Baffinland Iron Mines Corporation
Mary River Project

Quarry Management Plan Milne Inlet Quarry (Q1)

2013-03-06	0	Approved for Use	J. Keech	T. Mackay	J. Binns	J. Millard
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**	**Approved By**
HATCH						**Client**

Revision History

Revision No.	Section	Revision Date	Changes	Approval
C	Document Wide	March 6th, 2013	Document H337697-7000-07-126-0003 has been superseded by H349000-1000-07-126-0013. Revision succession has been kept for continuity	T. Mackay
C	Document Wide	March 6th, 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	March 6th, 2013	Quarry volume increased to 600,000m^3.	J. Millard
C	Section 2	March 6th, 2013	Project organization chart and structure updated.	J. Millard
C	Section 2.4.1	March 6th, 2013	Enhanced review of assessment for acid rock drainage.	J. Millard
C	Section 2.4.3	March 6th, 2013	Enhanced review of assessment drainage management.	J. Millard
C	Section 3	March 6th, 2013	Supporting management plans updated.	J. Millard
C	Appendix A	March 6th, 2013	Commercial Lease No Q10C3001- Existing Quarry Concession Agreement & Schedule A-1 - Lease Boundaries added.	J. Millard
C	Appendix B	March 6th, 2013	Quarry (Q1) drainage drawing added.	J. Millard
C	Appendix C	March 6th, 2013	Contractor's Blasting Operations Management Plan added.	J. Millard
C	Appendix D	March 6th, 2013	Tote Road Quarry and Borrow Pit Sampling Report added.	J. Millard

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1. Introduction

The Mary River Iron Ore Project requires sufficient aggregate resources to satisfy the requirements for the project infrastructure during the construction phase of the project. This document outlines the Site Description, Operations and Reclamation for the Milne Inlet Quarry (Q1).

1.1 Need for an Operations Plan

The guidelines provided by the Nunavut Impact Review Board (NIRB) and Aboriginal Affairs and Northern Development Canada (AANDC) 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:
   a) The volume being applied for is greater than 1,000 m^3 and/or
   b) The quarry site is being operated by multiple users.

The proposed quarry at Milne Port will exceed the volume threshold of 1000 m^3, and a plan is required. This plan should be used in conjunction with Borrow Pit and Quarry Management Plan, and other plans referred to in the document. In the case of the Q1 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 or new commercial 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 to Baffinland Iron Mines Corporation, Final Environmental Impact Statement, 2012, Volumes 6, 7, and 8. The Q1 quarry is currently a designated rock quarry (Rock Quarry No. 1) in Schedule B, Quarry Concession Agreement under existing QIA Commercial Lease No. Q10C3001 (Please refer to Appendix A).

1.2.1 Site Physical Description

The extent of the Milne Inlet Quarry (Q1) as designated in the existing Quarry Concession Agreement under QIA Commercial Lease Q10C3001 is shown in Schedule A1 of the existing commercial lease (Appendix A). A more detailed plan of the extent of the quarry concession boundaries as well as the maximum extent of planned quarry development is shown in Figure B.1 (Appendix B). The basic quarry specifics are shown in Table 1 below:

Table 1: Milne Inlet Quarry (Q1) Specifications

Requirement	Description
NTS Map Sheet (1:50,000)	• 37 H/16 Edition 1 ASE Series A 713
Quarry Concession Coordinates (UTM)	• 504192E 7975079N (centre point) • 503725E 7975078N (W extent) • 504830E 7975176N (E extent) • 504527E 7974191N (S extent) • 503889E 7975727N (N extent)
Total Area of Quarry Concession from Schedule A.1 from existing Commercial Lease Q10C3001 (Appendix A)	• 89.47 ha
Area of Proposed Quarry to to be developed	• Figure B.1, Appendix B, shows the quarry development extents • Area 64,200m^2
Total Volume of Material to be Quarried	• 600,000 m^3
Area of Clearing	• No clearing is required as site is primarily exposed bedrock
Topsoil/Overburden Storage Area	• None is required as site is primarily exposed rock
Access Roads/Trails	• The Milne Inlet Tote Road currently cuts through the southwestern corner of quarry concession, adjacent to the area to be quarried. As part of the project, a temporary access road will be constructed as approximately shown in Figure B.1, Appendix B.
Camp Locations	• No camp will be built specifically for the quarry operation. Personnel will be housed at the expanded Milne Inlet camp

Topography varies considerably across the Project area. The dominant landforms in the Milne Inlet area are typically a result of glacial activity, marine and mechanical forms in various degrees. Glacial activity is not overly apparent on the immediate Milne Port site but is more pronounced in the higher elevations south of the site where the proposed quarry is located. The Milne Port area consists of a series of variably dipping, dissected terraces sloping towards the waters of Milne Inlet. The surficial deposits are marine and glacial marine sediments, ranging from coarse beach sediments (gravel and sand), to finer deltaic sediments (clay, silt, sand, and gravel), to even finer deep water periglacial silt veneers (silt, clay and fine sand). The soils in the area are often covered by a thin layer of organics at the ground surface. The soils were noted to typically be frozen below 2 m depth and locally can contain ice lenses.

The nearest receivers that are considered to be fish habitat, as measured along interpreted flow paths, are between 1.6 and 2.2 km (Northeast to Phillips Creek estuary and North to Milne Inlet) (refer to Figure B.1, Appendix B). There are some small ephemeral channels discharging seasonally into several shallow ponds that are not fish habitat. The streams or oriented generally in a Northwest direction from the planned quarry area.

1.2.2 Environmental Setting

The existing surficial deposits near the quarry site range from coarse beach sediments (gravel and sand) to clay, silt, sand and gravel (Figure 1–1 and Figure 1–2) to even finer silt veneers (silt, clay and fine sand). The soils in the area are often covered by a thin layer of organics at the ground surface, creating a productive growing zone of topsoil for local vegetation.

Vegetation within the Mary River Project area is described in the Vegetation Baseline Study Report in Volume 6 of the FEIS (Appendix 6C). A total of 155 vascular plant species were recorded through the total Project area, a vegetation classification system was developed and a species list was compiled. No plant species considered to be “rare” in Canada were found to occur in the survey locations. Vegetation is present in the area of the proposed quarry, and exists in small patches where organic soil deposits occur along the hill slopes, and within the depressions between hills.

The existing surficial deposits near the quarry site range from coarse beach sediments (gravel and sand) to clay, silt, sand and gravel (Figure 1–1 and Figure 1–2) to even finer silt veneers (silt, clay and fine sand). These soils in the area are often covered by a thin layer of organics at the ground surface, creating a productive growing zone of topsoil for local vegetation.

Figure 1–1: Surface Deposits at Milne Inlet Quarry (Q1) Site

Figure 1–2: View of Quarry Area looking East

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 absent within and near the proposed quarry site, but is relatively abundant to the north and northwest. It should be noted that the Peregrine Falcon habitat is abundant in the area south of Milne Port, although the area itself is rated as not suitable. No major sea bird colonies or nesting areas were identified in the coastal waters near the quarry site.

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 present in the area include polar bear, ringed seal, bearded seal, walrus, beluga whale, and narwhal. With the exception of the polar bear, the quarry site is displaced from shoreline habitat sufficiently to avoid being regarded as suitable habitat.

There are currently no roads, buildings or structures at the site.

2. Environmental Responsibilities

2.1 Roles and Responsibilities

Personnel responsible for the Environment Health and Safety (EHS) on the project are divided into three distinct groups, each with their own representatives and responsibilities. Baffinland Iron Mines Corporation's (Baffinland) senior management is ultimately responsible for all policy creation, while the Baffinland onsite management team is responsible for monitoring and reporting to senior management and regulatory bodies. The respective contractors will each have their own EHS personnel to ensure compliance and implementation of their scope of work with regards to EHS.

These are described in detail in the following sections. For the sake of clarity the focus has been on those roles relevant to environment and site reporting procedures.

The first organizational chart, as shown in Figure 2–1 provides further detail. The second organizational chart in Figure 2–2 demonstrates the communication and reporting lines and responsibilities.

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 based in Baffinland's head office will be responsible for: environmental permitting applications/amendments and regulatory responsibilities, design and implementation of the overall Environmental Management System (EMS) and the Construction Environmental Protection Plan (CEPP), monitoring and baseline studies, and government and community relations. Further responsibilities of the Baffinland's corporate team are summarized in Table 2–1.

Table 2–1: 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 Operation	- 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
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 on-site Baffinland environmental team will be led by an Environmental Manager, reporting to Baffinland's VP Sustainable Development, Health, Safety & Environment. Reporting to the Environmental Manager will be the Environmental Coordinators based at both Milne and the Mine site. In addition there will be Environmental Monitors carrying out sampling, supervision and other tasks at all three areas of operation. There will also be a Construction Manager on-site who will be liaising with the Environmental Manager and reporting to the Project Site Director.

The Baffinland environmental team will be responsible for the implementation of the Environmental Management System, training programs, environmental status reports, leading site visits by regulators, and managing contractors and site inspections. The Company's environmental management staff will oversee all environmental activates on site. Table 2–2 summarizes these responsibilities.

Table 2–2: Baffinland Iron Mines Corporation On-Site Management Team

Baffinland Iron Mines Corporation On-Site Management Team	
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 EHS & Sustainability - Monitors environmental performance of contractors on site - Monitors compliance with permits, licences 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
Environmental Support Group	- Reports to the Environmental Supervisor - Environmental database management - Various sampling, monitoring and reporting activities as required by permits, licences and environmental management plans - Prepare updates to environmental protection plan and management plans
Environmental Monitors	- Reports to the Environmental Superintendent

2.1.1.2 Construction Contractor's Environmental Team

The Construction Contractor will designate a Construction Manager with overall responsibility for environmental management of the contractor's activities. The Construction Manager must be suitably qualified with construction experience and have knowledge of environmental management. In addition to this the Construction Manager will appoint site specific EHS supervisors who will oversee environmental components of the day to day activities on the individual sites. The responsibilities of the Construction Contractors environmental team is summarized in Table 2–3.

Table 2–3: Construction Contractor(s)

Construction Contractor(s)	
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 Superviser	- 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, please refer to Figure 2–1 and Figure 2–2 below. Figure 2–1 shows the organizational structure while Figure 2–2 provides an overview of the communication channels between individuals. The organizational structure is relevant for the entire project.

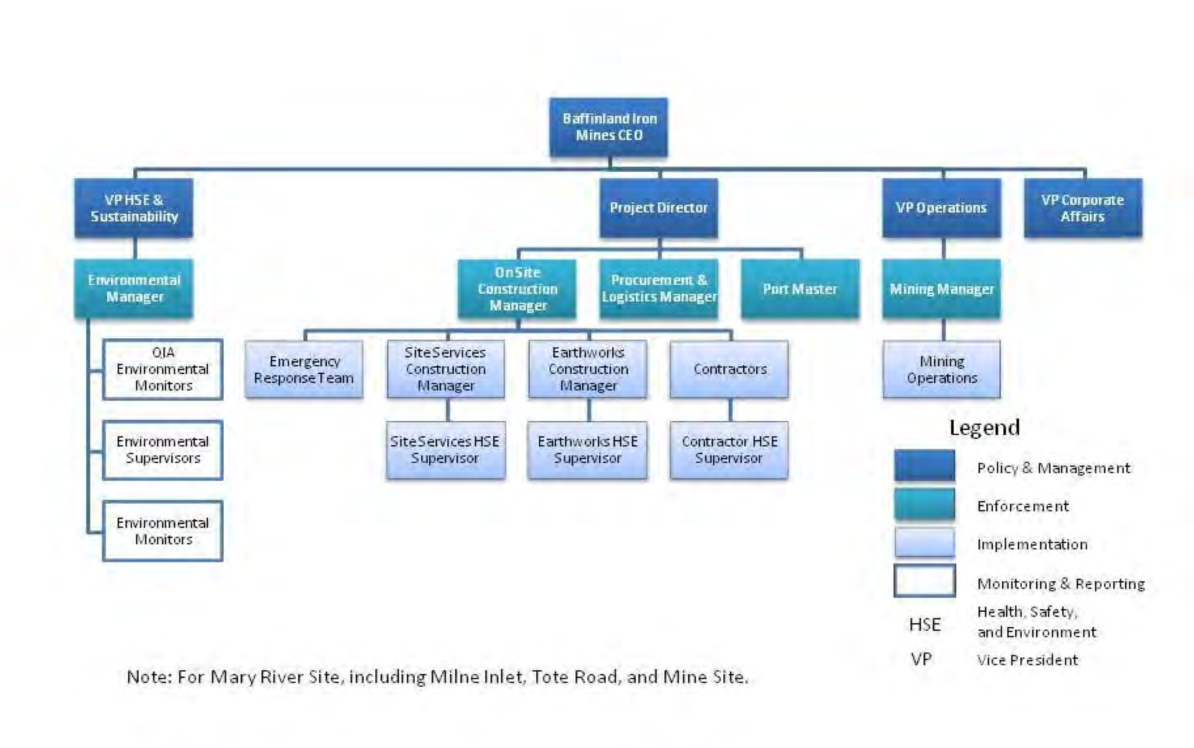


Figure 2–1: Mary River Project Organization Chart

Note: Quarry management responsibilities shall be shared by the Earthworks Contractor and the Site Services Contractor.*

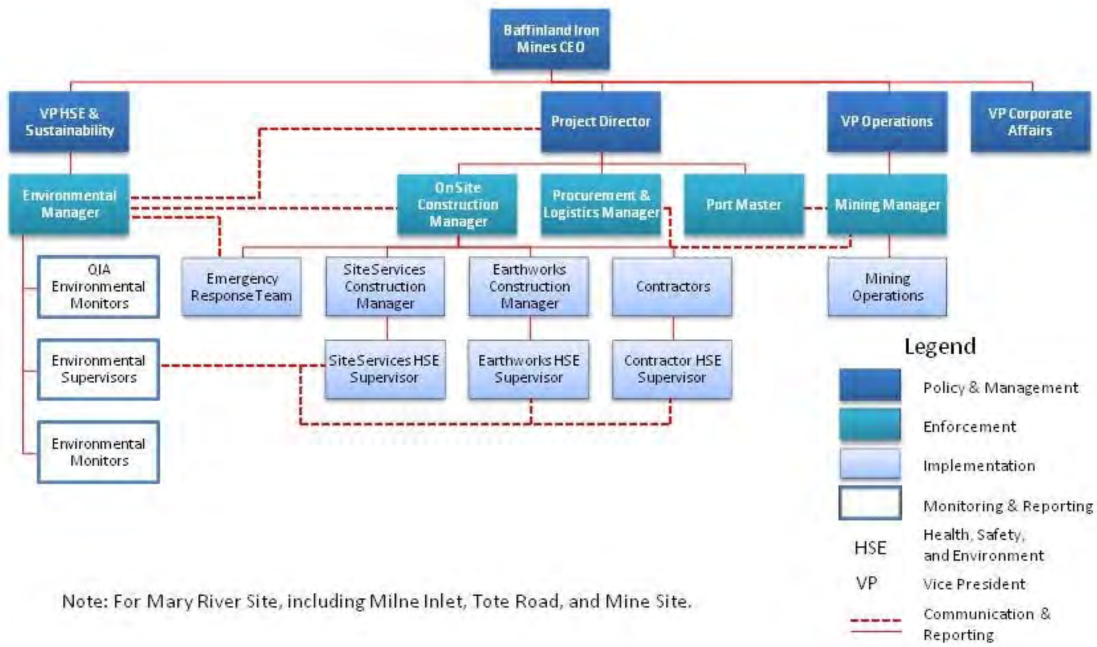


Figure 2–2: Mary River Project Organizational Chart with Communication Channels

2.2 Quarry Set Up and Operation

The quarry will be accessed by the existing Tote Road, which runs adjacent to the southwest corner of the proposed quarry site. The Milne Quarry site will share the portable crushing equipment currently located at the Mary River Camp é Mine Site. Equipment transported to the quarry site will include:

- A portable crushing, screening and cleaning plant (delivered via the Milne Inlet Tote Road from the Mine Site)
- Drilling Equipment
- Rock hauling trucks
- Scrapers
- Excavators
- Blasting Gear.

A small (<50 m^2) 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 Quarrying Activities

The following describes the general activities:

2.3.1 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 C 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 the Milne Inlet Quarry (Q1), during 2013, will consist of pre-packaged explosives with up to 250,000 kg stored at designated magazines in the Milne Inlet 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 have been developed previously by a contractor in the FEIS, Appendix 10C-4. This plan will be updated prior to the start of quarrying operation. A Blasting Operations Management Plan created by NUNA, a construction contractor with experience on the Mary River Project, is provided in Appendix A.

2.3.2 Excavation and Crushing

The entire operation takes place in an area of permafrost, and groundwater is therefore not normally 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 areas cannot be avoided, then they will be stripped and stored separately at the storage area for later re-use. Quarrying will work along the slopes of the quarry site 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.

Blast areas 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 location. Topsoil is present at the site, and would be retained in the stockpiling area for later re-use.

Crushing operations and screening operations will take place during the day shift, seven days per week. The operation will process rock from the quarry, as well as 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.

2.3.3 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 Milne Inlet Quarry (Q1) 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. All employees working on the quarry operation will receive bear awareness and deterrent training. Historically, this has been a low risk area for polar bears.

2.4 Site Management Measures

Best management practices for quarry operations will be followed for the Milne Inlet Quarry. The following management activities will be incorporated into the site operations:

2.4.1 Assessment for Acid Rock Drainage (ARD)

The Milne Inlet Quarry (Q1) 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 along the Tote Road to assess metal leaching and acid rock drainage (ML/ARD). One of the quarries assessed was the Milne Inlet Quarry (Q1). The AMEC report presenting these results is provided in Appendix D. Industry standard methods have confirmed that aggregate materials used will have a low potential for ARD/ML.

2.4.1.1 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 were observed during the site visit and there were no surface areas of visible sulphide oxidation.

2.4.1.2 *Sampling*

One borehole (BH10-04) was advanced to depth of 15 metres. Refer to Figure B-1, Appendix B for the borehole location. Three representative samples of the rock core were sent for laboratory analyses. The intervals for rock sample selection were based on review of available drill logs and photographs. The strategy for sample selection and collection was based upon guidance found in MEND 2009 (Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials). Visual inspection of the core from BH10-04 indicated only the rare presence of sulphide minerals, primarily on fracture surfaces.

2.4.1.3 *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)
- Mineralogy by X-ray diffraction (XRD) with Rietfeld refinement.

2.4.1.4 *Results*

The results of the above analyses for BH10-04 indicate that the bedrock gneiss underlying the Milne Inlet (Q1) quarry development area exhibit the following characteristics:

- Paste pH is weakly alkaline (9.56 to 9.92).
- Sulphide content was less than 0.01% for all samples.
- All samples had neutralization potential ratios (NPR) well in excess of 2. These materials are considered non potentially acid generating.
- Neutralization potential (NP) values were low and ranged from 7.9 to 8.8.
- 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.
- The Rietveld XRD analyses indicated no acid producing sulphide minerals identified, showing consistency with the low Acid Potential (AP) of all the samples analyzed. Calcite was identified in the sample.

2.4.1.5 *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. Regardless, the relatively low NP in the material sampled suggests that the presence of low sulphide could potentially result in ML/ARD conditions.

Based on the conclusions, above, an operational testing program is recommended during the quarry extraction process. It is recommended that to start, approximately one composite sample of quarry material representative of a blast (muck sample or blast hole cuttings) be collected per 10,000 m^3 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.

2.4.1.6 *Future reporting*

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

2.4.2 *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 Blasting Operations 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 C of this document.

2.4.3 *Drainage Management*

The potential exists to alter drainage patterns of overland flow paths and to cause minor affects to local water quality. The hydrological regime around the quarry site has been defined, and the appropriate direction of flows from site will be managed to maintain the natural flow patterns as much as possible. 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. The quarry is currently designed to avoid fish bearing streams. The nearest downstream fish bearing fish bearing receiver is over one kilometre as measured along the interpreted flow paths. A drainage plan showing interpreted flow paths and downstream receivers for Quarry Q1 is presented as Figure B-1, Appendix B.

Sources of contamination from the operation that could affect water quality include dust from blasting and refuelling of equipment. Blasting residue from explosives will be managed by following best practices to ensure that all material is fully consumed 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. Refuelling of stationary onsite equipment, such as generators, will take place in a secured area with approved spill containment.

2.4.4 Dust Management

The primary sources of dust at the Milne Inlet Quarry (Q1) are blasting, loading and crushing and screening of aggregates. Topsoil in limited quantities exists at the site. If areas are to be disturbed, they will avoid windy dry conditions to avoid creating dust. The management of dust will be accomplished by minimizing the creation of dust at source. Crushing activity will take place within or adjacent to the quarry development area, far from surface water fish bearing receivers or dust sensitive areas. 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, an action plan will be developed to mitigate potential risks to receiving waters.

2.4.5 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 and accommodations complex at Milne Inlet Camp.

During quarry operations, monitors will inform the quarry manager if significant wildlife activity, such as caribou movement or other wildlife movement, is occurring. Depending on the observed concentrations and likely effect of the noise generating activity, the on-site environmental supervisor may request that the contractor’s quarry manager may temporarily suspend operations.

2.5 Monitoring

Operation of the Milne Inlet Quarry (Q1) 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.
- Quantification and quality estimates of the granular resource material.
- 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.

Refer to Appendix C, Contractor’s Blasting Operations Management Plan, for the site specific monitoring plan associated with blasting activities.

3. Supporting Management Plans

This plan should be viewed in concert with the following additional plans prepared to support the FEIS and the 2013 Work Plan:

- Emergency Response and Spill Contingency Plan – refer to FEIS, Appendix 10C-1.
- Surface Water and Aquatic Ecosystems Management Plan – refer to FEIS, Appendix 10D-2.
- Explosives Management Plan – refer to FEIS, Appendix 10C-4 (to be updated prior to quarrying).
- 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

The closure and reclamation 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 and reclamation of the quarry will involve removing all materials, equipment and infrastructure and reclaiming the site to a self sustaining productive ecosystem.

4.1 Closure of Active Quarry Face

The active quarry face will be terraced during operation to closely manage issues related to drainage and will not be altered for closure. The quarry development will minimize the creation of pits and depressions to the degree practicable to reduce the potential for standing water. The quarry pit floor will be left as free draining.

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.
- 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 Milne Inlet Quarry (Q1) utilizes the existing Milne Tote Road for access. This road will be rehabilitated under the general Closure and Reclamation Plan for the Mary River Project.

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 established on site. Other contamination, such as heavy metals or toxins, will require containerization for shipping off site to an appropriate facility (refer to Preliminary Mine Closure and Reclamation Plan, FEIS Volume 10: Appendix 10G).

Appendix A

Commercial Lease No Q10C3001- Existing Quarry Concession Agreement

Schedule A-1 - Lease Boundaries

SCHEDULE "B"

QUARRY CONCESSION AGREEMENT

THIS AGREEMENT is made as of the 1st day of November, 2010.

BETWEEN:

QIKIQTANI INUIT ASSOCIATION,
an incorporated society subsisting pursuant to the
Societies Act (Nunavut), and having its registered
office address in the City of Iqaluit, Nunavut,

(hereinafter called the "Landlord")
OF THE FIRST PART;

- and -

BAFFINLAND IRON MINES CORPORATION,
a corporation incorporated pursuant to the
Business Corporations Act (Ontario), and having its registered office
address in the City of Toronto, Ontario, and extra-territorially
registered to carry on business in Nunavut,

(hereinafter called the "Tenant")
OF THE SECOND PART.

THE PARTIES HEREBY AGREE AS FOLLOWS:

1. The Landlord hereby authorizes the Tenant to take up to 50,000 cubic metres of certain Specified Substances, limited to sand and gravel material for the permitted purposes set forth in subsection 4.01(a) of the Lease, from the Lands described as a "Borrow Source", "Rock Quarry" and/or the Tote Road within the Property identified in Plan of Property - Schedule "A" of the Lease, to which this Agreement is annexed as a schedule, or from Lands otherwise agreed to by the Landlord and Tenant (the "Lands"), subject to the terms and conditions set forth in this Agreement.

2. The Tenant agrees that it will not take all of its required quantities of Specified Substances from one (1) site, and will, to the greatest extent practicable, conduct its quarrying activity from several permitted locations for the express purpose of reducing the size of disturbed area at any one (1) location on the Property.

3. Capitalized terms herein have the same meanings as the defined terms set forth in the Lease.

4. This Quarry Concession Agreement expires upon expiry or other termination of the Lease or when the quantity of material specified herein has been quarried or removed, whichever first occurs.

5. The Tenant agrees to pay the Landlord, on a monthly basis, $2.50 per bank cubic metre of actual sand and gravel material used (plus taxes, including, without limitation, Goods and Services Tax, if applicable.

6. This Quarry Concession Agreement is not a lease and does not create or grant any easement, profit a prendre, or any other claim or interest in land.

7. This Quarry Concession Agreement is not assignable and any purported assignment of it or of any rights or privileges hereunder shall be of no force nor effect.

8. All quarrying under this Quarry Concession Agreement shall be carried out in accordance with the terms of the *Mine Health & Safety Act* (Nunavut), as the provisions thereof may apply.

9. The Tenant agrees and acknowledges that the Landlord shall not be liable for any loss or damage to the Tenant, its agents, employees, contractors, licensees or invitees arising from or occasioned by the granting of this Quarry Concession Agreement or any activities pursuant hereto.

10. The Tenant shall indemnify and save the Landlord harmless from and against all manner of suit or action, cause of action, claim, demand, damage, cost, expense or liability for death, personal injury, economic loss, property damage, fines or costs of compliance with any permits, approvals certificates, licenses or orders of any authority of competent jurisdiction arising from or occasioned by any act or omission of the Tenant, its agents, employees, contractors, licensees or invitees (including without limitation any discharge of contaminants) on, or in respect of the Lands or arising out of or occasioned by the granting of the license herein, including, without limitation any liability arising from breach by the Tenant of any municipal, territorial or federal statute, regulation, bylaw, code or policy in force in the Nunavut Territory in respect of land utilization, health and safety, transportation of dangerous goods or environmental protection.

11. The Tenant shall be liable for any damage to the Lands occasioned by its entry and activity on the Lands in accordance with the terms and conditions of the Lease.

12. The Tenant represents and warrants that it is and shall remain in compliance with all federal, territorial and municipal statutes, regulations, bylaws, codes or policies and with the orders and requirements of any competent regulatory authorities, in respect of its entry and actions on the Lands.

13. Prior to the expiration of the term of this Quarry Concession Agreement or when the authorized quantity of material specified is quarried or removed, whichever first occurs, the Tenant shall restore the Lands to their condition as required by the terms and conditions of the Lease.

14. Overburden shall be removed only from the area required for removal of the material specified and shall be preserved for restoration to the excavation area.

15. "Carving stone," means uthugighak and sananguagaq, which means serpentines, argillite and soapstone as defined pursuant to Article 1.1.1 of the Nunavut Land Claims Agreement.

16. The Landlord may revoke this Quarry Concession Agreement and the license granted herein at any time for breach of any term of the Lease or this Agreement.

17. The Tenant shall observe, perform and abide by the Environmental Terms and Conditions, attached as Schedule "E" to the Lease, or by any Best Practices or standards established from time to time in addition thereto or in substitution therefore by the Landlord with ownership of or authority over the Lands pursuant to the Nunavut Land Claims Agreement.

18. In the event that any activity is undertaken on the Property pursuant to any other quarrying license, permit or mineral claim, the Tenant shall obtain the prior written consent of the Landlord before undertaking any operations or changing the location or nature of its operations pursuant to this Agreement and will otherwise coordinate such operations with the Landlord.

19. Prior to the tenth day of each month the Tenant shall submit a report to the Landlord indicating the quantity of material quarried and the quantity of material removed from the site. At the request of the Landlord, the quantity of material quarried that is reported by the Tenant shall be subject to certification (and adjustment of quarry fees) by an independent surveyor/assessor, who shall be acceptable to both parties, at the Tenant's sole cost and expense.

20. The Tenant shall provide any Carving Stone quarried pursuant to the terms of this Quarry Concession Agreement, without charge or fee, to such Inuit carvers in the Qikiqtani Region as the Landlord shall in its discretion determine, and the Tenant shall not provide Carving Stone to any other persons without the consent in writing of the Landlord.

21. This Quarry Concession Agreement is subject to the terms of the Nunavut Land Claims Agreement and to any consent to access or entry order issued pursuant to the terms of Article 21 thereof and to all applicable laws in force in the Nunavut Territory.

IN WITNESS WHEREOF, the parties have executed this Agreement as evidenced by the corporate seal and signatures of the duly authorized signing officers of the parties.

QIKIQTANI INUIT ASSOCIATION

Per: ______________________________
Okalik Eegeesiak, President

c/s

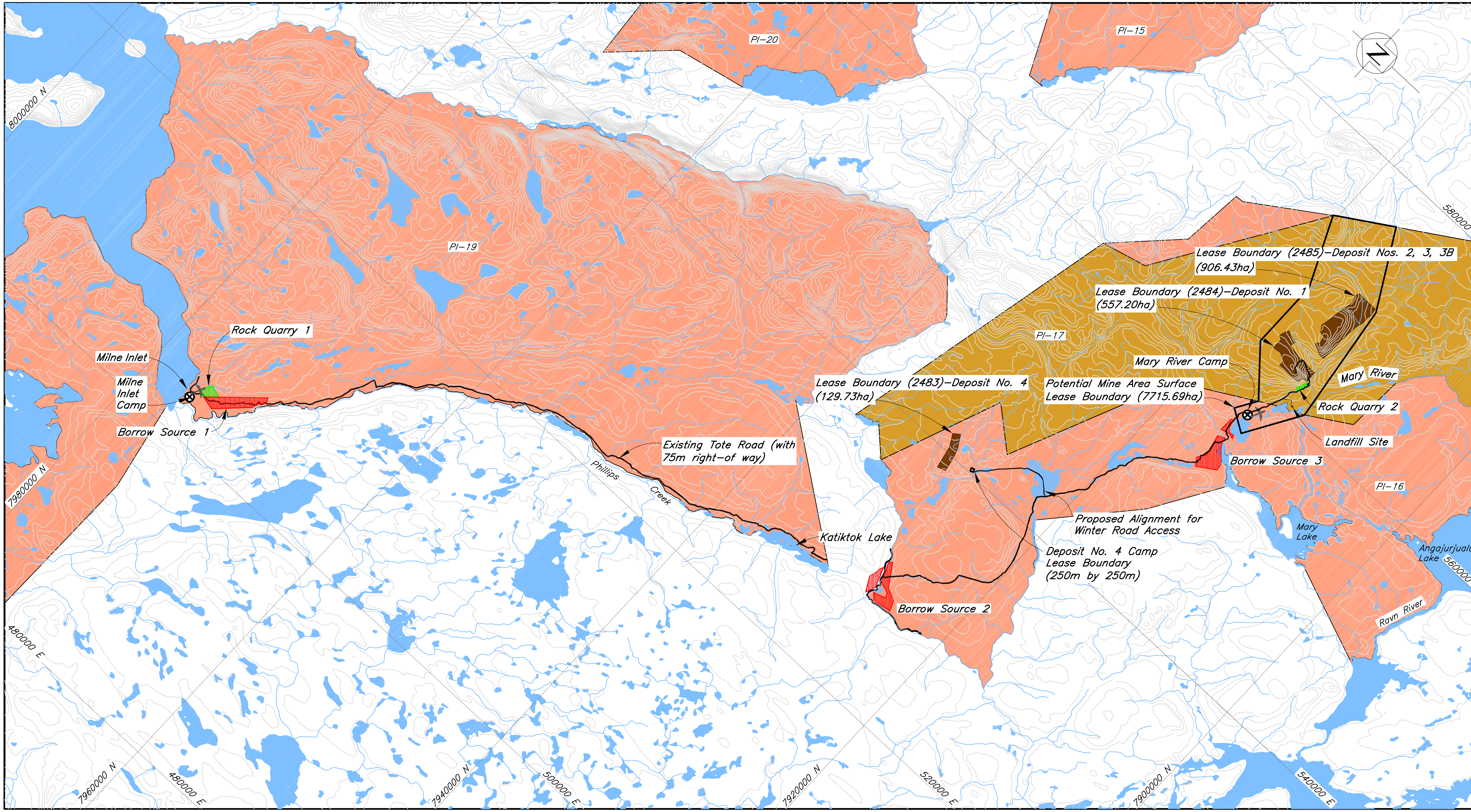
Per: ______________________________
Peter Tumilty, Acting Executive Director

BAFFINLAND IRON MINES CORPORATION

Per: ______________________________
Name & Title

c/s

Per: ______________________________
Name & Title



DESCRIPTION	AREA (ha)
MILNE INLET CAMP	83.20
EXISTING TOTE ROAD	601.21
BORROW SOURCE 1 (INCLUDES TEMPORARY EXPLOSIVES AREAS AND EXISTING TOTE ROAD)	355.49
ROCK QUARRY 1	89.47
BORROW SOURCE 2 (INCLUDES SECTION OF TOTE ROAD)	334.59
BORROW SOURCE 3 (INCLUDES SECTION OF TOTE ROAD)	352.46
DEPOSIT NO. 4 CAMP LEASE BOUNDARY (INCLUDES WINTER ROAD)	59.25
POTENTIAL MINE AREA SURFACE LEASE BOUNDARY (EXCLUDES MINING LEASES)	7715.69

LEGEND:

- Water
- Inuit Owned Land-Surface Only Excluding Minerals
- Inuit Owned Land-Surface and Subsurface Including Minerals
- Crown Land
- Mining Lease Boundary
- Borrow Areas
- Rock Quarry Location
- River/Stream/Drainage
- Existing Tote Road
- Airstrip
- Exploration Camp Location

NOTES:

1. Base Map: © Her Majesty the Queen in Rights of Canada, Department of Natural Resources (2004). All rights reserved (Government of Canada, 2006).
2. Contours are in metres. Contour interval varies.
3. Coordinate grid is shown in UTM (NAD 83) Zone 17 West and is in metres.
4. A right-of way (ROW) width of 75m has been applied to linear features (i.e., roads and pipelines) for the purpose of lease calculations.

Scale 3 1.5 0 3 6 9 12 15 Kilometres

Baffinland

MARY RIVER PROJECT

MARY RIVER PROJECT LEASE BOUNDARIES

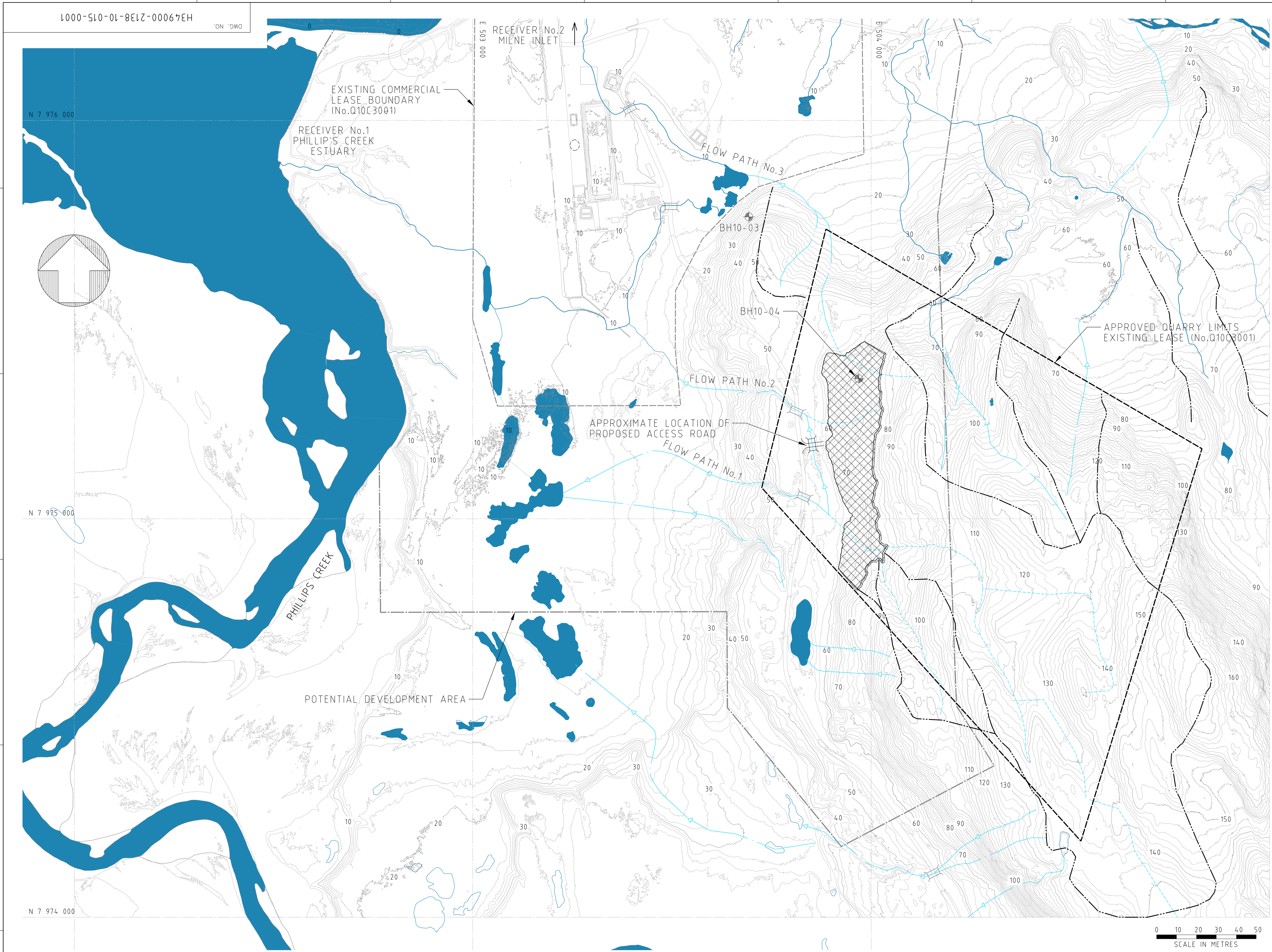
Knight Piésold CONSULTING

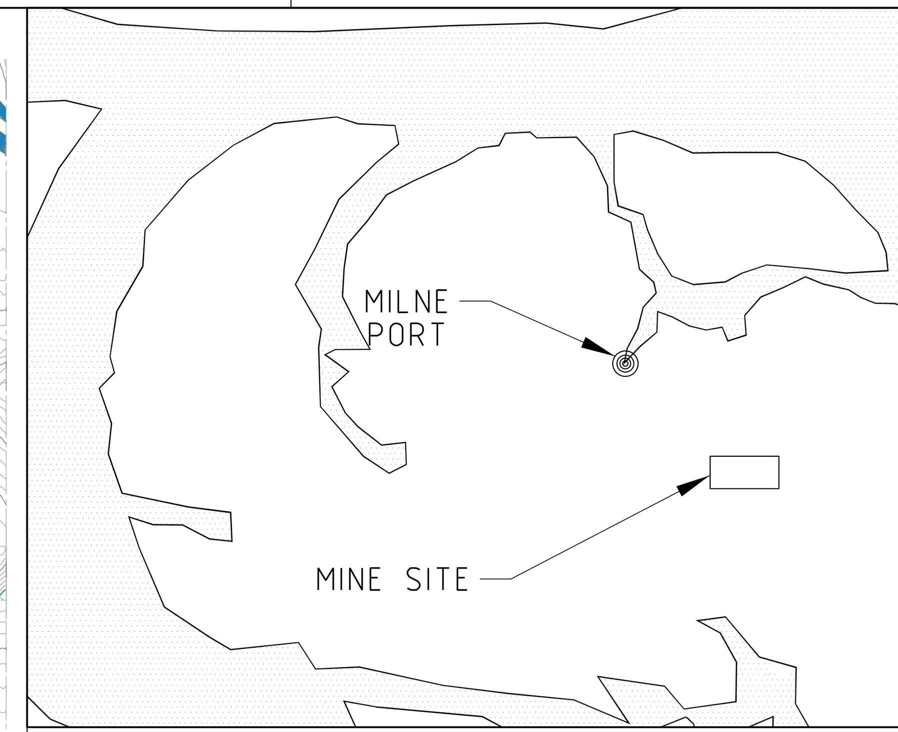
P/A NO.	REF.	REV.
NB102-00181/10	NB07-00964	0

SCHEDULE A1

Appendix B

Quarry (Q1) Drainage Drawing





KEY PLAN

LEGEND

- PROPOSED FOOTPRINT FOR QUARRY Q1
- EXISTING STREAM
- POTENTIAL ROUTE FOR FLOW PATH No.1
- OVERLAND FLOW PATH
- FLOW DIRECTIONS
- RIDGE LINE (HIGH POINT)
- PROPOSED CULVERT
- EXISTING CULVERT (LOCATION APPROXIMATE)
- EXISTING BOREHOLE

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.
4. FLOW PATH No.1 DISTANCE FROM QUARRY TO RECEIVER No.1 IS 2,219m.
5. FLOW PATH No.2 DISTANCE FROM QUARRY TO RECEIVER No.1 IS 1,880m.
6. FLOW PATH No.3 DISTANCE FROM QUARRY TO RECEIVER No.2 IS 1,632m.

APPROVED FOR USE

DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE

REVISIONS

REV.	ISSUE FOR	AUTH.	BY	DATE
A	FOR USE	SH	MM	2013-03-06

ISSUE AUTHORIZATION

HATCH

DESIGNED BY A. MOHEBKHANI DATE 2013-03-06	DRAWN BY M. MCDOUGALD DATE 2013-03-06
CHECKED BY S. HASSAN DATE 2013-03-06	DISCIP. ENGR. S. HASSAN DATE 2013-03-06
PROJ. DES. COORD. T. THERTELL DATE 2013-03-06	PROJ. ENGR. J. CLELAND DATE 2013-03-06
PROJ. MGR. S. PERRY DATE 2013-03-06	

Baffinland Iron Mines Corporation

MARY RIVER PROJECT - ERP

MILNE PORT
QUARRY Q1 DRAINAGE
PLAN
FIGURE B-1

SCALE	DWG. NO.	REV.
1:5000 OR AS NOTED	H349000-2138-10-015-0001	A

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Appendix C

Contractor's Blasting Operations Management Plan

Quarry Blasting Operations Management Plan

Baffinland Iron Mines Corporation

Mary River Project, NU

March 2012

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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 Milne Inlet Q1 Quarry 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 documents:

- Borrow Pit and Quarry Management Plan, and
- Quarry Management Plan - Milne Inlet Quarry (Q1)

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. It is NUNA's understanding based on a review of the Quarry Management Plan for the Milne Inlet Q1 Quarry that the nearest fish bearing receivers are Phillips Creek and Milne Inlet.

2.3. Archeological Sites

An archeologist has been brought to site at the owner's discretion to complete archaeological surveys for all areas of potential disruption due to work programs. The archaeologist reports that within the quarry development area there are no archaeological resources. 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. If needed, a buffer zone will established around the archaeological site as required by the site regulations. No construction is to take place within the buffer zone and no employees will be permitted to enter the site.

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.

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

- 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.

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 **Error! Reference source not found.**, 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.	

<table>
<tr><td>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.</td><td rowspan="6">Drill & Blast Supervisor</td></tr>
<tr><td>• Provide on the job observations and instructions to the drill/blast crews.</td></tr>
<tr><td>• Ensure the mining / quarrying plan is followed regarding drill and blast patterns, as directed by the Superintendent.</td></tr>
<tr><td>• Ensure the drill/blast crew has the required supplies to complete their daily tasks.</td></tr>
<tr><td>• Ensure the Mine Supervisor is informed of any hazards that may affect the safety of the mine employees or equipment.</td></tr>
<tr><td>• Provide directions and instructions to all employees during the blasting operations regarding the notification and guarding during the blast.</td></tr>
<tr><td>MISCELLANEOUS DUTIES:</td><td rowspan="4">Superintendent/ Supervisor/ Safety</td></tr>
<tr><td>• Develop and present timely safety topics at the regular crew Safety meetings.</td></tr>
<tr><td>• Provide developmental training for drill/blast crews.</td></tr>
<tr><td>• 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.</td></tr>
</table>

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.

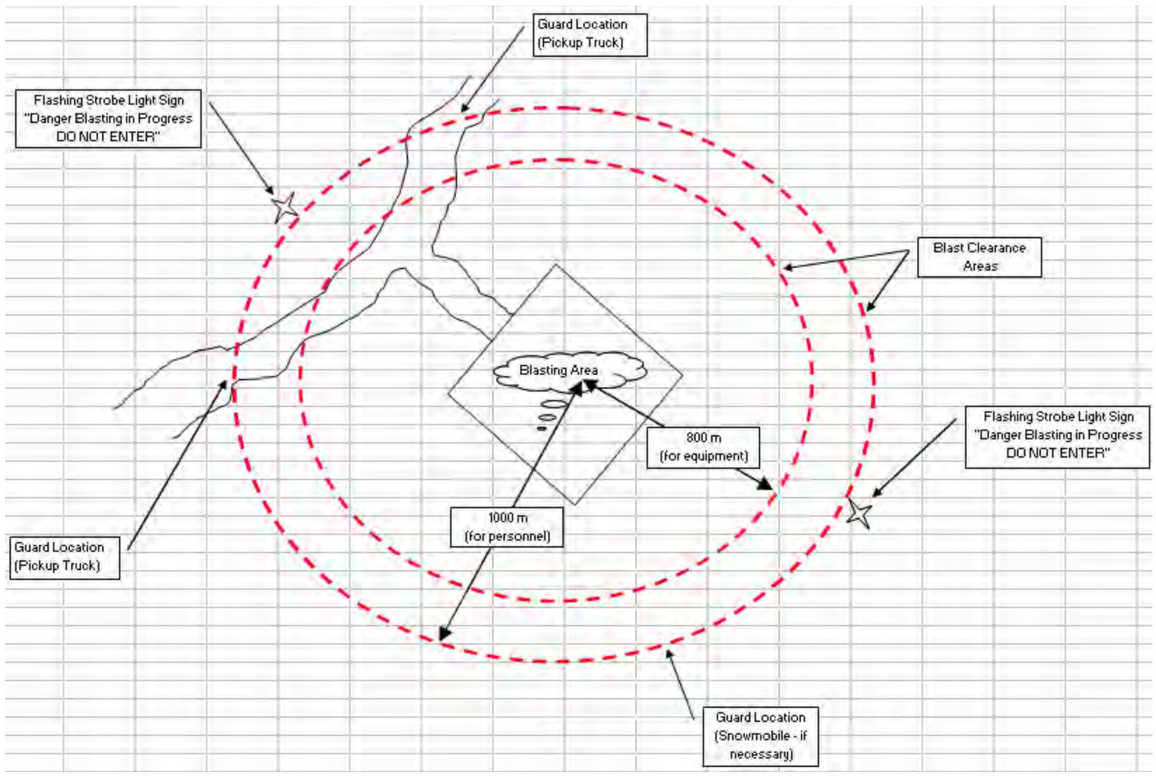
In addition to the guards posted at strategic locations around the blast area, flashing strobe light warning signs are recommended to be placed at the outer perimeter of the blasting danger area. The signs shall be deployed prior to the initiation of each blast, and collected afterwards.

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 D

Tote Road Quarry and Borrow Pit Sampling Report

APPENDIX 6B-2

TOTE ROAD AGGREGATE SOURCES GEOCHEMISTRY CHARACTERIZATION REPORT

TECHNICAL MEMORANDUM

To	**Greg Wortman, AMEC** **Doron Golan, AMEC**	Project No. File No.	**TC101510** **017**
From	**Catherine Daniels, AMEC** **Steve Walker, AMEC**	cc	**Brian Lapos – AMEC** **Stephan Theben - AMEC** **Steve Sibbick – AMEC**
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Date	**December 10, 2010**		

Subject **Baffinland Mary River Project – Trucking Feasibility Study**
Interim ML/ARD Assessment of Tote Road Quarry and Borrow Pit Samples
Rev1 – Issued for DEIS

1.0 INTRODUCTION

AMEC was retained by Baffinland Iron Mines Corporation (Baffinland) to conduct environmental studies in support of an environmental impact assessment (EIA). As part of the supporting environmental studies, AMEC assessed the metal leaching and acid rock drainage (ML/ARD) characteristics of rock samples to support future borrow pit and quarry development along the proposed Milne Inlet Tote Road alignment upgrade.

Drill core and unconsolidated surficial materials were collected from potential quarry and borrow pit locations along the Tote Road alignment during a geotechnical investigation aggregate sourcing program. AMEC submitted selected samples to SGS Mineral Services (SGS) of Lakefield for geochemical analyses on the potential quarry and borrow pit materials. This memo reports on a screening level ML/ARD assessment of these materials.

2.0 SITE DESCRIPTION

The Mary River Project is located in the northern region of Baffin Island in Nunavut territory, Canada. This area experiences a mean annual temperature of approximately -12^{o}C and monthly averages below -20^{o}C from December to March. Above freezing temperatures occur only from June to August, with an average high of 4.4^{o}C in July.

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The existing all-season Milne Inlet Tote Road (Tote Road) is currently undergoing design for the purpose of upgrades for the transportation of ore from the mine site to Milne Inlet. The road was originally established in the 1960's and runs approximately 107 km from the Mary River exploration camp to Milne Inlet.

The majority of the Tote Road alignment follows the valley of Phillips Creek which is bounded by steep ridges located on either side of the road corridor.

Regional geologic mapping is available for the entire route of the Tote Road (Scott and de Kemp, 1998). Approximately the first 20 km of the Tote Road from Milne Inlet passes through Precambrian terrane. The middle 73 km of the road travels across relatively flat lying Paleozoic rocks and the final 14 km of the road to the Mary River site again passes through Precambrian terrane near the boundary with the Paleozoic units.

Paleozoic rocks along the route include the Cambrian-Ordovician age Gallery and Turner Cliffs Formations, the Ordovician age Ship Point Formation, and the Ordovician Sillurian age Baillarge Formation. The Gallery Formation is ~340 m thick medium to coarse grained quartzose sandstone with minor siltstone, conglomerate and shale, and rare breccia, dolomitic sandstone and dolostone. The Turner Cliffs Formation is an approximately 310 m thick shaly to pure dolostone unit with intra-beds of dolomitic clastic sedimentary rocks. The Ship Point Formation is a 50 to 275 m thick finely crystalline dolostone that is commonly silty or sandy and interbedded with clastic dolomitic rocks. The formation is resistate and forms prominent cliffs in the area. The Baillarge Formation is an ~490 m thick unit of fine-grained limestones interbedded with minor dolostone, breccia, conglomerate, sandstone and cherty beds, and is often fossiliferous.

The Precambrian rocks are interpreted to be Archean age migmatitic gneisses in the region between Milne Inlet and the Paleozoic rocks and again between the Paleozoic sediments and the Mary River site. The migmatitic gneisses are heterogeneous commonly with inclusions and bands of mafic, metasedimentary and other granitic rocks. Archean Mary River Group rocks are present in close proximity to the migmatites along the route near the Mary River site. Mary River Group rocks consist mainly of siliciclastic sedimentary and mafic volcanic rocks. The Mary River Group hosts the Algoman-type iron formation deposits at the site.

3.0 METHODS

3.1 Sampling

During the autumn of 2010, AMEC conducted a geotechnical investigation of proposed quarry and borrow pit locations along the Tote Road alignment. The investigation included the collection of drill core from the quarry locations and the collection of unconsolidated material from borrow pit locations. .

3.2 Sample Selection for Testing

The objective in sample selection for ML/ARD characterization was to collect a set of samples for analysis which are representative of the geochemical variation of the different soil and rock types that will be used as quarry and borrow material for the Tote Road upgrade . Samples were selected from drill core and from the collected borrow pit material.

Intervals for rock sample selection were identified by AMEC after reviewing available drill logs, photographs and following direct inspection of the core. The strategy for sample selection and collection was based upon the guidance found within the document *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials* (MEND 2009). Borehole locations and observed rock types are tabulated below.

Regional Mapped Geology and Borehole Rock Type

Regional Mapped Geology*	Borehole Number	Approximate Tote Road Chainage	Rock Type
Archean Migmatitic Gneiss	BH-10-04	2+100	Granitic Gneiss
	BH-10-05	3+100	Granitic Gneiss
	BH-10-06	4+100	Granitic Gneiss
	BH-10-07	5+000	Granitic Gneiss
	BH-10-08	6+000	Granitic Gneiss
	BH-10-09	7+000	Granitic Gneiss
	BH-10-12	22+000	Granitic Gneiss
Cambrian-Ordovician Gallery or Turner Cliffs Formation	BH-10-13	39+100	Carbonate bound quartz sandstone with silty interlayers
	BH-10-14	45+200	Sandy carbonate
	BH-10-15	50+000	Carbonate with minor shale and mudstone
	BH-10-16	61+500	Carbonate
Archean Migmatitic Gneiss	BH-10-21	85+000	Schist with pegmatite veining

* Scott and de Kemp, 1998

The drill core and material from 14 of the 15 borrow pits were shipped from the site to AMEC offices in Hamilton Ontario where the samples were split for ML/ARD analyses and aggregate testing. For the purposes of ML/ARD characterization, three sections of 1 m lengths of drill core were selected from each of the 12 boreholes. The 1 m lengths of core were split in half with half retained and half submitted for geochemical analysis.

Borrow pit material was crushed and screened to <20 mm. The unconsolidated material from the borrow pits was then split such that approximately two kilograms of each sample was sent for geochemical analyses. The remainder of the borrow pit material and the remainder of quarry material will be used for aggregate source material testing presently underway.

The drill core samples selected represented 21 samples of gneiss and three samples of schist from the Precambrian units, and 12 samples of clastic and carbonate sedimentary rocks from the Paleozoic units. The borrow pit materials were typically sand or silty sand with varying quantities of gravel cobbles and boulders. Some had finer grained material as well as occasional small boulders. Cobbles and boulders in the samples generally consisted of carbonate or gneiss.

Visual inspection of the Precambrian core during the sample collection indicated the rare presence of sulphide minerals, primarily on fractured surfaces. No visible sulphide minerals were observed during inspection of the Paleozoic rock core samples at the time of sample selection. However, there was some iron staining noted in some samples.

3.3 Testing Methods

Split samples were shipped to SGS Lakefield for analysis. Testing methodologies followed those described in MEND (2009).

Analytical tests conducted included:

- 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 by aqua regia digestion with ICP-MS finish;
- Leachable metals by shake flask extraction (SFE); and
- Mineralogy by X-ray diffraction (XRD) with Rietveld refinement.

Each sample was analysed for ABA and total metals. Testing by SFE and XRD were performed on a subset of samples, selected from the initial sample set. Considering project time-lines, the subset was selected prior to completion of the ABA and metals analyses. The subset was selected to best represent the entire sample set using the data available at the time.

4.0 GEOCHEMICAL TESTING RESULTS

4.1 Acid Base Accounting (ABA)

Results of ABA testing are summarized in Figures 1 and 2, with complete results presented in Table 1. A statistical summary of the results presented in Table 2. Results for rock samples are subdivided by lithology.

Figure 1 shows the relationship between modified Sobek NP and carbonate NP (CaNP) and indicates that carbonate minerals are the main source of NP in the sedimentary rocks and unconsolidated borrow pit materials. Non-carbonate minerals appear to be the primary source of NP for the schist and gneiss samples (Figure 1).

For the purposes of this screening level assessment, the calculated acid potential of the samples has been conservatively based on the total sulphur content, and is referred to as the maximum potential acidity (MPA) (Figure 2).

Overall findings of the results are summarized as follows:

- Paste pH of all samples were weakly alkaline. Carbonate rocks had a median paste pH of 8.3), whereas the schist and gneiss samples had the higher paste pH with a median of 9.8). Borrow pit materials reported a median paste pH of 8.9.
- Sulphide content of all samples was very low with the maximum concentrations ranging from 0.04% in carbonate sedimentary rocks to 0.02% in schist and 0.01% in gneiss and unconsolidated borrow pit materials.
- All samples had neutralization potential ratios (NPR) well in excess of 2 based on the more conservative MPA (Figure 2). These materials are considered non potentially acid generating (non-PAG).
- Gneiss and schist samples exhibited low NP values (median 8 and 10 kg $CaCO_3$/t respectively).
- Carbonate rich sedimentary rocks exhibited high NP (median carbonate NP of 890 kg $CaCO_3$/t).
- Unconsolidated materials had a generally high NP with most samples reporting >100 kg $CaCO_3$/t (median CaNP of 218 kg $CaCO_3$/t). However, the lowest NP of the sample set (5 kg $CaCO_3$/t) was from an unconsolidated borrow pit sample.

4.2 Metals Analyses

4.2.1 Total Metals

In order to identify metals of potential environmental significance, total metals results were compared to average continental crustal abundances (Price 1997). For screening purposes the concentration of an element was considered enriched if concentrations were greater than ten times the average crustal abundance. Metal results are presented in Table 3 and a statistical summary is provided in Table 4. It should be noted that the total concentration of an element does not determine the metal leaching potential of that element.

In general, the quarry and borrow pit samples demonstrated no notable elevation of elements relative to the average composition of the continental crust. However, the MDL values for bismuth and selenium were greater than ten times the average continental crust values. Therefore, any detectable values for bismuth or selenium were above ten times the average continental concentration.

4.2.2 Shake Flask Extraction Test

Eleven samples representing the three different rock types and four samples of unconsolidated borrow material underwent Shake Flask Extraction (SFE) testing. The SFE testing (Table 5) were compared to Metal Mining Effluent Regulation values (MMER, 2002). More stringent guideline values are also provided for reference purposes only. Guidelines for the protection of aquatic life and the drinking water guidelines (CWQG-PAL and CDWG guidelines in Table 5), which are focused on the preservation of water quality in the receiving waterbody for specific receptors (i.e., aquatic life, drinking water) are conservative since these values represent concentrations at point of use or exposure, not point of discharge. These guidelines are useful to identify parameters of interest when evaluating final discharge to receiving waters.

Results of SFE analyses (Table 5) for all samples, had a final pH that was neutral to alkaline with generally low concentrations of metals and no exceedances of MMER limits. The pH in SFE leachates for a number of these samples exceeded the MMER limit of 9.5. This is not unexpected for freshly exposed rock materials under agitation and at the high solid-solution ratios of the test. The high pH (and corresponding elevated aluminum concentrations) were likely related to the weak alkalinity associated with aluminosilicate mineral dissolution. It is unlikely the elevated pH (and associated aluminum) will be observed under field conditions. A single borrow material sample had an elevated copper concentration in comparison to the rest of the sample set. However, the concentration was an order of magnitude lower than the MMER limit.

4.3 Mineralogy

Rietveld XRD analysis was completed on 15 selected quarry and unconsolidated borrow pit samples. Results are presented in Table 6. The Rietveld method is effective at identifying crystalline phases present in abundance greater than a few weight percent. Lower abundances can be quantified where favourable scattering properties exist.

There were no acid producing sulphide minerals identified by XRD in the quarry or borrow pit samples, which is consistent with the low AP of all samples analysed. There were carbonate minerals identified in most of the samples.

Calcite was identified at low weight percent to trace values (<1.2%) in all but one of the granitic gneiss samples. Trace amounts of dolomite and rhodocrosite were also identified in a single granitic gneiss sample along with similarly low calcite. No carbonates were identified in one granitic gneiss sample and the single schist sample analysed.

Calcite was the dominant mineral (>98 wt.%) identified in the three carbonate samples. Trace dolomite and ankerite were also identified in these samples. In the carbonate cemented sandstone, dolomite (approximately 26%) was the only carbonate mineral identified.

Calcite, dolomite and ankerite were identified in most of the borrow material samples. Rhodocrosite was also identified in one sample. In the fourth sample the only carbonate mineral identified was calcite at very low weight percent (0.2%).

Calcite and dolomite have effective acid neutralizing properties, while the neutralizing ability of iron and manganese bearing carbonate minerals such as ankerite and rhodocrosite is uncertain. Dissolution rates of these minerals may be slower and under oxidizing conditions, hydrolysis of the iron and manganese released leads to no net neutralization. However, for this sample set the iron and manganese carbonates, when present, are always in low abundance compared to calcite and dolomite. Therefore, the presence of these minerals in this case will have only a minor influence on the neutralization potential of the materials.

5.0 CONCLUSIONS

Lithologically-based ML/ARD assessments have been completed on selected quarry and borrow materials along the Tote Road. Based on the results of this assessment, the following conclusions are made:

- The materials investigated in the proposed quarries and borrow pits along the Tote Road route appear to have a low potential for ML/ARD and are expected to be suitable as quarry or borrow sources. However, individual quarry and borrow sites should be subjected to additional site specific ML/ARD characterization with consideration given for additional assessment depending upon the tonnages to be used and anticipated geological variability.

- The relatively low NP in the Precambrian rocks suggests that the presence of low contents of sulphide could potentially result in ML/ARD conditions. Diligence through adequate levels of sampling and monitoring during extraction operations will be necessary to ensure that the low concentrations of sulphide observed in this study are confirmed elsewhere.
- Paleozoic sedimentary rocks selected as potential quarry sources in this study are all carbonate rich and pose no ML/ARD risk. However, other non-carbonate sedimentary rocks are present in the region, so caution should be exercised should other quarry locations in the Paleozoic region be selected.
- Rietveld XRD results are consistent with ABA data for the rock-types analysed. Calcite or dolomite is confirmed to be in abundance in all carbonate rich samples and low to trace carbonate minerals are present in the granitic gneiss samples. For the gneiss samples neutralization from silicate minerals present in greater abundance than the carbonates is inferred.
- Borrow materials tested have high NPR values and pose no apparent ML/ARD risk.
- Carbonate as calcite and dolomite appear to be common components in most borrow materials tested; however, one sample was identified that was carbonate poor and quartz rich, thus having very low NP and suggesting not all borrow sources will have high carbonate NP.
- Ankerite and rhodocrosite were sometimes identified in carbonate-bearing samples, suggesting a portion of the carbonate content may not contribute to neutralization under oxidizing conditions. However, these carbonate forms were always subordinate to calcite or dolomite.

6.0 FUTURE WORK

The following work is planned and proposed.

- Continued collection and analysis of material from any future drilling or excavation programs along the Tote Road alignment to the extent necessary to minimize risk of ML/ARD.

7.0 REFERENCES

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Attachments:
Table 1 — Acid Base Accounting Results
Table 2 — Acid Base Accounting Statistics
Table 3 — Total Metals Results
Table 4 — Total Metals Statistics
Table 5 — Shake Flask Analysis Results
Table 6 — Rietveld Quantitative Analysis X-ray Diffraction Results
Figure 1 — ABA Results - CaNP vs. NP
Figure 2 — ABA Results – NP vs. MPA

TABLES

Table 1 Acid Base Accounting Results

Sample ID	Drill Log Lithology	Sample weight(g)	HCl added mL	HCl Normality	NaOH Normality	NaOH to pH=8.3 mL	Final pH units	Fizz Rate ---	Paste pH units
10-TR-001 BH10-04	gneiss	2.05	20.00	0.10	0.10	16.77	1.36	1	9.56
10-TR-002 BH10-04	gneiss	2.01	20.00	0.10	0.10	16.75	1.39	1	9.92
10-TR-003 BH10-04	gneiss	1.98	20.00	0.10	0.10	16.50	1.39	1	9.58
10-TR-004 BH10-05	gneiss	2.03	20.00	0.10	0.10	17.00	1.40	1	9.79
10-TR-005 BH10-05	gneiss	1.97	20.00	0.10	0.10	17.41	1.38	1	9.76
10-TR-006 BH10-05	gneiss	2.03	20.00	0.10	0.10	17.48	1.38	1	9.73
10-TR-007 BH10-06	gneiss	1.98	20.00	0.10	0.10	17.03	1.39	1	9.78
10-TR-008 BH10-06	gneiss	2.01	20.00	0.10	0.10	17.05	1.42	1	9.65
10-TR-009 BH10-06	gneiss	1.98	20.00	0.10	0.10	16.95	1.41	1	9.90
10-TR-010 BH10-07	gneiss	2.00	20.00	0.10	0.10	16.18	1.46	1	9.98
10-TR-011 BH10-07	gneiss	1.98	20.00	0.10	0.10	15.37	1.50	1	9.66
10-TR-012 BH10-07	gneiss	1.96	20.00	0.10	0.10	15.48	1.43	1	9.90
10-TR-013 BH10-08	gneiss	2.00	20.00	0.10	0.10	17.47	1.38	1	9.68
10-TR-014 BH10-08	gneiss	2.04	20.00	0.10	0.10	16.10	1.44	1	9.46
10-TR-015 BH10-08	gneiss	2.04	20.00	0.10	0.10	15.75	1.46	1	9.52
10-TR-016 BH10-09	gneiss	1.98	20.00	0.10	0.10	17.53	1.40	1	10.00
10-TR-017 BH10-09	gneiss	2.04	20.00	0.10	0.10	17.10	1.41	1	9.91
10-TR-018 BH10-09	gneiss	1.99	20.00	0.10	0.10	17.36	1.37	1	9.99
10-TR-019 BH10-12	gneiss	2.05	20.00	0.10	0.10	16.74	1.42	1	9.94
10-TR-020 BH10-12	gneiss	1.98	20.00	0.10	0.10	15.89	1.44	1	9.93
10-TR-021 BH10-12	gneiss	2.04	20.00	0.10	0.10	16.43	1.42	1	9.84
10-TR-034 BH10-21	schist	1.97	20.00	0.10	0.10	15.09	1.26	2	9.97
10-TR-035 BH10-12	schist	2.02	20.00	0.10	0.10	15.86	1.26	1	9.80
10-TR-036 BH10-12	schist	2.03	20.00	0.10	0.10	15.76	1.17	1	9.67
10-TR-022 BH10-13	sandstone	2.01	118.20	0.10	0.10	26.10	1.70	3	9.43
10-TR-023 BH10-13	sandstone	2.00	127.75	0.10	0.10	27.00	1.76	3	9.34
10-TR-024 BH10-13	sandstone	1.95	135.60	0.10	0.10	29.10	1.75	3	9.38
10-TR-025 BH10-14	sandy carbonate	2.03	589.90	0.10	0.10	200	1.51	4	8.27
10-TR-026 BH10-14	sandy carbonate	2.02	643.90	0.10	0.10	268	1.52	4	8.07
10-TR-027 BH10-14	sandy carbonate	2.00	641.20	0.10	0.10	259	1.50	4	8.22
10-TR-028 BH10-15	carbonate	1.97	685.90	0.10	0.10	301	1.50	4	8.22
10-TR-029 BH10-15	carbonate	1.96	640.00	0.10	0.10	266	1.50	4	8.38
10-TR-030 BH10-15	carbonate	1.98	490.00	0.10	0.10	116	1.71	4	8.23
10-TR-031 BH10-16	carbonate	1.99	490.00	0.10	0.10	106	1.74	4	8.23
10-TR-032 BH10-16	carbonate	1.98	474.20	0.10	0.10	93.80	1.78	4	8.27
10-TR-033 BH10-16	carbonate	1.96	470.00	0.10	0.10	96.20	1.76	4	8.26
S449-10	sand/gravel	2.00	393.20	0.10	0.10	122	1.60	4	8.75
S450-10	sand/gravel	2.01	338.10	0.10	0.10	57.00	1.85	4	8.38
S451-10	sand/gravel	1.97	131.70	0.10	0.10	38.20	1.55	4	8.55
S452-10	sand/gravel	1.97	146.40	0.10	0.10	48.00	1.59	4	8.97
S453-10	sand/gravel	1.99	135.30	0.10	0.10	29.10	1.69	4	8.87
S454-10	sand/gravel	1.95	20.00	0.10	0.10	17.94	1.11	1	8.42
S455-10	sand/gravel	1.96	26.00	0.10	0.10	11.31	1.57	1	9.51
S456-10	sand/gravel	1.97	79.10	0.10	0.10	20.21	1.75	3	8.99
S457-10	sand/gravel	2.00	83.90	0.10	0.10	15.24	1.85	3	9.07
S458-10	sand/gravel	1.97	55.40	0.10	0.10	21.25	1.58	3	9.24
S459-10	sand/gravel	2.03	154.20	0.10	0.10	28.60	1.83	4	8.86
S460-10	sand/gravel	1.96	77.40	0.10	0.10	23.81	1.65	4	8.93
S461-10	sand/gravel	1.99	97.90	0.10	0.10	21.30	1.78	3	9.14
S462-10	sand/gravel	2.01	153.10	0.10	0.10	28.40	1.82	3	8.95

Table 1 Acid Base Accounting Results (Continued)

Sample ID	Drill Log Lithology	Total Carbon	CO3	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	Neutralization Potential	Acid Potential
		%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t
10-TR-001 BH10-04	gneiss	0.059	0.103	0.014	0.01	<0.01	7.9	0.31
10-TR-002 BH10-04	gneiss	0.050	0.101	<0.005	<0.01	<0.01	8.1	0.31
10-TR-003 BH10-04	gneiss	0.064	0.137	<0.005	<0.01	<0.01	8.8	0.31
10-TR-004 BH10-05	gneiss	0.041	0.059	0.020	0.02	<0.01	7.4	0.31
10-TR-005 BH10-05	gneiss	0.032	0.033	0.015	0.01	<0.01	6.6	0.31
10-TR-006 BH10-05	gneiss	0.029	0.028	0.038	0.02	0.01	6.2	0.44
10-TR-007 BH10-06	gneiss	0.036	0.048	<0.005	<0.01	<0.01	7.5	0.31
10-TR-008 BH10-06	gneiss	0.028	0.025	0.008	<0.01	<0.01	7.3	0.31
10-TR-009 BH10-06	gneiss	0.035	0.075	0.006	<0.01	<0.01	7.7	0.31
10-TR-010 BH10-07	gneiss	0.027	0.014	0.035	0.02	0.01	9.5	0.36
10-TR-011 BH10-07	gneiss	0.038	0.027	0.036	0.04	<0.01	11.7	0.31
10-TR-012 BH10-07	gneiss	0.036	0.052	0.019	0.02	<0.01	11.5	0.31
10-TR-013 BH10-08	gneiss	0.028	0.035	<0.005	<0.01	<0.01	6.3	0.31
10-TR-014 BH10-08	gneiss	0.044	0.380	0.020	0.02	<0.01	9.6	0.31
10-TR-015 BH10-08	gneiss	0.043	0.062	0.028	0.03	<0.01	10.4	0.31
10-TR-016 BH10-09	gneiss	0.020	0.034	0.012	0.01	<0.01	6.2	0.31
10-TR-017 BH10-09	gneiss	0.070	0.048	0.012	0.01	<0.01	7.1	0.31
10-TR-018 BH10-09	gneiss	0.023	<0.005	0.038	0.04	<0.01	6.6	0.31
10-TR-019 BH10-12	gneiss	0.035	0.018	0.029	0.03	<0.01	8.0	0.31
10-TR-020 BH10-12	gneiss	0.051	0.071	0.028	0.02	0.01	10.4	0.40
10-TR-021 BH10-12	gneiss	0.046	0.065	0.006	<0.01	<0.01	8.8	0.31
10-TR-034 BH10-21	schist	0.096	0.282	0.015	0.02	<0.01	12.5	0.31
10-TR-035 BH10-12	schist	0.052	0.054	0.060	0.04	0.02	10.2	0.77
10-TR-036 BH10-12	schist	0.049	0.023	0.023	0.01	0.01	10.4	0.41
10-TR-022 BH10-13	sandstone	2.77	12.0	<0.005	<0.01	<0.01	229	0.31
10-TR-023 BH10-13	sandstone	2.98	12.5	<0.005	<0.01	<0.01	252	0.31
10-TR-024 BH10-13	sandstone	3.25	14.0	<0.005	<0.01	<0.01	273	0.31
10-TR-025 BH10-14	sandy carbonate	11.1	54.3	<0.005	<0.01	<0.01	959	0.31
10-TR-026 BH10-14	sandy carbonate	10.8	52.3	<0.005	<0.01	<0.01	930	0.31
10-TR-027 BH10-14	sandy carbonate	11.2	54.0	0.071	0.03	0.04	956	1.29
10-TR-028 BH10-15	carbonate	10.9	53.2	0.014	0.01	<0.01	978	0.31
10-TR-029 BH10-15	carbonate	10.7	51.3	0.041	0.02	0.02	953	0.77
10-TR-030 BH10-15	carbonate	10.7	51.5	0.020	<0.01	0.01	945	0.34
10-TR-031 BH10-16	carbonate	10.8	53.5	<0.005	<0.01	<0.01	965	0.31
10-TR-032 BH10-16	carbonate	10.7	52.9	<0.005	<0.01	<0.01	961	0.31
10-TR-033 BH10-16	carbonate	10.7	52.1	<0.005	<0.01	<0.01	954	0.31
S449-10	sand/gravel	7.86	33.9	0.011	0.01	<0.01	678	0.31
S450-10	sand/gravel	8.02	36.0	<0.005	<0.01	<0.01	699	0.31
S451-10	sand/gravel	2.92	11.7	<0.005	<0.01	<0.01	237	0.31
S452-10	sand/gravel	2.89	12.4	0.014	0.01	<0.01	250	0.31
S453-10	sand/gravel	3.22	13.9	<0.005	<0.01	<0.01	267	0.31
S454-10	sand/gravel	0.061	0.016	<0.005	<0.01	<0.01	5.3	0.31
S455-10	sand/gravel	0.410	0.255	<0.005	<0.01	<0.01	37.5	0.31
S456-10	sand/gravel	1.82	6.20	0.007	<0.01	<0.01	150	0.31
S457-10	sand/gravel	1.44	5.37	<0.005	<0.01	<0.01	172	0.31
S458-10	sand/gravel	1.12	4.17	0.007	<0.01	<0.01	86.7	0.31
S459-10	sand/gravel	3.87	16.2	<0.005	<0.01	<0.01	309	0.31
S460-10	sand/gravel	1.71	7.29	<0.005	<0.01	<0.01	137	0.31
S461-10	sand/gravel	2.33	10.2	0.005	<0.01	<0.01	192	0.31
S462-10	sand/gravel	3.75	16.7	0.007	<0.01	<0.01	310	0.31

Table 1 Acid Base Accounting Results (Continued)

Sample ID	Drill Log Lithology	Maximum Potential Acidity kg $CaCO_3$/t	Carbonate Neutralization Potential kg $CaCO_3$/t	Ratio NP/AP ratio	Ratio NP/MPA ratio	Ratio CaNP/AP ratio	Net NP kg $CaCO_3$/t
10-TR-001 BH10-04	gneiss	0.44	4.92	25.5	18.1	15.9	7.59
10-TR-002 BH10-04	gneiss	0.16	4.17	26.1	51.8	13.4	7.79
10-TR-003 BH10-04	gneiss	0.16	5.33	28.4	56.3	17.2	8.49
10-TR-004 BH10-05	gneiss	0.63	3.42	23.9	11.8	11.0	7.09
10-TR-005 BH10-05	gneiss	0.47	2.67	21.3	14.1	8.6	6.29
10-TR-006 BH10-05	gneiss	1.19	2.42	14.2	5.2	5.5	5.76
10-TR-007 BH10-06	gneiss	0.16	3.00	24.2	48.0	9.7	7.19
10-TR-008 BH10-06	gneiss	0.25	2.33	23.5	29.2	7.5	6.99
10-TR-009 BH10-06	gneiss	0.19	2.92	24.8	41.1	9.4	7.39
10-TR-010 BH10-07	gneiss	1.09	2.25	26.2	8.7	6.3	9.14
10-TR-011 BH10-07	gneiss	1.13	3.17	37.7	10.4	10.2	11.4
10-TR-012 BH10-07	gneiss	0.59	3.00	37.1	19.4	9.7	11.2
10-TR-013 BH10-08	gneiss	0.16	2.33	20.3	40.3	7.5	5.99
10-TR-014 BH10-08	gneiss	0.63	3.67	31.0	15.4	11.8	9.29
10-TR-015 BH10-08	gneiss	0.88	3.58	33.5	11.9	11.6	10.1
10-TR-016 BH10-09	gneiss	0.38	1.67	20.0	16.5	5.4	5.89
10-TR-017 BH10-09	gneiss	0.38	5.83	22.9	18.9	18.8	6.79
10-TR-018 BH10-09	gneiss	1.19	1.92	21.3	5.6	6.2	6.29
10-TR-019 BH10-12	gneiss	0.91	2.92	25.8	8.8	9.4	7.69
10-TR-020 BH10-12	gneiss	0.88	4.25	26.0	11.9	10.6	10.0
10-TR-021 BH10-12	gneiss	0.19	3.83	28.4	46.9	12.4	8.49
10-TR-034 BH10-21	schist	0.47	8.00	40.3	26.7	25.8	12.2
10-TR-035 BH10-12	schist	1.88	4.33	13.3	5.4	5.6	9.43
10-TR-036 BH10-12	schist	0.72	4.08	25.6	14.5	10.0	9.99
10-TR-022 BH10-13	sandstone	0.16	230.85	739	1465.6	744.7	229
10-TR-023 BH10-13	sandstone	0.16	248.35	813	1612.8	801.1	252
10-TR-024 BH10-13	sandstone	0.16	270.85	881	1747.2	873.7	273
10-TR-025 BH10-14	sandy carbonate	0.16	925.06	3095	6137.6	2984.1	959
10-TR-026 BH10-14	sandy carbonate	0.16	900.06	2998	5952.0	2903.4	929
10-TR-027 BH10-14	sandy carbonate	2.22	933.40	742	430.9	723.6	955
10-TR-028 BH10-15	carbonate	0.44	908.39	3155	2235.4	2930.3	978
10-TR-029 BH10-15	carbonate	1.28	891.73	1245	743.8	1158.1	952
10-TR-030 BH10-15	carbonate	0.63	891.73	2749	1512.0	2622.7	945
10-TR-031 BH10-16	carbonate	0.16	900.06	3114	6176.0	2903.4	965
10-TR-032 BH10-16	carbonate	0.16	891.73	3099	6150.4	2876.5	960
10-TR-033 BH10-16	carbonate	0.16	891.73	3076	6105.6	2876.5	953
S449-10	sand/gravel	0.34	655.04	2185	1972.4	2113.0	677
S450-10	sand/gravel	0.16	668.38	2256	4473.6	2156.1	699
S451-10	sand/gravel	0.16	243.35	765	1516.8	785.0	237
S452-10	sand/gravel	0.44	240.85	805	571.4	776.9	249
S453-10	sand/gravel	0.16	268.35	861	1708.8	865.6	266
S454-10	sand/gravel	0.16	5.08	17.1	33.9	16.4	4.99
S455-10	sand/gravel	0.16	34.17	121	240.0	110.2	37.2
S456-10	sand/gravel	0.22	151.68	482	685.7	489.3	149
S457-10	sand/gravel	0.16	120.01	554	1100.8	387.1	171
S458-10	sand/gravel	0.22	93.34	280	396.3	301.1	86.4
S459-10	sand/gravel	0.16	322.52	998	1977.6	1040.4	309
S460-10	sand/gravel	0.16	142.51	441	876.8	459.7	136
S461-10	sand/gravel	0.16	194.18	621	1228.8	626.4	192
S462-10	sand/gravel	0.22	312.52	1001	1417.1	1008.1	310

Note:
CaNP = Carbonate neutralization potential was calculated based on total carbon content (%C)
MPA = Maximum potential acidity was calculated based on total sulphur content (%S)

Table 2 Statistical Summary of Acid Base Accounting Results

	Paste pH	Total Carbon %	Total Sulphur %	Sulphate Sulphur %	Sulphide Sulphur %	Neutral-ization Potential kg $CaCO_3$/t	Acid Potential kg $CaCO_3$/t	CaNP kg $CaCO_3$/t	Maximum Potential Acidity kg $CaCO_3$/t	Ratio NP/AP (NPR) calculated ratio	Ratio NP/MPA calculated ratio	Ratio CaNP/AP calculated ratio
All Quarry Pit Rock (gneiss, schist, carbonate rocks)												
Min	8.1	0.02	<0.005	<0.01	<0.01	6.2	0.31	1.7	0.16	13	5.2	5.4
Max	10	11	0.071	0.04	0.04	978	1.29	933	2.2	3155	6176	2984
Mean	-	2.99	0.019	0.02	0.01	266	0.37	249	0.58	710	458	666
Median	9.7	0.1	<0.014	<0.01	<0.01	10.3	0.31	4.2	0.44	33	24	13.6
Standard Deviation	0.7	4.7	0.016	0.01	0.01	410	0.19	389	0.51	1191	2111	1130
No. of Samples	36	36	36	36	36	36	36	36	36	36	36	36
5th Percentile	8.2	0.026	0.005	0.01	0.01	6.3	0.31	2.2	0.16	19	5.5	5.6
25th Percentile	9.1	0.036	0.005	0.01	0.01	7.7	0.31	3.0	0.16	24	14	9.4
75th Percentile	9.9	5.1	0.028	0.02	0.01	437	0.31	426	0.88	830	1477	819
95th Percentile	10	11	0.046	0.04	0.02	962	0.77	913	1.43	3103	6141	2910
Gneiss												
Min	9.5	0.02	<0.005	<0.01	<0.01	6.2	0.31	1.7	0.16	14	5.2	5.4
Max	10	0.07	0.038	0.04	0.01	11.7	0.44	5.8	1.19	38	56	19
Mean	-	0.04	0.018	0.02	0.01	8.3	0.32	3.3	0.57	26	14	10
Median	9.8	0.04	0.015	<0.01	<0.01	7.9	0.31	3.0	0.47	25	17	9.7
Standard Deviation	0.17	0.01	0.012	0.01	0.00	1.7	0.03	1.1	0.38	5.6	17	3.7
No. of Samples	21	21	21	21	21	21	21	21	21	21	21	21
5th Percentile	9.5	0.02	0.005	0.01	0.01	6.2	0.31	1.9	0.16	20	5.6	5.5
25th Percentile	9.7	0.03	0.006	0.01	0.01	7.1	0.31	2.4	0.19	23	12	7.5
75th Percentile	9.9	0.05	0.028	0.02	0.01	9.5	0.31	3.8	0.88	28	40	12
95th Percentile	10	0.06	0.038	0.04	0.01	12	0.40	5.3	1.19	37	52	17
Schist												
Min	9.7	0.05	0.015	<0.01	<0.01	10	0.31	4.1	0.47	13.3	5.4	5.6
Max	10	0.10	0.060	0.04	0.02	13	0.77	8.0	1.88	40	27	26
Median	9.8	0.05	0.023	0.02	0.01	10	0.41	4.3	0.72	26	14	10
No. of Samples	3	3	3	3	3	3	3.00	3	3.00	3	3	3

Table 2 Statistical Summary of Acid Base Accounting Results (Continued)

	Paste pH	Total Carbon %	Total Sulphur %	Sulphate Sulphur %	Sulphide Sulphur %	Neutral-ization Potential kg $CaCO_3$/t	Acid Potential kg $CaCO_3$/t	CaNP kg $CaCO_3$/t	Maximum Potential Acidity kg $CaCO_3$/t	Ratio NP/AP (NPR) calculated ratio	Ratio NP/MPA calculated ratio	Ratio CaNP/AP calculated ratio
Carbonate Rocks												
Min	8.1	2.8	<0.005	<0.01	<0.01	229	0.31	231	0.16	739	431	724
Max	9.4	11	0.071	0.03	0.04	978	1.29	933	2.2	3155	6176	2984
Mean	-	8.9	0.016	0.01	0.01	780	0.43	740	0.48	1803	1609	1712
Median	8.3	11	<0.005	<0.01	<0.01	954	0.31	892	0.16	3076	6102	2877
Standard Deviation	0.5	3.6	0.021	0.01	0.01	319	0.30	296	0.64	1122	2469	1044
No. of Samples	12	12	12	12	12	12	12	12	12	12	12	12
5th Percentile	8.2	2.9	0.005	0.01	0.01	242	0.31	240	0.16	741	603	735
25th Percentile	8.2	8.8	0.005	0.01	0.01	766	0.31	737	0.16	864	1500	856
75th Percentile	8.2	11	0.005	0.01	0.01	932	0.31	892	0.16	930	1526	912
95th Percentile	9.4	11	0.055	0.02	0.03	971	1.00	929	1.70	3132	6162	2954
Unconsolidated Borrow Material												
Min	8.4	0.1	<0.005	<0.01	<0.01	5.3	0.31	5.1	0.16	17	34	16
Max	9.5	8.0	0.014	0.01	0.01	699	0.31	668	0.44	2256	4474	2156
Mean	-	3.0	0.0065	0.01	0.01	252	0.31	247	0.20	813	1241	795
Median	8.9	2.6	<0.005	<0.01	<0.01	215	0.31	218	0.16	692	1373	702
Standard Deviation	0.3	2.4	0	0	0	207	0	200	0.09	667	1105	646
No. of Samples	14	14	14	14	14	14	14	14	14	14	14	14
5th Percentile	8.4	0.3	0.005	0.01	0.01	26	0.31	24	0.16	85	168	77
25th Percentile	8.8	1.5	0.005	0.01	0.01	140	0.31	126	0.16	451	600	405
75th Percentile	8.9	2.2	0.005	0.01	0.01	185	0.31	180	0.16	598	1024	579
95th Percentile	9.3	7.9	0.012	0.01	0.01	685	0.31	660	0.38	2210	2851	2128

Note:

CaNP = Carbonate neutralization potential was calculated based on total carbon content (%C)

MPA = Maximum potential acidity was calculated based on total sulphur content (%S)

Table 3 Results of Metals Analyses

Sample ID	Drill Log Lithology	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu
		%	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g
Average Crustal Abundance		8.23	1.8	425	3	0.0085	4.15	0.15	25	102	60
10x Average Crustal Abundance		82.3	18	4250	30	0.085	41.5	1.5	250	1020	600
10-TR-001 BH10-04	gneiss	0.33	<0.5	21	0.13	<0.09	0.12	<0.02	1.2	100	18
10-TR-002 BH10-04	gneiss	0.36	<0.5	23	0.15	<0.09	0.13	<0.02	1.1	99	5.0
10-TR-003 BH10-04	gneiss	0.35	<0.5	24	0.13	<0.09	0.14	<0.02	1.1	110	8.5
10-TR-004 BH10-05	gneiss	0.41	<0.5	23	0.17	<0.09	0.11	<0.02	1.5	91	2.9
10-TR-005 BH10-05	gneiss	0.39	<0.5	27	0.15	<0.09	0.07	<0.02	1.3	110	8.1
10-TR-006 BH10-05	gneiss	0.37	<0.5	20	0.18	<0.09	0.06	<0.02	1.3	87	3.2
10-TR-007 BH10-06	gneiss	0.43	<0.5	23	0.20	<0.09	0.10	<0.02	2.0	110	5.2
10-TR-008 BH10-06	gneiss	0.50	<0.5	25	0.29	<0.09	0.10	<0.02	2.3	110	6.6
10-TR-009 BH10-06	gneiss	0.49	<0.5	39	0.19	<0.09	0.14	<0.02	2.5	94	8.4
10-TR-010 BH10-07	gneiss	0.78	<0.5	68	0.25	<0.09	0.29	<0.02	5.2	92	17
10-TR-011 BH10-07	gneiss	1.20	<0.5	110	0.40	0.09	0.36	<0.02	8.0	75	17
10-TR-012 BH10-07	gneiss	1.10	<0.5	57	0.27	0.10	0.36	<0.02	9.9	110	16
10-TR-013 BH10-08	gneiss	0.32	<0.5	23	0.16	<0.09	0.07	<0.02	1.4	110	5.3
10-TR-014 BH10-08	gneiss	0.85	<0.5	64	0.49	<0.09	0.21	<0.02	4.4	79	10
10-TR-015 BH10-08	gneiss	1.00	<0.5	78	0.48	<0.09	0.23	<0.02	5.9	78	12
10-TR-016 BH10-09	gneiss	0.43	<0.5	33	0.14	<0.09	0.09	<0.02	2.4	82	4.3
10-TR-017 BH10-09	gneiss	0.45	<0.5	33	0.17	<0.09	0.14	<0.02	2.6	100	7.2
10-TR-018 BH10-09	gneiss	0.39	<0.5	32	0.14	0.13	0.11	0.05	4.9	81	12
10-TR-019 BH10-12	gneiss	0.59	<0.5	30	0.17	<0.09	0.26	<0.02	5.7	100	28
10-TR-020 BH10-12	gneiss	0.83	<0.5	51	0.18	<0.09	0.23	<0.02	6.1	100	14
10-TR-021 BH10-12	gneiss	0.49	<0.5	24	0.15	<0.09	0.19	<0.02	2.8	100	8.8
10-TR-034 BH10-21	schist	0.74	<0.5	36	0.17	<0.09	0.30	<0.02	2.2	67	6.3
10-TR-035 BH10-12	schist	1.10	<0.5	35	0.27	0.09	0.18	0.03	3.6	69	13
10-TR-036 BH10-12	schist	1.30	1.1	37	0.41	<0.09	0.14	<0.02	3.6	70	8.0
10-TR-022 BH10-13	carbonate rocks	0.05	<0.5	5.5	0.06	<0.09	3.9	<0.02	1.3	99	5.0
10-TR-023 BH10-13	carbonate rocks	0.31	<0.5	16	0.32	<0.09	4.1	0.03	2.1	96	6.1
10-TR-024 BH10-13	carbonate rocks	0.23	<0.5	13	0.22	<0.09	4.8	0.02	1.5	82	2.0
10-TR-025 BH10-14	carbonate rocks	0.08	<0.5	3.0	0.06	<0.09	28.8	<0.02	1.6	2.2	4.0
10-TR-026 BH10-14	carbonate rocks	0.16	0.7	5.3	0.14	<0.09	28.3	0.06	2.1	3.4	3.9
10-TR-027 BH10-14	carbonate rocks	0.08	0.5	2.7	0.06	<0.09	27.0	<0.02	1.6	2.6	4.3
10-TR-028 BH10-15	carbonate rocks	0.08	0.6	3.4	0.07	<0.09	28.2	<0.02	1.7	4.1	2.2
10-TR-029 BH10-15	carbonate rocks	0.12	1.8	4.5	0.08	<0.09	26.7	<0.02	1.9	2.2	4.5
10-TR-030 BH10-15	carbonate rocks	0.13	1.2	4.2	0.08	<0.09	28.4	<0.02	2.0	2.6	5.4
10-TR-031 BH10-16	carbonate rocks	0.08	<0.5	3.2	0.06	<0.09	27.4	<0.02	1.7	2.1	2.0
10-TR-032 BH10-16	carbonate rocks	0.08	1.2	3.1	0.07	<0.09	27.3	<0.02	1.7	2.2	3.9
10-TR-033 BH10-16	carbonate rocks	0.13	1.1	3.9	0.07	<0.09	27.5	<0.02	1.9	2.6	2.4
S449-10	borrow pit material	0.26	1.7	11	0.18	<0.09	13.4	0.03	2.9	39	8.1
S450-10	borrow pit material	0.12	<0.5	6.7	0.09	<0.09	17.2	<0.02	1.9	30	3.5
S451-10	borrow pit material	0.29	0.8	16	0.20	<0.09	4.0	0.03	3.0	89	12
S452-10	borrow pit material	0.39	<0.5	29	0.18	<0.09	5.0	<0.02	3.2	64	8.3
S453-10	borrow pit material	0.20	1.2	16	0.27	<0.09	4.8	0.02	3.4	79	7.5
S454-10	borrow pit material	0.08	<0.5	5.0	0.03	<0.09	0.1	<0.02	0.73	110	2.0
S455-10	borrow pit material	0.24	<0.5	20	0.12	<0.09	0.6	0.02	7.0	170	10
S456-10	borrow pit material	0.35	<0.5	16	0.21	<0.09	3.6	<0.02	2.0	75	6.9
S457-10	borrow pit material	0.39	<0.5	25	0.25	<0.09	2.4	<0.02	2.5	90	4.3
S458-10	borrow pit material	0.38	0.7	25	0.21	<0.09	1.8	<0.02	2.0	82	6.7
S459-10	borrow pit material	0.18	<0.5	9.6	0.14	<0.09	7.4	<0.02	1.7	68	4.2
S460-10	borrow pit material	0.20	<0.5	12	0.13	<0.09	3.6	<0.02	1.5	93	19
S461-10	borrow pit material	0.29	<0.5	15	0.17	<0.09	3.6	<0.02	1.8	74	38
S462-10	borrow pit material	0.25	<0.5	14	0.19	<0.09	6.2	<0.02	1.8	73	8.7

Table 3 Results of Metals Analyses (Continued)

Sample ID	Drill Log Lithology	Fe	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb
		%	%	µg/g	%	µg/g	µg/g	%	µg/g	µg/g	µg/g
Average Crustal Abundance		5.63	2.085	20	2.33	950	1.2	2.355	84	1050	14
10x Average Crustal Abundance		56.3	20.85	200	23.3	9500	12	23.55	840	10500	140
10-TR-001 BH10-04	gneiss	0.71	0.15	15	0.12	150	0.4	0.05	3.9	25	11
10-TR-002 BH10-04	gneiss	0.66	0.17	18	0.13	180	0.4	0.05	4.1	28	9.3
10-TR-003 BH10-04	gneiss	0.76	0.17	14	0.13	160	0.4	0.05	3.9	47	7.1
10-TR-004 BH10-05	gneiss	0.88	0.17	13	0.20	200	0.4	0.05	3.8	140	5.4
10-TR-005 BH10-05	gneiss	0.82	0.16	11	0.16	190	0.3	0.05	4.3	67	4.1
10-TR-006 BH10-05	gneiss	0.75	0.11	10	0.16	170	0.6	0.05	3.7	61	4.0
10-TR-007 BH10-06	gneiss	0.88	0.24	15	0.22	140	0.3	0.05	3.8	210	4.2
10-TR-008 BH10-06	gneiss	0.93	0.19	15	0.29	160	0.2	0.05	3.7	230	3.8
10-TR-009 BH10-06	gneiss	1.20	0.33	19	0.24	160	0.2	0.05	4.3	270	6.5
10-TR-010 BH10-07	gneiss	1.90	0.56	23	0.50	280	0.4	0.06	5.6	630	9.3
10-TR-011 BH10-07	gneiss	2.60	0.71	36	0.93	300	0.5	0.05	7.1	1000	2.8
10-TR-012 BH10-07	gneiss	1.86	0.72	34	1.10	290	2.1	0.06	25	440	3.2
10-TR-013 BH10-08	gneiss	0.83	0.17	11	0.16	150	0.3	0.05	3.4	92	5.3
10-TR-014 BH10-08	gneiss	1.40	0.49	26	0.59	240	0.4	0.04	4.9	490	2.5
10-TR-015 BH10-08	gneiss	1.70	0.70	29	0.76	320	0.2	0.04	5.3	670	2.0
10-TR-016 BH10-09	gneiss	1.00	0.28	17	0.23	150	2.5	0.05	3.2	230	6.6
10-TR-017 BH10-09	gneiss	1.20	0.30	20	0.25	180	1.1	0.05	4.2	260	5.8
10-TR-018 BH10-09	gneiss	0.95	0.28	13	0.20	140	1.5	0.05	3.4	220	29
10-TR-019 BH10-12	gneiss	1.10	0.35	10	0.46	180	1.0	0.06	20	160	5.0
10-TR-020 BH10-12	gneiss	1.90	0.54	20	0.64	280	6.8	0.05	15	220	6.8
10-TR-021 BH10-12	gneiss	1.40	0.27	9	0.30	140	3.4	0.05	5.0	250	12
10-TR-034 BH10-21	schist	1.10	0.54	8	0.41	250	0.4	0.03	2.9	120	3.2
10-TR-035 BH10-12	schist	1.60	0.60	12	0.74	280	0.2	0.03	3.1	260	3.3
10-TR-036 BH10-12	schist	1.80	0.50	17	1.00	280	0.4	0.03	3.8	120	1.7
10-TR-022 BH10-13	carbonate rocks	0.40	0.04	<2	2.20	270	0.5	0.01	5.0	370	0.83
10-TR-023 BH10-13	carbonate rocks	0.73	0.17	18	2.60	280	0.4	0.01	8.9	540	0.98
10-TR-024 BH10-13	carbonate rocks	0.58	0.14	13	2.80	340	<0.1	0.02	7.0	1090	0.89
10-TR-025 BH10-14	carbonate rocks	0.16	0.03	<2	0.65	70	<0.1	0.02	14	21	1.0
10-TR-026 BH10-14	carbonate rocks	0.28	0.04	<2	0.41	120	<0.1	0.01	15	43	1.6
10-TR-027 BH10-14	carbonate rocks	0.17	0.03	<2	1.30	71	<0.1	0.01	14	42	1.1
10-TR-028 BH10-15	carbonate rocks	0.19	0.03	<2	0.95	77	<0.1	0.02	14	78	1.3
10-TR-029 BH10-15	carbonate rocks	0.25	0.04	2	0.57	170	<0.1	0.02	15	85	2.0
10-TR-030 BH10-15	carbonate rocks	0.25	0.04	3	0.66	120	<0.1	0.02	15	86	1.6
10-TR-031 BH10-16	carbonate rocks	0.17	0.03	<2	0.98	66	<0.1	0.02	14	57	1.2
10-TR-032 BH10-16	carbonate rocks	0.18	0.03	<2	0.98	62	<0.1	0.02	14	70	1.4
10-TR-033 BH10-16	carbonate rocks	0.26	0.05	3	0.86	89	<0.1	0.02	15	92	1.8
S449-10	borrow pit material	0.59	0.18	24	4.90	140	0.5	0.02	11	130	4.3
S450-10	borrow pit material	0.34	0.07	<2	2.90	100	0.2	0.02	10	120	1.9
S451-10	borrow pit material	0.74	0.12	5	2.50	130	0.3	0.02	10	230	7.0
S452-10	borrow pit material	0.99	0.24	10	2.10	140	0.2	0.03	6.9	200	3.8
S453-10	borrow pit material	0.89	0.09	4	2.80	270	0.1	0.02	8.6	830	2.1
S454-10	borrow pit material	0.30	0.03	<2	0.03	25	0.4	0.01	3.4	16	0.75
S455-10	borrow pit material	1.10	0.09	2	1.20	120	0.3	0.02	110	130	2.7
S456-10	borrow pit material	0.79	0.13	9	1.10	140	0.5	0.03	5.2	140	3.5
S457-10	borrow pit material	0.81	0.15	11	1.20	130	0.2	0.03	5.7	140	3.7
S458-10	borrow pit material	0.87	0.16	9	1.00	130	0.4	0.03	5.1	240	4.5
S459-10	borrow pit material	0.50	0.07	5	2.00	94	0.3	0.02	6.3	120	2.2
S460-10	borrow pit material	0.53	0.09	3	0.77	74	0.6	0.02	5.5	140	2.0
S461-10	borrow pit material	0.70	0.12	8	1.90	130	0.3	0.03	4.6	170	3.8
S462-10	borrow pit material	0.63	0.11	7	2.70	100	0.3	0.02	6.6	110	3.3

Table 3 Results of Metals Analyses (Continued)

Sample ID	Drill Log Lithology	Sb	Se	Si	Sn	Sr	Ti	Tl	U	V	Y	Zn
		µg/g	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g
Average Crustal Abundance		0.2	0.05	281500	2.3	370	0.565	0.85	2.7	120	33	70
10x Average Crustal Abundance		2	0.5	2815000	23	3700	5.65	8.5	27	1200	330	700
10-TR-001 BH10-04	gneiss	<0.8	0.8	530	<0.5	6.6	0.02	0.07	4.8	3	2.0	20
10-TR-002 BH10-04	gneiss	<0.8	<0.7	450	<0.5	6.6	0.02	0.09	5.2	3	2.2	20
10-TR-003 BH10-04	gneiss	<0.8	<0.7	480	<0.5	6.2	0.02	0.08	4.4	3	2.4	21
10-TR-004 BH10-05	gneiss	<0.8	<0.7	440	<0.5	5.6	0.02	0.10	5.2	5	4.1	21
10-TR-005 BH10-05	gneiss	<0.8	<0.7	460	<0.5	6.3	0.02	0.07	2.8	3	2.7	22
10-TR-006 BH10-05	gneiss	<0.8	<0.7	440	<0.5	5.6	0.01	0.06	13	3	3.9	18
10-TR-007 BH10-06	gneiss	<0.8	<0.7	490	<0.5	6.5	0.04	0.12	2.1	9	4.1	24
10-TR-008 BH10-06	gneiss	<0.8	<0.7	560	<0.5	6.2	0.03	0.10	2.7	10	4.9	27
10-TR-009 BH10-06	gneiss	<0.8	<0.7	530	0.6	7.6	0.06	0.23	6.0	14	6.7	31
10-TR-010 BH10-07	gneiss	<0.8	<0.7	700	1.2	13	0.17	0.38	4.5	32	16	46
10-TR-011 BH10-07	gneiss	<0.8	<0.7	650	0.8	14	0.19	0.44	4.0	48	14	49
10-TR-012 BH10-07	gneiss	<0.8	<0.7	780	<0.5	7.3	0.14	0.48	3.5	43	9.8	36
10-TR-013 BH10-08	gneiss	<0.8	<0.7	500	<0.5	6.6	0.03	0.07	2.5	5	3.3	19
10-TR-014 BH10-08	gneiss	<0.8	<0.7	690	<0.5	8.5	0.09	0.31	4.7	22	7.1	34
10-TR-015 BH10-08	gneiss	<0.8	<0.7	610	<0.5	8.2	0.13	0.46	3.1	28	8.2	50
10-TR-016 BH10-09	gneiss	<0.8	<0.7	470	<0.5	6.6	0.06	0.17	2.6	13	3.7	23
10-TR-017 BH10-09	gneiss	<0.8	<0.7	460	0.6	7.1	0.07	0.19	4.2	15	4.7	31
10-TR-018 BH10-09	gneiss	<0.8	<0.7	520	<0.5	8.1	0.06	0.22	9.6	12	5.5	29
10-TR-019 BH10-12	gneiss	<0.8	<0.7	470	<0.5	6.8	0.08	0.19	2.9	19	3.5	24
10-TR-020 BH10-12	gneiss	<0.8	<0.7	600	1.2	9.7	0.12	0.31	4.0	30	3.4	38
10-TR-021 BH10-12	gneiss	<0.8	<0.7	600	0.8	17	0.07	0.13	4.9	12	8.2	31
10-TR-034 BH10-21	schist	<0.8	1.5	540	<0.5	5.8	0.06	0.21	2.2	6	3.9	23
10-TR-035 BH10-12	schist	<0.8	2.2	590	<0.5	4.8	0.06	0.21	2.3	6	7.4	26
10-TR-036 BH10-12	schist	<0.8	0.9	630	<0.5	3.4	0.03	0.15	2.2	7	5.2	28
10-TR-022 BH10-13	carbonate rocks	<0.8	<0.7	270	<0.5	14	0.00	0.02	0.31	7	2.3	2.2
10-TR-023 BH10-13	carbonate rocks	<0.8	<0.7	590	<0.5	24	0.02	0.04	0.40	11	5.0	9.9
10-TR-024 BH10-13	carbonate rocks	<0.8	1.0	450	<0.5	22	0.01	0.02	0.41	7	9.1	5.8
10-TR-025 BH10-14	carbonate rocks	<0.8	<0.7	390	<0.5	290	0.00	<0.02	0.30	4	1.5	4.0
10-TR-026 BH10-14	carbonate rocks	<0.8	<0.7	420	<0.5	300	0.00	<0.02	0.34	5	4.0	6.4
10-TR-027 BH10-14	carbonate rocks	<0.8	0.9	350	<0.5	280	0.00	<0.02	0.34	4	1.6	4.5
10-TR-028 BH10-15	carbonate rocks	<0.8	0.9	530	<0.5	270	0.00	<0.02	0.34	4	2.2	3.3
10-TR-029 BH10-15	carbonate rocks	<0.8	1.0	340	<0.5	240	0.00	<0.02	0.39	5	2.8	6.1
10-TR-030 BH10-15	carbonate rocks	<0.8	1.0	430	<0.5	290	0.00	<0.02	0.33	5	2.9	6.2
10-TR-031 BH10-16	carbonate rocks	<0.8	1.5	440	<0.5	270	0.00	<0.02	0.28	4	1.8	3.0
10-TR-032 BH10-16	carbonate rocks	<0.8	1.8	400	<0.5	260	0.00	<0.02	0.32	4	2.2	5.0
10-TR-033 BH10-16	carbonate rocks	<0.8	1.0	420	<0.5	270	0.00	<0.02	0.34	5	2.7	3.9
S449-10	borrow pit material	<0.8	2.1	520	<0.5	85	0.01	0.05	0.37	12	3.5	9.6
S450-10	borrow pit material	<0.8	0.9	350	<0.5	130	0.01	0.03	0.36	7	2.1	4.4
S451-10	borrow pit material	<0.8	1.2	470	<0.5	18	0.03	0.07	0.47	13	4.4	14
S452-10	borrow pit material	<0.8	1.1	530	0.7	31	0.05	0.11	1.2	15	3.2	18
S453-10	borrow pit material	<0.8	1.7	430	<0.5	21	0.01	<0.02	0.57	10	3.4	7.7
S454-10	borrow pit material	<0.8	1.9	310	<0.5	2.2	0.00	<0.02	0.24	1	0.60	1.7
S455-10	borrow pit material	<0.8	2.0	610	<0.5	5.3	0.02	0.03	0.71	8	2.2	13
S456-10	borrow pit material	<0.8	1.8	370	0.6	27	0.02	0.06	1.7	9	3.8	17
S457-10	borrow pit material	<0.8	1.4	440	<0.5	18	0.02	0.07	2.3	10	4.3	14
S458-10	borrow pit material	<0.8	2.0	520	0.6	13	0.03	0.08	2.6	9	4.8	18
S459-10	borrow pit material	<0.8	2.0	380	<0.5	47	0.01	<0.02	0.68	7	2.4	6.9
S460-10	borrow pit material	<0.8	1.7	370	<0.5	27	0.01	<0.02	0.62	6	2.0	12
S461-10	borrow pit material	<0.8	1.9	400	0.8	21	0.02	0.04	1.8	8	3.4	20
S462-10	borrow pit material	<0.8	1.8	400	<0.5	36	0.02	0.03	1.3	8	2.8	13

*Price (1997)

Table 4 Statistical Summary of Metals Analyses

	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn
	%	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	%	%	µg/g	%	µg/g
Average Concentration (Continental Crust)*	8.2	1.8	425	3	0.0085	4.15	0.15	25	102	60	5.63	2.09	20	2.33	950
Ten Times Average Concentration (Continental Crust)*	82	18	4250	30	0.085	42	1.5	250	1020	600	56	21	200	23.3	9500
All Quarry Pit Rock (gneiss, schist, carbonate rocks)															
Min	0.05	0.50	2.7	0.1	0.09	0.06	0.02	1.1	2.1	2.0	0.16	0.03	2.0	0.12	62
Max	1.30	1.8	110	0.5	0.13	29	0.06	9.9	110	28	2.60	0.72	36	2.80	340
Mean	0.46	0.62	28	0.2	0.09	7.40	0.02	2.9	70	8.1	0.93	0.26	13	0.69	186
Median	0.39	0.50	24	0.2	0.09	0.23	0.02	2.1	85	6.2	0.86	0.17	13	0.54	170
Standard Deviation	0.35	0.29	24	0.1	0.01	12	0.01	2.1	41	5.7	0.62	0.22	9.2	0.66	80
No. of Samples	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
5th Percentile	0.08	0.5	3.1	0.06	0.09	0.07	0.02	1.2	2.2	2.2	0.17	0.03	2.0	0.13	69
25th Percentile	0.15	0.5	5.5	0.12	0.09	0.13	0.02	1.6	51	4.2	0.37	0.05	3.0	0.23	140
75th Percentile	0.63	0.5	35	0.23	0.09	10	0.02	3.6	100	11	1.25	0.39	18	0.94	273
95th Percentile	1.13	1.2	71	0.43	0.09	28	0.04	6.6	110	17	1.90	0.70	30	2.30	305
Gneiss															
Min	0.32	0.5	20	0.13	0.09	0.06	0.02	1.1	75	2.9	0.66	0.11	9.0	0.12	140
Max	1.20	0.5	110	0.49	0.13	0.36	0.1	9.9	110	28	2.60	0.72	36	1.10	320
Mean	0.57	0.5	39	0.22	0.09	0.17	0.02	3.5	96	10	1.21	0.34	18	0.37	198
Median	0.45	0.5	30	0.17	0.09	0.14	0.02	2.5	100	8.5	1.00	0.28	15	0.24	180
Standard Deviation	0.27	0.0	24	0.11	0.01	0.09	0.01	2.5	12	6.2	0.51	0.20	7.7	0.28	60
No. of Samples	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
5th Percentile	0.33	0.5	21	0.13	0.09	0.07	0.02	1.1	78	3.2	0.71	0.15	10	0.13	140
25th Percentile	0.39	0.5	23	0.15	0.09	0.10	0.02	1.4	87	5.3	0.83	0.17	13	0.16	150
75th Percentile	0.78	0.5	51	0.25	0.09	0.23	0.02	5.2	110	14	1.40	0.49	20	0.50	240
95th Percentile	1.10	0.5	78	0.48	0.10	0.36	0.02	8.0	110	18	1.90	0.71	34	0.93	300
Schist															
Min	0.74	0.5	35	0.2	0.09	0.14	0.02	2.2	67	6.3	1.10	0.50	8.0	0.41	250
Max	1.30	1.1	37	0.4	0.09	0.30	0.03	3.6	70	13	1.80	0.60	17.0	1.00	280
Median	1.10	0.5	36	0.3	0.09	0.18	0.02	3.6	69	8.0	1.60	0.54	12.0	0.74	280
No. of Samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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Table 4 Statistical Summary of Metals Analyses (Continued)

	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn
	%	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	%	%	µg/g	%	µg/g
Average Concentration (Continental Crust)*	8.2	1.8	425	3	0.0085	4.15	0.15	25	102	60	5.63	2.09	20	2.33	950
Ten Times Average Concentration (Continental Crust)*	82	18	4250	30	0.085	42	1.5	250	1020	600	56	21	200	23.3	9500
Carbonate Rocks															
Min	0.05	0.5	2.7	0.06	0.09	3.90	0.02	1.3	2.1	2.0	0.16	0.03	2.0	0.41	62
Max	0.31	1.8	16	0.32	0.09	29	0.06	2.1	99	6.1	0.73	0.17	18	2.80	340
Mean	0.13	0.8	5.7	0.11	0.09	22	0.02	1.8	25	3.8	0.30	0.06	4.4	1.25	145
Median	0.10	0.6	4.1	0.07	0.09	27	0.02	1.7	2.6	4.0	0.25	0.04	2.0	0.97	105
Standard Deviation	0.08	0.4	4.3	0.08	0	11	0.01	0.2	41	1.4	0.18	0.05	5.3	0.82	98
No. of Samples	12.0	12	12	12	12	12	12	12	12	12	12	12	12	12	12
5th Percentile	0.07	0.5	2.9	0.06	0.09	4.01	0.02	1.4	2.2	2.0	0.17	0.03	2.0	0.50	64
25th Percentile	0.08	0.5	3.2	0.06	0.09	21	0.02	1.6	2.2	2.4	0.18	0.03	2.0	0.66	71
75th Percentile	0.14	1.1	5.4	0.10	0.09	28	0.02	1.9	24	4.6	0.31	0.04	3.0	1.53	195
95th Percentile	0.27	1.5	14	0.27	0.09	29	0.04	2.1	97	5.7	0.65	0.15	15	2.69	307
Unconsolidated Borrow Material															
Min	0.08	0.5	5.0	0.03	0.09	0.05	0.02	0.7	30	2.0	0.30	0.03	2.0	0.03	25
Max	0.39	1.7	29	0.27	0.09	17	0.03	7.0	170	38.0	1.10	0.24	24	4.90	270
Mean	0.26	0.7	16	0.17	0.09	5.3	0.02	2.5	81	9.9	0.70	0.12	7.2	1.94	123
Median	0.26	0.5	16	0.18	0.09	3.8	0.02	2.0	77	7.8	0.72	0.12	6.0	1.95	130
Standard Deviation	0.10	0.4	7.0	0.06	0	4.8	0.004	1.5	33	9.1	0.23	0.05	5.8	1.21	53
No. of Samples	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
5th Percentile	0.11	0.5	6.1	0.07	0.09	0.41	0.02	1.2	36	3.0	0.33	0.05	2.0	0.51	57
25th Percentile	0.20	0.5	11	0.13	0.09	2.7	0.02	1.8	69	4.9	0.55	0.09	3.3	1.13	100
75th Percentile	0.34	0.7	19	0.21	0.09	5.9	0.02	3.0	90	9.7	0.86	0.15	9.0	2.65	138
95th Percentile	0.39	1.4	26	0.26	0.09	15	0.03	4.7	131	26	1.03	0.20	16	3.60	186

Table 4 Statistical Summary of Metals Analyses (Continued)

	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sn	Sr	Ti	Tl	U	V	Y	Zn
	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g
Average Concentration (Continental Crust)*	1.2	2.4	84	1050	14	0.2	0.05	281500	2.3	370	0.57	0.85	2.7	120	33	70
Ten Times Average Concentration (Continental Crust)*	12	24	840	10500	140	2	0.5	2815000	23	3700	5.7	8.5	27	1200	330	700
All Quarry Pit Rock (gneiss, sch																
Min	0.10	0.012	2.9	21	0.8	0.8	0.7	270	0.5	3.4	0.001	0.02	0.3	3.0	1.5	2.2
Max	6.8	0.062	25	1090	29.0	0.8	2.2	780	1.2	300	0.19	0.48	13.0	48.0	16	50.0
Mean	0.73	0.038	8.3	245	4.7	0.8	0.9	506	0.6	75.4	0.05	0.14	3.0	11.6	4.9	20.9
Median	0.40	0.047	5.0	150	3.3	0.8	0.7	485	0.5	8.2	0.03	0.10	2.7	6.5	3.9	21.5
Standard Deviation	1.3	0.017	5.8	261	5.1	0.0	0.3	108	0.2	117	0.05	0.14	2.8	11	3.3	14
No. of Samples	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
5th Percentile	0.10	0.014	3.2	27	1.0	0.8	0.7	348	0.5	5.4	0.001	0.02	0.3	3.0	1.8	3.2
25th Percentile	0.10	0.016	3.8	69	1.6	0.8	0.7	440	0.5	6.6	0.002	0.02	0.4	4.0	2.6	6.2
75th Percentile	0.50	0.052	14	263	6.0	0.8	0.9	590	0.5	78	0.06	0.21	4.4	13.3	5.8	29.5
95th Percentile	2.7	0.056	16	753	11.3	0.8	1.6	693	0.9	290	0.15	0.45	6.9	34.8	10.9	46.8
Gneiss																
Min	0.20	0.040	3.2	25	2.0	0.8	0.7	440	0.5	5.6	0.01	0.06	2.1	3.0	2.0	18.0
Max	6.8	0.062	25	1000	29.0	0.8	0.8	780	1.2	17	0.19	0.48	13.0	48.0	16	50.0
Mean	1.1	0.051	6.6	273	6.9	0.8	0.7	544	0.6	8.1	0.07	0.20	4.6	15.8	5.7	29.2
Median	0.40	0.051	4.2	220	5.4	0.8	0.7	520	0.5	6.8	0.06	0.17	4.2	12.0	4.1	27.0
Standard Deviation	1.6	0.005	5.9	248	5.7	0.0	0.0	97	0.2	3.0	0.05	0.14	2.5	13.4	3.8	9.9
No. of Samples	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
5th Percentile	0.20	0.042	3.4	28	2.5	0.8	0.7	440	0.5	5.6	0.02	0.07	2.5	3.0	2.2	19.0
25th Percentile	0.30	0.049	3.8	92	4.0	0.8	0.7	470	0.5	6.5	0.02	0.09	2.9	5.0	3.4	21.0
75th Percentile	1.1	0.053	5.3	270	7.1	0.8	0.7	600	0.6	8.2	0.09	0.31	4.9	22.0	7.1	34.0
95th Percentile	3.4	0.056	20	670	12.0	0.8	0.7	700	1.2	14	0.17	0.46	9.6	43.0	14.0	49.0
Schist																
Min	0.20	0.031	2.9	120	1.7	0.8	0.9	540	0.5	3.4	0.03	0.2	2.2	6.0	3.9	23.0
Max	0.40	0.033	3.8	260	3.3	0.8	2.2	630	0.5	5.8	0.06	0.2	2.3	7.0	7.4	28.0
Median	0.40	0.033	3.1	120	3.2	0.8	1.5	590	0.5	4.8	0.06	0.2	2.2	6.0	5.2	26
No. of Samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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Table 4 Statistical Summary of Metals Analyses (Continued)

	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sn	Sr	Ti	Tl	U	V	Y	Zn
	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g
Average Concentration (Continental Crust)*	1.2	2.4	84	1050	14	0.2	0.05	281500	2.3	370	0.57	0.85	2.7	120	33	70
Ten Times Average Concentration (Continental Crust)*	12	24	840	10500	140	2	0.5	2815000	23	3700	5.7	8.5	27	1200	330	700
Carbonate Rocks																
Min	0.10	0.012	5	21	0.8	0.8	0.7	270	0.5	14	0.001	0.02	0.3	4.0	1.5	2.2
Max	0.50	0.018	15	1090	2.0	0.8	1.8	590	0.5	300	0.02	0.04	0.4	11.0	9.1	9.9
Mean	0.16	0.015	13	215	1.3	0.8	1.0	419	0.5	211	0.004	0.02	0.3	5.4	3.2	5.0
Median	0.10	0.015	14	82	1.3	0.8	1.0	420	0.5	270	0.001	0.02	0.3	5.0	2.5	4.8
Standard Deviation	0.14	0.002	3.5	317	0.4	0	0.3	84	0	116	0.01	0.01	0.0	2.1	2.1	2.1
No. of Samples	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
5th Percentile	0.10	0.013	6.1	33	0.9	0.8	0.7	309	0.5	18	0.001	0.02	0.3	4.0	1.6	2.6
25th Percentile	0.10	0.014	13	54	1.0	0.8	0.7	380	0.5	186	0.001	0.02	0.3	4.0	2.1	3.8
75th Percentile	0.10	0.016	15	162	1.6	0.8	1.0	443	0.5	283	0.002	0.02	0.4	5.5	3.2	6.1
95th Percentile	0.45	0.017	15	788	1.9	0.8	1.6	557	0.5	295	0.02	0.03	0.4	8.8	6.8	8.0
Unconsolidated Borrow Materia																
Min	0.10	0.011	3.4	16	0.8	0.8	0.9	310	0.5	2.2	0.004	0.02	0.2	1.0	0.6	1.7
Max	0.60	0.031	110	830	7.0	0.8	2.1	610	0.8	130	0.05	0.11	2.6	15.0	4.8	20.0
Mean	0.33	0.021	14	194	3.3	0.8	1.7	436	0.6	34	0.02	0.05	1.1	8.8	3.1	12.1
Median	0.30	0.020	6.5	140	3.4	0.8	1.8	415	0.5	24	0.02	0.04	0.7	8.5	3.3	13.0
Standard Deviation	0.14	0.006	28	191	1.5	0.0	0.4	84	0.1	34	0.01	0.03	0.8	3.4	1.1	5.4
No. of Samples	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
5th Percentile	0.17	0.014	4.2	77	1.5	0.8	1.0	336	0.5	4.2	0.01	0.02	0.3	4.3	1.5	3.5
25th Percentile	0.23	0.017	5.3	123	2.1	0.8	1.5	373	0.5	18	0.01	0.02	0.5	7.3	2.3	8.2
75th Percentile	0.40	0.026	9.7	193	3.8	0.8	2.0	508	0.6	35	0.02	0.07	1.6	10.0	3.7	16.3
95th Percentile	0.54	0.030	46	447	5.4	0.8	2.0	558	0.7	101	0.03	0.09	2.4	13.7	4.5	18.7

*Price (1997)

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Table 5 Results of Shake Flask Extraction Test

	Units	MMER	CWQG (PAL)	CDWQ	10-TR-001 BH10-04	10-TR-005 BH10-05	10-TR-009 BH10-06	10-TR-014 BH10-08	10-TR-017 BH10-09	10-TR-019 BH10-12	10-TR-035 BH10-12
					Gneiss	**Gneiss**	**Gneiss**	**Gneiss**	**Gneiss**	**Gneiss**	**Schist**
Sample Weight	g				250	250	250	250	250	250	250
Volume mL	D.I. H_2O				750	750	750	750	750	750	750
InitialpH	units				9.51	9.41	9.63	9.63	9.59	9.58	9.74
Final pH	units	6.0 - 9.5	6.5 - 9.0	6.5 - 8.5	9.45	**9.64**	**9.73**	**9.67**	**9.69**	**9.73**	**9.67**
Mercury (Hg)	mg/L	-	0.026	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Aluminum (Al)	mg/L	-	0.005-0.1[a]	-	0.97	0.84	0.98	0.58	0.91	0.75	1.42
Arsenic (As)	mg/L	0.5	0.005	0.005	0.0013	0.0004	0.0009	0.0005	0.0005	<0.0002	0.0012
Barium (Ba)	mg/L	-	-	1	0.00450	0.00444	0.00438	0.00420	0.00340	0.00309	0.00449
Beryllium (Be)	mg/L	-	-	-	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth (Bi)	mg/L	-	-	-	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium (Ca)	mg/L	-	-	-	2.95	3.01	2.86	2.96	2.59	2.25	1.29
Cadmium (Cd)	mg/L	-	0.000017	0.005	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003
Cobalt (Co)	mg/L	-	-	-	0.000028	0.000030	0.000049	0.000060	0.000053	0.000122	0.000062
Chromium (Cr)	mg/L	-	0.001	0.051	<0.0005	0.0009	0.0010	<0.0005	0.0011	0.0013	0.0010
Copper (Cu)	mg/L	0.3	0.002-0.004[b]	≤1.0[c]	0.0009	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	<0.0005
Iron (Fe)	mg/L	-	0.3	<0.3[c]	0.069	0.094	0.115	0.127	0.116	0.186	0.233
Potassium (K)	mg/L	-	-	-	6.75	6.51	8.50	8.88	7.66	8.41	13.8
Lithium (Li)	mg/L	-	-	-	0.006	0.006	0.011	0.016	0.012	0.010	0.003
Magnesium (Mg)	mg/L	-	-	-	0.245	0.477	0.370	0.788	0.345	0.422	0.321
Manganese (Mn)	mg/L	-	-	≤0.05	0.00225	0.00268	0.00279	0.00265	0.00308	0.00364	0.00330
Molybdenum (Mo)	mg/L	-	0.073	-	0.00125	0.00096	0.00039	0.00084	0.00073	0.00432	0.00118
Sodium (Na)	mg/L	-	-	-	5.94	5.21	5.39	6.26	5.53	3.75	11.7
Nickel (Ni)	mg/L	0.5	0.025-0.15[b]	-	0.0001	< 0.0001	0.0002	0.0002	0.0002	0.0006	0.0003
Lead (Pb)	mg/L	0.2	0.001-0.007[b]	0.01	0.00083	0.00029	0.00043	0.00013	0.00053	0.00046	0.00032
Antimony (Sb)	mg/L	-	-	0.006	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0003
Selenium (Se)	mg/L	-	0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Tin (Sn)	mg/L	-	-	-	0.00003	0.00004	0.00003	0.00003	0.00004	0.00002	< 0.00001
Strontium (Sr)	mg/L	-	-	-	0.0105	0.0109	0.0123	0.0190	0.0109	0.0077	0.0037
Titanium (Ti)	mg/L	-	-	-	0.0037	0.0047	0.0118	0.0138	0.0134	0.0185	0.0126
Thallium (Tl)	mg/L	-	-	-	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Uranium (U)	mg/L	-	-	-	0.00940	0.00860	0.00817	0.00277	0.00528	0.00242	0.00143
Vanadium (V)	mg/L	-	-	-	0.00200	0.00268	0.00547	0.0111	0.00557	0.0129	0.00299
Zinc (Zn)	mg/L	0.5	0.03	≤5.0	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.001	< 0.001

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Table 5 Results of Shake Flask Extraction Test (Continued)

	Units	MMER	CWQG (PAL)	CDWQ	10-TR-024 BH10-13 Sand-stone	10-TR-025 BH10-14 Sandy Carbonate	10-TR-029 BH10-15 Carb-onate	10-TR-033 BH10-16 Carb-onate	S449-10 Sand/ Gravel	S454-10 Sand/ Gravel	S458-10 Sand/ Gravel	S461-10 Sand/ Gravel
Sample Weight	g				250	250	250	250	250	250	250	250
Volume mL	D.I. H_2O				750	750	750	750	750	750	750	750
InitialpH	units				9.66	9.52	9.60	9.64	9.46	7.44	9.53	9.31
Final pH	units	6.0 - 9.5	6.5 - 9.0	6.5 - 8.5	9.38	9.11	8.95	9.03	8.94	7.90	9.30	9.27
Mercury (Hg)	mg/L	-	0.026	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Aluminum (Al)	mg/L	-	0.005-0.1[a]	-	0.04	0.23	0.16	0.10	0.04	0.50	0.21	0.25
Arsenic (As)	mg/L	0.5	0.005	0.005	0.0013	0.0003	0.0004	<0.0002	0.0008	0.0003	0.0014	0.0007
Barium (Ba)	mg/L	-	-	1	0.00385	0.00167	0.00170	0.00144	0.00376	0.00406	0.00324	0.00388
Beryllium (Be)	mg/L	-	-	-	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth (Bi)	mg/L	-	-	-	< 0.00001	< 0.00001	0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium (Ca)	mg/L	-	-	-	8.32	10.8	12.2	11.4	11.3	4.61	9.28	13.0
Cadmium (Cd)	mg/L	-	0.000017	0.005	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003
Cobalt (Co)	mg/L	-	-	-	0.000039	0.000051	0.000059	0.000054	0.000080	0.000137	0.000045	0.000099
Chromium (Cr)	mg/L	-	0.001	0.051	0.0013	0.0007	0.0006	0.0006	0.0027	0.0014	0.0006	0.0008
Copper (Cu)	mg/L	0.3	0.002-0.004[b]	≤1.0[c]	<0.0005	<0.0005	<0.0005	<0.0005	0.0011	0.0023	0.0015	0.0484
Iron (Fe)	mg/L	-	0.3	<0.3[c]	< 0.002	< 0.002	< 0.002	< 0.002	0.010	0.169	0.004	0.059
Potassium (K)	mg/L	-	-	-	8.56	2.03	2.27	2.51	6.90	0.818	7.14	4.94
Lithium (Li)	mg/L	-	-	-	0.009	0.004	0.005	0.006	0.028	< 0.001	0.004	0.010
Magnesium (Mg)	mg/L	-	-	-	7.40	2.55	2.74	3.71	11.3	1.73	3.42	3.83
Manganese (Mn)	mg/L	-	-	≤0.05	0.00037	0.00030	0.00065	0.00023	0.00064	0.00898	0.00024	0.00165
Molybdenum (Mo)	mg/L	-	0.073	-	0.00073	0.00048	0.00207	0.00069	0.00390	0.00053	0.00177	0.00226
Sodium (Na)	mg/L	-	-	-	0.94	1.38	1.82	1.65	1.85	0.15	4.06	2.35
Nickel (Ni)	mg/L	0.5	0.025-0.15[b]	-	0.0001	< 0.0001	0.0002	0.0001	0.0004	0.0006	0.0002	0.0004
Lead (Pb)	mg/L	0.2	0.001-0.007[b]	0.01	< 0.00002	0.00002	< 0.00002	< 0.00002	< 0.00002	0.00079	< 0.00002	0.00015
Antimony (Sb)	mg/L	-	-	0.006	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0013
Selenium (Se)	mg/L	-	0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Tin (Sn)	mg/L	-	-	-	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.00001	< 0.00001	0.00006
Strontium (Sr)	mg/L	-	-	-	0.0224	0.139	0.121	0.120	0.0422	0.0073	0.0217	0.0202
Titanium (Ti)	mg/L	-	-	-	0.0003	< 0.0001	0.0003	0.0001	0.0008	0.0111	0.0001	0.0037
Thallium (Tl)	mg/L	-	-	-	< 0.00002	< 0.00002	0.00006	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Uranium (U)	mg/L	-	-	-	0.000234	0.000071	0.000095	0.000107	0.000486	0.000243	0.000974	0.00225
Vanadium (V)	mg/L	-	-	-	0.00494	0.00084	0.00068	0.00042	0.00112	0.00109	0.00456	0.00417
Zinc (Zn)	mg/L	0.5	0.03	≤5.0	< 0.001	< 0.001	< 0.001	0.001	< 0.001	0.001	< 0.001	0.001

Note:

MMER = Metals, Mining Effluent (SOR 2002 - 222)

Bold values indicate parameters above the MMER value.

** Lab data reported for total chromium.

CWQG (PAL) and CDWQ provided for reference only (see text)

CWQG (PAL) = Canadian Water Quality Guidelines Protection of Aquatic Life, 2007

CDWQ = Health Canada - Canadian Drinking Water Guideline

a) varies with pH

b) varies with hardness

c) Aesthetic objective

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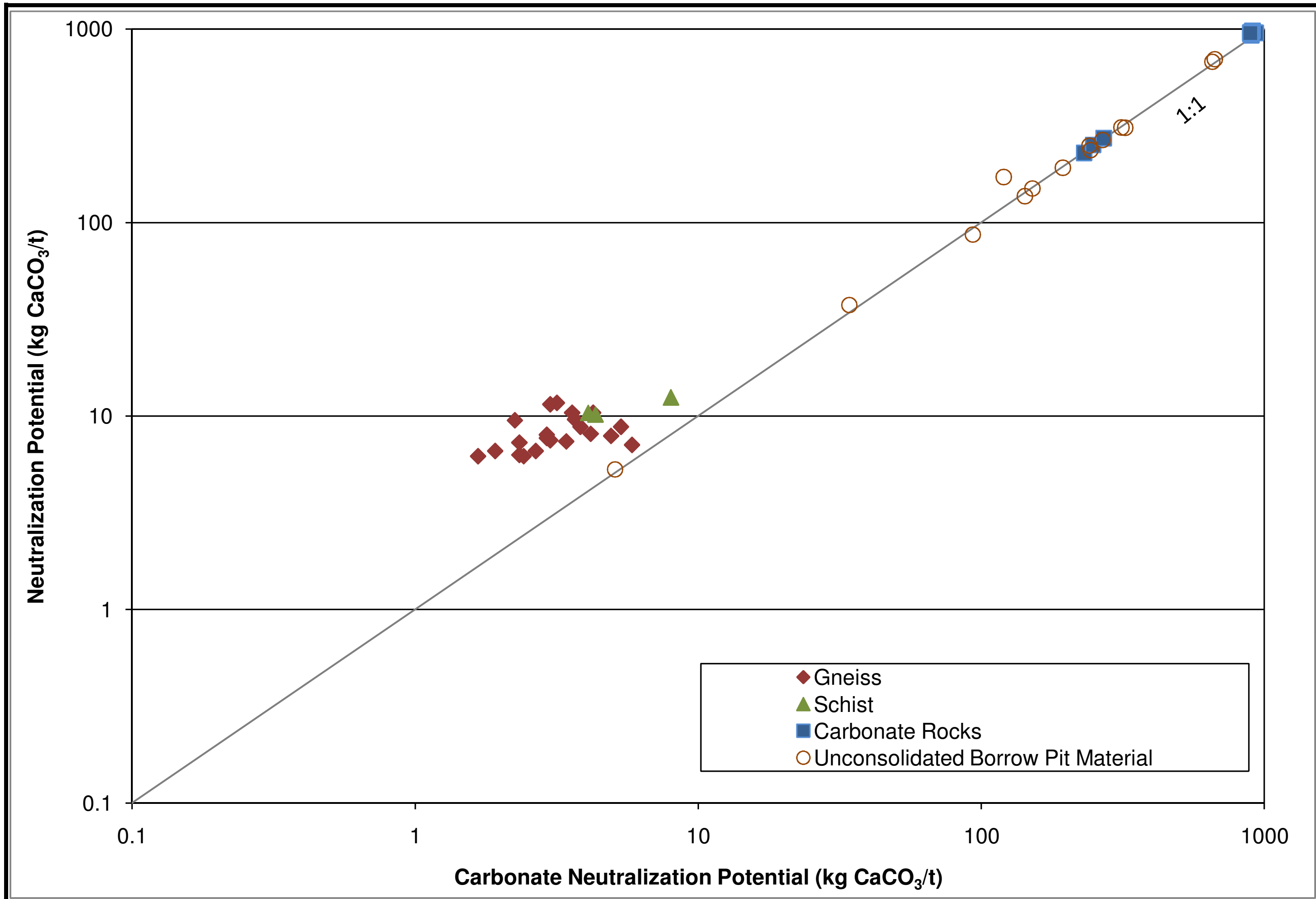
Table 6 - Rietveld Quantitative Analysis X-ray Diffraction Results

Mineral/Compound		Ideal Formula	10-TR-001 BH10-4 *granitic gneiss* (wt %)	10-TR-005 BH10-5 *granitic gneiss* (wt %)	10-TR-009 BH10-6 *granitic gneiss* (wt %)	10-TR-014 BH10-8 *granitic gneiss* (wt %)	10-TR-017 BH10-9 *granitic gneiss* (wt %)	10-TR-019 BH10-12 *granitic gneiss* (wt %)	10-TR-035 BH10-12 *schist* (wt %)
Calcite	Carbonates	$CaCO_3$	1.2	0.6	0.1	--	0.3	0.2	--
Rhodochrosite	Carbonates	$MnCO_3$	--	--	--	--	--	0.7	--
Dolomite	Carbonates	$CaMg(CO_3)_2$	--	--	--	--	--	0.5	--
Ankerite	Carbonates	$Ca(Mg, Fe)(CO_3)_2$	--	--	--	--	--	--	--
Quartz		SiO_2	34.4	38.1	34.2	33.6	32.5	30.4	42.6
Albite	Feldspars	$NaAlSi_3O_8$	33.4	30.9	35.0	29.7	36.6	27.7	12.4
Anorthite	Feldspars	$CaAl_2Si_2O_8$	4.2	4.7	5.7	7.4	5.4	8.4	5.7
Orthoclase	Feldspars	$KAlSi_3O_8$	2.5	1.8	1.6	4.5	1.8	2.6	4.1
Microcline	Feldspars	$KAlSi_3O_8$	21.8	20.7	16.5	16.8	16.2	10.8	19.5
Diopside (clinopyroxene)		$CaMgSi_2O_6$	--	--	2.9	2.8	3.1	3.0	4.3
Actinolite (amphibole)		$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	--	--	--	--	--	9.5	--
Phlogopite	Phyllo-silicates	$KMg_3(AlSi_3O_{10})(OH)_2$	0.4	0.8	3.1	4.3	3.1	5.2	3.4
Biotite	Phyllo-silicates	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	--	--	--	--	--	--	3.9
Clinochlore (chlorite)	Phyllo-silicates	$(Mg, Fe)_5 (Si_3Al)O_{10}(OH)_8$	1.3	1.4	0.01	0.01	0.01	0.9	4.1
Magnetite		Fe_3O_4	0.8	0.9	0.9	0.9	0.9	--	0.1
TOTAL			100	100	100	100	100	100	100

Mineral/Compound		Ideal Formula	10-TR-024 BH10-13 *carbonate cemented sandstone* (wt %)	10-TR-025 BH10-14 *carbonate* (wt %)	10-TR-029 BH10-15 *carbonate* (wt %)	10-TR-033 BH10-16 *carbonate* (wt %)	S449-10 *borrow material* (wt %)	S454-10 *borrow material* (wt %)	S458-10 *borrow material* (wt %)	S461-10 *borrow material* (wt %)
Calcite	Carbonates	$CaCO_3$	--	99.3	98.9	98.3	22.6	0.2	0.1	2.2
Rhodochrosite	Carbonates	$MnCO_3$	--	--	--	--	--	--	--	0.6
Dolomite	Carbonates	$CaMg(CO_3)_2$	25.9	0.3	0.3	0.6	46.4	--	6.2	11.5
Ankerite	Carbonates	$Ca(Mg, Fe)(CO_3)_2$	--	0.1	0.1	0.3	11.7	--	3.3	3.0
Quartz		SiO_2	56.3	0.3	0.7	0.8	9.7	98.8	33.0	28.5
Albite	Feldspars	$NaAlSi_3O_8$	1.2	--	--	--	1.1	0.7	22.7	25.2
Anorthite	Feldspars	$CaAl_2Si_2O_8$	--	--	--	--	--	--	5.1	3.5
Orthoclase	Feldspars	$KAlSi_3O_8$	1.4	--	--	--	1.3	--	3.9	4.1
Microcline	Feldspars	$KAlSi_3O_8$	15.2	--	--	--	4.6	--	18.3	12.8
Diopside (clinopyroxene)		$CaMgSi_2O_6$	--	--	--	--	--	--	2.8	3.1
Actinolite (amphibole)		$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	--	--	--	--	--	--	--	--
Phlogopite	Phyllo-silicates	$KMg_3(AlSi_3O_{10})(OH)_2$	--	--	--	--	--	--	3.7	3.4
Biotite	Phyllo-silicates	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	--	--	--	--	--	--	--	--
Clinochlore (chlorite)	Phyllo-silicates	$(Mg, Fe)_5 (Si_3Al)O_{10}(OH)_8$	--	--	--	--	2.6	0.3	0.5	1.6
Magnetite		Fe_3O_4	--	--	--	--	--	--	0.4	0.5
TOTAL			100	100	100	100	100	100	100	100

FIGURES



Aggregate Source Material
CaNP vs. NP
Milne Inlet Tote Road

Baffinland Iron Mine Corporation

December 2010 | FIGURE 1

Job No. TC101510

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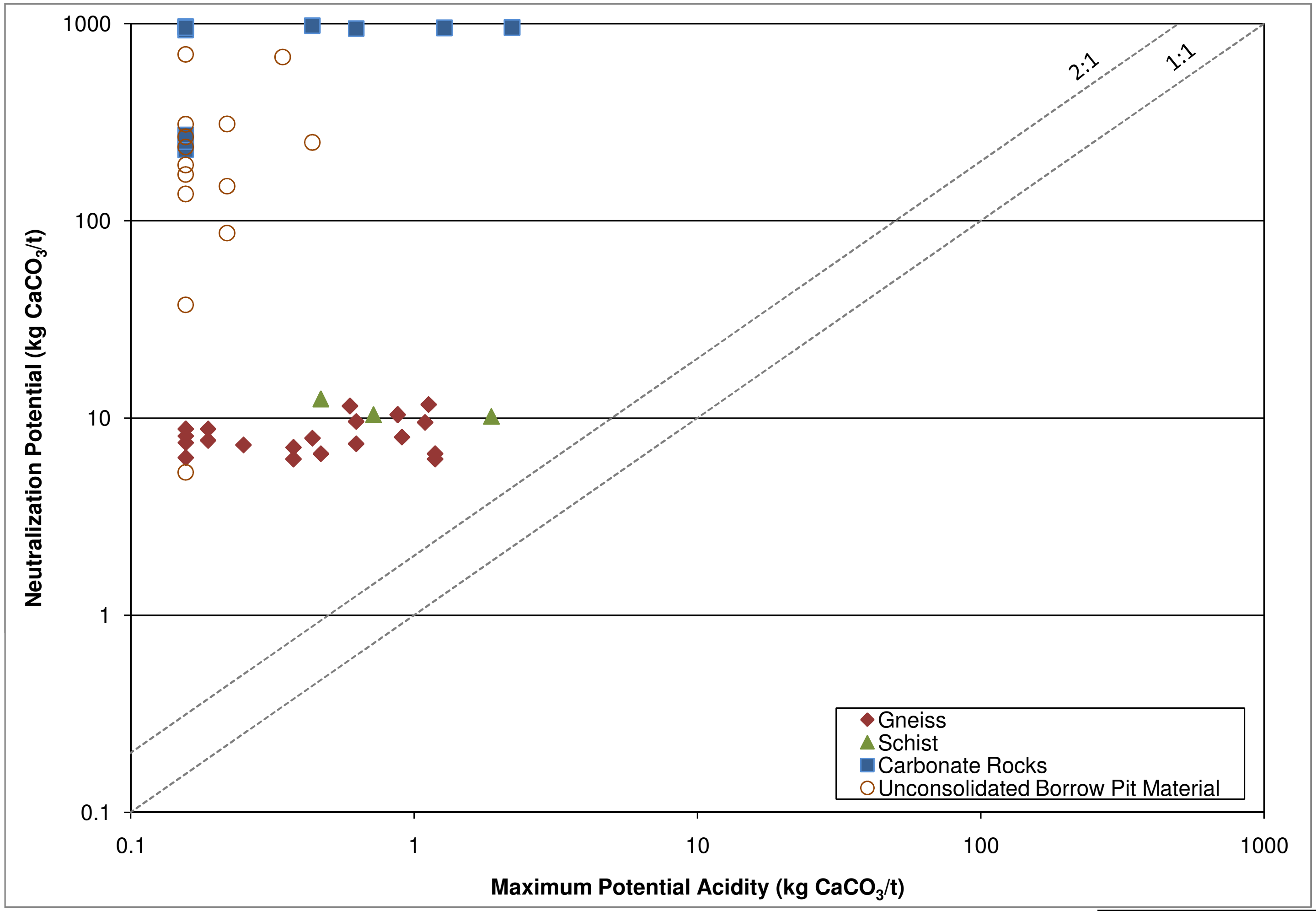

Aggregate Source Material NP vs. MPA Milne Inlet Tote Road	
Baffinland Iron Mine Corporation	
December 2010	FIGURE 2

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