

## **APPENDIX E.3**

### **STREAMFLOW DATA FOR TYPE 'A' WATER LICENCE MONITORING LOCATIONS**

# MEMORANDUM

**To:** Andrew Vermeer  
Regulatory Reporting Specialist, Baffinland Iron Mines Corporation

**Date:** March 13, 2019

**From:** Andrew Rees, Ph.D.  
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**Re:** 2018 SNP Hydrometric Monitoring Program

## 1 Introduction

A monitoring requirement of the Mary River Project's (the Project) Type 'A' Water Licence - 2AM-MRY1325 – Amendment No. 1 (Type 'A' Water Licence), issued to Baffinland Iron Mines Corporation (Baffinland) by the Nunavut Water Board (NWB), is to measure and document the surface water flow volumes at or near locations established under the Project's Surveillance Network Program (SNP), prescribed by the Type 'A' Water Licence. To ensure compliance with the monitoring requirement, a hydrometric monitoring network consisting of nine (9) monitoring locations at or near existing SNP monitoring stations was established in 2014 and continued to be monitored during periods of flow during 2018. Table 1.1 summarizes the SNP Hydrometric Station IDs, types, and data collected in 2018.

**Table 1.1 SNP Hydrometric Stations**

Station ID	Hydrometric Station Type	Data Collected
MQ-C-B MQ-C-D MS-C-A/B	Hydrometric station installed using natural channel control.	Discharge and water level were measured during weekly sampling events to validate stage-discharge relationships. Pressure transducers used to measure water level were downloaded monthly.
MP-Q1-01 MP-Q1-02 MP-C-B MS-MRY-13A MQ-C-A	Hydrometric station installed using thin plate V-notch weir flow measurement structures.	Water levels were measured during weekly sampling events. Pressure transducers used to measure water level were downloaded monthly.

## 2 Methods and Data Collection

Site visits were made to the SNP hydrometric stations in June, July, and August 2018. An initial site visit was conducted in June to re-install the pressure transducers, measure flow, and perform maintenance where required. Follow up site visits were conducted in June, July and August to measure flow and water level and to download data. All pressure transducers were removed in September prior to freeze-up.

Water level data were recorded at each station on 15-minute intervals. Daily discharge at each station was calculated by averaging the 15-minute data on a daily basis.

## 3 Results and Discussion

The daily discharge data recorded at the SNP Hydrometric Stations during 2018 are shown in Tables 3.1 and 3.2. The daily discharge data for the SNP Hydrometric Stations at the Milne Port and the Mine Site are shown in Figures 3.1 and 3.2, respectively.

The 2018 data record at the MQ-C-B station was not considered accurate as there were erroneous trends noted. Possible reasons for the erroneous trends noted include malfunction of the pressure transducer, movement of the pressure transducer mounting location or the movement of the water level benchmark. There is a strong

relationship between the flow at MQ-C-D and MQ-C-B as MQ-C-B is located a short distance upstream from MQ-C-D. A linear regression of concurrent flow data from MQ-C-D and MQ-C-B in 2017 was used to define a relationship between flow at the two sites. Using the strong relationship observed in 2017 ( $r^2 = 0.98$ ), the 2018 daily flow at MQ-C-B was estimated from the 2018 daily flow at MQ-C-D.

#### 4 General Conclusion and Recommendations

The SNP Hydrometric Stations were established in 2014. Weirs were installed at six (6) of the stations using aluminum plates. The installations have been relatively stable since installation in 2014, however, several of the weirs are beginning to show signs of deterioration, primarily the wood used to construct the weir boxes. Maintenance performed in 2018 to address the deterioration of the weir boxes consisted of the installation of a new all-aluminum weir at MS-MRY-13A during June 2018.

Additional work planned for June 2019 includes:

- Relocation of MP-C-B, MP-Q-01, and MP-Q1-02 at Milne Port to reflect planned changes in infrastructure and surface water flow drainage routes;
- Installation of new all-aluminum weirs at MP-C-B, MP-Q1-01, MP-Q1-02 and MQ-C-A stations; and
- Expansion of the SNP Hydrometric Monitoring Program by establishing a new SNP Hydrometric Station near the existing SNP Station MS-C-E, currently monitored for water quality. The SNP Hydrometric Station will allow for the quantification of surface flow rates at MS-C-E.

The MS-C-A/B and MQ-C-D stations continue to produce reliable data and won't require any upgrades or changes in 2019. To address potential sources of erroneous data described in Section 3, the location of the pressure transducer installed at MQ-C-B will be reviewed and improved upon in 2019.

To ensure compliance with the Type 'A' Water Licence, Baffinland plans to continue to monitor surface water flow volumes at Project sites in 2019 using the established SNP Hydrometric Monitoring Program.

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#### Attachments:

Table 3.1 SNP Station Daily Average Discharge – June and July

Table 3.2 SNP Station Daily Average Discharge – August and September

Figure 3.1 Milne Port SNP Stations – Daily Discharge

Figure 3.2 Mine Site SNP Stations – Daily Discharge

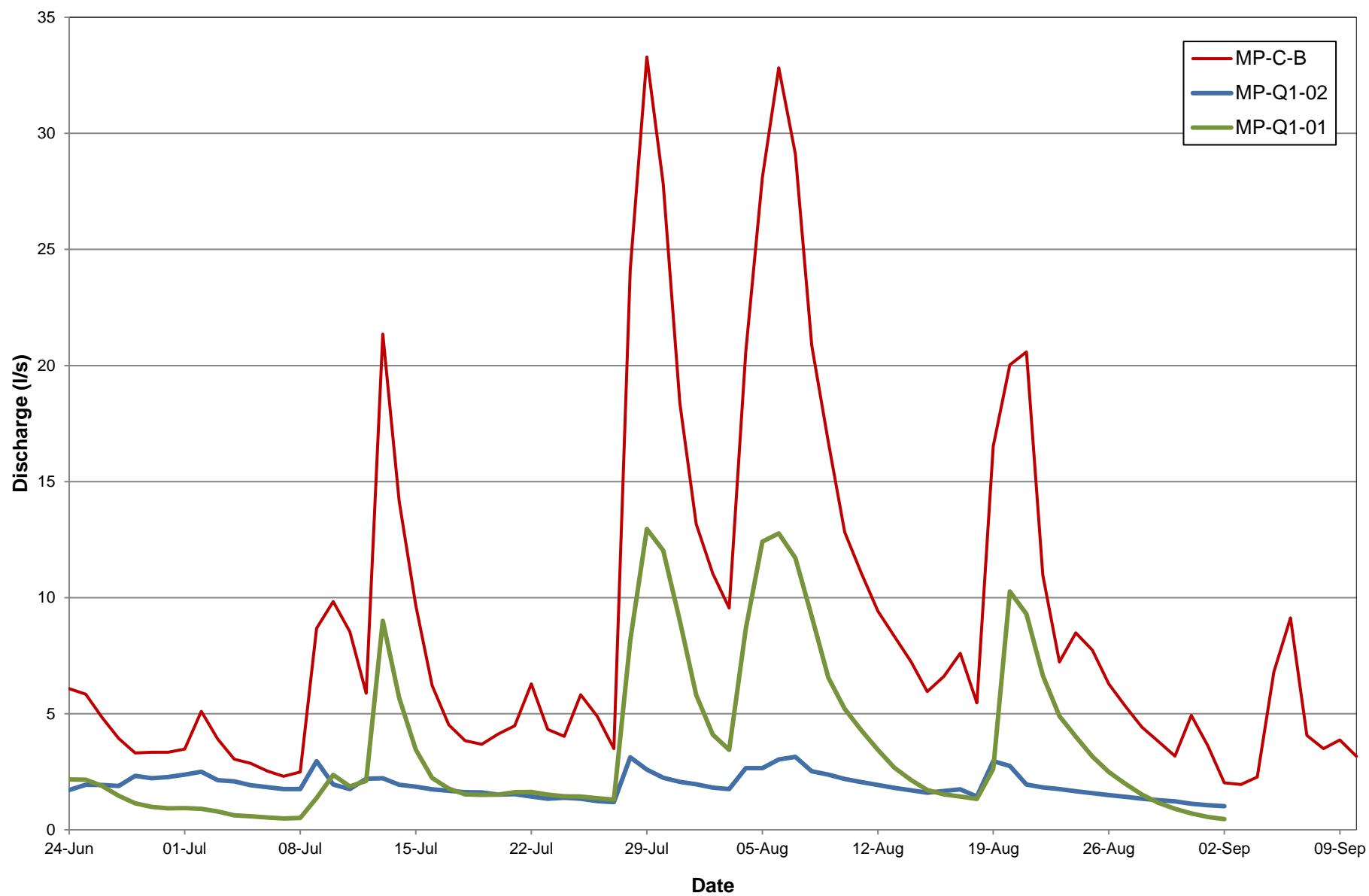
## **Attachments**

**Table 3.1 - SNP Station Daily Average Discharge - June and July**

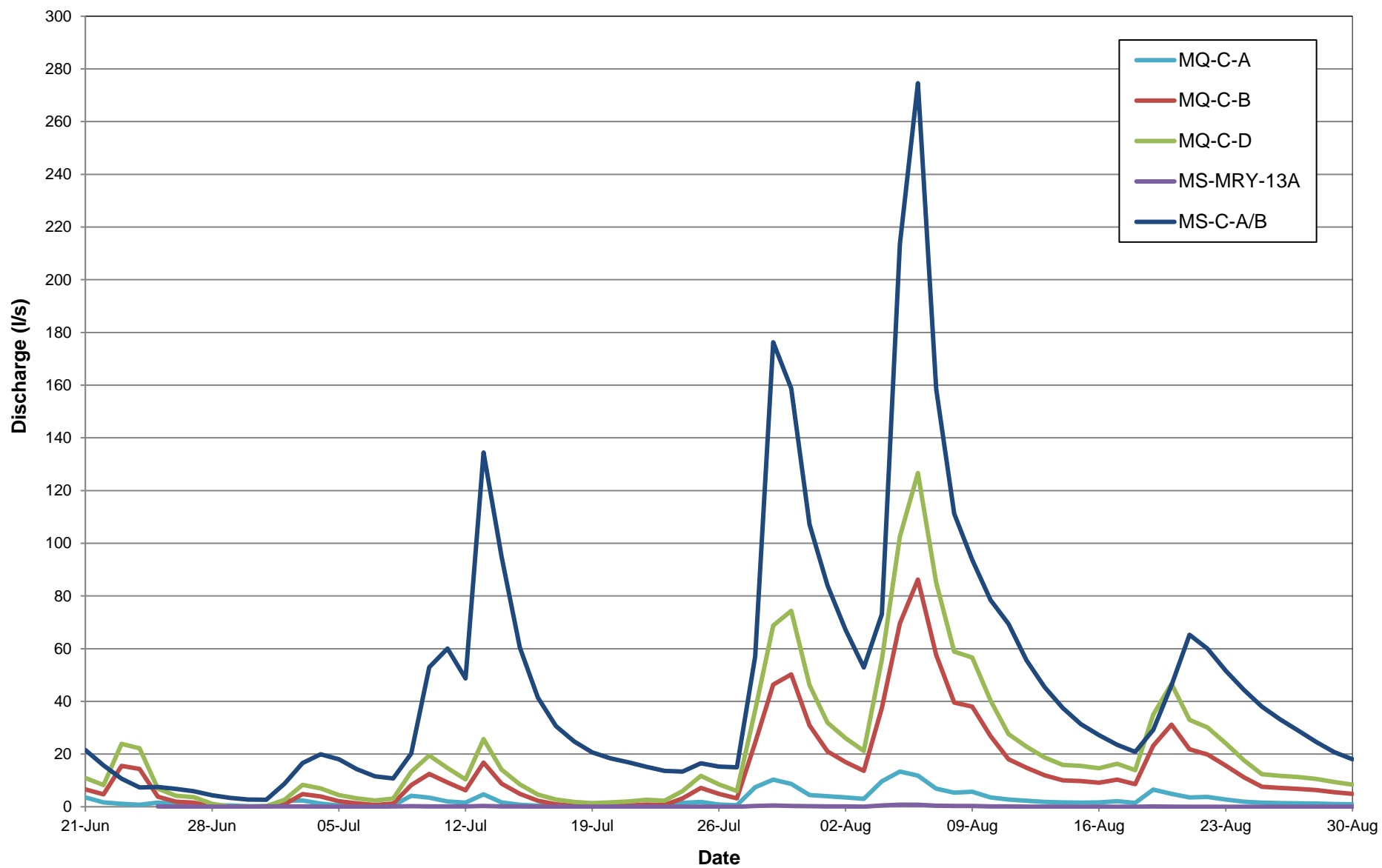
Date	Daily Average Discharge (l/s)							
	MP-C-B	MP-Q1-01	MP-Q1-02	MQ-C-A	MQ-C-B	MQ-C-D	MS-MRY-13A	MS-C-A/B
21-Jun-18				3.5	6.6	10.9		21.6
22-Jun-18				1.7	4.8	8.3		15.7
23-Jun-18				1.1	15.5	23.9		10.7
24-Jun-18	6.1	2.2	1.7	0.7	14.4	22.2		7.4
25-Jun-18	5.8	2.2	1.9	1.6	3.8	6.9	0.092	7.5
26-Jun-18	4.8	1.9	1.9	1.2	1.9	4.1	0.067	6.8
27-Jun-18	3.9	1.5	1.9	0.7	1.6	3.6	0.052	5.9
28-Jun-18	3.3	1.1	2.3	0.5	0.0	1.1	0.056	4.3
29-Jun-18	3.3	1.0	2.2	0.5	0.0	0.1	0.057	3.3
30-Jun-18	3.3	0.9	2.3	0.3	0.0	0.1	0.054	2.8
1-Jul-18	3.5	0.9	2.4	0.2	0.0	0.2	0.091	2.7
2-Jul-18	5.1	0.9	2.5	2.3	0.9	2.7	0.128	8.8
3-Jul-18	3.9	0.8	2.1	2.4	4.8	8.3	0.107	16.6
4-Jul-18	3.0	0.6	2.1	1.2	3.9	7.0	0.072	19.9
5-Jul-18	2.9	0.6	1.9	0.5	2.1	4.4	0.052	18.0
6-Jul-18	2.5	0.5	1.8	0.3	1.3	3.2	0	14.3
7-Jul-18	2.3	0.5	1.8	0.3	0.7	2.4	0	11.6
8-Jul-18	2.5	0.5	1.8	0.5	1.2	3.1	0	10.8
9-Jul-18	8.7	1.4	3.0	4.2	8.2	13.2	0	20.2
10-Jul-18	9.8	2.4	2.0	3.5	12.5	19.5	0	52.9
11-Jul-18	8.5	1.9	1.8	2.0	9.2	14.7	0	60.0
12-Jul-18	5.9	2.1	2.2	1.6	6.2	10.4	0	48.7
13-Jul-18	21.3	9.0	2.2	4.8	16.8	25.7	0	134.4
14-Jul-18	14.2	5.7	1.9	1.7	8.8	14.1	0.150	94.9
15-Jul-18	9.7	3.5	1.9	0.8	4.9	8.5	0	60.4
16-Jul-18	6.2	2.2	1.7	0.4	2.2	4.6	0.068	41.5
17-Jul-18	4.5	1.8	1.7	0.3	0.9	2.7	0	30.7
18-Jul-18	3.8	1.5	1.6	0.2	0.4	1.9	0.014	24.8
19-Jul-18	3.7	1.5	1.6	0.2	0.1	1.4	0	20.6
20-Jul-18	4.1	1.5	1.5	0.3	0.2	1.7	0	18.4
21-Jul-18	4.5	1.6	1.5	0.4	0.5	2.0	0	16.9
22-Jul-18	6.3	1.6	1.4	0.3	0.9	2.6	0	15.2
23-Jul-18	4.3	1.5	1.3	0.3	0.6	2.3	0	13.6
24-Jul-18	4.0	1.4	1.4	1.5	3.2	6.0	0	13.4
25-Jul-18	5.8	1.4	1.3	1.8	7.2	11.7	0	16.5
26-Jul-18	4.9	1.4	1.2	0.9	4.9	8.5	0	15.3
27-Jul-18	3.5	1.3	1.2	0.6	3.2	6.0	0	15.0
28-Jul-18	24.1	8.2	3.1	7.4	24.3	36.7	0	57.1
29-Jul-18	33.3	13.0	2.6	10.3	46.4	68.8	0	176.3
30-Jul-18	27.8	12.0	2.2	8.7	50.2	74.3	0.296	158.7
31-Jul-18	18.4	9.0	2.1	4.5	30.9	46.2	0.182	107.2

**Table 3.2 - SNP Station Daily Average Discharge - August and September**

Date	Daily Average Discharge (l/s)							
	MP-C-B	MP-Q1-01	MP-Q1-02	MQ-C-A	MQ-C-B	MQ-C-D	MS-MRY-13A	MS-C-A/B
1-Aug-18	13.2	5.8	2.0	4.0	21.0	31.9	0.152	84.0
2-Aug-18	11.0	4.1	1.8	3.6	17.0	26.0	0.101	67.1
3-Aug-18	9.6	3.4	1.8	3.0	13.7	21.2	0.080	52.9
4-Aug-18	20.6	8.7	2.7	9.6	37.5	55.8	0.530	73.1
5-Aug-18	28.1	12.4	2.7	13.4	69.6	102.5	0.790	213.5
6-Aug-18	32.8	12.8	3.0	11.8	86.2	126.7	0.731	274.6
7-Aug-18	29.1	11.7	3.1	6.9	57.6	85.0	0.396	158.6
8-Aug-18	20.9	9.2	2.5	5.4	39.6	58.9	0.325	111.2
9-Aug-18	16.7	6.6	2.4	5.7	38.0	56.6	0.277	93.7
10-Aug-18	12.8	5.2	2.2	3.6	26.9	40.4	0	78.5
11-Aug-18	11.1	4.3	2.1	2.7	18.1	27.6	0	69.4
12-Aug-18	9.4	3.4	1.9	2.3	14.8	22.8	0	55.6
13-Aug-18	8.3	2.7	1.8	1.8	11.9	18.6	0	45.3
14-Aug-18	7.2	2.1	1.7	1.6	10.0	15.9	0.008	37.4
15-Aug-18	6.0	1.7	1.6	1.5	9.7	15.5	0.000	31.3
16-Aug-18	6.6	1.5	1.7	1.6	9.1	14.6	0	27.2
17-Aug-18	7.6	1.4	1.7	2.1	10.3	16.3	0	23.5
18-Aug-18	5.5	1.3	1.4	1.5	8.6	13.9	0	20.8
19-Aug-18	16.5	2.6	3.0	6.5	23.1	35.0	0	29.2
20-Aug-18	20.0	10.3	2.7	4.9	31.2	46.7	0	46.1
21-Aug-18	20.6	9.3	1.9	3.6	21.8	33.0	0	65.3
22-Aug-18	11.0	6.7	1.8	3.7	19.8	30.1	0	59.9
23-Aug-18	7.2	4.9	1.8	2.7	15.6	24.0	0	51.6
24-Aug-18	8.5	4.0	1.7	1.9	11.2	17.6	0	44.3
25-Aug-18	7.7	3.2	1.6	1.6	7.6	12.3	0	38.0
26-Aug-18	6.3	2.5	1.5	1.4	7.1	11.7	0	33.2
27-Aug-18	5.3	2.0	1.4	1.3	6.8	11.3	0	28.9
28-Aug-18	4.4	1.5	1.3	1.2	6.3	10.5	0	24.6
29-Aug-18	3.8	1.2	1.3	1.0	5.5	9.4	0	20.8
30-Aug-18	3.2	0.9	1.2	0.9	4.9	8.4	0	18.1
31-Aug-18	4.9	0.7	1.1					
1-Sep-18	3.6	0.6	1.1					
2-Sep-18	2.0	0.5	1.0					
3-Sep-18	2.0							
4-Sep-18	2.3							
5-Sep-18	6.8							
6-Sep-18	9.1							
7-Sep-18	4.1							
8-Sep-18	3.5							
9-Sep-18	3.9							
10-Sep-18	3.2							



**Figure 3.1 Milne Port SNP Stations - Daily Discharge**



**Figure 3.2** Mine Site SNP Stations - Daily Discharge