VOISEY'S BAY NICKEL COMPANY LIMITED

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# Voisey's Bay Real-Time Water Quality Monitoring Network Annual Report 2007

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## Acknowledgements

The Real-Time Water Quality Monitoring Network in Voisey's Bay is successful in tracking emerging water quality issues due to the hard work and diligence of certain individuals. The management and staff of Voisey's Bay Nickel Company Limited (VBNC) work in cooperation with the management and staff of the Department of Environment and Conservation (DOEC) as well as Environment Canada (EC) to ensure the protection of ambient water resources in Voisey's Bay, Labrador.

The VBNC Environmental Coordinators on-site, Perry Blanchard and Paul Hounsell, work to ensure the Real-Time Water Quality Monitoring Network is operating to the standards set by DOEC. It is only through their dedication to properly maintain and calibrate the equipment that the data can be viewed as reliable and accurate.

Various individuals from DOEC have been integral in ensuring the smooth operation of such a technologically advanced network. Annette Tobin plays the lead role in coordinating and liaising between the major agencies involved, thus, ensuring open communication lines at all times. In addition, Annette is responsible for the data management/reporting, troubleshooting, along with ensuring the quality assurance/quality control measures are satisfactory. Throughout the deployment season of 2007, Annette has travelled to the Voisey's Bay Mine Site on two separate occasions (July & October) to ensure all procedures were being followed and to provide technical assistance. Paul Neary, Leona Hyde and Amir Ali Khan have worked on the communication aspects of the network ensuring the data is being provided to the general public on a near real-time basis through the departmental web page.

The staff of EC under Meterological Service of Canada Water Survey Canada (Percy Roberts, Perry Pretty, Bill Mullins and Brent Ruth) play an essential role in the data logging/communication aspect of the network. These individuals visit the site often to ensure the data logging equipment is operating properly and transmitting the data efficiently. Finally, they play the lead role in dealing with hydrological quantity and flow issues.

The managers from each agency (Earl Dwyer – VBNC; Haseen Khan – DOEC; Howie Wills – EC) are fully committed to improving this network and ensuring it provides meaningful and accurate water quality/quantity data that can be used in the decision-making process. This network is only successful due the cooperation of all three agencies involved.

# Section 1.0 Introduction

The Real-Time Water Quality Monitoring Network began in Voisey's Bay during the summer of 2003 with the establishment of three surface water stations (**Upper Reid Brook – NF03NE0009**; **Camp Pond Brook – NF03NE0010**; **Lower Reid Brook – NF03NE0011**). These three stations have been operational (for summer/fall months) on an annual basis since 2003 acting as an early warning system to capture water quality related events. The three above-noted surface water stations have been providing invaluable water quality information and an additional surface water station on the **Tributary to Lower Reid Brook – NF03NE0012** was installed in 2006. This station is located in fairly close proximity to the ovoid and thus it was chosen in particular to capture any water quality events that may result from the actual open-pit mining activities. The groundwater monitoring station at Headwater Pond was not installed this year due to complications with the location of the well and damage that occurred over the 2007 winter months. An alternative set-up for this station will be considered in the winter of 2008 for the 2008 deployment year. All five real-time water quality stations can be seen in **Figure 1**.

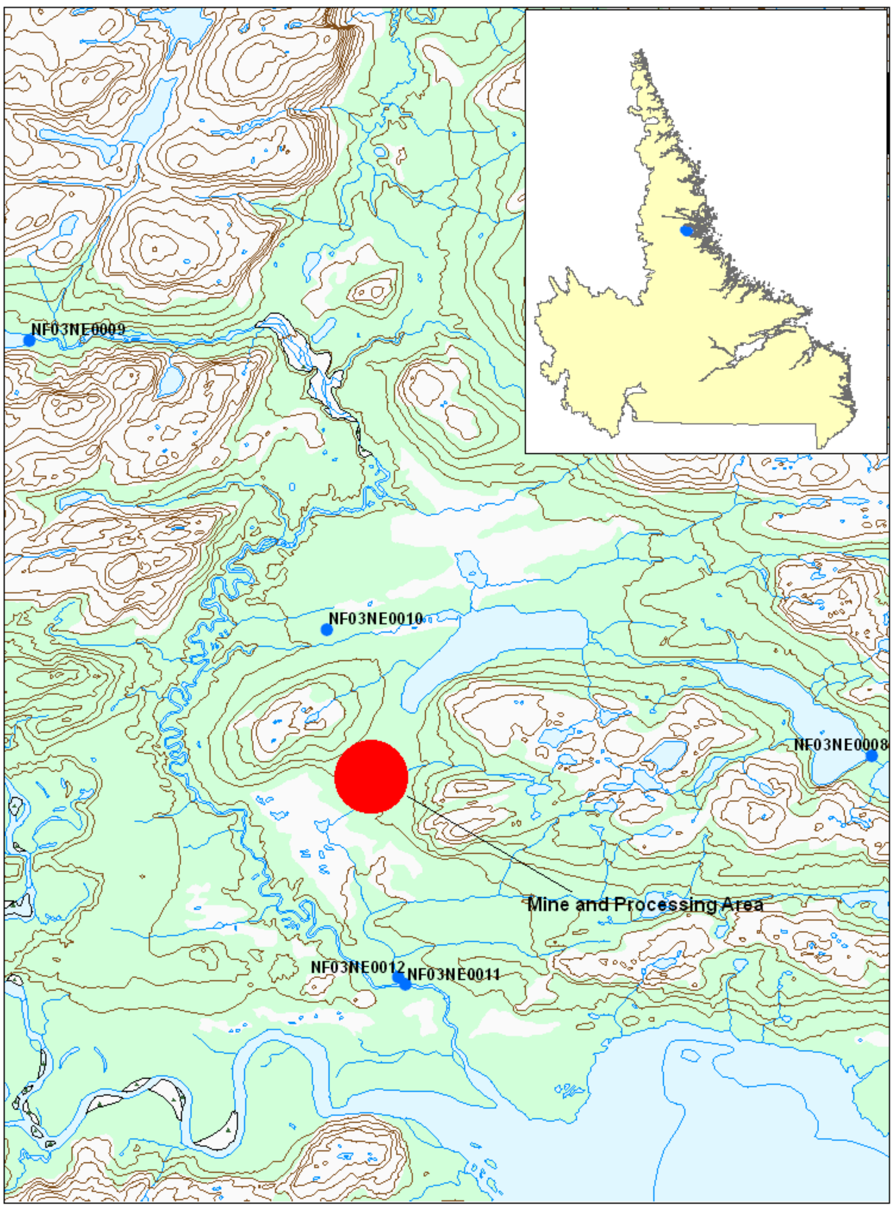


**Figure 1: Location of Real-Time Water Quality Monitoring Stations in Voisey's Bay, Labrador**

As in previous years, the water quality instruments were removed for the winter months in the fall of 2006 and sent to the DOEC office in St. John's for winter storage. Instruments were sent to Campbell Scientific in the winter for the annual servicing of the Hydrolabs. In May 2007, all instruments were removed from storage and cleaned, calibrated and checked by DOEC staff before being shipped to the VBNC mine site.

In May 2007 a Real-time Water Quality Workshop was conducted by DOEC staff. VBNC staff presented at this workshop on the RTWQ program at Voisey's Bay Nickel Company entitled "Voisey's Bay Real-time Water Quality Monitoring Program". This presentation was well received by the delegation with interest in the availability of all data and information from this program on-line.

In the spring of 2007, when the ice began to break apart, it was decided that the instruments should be returned to the water. On June 7$^{th}$, the EC staff arrived for a site visit with a helicopter available to travel to the remote sites. DOEC staff accompanied the EC staff and successfully deployed the instruments at the Camp Pond Brook station, Lower Reid Brook station, Upper Reid station and Tributary to Reid Brook station.

In July 2007, both DOEC and EC staff travelled to the VBNC mine site for a site visit to ensure that proper maintenance/calibration procedures were being followed and at the same time provide technical assistance to the VBNC staff. Training on the new ammonium and nitrate sensor calibration protocols was provided to the VBNC staff.

In August/September 2007, the VBNC staff performed the regular monthly maintenance/calibration procedures.

In October 2007, DOEC staff travelled again to Voisey's Bay to provide technical assistance to the VBNC staff. Again, training on the new ammonium and nitrate sensor calibration protocols was provided to the VBNC staff.

In November 2007, the rivers began to freeze and the instruments were removed on November 3$^{rd}$ for the winter months. VBNC staff cleaned the instruments and sent them to Campbell Scientific for their annual servicing/warranty work. The instrument will be shipped to the DOEC office in St. John's for winter storage.

# Section 2.0 Maintenance/Calibration

It is recommended by DOEC that regular maintenance/calibration take place on a monthly basis in order to ensure accuracy of the data from the real-time water quality monitoring stations. **Table 1** identifies the dates that the instruments were removed/reinstalled for regular maintenance and calibration in 2007. It is important to note that some deployment periods were longer than thirty days due to such issues as availability of helicopters to get to remote locations; allowing for additional monitoring time before winter removal; etc.

**Table 1: Dates of Maintenance/Calibration of Instruments**

| Station | Installation | Removal | Total # of Days | Remarks |
|---|---|---|---|---|
| **Upper Reid Brook** | June 7, 2007 | July 2, 2007 | 26 | |
| | July 4, 2007 | August 20, 2007 | 48 | Extended deployment due to lack of access to remote sites; removed stations when helicopter was available |
| | September 1, 2007 | November 3, 2007 | 64 | Extended deployment to allow more data collection before removal for winter months |
| | | | | |
| **Camp Pond Brook** | June 7, 2007 | July 2, 2007 | 26 | |
| | July 4, 2007 | August 20, 2007 | 48 | Extended deployment due to lack of access to remote sites; removed stations when helicopter was available |
| | September 1, 2007 | November 3, 2007 | 64 | Extended deployment to allow more data collection before removal for winter months |
| | | | | |
| **Lower Reid Brook** | June 7, 2007 | July 2, 2007 | 26 | |
| | July 4, 2007 | August 20, 2007 | 48 | Extended deployment due to lack of access to remote sites; removed stations when helicopter was available |
| | September 1, 2007 | November 3, 2007 | 64 | Extended deployment to allow more data collection before removal for winter months |
| | | | | |
| **Trib Lower Reid Brook** | June 7, 2007 | July 2, 2007 | 26 | |
| | July 4, 2007 | August 20, 2007 | 48 | Extended deployment due to lack of access to remote sites; removed stations when helicopter was available |
| | September 1, 2007 | November 3, 2007 | 64 | Extended deployment to allow more data collection before removal for winter months |

# Section 3.0 Data Interpretation

## REID BROOK AT OUTLET OF REID POND (UPPER REID BROOK)

The Upper Reid Brook site is a control station that is not directly impacted by development. Throughout the majority of the deployment period from June to November 2007, the water quality remained pristine.

The water temperature (**Figure 2**) increased until early August and then began to decrease for the remainder of the deployment period. This increasing/decreasing pattern is expected for the time of year of the deployment. The dissolved oxygen (Figure 3) showed a decrease until mid-August and an increase for the remainder of the deployment corresponding to the pattern seen in temperature. The points in the graph where the values drop to zero indicate the periods when the instrument was out of the water for maintenance/calibration purposes.

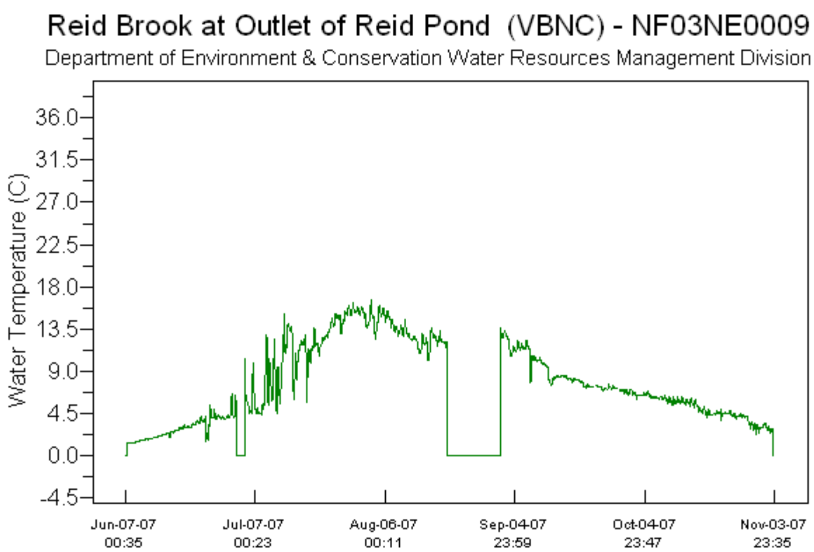


**Figure 2**

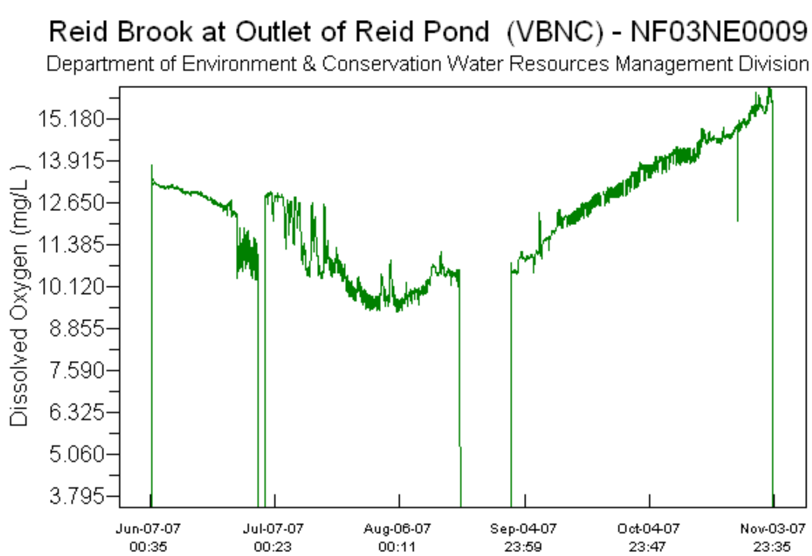


**Figure 3**

The conductivity values (**Figure 4**) remained very low at this fairly pristine station only ranging from 6.4 uS/cm – 10.0 uS/cm over the deployment period. The values before and after the scheduled maintenance/calibration check in late August were noticeably different due to the scale of the graph, however, the change in values from before and after were only in the magnitude of approximately 2.8 uS/cm.

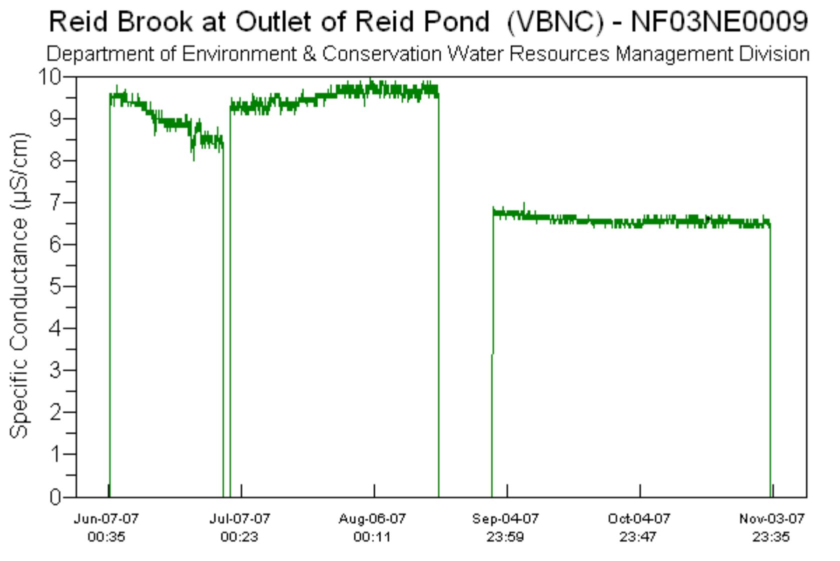


**Figure 4**

The pH (**Figure 5**) values between June 7th and July 2nd (the first deployment period) appear to be lower than normally seen and decrease significantly throughout the period of the month. During the second deployment on July 4th, pH values return to normal background pH levels. This would indicate that the pH values seen in the month of June were likely affected by a calibration error during the initial installation of the instrument in June. The value seen on the first reading when installed on July 4th is not a correct value and was likely due to a reading that was taken while the instrument was being deployed. After July 4th, the pH values remained relatively consistent at normal background levels until the instrument was removed in November for the winter months.

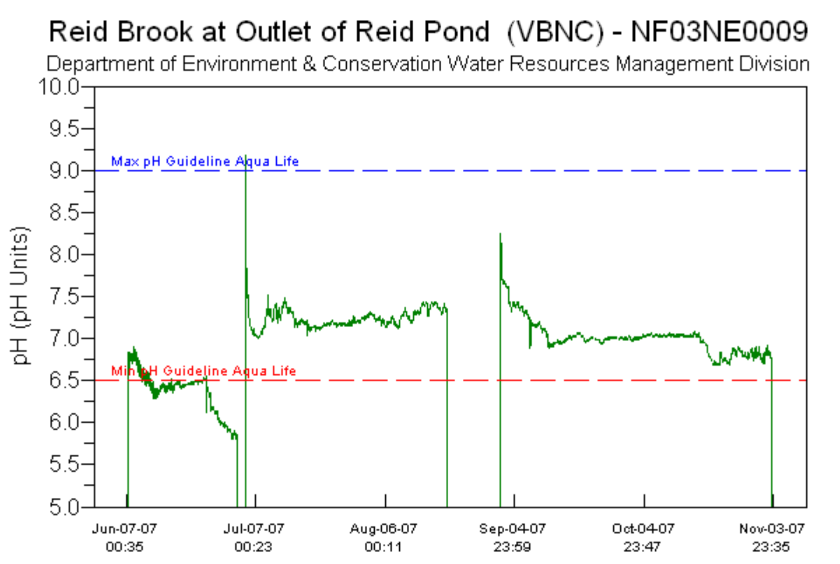


**Figure 5**

The turbidity (**Figure 6**) remained relatively stable at background levels for the duration of the deployment period. The value (656.9 NTU) seen on August 8th for a one hour period is not likely a water quality event due to the one-hour period. July 11th – July 13th shows an increase in turbidity values above background levels. This increase in not due to activities at Voisey's Bay because this is a control site and not affected by any activities by VBNC.

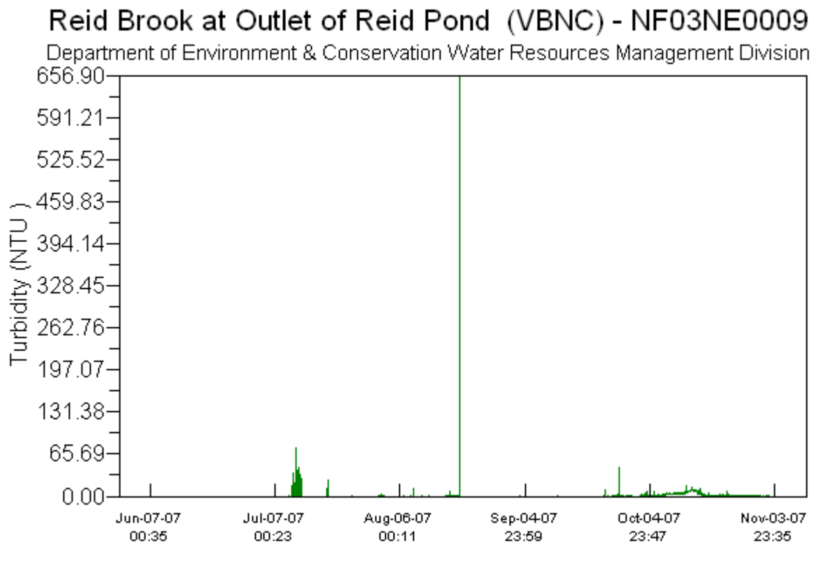


**Figure 6**

The stage (**Figure 7**) values between July 25th and September 26th did not transmit for that period. Environment Canada staff rectified this problem when they visited the site in September.

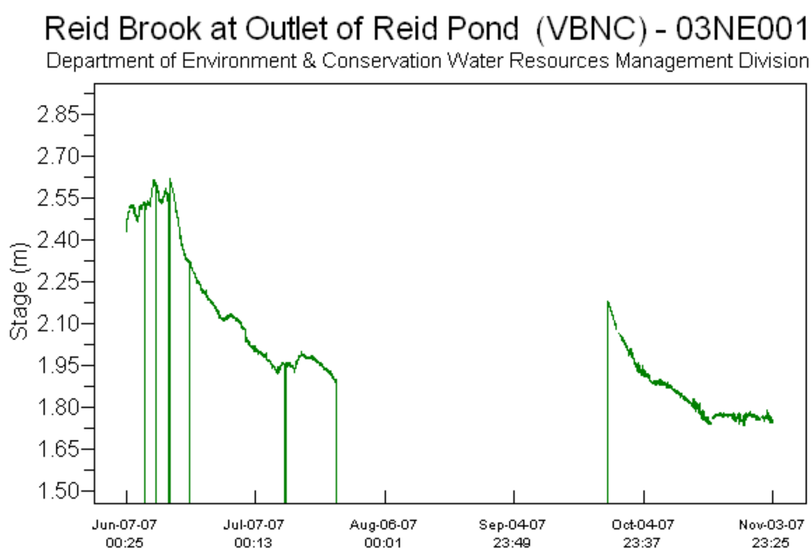


**Figure 7**

Overall, the Upper Reid Brook station displayed very consistent values for all major parameters over the deployment period. Upper Reid Brook is a pristine water body that can be used successfully as a control station to determine the natural background levels expected in the Voisey's Bay area.

## CAMP POND BROOK BELOW CAMP POND

The Camp Pond Brook site was chosen to capture any emerging water quality events due to the nearby development of the mine/mill site. Throughout the majority of the deployment period from June to November 2007 the water quality remained fairly consistent for most parameters monitored.

The water temperatures and dissolved oxygen (**Figures 8 & 9** respectively) values followed the expected pattern with water temperatures increasing over the summer months and dissolved oxygen values subsequently decreasing. Then as the fall approached, the water temperatures began to decrease as the dissolved oxygen values increased. The points in the graph where the values drop to zero indicate the periods when the instrument was out of the water for maintenance/calibration purposes.

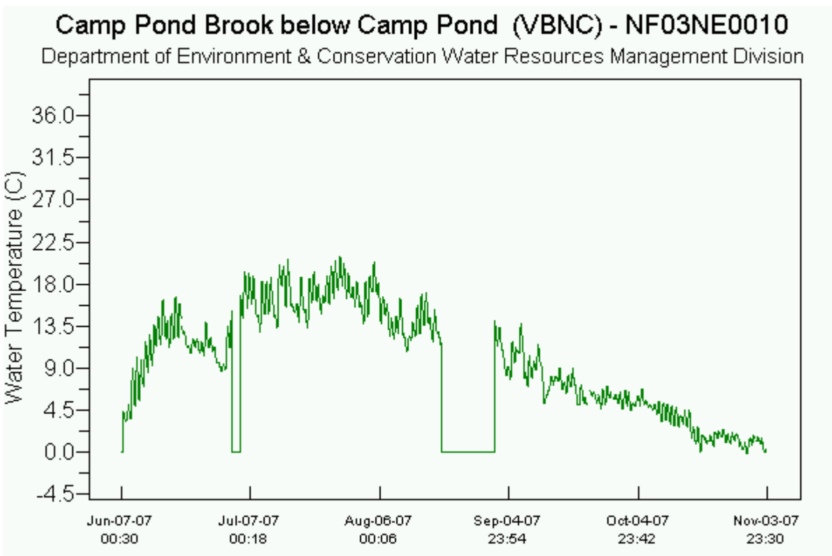


**Figure 8**

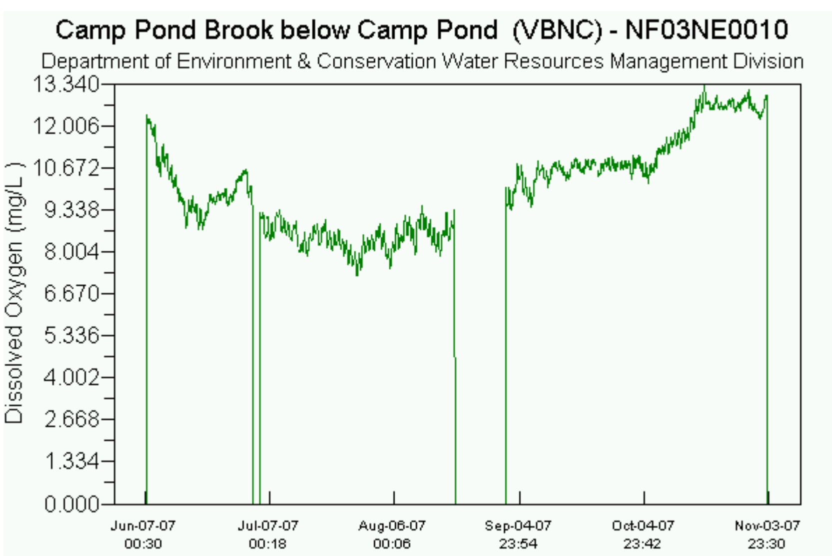


**Figure 9**

The pH values (**Figure 10**) at the Camp Pond Brook station remained very consistent over the entire deployment period with no major water quality events being captured. All the pH values remained in the recommended range (6.5 – 9.0) for the CCME Protection of Aquatic Life guidelines.

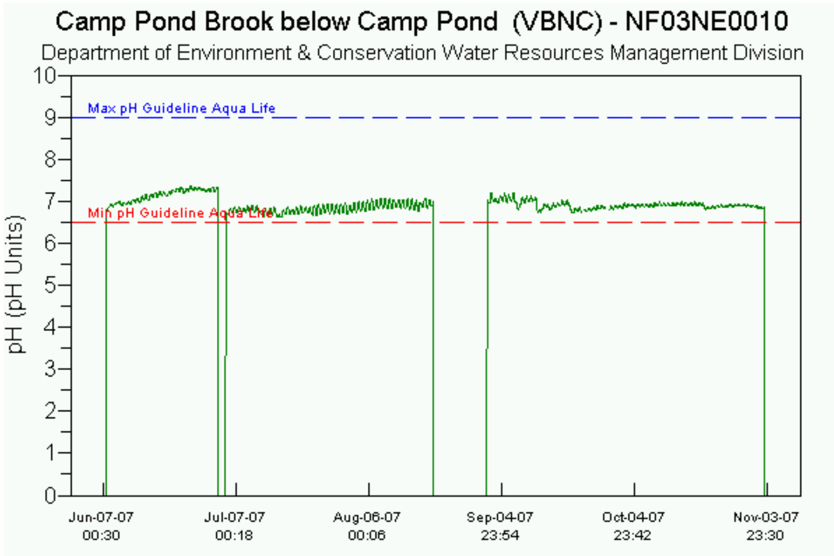


**Figure 10**

The conductivity values (**Figures 11**) remained fairly consistent throughout the deployment period. The conductivity values ranged from 13.5uS/cm – 57.4uS/cm which corresponds to values seen in the 2006 year. The maximum conductivity value of 57.4uS/cm occurred on September 8$^{th}$ which corresponds to a change in stage (**Figure 13**) at the same period of time. Values are higher than that of the control station (Upper Reid Brook) but are expected due to the level of development surrounding Camp Pond Brook.

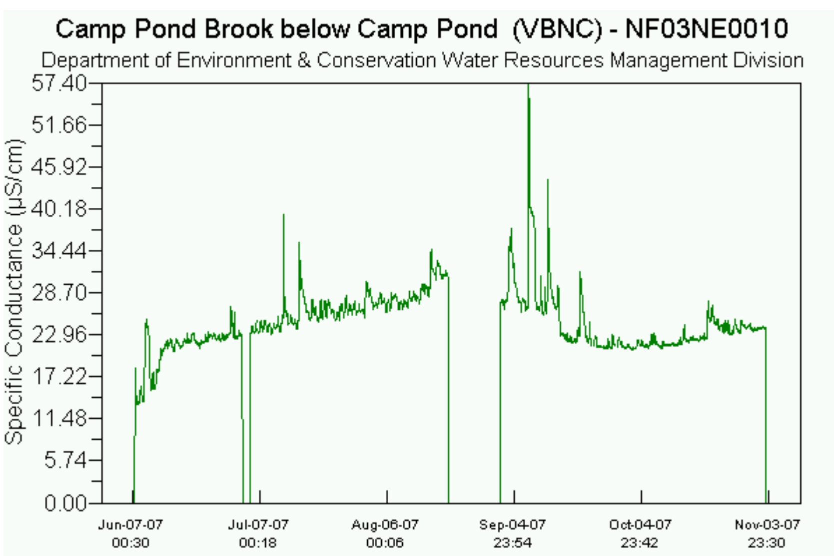


**Figure 11**

Turbidity (**Figure 12**) values remained around background levels for the majority of the deployment period (June – November) in Camp Pond Brook. The four spikes with values of 3000 NTU (August 18th, 19th and 20th) was not likely a water quality incident due to the one-hour periods in which they occurred. There was a turbidity spike in turbidity between September 8th and 9th with a maximum value of 592.0 NTU. This turbidity event occurred during the same period of time as an increase in stage (Figure 13) and rainfall events (Appendix A).

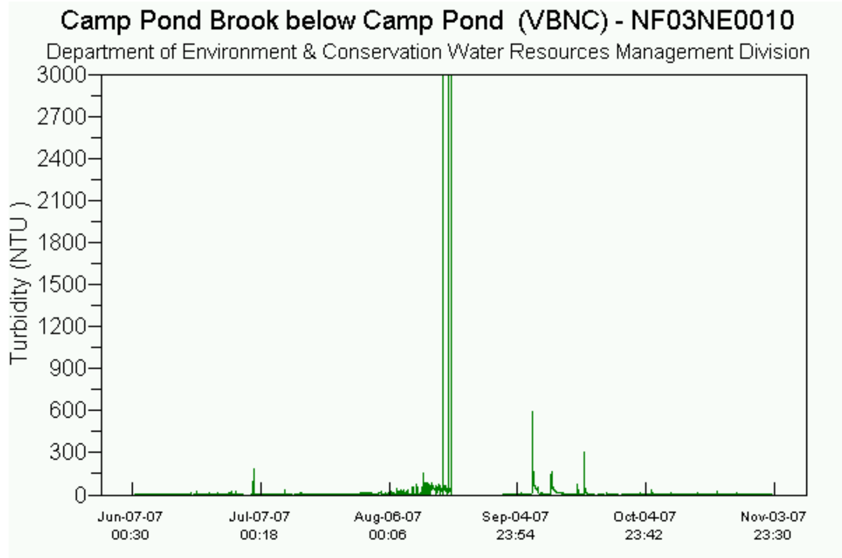


**Figure 12**

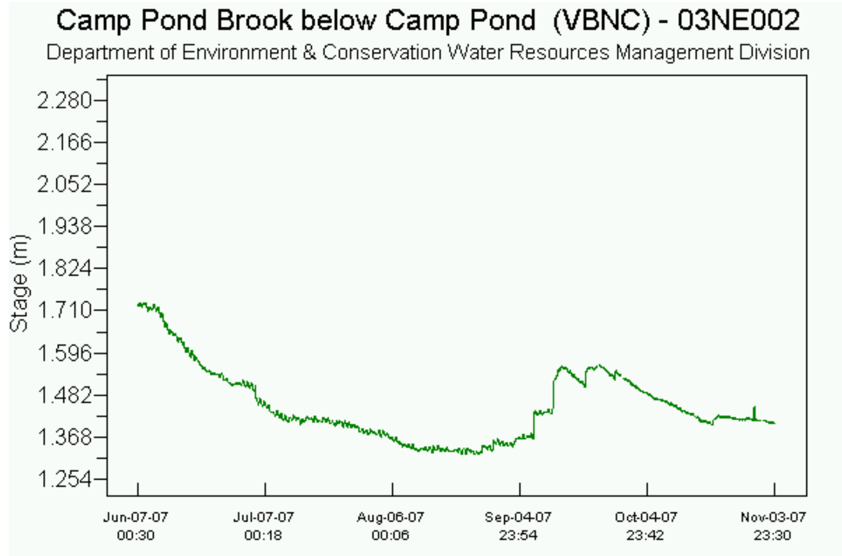


**Figure 13**

Overall, the Camp Pond Brook station displayed consistent values for all major parameters over the deployment period. The movement in both the specific conductivity and turbidity values can be attributed to increased stage height due to increased rainfall amounts in most cases.

## LOWER REID BROOK

The Lower Reid Brook site was chosen as a downstream location that could be used to determine if water quality events from the upstream development area were still having an impact downstream just before the stream runs into the ocean. Throughout the deployment period from June to November 2007, the water quality at this station was slightly more variable than both the Upper Reid Brook and Camp Pond Brook stations.

The water temperatures and dissolved oxygen (**Figures 14 & 15** respectively) values followed the expected pattern with water temperatures increasing over the summer months and dissolved oxygen values subsequently decreasing. Then as the fall approached, the water temperatures began to decrease as the dissolved oxygen values increased. The points in the graph where the values drop to zero indicate the periods when the instrument was out of the water for maintenance/calibration purposes.

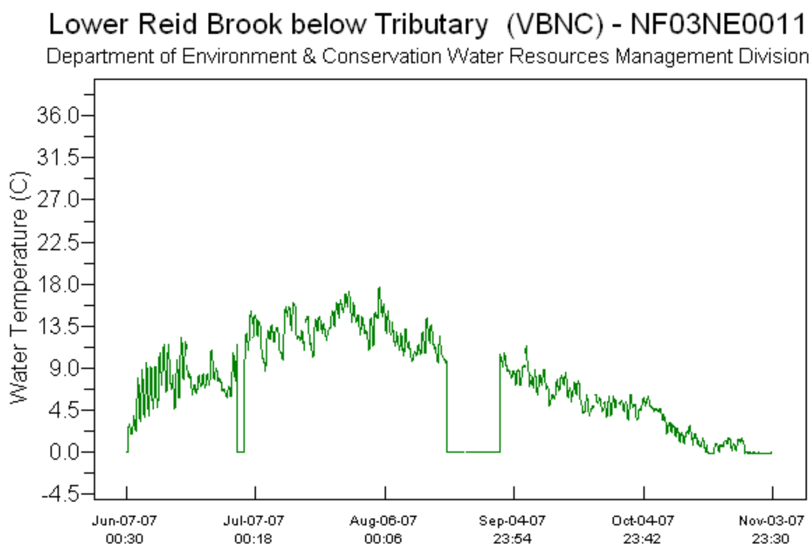


**Figure 14**

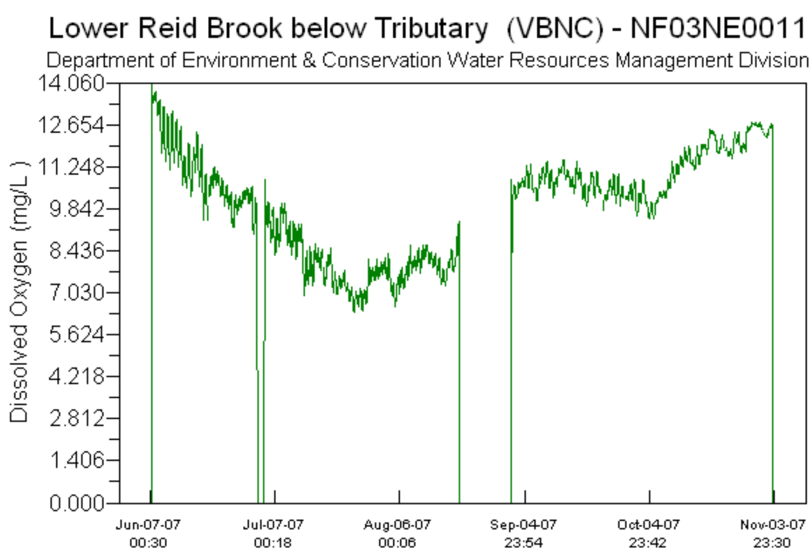


**Figure 15**

As can be seen in **Figure 16**, the pH of the water at the Lower Reid Brook station fluctuated throughout the deployment period from June to November with a range of 6.34 to 8.31. As has been seen in previous years, the pH values change with fluctuations in stage (**Figure 18**). The fluctuations seen in early September correspond to a fluctuation in stage at the same time. By comparing the pH graph to the stage graph it is evident that increases in stage have an effect on the pH values. The majority of the pH values however, remained in the recommended range (6.5 – 9.0) for the CCME Protection of Aquatic Life guidelines.

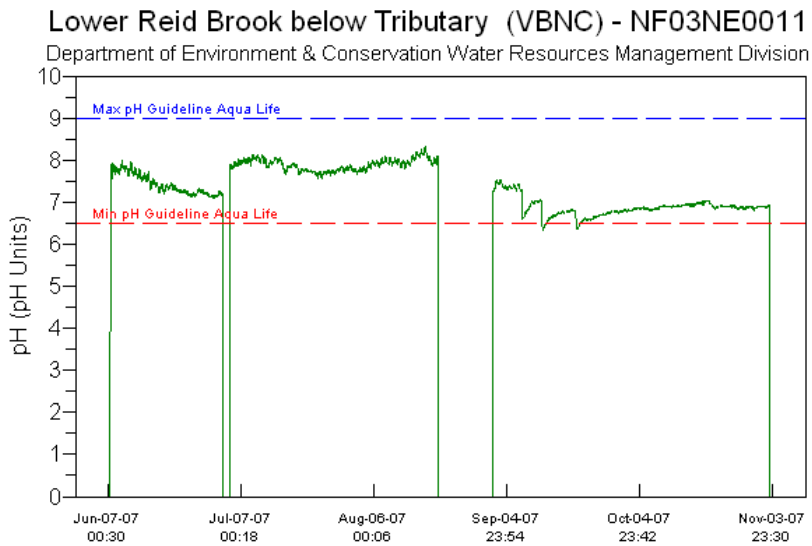


**Figure 16**

The conductivity values (**Figure 17**) during the deployment period between June and November ranged from 8 uS/cm - 29 uS/cm for the Lower Reid Brook station. It is obvious that the times when the conductivity values decreased can be attributed to increases in the stage graph (**Figure 18**). It appears as though the increased rainfall amounts work to dilute the river system thus seeing a noticeable drop in ion concentrations.

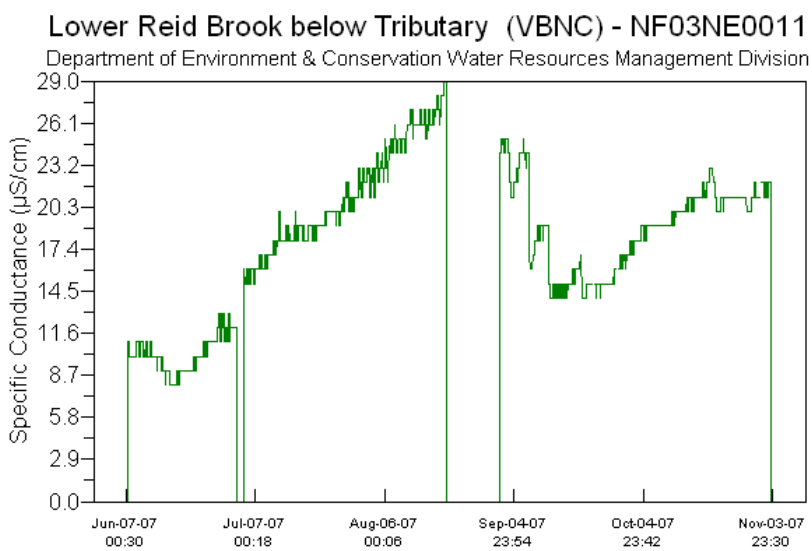


**Figure 17**

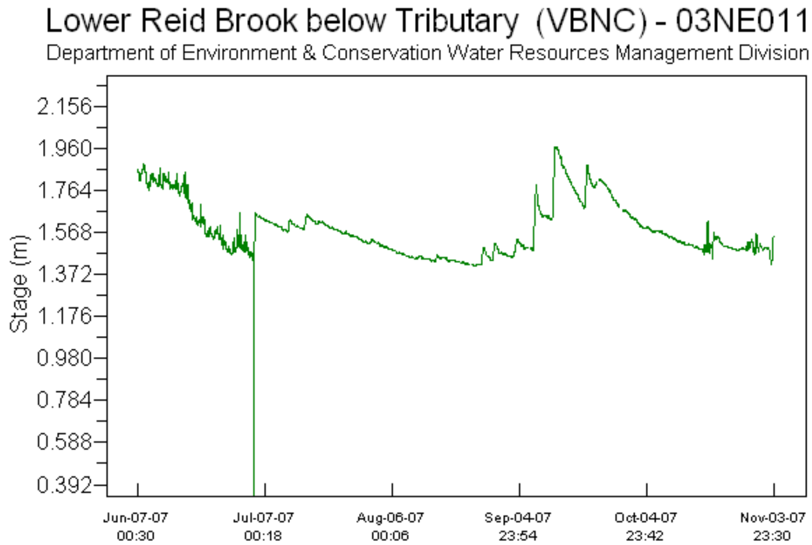


**Figure 18**

The turbidity (**Figure 19**) of the water at the Lower Reid Brook station is typically higher than the other three stations at Voisey's Bay with a range of 0 to 246 NTU. This is likely due to the sandy bottom of the station and the significantly larger width that both Camp Pond Brook and Tributary to Lower Reid Brook. The larger turbidity spikes seen in late August and mid-October correspond to increases in stage (**Figure 18).** The number of turbidity spikes at the Lower Reid Brook station during the past two sampling season (2006-2007) is significantly less than the activity in turbidity values of previous years. Moving from the construction phase into the operational phase of the project has alleviated many of the turbidity issues encountered in the past.

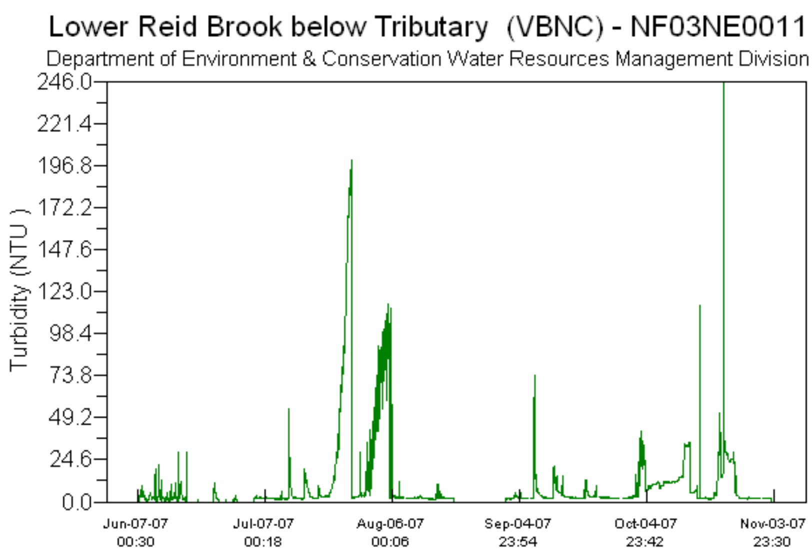


**Figure 19**

Overall, the Lower Reid Brook station displayed fairly consistent values for all major parameters during the deployment period. It is evident from the graphs that many of the parameters at this station are dependent on the changes in stage (pH, conductivity and turbidity).

## TRIBUTARY TO LOWER REID BROOK

The tributary to Lower Reid Brook station is located in fairly close proximity to the ovoid and thus it was chosen in particular to capture any water quality events that may result from the actual open-pit mining activities. The deployment period extended from June – November 2007.

The water temperatures and dissolved oxygen (**Figures 20 & 21** respectively) values followed the expected pattern with water temperatures increasing over the summer months and dissolved oxygen values subsequently decreasing. Then as the fall approached, the water temperatures began to decrease as the dissolved oxygen values increased. The points in the graph where the values drop to zero indicate the periods when the instrument was out of the water for maintenance/calibration purposes.

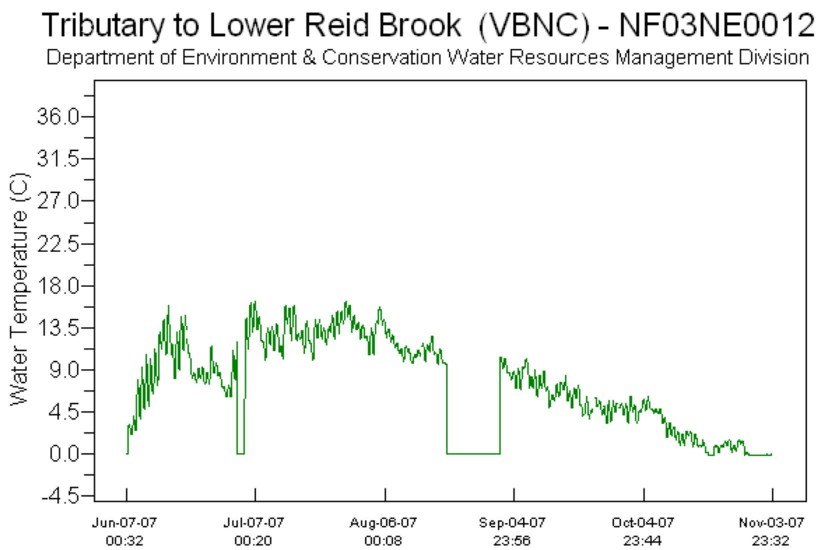


**Figure 20**

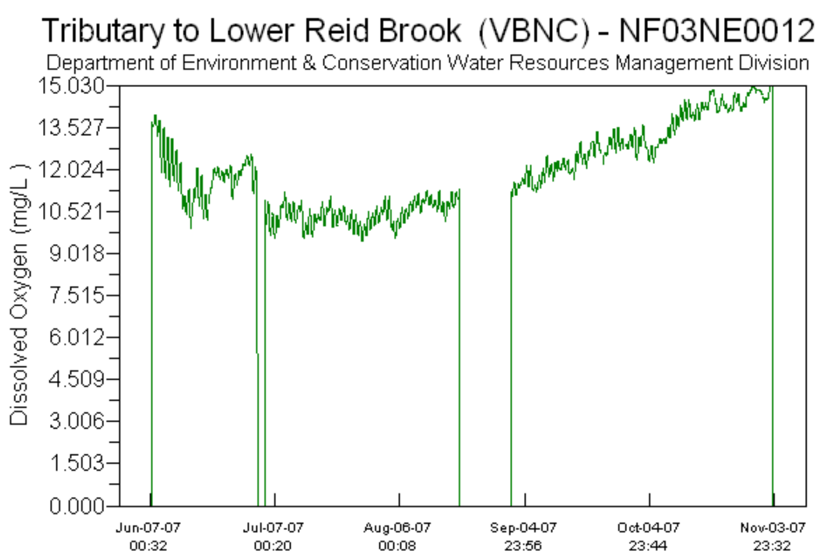


**Figure 21**

The pH (**Figure 22**) of the water at the Tributary to Lower Reid Brook station was fairly consistent throughout the deployment period until early September. At this point, pH fluctuated until mid-September which corresponds to a fluctuation in stage (**Figure 25**) during the same time period. The majority of pH values remained in the recommended range (6.5 – 9.0) for the CCME Protection of Aquatic Life guidelines. A similar pattern was also seen in Lower Reid Brook which shows that increases in stage have an effect on the pH values

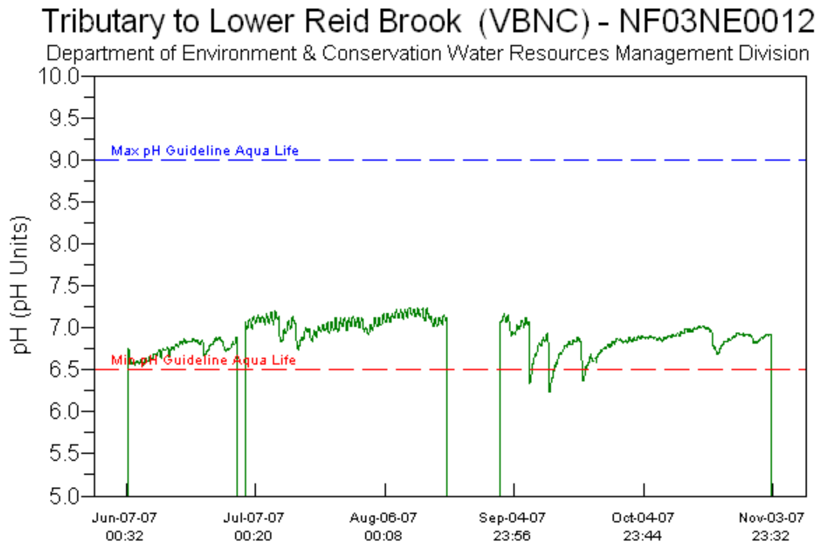


**Figure 22**

As can be seen in **Figure 23,** the turbidity of the water remained fairly consistent with only one major spike during the deployment period. The maximum turbidity value recorded (406.0 NTU) occurred during a period when turbidity levels were above background levels for two days (August 18th to August 20th). The instrument was removed on August 20th for regular maintenance and calibration. At this time there were no visible signs of a water quality incident. Upon redeployment on September 1st, the turbidity values were reading 100 NTU and remained fixed on this value until the instrument was removed for the winter months. During this time period, the turbidity sensor was not reading correctly and did not record correct data for turbidity.

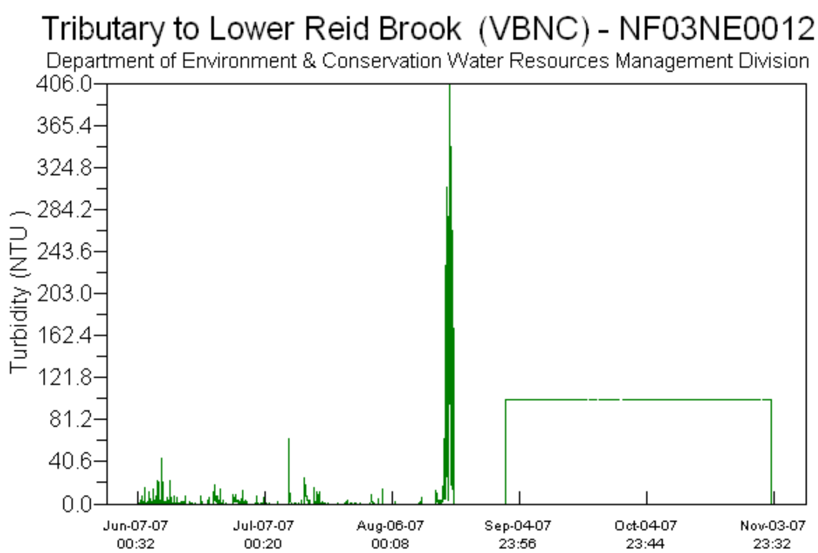


**Figure 23**

Conductivity (**Figure 24**) at the Tributary to Lower Reid Brook station showed a fluctuation in values over the deployment period from June to November. The conductivity values ranged from 10.4 uS/cm – 29.2 uS/cm. This range is comparable to that of the Lower Reid Brook stations and values from this station in 2006. As was the case with the Lower Reid Brook station, the times when the conductivity values decreased can be attributed to increases in the stage graph (**Figure 25**).

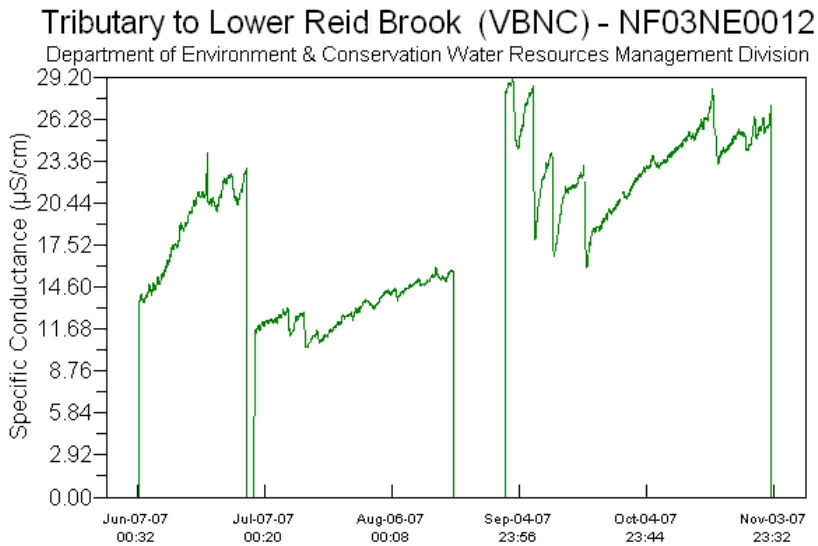


**Figure 24**

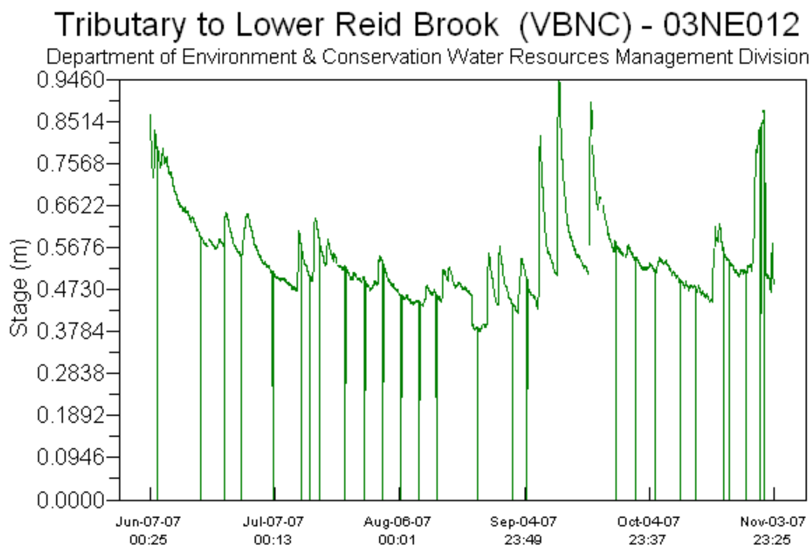


**Figure 25**

Overall, the Tributary to the Lower Reid Brook station parameter values remained in expected ranges for all major parameters during the deployment period. Parameters are typically slightly higher than the control site, Upper Reid Brook, but similar to Lower Reid Brook stations.

# Section 4.0 Quality Assurance/Quality Control (QA/QC) Measures

Quality Assurance/Quality Control (QA/QC) measures are a very important aspect of the Real-Time Water Quality Monitoring Network in Voisey's Bay. These measures are put in place to ensure that the instruments are reading data accurately. The QA/QC procedures established by DOEC are two-fold:

1) Data from the water quality monitoring instrument in-situ (Datasonde) are compared to data from a portable instrument in-situ (Minisonde) at the time of redeployment after maintenance/calibration procedures have been performed; data must fall within a specified range. **Table 2** summarizes the QA/QC results comparing the Datasonde readings against the Minisonde readings for each real-time water quality station.

2) Grab water samples are taken from each station at the time of redeployment and sent to a laboratory for analysis; the results are then compared to those of the water quality monitoring instrument in-situ (Datasonde); data must fall within a specified range. **Table 3** summarizes the QA/QC results comparing the Datasonde readings against the laboratory readings (only three readings available from the lab for comparison – pH; conductivity; turbidity).

As can be seen in **Table 2**, the QA/QC comparison between the Datasondes and the Minisonde at the time of redeployment for all stations is generally excellent, good or fair. There are some instances throughout the deployment period when the QA/QC comparison rankings fell in the marginal and poor categories. For the most part, it is the dissolved oxygen probes (membrane) that are somewhat variable and fall outside the fair, good or excellent categories. There were also some poor readings for pH at the Upper Reid and Lower Reid Brook stations. The instruments have been sent to Edmonton for servicing.

It should be noted that the conductivity values from the Minisonde were not recorded due to a malfunction in the sensor leading to erroneous values. The Minisonde was sent for manufacturer servicing at the end of the field season to address this issue.

As can be seen in **Table 3**, the QA/QC comparison between the Datasondes and laboratory data was excellent for all turbidity sample comparisons. The rankings were excellent and good in five of the eight sample comparisons for pH. However, the conductivity comparisons ranked poor in the majority of cases. This issue has recently been encountered with a variety of the QA/QC samples for a number of other real-time water quality samples and will be looked at in more detail in 2008.

**Table 2: QA/QC Results (Datasonde vs. Minisonde)**

| Station | Reinstallation Date | Parameters | Datasonde Data | Minisonde Data | Rating |
|---|---|---|---|---|---|
| Upper Reid Brook | June 7, 2007 | Temp (°C) | 1.409 | 4.29 | Excellent |
| | | pH (units) | 6.829 | 6.03 | Fair |
| | | Conductivity (µS/cm) | 9.6 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 13.77 | 13.3 | Good |
| | July 4, 2007 | Temp (°C) | 7.809 | 4.59 | Poor |
| | | pH (units) | 7.71 | 6.24 | Poor |
| | | Conductivity (µS/cm) | 9.3 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 12.59 | 13.1 | Fair |
| | September 1, 2007 | Temp (°C) | 13.56 | 13.72 | Excellent |
| | | pH (units) | 8.25 | 6.86 | Poor |
| | | Conductivity (µS/cm) | 6.8 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 10.85 | 10.93 | Poor |
| Camp Pond Brook | June 7, 2007 | Temp (°C) | 4.34 | 4.31 | Excellent |
| | | pH (units) | 6.71 | 6.19 | Fair |
| | | Conductivity (µS/cm) | 18.4 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 12.35 | 11.36 | Marginal |
| | July 4, 2007 | Temp (°C) | 16.02 | 15.97 | Excellent |
| | | pH (units) | 6.63 | 6.91 | Good |
| | | Conductivity (µS/cm) | 23.2 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 9.2 | 9.62 | Good |
| | September 1, 2007 | Temp (°C) | 14.06 | 13.77 | Good |
| | | pH (units) | 7.13 | 7.13 | Excellent |
| | | Conductivity (µS/cm) | 27.1 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 10.05 | 10.56 | Fair |
| Lower Reid Brook | June 7, 2007 | Temp (°C) | 2.51 | 2.65 | Excellent |
| | | pH (units) | 7.85 | 6.12 | Poor |
| | | Conductivity (µS/cm) | 11 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 13.84 | 13.02 | Marginal |
| | July 4, 2007 | Temp (°C) | 9.7 | 9.32 | Good |
| | | pH (units) | 7.89 | 6.57 | Poor |
| | | Conductivity (µS/cm) | 16 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 10.81 | 11.64 | Marginal |
| | September 1, 2007 | Temp (°C) | 10.46 | 10.4 | Excellent |
| | | pH (units) | 7.11 | 7.03 | Excellent |
| | | Conductivity (µS/cm) | 24 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 10.82 | 11.26 | Good |
| Trib. to Lower Reid Brook | June 7, 2007 | Temp (°C) | 2.71 | 2.79 | Excellent |
| | | pH (units) | 6.7 | 6.08 | Fair |
| | | Conductivity (µS/cm) | 13.6 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 13.69 | 12.68 | Poor |
| | July 4, 2007 | Temp (°C) | 11.63 | 11.05 | Fair |
| | | pH (units) | 7.01 | 6.7 | Good |
| | | Conductivity (µS/cm) | 11.3 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 10.93 | 10.84 | Excellent |
| | September 1, 2007 | Temp (°C) | 10.11 | 10.11 | Excellent |
| | | pH (units) | 7.01 | 7.1 | Excellent |
| | | Conductivity (µS/cm) | 28.1 | NA* | NA* |
| | | Dissolved Oxygen (mg/L) | 11.23 | 11.46 | Excellent |

* - The conductivity sensor on the Minisonde was not functioning properly. Minisonde is sent to Campbell Scientific for repairs.

**Table 3: QA/QC Results (Datasonde Data vs. Laboratory Data)**

| Station | Reinstallation Date | Parameters | Datasonde Data | Laboratory Data | Rating |
|---|---|---|---|---|---|
| **Upper Reid Brook** | July 4, 2007 | Temp (°C) | 7.81 | | |
| | | pH (units) | 7.71 | 6.62 | Poor |
| | | Conductivity (µS/cm) | 9.3 | 13 | Poor |
| | | Dissolved Oxygen (mg/L) | 12.59 | | |
| | | Turbidity (NTU) | 0 | 0.9 | Excellent |
| | September 1, 2007 | Temp (°C) | 13.56 | | |
| | | pH (units) | 8.25 | 6.67 | Poor |
| | | Conductivity (µS/cm) | 6.8 | 12 | Poor |
| | | Dissolved Oxygen (mg/L) | 10.85 | | |
| | | Turbidity (NTU) | 0 | 0.2 | Excellent |
| **Camp Pond Brook** | July 4, 2007 | Temp (°C) | 16.02 | | |
| | | pH (units) | 6.63 | 7.02 | Good |
| | | Conductivity (µS/cm) | 23.2 | 26 | Fair |
| | | Dissolved Oxygen (mg/L) | 9.2 | | |
| | | Turbidity (NTU) | 1 | 0.5 | Excellent |
| | September 1, 2007 | Temp (°C) | 14.06 | | |
| | | pH (units) | 7.13 | 6.99 | Excellent |
| | | Conductivity (µS/cm) | 27.1 | 34 | Poor |
| | | Dissolved Oxygen (mg/L) | 10.05 | | |
| | | Turbidity (NTU) | 2 | 0.5 | Excellent |
| **Lower Reid Brook** | July 4, 2007 | Temp (°C) | 9.7 | | |
| | | pH (units) | 7.89 | 6.98 | Marginal |
| | | Conductivity (µS/cm) | 16 | 23 | Poor |
| | | Dissolved Oxygen (mg/L) | 10.81 | | |
| | | Turbidity (NTU) | 2 | 0.6 | Excellent |
| | September 1, 2007 | Temp (°C) | 10.46 | | |
| | | pH (units) | 7.11 | 7.04 | Excellent |
| | | Conductivity (µS/cm) | 24 | 34 | Poor |
| | | Dissolved Oxygen (mg/L) | 10.82 | | |
| | | Turbidity (NTU) | 2 | 2.1 | Excellent |
| **Trib. to Lower Reid Brook** | July 4, 2007 | Temp (°C) | 11.63 | | |
| | | pH (units) | 7.01 | 6.95 | Excellent |
| | | Conductivity (µS/cm) | 11.3 | 26 | Poor |
| | | Dissolved Oxygen (mg/L) | 10.93 | | |
| | | Turbidity (NTU) | 0 | 0.8 | Excellent |
| | September 1, 2007 | Temp (°C) | 10.11 | | |
| | | pH (units) | 7.01 | 7.02 | Excellent |
| | | Conductivity (µS/cm) | 28.1 | 34 | Poor |
| | | Dissolved Oxygen (mg/L) | 11.23 | | |
| | | Turbidity (NTU) | NA* | 1.0 | NA* |

*NA – Turbidity sensor on the Hydrolab was not reading properly for the deployment period of September 1st – November 3rd.

# Section 5.0 Additional Activities

## Updates to the Automatic Data Retrieval System

In 2007, the Water Resources Management Division has implemented additional functionality to the Automatic Data Retrieval System (ADRS) that was implemented in 2006.

- The communications setup with the satellite data provider was updated due to a hardware failure on the provider side. Code and configuration changes were required to access an Internet data channel. This work was completed in a very short time period without any data loss to the real-time water quality network.
- Various adjustments to the graphical web page output were completed to aid in interpretation of data.
- The internal web tools to the new development platform were upgraded
- Addressed a recurring issue with delays in posting to the public web server with the IT group.
- Training of new staff on the ADRS operations to act as a backup resource.

Overall, the additional functionality added to the ADRS and all of its associated products have allowed the real-time water quality monitoring program to move forward. There are plans to implement additional functionality to the system in 2008.

## Presentation at the Real-time Water Quality Monitoring Workshop 2007

In May 2007, Perry Blanchard and Paul Hounsell of VBNC gave a presentation entitled "Voisey's Bay Real-Time Water Quality Program" at the Real-time Water Quality Monitoring Workshop 2007 in St. John's, NL. The Real-Time Water Quality Monitoring Network at Voisey's Bay, Labrador was used as a case study to demonstrate how continuous water quality monitoring can be used to identify emerging water quality events and allow the issues to be addressed in a proactive manner. The presentation was well received by the audience and clearly demonstrated environmental stewardship on the part of VBNC.

## Section 6.0 Conclusions

The Voisey's Bay real-time water quality monitoring network has been very successful as a regulatory tool throughout the past year. The near-real time water quality data allows the VNBC staff to act immediately on emerging water quality events. It has clearly shown that the ambient water quality surrounding the development area is being protected. Moving from the construction phase to the operational phase of the project has decreased the number of water quality events significantly (ie: number/extent of turbidity spikes is greatly reduced).

Upper Reid Brook is a pristine area that can effectively be used as a control station that provides reliable natural background water quality data for comparison purposes. Most importantly, the water quality of both Camp Pond Brook and Lower Reid Brook did not change drastically from the natural background concentrations even though there is a significant amount of development occurring in the watersheds. Additionally, the water quality at the new surface water station (tributary to Lower Reid Brook) also remained within expected levels with no major water quality events being captured. It is evident that the mitigation measures that have been established by VBNC have significantly reduced the effect of development on the overall water quality.

## Section 7.0 Path Forward

In order for a program to be successful, it is essential to continually evaluate and move forward. The following is a list of planned activities to be carried out in the upcoming year. The list also includes some multi-year activities planned in the previous year that are still in progress.

- shipment of instruments for servicing work during the winter months
- testing/preparation of instruments in St. John's office prior to spring deployment to ensure all instruments are functioning properly
- consider methods for installation of the groundwater probe that will allow for earlier deployment and reduce damage to the hut and exposed equipment
- spring site visitation to install all instruments and make changes to data logger programming
- continued monitoring of water quality from late spring to late fall 2008 with continued data analysis in the form of monthly reports
- continued direct communication between DOEC and VBNC staff to respond to emerging issues on a proactive basis
- continued site visitation and training by DOEC staff throughout the summer and fall
- retraining of VBNC staff on the updated maintenance/calibration procedures for real-time water quality instrumentation
- continued work on Automatic Data Retrieval System to incorporate new capabilities
- continued transfer of data from DOEC to VBNC staff through the departmental web page
- provide on-line statistical analysis of data
- evaluation and upgrading of QA/QC procedures
- work on extrapolation of other water quality parameters using regression analysis
- increased understanding/knowledge of groundwater quality
- creation of value added products using the real-time water quality data, remote sensing and water quality indices

# Appendix A

# Climate Data for Nain, Labrador

**Daily Data Report for June 2007**

| Day | Max Temp °C | Min Temp °C | Mean Temp °C | Heat Deg Days °C | Cool Deg Days °C | Total Rain mm | Total Snow cm | Total Precip mm | Snow on Grnd cm | Dir of Max Gust 10's Deg | Spd of Max Gust km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 6.7 | -2.1 | 2.3 | 15.7 | 0.0 | | | 4.1 | 0 | | |
| 02 | 4.2 | -1.6 | 1.3 | 16.7 | 0.0 | | | 0.0 | 0 | | |
| 03 | 7.5 | -0.8 | 3.4 | 14.6 | 0.0 | | | 0.0 | 0 | | |
| 04 | 8.7 | -4.2 | 2.3 | 15.7 | 0.0 | | | 0.7 | 0 | | |
| 05 | 11.7 | 2.1 | 6.9 | 11.1 | 0.0 | | | 0.0 | 0 | | |
| 06 | 16.2 | 2.8 | 9.5 | 8.5 | 0.0 | | | 0.0 | 0 | | |
| 07 | 4.5 | 2.2 | 3.4 | 14.6 | 0.0 | | | 16.8 | 0 | | |
| 08 | 5.1 | 1.9 | 3.5 | 14.5 | 0.0 | | | 0.0 | 0 | | |
| 09 | 18.4 | 0.1 | 9.3 | 8.7 | 0.0 | | | 0.0 | 0 | | |
| 10 | 16.2 | 4.1 | 10.2 | 7.8 | 0.0 | | | 0.0 | 0 | | |
| 11 | 12.2 | 1.5 | 6.9 | 11.1 | 0.0 | | | 0.0 | 0 | | |
| 12 | 10.4 | -0.6 | 4.9 | 13.1 | 0.0 | | | 0.0 | 0 | | |
| 13 | 8.3 | 2.3 | 5.3 | 12.7 | 0.0 | | | 0.0 | 0 | | |
| 14 | 21.1 | 0.8 | 11.0 | 7.0 | 0.0 | | | 0.0 | 0 | | |
| 15 | 23.0 | 7.0 | 15.0 | 3.0 | 0.0 | | | 0.0 | 0 | | |
| 16 | 23.7 | 3.3 | 13.5 | 4.5 | 0.0 | | | 7.4 | 0 | | |
| 17 | 9.8 | 6.3 | 8.1 | 9.9 | 0.0 | | | 0.0 | 0 | | |
| 18 | 13.0 | 0.2 | 6.6 | 11.4 | 0.0 | | | 0.0 | 0 | | |
| 19 | 16.2 | 0.7 | 8.5 | 9.5 | 0.0 | | | 0.0 | 0 | | |
| 20 | 18.8 | 6.9 | 12.9 | 5.1 | 0.0 | | | 0.0 | 0 | | |
| 21 | 9.7 | 6.0 | 7.9 | 10.1 | 0.0 | | | 0.0 | 0 | | |
| 22 | 5.6 | 2.2 | 3.9 | 14.1 | 0.0 | | | 5.8 | 0 | | |
| 23 | 7.4 | 3.8 | 5.6 | 12.4 | 0.0 | | | 1.8 | 0 | | |
| 24 | 6.6 | 4.0 | 5.3 | 12.7 | 0.0 | | | 9.3 | 0 | | |
| 25 | 9.4 | 4.1 | 6.8 | 11.2 | 0.0 | | | 2.1 | 0 | | |
| 26 | 12.7 | 4.3 | 8.5 | 9.5 | 0.0 | | | 0.0 | 0 | | |
| 27 | 8.4 | 4.1 | 6.3 | 11.7 | 0.0 | | | 0.0 | 0 | | |
| 28 | 6.5 | 3.0 | 4.8 | 13.2 | 0.0 | | | 5.1 | 0 | | |
| 29 | 4.5 | 2.7 | 3.6 | 14.4 | 0.0 | | | 13.5 | 0 | | |
| 30 | 9.2 | 3.6 | 6.4 | 11.6 | 0.0 | | | 2.0 | 0 | | |
| Sum | | | | 336.1 | 0.0 | | | 68.6 | | | |
| Avg | 11.2 | 2.4 | 6.8 | | | | | | | | |
| Xtrm | 23.7 | -4.2 | | | | | | | | | |

**Daily Data Report for July 2007**

| Day | Max Temp °C | Min Temp °C | Mean Temp °C | Heat Deg Days °C | Cool Deg Days °C | Total Rain mm | Total Snow cm | Total Precip mm | Snow on Grnd cm | Dir of Max Gust 10's Deg | Spd of Max Gust km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 10.6 | 1.8 | 6.2 | 11.8 | 0.0 | | | 0.0 | 0 | | |
| 02 | 12.5 | 1.8 | 7.2 | 10.8 | 0.0 | | | 0.0 | 0 | | |
| 03 | 10.6 | 2.2 | 6.4 | 11.6 | 0.0 | | | 0.0 | 0 | | |
| 04 | 17.4 | 1.8 | 9.6 | 8.4 | 0.0 | | | 0.0 | 0 | | |
| 05 | 15.5 | 4.1 | 9.8 | 8.2 | 0.0 | | | 0.0 | 0 | | |
| 06 | 12.6 | 4.1 | 8.4 | 9.6 | 0.0 | | | 0.0 | 0 | | |
| 07 | 9.8 | 3.4 | 6.6 | 11.4 | 0.0 | | | 0.6 | 0 | | |
| 08 | 10.5 | 4.6 | 7.6 | 10.4 | 0.0 | | | 0.0 | 0 | | |
| 09 | 17.1 | 4.2 | 10.7 | 7.3 | 0.0 | | | 0.0 | 0 | | |
| 10 | 10.6 | 5.0 | 7.8 | 10.2 | 0.0 | | | 0.0 | 0 | | |
| 11 | 10.9 | 3.1 | 7.0 | 11.0 | 0.0 | | | 0.0 | 0 | | |
| 12 | 10.7 | 5.4 | 8.1 | 9.9 | 0.0 | | | 11.7 | 0 | | |
| 13 | 20.7 | 6.2 | 13.5 | 4.5 | 0.0 | | | 0.0 | 0 | | |
| 14 | 21.7 | 8.7 | 15.2 | 2.8 | 0.0 | | | 0.0 | 0 | | |
| 15 | 18.9 | 8.5 | 13.7 | 4.3 | 0.0 | | | 2.5 | 0 | | |
| 16 | 12.1 | 6.3 | 9.2 | 8.8 | 0.0 | | | 3.6 | 0 | | |
| 17 | 15.4 | 5.7 | 10.6 | 7.4 | 0.0 | | | 0.0 | 0 | | |
| 18 | 15.1 | 7.7 | 11.4 | 6.6 | 0.0 | | | 1.3 | 0 | | |
| 19 | 10.2 | 7.7 | 9.0 | 9.0 | 0.0 | | | 3.8 | 0 | | |
| 20 | 23.4 | 5.2 | 14.3 | 3.7 | 0.0 | | | 2.3 | 0 | | |
| 21 | 11.6 | 6.6 | 9.1 | 8.9 | 0.0 | | | 1.1 | 0 | | |
| 22 | 10.3 | 5.1 | 7.7 | 10.3 | 0.0 | | | 2.5 | 0 | | |
| 23 | 19.0 | 4.8 | 11.9 | 6.1 | 0.0 | | | 2.8 | 0 | | |
| 24 | 22.3 | 8.6 | 15.5 | 2.5 | 0.0 | | | 0.0 | 0 | | |
| 25 | 24.7 | 10.5 | 17.6 | 0.4 | 0.0 | | | 2.5 | 0 | | |
| 26 | 13.4 | 11.2 | 12.3 | 5.7 | 0.0 | | | 0.7 | 0 | | |
| 27 | 22.3 | 8.1 | 15.2 | 2.8 | 0.0 | | | 1.5 | 0 | | |
| 28 | 21.0 | 9.7 | 15.4 | 2.6 | 0.0 | | | 0.0 | 0 | | |
| 29 | 20.6 | 8.9 | 14.8 | 3.2 | 0.0 | | | 0.0 | 0 | | |
| 30 | 17.7 | 12.5 | 15.1 | 2.9 | 0.0 | | | 1.3 | 0 | | |
| 31 | 18.3 | 9.5 | 13.9 | 4.1 | 0.0 | | | 0.7 | 0 | | |
| Sum | | | | 217.2 | 0.0 | | | 38.9 | | | |
| Avg | 15.7 | 6.2 | 11.0 | | | | | | | | |
| Xtrm | 24.7 | 1.8S | | | | | | | | | |

**Daily Data Report for August 2007**

| Day | Max Temp °C | Min Temp °C | Mean Temp °C | Heat Deg Days °C | Cool Deg Days °C | Total Rain mm | Total Snow cm | Total Precip mm | Snow on Grnd cm | Dir of Max Gust 10's Deg | Spd of Max Gust km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01† | 9.4 | 4.8 | 7.1 | 10.9 | 0.0 | M | M | 1.3 | | | <31 |
| 02† | 16.6 | 4.7 | 10.7 | 7.3 | 0.0 | M | M | 0.0 | | | <31 |
| 03† | 17.2 | 4.1 | 10.7 | 7.3 | 0.0 | M | M | 0.0 | | 14 | 50 |
| 04† | 24.9 | 8.5 | 16.7 | 1.3 | 0.0 | M | M | 0.0 | | 27 | 50 |
| 05† | 19.0 | 11.2 | 15.1 | 2.9 | 0.0 | M | M | 0.0 | | 31 | 74 |
| 06† | 18.1 | 8.9 | 13.5 | 4.5 | 0.0 | M | M | 0.0 | | 29 | 46 |
| 07† | 18.1 | 7.4 | 12.8 | 5.2 | 0.0 | M | M | 0.8 | | 29 | 61 |
| 08† | 15.1 | 8.2 | 11.7 | 6.3 | 0.0 | M | M | 0.0 | | 28 | 57 |
| 09† | 11.2 | 3.9 | 7.6 | 10.4 | 0.0 | M | M | 0.0 | | | <31 |
| 10† | 17.9 | 5.2 | 11.6 | 6.4 | 0.0 | M | M | 1.7 | | 32 | 46 |
| 11† | 11.0 | 8.5 | 9.8 | 8.2 | 0.0 | M | M | 4.5 | | 29 | 59 |
| 12† | 12.1 | 7.2 | 9.7 | 8.3 | 0.0 | M | M | 0.6 | | 31 | 52 |
| 13† | 9.9 | 6.0 | 8.0 | 10.0 | 0.0 | M | M | 0.6 | | | <31 |
| 14† | 17.1 | 5.7 | 11.4 | 6.6 | 0.0 | M | M | 0.0 | | | <31 |
| 15† | 15.5 | 5.5 | 10.5 | 7.5 | 0.0 | M | M | 4.0 | | 9 | 37 |
| 16† | 14.2 | 3.4 | 8.8 | 9.2 | 0.0 | M | M | 11.4 | | | <31 |
| 17† | 10.8 | 3.3 | 7.1 | 10.9 | 0.0 | M | M | 2.0 | | 28 | 32 |
| 18† | 14.5 | 5.9 | 10.2 | 7.8 | 0.0 | M | M | 0.0 | | 28 | 50 |
| 19† | 9.9 | 5.5 | 7.7 | 10.3 | 0.0 | M | M | 0.6 | | 32 | 57 |
| 20† | 16.3 | 6.6 | 11.5 | 6.5 | 0.0 | M | M | 0.0 | | 30 | 48 |
| 21† | 11.8 | 4.5 | 8.2 | 9.8 | 0.0 | M | M | 0.8 | | | <31 |
| 22† | 18.3 | 3.9 | 11.1 | 6.9 | 0.0 | M | M | 0.0 | | | <31 |
| 23† | 25.8 | 7.0 | 16.4 | 1.6 | 0.0 | M | M | 0.0 | | 28 | 39 |
| 24† | 22.4 | 13.3 | 17.9 | 0.1 | 0.0 | M | M | 0.0 | | 18 | 37 |
| 25† | 18.3 | 10.8 | 14.6 | 3.4 | 0.0 | M | M | 1.7 | | | <31 |
| 26† | 15.4 | 7.8 | 11.6 | 6.4 | 0.0 | M | M | 15.3 | | | <31 |
| 27† | 11.6 | 6.7 | 9.2 | 8.8 | 0.0 | M | M | 5.8 | | 31 | 32 |
| 28† | 20.1 | 5.6 | 12.9 | 5.1 | 0.0 | M | M | 0.0 | | 30 | 54 |
| 29† | 12.2 | 5.4 | 8.8 | 9.2 | 0.0 | M | M | 16.2 | | 30 | 33 |
| 30† | 16.9 | 7.2 | 12.1 | 5.9 | 0.0 | M | M | 0.0 | | 30 | 35 |
| 31† | 17.6 | 7.0 | 12.3 | 5.7 | 0.0 | M | M | 1.4 | | 27 | 48 |
| **Sum** | | | | **210.7** | **0.0** | **M** | **M** | **68.7** | | | |
| **Avg** | **15.8** | **6.6** | **11.18** | | | | | | | | |
| **Xtrm** | **25.8** | **3.3** | | | | | | | | **31** | **74** |

**Daily Data Report for September 2007**

| Day | Max Temp °C | Min Temp °C | Mean Temp °C | Heat Deg Days °C | Cool Deg Days °C | Total Rain mm | Total Snow cm | Total Precip mm | Snow on Grnd cm | Dir of Max Gust 10's Deg | Spd of Max Gust km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01† | 16.3 | 5.7 | 11.0 | 7.0 | 0.0 | M | M | 0.9 | | 29 | 44 |
| 02† | 12.8 | 3.6 | 8.2 | 9.8 | 0.0 | M | M | 0.0 | | 31 | 39 |
| 03† | 6.5 | 3.7 | 5.1 | 12.9 | 0.0 | M | M | 10.1 | | 9 | 44 |
| 04† | 7.1 | 4.6 | 5.9 | 12.1 | 0.0 | M | M | 1.0 | | 2 | 48 |
| 05† | 11.9 | 2.1 | 7.0 | 11.0 | 0.0 | M | M | 0.0 | | 30 | 43 |
| 06† | 14.1 | 3.7 | 8.9 | 9.1 | 0.0 | M | M | 0.8 | | 16 | 72 |
| 07† | 14.5 | 5.8 | 10.2 | 7.8 | 0.0 | M | M | 0.0 | | 30 | 61 |
| 08† | 9.4 | 4.5 | 7.0 | 11.0 | 0.0 | M | M | 36.4 | | 10 | 70 |
| 09† | 10.2 | 1.3 | 5.8 | 12.2 | 0.0 | M | M | 0.0 | | 31 | 70 |
| 10† | 9.9 | 0.9 | 5.4 | 12.6 | 0.0 | M | M | 0.7 | | | <31 |
| 11† | 10.1 | 1.6 | 5.9 | 12.1 | 0.0 | M | M | 0.0 | | | <31 |
| 12† | 5.9 | 1.6 | 3.8 | 14.2 | 0.0 | M | M | 36.8 | | 8 | 85 |
| 13† | 6.3 | 4.5 | 5.4 | 12.6 | 0.0 | M | M | 9.6 | | 2 | 78 |
| 14† | 9.3 | 5.3 | 7.3 | 10.7 | 0.0 | M | M | 0.0 | | 30 | 69 |
| 15† | 15.0 | 5.7 | 10.4 | 7.6 | 0.0 | M | M | 1.6 | | 17 | 48 |
| 16† | 12.4 | 2.0 | 7.2 | 10.8 | 0.0 | M | M | 3.2 | | 29 | 54 |
| 17† | 8.0 | 1.1 | 4.6 | 13.4 | 0.0 | M | M | 0.0 | | 25 | 41 |
| 18† | 9.8 | 3.1 | 6.5 | 11.5 | 0.0 | M | M | 0.0 | | 28 | 69 |
| 19† | 9.2 | 1.1 | 5.2 | 12.8 | 0.0 | M | M | 0.0 | | | <31 |
| 20† | 4.8 | 1.1 | 3.0 | 15.0 | 0.0 | M | M | 31.0 | | 1 | 74 |
| 21† | 6.7 | -1.7 | 2.5 | 15.5 | 0.0 | M | M | 0.0 | | | <31 |
| 22† | 6.4 | -2.6 | 1.9 | 16.1 | 0.0 | M | M | 12.7 | | 13 | 59 |
| 23† | 7.8 | 3.2 | 5.5 | 12.5 | 0.0 | M | M | 2.7 | | 26 | 44 |
| 24† | 5.5 | 2.9 | 4.2 | 13.8 | 0.0 | M | M | 0.6 | | 30 | 80 |
| 25† | 4.0 | 1.0 | 2.5 | 15.5 | 0.0 | M | M | 0.0 | | 33 | 72 |
| 26† | 6.7 | -0.7 | 3.0 | 15.0 | 0.0 | M | M | 0.0 | | 32 | 33 |
| 27† | 7.2 | -1.5 | 2.9 | 15.1 | 0.0 | M | M | 0.0 | | 8 | 33 |
| 28† | 4.8 | 2.0 | 3.4 | 14.6 | 0.0 | M | M | 0.0 | | 33 | 35 |
| 29† | 3.7 | 2.2 | 3.0 | 15.0 | 0.0 | M | M | 15.9 | | 31 | 48 |
| 30† | 8.2 | 1.5 | 4.9 | 13.1 | 0.0 | M | M | 0.0 | | 31 | 48 |
| **Sum** | | | | **372.4** | **0.0** | **M** | **M** | **164.0** | | | |
| **Avg** | **8.8** | **2.3** | **5.56** | | | | | | | | |
| **Xtrm** | **16.3** | **-2.6** | | | | | | | | **8** | **85** |

| Daily Data Report for October 2007 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Max Temp °C | Min Temp °C | Mean Temp °C | Heat Deg Days °C | Cool Deg Days °C | Total Rain mm | Total Snow cm | Total Precip mm | Snow on Grnd cm | Dir of Max Gust 10's Deg | Spd of Max Gust km/h |
| 01† | 14.9 | 0.3 | 7.6 | 10.4 | 0.0 | M | M | 1.3 | | 29 | 89 |
| 02† | 7.4 | 1.8 | 4.6 | 13.4 | 0.0 | M | M | 0.0 | | 29 | 65 |
| 03† | 5.1 | -0.6 | 2.3 | 15.7 | 0.0 | M | M | 2.1 | | | <31 |
| 04† | 12.2 | 3.1 | 7.7 | 10.3 | 0.0 | M | M | 5.9 | | 30 | 95 |
| 05† | 12.0 | 3.8 | 7.9 | 10.1 | 0.0 | M | M | 0.0 | | 30 | 70 |
| 06† | 6.4 | 3.0 | 4.7 | 13.3 | 0.0 | M | M | 8.2 | | 30 | 67 |
| 07† | 4.2 | 2.9 | 3.6 | 14.4 | 0.0 | M | M | 3.1 | | 32 | 65 |
| 08† | 3.8 | 1.4 | 2.6 | 15.4 | 0.0 | M | M | 5.7 | | 31 | 63 |
| 09† | 4.6 | 1.2 | 2.9 | 15.1 | 0.0 | M | M | 0.6 | | 32 | 65 |
| 10† | 6.4 | 1.4 | 3.9 | 14.1 | 0.0 | M | M | 0.0 | | 30 | 44 |
| 11† | 9.5 | -2.5 | 3.5 | 14.5 | 0.0 | M | M | 0.0 | | 31 | 43 |
| 12† | 6.5 | -3.1 | 1.7 | 16.3 | 0.0 | M | M | 0.0 | | | <31 |
| 13† | 9.2 | -2.9 | 3.2 | 14.8 | 0.0 | M | M | 0.0 | | | <31 |
| 14† | 2.8 | -1.2 | 0.8 | 17.2 | 0.0 | M | M | 0.0 | | | <31 |
| 15† | 4.4 | -2.7 | 0.9 | 17.1 | 0.0 | M | M | 0.0 | | | <31 |
| 16† | 8.4 | -3.0 | 2.7 | 15.3 | 0.0 | M | M | 0.7 | | 30 | 74 |
| 17† | 2.4 | -0.9 | 0.8 | 17.2 | 0.0 | M | M | 0.0 | | 30 | 85 |
| 18† | 5.7 | -1.3 | 2.2 | 15.8 | 0.0 | M | M | 0.0 | | 29 | 74 |
| 19† | 3.2 | -3.3 | -0.1 | 18.1 | 0.0 | M | M | 0.0 | | 30 | 59 |
| 20† | 2.4 | -2.9 | -0.3 | 18.3 | 0.0 | M | M | 15.5 | | 15 | 56 |
| 21† | 2.5 | -0.6 | 1.0 | 17.0 | 0.0 | M | M | 3.9 | | 34 | 43 |
| 22† | 4.5 | -3.2 | 0.7 | 17.3 | 0.0 | M | M | 0.0 | | 24 | 44 |
| 23† | 0.4 | -1.0 | -0.3 | 18.3 | 0.0 | M | M | 6.9 | | | <31 |
| 24† | 1.0 | -4.8 | -1.9 | 19.9 | 0.0 | M | M | 0.0 | | 30 | 33 |
| 25† | 2.8 | -6.6 | -1.9 | 19.9 | 0.0 | M | M | 0.0 | | 29 | 67 |
| 26† | 6.7 | -3.0 | 1.9 | 16.1 | 0.0 | M | M | 0.6 | | 27 | 76 |
| 27† | 6.4 | -0.3 | 3.1 | 14.9 | 0.0 | M | M | 0.0 | | 29 | 74 |
| 28† | 0.0 | -3.1 | -1.6 | 19.6 | 0.0 | M | M | 13.3 | 6 | 2 | 61 |
| 29† | -2.2 | -9.9 | -6.1 | 24.1 | 0.0 | M | M | 0.0 | 8 | 32 | 44 |
| 30† | -2.3 | -9.2 | -5.8 | 23.8 | 0.0 | M | M | 0.0 | 7 | 23 | 37 |
| 31† | 0.8 | -4.3 | -1.8 | 19.8 | 0.0 | M | M | 0.0 | 5 | 26 | 37 |
| Sum | | | | 507.5 | 0.0 | M | M | 67.8 | | | |
| Avg | 4.9 | -1.7 | 1.62 | | | | | | | | |
| Xtrm | 14.9 | -9.9 | | | | | | | | 30 | 95 |

| Daily Data Report for November 2007 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Max Temp °C | Min Temp °C | Mean Temp °C | Heat Deg Days °C | Cool Deg Days °C | Total Rain mm | Total Snow cm | Total Precip mm | Snow on Grnd cm | Dir of Max Gust 10's Deg | Spd of Max Gust km/h |
| 01† | 3.8 | -1.8 | 1.0 | 17.0 | 0.0 | M | M | 4.3 | 5 | 26 | 37 |
| 02† | 2.5 | -5.8 | -1.7 | 19.7 | 0.0 | M | M | 0.7 | 7 | 31 | 95 |
| 03† | 3.7 | -7.4 | -1.9 | 19.9 | 0.0 | M | M | 0.0 | 5 | 25 | 46 |