

Appendix 4

Knight Piésold, Hydrological Assessment of Phillips Creek and km 32 Lake Watersheds

MEMORANDUM

To: Mr. Oliver Curran Date: April 22, 2014

Copy To: File No.: NB102-181/34-A.01

From: Andrew Rees Cont. No.: NB14-00217

Re: Increasing Milne Port's Water Usage from Phillip's Creek and Km 32 Lake

1 – BACKGROUND

As a result of the implementation of the proposed Early Revenue Phase of the Mary River Project, Baffinland will need to increase its water take at the Milne Port facilities by 299 m³/day as a result of the implementation of the Early Revenue Phase of the Mary River Project. This volume would be in addition to the currently approved volume of 68.5 m³/day under the Type A Water Licence 2AM-MRY1325. The combined water demand under both licences during construction would amount to 367.5 m³/day from the two previously approved sources under the Type A licence.

The currently approved Type A Water Licence (2AM-MRY1325) stipulates that Baffinland may withdraw 68.5 m³/day during construction and 31.0 m³/day during operations from Phillips Creek during summer (June through September) and Km32 Lake during winter (October through May).

The new water take requirement is 367.5 m³/day and would be obtained from Phillip's Creek during the summer period (approximately June 1 to September 30) and Km32 Lake during either the summer period or the winter period. To meet the water take requirements, it is assumed that the increase of 299 m³/day would be approved under an amended Type B Water Licence in addition to the 68.5 m³/day authorized under the Type A Water Licence.

The same methodologies used in the Final Environmental Impact Statement (FEIS) and the Addendum to the FEIS for the Early Revenue Phase were used to evaluate the capacity of these water sources.

2 – METHODOLOGY

To assess the proposed increase in water taking, a water usage of 367.5 m³/day was related to the calculated open water low flow estimate for Phillips Creek and to the water volume of Km 32 Lake (under ice for winter water taking and ice-free for summer water taking).

A hydrology station was installed on a tributary of Phillips Creek (H1) in July 2006. Discharge was monitored at H1 from 2006 to 2008 and in 2011. The flow data are summarized in the Baseline Hydrology Report (KP, 2012). The mean annual unit runoff at H1 was estimated to be 7.5 l/s/km² and the lowest measured mean annual unit runoff was 4 l/s/km² (2011). Mean monthly discharge for 10-year wet and dry return periods were estimated to illustrate a range of mean monthly discharge likely to occur at H1 (KP, 2012). The monthly discharge in Phillips Creek at Milne Inlet was estimated by pro-rating the mean and 10-year return period dry monthly unit runoff at H1 to the Phillips Creek at Milne Inlet drainage area.

An assessment of the current water usage from Km32 Lake is contained in Volume 7 of the FEIS (Baffinland, 2012). The assessment draws upon a previous bathymetric survey that provided an estimate of the total lake volume, and the under ice water volume calculated assuming 2 m of ice cover in accordance with Department of Fisheries and Oceans Canada (DFO) guidelines for winter water withdrawals (DFO, 2010). This assessment was updated using 367.5 m³/day to determine if the proposed water usage rate varies

meaningfully from what was assessed in the FEIS, and/or if the proposed water usage rate approaches the 10% limit identified by DFO (2010).

3 – RESULTS AND CONCLUSIONS

Summer Water Take from Phillips Creek

The estimated monthly discharge in Phillips Creek at Milne Inlet for the open water season (June to September) is shown in Table 1.

Table 1 Monthly Discharge of Phillips Creek at Milne Inlet

	June	July	August	September
<i>Mean Monthly Measured Discharge</i>				
Mean Monthly Unit Runoff (l/s/km ²)	34	28	15	7
Mean Monthly Discharge (m ³ /s)	31	26	13	6.4
Total Daily Discharge (m ³)	2,670,800	2,225,700	1,168,500	556,400
<i>10-Year Dry Return Period Monthly Discharge</i>				
Mean Monthly Unit Runoff (l/s/km ²)	10	11	3.9	1.0
Mean Monthly Discharge (m ³ /s)	9.2	10	3.6	0.96
Total Daily Discharge (m ³)	798,000	897,000	308,000	83,000

NOTE:

1. MEAN MONTHLY DISCHARGE NUMBERS ARE ROUNDED AND DO NOT EQUAL THE TOTAL DAILY DISCHARGE.

The lowest flow conditions occur during September. The 10-year return period dry mean monthly discharge for September is estimated to be 0.96 m³/s or 83,000 m³/day (Table 1). A daily withdrawal of 367.5 m³/day represents 0.4% of the estimated low flow in Phillips Creek. As identified in the FEIS, the least uncertainty associated with the best flow measurement methods is +/-5%. Therefore, a 0.4% reduction in flow is within the uncertainty of the measurements could be used to quantify the change. Additionally, the withdrawal location is just upstream of the mouth of the river. The downstream receptor is Milne Inlet (the ocean) and such a minor reduction in flow at this location would be inconsequential to the downstream environment. Therefore, withdrawing 367.5 m³/day from Phillip's Creek from June through September will result in a negligible and immeasurable effect on the downstream aquatic ecosystem.

Over-winter Water Withdrawals from Km 32 Lake

The estimated under ice lake volume and water withdrawal requirements for Km 32 Lake during the winter season (October to May) are presented in Table 2.

The overwinter percent total under-ice volume reduction under the proposed increased water withdrawal is estimated to be 0.19%, compared to 0.03% during construction and 0.01% during operation as indicated in the FEIS. The overwinter depth reduction is estimated to be 0.058 m versus the 0.011 m during construction and 0.005 m during operation outlined in the FEIS. While this represents an order of magnitude increase in depth reduction compared to the FEIS, the estimated winter drawdown would not be measurable considering the variability in lake water level at freeze-up and variable ice thickness from year-to-year. The proposed increase in water withdrawal also remains well below DFO's 10% limit.

Table 2 Overwinter Water Withdrawal Volumes from Km 32 Lake

	FEIS Water Use	Proposed Water Use
Available Under-Ice Lake Volume (m ³)	47,895,100	
Daily Withdrawal Rate (m ³ /d)	67.5	367.5
Overwinter Withdrawals (m ³)	16,402	89,303
Overwinter Percent Total Under-Ice Volume Reduction (%)	0.03	0.19
Overwinter Depth Reduction (m)	0.011	0.058

NOTES:

1. AVAILABLE UNDER-ICE VOLUME REFERS TO THE VOLUME OF AVAILABLE WATER BENEATH THE ICE SURFACE DURING PERIODS OF MAXIMUM ICE THICKNESS WAS ASSUMED TO BE 2 M ACCORDING TO DFO GUIDELINES.
2. THE AVAILABLE UNDER-ICE WATER VOLUME ASSUMES THAT THE LAKE SURFACE WAS AT THE LAKE OUTLET INVERT ELEVATION DURING THE BATHYMETRIC SURVEY.
3. THE WATER LEVEL REDUCTION CALCULATIONS ASSUME THAT THE UNDER-ICE SURFACE AREA IS EQUAL TO THE OPEN WATER SURFACE AREA OF THE LAKE.

Summer Withdrawals from Km32 Lake

Withdrawals from Km32 Lake during the summer period were assessed in the FEIS and were updated for the increased water taking. To simplify the assessment of water taking from Km32 Lake, it was assumed that 367.5 m³/day would be removed from the lake every day in a given month and no water would be obtained from Phillips Creek. This water take was related to the mean monthly discharge of Km32 Lake. The revised water usage is assessed next to the FEIS-assessed water take in Table 3.

Table 3 Reduction in Flow Downstream of Km32 Lake during Summer Water Withdrawals

Project	Description	Withdrawal Rate (m ³ /day)	Upstream Drainage	Monthly Withdrawal Volume (m ³)	Reduction in Mean Monthly Discharge (%)			
					June	July	August	September
FEIS Assessment	Domestic and Industrial Water Consumption	67.5	464	2,025	0.04	-	-	-
Revised Water Usage for ERP		367.5	464	11,025	0.25	0.03	0.06	0.13

NOTES:

1. THE MEAN ANNUAL UNIT RUNOFF WAS ESTIMATED FROM MEASURED DATA COLLECTED AT STATION H1, AS DISCUSSED IN VOLUME 7 SECTION 1 OF THE FEIS.
2. THE ANNUAL DISTRIBUTION OF STREAMFLOW WAS ASSUMED EQUAL TO THE 2007-2011 AVERAGE DISTRIBUTION AT MONITORING STATION H1.
3. THE JUNE FLOW REDUCTION CONSIDERS BOTH THE MONTHLY WATER WITHDRAWAL PLUS THE PREVIOUS WINTER'S WATER WITHDRAWAL.

Similar to the assessment of winter water withdrawal increases, the increased water take results in up to an order of magnitude increase compared to what was assessed in the FEIS, as a percentage of the mean monthly discharge from Km32 Lake. The percent to be removed still remains very small and below what could be measured. Therefore, the effect of water takes from Km32 Lake during the summer months will result in a negligible and immeasurable effect on the downstream aquatic ecosystem.

4 – CLOSURE

The effects of increased water takes from Phillip's Creek during the summer and Km32 Lake during the summer and winter were assessed using the methodologies applied in the FEIS. The conclusion is that the increased water takes remain negligible and immeasurable, with no changes to the conclusions presented in the FEIS or FEIS Addendum.

We trust that this meets your present requirements. Please do not hesitate to contact the undersigned for further information.

5 – REFERENCES

- Baffinland Iron Mines Corporation. 2012. *Mary River Project Final Environmental Impact Statement - Volume 7*.
- Department of Fisheries and Oceans. 2010. *DFO protocol for winter water withdrawal from ice-covered waterbodies in the Northwest Territories and Nunavut*. June 21, 2010. 3 p.
- Knight Piésold Ltd. 2012. *Baffinland Iron Mines Corporation - Mary River Project - Baseline Hydrology Report*. January 4. North Bay, Ontario. Ref. No. NB102-181/30-7, Rev. 1.

Signed:



Andrew Rees, Ph.D. - Project Environmental Scientist

Reviewed and
Approved:



Richard Cook, P.Geo. (Ltd.) - Senior Environmental Scientist

/rc