Canada

CLIENT: Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)

PROJECT: Mary River Project – Annual Geotechnical Site Inspections (2018)

		SIGNATURE	DATE
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PERMIT TO PRACTICE
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Signature NAME
Date DATE 31 OCT 2018
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The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

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ISSUE/REVISION INDEX

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Issue Codes: RC = Released for Construction, RD = Released for Design, RF = Released for Fabrication, RI = Released for Information, RP = Released for Purchase, RQ = Released for Quotation, RR = Released for Review and Comments.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

This report presents the main findings of the annual (year 2018) geotechnical site inspections carried out during August 22 & 23, 2018. The inspections were based on walk-over visual inspections of the facilities associated with water licensing, for details refer to Appendix A - Schedule of Inspections. Appendix B presents a selected photo collage of the inspections.

SNC-Lavalin Inc. (SLI) is assisting Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) in site inspections of the Mary River Project operated by Baffinland Iron Mines Corporation (BIMC). BIMC, as a part of water licence compliance requirement (Type A, 2AM-MRY1325 Amendment #1), is required to carry out two geotechnical inspections every year of the project facilities – earth works as well as water-related site works. SLI's site inspections are independent of BIMC's geotechnical inspections.

These geotechnical site inspections are a task (Task 1) of larger call-up mandate for SLI associated with the Mary River Project mine licensing and site closure and reclamation.

These geotechnical site inspections were carried out by Hafeez Baba, Ph.D., P. Eng. Senior Geotechnical Engineer at SLI. During this visit, Dr. Baba was accompanied by Mr. Wajid Daouda, P. Eng. – Senior Engineer Major Projects, Ms. Bridget Campbell - as Water Resources Coordinator, and Mr. Jonathan Mesher – Water Resources Officer all at CIRNAC, and also by Ms. Martine Paradis, MEng., PMP – Environmental Engineer at SLI. This visit was facilitated by BIMC's - Environmental Superintendent, Mr. Bill Bowden and his designated staff.

The sites visited and inspected during the inspection were the Mine Site, Milne Port Site, and the Tote Road which is about 100 km long. The team traveled both ways in pick-up trucks.

Dr. Baba had previously carried out some annual (year 2015 and 2016) geotechnical site inspections and at that time the project was in the process of its initial developments and start of export shipment. During this visit the mine production, crushing and hauling of crushed ore, and loading of crushed ore to ship were in full operation. Several ore shipments had already taken place since the beginning of this year's shipping activity.

1.1 Project Facilities

Mary River project is located on North Baffin Island, in the Qikiqtani Region of Nunavut. The Mine Site is located approximately 160 km south of Pond Inlet (Mittimatalik) and approximately 960 km northwest of Iqaluit. There are three main project locations consisting of the Mine Site, Milne Inlet Port Area (or simply 'Port Area', located north of the Mine Site), and Steensby Port (south of the Mine Site). Milne Port Area is connected to the Mine Site by a 100 km Tote Road. The current project approval also contains a 149 km railway that will eventually be constructed to connect Steensby Port to the Mine Site. At this time project is focussed on the Mine Site, Tote Road and Milne Port Site developments enabling BIMC to ship a nominal 4.2 Mtpa of ore. It is to be noted that the mine is operational and ore shipment is in its 4th year of operations and during the 2018 inspections ore was being hauled to the Milne Inlet Port site and was loaded onto an ore export ship. The Mine Site includes early exploration facilities, air strip, mining and crushing, main residential and maintenance complexes. The Milne Port Area includes the port, crushed ore-stockpile, fuel import and bulk storage system, maintenance facilities, residential and other general facilities.

In April, 2018 BIMC submitted a proposal to modify some aspects of the operations which are summarised below:

- Increase in iron ore production and transportation from 4.2 Million tonnes per year under the Early Revenue Phase of the Mary River Project to 12 Million tonnes per year via the northern transportation corridor.

- Construction and operation of a 110 km railway within the Mary River Transportation Corridor between the mine site and Milne Port, generally following the existing Tote Road. Once the railway is in place the Tote Road will remain operational, but its use by BIMC will drop substantially and will be limited to moving personnel and key goods.

- Expansion and improvement of the Milne Port facilities. A second ore dock to accommodate cape-sized vessels; a second ship loader, railway unloading and maintenance facilities, and additional support infrastructure will be developed in addition to an enclosed crushing facility.

- Modification of the shipping season. The ore shipping season is proposed to be from July 1 to November 15, but would be adapted annually in consultation with the Pond Inlet Hunters and Trapper Organization (HTO) based on ice conditions

and thickness. It is noted that winter sealift is not included in this proposal, because on October 24, 2017, due to concerns expressed by the communities regarding ice breaking, the proponent has removed the winter sealift component from the original application.

- Expansion of the existing accommodation camp at the Mine site.

These modifications are expected to result in amendments of the Type "A" Water Licence under which the project is currently operating. The amendment process has been initiated by BIMAC in October, 2018. The geotechnical inspections of the site also considered these proposed modifications as appropriate.

The weather during the field visit was favourable and the team was able to inspect most of the facilities. The detailed schedule of these inspections are presented in Appendix A and briefly summarised below:

Day 1: Mine Operations/Infrastructure – Crusher Pad Area (including its ditches and sediment pond); Polishing and Waste Stabilization Ponds (three PWSP); Hazardous Waste Storage and Environmental Containments Systems (a number of these facilities); Incinerator; Landfill; Sewage Effluent Discharge Point; Waste Rock Area (including Waste Rock Stockpile and its ditches, sediment pond, seepage ditches and ponds, water treatment facility and its associated sediment pond); Bulk Fuel Storage area; and water intake jetty.

Day 2: Tote Road and Milne Port Area: Tote Road (bridges, culverts, side slopes and ditches along the road); Ore Stockpile and its associated Run-off Collection ditches and Sedimentation Ponds (East Pond and West Pond); Polishing and Waste Stabilization Pond (PWSP); Fuel Tank Farm; Land Farm; Contaminated Snow Melt Pond; and New Laydown Area (including fuel service station).

These inspections were completed in accordance with the guidelines set out in the "*Dam Safety Guidelines 2007, Revised 2013*", published by the Canadian Dam Association (CDA). It is to be recognized here that the CDA Dam Safety Guidelines endorses risk-based approach to dam safety which includes traditional deterministic standards-based analysis as one of many considerations.

The observational approach has long been recognized as a key component of the performance monitoring process for earthworks, foundations and slopes. The review of design or as-built reports or operations manuals was not a part of the present mandate.

This review was based on visual inspections of the facilities and no instrumentation or monitoring data was reviewed. It is also worth noting here that this review was not a follow-up after any extreme event or a set milestone for the performance of the containments.

These inspections were based on walk-over visual inspections of each facility and recorded the following:

- Any signs of settlement or heave;
- Any signs of high water marks – flooding or overtopping of dam crests;
- Any signs of slope instability or loading distress;
- Any signs of creep or other mass movements;
- Any destabilizing signs, sinkholes, slumping, ruts or loss of material;
- Any evidence of piping or erosion features which may impact dam safety or stability;
- Any material de-solution feature both on embankment or subgrade or washouts; and
- Any other geo-hazard-related manifestation.

2.0 REPORT FINDINGS

2.1 2018 Inspections - General Remarks

For presenting the findings of these inspections, we have listed various project-wide facilities in the same order as the schedule for inspections allowed. Figures 1 to 4 describe the general situation with respect to Crusher Pad and its Ore Stockpile; Mine Waste Rock Storage Facility and its runoff/seepage collection ditches and pond; Milne Port area ore stockpiles; and typical secondary containment berms or dams for bulk fuel storage facility at Milne Port site. All of the water, fuel and other environmental liquid and solid hazardous waste containments at the site are lined with geo-membrane. The material used in the construction of these dams/embankments or berms are from local granular borrows. These granular materials hold less water and are less prone to degradation on freeze-thaw cycles. These materials have full gradation sizes from gravel to fine size and compact reasonably well with tracked or other appropriate machinery.

The dam/embankment or the berms as a structural unit are performing satisfactorily. The dam/embankment or berm slope profiles and the earthworks profile at the subgrade level are straight and smooth, thereby indicating no major degradation of either underlying permafrost or the earthworks construction (dikes, embankments, slopes and dams).

The observations from the walk-over inspections of each facility are described in detail in the following sections.

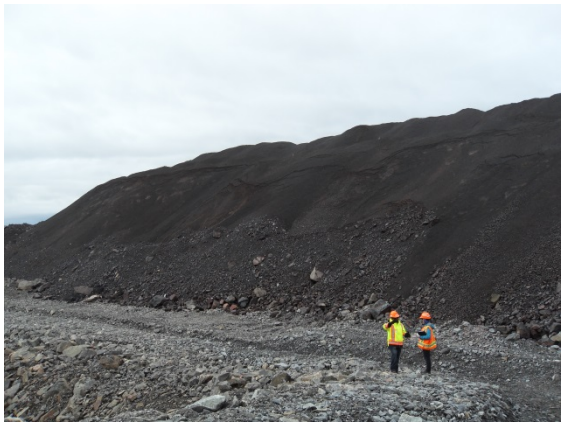

Figure 1: A view of the Crusher Pad and Ore Stockpile Expansion at Mine Site

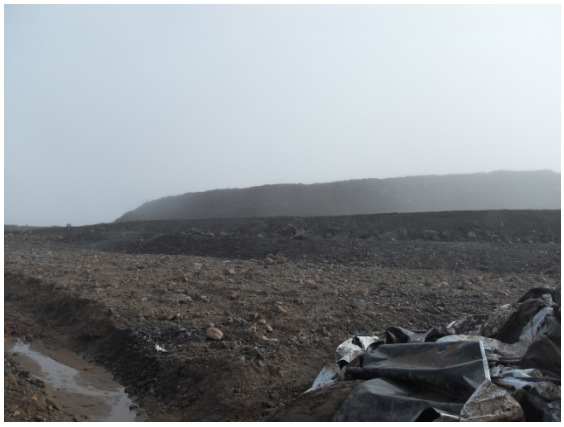

Figure 2: A view of the Mine Waste Rock Storage Facility at Mine Site and its associated Water Management Facilities

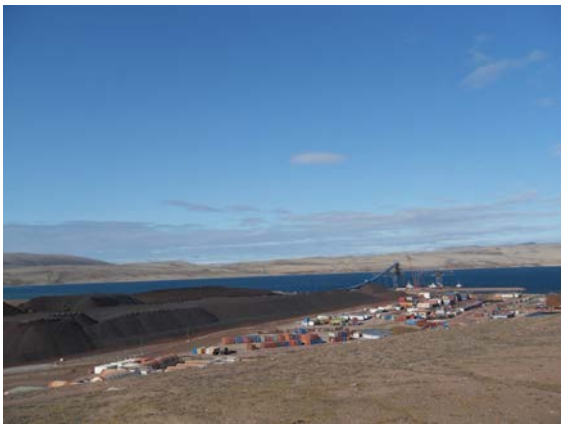

Figure 3: A view of the Milne Port Ore Stockpiles (ready for shipment) Area and its Vicinity

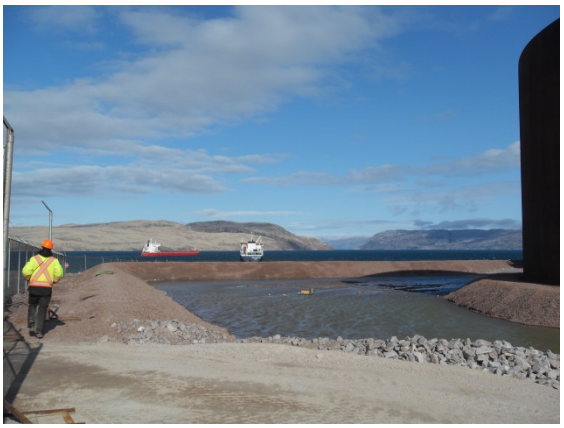

Figure 4: A view of the Milne Port Bulk Fuel Storage Facility's Secondary Containment Berm/Dam

2.2 Crusher Pad Area

The crusher pad, expanded crushed ore (products) storage, surface runoff drainage ditches/channels and its associated sediment control pond with its intake channel, emergency spillway were included in these inspections. Figure 1 shows a view of the crusher pad area, crushed ore stockpile, and its associated toe ditch/drain. Photo B1 - 1 shows the conditions associated with the base of pad post a recent rainfall event; Photo B1-2 shows its expansion in the vicinity of the existing natural drainage channel; Photos B1 - 3 & 4 show the expansion of the crushed ore stockpile and its associated toe ditch/drain; and Photos B1 - 5 & 6 show crusher pad area sedimentation/settling pond and its dam raising in progress. The following observations were noted:

- The pond dam raising was in progress at the time of the 2018 inspections– dam raising with granular material, liner extension was to follow.

- The visit coincided with rainfall season, local accumulation of mud or muddy surfaces were visible on the crusher pad (see Photo B1 - 1). A better material handling system is required or some local sumps on the pad should be considered to avoid the accumulation mud or muddy surfaces on the pad.

- A natural drainage channel runs along the crusher pad. The crusher pad expansion that is currently under way may be reaching the limits of the natural drainage channel. It is recommended that the natural drainage channel in this area be clearly demarcated so that encroachment, either through unplanned expansion or ore spillage, could be prevented.

- The crusher pad slopes along the flow path of the natural drainage channel should be constructed with considerations for flooding in the natural drainage channel and potential for erosion. The slopes should be constructed with coarser material and with appropriate placement and compaction considerations to slope instability and wash-out during an extreme flooding situation (see Photo B1 - 2).

- Adequacy of drainage ditches around the crusher pad should be examined (see Photos B1 – 3 & 4).

- The pond liner, embankment, intake and emergency spillway performance appeared satisfactory. There were no signs of any leakage around the perimeter embankment or overflow on embankment or any embankment instability or any weakness of the existing natural terrain in the pond vicinity. However, pond

capacity is being augmented with perimeter dam raising (See Photos B1 – 5 & 6).

2.3 Polishing and Waste Stabilization Ponds

Three (3) Polishing and Waste Stabilization Ponds (PWSP's) at the mine site were inspected. Photos B1 - 7 & 8 show the typical conditions associated with the exposed liner, high water levels and embankment conditions at these ponds. The following observations were noted:

- The performance of these ponds appears satisfactory. There were no signs of leakage around the perimeter embankments of these ponds or overflow on embankment or any embankment instability or ground instability in the vicinity. The exposed pond liners showed extensive wrinkles (see Phots B1 – 7 & 8). Although this may not be of any immediate concern, with consideration for long term performance it is recommended that a liner specialist advice should be sought since this liner is the only defence against leakage and no leak detection system is in place.

2.4 Hazardous Waste and Environmental Containment Systems

There are several hazardous waste and environmental containment systems at the mine site and some have been operational since the early exploration phase. Photos B1 - 9 & 10 show typical containment details. These are all geo-membrane lined facilities, with the liner on the base and extending on the perimeter berms. The berms and the cover on the geo-membrane are constructed with sand and gravel fill. Many of these facilities are drive-through facilities, allowing loaded vehicles to enter the containment to place waste. Drive-through access is allowed from one of the berms which have a lower crest for the drive-through section and a ramp on either side. There are no penetrations (i.e., for pipelines or cables or other services) through any of these facilities. Pipelines or cables or other services are run over the crest of the berms. All of these facilities are open facilities with no fence or access control. Access control is mainly through signs posted at some facilities. All of these facilities are located on relatively level platforms with no outside catchment draining into these containments. The following observations were noted:

- These facilities appear to perform satisfactory. There were no signs of any leakage around the perimeter berms of the facilities inspected.

- Most of these facilities are early facilities associated with exploration/early production phase. The hazardous waste containment requirements should be re-established and progressive closure of some of these earlier facilities and upgrading of the rest should be considered.

As a part of the hazardous waste and environmental containment systems inspections the incinerator facility was also inspected (interior floor surface and drains, sorting bins etc). At the time of these inspections incinerator was not operational.

2.5 Mine Site Landfill

The Mine Site Landfill is progressively reclaimed and covered. Photos B1 - 11 & 12 show typical progressive cover placement, the conditions of side slopes, and the general vicinity. It is understood that the project is planning to put a permanent metal fence around this facility to prevent blow-off of loose material from the site. The following observations are noted:

- The facility earthworks appear to perform satisfactory. There were no signs of any side slope or bearing capacity instability or leakage around the vicinity.

2.6 Sewage Effluent Discharge Point

The team drove to the effluent discharge point and inspected the discharge area. The pipeline runs parallel to the access road to the discharge point. Photos B1 - 13 & 14 show conditions at the discharge point and in its general vicinity. The following observations were noted:

- The road leading to the discharge point along with the pipeline appeared stable with no visible concerns of ground instability.
- The earthworks at the discharge station and the flow course emanating from the discharge point seem stable.
- Some local sloughing was observed in the vicinity of the discharge point. This requires attention before it potentially develops into a large slide.

2.7 Mine Waste Rock Area

The mine waste rock, its drainage ditches, sedimentation/settling pond, seepage collection area, water treatment facility and its associated polishing pond were included

in these inspections. Figure 2 shows a view of the Mine Waste Rock Storage Facility and its associated water management. Photos B1 - 15 & 16 show the conditions of the settling pond; Photos B1 - 17 & 1 8 show new water treatment facility; and Photos B1 - 19 & 20 show the polishing pond berm, liner and solids settling arrangement detail. The following observations were noted:

- The embankments associated with water ponds appeared structurally sound, showing no signs of any slope or basal instability. There were signs of erosion on slopes and some local ponding of water both on the upstream side, outside of the lined portion, and on the downstream side. The slopes should be maintained to the design profile and local drainage works should be carried out to minimize water accumulation at the unlined embankment slope toes to minimise the potential for weakening of the subgrade.

- Toe and downstream leakages were noted during the inspection in 2017 (Arcadis) which was noted to be an indication of poor performance of the lined pond. At the time of the 2018 inspection, pond level was maintained at low level. Some temporary secondary containment and pump back arrangements have also been installed here, however, we were not able to verify the quantities or the secondary containment and pump back details.

- Seepage water is recycled back to the pond.

- Water quality upsets have been noted in the past and a water treatment facility has been installed which was staffed and operational during the 2018 inspections.

- The engineer of record for this facility should be engaged to update geochemistry, water quality and leakage challenges in this area and provide some practical long-term sustainable measures for routing, storing and treating contact water.

- Drainage ditches alignment and profiles should be maintained and upgraded to the design alignment and profiles.

2.8 Mine Site Bulk Fuel Storage Facility

The mine site bulk fuel storage tank farm has four above grade tanks with a single secondary containment. The purpose of the secondary containment is to contain any accidental release/spillage from the primary containment without any release to the

environment and to allow time for cleanup operations. Photos B1 - 21 & 22 show the conditions of the secondary containment and its perimeter dikes. There were no penetrations through the containment dike systems. It appears all the piping, cables and other related service gear were mounted over the containment dikes. The following observations were noted:

- There were no signs of elevated water level or containment release or seepage around the perimeter embankment.
- There were no signs of perimeter embankment slopes instability or bearing capacity failure manifestations such as heaving of natural subgrade or irregular crest profile.

2.9 Raw Water Intake Jetty

Raw water intake jetty earthworks; and earthworks associated with check dams for runoff along the road to jetty were inspected. Photos B1 - 23 & 24 show the conditions of the earthworks associated with the jetty extending in to the lake, check dams and water ponds associated with surface runoff, and sediment control along the access road to jetty prior to release into the lake. The following observations are noted:

- There were no signs of any slope or bearing capacity or wave erosion instability of the earthworks.
- Drainage channels check dams and sedimentation ponds at the raw water intake jetty location have been upgraded and these appeared to be functioning well.

2.10 Tote Road

Due to limited time for these inspections only selected locations along the Tote Road representing typical bridge facility, drainage culvert crossing and haul road surface and side slope features were inspected. The inspection followed a recent rainfall event and rainfall season prior to our arrival at site. Photos B1 - 25 & 26 show the conditions at a bridge abutment (KM 97) and typical water course approach details; Photo B1- 27 & 28 show slope treatment with granular fill and rockfill buttress (KM 90); and Photos B1 - 29 & 30 show typical conditions associated culverts (drainage crossing), road surface and embankment slopes. The following observations were noted:

- Bridge abutments, foundations and other earthworks performances appeared satisfactory. Some signs of flood related erosion were noticeable at the bridge

located at KM 90, therefore, proper river training works on both sides immediately upstream (U/S) and downstream (D/S) of the bridge structure should be considered to prevent earthworks erosion and wash-outs. Similar river training works should be considered at other major bridge locations where there are signs of abutment erosion.

- The technique of using natural granular fill and rockfill buttresses (KM 90) seems to address the slope instability and erosion challenges through some cut areas along the Tote Road. This application should be considered at other potential vulnerable spots along the Tote Road.

- Culvert lengths both U/S and D/S are terminated almost within the embankment slopes, lengths appear to be short and the water-flows have the potential to accentuate erosion on the slopes in the vicinity of intake/exist of the culvert. This has potential to destabilise the road embankment and eventually may result in a washout. Extensions to culvert lengths with proper cover (forming road footprint like + shape) and proper drainage trainings works should be considered (see Photos B1 - 29 & 30).

- A surface geology map along the Tote Road footprint and its immediate vicinity should be prepared. This map should be updated with details such as the sections where slope stability concerns and locations with potential flow washouts are identified. This map should be updated with observations by an experienced geologist following his regular visit after every freshet and any major construction update. An observation approach and early attention to any slope instability and flow related washout is required.

2.11 Port Site Ore Stockpile Area

The Port Site Ore Stockpile Pad, its drainage ditches/channels, and its associated sediment control/settling ponds (East and West Ponds were inspected). Figure 4 shows a view of the ore stockpile area. Photos B1 - 31 & 32 show the conditions associated with the West Pond; and Photo B1 - 33 & 34 show the conditions associated with the East Pond. The following observations were noted:

- The liner, earthworks, intake and emergency spillways were completed for each pond and each pond was fully functional at the time of these inspections.

- The performance of these ponds appeared satisfactory. There were no signs of leakage around the perimeter embankments of these ponds, overflow on embankment, nor any embankment or ground instability in the vicinity.

2.12 Port Site Polishing and Waste Stabilization Pond

Polishing and Waste Stabilization Pond at the port site was inspected. Photos B1 - 35 & 36 show the typical conditions associated with the exposed liner, water levels and embankment conditions at this pond. The following observations were noted:

- The performance of this pond appears satisfactory. There were no signs of leakage around the perimeter embankments, overflow on embankment, nor any embankment instability or ground instability in the vicinity.

2.13 Port Site Bulk Fuel Storage Facility

Port site bulk fuel storage facility was inspected. A new pad for an additional tank has been completed which was also inspected. Photos B1 - 37 & 38 show the tank farm, the newly constructed foundation pad for an additional tank, secondary containment embankment and its vicinity. The following observations are noted:

- The earthworks for the new additional tank foundation pad appeared reasonably well compacted.

- The performance of the containment base and its perimeter embankment appeared satisfactory. There were no signs of leakage around the perimeter embankment or overflow on embankments or any embankment instability or ground instability in its vicinity.

2.14 Port Area Land Farm and Contaminated Snow Melt/Water Pond

The Land Farm and the contaminated Snow Melt/Water Pond are located at high ground at the port area. A new water treatment facility has been installed beside the pond and it was staffed and operational during the visit. Photos B1 – 39 & 40 show general conditions of the land farm containment system and its associated embankments, water collection system, contents and its immediate vicinity. Photo B1 – 41 shows general conditions of the water pond and its associated perimeter embankments. Photo B1 – 42 shows water treatment facilities located next to the pond in shipping container style housing. The following observations were noted:

- Land Farm facility perimeter embankment and liner performance appeared satisfactory and there were no signs of any instability or leakage through the embankments.

2.15 Port Site Laydown Area

Photos B1 – 43 & 44 show conditions of the newly developed laydown area and its associated surface runoff diversion ditches. The following observations were noted:

- The pad earthworks performance appeared satisfactory.
- By and large the diversion ditch looks to be performing satisfactorily with exception of a limited section in the east side of the development (See Photo B1 – 44) where some local sloughing and depression has developed. This could perhaps have resulted from washouts from local runoff and/or permafrost degradation. The presence of organic/peat or soft soils below the surface was noted. Repair to this section was noted and the degradation does not appear to be of a progressive nature; however, regular monitoring is warranted to rule out its progressive nature.

In the vicinity of the laydown area a fuel service station was also inspected. All earthworks in the area were found satisfactory and no abnormal signs associated with surface runoff erosion, slope instability or bearing capacity instability, were noticeable. It is a lined facility with side berms forming part of the containment. The profiles of the side berms were irregular and the vicinity of berms appeared poorly kept. The berms should be maintained to the design profile and its vicinity should be kept in good conditions.

3.0 COMMENTARY ON THE FINDINGS OF THE 2017 GEOTECHNICAL INSPECTIONS

As a part of 2018 Geotechnical inspection, a review of 2017 geotechnical inspections (Arcadis 2017) was carried out and the following main observations were noted:

3.1 Waste Rock Sedimentation Pond

Arcadis 2017 report indicated that the water in the Waste Rock Sedimentation pond was unexpectedly acidic, not fit for release to the environment, and was being treated before discharge. Arcadis 2017 also reported leakage through the pond liner, however no quantitative details were provided.

During this 2018 visit the water treatment facility was operating, the pond level was kept low, the seepage was pumped back to the pond, see Sec 2.7 above for further details on these observations and recommendation going forward.

3.2 Crusher Pad Sedimentation Pond

Arcadis 2017 reported some localised ground subsidence, along the crusher pad east ditch, leading to the drainage berm basal instability.

See Section 2.2, for the 2018 visit observations and recommendations. While the subsidence noted in the 2017 report has been treated, this stretch of the ditch is located along the natural drainage channel and does require a proper rip-rap to prevent future instability.

3.3 Milne Port -East Ore Pile Sedimentation Pond

Arcadis 2017 reported that the East Ore Pile Sedimentation pond is under-capacity, however no details or recommendations to its augmentation were provided.

BIMC's 2018 Phase 2 Development proposal includes update of the ore stockpile handling and augmentation of the east and west sedimentation pond facilities.

3.4 General

Arcadis 2017 raised some concerns about the potential of deterioration of the exposed (to the atmosphere) HDPE geomembrane (geosynthetic liner or simply liner) from ultraviolet light (UV) attack and also suggested using of white coloured liner.

It is preferred to cover the liners for UV protection. Liner performance is also dependent on bedding preparation and placement technique. Exposed liners on some of the earlier facilities, such as PWSP's at the mine site (refer to Section 2.3 above) have developed extensive wrinkles compared to more recent facilities where better bedding preparations, placement techniques and securing intimate contact have been used. White surfaces reflect the light and minimize heat absorption and thus reduce the thermal expansion/contraction of the liner. Hence minimize the potential for wrinkles. However where it is not possible to cover the liner due to field and/or other practical considerations, our opinion is that for items like these a liner specialist advice should be sought considering the application is located in arctic climate.

4.0 COMMENTARY ON BIMC'S 2018 MODIFICATION REQUESTS

As a part of the 2018 geotechnical inspection, a review of a number of modification requests was carried out and our commentary is provided below:

4.1 Crusher Pad Expansion and its Associated Storm-water Management Infrastructure

The BIMC's 2018 Work Plan included the expansion of Mine Site Crusher Pad area by 10% and updates associated with its storm-water management facilities including sedimentation pond (Modification Requests 1 and 5).

The expansion of the existing storm-water sedimentation pond included raising and widening the existing berm and liner, and updating spillway and associated structures. The expansion is designed to increase the pond capacity and the construction is carried out without disrupting the operation/ functionality of the existing facility.

CIRNAC has sought some clarifications with respect to the size of pad expansion and volume of pond expansion; and had questioned whether the recent site specific meteorological data gathered since 2013 has been used to update the hydrotechnical design criteria of ditches and pond.

SNC-Lavalin commentary on the proposed modification is provided below:

- We endorse the review comments by CIRNAC.
- No immediate geotechnical concerns with respect to structural stability of the berms were identified.
- The expected highest water level and flow along the natural drainage channel located NE-SW boundary of the Pond Berm should be established and documented and included in the design analysis and construction drawings.
- The pond storage capacity is significant and an unlikely event of its sudden release and its impact on infrastructure located downstream should be carried out. Remoteness of the site; time required for repairs; and climatic challenges should be considered with respect to disruptions to the mine operations.

4.2 Waste Rock Facility Sedimentation Pond

The BIM's 2018 Work Plan Modification Request 8 included the expansion of WRF footprint; management of PAG material placement within the WRF; and update to the

associated storm-water management system such as the ditches, berms and expansion of the sedimentation pond.

The proposed WRF Pond expansion involves the raising of the berm and expansion of the footprint to increase the pond capacity, construction of a new emergency spillway, two perimeter diversion ditches, and a culvert crossing for a road to access water treatment system pad.

CIRNAC has requested to identify the root cause(s) of seepage from waste WRF sedimentation pond; rational behind selecting the design parameters for slope stability analysis and update diversion ditch construction given the acidic nature of contact water.

SNC-Lavalin commentary on the proposed modification is provided below:

- We endorse the review comments by CIRNAC.

4.3 Milne Port Ore Stockpile Water Management Upgrades

The BIM's 2018 Work Plan Modification Request 9 included the expansion of the Ore Stockpile Pad and upgrades to its associated water ponds (Pond 1 and Pond 2). The upgrades include addition of two new lined compartments to the existing ponds and increasing the capacity of the Pond 2 by dam raising.

SNC-Lavalin commentary on the proposed modification is provided below:

- No immediate geotechnical concerns with respect to the planned berms were identified.

5.0 COMMENTARY ON NEW ORE DOCK AREA AT MILNE PORT

A drive through inspection of the Ore Dock area (existing and proposed new Ore Dock) showed no signs of any ground distress, coastal erosion or slope instability. Due to time constraints detailed walkovers of the existing dock structures/foundations or the area associated with the proposed new Ore Dock was not possible, nor were any over the water or underwater inspections carried out.

A review was done of proposed Phase 2 development marine facilities at the Milne Port site marine area including: Second Ore Dock – Cape-Size with its ship loader; Freight Dock; its associated new infrastructure; and relocation of some existing facilities such as treated sewage effluent discharge related documentation (Phase 2 Proposal – Knight

Piesold 2018). A review of the geophysical and geotechnical investigation data provided, and an overview of the proposed project execution plan was carried out.

SNC-Lavalin commentary on the proposed modification is provided below:

- This will be a larger facility compared to the existing facility.
- The investigation data presented included geophysical seismic surveys, sonic boreholes, piezocone penetration tests (CPT) and laboratory investigations.
- The nature of the investigation (geophysical, CPT, sonic boreholes) is appropriate and the number of boreholes and CPTu, and its depth range are reasonable for this facility and ground conditions encountered.
- The proposed construction plan of piling and earthworks for this development follows a proven method of dock construction.
- Some shallow seabed dredging of soft sediments is planned and alternative disposal methods were explained.
- Winter construction methodology (ice breaking) and earthworks construction plans were presented.

It is reported that significant ground ice was found in deep excavations near the new ore dock however none was reported in the marine boreholes. Geophysical investigation has interpreted bedrock elevation from approximately 90 m to 140 m below sea-level. The deepest borehole was about 42 m below seabed or the explored depth corresponds to an elevation of 60 m below sea-level. Therefore sand and silt material may continue beyond the explored depth to bedrock. If the permafrost is deeper and located within the bedrock, it is likely to have minimal impact on the dock facility. However, if it is within the overburden it has the potential for sea bed slope creep. If the overburden within the permafrost interface happens to be silt, it has potential for loss of strength upon melting (seabed warming – climate change) which may cause slope instability. The depth of permafrost should be established in the Ore Dock area. Liquefaction analysis, seabed slope stability analysis, and scour protection details should be included in the detailed design for this facility.

6.0 CONCLUSIONS & RECOMMENDATIONS

1) In general there has been noticeable project-wide improvement in housekeeping since our last visit in 2016; intake and emergency spillway profiles and arrangements, securing of exposed water pond liners.

2) The hydrology design of ditches and ponds should be verified by the Engineer of Record for these facilities utilizing the site specific data accumulated over the present times and the capacities augmented if required to be consistent with the current design requirements.

3) The existing configurations of the natural water channel along the Crusher Pad Area should be maintained and its slopes should be constructed to withstand an extreme flooding situation.

4) Most of the hazardous waste containment facilities are early facilities associated with exploration/early production phase. The hazardous waste containment requirements should be re-established and progressive closure of some of these earlier facilities and upgrading of the rest should be considered.

5) The engineer on record for Waste Rock Storage Facility and its associated water management should be engaged to update geochemistry, water quality, pond leakage and water treatment challenges for this facility and to provide some practical long-term sustainable measures.

6) Drainage ditches should be progressed to final configurations at Mine Waste Rock Storage Area and Port Site Crushed Ore Stockpile Pad Area and the ditches profiles and alignments should be maintained to prevent spills and washouts.

7) On Tote Road, proper river trainings works (graded granular fill) at major bridge locations on both sides of each abutment, immediately upstream (U/S) and downstream (D/S) of the bridge structure, should be considered to prevent earthworks erosion and wash-outs.

8) On Tote Road, some culvert lengths both U/S and D/S terminate almost within the embankment slopes, lengths appear to be short and the water-flows accentuating erosion on the slopes which has potential to destabilise the road embankment and eventually result in a washout. Extensions to culvert lengths with proper cover (forming road footprint like + shape) and proper drainage trainings works should be considered.

9) All of these geotechnical facilities associated with water licensing should be inspected and maintained as part of BIMC's regular inspections and monitoring program.

7.0 REFRENCES

1. Canadian Dam Association, CDA 2013. Dan Safety Guidelines 2007. Revised Edition 2013.
2. Arcadis 2017. Geotechnical Inspections Report, Mary River Mine, dated September 15, 2017.
3. Knight Piesold 2018. Baffinland Iron Mines Corporation, Mary River Project – Phase 2 Proposal, dated August 10, 2018.
4. Modification No. 5 Mine Site Crusher Pad Sediment Pond Expansion for Water Licence 2AM-MRY1325 – Amend. No. 1, Baffinland Iron Mines Corporation, May 25th, 2018.
5. 2018 Mine Site Crusher Pad Expansion (Modification Request No.1) for Water Licence 2AM-MRY1325 – Amend. No. 1, Baffinland Iron Mines Corporation, May 29th, 2018
6. Modification No. 8 Waste Rock Facility Pond for Water Licence 2AM-MRY1325 – Amend. No. 1, Baffinland Iron Mines Corporation, June 26th, 2018.
7. BIMC - INAC Inspection Report, May 16-18th, 2018

END OF DOCUMENT

Appendix A – SCHEDULE OF INSPECTIONS

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)
658342: Marry River Project – Annual Geotechnical Site Inspections (2018)
Hafeez Baba
Inspections Schedule
Schedule

Date/2018	Travel/Accommodation Details
Aug 19/Sun	Travel to Clyde River: Air Canada AC 0440 Toronto - Ottawa (7:10 am – 8:14 am) First Air 7F 0860 Ottawa – Iqaluit (9:15 AM- 12:25 pm) Met with CIRNAC Team at Iqaluit Airport Wajid Daouda and Bridget Campbell (We met Jonathan Mesher at site) First Air 7F 0886 Iqaluit – Clyde River (13:15 AM- 15:15 pm) Check In at Hotel Naujaaraaluit (for Sunday night) Discussions with CIRNAC Team and Planning for Inspections
Aug 20/Mon	Travel to Mary River: Standby for weather advisory 5pm flight cancelled. New expected time of departure tomorrow at 3PM
Aug 21/Tue	Check out and travel to airport 2:30 PM at Clyde River Airport
Aug 21/Tue	Arrive at site 4:00 PM Mine Orientation 5:30 PM Meeting with Baffinland Staff and planning for inspections
August 22/Wed	Site Inspections AM: Crusher pad and vicinity PM: Waste Rock and mine area.
August 23/Thu	Site Inspections Tote Road and Milne Port
Aug 23/Thu	PM Checkout Mine Camp and Fly to Iqaluit (Mine Chartered Flight) PM Check in at Frobisher Inc. (Night Stay)
Aug 24 /Fri	Check out and drive to Iqaluit Airport 7F 0861 Iqaluit – Ottawa (1:45pm – 4:50 pm) AC 0465 Ottawa – Toronto (8:00 pm)