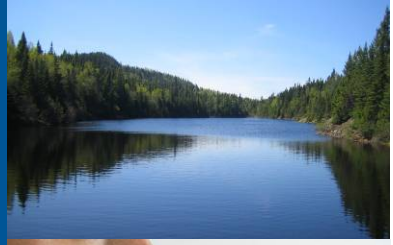




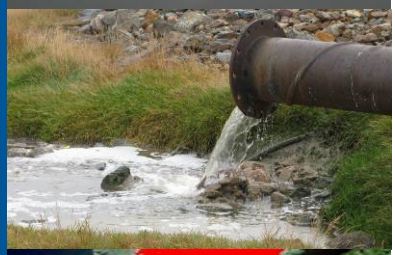


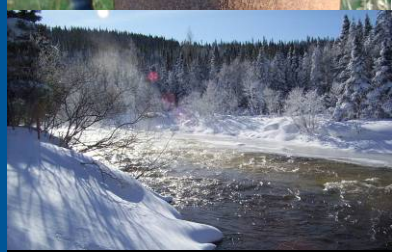

Real Time Water Quality Report

Tata Steel Minerals Canada

Elross Lake/Joan Brook Network

Deployment Period
2018-08-29 to 2018-10-02

Government of Newfoundland & Labrador
Department of Municipal Affairs & Environment
Water Resources Management Division
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General

- The Water Resources Management Division, in partnership with Tata Steel Minerals Canada Limited and Environment and Climate Change Canada, maintains three 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, GOODREAM CREEK 2KM NORTHWEST OF TIMMINS 6, and JOAN BROOK BELOW OUTLET OF JOAN LAKE, hereafter referred to as the *Elross Creek Station*, the *Goodream Creek Station*, and the *Joan Brook Station,* respectively.
- **Please note that the Goodream Creek Station has been temporarily shut down to allow for moving the station to a new location further downstream near Triangle Lake. It is hoped that this move will be completed early in the 2019 field season and that the station will be fully operational at the new location before the end of the 2019 field season.**
- Station sites were selected to monitor all surface water outflows from the Elross Lake and the DSO4 Project 2B mining sites. The Elross Creek Station is situated downstream of the Timmins 1 pit, and downstream of Pinette Lake. The original Goodream Creek Station served to monitor potential impacts from groundwater flowing from Timmins 6 pit into the surface water of Goodream Creek. The new Goodream Station will monitor impacts from the development of the Howse deposit. The Joan Brook station is downstream of the five pits (Kivivic 1, 2, 3N, 4 and 5) which are included in the DSO4 Project 2B mining operation.
- 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 and Joan Brook stations from August 29th, 2018 to October 2nd, 2018 which was the third and final deployment period for the 2018 field season.

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 instruments deployed at the water monitoring stations.

- **With the exception of water quantity data (stage height), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.

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

	Elross Creek		Joan Brook	
Stage of deployment	Beginning	End	Beginning	End
Date	2018-8-29	2018-10-2	2018-8-29	2018-10-2
Temperature	Excellent	Excellent	Excellent	Excellent
pH	Good	Good	Excellent	Excellent
Specific Conductivity	Excellent	Excellent	Excellent	Excellent
Dissolved Oxygen	Excellent	Excellent	Excellent	Excellent
Turbidity	Excellent	Good	Excellent	Excellent

The performance of all sensors at both stations was within acceptable limits during this deployment period (Table 1).

Deployment Notes

- Water quality monitoring for this deployment period started at on August 29th, 2018 at Elross Creek and at Joan Brook. Continuous real-time monitoring continued at Elross Creek and at Joan Brook until October 2nd. Both stations ran for the full deployment period with only minor operational issues.

Data Interpretation

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

(i.) Stage (m)
(ii.) Temperature (°C)
(iii.) pH
(iv.) Specific conductivity (µS/cm)
(v.) Dissolved oxygen (mg/l)
(vi.) Turbidity (NTU)

Stage

- **The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.
- During the deployment period covered by this report, stage height values ranged from 1.11 m to 1.21 m at Elross Creek, and from 1.53 m to 1.59 m at Joan Brook (Figures 1 & 2). 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.
- At both Elross Creek and Joan Brook there were two significant spikes in stage height, see inside red ovals, which correspond closely with significant rainfall events.
- Please note that stage height data for Joan Brook was missing for about nine days from September 17th to 26th, due to technical issues with the data transmission system.

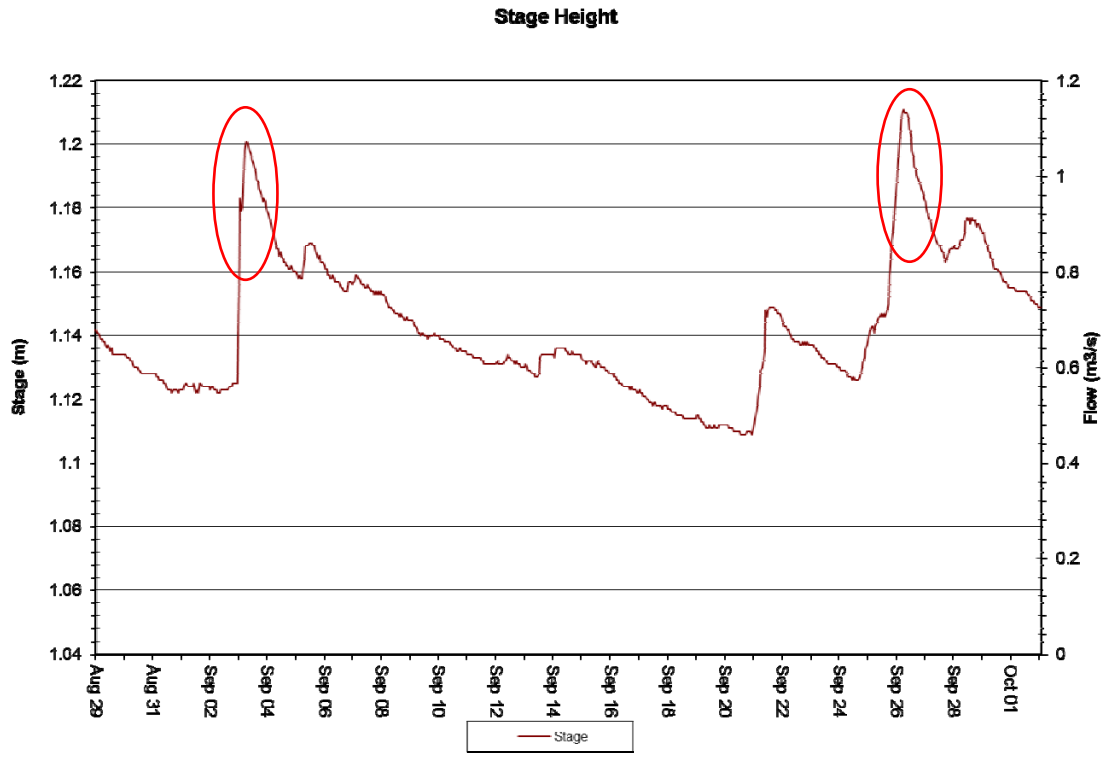

Figure 1: Stage Height (m) at Elross Creek – August 29, 2018 to October 02, 2018

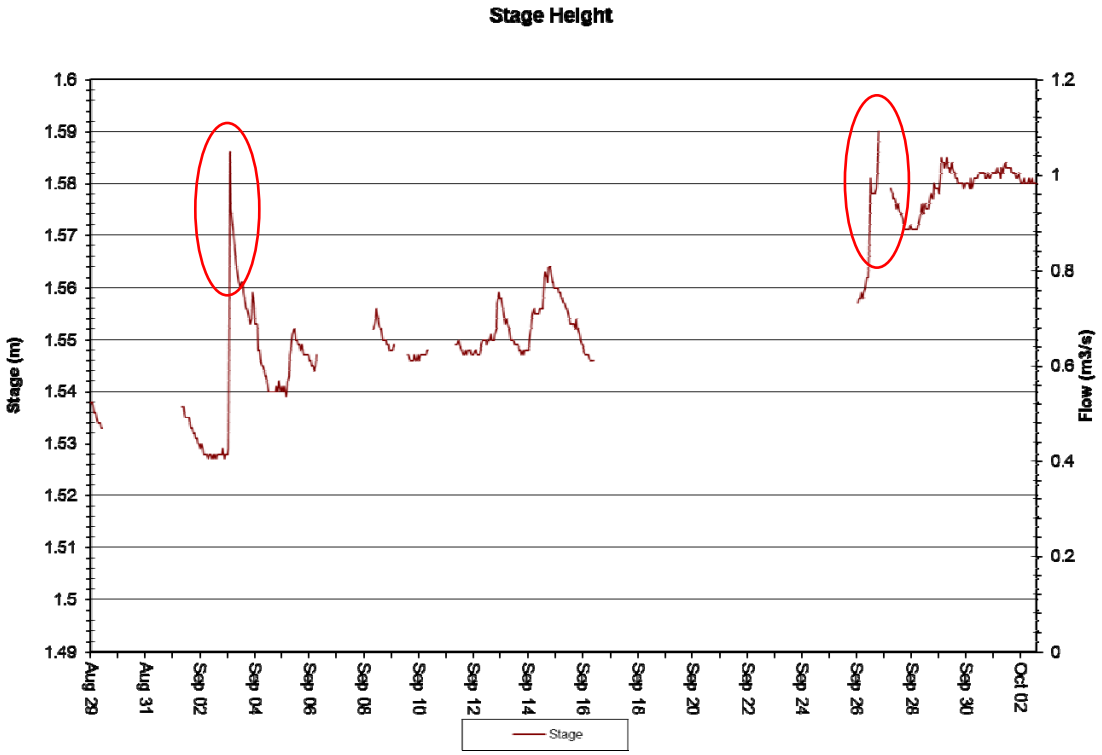

Figure 2: Stage Height (m) at Joan Brook – August 29, 2018 to October 02, 2018

Temperature

- **The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.
- During the deployment period covered by this report, water temperature ranged from 0.7˚C to 13.0˚C at Elross Creek, and from -0.01 ˚C to 12.70 ˚C at Joan Brook (Figures 3 & 4).
- Both stations display noticeable diurnal variations, typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures.
- At both Elross Creek and Joan Brook there is a decreasing temperature trend which is consistent with the transition from late summer to fall.

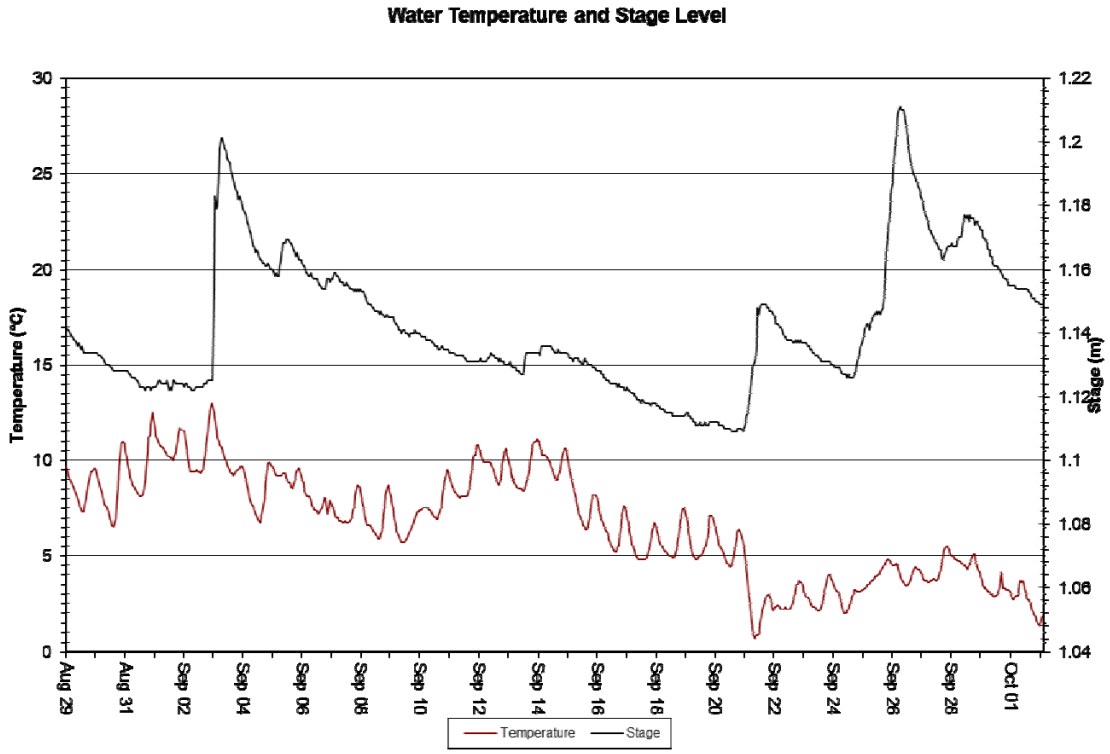

Figure 3: Temperature (°C) - Elross Creek – August 29, 2018 to October 02, 2018

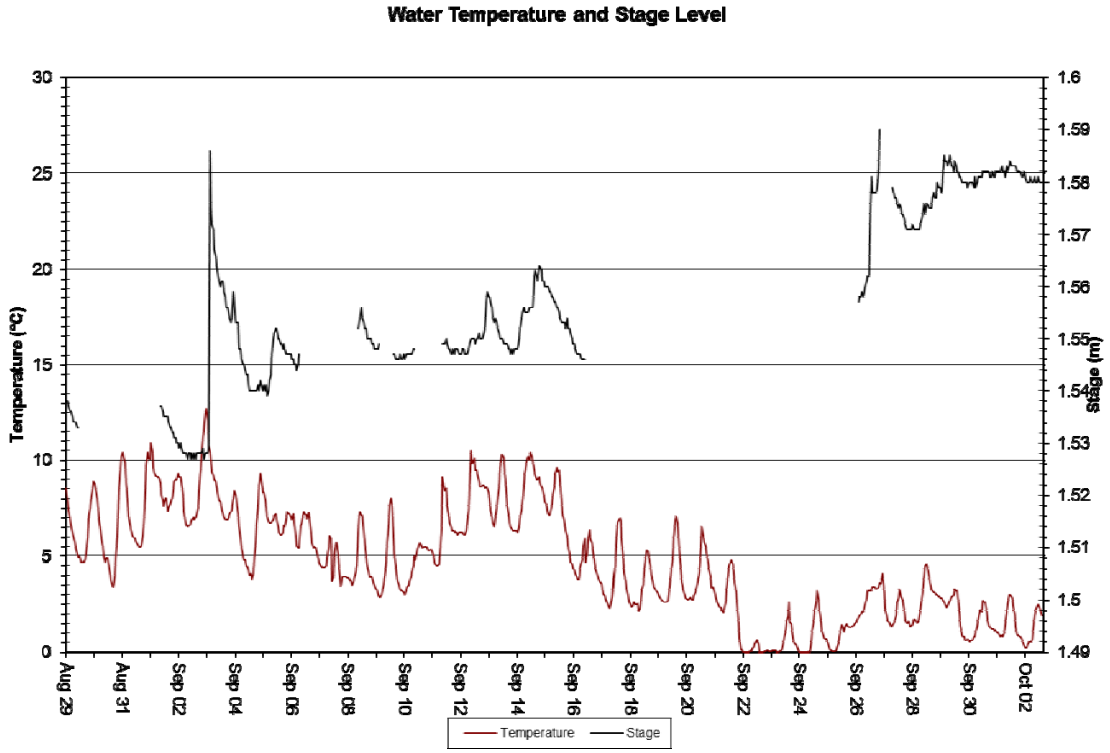

Figure 4: Temperature (°C) – Joan Brook – August 29, 2018 to October 02, 2018

pH

- **The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.
- During the deployment period covered by this report, pH values ranged from 6.33 units to 7.11 units at Elross Creek, and from 6.26 units to 6.64 units at Joan Brook (Figures 5 & 6).
- pH tends to show a diurnal trend which is related to the diurnal temperature trend. This diurnal trend is visible at both stations.
- pH appears to be relatively stable at both stations during this deployment period.
- With a median value of 6.67 units, most of the pH values at Elross Creek are just above the minimum guideline set for the protection of aquatic life (i.e., 6.5 units), as defined by the Canadian Council of Ministers of the Environment (CCME) (2007). At Joan Brook the median pH value was 6.42 units with most of the values just below the minimum guideline range. It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally below the 6.5 unit guideline.

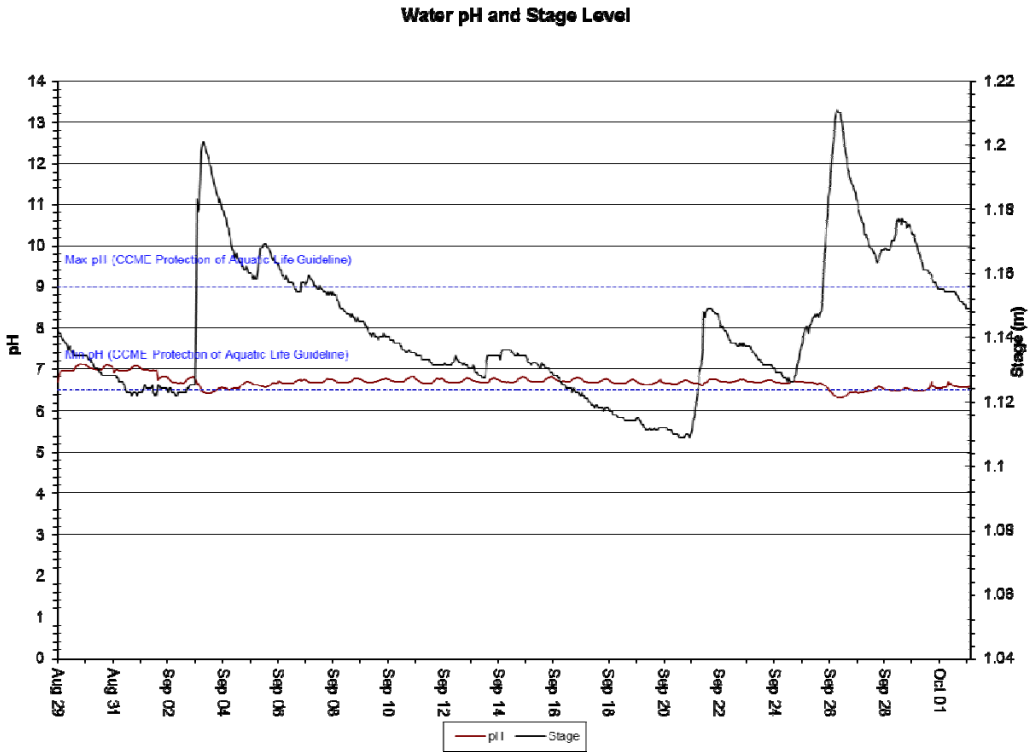

Figure 5: pH at Elross Creek – August 29, 2018 to October 02, 2018

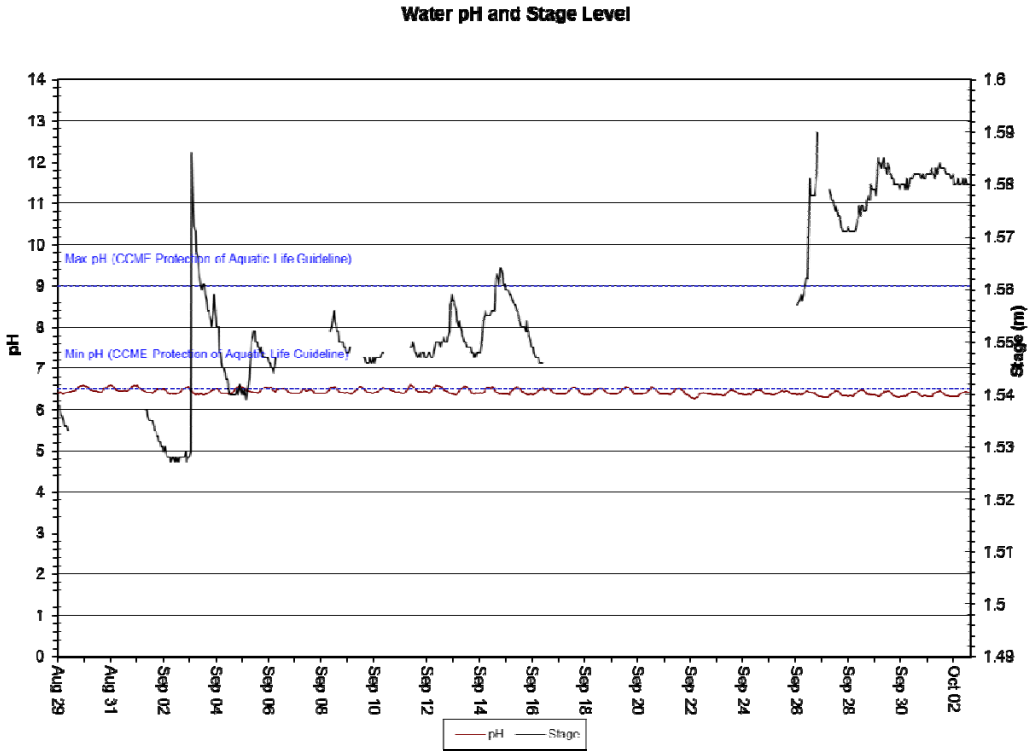

Figure 6: pH at Joan Brook – August 29, 2018 to October 02, 2018

Specific Conductivity

- **The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.
- During the deployment period covered by this report, specific conductivity ranged from 11.2 µs/cm to 17.3 µs/cm at Elross Creek, and from 5.0 µs/cm to 8.4 µs/cm at Joan Brook (Figures 7 & 8).
- Specific conductivity normally shows clear diurnal trends which are related to the diurnal temperature trend.
- At Elross Creek it is possible to see that significant spikes in stage height lead to a noticeable drop in specific conductivity (see inside red ovals).

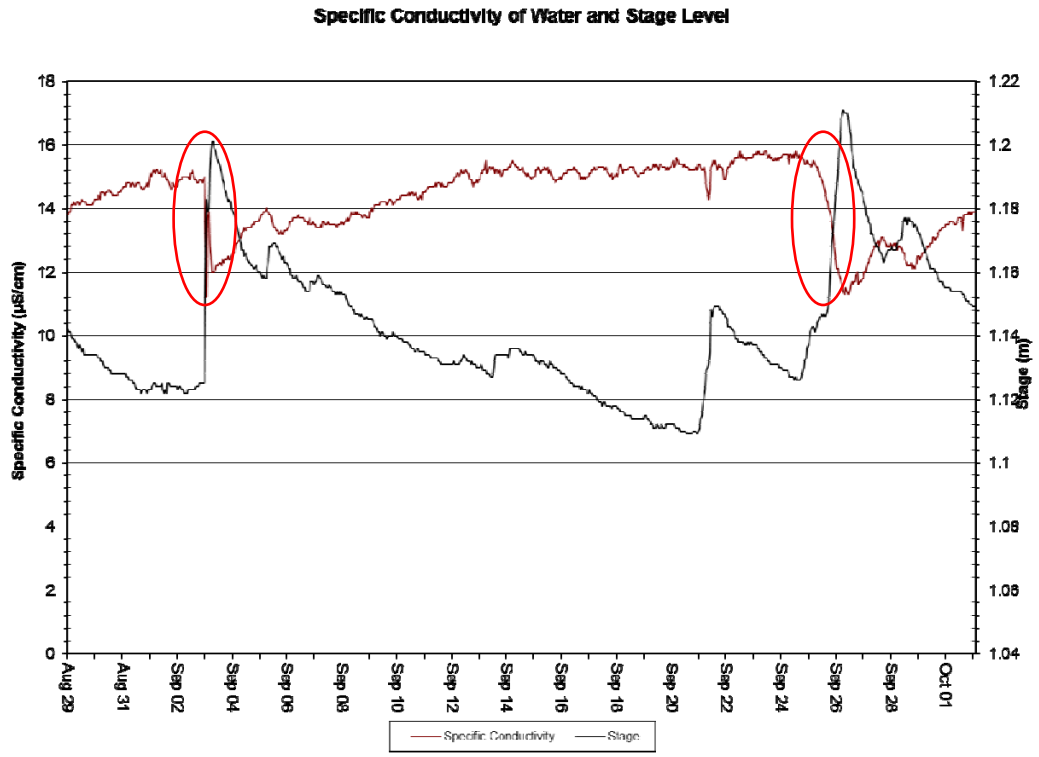

Figure 7: Specific Conductivity at Elross Creek – August 29, 2018 to October 02, 2018

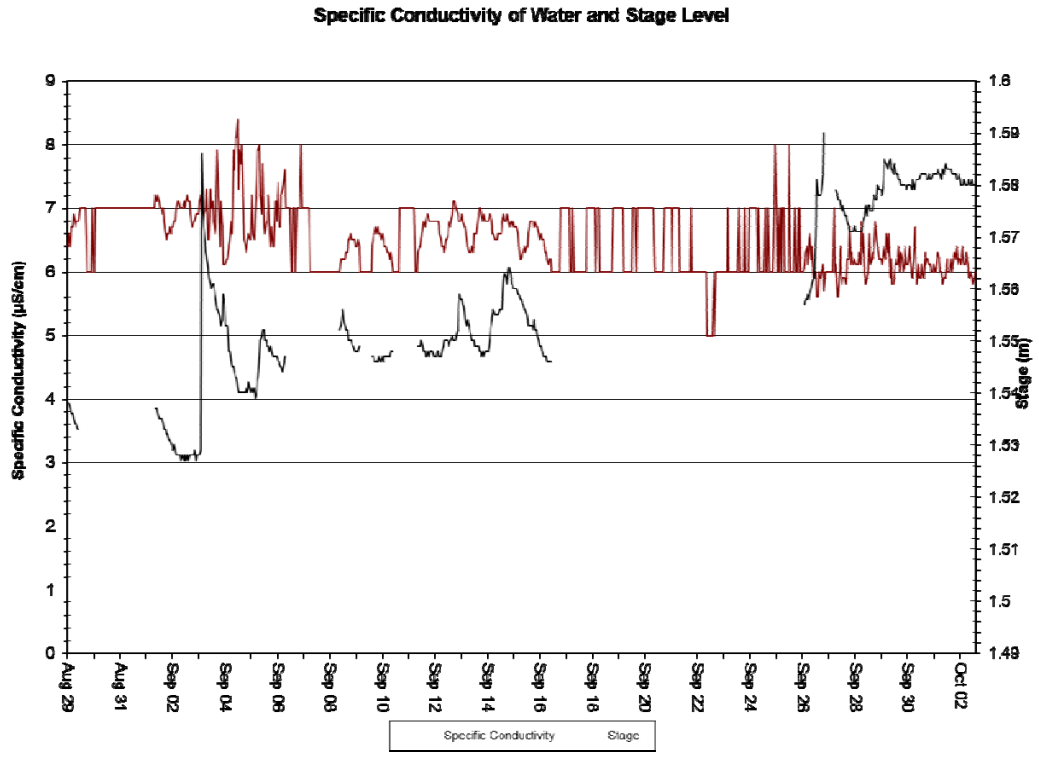

Figure 8: Specific Conductivity at Joan Brook – August 29, 2018 to October 02, 2018

Dissolved Oxygen

- During the deployment period covered by this report, dissolved oxygen (DO) values ranged from 9.44 mg/l (90.5% saturation) to 12.57 mg/l (100.4% saturation) at Elross Creek, and from 9.83 mg/l (90.3% saturation) to 13.19 mg/l (101.8% saturation) at Joan Brook (Figures 9 & 10).
- DO was relatively stable over the deployment period for both stations.
- At both stations there are obvious diurnal trends in DO which are related to diurnal temperature trends.
- The DO values at Elross Creek and Joan Brook are above the minimum guidelines set for other life stages (6.5 mg/l) and near or above the minimum guideline set for cold-water biota during early life stages (9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

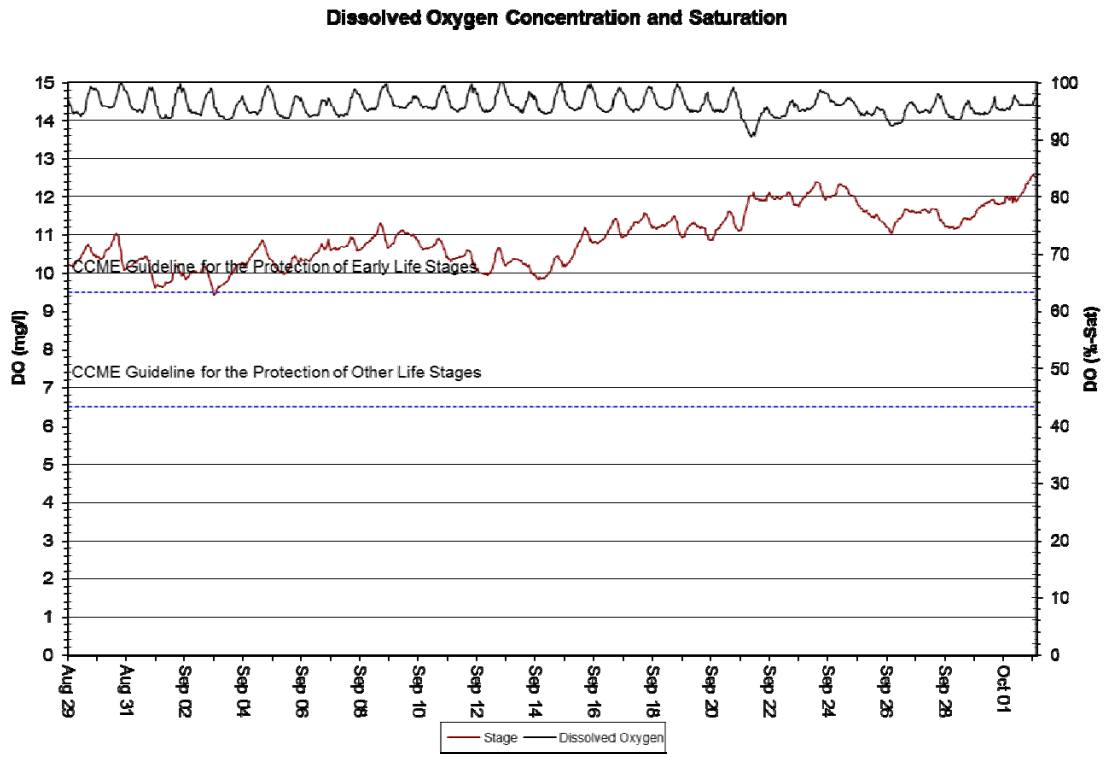

Figure 9: DO (mg/l & % Sat.) at Elross Creek – August 29, 2018 to October 02, 2018

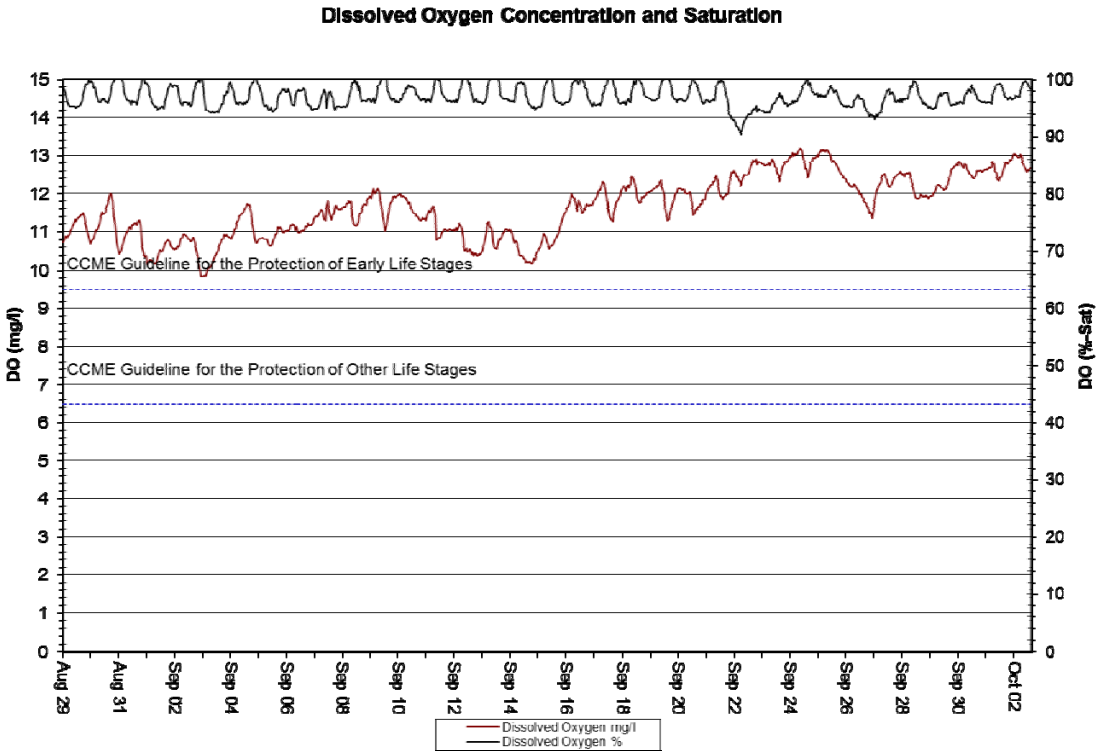

Figure 10: DO (mg/l & % Sat.) at Joan Brook – August 29, 2018 to October 02, 2018

Turbidity

- **The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.
- During the deployment period covered by this report, turbidity values ranged from 4.7 NTU to 2998.0 NTU at Elross Creek, and from 0.0 NTU to 2336.0 NTU at Joan Brook (Figures 11 & 12).
- At both Elross Creek and Joan Brook, there is a significant spike in turbidity on September 3rd (see inside red ovals) which is most likely related to significant precipitation for the same time period.

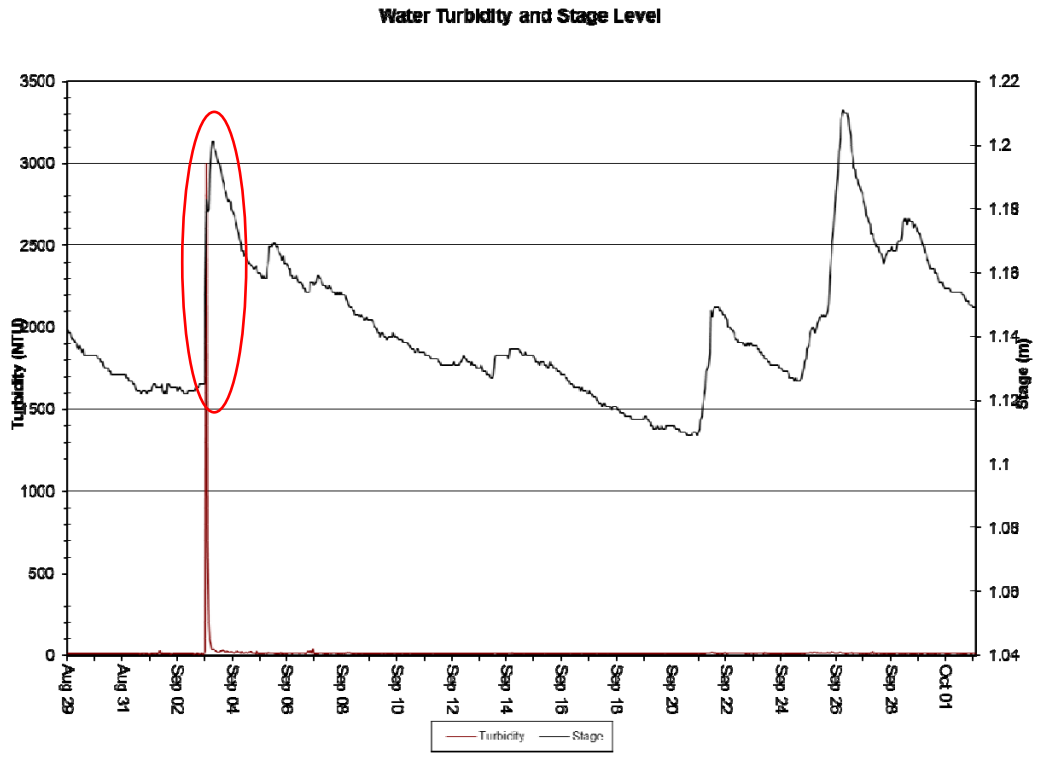

Figure 11: Turbidity (NTU) at Elross Creek – August 29, 2018 to October 02, 2018

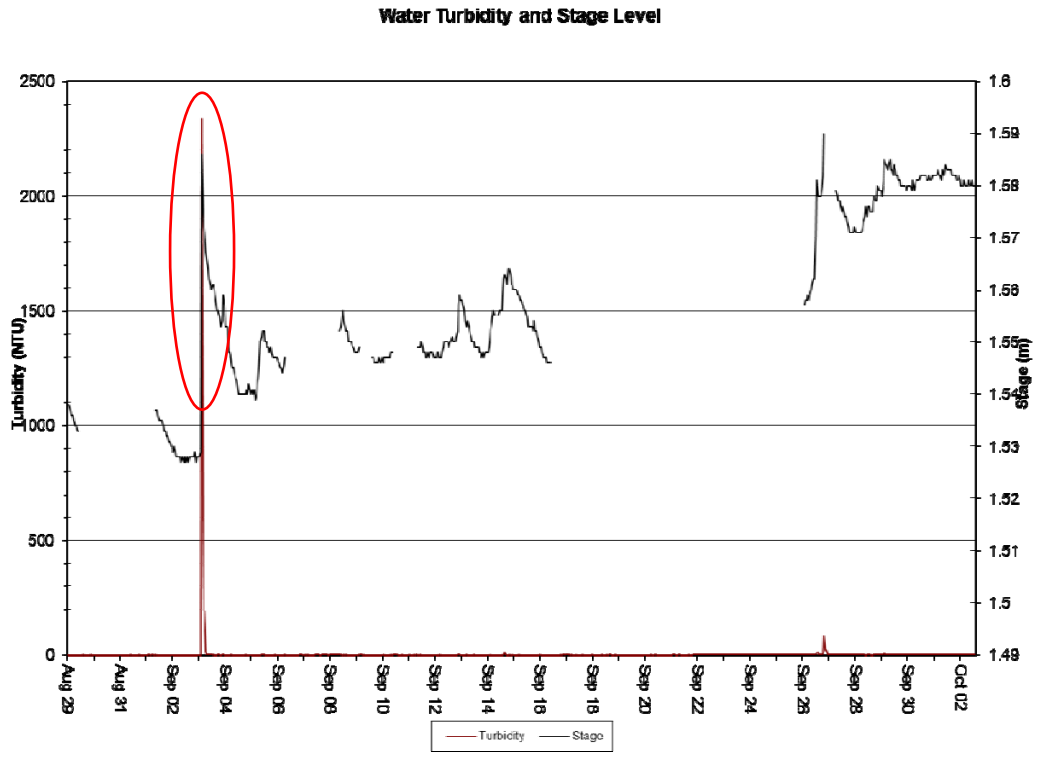

Figure 12: Turbidity (NTU) at Joan Brook – August 29, 2018 to October 02, 2018

Conclusions

- This monthly deployment report, presents water quality and water quantity data recorded at the Elross Creek and Joan Brook stations from August 29th, 2018 to October 2nd, 2018.
- Field instruments for both stations performed well over the deployment period with only minor operational issues.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - For both stations the stage height was typical for the late summer to early fall season when hydrological conditions are affected by significant rainfall events which cause spikes that are relatively short lived.
    - For both stations there was a decreasing temperature trend which is consistent with the transition from late summer to early fall.
    - During the deployment period covered by this report, pH values ranged from 6.33 units to 7.11 units at Elross Creek, and from 6.26 units to 6.64 units at Joan Brook.
    - During the deployment period covered by this report, specific conductivity ranged from 11.2 µs/cm to 17.3 µs/cm at Elross Creek, and from 5.0 µs/cm to 8.4 µs/cm at Joan Brook.
    - During the deployment period covered by this report, dissolved oxygen (DO) values ranged from 9.44 mg/l (90.0% saturation) to 12.57 mg/l (100.4% saturation) at Elross Creek, and from 9.83 mg/l (90.3% saturation) to 13.19 mg/l (101.8% saturation) at Joan Brook.
    - During the deployment period covered by this report, turbidity values ranged from 4.7 NTU to 2998.0 NTU at Elross Creek, and from 0.0 NTU to 2336.0 NTU at Joan Brook.

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*

APENDIX B

Environment Canada Weather Data – Schefferville (August 29, 2018 to October 02, 2018)

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
8/29/2018	9.8	4.2	7	11	0	0
8/30/2018	9.9	1.8	5.9	12.1	0	0.3
8/31/2018	14.8	-0.1	7.4	10.6	0	0
9/1/2018	21.3	10.4	15.9	2.1	0	1.6
9/2/2018	15.7	7	11.4	6.6	0	0.7
9/3/2018	23.2	9.2	16.2	1.8	0	16.7
9/4/2018	10.4	3	6.7	11.3	0	0.6
9/5/2018	11.2	0.1	5.7	12.3	0	7.4
9/6/2018	11.5	3.4	7.5	10.5	0	1.8
9/7/2018	7.6	0	3.8	14.2	0	4.1
9/8/2018	9	0.2	4.6	13.4	0	0.4
9/9/2018	8.5	-0.1	4.2	13.8	0	0.2
9/10/2018	13	3.2	8.1	9.9	0	0.4
9/11/2018	17	8	12.5	5.5	0	0
9/12/2018		11				
9/13/2018	14.6	6.3	10.5	7.5	0	1.2
9/14/2018	21.8	8.6	15.2	2.8	0	4.3
9/15/2018	13.1	0.3	6.7	11.3	0	1.1
9/16/2018	6.1	-0.5	2.8	15.2	0	
9/17/2018	4.4	-1.9	1.3	16.7	0	0
9/18/2018	2.5	-0.8	0.9	17.1	0	0
9/19/2018	7.4	-0.9	3.3	14.7	0	0
9/20/2018	10.3	-0.1	5.1	12.9	0	2.3
9/21/2018	3.4	-1	1.2	16.8	0	4.2
9/22/2018	0.6	-3.6	-1.5	19.5	0	14.7
9/23/2018	0.9	-3.1	-1.1	19.1	0	0.9
9/24/2018	1.8	-3.5	-0.9	18.9	0	1
9/25/2018	4.7	-3.7	0.5	17.5	0	9.7
9/26/2018	11.8	1.9	6.9	11.1	0	
9/27/2018	4.7	0.3	2.5	15.5	0	
9/28/2018	9.4	1.9	5.7	12.3	0	
9/29/2018	5.2	-1.4	1.9	16.1	0	4.9
9/30/2018	3.8	-1.2	1.3	16.7	0	0.5
10/1/2018	3	-3.7	-0.4	18.4	0	1.2
10/2/2018	0.9	-5.7	-2.4	20.4	0	0