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ECCC File: 6100 000 011/004
NIRB File: 2AM-MRY1325

July 15, 2021

via email at: licensing@nwb-oen.ca

Richard Dwyer
Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

Dear Richard Dwyer:

RE: 2AM-MRY1325 – Baffinland Iron Mines Corporation – Mary River Project – 2020 Annual Water Licence Report

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Nunavut Water Board (NWB) regarding the above-noted Annual Report. You will find our comments below.

ECCC's specialist advice is based on our mandate pursuant to the *Canadian Environmental Protection Act* and the pollution prevention provisions of the *Fisheries Act.*

ECCC provides the following comments:

1. Contaminant Migration in Groundwater Adjacent to the Landfill

Reference(s)

- NWB 2020 Annual Report, Appendix E.12 - 2020 Groundwater Monitoring Report
- Nunavut Impact Review Board (NIRB) Annual Report, Project Certificate Condition No.23, pdf page 133

Comment
The NIRB Annual Report states:

> *"At monitoring locations MS-LF-GW1, MS-LF-GW2, and MS-LF-GW3, located in the vicinity of the Landfill Facility, the chloride and sulphate concentrations were greater than the Federal Interim Groundwater Quality (FIGQ) Guidelines and were elevated compared to concentrations observed at the reference locations and further down-gradient piezometers. This suggests the presence of groundwater impacts due to landfill operations; however, the results suggest the potential impacts are limited to the immediate vicinity of the Landfill Facility.*

Dissolved metal parameters including boron, cadmium, iron, lead, mercury, nickel, silver, and uranium exceeded their respective FIGQ Guideline at one (1) or more down-gradient monitoring locations MS-LF-GW1, MS-LF-GW2 and MS-LF-GW3. Also increasing trends in select dissolved metals parameters were observed at MS-LF-GW1, and MS-LF-GW2. This also suggests the presence of groundwater impacts due to landfill operations; however, these results also suggest the potential impacts are limited to the immediate vicinity of the Landfill Facility.

… Results of the trend analysis indicate that dissolved iron, dissolved nickel and dissolved uranium are demonstrating an increasing trend."

Section 5.2 Dissolved Metals of the 2020 Groundwater Report further states:

"Increasing trends in dissolved iron and dissolved uranium concentrations were observed at MS-LF-GW1 with concentrations greater than the FIGQ in 2020 (Table 2). Increasing trends in dissolved nickel and dissolved uranium concentrations were observed at MS-LF-GW2 with concentrations greater than the FIGQ Guidelines and reference location concentrations since 2019 (Table 2). The dissolved metals showing increasing trends and concentrations greater than the FIGQ Guidelines and reference locations may indicate groundwater quality impacts due to dissolution from the metal debris that has been disposed in the Landfill Facility; however, additional monitoring is recommended to verify whether a trend is occurring."

Section 5.3 Hydrocarbons and Oil and Grease of the 2020 Groundwater Report states:

"The elevated TOC and DOC detected during the 2020 Monitoring Program combined with historical detection of oil and grease in 2017 and 2018 suggests the presence of potential petroleum hydrocarbon impacts in the groundwater at the two (2) piezometers (MS-LF-GW1 and MS-LF-GW2) located in close vicinity of the Landfill Facility. To further evaluate PHC impacts, BTEX will be analyzed in conjunction with TOC and DOC in 2021."

Section 7.0 Recommendations of the 2020 Groundwater Report states:

"If groundwater quality impacts and trends are confirmed during the 2021 Monitoring Program, a risk assessment is recommended to assess potential impacts to any nearby receptor(s) at the Project site. If risks to nearby receptor(s) are identified through the risk assessment process, implementation of a risk management plan/remediation action plan is recommended."

In the 2020 Groundwater Report, Section 4.2 Groundwater Analytical Results, the range for sulphate is described as 13.3 to 937 mg/L, but the concentration at MS-LF-GW1 is 1150 mg/L. It is unclear whether the range presented is an error.

ECCC Recommendation(s)

ECCC concurs with the recommendation to assess impacts to nearby receptors (i.e. Sheardown Lake NW and SE) with 2021 data, and if trends and elevated levels are confirmed, ECCC recommends further actions be identified to assess risk to receptors and mitigative measures. ECCC notes that the data for sampling stations in Sheardown Lake NW and SE closest to the landfill do not yet show any differences in the parameters that are elevated in groundwater, but recommends that the movement of contaminants towards the lake be monitored, and mitigation identified if necessary.

ECCC recommends the Proponent confirm whether the range presented for sulphate in Section 4.2 of the 2020 Groundwater Report is an error.

2. Monitoring of Total and Dissolved Metals in Groundwater

Reference(s)

- NWB 2020 Annual Report, Appendix E.12 - 2020 Groundwater Monitoring Report

Comment

Section 7.0 Recommendations of the 2020 Groundwater Report states:

> *"Discontinue the analysis of total metals as dissolved metals results are more representative for assessing groundwater quality impacts."*

The basis for this is to be consistent with the FIGQ Guidelines which apply to dissolved contaminants, potential sorption of contaminants to soil particles, and factors such as turbidity, sediment content, or surface water infiltration.

Total suspended solids (TSS) were only measured in 2020 samples (Table 2 Groundwater Analytical Results) and ranged from 8 mg/L and 286 mg/L at the two reference stations, and 10.8 mg/L to 103 mg/L at the groundwater stations. Comparisons of the total metals at the reference sites indicate that the elevated total metals results appear to be correlated with the higher TSS, and on that basis it is reasonable to focus analyses on the dissolved fraction. However, there is no discussion of contaminant behaviour for particulate-associated parameters, and it should be identified whether this fraction has the potential to reach receptors.

ECCC Recommendation(s)

ECCC recommends the Proponent evaluate contaminant mobility in the substrate adjacent to the landfill; specifically, the likelihood of movement of particulate-associated contaminants whether through direct transport or desorption processes.

3. Aluminum and Iron – Mary River Water Samples

Reference(s)

- NWB Annual Report, Appendix E.9.1 – Aquatic Effects Monitoring Reports
- NIRB Annual Report, Appendix G.1 – CREMP Report
    - Section 5.2.6 Effects Assessment and Recommendations
    - Appendix C Water Quality Data, Figure C.23, pdf pages 105 & 106

Comment

Benchmarks were exceeded in 2020 for aluminum and iron at sampling stations adjacent to and downstream of the mine during summer sampling. The report attributes this to higher turbidity encountered in the summer sampling event, noting comparability of turbidity to baseline and upstream concentrations. ECCC notes that this is borne out by the low concentrations of dissolved aluminum and iron (Table C.60).

Figure C.23 shows temporal comparisons of water chemistry at Mary River stations over mine baseline and operations. Results in 2019 (fall) and 2020 (summer) appear to show higher variability and higher concentrations overall for aluminum, copper and iron than the baseline or 2015-2018 data. It is unclear if this has been tested statistically with respect to

links to turbidity and/or comparisons to previous years. ECCC notes that dust control measures have improved after 2017 so there may be meteorological or other factors.

ECCC Recommendation(s)
ECCC recommends the Proponent provide a discussion of 2019 and 2020 results for aluminum, copper and iron in Mary River samples.

4. Updated Zinc and Manganese Guidelines – Outstanding Comment from 2019 Annual Report

Reference(s)

- NIRB Annual Report, Appendix G.1 – CREMP Report
  - Section 2.2.3 Water Chemistry Sampling and Data Analysis
  - Table 2.2
- NWB Annual Report, Appendix E.14 - Response to Outstanding 2019 Annual Report Comments

Comment
ECCC provided the following comment on the 2019 Core Receiving Environment Monitoring Program Report (CREMP) Report:

> *"Table 2.2 lists the water quality guidelines used for the Mary River project with the majority of the guidelines being based on the CCME Water Quality Guidelines for the Protection of Aquatic Life. Where no CCME guidelines exist the Proponent has implemented the lowest of either the Ontario or BC Provincial Water Quality Guidelines. ECCC notes that the zinc guideline has not been updated in accordance with the updated CCME dissolved zinc water quality guideline that was released in 2018. In addition, in 2019 the CCME released a manganese water quality guideline which is not included in the Proponent's list of guidelines, and instead are using the BC guideline. The equation for guideline derivation released by CCME is based on hardness and pH appears to result in a potentially lower water quality guideline than the 0.935 mg/L BC Water Quality Guideline and may be a more appropriate metric for use at Mary River.*
>
> *Recommendation:*
>
> *ECCC recommends the Proponent:*
>
> *o Use the updated zinc CCME Water Quality Guideline for analysis in future monitoring years.*
>
> *o Discuss whether the newly released CCME Manganese Water Quality Guideline is more appropriate for use at the mine site than the BC Water Quality Guideline."*

In the response to comments on the 2019 Annual Report, the Proponent stated,

> *"Baffinland is further evaluating the groundwater monitoring program in 2020, Baffinland has retained groundwater consultants knowledgeable in Arctic environments to further assess the current program and provide recommendations in 2020. As part of this work, Baffinland and the supporting consultants will be reevaluating the updated zinc CCME Water Quality Guideline for analysis in future monitoring years. Baffinland will also evaluate the newly released CCME Manganese Water Quality Guideline and determine whether it is more appropriate for use at the mine site than the BC Water Quality*

Guideline. Once assessed Baffinland will provide further recommendations to CIRNAC, NWB and other relevant parties."

ECCC notes that the comment on zinc and manganese guidelines referred to surface waters in the CREMP studies as noted in the Table 2.2 reference. The previously provided recommendations are still outstanding.

ECCC Recommendation(s)
ECCC reiterates its previous recommendations, which suggest the Proponent:

- use the updated zinc CCME Water Quality Guideline for analysis in future monitoring years, and
- discuss whether the newly released CCME Manganese Water Quality Guideline is more appropriate for use at the mine site than the BC Water Quality Guideline.

5. Closure Planning – Open Pit

Reference(s)

- NWB Annual Report, Appendix E.10 - Reclamation Research Studies Pit Lake Literature Review
    - Section 6.0 Additional Data Collection and Studies

Comment
Appendix E.10 provides a high level overview of Canadian Arctic pit lakes from the literature and regulatory submissions in the Northwest Territories and Nunavut. It includes recommendations for future data collection, stating:

"On-site data should be collected in the vicinity of the open pit and must include site weather, wind conditions, precipitation, and groundwater inflows and water quality to the open pit during operations. Ongoing geochemical characterization of waste rock can be used to understand the potential influence of the exposed pit walls on water quality at closure and during filling of the open pit at closure. This information will also support alternative pit filling strategies."

The memo does not indicate what the final depth of the pit is likely to be, nor whether this will be below the permafrost level. The Surface Water and Aquatic Ecosystem Management Plan Section 8.1.2.1 references the Final Environmental Impact Statement dimensions with a maximum depth of 465 m (northern side) but it is not known if this will be updated with further extraction of ore. Investigations of permafrost depth and changes to permafrost depth associated with development of the pit may be relevant.

ECCC Recommendation(s)
ECCC recommends the Proponent provide a discussion of final pit depth and geotechnical investigations required to evaluate groundwater inflows which may inform data collection activities outlined in the memo.

6. *Metal and Diamond Mining Effluent Regulations* (MDMER) Reference

Reference(s)

- NWB Annual Report, Appendix E.5.4 - Fresh Water Supply, Sewage, and Wastewater Management Plan (FWSSWMP)

Comment
Table 8-2 provides the effluent discharge limits for open pit, stockpiles and surface water management ponds which are regulated under the *Metal and Diamond Mining Effluent Regulations* (MDMER). The plan references Appendix I as providing additional information on the MDMER requirements pertaining to the project. However, the subject of that appendix is:
Appendix I – Oily Water Treatment Plant (For Vehicle Wash Water) O & M Manuals (Available upon request)

ECCC Recommendation(s)
ECCC recommends the Proponent clarify the MDMER details and whether they are in the referenced appendix.

ECCC also notes that the discharge criteria for arsenic and lead were amended as of June 1, 2021 (for reference in the next Annual Report).

7. Data Quality Objectives

Reference(s)
- NWB Annual Report, Appendix E.5.5 - Sampling Program - Quality Assurance and Quality Control Plan
    - Section 10 Data Management and Reporting

Comment
Section 10 briefly outlines storage, handling and data validation responsibilities. Data quality objectives have not been described or referenced.

Recommendation(s)
ECCC recommends the Proponent provide a discussion of data quality objectives and procedures.

8. Update to Thermal Assessment for the Waste Rock Facility

Reference(s)
- NWB Annual Report, Appendix E.17 - Update to Thermal Assessment for the WRF
    - Section 2.3 Summary and Discussion

Comment
In the conclusion of the Update to Thermal Assessment for the Waste Rock Facility (WRF), the Proponent states,

> *"It is probable that the thermal regime of the pile is affected by a combination of seasonal variations in air temperature, preferential air flow through the pile and temporary localized heat generation associated with sulphide oxidation and/or mineral dissolution, but the fact that, other than the active zone subject to seasonal freezing and thawing, the pile remained frozen during all times indicates that the site cold climatic condition is the prevailing mechanism governing the thermal regime in the pile, as intended in the design."*

ECCC agrees that the temperature variation or thermal regime in the WRF could be the result of the stated factors.

Given the limited number of thermal sensors installed in the pile, it is likely that these temperature variations are also occurring in other locations in the pile away from and undetected by the sensors. Given that model assumptions do not always capture the complex reality of temperature variance, uncertainty remains regarding whether airflow is the actual cause of the observed temperature variation deeper inside the pile.

ECCC Recommendation(s)
ECCC recommends the Proponent continue monitoring, investigating and updating the thermal assessment of the WRF and identifying other possible hot spots in the WRF.

If you need more information, please contact Melissa Pinto at 867-445-5384 or Melissa.Pinto@ec.gc.ca.

Sincerely,

[original signed by]

Melissa Pinto
Senior Environmental Assessment Coordinator

cc: Jody Small, Acting Head, Environmental Assessment North (NT and NU)
Cory Barker, Technical Advisor II, Nunavut Impact Review Board