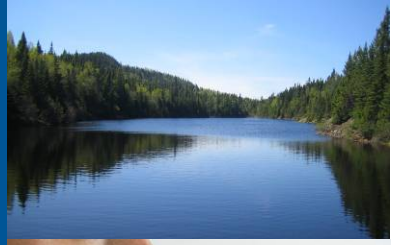




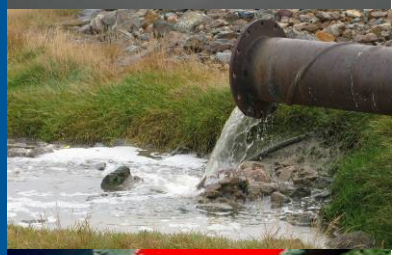


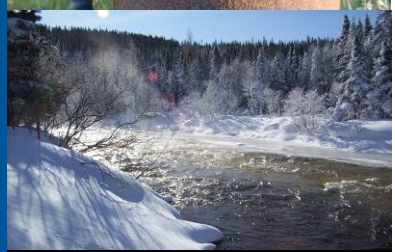

Real Time Water Quality Report

Tata Steel Minerals Canada

Elross Lake Network

Deployment Period
2013-07-03 to 2013-08-07

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

Prepared by:

Ian Bell
Environmental Scientist

Department of Environment & Conservation
Water Resources Management Division
PO Box 2006, Corner Brook, NL, A2H 6J8

t. 709.637.2431
f. 709.637.2541
e. ianbell@gov.nl.ca

General

- The Water Resources Management Division, in partnership with Tata Steel Minerals Canada Limited and Environment Canada, maintain two real-time water quality and water quantity stations in close proximity to the Elross Lake Iron Ore Mine in western Labrador, near Schefferville, QC.
- The official name of each station is ELROSS CREEK BELOW PINETTE LAKE INFLOW and GOODREAM CREEK 2KM NORTHWEST OF TIMMINS 6, hereafter referred to as the *Elross Creek Station* and the *Goodream Creek Station*, respectively.
- Station sites were selected to monitor all surface water outflows from the Elross Lake mining site. The Elross Creek Station is situated downstream of the Timmins 1 pit, and downstream of Pinette Lake. The Goodream Creek Station will serve to monitor potential impacts from groundwater flowing from Timmins 6 pit into the surface water of Goodream Creek.
- The Water Resources Management Division will inform Tata Steel Minerals Canada Limited of any significant water quality events by email notification and by monthly deployment reports.
- This monthly deployment report, presents water quality and water quantity data recorded at the Elross Creek station from July 3, 2013 to August 7, 2013.
- **It should be noted that due to extremely low flow conditions it was not possible to deploy an instrument at the Goodream Creek station during this deployment period.**

Quality Assurance / Quality Control

- Water quality instrument performance is tested at the beginning and end of its deployment period. The process is outlined in Appendix A.
- Instruments are assigned a performance rating (i.e., poor, marginal, fair, good or excellent) for each water quality parameter measured.
- Table 1 shows the performance ratings of five water quality parameters (i.e., temperature, pH, specific conductivity, dissolved oxygen and turbidity) measured by the instrument deployed at the water monitoring station.

Table 1: Water quality instrument performance at the beginning and end of deployment

	Elross Creek	
Stage of deployment	Beginning	End
Date	2013-07-03	2013-08-07
Temperature	Fair	Excellent
pH	Excellent	Excellent
Specific Conductivity	Good	Excellent
Dissolved Oxygen	Excellent	Excellent
Turbidity	Excellent	Excellent

Deployment Notes

- Water quality monitoring for this deployment period started at Elross Creek on July 3, 2013 at 6:30 pm. Continuous real-time monitoring continued without any significant operational issues until August 7, 2013 when the instrument was removed for routine calibration and maintenance.

Data Interpretation

- Data records were interpreted for each station during the deployment period for the following six parameters:

  (i.) Stage (m)
  (ii.) Temperature (^{o}C)
  (iii.) pH
  (iv.) Specific conductivity (□S/cm)
  (v.) Dissolved oxygen (mg/l)
  (vi.) Turbidity (NTU)

Stage

- Stage height values ranged from 1.09 m to 1.31 m at Elross Creek from July 3, 2013 to August 7, 2013 (Figure 1). Stage height is directly related to the volume of flow in a stream as defined by a rating curve which is unique for every site.
- For Elross Creek stage height remained relatively stable over most of the deployment with a significant rise over the last five days which is related to significant rainfall over several days (Climate data located in Appendix B).

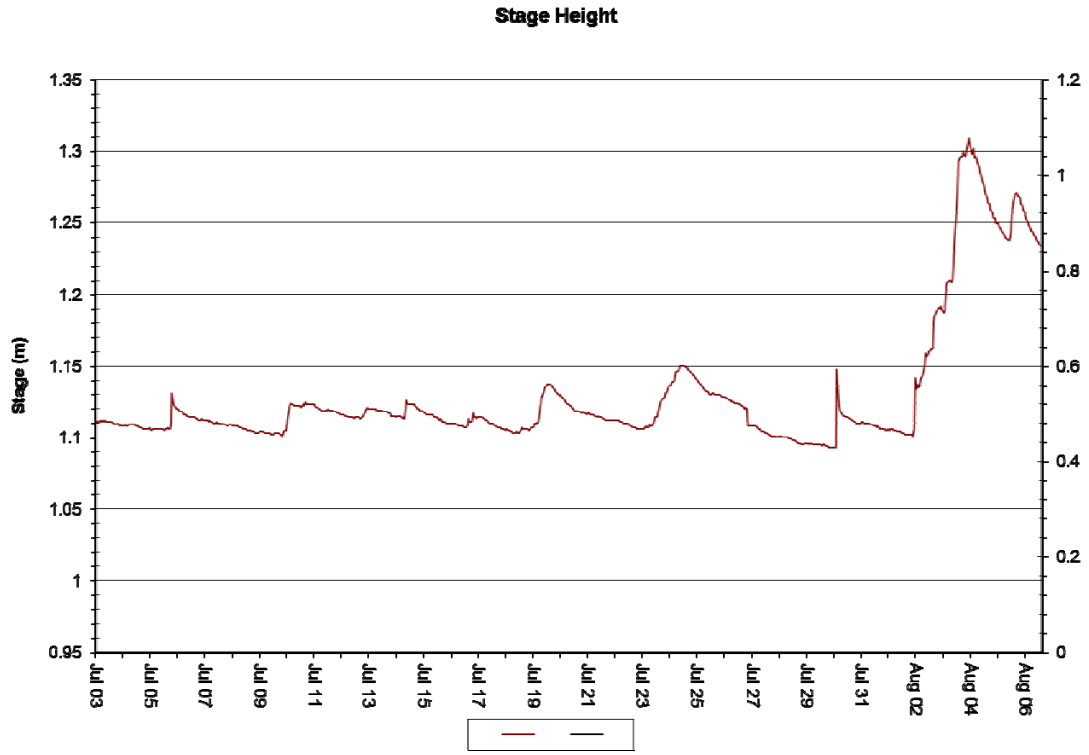

Figure 1: Stage height (m) recorded at Elross Creek – July 3, 2013 to August 7, 2013.

Temperature

- Water temperature ranged from 6.90˚C to 16.90˚C at Elross Creek from July 3, 2013 to August 7, 2013 (Figure 2).
- Temperature at Elross Creek was relatively stable throughout the deployment period.
- Water temperature at Elross Creek displays very noticeable diurnal variations, typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures.
- During periods of higher stage and flow at the end of the deployment period the normal diurnal variations are significantly reduced.

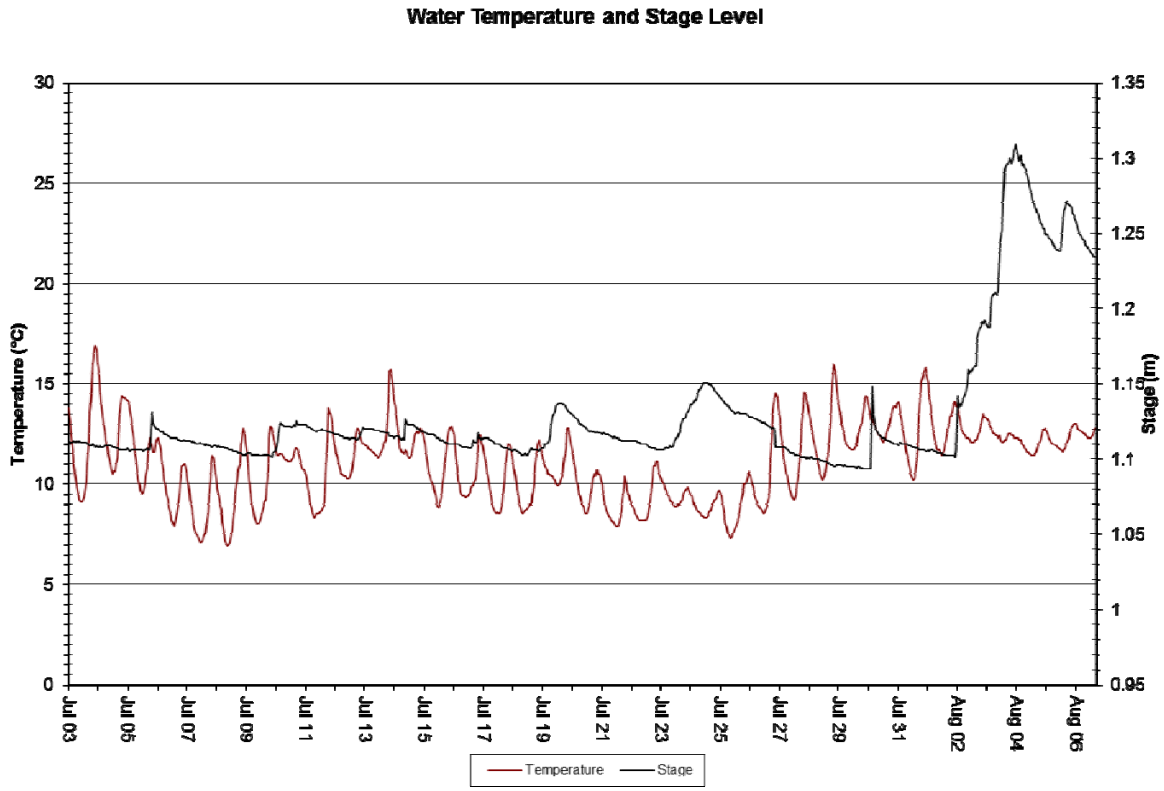

Figure 2: Water temperature (°C) - Elross Creek – July 3, 2013 to August 7, 2013.

pH

- pH values ranged from 6.18 units to 6.83 units at Elross from July 3, 2013 to August 7, 2013 (Figure 3).
- pH tends to show a diurnal trend which is related to the diurnal temperature trend.
- It appears that pH is affected by significant changes in stream flow (see inside red oval), with a slight dip around August 3 due to a significant increase in flow at that time.
- With a mean value of 6.62, pH values recorded at Elross Creek were at, or slightly above, the minimum pH guideline set for the protection of aquatic life (i.e., 6.5 units), as defined by the Canadian Council of Ministers of the Environment (2007). It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally below this 6.5 unit guideline.

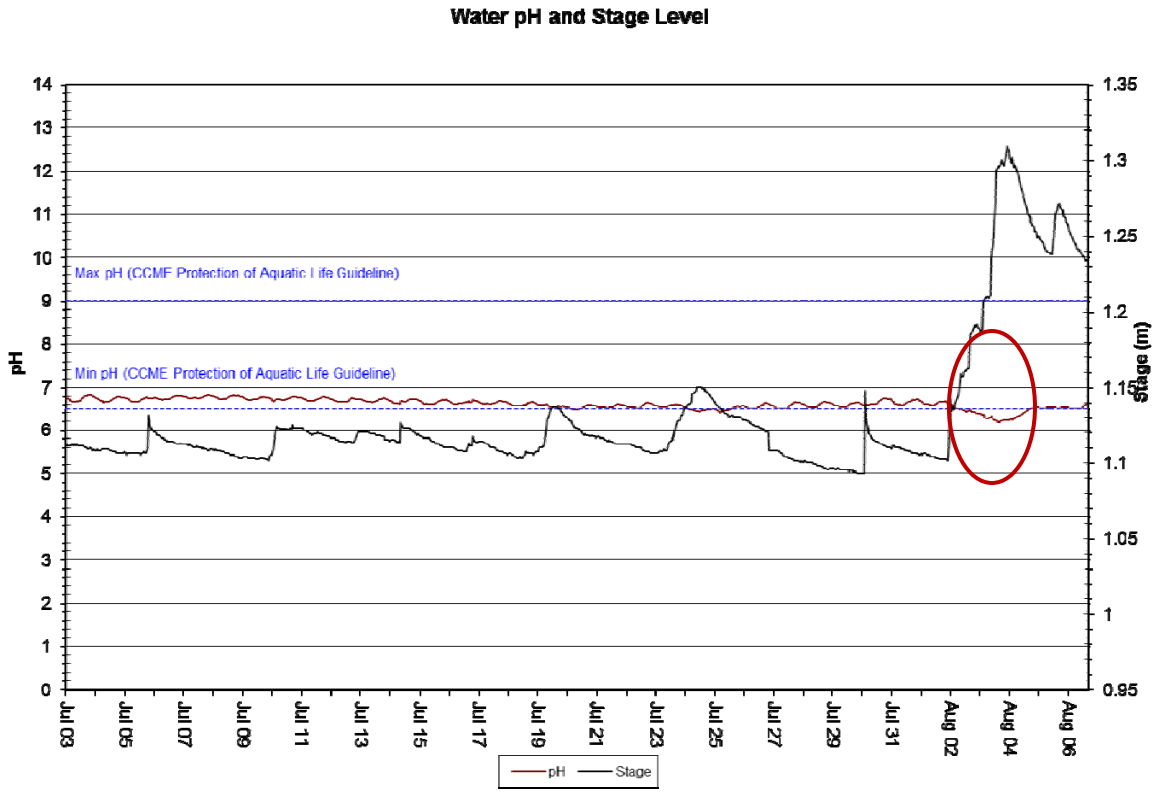

Figure 3: pH at Elross Creek – July 3, 2013 to August 7, 2013.

Specific Conductivity

- Specific Conductivity ranged from 12.6 µs/cm to 18.7 µs/cm at Elross Creek from July 3, 2013 to August 7, 2013 (Figure 4).
- There is a diurnal trend in specific conductivity visible which is related to the diurnal temperature trend.
- Sudden changes in flow appear to have an impact on specific conductivity (see inside red ovals). This relationship can be seen at Elross Creek where increases in flow around July 19 & 24, and August 3 all correspond with noticeable dips in conductivity.

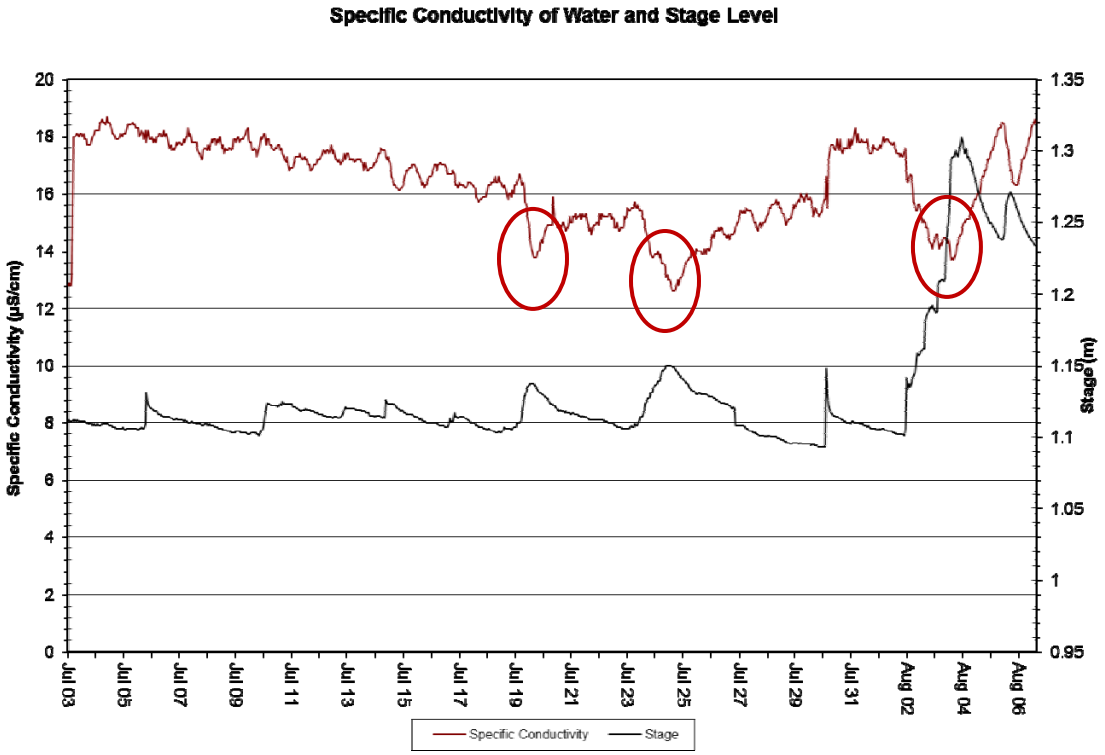

Figure 4: Specific conductivity (µs/cm) - Elross Creek – July 3, 2013 to August 7, 2013.

Dissolved Oxygen

- It appears that during this deployment period the oxygen probe on the deployed instrument was experiencing intermittent technical issues which make the quality of the data for the entire deployment period questionable. All oxygen data has been removed from the dataset for this deployment period. Because of these technical issues, no interpretation is offered for oxygen during this deployment period.

Turbidity

- Turbidity values ranged from 0 NTU to 2760.0 NTU at Elross Creek from June 4, 2013 to July 3, 2013 (Figures 5).
- It appears that two large spikes around July 30 and August 2 may be related to significant increases in flow at the corresponding time. Likewise a series of spikes in turbidity from August 2 to 4 may also be related to significant rainfall events and increases in flow at that time.

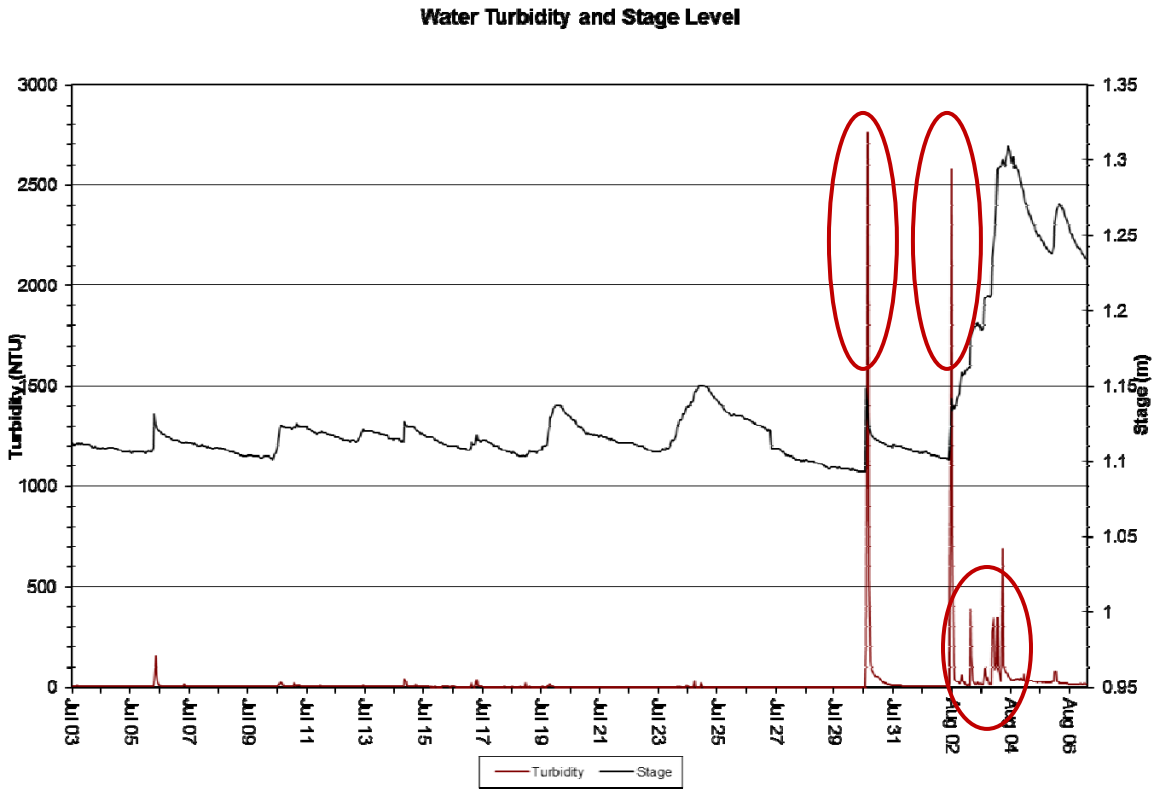

Figure 5: Turbidity (NTU) at Elross Creek – July 3, 2013 to August 7, 2013.

Conclusion

- This monthly deployment report, presents water quality and water quantity data recorded at the Elross Creek station from July 3, 2013 to August 7, 2013.
- The performances of all sensors were rated in the range of fair to excellent at the beginning of the deployment and all excellent at the end. It should be noted that the oxygen sensor experienced intermittent technical issues during the deployment period and therefore all oxygen data are considered unreliable and are not included in this report.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - Stage height remained relatively stable over most of the deployment with a significant rise over the last five days which is related to corresponding significant rainfall over several days.
    - Temperature at Elross Creek was relatively stable throughout the deployment period.

- Diurnal fluctuations in water temperature corresponded with fluctuations in air temperature. This diurnal temperature trend is reflected in similar diurnal trends for pH, specific conductivity and dissolved oxygen.
- Several major turbidity events at Elross Creek appear to coincide with significant rainfall events which likely caused an increase in stream sediment loads.

References

Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated December, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. (Website: http://ceqg-rcqe.ccme.ca/download/en/222/)

APPENDIX A
Quality Assurance / Quality Control Procedures

- As part of the Quality Assurance / Quality Control (QA/QC) protocol, the performance of a station's water quality instrument (i.e., Field Sonde) is rated at the beginning and end of its deployment period. The procedure is based on the approach used by the United States Geological Survey (Wagner *et al.* 2006)[1].
- At the beginning of the deployment period, a fully cleaned and calibrated QA/QC water quality instrument (i.e., QA/QC Sonde) is placed *in-situ* with the fully cleaned and calibrated Field Sonde. After Sonde readings have stabilized, which may take up to five minutes in some cases, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde. If the readings from both Sondes are in close agreement, the QA/QC Sonde can be removed from the water. If the readings are not in close agreement, there will be attempts to reconcile the problem on site (e.g., removing air bubbles from sensors, etc.). If no fix is made, the Field Sonde may be removed for recalibration.
- At the end of the deployment period, a fully cleaned and calibrated QA/QC Sonde is once again deployed *in-situ* with the Field Sonde, which has already been deployment for 30-40 days. After Sonde readings have stabilized, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde.
- Performance ratings are based on differences listed in the table below.

	Rating				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (^{o}C)	≤ ±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

[1] Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at *http://pubs.water.usgs.gov/tm1d3*

APPENDIX B

Environment Canada Weather Data – Schefferville (July 3, 2013 to August 7, 2013)

Date	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Rain Flag	Total Snow Flag	Total Precip (mm)
7/3/2013	23.6	10.3	17	1	0	M	M	0
7/4/2013	28.8	10.5	19.7	0	1.7	M	M	0
7/5/2013	24.8	12.2	18.5	0	0.5	M	M	0
7/6/2013	22.5	6.1	14.3	3.7	0	M	M	2.1
7/7/2013	10.6	3.6	7.1	10.9	0	M	M	0.3
7/8/2013	11.6	3.5	7.6	10.4	0	M	M	1.6
7/9/2013	19.3	5.4	12.4	5.6	0	M	M	0
7/10/2013	23.8	8.5	16.2	1.8	0	M	M	8.8
7/11/2013	M	14.6	M	M	M	M	M	1.3
7/12/2013	18.3	8.6	13.5	4.5	0	M	M	3.3
7/13/2013	21.7	15.1	18.4	0	0.4	M	M	3.8
7/14/2013	24.6	16.3	20.5	0	2.5	M	M	0
7/15/2013	18.4	8	13.2	4.8	0	M	M	5.5
7/16/2013	17.9	6.3	12.1	5.9	0	M	M	0
7/17/2013	18.8	6	12.4	5.6	0	M	M	5.8
7/18/2013	14.7	5.5	10.1	7.9	0	M	M	0
7/19/2013	21.2	8.2	14.7	3.3	0	M	M	12.6
7/20/2013	14.5	5.1	9.8	8.2	0	M	M	4.8
7/21/2013	12.1	4.5	8.3	9.7	0	M	M	1.8
7/22/2013	9.2	4.6	6.9	11.1	0	M	M	1.6
7/23/2013	14.5	7.2	10.9	7.1	0	M	M	4.8
7/24/2013	9.8	6.4	8.1	9.9	0	M	M	41.9
7/25/2013	11.6	3.8	7.7	10.3	0	M	M	0.8
7/26/2013	18.6	3.7	11.2	6.8	0	M	M	1.4
7/27/2013	21.3	6.7	14	4	0	M	M	0.3
7/28/2013	22.3	6.2	14.3	3.7	0	M	M	0
7/29/2013	22.6	11.6	17.1	0.9	0	M	M	0
7/30/2013	21.6	13.4	17.5	0.5	0	M	M	0.3
7/31/2013	19.3	11.3	15.3	2.7	0	M	M	2
8/1/2013	23.6	8.7	16.2	1.8	0	M	M	0
8/2/2013	23.1	12.6	17.9	0.1	0	M	M	9.8
8/3/2013	17.2	12.9	15.1	2.9	0	M	M	22
8/4/2013	14.6	10.5	12.6	5.4	0	M	M	27.9
8/5/2013	15.3	9.9	12.6	5.4	0	M	M	4.8
8/6/2013	15.7	10.5	13.1	4.9	0	M	M	1.8