

# Real Time Water Quality Report Teck Duck Pond Operations

Deployment Period 2012-10-01 to 2012-11-14

2012-11-29



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) for most of the deployment period, with brief periods without discharge from October 12, 2012 to October 17, 2012 and October 21, 2012 to October 26, 2012.

### Maintenance and Calibration of Instrumentation

- After being cleaned and freshly calibrated a spare **DataSonde**<sup>®</sup>(s/n 45036) for East Pond Brook was installed on October 1, 2012, and remained deployed continuously until November 14, 2012; a 43 day period. The new **DataSonde**<sup>®</sup>(s/n 62267) was returned to the vendor for performance testing and evaluation prior to the expiry of the warranty period, due to some issues with the DO sensor and voltage draw, during prior deployment.
- After being cleaned and freshly calibrated the new DataSonde<sup>®</sup>(s/n 62268) for Tributary to Gills Pond Brook was installed on October 3, 2012, and remained deployed continuously until November 14, 2012, a 41 day period
- The regular **MiniSonde**<sup>®</sup> (s/n 47591) was used for QA/QC purposes during the installation and removal of the instruments. It too, was cleaned and freshly calibrated prior to each use.
- The regular Quanta G<sup>®</sup> (s/n 00035) was deployed on October 3, 2012 after being cleaned and freshly calibrated. It remains deployed continuously in Monitoring Well After Tailings Dam Station (MW1) until some time in the spring of 2013. The reporting period for this instrument is from October 3, 2012 to November 14, 2012; a 41 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 $\mu$ S/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
		<b>T</b> 11 4			

#### Table 1

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

- The ranking at the beginning and end of the deployment period is shown in **Table 2** for Tributary to Gill's Pond Brook and **Table 3** for East Pond Brook.
- 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. The ranking for the beginning of the deployment period is shown in Table 4. No ranking can be determined for the end of the deployment period, as the unit remains deployed.
- From October 23, 2102 to November 14, 2012 there was some interference (presumably leafy debris) with the turbidity sensor at East Pond Brook. Accordingly, all turbidity data have been removed from the data set for this period.
- For the entire deployment period, unusual turbidity values were reported from the turbidity sensor at Tributary to Gills Pond Brook. Accordingly, all these turbidity data for this period have been removed from the data set, and there is no discussion of turbidity for this site in sections below.
- There was a "Fair" ranking for pH upon deployment of the instrument Well After Tailings Dam (MW1) Station. The Quanta G Sonde reported a pH of 7.36, while the laboratory data reported a pH of 8.09. Sometimes, there is a significant change in a sample's pH from the time it is collected, until analysed at the laboratory. Also, immediately following deployment of the instrument, there is a rapid change in pH in the well. See the discussion on pH in the report below.
- 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
2012-10-03 Deployment	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	n/a
2012-11-14 Removal	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	n/a

Page	3
1 450	-

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	Parameter	Ranking
2012-10-01 Deployment	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2012-11-14 Removal	Temp (°C)	Good
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent

Table 3

Well After Tailings Dam (MW1) Station (NF02YO0193)			
Date (yyyy-mm-dd)	Parameter	Ranking	
2012-10-03	pH (units)	Fair	
Deployment	Sp. Conductivity (uS/cm)	Excellent	
T-11-4			

Table 4

# **Data Interpretation**

# TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 1.70 °C to a maximum of 14.60 °C.
- Temperature tended to decline throughout the deployment period, with the diurnal variation still quite evident.
- There appears to be little correlation with stage.



Figure 1

- Throughout the deployment period pH values (Figure 2) ranged from a minimum of 6.25 to a maximum of 7.45 with the majority of values falling just above 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 the several events throughout the deployment period.
- The two periods indicated by the red circles correspond with periods when there was a cessation of discharge from the Polishing Pond. pH in the stream dropped markedly, bringing the levels to near normal (background) levels. pH of discharged water is generally higher than the background pH of the stream.
- From November 2, 2012 through the end of the deployment period, there were three marked decreases in pH which correspond to three very similar increases in stage.
- 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 63.2 μS/cm to a maximum of 1221.0 μS/cm over the deployment period.
- There are four significant decreases in specific conductance obvious during this deployment period: The middle two incidences, highlighted by the solid red ellipses, are the direct result of cessations of discharge from the Polishing Pond. The remaining first and last incidences, highlighted by the dashed red ellipses, are resultant from increases in stage resulting from precipitation.
- Notice that the response of the graph is different. Following cessation of discharge, the specific conductance falls off slowly over about four or five days, then increases rapidly once discharge resumes. Following a major precipitation event, the specific conductance drops off almost immediately, and slowly recovers over the next four or five days.
- Precipitation effectively has a dilution effect on this stream which is the receiving water from the Polishing Pond.



Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 9.53 mg/L to a maximum of 12.90 mg/L over the deployment period, with the percent saturation ranging between 85.1 and 98.6.
- 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 stage or water level ranged from a minimum of 1.29 m to a maximum of 1.56 m. The flow or discharge ranged from a minimum of 0.07 m<sup>3</sup>/s to a maximum of 1.43 m<sup>3</sup>/s (**Figure 5**).
- The drops in stage and flow are obvious from October 12, 2012 to October 17, 2012 and October 21, 2012 to October 26, 2012 corresponding with the cessation of discharge from the Polishing Pond.
- From November 2, 2012 through the end of the deployment period, there was a marked increase in stage and flow with three distinct peaks. This increase was the result of heavy periods of precipitation and subsequent runoff. A similar hydraulic response is also evident for the same period in East Pond Brook.
- Water quality parameters pH and Specific Conductance exhibited an inverse response to the change in stage and flow during this period.
- All values are within the normal range.



Figure 5

- The water temperature (**Figure 6**) ranged from a minimum of 0.23 °C to a maximum of 14.69 °C.
- Temperatures generally decreased throughout the deployment period, with the diurnal variation still quite evident.
- There appears to be little correlation with stage



Figure 6

- Throughout the deployment period pH values (**Figure 7**) ranged from a minimum of 6.08 to a maximum of 6.97 with pH remaining constant until November 4, 2012.
- Following the significant increase in runoff that began on November 2, 2012, the pH began to drop off on November 4, 2012 (two day delay) and remained lower for the remainder of the deployment period.
- Distinct decreases in pH corresponding to the three peaks in Stage, are not as evident as they are in Tributary to Gills Pond Brook.
- Prior to November 4, 2012, pH values fell just above the lower limit of the recommended range (6.5 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*. Following this event, pH values were generally lower than the lower limit.
- The background pH of this stream is normally quite low, and values near and below the lower limit are not unusual.



Figure 7

- The specific conductivity (Figure 8) ranged from a minimum of 14.0  $\mu$ S/cm to a maximum of 34.4  $\mu$ S/cm, with a slight decrease over the deployment period.
- Following in increase in runoff on November 4, 2012 the specific conductance decreased, and subsequently remained much lower for the remainder of the deployment period. Distinct decreases in specific conductance corresponding to the three peaks in Stage, are not as evident as they are in Tributary to Gills Pond Brook.
- All values are within the normal range.



Figure 8

- The dissolved oxygen (**Figure 9**) values ranged from a minimum of 9.44 mg/L to a maximum of 13.77 mg/L over the deployment period, with the percent saturation ranging between 90.7 and 97.8.
- 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 9

- The turbidity values (Figure 10) were constant at 0.0 NTU.
- From October 23, 2102 to November 14, 2012 there was some intermittent interference (presumably leafy debris) with the turbidity sensor. Accordingly, all turbidity data have been removed from the data set for this period.
- Neither in-situ nor grab sample measurements nor visual observation indicated turbidity issues.



Figure 10

- The stage or water level ranged from a minimum of 1.03 m to a maximum of 1.52 m. The flow or discharge ranged from a minimum of 0.56 m<sup>3</sup>/s to a maximum of 6.23 m<sup>3</sup>/s (Figure 11).
- From November 2, 2012 through the end of the deployment period, there was a marked increase in stage and flow with three distinct peaks. This increase was the result of heavy periods of precipitation and subsequent runoff. A similar hydraulic response is also evident for the same period in Tributary to Gills Pond Brook
- Water quality parameters pH and Specific Conductance exhibited an inverse response to the change in stage and flow during this period.
- All values for stage and flow are within the normal range.



Figure 11

- The water temperature (**Figure 12**) ranged from a minimum of 5.49 °C to a maximum of 5.85 °C with a slight increase over deployment period.
- There appears to be no correlation with water elevation.



Figure 12

- The pH (**Figure 13**) ranged from a minimum of 7.63 to a maximum of 8.21.
- There was a slight increase over the deployment period.
- Upon deployment of the Quanta G Sonde in the well on October 3, 2012, there was the characteristic rapid increase (and subsequent levelling off) in pH which has been observed with each previous deployment in this well. It is assumed that this is due to the displacement of water in the well as the Sonde is deployed in the small diameter casing.
- There does not appear to be any correlation with water elevation.



Figure 13

- The specific conductivity (Figure 14) ranged from a minimum of 0.702 mS/cm to a maximum of 0.729 mS/cm.
- Specific conductance values decreased slightly for a few hours following deployment, but subsequently increased gradually over the remainder of the deployment period.
- There does not seem to be any correlation with water elevation.



Figure 14

- The Water Elevation (Figure 15) ranged from a minimum of 270.83 m to a maximum of 270.93 m. with little variation 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 15

Prepared by:

Robert WightEnvironmental ScientistWater Resources Management DivisionDepartment of Environment and ConservationTel:709-292-4280Fax:709-292-4365e-mail:robertwight@gov.nl.ca