

# General

- Department of Environment and Conservation staff monitors the real-time web pages consistently.
- This monthly deployment report interprets the data from Rattling Brook Big Pond, Rattling Brook below Bridge and Rattling Brook below Plant Discharge stations for the period of December 16<sup>th</sup>, 2009 to February 1<sup>st</sup>, 2010; a period of 46 days.
- Vale Inco will be informed of any significant water quality events in the form of a monthly deployment report and automated alerts as they occur.
- On December 17<sup>th</sup>, 2009 and January 4<sup>th</sup>, 2010, a berm at the outlet of Pond 25 was altered and allowed heavily silted water to pass into the Rattling Brook system.
- On December 27<sup>th</sup>, 2009, a generator pumping water to a vegetated area failed and allowed water to pass overland into the Rattling Brook system causing a turbidity spike.
- Temporary voluntary work stoppages occur in certain areas when it is deemed that conditions have deteriorated to a point where an adverse environmental impact may occur.

# **Maintenance and Calibration of Instrument**

- As part of the Quality Assurance and Quality Control protocol (QAQC), an assessment of data reliability recorded by an instrument is made at the beginning of deployment and at removal. Upon installation, a comparison is made between the field sonde and a QAQC instrument placed side by side in the receiving water body. A grab sample is also taken at this time. Following deployment, an assessment of biofouling and calibration drift is made and a retroactive correction is applied to the data based on identified error.
- Upon deployment, readings from the field sonde are compared to pH, Conductivity and Turbidity results from a grab sample. Temperature and Dissolved Oxygen are ranked according to difference between the QAQC instrument and Field instrument due to the impracticality of measuring temperature and dissolved oxygen in the lab.

Station	Date	Action	Instrument Comparison Ranking				
			Temperature	pН	Conductivity	Dissolved Oxygen	Turbidity
Big Pond	December 16 <sup>th</sup> , 2009	Deployment	Good	Good	Good	Fair	Good
	February 1 <sup>st</sup> , 2010	Removal	NA	NA	NA	NA	NA
Below Bridge	December 16 <sup>th</sup> , 2009	Deployment	Excellent	Poor	Fair	Excellent	Good
	February 1 <sup>st</sup> , 2010	Removal	Good	Good	Fair	Excellent	Excellent
Below Plant Discharge	December 16 <sup>th</sup> , 2009	Deployment	Good	Fair	Excellent	Poor	Marginal
	February 1 <sup>st</sup> , 2010	Removal	Excellent	Poor	Marginal	Good	Excellent

Table 1: QA/QC Data Comparison Rankings upon Deployment on December 16<sup>th</sup>, 2009 to February 1<sup>st</sup>, 2010.

• QAQC information could not be taken from the Big Pond instrument upon removal because of battery failure in cold weather.

# **Data Interpretation**

- The following sections provide an analysis of parameters recorded by the Rattling Brook network on the Vale Inco property at Long Harbour, Newfoundland and Labrador.
- Data corrections have been calculated in instances where the combined biofouling and calibration drift (total error) exceed a data correction criterion. Corrected data is graphed alongside raw data for parameters requiring correction.

# RATTLING BROOK BIG POND

• Water temperature at Rattling Brook Big Pond ranged from a high of 1.78°C to a low of 0.04°C. Peaks in the temperature graph occur during periods of increasing stage caused by above-zero air temperature and precipitation events. At the end of deployment, Big Pond was found to be frozen and the water quality sonde was removed by chopping a hole in the 8" thick ice. No corrections were made to temperature since total error was less than the data corrections criteria.

# Figure 1: Water Temperature at Rattling Brook Big Pond



## **Corrected Vs Uncorected Temperature**

• For the deployment period, pH remained below the CCME Guideline for the Protection of Aquatic Life. pH peaked at 6.41 and reached a low of 5.86. Given the lack of fluctuations in pH over the deployment period, no concern is warranted regarding the below-CCME pH values.

# Figure 2: pH at Rattling Brook Big Pond



# Corrected vs. Uncorrected pH

 Specific Conductivity at Big Pond ranged from 27.4 µS/cm to 33.0 µS/cm during the deployment interval. Few fluctuations are noticed and tend to occur with precipitation and warmer air temperatures.

# Figure 3: Specific Conductivity at Rattling Brook Big Pond



### **Conductivity Vs. Uncorrected Conductivity**

Dissolved oxygen at Big Pond ranged from 12.19 mg/l to 13.53 mg/l from November 16<sup>th</sup> to February 1<sup>st</sup>. Given the CCME Guidelines of 9.5 mg/l for early life-stage organisms and 6.5 mg/l for other life stages, no concern is warranted regarding DO at this station. All values are far above the stated limits.





### Dissolved Oxygen (mg/l and %Sat)

During this deployment period, turbidity ranged from 4.0 to 16.3 NTU during the deployment. During the descending limb of the stage graph in Figure 5, turbidity is seen to slowly decrease. This may be an effect of ice forming at Big Pond and decreasing the impact of wave action stirring up sediment. The deployment method at this station will be assessed in the spring to ensure that wave action does not have an undue impact on turbidity values.

# Figure 5: Turbidity at Rattling Brook Big Pond



# Turbidity Vs. Uncorrected Turbidity

# RATTLING BROOK BELOW BRIDGE

Values for corrected Temperature ranged from -0.43°C to 1.73°C during the deployment period at Rattling Brook below Bridge. Ice cover can be inferred from flat and stable water temperature values below 0°C as seen after January 11<sup>th</sup>. Also of note is the stage graph for the period of January 18<sup>th</sup> to January 27<sup>th</sup>. During this period, stage fluctuates rapidly, potentially due to ice damming or freezing of the orifice line used to record water depth. During removal, it was found that fouling had impacted temperature values resulting in the need for correction.



### **Corrected Vs Uncorected Temperature**

Figure 6: Water Temperature at Rattling Brook below Bridge

Like Big Pond, Rattling Brook below Bridge station also recorded pH values below the CCME Guideline for the Protection of Aquatic Life for the whole deployment period. No cause for concern is warranted as this is the norm for the Rattling Brook system. Values for corrected pH ranged from 5.91 to 6.39. At removal, it was found that fouling resulted in pH values reporting lower than expected.

# Figure 7: pH at Rattling Brook below Bridge



### Corrected vs. Uncorrected pH

Specific Conductivity values ranged from 27.4 to 34.2 µS/cm over the deployment period. A peak in conductivity is observed on January 4<sup>th</sup> coinciding with a precipitation event and a documented incident of turbid, silt-laden water being released into the Rattling Brook system upstream of the below Bridge station; discussed thoroughly in the turbidity subsections of below Bridge and Plant Discharge sections of this report.

# Figure 8: Specific Conductivity at Rattling Brook below Bridge



### **Conductivity Vs. Uncorrected Conductivity**

Dissolved Oxygen at Rattling Brook below Bridge ranged from 13.05 mg/l to 14.26 mg/l from November 16<sup>th</sup>, 2009 to February 1<sup>st</sup>, 2010. The concentration of oxygen remained above the CCME Guidelines of 9.5 mg/l for early-life-stage cold water biota and 6.5 mg/l for other life stage cold water biota.



Dissolved Oxygen (mg/l and %Sat)

Figure 9: Dissolved Oxygen at Rattling Brook below Bridge

- Turbidity at Rattling Brook ranged from 2.7 NTU to 689.0 NTU over the deployment period from November 16<sup>th</sup>, 2009 to February 1<sup>st</sup>, 2010. On December 17<sup>th</sup>, 2009 and January 4<sup>th</sup>, 2010 incidents were documented wherein a berm upstream of below Bridge station was altered to allow the passage of turbid, silt-laden water into the Rattling Brook system. Though a rainfall of 15.2 mm and 12.9 mm occurred on December 17<sup>th</sup> and January 4<sup>th</sup>, respectively, the increase in turbidity is far beyond what would be expected for such rainfall. On these dates, turbidity increased to 690.0 NTU and 357.5 NTU. This is far in excess of the CCME Guideline where induced turbidity "… should not exceed a change of 8 NTUs for a short-term exposure (e.g., 24 h) above the background concentration in all waters during clear flows.<sup>1</sup>"
- Data correction was not required on turbidity data as the data correction criterion was not exceeded.

<sup>&</sup>lt;sup>1</sup> Canadian Water Quality Guidelines for the Protection of Aquatic Life: Total Particulate Matter. (2002). Canadian Council of Ministers of the Environment

# Figure 10: Turbidity at Rattling Brook below Bridge



### Turbidity Vs. Uncorrected Turbidity

RATTLING BROOK BELOW PLANT DISCHARGE

Water temperatures ranged from 0.02°C to 2.08°C at Rattling Brook below Plant Discharge. Evidence of ice cover exists from January 16<sup>th</sup> onwards as water temperature is flat and stable near zero.



## **Corrected Vs Uncorected Temperature**

Figure 11: Water Temperature at Rattling Brook below Plant Discharge

• pH ranged from 5.10 to 6.77. Most values were found to be below the CCME Guideline of 6.5, however this is of no concern since the typical pH of the Rattling Brook system is slightly acidic. A slow decline in pH is seen towards the end of the deployment period. This may be due to fouling of the pH reference electrode.

# Figure 12: pH at Rattling Brook below Plant Discharge



# Corrected vs. Uncorrected pH

• Specific Conductivity ranged from 35.5  $\mu$ S/cm to 60.0  $\mu$ S/cm from November 16<sup>th</sup> to February 1<sup>st</sup>. Some peaks in conductivity occur in conjunction with increases in stage as seen in Figure 14.

# Figure 13: Specific Conductivity at Rattling Brook below Plant Discharge



## **Conductivity Vs. Uncorrected Conductivity**

• Figure 15 indicates that the concentration of dissolved oxygen at Rattling Brook below Plant Discharge was well above the CCME Guidelines for the Protection of Aquatic Life (9.5 mg/l for early-life-stage biota and 6.5 mg/l for other life stage biota). Dissolved Oxygen ranged from 11.90 mg/l to 13.32 mg/l.





#### Dissolved Oxygen (mg/l and %Sat)

• An average corrected turbidity of 45.8 NTU was found during the deployment interval and ranged from 3.3 to 1094.0 NTU. Two significant incidences of induced turbidity were recorded on December 17<sup>th</sup>, 2009 and January 4<sup>th</sup>, 2010 and were documented by Vale Inco. According to incident reports, a berm structure upstream of the Rattling Brook Stations was altered to allow the passage of turbid water from Pond 25 into Forgotten Pond and into Rattling Brook. Although Figure 16 indicates that the correction criterion for turbidity was exceeded, the correction factor is small and it is difficult to discern a difference between the raw and corrected datasets.

#### 1200 73.1 Turbidity events in relation to the 73 alteration of a berm Turbidity spike on structure upstream of 1000 December 22 due to the station. 72.9 warm temperatures increasing stage due to stage level rise. 800 72.8 Turbidity (NTU) 72.7 **(m**) Stage (m) 72.6 600 400 72.5 Turbidity spike due 72.4 to heavy precipitation, and 200 temperatures >0°C 72.3 0 72.2 18 20 22 24 26 28 30 01 03 05 07 09 11 13 15 17 19 21 23 25 27 16 29 31 Turbidity -- Corrected Turbidity -- Stage

# Turbidity Vs. Uncorrected Turbidity

Figure 15: Turbidity at Rattling Brook below Plant Discharge

# Appendix



## Figure 16: Max Daily Wind Speed at Argentia



Figure 17: Mean Daily Temperature and Total Daily Precipitation at Argentia

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