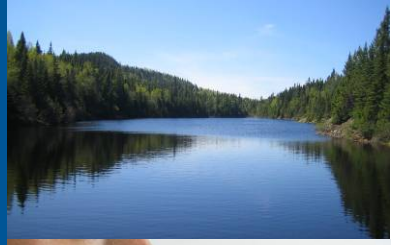
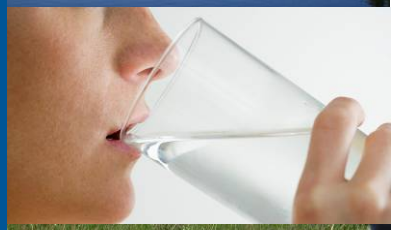



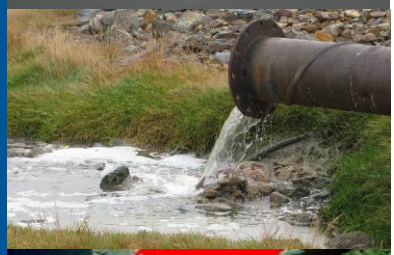


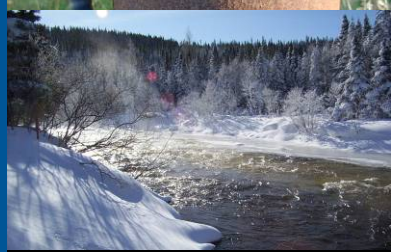

Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2012-01-01 to 2012-05-10

2012-08-10

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 one planned discharge of effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) from April 16, 2012 to April 27, 2012.

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 November 3, 2011, and remained deployed continuously until May 10, 2012 due to ice conditions and spring water levels in the streams. A previous report covers the period from the beginning of the deployment until December 31, 2012. Data will be discussed for the 129 day period covered by this report.

- The regular **Quanta G®** (s/n 00035) has remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1) since September 7, 2011 and remained deployed until several days past the current reporting period. Data will be discussed for the 129 day period covered by this report.

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 QA/QC **MiniSonde®** a qualitative statement (Ranking) is usually made on the data.
- The ranking 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 installed in the fall, prior to winter freeze-up, the rankings for the beginning of the deployment period are documented in the previous report.

- 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 reporting period, no comparisons or rankings are possible.
- For the Tributary to Gills Pond Brook Station, there is a Fair ranking for pH. This is likely due to fouling on the sensor following a prolonged deployment period.
- The East Pond Brook Station experienced some problems whereby in-stream debris and icing conditions caused some interference with the Turbidity sensor throughout the reporting period. The Poor ranking for this parameter at the end of the deployment period is therefore to be expected. All turbidity data for this period are unreliable and have been removed from the data set. Accordingly, no graph or commentary is available.

- There is a significant period of incomplete and missing data for Well After Tailings Dam (MW1) from 08:30 on February 3, 2012 until 09:30 on April 24, 2012, with absolutely no data from February 28, 2012 to April 16, 2012 due to data communications issues. Remedial measures have been employed, in an effort to avoid this situation in the future.

- 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**
2012-01-01	Temp (^{o}C)	n/a
	pH (units)	n/a
	Sp. Conductivity (uS/cm)	n/a
	Dissolved Oxygen (mg/L)	n/a
	Turbidity (NTU)	n/a
2012-05-10 Removal	Temp (^{o}C)	Good
	pH (units)	Fair
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2012-01-01	Temp (^{o}C)	n/a
	pH (units)	n/a
	Sp. Conductivity (uS/cm)	n/a
	Dissolved Oxygen (mg/L)	n/a
	Turbidity (NTU)	n/a
2012-05-10 Removal	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Poor

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of - 0.41 ˚C to a maximum of 12.66 ˚C.
- Temperature remained constant at just below zero for most of the deployment period until mid April.
- There appears to be little correlation with stage.

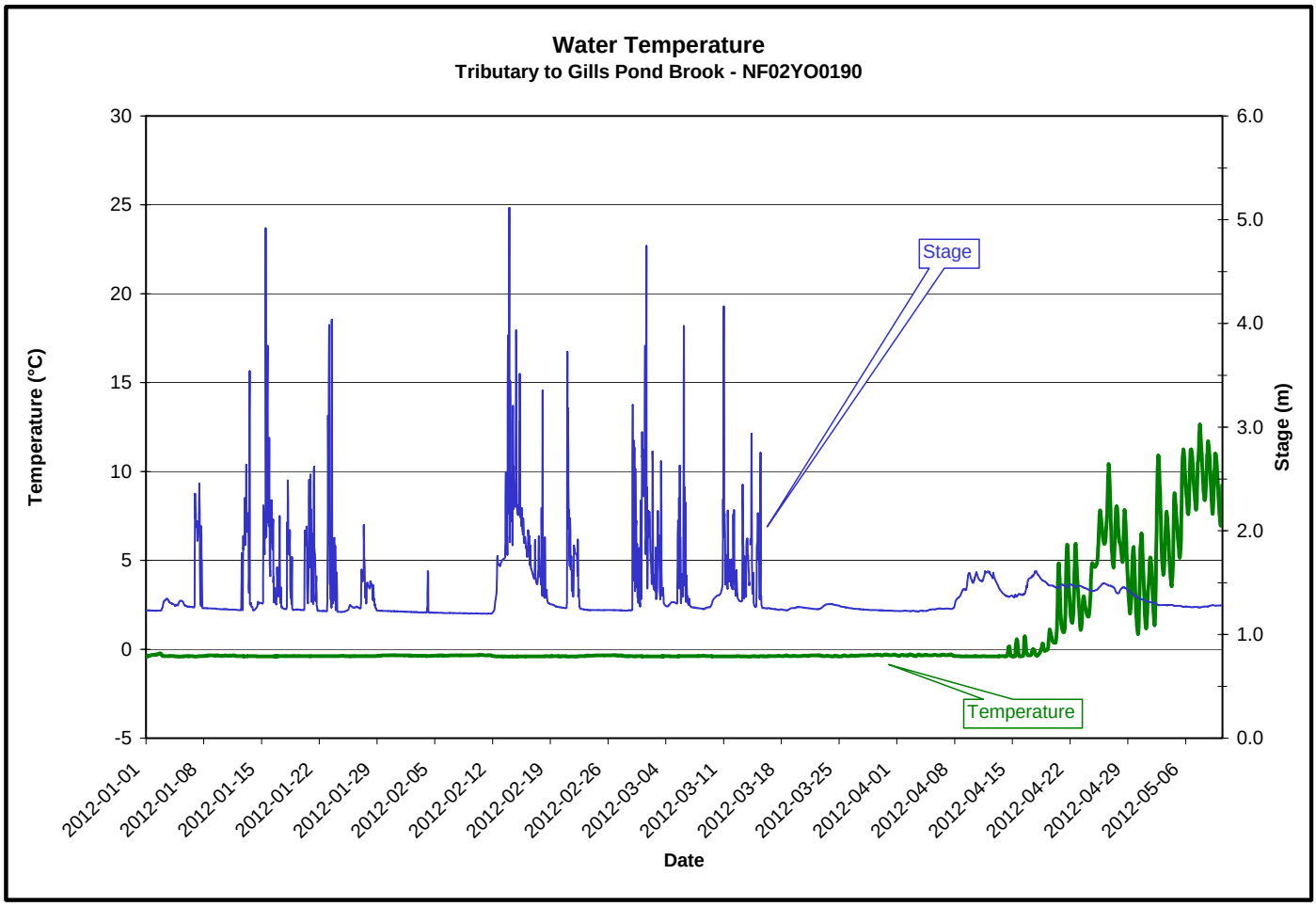

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 5.86 to a maximum of 7.13 with the majority of values falling near or 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*.
- An inverse relationship with stage is obvious during several events over much of this deployment period.
- The background pH of this stream is normally around the lower limit of the recommended range.

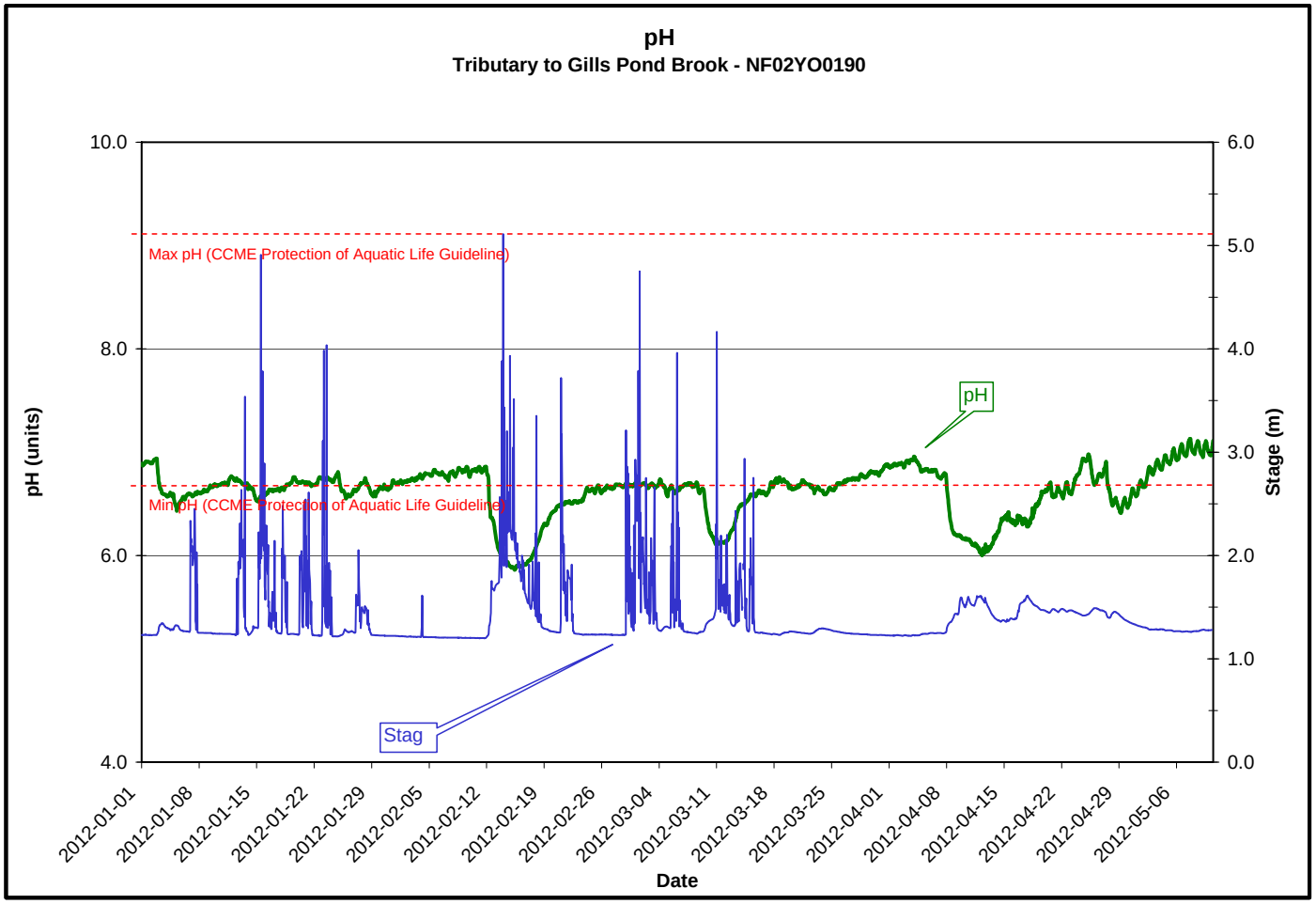

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 20.1 µS/cm to a maximum of 207.0 µS/cm over the deployment period.
- The highest specific conductance readings correspond with periods of discharge from the Polishing Pond. At the beginning of this Deployment Period, the specific conductivity is still dropping, following the cessation of discharge on December 25, 2011. The spike in specific conductivity towards the end of the deployment period corresponds with the discharge from Polishing Pond from April 16, 2012 to April 27, 2012.
- The 'V' shaped dips are the result of dilution caused by precipitation/runoff events, indicated by increases in the stage.

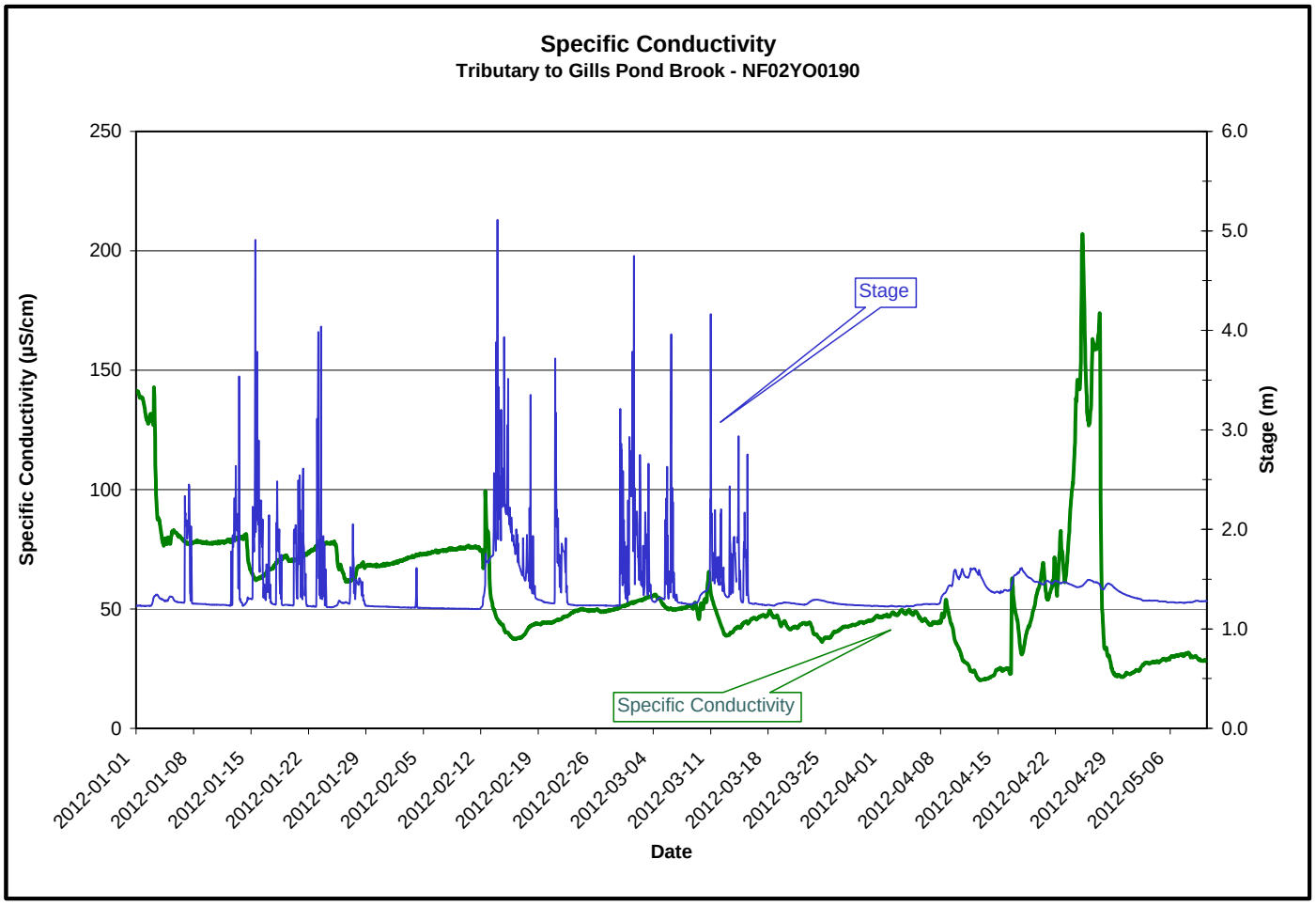

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 10.03 mg/L to a maximum of 14.13 mg/L over the deployment period, with the percent saturation ranging between 79.2 and 97.5.
- Dissolved oxygen is generally inversely proportional to water temperature.
- All of the dissolved oxygen values fell above 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.

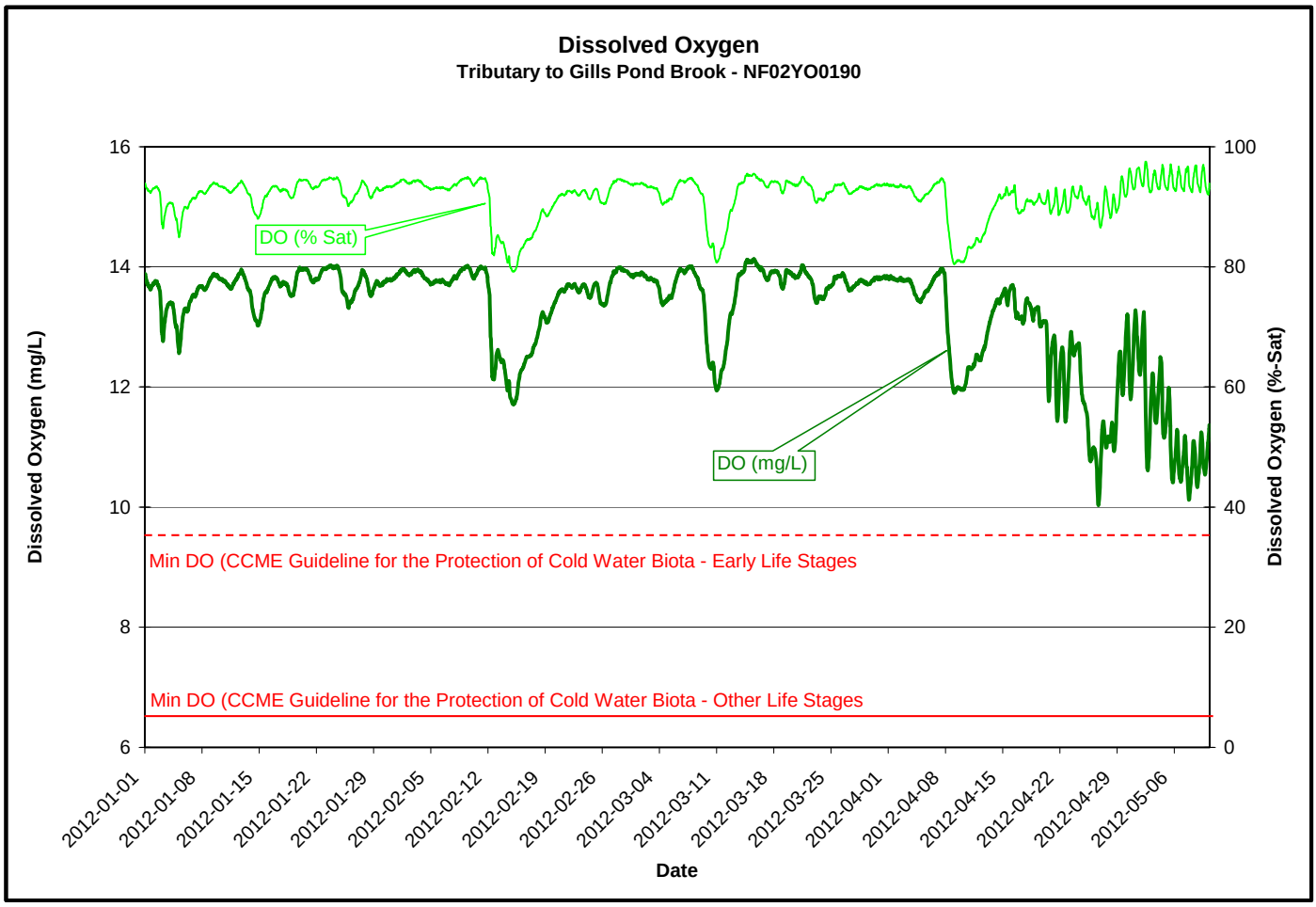

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 96.7 NTU.
- The highest turbidity spikes, and most frequent turbidity measurements correspond to the period when there was discharge from the Polishing Pond.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during higher flows.
- The individual turbidity spikes up to the end of March are likely due to air bubbles or in-stream debris passing over the sensor.

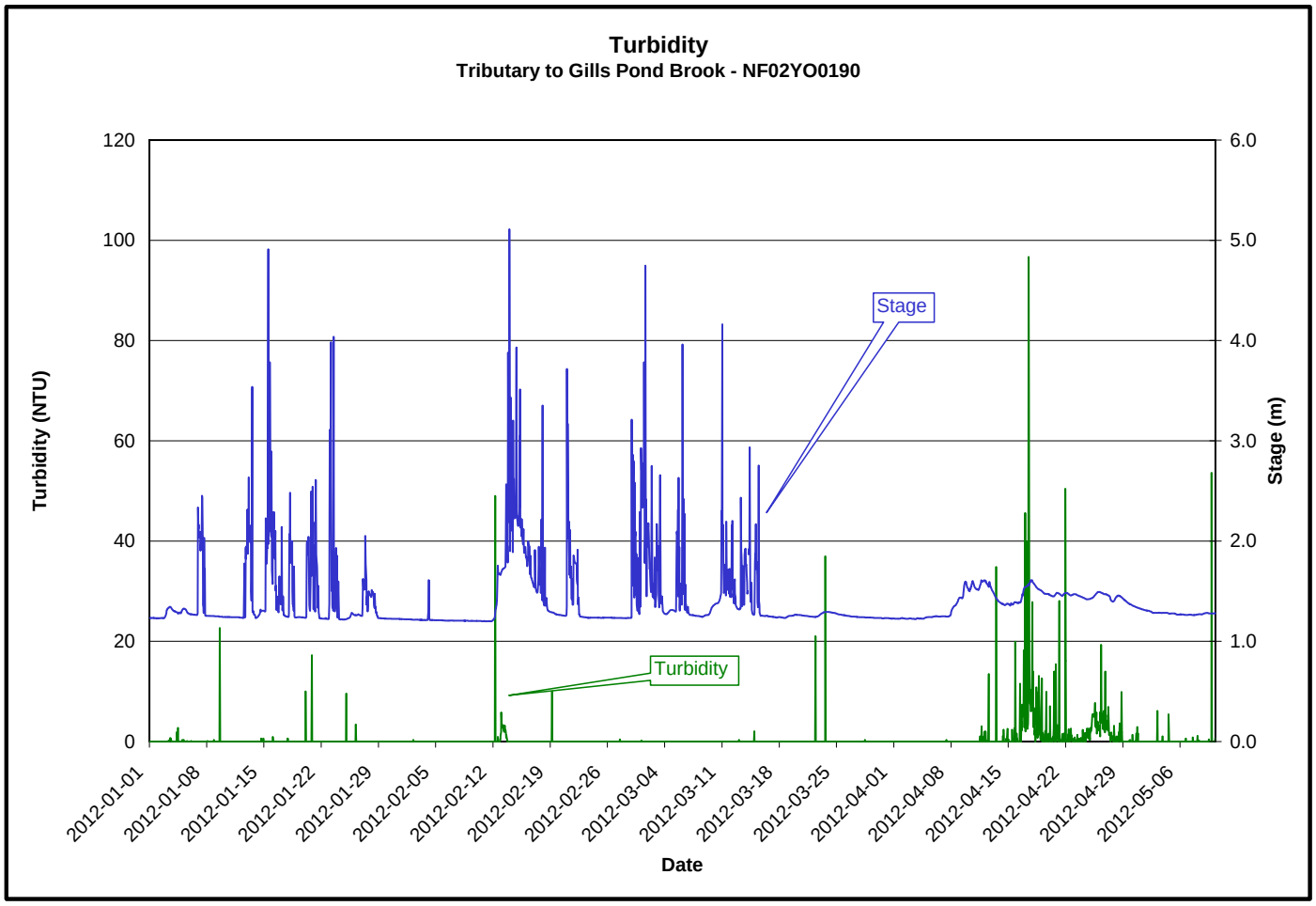

Figure 5

- The stage or water level ranged from a minimum of 1.20 m to a maximum of 5.11 m. The flow or discharge ranged from a minimum of 0.01 m^3/s to a maximum of 2.49 m^3/s (**Figure 6)**.
- The higher levels are related to the backwater effect caused during ice cover.
- All values are within the normal range.

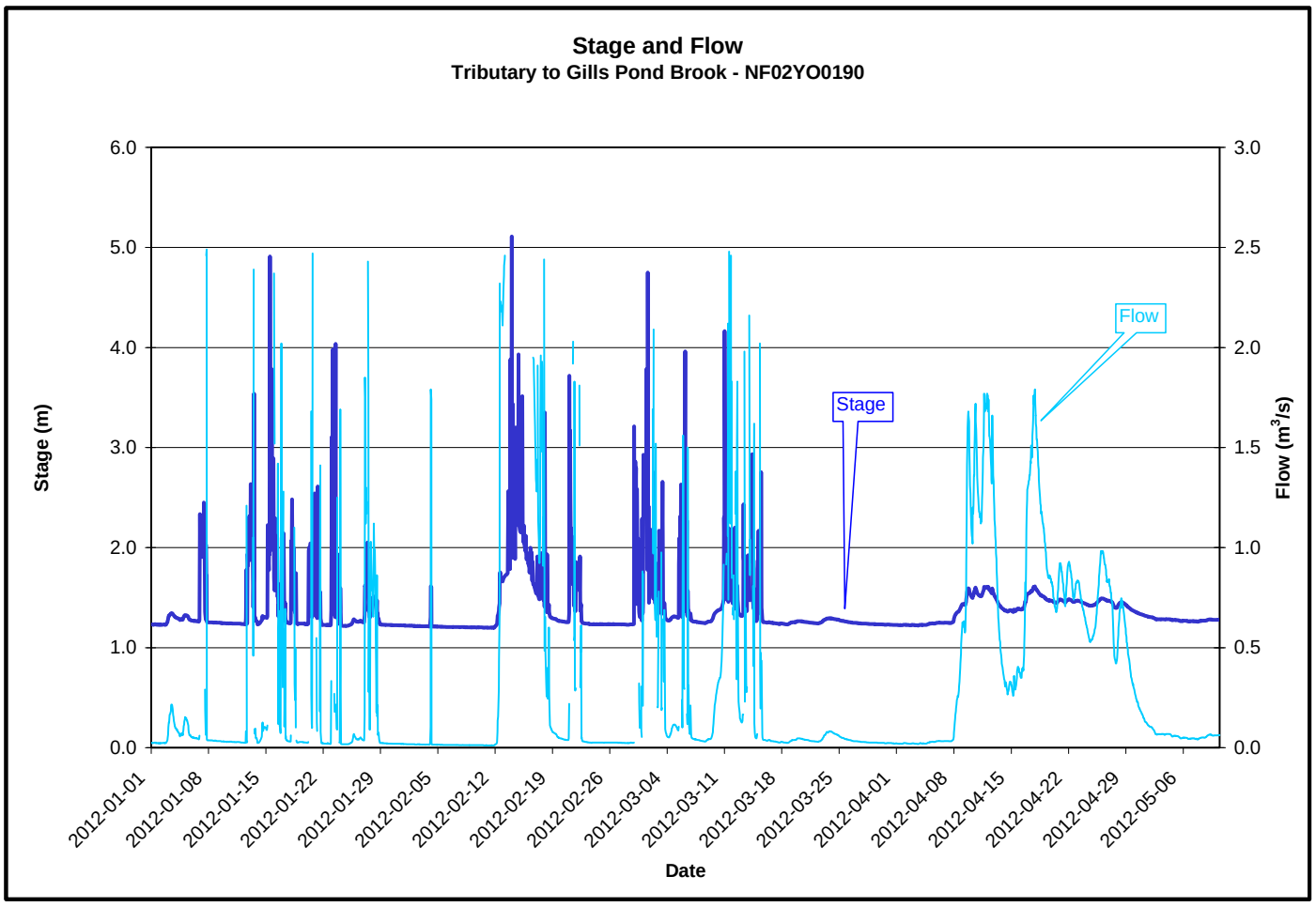

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of - 0.04 ˚C to a maximum of 12.88 ˚C.
- Temperatures remained constant just below zero until the third week of March. Note that water in this stream began to warm up approximately three weeks prior to Tributary to Gills Pond Brook.
- There appears to be little correlation with stage, although during peak flows, the diurnal variation in temperature is less, presumably due to precipitation, cloud cover and lower daytime ambient temperatures.

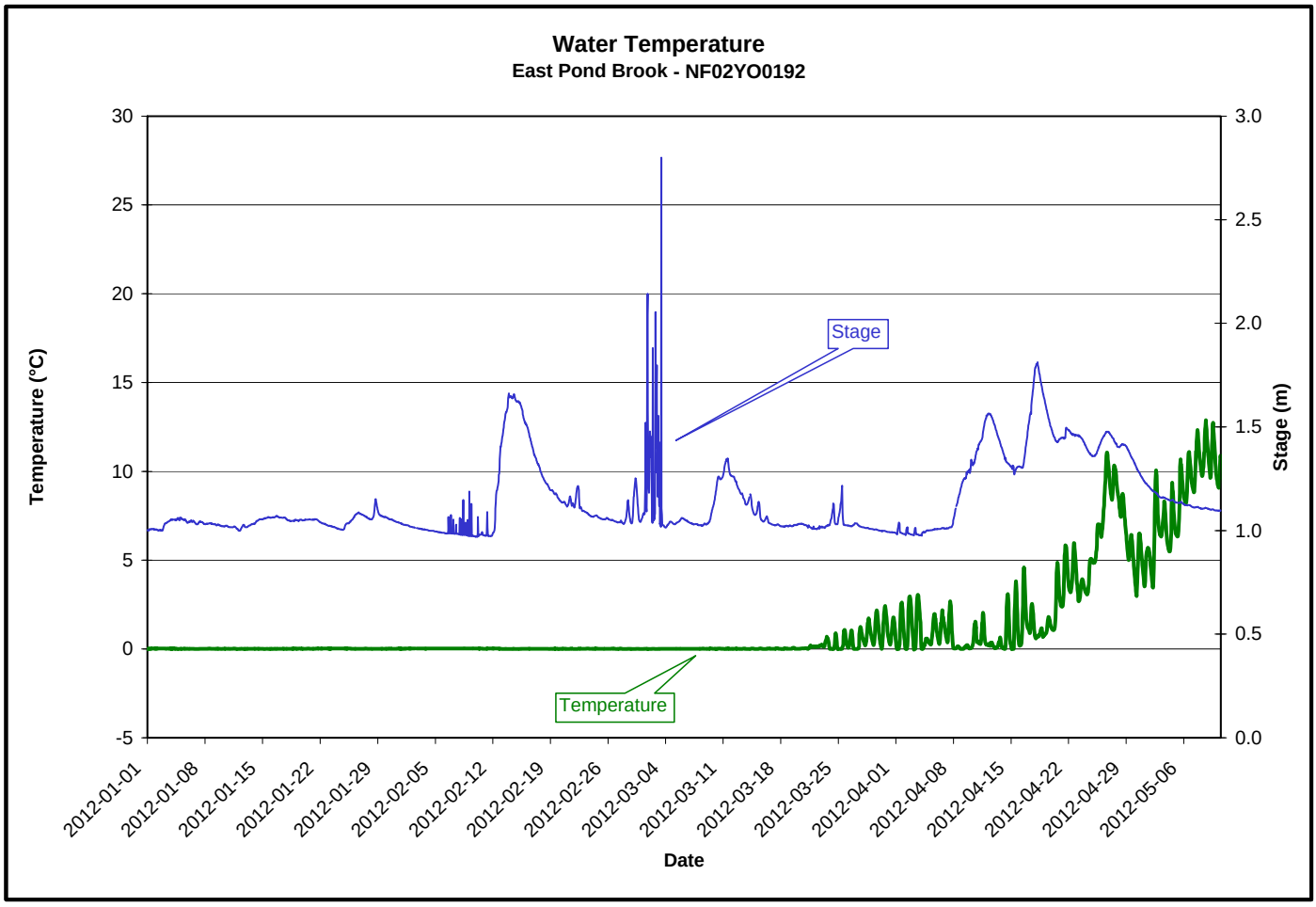

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 5.44 to a maximum of 6.32 with pH decreasing just slightly throughout the deployment period.
- There is a temporary decrease in pH corresponding with peak flows.
- For the entire deployment period, pH values fell well 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.

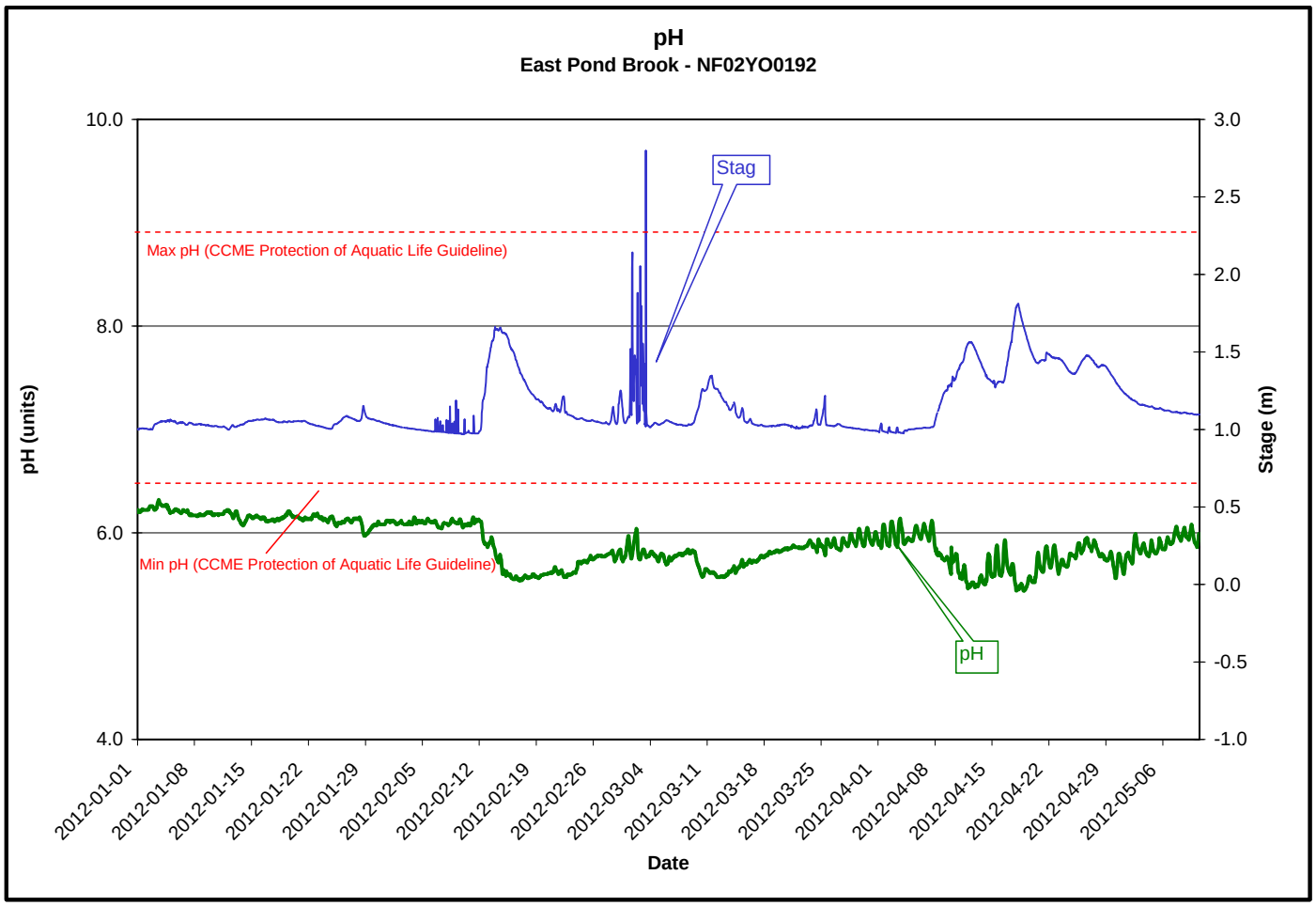

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 11.3 µS/cm to a maximum of 40.3 µS/cm, with a slight decrease over the deployment period.
- There are notable decreases in specific conductivity corresponding with higher flows.
- All values are within the normal range.

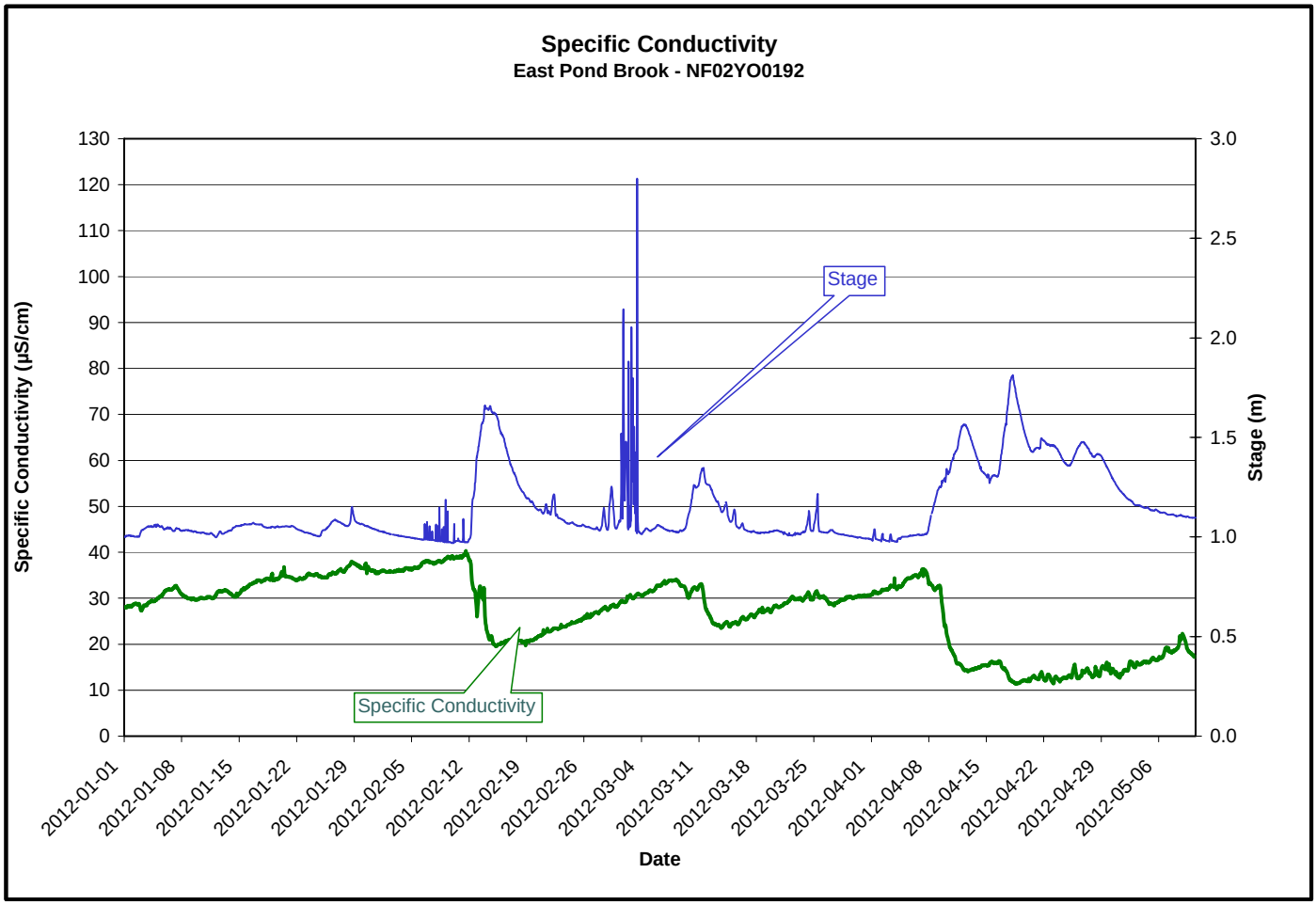

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 9.77 mg/L to a maximum of 13.73 mg/L over the deployment period, with the percent saturation ranging between 80.8 and 96.3.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout the deployment period, all dissolved oxygen values fell above 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.

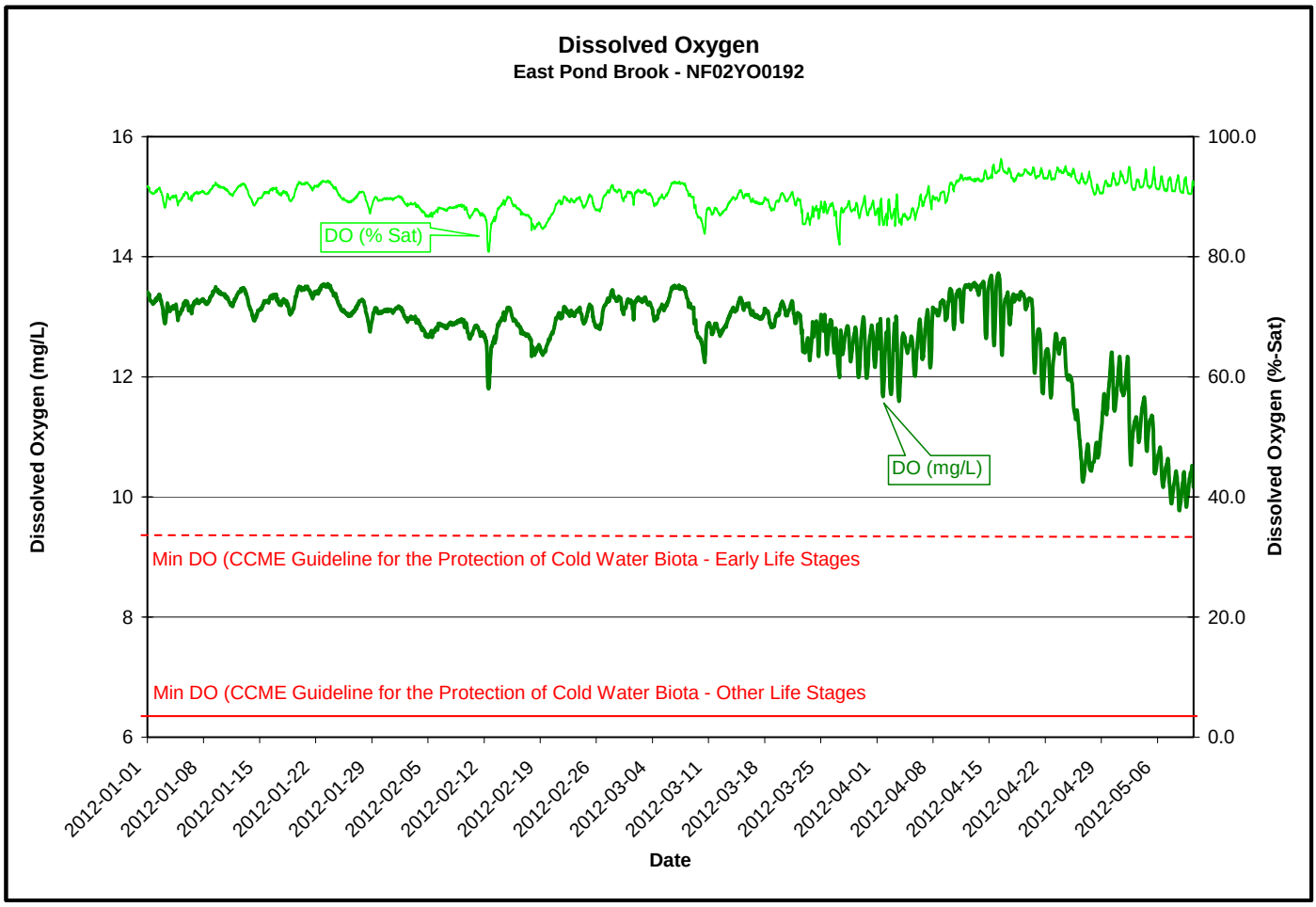

Figure 10

- The stage or water level ranged from a minimum of 0.97 m to a maximum of 2.80 m. The flow or discharge ranged from a minimum of 0.31 m^3/s to a maximum of 12.30 m^3/s **(Figure 11)**.
- The stage and flow peaked rapidly in early March. Based on the hydrograph's response, it is likely that this is a backwater effect caused by ice build-up in the stream. Other peaks appear to be related primarily to precipitation / runoff events, although there may have been some component of backwater
- Both stage and flow are within normal ranges.

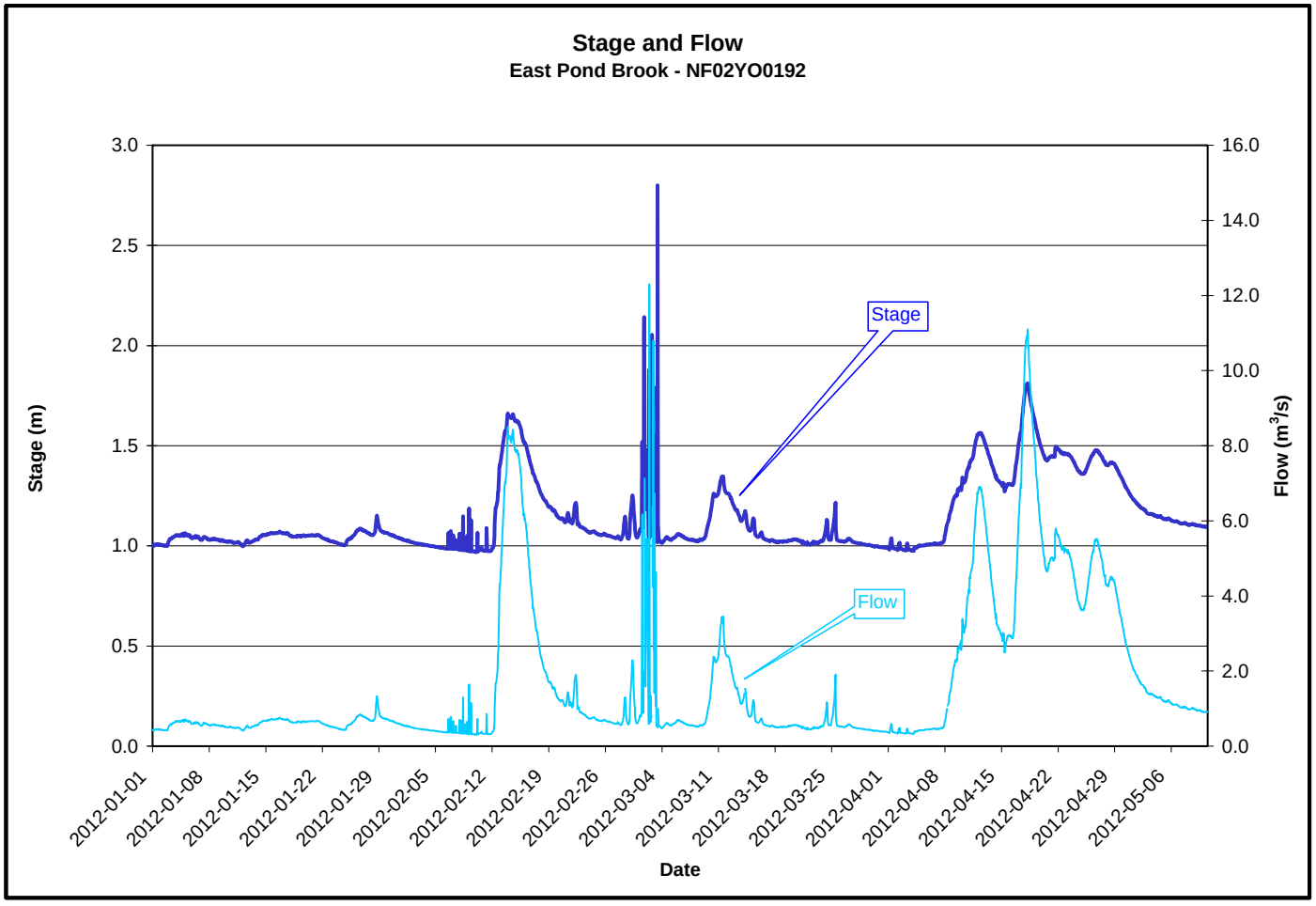

Figure 11

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 12**) ranged from a minimum of 5.73 ˚C to a maximum of 5.98 ˚C with a slight decrease over the deployment period.
- There appears to be little correlation with water elevation.

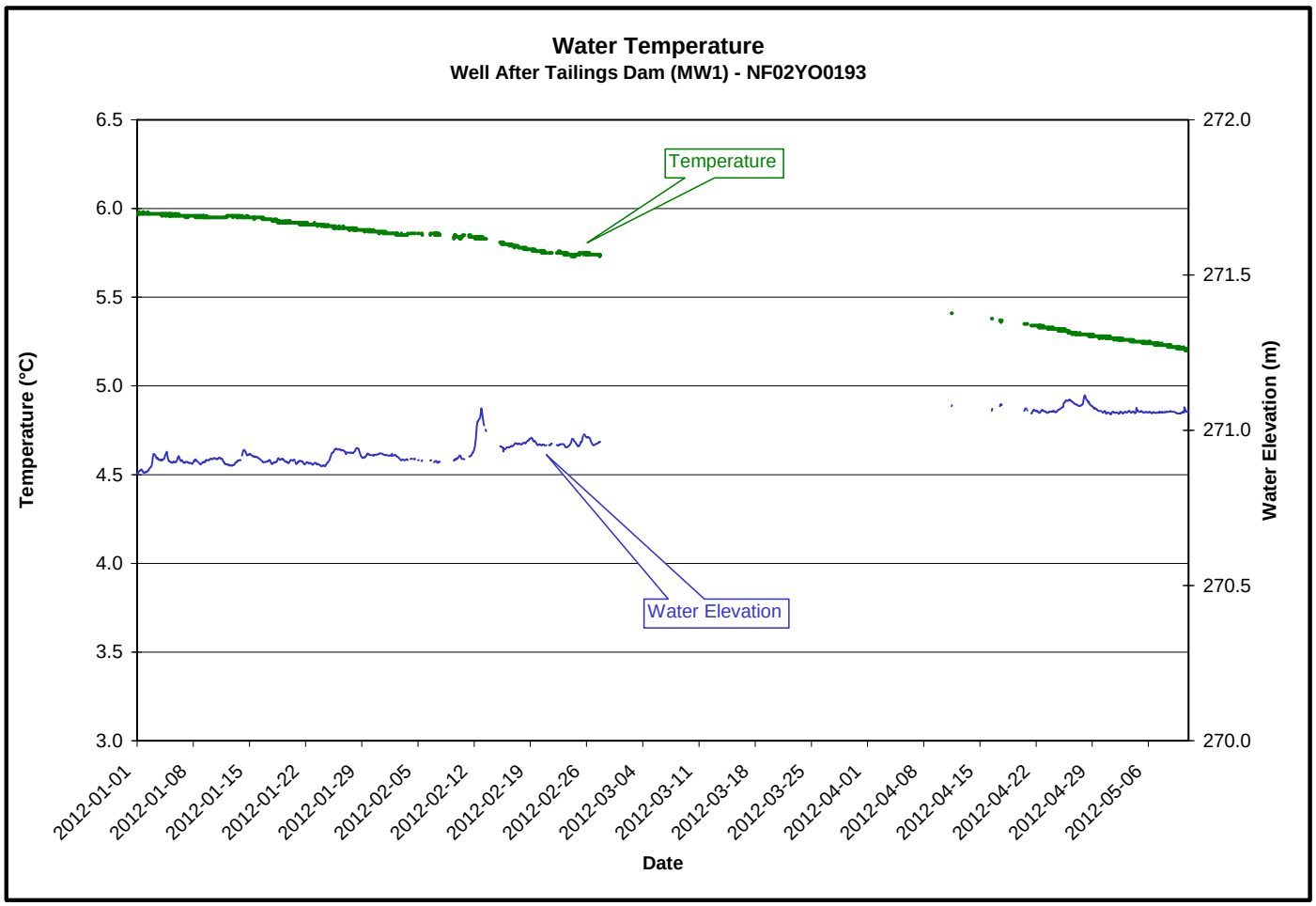

Figure 12

- The pH (**Figure 13**) ranged from a minimum of 7.92 to a maximum of 8.59.
- There was a significant dip in pH in mid-January, which is uncharacteristic for this well. The reason is unknown.
- At the end of the deployment period the pH was significantly lower than at the beginning of the deployment period. It has subsequently been determined that the pH sensor could not be calibrated following its removal from the well (after the deployment period). Accordingly, the pH data from April 16, 2012 onward are suspect and may not be reliabe
- There does not appear to be any correlation with water elevation.

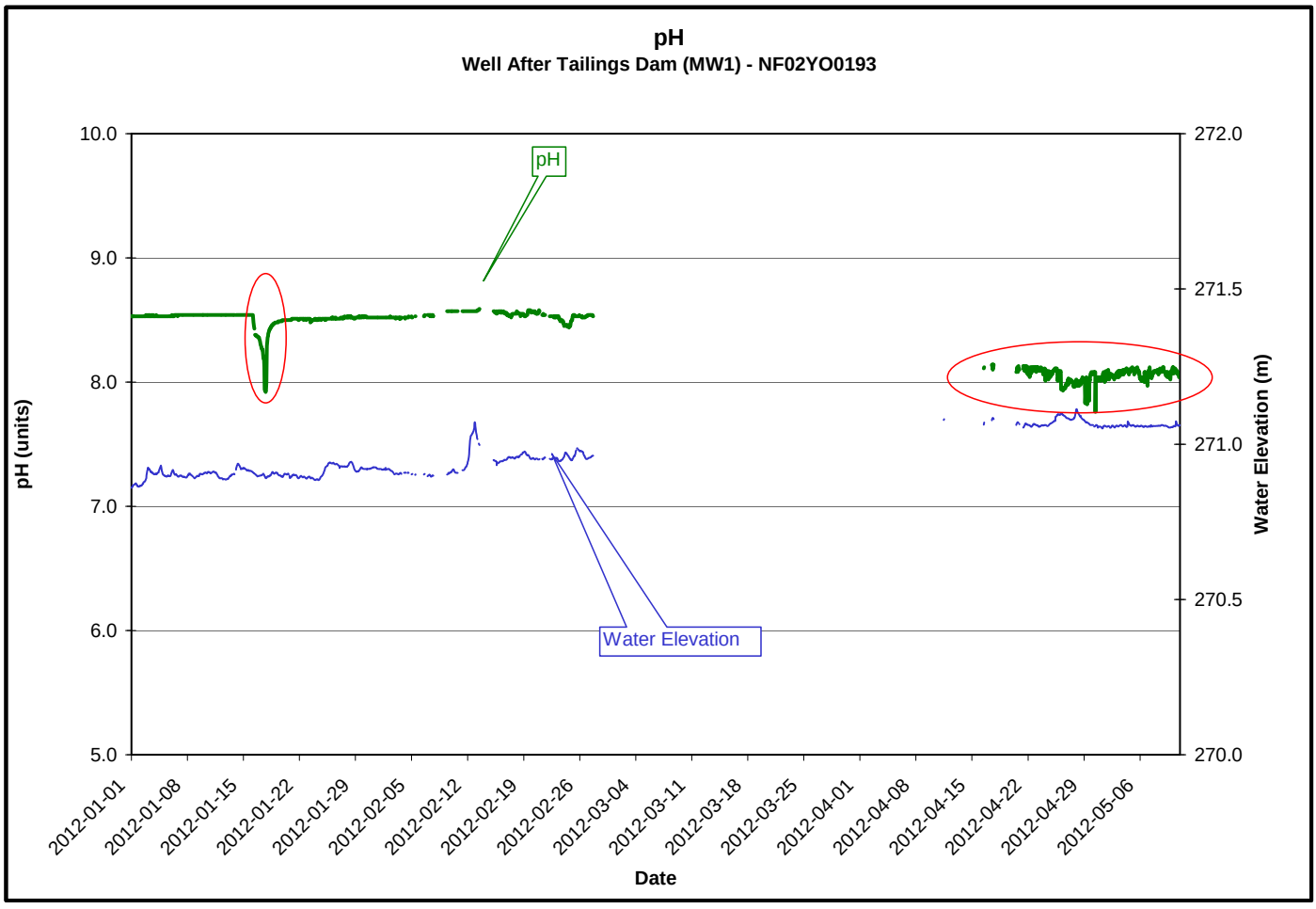

Figure 13

- The specific conductivity **(Figure 14)** ranged from a minimum of 0.661 mS/cm to a maximum of 0.676 mS/cm over the deployment period, with values remaining fairly constant.

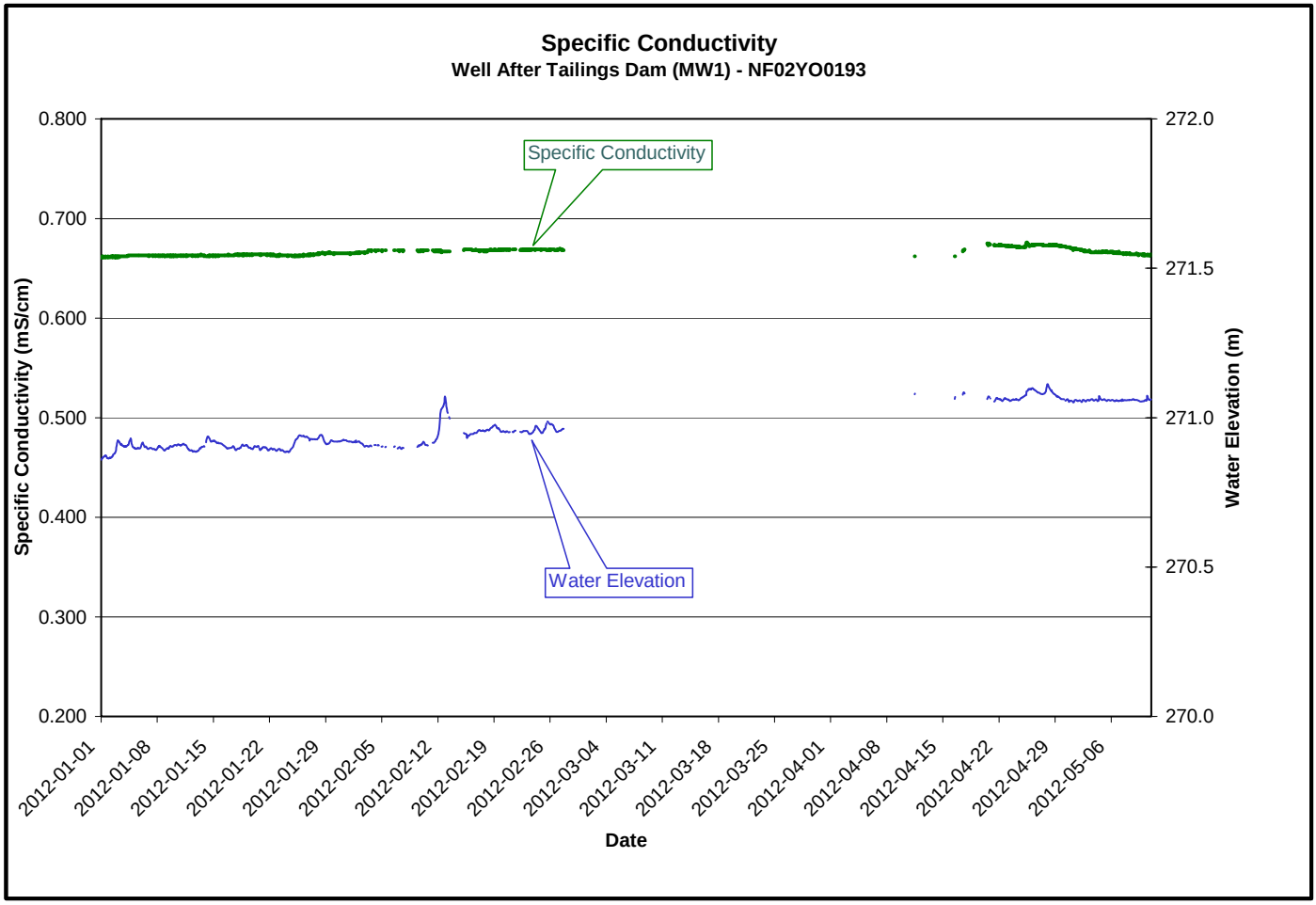

Figure 14

- The Water Elevation **(Figure 15)** ranged from a minimum of 270.86 m to a maximum of 271.07 m. with a slight increase over the reporting period.
- Water elevation in this well corresponds to increased water level in an adjacent stream, and is influenced by runoff from precipitation.

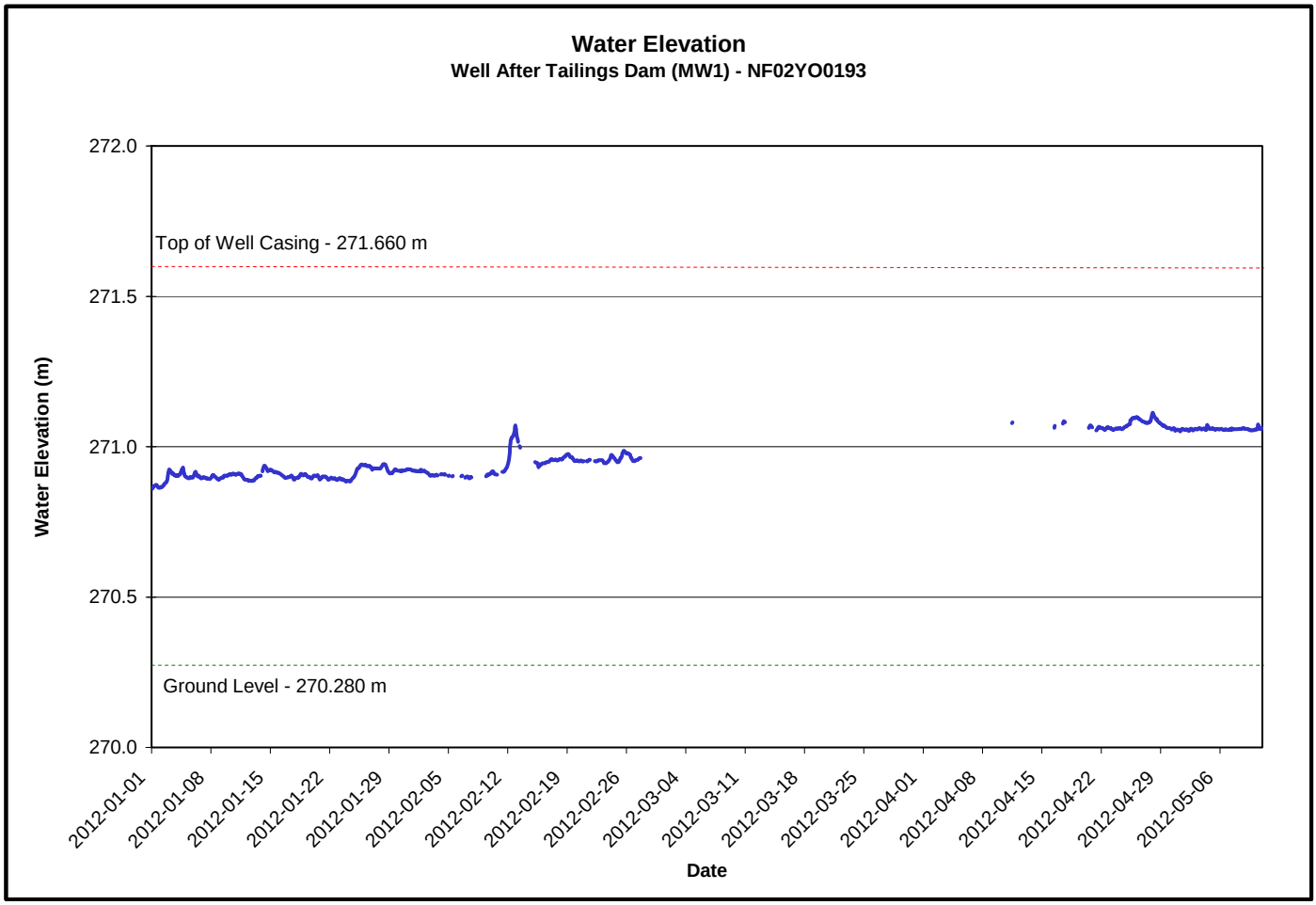

Figure 15

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