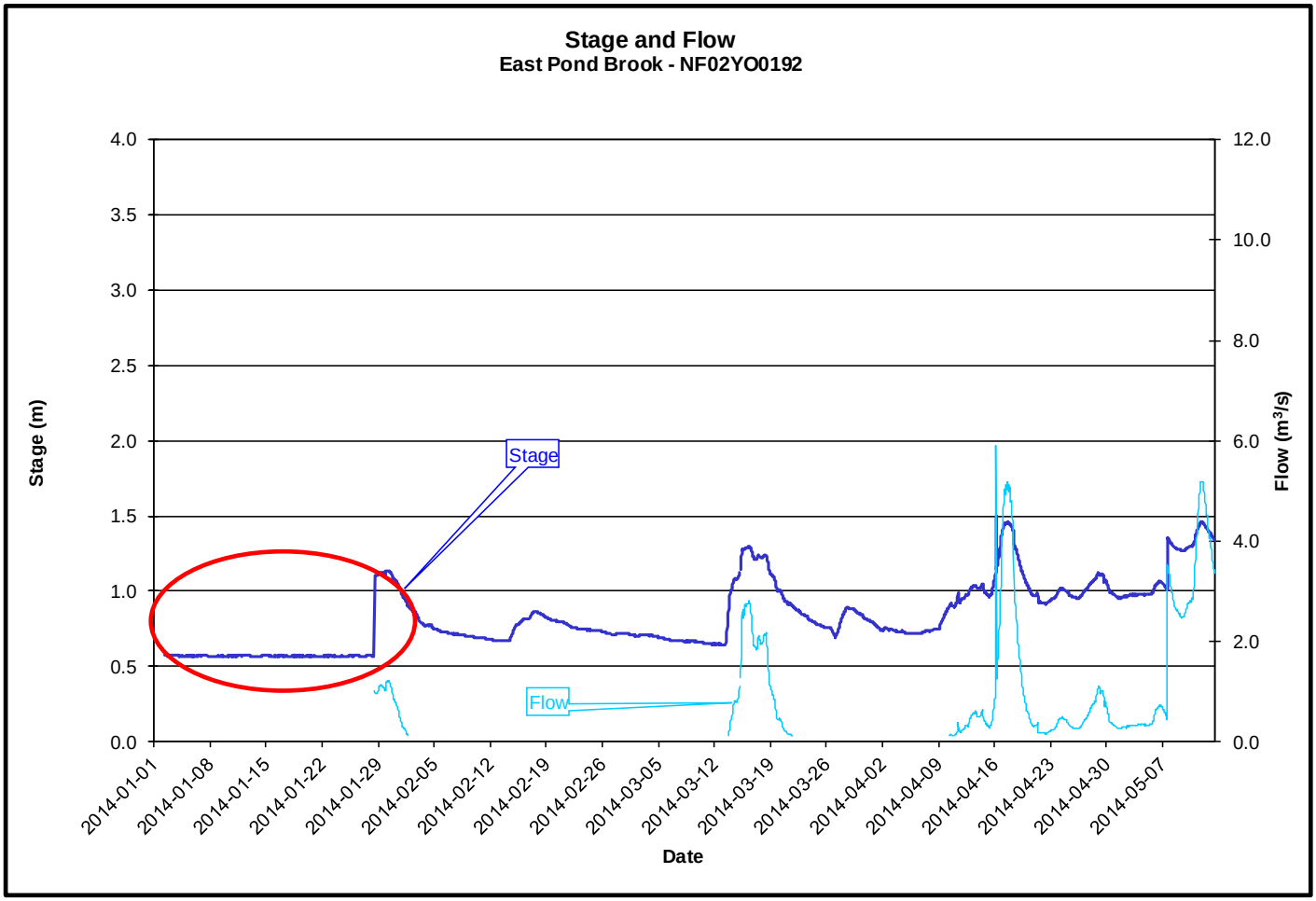

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.48 ˚C to a maximum of 6.33 ˚C with a decrease over the deployment period.
- There appears to be no correlation with water elevation.

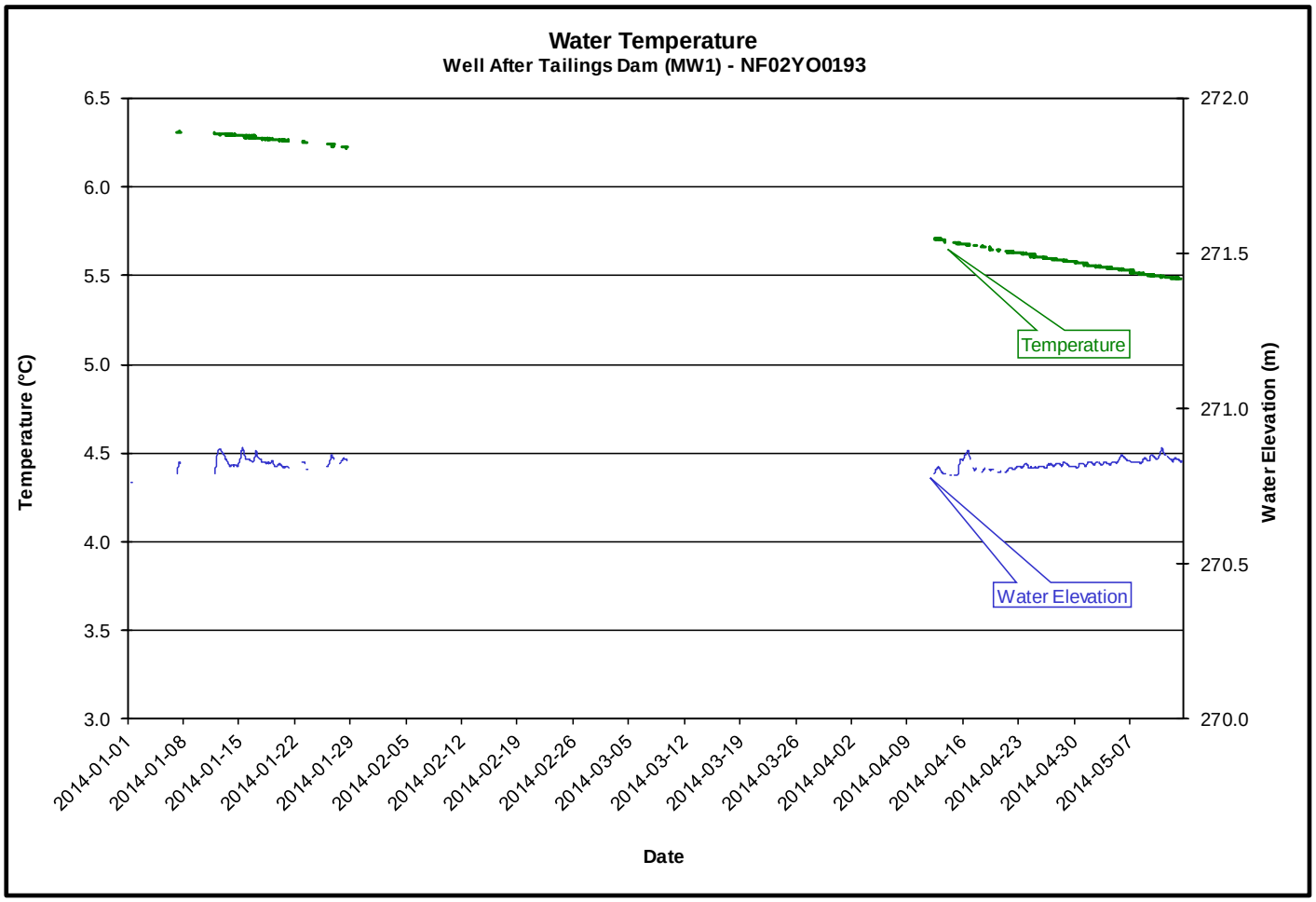

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.44 to a maximum of 8.59, with little change over the deployment period.

- There does not appear to be any correlation with water elevation.

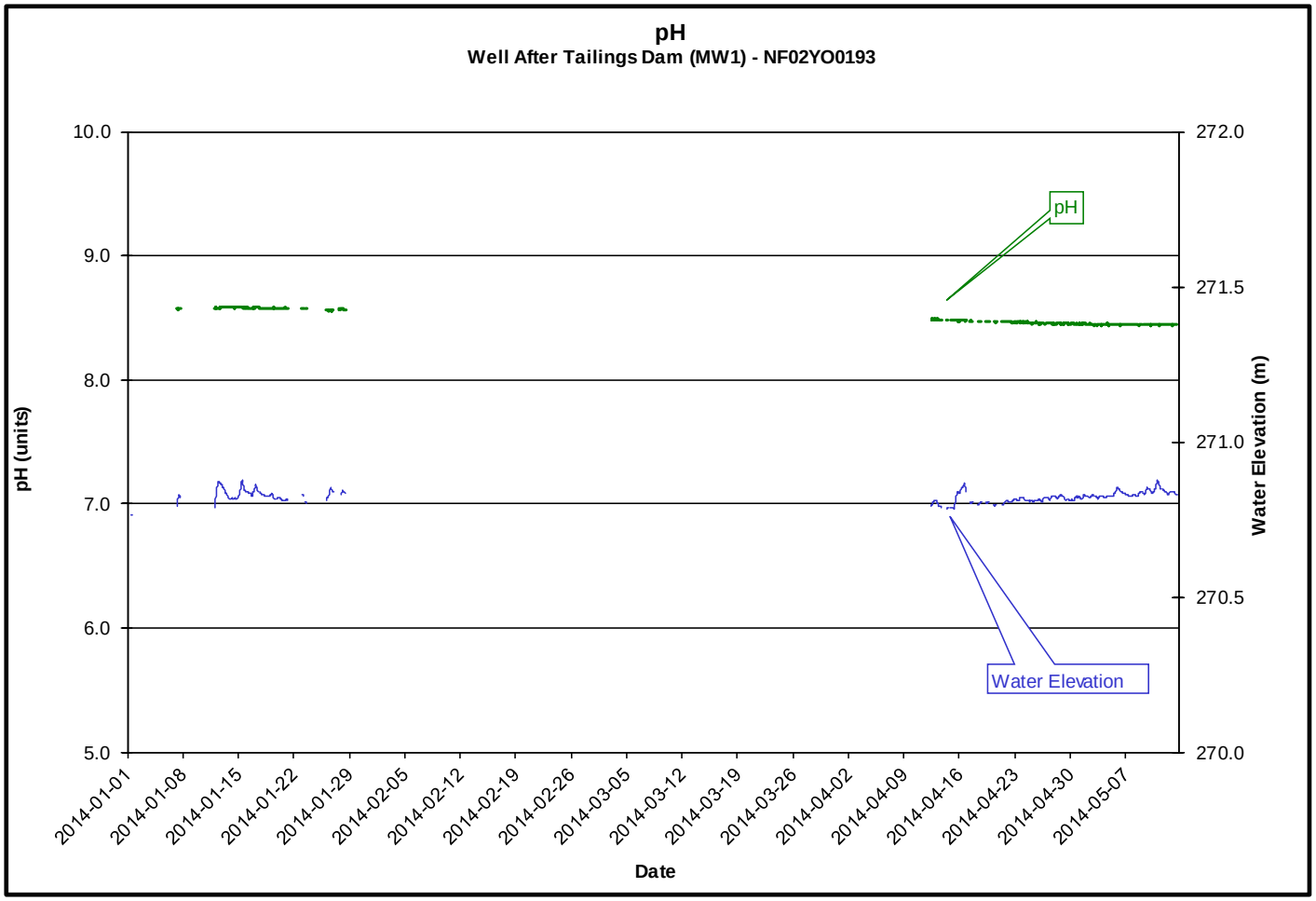

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.808 mS/cm to a maximum of 0.817 mS/cm.
- There was little change over the deployment period.
- There does not seem to be any correlation with water elevation.

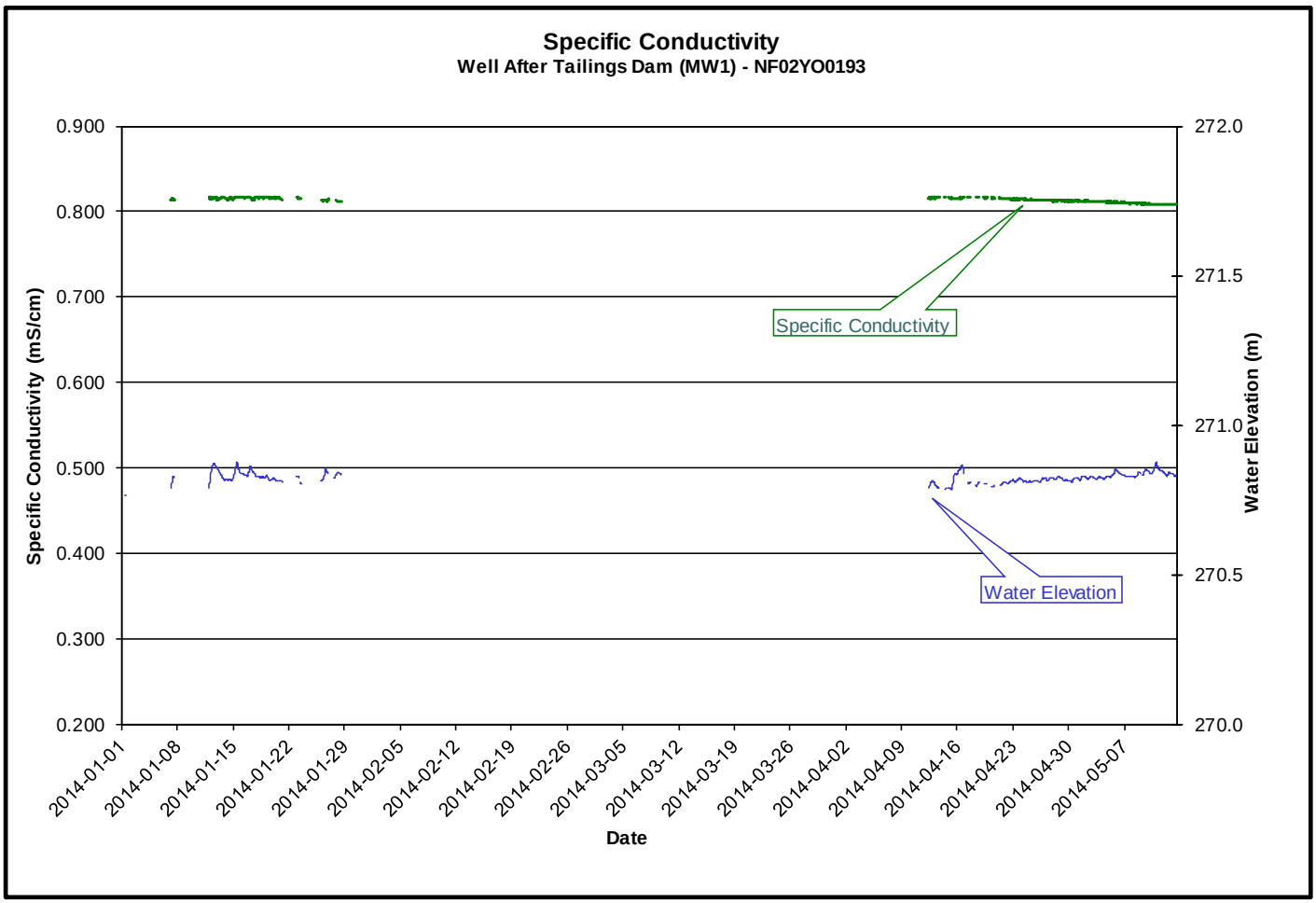

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.76 m to a maximum of 270.88 m, remaining fairly constant 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.

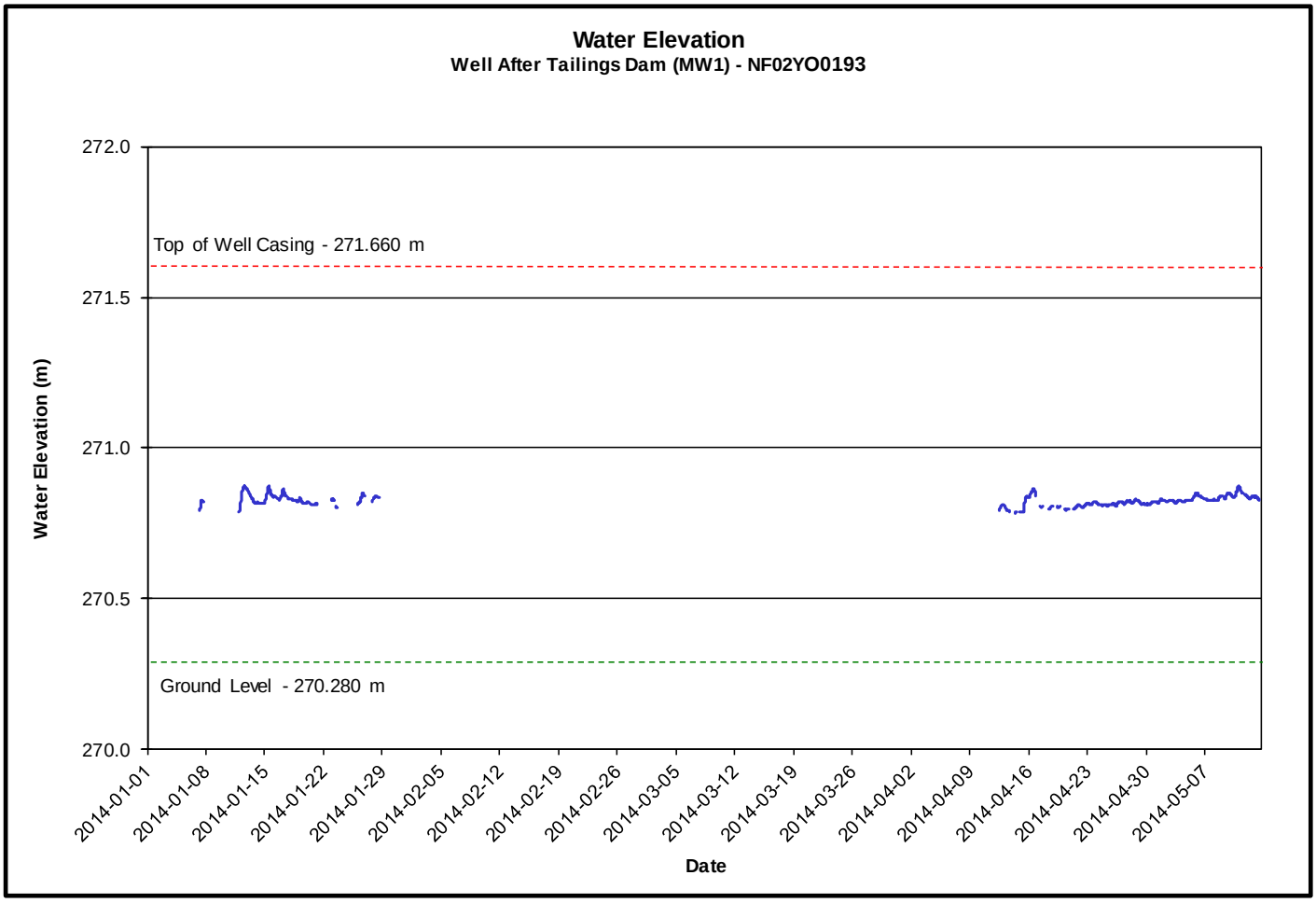

Figure 16

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