Water Resources Division
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Your file - Votre référence
2AM-MRY1325
Our file - Notre référence
CIDM#1287147

July 24, 2020

Robin Ikkutisluk
Licensing Administrator
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU, X0B 1J0
E-mail: licensing@nwb-oen.ca

Re: Crown-Indigenous Relations and Northern Affairs Canada Review Comments on the 2019 Annual Report for the Mary River Project, Water Licence No. 2AM-MRY1325 – Amendment No. 1

Dear Ms. Ikkutisluk,

Thank you for your May 19, 2020 invitation to review the referenced 2019 Annual Report for the Mary River Project, Water Licence No. 2AM-MRY1325 – Amendment No. 1, submitted by Baffinland Iron Mines Corporation (BIMC).

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) examined the submission pursuant to CIRNAC's mandated responsibilities under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Department of Crown-Indigenous Relations and Northern Affairs Act*. Comments have been provided in the attached Technical Memorandum.

If there are any questions or concerns, please contact me at (867) 975-4282 or bridget.campbell@canada.ca.

Sincerely,

Bridget Campbell,
Water Resources Coordinator

Canada

Technical Review Memorandum

Date: July 24, 2020

To: Robin Ikkutisluk, Licensing Administrator, Nunavut Water Board

From: Bridget Campbell – Water Management Coordinator, CIRNAC

Subject: **Crown-Indigenous Relations and Northern Affairs Canada Review Comments on the 2019 Annual Report for the Mary River Project, Water Licence No. 2AM-MRY1325 – Amendment No. 1**

Region: ☐ Kitikmeot ☐ Kivalliq ☒ Qikiqtani

A. BACKGROUND

The Mary River Project (the Project) is an operating high-grade iron mine located in the Qikiqtani Region of northern Baffin Island, Nunavut. The mine is owned and operated by Baffinland Iron Mines Corporation (BIMC) and includes the mine site, the Milne Port site, and a tote road connecting the two sites. The current approved project allows iron ore production through open pit mining. Part B Item 4 of Water Licence 2AM-MRY1325 – Amendment No. 1 requires the proponent to submit an Annual Report for operations.

BIMC has submitted plans for a "Phase 2 Proposal" that involves the construction of a new railway running adjacent to the existing Tote Road (called the North Railway) and an increase in total mine production. Phase 2 also involves development of additional infrastructure at Milne Port, including a second ore dock. Various upgrades and additional infrastructure will also be required at the Mine Site and along both the north and south transportation corridors to support the increase in production and construction of the two rail lines. This licence amendment process is currently on hold in the Technical Review and Technical Meetings stage.

During 2019, mining operations at Deposit No. 1 continued to increase and produced a total of 5.7 million tonnes (Mt) of ore, a production increase of 100,000 tones over the 5.6 Mt ore produced in 2018. Ore produced by mining operations was transported by 150 tonne ore haul trucks along the Milne Inlet Tote Road (Tote Road) and stockpiled at Milne Port. A total of 5.86 Mt of ore was shipped to international markets via 82 individual ore carrier vessel voyages during the 2019 shipping season (July to October). Following the shipping season, ore continued to be stockpiled at the port for shipment to market in 2020. Mining operations in 2019 produced 4.3 Mt of waste rock which was deposited in the waste rock storage facility.

In addition to mining related activities, construction activities in 2019 included:

- Mary River Mine Truck Shop
- Mary River Tank Farm
- Mary River Sailiivik Camp Effluent Line
- Mary River Tank Piping and Electrical
- Mary River 800 Person Sailiivik Camp
- Milne Port Tank Farm Addition
- Milne Port Ore Stockpile Pond 1A
- Milne Port Ore Stockpile Expansion
- Milne Port Water Management Structures
- Milne Port 380 Person Camp

Summary reports for the works completed in 2019 are provided in Appendix C.1. In addition to the above noted construction works, other 2019 physical works, repairs and maintenance included:

- Repair and expansion of the WRF pond, liner, and new perimeter ditching for the expanded WRF footprint.
- Expansion of the Mine Site Non-Hazardous Landfill Facility.
- Installation of an Incinerator at the Milne Port camp site.
- Initiation of Milne Port Stockpile #1 expansion including the water management works.
- Other works associated with maintenance and repairs of project infrastructure including roads, laydown areas, water management infrastructure including berms, ditches, culverts and bridges.

During the course of 2019, equipment, materials, consumables and fuel required for the operation and continued development of the Project were transported to Milne Port via marine shipments between July and October, 2019. In 2019, inbound marine shipments included fourteen (14) cargo sealifts to Milne Port delivering equipment, materials, and consumables; and five (5) fuel shipments to the Milne Port Bulk Fuel Storage Facility via floating-hose transfer. Once at the Port, received equipment, materials, consumables and fuel were either stored at Milne Port or transported to the Mine Site via the Tote Road.

Equipment and materials not required by Project operations, including non-hazardous and hazardous wastes generated by Project activities, were shipped off site from Milne Port via marine shipments between July and October 2019. Outbound marine shipments in 2019 included five (5) cargo sealifts to the Ports of Valleyfield, Cote St. Catherine and Becancour in Quebec. All wastes backhauled in 2019 were unloaded at the Port of Valleyfield, Quebec and subsequently transported to licensed, waste disposal facilities in Quebec. No wastes were backhauled to communities in Nunavut for disposal.

A summary of the subjects of CIRNAC review comments can be found in Table 1. A summary of the documents reviewed can be found in Table 2 of Section B. Detailed CIRNAC review comments on the 2019 Annual Report are provided in Section C. An assessment of outstanding review comments from the 2018 Annual Report are provided in Section D. References are listed in Section E.

Table 1: Summary of Recommendations

Recommendation	Subject
	Section C. 2019 Review Comments
R-01, R-02	Waste Rock Placement
R-03, R-04	Assessment and Management of Acid Rock Drainage (ARD) at Quarries
R-05, R-06	Sedimentation Management During Freshet
R-07, R-08	Inspections of Mine Haul Road Earthworks
R-09, R-10	Spill Prevention
R-11, R-12, R-13	Permafrost Degradation
R-14	Material Deposition into Watercourses by Haul Trucks at Bridges
R-15	Exceedances of Freshwater Daily Withdrawal Limit
R-16, R-17, R-18	Tracking and Notification / Awareness of Field Revisions
R-19	Annual Report Content
R-20	Aquatic Effects and Core Receiving Environment Monitoring Programs
R-21, R-22	Tracking of Inspection Issues
Section D. Resolution of Comments on 2018 Annual Report for Operations	
R-23, R-24, R-25	Waste Rock Facility – Potential Causes of Acid Rock Drainage/Metal Leaching (ARD/ML) Formation
R-26	Waste Rock Facility – Uncertainty in Tonnage Estimate for Potentially Acid Generating (PAG) Waste Rock
R-27	Waste Rock Facility – Drainage Containment Pond Liner
R-28	Discharge and Spills – Discharge Prevention at Crusher Pad Drainage Ditch
R-29	Hydrometric Monitoring Report – Development of Rating Curves
R-30	Hydrometric Monitoring Report – Water Quality
R-31	Sedimentation Monitoring Report – Identification of Trends
R-32	Reclamation and Closure
R-33	Waste Management – Incinerator Bottom Ash Waste
R-34	Surface Water and Aquatic Ecosystem Management Plan (SWAEMP) – Water Quality Monitoring at Quarries

B. DOCUMENTS REVIEWED

The following table (Table 1) provides a summary of the documents submitted by BIMC as part of the 2019 Annual Report, and reviewed by CIRNAC.

Table 2: Documents Reviewed

Document Title	Author, Date, File No.
2019 Annual Report for Operations & Appendices Reviewed by CIRNAC	
Mary River Project, 2019 QIA and NWB Annual Report for Operations	BIMC, 03 April 2020
Appendix Documents	
Appendix C.1 – Construction Summary Report (CSR)	Hatch
CSR – Stockyard #1 Expansion	Hatch, 8 August 2019, Rev0
CSR: Mary River Tank Farm Piping (2019) Piping and Electrical	Hatch, 8 April 2020, Rev0
CSR: Pond 1A	Hatch, 31 March 2019, Rev0
CSR: Milne Port Tank Farm - Capacity Addition	Hatch, 8 April 2020, Rev1
CSR: Milne Port Water Management Structures	Hatch, 28 April 2020, Rev0
CSR: Sailiivik Camp	Hatch, 28 April 2020, Rev0
CSR: 386p Camp	Hatch, 30 April 2020, Rev0
CSR: Mary River Tank Farm (2019)	Hatch, 07 April 2020, Rev0
CSR: Mine Truck Workshop	Hatch, 30 July 2019, Rev0
CSR: Sailiivik Camp Effluent Line	Hatch, 15 April 2020, Rev0
Appendix C.2 – Geotechnical Inspection Reports	Wood, 31 August 2019 & 22 November 2019
Appendix C.3 – DFO Tote Road Fish Habitat Monitoring	BIMC & North/South Consultants, 31 December 2019, Rev0
Appendix C.4 – 2019 Inspection of the Milne Inlet Tote Road and Associated Borrow Sources	Tetra Tech, 30 October 2019
Appendix E.1 – Waste Backhaul Report	Qikiqtaaluk Environmental, 11 March 2020
Appendix E.2 – Incinerator Ash Testing Results	ALS, 29 January 2019
Appendix E.3 – 2019 Surveillance Network Program (SNP) Hydrometric Monitoring Program (Memorandum)	EAG, 26 March 2020
Appendix E.5.1 – Phase 1 Waste Rock Management Plan	BIMC, 31 December 2019, Rev2
Appendix E.5.3 – Surface Water and Aquatic Ecosystems Management Plan	BIMC, 29 April 2020, Rev6
Appendix E.5.4 – Waste Management Plan	BIMC, 31 March 2020, Rev8
Appendix E.5.5 – Spill Contingency Management Plan	BIMC, 29 April 2020, Rev5
Appendix E.5.6 – Roads Management Plan	BIMC, 14 February 2020, Rev7
Appendix E.5.9 – Q1 Quarry Management Plan	BIMC, 6 May 2019, Rev1
Appendix E.6 – Waste Rock Geochemistry Analytical Sampling Results	BIMC, 2019
Appendix E.7 – Quarry Geochemistry Analytical Sampling Results	BIMC, 2019
Appendix E.8.1 – CIRNAC Inspections and Baffinland Responses	BIMC, 2020
Appendix E.8.1 – WSCC Inspection Reports	BIMC, 2020
Appendix E.8.4 – Initial and Follow-up Spill Report	BIMC, 2020
Appendix E.9.1 – 2019 Core Receiving Environmental Monitoring (CREMP) Report	Minnow, March 2020
Appendix E.9.2 – 2019 Lake Sedimentation Monitoring Report	Minnow, March 2020
Appendix E.9.3 – 2019 Aquatic Effects Monitoring Plan (AEMP) Hydrometric Monitoring Report (Memorandum)	EAG, 26 March 2020

Document Title	Author, Date, File No.
Appendix E.10 – Reclamation Research Studies	
Revegetation Survey & Preliminary Reclamation Trial	EDI, March 2020, Rev1
Research Review Advances in Arctic Reclamation	EDI, March 2019
Appendix E.11 - 2019 Freshet Monitoring Report	BIMC, April 2020, Rev0
Appendix E.12 - 2019 Groundwater Monitoring Report	BIMC, 31 March 2020, Rev0
Appendix E.14 – Response to Outstanding 2018 Annual Report Comments	BIMC, 21 March 2020
Appendix E.15 – Response to Outstanding 2019 Inspection Reports	BIMC
2019 Annual Report for Operations & Appendices Not Reviewed by CIRNAC	
Appendix E.5.2 – Fresh Water Supply, Sewage and Wastewater Management Plan	BIMC, 31 March 2020, Rev7
Appendix E.5.7 – Air Quality and Noise Abatement Management Plan	BIMC, 31 March 2020, Rev7
Appendix E.5.8 – Sampling Program – Quality Assurance and Quality Control Plan	BIMC, 31 March 2020, Rev3

C. REVIEW COMMENTS

Crown-Indigenous Relations and Northern Affairs Canada's (CIRNAC) general comment is that the report structure is generally appropriate as provided. In terms of content, the 2019 Annual Report for Operations is generally in keeping with the expectations and requirements of the Water Licence. With some exceptions, the document Specifically reports on the status of the Project in 2019 as required by Part K, Schedule B of the Type A Water License 2AM-MRY1325 – Amendment 1. For the most part the information provided allows for comparison of predicted and actual impacts. Notwithstanding the above, suggestions for improvements to the main report document and some of the supporting information are provided below.

1. Waste Rock Placement

Comment:

Open pit mining operations during 2019 resulted in the generation of a total of approximately 4.3 Mt of waste rock. Waste rock geochemistry was assessed and waste rock was classified as Potentially Acid Generating (PAG) or Non-Acid Generating (Non-PAG) material. This classification is based on operational testing protocols outlined in the Project's Phase 1 - Waste Rock Management Plan (Appendix E.5.1), is discussed in Section 9.6 of the 2019 Annual Report, and is provided in the Waste Rock Geochemistry Analytical Sampling Results (Appendix E.6). All PAG waste rock generated from mining operations in 2019 was deposited at the Waste Rock Facility (WRF) and Non-PAG waste rock was used for construction or deposited at the WRF.

Table 5.6 provided the monthly and annual quantities of waste rock generated, deposited at the WRF and used for construction purposes. As shown in the table, of the approximately 4.3 Mt, based on the pre-existing 2019 classification criteria that use a cutoff of total Sulphur content of 0.2 wt% as S, approximately 1.116 Mt (29%) was classified as Non-PAG and was used for construction, approximately 2.116 Mt (49%) was classified as Non-PAG and placed in the WRF, and approximately 1.106 Mt (25%) was classified as PAG and placed in the WRF. However, based on the proposed new classification criteria for waste rock that use both a total sulphur content of 0.2 wt% as S and a paste pH of 6 to distinguish between Non-PAG and PAG, some of the Non-PAG material used previously in construction may reclassify as PAG.

The report provided no information on where Non-PAG waste rock was used for construction and no information on actual waste rock handling and placement activities at the WRF during 2019. As such, it is not possible to assess if these activities were carried out in accordance with the mine plan and waste rock management plan and to track where Non-PAG materials have been placed during construction activities.

Recommendation:

(R-01) CIRNAC recommends that BIMC indicate where Non-PAG waste rock has been used as construction material in 2019 and earlier.

(R-02) CIRNAC recommends that BIMC provide an update on the actual verses planned waste rock placement in the Waste Rock Facility in 2019.

2. Assessment and Management of Acid Rock Drainage (ARD) at Quarries

Comment:

In Section 9.5 of the Annual Report it is noted that one (1) sample from Q1 Quarry yielded a total sulphur concentration of 0.33% and seven (7) samples from QMR2 Quarry had measured sulphur concentrations >0.2 wt%, which is above the threshold for Potentially Acid Generating (PAG) rock. For both quarries these samples were considered to be localized anomalous samples occurring adjacent to low sulphur results that did not meet the criteria to be delineated as PAG when considering the volumes being mined.

With respect to Q1 Quarry, BIMC indicated in the 2019 Annual Report (pg. 35) that:

> Baffinland collected greater than 1 in 10,000 BCM [block cubic meters] samples in 2020, greater than the frequency outlined in the Quarry Management Plan, and as a result the average of this anomalous sample with the corresponding samples in the same blast resulted in the material block being classified as NAG. Baffinland will further investigate the presence of PAG within Q1 Quarry and evaluating the sampling frequency in 2020 to determine if additional sampling within each blast is required to delineate the presence of PAG.

Localized areas of PAG material were identified in QMR2 in previous years. As such, in order to properly manage aggregates with localized PAG in 2019, the on-site geologist reviewed and evaluated the geochemical results of the blasthole cuttings and delineated the limits of the PAG for each blast pattern prior to the blast. In 2019 additional sampling was completed to ensure sufficient resolution of sulphur data within each blast to delineate the PAG limits. Material blocks were determined based on a minimum separable size of 2,000 BCM with average sulphur of less than 0.2% within each 10,000 BCM. Based on this approach, no PAG blocks were delineated in QMR2 in 2019.

CIRNAC finds the occurrence of high sulphur samples in Q1 and QMR2 concerning, and the procedures leading to the classification of these materials as Non-PAG are not clear. CIRNAC supports BIMC's commitment to further investigate PAG presence in Q1 Quarry and evaluating 2020 sampling to see if additional sampling is needed.

Recommendation:

(R-03) CIRNAC recommends that BIMC investigate PAG presence in Q1 Quarry and evaluate 2020 sampling to see if additional sampling is needed to delineate the presence of PAG, and provide an update outlining the investigation approach, findings, and conclusions of the investigation.

(R-04) CIRNAC recommends that BIMC update the Quarry Management Plan(s), as appropriate, based on investigation findings and conclusion.

3. Sedimentation Management During Freshet

Comment:

As reported in the 2019 Annual Report package, site water management has been, and continues to be, a challenge at the Mary River Project site, especially during freshet. Section 7.4 (pg. 26) notes that, "*Similar to 2018, managing surface water drainage at the Project during freshet remained a challenge and resulted in several sedimentation events and incidents where surface water flows downstream of Project areas exceeded the applicable discharge criterion for TSS [total suspended solids].*" Locations of TSS exceedances included quarries and drainage site runoff. TSS exceedances are also noted by CIRNAC Field Operations in Inspection Reports, provided in Appendix E.8.1.

BIMC's response to inspection reports (Appendix E.8.1), dated 16 December, 2019, noted that improvements to facility design and repairs have been ongoing and that BIMC has developed a short term Mine Operation 2020 Freshet and Mine Haul Road Water Management Improvements Plan, including a Trigger Action Response Plan (TARP), to assist in sedimentation management during the 2020 Freshet. BIMC also committed to developing a comprehensive Long Term Water Management Plan with the help of a third party consultant by Q3 2020.

Recommendation:

(R-05) CIRNAC recommends that BIMC provide an update on the performance of the short term Mine Operation 2020 Freshet and Mine Haul Road Water Management Improvements plan in regard to mitigation of freshet exceedances, including any lessons learned to be implemented in the development of the Long Term Water Management Plan.

(R-06) CIRNAC recommends that BIMC provide the expected timeline for the development of the Long Term Improvements plan.

4. Inspections of Mine Haul Road Earthworks

Comment:

The Annual Report noted that water management and erosional issues are related to the Mine Haul Road. The 2019 Inspection of Milne Inlet Tote Road and Associated Borrow Sources Report (Appendix C.4), completed by Tetra Tech on behalf of BIMC, also highlights the significant water management erosional issues existing along the Mine Haul Road.

BIMC noted that addressing these issues for the Mine Haul Road will be quite challenging given the location and setting of the road (steep slopes, etc.). As a result, BIMC has developed a two pronged approach; first BIMC will undertake short term mitigation plans for the 2020 freshet, and second BIMC will develop a long term water management plan using a third party consultant by Q3 of 2020.

BIMC is required to conduct bi-annual inspections of the of earthworks and geological and hydrological regimes of the Project, including the Mine Haul Road, as required by Part D, Item 18 of Licence 2AM-MRY1325 Amendment No. 1. Given the context of erosional and water management issues on the Mine Haul Road, it is not clear as to why this major component was not assessed as part of the bi-annual inspections. In reviewing the two Geotechnical Reports, CIRNAC found no reference to inspection notes, comments, or observations with respect to the Mine Haul Road.

Recommendation:

(R-07) CIRNAC recommends that BIMC provide the bi-annual inspection of the Mine Haul Road, or clarify the rationale for excluding the Mine Haul Road from the recent bi-annual inspection.

(R-08) CIRNAC recommends that BIMC include the Mine Haul Road in future bi-annual inspections.

5. Spill Prevention

Comment:

During 2019, twenty-five (25 with 4 occurring within secondary containment) spills were reported to the Northwest Territories-Nunavut (NT-NU) Spill Line, CIRNAC and QIA by BIMC for the Mary River Project. This represented a 28% decrease of reportable spills from 2018. In addition to the original spill report, a detailed follow-up report was submitted for each reported spill that included a description of the event, the immediate cause(s), corrective action(s), photos, and a map showing spill location.

The analysis of the spill records provided by BIMC noted that the most common causes of spills related to: a) equipment failure, b) improper operation of equipment, and c) procedural issues such as inadequate procedure or training. Based on this analysis, 2019 actions taken by BIMC to reduce spills included: additional and awareness training and education, heightened focus on maintenance, and equipment and facility inspections. BIMC continued to investigate the basic causes of all spills that occurred on site in 2019 so that effective long-term corrective actions could be implemented to reduce the frequency of spills at Project sites.

CIRNAC notes that 12 (48%) of the 25 spills were related to the project sewage systems (7 at the mine and 5 at the port). CIRNAC encourages BIMC to continue the practice of undertaking spill analyses to identify root causes and implementing corrective actions for sewage system related spills. By doing so, it would be expected that operations of these systems should improve over time.

Recommendation:

(R-09) CIRNAC recommends that BIMC continue to conduct root cause analyses for all sewage system related spills, and provide this analysis and a plan of action for mitigation in the 2020 Annual Report.

(R-10) CIRNAC recommends that BIMC continue to conduct root cause analyses for spills to allow for performance and trend evaluation.

6. Permafrost Degradation

Comment:

The 2019 Annual Report provides summary information on construction activities carried out during the year in Section 2 of the main body of the report. More detailed information regarding the Construction Summary Reports can be found in Appendix C.1. Many of the construction activities included excavations in existing permafrost soils. Challenges associated with permafrost degradation, erosion and sediment release are acknowledged in the report.

The 2019 Tote Road and Associated Burrow Areas Inspection Report by Tetra Tech (Appendix C.4) identified numerous areas requiring actions that need to be undertaken to mitigate permafrost degradation. Table 1 of the document provides a summary of the 2019, 2014, and 2009 inspections, along with an action priority rating for each item inspected. The report noted the presence of potential *very high-risk areas* (designated as *A*+++ including Site 14-km 89.8, Site 22-km 72.4, Site 29-km 63.7, Site 32/33-km 56.9R/56.7L) that may be susceptible to sudden catastrophic failure due to permafrost degradation and require priority action and immediate attention. In addition, there were 8

sites with high risk A+ priority, and 22 sites with a B priority rating. Of the 87 sites assessed, only 5 sites had lower risk ratings in 2019 compared to earlier years.

In Section 8.1 of the Annual Report (pg. 32), BIMC states:

> Evaluation of the condition of the Tote Road by Tetra Tech led to the implementation of an action plan to address the historic borrow sources on the Tote Road, to be executed in 2019 and 2020. Works were initiated at the KM7.2 borrow with the placement of material to restore the grade of the borrow pit. Further work is required to restore the overburden material, as well as other infilling and stabilization activities at the remaining priority historic roadside borrow source locations.

In addition to the Tote Road, the Tetra Tech report also commented on slope instability and erosion along the Haul Road from the Open Pit where several large erosion channels have formed downslope of the road (Appendix C.1, Photos 49, 50, and 51). Concentrated flow from the culverts now channelizes the flow causing both thermal and mechanical erosion. This erosion has been the source of considerable amounts of sediment into the creek below the road which flows directly into Mary River. The flowing water and erosion have caused permafrost thaw, which reduces the soil strength making it considerably more prone to erosion. Tetra Tech stated that to be able to develop appropriate remediation methods, it will be necessary to carefully investigate permafrost conditions on the slope and along the haul road and to have an accurate topographic survey carried out for the slope.

In its 16 December 2019 letter response to CIRNAC Inspections (Appendix E.8.1), BIMC commented on the complexity of water management and erosion control in general and specifically as related to the Open Pit mine haul road. BIMC committed to carrying out short term actions to mitigate the potential impacts of the 2020 freshet and for the development of a long-term freshet and mine haul road water management plan in 2020.

Recommendation:

(R-11) CIRNAC recommends that BIMC provide a copy of the Action Plan that was implemented to address historic borrow sources along the Tote Road, indicating which items have been implemented to date.

(R-12) CIRNAC recommends that BIMC provide an overall action plan for all disturbed areas identified at the existing and historic borrow areas along Tote Road and for the Mine Haul Road.

(R-13) CIRNAC recommends that BIMC provide their strategy to addresses mitigation of permafrost degradation during all aspects of the project and across the project life cycle.

7. Material Deposition into Watercourses by Haul Trucks at Bridges

Comment:

CIRNAC Inspections in 2019 as well as the Tetra Tech Inspections noted that significant amounts of road surface materials were being deposited into water courses at bridge crossings. The deposition of these materials is not caused by erosion around the bridges but by materials dropping from the haul trucks onto the bridge decking and thereafter into the water course.

Section 1 of the September 2019 Inspection, Item 1(b), stated:

> The inspector noted significant amounts of sediment under the bridges. The licensee installed wood on the bridges in an attempt to prevent this deposit of sediment to the rivers below. During the inspection the bridges were covered in mud and sediment rich waters was trickling off the bridges onto the rocks below. See Photos 1 and 2 for images of the sediment accumulation under the bridges.

Page 9 of the October 2019 Tetra Tech review of the Tote Road and Quarry (Appendix C.4) notes that for KM 80 Bridge: *"Photo 35 shows significant amounts of road surfacing gravel that has fallen into the water through the centreline joint of the bridge deck."* and similarly states that for KM 97 Bridge, "*Photo 36* … *There was evidence of road surfacing gravel in the water below the centreline of this bridge as well*."

Under the Comments Section of the CIRNAC September Inspection Report (Appendix E.8.1), both the *Non-Compliance with Act or Licence* and *Actions Required* boxes were checked, but no specific action was requested with respect to materials entering the water from the bridges themselves. As a result, BIMC's responses to the September inspection did not address this matter. The subject still needs to be addressed to prevent these materials from entering the water courses.

Recommendation:

(R-14) CIRNAC recommends that BIMC carry out an assessment of mitigation measures that could be implemented either before or at bridge crossings to prevent material deposition into the watercourses and initiate preventative measures.

8. Exceedances of Freshwater Daily Withdrawal Limit

Comment:

The daily fresh water withdrawal limits have been instituted to protect the integrity of water bodies and aquatic organisms relying on the water bodies. Every effort should be made to

adhere to the limits and accurately track water volumes withdrawn for domestic and industrial purposes.

In Section 4.2 of the 2019 Annual Report main Document, BIMC notes that "*Although the total daily water withdrawal limit for Camp Lake (355.4 m^3/day) was not exceeded in 2019, there were twelve (12) incidents where the daily water volume withdrawn for domestic purposes exceeded Camp Lake's domestic daily water withdrawal limit (203.8 m^3/day)"* and that "*In addition, there was one (1) incident where the daily water volume withdrawn for industrial purposes exceeded the Km 32 Lake daily water withdrawal limit (67.5 m^3/day)".* All of the aforementioned exceedances were highlighted in Table 4.1.

All exceedances of the Camp Lake daily withdrawal limit for domestic uses (203.8 m^3/day) were slight ranging from 204 to 257 m^3/day, and the total daily withdrawal limit for Camp Lake (355.4 m^3/day; MS-MRY-1) was not exceeded on any occasion. BIMC attributed these exceedances to a mis-categorization of water volumes withdrawn for industrial purposes, and to operator error due to water capacity constraints. Plans were indicated for improving the documentation and categorization of water volumes withdrawn to support Project activities.

Recommendation:

(R-15) CIRNAC recommends that BIMC provide training regarding water withdrawal procedures and tracking be provided to BIMC operators and develop a plan to improve documentation and categorization of water volumes withdrawn from all approved sources to reduce exceedances of daily withdrawal limits for freshwater.

9. Tracking and Notification / Awareness of Field Revisions

Comment:

During 2019, CIRNAC inspection observations noted variances in 'as constructed" features at the Mine (e.g. the location of the crusher ore pad ditch, some of the ditching and grading, etc.) and at the Milne Port (e.g. missing south east (SE) portion of the perimeter ditch) and the use of materials different from the materials specified in the approved civil designs (e.g. poor ore).

Given the extensive framework for design approval, construction oversight and development of construction reports, it is concerning that communications of construction changes are not being reported as appropriate and prior to or during the inspection of facilities where known material changes have occurred. Failure to do so results in unnecessary confusion and delays in resolving whether these changes are acceptable or if revisions need to be implemented.

In addition to known changes such as the ditch at the mine crusher and the use of poor ore for the Milne Port ore pad discussed above, it is also concerning that any portion of an approved water management design control feature, such as the SE portion of the perimeter ditch at the Milne Port ore pad, has not been constructed. There are two aspects to this concern; in the first case it is possible that BIMC was not aware of this omission, and in the second case it is possible that BIMC had knowledge of this omission and did not communicate that this portion of the approved water management work had not been constructed. In either case, changes of this nature reflect poorly on BIMC's construction management, as well as BIMC's construction oversight and the contractor that carried out the work.

Recommendation:

(R-16) CIRNAC recommends that BIMC provide information on all locations where poor ore has been used in the past.

(R-17) CIRNAC recommends that BIMC provide a rationale for its past use of poor ore as construction materials and where such materials could be used in future.

(R-18) CIRNAC recommends that BIMC carry out a review of its protocols for approval and communication of construction changes to avoid future issues related to field changes to approved designs and plans of water management features.

10. Annual Report Content

Comment:

CIRNAC notes that the structure of the 2019 Annual Report (main report, appended tables and figures) is appropriate and the content in keeping with the requirements of the Type "A" Water Licence. However, some improvements could be made as discussed below:

a) The report lacks general description of the approved project that would provide context to the activities described in the report, e.g. how many people (total, construction, QIA / other) in construction & operations; description of primary activities and operations (ore unloading at port, ore loading to ships, rate duration etc.).

b) The information provided in the main report is often not detailed or descriptive and in many cases reference is simply made to an appendix or table contained in a separate file. For example, in Section 5.3.1 describing the Mine Site WRF it is noted that "Table 5.6 presents the monthly and annual quantities of waste rock generated, deposited at the WRF and used for construction purposes" but no

comment is provided on NAG versus PAG quantities or how much NAG was used in construction or any aspect of the construction and management of the WRF. Other examples include Section 10.1.1 CIRNAC Inspections which simply provides the inspection dates and notes that debriefings were held and inspection reports filed; similarly Section 12 provides a generic paragraph and refers to Tables 12.0 and 12.1 for a list of meetings and visits.

c) Table 7.1 includes all of the tables that summarize monitoring results from the various monitoring stations. The tables are labelled as 7.1.1 to 7.1.39 and they don not appear to be in any particular order including the order in which they are presented in the main report. Furthermore, when referencing monitoring results in the text of Section 7, reference is made to Table 7.1 as opposed to the specific number used for that monitoring station. As a result, it is difficult to find a specific table among the numerous tables included in Table 7.1. The individual tables are also not included in the List of Tables following the Table of Contents at the beginning of the main report. It would be very helpful and make it easier to find specific tables if the exact table number were referenced in the text as opposed to the generic reference to Table 7.1. It would also be helpful if the tables were actually embedded within the report for quick reference while reading as opposed to a separate file where one has to scroll through the entire file to locate the required table.

Recommendation:

(R-19) CIRNAC recommends that BIMC consider making the following changes to the Annual Report structure and content to help improve the utility of the document:

a) Include a description of the approved project to provide context to the activities described in the report, e.g. how many people in construction & operations; description of primary activities and operations (ore unloading at port, ore loading to ships, rate duration etc.).
b) Include more detailed descriptions in the report and avoid high level generic descriptions where the reader is referred to an appendix for any understanding of the item being discussed.
c) Either embed the tables within the report for easy access or refer to specific tables numbers in the report as opposed to generic numbers; e.g., Table 7.1 actually consists of 39 different tables and it would be helpful if the reader was referred to the specific table being discussed as opposed to Table 7.1.

11. Aquatic Effects and Core Receiving Environment Monitoring Programs

Comment:

Appendix E.9.1 presents the 2019 Core Receiving Environment Monitoring Program (CREMP) Report. CIRNAC notes that the 2019 CREMP does not include monitoring of the receiving environment at Milne Port where treated effluent from the east and west surface water management ponds associated with the Ore Stockpile Facility is discharged to Milne Inlet, and where the Project has significantly increased port traffic.

In Section 7.7 of the Annual Report BIMC notes that the Aquatic Effects Monitoring Plan (AEMP) has been modified to take into account discussions and feedback received at the 2017 Freshwater Workshop on the CREMP, and that BIMC resubmitted a modified version of the AEMP (Revision 2) in May 2019 to regulators and stakeholders through the Phase 2 Proposal water licence amendment, for review and approval. It is not clear whether the revisions made to the AEMP expand the scope of the CREMP to include monitoring at Milne Port.

Recommendation:

(R-20) CIRNAC recommends that BIMC clarify what revisions were made to the AEMP and CREMP, and if the CREMP now includes monitoring at the Milne Port.

12. Tracking of Inspection Issues

Comment:

A variety of informal and formal inspections are carried out on project construction and operational activities, facilities, and of the immediate and local environment. Formal inspections include those carried out by BIMC and its consultants as required under the licence, as well as inspections carried out by CIRNAC, QIA, ECCC and WSCC. The issues raised as a result of an inspection are recorded and provided to BIMC for actions where needed. BIMC in turn responds to the inspection items within a timeframe as required.

While this process is appropriate and in keeping with licence requirements, it does not provide an overall perspective on site wide issues (e.g. permafrost degradation, ongoing non-compliant TSS releases, etc.), or perspective with respect to ongoing challenges associated with a specific site feature, operation, or system. From review of the report we did not see any evidence of efforts to cross reference the findings or recommendations of separate inspections or the generation of a cumulative tracking of findings and recommendations.

Recommendation:

(R-21) CIRNAC recommends that BIMC track inspection findings and recommendations, and report on actions taken on a category and site feature basis to allow for easier tracking of issues, concerns and resolution actions.

(R-22) CIRNAC recommends that BIMC include a summary of issues in the 2020 Annual report to indicate any patterns or particular areas of concern/interest.

D. Outstanding Review Comments and Recommendations from 2018 Annual Report

Table E.15 in Appendix E.15 included 18 comments that were provided by CIRANC to BIMC on the 2018 Annual Report for Operations. A review of BIMC's responses to these comments determined that 8 have been completely addressed. Remaining outstanding items are listed below in sequence.

13. Waste Rock Facility – Potential Causes of Acid Rock Drainage/Metal Leaching (ARD/ML) Formation (1-R1 to 1-R4)

Comment:

This comment has been partially addressed.

The results of the waste rock geochemical investigation conducted in 2019 (appended to the updated Phase 1 Waste Rock Management Plan, Rev 2 dated 31 December 2019, Appendix E.5.1 of 2019 Annual Report) lead to a recommendation from Golder to modify the current waste rock classification criteria that delineate Non-Acid Generating (NAG) and Potentially Acid Generating (PAG) materials for disposal purposes. The criteria, which provide a threshold for NAG materials based on a total sulphur cutoff of <0.20 wt% as S, were consequently modified to include paste pH as follows:

PAG – Total sulphur >0.20 wt% as S
PAG - Total sulphur <0.20 wt% as S and paste pH <6.
NAG - Total sulphur <0.20 wt% as S and paste pH >6.

The modified criteria reclassify materials with low sulphur content (<0.2 wt%) and low pH (<6) resulting from stored acidity in sulphate minerals from NAG to PAG. Golder also recommended that select blasthole samples of both NAG and PAG are submitted on an ongoing basis for acid base accounting (ABA) and shake flask analysis (SFE) (as opposed to just PAG samples).

These recommendations are presented in the 2019 Phase 1 Waste Rock Management Plan Rev 2. However, in reviewing the 2019 Annual Report Section 9.6, CIRNAC noted that the modified waste rock classification system to delineate NAG and PAG materials was not implemented in 2019. BIMC indicates that they will be implementing the use of paste pH testing in compliment to current blast hole geochemical testing to be rolled out in early 2020, for the purpose of screening material that may contain soluble sulfide material to aid in characterizing and identifying PAG/NAG materials within the deposit. Implementation of the modified waste rock classification criteria and methods will need to be verified in the 2020 Annual Report.

While CIRNAC agrees with the modification to the waste rock classification criteria to incorporate paste pH on low sulphur samples (total sulphur <0.20 wt% as S) to manage waste rock during the operational phase, some fundamental issues remain regarding the identification and management of ARD/ML materials, especially with respect to long-term storage and closure.

Specifically, use of a 0.2% total sulphur threshold (an analogue for an NPR of 2) to differentiate between PAG and NAG materials does not account for an absence of Calcium/Magnesium (Ca/Mg) carbonate mineral content which significantly reduces effective neutralization capacity. Golder's testwork noted above confirmed that the waste rock on average has only 39% of neutralizing potential (NP) contributed from Ca/Mg carbonate minerals. This suggests that the NP is mainly contributed by other buffering minerals such as aluminosilicates whose reaction kinetics at pH >6 (NAG samples) maybe slower than that of carbonate compounds and thus may not provide effective buffering capacity as assumed with the NAG classification. Also, there are samples in the geochemical dataset included in Table 4 (ABA Results) of Appendix A of the WRMP Rev. 2 that have an NPR < 2 despite having a total S of <0.2 wt% (e.g. sample S684262; NRP = 1.8, total S = 0.11%), suggesting that the total sulphur threshold would need to be lower to reliably achieve an NPR > 2.

Recommendation:

(R-23) CIRNAC recommends that BIMC immediately begin to use the modified waste rock classification criteria incorporating paste pH, if this has not already been implemented.

(R-24) CIRNAC recommends that the 2020 Annual Report be updated to reflect this change in methodology and that the results of paste pH be included in Appendix E.6 and E.7 summarizing geochemical analytical sampling results.

(R-25) CIRNAC recommends that BIMC review the adequacy of the 0.2% total sulphur cut-off and conduct a sensitivity analysis to determine the potential effect of the uncertainty on the projected volumes of PAG and NAG waste rock and implications in the design and operation of the WRF and potential closure of the WRF.

14. Waste Rock Facility – Uncertainty in Tonnage Estimate for Potentially Acid Generating (PAG) Waste Rock (R5)

Comment:

CIRNAC recommended that either the neutralization potential ratio (NPR) be adjusted to a value greater than 2 to account for a lack of Ca/Mg carbonate minerals, or suitable

supplementary test work be undertaken to validate that there is effective neutralization capacity above pH 6.

The geochemical study conducted by Golder in 2019 (appended to Phase 1 Waste Rock Management Plan, dated 31 December 2019, Appendix E.6 of 2019 Annual Report) confirmed low Ca/Mg carbonate neutralizing potential (NP) in waste rock from Deposit No. 1 accounting for only 39% of NP. Furthermore, Golder noted that "In cases where the NP is significantly greater than CO3-NP, the NP could be overestimated due to the partial dissolution of the less soluble, non-carbonate minerals. The rate of aluminosilicate or silicate mineral dissolution may be too slow to provide effective neutralizing capacity depending on the ambient field conditions. However, aluminosilicate and silicates can be the predominant neutralizing mineral phases under low-pH conditions or where water-rock interaction times are very long".

While the 2019 geochemical study provided recommendations to modify the PAG/Non-PAG classification criteria, the study did not include test work to validate that in these low Ca/Mg carbonate waste rock samples there is effective neutralization capacity above a pH of 6 (Non-PAG waste rock). CIRNAC recommends that either the neutralization potential ratio (NPR) be adjusted to a value greater than 2 to account for a lack of Ca/Mg carbonate minerals, or suitable supplementary test work be undertaken to validate that there is effective neutralization capacity above pH 6.

Recommendation:

(R-26) CIRNAC recommends that BIMC account for a lack of Ca/Mg carbonate minerals by either adjusting the neutralization potential ratio (NPR) to a value greater than 2, or undertake suitable supplementary test work to validate that there is effective neutralization capacity above pH 6.

15. Waste Rock Facility – Drainage Containment Pond Liner (R8)

Comment:

CIRNAC recommended that BIMC document and apply the lessons learned from the WRF pond liner leakage study to the assessment of the status of all current and planned lined pond facilities at the Mary River Project. This issue remains ongoing as BIMC has indicated that the timeline for the design memorandum is 31 March 2020.

Recommendation:

(R-27) CIRNAC recommends that BIMC document and apply the lessons learned from the WRF pond liner leakage study to the assessment of the status of all current and planned lined pond facilities at the Mary River Project. CIRNAC requests that the documentation be provided to CIRNAC once it has been completed.

16. Discharge and Spills – Discharge Prevention at Crusher Pad Drainage Ditch (R12)

Comment:

CIRNAC recommended that BIMC address all the noted design and layout challenges at the crusher drainage pad while maintaining the 3 m buffer zone (approved plan was for 8 m buffer).

In 2019, BIMC continued to make improvements to the Crusher Facility's surface water management infrastructure including upgrades to the perimeter ditch network and the Crusher Facility Pond spillway. In Section 2.2.2.3 of the 2019 Annual Report, BIMC stated that a Construction Summary Report will be submitted after additional remedial earthworks are completed to the ditching system.

This issue remains ongoing until all remedial earthworks are completed to the ditching system and the Construction Summary Report is submitted and reviewed.

Recommendation:

(R-28) CIRNAC recommends that BIMC continue to address design and layout challenges at the crusher drainage pad to expand the 3m buffer zone and submit a Construction Summary Report once all remedial earthworks are completed.

17. Hydrometric Monitoring Report – Development of Rating Curves (R15)

Comment:

CIRNAC recommended that BIMC adjust the flow-monitoring program to capture additional flow measurements to further refine/verify the rating curves.

The 2019 Hydrometric Monitoring Report (Appendix E.9.3 of 2019 Annual Report) recommended the following:

> Peak flows at H04 and H11 tend to occur over a shorter time period than at other stations due to their relatively small watershed size. As such, the flow monitoring program needs to be adjusted to accommodate rapidly changing flow conditions at these sites. Precipitation events of greater than 4 mm per day result in an appreciable increase in flow at these sites. However, precipitation events that last for more than one day, with cumulative precipitation over 10 mm result in much higher flow, especially earlier in the summer (mid-July to mid-August) before the active layer fully develops. Site visits to H04 and H11 should be made following any precipitation event that lasts more than one day and/or results total precipitation approaching or

greater than 10 mm. Such high flow conditions should be targeted and measured as often as possible at these stations.

The issue remains ongoing until the rating curves (stations H04, H01 and H11) are validated through the collection of additional high and low measurements and proposed modifications to the Hydrometric Monitoring Program.

Recommendation:
(R-29) CIRNAC recommends that BIMC adjust the flow-monitoring program to capture additional flow measurements to further refine/verify the rating curves.

18. Hydrometric Monitoring Report – Water Quality (R19)

Comment:
CIRNAC recommended that BIMC incorporate the findings and data from the Hydrometric Monitoring Program into other monitoring and mitigation programs to develop a holistic view of on-going environmental conditions, trends, and impact predictions.

In reviewing the documentation of the 2019 Annual Report, it is not clear if and where BIMC has incorporated the findings of the Hydrometric Study. In their response to the comment BIMC stated that: "*Baffinland will investigate ways to incorporate data and observations from the hydrometric monitoring into other monitoring programs and in the interpretation of overall environmental conditions where possible*".

Recommendation:
(R-30) CIRNAC recommends that BIMC incorporate the findings and data from the Hydrometric Monitoring Program into other monitoring and mitigation programs to develop a holistic view of on-going environmental conditions, trends, and impact predictions.

19. Sedimentation Monitoring Report – Identification of Trends (R23)

Comment:
CIRNAC recommended that BIMC develop a holistic view of on-going environmental conditions and trends that can tie back into the monitoring and mitigation programs by incorporating findings and data from other monitoring programs.

All studies conducted in 2019 under the Aquatic Effects Monitoring Plan (AEMP) have been included in Appendix E.9 of the 2019 Annual Report. Section 7.7 of the 2019 Annual

Report discusses the AEMP but merely outlines the scope of the plan and lists the component studies, indicating which ones were completed in 2019.

The Annual Report would benefit from the inclusion of a holistic discussion/interpretation of data collected under the AEMP to assess ongoing environmental conditions and trends at the Project to inform monitoring and mitigation programs.

Recommendation:
(R-31) CIRNAC recommends that BIMC develop a holistic view of on-going environmental conditions and trends that can tie back into the monitoring and mitigation programs by incorporating findings and data from other monitoring programs.

20. Reclamation and Closure (R24)

Comment:
CIRNAC recommended that BIMC provide a summary description of the activities performed to address the permafrost degradation in the borrow areas in subsequent Annual Reports.

This issue remains ongoing. The extent of discussion in Section 8.1 of the 2019 Annual Report on Progressive and Final Reclamation is that dewatering was carried out at KM97 and that placement of material to restore grade was done at KM7.2. No mention is made of preventative or maintenance works that may have been completed or are needed with respect to permafrost degradation.

Recommendation:
(R-32) CIRNAC recommends that BIMC provide a summary description of the activities performed to address the permafrost degradation in the borrow areas in subsequent Annual Reports.

21. Waste Management – Incinerator Bottom Ash Waste (R26)

Comment:
CIRNAC recommended that BIMC demonstrate compliance to the regulatory criteria in subsequent Annual Reports by providing a table that compares results to the allowable limits. BIMC has not included a comparison of results to a table with the applicable criteria in the Annual Report or Appendix E.2.

As in previous annual reports, Section 9.4 of the 2019 Annual Report indicates that Toxicity Characteristic Leaching Procedure (TCLP) analysis was used to test residual bottom ash from the incinerator to confirm that disposal at the Landfill Facility would not generate leachate at concentrations above the applicable water quality criteria. Appendix E.2 provides all of the laboratory analytical analysis reports (laboratory certificates of analysis). However, no comparison to the applicable criteria is provided in either the main report or appendix to verify the TCLP tests results and compliance with disposal criteria.

Recommendation:

(R-33) CIRNAC recommends that BIMC demonstrate compliance to the regulatory criteria in subsequent Annual Reports by providing a table that compares results to the allowable limits.

22. Surface Water and Aquatic Ecosystem Management Plan (SWAEMP) – Water Quality Monitoring at Quarries (R33)

Comment:

CIRNAC recommended that BIMC include all sample sites at quarries including Q1 and QMR2 in tables 9-2 and 9-3 of the Surface Water and Aquatic Ecosystem Management Plan. CIRNAC has reviewed this plan under the Phase 2 Amendment Application and will review the next update, expected in December 2019, when it is submitted. CIRNAC has no comments on this management plan at this time.

The SWAEMP (Rev 6, 29 April 2020) was updated for the 2019 Annual Report submission (Appendix E.5.3). The relevant tables in this version that summarize Water Licence Monitoring Stations are Table 9-3 for the Milne Port and Table 9-4 for the Mine Site. Neither table includes surface water monitoring stations downstream of quarries, specifically:

- MP-Q1-01 and MP-Q1-02 downstream of Q1 Quarry
- MQ-C-A, MQ-C-B and MQ-C-D downstream of QMR2 Quarry
- MQ-C-E downstream of D1Q2 Quarry

Recommendation:

(R-34) CIRNAC recommends that BIMC include surface water monitoring stations occurring downstream of quarries in Table 9-3 (Milne Port) and Table 9-4 (Mine Site) of the Surface Water and Aquatic Ecosystem Management Plan updated in 2019. Specifically, the following stations should be included:

- MP-Q1-01 and MP-Q1-02 downstream of Q1 Quarry
- MQ-C-A, MQ-C-B and MQ-C-D downstream of QMR2 Quarry
- MQ-C-E downstream of D1Q2 Quarry

E. REFERENCES

Works Cited

Nunavut Water Board Licence No. 2AM-MRY1325 – Amendment No.1. Awarded July 31, 2015.

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC). Letter to the Nunavut Water Board Re: Crown-Indigenous Relations and Northern Affairs Canada Review Comments for Baffinland Iron Mines Corporation 2018 Annual Report for the Mary River Project under Type “A” Water Licence 2AM-MRY1325 - Amendment No. 1. August 6, 2019.