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RE: Response to Comments, Phase 1 Waste Rock Management Plan Revision 2
Mary River Project, Type 'A' Water Licence - 2AM-MRY1325 - Amend. No. 1

Baffinland Iron Mines Corporation (Baffinland) provides the attached additional responses to comments received from Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)[1] as part of their submission for comments on the Phase 2 Proposal currently under consideration by the Nunavut Impact Review Board (NIRB). These comments were inadvertently omitted from Baffinland's previous response to comments on the Phase 1 Waste Rock Management Plan Revision 2, and is issuing these to all interested parties for consistency.

Please do not hesitate to contact the undersigned should you have any remaining questions or comments.

Regards,

Christopher Murray
Environmental & Regulatory Compliance Manager

Attachments:
Attachment 1: Additional Comments Responses to CIRNAC

Cc: Assol Kubeisinova, Karén Kharatyan (NWB)
Chris Spencer, Jared Ottenhof (QIA)
Bridget Campbell, Godwin Okonkwo, Felexce Ngwa, Alexandre Chaikine (CIRNAC)
Anne Wilson, Reg Ejeckam, Gabriel Bernard-Lacaille (ECCC)
Megan Lord-Hoyle, Lou Kamermans, Tim Sewell, Shawn Stevens, Connor Devereaux, Simon Fleury, Daniel Janusauskas (Baffinland)

[1] CIRNAC (2020) Technical Comments, Baffinland Iron Mines Corporation Mary River Project Phase 2 Proposal. February 6, 2020

Attachment 1

Additional Comment Responses to CIRNAC

Comment ID : CIRNAC (NIRB) Technical Comment #1	
Summary/Issue	Baffinland provided a summary of the results of the thermal analyses in several structure-specific geotechnical recommendations reports, including thermal modelling for port infrastructure. Baffinland submitted the updated Waste Rock Management Plan for review in December 2019. Following review of these documents, CIRNAC concluded that there are still outstanding concerns for Thermal Model of the Waste Rock Facility (WRF) and additional efforts are required to demonstrate that WRF design assumptions are appropriate. Based on the information provided, it is not clear whether a heat balance has been performed and whether the internal heat generation correlates with the heat generation associated with the exothermic reaction of PAG waste rock. It is not clear if the oxygen consumption correlates with the extent of oxidation process taking place and if the water balance reflects that the dry piezometers are a result of infiltration rainfall that percolates through the waste rock. Considering that the project site contains areas with continuous permafrost with massive ground ice, thermal modelling results are important for the environmental impact assessment in order to determine if permafrost conditions during and post-construction will affect the Project infrastructure. Management of WRF relies on freeze-back to mitigate acid rock drainage/ metal leaching (ARD/ML) issues. Thermal modeling is required to demonstrate that the proposed management approach is appropriate.
Detailed Review Comment	During the Technical Review, CIRNAC requested Baffinland to develop and implement a site-wide program to monitor the thaw consolidation and soil deformation under the structures/ embankments. In response, Baffinland provided the document titled: Geotechnical Recommendations for Northern Railway, Hatch, April 26, 2019, which addresses theconcerns regarding the North Railway and associated infrastructure. The thermal modelling and analysis for the area of the WRF was not included in that document. In the Interim Closure and Reclamation Plan, Appendix D, updated May 1, 2019, Baffinland stated that a thermal model of the WRF will be completed once sufficient data have been collected for model calibration. The results of the available thermal modelling have been included as Thermal Model Memorandum in the updated Waste Rock Management Plan, Appendix A2 submitted in December 2019. The thermal assessment was undertaken by Baffinland to characterize the freezing patterns of deposited waste rock and assess the WRF thermal performance. The instrumentation program implemented for the thermal assessment included three vertical thermistors, two vertical oxygen sensor strings, two vertical thermistors to monitor the WRF pond liner and foundation, three horizontal thermistors, a barometer and two vibrating wire piezometers. The data from these sensors was used for the calibration and development of a thermal model used to assess the time for waste rock placed during the summer and the subsequent winter months to freeze back. The Memorandum presents the results of laboratory testing of waste rock thermal properties and describes the model boundary conditions, the calibration and the model results for the waste rock deposition phase during summer and summer plus winter scenarios. CIRNAC has reviewed the WRF Thermal Model and confirms that, in general, the approach adopted for instrumentation and modelling is acceptable. Based on the review of the information presented, the following items need further consideration: **1. Internal heat generation** It appears that there is some internal heat generation taking place within the waste rock deposit. Baffinland states that the internal heat may be resulting from geochemical reactions taking place within the waste rock deposit. Based on the information provided, it is not clear whether a heat balance has been performed and whether the internal heat generation correlates with the heat generation associated with the exothermic reaction of PAG waste rock. Greater understanding of heat balance is particularly important in light of the following:

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	• Presence of soluble iron sulphate minerals is likely to result in a significantly different magnitude of heat generation as compared to oxidation of iron sulphide minerals; and • Relevance and limitation of thermistor monitoring since it may be limited to providing an indication of the depth at which water is likely to be frozen rather than the presence of waste rock where soluble iron sulphate minerals are readily dissolving. CIRNAC notes that the thermal model incorporated some heat flux of 30 kJ/d to match the observed temperature profile with the predicted profile, however, it is not clear at what depth and to what horizontal extent the heat flux was introduced and for how long. **2. Oxygen consumption** Baffinland indicates that air flow within the pile associated with barometric pumping, temperature-driven air convection and/or other processes are likely influencing the observed temperature variation within the waste rock deposit. The data from oxygen sensors measured at different depths in various areas of the pile during May, June, July and August is presented. However, it is not clear if an oxygen balance has been performed and if the oxygen consumption correlates with the extent of oxidation process or oxidation volume taking place. This is particularly relevant in the presence of soluble sulphates as there is likely to be a significantly lower oxygen demand as compared to the presence of oxidizing sulphides. Oxygen depletion has been observed below the maximum active depth. This does not support the basic assumption of the management of the WRF to maintain the deposited waste rock in a frozen state and to address the ARD challenges. **3. Vibrating Wire Piezometers data** The Vibrating Wire Piezometers (VWP) data from March through September 2019 did not report any standing water (piezometers have remained dry). Baffinland should assess whether the water balance reflects the infiltration rate and seepage quantity/timing. It is unclear if the results indicate that rainfall percolates through the waste rock or the dry piezometers are a result of poor functioning of the VWP instrumentation. This trend of the VWP data needs to be compared with the chemical load of the seepage and runoff in order to obtain a general appreciation of the results. **4. Waste rock layer** The Thermal Model Memorandum recommends as a model prediction that a 5 m thick lift of waste rock deposited in summer, covered by a 5 m thick layer of waste rock layer of waste rock in winter, would freeze prior to the following summer in most scenarios. However due to heat exchange between layers of waste rock it was recommended to delay the winter deposition or reducing the thickness of summer deposition. This would decrease freezing times and reduce or eliminate the possible extent of thawed portions within the WRF. **5. Continued monitoring** CIRNAC is of the view that, this recommendation should be confirmed by continued monitoring of the temperature and oxygen concentrations within the waste rock. Further, the Proponent should conduct periodic review of the data and observe if any trends exist requiring any changes in deposition strategy. This is particularly relevant as the presence of soluble sulphates may require alteration of the design concept (e.g. the WRF may need to adopt means to control rainfall infiltration through the dump during spring and summer rather than long term establishment of permafrost).
Recommendation/ Request	CIRNAC recommends that Baffinland: • Internal heat generation: Provide a heat balance to clarify if the internal heat generation correlates with the heat generation associated with the exothermic reaction of PAG waste rock deposited. Such a heat balance needs to account for the expected effects of soluble sulphates. • Oxygen consumption: Clarify if an oxygen balance has been performed and if the oxygen consumption correlates with the extent of oxidation process or oxidation volume taking place. Such an oxygen balance needs to account for the expected effects of soluble sulphates. • Vibrating Wire Piezometers data: Assess if the water balance reflects that the dry piezometers are a result of infiltration rainfall that percolates through the waste rock or indicate poor functioning of the VWP instrumentation.

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	• Continued monitoring: Ensure installation of additional relevant instrumentation (e.g. further thermistors, moisture probes) and update the thermal modeling to account for three dimensional variations (where required, particularly if there needs to be an alteration to the design of the WRF). CIRNAC also recommends Baffinland to develop a detailed site wide program to monitor the thaw consolidation and soil deformation under the structures/embankments constructed as part of the Project. The monitoring results shall be compared with the FEIS Addendum predictions and appropriate mitigation measures shall be identified and incorporated into the adaptive management approach.
Baffinland Response	**Internal Heat Generation** For clarity, there are no measured data that indicate the presence of heat generation within the WRF. Data from thermistors installed in the WRF indicate the pile remains frozen, with the exception of a seasonal active layer at the surface. Rather an internal heat source was added to calibrate the models (i.e. predicted temperature profiles vs. time in reasonable agreement with measured temperature profile vs. time). Without an internal heat source that models predicted temperature profiles that were much colder than measured. The thermistor data provides a direct measurement of the surrounding waste rock temperature and provides a reliable means of measuring the temperature regime within the WRF. On-going monitoring of the thermal condition of the pile will demonstrate if there is heat generation at depth, however current data indicate the WRF is frozen as intended. The thermistor data must be reviewed in combination with measured oxygen concentrations, water quality data, waste rock geochemistry, climatic conditions, etc. to understand the process resulting in the water chemistry observed at the waste rock facility pond. **Oxygen Consumption** An oxygen balance was not performed. Rather, variation in O_2 concentrations with time and depth were correlated with variation in measured temperatures with time and depth, and as a possible correlation was identified, it was assumed that oxidation may be occurring. Comparing the location of the oxygen probes and borehole logs, the O_2 sensors showed variation in concentration where installed in PAG waste rock, so it is assumed this variation in concentration is related to oxidation of PAG. No detailed evaluation of the source of oxygen consumption has been carried out at this time, however on-going monitoring of temperature and oxygen profiles as outlined in the Waste Rock Facility QA/QC Monitoring Plan will inform future evaluations of oxidation within the WRF. It is possible that previous deposition of PAG and Non-AG material at the WRF resulted in segregation of fines and coarse material, thereby creating potential for preferential pathways of airflow. To address this, the current waste rock placement strategy emphasizes the placement of material to avoid segregation (Section 8.2 of the WRMP). As the WRF expands in size and the current footprint is encapsulated with continued placement of waste rock, existing preferential pathways (if any) for airflow will be cut off. Ongoing monitoring of the O_2 profiles in the WRF will be required to demonstrate that the deposition strategy is effective, and will be evaluated throughout the life of mine and in subsequent iterations of the Waste Rock Management Plan. **Vibrating Wire Piezometers** At the time of preparing the December 2019 Waste Rock Management Plan, the two (2) VWP were reporting dry conditions. The VWP boreholes were observed dry at the time of installation. There is no indication that the VWP are not functioning correctly. The results of the instrumentation indicate that liquid water does not mound at the waste rock stockpile base where the VWP are installed. This observation is also supported by the thermistor data which shows the stockpile base is frozen. Installation of additional monitoring locations and profiles is currently under consideration to assess the continued expansion of the WRF footprint, as well as vertical profiles within the WRF to assess infiltration rates.

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	Continued monitoring As outlined in the Waste Rock Facility QA/QC Monitoring Plan, Section 3.4, Baffinland will continue to monitor the data from the WRF on an ongoing basis. Additional instrumentation will be placed as the WRF expands, with number and location of instruments yet to be determined. This data will be used to update the thermal model throughout the life of mine, and will be reviewed to inform future iterations of the Waste Rock Management Plan as the WRF footprint expands, including reassessment of placement strategy and assessment of mitigation measures required (if any) to address current conditions. All models used in the development of the WRMP (water quality, water balance, thermal, geochemistry) will be updated prior to the next revision of the WRMP in 2021 following the collection of additional relevant data. CIRNAC's recommendation to Baffinland to develop a detailed site wide program to monitor the thaw consolidation and soil deformation under the structures/embankments constructed as part of the Project is unrelated to the review of the Phase 1 Waste Rock Management Plan Revision 2. Baffinland included a response to this recommendation directly to the NIRB on February 21, 2020, consistent with previous commitment language provided by CIRNAC following the November 2019 Public Hearings for Phase 2.

Comment ID : CIRNAC (NIRB) Technical Comment #2	
Summary/Issue	Baffinland earlier submitted Borrow Source Investigation Factual Data Report (April 26, 2019) to address potential ARD/ML issues for construction of the Northern Railway. During the technical review, CIRNAC noted that this report was substantially deficient in the rock sampling and representative test work in the southern section of the intended Northern Railway corridor, south-west of Deposit 4, which leads to uncertainty in assessment of the ARD/ML potential of the railway cut material, quarries and pit walls. To address this deficiency Baffinland submitted an additional Borrow Source Investigation Factual Data Report (July 24, 2019) and committed to avoidance, mitigation and monitoring of ARD/ML at all rail corridor quarries. Rail corridor rock surfaces and quarries in this area that come into regular contact with rainfall / snowmelt may become sources of adverse water quality due to ARD/ML. Assessment of the ARD/ML potential is required to better understand any potential adverse environmental impacts and develop appropriate mitigation measures. Adequate interpretation and investigation of ARD/ML material, particularly leachate results is an important part of predicting probable drainage water quality from rail quarries and construction materials.
Detailed Review Comment	During the Review of the Project proposal, CIRNAC noted that there was uncertainty in ARD/ML potential of the railway cut material, quarries and pit walls. CIRNAC requested Baffinland perform a representative sampling program and geochemistry test work program in the area of the Northern railway corridor south-west of Deposit 4. In response, Baffinland issued a Memo (July 3, 2019) committing to avoidance, mitigation and monitoring of ARD/ML at all rail corridor quarries. The detailed and specific mitigation measures were earlier presented in Baffinland's Memo to ECCC (May 14, 2019). These include water monitoring for ARD/ML parameters, water diversion, covering PAG materials with crushed carbonate rock and / or engineered covers and contingency for passive / active water treatment prior to discharge. Baffinland also provided both the original project and Phase 2 ARD/ML test work program results, which is representative of the majority of potential quarry locations along the rail route. In light of completion of the Phase 2 ARD/ML test work program, sampling locations appear to be significantly more representative of rock types that will be encountered along the railway corridor than prior investigations (including the deviation between Tote Road and the rail route immediately south-west of the mine). Overall, the results suggest that rock materials sourced from quarry and borrow pits for road / rail construction represent a low risk in terms of ARD. These rock materials appear to have negligible potential for generating acidity as a result of low sulphur content and an abundance of carbonate minerals. However Shake Flask Extraction (SFE) results suggested that some rock materials may leach certain metals at concentrations greater than the adopted Canadian Water Quality Guidelines for Aquatic Life, specifically aluminum, mercury and copper. The origin of these exceedances (dissolved phase vs suspended solids) and implications for drainage water quality is yet to be determined.
Recommendation/ Request	CIRNAC recommends that Baffinland: • Confirm the origin of elevated concentrations of aluminum, mercury and copper in Shake Flask Extraction test results for rock materials sourced from quarry and borrow pits for road / railway construction, and develop and implement an appropriate water quality monitoring and management strategy for railway corridor rock quarries. • Compare the monitoring results with the FEIS Addendum predictions, identify and implement the appropriate mitigation measures.
Baffinland Response	This comment is unrelated to the Phase 1 Waste Rock Management Plan Revision 2. Baffinland included a response to this recommendation directly to the NIRB on February 21, 2020, consistent with previous commitment language provided by CIRNAC following the November 2019 Public Hearings for Phase 2. In accordance with the Type A Water Licence 2AM-MRY1325 Part D, Item 14, Baffinland monitors all runoff from quarry activities and reports these results on a monthly and annual basis. Discussion on parameters of concern to be included in the analytical suite can be addressed during the amendment process for the Type A Water Licence for the Phase 2 proposal. It should be noted that baseline and reference lake monitoring under the Aquatic Effects Monitoring Program has identified

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	naturally occurring elevated metals concentrations, such as aluminum, in and around the Project area.