CLIENT: Indigenous and Northern Affairs Canada (INAC)

PROJECT: Mary River Project – Annual Geotechnical Site Inspection (2016)

		SIGNATURE	DATE
PREPARED BY : (Geotechnical Engineer)	Hafeez Baba		2016-09-22
REVIEWED BY : (Environmental Engineer)	Mart Lupp		2016-09-22
APPROVED BY: (Project Manager)	Mart Lupp		2016-09-22

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1.0 INTRODUCTION

This report presents the main findings of the annual (year 2016) geotechnical site inspections carried out during July 27 to August 3, 2016. The inspection was based on walk-over visual inspection of the facilities associated with water licensing, for details refer to Appendix A - Schedule of Inspection. Appendix B presents a selected photo collage of the inspections.

SNC-Lavalin Inc. (SLI) is assisting Indigenous and Northern Affairs Canada (INAC) in a third-party site inspection of the Mary River Project operated by the Baffinland Iron Mines Corporation (BIMC). BIMC, as a part of water licence compliance, is required to carry out annual geotechnical inspection of the project facilities – earth works as well as water-related site works. SLI's site inspection is independent of BIMC's annual geotechnical inspection.

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

This geotechnical site inspection was carried out by Hafeez Baba, Ph.D., P. Eng. Senior Geotechnical Engineer at SLI. During this visit, Dr. Baba was accompanied by Mr. Scott Burgess, P. Geo – Manager, Mary River Project, Mr. Michael Brown – Project Officer and Mr. Jonathan Mesher – Water Resources Officer at INAC. BIMC's geotechnical engineering consultant Mr. Barry Martin, P. Eng. (Consultant to BIMC) also attended most of the inspections at the Mine, Mine Operations Facilities and Infrastructure, Tote Road and Milne Inlet Port site. This visit was facilitated by BIMC's - Environmental Manager, Mr. Allan Knight whose designated staff also attended most of the above inspections. The team was further assisted by BIMC's Environment Coordinator Mr. Ali Williams and Environment Advisor Mr. Bill Bowden.

Mine Site to Milne Port Site, the Tote Road is about 100 km long and the team traveled both ways in pick-up trucks. Mine to Steensby Port site of the project was not visited this time.

Dr. Baba also carried out the previous annual (year 2015) geotechnical site inspection and at that time the project was in the process of loading its first ore export shipment. During the current visit the mine production, crushing and hauling of crushed ore, and loading of crushed ore to ship were in operation. Several ore shipments have already

taken place since the beginning of this year's shipping activity. The visit also coincided with an annual rainfall event and that provided an opportunity to witness the operation and performance of surface water runoff management systems, and erosion and sediment control measures in place along the Mine Haul Road and Tote Road.

At the close of inspection, inspection findings were briefly presented to and discussed with BIMC's Operations and Environment Executives.

1.1 PROJECT FACILITIES

Mary River project is located on North Baffin Island, in the Qikiqtani Region of Nunavut. There are three main project locations consisting of the Mine Site, the Port Site (located north of the Mine Site), and the Steensby Port (south of the Mine Site). The Port Site is connected to the Mine Site by a 100 km Tote Road. A 149 km railway will eventually be constructed to connect Steensby Port to the Mine Site. The Mine Site is located approximately 160 km south of Pond Inlet (Mittimatalik) and approximately 960 km northwest of Iqaluit. The current phase of the project is focussed on the Mine Site, Tote Road and Port Site developments enabling BIMC to ship a nominal 3.5 Mtpa of ore. BIMC is also looking at a rail corridor to the port site. At a latter phase Steensby Port facilities will be completed and connected by railway to the Mine Site enabling BIMC to ship an additional 18 Mtpa by rail with a year round operational port. The locations of the main project facilities are shown in Figure 1. It is to be noted that the mine is operational and ore shipment is in its 2nd year of operations. During this inspection ore was being hauled to the Milne Inlet Port site, and ore was also being loaded onto an ore export ship. The Mine Site includes early exploration facilities, air strip, mining and crushing, residential and maintenance complexes. The Milne Port Site includes the port, crushed ore-stockpile, fuel import and bulk storage system, maintenance facilities, residential and other general facilities.

Figure 1: The Location of Mine Site, Milne Port Site and Steensby Port Site

In spite of some heavy rains, the logistics and access conditions were favourable to inspect most of the facilities planned for this visit. The detailed schedule of this inspection is presented in Appendix A and briefly summarised below:

Day 1: Mine Operations/Infrastructure – Bulk Fuel Storage Tank Farm Containment, Quarry, Jet Fuel (2 doubled walled bulk tanks) Containment, Hazardous Waste Storage Containments; a number of Environmental Storage Containments, Polishing and Waste Stabilization Ponds (PWSP), Mine Haul Road, Mine Waste Rock Storage, Mine Waste Rock Storage Run-off Collection and Sedimentation Pond, Mine, Crusher Pad, Crusher Area Run-off Collection and Sedimentation Pond and Land Fill.

Day 2: Open Burn Site, Tote Road to KM 50 (bridges, culverts, ditches and major ground disturbance/ slope issue area).

Day 3: Milne Port Site including: Hazardous Waste and Environmental Storage Berms, Ore Stockpile, and its associated Run-off Collection and Sedimentation Ditches and Ponds (East Pond and West Pond), Polishing and Waste Stabilization Pond (PWSP), Fuel Tank Farm, Land Farm, Contaminated Snow Melt Pond, Quarry and Salt Storage Area.

Day 4: Camp Lake Tributary, Water Intake Jetty Area, Airstrip Run-off Collection and Sedimentation Pond, Treated Sewage Discharge Point, Magazine Area, Mine Waste Rock Storage Area Discharge Point, Sewage and Water Treatment Plants, Residential General Area.

Day 5: Weather- heavy rain, Mine Haul Road and Tote Road to KM 68.

Day 6: Rain all day, organise inspection photo album and meeting with BIMC Environment and Operations executives presenting an overview of Inspection Findings.

1.2 NATURE OF INSPECTIONS

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 inspection of the facilities and no instrumentation, or monitoring data was available or 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 inspection of each facility and recorded the following:

- Any signs of settlement or heave;
- Flooding water level marks;

- 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/dike 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 General

For presenting the findings of this inspection, we have listed various project-wide facilities in the following major groups based on their common geotechnical nature and potential impacts to the environment:

- Bulk Fuel Storage Secondary Containments;
- Major Water Ponds;
- Hazardous Waste and Environmental Containments;
- Mine Haul Road and Tote Road; and
- Other Facilities

Figures 2 to 5 describe the general situation with respect to earthwork and its long term performance and performance during an annual rainfall event. All of the liquid and solid hazardous waste containments at the site are lined with geo-membrane. The material used in the construction of these embankments or berms or dikes 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 embankment or the berms, as a structural unit, are performing satisfactorily. The 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).

Figure 2: A View of the Port Site Bulk Fuel Tank Farm Secondary Containment Dike Earthworks

Figure 3: A View of the Mine Site PWSP Pond Liner, Embankment Earthworks and its Immediate Vicinity

Figure 4: A View of the Mine Site Hazardous Waste Containment Dike Earthworks, Access Arrangements and General Vicinity

Figure 5: A View of the Mine Haul Road Surface Conditions and Side Drainage Arrangements During an Annual Rainfall Event

Hence, the majority of the earthworks at the project site both at the Mine Site and at the Milne Port Site have performed satisfactorily and there were no indication of slope

instability, bearing capacity failure or excessive settlement observed at these earth works. The geo-membrane performance also appeared satisfactory as there was no indication of seepage or wetness outside of these containments. The observations from the walk-over inspection of each facility are described in detail in the following sections.

2.2 Bulk Fuel Storage Secondary Containments

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. There are three main bulk fuel storage facilities at the site namely:

- Mine Site Bulk Fuel Storage Facility;
- Mine Site Jet Fuel Storage Facility; and
- Milne Inlet Port Site Bulk Fuel Storage Facility.

The re-fuelling module, at the Port Site was not operational during this visit but may be grouped under this heading during the next inspection. Figures 6 and 7 show the secondary containment details such as: containment floors, containment dikes, tank foundations, interior pipelines and other operational ancillaries, and fence where applicable. The secondary containment is made up of, primarily, geo-membrane liner both on the containment floor up to and extending over the dikes. The dikes and the cover on the geo-membrane are constructed with sand and gravel and with granular fill as slope protection or wind/rain erosion protection. There were no penetrations through the containment dike systems, it appears all the piping, cables and other related service gear is mounted over the containment dikes. Both the mine site facilities are open facilities while the facility at Milne Inlet Port Site is fenced and locked. Each of these three facilities are located on an isolated spot with no outside catchment draining into these secondary containment areas, therefore servicing exclusively as its own catchment. Further, the three facilities are not located along any drainage paths; hence there is little potential for washouts during any significant runoff events.

The sumps/pumps for disposal of rainwater or snow melt water accumulated with the secondary containments for the bulk fuel storage facilities at the Mine Site and the Port Site should be checked by the Engineer-of-Record for these two facilities to ensure these are appropriately located and operational, and do not undermine the secondary containment capacities in case of accumulation of rain/snow melt.

Figure 6: A View of the Milne Inlet Port Site Bulk Fuel Storage Tank Farm

Figure 7: A View of the Mine Site Bulk Fuel Storage Tank Farm

All of the Tank Farms at site are above ground and were accessible for visual inspection. From the discussions with BIMC representatives it is understood that the minimum capacities of these secondary containments are based on one full tank (largest) plus 10% of the containment (aggregate), however, we did not assess the secondary containment capacities. There was adequate clearance at each of the Tank Farms from the surrounding facilities, and containments were clear and open and not used for any other storage. Inspection observations are further described below for each facility.

2.2.1 Mine Site Bulk Fuel Storage Facility

The Mine Site Bulk Fuel Storage Facility is a single containment for a group of 4 tanks. The containment was partially wet with some localised water collection (See Photos B – 1 and 2). There was no indication of any overflow or of highest water level marks reaching its top. No structural weakness of the containment or any ground weakness within the containment or its vicinity was noted. There were no signs of any seepage on the sides or immediate vicinity. The tank farm appeared stable.

2.2.2 Mine Site Jet Fuel Storage Facility

The Mine Site Jet Fuel Storage Facility is a single containment for a group of 2 tanks; a relatively small facility (See Photos B – 3 and 4). The containment was partially wet but there were no indications of any overflow or of the highest water level marks reaching its top. There was no evidence of any structural weakness of the containment or any

ground weakness within the containment or its vicinity. There were no signs of any seepage on the sides or immediate vicinity. The Tank Farm appeared stable.

There were vehicle tracks inside the containment but it was not evident if these tracks would have resulted in any damage to the liner. The facility should be sign posted as to what can and cannot be allowed to operate within the facility or possibly fenced for controlled access. In general, the dike profiles require wind/rain erosion protection and maintenance.

2.2.3 Milne Inlet Port Site Bulk Fuel Storage Facility

This is the largest fuel storage facility at the site, with a total of 8 small to large diameter tanks within a single containment (See Photos B – 5 and 6). The containment was partially wet with rain water collected in several locations. There were no indications of any overflow or of highest water level marks reaching its top. There were no signs of any structural weakness of the containment or any ground weakness within the containment or its vicinity. There were no signs of any seepage on the sides or immediate vicinity. The Tank Farm appeared stable.

Some minor pipeline supports appeared stressed and some foundations were exposed. The Engineer-of-Record for this facility should inspect these supports and comment on their stability.

2.3 Major Water Ponds

This section lists relatively large-size water holding ponds on the project site which are primarily grouped into two main types, namely:

- PWSP Ponds (Polishing and Waste Stabilization Ponds); and
- Runoff Collection Sediment/Settling Ponds.

There are three PWSP ponds (Ponds 1, 2 and 3) at the general Mine Site (See Photo B – 7 for pond layout and designations) and one PWSP at the Milne Inlet Port Site. These are historically old facilities and were associated with the exploration phase of the project, and currently serve as emergency holding ponds should problems arise which prevent discharge of treated effluent to the receiving environment. Runoff collection sedimentation ponds are newer facilities and are associated with production/operation phase of the project located at the ore crushing pad at the Mine Site and the crushed ore-stockpile area at the Milne Inlet Port Site, and more recently an upgraded

Sediment/Settling pond associated with the Waste-rock Stockpile near the mine. Ponds associated with the ore and waste-rock stockpiles are relatively large in size compared with other water holding ponds at the site. All of these water holding ponds are holding water unsuitable for release to environment having either high total suspended solids (TSS) or unsuitable chemistry or both. The ponds are designed to allow time for settling/sedimentation, or polishing for chemical stabilization, or the addition of stabilizing agents for sedimentation and/or polishing before release to environment.

All of these ponds are primary containments made up of, primarily, geo-membrane liner both on the base, up to and extending over the crest of the dikes. The dikes and the limited cover on the geo-membrane (at edges) are constructed with sand and gravel and with granular fill as slope protection or wind/rain erosion protection. There were no penetrations through the containment dike systems for inflow or discharge or for any other purposes. Penetrations through dikes are usually considered as weakness in secondary containment system and hence require extra care and maintenance during operations. For PWSPs, the flows both in and out are through over-the-crest pipelines with pumps. For ore/waste-rock stockpiles runoff ponds, the runoff is directed through ditches by gravity into the ponds through selected inlet location(s) and the discharge from these ponds is through pumping systems. Emergency spillways are also provided, made up with a localised depression in the liner system, as a safety measure.

The PWSPs have no outside catchment runoff coming in, while ore/waste-rock stockpiles associated ponds are receiving direct general area runoff and are, therefore, located at the lowest elevation in their respective catchment areas. Thus, during any significant rainfall event, or runoff event, the potential for a washout situation is remote for the PWSP ponds. However there is a potential for washout for the ore/waste-rock associated ponds during any challenges with surface runoff management; see Figures 8 to 11 for pond details. There is also potential for local washout along the downstream flow pathways from any potential accidental breaches.

Figure 8: A View of the PWSP Ponds 2 and 3 at Mine Site

Figure 9: A View of the Crushed Ore Stockpile Pond at Milne Inlet Port Site

Figure 10: A View of the PWSP Pond at Port Site

Figure 11: A View of the Ore Crushing Settling Pond at Mine Site

Inspection observations are further described below for each facility.

2.3.1 PWSP Ponds at the Mine Site

Photos B - 8 to 13 show general conditions of PWSP pond liner, dikes, and their immediate vicinity. The liner and embankment performance appears satisfactory. There is no indication of any overflow or of highest water level marks reaching to its top. No structural weakness of the containment or any ground weakness within the containment

or its vicinity was noted. There were no signs of any seepage on the sides or immediate vicinity. The following suggestions are made:

- A general housekeeping up-keep of the PWSP area;
- Air bubble exposures in the liner system need to be addressed during a drain-out phase; and
- General maintenance of the pond embankment profiles to their design profiles.

2.3.2 PWSP Ponds at Milne Inlet Port Site

Photos B - 14 and 15 show general conditions of the Port Site PWSP pond liner, dikes and their immediate vicinity. The liner and embankment performance appears satisfactory. There is no indication of any overflow or of the highest water level marks reaching its top. No structural weakness of the containment or any ground weakness within the containment or its vicinity was noted. There were no signs of any seepage on the sides or immediate vicinity.

2.3.3 Ore Crusher Pad Sedimentation Pond

Photos B- 16 and 17 show general conditions of the mine site ore crusher pad drainage systems and associated pond liner, dikes, its erosion protection, spillway and its immediate vicinity. The liner and embankment performance appears satisfactory. There is no indication of any overflow or of the highest water level marks reaching its top. No structural weakness of the containment or any ground weakness within the containment or its vicinity was noted. There were no signs of any seepage on the sides or in the immediate vicinity. Several improvements from the previous inspection were noted such as:

- Dike erosion protection provided along one of its sides which followed a natural drainage path;
- Emergency spillway upgrades; and
- General repairs to liner.

2.3.4 Ore Stockpile Sedimentation Ponds (East and West)

Photos B- 18 to 21 show general conditions of the Port Site ore stockpile east and west pond's liners, drainage ditches, dikes, inlets, spillway and their immediate vicinity. The

liner and embankment performance appears satisfactory. There are no indications of any overflow or of the highest water level marks reaching its top. No structural weakness of the containment or any ground weakness within the containment or in the immediate vicinity was noted. There were no signs of any seepage on the sides or in the immediate vicinity. Several improvements from the previous inspection were noted such as:

- Ballast over the liner; and
- Anchorage of the liner.

The following suggestions are made:

- There is a need to upgrade the inlet facilities at both of these ponds;
- There is a need for installing trash racks at the inlets to prevent boulders and other undesirable material entering into the ponds and potentially damaging the liner and other components through rubbing action;
- Downstream areas of the spillway should be configured and provided with erosion protection;
- Ponds should be clearly identified and posted to restrict any unauthorized access, and no temporary construction should be allowed in their immediate vicinity to prevent accidental falling of objects over the liner or welding sparks damaging the liner given the liner is exposed and uncovered.
- There is a general need for effective surface water management in the whole Port Site and particularly in the immediate vicinity of these two ponds so as not to allow localised water accumulation and seepage resulting in localised ground settling/sloughing which may lead to localised destabilisation of pond dikes.

2.3.5 Mine Waste-rock Sedimentation Pond

Photos B - 22 and 23 show general conditions of mine waste-rock pond and its drainage systems and associated pond liner, dikes, pumping system and the immediate vicinity. The liner and embankment performance appears satisfactory. There are no indications of any overflow or of the highest water level marks reaching its top. No structural weakness of the containment or any ground weakness within the containment or its vicinity was noted. There were no signs of any seepage on the sides or in the immediate vicinity.

This facility is relatively new and therefore should be monitored regularly for any potential degradation of the underlying permafrost and its manifestation on the functioning of liner system. This may also manifest in opening up seepage pathways facilitating seepage underneath the pond.

2.4 Hazardous Waste and Environmental Containment Systems

There are several hazardous waste and environmental containment systems at the project site and some have been operational since the early exploration phase. Figures 12 and 13 show some typical containment details. These are all geo-membrane lined facilities, with the liner both on the base, up to and extending over the crest of the perimeter dikes. The dikes 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 the waste. Drive-through access is allowed from one of the dikes which has 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, these services are typically run over the crest of the dikes. All of these facilities are open facilities with no fence or access control. Access control is mainly through signs posted at some facilities, though several signs had fallen over. All of these facilities are located on relatively level platforms with no outside catchment draining into these containments.

Figure 12: A View of the Hazardous/Environmental Waste Containment at Mine Site

Figure 13: A View of the Hazardous/Environmental Waste Containment at Milne Inlet Port Site

The following general inspection observations compared with last year inspection are noted as follows:

- There has been general improvement in house-keeping around these facilities;
- Most of the containment dike profiles were in better shape;
- Some containments were sign-posted to prevent traffic movements over the berms.

Further observations specific to each facility or a group of facilities are presented below:

2.4.1 Mine Site Hazardous Waste Containment

Photos B - 24 and 25 show general and typical conditions of the hazardous waste containment system at the mine site and its associated dikes, its immediate vicinity and contents. There were no signs of any instability or leakages. The following suggestions are made with respect to the mine site hazardous waste containment systems:

- The dike profiles should be upgraded and maintained;
- Sign posts should be further upgraded to allow restricted or control access to these sites and the nature of contents to be placed in each containment;
- The hazardous waste containment requirements should be re-established; progressive closure of earlier facilities should be considered; and as per the present and future needs, upgrading of some selected facilities should be considered.

2.4.2 Mine Site Environmental Storage Containments

Several containments were inspected, including solid waste and oily water containments. Some selected photos show the general conditions within each containment and its immediate vicinity (See Photos B - 26 to 31). Dikes and the containments were stable and there were no signs of leakages outside the containments. The following general recommendations are made:

- The dike profiles should be upgraded and maintained;
- Sign posts should be further upgraded to allow restricted or control access to these sites;

- The environmental waste containment requirements should be re-established; progressive closure of earlier facilities should be considered; and as per the present and future needs, upgrading of some selected facilities should be considered.

2.4.3 Port Site Hazardous Waste Containment

Photos B - 32 and 33 show general and typical conditions of the hazardous waste containment systems at the Port Site and its associated dikes, its immediate vicinity, collection pond, access arrangements, control signs and contents. Dikes and the containments were stable and there were no signs of leakages outside the containments. The following general recommendations are made:

- The dike profiles should be upgraded and maintained;
- Sign posts should be further upgraded to allow restricted or control access to these sites;
- Port Site hazardous waste containment requirements should be re-established; progressive closure of earlier facilities should be considered; and as per the present and future needs, upgrading of some selected facilities should be considered.

2.4.4 Port Site Environmental Storage Containments

Photos B - 34 and 35 show general and typical conditions of the environmental waste containment systems at the Port Site, its associated dikes and its immediate vicinity. Several storages were inspected but no issues were identified with respect to geotechnical stability or leakage.

2.4.5 Port Site Land Farm and Snow Melt Pond

Photos B - 36 and 37 show general conditions of the land farm containment system at the Port Site and its associated dikes, water collection system, contents and the immediate vicinity. Dike and liner performance appeared satisfactory and there were no signs of any instability or leakage through the berms. The land farm appeared like a land fill with no control on the contents being delivered to the site.

The Snow Melt pond adjacent to the land farm appeared to be performing satisfactory.

The following general recommendations are made:

- Sign posts should be further upgraded to allow restricted or control access to these sites;
- The contents which cannot be processed at the land farm site should be removed and the facility should not be used as storage other than for the soil contaminated with hydrocarbon related spills.

2.5 Mine Haul Road and Tote Road

During this inspection there was continuous rain for a few days. The Mine Haul Road and Tote Road were inspected prior to the rainfall event and during the rainfall event (at the time of peak flows) to observe the operation and performance of surface water runoff management systems, and erosion and sediment control measures/facilities such as drainage ditches, check dams and culverts, sedimentation ponds and silt fences.

In general the ditches, culverts, check dams and runoff collection/ sedimentation control ponds, silt fences along the disturbed drainage areas and mine hill side slopes all along the Mine Haul Road appeared functional (See Figures 14 and 15). However, there are limited sections of the Haul Road where soil conditions are prone to excessive sediment load, particularly the upper reach areas where the flow was laden with clay/silt (red colouration). Some drainage sections were not functional resulting in flows over the Haul Road, deterioration of the road surface, and disruption to hauling operations.

It is recommended that a senior geotechnical engineer should do a walk-over survey of the Mine Haul Road and map the geology of the area and identify areas which are more prone to silt loading and where a closely-spaced series of check dams and sedimentation ponds may be required to prevent silt load flowing over the mountain slopes. A hydraulic engineer should check the adequacy of drainage measures along the Haul Road so that water does not accumulate and saturate the berms or slopes and result in sloughing. This will also prevent disruptions to the hauling operations. Both these experts should also ensure that Haul Road profile and drainage profiles are maintained to the design grades to ensure smooth runoff.

Photos B - 38 and 39 show general and typical Mine Haul Road conditions during this rain event and the surface runoff conditions at the confluence with the Mary River tributary at the base of the hill.

During this inspection of Tote Road prior to the rainfall event, the generation of road dust appeared to be under control with application of water, and/or calcium chloride (salt) on the road surface. In general the road surfaces, ditches, culverts and sedimentation control ponds, silt fences along the disturbed drainage areas and the side slopes all along the road appear relatively functional (See Figures 16 and 17). At KM 90.5, there is a localised instability of the hill slope (See Figure 16).

Figure 14: A View of the Drainage and Culvert Along a Section of the Haul Road

Figure 15: A View of the Drainage Along the Berm Side of Mine Haul Road

Figure 16: A View of a Problematic Section of the Tote Road. Ground sloughing – Sand/Silt Deposit with Steep Slopes

Figure 17: A View of a Typical Drainage Crossing Along the Tote Road (Soon After a Rainfall Event)

The material at KM 90.5 there appeared be sandy deposits which soften on saturation and result in instability. However, no major siltation issues were identified at this location. There are some localised sections along the road where perhaps soil conditions are prone to sloughing on excessive wetness and could result in silt loading to drainages; these would need more attention than other areas both for maintenance and engineering for a permanent solution.

It is recommended that a senior geotechnical engineer should do a walk-over survey of the Tote Road and map the geology of the area and identify areas which are more prone to sloughing and silt loading and provide a closely spaced series of check dams; reinforcement of side slopes and upgraded surface water management.

The bridges and their abutments and associated watercourses appeared stable. Further, it appears the road is being upgraded and the culvers at certain locations would also require upgrading to align with the upgraded road width.

Photos B- 40 and 41 show general and typical Tote Road surface conditions during this rainfall event and condition of surface runoff along the drainage tributary at the culvert crossings.

2.6 Other Facilities

A number of other facilities at the general Mine Site, Port Site and along the Tote Road and Mine Haul Road were also inspected during this visit. Some of these are listed in the schedule of daily activities and only a selected few are described here.

2.6.1 Mine Site Landfill and Land Farm

No issues were identified with Mine Site Landfill and the work on the Mine Site Land Farm has not started yet.

2.6.2 Raw Water Intake Jetty

The drainage, check dam and sedimentation ponds at the raw water intake jetty location have been upgraded; these appeared to be functioning well. The jetty head has eroded from wave action/erosion and requires upgraded wave/erosion protection for long term stability (See Photo B - 42). It is understood the same is in planning and will be installed soon.

2.6.3 Sewage Effluent Discharge Point

The effluent discharge point for the Mine Site, and the road leading to it along with the pipelines appeared stable with no visible concerns. Some local sloughing was observed in the vicinity of the discharge point. This requires attention before it potentially develops into a large slide (See Photo B – 43).

The waste-rock pond discharge line and discharge point was also inspected but no issues were identified.

2.6.4 Magazine Off Road Settling Pond

Photos B – 44 and 45 show the conditions of the settling pond prior to the rainfall event and during the rainfall event. This pond captures runoff from a large disturbed mine hill slope. It is understood that BIMC is experimenting with some flocculants to enhance settling (see some equipment on the pond dike). However, this experimentation was not in operation during this visit nor were any details or results of this experimentation provided. It does appear that there is a need to facilitate settling with chemical agents during a rainfall event and also a need for better sediment controls through the early stages of runoff.

2.6.5 Rock Quarries and Granular Borrows

Rock quarries and granular borrows at the Mine Site, Port Site and some along the Tote Road were also inspected. During the inspection none of these were in active operations. No major issues were identified.

2.6.6 General Mine Site, Port Site and Service Areas along the Mine Haul and Tote Road

General areas at the Mine Site including residential, Weatherhaven camp area, immediate watershed areas; general areas at the Port Site including residential, maintenance, salt storage, fuel re-filling station; and along the road including bridge locations, culverts, radio towers, maintenance areas, erosion/sediment control facilities, and drainage ditches were inspected. No major issues were identified.

3.0 CONCLUSIONS & RECOMMENDATIONS

1) In general, improvement in housekeeping, maintaining profiles associated with earthwork structures for water, waste and other containments was noticeable.

2) Many containment facilities were sign-posted warning controlled access to these facilities.

3) Mine Waste-rock Stockpile run-off collection ditches and associated collection/sedimentation/settling pond have been significantly upgraded and were performing satisfactorily.

4) Mine Crushing Pad runoff collection ditches and sedimentation pond have been upgraded to satisfactory level.

5) Exposed liners on ponds and over embankments were secured with dead weights and anchored at the edges to prevent lifting and risk of tearing due to high winds and associated uplift drag forces.

6) Pond liner and embankment performance appear satisfactory. No signs of any leakage and bearing capacity failure or excessive settlement or slope instability associated with containment berms were observed.

7) Landfill cover surface and side slopes show no signs of any settlement or bearing capacity or slope instability or any seepage on the slopes or in the vicinity of the landfill area.

8) As-designed grades and profiles of all containment berms (embankments) should be maintained and periodically (annually) surveyed to ensure as-designed profiles are maintained to provide the necessary containment capacities.

9) Exposed liners on ponds and over embankments should be protected from accidental damages and an adequate offset should be reserved from each facility to restrict any temporary construction which has the potential to damage the liner.

10) Signage should be placed near each solid waste containment facility indicating thickness of fill over liner to prevent liner tearing/puncture by sharp and large heavy objects or operating machinery.

11) A general improvement in maintaining silt curtains in various drainage areas all across the project is recommended.

12) The ore stockpile settling ponds at the Milne Port Site have large catchment areas draining into these ponds, and these are relatively large facilities at the project site. The

intake drainage channels feeding into these ponds require upgrades to prevent damage to liner and to enhance general stability in their vicinity.

13) The majority of overburden all across the project site is sandy in nature and is prone to erosion during a freshet or rainfall event. Therefore special attention should be paid to surface water management all across the site. Where these soils are in a loose state, water accumulation or extensive wetting or soaking of these deposits will result in their instability or even sinkhole formations or subsidence on relatively flatter topography or mass wasting on slopes. If not attended to on a regular basis, this erosion or subsidence process has the potential to result in larger problems and may impact the operation of roads or containment facilities.

14) Camp water intake jetty head appeared in continual erosion stage from wave action/erosion and would need relatively larger size rip-rap/armour to stabilize.

15) There are some signs of slope instability or permafrost degradation at the sewage discharge point which needs attention before it potentially impacts the pipeline stability.

16) Downstream areas of the spillway should be configured and provided with erosion protection for all sediment collection/settling ponds associated with Port Site ore-stockpiles.

17) All of these facilities need to be inspected and maintained as part of BIMC's regular inspection and monitoring program.

4.0 ACKNOWLEDGEMENTS

SLI wishes to express appreciations to Mr. Scott Burgess, Mr. Michael Brown and Mr. Jonathan Mesher at INAC as well as representatives of BIMC, in particular, Mr. Allan Knight, Environmental Manager for facilitating access to all the facilities, efficient logistics support and for their frank and informative discussion during the site visit. SLI would also like to thank the following representatives/consultant of BIMC who were also closely related with this inspection: Mr. Barry Martin – Geotechnical Engineer (Consultant); Mr. Ali Williams – Environmental Coordinator, and; Mr. Bill Bowden – Environment Advisor.

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Appendix A – SCHEDULE OF INSPECTION

Indigenous and Northern Affairs Canada (INAC)
640120: Marry River Project – Annual Geotechnical Site Inspection (2016)
Hafeez Baba
Inspections Schedule

Date	Travel/Accommodation Details
July 26/Tuesday	Travel to Iqaluit: Air Canada AC 0440 Toronto - Ottawa (7:10 am – 8:14 am) First Air 7F 0860 Ottawa – Iqaluit (9:15 AM- 12:25 pm) Hotel Arctic Check In (for Tuesday night) 13:30 – "INAC office for meeting (Scott Burgess, Michael Brown) Received NIRB Report and started reviewing the report.
July 27/Wednesday	Travel to Project Site: 04:00 Check out and ready for transfer to airport for scheduled charter flight (BIMC's Nolinor flight from Mirabelle Montreal to Mary River Project site with stop at Iqaluit) at 06:00. Advised flight not stopping at Iqaluit, report to INAC office at 9 am for further instruction 09:00 Attend INAC office; advised reschedule via commercial flight to Pond Inlet and BIMC is arranging small plane for us to be picked up from Pond Inlet; contacted SLI office and booked flight for Pond Inlet Continue reading NIRB report 14:00 Check at Airport 14:45 7F 800 Flight to Pond Inlet 17:25 Arrive at Pond Inlet and get ready for boarding BIMC plane to site Check in at Mine Camp. Planning for next day inspection.
July 28/Thu	Site Inspection - Day 1: Meeting with BIMC Environment Staff Mine complex fuel, waste containments and PWSP Ponds, Quarry, Mine haul road, Waste Rock Stockpile and its associated ditches and sedimentation pond, Mine, Crusher area, Crusher Pad and its associated drainage ditches and sedimentation pond and solid waste disposal area.
July 29/Fri	Site Inspection Day 2: Meeting with BIMC Environment Staff Tote Road to KM 50, Open Burn Site, Km 55 – Construction area, KM 60 – The temporary structure/maintenance shed/laydown area, KM 66.5 - The Bridge, KM 90.5 - The land slip area, KM 97 – Near the bridge borrow area, and other facilities along the Tote Road including: bridges, culverts, slopes and ditches erosion and sediment control measures.

July 30/Sat	Site Inspection - Day 3: Meeting with BIMC Environment Staff Travel to Milne Inlet Port Site, Hazardous and environment waste containment berms, PWSP pond, bulk fuel tank farm secondary containment, ore stockpile and its associated ditches and run-off collection and sediment control ponds, land farm, quarry and salt storage.
Jul 31/Sun	Site Inspection - Day 4: Meeting with BIMC Environment Staff Continue with general mine site facilities general drainage tributaries and contribution watershed areas, water intake jetty, sewage discharge point, mine haul road, magazine area, waste rock sedimentation pond and discharge point. Continue with Mine Site – Residential, water treatment and sewage treatment facilities.
Aug 01/Mon	Site Inspection - Day 5: Meeting with BIMC Environment Staff All day rain PM to mine haul road, its drainage ditches, culverts and sediment control facilities Tote Road to KM 68 and Back.
Aug 02/Tue	Site Inspection - Day 6: Meeting with BIMC Environment Staff Rain all day Review IFC drawings for re-fueling facility at Milne inlet port. Consolidate and Compile inspection findings Meeting with BIMC Environment and Operations to present inspection findings.
Aug 03/Wed	Travel to Iqaluit: Check out, Travel to Pond Inlet by BIMC plane and then to Iqaluit.
Aug 03/Wed	First Air 7F 0801 Pond Inlet – Iqaluit (5:15 pm- 8:35 pm) Check in Arctic Hotel.
Aug 04 /Thu	Travel to Toronto: Check out and walk to INAC office 0900 - Review Inspection Photos and compile a selection for report 7F 0861 Iqaluit – Ottawa (1:45pm – 4:50 pm) AC 0463 Ottawa – Toronto (6:00 pm).

Appendix B – PHOTO COLLAGE