Baffinland Iron Mines Corporation - Mary River Project Quarry Management Plan Mine Site Quarry (QMR2)

2013-05-15	0	Approved for Use	S. Potter	A. Grzegorczyk	J. Binns	J. Millard
DATE	**REV.**	**STATUS**	**PREPARED BY**	**CHECKED BY**	**APPROVED BY**	**APPROVED BY**

Revision History

Revision No.	Section	Revision Date	Changes	Approval
C	Document Wide	May 15th, 2013	Document H337697-7000-07-126-0004 has been superseded by H349000-4100-07-245-0001. Revision succession has been kept for continuity	T. Mackay
C	Document Wide	May 15th, 2013	Quarry/Blasting activities will not occur within 100m of fish bearing streams, as opposed to 31m as previously stated.	J. Millard
C	Section 1.2.1	May 15th, 2013	Updated Environmental Setting Section	J. Millard
C	Section 2	May 15th, 2013	Project organization chart and structure updated.	J. Millard
C	Section 2.3	May 15th, 2013	Added Quarry Development Information.	J. Millard
C	Section 2.5.1	May 15th, 2013	Enhanced review of assessment for acid rock drainage.	J. Millard
C	Section 2.5.3	May 15th, 2013	Enhanced review of assessment drainage management.	J. Millard
C	Section 3	May 15th, 2013	Supporting management plans updated.	J. Millard
C	Section 4	May 15th, 2013	Updated Closure and Reclamation Section	J. Millard
C	Appendix A	May 15th, 2013	QMR2 Drainage drawings added	J. Millard
C	Appendix B	May 15th, 2013	Contractor's Blasting Operations Management Plan added.	J. Millard
C	Appendix C	May 15th, 2013	Analytical Certificates-ABA Results, Metals Results, NAG Leachate Results and Bore Hole Log	J. Millard

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1. Introduction

The Mary River Iron Ore Project requires a number of separate infrastructure components to be completed as part of the construction phase of the project. To satisfy the need for aggregate resources for construction, this document outlines the Site Description, Operations and Reclamation for the Mary River Mine Site Quarry (QMR2).

1.1 Regulatory Context

The guidelines provided by the Nunavut Impact Review Board (NIRB) and Indian and Northern Affairs Canada (INAC) with regards to a Quarrying Permit Application state:

1. A Quarry Operations Plan is required with (this) application and must be approved by a Land Use Inspector prior to approval and issuance of the quarry permit if:
2. The volume being applied for is greater than 1,000 m3 and/or
3. The quarry site is being operated by multiple users

The proposed quarry at the Mary River Mine Site will exceed the volume threshold of 1000 m3, and a plan is required. This plan should be used in conjunction with the Borrow Pit and Quarry Management Plan, and other plans referred to in the document. In the case of the QMR2 Quarry, because the quarry is situated on Inuit Owned Lands, the Qikiqtani Inuit Association (QIA) is the regulatory body that approves the quarry operation. The plan is expected to be approved under a quarry concession schedule that forms part of an existing commercial and new operating lease.

1.2 Site Description

The following physical description and environmental setting are summaries from the Mary River Final Environmental Impact Statement (FEIS). For a more complete description, refer Baffinland Iron Mines Corporation, Final Environmental Impact Statement, 2012, Volumes 6, 7, and 8. Site Physical Description. The layouts for the proposed Mary River Mine Site Quarry (QMR2) is shown in Appendix A from the FEIS. The basic quarry specifics are shown in Table 1 below:

Table 1: Mary River Mine Site Quarry (QMR2) Specifications

Requirement	Description
NTS Map Sheet (1:50,000)	• 37 G/2 Edition 1 ASE Series A 713
Quarry vertices Coordinates (UTM)	• 559997E 7914429N (centre point) • 559412E 7914288N (W extent) • 560511.48E 7914389N (E extent) • 560043E 7914049N (S extent) • 560141E 7914598N (N extent)
Total Area of Quarry	• 258580m^2 (25.9 ha)
Volume with Contingency	• 538,000m^3
Area of Existing Clearing	• No clearing is required as site is primarily exposed rock
Area of Proposed Quarrying	• Appendix A shows the quarry extents
Topsoil / Overburden Storage Area	• None is required as site is primarily exposed rock
Access Roads/Trails	• The Mine Site Road currently runs south of the area to be quarried. As part of the project, temporary access roads will be constructed as shown in Appendix A
Camp Locations	• No camp will be built specifically for the quarry operation. Personnel will be housed at the existing Mary River camp

Topography varies considerably across the Project area. Topography at the Mary River Site in the vicinity of the proposed quarry is described as quickly rising to 679 m asl from the fairly flat and sandy outwash plain at 188 m asl where the exploration camp is currently located. The land to the west is equally mountainous with some minor coverage of glaciers. There are several elevated plateaus to the east formed by horizontal sedimentary deposits.

Valley walls are generally steep and abrupt, often with distinct terraces.

Near surface bedrock is dominant in the quarry area. Limited overburden is in the form of localized deposits of till. The majority of the overburden is located in depressions between the numerous bedrock outcrops and is typically overlain by a layer of vegetation and boulders. This is evident along the base of the rock outcrops at the quarry site.

The Project is located in a zone of continuous permafrost. The active layer through the Project area typically ranges from approximately 1 m to 2 m but may be greater in areas where there is loose, sandy soil at the edges of lakes or ponds and less in areas with a substantial surface layer of wet organics. The proposed quarry site has areas where permafrost would be encountered. These are primarily in the deposition areas and deposits to the south of the actual site can range up to 30 m in depth with ice rich deposits. Other Project-related infrastructure in the Mine Site area will be located on areas of glaciofluvial terrace.

1.2.1 *Environmental Setting*

In general, the proposed quarry area at the proposed Mary River quarry was found to be primarily either exposed bedrock hills or bedrock very close to surface (see Figure 1 and Figure 2). Lower depressions between the hills generally have a moderate layer of wet organics at surface and drainage is poor. These lower areas have a range of materials present from colluvial/alluvial type deposits to till with significant fines present. In areas where overburden was present, this generally comprised of a thin layer of organics, underlain by moist gravely sand with some silt.

At least 10 different surface water bodies exist within 200 m of the quarry boundary. All of these are relatively small (<2 ha) with several being less than 0.1 ha in size and are shown in the quarry drainage plan in Appendix A. None of these lakes were found to contain fish species, due to the shallow nature of the basins. Camp Lake located 2 km to the west, and the north basin of Sheardown Lake, 500 m to the south east are known to contain arctic char. The Camp Lake tributary is indicated to support char as far east as the East end of the airstrip and may support stickleback upstream of this. Three monitoring points will be established in the drainages downstream of the quarry and upstream of fish bearing waters (refer to Quarry Drainage Plan in Appendix A). The flow path from where the drainage from 2013 quarry operations flows into the fish bearing water of CL1b is approximately 150m.

Figure 1: Mary River Mine Site Quarry (QMR2) Showing Bedrock Outcroppings

Figure 2: Proposed Mary River Mine Site Quarry (QMR2) Looking West

Vegetation within the Mary River Project area is described in the Vegetation Baseline Study Report in Volume 6 of the FEIS (Appendix 6C). No plant species considered to be “rare” in Canada were found to occur in the survey locations. Vegetation is extremely limited in the area of the proposed quarry, and exists in small patches where organic deposits occur around the base of the rock outcroppings, and in the valleys in between large boulders.

Several species of songbirds and shorebirds migrate to this area annually to breed, and were predominately found in the various types of lowland habitats (river deltas, coastal plains, tundra, and near wetlands) that offer an abundant source of insects and vegetation for foraging and nesting habitat. This type of habitat is present near Camp and Sheardown lakes, within 2 km of the proposed quarry site. Bird densities though, are considered to be relatively low.

Terrestrial wildlife on north Baffin Island is described in the terrestrial wildlife baseline report (Volume 6: Terrestrial, Appendix 6F). Terrestrial wildlife includes caribou, wolves, foxes, arctic hares, ermine, and small mammals. Occurrence of most wildlife species on north Baffin Island is relatively sparse, and this is expected to be especially true at the quarry site given the type of terrain.

Marine mammals are not present in the area as the quarry site is located 100 km inland from Milne Inlet. No settlements or known hunting camps or areas are located in proximity to the proposed quarry site.

2. Environmental Responsibilities

2.1 Roles and Responsibilities

The Baffinland environmental team is organised into two parts, on site as well as off site. The organisational structure for the Mary River Project in relation to the environment discipline is shown in the Table 2 below. Communication channels are described as liaisons in the tables outlining the responsibilities and accountabilities in the following sections.

2.1.1 Environmental Project Team

2.1.1.1 The Baffinland Environmental Team

The Baffinland Environmental Team will oversee all environmental and community works on and off site. The Baffinland Corporate Environmental Team responsibilities are summarized in Table 2.

Table 2: Baffinland Iron Mines Corporation Senior Management

Baffinland Iron Mines Corporation Senior Management	
Position	**Responsibilities and Accountabilities**
Project Director	- Reports to Baffinland's CEO - Overall accountability for the Project execution - Allocation of resources (human and financial) for the implementation of Baffinland's commitments and objectives related to health, safety and environment during Construction of the Project - Accountable for on-site environmental, health and safety performance during construction of the Project
VP Operations	- Reports to Baffinland's CEO - Overall accountability for the Operation of the Project once constructed - Allocation of resources (human and financial) for the implementation of Baffinland's commitments and objectives related to health, safety and environment during Operation - Accountable for on-site environmental, health and safety performance during Operation
VP Sustainable Development, Health, Safety and Environment	- Reports to Baffinland's CEO - Establish corporate environmental policies and objectives - Monitors and reports on Baffinland's performance related to environmental, health and safety policies and objectives - Community liaison - Liaise with regulatory authorities - Obtains necessary permits and authorizations - Monitors compliance with terms and conditions of permits and licences - Routine EHS audit of contractor performance while on site
Manager Purchasing and Contract	- Reports to Baffinland's Project Director - Accountable for procurement and purchasing - Ensure that environmental commitments, policies and objectives are included in all contract documents

Baffinland Iron Mines Corporation Senior Management	
Position	**Responsibilities and Accountabilities**
VP Corporate Affairs	- Reports to Baffinland's CEO - Accountable for external communication (Governments, media, NGO, others) related to Baffinland's press release and overall communication of site incidents/events

The Baffinland Environmental Team will oversee all environmental activities on site. These responsibilities on site are outlined in Table 3.

Table 3: Baffinland Iron Mines Corporation On-Ste Management Team

Baffinland Iron Mines Corporation On-Site Management Team	
Position	**Responsibilities and Accountabilities**
Construction Manager	- Reports to the Project Director - Responsible for daily on-site management of construction activities - Accountable to the Project director for site environmental, health and safety performance - Organize and provides necessary induction, safety and environmental training for all employees - Ensure that all contractors on-site abide by Baffinland's policies, EHS commitments
Environmental Manager	- Reports to VP Sustainable Development, Health, Safety and Environment - Liaises with the Project Director, Construction Manager and the Emergency Response Team - Monitors environmental performance of contractors on site - Monitors compliance with permits, licenses and authorizations - Regulatory environmental monitoring and reporting (monthly, annual) - Routine audit of contractor's environmental performance on-site - Initiate/supervise environmental studies - Investigate and reports on accidents and incidents when they occur - Review and update environmental management plans
Environmental Supervisor (s)	- Reports to Environmental Manager - Specific accountabilities for environmental monitoring and reporting - Provides induction and environmental awareness training to new employees and contract workers

Baffinland Iron Mines Corporation On-Site Management Team	
Position	**Responsibilities and Accountabilities**
Environmental Support Groups	- Reports to the Environmental Manager - Environmental database management - Various sampling, monitoring and reporting activities as required by permits, licenses and environmental management plans - Prepare updates to environmental protection plan and management plans
Environmental Monitors	- Reports to the Environmental Manager - Conduct monitoring activities as per the management plans
QIA Monitors	- Various monitoring and follow up activities - Roles will be defined in the IIBA agreement

2.1.1.2 Construction Contractor's Environmental Team

The Construction Contractor will have their own organisational structure which is yet to be defined, but at a minimum the responsibilities for the environmental portion are summarized in Table 4 below:

Table 4: Construction Contractor(s)

Construction Contractor(s)	
Position	**Responsibilities and Accountabilities**
Construction Manager	- Reports to the Baffinland's Construction Manager - Accountable for the EHS components of his scope of work - Accountable for implementation of the Construction Environmental Protection Plan - Co-ordination/interaction with Baffinland and Baffinland's Representative Environmental Monitors.
EHS Supervisor	- Reports to the Contractor's Construction Environmental Manager - Liaise with Baffinland's Environmental Supervisors and monitors. - Holds daily EHS briefing - Monitors and ensures that Contractor complies with requirements of management plans, terms and conditions of all authorization, licences and permits associated with the Contractor's scope of work - Investigate, reports and follow up on environmental accidents and incident - Provides site specific environmental monitoring - Daily supervision of construction activities for environmental performance - Attendance at all environmental meetings/Project meetings (as required). - Routine interaction with construction crews to ensure all construction activities are in compliance with requirements of the CEPP and Contractors Environmental Method Statements. Monitor the environmental permitting status of the Project to ensure that no work proceeds until appropriate and complete permitting is received for the applicable facility.

2.1.2 *Mary River Project Organizational Charts*

For further information regarding the Mary River Projects organizational structure in relation to the environment discipline, please refer to the Figure 3 below:

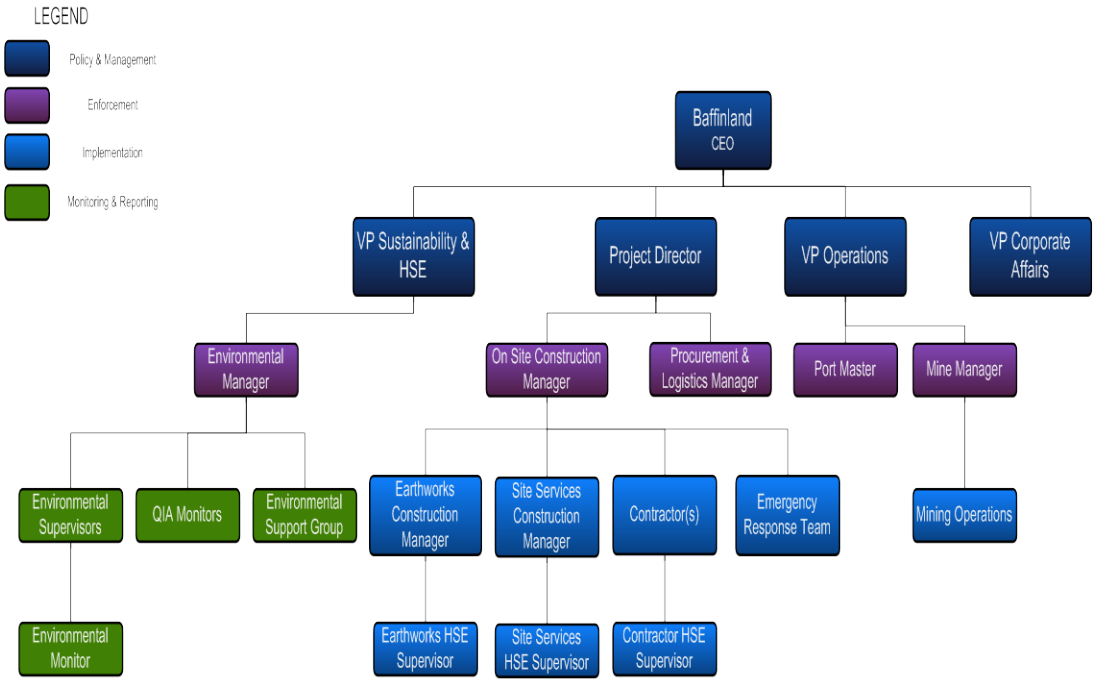


Figure 3: Mary River Organizational Chart

2.2 Quarry Development and Operation

The quarry will be accessed by a temporary road from the main staging area road, to be constructed of granular material. Equipment transported to the quarry site will include:

- Crushing and screening (present at Mary River)
- Drilling Equipment
- Rock hauling trucks
- Excavators
- Blasting equipment

A small (<50 m2) portable field office trailer will be placed at the quarry site. Equipment will be serviced at maintenance facilities located at the nearby laydown area.

2.3 Quarry Development

The following steps provide a description of how quarry development will proceed at QMR2 and provide details of the different quarry activities associated with development. Since there will be two different faces where quarry mining is progressed at QMR2, the following steps apply to each quarry face.

1. Crusher Pad: Construct a small crusher pad near the Tote Road using fill material from a previously developed borrow/quarry site. The crusher pad will subsequently be expanded in size to the appropriate size for crushing and screening operations, stockpiles of finished product, and loading operations to deliver produced rock materials.

2. Access Road: Construct an access road with culvert water crossings and sediment and erosion controls from the crusher pad to the quarry face using fill material from a previously developed borrow/quarry site. This access road is used to transport the blasted quarry rock to the crusher pad.

3. Pioneer Bench and Loading Pad: Using a pioneer track drill, the first bench is drilled and blasted at some higher elevation so the bench bottom elevation is similar to the desired loading pad elevation. A portion of the initial blasted quarry rock will be utilized at the quarry face to create a level pad for loading quarry rock into haul trucks. After the loading pad is finished, blasted quarry rock is hauled to the crushing pad for expansion of the crusher pad and as crusher feed material to produce rock products.

4. Bench Drilling: As each drill round is blasted out, the drill either stays at this elevation to expand the bench in a longitudinal direction along the face, or the drill climbs up the quarry site to a higher elevation to drill and blast subsequent higher elevation benches. These benches are expanded in length as required for subsequent blasting of rock at that bench elevation. Benches are created for safety and for efficient drill/blast operations.

5. Subsequent Bench Development: Additional benches are created at higher elevations, starting at the open face of the site. Each bench proceeds toward the main body of rock at that elevation. Lower benches follow behind upper benches and drilled and blasted to move toward the main body of rock. Ramps may be constructed to the upper benches for truck loading near the blasted rock. Material is excavated from benches and loaded onto trucks for delivery to the crusher.

6. Drilling Quarry Rock: Drilling of the quarry rock is normally completed with the use of one drill rig. The boreholes are laid out by a surveyor to the engineered spacing and burden for each particular rock type, geology, and desired product size. The drill is removed from the area for loading explosives and blasting. The drill can proceed along the bench to continue drilling or proceed to a new bench.

7. Blasting Operations: Blasting rock is completed by installing high explosive detonating boosters with initiation wires, followed by dropping pre-packaged sticks of explosives, or pouring from pre-packaged bags, or by pumping bulk explosives from an explosives truck into the boreholes. Detonation and initiation is carried out with the use of delays to time the detonators in a very fast millisecond sequence of smaller blasts for efficient rock breakage. Blasting lags behind the drill as more drilling is completed. As each new drill round is completed, the drill moves on and the drilled round is loaded with explosives and blasted.
8. Hauling Quarry Rock: The blasted rock is loaded onto trucks for delivery to the crusher.
9. Crushing Operations: Quarry rock is fed to the crusher and screening equipment to size and produce the desired rock product, stored in stockpiles and loaded into trucks for delivery to construction sites.

2.4 Quarrying Activities

The following provides detailed description of the general activities associated with quarrying:

2.4.1 Explosives Management and Blasting

A Blasting Management Framework has been developed and is presented in Annex 3 of the Borrow Pit and Quarry Management Plan. A detailed Contractor's Blasting Operations Management Plan, incorporating the key items in the Blasting Management Framework has been prepared by the blasting contractor and is provided in Appendix B of this document.

The blasting operations will be carried out by an experienced contractor. The Blasting Contractor will eventually be manufacturing, and using, Ammonium Nitrate Emulsion (ANE). However, explosives for the development of Mary River Mine Site Quarry (QMR2), during 2013, will consist of pre-packaged explosives with up to 212,000 kg stored within the Mary River Mine Site Area. Pre-packaged explosives will gradually be replaced by emulsion mixtures once a temporary plant is erected and made operational during 2014. Transportation of explosives to and from the quarry site will occur from the temporary magazine storage area via road.

Blast hole drilling will take place on an appropriate grid pattern, determined by field testing, in an effort to optimize blast rock size and blasting efficiency. Blasting will normally take place at the beginning and end of each shift on a seven days per week basis. An Explosives Management Plan for the Project and an ANE Bulk Temporary Plant document has been developed previously by a contractor in the FEIS, Appendix 10C-4. This plan will be updated prior to the manufacture and use of bulk ANE. A Blasting Operations Management Plan created by NUNA, a construction contractor with experience on the Mary River Project, is provided in Appendix B.

2.4.2 *Excavation and Crushing*

The entire operation takes place in an area of permafrost, and groundwater is therefore not an issue. Drilling will be monitored to avoid creating run off and drainage issues. Washing of aggregate is not required, as the material will be used for site preparation only.

Some minor organic surface soils are present in the quarry area. If these overburden soils cannot be avoided, then they will be stripped and stored separately at the storage area for later re-use. Quarrying will work along the exposed rock faces and will be terraced to minimize run off from the site. Efforts will be made during blasting operations to avoid creating depressions which might collect run off or melt waters .Drilling and extraction exercises may occur concurrently, depending on issues of safety and schedule. Blasted rock will be cleared by loader and/or scraper and put into rock trucks for transport to the crusher/screener facility. Loaders will feed rock to the crushing and screening operation.

Crushing and stockpiling areas will be located as near as practical to the southern extent of the quarry within easy access to the road.

Crushing operations and screening operations will take place during the day shift, seven days per week. The operation will process rock from the quarry, and may also process rock from other areas if required. Final material will be cleaned and stored by aggregate size in stockpiles for transport to the appropriate construction sites.

2.4.3 *Site Security and Safety*

Copies of all safety and management documents will be made available to on site personnel and mandatory training for operations at the Mary River Mine Site Quarry (QMR2) will take place. The Area Coordinator will ensure that operations are consistent with other management plans, terms and conditions of the issued permits and safety procedures for the Project.

Security signage will be posted at the entrance to the quarry. The remoteness of the quarry and the onsite presence of operations personnel will make perimeter fencing unnecessary. Audible warning systems will be employed for all blasting operations at posted intervals prior to any detonations.

Blasting and processing operations will be suspended if incursions into the quarry occur, or if observations of wildlife in the immediate quarry area are made. On site monitors for bears will provide warnings if approach by any animals is noted. All employees working on the quarry operation will receive bear awareness and deterrent training.

2.5 Site Management Measures

Best management practices for quarry operations will be followed for the Mary River Mine Site Quarry (QMR2). The following management activities will be incorporated into the site operations:

2.5.1 Assessment for Acid Rock Drainage (ARD)

The Mary River Quarry (QMR2) has been assessed utilizing the Protocol for the Assessment for the Potential for Acid Rock Drainage (Borrow Pit and Quarry Management Plan, Annex 2). AMEC was retained in the summer and fall of 2010 to undertake an assessment of proposed quarries to assess metal leaching and acid rock drainage (ML/ARD). The sampling certificates showing these results are presented in Appendix C. Industry standard methods have confirmed that aggregate materials used will have a low potential for ARD/ML.

2.5.1.1 *Review of existing geological information and site reconnaissance*

A review was conducted of existing site information and a visual inspection of surface portions of the proposed quarry development area was undertaken by means of a walk around. The review indicated that the quarry and surrounding areas are underlain by Archean age Precambrian rocks consisting of migmatitic gneisses. The gneisses are heterogeneous commonly with inclusions and bands of mafic, metasedimentary and other granitic rocks. Visual observations of the quarry development area indicated that outcrop exposure was excellent with little soil covering. Trace to no sulphides was observed during the site visit and there were no surface areas of visible sulphide oxidation.

2.5.1.2 *Sampling*

One borehole QMR2 (was advanced to depth of 26 meters. Refer to Appendix A for the borehole location and Appendix C for borehole log. One representative sample of the rock core from QMR2 was sent for laboratory analysis.

2.5.1.3 *Analytical Testing Methods*

Analytical tests included the following:

- Acid base accounting (ABA) including paste pH, modified Sobek neutralization potential (NP), total sulphur, sulphate sulphur, sulphide sulphur by difference, total carbon (TC) and total inorganic carbon (TIC)
- Total metals analysis
- Leachable metals by shake flask extraction (SFE)

2.5.1.4 *Results*

The results of the above analysis for QMR2 indicate that the bedrock gneiss underlying the QMR2 Mary River quarry development area exhibit the following characteristics:

- Paste pH is weakly alkaline (9.95)
- Sulphide content was less than 0.01%
- The neutralization potential ratio (NPR) is well in excess of three. This material is considered non acid generating
- Neutralization potential (NP) value was 4.9

- In a comparison of total metal results of samples to crustal abundances, no notable elevation of metals were noted
- There were no concerns regarding the results of the SFE tests

2.5.1.5 *Key conclusions and recommendations.*

- Based on the results of geochemical and mineralogical analyses and general surface and subsurface geological observations there is a low potential for ML/ARD and the materials are therefore expected to be a suitable quarry source.
- Based on the work to date, both locally and regionally, in other areas of gneiss that have been investigated along the Tote Road, there is no evidence of elevated sulphide.

Based on the recommendation, above, an operational testing program is recommended throughout the quarry extraction process. It is recommended that to start, approximately one composite sample of quarry material representative of a blast (muck or blast hole cuttings sample) be collected per 10,000 m3 of material quarried. The analytical methods to be adopted will be as for the predictive sampling (MEND, 2009) or a defined alternative that has been shown to be predictive of ARD/ML. The sampling frequency should be adjusted to account for ongoing results. The quarried material can also be visually inspected for the presence of sulphides.

2.5.1.6 *Future reporting*

Operational testing results will be included in the annual reporting for the project.

2.5.2 *Blasting Operational Management*

A Blasting Management Framework has been developed and is presented in Annex 3 of the Borrow Pit and Quarry Management Plan. A detailed Quarry Operations and Blasting Management Plan, incorporating the key items in the Blasting Management Framework as well as general procedures to be used for blasting has been prepared by the blasting contractor and is provided in Appendix B of this document.

2.5.3 *Drainage Management*

The potential exists to alter drainage patterns of overland flow paths and to cause minor effect on local water quality. The hydro-geological regime around the quarry site will need to be maintained and appropriate direction of flows from site managed to maintain the natural flow patterns as much as possible. As much as possible, upstream runoff will be diverted to maintain water quality and avoid contact with quarry operations. Poorly developed overland flow paths that intersect with the quarry development area will be modified as required to accommodate flows around the quarry development. This can be accomplished by means of diversion berms or excavation of shallow ditches.

There will only be a discontinuous discharge from quarries, water runoff from quarries will be managed. As required, the quarry runoff collection locations will change over time. The drainage plans showing interpreted flow paths and downstream receivers for Quarry QMR2 are presented in Appendix A.

Sources of contamination from the operation that could affect water quality include blasting residues from blasting and spills from refuelling of equipment. Blasting residue from explosives will be managed by following best practices to ensure that all material is ignited during the blasting process. Vehicle re-fuelling will be conducted at a centralized fuelling facility off site that has proper containment and spill response capability. Re-fuelling of stationary onsite equipment, such as generators, will take place in a secured area with approved spill containment. Spill kits will be strategically located at the QMR2 quarry site.

2.5.4 Dust Management

The primary sources of dust at the Mary River Mine Site Quarry (QMR2) are blasting, loading and crushing and screening of aggregates. Very little topsoil exists at the quarry site, and is not considered a primary source of dust. The management of dust will be accomplished by minimizing the creation of dust at source. Crushing activity will take place as far from surface water or dust sensitive areas as is practical at the site. If possible, protection from prevailing winds will be accomplished by situating the crushing operation to take advantage of the local topography for shelter. Transport of material will be subject to speed limit restrictions to help reduce dust.

Dust management activities will include monitoring surrounding snow for accumulations of quarry dust. If such deposits are noted, the snow layer will be removed prior to melting, and transported to the land farm.

2.5.5 Noise Management

Quarry activities will generate noise from equipment operation, blasting and crushing and screening operations. Noise receptors within the area are restricted to wildlife, as no dwellings or other land use that is sensitive to noise occur nearby.

During quarry operations, monitors will inform the quarry manager if significant wildlife activity, such as caribou movements, is occurring. Depending on the concentrations and likely effect of the noise generating activity, the quarry manager may temporarily suspend operations.

2.6 Monitoring

Operation of the Mary River Mine Site Quarry (QMR2) must be monitored to ensure compliance with the Borrow Pit and Quarry Management Plan and to meet the terms and conditions of the regulations and land-use permits granted for the Project. Monitoring will focus on:

- Regular inspection of site-preparation measures
- Regular inspection of drainage from the quarry site
- Volume and quality estimates of the granular resource material produced
- Monitoring for ground-ice presence
- Monitoring for presence of avian, terrestrial and marine mammals in the area

- Monitoring of water quality for changes
- Monitoring of snow surrounding quarries for dust deposition
- Reporting requirements as outlined in any permits

Turbidity/TSS and ammonia will be monitored in the field by means of field testing methods and meters that are based on approved methodologies. If field testing detects elevated Turbidity/TSS and/or ammonia in collected runoff at levels acutely toxic (assumed to be > 20 mg/L ammonia (as N), further downstream sampling will be conducted near the discharge location to potential fish habitat for the parameters of concern as well as for acute toxicity.

3. Supporting Management Plans

This plan should be viewed in concert with the following additional plans prepared for the pre-development works:

- Emergency Response & Spill Contingency Plan – FEIS, Appendix 10C-1
- Surface Water and Aquatic Ecosystems Management Plan –FEIS, Appendix 10D-2;
- Explosives Management Plan – FEIS, Appendix 10C-4
- Waste Management Plan – refer to FEIS, Appendix 10D-4
- Acid Rock Drainage Testing Protocol (refer to Borrow Pit and Quarry Management Plan, Annex C)
- Blasting Management Framework Protocol (refer to Borrow Pit and Quarry Management Plan, Annex B)
- Contractor's Blasting Operations Management Plan (refer to Appendix C of this document

4. Closure and Reclamation Activities

4.1 Closure of Active Quarry Face

The closure and reclamation of the QMR2 quarry and access roads will be integrated into the overall Project Closure plan. However, separate closure plans for Mary River Mine Site Quarry and borrow pit operations are required. Closure of the active quarry face will involve removing all materials, equipment and infrastructure and reclaiming the site to a self sustaining productive ecosystem.

4.2 Waste Disposal

All site waste will be collected and placed in appropriate containers for removal. Pre and post waste removal inspections will be made to ensure the thoroughness of the program. Waste will include metallic waste, construction material waste and domestic waste.

At the current time, no washroom facilities for personnel are expected at the quarry site. Any requirement for such facilities will be met by easily removable portable toilets. These will be operated in a manner consistent with regulations, and disposal will be in accordance to the waste management plans.

4.3 Stockpile Removal

Quarrying activities will be closely managed to avoid the accumulation of unnecessary stockpiles of aggregate. Any stockpiles that do remain will be dealt with as follows:

- Large rock will be spread out on the landscape or used as rip-rap for erosion control
- Medium sized rock will be used to re-contour affected areas to re-establish a more natural appearance to the area
- Small crushed rock will be used to assist in drainage restoration, and spread on the landscape to re-establish more natural contours
- Any collected soils will be spread to allow for the re-establishment of vegetation. No vegetation planting or seeding operations will take be undertaken to avoid introducing invasive species and natural re-vegetation will be allowed to take place

4.4 Road Reclamation

The Mary River Mine Site Quarry (QMR2) access road is a relatively short aggregate structure. The entire road bed will be removed, and the material utilized in re-establishing natural contours throughout the area.

4.5 Soil Remediation for Contaminated Soils

A pre-closure inspection of the entire quarry site will be made. Any contaminated soils, snow or ice packs, or overburden will be flagged. The extent of the contamination will be determined, and the material removed. Hydrocarbon contaminated soils or overburden will be transported to the land farm to be established on site. Should a spill occur before the landfarm is ready, the contaminated soil would be placed within existing lined and bermed areas as is currently the practice under the existing Type B Water Licence. Other contamination, such as heavy metals or toxins, will require containerization for shipping off site to an appropriate facility (refer to Preliminary Mine Closure & Reclamation Plan, FEIS Volume 10: Appendix 10G).

Appendix A

QMR2 Mine Site Drainage Drawing

DWG. NO. H349000-4000-00-015-0008

N 7,915,000

E 558 000

E 559 000

PLANT NORTH

CAMP LAKE

FLOW PATH TO CAMP LAKE

TOTE ROAD ALIGNMENT

TOTE ROAD ALIGNMENT DURING CONSTRUCTION

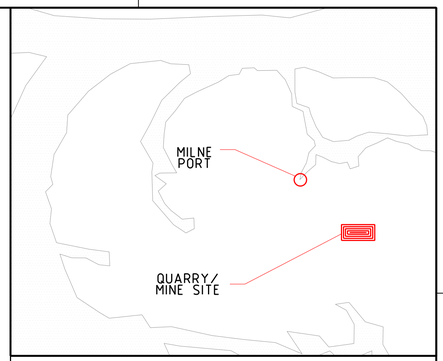
CONSTRUCTION QUARRY CRUSHER PAD #2

NEW AERODROME APRON

N 7,914,000

MATCHLINE SEE H349000-4000-00-015-0009

0 30 60 90 120 150
SCALE IN METRES



KEY PLAN

LEGEND

- PROPOSED FOOTPRINT FOR CONSTRUCTION QUARRY PADS
- EXISTING WATERBODY
- WASTE ROCK DUMP BOUNDARY AT END OF OPERATION
- POTENTIAL DEVELOPMENT AREA
- EXISTING STREAM
- SURFACE DRAINAGE DIVERSION
- OVERLAND FLOW PATH
- RIDGE LINE (HIGH POINT)
- PROPOSED CULVERT
- EXISTING CULVERT (LOCATION APPROXIMATE)
- PROPOSED ROAD
- TOTE ROAD ALIGNMENT DURING CONSTRUCTION
- EXISTING ROAD

NOTES:

1. TOPOGRAPHY PROVIDED BY TERRAPOINT CANADA INC.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 2.0m.

APPROVED FOR USE

H349000-4000-00-015-0009	MINE SITE – QUARRY QMR2 – DRAINAGE PLAN
DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE

REVISIONS

REV.	ISSUE FOR	AUTH. BY		DATE
A	FOR USE	T.M.	T.T.	2013-05-15

ISSUE AUTHORIZATION

HATCH™

DESIGNED BY	DRAWN BY C LEISTNER
DATE	DATE 2013-05-15
CHECKED BY	DISCIP. ENGR.
DATE	DATE
PROJ. DES. COORD. T. THERTELL	PROJ. ENGR. J. CLELAND
DATE 2013-05-15	DATE 2013-05-15
PROJ. MGR. S. PERRY	
DATE 2013-05-15	

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MINE SITE
QUARRY QMR2
DRAINAGE PLAN

SCALE	DWG. NO.	REV.
1:3000 OR AS NOTED	H349000-4000-00-015-0008	A

ORIGINAL SHEET SIZE: ISO A1 (841 x 594)

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leis59970

DWG. NO. H349000-4000-00-015-0009

PLANT NORTH

MQ-C-A

BH-QMR2

QUARRY QMR2

E 560,000

E 561,000

MQ-C-D

FISH BEARING CULVERT

N 7,914,000

EXISTING TOTE ROAD

MQ-C-B

NON-FISH BEARING CULVERT

PROBABLE FISH BEARING CULVERT

ALTERNATE ACCESS TO QMR 2

NON-FISH BEARING CULVERT

SERVICE BERM FOR WATER & POWER

CONSTRUCTION QUARRY CRUSHER PAD #1

EXISTING FISH BEARING CULVERT

EXISTING CRUSHING PAD

SHEARDOWN LAKE NW

MATCHLINE SEE H349000-4000-00-015-0008

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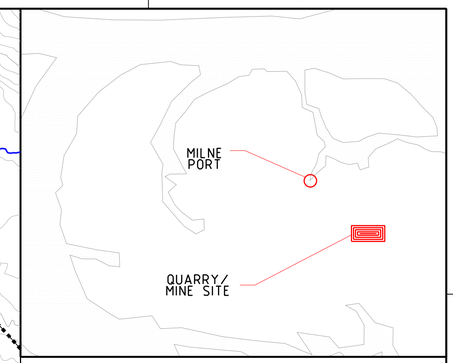
SCALE IN METRES



KEY PLAN

LEGEND

- PROPOSED FOOTPRINT FOR QUARRY QMR2
- PROPOSED FOOTPRINT FOR CONSTRUCTION QUARRY PADS
- EXISTING WATERBODY
- POTENTIAL DEVELOPMENT AREA
- EXISTING STREAM
- INTERNAL SURFACE DRAINAGE
- SURFACE DRAINAGE DIVERSION
- OVERLAND FLOW PATH
- RIDGE LINE (HIGH POINT)
- PROPOSED CULVERT
- EXISTING CULVERT (LOCATION APPROXIMATE)
- PROPOSED ROAD
- TOTE ROAD ALIGNMENT DURING CONSTRUCTION
- EXISTING ROAD
- PROPOSED WATER QUALITY MONITORING LOCATION (MQ-C-)
- EXISTING BOREHOLE
- SITE PREPARATION WORKS (MAY TO JULY 2013)

NOTES:

1. TOPOGRAPHY PROVIDED BY TERRAPOINT CANADA INC.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 2.0m.

APPROVED FOR USE

H349000-4000-00-015-0008	MINE SITE – QUARRY QMR2 – DRAINAGE PLAN				
DRAWING NO.	DRAWING TITLE				

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE

REVISIONS

REV.	ISSUE FOR	AUTH. BY	DATE
A	FOR USE	T.M.	T.T. 2013-05-15

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DATE 2013-05-15	

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MINE SITE
QUARRY QMR2
DRAINAGE PLAN

SCALE	DWG. NO.	REV.
1:3000 OR AS NOTED	H349000-4000-00-015-0009	A

ORIGINAL SHEET SIZE: ISO A1 (841 x 594)

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Appendix B

Contractors Blasting Operations Management Plan

Quarry Blasting Operations Management Plan – Mine Site

Baffinland Iron Mines Corporation

Mary River Project, NU

April 2013

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List of Tables

List of Figures

1. Purpose of Document

At the request of Baffinland Iron Ore Corporation (Baffinland), Nuna Contracting Ltd. (NUNA) developed a document that would provide a site specific blasting operational management plan for the Mine Site Quarry (QMR2) based in part on Baffinland's Blasting Management Framework document. NUNA endeavors to work pro-actively with Baffinland to develop quarries in an environmentally acceptable manner that meets the requirements of all Project permits and authorizations.

2. Environmental Management Plan

2.1. Introduction

The information provided, herein, supplements that provided in the related document:

- Borrow Pit and Quarry Management Plan

2.2. Setbacks

A 100 meter buffer zone will be established between the construction areas directly adjacent to fish bearing streams. Buffers will be surveyed in before any construction can proceed.

2.3. Archeological Sites

The Client will notify NUNA of any archeological site within the quarry development area. The identified archeological site will be marked and if required, a buffer zone will be established around the archaeological site as required by the site regulations or as recommended by the archeologist. No construction is to take place within the buffer zone and no employees will be permitted to enter the site. If a relevant archaeological site is identified during the course of the operations, all work will cease and the archaeologist will be contacted and brought to the site. Work in the area would only proceed based on the recommendations of the archaeologist with input from the government of Nunavut.

2.4. Explosives Usage

During 2013, high quality pre-packaged emulsion explosives have been selected for blasting operations. The pre-packaged explosives utilize an optimally mixed hydrophobic emulsion compound that works to repel water and keep AN out of the surrounding ecosystem. Industry best practices will be adopted to maximize source control and to minimize the potential for AN dissolution to downstream waters. The following protective measures will be taken:

- When handling, transporting or storing explosives, care will be taken to avoid any spillage. Any spilled product will be promptly reported, cleaned up, and properly disposed in accordance to approved site waste management practices. A Spill Report detailing the incident will be submitted to the Baffinland Environment supervisor. A follow-up report will be provided that details basic cause of the spill and any corrective actions taken to minimize the type of incident from reoccurring.

- Prior to loading explosives, blastholes will be inspected for the presence of water. If water is detected, plastic liners will be installed prior to the loading of holes. This will minimize deterioration and dissolution of the explosives within the blast hole.

- Stand time for explosives will be minimized and the lag time between load and blast will be kept to a minimum.

- If there is a miss hole resulting in incomplete detonation of explosives, the event will be reported to the Baffinland Environment supervisor. If the residual blasted material in the vicinity of the miss hole represents a potential source of nitrogen compounds, this material will be appropriately stored and managed to minimize the potential for soluble nitrogen compounds from entering fish bearing waters.

- Upstream overland flows that impinge on quarry operations and have the potential to contaminate clean upstream water will be diverted around the active pit area by means of berms, check dams, or minor diversions. Based on the site drainage plan, the upstream flows from the quarry development area are anticipated to be minor.

- In the event that there is the potential for nitrogen compounds to adversely impact downstream fish bearing waters contingency actions will be taken that could include:

    - Storage of impacted water within the pit in constructed sumps.

- Pumping of water into tanker trucks for disposal in holding ponds or the sewage treatment plant.

- Other treatment options such as the careful discharge to the tundra or where there is abundant surface vegetation (approval may be required) after meeting regulatory requirements for water quality.

2.5. Training

Training is seen as a key element in the safe usage and proper environmental management of explosives and blasting. All employees working on or around blasting operations will undergo rigorous employee orientation and training procedures for: managing, transporting and loading explosives into blast holes. Experienced competent employees are an essential part of blasting best management practices.

2.6. Management of grubbing and disposal of related debris

The principle concerns associated with grubbing and disposal of related debris are:

- Potential effects on water quality caused by erosion and sedimentation;
- Disturbance of the permafrost leading to ground failure (slumping and erosion)

NUNA is committed to meeting the Client's and or the Territorial regulations for maximum allowable concentrations of total suspended solids (TSS) .

All grubbing and disposal of related debris near watercourses will comply with approvals from respective regulators and the landlord. At a minimum measures to be undertaken to minimize effects on aquatic habitat and resources are as follows:

- Grubbing of the organic vegetation mat and/or the upper soil horizons will be minimized, and left in place where possible due to the sensitivity of arctic soils;
- If needed, the organic vegetation mat and upper soil horizon material, which has been grubbed, will be spread in a manner that attempts to cover exposed areas. Any surplus of such material will be stored or stockpiled for site rehabilitation and re-vegetation purposes elsewhere in the project area. Topsoil will be stockpiled separately from the

overburden. The location of the stockpiles will be recorded and accessible for future rehabilitation purposes;

- During grubbing, care will be taken to ensure that grubbed material will not be pushed into areas which are to be left undisturbed.

2.7. Till Management

Till stripped from the quarries will be placed in an area approved by the Client or the onsite environmental personnel. These areas can be an area currently identified for till/topsoil storage area or an area close to a quarry that is unlikely to erode into any water bodies during spring thaw.

Till can be used for building a berm around quarry as a means to prevent runoffs and snow melts into nearby natural drainage systems. If seepage through a berm wall is occurring, sediment control mats will be laid the foot of the berm wall to minimize transportation of fines into water courses.

2.8. Storm Runoff & Snow Melts

The final quarry configuration will consist of a flat surface graded at approximately 1% in the down slope direction, adjoining a steeper angle rock surface that forms the transition to natural ground on the ridge above. Storm and snow melts water will be diverted away from the quarry by a small 0.5 m berm on the upslope edges of the excavation. All runoffs and snow melts will be contained in a lined designated location within the quarry. Runoffs will be released onto the tundra after meeting regulatory requirements for water quality.

2.9. Water Sampling

Water sampling will be conducted at locations and frequency specified by the Baffinland Environmental supervisor. Water sampling locations will be based on the location of quarry operations, site drainage configuration (refer to site drainage plan), and seasonality. The sampling will be undertaken by the onsite environmental personnel.

2.10. Blasting near water

Particular care must be taken when blasting near water bodies. This includes proper explosives handling, selection of the correct explosive (see: Section 2.3), and utilization of best management practices. All quarries blasting on the Mary River Project will adhere to the Department of Fisheries and Oceans (DFO) "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters"[1].

2.11. Performance Monitoring

A performance monitoring program will be implemented to ensure that AN release to receiving waters from AN explosives is minimized and remains non-acutely toxic to aquatic organisms. NUNA is committed to working with the Client and their regulators to develop effective site specific performance targets. These targets and methods to monitor performance will be developed during quarry start up. Initially, the following types of monitoring procedures are anticipated:

- Procedure for blast performance monitoring to optimize blasting efficiency and to minimize the potential for unexploded product.
- Procedure for monitoring and auditing of field operations related to explosive storage, handling, and blast hole loading.
- Procedure for auditing and assessing individual employee environmental awareness and effectiveness of training with regard to blasting operations and the procedures related to environmental management.
- Ammonia and nitrate monitoring of surface water flows to fish bearing waters.

In the event that performance monitoring indicates that targets are not being met, corrective actions will be taken to improve performance and contingency measures will be taken to prevent the discharge of acutely toxic ammonia discharges to the aquatic receiving environment.

[1] Wright and Hopky 1998, Guidlines for the USE of Explosives In or Near Canadian Fisjeries Waters

3. Blast pattern design

3.1. Objective

To provide the engineering department with a safe procedure for designing blasting patterns.

3.2. Introduction

This procedure was developed to ensure that the engineering department, including sub-contractors, are aware of their safety responsibilities while designing and staking blast patterns at the Mary River Project.

3.3. Definitions

- Criteria: All personnel involved in engineering and survey of blast patterns are to follow the responsibilities outlined in this procedure.

3.4. Tasks

Table 3.4-1: Requirements and Responsibilities for Blast Pattern Design

Task	Person Responsible
All borehole locations designed by engineering are to be placed at a distance of one meter or greater from any bootleg locations	Site Engineer
If any holes designed by engineering cannot be drilled in the design location due to ground conditions, then a new location can be used only if it is picked up by survey and found to be one meter or further away from any bootleg locations	Surveyor / Mine Engineer
No holes are to be designed in a location within five meters of a misfired hole	Mine Engineer
Prior to firing any blast, all borehole locations loaded with explosives are to be picked up by survey, and entered into the engineering database by the mining engineer. This will be called the as-built map of each blast pattern	Surveyor / Mine Engineer

3.5. Blasting Parameters – Burden & Spacing

In order to produce a rock gradation profile suitable for specified use, the final blast hole spacing will need to be determined from field testing.

3.6. Blasting Parameters – Bench height and wall slopes

Quarry locations have been selected as per section 1.1 above, in areas that present stable geological characteristics. The benches will be designed according the topography of the natural grade at the quarry site. A 5 m bench height with a minimum 8 m catchment will be used based on safety and the capabilities of our loading equipment.

3.7. Typical Blast Pattern Designs

The following summaries may vary depending on bench height.

Table 3.7-1: Initial Blasting Parameters - 160 mm Borehole

Product	ANFO
Density (g/cc)	0.82
Load per meter of borehole (kg)	16.21
Bench Height (m)	5
Sub-Drill (m)	0.9
Collar (m)	2.5
Load Column (m)	3.4
Load per hole (kg)	55
Pattern Type	Equilateral
Spacing (m)	3.7
Burden (m)	3.2
Rock released per hole (m^3)	59.2
Powder Factor (kg/m3)	0.93

Table 3.7-2: Initial Blasting Parameters - 90 mm Borehole

Product	ANFO
Density (g/cc)	0.82
Load per meter of borehole (kg)	5.08
Bench Height (m)	5
Sub-Drill (m)	0.5
Collar (m)	2
Load Column (m)	3.5
Load per hole (kg)	17.8
Pattern Type	Equilateral
Spacing (m)	2.1
Burden (m)	1.8
Rock released per hole (m^3)	18.9
Powder Factor (kg/m^3)	0.94

4. Drill & Blast Employee Responsibilities

4.1. Blast Helpers

4.1.1. Objective

To provide Drill and Blast (D&B) Supervisors, blasters and blaster helpers with a procedure for assisting a blaster in the preparation of a blast.

4.1.2. Scope

The D&B Supervisor is responsible to ensure that blast helpers assisting in the preparation of a blast are trained and understand the procedure.

4.1.3. Introduction

This standard operating procedure is to be used for drill and blast operations.

4.1.4. Definitions

- D/B Supervisor: Drill & Blast Supervisor

4.1.5. Preparation

- Tools: PPE
- Hazards: Slips, trips, and falls, personal injury or death, premature detonation

4.1.6. Tasks

Table 4.1-1: Requirements and Responsibilities for Blast Helpers

Task	Person Responsible
Before assisting in the preparation of a blast, the blast helper will be trained on the safe handling and preparation of the explosives used during the loading procedure.	Drill & blast Supervisor
Either, D&B Supervisor or the blaster in charge of the blast pattern to be loaded will explain exactly the duties of the blast helper before the work begins.	Drill & blast Supervisor
The blast helper will remain under the direction of the D&B Supervisor or the blaster at all times.	Drill & blast Supervisor
The blast helper will conduct only that part of the blasting operation as directed by the D&B Supervisor or the blaster.	Drill & blast Supervisor

4.2. Drill & Blast Supervisors' Daily Duties

4.2.1. Objective

To provide the Drill/Blast Supervisors with a comprehensive inventory of duties to be completed on a daily basis.

4.2.2. Scope

The Superintendent is responsible to ensure all Drill/Blast Supervisors are trained and understand this procedure.

The Drill/Blast Supervisor is responsible to follow this procedure as directed by the Superintendent.

4.2.3. Introduction

NWT / Nunavut Mine Health and Safety Act and Regulations: require a supervisor to ensure his charges are working safely in a safe environment and in compliance with the regulations, company policy and procedures.

4.2.4. Preparation

- Hazards: Work about charged drill holes, work with explosives, falling rock, slips, trips & falls
- Tools: Blasting Certificate, Supervisor Level I Certificate, PPE

4.2.5. Tasks

Table 4.2-1: Requirements and Responsibilities of a Drill & Blast Supervisor

Task	Person Responsible
The Drill / Blast Supervisor will:	Drill & Blast Supervisor
• Do a pre shift site tour.	
• Read and sign the Daily logbook from the previous shift prior to line up.	
• Review maintenance problems and equipment down time with superintendent and previous shifter.	
• Prepare D/B crews work assignments with superintendent.	
• Prepare daily safety toolbox meeting notes	
• Provide instructions to the D/B crew for the daily work assignments	
• Directs the blaster and helper to prepare all explosives for the days activities.	
• Drill crews are transported to the drill locations. Review previous shift with the off-going driller.	
• The area is inspected and the drillers' duties are reviewed.	
• The night shift crews are transported to the line-up area	
• Record all information in the D/B Daily Logbook. Completed the required documentation for the night-shift crews.	
• Participate and provide information during the daily production meeting for all Mine Supervisors and Managers.	

DUTIES IN THE MINE: **The Drill/Blast Supervisor will:** • Inspect the area of his/her responsibility, identifying and correcting hazards, sub-standard conditions or non-compliance of Nuna procedures, or the NWT / Nunavut Mine Regulations or client.	Drill & Blast Supervisor
• Provide on the job observations and instructions to the drill/blast crews.	
• Ensure the mining / quarrying plan is followed regarding drill and blast patterns, as directed by the Superintendent.	
• Ensure the drill/blast crew has the required supplies to complete their daily tasks.	
• Ensure the Mine Supervisor is informed of any hazards that may affect the safety of the mine employees or equipment.	
• Provide directions and instructions to all employees during the blasting operations regarding the notification and guarding during the blast.	
MISCELLANEOUS DUTIES:	Superintendent/ Supervisor/ Safety
• Develop and present timely safety topics at the regular crew Safety meetings.	
• Provide developmental training for drill/blast crews.	
• Under the direction of the Superintendent, provide up-to-date information regarding manpower, production targets or delays, order and track consumables, complete special assignments, ensure that explosives are handled properly and security is maintained.	

5. Drilling & Loading Procedures

5.1. Re-Drill & Explosives Loading Procedure

5.1.1. Objective

To provide Supervisors and workers with a procedure, which will ensure the safety of all personnel on or near a drill pattern where re-drilling of caved or frozen holes on a loaded pattern is necessary.

5.1.2. Scope

The D&B Supervisor shall be responsible to ensure that the workers are trained and follow the procedures.

The driller is responsible to ensure that the procedures are followed as directed by the D&B Supervisor.

5.1.3. Introduction

This procedure was developed to ensure the safety of all personnel involved or close to the blast area.

5.1.4. Definitions

- D&B: Drill & Blast
- D/B Supervisor: Drill & Blast Supervisor

5.1.5. Preparation

- Requirements: Blasters Certificate, Supervisor Level I
- Tools: Drill, PPE
- Hazards: Charged holes, slips, trips, falls, explosion

5.1.6. Tasks

Table 5.1-1: Re-Drill and Explosive Loading Procedure

Task	Person Responsible
All holes shall be jigged and visually checked in patterns that have the potential for frozen or caved holes, before loading operations commence.	Blaster / Blast helper / D&B Supervisor
Drill holes that are caved and or frozen and that require re-drilling are to be marked out with flagged stakes.	Blaster / Blast helper / D&B Supervisor
Holes noted for re-drilling will be immediately brought to the attention of the blaster in charge and the D/B Supervisor.	Blaster / D&B supervisor
The holes requiring re-drilling will be marked in the daily log and noted on the daily blast hole sheets as re-drilled.	D&B Supervisor
No loading of holes closer than **8** meters to the re-drilling operation shall be permitted except under the direct supervision of the D/B Supervisor.	Blaster
The re-drilling shall take place in a retreat direction; all loading operations shall take place away from the travel direction of the drill.	D&B Supervisor
Only personnel directly involved with the drilling and blast hole loading activities are to be within 30 meters of re-drilling operations.	Blaster / D&B Supervisor
No surface delays or detonating cord is to be present within the blast pattern during re-drilling operations.	D&B Supervisor
All down hole Nonel delay detonator ends are to be neatly bundled and tied to the blast hole stake to ensure visibility and minimize the potential of any inadvertent machinery contact.	Blaster
The D/B Supervisor will ensure that the drill operator and blaster walk through the drill pattern prior to moving the drill onto the pattern. The drill operator will be made aware of any loaded blast holes that may come within **2 m** of the machine.	D&B Supervisor
The D/B Supervisor will advise the drill operator which blaster will guide the drill onto the loaded pattern, for the purpose of re-drilling.	Blaster / D&B Supervisor

The D/B Supervisor will ensure that the drill is guided to the re-drill location and, when drilling is complete, ensure a guide is provided for the route of travel out of the loaded pattern.	D&B Supervisor

5.2. Explosives Management

5.2.1. Objective

To provide Supervisors with a safe and effective standard which will ensure the safety of all employees and equipment.

5.2.2. Scope

The Manager shall appoint a person(s) who is/are qualified, certified and authorized under the Mine Health and Safety Act and Regulations of the Northwest Territories / Nunavut to conduct/supervise all blasting operations on the mine site. The Manager shall also be responsible for authorizing persons to enter the explosive magazine for inspection, receiving and issuing of all explosives materials.

5.2.3. Introduction

The NWT / Nunavut Mine, Health & Safety Act and Regulations require a manager to ensure his charges are working safely in a safe environment and in compliance with the regulations, company policy and procedures.

5.2.4. Preparation

- Hazards: Explosives, detonators, delays
- Tools: Blasters Certificate, Supervisor Level I Certificate, Log Book, broom, Mag key

5.2.5. Tasks

Table 5.2-1: Explosives Management

Task	Person Responsible
Ensure a copy of the explosives magazine permit is posted inside the magazine.	Area Manager
Carry out a weekly inspection of the magazine and record the results in a logbook.	Blast Supervisor
Ensure a record of all explosives issued and received and the inventory of the magazine is kept, and authorized persons sign all entries.	Blaster/ Supervisor
Ensure the magazine is kept clean, dry and free from grit at all times.	Blaster/ Supervisor
Ensure the stock of explosives is rotated so that the oldest stock is used first.	Blaster/ Supervisor
Ensure all signage is visible and in good condition.	Blaster/ Supervisor
Ensure that the magazine is locked at all times except when an authorized person is present.	Blaster/ Supervisor
Ensure all mobile equipment transporting explosives meets or exceed requirements as set out in the Mine Health and Safety Act and Regulations of the NWT / Nunavut.	Blaster/ Supervisor
Ensure appropriate records of each primary blast are kept.	Blaster/ Supervisor
Ensure all warnings, guarding of access routes and clearance of areas has taken place prior to initiating any blasts.	Blaster/ Supervisor
The appointed person has the authority to safely conduct and direct all activities within the blasting area. All employees must support the blaster in exercising this authority.	Blaster/ Supervisor
Ensure all blasters have a valid blasting certificate issued by the Chief Inspector of Mines.	Blaster/ Supervisor
Ensure all persons who are assisting in the preparation or firing of charges is under the direct supervision of a person who is a valid holder of a blasting certificate.	Blaster/ Supervisor
All blasters shall deliver their blasting certificates to the Manager or his designate when commencing employment. The certificate will be returned upon termination with the company.	Blaster/ Supervisor

6. Blasting Protocol and Procedure

6.1. General Protocol

- All blasting operations will follow all protocol of The Northwest Territories / Nunavut Mine Health and Safety Act and Regulations, as well as standard operating procedures from both Baffinland Iron Mines Corporation and subcontractors, whichever is more stringent.
- All records of blasting shall be kept by the Nuna engineering department
- All blasts will be numbered according to location (i.e. quarry number, bench elevation at grade, and individual blast)
- All loaded boreholes will be recorded by survey prior to blasting, and as-built mapping entered into survey database to eliminate possibility of drilling into bootlegs on benches at lower elevations
- Daily records of all holes loaded and explosive products used will be maintained, recorded, and submitted with blast reports
- All blast design will be subject to change and improvement, as site specific geological conditions dictate
- Wall control issues will be negligible with the plan of day lighting all benches
- Standard Operating Procedures regarding drilling proximity to bootlegs or misfired holes will be reviewed with all drilling and blasting crews and adhered to for all drilling and blasting operations.
- All production holes are to be drilled vertically, to ensure the integrity of projected bootleg locations
- Borehole liners are to be used for wet or fractured areas

6.2. Guarding Typical Quarry Excavation

It is imperative that the guards follow the instructions and not leave their assigned area until told so by the Drill & Blast Supervisor. The positions assigned will be outside the Blast Danger Area as determined by the Drill & Blast Supervisor / Blaster.

In addition to the guards posted at strategic locations around the blast area, flashing strobe light warning signs are recommended to be placed at the outer perimeter of the

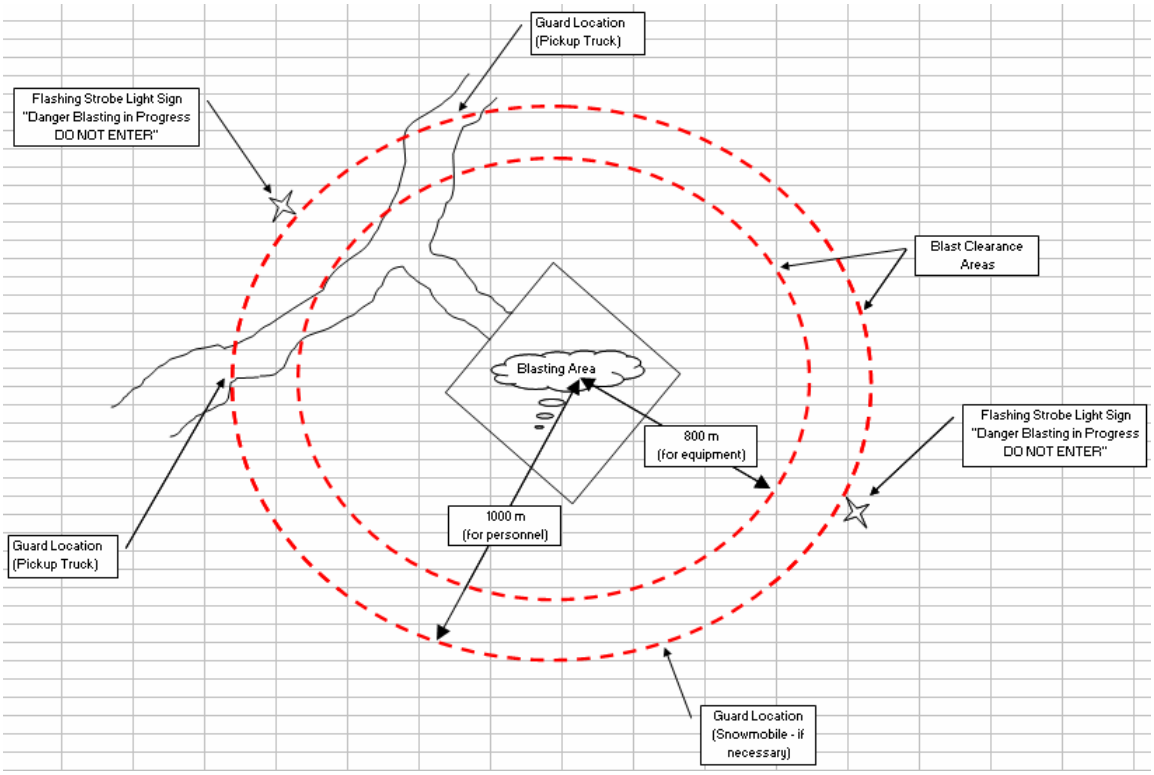
blasting danger area. The signs shall be deployed prior to the initiation of each blast, and collected afterwards.

While guarding a blast area, the vehicle window facing the “tundra” side must be rolled down slightly. The vehicle must be turned off and put in auxiliary such that the radio remains functional (alternatively: use a hand held radio).

All blasting will be scheduled during daylight hours. Due to the possibility of shallower cuts, the blasting clearance zones have been increased to 1000 m and 800 m for personnel and equipment respectively.

A typical guarding schematic is as follows:

Figure 6-1: Typical Blast Guarding Layout



6.3. Guarding Procedure

6.3.1. Objective

To provide the Drill & Blast (D&B) Supervisor with a safe and effective procedure for guarding of a blasting operation.

6.3.2. Scope

The D&B Supervisor is responsible to ensure that all employees engaged in the guarding procedure are trained and understand their duties.

The employees assigned the task of guarding are responsible to follow this procedure as directed by the D&B Supervisor.

6.3.3. Introduction

As per NWT / Nunavut Mine Health and Safety Act and Regulations, these precautions are required.

6.3.4. Definitions

- D&B Supervisor: Drill & Blast Supervisor

6.3.5. Preparation

- Tools: PPE
- Hazards: Slips, Trips, Falls, Personal injury or death

6.3.6. Tasks

Table 6.3-1: Requirements and Responsibilities for guarding a blast

Task	Person Responsible
The D&B Supervisor, in consultation with the Operations Supervisor, will be responsible for appointing all guards and ensuring each guard is fully versed in their responsibilities	Drill & Blast Supervisor / Operations Supervisor
The D&B Supervisor is responsible for establishing the limits of the danger zone and the guard post locations.	Drill & Blast Supervisor
Upon notification from the D&B Supervisor, all guards will ensure their assigned areas are clear of all personnel and equipment and proceed to their designated guard posts.	Drill &Blast Supervisor / Guards
All guards will notify the D&B Supervisor when they have arrived at their assigned positions, and give a status report of their assigned area.	Drill & Blast Supervisor / Guards
No guard shall leave their position or allow any person to enter the blast area until the D&B Supervisor gives the “All Clear”	Drill & Blast Supervisor
The D&B Supervisor will ensure all guards are in their assigned location.	Drill & Blast Supervisor
The D&B Supervisor will then proceed with the blast as per SOP #202.	Drill & Blast Supervisor
Following the blast, the D&B Supervisor will announce on the radio, the “All Clear” message. All guards will be removed, crews can return to work in the blast area and regular radio communications can recommence	D&B Supervisor

6.4. Blasting Procedure

6.4.1. Objective

To provide the Drill & Blast (D&B) Supervisor with a Pre-Blast, Guarding and a Post Blast procedure that will ensure the safety of all personnel and equipment

6.4.2. Scope

The D&B Supervisor shall ensure that all workers who are assigned the duties of a guard during the blasting operations are trained and understand this procedure.

The workers who are assigned guarding duties during the blasting operations will follow this procedure as directed by the D&B Supervisor.

6.4.3. Introduction

This standard operating procedure is to be used to ensure all employees involved, are trained to understand the blasting procedure

6.4.4. Definitions

- D&B Supervisor: Drill and Blast Supervisor

6.4.5. Preparation

- Tools: PPE, Portable radio, Electric blasting cap, Detonating cord, Blasting wire, Blasting machine
- Hazards: Slips, Trips, Falls, Personal injury of death; Premature detonation

6.4.6. Tasks

Table 6.4-1: Requirements and Responsibilities for initiation of a Blast Pattern

Task	Person Responsible
The D&B Supervisor will notify all employees of the impending blasting times during the daily crew line up at the beginning of each shift.	Drill & Blast Supervisor
The D&B Supervisor will ensure that the daily blasting times are posted at quarry entrances 2 hours before the blasting operation is conducted	Drill & Blast Supervisor
The D&B Supervisor will give a 2 hour blast warning, by radio , to the following people: Medic, Operations Supervisor, and Safety Supervisor. Each of these people will acknowledge, by radio, that they have received and understood the 2 hour blast warning.	Drill & Blast Supervisor
The Medic will contact the following to give them notification of the upcoming blast: the Baffinland Iron Mines Corporation Office and the Airport Operations Office.	Medic
The Operations Supervisors will instruct all workers and equipment operators to evacuate the blasting area at the appropriate time.	Operations Supervisor
The D&B Supervisor, in consultation with the blaster, will determine the “Blast Danger Zone”	Drill & Blast Supervisor / Blaster
The D&B Supervisor, in consultation with the Operations Supervisor, will assign required personnel the duties of guards during the blasting procedure.	Drill & Blast Supervisor / Operations Supervisor
The D&B Supervisor, in consultation with the Operations Supervisor, will designate the areas to be guarded	Drill & Blast Supervisor / Operations Supervisor
The Guards will follow the instructions of the D&B Supervisor as per the SOP	Guards
The D&B Supervisor will give a 10 minute blast warning, by radio, to the following people: Medic, Operations Supervisor, and Safety Supervisor. Each of these people will acknowledge, by radio, that they have received and understood the 10 minute blast warning.	Drill & Blast Supervisor

The D&B Supervisor will inspect the Blast Danger Zone and instruct the blaster to begin the pre-blast procedure when the Blast Danger Zone has been cleared of personnel and equipment. The Blaster will lay out the shooting line (detonating cord) from the pattern initiating point to a location approximately 100 m from the blaster's firing location	Drill &Blast Supervisor
The Blaster will connect an electric blasting cap to the detonating cord, and then roll out the 100 m of blasting wire from the blasting cap to a safe firing location, ensuring that the blasting wire is kept clear of electrical sources. The blaster will notify the D&B Supervisor when the blast is ready to be initiated.	Blaster
The D&B Supervisor will give a 2 minute blast warning, by radio, to the Operations Supervisor. The Operations Supervisor will acknowledge, by radio, that he has received and understood the 2 minute blast warning.	Drill & Blast Supervisor / Operations Supervisor
The D&B Supervisor will ensure that the blast warning signal siren is sounded for 1 full minute	Drill &Blast Supervisor
At the completion of the 1 minute siren warning, the D&B Supervisor will instruct the blaster to proceed with the initiation of the blast.	Drill & Blast Supervisor / Blaster
The D&B Supervisor will ensure that the all-clear siren is sounded for 20 seconds and announce that regular radio communications may resume.	Drill & Blast Supervisor
The D&B Supervisor will notify the following people of completion of blasting activities: Medic, Operations Supervisor, and Safety Supervisor. Each of these people will respond that they have received and understood the blasting activities are complete.	Drill &Blast Supervisor / Medic
The D&B Supervisor will instruct all guards to resume their regular duties	Drill & Blast Supervisor

6.5. Misfires or Cut-off Holes

6.5.1. Objective

To establish a procedure to ensure all misfires/cut-off holes are handled safely and all blasting personnel are fully trained prior to commencing this task.

6.5.2. Scope

The Drill/ Blast Supervisor shall be responsible for ensuring the blaster follows all safe work practices when performing work on misfired or cut-off holes. These procedures will be reviewed annually or updated when required.

The blaster is responsible to follow this procedure as required by the D/B Supervisor.

6.5.3. Introduction

The NWT / Nunavut Mine Health Safety Act and Regulations require all personnel be adequately trained to do their jobs safely, inspect their worksite or machinery and understand the lock out procedure and fire prevention apparatus and use.

6.5.4. Definitions

- Bootleg: Part of a drilled blast hole that remains when the force of the explosion does not break the rock completely to the bottom of the hole.
- D/B Supervisor: Drill & Blast Supervisor

6.5.5. Preparation

- Tools: PPE
- Hazards: Slips, trips, and falls, personal injury or death

6.5.6. Tasks

Table 6.5-1: Misfires or Cut-off Holes

Task	Person Responsible
All workers on a blast pattern will be fully trained in all procedures associated with misfires/cut-off holes.	Workers
Before drilling is commenced, the blaster shall walk the complete pattern to check for any misfire/cut-off holes. The blaster will look for any signs of explosives or lack of ground movement that might indicate a misfire or cut-off hole.	Blaster
No person shall drill in loose rock produced by blasting unless the rock has been thoroughly examined by the blaster for explosives, the pattern has been designed to prevent the overlaying of holes and where a hole is discovered containing explosives, drilling will not be closer than 5 m from the hole.	Driller / Blaster
The D/B Supervisor and driller shall not drill or allow drilling to be conducted within 1 m of any part of a bootleg on a blasting pattern or within 5 m of a misfired hole, a cut-off hole or a hole containing explosives.	D/B Supervisor / Blaster
Where an explosive charge has been misfired or cut-off, no work may be performed in the area other than that required making the area safe.	D/B Supervisor / Blaster
All holes must be inspected for detonators or explosives, the blasting area will remain guarded and the hole re-blasted.	Blaster
Once the hole has been cleaned out, the hole may be re-charged, re-stemmed and blasted	Blaster
A hole may be re-drilled for the purpose of re-blasting a missed hole once a Supervisor has determined, after consultation with the driller, the location angle and depth of the hole to be drilled.	D/B Supervisor / Driller
The D/B Supervisor shall supervise the drilling of the hole.	D/B Supervisor
The new hole shall not be closer than 5 m to any part of the missed hole.	Driller
The only explosives that can be removed by washing or lancing from a misfired or cut-off hole include ANFO or slurry/emulsion.	D/B Supervisor / Blaster

The blast pattern shall not be abandoned until it has thoroughly been examined for the presence of explosives in misfired or cut-off holes.	Blaster
Note: If the blaster suspects a misfire, wait ten minutes, and then proceed to check the blast area.	Blaster

7. Excavating Blasted Muck

7.1. Dig Limits for Loading Equipment

7.1.1. Objective

To provide Supervisors and Equipment Operators with a procedure that will enhance safe-working conditions when mucking to a Loaded Blast Face.

7.1.2. Scope

The Supervisor is responsible to ensure that all Loading Equipment Operators (Backhoe, Face Shovel and Wheel Loaders) are trained and understand this procedure.

All Loading Equipment Operators are responsible to follow the procedure as directed by the Supervisor.

7.1.3. Introduction

NWT / Nunavut Mine Health and Safety Act and Regulations: require all personnel be adequately trained to do their jobs safely, inspect their work site or machinery and understand the lock out procedure and fire prevention apparatus and use.

7.1.4. Preparation

- Hazards: Slips, Trips, and Falls
- Tools: Metric measuring tape, red fluorescent paint, survey instrument, stakes, hammer, PPE

7.1.5. Tasks

Table 7.1-1: Requirements and Responsibilities for mucking into a loaded blast face

Task	Person Responsible
Prior to loading material from any blasted muck pile, the Supervisor will inspect the blasted area. He will consult with the Drill & Blast Supervisor, to ascertain if there is a charged blast pattern adjacent to the Blasted Material.	Supervisor
The Drill & Blast Supervisor will measure 8 meters perpendicular in front of each charged blast hole in the direction of the blasted material that is to be loaded and position red fluorescent pylons (construction cones) parallel to the charged blast holes.	D&B Supervisor/ Surveyor
The Supervisor is responsible for ensuring that the "Dig Limits" Pylons are in place before loading operations commence.	Supervisor
When facing up the Loading Equipment Operators must stop at the pylons. If a pylon falls down the muck pile the operator must inform the Supervisor immediately. The Loading Equipment will then move laterally to continue progressive loading of the muck pile.	Operator

Appendix C

Analytical Certificates – ABA Results, Metals Results, NAG Leachate Results and Borehole Log

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Modified ABA (Price 1997)

Baffinland Iron Mines Corp
Attn : Jim Millard

1016-120 Adelaide Street West
Toronto, ON, M5H 1T1
Canada

Phone: 416-364-8820
Fax:pdf

Wednesday, November 02, 2011

Date Rec. : 25 October 2011
LR Report: **CA10403-OCT11**
Reference: PO13013

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Analysis	15: QTR13	16: QS3A	17: Q50+000	18: Q138+000	19: Q25+500	20: QMR2	21: Q53+700	22: Q82+700	23: Q0+500	24: Q14+600	25: Q42+000	26: Q44+000	27: Q56+750
Paste pH [units]	9.67	9.85	9.87	9.61	9.84	9.95	9.88	9.53	8.68	10.02	9.48	9.63	9.91
Fizz Rate [---]	1	1	1	1	1	1	1	1	1	1	1	1	1
Sample weight [g]	2.02	2.02	2.01	1.99	1.96	2.04	1.98	2.02	1.95	1.98	2.01	2.04	2.00
HCl added [mL]	20.00	24.30	20.00	20.00	20.00	20.00	20.00	20.00	37.60	20.00	20.00	20.00	20.00
HCl [Normality]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH [Normality]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH to [pH=8.3 mL]	17.80	18.30	15.67	15.31	17.33	17.99	15.89	18.10	22.09	15.79	16.44	18.21	16.95
Final pH [units]	1.12	1.61	1.20	1.26	1.17	1.13	1.37	1.07	1.73	1.24	1.32	1.12	1.16
NP [t CaCO3/1000 t]	5.4	14.9	10.8	11.8	6.8	4.9	10.4	4.7	39.8	10.6	8.9	4.4	7.6
AP [t CaCO3/1000 t]	0.31	5.22	0.31	0.31	0.31	0.31	2.81	0.31	0.31	0.31	38.0	0.31	0.31
Net NP [t CaCO3/1000 t]	5.1	9.7	10.5	11.5	6.5	4.6	7.6	4.4	39.5	10.3	-29.1	4.1	7.3
NP/AP [ratio]	17.4	2.9	34.8	38.1	21.9	15.8	3.7	15.2	128	34.2	0.23	14.2	24.5
Sulphur (total) [%]	< 0.005	0.222	0.026	0.034	< 0.005	0.020	0.141	< 0.005	< 0.005	< 0.005	1.44	< 0.005	< 0.005
Acid Leachable SO4-S [%]	<0.01	0.06	0.03	0.03	<0.01	0.02	0.05	<0.01	<0.01	<0.01	0.22	<0.01	<0.01
Sulphide [%]	< 0.01	0.17	< 0.01	< 0.01	< 0.01	< 0.01	0.09	< 0.01	< 0.01	< 0.01	1.22	< 0.01	< 0.01
Carbon (total) [%]	0.031	0.030	0.038	0.061	0.030	0.016	0.030	0.007	0.039	0.024	0.022	< 0.005	0.017
Carbonate [%]	0.025	0.028	0.039	0.099	0.021	< 0.005	0.031	< 0.005	0.092	0.005	< 0.005	< 0.005	< 0.005

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*NP (Neutralization Potential)

$$= \frac{50 \times (N \text{ of HCL} \times \text{Total HCL added} - N \text{ NaOH} \times \text{NaOH added})}{\text{Weight of Sample}}$$

*AP (Acid Potential) = % Sulphide Sulphur x 31.25
*Net NP (Net Neutralization Potential) = NP-AP
NP/AP Ratio = NP/AP
*Results expressed as tonnes CaCO3 equivalent/1000 tonnes of material
Samples with a % Sulphide value of <0.01 will be calculated using a 0.01 value.

Sulphur analysis performed following BC ARD Guidelines (Price 1997)

Brian Graham B.Sc.
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Environmental Services, Analytical

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Tuesday, November 01, 2011

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Date Rec. : 25 October 2011
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Sample ID	Sample weight g	Vol H2O2 mL	Final pH units	NaOH Normality	Vol NaOH to PH 4.5 mL	Vol NaOH to PH 7.0 mL	NAG (pH 4.5) kg H2SO4/tonne	NAG (pH 7.0) kg H2SO4/tonne
3: Analysis Approval Date	01-Nov-11	01-Nov-11	01-Nov-11	01-Nov-11	01-Nov-11	01-Nov-11	01-Nov-11	01-Nov-11
4: Analysis Approval Time	13:07	13:07	13:07	13:07	13:07	13:07	13:07	13:07
5: Q131+100	1.5	150	6.79	0.10	0.00	0.12	0.0	0.4
6: Q7+500-P	1.5	150	7.07	0.10	0.00	0.00	0.0	0.0
7: Q4+100	1.5	150	6.87	0.10	0.00	0.12	0.0	0.4
8: QTR-9	1.5	150	3.25	0.10	1.20	2.50	4.0	8.3
9: Q45+000	1.5	150	7.42	0.10	0.00	0.00	0.0	0.0
10: Q10+250	1.5	150	6.68	0.10	0.00	0.43	0.0	1.4
11: Q44+300	1.5	150	7.19	0.10	0.00	0.00	0.0	0.0
12: Q38+700	1.5	150	4.02	0.10	0.21	0.54	0.7	1.8
13: Q88+800	1.5	150	6.68	0.10	0.00	0.41	0.0	1.4
14: Q52	1.5	150	7.02	0.10	0.00	0.00	0.0	0.0
15: QTR13	1.5	150	7.08	0.10	0.00	0.00	0.0	0.0
16: QS3A	1.5	150	5.00	0.10	0.00	0.30	0.0	1.0
17: Q50+000	1.5	150	7.47	0.10	0.00	0.00	0.0	0.0
18: Q138+000	1.5	150	7.71	0.10	0.00	0.00	0.0	0.0
19: Q25+500	1.5	150	7.20	0.10	0.00	0.00	0.0	0.0
20: QMR2	1.5	150	6.77	0.10	0.00	0.23	0.0	0.8
21: Q53+700	1.5	150	5.49	0.10	0.00	0.25	0.0	0.8
22: Q82+700	1.5	150	6.55	0.10	0.00	0.45	0.0	1.5
23: Q0+500	1.5	150	7.66	0.10	0.00	0.00	0.0	0.0
24: Q14+600	1.5	150	7.23	0.10	0.00	0.00	0.0	0.0
25: Q42+000	1.5	150	2.56	0.10	6.26	8.49	21.0	28.5
26: Q44+000	1.5	150	6.48	0.10	0.00	0.78	0.0	2.5
27: Q56+750	1.5	150	7.01	0.10	0.00	0.00	0.0	0.0
28: Q14+500-1	1.4	150	6.66	0.10	0.00	0.62	0.0	2.1
29: Q18+100	1.5	150	5.80	0.10	0.00	1.62	0.0	5.4
30: Q51	1.5	150	8.61	0.10	0.00	0.00	0.0	0.0
31: Q116+800	1.5	150	6.54	0.10	0.00	0.16	0.0	0.5
32: Q35+500	1.5	150	8.55	0.10	0.00	0.00	0.0	0.0
33: QTR-12	1.5	150	2.95	0.10	2.45	4.13	8.0	13.5
34: Q22+500	1.5	150	7.25	0.10	0.00	0.00	0.0	0.0
35: QTR-4	1.5	150	6.84	0.10	0.00	0.19	0.0	0.6
36: NTUN-DH-01	1.5	150	6.75	0.10	0.00	0.23	0.0	0.7

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Sample ID	Sample weight g	Vol H2O2 mL	Final pH units	NaOH Normality	Vol NaOH to PH 4.5 mL	Vol NaOH to PH 7.0 mL	NAG (pH 4.5) kg H2SO4/tonne	NAG (pH 7.0) kg H2SO4/tonne
37: NTUN-DH-03	1.5	150	6.99	0.10	0.00	0.09	0.0	0.3
38: STUN-03	1.5	150	6.78	0.10	0.00	0.20	0.0	0.7
39: SI-OLD-005	1.5	150	6.80	0.10	0.00	0.24	0.0	0.8
40: SI-OLD-007	1.5	150	6.83	0.10	0.00	0.20	0.0	0.6

NAG = (49 x Vol. of base x N of base)/sample weight
kg H2SO4/tonne

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Mercury [µg/g]	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Gold [µg/g]	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02
Silver [µg/g]	0.06	0.15	0.08	0.10	0.05	0.13	0.08	0.11	0.09	0.03	0.33	0.02	0.03
Aluminum [µg/g]	3400	18000	9100	9300	6700	6000	21000	4900	55000	6800	12000	4100	10000
Arsenic [µg/g]	< 0.5	0.7	0.6	< 0.5	< 0.5	0.8	< 0.5	0.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Barium [µg/g]	12	170	75	120	58	8.1	95	19	52	8.2	45	14	35
Beryllium [µg/g]	0.06	0.17	0.14	0.28	0.22	0.35	0.16	0.23	1.6	0.12	0.26	0.27	0.15
Bismuth [µg/g]	< 0.09	0.41	< 0.09	< 0.09	< 0.09	0.13	< 0.09	< 0.09	< 0.09	< 0.09	0.14	< 0.09	< 0.09
Calcium [µg/g]	940	1350	4400	4800	1900	370	1400	310	33000	7800	3200	340	1800
Cadmium [µg/g]	< 0.02	0.03	0.02	< 0.02	< 0.02	0.06	0.03	0.02	0.24	< 0.02	< 0.02	< 0.02	< 0.02
Cobalt [µg/g]	0.63	21	5.6	7.7	2.7	1.7	15	1.9	36	6.1	25	1.4	5.5
Chromium [µg/g]	40	210	69	64	39	60	120	64	100	140	53	28	59
Copper [µg/g]	3.6	73	17	14	5.4	13	39	33	68	4.0	580	4.8	4.6
Iron [µg/g]	8300	42000	15000	26000	11000	7800	52000	8000	84000	10000	48000	10000	20000
Potassium [µg/g]	2400	13000	8000	8300	4900	5200	20000	2400	11000	1600	7400	2100	8200
Lithium [µg/g]	5	24	17	29	26	9	23	9	38	5	19	5	21
Magnesium [µg/g]	340	16000	6500	7100	3900	3600	14000	2200	59000	8400	8100	2200	5800
Manganese [µg/g]	89	130	290	180	200	180	480	65	610	150	320	74	260
Molybdenum [µg/g]	1.1	2.2	0.6	1.0	0.7	1.0	1.2	0.9	0.3	0.4	0.7	0.6	0.7

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Sodium [µg/g]	980	1300	1200	1200	1200	690	1000	750	290	1200	1200	700	990
Nickel [µg/g]	3.6	83	25	9.7	6.7	2.5	43	2.6	73	41	86	3.9	6.8
Phosphorus [µg/g]	11	75	890	1000	180	62	66	56	15000	67	160	61	240
Lead [µg/g]	3.7	6.6	8.3	5.3	6.9	14	22	8.2	3.2	0.66	4.1	2.0	6.1
Antimony [µg/g]	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Selenium [µg/g]	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	1.5	< 0.7	< 0.7
Tin [µg/g]	< 0.5	1.3	0.8	0.9	< 0.5	< 0.5	1.9	< 0.5	2.1	< 0.5	0.8	< 0.5	0.8
Strontium [µg/g]	2.83	3.18	20	14	10.00	1.94	4.20	2.57	15	6.19	4.62	2.73	5.97
Titanium [µg/g]	47	4200	1100	1700	590	410	3400	140	4200	380	1900	56	1600
Thallium [µg/g]	0.02	0.81	0.35	0.34	0.33	0.32	1.00	0.04	0.49	0.06	0.50	0.03	0.46
Uranium [µg/g]	5.6	1.5	0.46	1.1	0.46	8.2	1.3	1.9	11	0.41	0.64	1.5	7.7
Vanadium [µg/g]	< 1	140	18	40	12	< 1	80	2	180	20	41	5	22
Yttrium [µg/g]	1.7	1.3	16	5.8	3.6	6.6	2.9	3.6	15	1.3	3.5	4.9	5.7
Zinc [µg/g]	9.5	75	31	38	30	24	75	11	59	15	42	12	41
Weight [g]	697	704	614	556	603	621	625	567	545	623	539	559	643

Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

OnLine LIMS

RECORD OF BOREHOLE QMR-2

PROJECT : Mary River Project
LOCATION : Mary River - Quarry
STARTED : August 7, 2011
COMPLETED : August 7, 2011

Project No. 19-1605-126

DRILLER: BOART LONGYEAR, LM-55
N 7 914 203 E 560 128

SHEET 1 OF 2
DATUM: CGVD28

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	RECOVERY %	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (50 100 150 200 250)	EXCESS ICE CONTENT, PERCENT (ice; 10 20 30 40) / WATER CONTENT, PERCENT (wp w wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	THERMISTER/ GROUND COND.
		GROUND SURFACE		0.00								
		COBBLES (< 100mm), granitic, fines washed out									FI	FROZEN
				0.90							1	UNFROZEN
1		**GRANITIC GNEISS**, grey, slightly weathered to fresh, very strong, quartz-rich			1	RUN			TCR=70% SCR=70% RQD=70%		1	UNCERTAIN
											1	
2											1	
3											1	
					2	RUN			TCR=100% SCR=100% RQD=95%		1	
4											1	
											1	
											1	
5											1	
6											1	
					3	RUN			TCR=100% SCR=100% RQD=100%			
7											1	
8											2	
											3	
											1	
9											1	
					4	RUN			TCR=100% SCR=100% RQD=90%			
10											1	
											1	
11											1	
											1	
12												
					5	RUN			TCR=100% SCR=100% RQD=99%			
13											1	
											1	
14		some quartz veins (100mm)									1	
											1	
15											1	
					6	RUN			TCR=100% SCR=100% RQD=94%			
16												
											2	
17		large plagioclase crystal at 17.0m to 17.69m									2	
											2	
											2	
18											2	
					7	RUN			TCR=97% SCR=97% RQD=93%			
19												

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

DEEP/DUAL INSTALLATION
WATER LEVEL (date)

PRELIMINARY

LOGGED : Boucher/Clarke
CHECKED :

THURBER

THURBER2S(5126) 5126.GPJ 9/30/11

RECORD OF BOREHOLE QMR-2

PROJECT : Mary River Project
LOCATION : Mary River - Quarry
STARTED : August 7, 2011
COMPLETED : August 7, 2011

Project No. 19-1605-126
DRILLER: BOART LONGYEAR, LM-55
N 7 914 203 E 560 128
SHEET 2 OF 2
DATUM: CGVD28

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	SAMPLES: RECOVERY %	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (50 100 150 200 250)	EXCESS ICE CONTENT, PERCENT (ice; 10 20 30 40) / WATER CONTENT, PERCENT (wp w wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	THERMISTER/ GROUND COND.
21					8	RUN			TCR=100% SCR=100% RQD=100%			
22												
23											1	
24					9	RUN			TCR=100% SCR=100% RQD=94%		6	
25												
26		END OF BOREHOLE AT 26.00m.		26.00								
27												
28												
29												
30												
31												
32												
33												
34												
35												
36												
37												
38												
39												

THERMISTER/ GROUND COND.: FROZEN; UNFROZEN; UNCERTAIN

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

DEEP/DUAL INSTALLATION
WATER LEVEL (date)

PRELIMINARY

LOGGED : Boucher/Clarke
CHECKED :

THURBER

THURBER2S(5126) 5126.GPJ 9/30/11