Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada

Water Resources Division
Resource Management Directorate
Nunavut Regional Office
P.O. Box 100
Iqaluit, NU X0A 0H0

Your file - Votre référence
2AM-MRY1325

August 6, 2019

Our file - Notre référence
CIDM#1257043

Ida Porter
License Administrator
Nunavut Water Board
Gjoa Haven, NU X0B 1J0

Sent via email: licensing@nwb-oen.ca

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.

Dear Ms. Porter,

Thank you for your April 5, 2019, invitation to interested parties to review the 2018 Annual Report submitted by Baffinland Iron Mines Corporation for the Mary River Project, Type "A" Water Licence 2AM-MRY1325 - Amendment No. 1.

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) reviewed the 2018 Annual report and associated updated management plans. Comments are provided in Attachment A pursuant to CIRNAC's mandated responsibilities from the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Department of Indian Affairs and Northern Development Act*.

If you have any questions or require further information with respect to this matter, please contact me at (867) 975-4282 or email bridget.campbell@canada.ca, or Godwin Okonkwo at (867) 975-4550 or godwin.okonkwo@canada.ca.

Regards,

Bridget Campbell
Water Resources Coordinator, Nunavut Regional Office

CC: Assol Kubeisinova, Nunavut Water Board
Lou Kamermans, Christopher Murray, Baffinland Iron Mines Corporation

Canada

Attachment A: Review Comments

To: Ida Porter, License Administrator, Nunavut Water Board

From: Bridget Campbell, Water Resources Coordinator, Water Resources Division, CIRNAC

Date: August 6, 2019

Re: Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) Review Comments for Baffinland Iron Mines Corporation (BIMC) 2018 Annual Report for the Mary River Project under Type "A" Water Licence No. 2AM-MRY1325 Amendment No. 1.

Applicant: Baffinland Iron Mines Corporation
Project: Mary River Iron Mine
Region: Qikiqtani

A. BACKGROUND

The Mary River Project is an iron mine located on northern Baffin Island with activities covered under Type A water licence 2AM-MRY1325 – Amendment No. 1. The proponent is required to submit an Annual Report each year Under Part B and Schedule B of the Type A water licence. On April 5, 2019, the Nunavut Water Board (NWB) distributed Baffinland Iron Mines Corporation's (BIMC) *2018 Qikiqtani Inuit Association (QIA) and Nunavut Water Board (NWB) Annual Report for Operations*, dated March 31, 2018 (herein referred to as the 2018 Annual Report). The 2018 Annual Report included updates to four management plans, listed in Table 1. CIRNAC reviewed the 2018 Annual Report and the modified management plans. The results are presented in two separate sections; the Annual Report Review is presented in Section B, and the Management Plan Review is presented in Section C. All comments are summarized according to subject below.

Table 1: Baffinland Iron Mines Corporation Updated Management Plans submitted with the 2018 Annual Report

	Plan Name	Revision Number	BIMC File Number
1	Fresh Water Supply, Sewage, and Wastewater Management Plan	6	BAF-PH1-830-P16-0010
2	Roads Management Plan	7	BAF-PH1-830-P16-0023
3	Surface Water and Aquatic Ecosystem Management Plan	5	BAF-PH1-830-P16-0026
4	Interim Waste Rock Management Plan	0	Golder Report 1790951 Doc 034_Rev0

Contents

B. RESULTS OF REVIEW OF 2018 ANNUAL REPORT

1. Waste Rock Facility – Potential Cause(s) of ARD/ML Formation

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Sections 5.3, 7.3.3 and 9.6;
  - Appendix E.13 - Table E.13 - Baffinland Response to
- Outstanding Comments on the 2017 QIA & NWB Annual Report for Operations - March 31, 2019.
- Interim Waste Rock Management Plan. Mary River Project. Baffinland Iron Mines Corporation. Rev 1790951 (DOC 034_Rev0). March 2019. Golder, Mississauga, Ontario, Canada.180914 2AMMRY1325 CIRNAC Comments 2017 QIA NWB Annual Report-ILAE.

The adequacy of follow-up geochemistry investigations is critical to validating processes for the identification and segregation of potentially acid generating (PAG) or metal leaching (ML) materials, and for validating appropriate mitigation measures for the protection of water quality. Appropriate geochemistry data sets and their interpretation are essential to ensure that Environmental Management Plans remain relevant and adaptive. This is particularly important in light of the significant differences between the predicted tonnages of PAG waste rock during the planning stages of the Environmental Assessment and the Water Licence application, and the predicted tonnages of PAG waste rock during the implementation stages of mine operation at Mary River.

In the 2017 Annual Report Review, CIRNAC noted in Comment 5 that that there was a lack of evidence to support the hypothesis presented by Golder in which it was suggested that acid rock drainage and metal leaching (ARD/ML) at the waste rock facility (WRF) in early 2017 was caused by soluble iron sulphate minerals (e.g. melanterite). CIRNAC therefore recommended that BIMC update its waste rock geochemical characterization programs and Waste Rock Management Plan by including soluble iron sulphate minerals in waste rock as a source of acid drainage. In the response presented in table E.13 of Appendix E.13, BIMC reports undertaking a geochemical field program during 2018-2019 to characterize the WRF and assess its thermal performance. This program was comprised of 18 samples taken from three boreholes within the WRF and is further described in the Interim Waste Rock Management Plan (IWRMP). The results showed a range of total sulphur content from 0.02 to 0.53 wt. % as S, a range of sulphide-sulphur content from <0.02 to 0.25 wt. % as S, and a range of sulphate-sulphur content from <0.02 to 0.28 wt. % as S. BIMC reiterated Golder's hypothesis and concluded that the preliminary geochemical results appear to support the theory that that dissolution of soluble sulphate minerals may be a key source of the acidic drainage currently observed from the WRF.

CIRNAC has noticed issues with the current data interpretation and geochemical program; while the current data set does support the hypothesis of the presence of soluble sulphate minerals being the source of the acidic and metalliferous drainage, CIRNAC does not find the geochemical program adequate to inform both the identification and behavior of problematic materials for three reasons. Specifically:

i. The methods chosen to analyze the samples (whole rock analysis, bulk metals, XRD mineralogy) may not be enough to identify the soluble iron sulphate minerals as these minerals may be amorphous. The XRD minerology method in particular is not likely to positively identify amorphous minerals.
ii. If there is a significant amount of soluble sulphate minerals present in certain waste rock materials, the release of acidity and metals would be very rapid (i.e. almost immediately upon contact as suggested by the SFE results) and thus the overall kinetics of the release of acidity and metals would be much faster than what was suggested in the kinetic work undertaken to inform the Environmental Assessment, the Water Licence application, and the associated Waste Rock Management Plan. The current geochemical test work program provides no insight into the overall effect of rapid release of acidity and metals by the soluble sulphate mineral content and the possible implications of that rapid release.
iii. There is insufficient data to support the conclusion that the overall 0.2% total sulphur cut-off is suitable for the identification of materials that may very quickly release significant loadings of acidity and metals. The current data set suggests that a soluble sulphate sulphur cut-off may need to be developed to identify such materials. If only 0.12% soluble sulphur is problematic, that also suggests that the overall 0.2% total sulphur cut-off may not be appropriate.

Recommendation:

R1: CIRNAC recommends that BIMC undertake supplementary test work to confirm the nature of the soluble sulphate fraction that is amorphous by use of a mineralogical technique that is able to confirm amorphous minerals.

R2: CIRNAC recommends that BIMC undertake further studies to investigate the potential effect of rapid release of acidity and metals from such materials on water quality upon seepage, and determine the appropriate water treatment requirements.

R3: CIRNAC recommends that BIMC review the 0.2% total sulphur cut-off. Further, BIMC should examine the necessity for an additional readily soluble sulphate cut-off to the identification of PAG materials in light of BIMC results indicating that waste rock with only 0.12% soluble sulphur demonstrate the potential for rapid release of significant loadings of acidity and sulphate salinity.

R4: CIRNAC recommends that, once addressed, the outcomes of these additional recommendations need to be incorporated into the Waste Rock Management Plan, with particular note to PAG segregation, WRF design, and water treatment requirements.

2. Waste Rock Facility – Uncertainty in Tonnage Estimate for PAG Waste Rock

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Sections 5.3, 7.3.3 and 9.6;
  - Appendix E.13 - Table E.13 - Baffinland Response to Outstanding Comments on the 2017 QIA & NWB Annual Report for Operations - March 31, 2019.
- Interim Waste Rock Management Plan. Mary River Project. Baffinland Iron Mines Corporation. Rev 1790951 (DOC 034_Rev0). March 2019. Golder, Mississauga, Ontario, Canada.
- 180914 2AM-MRY1325 CIRNAC Comments 2017 QIA NWB Annual Report-ILAE.
- William A. Price for the Mine Environment Neutral Drainage (MEND) Program, Natural Resources Canada, MEND Report 1.20.1, Prediction Manual for Drainage Chemistry from Sulphidic Geological Materials, December, 2009.

An understanding of the uncertainty surrounding the geochemical criteria that are used to identify potentially acid generating (PAG) waste rock, in this case total sulphur % and associated neutralization potential ratio (NPR) value, is crucial to inform the degree of uncertainty around the estimation of tonnages of PAG waste rock. If such uncertainty is not understood, it could lead to significant impacts to the surrounding environment; generation of unexpected poor quality drainage water (e.g. as occurred at the waste rock facility in early 2017), inappropriate waste rock facility design (e.g. insufficient Non-PAG to cover PAG materials), and/or areas of the mine with insufficient mitigation measures in place (e.g. no seepage collection or water treatment) are possible implications.

Qualifying the degree of uncertainty of the geochemical criteria that are used to identify PAG waste rock, and associated uncertainty in estimations of PAG waste rock tonnages, is essential to ensure Environmental Management Plans remain relevant and adaptive. This is particularly important in light of the significant differences between the predicted tonnages of PAG waste rock during the planning stages of the Environmental Assessment and the Water Licence application and the predicted tonnages of PAG waste rock during the implementation stages of mine operation at Mary River; the Phase 1 Waste Rock Management Plan predicted 11% of total waste rock to be PAG and Golder's revised prediction of life of mine PAG, which did not appear to account for soluble iron sulphate content, was 20.7%, and the 2017 Annual Report stated that 348 Kt of a total of 1206 Kt were PAG (29%, significantly higher than both of the predicted proportions of PAG).

The data presented in Appendices E.6 (Deposit No. 1 Waste Rock – Geochemistry Summary Statistics) and E.7 (QMR2 Quarry - Geochemistry – Analytical Sampling Results – 2018) of the 2018 Annual Report demonstrate that the majority of the bulk neutralization potential in both waste rock and quarry rock at the Mary River mine is provided predominantly by silicate minerals rather than by Ca/Mg carbonate minerals. Therefore, effective neutralization of acidity will not occur until silicate minerals are being dissolved (i.e. at pH well below 6). The Mine Environment Neutral Drainage (MEND) program clearly advocates for the adjustment of the NPR value to a suitable value greater than 2 to

account for a lack of Ca/Mg carbonate minerals (noting the current 0.2% total sulphur cut-off is based upon an NPR value of 2). As noted in Review Comment No. 1, above, samples with only 0.12% soluble sulphur demonstrated the potential to rapidly release significant loadings of acidity and sulphate salinity (well below 0.2% total sulphur if all sulphur is present as soluble sulphur).

Comment 6 of CIRNAC's 2017 Annual Report Review recommended that BIMC update its estimate of the tonnage of PAG waste rock from Deposit No. 1 by also considering soluble sulphate minerals in the PAG/Non-PAG classification, and then use the results to update the Waste Rock Management Plan accordingly. The response provided by BIMC in Table e.16 of Appendix E.16 states:

> Additional investigation into the presence of soluble sulphate minerals, with an emphasis on non-PAG waste rock, is part of the planned 2019 geochemical program to further assess presence and potential implications of soluble sulphate minerals within the WRF. The results of the 2019 geochemical program will be used to evaluate and potentially revise the current geochemical analysis and PAG classification process and the sequencing schedule.

However, there has yet to be any information presented on the uncertainties of PAG tonnages and the uncertainties around the 0.2% total sulphur content cut-off used to identify PAG. Information should be provided to demonstrate the level of uncertainty/variability between NPR values and associated total sulphur values across the deposit or at the mine quarries, the level of uncertainty/variability between total sulphur values and associated potential leachate water quality, and a factor of safety in relation to the derivation of the total sulphur threshold.

Recommendation:

R5: CIRNAC recommends that BIMC either adjust the NPR to a value greater than 2 to account for a lack of Ca/Mg carbonate minerals, or undertake suitable supplementary test work to validate that there is effective neutralization capacity above pH 6 and thus justify the use of an NPR threshold of 2.

R6: CIRNAC recommends that BIMC present statistics that demonstrate:

i. The level of uncertainty/variability between NPR values and associated total sulphur values;
ii. The level of uncertainty/variability between total sulphur values and associated potential leachate water quality; and
iii. A factor of safety in relation to the derivation of the total sulphur threshold.

3. Waste Rock Facility – Water Treatment Plant

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Sections 5.3, 7.3.3 and 9.6;
  - Appendix E.13 - Table E.13 - Baffinland Response to Outstanding Comments on the 2017 QIA & NWB Annual Report for Operations - March 31, 2019.
- Interim Waste Rock Management Plan. Mary River Project. Baffinland Iron Mines Corporation. Rev 1790951 (DOC 034_Rev0). March 2019. Golder, Mississauga, Ontario, Canada.
- 180914 2AM-MRY1325 CIRNAC Comments 2017 QIA NWB Annual Report-ILAE.

In CIRNAC's review of the 2017 Annual Report it was noted that low pH water from the waste rock facility (WRF) pond batch, treated with sodium carbonate, still had discharge exceedances for pH and TSS. Understanding why water treatment has not been effective in achieving discharge water quality objectives is critical to suitable modification of water treatment methods to achieve those discharge water quality objectives and ensure protection of ecosystems in the watershed.

The 2018 Annual Report suggests water containment and treatment have been significantly and adequately upgraded to better treat pH and TSS exceedances in discharge water from the WRF.

Recommendation:
R7: CIRNAC recommends that BIMC continue to monitor the water quality discharge to ensure run-off from the WRF treatment plant remains compliant.

4. Waste Rock Facility – Drainage Containment Pond Liner

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix C.2.2 Geotechnical Inspections, October 2018.

There are several lined pond facilities at the Mary River mine site used to contain and store contaminated contact water. These lined ponds are important to prevent the release of contaminated contact water from the Waste Rock Facility (WRF) to the environment. The Waste Rock Stockpile Drainage Containment Pond Liner is known to have leakage issues; however the cause of the leakage is still unknown.

CIRNAC understands that there are interim control measures in place to deal with leakage at Waste Rock Storage Facility which will be kept in good working/operational condition until the liner leakage is fixed, and that BIMC has commissioned an external professional

engineer to evaluate the cause of the leakage at the Waste Rock Stockpile Drainage Containment Pond. CIRNAC suggests that when BIMC establishes the causes of the leakage at the Waste Rock Stockpile Pond, the lessons learned should be documented and applied to the assessment of the status of all current and planned lined pond facilities.

Recommendation:
R8: 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.

5. Discharges and Spills – Reporting Unauthorized Discharges and Spills

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Section 6.0 - Reported Incidents;
  - Tables 6.0, 6.1;
  - Figure 8;
  - Appendix E.8.4.
- Type A Water License No. 2AM-MRY1325 Amendment No. 1:
  - Schedule B – General Conditions, item 1c. Spills i), ii), iii);
  - Part H – Conditions Applying to Emergency Response and Contingency Planning item 9.a), b), c), item 10.

Monitoring and reporting of spills in a timely manner is required by regulations and project terms and conditions. Leaks and spills can lead to environmental and safety violations and cause negative impacts to the environment and injuries and health impacts to workers and other people. Managing leaks, spills and discharges can help prevent impacts associated with project activities. Planning for and implementing adequate spill response capacity and emergency response demonstrates adequate oversight of project activities is occurring.

Table 6.0 of the 2018 Annual Report indicates there were 36 total reportable spills in 2018. This value was commented (pg 24) to be a “25% decrease when compared to the frequency of reportable spills in 2017.” Table 6.1 provides the required details for each spill incident including volume, dates, summary of events, and report number. Initial and follow-up reports with details (photos, map of location) are provided for each in Appendix E.8.4. CIRNAC encourages BIMC to continue reducing the frequency of spills.

CIRNAC notes that six of the initial spill reports (#18-051,141,153,154,180,182; provided in Appendix E.8.4) were reported after 24 hours had elapsed, and two of the detailed follow-up reports (#18-040, 244) were reported more than one month after the initial incident. Clauses 9(2) and 11(2) of the *Government of Nunavut Spill Contingency and Reporting Regulation R-068-93* and Part H, Section 9, Item b of Water Licence 2AM-MRY1325 require timely reporting of spills and unauthorized discharges (within 24 hours).

Further, of the total reported types of spilled material, untreated sewage was the most commonly spilled (20 of 36 spills). It was observed that in many of these incidents freezing conditions caused equipment to malfunction and spills to occur.

Recommendation:
R9: CIRNAC recommends that BIMC follow the requirements to report all reportable spills within 24 hours to the 24-Hour Spill Reporting Line and to the CIRNAC Inspector, and that written reports are provided to the CIRNAC Inspector within thirty days of the initial event.

R10: CIRNAC recommends that BIMC complete a review of all spills on the project site through an extended timeframe (annual or longer) to determine whether corrective and preventive actions need to be applied across the project at repeat failure locations. Changes should be tracked to determine if the improvements are effective.

6. Discharges and Spills – Discharge Prevention at Crusher Pad Drainage Ditch

References:
- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix C.2.2 – Geotechnical Inspections, October 2018.
- Hatch Ltd., Civil Design Criteria, Hatch Project No. H349000, Issued to Baffinland August 28, 2013.
- Nunavut Water Board Water Licence No. 2AM-MRY1325 – Amendment No.1, Baffinland Iron Mines Corporation Mary River Project, Signed July 21, 2015.

The Crusher Pad drainage containment channel at the mine site is designed to carry ore contact water to a settlement pond and to prevent the waste from entering the natural environment prior to undergoing treatment. This channel is aligned along the natural major drainage course. To maintain proper drainage of contact water, which is considered a waste under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Arctic Waters Pollution Prevention Act*, it is important that no materials slide from the crusher pad into the containment channel or into the natural drainage course (such as ore or snow/ice during winter from steep ore stockpile slopes). Any potential encroachment on the ditch and/or the natural drainage course has the potential to erode and wash out the crusher pad drainage channel and lead to the release of untreated contact water to the natural environment.

To prevent materials from entering the channel, it is important that the required buffer between the stockpile boundary and the ditch is well maintained, and that the ditch profile is maintained at all times. The original 2013 Hatch design prescribed a 3m setback of material from the ditching perimeter, meaning the ore on the pad should be placed more than 3m away from the channel. BIMC noted that the access to materials by heavy equipment has been setback 3m as per the original design, though accessibility issues persist, and that they are developing a progressive strategy to address stockpile placement design for 2019.

The inspections conducted between October 3 and 10, 2018 have identified other challenges with the design and maintenance of the Crusher Pad Expansion. These challenges are associated with the drainage ditch gradient, the Crusher Pad footprint, the stockpile design, and the potential for expansion into the 3m buffer zone between the ore stockpile boundary and associated ditch.

Recommendation:
R11: CIRNAC recommends that BIMC review the design of the ditch gradient profile and ensure it is maintained to prevent material from sliding from the crusher pad into the containment channel or into the natural drainage course.

R12: CIRNAC recommends that BIMC address all the noted design and layout challenges at the crusher drainage pad while maintaining the 3m buffer zone between the ore stockpile boundary and associated containment channel.

7. Hydrometric Monitoring Report – Measurements during Low Flow Conditions

References:
- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix E.9.3 2018 Hydrometric Monitoring Report.

It is important to capture flow measurements as accurately as possible so they can be used to verify the rating curve: a graph representing the relationship between flow (discharge) and water level (stage) for a given point on a stream. Inaccurate rating curves can lead to over- or under-estimating flows which may not reflect actual conditions.

The stage-discharge data obtained in 2018 were compared to the existing rating curves for each station. The stage-discharge measurement recorded at monitoring station H01 (Phillip's Creek Tributary) during June 2018 noted a discrepancy with the discharge predicted by the rating curve. The 2018 Hydrometric Monitoring Report notes that it can be challenging to get complete mixing of the rhodamine dye across the channel during lower flow conditions due to the large channel width and relatively shallow depth.

Recommendation:
R13: CIRNAC recommends that BIMC use a more effective approach to collecting flow measurements during low flow conditions.

8. Hydrometric Monitoring Report – Development of Rating Curves

References:
- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:

    - Appendix E.9.3 2018 Hydrometric Monitoring Report. Page 2: Figures 1-7.
  - Environment Canada, Hydrometric Manual: Data Computations, Beta Version, 2012.

When developing a rating curve (stage-discharge relationship) for volumetric flow estimates, the discharge measurements should cover the entire range of water levels and be sufficient to define all sections of the curve. The highest discharge measurement on a developed rating curve does not always coincide with the peak recorded water level. It is therefore usually necessary to extend or extrapolate the curve beyond the highest measured discharge. However, according to the Water Survey of Canada Hydrometric Manual (2012), the upper end of a rating curve should not be extended beyond twice the highest measured discharge measurement defining the rating curve. To extrapolate data beyond this recommendation will decrease the reliability of the measured relationship.

The rating curves for Stations H04 and H11 appear to extend beyond this recommendation. While the 2018 Annual Report notes that there remains some uncertainly around the higher stage (water level) discharge conditions, further assessment of this uncertainty and its potential implication on the Aquatic Effects Monitoring Plan (AEMP) may be required. The 2018 Hydrometric Monitoring Report recommended that additional measurements would be useful to verify the rating curves.

Recommendation:
R14: CIRNAC recommends that BIMC provide justification for extrapolating beyond twice the highest measured flow against the recommendation of the Water Survey of Canada.

R15: CIRNAC recommends that BIMC adjust the flow monitoring program to capture additional flow measurements to further refine/verify the rating curves, particularly the upper portions of the rating curves.

9. Hydrometric Monitoring Report – Update of Rating Curves

References:
  - Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
    - Appendix E.9.3 2018 Hydrometric Monitoring Report. Page 2: Figures 1-7.
  - Water Survey Canada, Hydrometric Technician Career Development Program: Lesson Package No. 10.1 – Principles of Discharge Measurement, 1999.

Shifts/changes in the stage-discharge relationship can occur over time due to changes in the shape of the stream profile caused by impermanent banks, unstable stream beds, or changes in slope due to raise or falling stage. At some locations, where the watercourse tends to be stable and well defined, one or two measurements may be sufficient to verify that no change has taken place; however, a full understanding of the stability and sensitivity of the stage-discharge relationship is important as these parameters form the basis of the discharge records. According to the Water Survey Canada Hydrometric Technician Career Development Program (1999), the decision on when and how to alter a

discharge measurement program will depend, to a great extent, on the background knowledge the technician has acquired of the area and on the characteristics of the watercourse.

Several of the rating curves used to develop the 2018 discharge records were noted in the Hydrometric Monitoring Report as being based on curves generated in 2012 and 2013, four of the stations (H01, H02, H06, and H07) had a single flow measurement for 2018, and, based on the rating curves, stations H02, H04, and H11 appear to have experienced shifts that required updates to the previous rating curves.

Recommendation:
R16: CIRNAC recommends that BIMC provide an explanation outlining why a single flow measurement was used and to demonstrate that changes to the watercourse/rating curve are not occurring.

R17: CIRNAC recommends that BIMC provide an explanation or discussion to explain why an updated rating curve was developed for stations H02, H04, and H11.

10. Hydrometric Monitoring Report – Water Quality

References:
- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix E.9.3 2018 Hydrometric Monitoring Report.
- Draft Aquatic Effects Monitoring Plan; Phase 2 Proposal Revisions, May 1, 2019: Appendix I - 2017 Freshwater Workshop Meeting Minutes.

In response to a question asked by CIRNAC (formerly INAC) during the 2017 Freshwater Workshop (Workshop Meeting Minutes, pg. 4, Day 1 – Slide 8), held by BIMC on November 8 and 9, 2017, BIMC stated that “Hydrology data collected under the Hydrometric Monitoring Program is used to inform effluent concentrations in receiving water bodies…” and that “The annual monitoring report for the Hydrometric Monitoring Program is included in the annual report submitted to QIA and the NWB.”

The 2018 Hydrometric Monitoring Report has been included in the 2018 Annual Report; however it does not include information about effluent concentrations or provide a discussion or assessment of the receiving water bodies’ ability to accept effluent.

Recommendation:
R18: CIRNAC recommends that BIMC incorporate information about effluent concentrations in receiving water bodies, or a reference to where this information can be found, into the Annual Reports.

R19: CIRNAC recommends that BIMC also 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.

11. Hydrometric Monitoring Report – Measurement of High Flows

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix E.9.3 2018 Hydrometric Monitoring Report.
- Draft Aquatic Effects Monitoring Plan; Phase 2 Proposal Revisions, May 1, 2019: Appendix I - 2017 Freshwater Workshop Meeting Minutes

The measurement of high flows is important to understand the changes in flow velocity and the potential effects in the aquatic ecosystem as well as predict and prevent erosion of the stream channels. In response to a question asked by CIRNAC (formerly INAC) during the 2017 Freshwater Workshop (Workshop Meeting Minutes, pg. 33, Day 2 – Slide 130), held by BIMC on November 8 and 9, 2017, BIMC stated the following:

> Safety concerns associated with in-stream flow measurements during high flows has prevented Baffinland from collecting high flow measurements in the past. Baffinland is currently [as of 2017] assessing alternate methods for measuring high flows at hydrology stations.

As per the 2018 Hydrology Monitoring Report, high flows measurements were not obtained in 2018.

Recommendation:

R20: CIRNAC recommends that BIMC provide an update on their proposed method for collecting high flow measurements in the future.

12. Groundwater Monitoring Report

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix E.11 2018 Groundwater Monitoring Report. Page 5.

The objective of the 2018 groundwater monitoring program was to further assess the feasibility and utility of monitoring groundwater near the Project infrastructure using drive-point piezometers. BIMC recognized that although challenges to implementing a Groundwater Monitoring Program in shallow soils do exist, the results of the 2018

Groundwater Monitoring Program demonstrate that groundwater monitoring may be feasible using drive-point piezometers at the Project site.

Section 3.3.1, Quality Assurance and Quality Control (QA/QC) of the Groundwater Monitoring Report notes that total aluminum, iron and titanium were above 3 times their respective maximum daily allowance (MDL). The elevated relative percent differences (RPDs) for these parameters as associated with the result of the amount of solids collected in the sample and corresponding duplicates. The Proponent notes that to ensure the continued collection of representative, accurate and reliable water quality data at the Project, BIMC will continue to require all personnel involved with water quality sampling to be experienced and fully trained in the Project's QA/QC procedures and processes outlined in the Project's QA/QC plan. However, it is unclear if the elevated parameters were due to an error in the sampling procedures or an issue with the Project's QA/QC procedures.

Recommendation:
R21: CIRNAC recommends that BIMC provide clarification on the rationale for the elevated parameters and/or lessons learned that can be implemented in future groundwater monitoring.

13. Lake Sedimentation Monitoring Report – Sediment Analysis

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix E.9.2 - 2018 Lake Sedimentation Monitoring Report.

An assessment of the chemical and mineralogical quality of sediments in the different areas of the project would allow for a comparison of current sediment characteristics with the baseline, and could help BIMC identify future potential contamination and the need for mitigation measures, if required. As per the 2018 Lake Sedimentation Monitoring Report, bulk density analysis was carried out on the collected sediment; however no chemical or mineralogical analysis was carried out.

Recommendation:
R22: CIRNAC recommends that BIMC conduct chemical and mineralogical quality analyses on future sediment samples.

14. Lake Sedimentation Monitoring Report – Identification of Trends

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Appendix E.9.2 - 2018 Lake Sedimentation Monitoring Report:

- Figures 3.1, 3.2 and 3.3.

Increased sediment deposition in mine area water bodies through fugitive dust and surface runoff/erosion from the mine site may lead to physical habitat alterations (i.e. changes in substrate composition) and/or chemical alteration (i.e. changes in metal and/or nutrient concentrations) that could lead to adverse ecological effects. It is therefore important to monitor sedimentation rates and identify trends that could suggest impacts from mining operations.

The Lake Sedimentation Monitoring Report compares the current 2018 data with the baseline years (2013 - 2014), and with the operational years (2015 - 2016 and 2016 - 2017); however, the current reporting method does not feed back into other monitoring plans. Reviewing sedimentation rates as a holistic view of monitoring and mitigation programs may be useful for noticing trends and relationships between sedimentation and changes in mining activities, such as dust management measures or erosion control procedures. While the data to date suggests mining activities have not increased sedimentation rates, given there was only a single year of sediment baseline data, it may be prudent to identify and correlate trends from the various monitoring programs to try to identify if potential future increases are naturally occurring or related to project activities.

Recommendation:
R23: 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.

15. Reclamation and Closure

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Section 8.0 – Reclamation, Closure and Financial Security.

Section 8.0 of the 2018 Annual Report mentions the implementation of a long-term multi-year plan to address localized areas of permafrost degradation associated with some borrow areas. There is reference to a Borrow Source Management Plan implemented during 2018 to be continued in 2019. Considering that this a multi-year plan and its importance, it will be beneficial for the next Annual Reports to include a description of the management activities and the results obtained during the monitoring after implementation of the plan to address the permafrost degradation in the borrowing areas.

Recommendation:
R24: CIRNAC recommends that BIMC provide a summary description of the activities performed to address the permafrost degradation in the borrowing areas in subsequent Annual Reports.

16. Waste Management – Land Farm Capacity

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Section 13.0 Summary of Project Plans for 2019;
  - Appendix E.13 Response to Outstanding 2017 Annual Report Comments, Table E.13 Comment 3 Land Farm Capacity.

The Milne Port landfarm facility design has a maximum soil capacity of 9,000 m3. The 2018 estimated volume of soils placed is over capacity at 9,800 m3 and petroleum impacted soils continue to be generated from spills and unauthorized discharges and continue to be placed in the facility, as stated in Section 5.2.4 of the Annual Report. Section 5.2.4 also states (pg 21) that "Table 5.5 in the Annual Report is to provide the estimated monthly and annual quantities of soil and contaminated water deposited at the Milne Port Land farm Facility during 2018." However, Table 5.5 does not include any soil volumes. There is a note indicating "Information not available. On December 31, 2018 there was approximately 9,800 m3 of soil stored at the Milne Port Landfarm Facility."

In the 2017 Annual Report Review Comments (Appendix E.13, Table E.13) , CIRNAC noted that the landfarm was over capacity and requested "… that the licensee specify where they intend to store any new contaminated soil and how they propose to treat or discard the soil presently at the landfarm." In Table E.13 of the Annual Report Baffinland responded:

> The 2019 Work Plan includes the addition of a land farm facility at the Mine Site to provide additional capacity at the Project for managing and treating hydrocarbon impacted soils. Soils currently stored at the Milne Port will continue to be remediated until they meet or exceed the relevant criteria for re-use at the Project. During 2018, Baffinland continued to till and remediate soils stored at the Milne Port Land farm Facility as well as remove intermingled debris.

Recommendation:

R25: CIRNAC recommends that BIMC provide a detailed explanation of the method of determining monthly generated soil volumes, and why there is no 2018 monthly petroleum contaminated soil volume data for the Land farm at Milne Port.

17. Waste Management – Incinerator Bottom Ash Waste

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Section 9.4 Results of Chemical Analysis of Incinerator Bottom Ash;
  - Appendix E.2 Incinerator Ash Testing Results.

- Type A Water License No. 2AM-MRY1325 - Amendment No. 1: Part F – Conditions Applying to Waste Disposal and Management.

Conditions under Part F, Item 7 of the Water License require that chemical analyses be conducted on residue generated from each incinerator system prior to disposal in any landfill, that acceptable test procedures are conducted, and that the waste be directed to an appropriate disposal facility if the composition of the ash makes it unsuitable for disposal at the landfill.

Section 9.4 of the 2018 Annual Report indicates that the ash was tested to determine whether the ash would generate leachate in concentrations above the water quality limits, a Toxicity Characteristic Leaching Procedure (TCLP) analysis was conducted, and that ash samples were all found to be suitable for landfill disposal. A reference to the applicable environmental guidelines (which presents the parameters and allowable limits) was provided, and the laboratory analytical analysis reports were provided in Appendix E2. However, it is tedious for reviewers to cross-check these results as the 2018 Annual Report does not include a comparison of the results to the criteria.

Recommendation:
R26: CIRNAC suggests that BIMC demonstrate compliance to the regulatory criteria in subsequent Annual Reports by providing a table that compares results to the allowable limits.

C. RESULTS OF REVIEW OF MANAGEMENT PLANS

Fresh Water Supply, Sewage, and Wastewater Management Plan (FWSWMP)

18. FWSWMP – Sewage Backhaul to Southern Canada

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Baffinland Iron Mines Corporation, Fresh Water Supply, Sewage, and Wastewater Management Plan, March, 2019.
- Type A Water License No. 2AM-MRY1325 - Amendment No. 1:
  - Part F – Conditions Applying to Waste Disposal and Management;
  - Schedule B: Annual Reporting.

In Section 5.2 of the Fresh Water Supply, Sewage, and Wastewater Management Plan, BIMC adds an option for sludge disposal which was not written in the previous version (revision 5) of the plan. No mention is made in the licence to landfill facilities in Southern Canada. In the plan, BIMC states (pg 19):

> Sludge generated from Sewage Treatment Facilities or any other facilities shall be incinerated using the Milne Port and Mine Site onsite incinerators, disposed of in the landfill with the appropriate approvals from authorities, or backhauled for disposal off site in Southern Canada.

Water Licence 2AM-MRY1325 – Amendment No. 1, Part F, Item 19 states (pg 21):

> Sludge generated from the Sewage Treatment Facilities or any other facilities shall be confirmed to be non-hazardous and the results provided to the Board for review prior to disposal at any Landfill Facility or as otherwise approved by the Board in writing.

Schedule B, Item 1, Section b, Sub-section iv states that the Annual Report should include (pg 46):

> the monthly and annual volumes in cubic metres of Sludge removed from each Sewage Treatment Facility and disposed of at each Landfill Facility or any approved alternative disposal facility;

Recommendation:

R27: CIRNAC recommends that BIMC acquire confirmation in writing from the NWB, stating that the selected landfill facility in Southern Canada has been approved, prior to any backhauling activity.

R28: CIRNAC recommends that, along with the volume, BIMC provide the details associated with any disposal in Southern Canada in the Annual Reports, including details on the alternative disposal facility, written approval from the NWB, and sewage volume.

19. FWSWMP – Run Of Mine Stockpile at Km 107

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Baffinland Iron Mines Corporation, Fresh Water Supply, Sewage, and Wastewater Management Plan, March, 2019.

Section 7.4 of the Fresh Water Supply, Sewage, and Wastewater Management Plan, makes reference to the Run of Mine Stockpile planned to be built at Km 107. A modification request has been put forward by BIMC to move this infrastructure to Km 106.

Recommendation:
R29: CIRNAC recommends that if/when the Run of Mine Stockpile is built, the Fresh Water Supply, Sewage, and Wastewater Management Plan be updated with the correct location.

Surface Water and Aquatic Ecosystem Management Plan (SWAEMP)

20. SWAEMP – List of Regulatory Instruments

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Baffinland Iron Mines Corporation, Surface Water and Aquatic Ecosystem Management Plan, March, 2019.

Section 1.2 of the Surface Water and Aquatic Ecosystem Management Plan includes a list of regulatory instruments which ends with the phrase “and;”, which may lead the reader to make assumptions of an incomplete report.

Recommendation:
R30: CIRNAC recommends that BIMC either include all of the regulatory instruments that inform this plan, or remove the “and;” from the end of the list to demonstrate a complete list, or include a phrase to indicate that the regulatory instrument list is not exhaustive.

21. SWAEMP – Routine Inspections and Monitoring

References:

- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:

- Baffinland Iron Mines Corporation, Surface Water and Aquatic Ecosystem Management Plan, March, 2019.

Table 9-1 of the Surface Water and Aquatic Ecosystem Management Plan includes a list of Routine Inspections and Monitoring Requirements which are separate from specific monitoring and reporting requirements subject to applicable regulatory approvals. This list has been updated from the revision 5 of the same plan so that a number of routine inspections have been removed. These include inspections for rutting by vehicles at various locations, environmental and wildlife concerns post-drilling at drill sites, and all parameters at soil stockpile locations.

Recommendation:
R31: CIRNAC requests clarification from BIMC on why these parameters (rutting by vehicles, environmental and wildlife concerns, and all soil stockpile parameters) have been removed from the list of routine inspections.

22. SWAEMP – Dust Control Measures

References:
- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Baffinland Iron Mines Corporation, Surface Water and Aquatic Ecosystem Management Plan, March, 2019.

Sections 4 and 7 of revision 4 of the Surface Water and Aquatic Ecosystem Management Plan refer to dust control measures such as dust suppressants and polymer flocculants. The current version, revision 5 of the plan, mentions dust control measures in flow diagrams A.1 and A.2, and under the Valued Ecosystem Components, but makes no further reference to dust control.

Recommendation:
R32: CIRNAC requests clarification from BIMC on why the section describing dust control measures has been removed from this management plan.

23. SWAEMP – Water Quality Monitoring at Quarries

References:
- Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019:
  - Baffinland Iron Mines Corporation, Surface Water and Aquatic Ecosystem Management Plan, March, 2019.

Tables 9-2 and 9-3 of the Surface Water and Aquatic Ecosystem Management Plan include lists of Water Licence Monitoring Stations for Milne Port and the Mine Site, respectively. From revision 4 to revision 5, the current version, sample locations for surface runoff at quarries Q1and QMR2 have been removed. BIMC clarifies in Section 9.6 that these details are found in the specific Quarry and Borrow Source Management Plans. CIRNAC is of the opinion that these details are important to include in the Surface Water and Aquatic Ecosystem Management Plan as they are relevant to surface water management.

Recommendation:
R33: CIRNAC recommends that BIMC include all sample sites at quarries including Q1and QMR2 in tables 9-2 and 9-3 of the management plan.

Roads Management Plan

CIRNAC has no comments on this management plan.

Interim Waste Rock 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.